03/02

**Climate Technology Initiative**
**Capacity Building Seminar for**
**CEE/FSU Countries**

# Climate Technology and Energy Efficiency – Dissemination „Best Practice“ Experience

**- Seminar Proceedings -**

**Ostritz, Germany, 5 – 9 December 2001**


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Berlin, November 2002

# Foreword

Ten years have almost passed since the Rio World Summit. United Nations' Climate Convention has existed for the same period of time. International awareness of the negative environmental impacts of air emissions has been growing. Energy produced by fossil fuels is the main source of the harmful emissions linked to climate change.

Therefore, focus has for a long period been on the creation of a more sustainable supply and use of energy in our societies. Substantial efforts are needed in energy efficiency and supply of renewable energy. This has been the main message of several international agreements, also emphasized in the Kyoto Protocol from 1997.

Clearly, it is no longer a question whether policies and measures in energy efficiency and renewable energy should be implemented. Such policies are indispensable and their introduction should extend far beyond the efforts of a few dedicated countries.

The climate change challenge is global. World trade is expanding. Energy consuming goods and equipment, as well as energy itself, are truly international commodities. It is a global task to implement these policies, and it is the responsibility of all governments, industry, NGOs and other parties.

Sustainable energy solutions and technologies must be part of the rapid transformation of markets and economies. The benefits to be gained are both economic and environmental, particularly for countries whose economies in transition offer a historical opportunity for enhanced and sustainable economic growth.

The CTI is an initiative in this direction. By creating an international focus on sustainable technologies and practices, the CTI is supporting a development in the right direction. Although being a limited effort, CTI has important implications to the implementation process.

*Ture Hammar, Representative of the Danish Presidency of CTI*

# Table of Contents

# CTI Capacity Building Seminar for CEE/FSU Countries

## *Climate Technology and Energy Efficiency – Disseminating "Best Practice" Experience*

## Organized by

Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit

Umwelt Bundes Amt für Mensch und Umwelt

ffu Environmental Policy Research Unit

ITUT Verein zur Förderung des internationalen Transfers von Umwelttechnologie - ITUT e.V

December 5 – 9, 2001

IBZ Sankt Marienthal

Ostritz, Germany

## Seminar Program

### Wednesday, December 5, 2001

| | | |
|---|---|---|
| ***Afternoon*** | | ***Arrival*** |
| ***Evening*** | 20.00 | *Welcome Buffet* |
| | 21.00 | *Introduction of the seminar participants* |

### Thursday, December 6, 2001

| | | |
|---|---|---|
| ***Morning Session*** | | ***Introduction and Welcome*** |
| | 09.00 – 09.30 | *Welcome and opening address*<br>Dr. Jürgen Landgrebe, Federal Environmental Agency, Germany<br>Ture Hammar, CTI Presidency, Denmark<br>John Millhone, US Department of Energy<br>Dr. Hanns-Joachim Neef, International Energy Agency, Paris |
| | 09.30 – 09.45 | *Results of the last and outlook at this capacity building seminar*<br>Dr. Jürgen Landgrebe, Federal Environmental Agency, Germany |
| | 09.45 – 10.00 | *US climate protection policy*<br>John Millhone, US Department of Energy |
| | 10.00 – 10.15 | *Best practices in technology deployment*<br>Dr. Hanns-Joachim Neef, International Energy Agency, Paris |
| | 10.15 – 10.30 | *Municipal climate protection*<br>Gotelind Alber, Klimabündnis, e.V., Germany |

| | | |
|---|---|---|
| | 10.30 – 11.00 | *Coffee Break* |
| | 11.00 – 11.20 | *Joint implementation – institution building and projects*<br>Franzjosef Schafhausen, Federal Environment Ministry, Germany |
| | 11.20 – 11.40 | *Energy and carbon intensities in Central Europe: a decade of transition in review*<br>Prof. Diana Ürge-Vorsatz, Central European University, Hungary |
| | 11.40 – 12.00 | *The German Energy Agency (dena) as a partner for energy savings in CEE & FSU*<br>Kristina Steenbock, Deutsche Energie-Agentur GmbH, Germany |
| | 12.00 – 12.30 | *Discussion* |
| | 12.30 - 13.45 | *Lunch* |
| ***Afternoon Session*** | | ***Biomass use***<br>Chair: Dr. Peter Pichl, Federal Environmental Agency, Germany |
| | 14.00 – 14.20 | *Overview of biomass use in Poland*<br>Prof. Piotr Kowalik, Politechnika Gdańska, Poland |
| | 14.20 – 14.40 | *Biomass use in Germany*<br>Peter Schrum, farmatic energy ag, Germany |
| | 14.40 – 15.00 | *Economical growth potential of energy biomass use in Slovenia*<br>Aleš Bratkovič, Energy Restructuring Agency, Slovenia |
| | 15.00 – 15.20 | *Biomass success stories in Ukraine*<br>Dr. Georgiy Geletukha, Scientific Engineering Centre “Biomass”, Ukraine |
| | 15.20 – 15.30 | *Discussion* |
| | 15.30 – 16.00 | *Coffee Break* |
| | 16.00 – 16.20 | *Biomass CHP unit in Pfaffenhofen/Germany – power, heat and chill based on wood chips*<br>Volkmar Schäfer, eta Energieberatung GbR, Germany |
| | 16.20 – 16.40 | *Biomass success stories in Romania*<br>Cristian Mihai Tantareanu, OPET Romania ENERO |
| | 16.40 – 17.00 | *Discussant*<br>Dr. Villu Vares, OPET Estonia, Estonian Energy Research Institute |
| | 17.00 – 17.30 | *Discussion* |
| | 18.00 – 19.15 | *Dinner* |
| ***Evening Session*** | | ***Aspects of financing successful projects*** |
| | 19.30 – 20.00 | *EBRD and energy efficiency*<br>Eric Herman, European Bank for Reconstruction and Development, London |
| | 20.00 – 20.30 | *Financial tools for CEE & FSU countries*<br>Georg Kraft, Kreditanstalt für Wiederaufbau, Germany |
| | 20.30 – 21.00 | *Discussion* |
| | 21.00 | *Tasting regional eco-wines in the wine cellar of the convent* |

## Friday, December 7, 2001

| | | |
|---|---|---|
| ***Morning Session*** | | ***CHP as a climate protection technology***<br>Chair: Prof. Piotr Kowalik, Politechnika Gdańska, Poland |

09.00 – 09.20 *CHP policy in the Netherlands*
Gert-Jan Bakker, COGEN Nederland

09.20 – 09.40 *CHP policy in Germany*
Dr. Hans-Joachim Ziesing, German Institute for Economic Research

09.40 – 10.00 *CHP incentives in Denmark*
Ture Hammar, Danish Energy Agency, Denmark

10.00 – 10.30 *Discussion*

10.30 – 11.00 *Coffee Break*

11.00 – 11.20 *The Austrian-Slovak Competence Centre for CHP Diffusion*
Ludovít Mikula, Slovak Energy Agency
Vladimir Hecl, OPET Slovakia, Energy Centre Bratislava

11.20 – 11.40 *Discussant*
Prof. Dagnija Blumberga, OPET Latvia, Ekodoma

11.40 – 12.10 *Discussion*

12.30 – 13.45 *Lunch*

***Afternoon Session*** ***Thermal energy conservation in the building sector***
**Chair**: Dr. Felix Chr. Matthes, Öko-Institut, Germany

14.00 – 14.20 *Implementation of the Thermorenovation Law in Poland*
Dr. Andrzej Szajner, Baltic Energy Conservation Agency, Poland

14.20 – 14.40 *The KfW-Housing Modernization Program.*
*Experiences with refurbishment of panel buildings in Eastern Germany*
Georg Kraft, Kreditanstalt für Wiederaufbau, Germany

14.40 – 15.00 *Best practice: Thermal energy conservation in the building sector in Georgia*
Tamuna Abazadze, Tebodin, Georgia
Paata Janelidze, National Climate Research Centre, Georgia

15.00 – 15.20 *Good energy efficiency practices in Bulgaria*
Dr. Zdravko Genchev, EnEffect – Centre for Energy Efficiency, Bulgaria

15.20 – 15.30 *Discussion*

15.30 – 16.00 *Coffee Break*

16.00 – 16.20 *The Energy Efficiency Housing Pilot Project in Lithuania*
Eduardas Kazakevičius, Lithuanian Housing and Urban Development Foundation

16.20 – 16.40 *Regional networking to promote EU accession process RENEUER*
Dr. Zdravko Genchev, EnEffect – Centre for Energy Efficiency, Bulgaria

17.00 – 17.20 *Discussant*
Dr. Igor Bashmakov, CENEf, Russia

17.20 – 17.40 *Discussion*

18.00 – 19.15 *Dinner*

***Evening Session*** ***ESCOs, energy agencies and third party financing***

19.30 – 20.00 *Prospects of performance contracting in CEE countries – achieved results and future strategies*
Ralf Goldmann, Berlin Energy Agency, Germany

| | | |
|---|---|---|
| | 20.30 – 21.00 | *Main principles of activity of the Ukrainian Energy Service Company (UkrEsko)*<br>Sherhiy M. Bevz, State Committee of Ukraine for Energy Conservation |

## Saturday, December 8, 2001

| | | |
|---|---|---|
| ***Morning Session*** | | ***Rational energy use in industry and household appliances***<br>Chair: Dr. Lutz Mez, Environmental Policy Research Unit, Germany |
| | 09.00 – 09.20 | *Energy audits: Lessons learned in the Czech Republic*<br>Jiří Zeman, SEVEn, Czech Republic |
| | 09.20 – 09.40 | *Rational energy use in the Russian industry*<br>Dr. Igor Bashmakov, CENEf, Russia |
| | 09.40 – 10.00 | *Energy auditung in Estonia*<br>Dr. Villu Vares, OPET Estonia, Estonian Energy Research Institute |
| | 10.00 – 10.20 | *Efficient Lighting Initiative – grassroots approach in the residential sector in Latvia*<br>Prof. Dagnija Blumberga, OPET Latvia, Ekodoma |
| | 10.20 – 11.00 | *Coffee Break* |
| | 11.00 – 11.20 | *Japanese industry efforts for energy conservation and technology transfer on climate change*<br>Prof. Morihiro Kurushima, NEDO, Japan |
| | 11.20 – 11.40 | *Leaking electricity? Stand-by losses and appliance-related energy efficiency policies in Central Europe*<br>Prof. Diana Ürge-Vorsatz, Central European University, Hungary |
| | 11.40 – 12.00 | *Really off? Stand-by campaign by Energy Foundation Schleswig-Holstein*<br>Dr. Holger Krawinkel, Energiestiftung Schleswig-Holstein, Germany |
| | 12.00 – 12.30 | *Summary of the seminar and outlook*<br>Dr. Jürgen Landgrebe, Federal Environmental Agency, Germany |
| ***Afternoon*** | 14.00 | ***Departure for sightseeing tour to the city of Bautzen***<br>*Paper-bag lunch on the bus* |
| ***Evening*** | 20.00 – 23.00 | ***Dinner at Eckberg Castle Hotel and Restaurant, Dresden***<br>*Classic Jazz* |

## Sunday, December 9, 2001

| | | |
|---|---|---|
| ***Morning*** | 04.00 / 04.30<br>and 09.30 | ***Bus transfer from Bautzen to Dresden***<br>*Possibility for sightseeing and visiting the Christmas market (Striezel Markt) in Dresden* |
| | | ***Departure*** |

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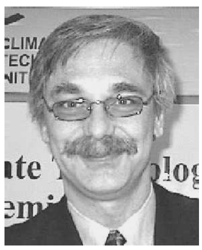

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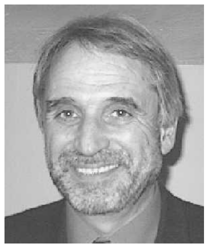

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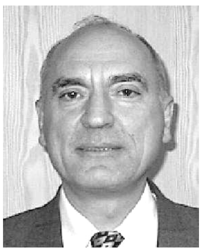

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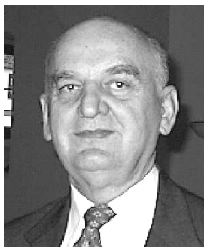

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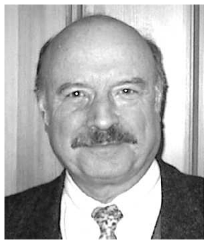

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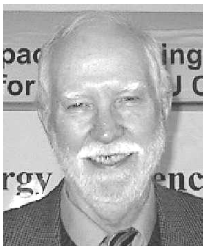


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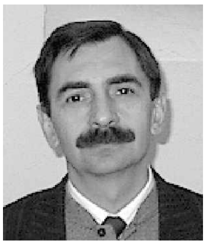


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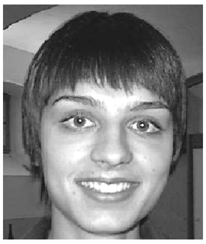

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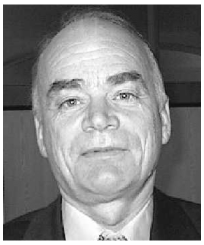

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# List of Abbreviations

| | |
|---|---|
| AIJ | Activities Implemented Jointly |
| ALTENER | EU Program Promoting the Use of Renewable Energy Sources |
| APEC | Asia Pacific Economic Cooperation |
| ARCE | Romanian Agency for Energy Conservation |
| ARENA-Eco | Agency for Rational Energy Use and Ecology (Ukraine) |
| AURE | Agency for Energy Efficiency (Slovenia) |
| Baltic CHAIN | Baltic Clearing House And Information Network |
| BAPE | Baltic Energy Conservation Agency |
| BelVIEC | Belorussian Scientific and Industrial Information Centre for Energy Saving |
| BMU | German Federal Ministry of Environment, Nature Conservation and Reactor Security |
| BOM | Board Of Management |
| BSR | Baltic Sea Region |
| CC-CHP | Combined Cycle – CHP |
| CDM | Clean Development Mechanism |
| CEA | Czech Energy Agency |
| CEE | Central and Eastern Europe |
| CEEC | Central and Eastern European Countries |
| CENEf | Center for Energy Efficiency, Moscow |
| CFL | Compact Fluorescent Lamps |
| CH4 | Methane |
| CHP | Combined Heat and Power Generation |
| CIS | Commonwealth of Independent States |
| CO | Carbon Monoxide |
| CO2 | Carbon Dioxide |
| COP | Conference of the Parties of UNFCCC |
| CR | Czech Republic |
| CTI | Climate Technology Initiative |
| CTIP | Cooperative Technology Implementation Plan |
| CZK | Czech Crown |
| DCA | Development Credit Authority |
| DEA | Danish Energy Agency |
| dena | Deutsche Energie Agentur |
| DH | District Heating |
| DHC | District Heating Company |
| DHP | District Heating Plant |
| DIW | German Institute for Economic Research |
| DSM | Demand Side Management |
| EAES | Environmentally Adapted Energy System in the Baltic Region and Europe |
| EBRD | European Bank for Reconstruction and Development |
| EC | European Community |
| EC BREC | EC Baltic Renewable Energy Center |
| ECCJ | Energy Conservation Center, Japan |

| | |
|---|---|
| EE | Energy Efficiency |
| EEC | Energy Efficiency Center |
| EEF | EBRD Energy Efficiency Fund |
| EEHPP | Energy Efficiency Housing Pilot Project in Lithuania |
| EEK | Estonian Crown |
| EERI | Estonian Energy Research Institute |
| EIA | US Energy Information Agency |
| EIT | Economies in Transition |
| ELI | Efficient Lighting Initiative |
| EMA | Emissions Marketing Association |
| ENERO | Center for the Promotion of Clean and Efficient Energy in Romania |
| ENSVET | Energy Advisory Network in Slovenia |
| EPC | Energy Performance Contracting |
| ESC | Energy Strategy Center (Armenia) |
| ESCO | Energy Service Company |
| ESF | Energy Saving Fund |
| ESI | Electricity Supply Industry |
| ET | Emissions Trading |
| EU | European Union |
| FFU | Environmental Policy Research Unit |
| FSU | Former Soviet Union |
| Gcal | Giga calory |
| GDP | Gross Domestic Product |
| GEF | Global Environmental Facility |
| Gg | Gigagramm |
| GHG | Greenhouse Gas |
| GHGM | Greenhouse Gas Mitigation |
| GJ | Giga Joule |
| GNP | Gross National Product |
| GPO | Gross Production Output |
| GT-CHP | Gas Turbine CHP |
| GWh | Giga Watt hour |
| GWP | Global Warming Potential |
| GWth | Gigawatt thermal |
| HFC | Hydrofluorocarbons |
| HOB | Heat Out Boilers |
| HPP | Hydro Power Plant |
| HUF | Hungarian Forint |
| ICECC | Intergovernmental Commission of Experts on Climate Change |
| ICEU | International Center for Energy and Environmental Technology |
| IEA | International Energy Agency |
| IEEN | Lithuanian Energy Efficiency Network |
| IFC | International Finance Corporation |
| IISD | International Institute for Sustainable Development |
| IJS | Institute Jozef Stefan, Ljubljana |

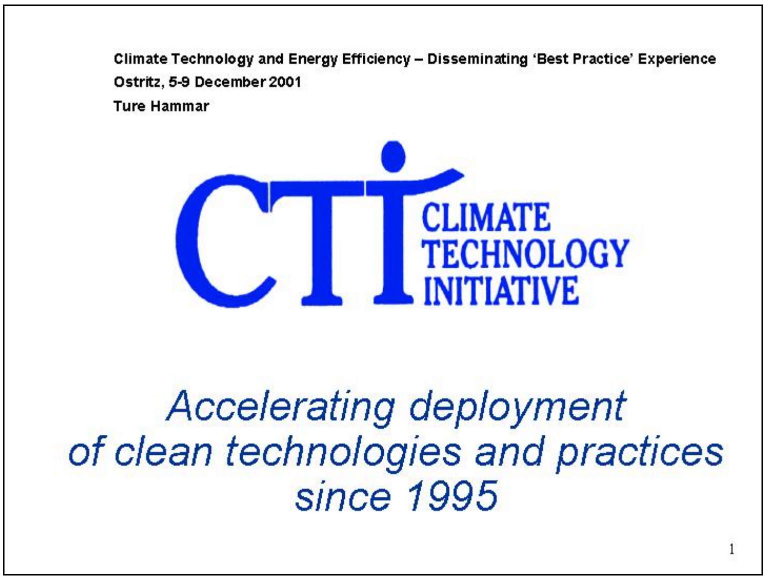
| | |
|---|---|
| IPCC | Intergovernmental Panel on Climate Change |
| IPP | Independent Power Producer |
| ISO | International Organization for Standardization |
| JI | Joint Implementation |
| JICA | Japanese International Cooperation Agency |
| KAPE | Polish Energy Conservation Agency |
| KfW | Kreditanstalt für Wiederaufbau |
| LDA | Latvian Development Agency |
| LFO | Light Fuel Oil |
| LPG | Loan Portfolio Guarantee |
| LVL | Latvian Lat |
| MAOP | Maximum Allowable Operation Pressure |
| MAPPM | Romanian Ministry of Waters, Forests and Environmental Protection |
| Masut | Heavy Oil |
| MEA | Ministry of Economic Affairs |
| MEEN | Municipal Energy Efficiency Network |
| MW | Mega Watt |
| Mwe | Megawatt electric |
| MWth | Megawatt thermal |
| $N_2O$ | Nitrous Oxide |
| NCRC | National Climate Research Center |
| NEDO | New Energy and Industrial Technology Development Organisation |
| NGO | Non Governmental Organization |
| NIB | Nordic Investment Bank |
| $No_x$ | Nitrogen Oxide |
| NPP | Nuclear Power Plant |
| NUTEK | National Board of Industry and Technology of the Swedish Kingdom |
| OECD | Organisation for Economic Cooperation and Development |
| OPET | Organisation for Promotion of Energy Technologies |
| PC | Performance Contracting |
| PFC | Perfluorocarbons |
| PHARE | Poland and Hungary: Assistance for Reconstruction of the Economy |
| PJ | Peta Joule |
| PLN | New Polish Zloty |
| PNNL | Pacific Northwest National Laboratory, USA |
| PPC | Project Preparation Committee |
| ppm | parts per million |
| PPP | Purchasing Price Parity |
| PR | Public Relations |
| QP | Qualified Producer |
| R&D | Research and Development |
| RA | Republic of Armenia |
| RD & D | Research, Development and Demonstration |
| RE | Renewable Energy |
| REC | Regional Energy Center |

| | |
|---|---|
| REEF | Renewable Energy and Energy Efficiency Fund of the World Bank |
| Ref. | References |
| RENEUER | Regional Network for Efficient Use of Energy Resources |
| RES | Renewable Energy Sources |
| RF | Russian Federation |
| SAVE | Special Actions for Vigorous Energy Efficiency |
| SECI | South East European Cooperative Initiative |
| SEF | State Environmental Fund |
| SEI | Stockholm Environment Institute |
| SEVEn | The Energy Efficiency Center, Prague |
| SHPP | Small Hydro Power Plant |
| SIDA | Swedish Development Agency |
| SIT | Slovenian Tolar |
| SME | Small and Medium-sized Enterprises |
| SO2 | Sulfur Dioxide |
| SOCER | Society for the Optimization of Energy Consumption in Romania |
| STEM | Swedish National Energy Administration |
| STL | Street Lighting |
| SWOT | Strengths, Weaknesses, Opportunities, Threats |
| SYNERGY | Energy Framework Program 1998-2002 of the EU |
| TACIS | Technical Assistance for CIS |
| TFC | Total Final Consumption |
| tfe | tons of fuel equivalent |
| THERMIE | Technologies Européennes pour la Maîtrise de L'Énergie |
| toe | tons of oil equivalent |
| TPES | Total Primary Energy Supply |
| TPF | Third Party Financing |
| TPP | Thermal Power Plant |
| TWh | Tera Watt hour |
| UBA | Federal Environmental Agency, Germany |
| UCPTE | Union for the Coordination of Production and Transmission of Electricity |
| UN | United Nations |
| UNCED | UN Conference on Environment and Development |
| UNDP | United Nations Development Program |
| UNFCCC | United Nations Framework Convention on Climate Change |
| UNITAR | United Nations Institute for Training and Research |
| US DOE | US Department of Energy |
| US EPA | US Environmental Protection Agency |
| US AID | US Agency for International Development |
| VAT | Value Added Tax |
| WB | World Bank |

# Welcome Address on Behalf of the CTI Chairman

**Ture Hammar**

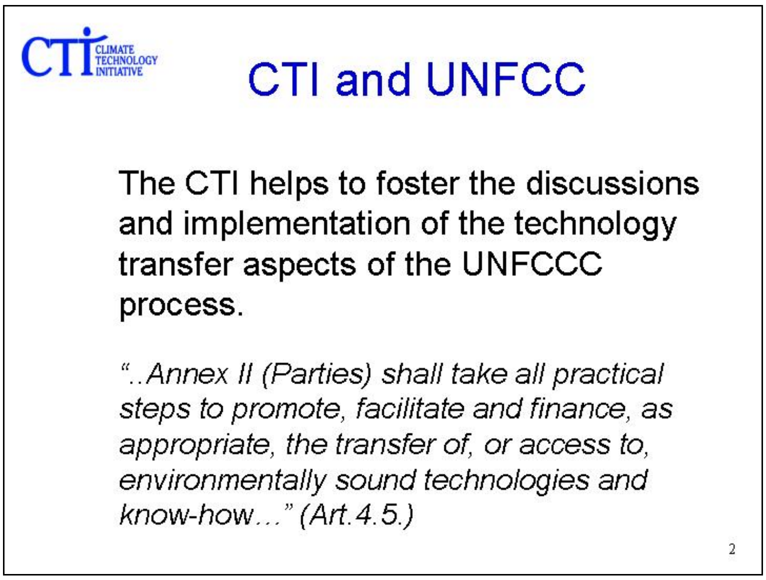
CTI Presidency



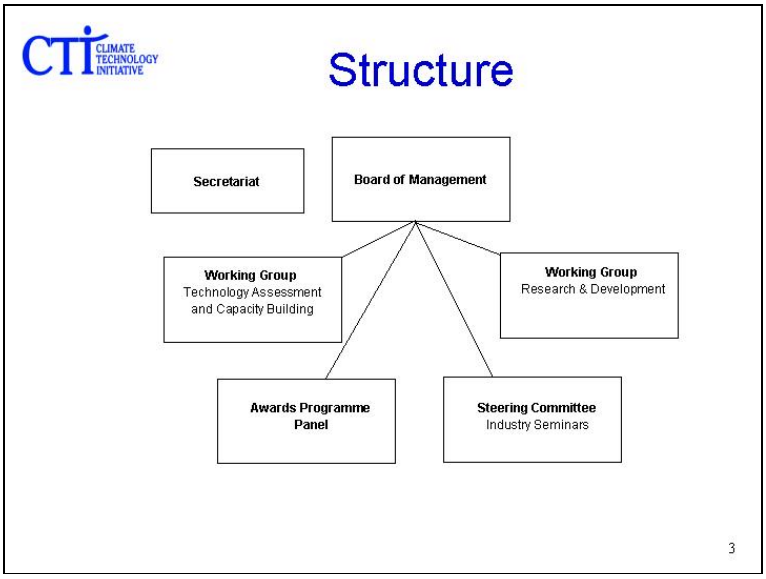

On behalf of the Chairman of the Climate Technology Initiative I would like to welcome everyone here this morning at the workshop "Climate Technology and Energy Efficiency – Disseminating 'Best Practice' Experience".

With us today we have the representatives of the governments, financing organizations, the representatives of the private sector and energy efficiency organizations from the many countries of Central, Eastern and Western Europe. We believe that this Seminar will provide an excellent opportunity to meet and to discuss and exchange views on energy efficiency and environmental aspects related to it; to share views about technologies and practices, to look at novel financing schemes.

We would like to thank our hosts, the German government, for their hospitality and for having us all here for their support in organizing the event. I would like now to take couple of minutes to give a brief overview of the Climate Technology Initiative



The Climate Technology Initiative was launched at the First Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) in March 1995. Twenty-three OECD countries and the European Commission created it to help meet their commitment to technology transfer under Article 4.5 of the Convention, fragment of which reads: *Annex II (Parties) shall take all practical steps to promote, facilitate and finance, as appropriate, the transfer of, or access to, environmentally sound technologies and know-how…"*




CTI organizes its activities through the Working Group on Technology Assessment and Capacity Building, Working Group on Research and Development, Steering Committee on Industry Seminars, CTI Awards Panel and CTI Secretariat.

The Working Group on Technology Assessment and Capacity Building promotes technology needs assessment and the effective diffusion of climate-friendly technologies and practices. The Working Group on Research and Development concentrates on promoting and accelerating the research and development of new climate-friendly technologies through the establishment of world-wide frameworks and networks of technology experts.

The CTI Awards Panel recognizes the outstanding achievements of those that have helped to promote climate-friendly technologies.

The CTI Secretariat, housed at the International Energy Agency, contributes to achieving the CTI's goals by supporting the activities of the Working Groups and the Awards Panel.

**CTI Awards Program**

The CTI annually gives several World Climate Technology Awards to recognize the outstanding achievements of individuals and organizations that have helped to promote climate-friendly technologies. Award winners receive global, high profile recognition for their valuable work. CTI hosted its third annual awards ceremony at COP-7 in Morocco. Next event at the COP8.


**CTI Website and search engine**

Our located at www.ClimateTech.net is an excellent resource for information. The site features a powerful search engine specialized on climate-friendly technologies and practices. It also offers a chat room and a calendar of upcoming events. For more information on the Climate Technology Initiative, you are welcome to contact the CTI Secretariat in Paris, at the International Energy Agency, at these numbers and addresses.

# Welcome Note

Climate Technology and Energy Efficiency –Disseminating “Best Practice” Experience

**Dr. Hanns-Joachim Neef**

International Energy Agency, Paris

On behalf of the International Energy Agency and the Climate Technology Initiative Secretariat I would like to welcome everyone to the workshop Climate Technology and Energy Efficiency – Disseminating “Best Practice” Experience. At the same time, I would like to express our thanks to the Government of Germany for hosting and supporting this event.

As it was already mentioned here this morning, this is a next seminar organized under the auspices of the Climate Technology Initiative. As the Head of Energy Technology Collaboration Division of the International Energy Agency , I am also overseeing the activities of the CTI Secretariat which is hosted by the International Energy Agency.

It is very encouraging to see with us today so many representatives from of the economies in transition. We are happy you could come here and share with the others your experiences on best practices.

This seminar, we believe, will be another milestone in the process of capacity building and networking among energy efficiency and renewable energy organizations and experts from Central and Eastern Europe (CEE) and Commonwealth of Independent States (CIS). We hope, that the seminar will be an opportunity to assess progress, exchange experiences and share projects results.

We believe that sharing the information and learning from each other is of the key importance in the process of deployment of clean technologies and practices.

The International Energy Agency promotes efficient energy markets and energy efficiency. The co-operation program in Central and Eastern Europe aims at assisting the countries to achieve market-oriented, long-term energy policy goals, and, in particular, a more energy efficient economy with increased energy security. The IEA activities include energy policy reviews, workshops, statistical harmonization and research and development work. Some of the countries represented here today are already the member countries of the IEA, the others, we hope, will become members in the near future.

IEA collaborates very closely with the Climate Technology Initiative. We work in close consultation on the projects with the economies in transition and developing countries in deployment of clean-energy technologies and practices. The CTI workshops have become a trademark of that collaboration. We try to join our resources and expertise as much as possible, and dwell on the wealth of technology and policy information researched by the IEA and available there.

When considering deployment of clean technologies and practices, it is of the utmost importance to bear in mind the interaction between the sector approach and policy development.

We believe that proper policies that create positive framework for energy efficiency ensure sustainability of all sector projects. We will certainly hear about these in the coming sessions, and certainly we will be able to see various approaches. Yet, while the approach may differ per country, the proper mix of policy instruments and the implementing structures and organizations may be the key to a future sustainable implementation of technologies. In some cases, the very lack of appropriate policies and structures severely hinders implementation of projects.

Capacity building and institutional development, often in the framework of international initiatives, create the necessary boundary conditions for the energy efficiency and climate change projects. As we understand, the experiences of local energy efficiency organizations from Prague to Tbilisi as well as of various international programs demonstrate that technology issue should always be considered along with policy and institutional building.

And now couple of words about the CTI training courses and seminars.

CTI training courses and seminars have been providing specialized training to decision-makers and practitioners in companies, and to government specialists who perform the technical analysis behind regulatory policies and incentive programs. Energy efficiency options that make both good business and environmental sense are often a focus of the training courses. How to access information sources on clean technologies is also featured.

CTI training courses and seminars have a regional focus. Participants learn first-hand from specialists. In Central and Eastern Europe, for example, a series of capacity building seminars has strengthened a network of energy efficiency centers where data and experiences are shared among professionals.

The training courses are designed to “train the trainer”. They encourage participants to take their new knowledge back home and train others. To facilitate this, the CTI is developing lesson plans and reference materials that are available on CD-ROM and at the CTI website. Feedback from training course alumni help to modify the curriculum.

The training courses are held over three or four days, which allows participants to explore concepts in detail. Participants typically have a technical background.

The training courses and capacity building seminars deliver technical assistance and help to disseminate climate-friendly technology information. As a multilateral initiative, these courses are a communal Annex I response to UNFCCC commitments to facilitate technology transfer. In the European region the workshops and training courses have been held in Estonia, Hungary, Slovakia, Poland, Italy and of course in Germany, here in Ostritz. In other regions the workshops and courses were held in Japan, Argentina, Mexico, and the United States.

Copies of three CTI workshop proceedings from the workshops that were held in Estonia, Slovakia and Poland are available here for the seminar participants.

There are more events planned ahead for the European region. The detailed information can be found on the CTI website, I will list just the headlines:

- CTI Workshop on Clean Technologies and Best Practices Relating to Fossil Fuels, Stavanger, Norway, early in 2002
- Regulatory Framework for Third Party Financing in Central Europe, just completed couple of days ago in Budapest - but please watch for the follow up in spring 2002
- Symposium: The Impact of Electricity Network Organization, Regulation and Pricing on Renewables and Distributed Generation in the Baltic Sea Region.

We hope to see you at those events as well.

And for now, I am convinced that we will see a lot of very interesting presentations and I wish all a very informational and fruitful seminar.

# Results of the Last Ostritz Seminar in 1999

## – and what we expect of the Second CTI Capacity Building Seminar for CEE/FSU Countries on “Climate Technology and Energy Efficiency”

**Dr. Jürgen Landgrebe**

Federal Environmental Agency, Germany

Dear Mr. Hammar (CTI Presidency),
dear colleagues and energy experts
from almost all over the world!

On behalf of the German Federal Minister for the Environment Jürgen Trittin, and the President of the Federal Environmental Agency, Prof. Andreas Troge, it is a great pleasure for me to welcome you to the Second CTI Capacity Building Seminar for Central and Eastern European and Former Soviet Union Countries on “Climate Technology and Energy Efficiency – Disseminating “Best Practice Experience” here in Ostritz, Germany.

Unfortunately, the representative of the Federal Ministry for the Environment whom we were expecting, Mr. Schafhausen - some of you know him from the last seminar - , cannot be with us today. At the present time he is on a mission to the Ukraine, helping us combat climate change at a different place on this planet.

He asked me to give all seminar participants the Federal Minister’s best regards and his best wishes for an intensive dialogue and a fruitful discussion on the energy and environment themes we will be dealing with in the coming days. Mr. Schafhausen will join us on Friday, so his presentation, originally scheduled for today, will simply be postponed to a later stage of our meeting.

My name is Jürgen Landgrebe. I work with the Federal Environmental Agency in Berlin, Germany, as head of the unit “Environment and Energy, and New Energy Technologies”.

I want to spare you a boring talk about all the activities of the 11 colleagues in my unit. The name of our unit will already give you an idea of what we are concerned with.

I simply would like to inform you about our most recent activity:

As part of the preparations for the Rio+10 Summit, to be held in Johannesburg in 2002, we are currently drafting a report on sustainable development including a chapter on sustainable energy use.

This chapter goes far beyond the classic dimensions of

- increasing energy efficiency,
- saving energy,
- switching to alternative fuels or
- increasing usage of renewable energies.

Technology itself is of no use if people refuse to change !!

Therefore, our strategy on sustainable energy use also includes efforts to change the behavior of consumers, encourage the use of particularly energy-efficient household appliances and implement our information and communication strategy.

As soon as our report is finalized, I will let you know and send you copies of it.

During our get-together last night, by the cozy open fireplace,

we found out that most of you also attended our first Seminar in 1999, when we discussed

- ·Climate change and energy efficiency policies in OECD and CEE countries,
- Climate technology databases on the internet,
- Energy efficiency in the supply sector, the building and end-use sector and in the industrial and commercial sector,
- Strategies to finance investments in energy efficiency.

We had an exchange of experience on energy efficiency centers, debated future tasks and challenges for energy efficiency networks, and developed recommendations at the end of the Seminar.

The results of the first Ostritz Seminar were very promising: The examples and the discussion showed that many of the problems concerning energy efficiency could be solved by networking and using the tools that have already been developed.

I do believe that the last seminar inspired you a lot to start new activities on the basis of the network of energy experts we created between all of us. In this context I would like to mention the very successful follow-up seminar that took place in Tallin, Estonia, on the subject of energy audits etc.

In the meantime, many things have changed concerning the Kyoto process. The resumed Sixth Conference of the Parties in Bonn and the Seventh Conference of the Parties in Marrakech have clarified the conditions for immediate ratification. To my mind, the majority of all nations of the world are now united in their efforts to prevent climate change. Taking specific action and making specific contributions, and doing this now, is an important task not only for the developed countries, but for all countries in the world.

In order to continue our activities to combat Climate Change, we have invited you all to this follow-up seminar, to encourage each other and to exchange the latest and best experiences on energy efficiency.

In examining the recommendations we received after the last seminar, we tried to take on board most of your proposals. In concrete terms, this means that over the next three days we will hear and talk about:

- new and general questions of energy efficiency and energy savings including items like municipal climate protection,
- possibilities for joint implementation and
- reflections on carbon intensity.

We think these aspects could be of interest for broadening our perspective on energy efficiency and its importance.

The use of biomass will be another focal point of our seminar. A lot of comprehensive practical examples will be presented and we hope to have intensive discussions on all ecological and economic problems associated with the use of biomass. Financial tools play an important role. Therefore, project preparation is also a main topic of this seminar, and we hope to clarify all questions concerning the "bankability" of projects.

Another point is Energy performance contracting – EPC or Third Party Financing, which is becoming more and more popular, especially when sufficient financial resources are not available.

We will also discuss combined heat and power generation – or CHP for short. You will be given an introduction to small CHP units and small fuel cells. Hopefully, in the future, all of us will find appropriate applications of these technologies. Thermal energy conservation and the refurbishment of panel buildings are special items for considerable energy savings in Germany, and we imagine you might have similar problems with this kind of buildings in your countries, too.

Finally, we will hear about the latest developments as regards rational energy use in industry and households.

Last but not least, please note that at the end of the seminar, on Saturday, we have scheduled one hour for evaluation, recommendation and conclusions.

During this hour we would like to discuss with you your intentions as regards future work on capacity building and networking.

We would appreciate receiving substantial proposals from you concerning both:

further items to include in the agendas of CTI-events, and your proposals for follow-up events in your home countries.

The CTI and our Agency are very keen to know what your ideas are when we talk about your contribution to the Climate Technology Initiative.

Please, take note of that and put all your ideas on a piece of paper, so that we can discuss them on Saturday.

At the very end, I must not forget to invite you to the social events, that is the tasting of regional eco-wines in the cellar of the convent on Thursday evening, the sight-seeing tour to Bautzen - a nice medieval town in Saxony - on Saturday afternoon and the farewell dinner we will have in Dresden on Saturday evening.

Thank you for your attention. In order to avoid any delay, I would now like to give the floor to Mr. Millhone of the US Department of Energy, who will introduce you to the US climate protection policy.

# U.S. Climate Change Policy

**John P. Millhone**

U.S. Department of Energy

I've been asked to provide an overview of U.S. Climate Change policy. This requires that I set forth the U.S. position on the Kyoto Protocol. However, it also requires that I articulate the major actions the United States is taking to reduce the buildup of greenhouse gases both nationally and internationally.

The U.S. position on Kyoto has received ample coverage in the media already, so I won't be repetitious and spend much time repeating what you already know. The United States does not believe that the Kyoto Protocol is the right answer to the challenge of climate change. We believe the Protocol is flawed – its targets are arbitrary and in many cases unrealistic. It does not include developing countries. And its costs would damage the U.S. economy.

These views were expressed in President Bush's policy statement on June 11, 2001, available at

*www.whitehouse.gov/news/releases/2001/06/20010611-2.html.*

At the Seventh Session of the Conference of Parties (COP-7) in Marrakech, Morocco, the U.S. position was expressed by Paula J. Dobriansky, Under Secretary of State for Global Affairs in her initial and closing remarks.

*www.state.gov/g/oes/climate/index.cfm?docid=5969* and *www.state.gov/g/oes/climate/index.cfm?docid=6050*

To focus only on Kyoto, however, would miss the large and promising opportunities for the United States and other countries to cooperate in their common interest in addressing the challenge of Climate Change.

This is reflected in the Joint Statement earlier this year by President George Bush and Chancellor Gerhard Schroeder on a Transatlantic Vision for the 21st Century. The Statement says:

> We share a common concern about global climate change. We openly note that we differ on the best way to protect the earth's climate. The Federal Republic of Germany, host of the Climate Change Conference in Bonn in July, emphasizes that the targets to reduce greenhouse gases agreed in Kyoto are indispensable to combat global climate change effectively. The United States opposes the Kyoto Protocol because it exempts many countries from compliance and would cause serious harm to the American economy. Both sides, however, are prepared to work constructively with friends and allies to solve the problem. In this context they deem it necessary to develop, among other means, technologies, market-based incentives, and other innovative approaches to meeting the challenge of global climate change.

*www.whitehouse.gov/news/releases/2001/03/20010329-5.html*

The last part of this Statement is the focus of this seminar...the constructive work we can do together to solve the problem. And that's where I want to focus my remaining remarks.

The United States already has made a significant investment in this constructive work through the U.S. Country Study Program (USCSP), the U.S. Initiative for Joint Implementation (USIJI), and our participation in this Climate Technology Initiative.

Beginning in 1993, the Country Study Program provided financial support to 56 countries–many of them in Central Europe and the Former Soviet Union – to undertake climate change analyses, to inventory their greenhouse gas (GHG) emissions, to assess their vulnerability to climate change and how to adapt to the changes, and how to reduce their greenhouse gas emissions. About two third of these funds went to the countries themselves to help build their own capacities; the other third was for technical assistance. We view this as an enormously successful investment. The countries taking part in this program are among the leaders in their knowledgeable participation in climate change issues.

Beginning the same time, the USIJI program was designed to show the value of flexible mechanisms in reducing GHG emissions. The program established clear criteria, drawn from the UNFCCC policies, that would need to be met to gain USIJI approval. We issued 13 solicitations for USIJI proposals, received some 200 proposals, processed them through a careful review, provided recommendations for how they could be approved, and approved 52 proposals, representing 26 countries. Over a period of some 60 years, according to the estimates of the project developers, these projects would reduce emissions by the equivalent of 350 million metric tons of $CO_2$. (We are developing a website to make the products of the USCSP and USIJI programs available electronically, but it's not up yet. In the meantime, I've brought hard copy information on these programs.)

We are proud of our role in CTI, launched at COP-1 in Berlin by 23 IEA/OECD countries. CTI has shown the value of a collaborative effort to promote the UNFCCC objectives through accelerated development and diffusion of climate-friendly technologies.

The United States Climate Change programs currently are in transition. We recognize the value of the USCSP, USIJI and CTI programs. We are examining how the successes achieved by these programs can be recast to make a positive contribute in the new global Climate Change environment. Some of the main elements of the future U.S. program are starting to emerge.

They include a recommendation in the National Energy Policy that DOE and other agencies "continue efforts to identify environmentally and cost-effective ways to use market mechanisms and incentives, continue development of new technologies; and cooperate with allies, including through international processes, to develop technologies, market-based incentives, and other innovative approaches to address the issue of global climate change." They also include the National Climate Change Technology Initiative (NCCTI), which is developing a series of white papers that analyze the contribution that advanced technologies can make to reducing global climate change. These papers are scheduled to be published early next year. A fuller description is available at

*www.whitehouse.gov/news/releases/2001/06/climatechange.pdf*

# Lessons Learned in Technology Deployment

**Dr. Hanns-J. Neef**
**Hans Nilsson**
**Clas-Otto Wene**

International Energy Agency

A project (slide 2) is under way at the International Energy Agency that is focusing on deployment of energy technologies. The purpose of this IEA project is to review successful programs for deployment of advanced energy technologies, and to identify factors that contributed to their success. With this project, we are following up on guidance from the IEA Energy Ministers, who told us in 1999 to share information on lessons learned in energy technology research and deployment.

It is a project of particular value and relevance because it addresses the need to:

- promote economic development through advanced technologies;
- give all countries access to the best technologies to foster sustainable development; and
- mobilize technology solutions to reduce climate-destabilizing emissions, which is a goal especially important to the Climate Technology Initiative.

The basic question is whether it is possible, through review of successful cases, to determine what precisely are the success factors for expanding markets for technologies that use energy more efficiently.

A number of questions are addressed in the deployment project, including:

- What strategic goals (such as energy security, global climate change, local pollution abatement, economic productivity) are used to define technology deployment goals and programs?
- What processes are used to define technology deployment goals and develop technology deployment programs?
- How is technology deployment policy linked to R&D policy?
- Can common factors be identified among successful programs?
- Do circumstances exist where a particular type of policy tends to work best?
- What "best practices" can be identified regarding industry involvement in developing and executing deployment programs?
- How is success in technology deployment defined and measured?
- What "best practices" can be identified concerning how and when programs are evaluated?

The IEA project thus focuses on how the process of developing markets for new energy technologies is shaped and implemented.

**The Analytical Framework for the Study**

Here you see the analytical framework for the study.

The ongoing analysis of deployment policies is being carried out within a combined framework based on the view that different models cannot be substituted for each other, and that none is superior to the others. Rather, the point of departure is that models are complementary and that successive applications give further insights. We call this the Triangulation Model (slide 3), because it incorporates three component models.

- **The Market Barrier Model** is the standard deployment model, consistent with a neo-classical economic viewpoint stating that it is legitimate for governments to intervene in the market to remove or reduce barriers due to market failures. Messages from this model refer to price-setting mechanisms (for example, removing subsidies, but internalizing externalities, or initiating information on dissemination programs to provide support for technology deployment).
- **The RD& Deployment Model** (research, development and deployment) states that it is legitimate for governments to intervene in the market to avoid high future opportunity costs due to externalities and under-investments in learning, which may appear as a public good.

And, finally,

- **The Market Transformation Model** (MT). Deployment policies should transform markets by stimulating market actors to develop, invest in and use technologies with higher performance. Messages from this model focus on measures to stimulate development and market uptake of efficient technologies by forming co-operative or competitive networks of public and private actors for technology procurement, or voluntary agreements.

Slide 4 shows the three key factors which contribute to shaping the market:

- political will (which should be used to establish the proper framework for the many actors involved in market development);
- technical ability (which will deliver good, reliable products to the market place); and
- customer acceptance (which is a prerequisite for market success).

That is how it works in theory!

**The Project**

With this theoretical matrix in mind, we started to collect case studies in 1999 so that lessons learned from programs in the real world could be shared.

Out of a group of 55 cases that were proposed by delegates from Member countries working within the IEA structure, a selection was made. 22 cases (slide 5) were finally submitted as case studies to be analyzed. They provide a good representative mix of focus on demand, on supply and on the different types of fuels.

Case studies and related information are available on the CTI homepage: www.climatetech.net/conferences/ostritz2/deploy.htm

Of special interest to this CTI Seminar are the case studies relating to energy efficiency. Eight case studies are devoted to the end-use of energy, another five have strong elements of energy efficiency. The next two overheads (slides 6 and 7) provide an overview of the case studies with a focus on the end-use sector.

**Austria** – Thermo-profit. A total service package to reduce the amount of energy consumed in buildings.

**Denmark** – An energy labeling scheme for buildings, through which some 50,000 houses are labeled per year.

**The Netherlands** – Application of high-efficiency mechanical ventilation with heat recovery (MVHR). This program has led to higher market penetration of MVHR.

**Sweden** – A program for procurement of high-frequency ballasts for fluorescent lights. High-frequency ballasts use less energy than conventional ballasts and last longer.

**Sweden** – A technology procurement project for market transformation for heat pumps. Sales in Sweden and exports have grown significantly.

**United States** – A program for compact fluorescent lamps. It motivated manufacturers to develop and produce such lamps in the expectation of a successful procurement effort.

**United States** – The Motor Challenge program promotes the use of more energy-efficient motors and acted as the prototype for similar programs for the so-called nine “Industries for the Future”.

**European Union** – The Energy Plus Program. This is a pan-European procurement scheme for refrigerator-freezers, aimed at products consuming considerably less energy than average cold appliances.

**Canada** – Canada’s program focuses on solar ventilation air heating systems, solar hot water systems, biomass combustion systems and ground-source heat pumps.

**Germany** – Solarbau is a German program focusing on R&D and demonstration for solar-optimized non-residential buildings. It is a pre-deployment program providing valuable information for future regulations, such as those involving mandatory energy saving.

**Sweden – Baltic Sea Region** – The goal of this program targeting the Baltic Sea Region is to reduce emissions from oil- or coal-fired energy production plants.

**United Kingdom** – This part of the Best Practices Program focuses on industry and buildings. For both components, current best practices in energy efficiency have been identified. Relevant, impartial information is disseminated, and the development of new technologies is supported. This is an important United Kingdom policy tool for delivering emissions reductions under the Kyoto Protocol.

And the final cast study on this list,

**United States** – The Industrial Assessment Centers, supported by the United States Department of Energy, train engineering students in energy-efficiency practices for small and medium-sized manufacturing plants. Assessments are carried out at no cost to manufacturers.

Generally, the strength of case studies is that they represent reality. They carry the weakness, however, of not lending themselves easily to generalization in terms of conclusions. One has to take into account the specific context of tradition, culture, politics etc. that surrounds the case being studied. This raises severe methodological problems. In the analytical process, case studies are taken apart piece by piece, according to the triangulation structure already described, in order to identify the factors contributing to success.

As part of the project, a workshop took place at IEA Headquarters in Paris on 28-29 November 2001. Prior to the workshop, three rapporteurs had reviewed the 22 case studies, covering the spectrum in terms of supply/demand and fuel focus. This workshop brought together more than 60 representatives from government policy-making bodies, industry and academia.

But I would add that, significantly, one stakeholder group – the financing sector – was not represented. It can be seen that this constitutes a missing link in the chain if we consider one of the workshop conclusions, which was that all stakeholders should be involved in successful deployment programs.

Analysis of the input from the case studies is still ongoing, with a view to establishing the most effective methods for sharing information on "best practices" and "lessons learned" in the deployment of advanced energy technologies. The results reported here are thus tentative.

During the workshop, the case studies were discussed by the rapporteurs from the three angles of the Triangulation Model, and some case studies were presented and examined in greater detail.

**Ways to improve things**

One clear finding is that while individual deployment programs are highly contextual and not easily reproduced between countries and/or sectors, it is nevertheless possible to identify factors for success that can be repeated in a context similar to that where they have already proved effective (slide 8):

- The really successful programs have been developed over a long period;
- they cover several policy issue/areas (coherency);
- they draw empirically from their own results (feedback);
- and they are demand-driven.

Let us look at what emerged from each of the three sessions of the workshop, which was structured according to the Triangulation Model.

***The first session dealt with*:**
**Overcoming Market Barriers.**

Here are the types of barrier that can be encountered. The key messages that emerged from the first session on barriers were as follows (slide 9):

- **Information**. Information must be available and understood at the time of investment for all types of goods and services. It needs to be easily accessible, reliable (and known to be so), and it needs to provide the basis for comparison between products. Examples are standardization, labeling, reliable independent sources, calculation methods.
- At the same time, **transaction costs** can constitute a major barrier. "Time is money": the time needed to take an informed decision to purchase and use equipment costs money. This applies at every level, from the purchase of a household washing machine to the decision of a government administration over large-scale, nation-level purchases. Here again, information is crucial.
- **Financing**. First cost is high and access to funds for new and risky technologies is sometimes difficult to obtain. Demonstration programs can be a good solution, which also help address risk issues.
- **Price distortion**. Costs associated with production and use, and their effects on the environment, health, the eco-system, are not included in assessments of cost. Regulations to internalize "externalities" or remove subsidies can address this price distortion.
- **Market Organization**. Here we have the problem of the split incentives, where the owner, the designer and the user are not the same person.
- **Regulation** is often based on old technologies, on outdated business traditions. Standards and codes are not in pace with technology development. Testing and demonstration can clear the vision of the decision-takers. Regulations should be based on performance.
- **Capital Stock Turnover**. Sunk Costs are deterrent to change. And tax rules that require long depreciation are also dissuasive because they lessen the level of tax re-

lief at a time when manufacturers are in need of funds to finance learning.
- **Technology Specificity**. Existing infrastructures are favored, as opposed to changes that involve new hardware and the institutional skills to handle it. To address this, the focus should be on the system aspects in the use of the technology. The value of measures should be seen in the light of other benefits such as productivity, environmental-friendliness.

***The second session of our workshop focused on:***
**The R&D and Deployment Perspective and Technology Learning.**

Here is one point that emerged from this session (slide 10): deployment and R&D policies are closely tied.

Deployment policies should stimulate learning investments, including private R&D, setting up a virtuous circle between public and private R&D and deployment on the market. Messages from this model would thus focus on measures to stimulate these investments through time-limited subsidies, mandated minimum prices and technology portfolios. A policy recommendation following from this would be that the design of any deployment project should take explicit account of the possibility of technology learning.

***The theme of the third session of the workshop was:***
**The Market Transformation Perspective and the Involvement of Market Actors and Stakeholders.**

Or, in other words: How to engage market actors? The messages that emerge are (slide 11):

- Deployment policies – which can include subsidies for more efficient, climate-friendly technologies – should transform markets by stimulating all market actors to develop, invest in, and use technologies with higher performance. “Partnership” is the key word here. This should ideally create a durable market which lasts after the intervention has been withdrawn. It is all about bringing a technology permanently onto the market.
- Policies should focus on the scope to change market preferences and orientate demand towards products/services with generally better performance. The aim is to introduce yet more new technologies with better performance by selling more of the existing high performance products/services and selling fewer of the low performing variations. In the case of energy efficiency, market transformation causes a shift toward more energy-efficient product categories, and eventually to the disappearance of the least efficient products.
- For the industrial stakeholder, this all means new market opportunities, and possibly more jobs, too.

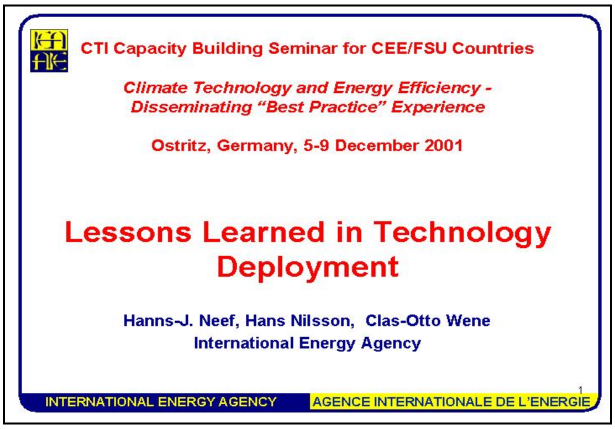
**To sum up:**

We have looked at some of the messages (slides 12 and 13) that emerged from the individual workshop sessions. Let me now identify some pointers that will be guiding our focus as this project continues.

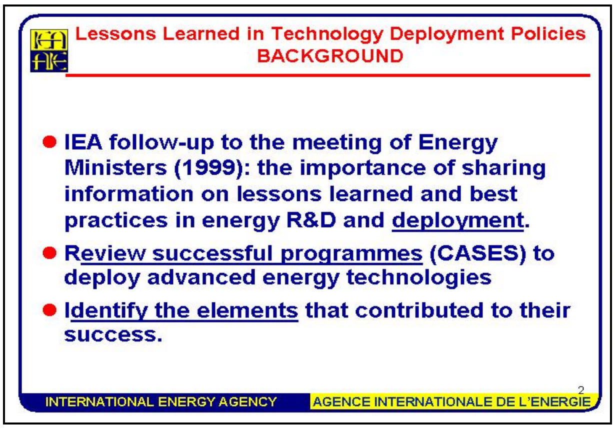
- Success takes time. It takes time to achieve full impact on the market.
- But it is possible to take a fast track when and where the technology is well established, and it is the applications that need to be adapted.
- Program adjustments from trial/error feedback are frequently necessary. Successful programs have often been adjusted during their execution on the basis of experience from trial and (sometimes) error.
- It is important to distinguish between projects working on fragmented markets and those that target a “known” group of actors.
- Monitoring should be carefully tailored to measure the early indicative results and interpret them.
- Aggregation of volume of demand is often crucial and it opens the fragmented markets, but it needs some involvement from operating agents on the market.
- Combining programs and policies designed for different purposes makes each more stable and adds arguments for the change the projects advocate.

Clarity of objectives is paramount. Market-based thinking is obviously the most effective method. And communication between all players – from the producer to the end-user – is absolutely crucial.

Our project on market development for new, efficient – and in this regard also climate-friendly technologies – was certainly placed in the limelight at our workshop in Paris. It was an occasion for open – and very enthusiastic – discussion of the case studies and for comparison to our model approaches. We will keep you informed on the progress of our analysis. Meanwhile, further information is available on the IEA and CTI homepages. In this way, we are making a modest contribution to what we have been asked to do. This is: to make information available on best practices in deployment of clean energy technologies.




Slide 1

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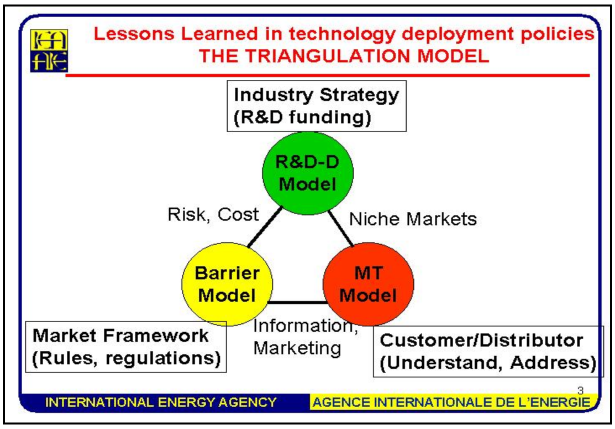


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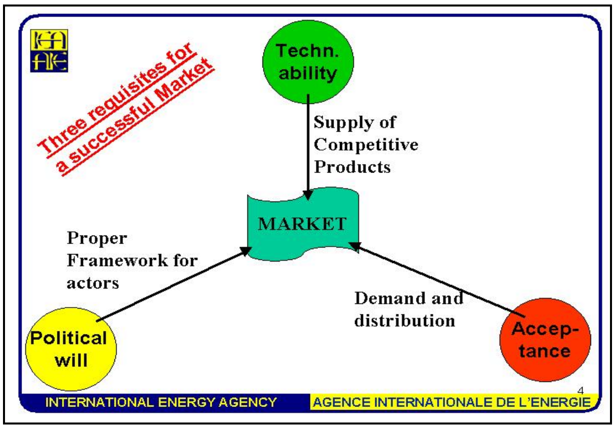


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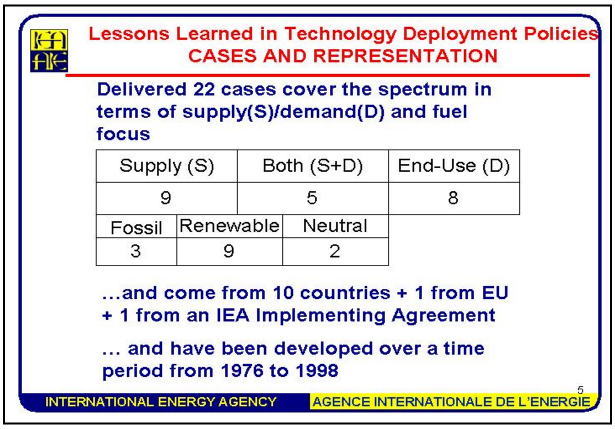


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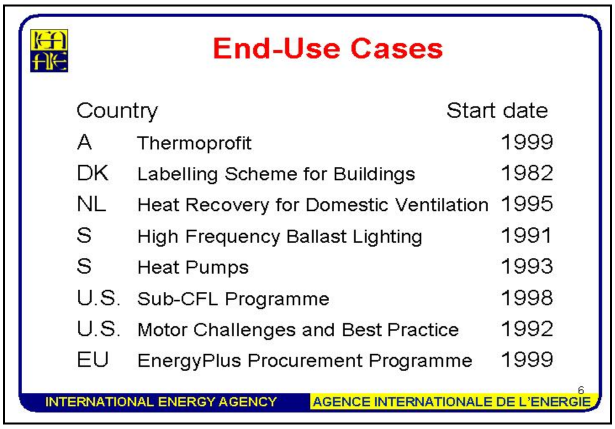


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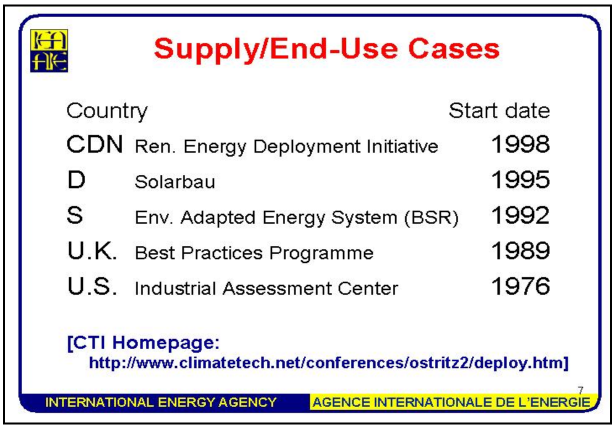


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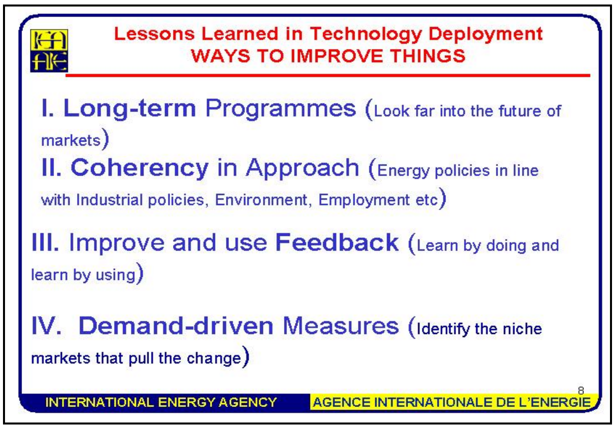


Slide 8

**Lessons Learned in Technology Deployment Policies**
**BARRIERS**

Barrier types:

- **Information** (Availability, Reliability, Comparability)
- **Transaction Costs** ("Time is money")
- **Financing** (High First Cost, Access to funds)
- **Price distortion** (Internalisation)
- **Market Organisation** (Split incentives, Calculation Methods)
- **Regulation** (Based on old technologies)
- **Capital Stock Turnover** (Sunk Costs)
- **Technology Specific** (Existing Infrastructures are favoured)

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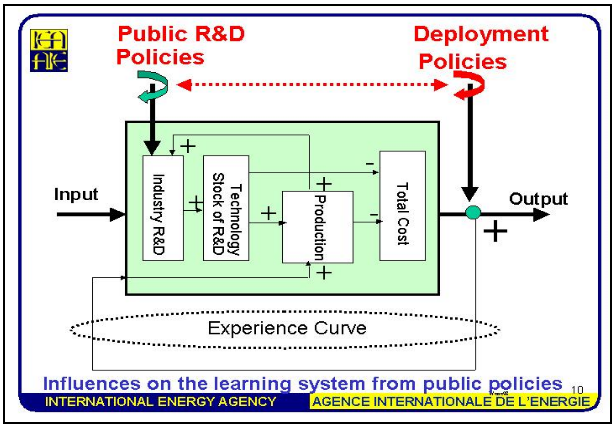
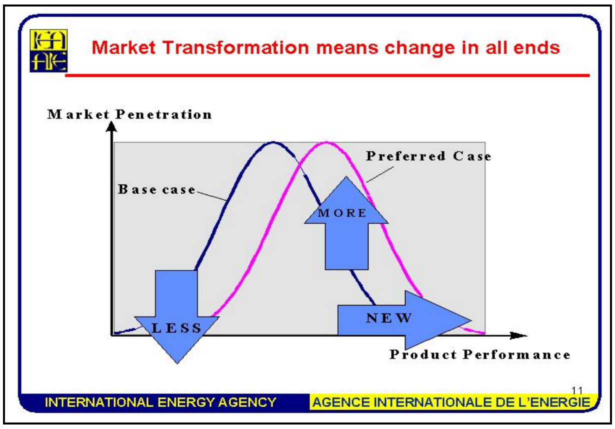
INTERNATIONAL ENERGY AGENCY AGENCE INTERNATIONALE DE L'ENERGIE

Slide 9




Slide 10




Slide 11

**Lessons Learned in Technology Deployment Policies**
**PROCESS RESULTS (1)**

- Success takes time
- Fast track is possible for technology adaptation
- Programme adjustments from trial/error feedback is often necessary
- Distinguish between project working on fragmented markets and those that target a "known" group of actors

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INTERNATIONAL ENERGY AGENCY AGENCE INTERNATIONALE DE L'ENERGIE

Slide 12

**Lessons Learned in Technology Deployment Policies**
**PROCESS RESULTS (2)**

- Monitoring should be carefully tailored to measure the early indicative results and interpret them
- Aggregation of volume of demand is often crucial and needs some involvement from operating agents on the market
- Combination of different purposes give stability to the programmes

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INTERNATIONAL ENERGY AGENCY AGENCE INTERNATIONALE DE L'ENERGIE

Slide 13

# Municipal Climate Protection

**Gotelind Alber**

Klima-Bündnis - Alianza del Clima e.V.

Climate Alliance of European Cities with Indigenous Rainforest Peoples

## 1. Introduction

**Why are local authorities so important for climate protection?**

- Everybody is an energy consumer
- Everybody lives in a municipality
- Cities and towns can influence nearly every sector
- Cities and towns can apply nearly every policy instrument.

**Specific areas for municipal climate protection**

- Local authorities are the government level next to citizens and thus can directly involve them
- Local authorities are responsible for spatial planning
- Local authorities are to a high degree responsible for local infrastructure and public services
- They maintain facilities such as public buildings, schools, car fleet, sports centers, swimming pools.

**Lessons learned during 10 years of municipal climate protection**

- Combine with administrational reform, introduce innovative procedures
- Involve citizens, in particular children
- Address all relevant sectors including waste, agriculture, forestry ...
- Create liveable cities
- Achieve double dividend: global and local benefits.

## 2. Municipal areas of activity

**Energy consumption by local authorities themselves**

An obvious starting point for municipalities is their own energy consumption, which represents between 3% and upwards of 10% of total energy use. This includes heat and electricity consumed in municipal office buildings or for street lighting, sewage treatment, water pumping, municipal car fleets, swimming pools, etc. In many European countries, schools are also in municipal hands. Some local authorities also own large amounts of tenanted social housing. Climate protection in their direct sphere of influence serves several purposes: municipalities can show leadership, save costs and practice more effective administrative action. Moreover, they can demonstrate and disseminate new technologies and procedures.

Many municipalities have reduced their energy demand by up to 15%, without major investment, solely by means of energy management techniques such as monitoring consumption, improved control, early recognition and elimination of weak points. Measures that involve building users are highly successful, for example awareness-raising and motivation. Moreover, municipalities have introduced innovative schemes offering incentives by sharing the monetary savings with building users. Energy efficiency and environmental acceptability are also used as criteria in public procurement.

Many municipalities systematically plan their investments in energy efficiency, based on regular energy book-keeping and energy consumption indicators from which priorities can be derived. Investments include retrofitting of buildings and heating systems, installation of efficient lighting systems, and construction of combined heat and power units in large public buildings. Many municipalities explore new ways to ensure funding for these investments: either they work with energy service companies that offer performance contracting, or they restructure their own budget in order to create a revolving fund (“intracting”).

**Energy supply**

Municipalities may also be responsible for acting as local utilities – distributing energy and sometimes also producing it as well. This function is usually, though not always, delegated to a municipally-owned company and is widespread in Northern and Central Europe. Many such utilities own district heating systems.

Major potential for substantial short-term greenhouse gas reductions lies in the extension of existing and creation of new district heating systems, the upgrading of old systems and their conversion into combined heat and power stations. Small municipalities in particular utilize biogas or biomass for their district heating. A large number of municipalities provide support for the use of renewable energies.

**Urban planning**

Local authorities are usually responsible for land-use planning decisions. They may have powers over the local energy distribution network through the power of concession.

The basic planning level, urban development planning, is a key determinant of demand for mobility: whether it is a compact city; where the various functions – residential and commercial, services, education and recreation – are located and how they interconnect; if there is public transport available for newly developed areas, etc. Cities can make a substantial long-term contribution to car traffic prevention if they consider these aspects early in the planning process. Local climatic concerns have also to be addressed.

The next step of urban planning, the detailed planning of housing areas, also significantly affects energy consumption. Many cities already apply comprehensive catalogues of criteria including orientation and arrangement of buildings to ensure that solar energy can be utilized and district heating systems can be installed cost-effectively, and environmental and energy-efficiency standards for individual buildings.

**Transport policy**

Many European municipalities control local public transport companies that operate underground railways (in big cities), trams (in big and medium-sized cities), and buses. Some urban railways are operated by the national railway companies; elsewhere, local public transport is provided only by private companies.

An energy-efficiency strategy like that used in the energy sector, which in transportation would target the fuel consumption of individual vehicles, is not possible for local authorities as they have barely any influence on purchase decisions outside their own fleet and virtually no influence on manufacturers. The key factors in local transport policy are demand for mobility (where the strategic aim is traffic avoidance) and the means of transport (where it is a shift to public transport, cycle and pedestrian traffic).

In addition to their role in long-term urban planning (see above), it is local authorities that impose restrictive measures stemming car use while providing low-cost and attractive alternatives. Measures to cut motor traffic rarely achieve consensus. Implementing a “push and pull” strategy in spite of this fact entails winning acceptance and providing the necessary funding for public transport. This is one of the greatest challenges of local climate protection, not least because this area is more often seen from the short-term perspective of reducing traffic jams.

**Private sector**

Finally, local authorities can have a considerable influence on energy demand in the private sector. Many municipal energy utilities apply demand-side policies, offering advice and incentives for efficient devices and integrated energy services in the heating sector. In a liberalized market, local authorities are likely to play an increasing part in this area since freely competing energy producers have little interest in limiting consumption.

A core area of municipal energy-efficiency policy in most parts of Europe involves developing the manifold opportunities to save energy in public and private buildings, since in a typical municipality these contribute over 50% of emissions. Municipalities in some countries have explored the legal possibilities for applying stricter building codes than are required by national legislation. Some have introduced innovative schemes committing investors to stricter standards either by contractual means or by using competitive mechanisms.

Beyond this, municipalities have to rely on awareness-raising, advice and consultancy, funding programs, and cooperation with relevant trades people such as heating engineers and chimney sweeps. Information, motivation and cooperation are playing an increasing part in municipal policy.

**Other areas**

Beyond the core sectors in terms of $CO_2$ emissions, municipal climate protection is presently expanding to other fields, too, that are sources of greenhouse gases. Since many municipalities are owners of substantial forestry and agricultural areas, they can influence how these areas are managed. Waste management, which is in most countries a municipal task, is increasingly viewed under climate change aspects as well. Moreover, municipalities can influence private consumers and businesses in many ways.

## 3. The Climate Alliance Methodology

Municipal climate protection is not only an important contribution to protecting the Earth's climate, but also yields local benefits such as promoting industry, or reducing emissions and noise and, not least, provides incentives for innovation and new forms of cooperation. Nonetheless, climate protection remains a challenge, for there is still a long way to go until the necessary climate change policy targets are met!

Therefore, the Climate Alliance has developed a methodology as a recommendation to local authorities for the strategic development of programs of action that encompass all activity areas of relevance to climate protection. It is to support local authorities from their initial decision to engage in climate protection right through to their monitoring of the performance of measures implemented.

The key elements of this methodology are:

- The "10 Steps" for internalizing climate protection within the municipality
- The Climate Alliance Catalogue of Measures
- The Climate Alliance Monitoring System and Indicators.

**The 10 steps**

give municipalities a structured orientation defining the cross-sectoral tasks for political and institutional internalization of climate protection:

(1) Formally resolving to define climate protection as a local authority task
(2) Creating a climate protection office/department with appropriate competencies and budget
(3) Establishing a forum with external stakeholders
(4) Defining visions for all spheres of action
(5) Drawing up a greenhouse gas abatement action plan
(6) Adopting binding, sector-specific targets
(7) Adopting and implementing action programs
(8) Drawing up greenhouse gas emissions inventories
(9) Applying sustainability indicators
(10) Publishing a climate protection report.

The Climate Alliance Catalogue of Measures comprises some 100 individual measures in all activity areas of a municipality of relevance to climate protection. It provides

- the basis for developing local climate protection action plans,
- a matrix for local authority reporting, and
- a tool for the qualitative assessment of municipal climate protection activities with regard to the range of measures planned and being implemented.

The structure of the Catalogue proceeds from the various roles and functions that local authorities have in the development and implementation of climate protection measures. These are consumer and model, planner and regulator, supplier and provider, and advisor and promoter. Within all these roles, energy, land use planning and transport, procurement, waste management, and agriculture and forestry should be addressed. Since global equity issues are closely connected with climate change policy, the Climate Alliance Catalogue of Measures includes practical approaches to North-South cooperation, too.

**The Climate Alliance Indicators**

serve to monitor in quantitative terms the performance of local authority climate protection activities. They supplement the limited information provided by $CO_2$ emissions inventories on the impacts of local authority climate protection policy. The set of 18 indicators builds on the structure of the Catalogue of Measures.

# 4. The Climate Alliance Catalogue of Measures

**The local authority as consumer and model**

- Energy management in own facilities, and reporting
- Energy conservation investments, financing schemes, commitment to best possible energy standards for new public buildings, and in retrofitting public buildings
- Energy supply: renewable sources of energy and co-generation in municipally owned buildings, purchase of 'green' electricity
- Transport - staff: support efforts to prevent or shift the modal split of private motor vehicle traffic by own staff on the way to work
- Transport - fleet: low-emission vehicles and shift to climate-friendly option
- F-Gases: phase out (H)CFCs, HFCs and PFCs
- Procurement: environmentally sound purchasing policy system through guidelines for climate-friendly purchasing, giving preference to products with certified environmental labels, guidelines for award of contracts giving preference to best over cheapest offers
- Procurement and waste management: abstain from using tropical timber, give preference to domestic, and FSC certified timber
- Waste: work towards rigorous waste prevention and reduction
- Agriculture and forestry: certified organic criteria, ecologically adapted silviculture, forests certified to FSC standards
- North-South co-operation: support sustainable projects in the South, use 'fair trade' products.

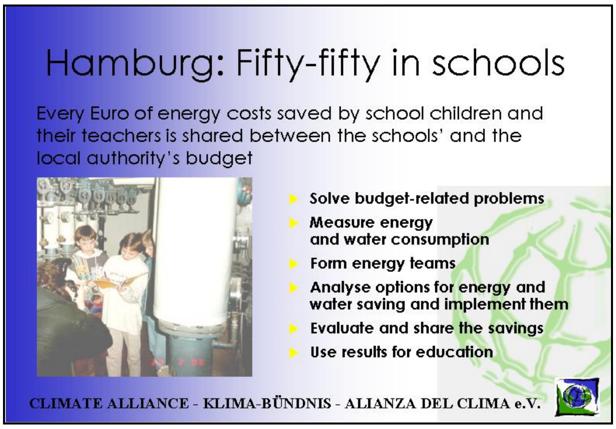
**The local authority as planner and regulator**

- Urban development: reduce the area required for new construction, stop urban sprawl, integrate traffic prevention aspects in development planning
- Energy: optimize the energy performance of new developments by district heat supply, renewable sources of energy, small-scale CHP units, efficiency and solar-oriented urban development planning
- Transport in urban planning: support transportation patterns more conducive to liveable cities by means of legal and regulatory instruments and organizational measures.
- The local authority as supplier and provider
- Energy supply: promote climate-friendly options (co-generation, efficient heating systems, district heat, renewables
- Energy consumption: promote energy conservation and efficiency
- Local public transport: improve public transport acceleration and availability, expansion of public transport network, improve fare policy and comfort and service
- Infrastructure for pedestrians and cyclists: reduce the space devoted to cars in favor of walking, cycling and public transport
- Cycling and walking: promote these options by better infrastructure, better interlock with public transport
- Waste separation and recycling: minimize environmental impacts in the waste
- management sector by separate collection, utilizing landfill gas and biogas, disposal of (H)CFCs, HFCs and PFCs.

**The local authority as advisor and promoter**

- Energy sector: establish grant programs for efficient heating systems, low-energy houses, conversion of electric space heating and domestic hot water systems to other sources, cogeneration, renewables
- Agriculture and forestry: promote and provide incentives for organic and extensive farming practices and biomass facilities, support the marketing of regional produce
- Co-operation with industry and commerce: carry out joint climate protection projects with businesses and trades, co-operate with housing associations and with farmers
- Public education and awareness-raising: make professional PR work, organize regular climate protection related events
- Advice: offer energy, waste and mobility advice for citizens
- Education and awareness-raising: demonstration projects, schools projects, energy conservation campaigns, campaigns aiming at changing the choice of transport modes
- Co-operation and participation: co-operate with citizens, local groups and institutions in round tables or Local Agenda 21 process, involve municipally owned utilities and other energy suppliers
- Co-operation with other municipalities in city networks and in the region
- One-World activities: events on North-South related issues, co-operate with local North-South initiatives, create and maintain partnerships focusing on Agenda 21 and climate issues.

## 5. Some examples of good practice



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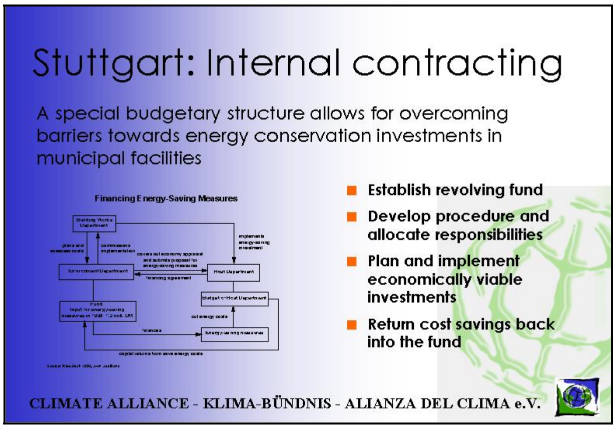

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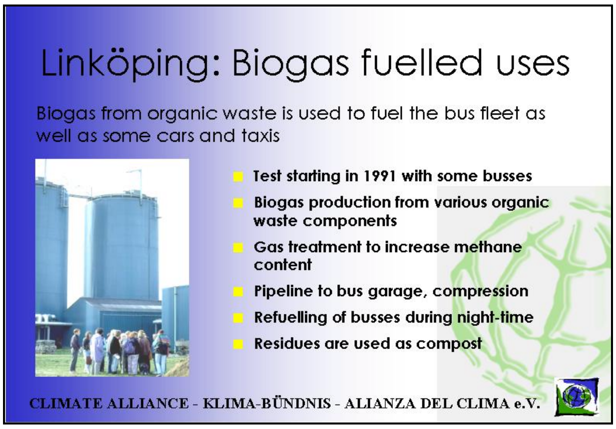


Slide 3

Slide 4

Slide 5

## 6. The Climate Alliance

The Climate Alliance is an association of European cities and municipalities that have entered into a partnership with indigenous rainforest peoples. This world-wide alliance is united by a common concern for the world's climate. Our climate protection contributions build upon commitment and diversity at the local level. We view our initiative as a part of efforts towards sustainable development and North-South equity.

**Objectives**

The aim of the Climate Alliance is to preserve the global climate. In our view, this involves reducing greenhouse gas emissions to a sustainable level in the industrialized countries of the north, and conserving the rainforests in the south of the planet.

By joining, the member municipalities have committed themselves to certain goals, activity areas and measures. These voluntary commitments are set out in the Climate Alliance Manifesto (1990) and Climate Alliance Declaration (2000) and go far beyond national and international targets. This commitment is backed by a tremendous amount of local action to protect the climate which is gaining recognition both nationally and internationally.

Indigenous communities are the ones who contribute the least to climate change, but could be affected the most since they are living in very vulnerable areas. In our partnership with them we support their goals to attain their basic rights as peoples and to be able to live and work in their natural environment according to their own development concepts.

**Members**

Since its foundation in 1990, almost 1000 European cities, municipalities and district authorities over 47 million inhabitants have joined the Climate Alliance. Regional governments and non-governmental organizations collaborate as associated members. Our indigenous partners are represented by the Coordinating Body for the Indigenous Peoples' Organizations of the Amazon Basin (COICA). Our world-wide cooperation partner is the International Alliance of the Indigenous-Tribal Peoples of the Tropical Forests (I.A.I.P.). Both organizations are committed to conserving tropical rainforests and their biological diversity.

The Climate Alliance is the connecting link between the local level and the international policy processes in the climate change, biodiversity and forest policy arenas. We represent the interests of European cities and municipalities committed to climate protection, and support indigenous organizations in developing positions of their own and putting these positions forward in the international processes.

**Activities of the Climate Alliance**

- Networking and exchange of experience
- Compilation, documentation and dissemination of good practice examples
- Evaluation of the members' activities
- Development of methodologies, recommendations, tools and guidelines
- Campaigns and activities inviting broad public participation

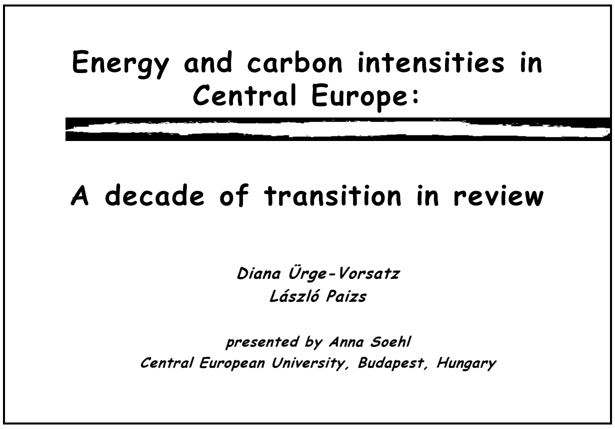
**Alliance**

- European Climate Alliance Award "Climate Star"
- Car-free day campaign "In town - without my car" and European Mobility Week
- Social marketing campaign "wild climate"
- Internet-based information and monitoring system in the area of renewable energies
- „Pathfinder" for local authorities in Southern, Central and Eastern Europe
- Partnership programs between local authorities in Western and CEE countries.

# Energy and Carbon Intensities in Central Europe: A Decade of Transition in Review

**Diana Ürge-Vorsatz**
**László Poizs**

Central European University Budapest, Hungary

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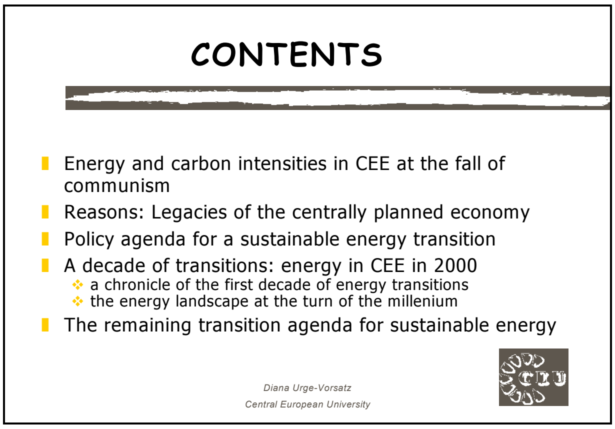


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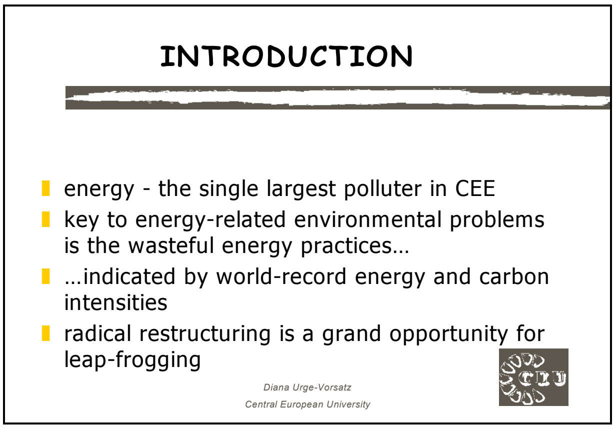


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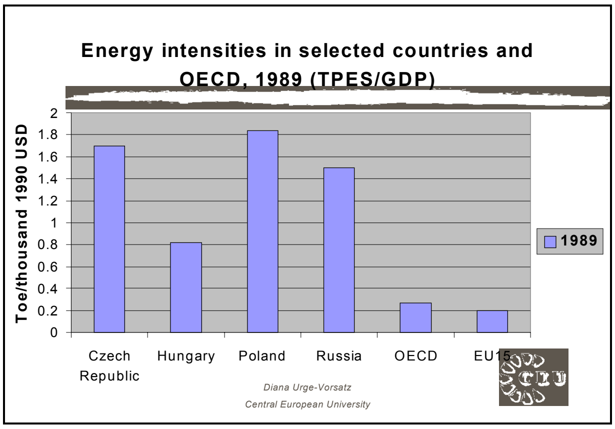


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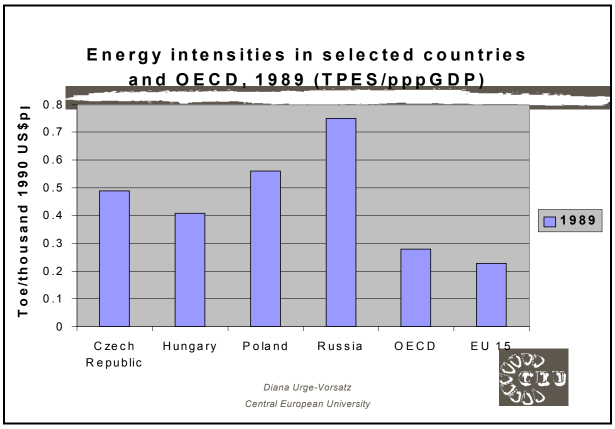


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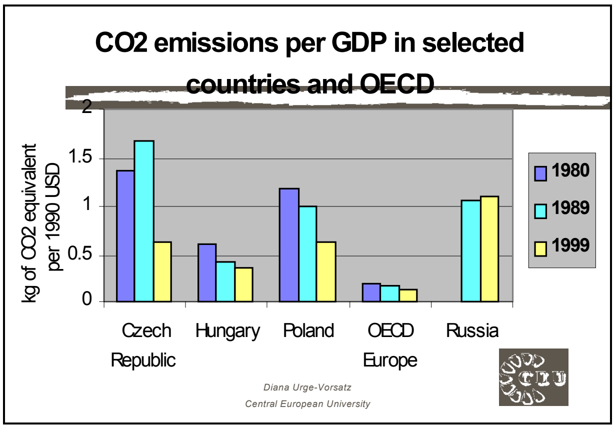


Slide 6

## Negative legacies of the centrally planned economy

- communist paradigm: efficiency has no role
  - subsidised energy prices
  - flat rates
  - lack of metering
- marxist resource economics: unrealistic resource valuation ( e.g.. Bucharest formula)
- planned economy: no competition, no penalty for inefficiency
  - normative planning
- dominance of the heavy industry
- lack of awareness
- others: insufficient data and information, economies of scale, corruption

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Slide 7

## Positive legacies of the centrally planned economy

- potential for leap-frogging
- centrally planned economy favours collective consumption
  - high share of public transport in modal split
  - high share of rail freight shipping
  - high share of district heating
- others

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Slide 8

## Policy agenda for reducing energy and carbon intensities in CEE

- key goal: addressing the legacies affecting energy consumption patterns identified above
  - positive legacies: potential for leap-frogging
  - negative legacies: policy goals to be tailored targeting each legacy

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Slide 9

| Feature of centrally planned economy contributing to high energy intensity | Policy response to address feature |
|---|---|
| No competition, no penalty for inefficiency | Transition to a market economy<br>Privatisation |
| Unrealistic resource valuation | Introduction of market prices |
| Subsidised energy prices | Lifting subsidies<br>Liberalisation of energy prices |
| Flat rates | Consumption based billing<br>Introduction of metering |
| Dominance of heavy industry | Transition to a market economy<br>Restructuring |
| Economies of scale | Transition to a market economy, Privatisation |
| Lack of expertise and awareness | Education, technology transfer |
| Insufficient data and understanding related to energy use | Data collection on end-use practices<br>Establishment of energy related state institutional background<br>Open access to information |

Slide 10

## Chronicle of the first decade of energy transitions

- Economic reforms in advanced stage in Central European countries (Hungary, Czech Republic, Poland)...
- ... but require further progress in Russia and much of CIS
- energy sector reforms at different stages:
  - lifting subsidies
  - corporatisation, unbundling
  - privatisation
  - liberalisation

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Slide 11

| Policy goal to address factor contributing to high energy intensities | Status of the implementation of policy goal | | | |
|---|---|---|---|---|
| | Poland | Hungary | Czech Republic | Russia |
| Transition to a market economy | Completed | Completed | Completed | Started; much further progress needed |
| Privatisation of the economy | Largely completed | Largely completed | Largely completed | Partially completed |
| Privatisation of the energy industry (electricity here) | Started | Largely completed | Partially completed | Partially completed |
| Liberalisation of the energy industry | Started | Start planned for 2003 | Start planned for 2002 | Not started |
| Lifting energy price subsidies | Completed | Completed | Completed | Not completed |
| Consumption based billing | Mostly completed | Mostly completed | Mostly completed | Partially completed |
| Introduction of metering | In process | In process | In process | In process |

Slide 12

## Results: Energy landscape at the turn of the millenium

- GDP developments have followed 2 pathways:
  - fast transitioning economies (CE) rebounded
  - slow transitioning countries (Russia) slowly rebounding

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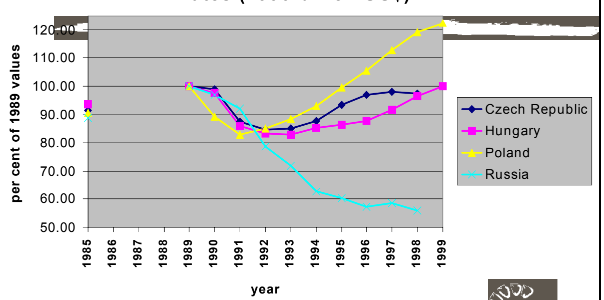
Slide 13

**GDP of selected countries using exchange rates (1990 billion US$)**

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Slide 14

## Results: Energy landscape at the turn of the millenium (cont. 1)

- GDP developments have followed 2 pathways:
  - fast transitioning economies (CE) rebounded
  - slow transitioning countries (Russia) slowly rebounding
- TPES follows similar pattern, but
  - shrank more than GDP in CE
  - shrank less than GDP in slow transitioning countries

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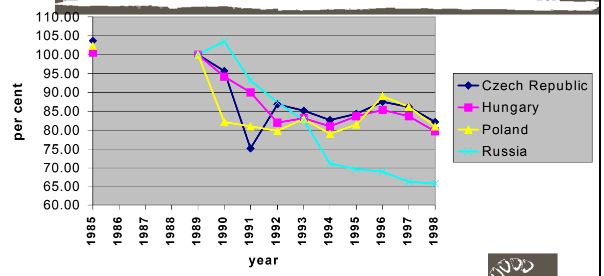
Slide 15

## TPES of selected countries, 1985-1998 (1989 = 100%)

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## Results: Energy landscape at the turn of the millenium (cont 2.)

- GDP developments have followed 2 pathways:
  - fast transitioning economies (CE) rebounded
  - slow transitioning countries (Russia) slowly rebounding
- TPES follows similar pattern
- Energy intensities develop two different pathways: fast and slow transitioning economies
- Energy intensities have not fallen as expected based on radical transition even in CE

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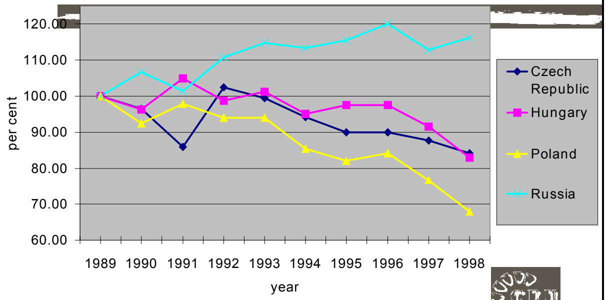
Slide 17

## Energy intensities in selected countries (1989 = 100%)

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## The remaining policy agenda for sustainable energy transitions

- Economic restructuring and energy sector reforms alone will not close the efficiency gap
- Further reforms needed: specific policies targeting energy efficiency

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| Policy goal to address high energy intensities | Status of the implementation of policy goal | | | |
|---|---|---|---|---|
| | Poland | Hungary | Czech Republic | Russia |
| Increasing energy efficiency awareness | Limited progress | Limited progress | Limited progress | Limited/no progress |
| Energy efficiency education of experts | Limited/no progress | Limited/no progress | Limited/no progress | Limited/no progress |
| Data collection on end-use practices | Worsened during the 90s | Worsened during the 90s | Worsened during the 90s | Worsened during the 90s |
| Establishment of energy efficiency related state institutional background | Further progress needed | Much progress made in 2000; further progress needed | Further progress needed | Situation worsened during Putin administration |
| Open access to information | Improveme nt needed | Improvement needed | Improvement needed | Improvement needed |

Slide 20

## The remaining policy agenda for sustainable energy transitions (cont)

- Economic restructuring and energy sector reforms alone will not close the efficiency gap
- Further reforms needed: specific policies targeting energy efficiency
- Even with the most radical policies, the closing of the gap will be slow due to behavioural, cultural and organisational momentum.

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Slide 21

## Conclusion

- the reduction of energy intensities is the key towards carbon emission control in CEE
- economic reforms and energy sector restructuring will address many legacies from central planning causing high energy intensities
- ...but they are not sufficient for closing the energy efficiency gap
- for bridging the energy and carbon intensity gap with EU levels, strong legal, financial and institutional commitment is needed from governments
- leap-frogging requires inventive and dedicated policy-making to design new pathways of development.

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Slide 22

# The German Energy Agency as a Partner for Energy Savings in CEE and FSU

**Kristina Steenbock**

German Energy Agency

## 1. Who is dena?

- New and first national energy agency
- Founded in 2000 by the German government and the KfW
- Background-idea that led to founding dena and major tasks of the agency
- Dena's structure and partners
- Dena's board and funding

## 2. Dena's domestic action program Examples of projects:

- Efficiency in compressed air systems
- Public information campaign to reduce standby losses
- Coordination of the offshore wind park planning
- Climate campaign

## 3. Dena's international cooperation

- Cooperation, consultation and projects to energy efficiency and the deployment of new technology within the EU
- Export-orientation and -strategy of renewable energy technology
- Energy-efficiency in CEE and Russia

## 4. Examples

- Cooperation with Russia
- Bankable energy efficiency projects in 5 CEE countries

Slide 1

Slide 2

## Background Idea

New energy policy needs the active support of consumers, cooperations, administration. Not done with a legislative act only. Particular concern: market penetration of new efficient technologies as well as the development of innovative service concepts.

**dena´s estimate:**
Primary Energy Consumption in Germany can be reduced by approximately 30%, economically sound and under the given prize levels.

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Slide 3

## dena´s task

**Statute (Gesellschaftervertrag):**
„Support for efficient and environmentally sound energy production and consumption, including renewable energy by

- Dissemination of information available for both the public and experts,
- Developing, implementing and evaluating programmes and projects,
- Providing advice for decision makers and the administration on the national and regional level as well as for the private business and scientific institutions,
- International cooperation".

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## Partners of dena

Dena cooperates with all partners, both national and international, which are able to provide relevant contributions within the energy sector. Among these partners are other energy agencies, companies, associations and authorities, as well as financial, promotional and scientific institutions.

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## dena´s board

**Dr. Werner Müller**
Federal Minister for Economics and Technology (Chair)

**Hans W. Reich**
Company Spokesman for the Kreditanstalt für Wiederaufbau (Deputy Chair)

**Kurt Bodewig**
Federal Minister for Transport, Building and Housing

**Dr. Rolf-E. Breuer**
Company Spokesman of the Deutsche Bank

**Detlef Leinberger**
board member of the Kreditanstalt für Wiederaufbau

**Jürgen Trittin**
Federal Minister for the Environment, Nature Conservancy and Nuclear Safety

dena
Deutsche Energie-Agentur 6

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## dena´s structure

| Executive Management | Divisions | Projects |
|---|---|---|
| Secretariat<br>Commercial Management | Energy efficiency within the Electricity Sector | eg. Efficiency in compressed Air Production |
| **Communication Management** | Climate Protection and Sustainable Development | eg. Standby |
| Call-Center<br>Press and Public Relations<br>Networks | Energy efficiency in the Building Sector | eg. Implementing Dir. on Energy Saving |
| **Special Projects / Assignments** | Renewable Energy | eg. solar energy, biomass |
| Coordination of offshore Windparks<br>Coordination of fuel cells projects | International Cooperations | eg. german-russian council |

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## Examples from dena´s domestic work programme

- **Efficiency in compressed air systems** – Partners: Joint project with the VDMA (German Engineering Federation) and 18 corporate partners to increase the efficiency of compressed air systems.

  Goal: Compressed air systems consume up to 7% of the annual industrial electricity requirement. According to a study, these levels could be reduced by 30%. Project to motivate operators of compressed air systems to optimize their systems.

  Means: Information and Measurement campaign (operators usually don´t know how much their systems consume – dena offers cost-free measurement done by our partners. Win-win for both sides: For partners it generates new contacts and clients, for system operators a cost-free consultation).

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## Examples from dena´s domestic work programme

- **Campaign to reduce standby-losses** in household appliances, which cause energy-losses as high as the annual energy consumtion of the City of Berlin.

  Goal: To push for and to introduce new technology for these appliances with less energy consumption in the standby modus.

  Partners: Joint project with the Deutsche Bundesumweltstiftung and business partners from electricity companies.

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## Examples from dena´s domestic work programme

- Coordination of the **governmental project to install wind power plans offshore** in the North Sea and the Baltic Sea (Potentially an energy-supply of 20 to 25 00 MW in the year 2025)
- Dena is coordinating the **Climate Campaign of the Bundesregierung**, which starts ist public appearanlce in spring 2002 and will focus on raising public awareness on climate change as well as informing about the opportunity everybody has to save energy in his/her day-to-day life. Financed in public-private partnership.

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## dena´s international cooperation

- Cooperation, consultation and projects to improve energy efficiency and the deployment of new technology within the EU.
- Improve export orientation and export strategies of renewable energy technology.
- Energy efficiency in CEE and Russia.

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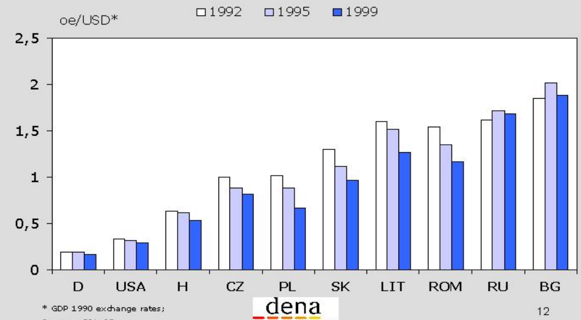
Slide 11

## Energy Intensities in Eastern Europe




* GDP 1990 exchange rates;
Sources: EIA, BP

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## Bankable Energy Efficiency Projects - BEEP

**Aims of the project:**

Development of bankable projects on large-scale energy efficiency investments (best practice cases) in five Central and Eastern European (CEE) countries ready for financing application to EBRD or national financial institutions

**Participants of the project / National Energy Agencies**

| Western Partners | Eastern Partners |
|---|---|
| Germany – dena (Coordinator) | Czech. Republic – March |
| Austria E.V.A. | Romania – ISPE |
| Greece – CRES | Poland – KAPE |
| Norway – IFE | Slovakia – SEA |
| | Bulgaria - SEEA |

Planned duration: 24 months

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## Bankable Energy Efficiency Projects - BEEP

**Background**

A number of project proposals on energy-saving measures in CEE countries have been outlined in recent years but had to be rejected since business plan outlines of CEE investors have shown substantial problems and deficits including:

- lack of information on markets and competition
- insufficient examination of legal and administrative requirements
- little experience with implementation plans
- lack of contingency plans and sensitivity analyses
- insufficient financial information and projections
- deficits in the selection of partners
- emphasis on production and supply-side energy efficiency measures, with little examination of lucrative end- use energy efficiency potentials.

The project is aimed to help to overcome these deficits.

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## Bankable Energy Efficiency Projects - BEEP

**Working stages of the project**

- Elaboration of a report on national framework conditions in the participating CEE countries
- Training-workshop with a presentation of EBRD requirements for fully bankable projects
- Selection of appropriate projects for energy efficiency
- Elaboration of a business plan according to EBRD standards
- Identification of possible investors
- Negotiation of the financing plan
- Selection of the investor
- Dissemination of final results

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## Bankable Energy Efficiency Projects - BEEP

**Expected results**

- complete development of a bankable investment project on energy efficiency as a blue print for further projects
- extension of the existing EBRD "Guide to Energy Efficiency Bankable Proposals" by the specific national pre-requisites and requirements
- opening up of new market opportunities for technology suppliers and energy providers in EU member countries
- dissemination of information on the pre-conditions for energy efficiency measures in CEE countries throughout the EU.
- substantial reduction of risks for investors and financing banks to participate in energy efficiency investments

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## Co-operation with Russia

**Situation in Russia**

- High energy intensity and low energy tariffs
- Inefficient use and waste of energy

⇓

- High potential for energy saving:
  350 - 400 mln tce = up to 40% of current Russian energy consumption

⇓

- Main aims of the current Russian Energy Strategy - 2020:
  Energy efficiency and energy saving measures

dena 17

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## Co-operation with Russia

**Perspectives**

- dena and the Russian Ministry of Energy co-operate in the area of the energy conservation and energy efficiency
- Examples of first projects:
  - "Sectoral integrated energy concepts/planning" in food-industry enterprises in St. Petersburg;
  - "Sectoral integrated energy concepts/planning" in public service sector;
  - Development of energy supply alternatives for energy deficit regions.

dena 18

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# Overview of Biomass Use for Energy in Poland

**Prof. Piotr Kowalik**

Politechnical University of Gdańsk

Faculty of Environmental Engineering, Department of Sanitary Engineering

## 1. Concept of biomass

Biomass is the organic substance originated from vegetation or animals. It may be produced by the so called societal metabolism as well. The most common form of the biomass is wood, straw, sewage sludge similar to a peat, or the solid communal waste with high content of the waste paper. Biomass is cumulated mainly in the place of production or processing of the plant material (surplus of straw during the production of grain, waste wood in the timber wood processing and pulp and paper industry), or it may be the plant material produced only in purpose of energy, for example on the fast growing short-rotation tree plantations of selected poplar or willow clones.

Organic waste material originated from animal metabolism may include biogas from the anaerobic digestion of the animal manure or dung, biogas from the anaerobic fermentation of sewage sludge in the waste water treatment plants, or biogas from the anaerobic digestion of the wastes on the sanitary landfills. Organic material may be transformed into pyrolitic gas (mainly during the process of gasification of wood) and this pyrolitic gas may drive gas engines for electricity production or may be used in the gas boilers for heat production.

Very common is biomass as a liquid transport bio-fuels in the form of oil or ethanol. Two technologies are existing on the Polish market. The first one is the production of esters from the rape seed oil giving so called bio-diesel. The second one is the production of alcohol in the form of dewatered bio-ethanol mixed with the ordinary petrol (5% of bio-ethanol, 95% of petrol) and distributed in the petrol stations under the name bio-petrol E94E (Kowalik, 1997a).

Biomass according to the terminology introduced in the European Union (Grassi et al., 1992) contains all organic material of biological origin (mainly from vegetation), which may be produces on the special energy plantations, or may be originated from the residues in forestry, in timber production, in municipalities, in agriculture, and in agro-business (mainly in food processing industry). In the past biomass was commonly used for energy in the form of fuel wood and organic residues. About 2 tons of dry wood or straw are equivalent of the energetic value of 1 ton of black coal. For example fossil fuel like Polish black coal has the parameters 25/22/0.8 (25 MJ/kg, 22% ash, 0.8% sulfur), but biomass from plant material (wood or straw) 13/3/0.03. Dry sewage sludge has the parameters 14/45/0.8, which is similar to the contents of the coal waste mud produced during the process of washing of the black coal or to the contents of the low quality lignite (brown coal) or dry peat. But in the energy production such a material may be utilized, it means that coal waste mud, low quality lignite, peat, or dry sewage sludge are considered as an energy resource in the very local solutions.

In the terminology proposed in European Union (THERMIE, 1995) biomass contains all kind of organic material originated from plants or animals, as well as all materials originated from the transformation of the plant and animal origin. The resources of biomass are: wood from the fast growing tree plantations, wood residues in forestry and in timber production, manure and dung in the animal production, straw produced together with grain, organic waste in agro-business during food processing. Biomass contains organic material in the sewage sludge produced in the municipal waste water treatment plants. It means that the producers of biomass for energy are: agriculture (straw, biogas from animal manure), forestry and wood processing industry (solid fuel wood), municipalities (waste paper, biogas from the sanitary landfills or biogas from the waste water treatment plants), or from the industry (residues from the paper and pulp industry, textile industry, food processing industry, etc.).

In the Polish literature was proposed the definition by Solinski (1994) as follows: „renewable energy resource means the source or energy carrier, which is able to regeneration under the influence of the energy coming from Sun or Earth". In agreement with this definition one can propose that biomass is renewable energy resource (in the form of solid, liquid or gas energy carriers), which are able to regenerate under the influence of the energy, coming from the Sun and under the influence of the societal metabolism. In this context biomass is the material originated from vegetation (wood, straw, lignin liquid waste as black liquor, waste paper), from animals (municipal sewage sludge, manure, dung), or substances after the processing of biomass producing biogas (from anaerobic digestion of manure, sewage sludge, or from organic solid waste on the sanitary landfills), bio-ethanol (mainly from alcoholic fermentation of potatoes), or pyrolitic gas (produced from wood or sewage sludge).

According to these definitions the biomass is treated in two separated groups of resources:

- primary energy resources, including wood, straw and sewage sludge (analog of peat) and
- processed energy resources, upgraded into the form of biogas, bio-ethanol and pyrolitic gas (from pyrolysis and gasification of biomass).

## 2. Fuel wood

In Poland mean annual production of forestry is estimated to be 19 mln cubic meters of wood (it was for example during 1993). Recently Polish forestry is offering additional forest residues in amount of about 3.5 mln cubic meters per year (during 1997) in the form of the fuel wood for direct combustion in small wood boilers. This wood has a form of logs or fine wood (branches), about 2 mln cubic meters of logs and 1.5 mln cubic meters of fine wood (M. Jaworski, 1998, direct information). Bigger wood has a form of trunks cut to the pieces 1 m long and divided into logs in the case when the diameter of the trunk is bigger than 25 cm. Fine wood is obtained mainly from branches and small trees with a diameter lower than 8 cm and cut into pieces 1 m long. Fuel wood is stored into cords of cut wood inside of the forest for drying and selling. Most of such fuel wood is offered for clients in the Forest Regions of Wroclaw, Szczecin, Bialystok and Olsztyn, but the smallest amount is available in the Forest Regions of Warszawa, Radom, Krakow and Pila. Beside of the 3.5 mln cubic meters of fuel wood in the forestry is produced additional 2 to 2.5 mln cubic meters of clearing residues and fine branches (with diameter below 6 cm), but this particular material is not present on the market, because according to the opinion of ecological foresters smallest residues should be included into forest litter for organic fertilization and reproduction of the soil humus content. Fuel wood is offered for sell „loco forest" it means inside of the forestry, with additional cost of the long transportation. Actual price of the fuel wood in Poland is about 50 PLN/cubic meter for logs and about 30 PLN/cubic meter for fine wood in the form of cords of cut wood (1 USD = 4 PLN now). The concurrent customers buying this wood are: owners of small wood boilers for production of heat, or big hardboard factories producing elements of furniture. Until now the hardboard factories are dominating client.

Big amount of waste wood is existing in the wood industry. It is important to note that every 100 cubic meters of wood taken from the forest in the form of trunks contains at least 10 cubic meters of bark, fine wood is giving 15 cubic meters, low quality big wood in the form of logs is 20 cubic meters, sawdust and wooden chips 19 cubic meters, sown timber (lumber) contains 36 cubic meters, and the final products from trunk wood is giving only 20–25 cubic meters (Guzenda and Swigon, 1997). According to the recent evaluations it is not possible to increase the total wood production of the Polish forestry in the coming years, even after intensification of the plantations of the fast growing poplars (30000 ha) and willows (7000 ha). Taking for the simple balance annual production of 20 mln cubic meters of trunk wood and considering that 4/5 of this wood became wood waste, it gives about 16 mln cubic meters of wood in the scale of whole country. Wood density is about 450 kg in cubic meter (Gawronska, 1997) and the 16 mln cubic meters means 7.2 mln t of wood per year, equivalent of about 4 mln tons of black coal per year (Kowalik, 1994).

Combustion of wood in Poland is realized in the boilers, produced by several local factories. Most common producer is Factory KUBACKI from Hajnowka, producing boilers under the name MODERATOR. Another producer is Factory WUSP–MET in Pleszew or Factory FUWI in Elblag. Recent balance of the wood boilers was made by Dakowski (1998) who estimates that about 18000 wood boilers are in use in Poland, with heat capacity between 14 kW up to 820 kW, with the total heat capacity 600 MW and consumption of fuel wood equivalent to 300 thousands tons of black coal per year. Substitution of coal by wood is eliminating of the emission of at least 6 thousands tons of sulfur per year, but the existing potential is much bigger, up to equivalent of 4 mln tons of black coal with comparison to 0.3 mln tons of equivalent of black coal in actual use. It means that the utilization of fuel wood may increase in Poland in the future even 10 times more than now. During last year (2000) the export of wood waste from Poland to Denmark was about 0.4 mln t with a tendency to increase.

## 3. Straw for energy

Poland is producing about 25 mln tons of straw (equivalent to 12.5 mln tons of black coal). In Denmark utilization of straw for energy is equal to 16% of annual straw production, but in some years even more (up to 50%). Taking 16% of annual Polish production of straw the energy resources would be equivalent to 2 mln tons of black coal per year. This potential is stimulating the quick development of the straw fired boilers on the Polish market (Kowalik and Wichowski, 1998).

First bigger straw boiler for district heating system was opened 26 October 1996 in the settlement Zielonki in the village of Szropy, commune Stary Targ near Malbork. It is an example of the transfer of Danish technology to the Polish market. Two Danish straw combustion boilers type DANSTOKER were installed with capacity 500 kW each. Heat supply is enough for 450 flats in few blocks. Straw is pressed in ballots with dimension 2 x 1.2 x 0.85 m. Supply of straw into boilers is continuous and automatic. Ash and slang is about 3.5% of the straw. Quality of flue gases is monitored for environmental impact assessment. Employment is equal 2 workers on one shift. During the heating season 1996/97 the price to buy the straw was 57000 PLN, but the avoided cost to buy a coal was 169000 PLN. It means that the production of heat energy is cheaper from straw than from coal about three times. Change from coal boilers to straw boilers was an investment with a pay-back period equal 4 years (Denisiuk, 1998, personal communication).

Similar straw boilers like in Zielonki were installed at the beginning of 1997 in Grabowiec near Zamosc (1 MW) and in the middle of the year 1997 in Czernin near Malbork (3 MW). Original Polish solution was implemented in the village Wieniec on Sobieszewo Island near Gdansk (0.6 MW), where the existing coal boilers were expanded by the straw pre-firing boilers and flue gases from straw are used to heat the old coal boilers and heat exchangers. Several straw boilers were produced by the factory GRASO from Starogard Gdanski. It was constructed in Baczek near Starogard Gdanski (0.6 MW), in Kamiennik near Elblag (0.3 MW), in Trutnowy near Tczew (0.3 MW). In the middle of 1998 more than 10 straw boilers of the capacity 0.3 MW each were installed by the Factory GRASO. Straw boilers from Baczek, Kamiennik and Trutnowy are using the straw bales of cylindrical shape, diameter 1.5 m and height 1.2 m. Combustion is performed without continuous supply of straw, because the straw bales are located into boiler every 4–9 hours, dependent upon the actual air temperature. It is so called „cigar burning" inside the boiler. In Kamiennik the production of heat is used for district heating system for 82 flats, in Baczek for heating the big animal farm with 6000 pigs. Most of the straw boilers produced by factory GRASO has a capacity of 350 kW.

Poland is producing smaller units as well. Straw boiler with heat capacity of 50–60 kW for individual farms is produced by Factory ENERGOMONTAZ in Gdansk (0.45 kW), or by METALERG from Olawa near Wroclaw (60 kW). It is estimated that recently more than 100 straw boilers were installed in Poland with the total heat capacity up to 100 MW (P. Gradziuk, 1998, personal communication), but these numbers seems to be too optimistic till now.

Most important factor in the development of the straw boilers is related to the activity of the Voivodship Funds for Environmental Protection and Water Management (WFOSiGW). Development of utilization of straw for energy is observed only in the Vojevodships where these Funds are supporting the investment for elimination of emission of dust and sulphur from small district heating boilers. Substitution of black coal by straw was supported until now only in the regions of Elblag, Gdansk and Zamosc. Expected support from the Polish Ministry of Agriculture would have the decisive importance.

# 4. Sewage sludge (analogue of peat)

Utilization of sewage sludge for energy was initiated, because the parameters of sewage sludge are similar to the low peat or to lacustrine deposits reach with detritus. Annual production of sewage sludge and similar organic waste is estimated to be 2.5 mln tons d.m. in Poland (Kowalik, 1997b).

Most of the organic residues are utilized in the Polish pulp and paper industry. Annual production of the organic waste from this industry is about 1 mln tons d.m., mostly in the form of lignin liquid waste (black liquor). Combustion of this material is producing heat for steam turbines, most of them with capacity 15 MW(e). Heat is produces from combustion of waste wood, bark, waste paper and black liquor. It is located in the pulp and paper factories in Swiecie, Kwidzyn and Ostroleka. Utilization of biomass is equivalent to the 0.1 mln tons of black coal, substituted by the renewable resource in Polish pulp and paper industry (Tarnawski, 1994). In the year 1998 new fluidized bed boiler was installed in Ostroleka Electrical Company for combustion of waste bark only. Utilization of bark for energy allowed to substitute 23000 tons of black coal per year here, eliminating the emission of sulfur (460 tons S per year) and cutting the emission of carbon dioxide.

Sewage sludge produced by the Polish waste water treatment plants is equal to 0.25 mln tons d.m., but in the near future it will increase up to 0.5 mln tons d.m. per year, after completing many WWTP under construction now. Sewage sludge after dewatering is similar to humified low peat. The first incineration plant for sewage sludge was constructed in WWTP in Gdynia Debogorze with fluidized bed (opened in 1998). The capacity of this boiler is 10 t d.m. of sewage sludge per day and production of heat equal to 2 MW.

Gasification and combustion of sewage sludge for central heating plant is realized in the small boilers, produced by the Factory FUWI from Elblag. The capacity of this boilers is 0.2 MW. The supply of the boiler contains about 200 kg d.m. of sewage sludge per day with the water content of 65% of sludge, which is mixed with the 200 kg per day of wooden chips. Example of such solution may be visited in the WWTP in Swarzewo near Puck, in Radziejow near Konin, in Brzozow near Krosno or in Makow near Ciechanow. Sewage sludge may be mixed with wooden chips, but may be mixed with coal dust as well (25% dry coal dust, 75% of wet sewage sludge). It is growing interest for utilization of sludge for energy, because substitution of black coal by sewage sludge is allowing to obtain the pay-back period of installed boilers in the range of two years. Emission of pollutants in the flue gases are very low because of the process of pyrolysis and combustion only of gases, instead of conventional grid combustion. Emissions from boilers for gasification of sewage sludge are lower than from the conventional gas boilers.

# 5. Biogas

**Biogas from waste water treatment plants**

The most frequent solution used in the small electricity production is biogas to drive the engines and electricity generator. Example of this solution may be seen in Bielsko-Biala, implemented by dr M. Rutkowski from IBMER of Krakow (Rutkowski and Rutkowski, 1997). Generator of electricity has a capacity 100 kW(e) and the biogas is originated from the anaerobic digestion chambers of sewage sludge of the municipal WWTP. Electricity is used on site for driving pumps, and the consumption of the electricity from the state grid is reduced 25–30%, giving the savings of money to be spend to purchase electricity if the biogas is not utilized. Additional production of heat from cooling the engines is allowing to have additional heat supply for fermentation chambers and for heating the offices. During two years it was possible to save about 100000 PLN because of the avoided cost of the electricity from outside. Production of heat allowed to save 160 tonnes of black coal during two years. Pay-back period of the investment in the engine and generator was two years. Similar solution was made in Olsztyn where electricity production from biogas on WWTP is on the level of 50 MWh and is covering the demand for electricity of WWTP on the level of 26%. Several others solutions are working on the Polish market, for example in Czestochowa, Zamosc and Sosnowiec. It is a growing interest for such solutions.

**Biogas from sanitary landfills**

Tyminski (1997) indicates that it is not easy to evaluate the existing potential of the sanitary landfill gas in Poland. In

1993 about 786 sanitary landfills were in use in Poland with the total surface of 2845 ha. One cubic meter of biogas is equivalent to 1 kg of black coal. In the mean conditions from the sanitary landfill with surface 15 ha and annual deposition of 180000 tons it is possible to obtain about 20–60 GWh heat energy per year (Nowakowski, 1997). Exploitation of biogas from sanitary landfill may last 10–20 years. At the end of 1996 it was working in Poland 9 installations to obtain biogas from sanitary landfills and most was using biogas to generate electricity. For example in Bydgoszcz is working installation of capacity 300 kW(e), in Poznan 400 kW(e), in Grudziadz 100 kW(e), in Koszalin 100 kW(e). Design for such utilization of biogas is performed for Krakow, Katowice, Lublin, Warszawa, Krasnik. Recently such equipment was completed for sanitary landfill in Gdansk for 200 kW(e) and few years ago in Braniewo for district heat production in gas boiler of capacity of 0.1 MW(t). The installation for biogas uptake from sanitary landfill and production of electricity with capacity 400 kW(e) has a cost about 2 mln PLN in Polish conditions (Nowakowski, 1997).

**Biogas from animal manure and dung**

Biogas may be produced in agricultural conditions in animal farms. According to Romaniuk (1995) in Polish farms is produced 38 mln cubic meters of manure and 85 mln of cubic meters of dung per year. From 1 cubic meter of manure may be obtained about 20 cubic meters of biogas (equivalent to 20 kg of black coal) and from 1 cubic meter of dung – about 30 cubic meters of biogas (equivalent to 30 kg of black coal). Tyminski (1997) is giving the results of the calculations that if only half of the manure and dung would be transferred into biogas, the production of energy would be equal 0.38 mln tons of black coal, about 9 PJ. Institute of Buildings, Machinery and Electricity in Agriculture (IBMER) of Warsaw created several pilot plants in Polish farms. One anaerobic digestor was installed in the farm using 25 ha of land, with volume of 25 cubic meters. It was in use during 15 years producing biogas for gas combustion kitchen of the farm. Several biogas reactors was installed in Poland, but the results are not very positive. It was summarized by Tyminski (1997) who wrote: „Considering the technology of the anaerobic digestion of manure and dung in Polish conditions for production of biogas till today it is difficult to find positive results. This technology of production of biogas in agriculture is on the stage of research only. It was not implemented in the larger scale because of the high cost of the reactors and it has very marginal importance now" (p. 115).

## 6. Bio-ethanol

Consumption of the spirit in Polish conditions is about 130 mln liters per year, but application of spirit as a liquid biofuel in the transport sector is about 100 mln liters per year. It was found that the addition of 5% of alcohol to the ordinary petrol is allowing to decrease the content of lead of 50%, which has beneficial influence on the health conditions of the users of the roads. Petrol with 5% content of dewatered ethanol is distributed on the Polish market under the name „petrol E94E". Production of bio-ethanol in Poland is supplied from the 50000 ha of potato fields now, but it would be easy to increase this area up to 150000 ha of potatoes. Existing 900 small alcohol distilleries are processing potatoes into alcohol (ethanol). This raw ethanol is processed in the few spirit distilleries to obtain pure dewatered ethanol which is sent to the oil refineries (Trzebinia, Plock) to be mixed with ordinary petrol and to produce bio-petrol with 5% of ethanol for petrol stations as petrol E94E. This technology is implemented in USA and This technology is implemented in USA and Brazil, but on the European market only in Poland.

Support for development of this technology should come from farmers, alcohol distilleries, oil refineries and petrol stations. Many positive arguments exist from economical, energetic and ecological points of view to support this solution, but the progress is dependent upon the decisions of Polish Ministry of Finance (taxes) and Polish Ministry of Agriculture (policy). It is a great potential to produce bio-ethanol as liquid bio-fuel for transport in Poland, but not fully realized yet.

Bio-diesel from the rape seed oil is not produced in Poland yet. Import of bio-diesel from Czech Republic to Poland is estimated to be 10000 tons per month (year 2001), but the market is stil very limited.

## 7. Pyrolytic gas from wood or sewage sludge

Technology of gasification of organic matter is giving the gas product (mainly wood gas or coal gas) which can be used to run the gas engine and generator of electricity. Row material for gasification may be wooden chips, pellets from straw or dry organic wastes. In most of the technologies it is needed to use the organic material with relatively small content of mineral fraction and low ash content. Tyminski (1997) indicates that the pyrolysis and wood gasification is used in Poland during last years. For example the Factory WUSP–MET in Pleszew and factory HAMECH in Hajnowka are producing the special pre-boilers type UZE with the capacity from 25 till 197 kW. They are installed at the front of the conventional coal-boilers, to substitute fossil fuel by wood. In this equipment the fuel may be sawdust, shavings, wooden chips, fine fractions of bark and all wood wastes. After gasification the product is a mixture of combustible gases, containing carbon mono-oxide, hydrogen and methane. Original solution was invented by factory FUWI of Elblag. They are producing boilers for gasification of very moist wood in the form of logs or fine wood. The mixture of wooden chips with sewage sludge may be gasified and produced gas may be combusted in the central heating installations, with capacity 0.1–0.2 MW.

New equipment for production of electricity and heat from wood was designed and implemented Dr B. Deptula from Politechnical University of Poznan, Department of Heat Technology. The starting point was that in the natural reserve near Poznan in the village Jeziory was necessary to solve the problem of the supply of heat and electricity of the local hospital for children. The project of the gasification of wooden chips and production of heat and power was implemented during winter 1997/98. Previous system was producing heat from the coal fired boiler with capacity 320 kW. Coal boiler was too old for exploitation. Electricity supply was from the state grid, but it was a need for additional electricity generator with capacity 50 kW(e), as well too old for farther use.

New system was designed and constructed for boiler using wooden chips. Elements of the system are: gasifier for gas generation, gas engine, electricity generator, heat pump, heat exchangers. According to the description of Deptula et al. (1997) wooden gas is produced in the generator type IMBERT. Gas engine is a conventional Diesel unit, running electricity generator. Most important was comparison of the ecological consequences of the solution. After substitution of black coal by wood the emission of carbon mono-oxide was greatly reduced, from 1000 to 40 mg/MJ, and similarly the emission of sulfur dioxide was reduced from 420 till 10 mg/MJ. Economical evaluation is giving some new informations. Taking the investment cost, the system of heat and power production from wood is costly, 760 PLN/kW with comparison of the investment cost of the oil boiler, 329 PLN/kW, but the exploitation cost is very different, giving 45 PLN/kW for wood firing system with comparison to 157 PLN/kW for oil firing boiler. The cost of investment is not surprising, because it is a prototype in the Polish conditions. Replications should be much cheaper in the future.

It is important to stress hat it is a first in Poland the system to produce heat and power from wood, using technology of gasification of wooden chips. Capacity of the system is 50 kW(e), 300 kW of heat energy, but the emissions of the air pollutants was reduced 20 times if one compares the emissions from coal boiler and new wood gasifing plant.

## 8. Barriers for implementation of biomass for energy

Several reasons are existing which are the barriers for the implementation of biomass to energy in Poland. They are

(1) lack of the knowledge that the production of heat energy and electricity from the cheap residual biomass is very economical and competing easily with the conventional fossil fuels;

(2) too low prices of the conventional fossil fuels, without counting of the external negative influences of the damage to environment and to the human health of coal, oil and natural gas;

(3) too low progress with the technological development of the most efficient production of heat and power from biomass;

(4) difficulties with the selling outside the produced heat energy and electricity to the state electrical grid or to the district heating distribution pipes. It is lack of the detailed regulations on the tariffs of heat and power from renewable

energy sources. The most logical seems the price for producer of renewable energy is equal to 85% of the detailed price paid by the end-user, but it is not solved yet;

(5) lack of the experience how to implement renewable energy in the obligatory local energy plans for communes in Poland;

(6) the national strategy of the development of the renewable energy of the country was accepted by Polish Government in 2000 and by Polish Parliament in 2001, but no visible results so far.

The most important point is the dissemination of knowledge on the existing pilot and demonstration solutions. Until now it is a limited number of the success stories and positive solutions, but in the future should be more and more demonstration installations and commercial replications.

Production of heat and power from biomass is very promising, if we take into account the existing positive demonstration plants. The supporting argument are very good technical parameters of the boilers, very good economical results with relatively short pay-back period of investments if the residual biomass is used, and the very positive ecological results with low level of the emission of flue gases and low emission of the pollutants to the atmosphere. Biomass is much more environment friendly than any fossil fuel.

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# Biomass Use in Germany

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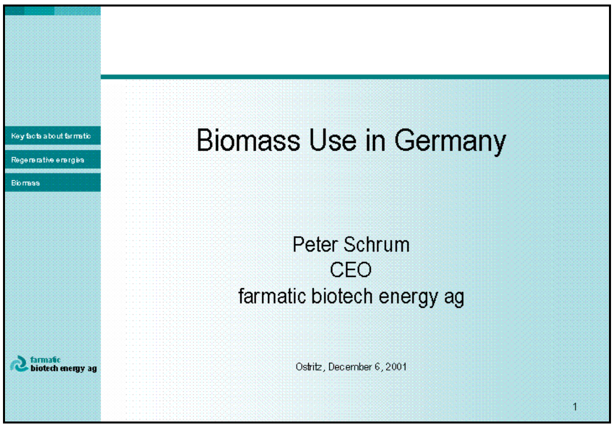


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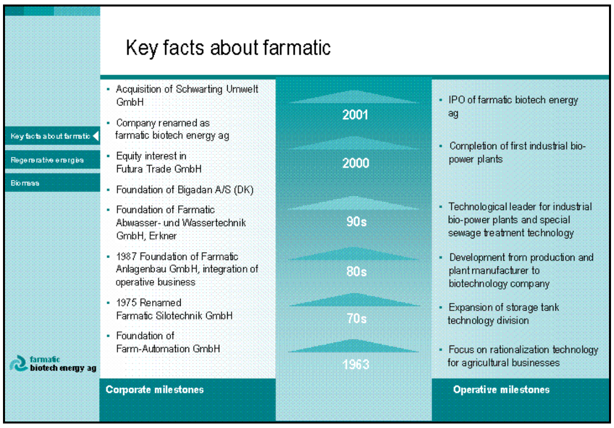


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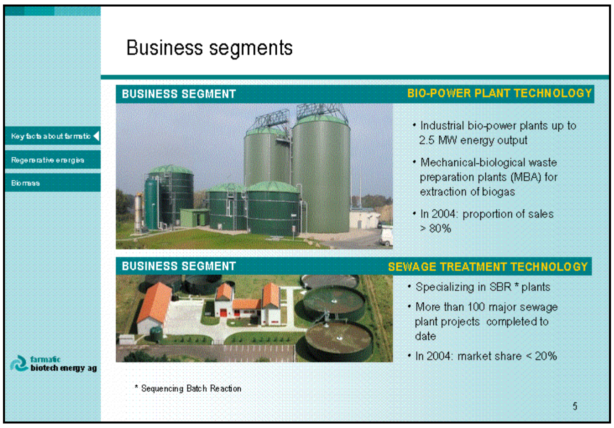


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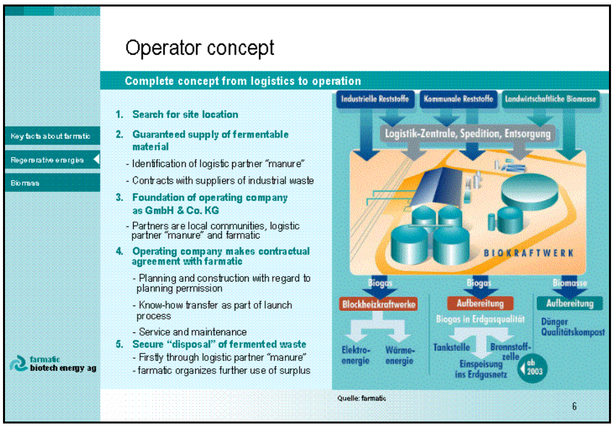


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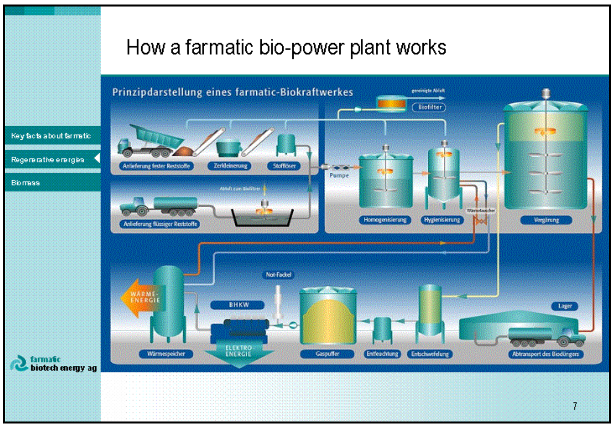

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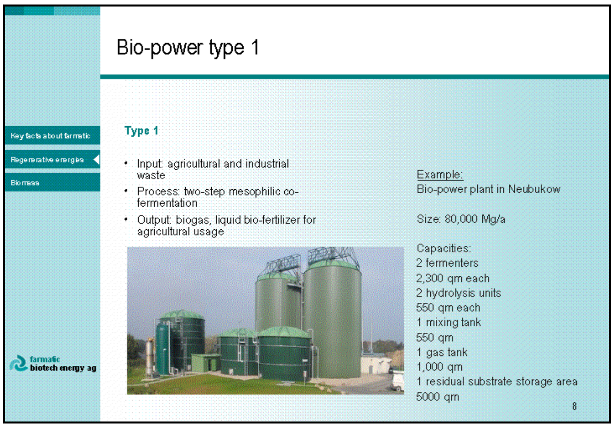

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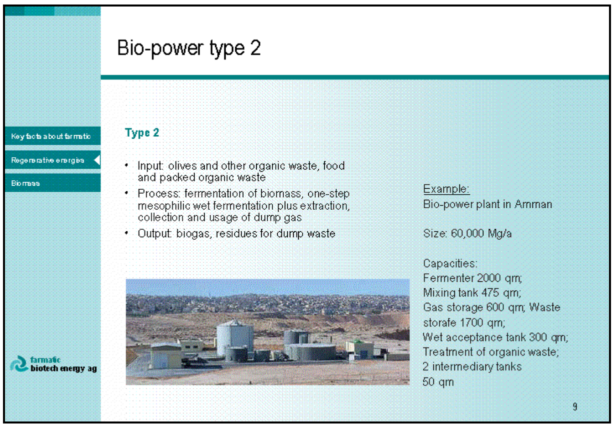

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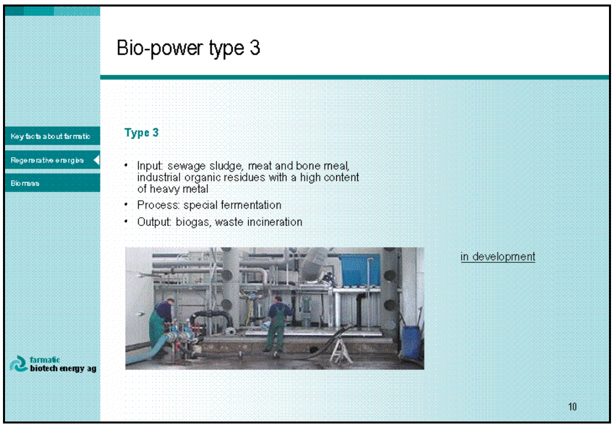

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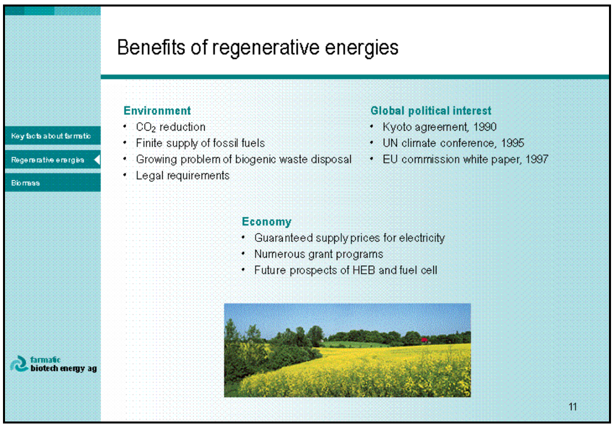

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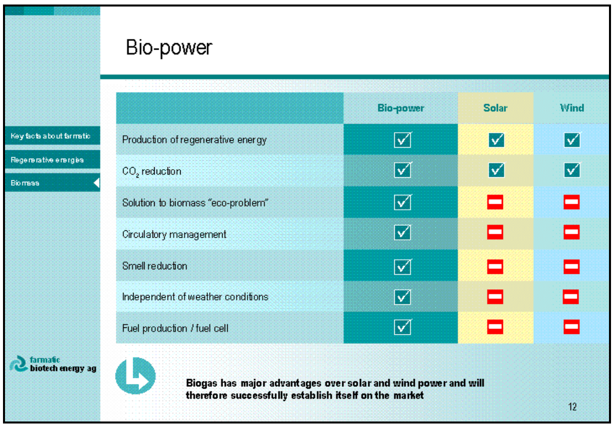

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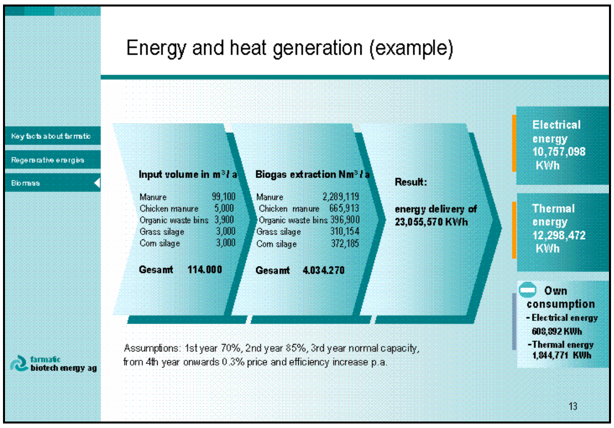

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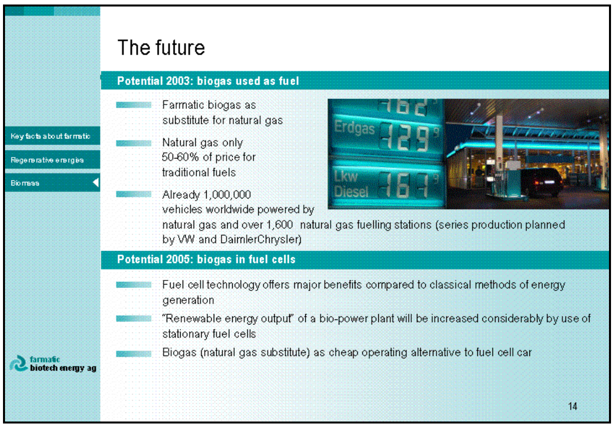

Slide 14

# Economical Growth Potential of Energy Biomass Use in Slovenia

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## 1. Wood biomass – energy source for the next century

In the past years Renewable Energy Sources (RES), or sustainable energy sources - among which biomass occupies an important place - experienced an increasing attention. The 1994 Madrid declaration foresaw that up to 2010 there would be 15% of conventional needs of the EU replaced by RES. A more recent document, the EU White Paper (Communication from the Commission - ENERGY FOR THE FUTURE: RENEWABLE SOURCES OF ENERGY - White Paper For a Community Strategy and Action Plan) states that by 2010 the use of biomass in the area of the EU would have saved 255 million tons/year of $CO_2$ emissions. This is more than 60% of the decrease in $CO_2$ emissions that could be contributed by all the RES.

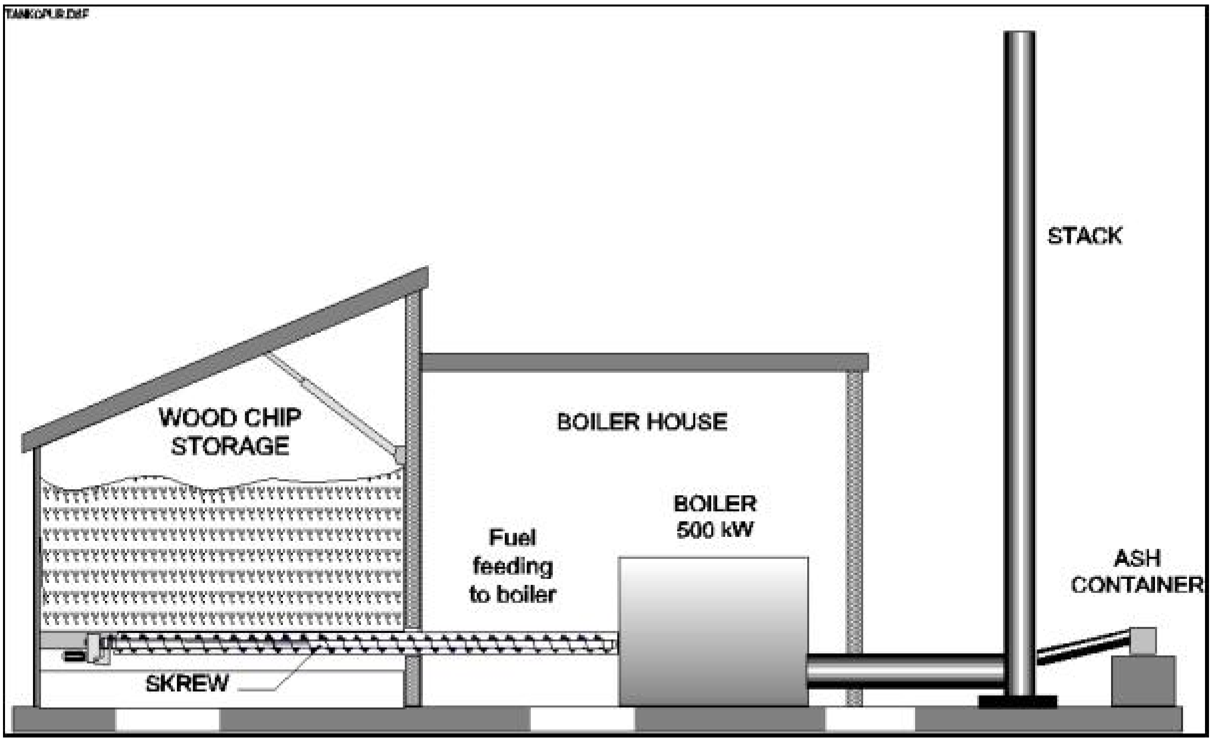
*Figure 1: Chipping on the road side and transported using tractors and trailers*

### 1.1 Modern fuel preparation and combustion technology

Modern use of wood biomass is far different from the traditional concept of wood biomass burning. Available technologies enable a very efficient, automatic and comfortable way of wood biomass preparation and burning. One of the available technologies is presented below. "Harvesting" is carried out by manual felling in forest, chipping on the road side and transportation to the plant. The typical harvesting chain is presented in figure 1.

The boiler plant consists of the fuel storage with an automatic fuel feeding system to the boiler. The plant usually has a stoker-burner and a mechanical moving grate with an automatic combustion control system. The plant is usually operating automatically and heating entrepreneurs only visit the plant, feeding the fuel storage or abolishing unexpected operational disturbances in the plant.

*Figure 2: Typical wood chips heating system*

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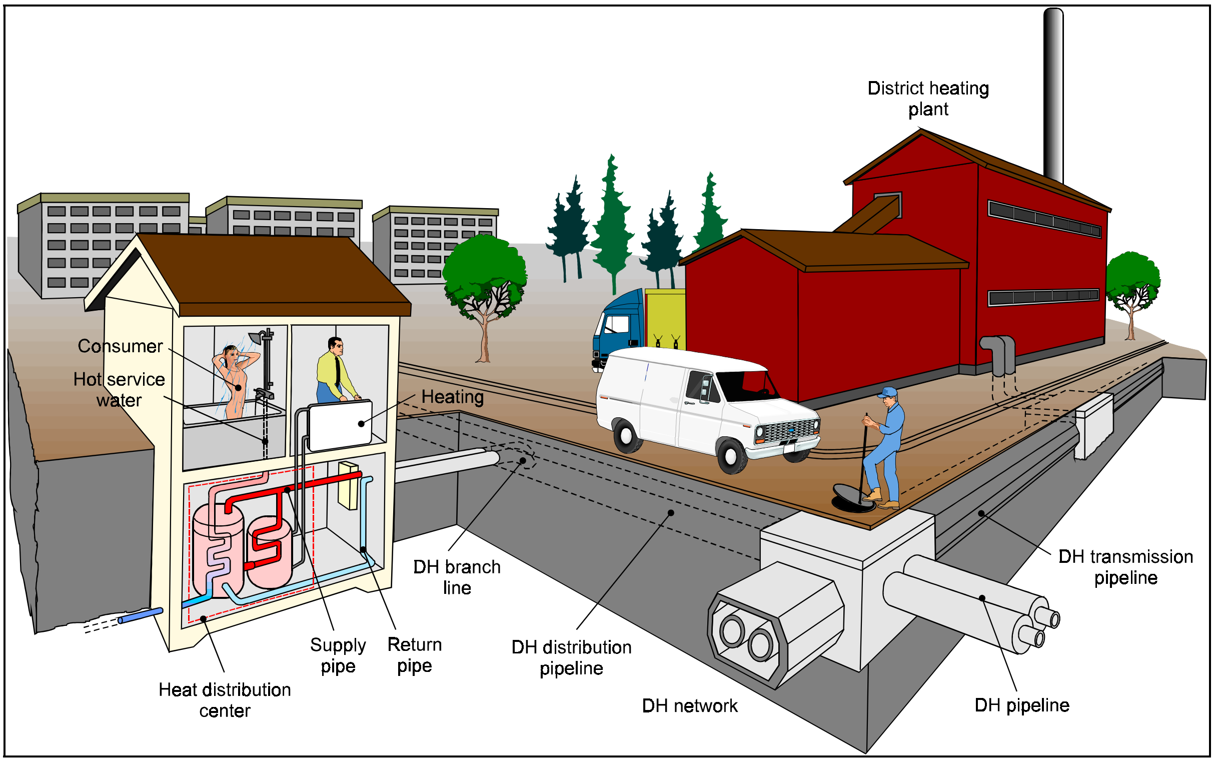
Through the computerized district heating network "green" heat is supplied to the final consumers. The consumers enjoy full comfort of heat supply, have no fuel storage costs, no fire in the house, no chimney and no operation obligation.

*Figure 3: Fully computerized district heating system on wood biomass*



### 1.2 Comparative advantages & disadvantages of wood biomass use

Compared to fossil fuels the wood biomass use has several advantages that relate to national economy, employment, safety, security of supply and environment. Among others nowadays wood biomass systems present:

- Comfortable, safe and efficient heat supply
- High security of fuel supply with very stable prices
- Low operating costs
- Clean burning with zero $CO_2$ emissions
- Initiate forests cleaning, lower wood waste disposal, prevented overgrowing
- Possible fossil fuels savings, lower country import and foreign currency saving
- New income for farmers and foresters
- Regional and country development, employment and new branch industry development
- Sustainable region development, attractiveness and tourism development.

Despite obvious advantages for the economy as a whole its large disadvantages are high investment costs. The market penetration of modern, highly efficient and environmentally friendly technologies is difficult. This corresponds to technological reasons[1], small production, high development costs and market distortion. Especially fossil fuel prices at present do not incorporate all external costs of their use[2].

## 2. Wood biomass use in Slovenia

### 2.1 Current situation

In general RES are considered as an important future primary energy source in Slovenia. Considering the fact that about 70% of Slovenia's total primary energy need is imported, the renewable energies - beside their obvious environmental and social benefits - are considered as an important national strategic reserve. The Resolution on the Strategy of Energy Use and Supply of Slovenia (ReSROE) has set a target to substantially increase the share of renewable energy sources within the primary energy balance by the year 2010. The Slovenian National Energy Plan envisages to increase the share of wood biomass within the primary energy balance by 50%. The current share of biomass in primary energy supply reaches 4.4% (11.2 PJ). Given the fact that over 56% of the Slovenian territory is covered by forests and that there is a significant wood processing industry in the country, the increasing use of biomass for energy supply should have a specific emphasis.

The Government of Slovenia has systematically supported renewable energy programs and investment projects since 1991 through its public competition program. The support was spent through a number of instruments, as soft loans, interest rate subsidies and grants. The available state support has enabled a number of municipalities to prepare local energy plans and feasibility studies for biomass district heating projects. In the majority of cases, district heatings are based on existing industrial boilers. According to the most recent data there are 78 wood waste boilers in operation in the Slovenian wood reprocessing industry, with a nominal power of over 1 MW. The overall installed capacity is 340 MW. Most of the existing old boilers do not meet the new emission requirements, and therefore need to be replaced with new, modern boilers equipped with automatic fuel feeding.

### 2.2 Barriers in wood biomass utilization

An analysis conducted in recent years identified the following key barriers and obstacles in development of wood biomass projects in Slovenia:

**Institutional barriers**

- Lack of a cross-sectoral strategy and policy framework to promote biomass energy projects
- Lack of a strong national focal point to support and promote biomass energy activities
- Strong competition with big, well organized oil and gas companies.

**Awareness, information and capacity barriers**

- Lack of information and awareness of the local communities on the social and environmental benefits of increasing the use of biomass as an energy source
- Lack of awareness of the end users regarding the costs, benefits and possible constraints of changing the individual heating systems to district heating
- Lack of information to determine accurately the specific investment and operational costs of biomass based district heating and co-generation plants
- Lack of capacity and guidelines for preparation of feasibility studies and "bankable" project proposals
- Lack of capacity and information for the assessment of the sustainability of the wood fuel and for the mobilization/organization the local wood fuel market
- Lack of information about the possible substitutions of old boilers with high-efficient ones
- Lack of capacity and experience of local communities to prepare all required documentation for project financing
- Perception of biomass boilers as being environmentally questionable technology (due to the inefficient and polluting old wood boilers).

**Financial barriers**

- Weak financial status of the communities and wood processing companies to acquire commercial credits, although the projects themselves would be financially strong
- Interest rates of the banks which are still above the average European level
- Lack of information about the possible sources of financing
- Uncertainties on the long term market price of biomass fuel
- Absence of a stable, long-term financing mechanism to support renewable energy projects (the present government support from the annual budget does not allow long term planning)
- Short requested pay-back time of the commercial loans
- High project preparation costs without assurance to obtain financing for implementation.

# 3. Program for wood biomass use in Slovenia

To increase the wood biomass utilization in modern, efficient, emission friendly systems significantly the Ministry for Economy started a 10-years developing program. Since modern wood biomass fired boilers are far too expensive to compete with fossil fuels boilers, the Government intends to support the program with a sufficient level of subsidies. For the implementation of the program an establishment of a long-term financing mechanism has to be found. As the main source a $CO_2$ tax was proposed.

## 3.1 Project activities and expected results

- To reach the envisioned objectives the following activities are foreseen:
- Raising the awareness and advising the local communities, land owners associations and industry on the latest available technical options for using biomass as an energy source, and their economic, environmental and social benefits and constraints
- Organize public hearings, publish and distribute public awareness documentation and implement other measures to facilitate participation of local communities and their residents into the evaluation and development of the planned biomass energy projects
- Develop a model for long term biomass supply agreements for creation of stable environment for investment decisions
- Based on the evaluation of the results of the feasibility studies and experiences gained in other countries, develop a financial support scheme for biomass energy activities, encouraging cost-effective use of resources and long term cost reduction objectives of biomass energy technologies
- Preparation of guidelines and organization of training for the local communities, industry and consultants to prepare "bankable" biomass projects and finalization of documentation required for projects financing
- Develop the criteria for selection of the demonstration projects and selection of 3-5 demonstration projects for execution
- Training of the local professional groups to install, service and operate the biomass installations
- Monitoring, evaluating and reporting the experiences and lessons learned during the implementation of the demonstration projects
- Preparation and dissemination of public awareness documentation, organization of seminars and study

tours to share the results of the demonstration projects, analysis of the lessons learned and promotion of biomass energy
- Establishment of a permanent financing mechanism to support biomass energy activities in Slovenia based on their local and global environmental and other benefits.

The projects for Government's and GEF's support will be selected on a competitive basis based on their economic feasibility, their "learning value" in terms of different technologies, financial approaches and sources of biomass and their possibilities to become a "success story" to be used as a model for other projects. The criteria for the support will be developed during the further preparation and implementation of the project. However, specific emphasis in that regard will be placed on evaluating several possible financing possibilities in order to select a modality that would support the efficient use of resources and long term costs reduction of biomass technologies. In that regard, the experiences in other countries (especially in Austria) will be deeply reviewed, and the lessons learned will be used in designing the support mechanisms.

In general, the support for biomass projects would be 25-40% of the total investment costs and should gradually decline to 0%, or to the level reflecting the additional, justified domestic benefits. Should the biomass energy require continued public support (e.g. to cover the still unaccounted external costs of fossil fuels), a proposal has been put forward to use the funds from the currently collected $CO_2$ tax for that purpose. The use of other grant financing sources or soft loans could also be justified.

### 3.2 Program components

The program consists of three main areas:

**Execution of 50 biomass district heating projects**

Installation of 50 biomass district heating projects (BDHP) with average boiler's size 3 MW is according to wood potential in Slovenia. The fact that today there are 300 BDHP working in Austria is a realistic and achievable goal. The program should be developed until the year 2010. Each project will gain in total subsidy support in range of 30-45% of the investment.

**Installation of 100 modern industrial small scale biomass boilers**

In Slovenia there are numerous industrial wood biomass boilers installed in wood processing industry. The boilers are relatively old and in some cases the boilers were despite available wood waste replaced by fossil fuels burning boilers. The installation of minimum 100 industrial boilers, powering from 50-500 kW, is foreseen in the next 10 years. The subsidy support will range up to 25% of the investment.

**Installation of 5,000 biomass boilers for individual households**

Based on a number of existing old fashioned wood fired boilers and the existing interest of owners, at least 5,000 small scale biomass boilers for individual households can be installed in Slovenia in the next 10 years. Since these boilers are very expensive compared to fossil fired boilers, the Government should offer a subsidy up to 50% of the investment. In Austria nowadays 20,000 of such boilers are in operation, gaining investment support form the Government. Three types of such boilers can be installed:

(a) Wood chip fired boilers up to 50 kW with automatic feeding system for individual households
(b) Modern log wood fired boilers for central or floor heating, with large water tank, powering from 15-50 kW
(c) Wood pellets fired boilers powering from 15-30 kW with automatic feeding system.

**Beneficiaries**

At the local level, the main target beneficiaries of the project are:

- Slovenian communities and their residents through the improved local environmental conditions, provision of modern heat and hot water supply and creation of new jobs (including the tourist centers that can utilize the image of "green communities" in marketing)
- Local wood processing companies through opening a market for industrial wood waste
- Local farmers and forest owners through increasing the market for wood fuel collected from the target oriented forest tending and intensified exploitation of the biomass potentials of the brushwood on the abandoned agricultural land
- Local consultant companies and NGOs providing expertise and services to promote and implement biomass energy activities
- Local firms producing wood biomass boilers and related equipment (secondary beneficiary).

# 4. Sources of program financing

### 4.1 Government budget

The Government of Slovenia is promoting wood biomass use with subsidies for project preparation as for project implementation. Especially recognizing the strong domestic benefits of biomass district heating projects, the Ministry for Economy offers to cover up to 25% of their investment costs. Despite of this support only one project was executed with an additional grant component from EU-PHARE. This financing is predicted to slowly decrease and will be substituted with the income of $CO_2$ tax on fossil fuels.

### 4.2 GEF / UNDP funding

In the year 2001 the final contract with GEF (Global Environmental Facility), UNDP (United Nations Development Program) and Government of Slovenia was signed. Slovenia will gain a subsidy of 4,3 million US $ to develop 3-5 biomass district heating projects and to promote the increase use of biomass. This source of financing will be used in the first years of the project development.

### 4.3 $CO_2$ tax

In the program proposal the long term financing source is the $CO_2$ tax. The wood biomass use namely contributes to $CO_2$ reduction. The fossil fuels are taxed in Slovenia from the beginning of 1997 while energy use of wood biomass is not taxed since biomass is $CO_2$ neutral. The primary goal of $CO_2$ instrument (beside fiscal) should be the reduction of $CO_2$ emissions. The source of financing for such projects should consequently be the $CO_2$ tax budget. Wood biomass projects usually replace the existing use of fossil fuels and have so called “negative” emissions. One possible criteria how to support the projects by $CO_2$ tax fund might be the actual project $CO_2$ savings. The amount to which individual wood biomass project reduce $CO_2$ emissions, evaluated by current $CO_2$ tax, could be the base for its governmental support.

*Table 1: Example of subsidy support calculation for BDHP*

| | Energy Use | Useful energy (MWh / year) | Yearly $CO_2$ emissions |
|---|---|---|---|
| Present situation | Extra light fuel oil<br>Coal<br>Wood | 6.723<br>251<br>606 | 1.792.000 kg<br>86.000 kg<br>0 kg |
| Total $CO_2$ emissions – A | | 7.580 | 1.878.000 kg |
| Situation after execution of Biomass District Heating Project | Wood biomass<br>Extra light fuel oil | 8.918<br>482 | 0 kg<br>128.000 kg |
| Total $CO_2$ emissions – B | | 9.400 | 128.000 kg |
| **$CO_2$ reduction: A minus B** | | | **1.750.000 kg** |
| With tax evaluated reduced $CO_2$ * | 1.750.000 kg $CO_2$ * 0,01429 €/kg $CO_2$ | | 25.000 € |
| Project's economic life | | | 20 years |
| **Financial support value** | *25.000 €/year * 20 years* | | **500.000 €** |

** At the moment full $CO_2$ tax amounts to 0,01429 €/kg of $CO_2$ emissions.*

An example of subsidy calculation for BDHP is given in 0**.** The project has a 2 MW wood biomass boiler, 6,4 km of district heating network, total useful heat consumption of 7,58 GWh/year; total primary energy to cover the district heating demand of 9,40 GWh/year (district heating losses included). With the project execution the $CO_2$ reduction would be 1,750 tons $CO_2$/year and its value 25,000 €/year. Considering 20 years of project’s economic life period the financial support should amount to 500,000 €.

To execute the 10 years biomass program the Government should support it in average with the amount of 6,2 million €/year, what corresponds to 17% $CO_2$ tax collected in the year 2000. Such financing approach would prove the validity of introducing the $CO_2$ instrument in Slovenia.

# 5. Macroeconomic and environmental impact of the program execution

## 5.1 Environmental benefits

A very important effect of the program execution represents the reduction of $CO_2$ and $SO_2$ emissions. In the year 2010 $CO_2$ emissions will be reduced by 0,33 million tons/year, while $SO_2$ emissions will decrease by 3,380 tons/year. The program in total contributes 26% to Kyoto requirements for Slovenia. The contribution to emission reduction is presented in table 2.

*Table 2: Kyoto requirements and expected program $CO_2$ and $SO_2$ reduction*

| **Targeted national $CO_2$ reduction according to Kyoto protocol** | | |
|---|---|---|
| | Years 2008-2012 | Required $CO_2$ reduction in year 2012 |
| Targeted total $CO_2$ emissions | 14.40 million tons | 1.25 million tons of $CO_2$ |
| **$CO_2$ and $SO_2$ reduction related to execution of national program** | | |
| | Year 2010 | Whole emission reductions until the year 2010 |
| $CO_2$ emission reductions | 0.33 million tons | 1.73 million tons |
| $SO_2$ emission reductions | 3.380 tons | 17.800 tons |

## 5.2 Economic and social impact

In the project we used an analysis macroeconomic tool – ELVIRE, developed by the ALTENER program, with the aim to perform the proper calculation of socio-economic impacts. The method is halfway between traditional "ex ante" evaluation of projects and the analytical methods for large projects. In summary, the model analysis the project related to the following impacts: the economic development of the region, employment, return on public finances, sustainable development and the environment. The analysis concerns effects on the following macroeconomic categories:

**Regional activity**

An item Regional activity accounts for regional activity created during the investment phase, discounted value of maintenance and value added for project operation and all additionally created activities. In calculation lost activities are considered also**.**

**Net regional income**

Net regional income is calculated by net income distributed during the investment phase, discounted income from the project operation and maintenance phase plus net consumers income balance (users' profitability).

**Regional benefit**

Regional benefits in whole project's life represent the net regional income, value added of non-imported fossil fuel energy and net public finances receipts.

**Public finances receipts**

Total public finances receipts evaluate all tax income, which occurs due to project execution but also due to the losses in public receipts. Net income of public receipts is usually negative due to the high tax rate for fossil fuels. Basic technical parameters and economic impact of the program are presented in the table below.

*Table 3: Macroeconomic influence of the program execution in Slovenia*

| | |
|---|---|
| NECESSARY CONDITIONS FOR THE PROGRAM EXECUTION | |
| Investment value for the program execution<br>Governmental support<br>Long term sources of financing<br>Dead line for the execution of the program | 162,9 million €<br>62,4 million €<br>$CO_2$ tax<br>Year 2010 |
| TECHNICAL parameters | |
| Total number of biomass based projects<br>Total installed power in the year 2010<br>Cumulative heat production until the year 2010<br>Heat production from wood biomass in the year 1998<br>Heat production of the program in the year 2010<br>Increase in biomass share in energy balance of Slovenia | 5.150 projects<br>330 MWt<br>6.310 GWh<br>3.100 GWh<br>1.200 GWh<br>38,7 % increase |
| ECOLOGY | |
| $CO_2$ emissions for the year 1986<br>8 % emission reduction according to Kyoto protocol<br>Emissions savings at program execution | 15,66 million ton $CO_2$<br>1,25 million ton $CO_2$ /year<br>0,33 million ton $CO_2$ /year |
| $SO_2$ emissions in the year 1995<br>$SO_2$ emissions savings in the year 2010 | 119.300 ton /year<br>3.390 ton $SO_2$ /year |
| ECONOMIC & SOCIAL influence until the year 2010 | |
| Cumulative savings of fossil fuels: alternative natural gas<br>Fossil fuels savings in year 2010: alternative natural gas | 668 million Sm3<br>128 million Sm3 |
| ECONOMIC & SOCIAL long term influence | |
| Net regional incomes<br>Regional activity<br>Regional benefit<br>Public finances receipts | 103,3 million €<br>178,6 million €<br>463,3 million €<br>-35,7 million € |

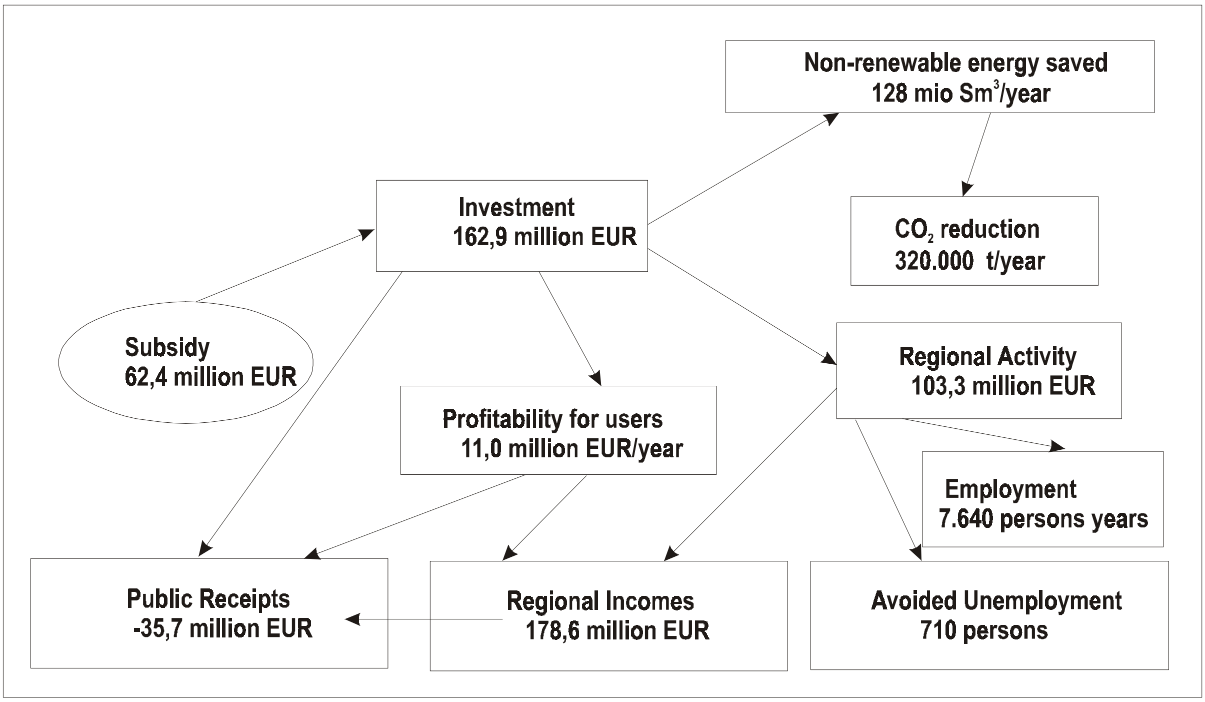
The results of the program execution can be summarized as follows:

- Total investment value 162,9 million €, needed subsidies 62,4 million €.
- 5,150 projects, 330 MWt power, heat prod. 1,200 GWh/year, 39% wood biomass growth.
- Yearly fossil fuels savings: 128 million $Sm^3$ natural gas equivalent.
- Emission reduction: 0,320 million tons $CO_2$/year, 3,390 ton $SO_2$/year.
- Regional activity growth: 178,6 million €, regional benefit: 463,3 million €.

In figure 4 the main economic categories are presented with their mutual influence and contribution to the regional development. We can summarize the results in the following categories:

- 1 € of subsidy creates 1,7 Euro of regional added value and 7,4 € of regional benefits. The impact in terms of economic development is very important, especially since new activities and new employment have been created.
- The program creates 380 new jobs and fossil fuels saving amounting 21,9 million €/year. The consumers themselves will participate in gain sharing: having a higher quality product at lower price.
- The project contributes to the spatial planning of the area thanks to the beneficial activity of the hedge/coppice trimming and the clearing of the forests. The project also serves to combat social exclusion while creating income flows in the region.

*Figure 4: Main economic categories with their contribution to the regional development*




The macroeconomic results show very high social profitability of the program in terms of GDP growth, improved balance of trade and increased employment. Overall country benefits far exceed with the Program execution associated costs and prove the decision for the program.

On the long run, since the era of fossil fuels is slowly dawning and the prices are raising, solutions for the biomass are expected to become predominant on the heat market. At that time subsidy support for the biomass systems is not needed any more.

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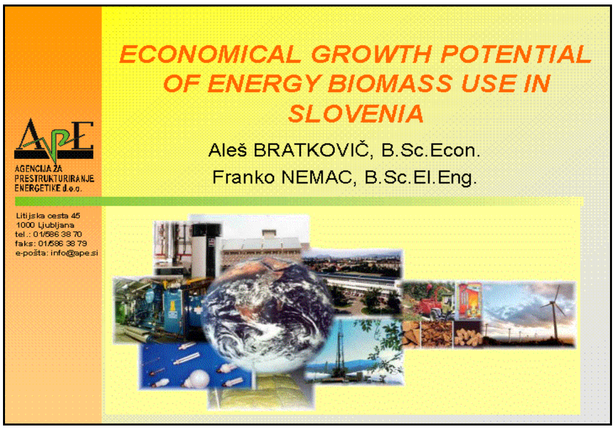


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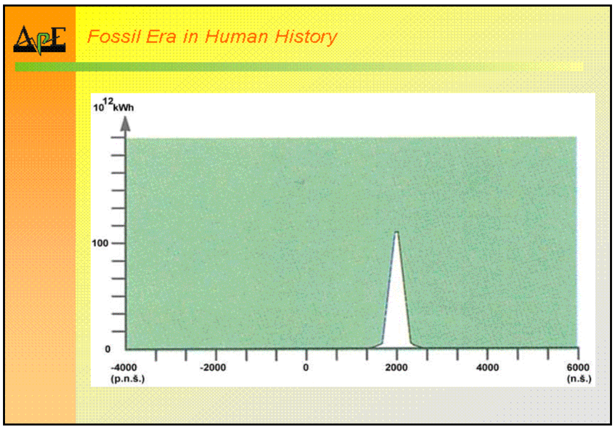


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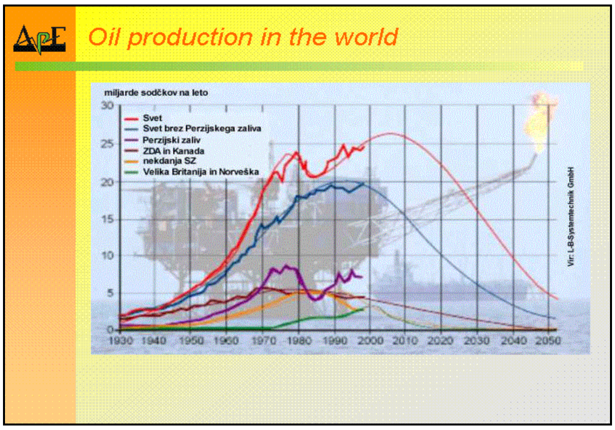


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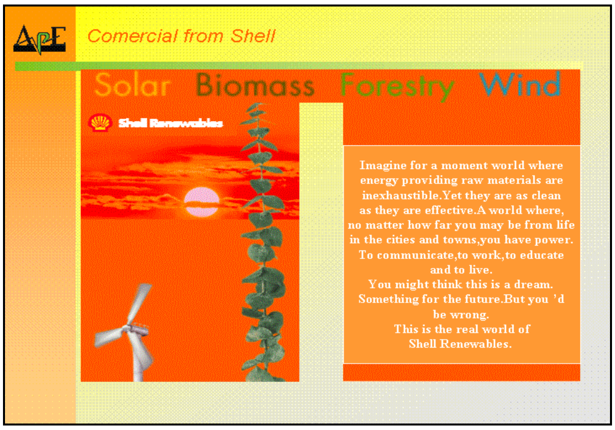


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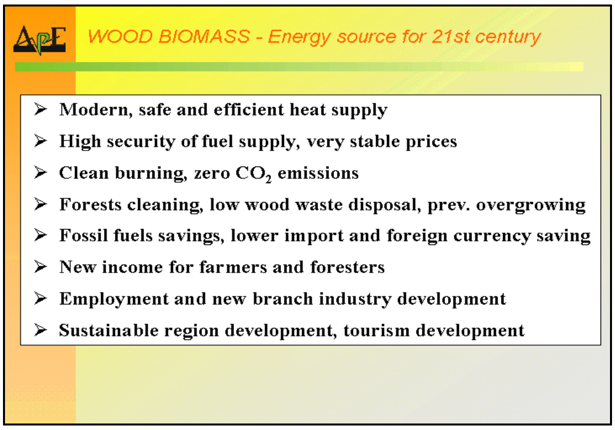


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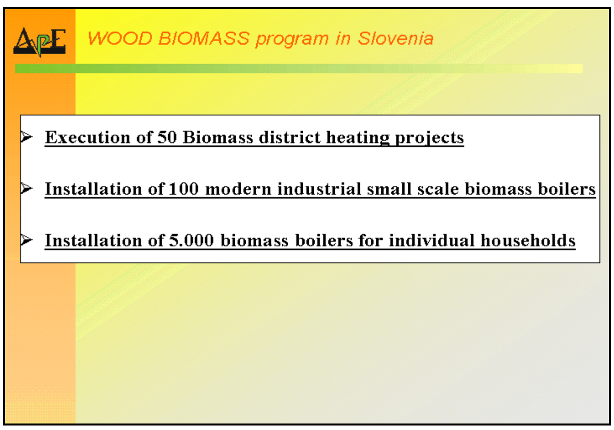


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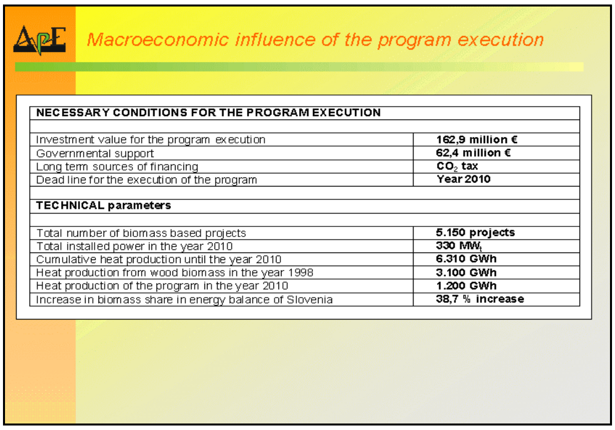


| NECESSARY CONDITIONS FOR THE PROGRAM EXECUTION | |
|---|---|
| Investment value for the program execution | 162,9 million € |
| Governmental support | 62,4 million € |
| Long term sources of financing | $CO_2$ tax |
| Dead line for the execution of the program | Year 2010 |
| **TECHNICAL parameters** | |
| Total number of biomass based projects | 5.150 projects |
| Total installed power in the year 2010 | 330 $MW_t$ |
| Cumulative heat production until the year 2010 | 6.310 GWh |
| Heat production from wood biomass in the year 1998 | 3.100 GWh |
| Heat production of the program in the year 2010 | 1.200 GWh |
| Increase in biomass share in energy balance of Slovenia | 38,7 % increase |

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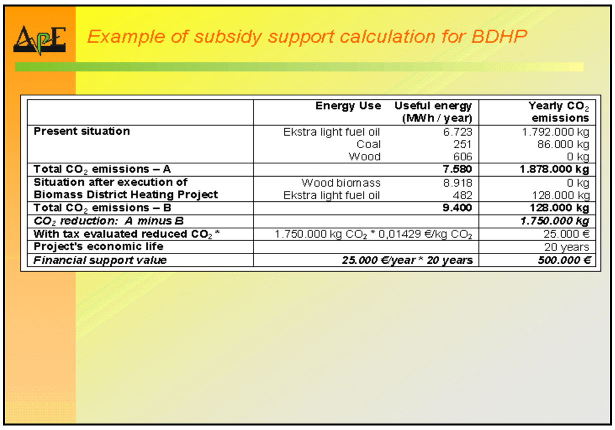


| | Energy Use | Useful energy (MWh / year) | Yearly $CO_2$ emissions |
|---|---|---|---|
| **Present situation** | Ekstra light fuel oil<br>Coal<br>Wood | 6.723<br>251<br>606 | 1.792.000 kg<br>86.000 kg<br>0 kg |
| **Total $CO_2$ emissions – A** | | **7.580** | **1.878.000 kg** |
| **Situation after execution of Biomass District Heating Project** | Wood biomass<br>Ekstra light fuel oil | 8.918<br>482 | 0 kg<br>128.000 kg |
| **Total $CO_2$ emissions – B** | | **9.400** | **128.000 kg** |
| ***$CO_2$ reduction: A minus B*** | | | ***1.750.000 kg*** |
| **With tax evaluated reduced $CO_2$ *** | 1.750.000 kg $CO_2$ * 0,01429 €/kg $CO_2$ | | 25.000 € |
| **Project's economic life** | | | 20 years |
| ***Financial support value*** | ***25.000 €/year * 20 years*** | | ***500.000 €*** |

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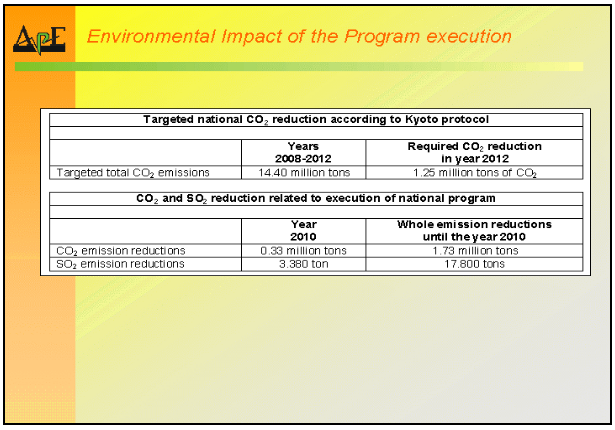
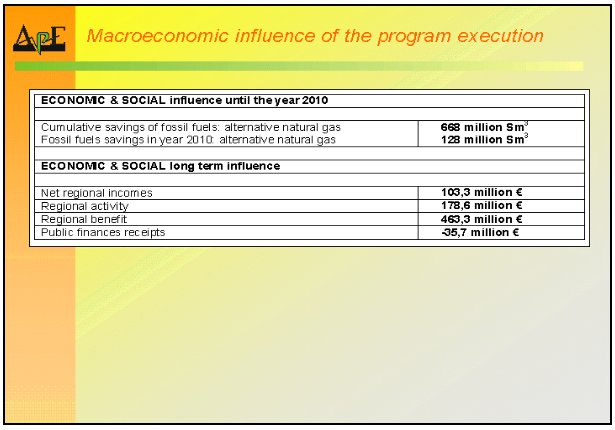



| **Targeted national $CO_2$ reduction according to Kyoto protocol** | | |
|---|---|---|
| | **Years 2008-2012** | **Required $CO_2$ reduction in year 2012** |
| Targeted total $CO_2$ emissions | 14.40 million tons | 1.25 million tons of $CO_2$ |

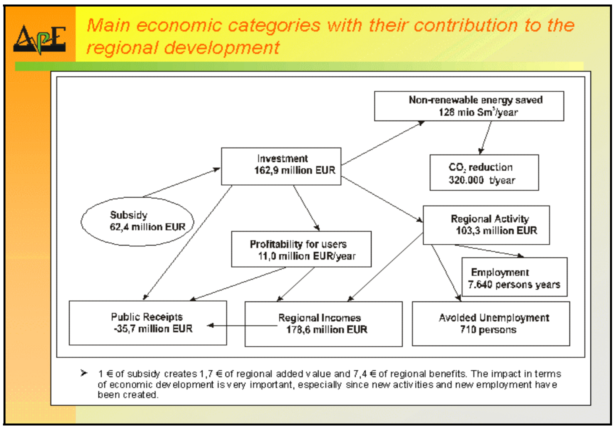
| **$CO_2$ and $SO_2$ reduction related to execution of national program** | | |
|---|---|---|
| | **Year 2010** | **Whole emission reductions until the year 2010** |
| $CO_2$ emission reductions | 0.33 million tons | 1.73 million tons |
| $SO_2$ emission reductions | 3.380 ton | 17.800 tons |

Slide 10




| **ECONOMIC & SOCIAL influence until the year 2010** | |
|---|---|
| Cumulative savings of fossil fuels: alternative natural gas<br>Fossil fuels savings in year 2010: alternative natural gas | **668 million $Sm^3$**<br>**128 million $Sm^3$** |
| **ECONOMIC & SOCIAL long term influence** | |
| Net regional incomes | **103,3 million €** |
| Regional activity | **178,6 million €** |
| Regional benefit | **463,3 million €** |
| Public finances receipts | **-35,7 million €** |

Slide 11

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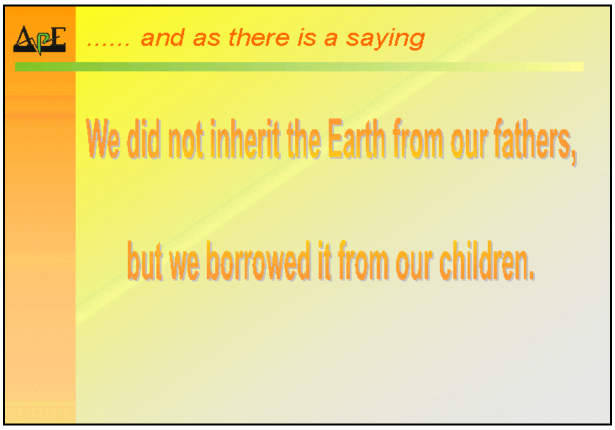


Slide 13

# Biomass Success Stories in Ukraine

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## 1. Energy production from biomass in EU countries

Energy production from biomass is developing dynamically in most European countries. The share of renewable energy was 74.3 mln tons of oil equivalent in EU countries in 1995 that came to about 6% of the total primary energy consumption. Among these biomass share was more than 60% that came to about 3% of the total primary energy consumption. In some countries biomass share in the total primary energy consumption exceeds the average European index significantly: In the USA biomass share is 3.2%, in Denmark - 6%, in Austria - 12%, in Sweden - 18%, in Finland - 23%. According to the program of renewable energy development biomass will cover about 74% of the total renewable energy contribution in 2010 in EU countries that will amount to about 9% of the total primary energy consumption. It is obvious that biomass is the most powerful sector of renewable energy in EU.

## 2. Biomass potential in Ukraine

An estimation of the biomass potential available for energy production in Ukraine was carried out on the basis of statistic data. The main source of biomass in Ukraine is agricultural residues and first of all cereals straw. Residues coefficients and the share of biomass that is not used by other sectors of economy and is available for energy production were defined on the basis of method literature and expert evaluation. For instance, consumption of straw for own demands by agricultural sector (fodder and bedding) is accepted as 80% of the total amount of straw in Ukraine. Thus only 20% of straw are available for energy purposes. This figure is notably lower than that for example in Denmark, where 60% of the total yield of straw are considered available for energy production. In the future the share of straw available for energy purposes may increase considerably in Ukraine.

Another big source of biomass in Ukraine is cattle manure. Calculation was done starting from livestock of animals. For that statistical data on livestock were used for cattle and pigs. The quantity of poultry was defined on the basis of existing data on eggs production starting from estimation that one hen lays 250 eggs per year. According to data of 1999 the total amount of biogas that can be obtained from manure of cattle, pigs and poultry came to 2,207.2 mln $m^3$ that was equivalent to 1.11 mln toe.

*Table 1: Energy potential of biomass in 1999-2000*

| Type of biomass | Energy potential mill toe |
|---|---|
| Cereal crops/ straw (without maize) | 2.54 |
| Maize for grain/ stems, ears | 0.83 |
| Sunflower/ stems, husk | 1.62 |
| Manure/ biogas | |
| - Cattle | 0.92 |
| - Pigs | 0.08 |
| - Poultry | 0.11 |
| Total on manure | 1.1 |
| Wood wastes | |
| Wood remained at felling areas (felling residues), W 50-60% (mass moisture content) | 0.314 |
| Residues at timber enterprises generated during sawing of round timber, W 40-45% | 0.114 |
| Residues at woodworking enterprises generated during production of finished products, W 25-30% | 0.180 |
| Firewood taken out of felling areas, W 40-45% | 0.969 |
| Total on wood wastes | 1.1 |
| Landfill gas | 0.21 |
| **TOTAL** | **7.42** |

The next big source of biomass in Ukraine is wood residues. According to statistical data of 1999 the energy potential of wood wastes of different types came to 1.11 mill toe/year. Landfill gas (LFG) generated from municipal solid wastes (MSW) during their degradation under anaerobic conditions at open dumps and landfills should be considered as separate type of biomass. Annually about 15 mln t of MSW are generated in Ukraine. The main part of MSW is disposed of at open dumps (more than 90%). Of the total quantity of dumps (655) only 140 is landfills which can be considered suitable for LFG extraction and utilization. Of 140 landfills 90 are of large scale and contain up to 30% of all MSW of Ukraine. These landfills are the most economically rational for LFG extraction and utilization, and therefore just these were taken into account when elaborating a conception for bio-energy development in Ukraine. Based on what was mentioned above, the potential of LFG available for energy production at the 90 most large-scale landfills comes to about 400 mln $m^3$/year, which is equivalent to 0.21 mln toe/year.

Summary data on energy potential of biomass are presented in table 1. Thus, according to 1999-2000 data, biomass potential in Ukraine amounted to about 7.4 mln toe/year. It comes to about 5.3% of the total primary energy consumption in Ukraine not taking into account the share of biomass that is used now by other sectors of economy.

## 3. Status of bio-energy development in Ukraine

At present the use of renewable energy in Ukraine (excluding large hydropower) is less than 0.5% of the total primary energy consumption. Now there are only some modern wood-fired boilers in operation in Ukraine. In addition a number of boilers originally designed for coal and oil combustion and later converted for wood combustion by own strength are now in operation at timber and woodworking enterprises. As a rule such boilers have fixed grates, batch fuel loading, low efficiency and high emission. Several boilers converted to combustion of husk are in operation at oil-extraction works now. Husk combustion is a cost-effective technology, which continues development in Ukraine. At present only one straw-fired boiler of 980 kW capacity is in operation in Ukraine. But there are not combined heat and power (CHP) plants based on biomass, large anaerobic digesters for processing of manure and food industry wastewater, and gasifiers for conversion of biomass in Ukraine.

Several demonstration projects in the field of bio-energy have been fulfilled in Ukraine recently. Plants implemented within the frames of these projects are the first modern large-scale bio-energy equipment operating in Ukraine. Firstly there is the Dutch-Ukrainian technical assistance project. In the frame of this project two steam wood-fired boilers were implemented: a 5 MW boiler at veneer plant “Odek-Ukraine” in the town of Orzhiv (Rivne oblast) and a 1.5 MW boiler at Malin state timber enterprise (Zhitomir oblast). The boilers are equipped with step moving grates and intended for combustion of wood chips, bark and sawdust with a moisture content up to 60%.

Besides, the Danish-Ukrainian technical assistance project has been fulfilled successfully. Within the frame of this project a 980 kW straw-fired boiler for big bales was installed at the village of Drozdy, Kyiv oblast.

In the field of biogas the Dutch-Ukrainian technical assistance project is being realized now. The CHP biogas plant of 160 $kW_e$+300 $kW_{th}$ capacity and 2000 $m^3$ reactors volume for treatment of 80 t/day of manure is now under construction at the pig-breeding farm with 15,000 heads in the village of Olenivka, Dnipropetrivsk oblast.

## 4. Technical and economic assessment of bio-energy technologies in Ukraine

Below there are presented the results of a feasibility study of bio-energy technologies in Ukraine, which were obtained first of all on the basis of the above mentioned demonstrational projects. table 2 contains the results of calculations for wood-fired steam boilers of the Dutch manufacturer KARA. Capital outlays include cost of boiler, auxiliary equipment, automatic and control system, multi-cyclone, chimney, expenditures on mounting and putting into operation. The costs of boiler house and heating network is not included. The following parameters were varied during the calculations: annual period of boiler operation, fuel cost, fuel moisture and others. Operation time of 8,000 h/year corresponds to boiler producing process steam, and 4,400 h/year corresponds to boiler operation during the heating season. The results of the feasibility study for straw-fired boilers are also presented in table 2. The 800 kWth automatic straw-fired boiler of the Danish manufacturer Lin-ka is intended for chaffed straw. Capital outlays include costs of boiler, chimney, buildings, expenditures for freight and installation of equipment. The following parameters were accepted for the calculations:

- Period of amortization – 15 years;
- labor cost of 0.65 thous. $/year corresponds to 3 men (1 man per shift) and operation period of 6 months; 1.30 thous. $/year is the same for operation period of 12 months;
- natural gas price – 80 $/1000 nm3.

Fuel consumption was calculated taking into account an average capacity of a plant during heating period that is 0.89 of nominal capacity. Prime cost of heat was calculated as operating costs divided by annual heat production. Payback period was calculated as capital costs divided by difference between cost of saved natural gas and operating costs. At that operating costs did not include amortization and profit.

*Table 2: Results of feasibility study on introduction of wood-fired and straw-fired boilers of foreign manufacture in Ukraine*

| Parameters | 5 MW KARA wood-fired boiler with step moving grate | | | 2 MW KARA under screw wood-fired boiler | | | 800 kW Lin-ka straw-fired boiler |
|---|---|---|---|---|---|---|---|
| Capital outlays, thous. $ | 750 | 750 | 750 | 250 | 250 | 250 | 133 |
| Fuel moisture, % | 60 | 60 | 60 | 40 | 40 | 40 | 15 |
| Operation time, h/year | 4400 | 8000 | 8000 | 4400 | 8000 | 8000 | 4400 |
| Operating costs, thous. $/year | | | | | | | |
| - Amortization | 50.25 | 50.25 | 50.25 | 16.75 | 16.75 | 16.75 | 8.91 |
| - Profit (annual interest is 10%) | 75 | 75 | 75 | 25 | 25 | 25 | 13.3 |
| - Labor | 0.65 | 1.30 | 1.30 | 0.65 | 1.30 | 1.30 | 0.65 |
| - Fuel | 66.1 | 0 | 135 | 24.2 | 0 | 49.4 | 3.2 |
| - Maintenance | 5 | 5 | 5 | 5 | 5 | 5 | 0.9 |
| TOTAL | 197 | 132 | 267 | 72 | 48 | 97 | 27 |
| Fuel consumption, t/year | 14685 | 30000 | 30000 | 3357 | 6857 | 6857 | 895 |
| Heating value, MJ/kg | 6 | 6 | 6 | 10.5 | 10.5 | 10.5 | 14 |
| Fuel cost, $/t | 4.5 | 0 | 4.5 | 7.2 | 0 | 7.2 | 3.6 |
| Heat production, TJ/year | 70.49 | 144 | 144 | 28.2 | 57.6 | 57.6 | 11.28 |
| Prime cost of heat, $/GJ | 2.79 | 0.91 | 1.85 | 2.54 | 0.83 | 1.69 | 2.39 |
| Saved natural gas, mill m$^3$/year | 2.01 | 4.11 | 4.11 | 0.81 | 1.65 | 1.65 | 0.32 |
| Saved natural gas, thous. $/year | 161.12 | 329.14 | 343.95 | 64.45 | 131.7 | 131.7 | 25.78 |
| Payback period, year | 8.4 | 2.3 | 4 | 7.2 | 2 | 3.3 | 6.3 |

Heat production based on wood residues and straw is profitable for Ukraine now even when using foreign boilers. The most profitable is production of processing steam at a long operation time of a boiler.

*Table 3: Data on feasibility study for biogas plant*

| Parameters | 2000 m$^3$ anaerobic digestion plant |
|---|---|
| Capital outlays, thous. $ | 413 |
| Operating costs, thous. $/year | 21 |
| Savings, thous. $/year | |
| - Electricity | 41.4 |
| - Heat | 5.6 |
| - Minerals (N, P, K) | 25.0 |
| Total | 72 |
| Payback period, years | 8.1 |

The results of the feasibility study for a CHP biogas plant of 160 kW$_e$+300 kW$_{th}$ capacity and 2000 m$^3$ digester volume are presented in table 3.Capital outlays include cost of equipment and expenditures on modification of infrastructure. Financial benefit caused by implementation of the biogas plant includes saved electricity, heat and mineral fertilizers.

Bio-energy equipment of foreign manufacture is rather expensive, and most of Ukrainian enterprises cannot afford it. This fact forms one of the most serious barriers for the development of bio-energy technologies. The most reasonable is to begin production of such equipment in Ukraine, the share of foreign components will come to 25-40%. At that cost of bio-energy equipment of Ukrainian manufacture comes down considerably. For example, a 5 MW boiler with step moving grate of the Dutch firm KARA costs 750 thous. $. The similar Ukrainian boiler with 30% of foreign components is expected to cost about 1,330 thous. UAH (about 240 thous. $) that is more than twice cheaper. The same can be said about an under screw wood-fired boiler and straw-fired boilers. Boilers of Ukrainian manufacture will have a rather short payback period of 1-2.5 years.

*Table 4: Feasibility study for 2 MW landfill gas power project at Lugansk landfill, Ukraine*

| Parameters | Engine of public corporation Pervomaisk-dieselmash (Ukraine) | Engine MAN (German) |
|---|---|---|
| Volume of landfill, mill $m^3$ | 2 | 2 |
| Landfill gas make mill $m^3$/year | 8 | 8 |
| Heating value of LFG, MJ/$m^3$ | 18 | 18 |
| Installed capacity of power plant, kW | 2×1000 | 2×1000 |
| Electricity production GWh/year | 14.4 | 14.4 |
| Capital outlays, thous. US$ | 571 | 1346 |
| Operating costs, thous. US$/year | | |
| - Amortization | 38.1 | 89.7 |
| - Profit | 57.1 | 134.6 |
| - Labour | 3.6 | 3.6 |
| - Maintenance | 5 | 5 |
| - TOTAL | 103.8 | 232.9 |
| Prime cost of electricity US$/kWh | 0.007 | 0.016 |
| IRR,% | 39 | 17 |
| Payback period, year | 2.0 | 4.6 |

As an example of technical and economical assessment of LFG extraction and utilization technologies table 4 presents the calculation results for Lugansk landfill containing 1.6 mln t of MSW. There were considered two variants of equipment for a small-scale power plant operating on LFG: engine of Ukrainian manufacture (public corporation "Pervomayskdiselmash") and engine of German manufacture (MAN). The following parameters were accepted in the calculations: average density of MSW - 800 kg/$m^3$, annual output of LFG – 5 $m^3$/t of wastes, total period of plant operation – 20 years. Prime cost of electricity generated from LFG is 0.007 and 0.016 $/kWh when using Ukrainian and German engines correspondingly. In both cases the prime cost is lower than the market price of electricity in Ukraine – 0.021 $/kWh.

The above given economical calculations do not take into consideration the potential opportunity to sell reduction of emissions of $CO_2$ and other greenhouse gases achieved when implementing bio-energy projects. However now a real opportunity exists to sell the mentioned reduction of greenhouse gases emissions, for instance, within the frame of the program Eru-PT supported by the Dutch Ministry of Economy. Reduction of emission of $CO_2$ and other greenhouse gases will be bought at the price of 4.54-9.08 EUR/t on condition that within 2008-2012 this reduction will be not less than 500 thous. t of $CO_2$ or $CO_2$-equivalent. Taking into account the opportunity of such sale, economical parameters of bio-energy projects rise significantly. For example, the reduction of methane emission achieved in the course of implementation of the project on LFG utilization at Lugansk landfill described above, amounts to about 70 thous. t/yr of $CO_2$-equivalent or 280 thous. t of $CO_2$-equivalent for four years (2008-2012). When selling it at the price of 9 EUR/t one can obtain about 2,520 thous. EUR. The sum is several times as much than capital outlays required for construction of a 2 MW power plant equipped with Ukrainian gas engines.

## 5. Analysis of barriers for bio-energy development in Ukraine

There are a number of technological barriers on the way of bio-energy development in Ukraine. At present there is no serial production of wood-fired boilers, straw-fired boilers as well as biogas plants. Foreign equipment is also practically absent in the market of Ukraine. One can mark the presence of 15-50 kW domestic wood-fired boilers mainly of foreign manufacture in the market, and also up to 200 kW wood-fired boilers mainly equipped with gasification furnace extension. Maximal capacity of steam boilers produced in Ukraine is 10 tons of steam per hour (6.5 MW), and the pressure is up to 13 bars. It forms a technological barrier for starting production of equipment for power plants and CHP plants operating on wood or straw.

Today the most widespread straw handling system in Ukraine is harvesting chaffed straw and its storage in fields in the form of stacks. Baling technology is not widespread yet. Due to this fact long distance transportation of straw is not profitable, and this puts obstacles on the way of construction of large-scale straw-fired plants and spreading of boilers for baled straw. At that it should be marked that more and more farms turn to the use of balers for harvesting straw regardless of plans concerning installation of straw-fired boilers. In themselves purchasing bales and harvesting straw in the form of bales are profitable actions. They are repaid at the expense of reduced grain loss during harvesting and also at the expense of reduced expenditures on storage and transportation of straw. According to experts' estimation, up to 50% of Ukrainian farms will have balers by 2010.

A great amount of large-scale pig-breeding farms in Ukraine are equipped with water wash systems for manure. In this case the moisture of manure (about 99%) is much higher than the moisture suitable for anaerobic digestion (88-90%) with obtaining a positive energy effect. To implement biogas plants on such farms, it is necessary to reconstruct the existing water wash systems.

An economic barrier for bio-energy development in Ukraine lies in the absence of any economic stimuli in the form of subsidizing, setting free of taxes etc for development and implementation of biomass-to-energy technologies. Even the most profitable technologies (such as industrial wood-fired boilers or LFG extraction and utilization plants) need financial stimuli for producers as well as for consumers of the equipment, at least at the beginning period of developing and launching production.

A legislative barrier is connected with the absence of state policy in the field of biomass combustion, biogas production and other technologies. A positive example of changing point of view of the state in this field is adopting the law "On alternative types of liquid and gaseous fuel" (N 1391-XIV of 14/01/2000). According to the law, the projects on utilization of landfill gas, biogas and liquid fuel produced from biomass must receive certain financial support. Unfortunately there are no laws encouraging the use of wood and straw as a fuel.

An ecological barrier is connected with the existing rather soft ecological legislation that does not let to include ecological constituent in economic effect from the use of bio-energy technologies. In developed countries the main effect from the construction of a biogas plant is considered an ecological one. In Ukraine biogas technologies have to compete with other technologies only at the expense of energy effect and effect from production of high-grade fertilizers.

In addition an almost complete informational vacuum on bio-energy technologies is typical for Ukraine. This forms an informational barrier on the way of bio-energy development. In Ukrainian libraries there are not profile periodicals of developed countries on these technologies, Ukrainian specialists practically do not have opportunities to participate in specialized foreign conferences. As a positive change of last years one can mark increased interest of Ukrainian mass media to renewable energy including bio-energy. A number of journals place publications on these technologies practically in each issue. Among them "Installation market", "Green energy", "Eco-technologies and Energy Saving" should be marked. Holding the First Ukrainian Conference on Biomass for Energy will contribute to overcoming the informational barrier. The conference will be held by the Institute of Engineering Thermo-physics in 2002 (details can be found on the web site www.i.com-.ua/~biomass). Positive events of last years also include the establishment and running of Bio-energy Association of Ukraine, whose task is promotion of bio-energy technologies in Ukraine (e-mail: uba@ukr.net).

An organizational barrier is formed by the absence of a co-ordinated policy in the area of bio-energy development in Ukraine and by the absence of state structures responsible for the policy. With regard to administrative barriers, it should be mentioned that independent producers of power from biomass are confronted with serious difficulties when selling electricity to the grid. The last concerns first of all LFG utilization systems.

## 6. The conception of bio-energy development in Ukraine.

The Danish conception of bio-energy development was accepted as a basis for the elaboration of the conception for Ukraine. Both countries have a relatively small territory covered by forest (about 14%) and a highly developed agricultural sector that leads to a similar structure of biomass potential in these countries.

The following technologies can be considered as the most promising for commercial use in Ukraine:

- 0.1-5 MW industrial wood-fired boilers for installation at timber enterprises and wood processing enterprises;
- 1-10 MW wood-fired district heating (DH) plants;
- 0.1-1 MW farm and neighbor heating straw-fired boilers;
- 1-10 MW straw-fired district heating plants;
- biogas plants for large-scale cattle farms, pig-breeding farms, poultry farms and food industry enterprises;
- systems for LFG extraction and utilization in small-scale power plants of 0.5-5 MW capacity.

Technologies of direct combustion of wood, first of all for heat and process steam production, require priority development in Ukraine. It is connected with a rather low electricity price existing in Ukraine (0.03 $/kWh) and at the same time with a quite high heat and fuel price. Implementation of small-scale power plants and CHP plants operating on solid biomass (wood, straw, husk) will be profitable if the electricity price rises significantly or in the case of subsidies. Heat production from biomass is profitable now even under the use of foreign equipment. Besides, Ukraine has the opportunity to launch its own production of wood and straw-fired boilers.

Technologies of straw combustion are very promising for Ukraine too. To implement them widely it is necessary to solve a number of questions connected with arrangements on collection, baling, transportation and storage of straw. First of all 0.1-1 MW farm and neighbor heating boilers for implementation at agricultural enterprises have the best prospects. After demonstration of advantages of these boilers large-scale district heating plants also have good opportunities for commercialization. As for 1-10 MWe biomass-based CHP plants, we restrict their position in the conception of bio-energy development in Ukraine only by two demonstrational plants (one wood-based and one straw-based) until electricity price rises greatly.

Large-scale biogas plants also play an important role in the conception. Their widespread implementation is possible on pig-breeding farms (with a livestock more than 5 thousand heads), cattle farms (with livestock more than 600 heads), poultry farms and food industry enterprises. According to our estimations, it is possible to construct 2,903 biogas plants in Ukraine with average digester volume of 1000 $m^3$ including 295 plants on pig-breeding farms, 130 plants at poultry factories and 2,478 plants on cattle farms and food industry enterprises.

The use of LFG is the most profitable at industrial enterprises located near landfills. If it is impossible to utilize LFG in nearby industry it can be used at small-scale power plants or CHP plants equipped with gas internal-combustion engines.

*Table 5: Bio-energy equipment that can be installed in Ukraine under realization of proposed conception*

| Type of equipment | Approximate capacity of Ukrainian market units | Installed capacity | | Operation time | Replacement of fossil fuels | Reduction of CO2 emission | Total capital investments |
|---|---|---|---|---|---|---|---|
| | | $MW_{th}$ | $MW_e$ | h/year | mtoe/year | mill t/year | mill US $ |
| Wood-fired DH plants 1-10 $MW_{th}$ | 250 | 500 | --- | 4400 | 0.21 | 0.49 | 38 |
| Industrial wood-fired boilers 0.1-5 $MW_{th}$ | 250 | 250 | --- | 8000 | 0.19 | 0.45 | 25 |
| Wood-fired CHP plants 1-10 $MW_e$ | 1 | 10 | 5 | 8000 | 0.014 | 0.05 | 5 |
| Domestic wood-fired boilers 10-50 $kW_{th}$ | 53000 | 1590 | --- | 4400 | 0.67 | 1.57 | 80 |
| Farm straw-fired boilers 0.1-1 $MW_{th}$ | 15900 | 3180 | --- | 4400 | 1.34 | 3.14 | 254 |
| Straw-fired DH plants 1-10 $MW_{th}$ | 1400 | 2800 | --- | 4400 | 1.18 | 2.76 | 280 |
| Straw-fired CHP plants 1-10 $MW_e$ | 1 | 10 | 5 | 8000 | 0.014 | 0.05 | 8 |
| Large-scale biogas plants | 2903*) | 711 | 325 | 8000 | 0.93 | 22.36 | 290 |
| Small-scale LFG power plants | 90 | 20 | 80 | 8000 | 0.17 | 3.26 | 48 |
| **TOTAL** | **73795** | **9071** | **415** | | **4.7** | **34.13** | **1027** |

**) including 2478 plants on cattle farms, 295 plants on pig-breeding farms, 130 plants at poultry factories.*

Liquid fuels are unlikely to be produced from biomass in Ukraine in the near future because their prime cost is much higher than cost of traditional liquid fuels. The main efforts in this area should be focused on research and demonstrational projects. The same can be said with regard to biomass fast pyrolysis and gasification technologies.

Table 5 contains data on equipment that can be installed in Ukraine under realization of developed conception. Reduction of $CO_2$ emission was calculated for a case of replacement of natural gas. Specific capital costs based on cost of equipment of Ukrainian manufacture have been accepted as follows (average capacities of equipment used in the calculations are given in brackets):

- wood-fired district heating plants – 75 $/kW_{th}$ (2 MW);
- industrial wood-fired boilers - 100 $/kW_{th}$ (1 MW);
- wood-fired CHP plants – 1000 $/kW_e$ (5 $MW_e$+10 $MW_{th}$);
- small domestic wood-fired boilers – 50 $/kW_{th}$ (30 kW);
- farm and neighbor heating straw-fired boilers – 80 $/kW_{th}$ (0.2 MW);
- straw-fired district heating plants – 100 $/kW_{th}$ (2 MW);
- straw-fired CHP plants – 1500 $/kW_e$ (5 $MW_e$+10 $MW_{th}$);
- biogas plants – 100 $/m$^3$ of digester volume, (volume of digester – 1000 m$^3$, 75 $kW_e$+150 $kW_{th}$);
- small-scale power plants operating on LFG – 600 $/kW_e$.

If the proposed conception is realized, the total installed capacity will come to 9,071 MWth and 415 MWe. It will result in replacement of 4.7 mln toe/year and reduction of $CO_2$ emission at the rate of 34 mln t/year.

## 7. Conclusions

Ukraine has rather big potential of biomass available for energy production. Biomass (excluding the share that is used by other sectors of economy) can cover about 5.3% of the total primary energy demand. Technologies of the utilization of biomass are just at the beginning of their development in Ukraine, but they have good prospects for commercialization in the near future.

The results of the feasibility study indicate that heat production from biomass is competitive even when using foreign equipment. With regard to electricity production from biomass, the most profit-making plants now are small-scale power plants operating on LFG. Production of electricity from wood and straw is not profitable under the existing tariffs on power. The following technologies are the most promising for Ukraine:

- 1-10 MW wood-fired district heating plants and 0.1-5 MW industrial wood-fired boilers for installation at timber enterprises and wood processing enterprises;
- 0.1-1 MW farm and neighbor heating straw-fired boilers; 1-10 MW straw-fired district heating plants;
- biogas plants for large-scale cattle farms, pig-breeding farms, poultry factories and food industry enterprises;
- plants for LFG extraction and utilization at large-scale landfills (0.5-5 MW power plants).

Production of corresponding licence European equipment at industrial enterprises of Ukraine seems to be the most promising strategy for the development of bio-energy technologies in Ukraine, at least at the first phase.

If the proposed conception is realized, the total installed capacity will come to 9,071 MWth and 415 MWe. It will result in replacement of 4.7 mln toe/year and reduction of $CO_2$ emission at the rate of 34 mln t/year. The development of bio-energy technologies will decrease Ukraine's dependence on imported fuels, enhance its energy security at the expense of organizing energy supply based on local renewable sources, create a lot of new jobs (mostly in rural area), and contribute significantly to improvement of the ecological situation.

## 8. Literature


- Energy for the Future: Renewable Sources of Energy. White Paper for a Community Strategy and Action Plan. Bruxelles, 1997, 53 p.
- Statistical yearbook of Ukraine, 1999 - Kyiv: Technika, 2000.

# Biomass CHP Unit in Pfaffenhofen / Germany - power, heat and chill based on wood chips

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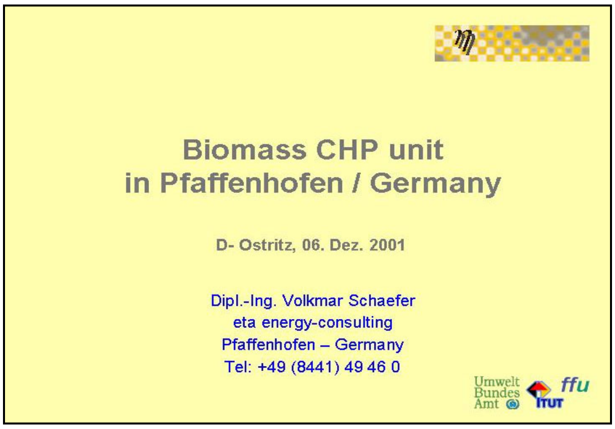
In Pfaffenhofen/Germany a biomass co-generation plant (heat, power, cooling) has started operation (27 $MW_{th}$ and 7.5 $MVA_{el}$) in July 2001. Existing municipal facilities are connected to the district heat supply system. Steam, heat and cooling is delivered to a hospital, a food producing company and further companies as well.

In Pfaffenhofen - Bavaria, a biomass cogeneration plant for producing electricity, steam, district heating and cooling has been erected. The location of the biomass cogeneration plant allows to deliver energy to the connected customers very easily: The plant supplies steam to a producer of baby-food at a temperature of 180°C / 356°F by a special conducting pipe. A district heating system for more than 100 customers on two levels of temperature (130°C / 266°F and 80°C / 176°F) and a low-temperature grid for neighboring customers (up to 40°C / 104°F) has been installed. Moreover absorption chillers run by district heating provide cooling for air conditioning and for low-temperature applications. Due to the fact that the demand of heat is rather constant over the year, the degree of effectiveness of a co-generation plant is very high.

Wood chips are burned in a special biomass boiler on a water-cooled vibration grate. The maximum heating power is 26.7 MW. Its capacity was calculated by means of comprehensive demand-related designing. In addition, there are two steam boilers with 10 respectively 20 MW heating power for supporting biomass-furnace during high loads and to ensure safe heat delivery. The main fuel is gas. In total up to 120 MWh heat are sold every year. With a capacity of about 7.5 MW electrical power, the steam turbine is supposed to supply an amount of more than 40 GWh electricity per year into the grid.

The calculated fuel demand will total 80,000 tons per year: 30% natural wood and bark; 70% wood waste of sawmills. The continuous demand of 250 t per day requires efficient logistics for harvesting, processing and transport of wood. Forest owners can supply wood ranging from intact stems to wood chips. All species of trees are suitable for wood chips production; chippers are operated. Container trucks will transport the fuel to the co-generation plant. This guaranties a flexible and efficient supply by minimal traffic.

The Federal Government has committed itself to reduce carbon dioxide emissions by 25% by 2005 in relation to 1990 figures. With putting the plant in operation, we have reached this target for Pfaffenhofen already in 2001. The co-generation in Pfaffenhofen offers both energy efficiency and labor policy advantages: We have particularly employment effects for 200 persons during the construction-phase and we have created permanent jobs for 25 persons in the plant and wood procurement.

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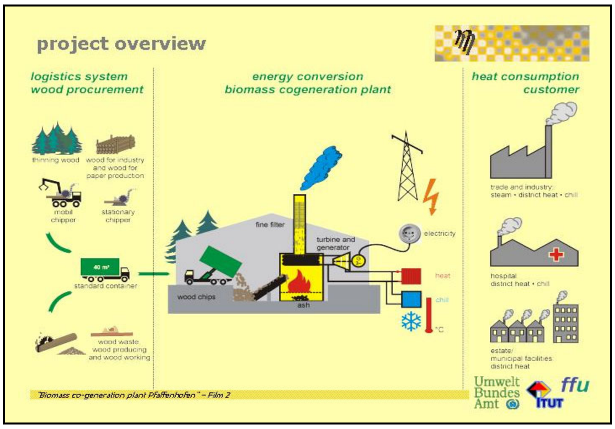


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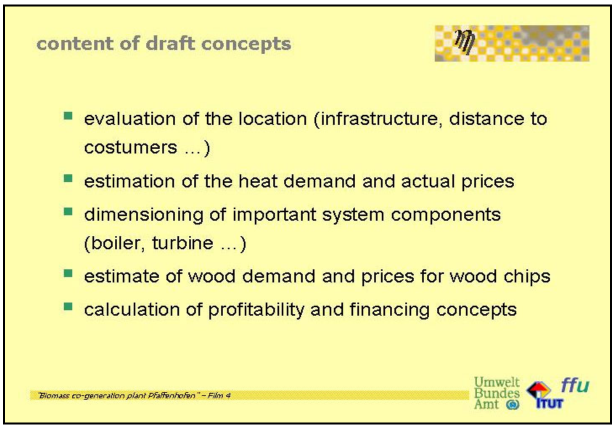


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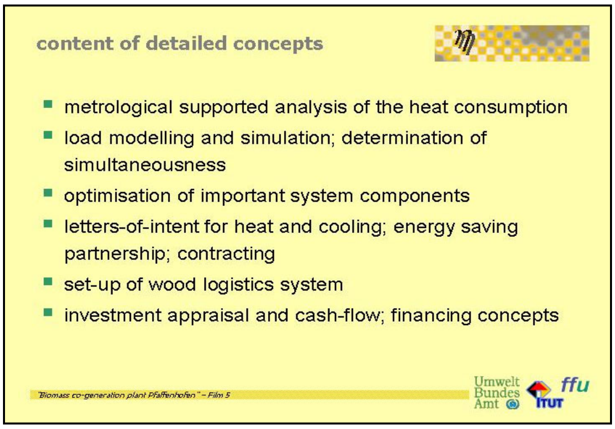


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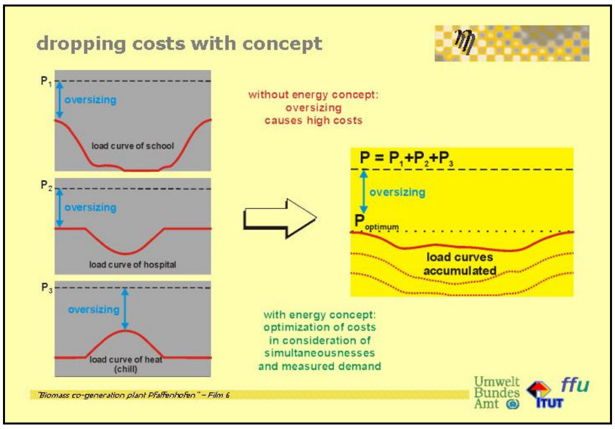


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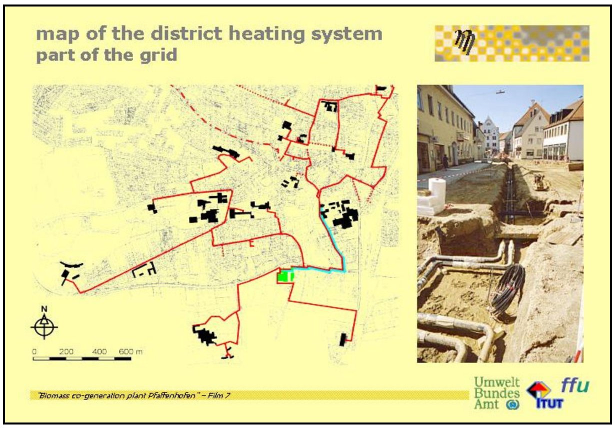


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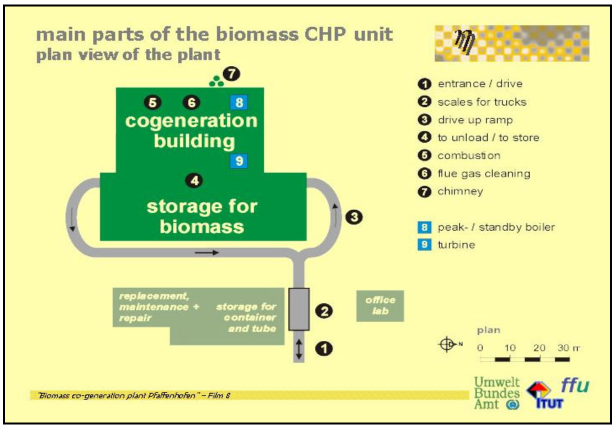


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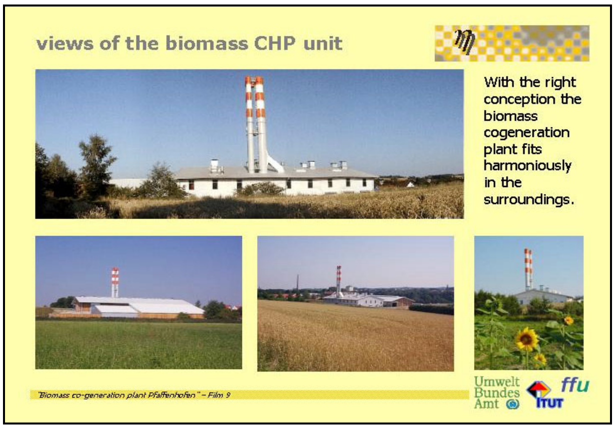


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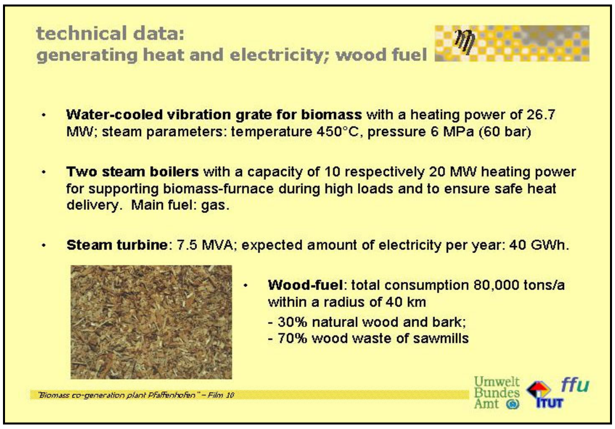


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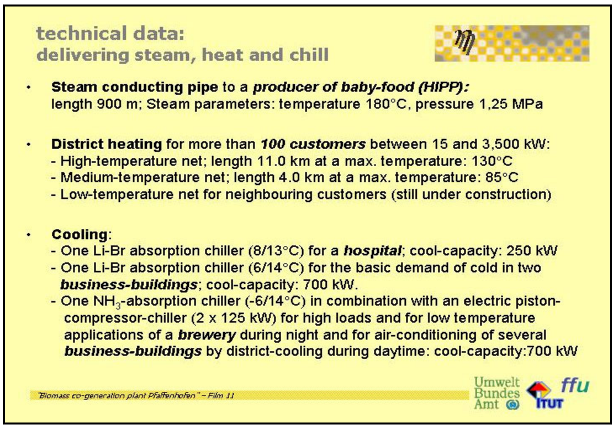


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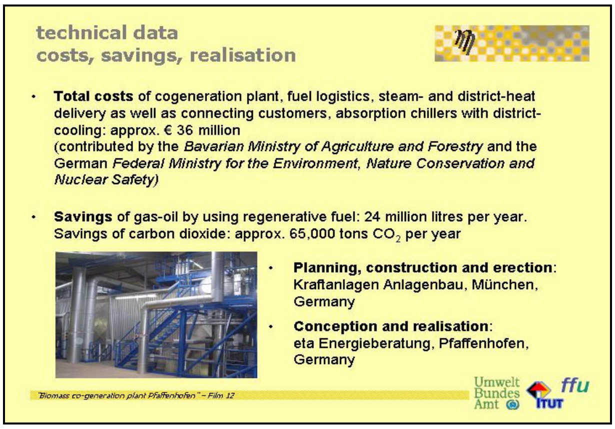


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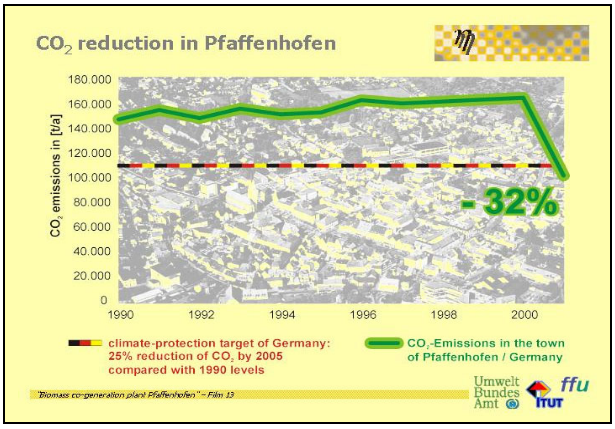


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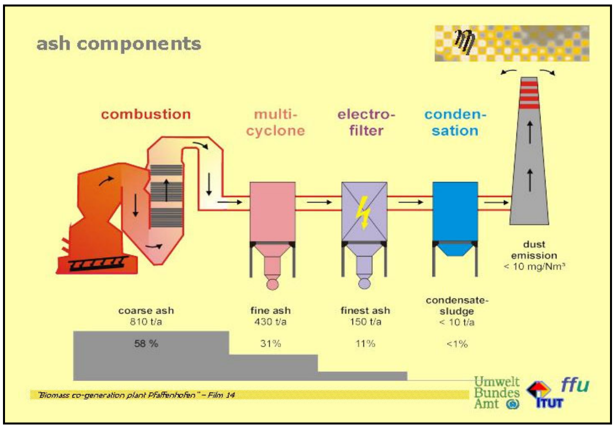


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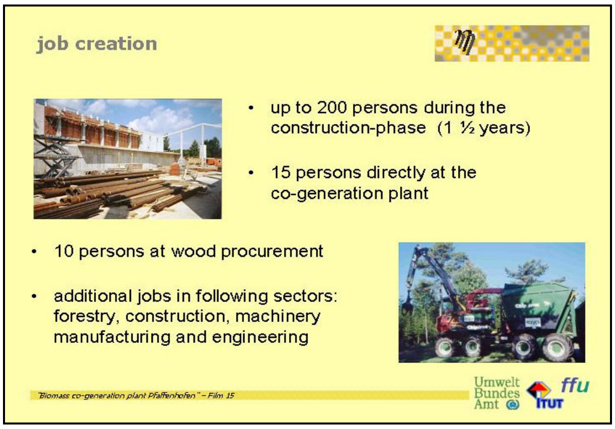


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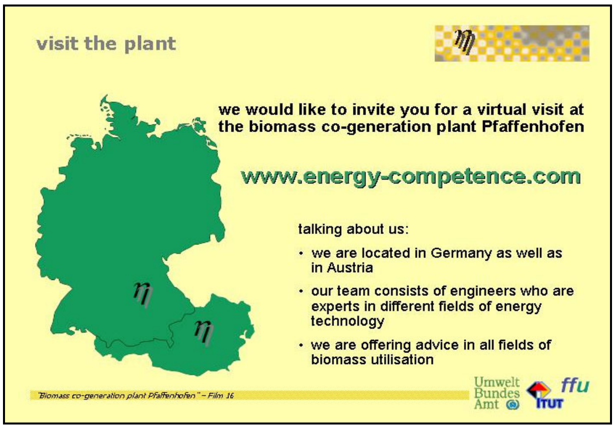


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# Biomass Success Stories in Romania

**Cristian Tantareanu**
**Joan Braga**
**Roxana Funduca**

Center for Promotion of Clean and Efficient Energy in Romania-ENERO

In Romania, today some 740 thousand cubic meters of wood waste are in no way valorized and are simply thrown away, polluting the environment. In the last years, several pilot applications were promoted in order to demonstrate how to use the wood waste for heating purposes in domestic DH systems or for industrial purposes. The advantages of such technologies are evident:

- Energy conservation;
- Reduction of environment pollution due to the dumping of this residue to the rivers;
- Reduction of costs for heat generation in public buildings and dwellings.

The main barrier is the quite high capital cost of the projects. This barrier, at least for the first demonstrations, was overcome by attracting external funds, mainly from European programs.

Three such demonstrative applications are presented:

- the retrofitting of the old thermal station in Câmpeni town;
- the station supply with heat and hot water for a group of blocks of flats.
- new thermal station for DH in the Tasca commune.

ENERO CTI Capacity Building Seminar, December 2001, Ostritz, Germany

# BIOMASS SUCCESS STORIES IN ROMANIA

Cristian Tantareanu
Ioan Braga
Roxana Funduca

ENERO- Center for Promotion of Clean and Efficient Energy in Romania-

Slide 1

ENERO CTI Capacity Building Seminar, December 2001, Ostritz, Germany

## The problem:

Some 740 thousand cubic meters of wood waste, resulting from the timber processing industry, are in no way valorized in Romania and are simply thrown away, polluting the environment.

In the same areas, the heating for industrial/domestic purposes is:
- insufficient,
- uses fossil fuels, expensive and polluting
- the equipment is obsolete and need replacement

Slide 2

ENERO CTI Capacity Building Seminar, December 2001, Ostritz, Germany

View on the Aries Valley, an area were some 54,000 tonnes of sawdust waste wood are available yearly

Slide 3

ENERO CTI Capacity Building Seminar, December 2001, Ostritz, Germany

## Possible solution:

Introducing innovative technology, using wood waste as fuel for district heating systems

Barriers:
- high capital costs
- the heat costs are still subsidized
- need of qualified maintenance
- low cost of natural gas, where available
- no experience and therefore no confidence

Overcoming the barriers: Attracting external funds to build successful applications, in carefully selected sites

Slide 4

ENERO CTI Capacity Building Seminar, December 2001, Ostritz, Germany

## First success cases:

- the retrofitting of the old thermal station in the Câmpeni town DH system
- new thermal station for DH in the Tasca commune
- new thermal station for industrial heating in the Tarcau commune

Slide 5

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## Retrofitting the thermal station in Câmpeni

Slide 6

ENERO CTI Capacity Building Seminar, December 2001, Ostritz, Germany

## The project:

-two boilers in the local DH thermal station using liquid fossil fuels were replaced with boilers running on sawdust, with calorific power of 2,100 kcal/kg;

-the operation is fully automatic;

- the majority of the capital costs come from PHARE funds : 100,000 Euro from 120,000 Euro total;

-commissioning in December 1998

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ENERO CTI Capacity Building Seminar, December 2001, Ostritz, Germany

## Results:

- the thermal output is now 4,087 Gcal/year, twice the previous production;
- consumption of about 2,345 tonnes sawdust/year, otherwise dumped;
-reduction of $CO_2$ emissions by some 1,000 t/year, in comparison with previous boilers

## Replication potential:

- In the same area, there are some 54,000 tones/year wood residues resulting from wood processing;
- with other two similar boilers, almost all the heat need of the Campeni DH system may be covered;

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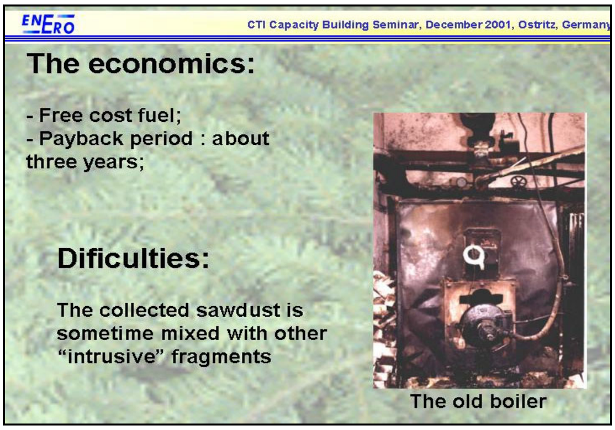


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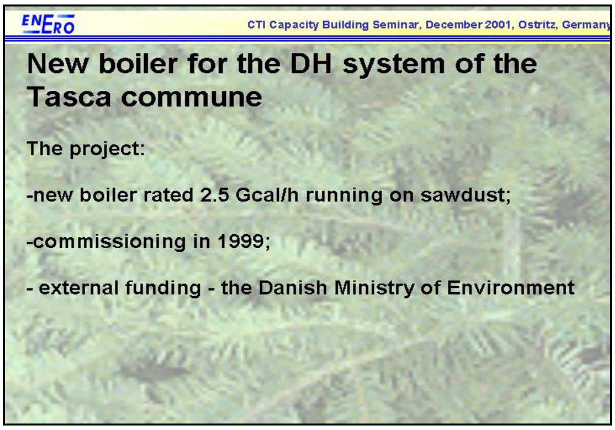


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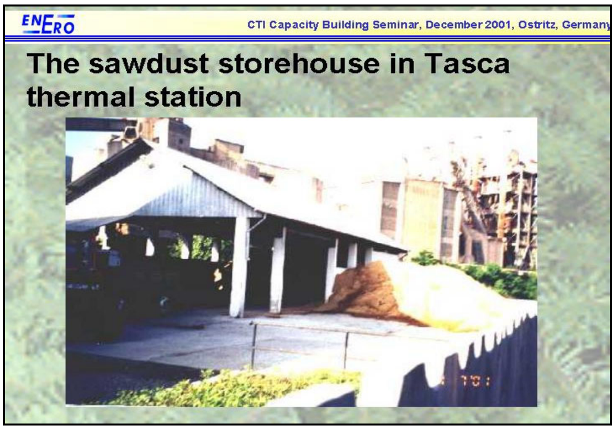


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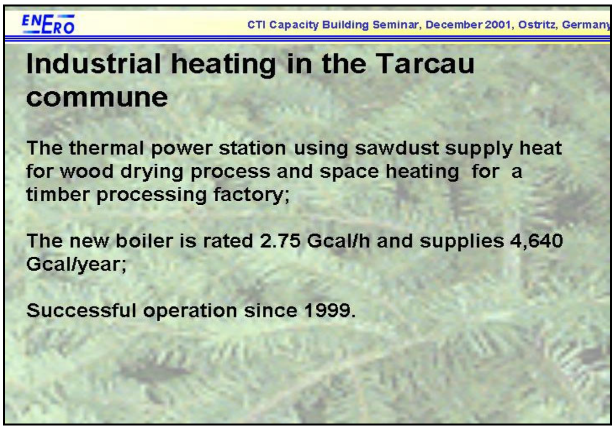


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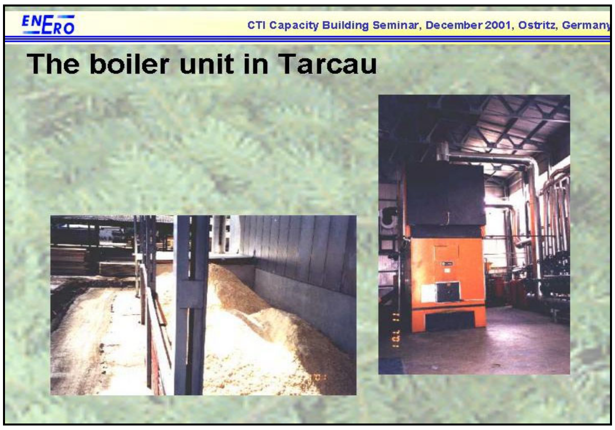


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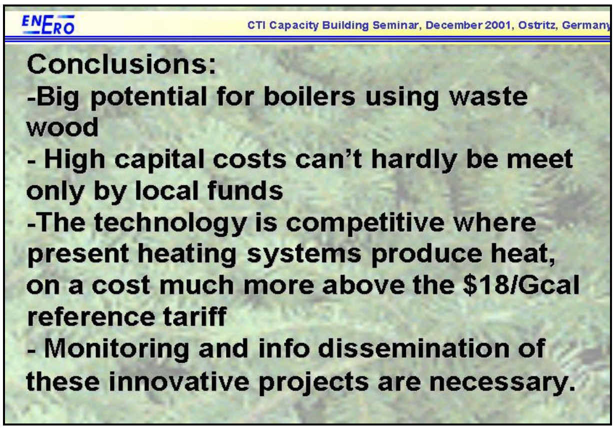


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Slide 15

# Best Practice: The Case of Biomass Utilization

## Combustion of sunflower husks in industrial steam generators

**Violetta Groseva**

Sofia Energy Centre / OPET Bulgaria

**Introduction**

The Bulgarian energy balance shows that more than 70% of the energy consumption is based on imported fuels. The rest is from local energy resources, which are low grade coal and RES (limited hydropower, solar energy, and biomass). Biomass overall theoretical potential varies between 3.5 and 5 million toe/year. The economical potential is assessed to about 0.7-0.8 million toe/year.

The use of agricultural wastes for energy production is an important RES. Traditionally most of these wastes have been either left to decompose naturally or removed and spread directly on land where they have some benefits as a fertilizer. For some wastes an increasingly important alternative is to recover the energy present in these wastes by using them as RES. This is the case of sunflower husks.

During the sunflower oil production, and depending on the technology used, sufficient quantities of sunflower husks are one of the by-products, which can be an important energy resource for the enterprise. The technologies for the husks utilization as a fuel are mainly combustion in grate boiler or refurbished one with pseudo-fluidized bed combustion.

The technical solution designed by Energoconsult company consists of incorporating a special cyclone chamber with highly efficient operation and small size and provides a feasible solution for refurbishment of existing in these enterprises steam generators producing steam over 5 t/h and using liquid fuel and/or gas.

**Installation**

The project has been implemented in 1999 via retrofitting of existing boilers (two steam generators PKM - 6.5, burning oil from Shabla deposits) in the steam station of Papas Oil enterprise – Balchik branch.

Pneumatically, the sunflower husks are fed into the bunkers for fuel storage (each with volume 34 м3) of the corresponding boiler. This volume provides for 6 hours of operation. Below the bunkers the feeding system is situated leading to the cyclone chamber. The husk quantities are controlled via multi-camera counter whose revolutions are regulated by the frequency. The transportation of the husks to the burner is done via air ventilator. The length of the cylinder part of the cyclone chamber is 1,500 mm, the inner diameter – 900 mm. The furnace is insulated with fireproof bricks and is cooled via separate water flow. The cooling of the connection between the cyclone chamber and the furnace of the steam generator is integrated within the water shell of the boiler. The air coming into the furnace is primary (through the husks burner); secondary - above the burner and tertiary - through the heavy fuel oil burner. At the exit of the steam generator, a flue gas ventilator is mounted to transmit the gases to a cyclone dust cleaner.

**Operation results**

The average heat value of liquid fuel is 9 445 kcal/kg and that of the sunflower husks vary between 3 485 kcal/kg and 3 750 kcal/kg, so it has been proved 68,78 % of oil savings at an average steam generation of 4,6 t/hour. It must be noted that during the efficiency testing the air temperature varied between -1 °C to +3 °C.

The installation burns simultaneously liquid fuel and sunflower husks. The liquid fuel consumption in nominal regime of operation is 70 – 110 kg/hour and sunflower husks - 900 - 1 200 kg/hour. Unburned liquid fuel (rated towards the husks) is not over 4 – 6 %, and dust emission levels vary between 145 – 160 mg/m3.

Heat surfaces are clean and no dust is observed on the flue gases track.

The counter and the sunflower husks feeding system operate stable, but they are sensitive regarding the purity of the husks. Additives like paper, chips longer than 4 cm and the others result in engorgement of the burner. The solution is a preliminary processing and sifting out the sunflower seed before feeding into the husk room and also designing proper outlets to clean up the track from the feeding fan to the burner.

### Investment

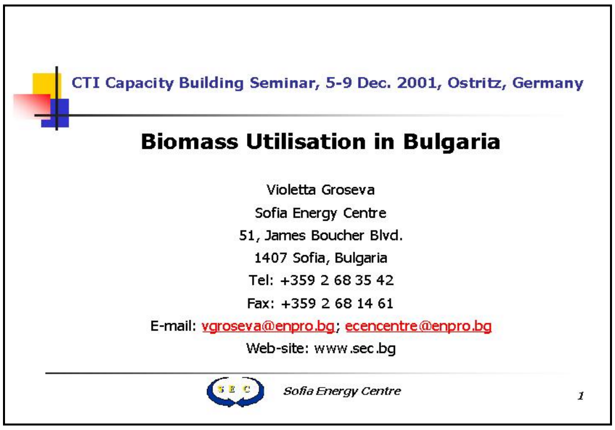
Total investment for both boilers´ refurbishment and renovation, installation, start-up period, a twelve months maintenance guarantee, as well as staff training, etc. amounted to 157,000 USD. It has been calculated that the payback period should be 1 1/2 year at the fixed price of the liquid fuel of 100 €/ton (1999). However, even with the increase of the price of the liquid fuel to 150 - 180 €/ton and depending on the load of the installation, it is considered that the payback period should be nearly 2 campaigns.

### Conclusions

The operation during the first year of this system has proven the capacity and the investment benefits for the proprietor - Papas Oil Ltd. The experience provides the opportunity to improve system components, in respect of changes in the specific reaction surface of the husks and also related with the partial automation of the process management.

From the implementation of the project several conclusions can be drawn. They are valid not only for biomass but for all RES. The following conclusions should be underlined:

- The renewable energy (biomass) in some cases is still more expensive than the consumer price of heat and electricity;
- there are no state funds in Bulgaria for the development of RES (incl. biomass) utilization;
- the Energy and Energy Efficiency Law (1999) treats only generally RES. Renewables are still not considered a priority in legislation and there are no incentives for their utilization;
- decentralization of the state regulation and larger autonomy of the local and regional authorities leads to the development of their natural resources as they see triple dividends: environmental improvements, economic development, and increased employment;
- the biomass utilization as an energy source is a new philosophy in our country and requires a new way of thinking and new approach for development. Joint efforts are necessary, both on the part of state with its regulatory functions, and on the part of the entrepreneurs and financing institutions. Regional and national information campaigns are needed, showing the advantages of biomass utilization for the energy savings and for the environment.

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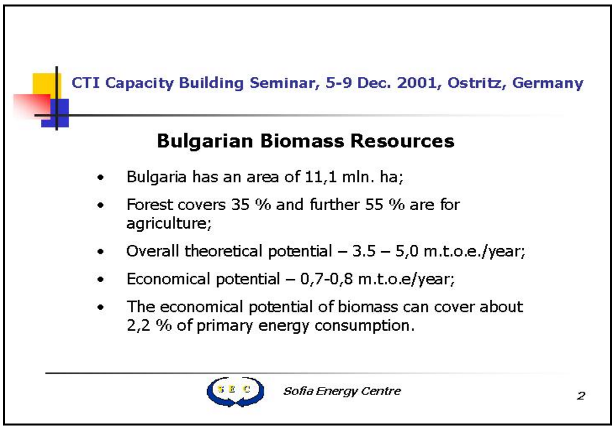


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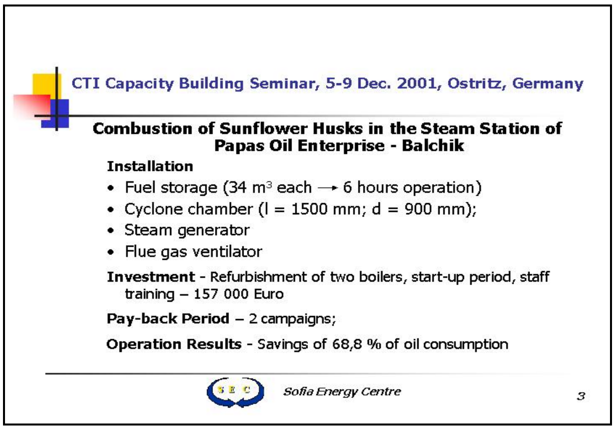


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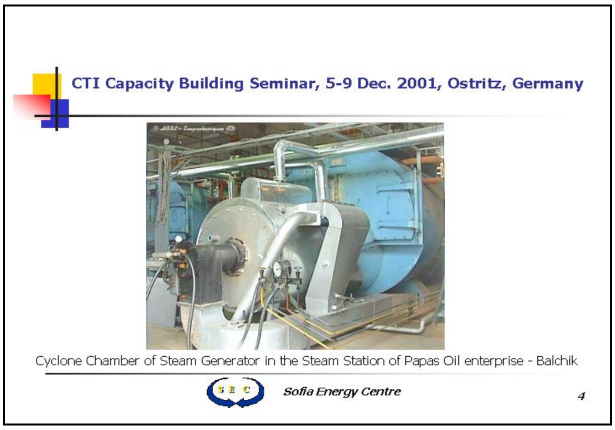


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# Discussant Notes

## Session: Use of Biomass

**Dr. Villu Vares**

Estonian Energy Research Institute / OPET Estonia

Four of five presentations at the session treated prospects and achievements in the use of biomass in East-European countries. In the fifth report the practical experience of realizing a biomass fired CHP plant in Bavaria was analyzed.

In the reports the following bio-fuels were considered:

- wood fuels, inclusive wood chips from forests, wood waste, etc;
- straw;
- organic waste, biogas and landfill gas;
- bio-diesel and bio-ethanol.

The upgraded wood fuels (wood and other biomass pellets and briquettes) and black liquor as a residual product of pulp industry essential for energy purposes were not considered. Problems related to growing energy forests and energy crops were not treated also. Evidently it refers to the fact that in the considered countries (Poland, Romania, Ukraine and Slovenia) the resources of energy biomass have not been exhausted by far and the use of renewables is not expanding with such a speed that finding of new resources becomes essential.

Among all the resources wood fuels are unanimously considered of highest priority while the developments and future expectations in the use of these fuels are the most noteworthy. At the same time some countries evaluate the aggregate potential for straw and biogas production approximately equal to wood fuels (Ukraine, Poland).

One can get an impression from the reports that there is no considerable demand for liquid bio-fuels yet, and creating prerequisites for starting the production of these fuels will still take some time.

The most essential obstacles to the energy use of biomass would be the following:

- relatively low price of fossil fuels;
- substantial need for investments;
- insufficient technical know-how and experience;
- lagged behind technology development;
- unavailability or insufficiency of a renewable energy promotion system;
- insufficient consideration of environmental impact from burning fossil fuels, including the $CO_2$ emissions;
- legal and economic difficulties by trading renewable based electricity to the grid, etc.

In spite of the modest competitiveness level of renewables, the reports and discussion of the biomass session show that the use of biomass is considered to be one of the most perspective applications for renewable energy production. The pilot projects and demo projects do not prove only technological potentials for the use of biomass, but also its economic and environmental expediency.

High cost of equipment and extensive need for investments was noted as a difficulty in the implementation of bio-fuel projects. For reducing the cost, less expensive technological solutions are looked for. Based on the Estonian experience, the discussant can see the following risks.

After Estonia regained independence, wide-scale conversion of DH boilers from fossil fuels (mainly from heavy fuel oil) to wood chips burning started. Major part of projects where efforts have been made to introduce simple and inexpensive technical solutions have proved to be successful. A conclusion has been drawn from this that primitive technical solutions do not provide sufficient reliability of the equipment and as a rule, later reconstruction or readjustment is expensive. Energy generated in boilers switched to wood fuel proves to be more competitive only if the equipment can be peak loaded throughout the year. The higher the boilers output rate is, the smaller the share of investments in the output heat will be.

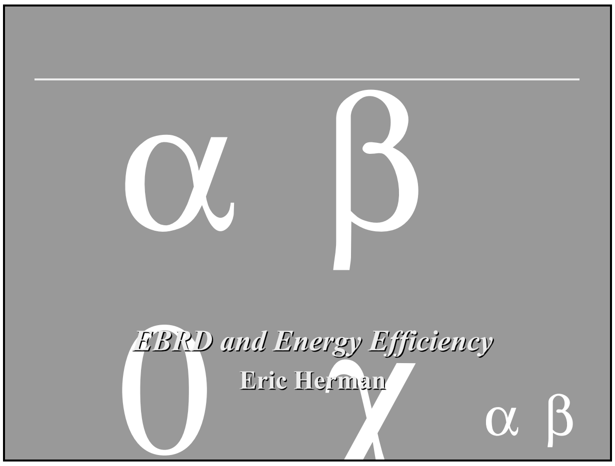
The Estonian experience has shown also that exact copying of technical solutions that have been expedient in other countries is expensive on one hand and could prove to be unsuitable under different conditions on the other hand. In Estonia lowering of the price on bio-fuels could be achieved by combining international and domestic technologies while most of the equipment was manufactured in the country. In several cases further close co-operation between Estonian and foreign companies (Sweden, Finland) developed from these projects. Within the further co-operation several wood chip based boiler houses operate in third countries (Latvia, Lithuania, Russia).

In the session presentations the state aid to bio-fuel projects was not considered directly, however, it appeared from the discussion that in most of East-European countries supporting mechanisms on the governmental level for expanding the use of bio-fuels , in particular in CHP production, would be substantial. In the following workshops and conferences on the use of bio-fuels and renewables it would evidently be expedient to develop a discussion about supporting the use of renewables.

# EBRD and Energy Efficiency

**Eric Herman**

European Bank for Reconstruction and Development, London

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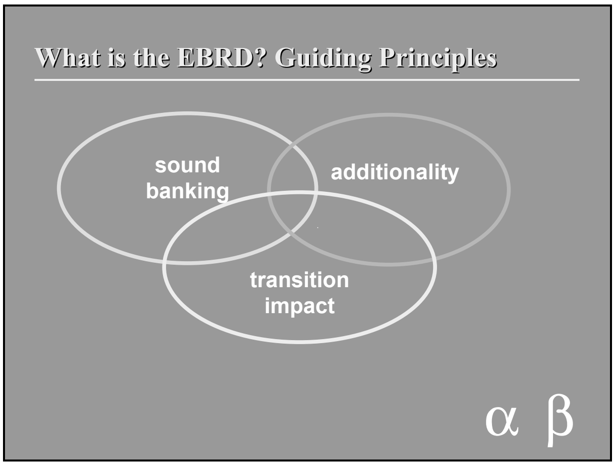


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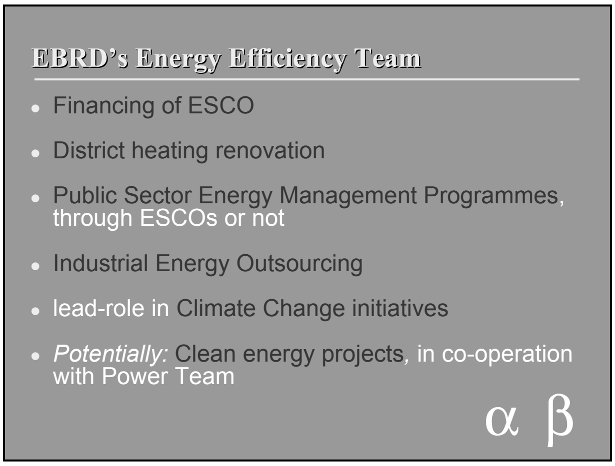


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### Key Issues and Challenges

- Progress towards energy efficiency has been too slow: energy intensities still way above EU average
- Key reasons:
  - restructuring of (still largely state-owned) energy-intensive industries is still ongoing
  - subsidisation of energy prices in various guises is still endemic
  - barriers to bankability/investments still high
- This presentation focuses on ESCOs and district heating

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### ESCOs: Achievements to date (1)

- The EBRD is currently financing 11 private ESCOs (all funded under Multi-Project Facilities involving large sponsors) and one state-owned ESCO…
- + 1 ESCO indirectly through its Energy Efficiency &Emissions Reduction Fund: *EETEK* in Hungary
- ... in 7 countries: Hungary, Poland, Czech Republic, Slovakia, Lithuania, Romania, Ukraine

Slide 8

### ESCOs: Achievements to date (2)

- However…
  - Market penetration still too modest
  - New project opportunities are fewer
  - Most of EBRD-funded ESCOs have under-performed their business plans
  - Few international private players have entered the market
  - Impediments and barriers are described in following slide

Slide 9

### ESCOs: Key Issues

- **Scepticism** - many potential clients don't believe that there can be a win-win scenario;
- **Control** - especially in the public sector, clients are unwilling to involve the private sector;
- **Profit** - municipal governments frequently object to allowing the private sector to make a reasonable profit;
- **Energy costs** - regulation and subsidies sometimes result in energy costs that are too low or that do not allow the ESCO to retain the benefits (e.g DH in Poland); and
- **Products** - standard ESCO offerings may not fit the exact needs of the prospective clients.

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### EBRD's dedicated ESCO product (1)

Dedicated ESCO for public sector entities

- Premise: Public entities are large consumers of energy and not incentivised to reduce energy consumption
- Concept: select through tender a qualified private ESCO operator to implement a series of investments and management improvement aimed at reducing energy consumption in facilities and buildings
- Economics: Savings should exceed the cost of capital and ESCO overheads over the life of the EPC and surplus savings will accrue to the public entity.

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### EBRD's dedicated ESCO product (2)

- The ESCO operator would set up a Special Purpose Company (SPC) or use an existing ESCO, and raise the financing on its balance sheet
- **Benefits** to public entity:
  - Reduced energy consumption and hence budgetary expenditure
  - Off-budget financing
  - Demonstration effect in the long run of private sector operator involvement.

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## EBRD's dedicated ESCO product (3)

- Pre-requisites:
  - Large public entity with significant energy budget and large potential for cost-effective savings
  - Energy is economically priced
  - Public entity pays its bills on time, in full and in cash
  - Acceptance of private sector involvement
  - No legal obstacles to Energy Saving Performance Contracting

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Slide 13

## EBRD's dedicated ESCO product (4)

- Role of EBRD is three-fold:
  - Help prepare and mobilise grant funding for preliminary assessment
  - Help prepare and mobilise grant funding for assistance to public entity in conducting the tender for the selection of a qualified ESCO operator
  - Finance the project company (either SPC or existing ESCO) through a direct limited recourse loan or a guarantee of payment by public entity

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Slide 14

## EBRD's dedicated ESCO product (5)

Examples:

- City of Lodz (Poland)
- Ministry of Interior (Czech Republic)

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Slide 15

## District Heating: Sector Overview (1)

- Market penetration for DH is high in the region: 40% in CEE and up to 60% in the CIS. Negligible in most Western countries except Scandinavia (up to 50%) and Germany (10%)
- Public ownership and management remain prevalent (fewer instances of PSP than in water sector)
- Economic rationale for DH still robust in densely populated urban areas: existing heat networks normally offer least cost investment solutions over alternatives
- DH has peaked, but vast investment needs mostly for rehabilitation and "commercialisation" investments

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Slide 16

## District Heating: Sector Overview (2)

- Scope for energy savings and hence air pollution and GHG emissions reduction is large
- Lack of investment capital due to cash-strapped public budgets and below-cost recovery tariffs
- Regulatory framework is evolving and often contains barriers to investment:
  - cost-plus tariff-setting methodology
  - *ad hoc* tariff approval mechanisms
  - unclear ownership title on assets (e.g. substations)
  - legal framework for PPP still in infancy

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## District Heating: Key Financing Issues

- Overriding issue is bankability or the lack of it!
  - Tariffs below cost-recovery in many countries (all CIS)
  - Subsidies not fully/timely paid by central/local government budgets
  - Poor revenue and cash collection
  - Affordability of tariffs is key constraint!
- Upshot is that projects need significant grant or soft co-financing to be bankable or of a meaningful size ...but ISPA funds not available for District Heating!

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Slide 18

## District Heating: EBRD's approach

- Focus on investments that significantly reduce energy consumption
  - CHP - HOB
  - modern compact customer sub-stations
  - pre-insulated pipe
  - automated controls and (block) metering
- Emphasis on reforms
  - tariff-setting & subsidies
  - commercialisation
  - EBRD supports changes to regulatory framework

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## District Heating: EBRD's approach

- Optimise private sector participation: pragmatic and tailor-made approach
- EBRD can provide financing to public or private entities alike: municipality; DH utility; special purpose company; concessionaire, etc…
- EBRD seeks increasingly to finance on a *non sovereign* basis while sovereign guarantees remain necessary in some countries...

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Slide 20

## District Heating: EBRD's Financing Panoply

- EBRD can finance up to 35% of a company's long term capitalisation
  - no formal ceiling for sovereign operations
  - ceiling can be exceeded if project is not "greenfield"
- EBRD can provide senior, junior or convertible debt, or risk, portage or quasi-equity, or guarantees
- Loan tenor of up to 15 years and 4 year grace

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Slide 21

## District Heating: EBRD's Financing Panoply

- Local currency funding already possible in Poland and Czech Republic
- Loan margin based on country & project risk (maximum 1% if sovereign guaranteed)
- EBRD can mobilise technical assistance grants for project preparation/institutional support

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Slide 22

## District Heating Pipeline

- Romania: concessions in 5 cities
- Lithuania: Siauliai, Klaippeda, Vilnius?
- Estonia: Tallinn?
- Bosnia: Sarajevo
- Russia: Surgut; St Petersburg, Kaliningrad, etc.
- FRY: Belgrade (signed 27 July)
- Uzbekistan: Tashkent, Andijan (signed 12 Nov.)
- Poland: Szczecin DH privatisation

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Slide 23

## Why work with EBRD?

- Country knowledge
- Unique expertise in energy efficiency/district heating
- Product flexibility
- Risk division

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Slide 24

# Financial Tools for CEE/FSU Countries

**Georg Kraft**

Kreditanstalt für Wiederaufbau, Germany

| **KfW** | Established by law in 1948<br>Seat: Frankfurt a. M. |
|---|---|
| Liable Equity | 5,9 billion |
| Balance-Sheet total | 223 billion (year 2000) |
| Employees | 2,032 (year 2000) |

## KfW-financial tools for CEE/FSU countries

- Investment Finance
  - Environmental protection Program - outside Germany
  - SME program for investments in trade and industry outside Germany
- Cooperation with development banks in CEE + FSU
- Export and project finance
- Financial cooperation with developing countries and countries with economies in transition

## KfW-investment finance: Environmental protection program

| | |
|---|---|
| Aim | To reduce and avoid emissions,<br>save energy in production processes,<br>promote renewable energies |
| Target group | Manufacturing industry |
| Eligible Investments | Corporate investments that help improve the environmental situation |
| Focus | Integrated environmental protection |

## KfW-investment finance: Environmental protection program outside Germany

Investments are eligible for funding

- in regions near the German border if such projects contribute to improving the environment in Germany
- in other countries if the investment is undertaken by a German enterprise

## KfW-investment finance: SME program for investments in trade and industry outside Germany

| | |
|---|---|
| Aim | Long term financing of investments outside Germany |
| Target group | German SME incl. their joint ventures and affiliates outside Germany |

## KfW-investment finance: Cooperation with development banks in CEE/FSU countries

- Joint development of credit programs
- Refinancing of credits to local SME
- Advice and refinancing of investment programs (e.g. infrastructure, environment etc.)

## KfW-export and project finance

General export and project finance:
- Industry

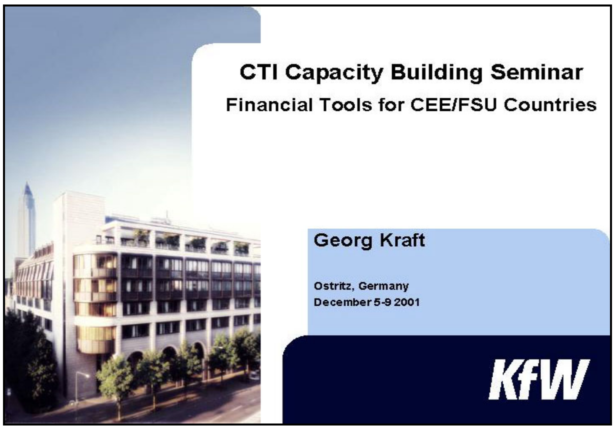
Energy and environmental technology
- Telecommunications
- Raw materials extraction

Export and project finance transport sector:
- Shipping
- Aviation
- Land-based transport
- Air and seaports

## KfW-financial cooperation with developing countries and countries with economies in transition

- concessional loans
- credit at market conditions
- grants for special purposes (i.e. environmental)

Guiding principle: Cooperation with governments
- Developing country status
- TRANSFORM Program

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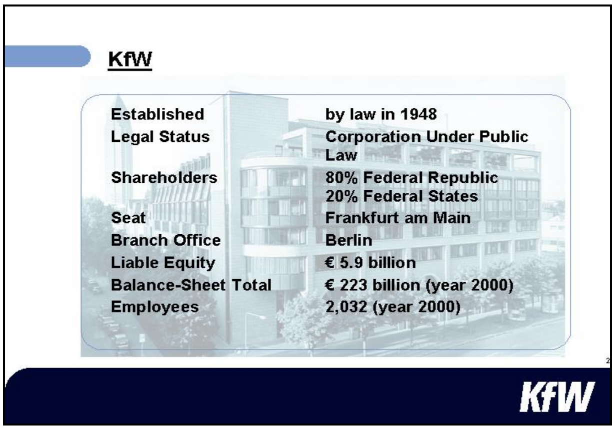


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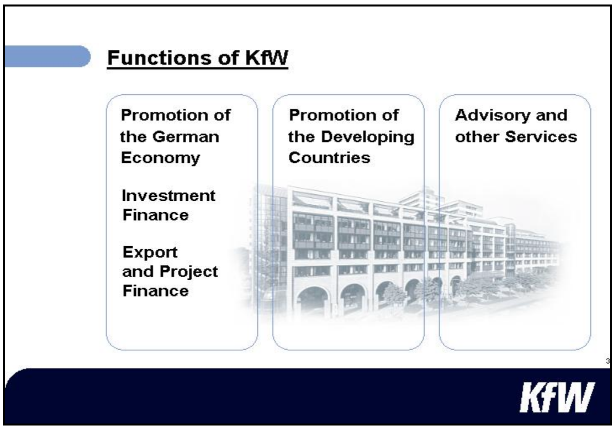


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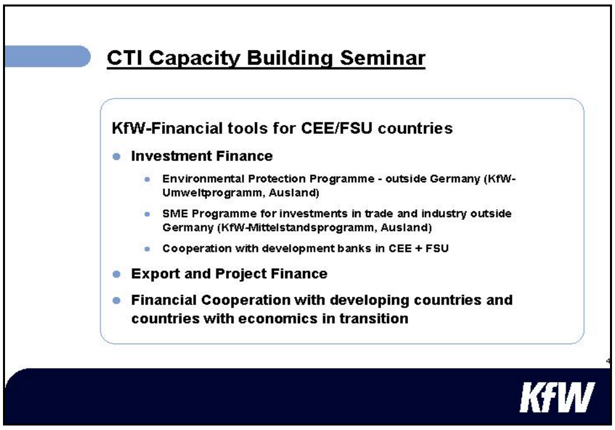


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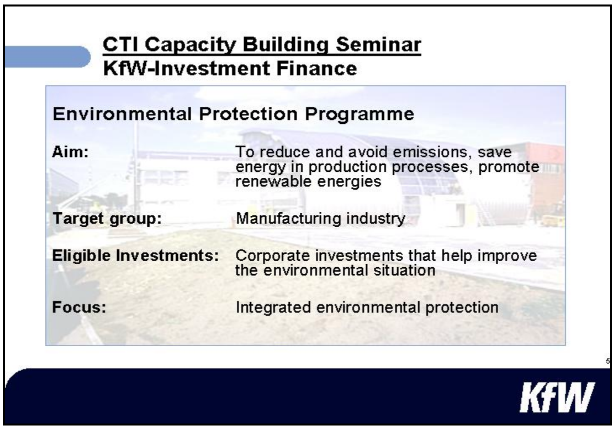


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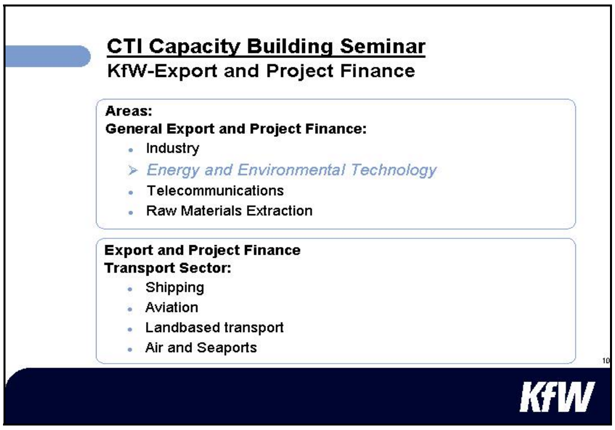


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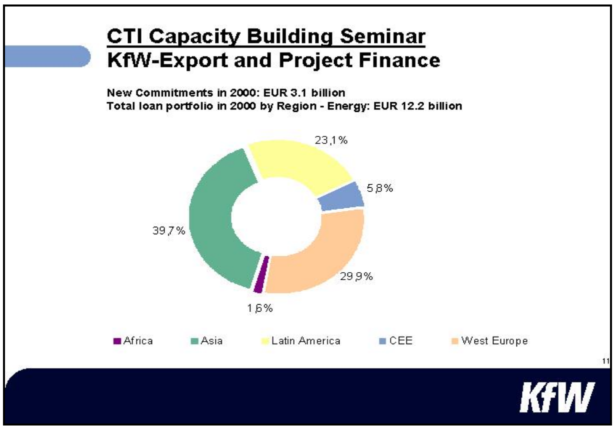


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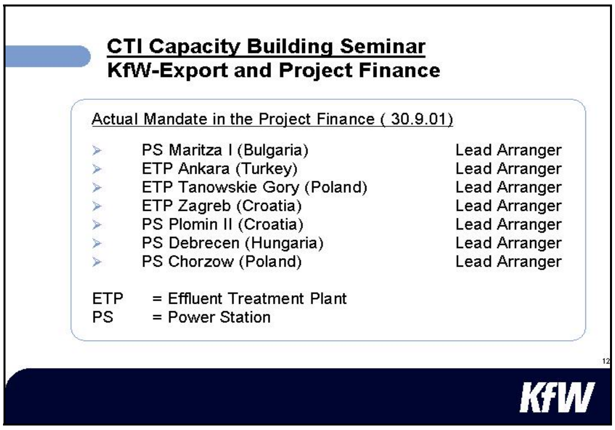


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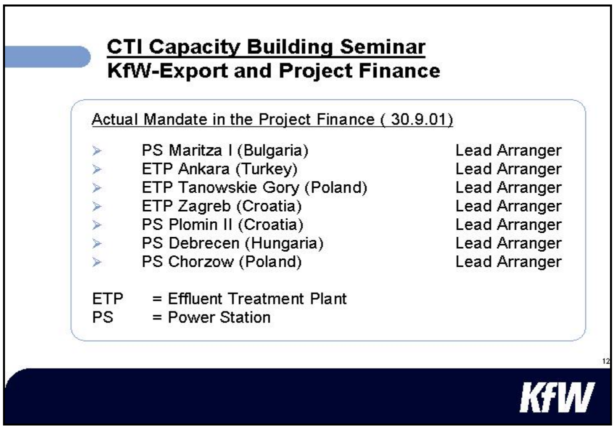


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Slide 14

# Co-Generation and Energy Supply - The Success Story of the Netherlands

**Gert-Jan Bakker**

COGEN, The Netherlands


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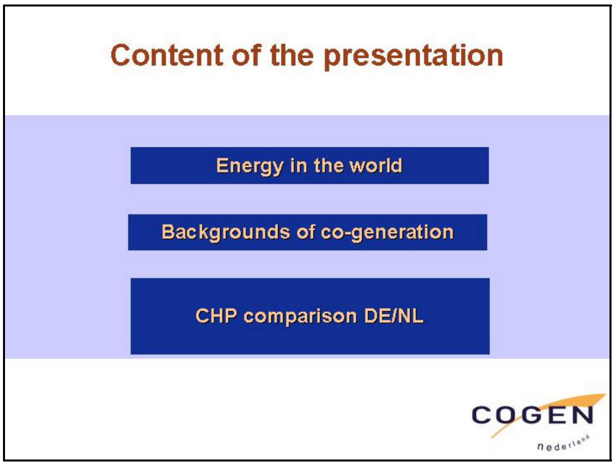


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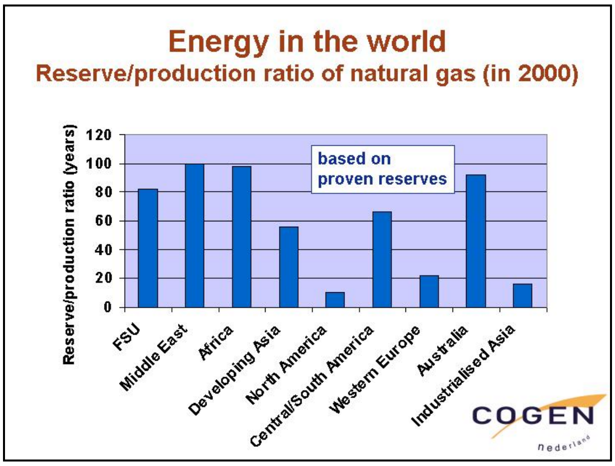


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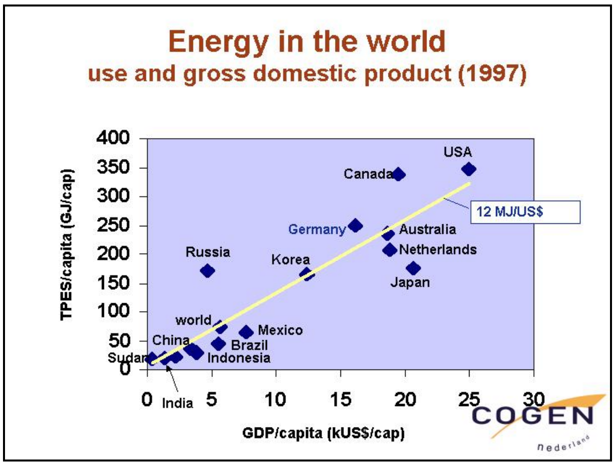


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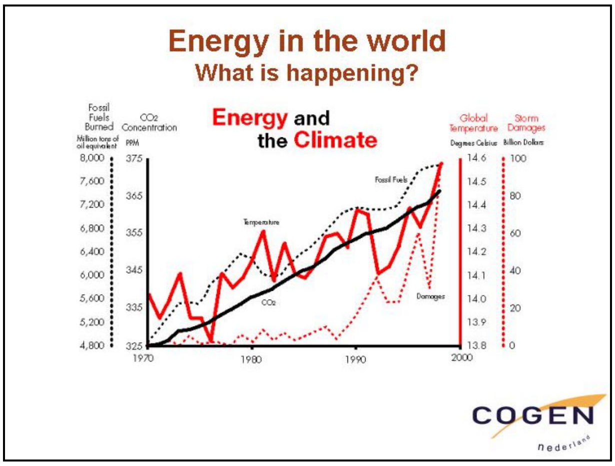


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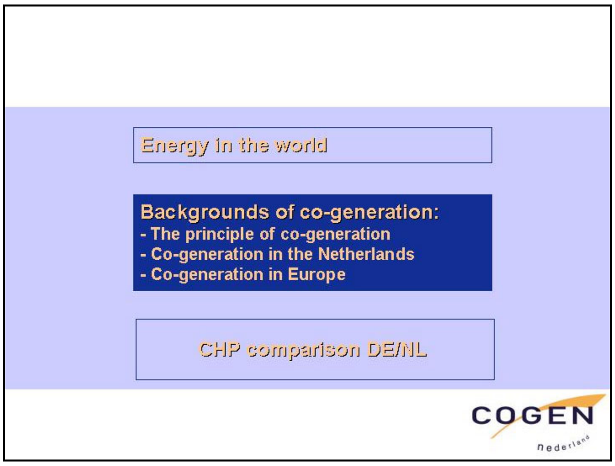


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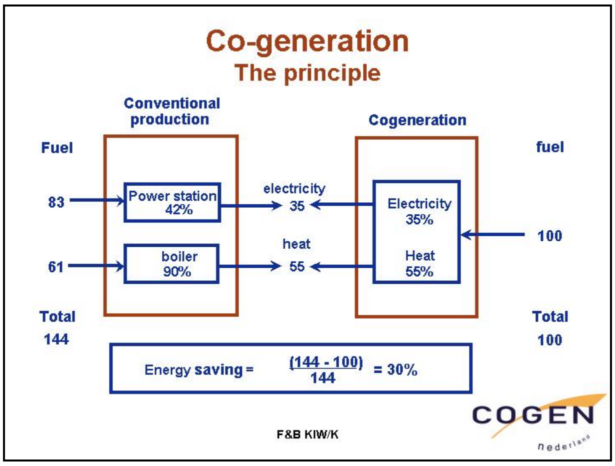


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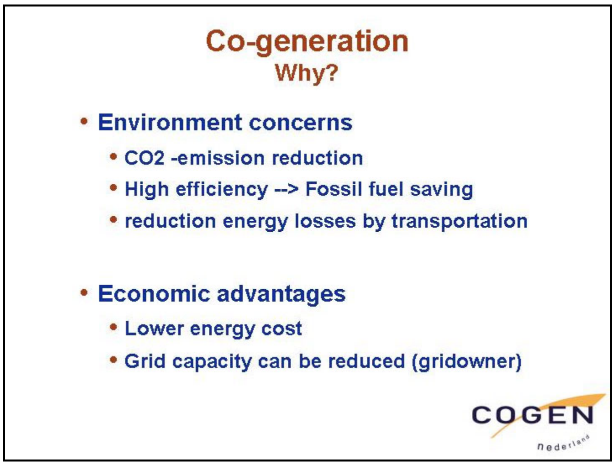


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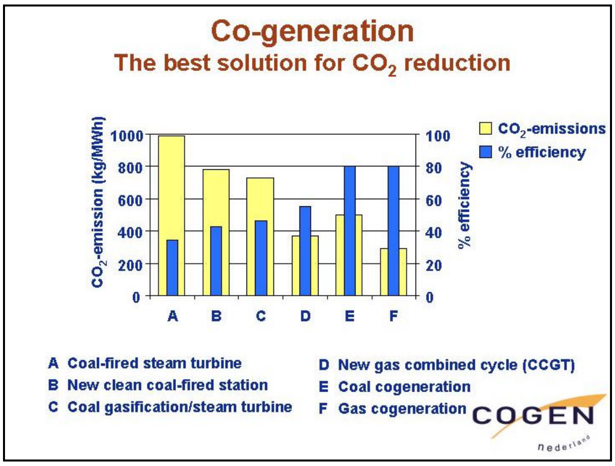


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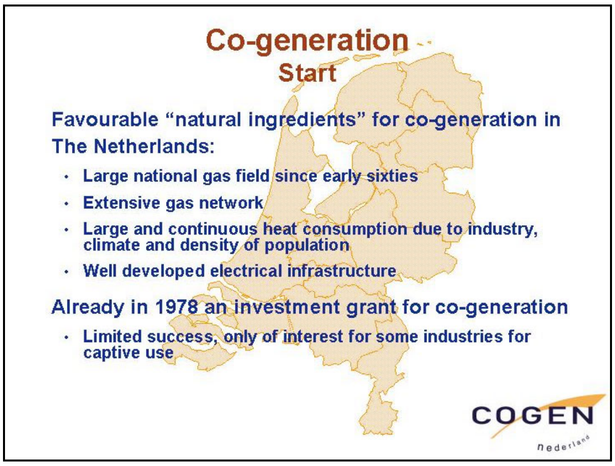


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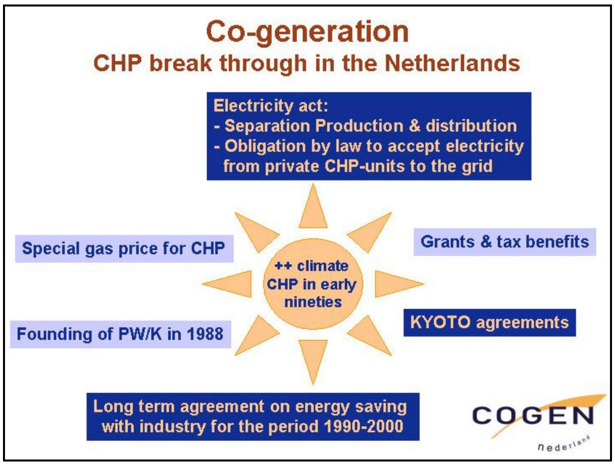


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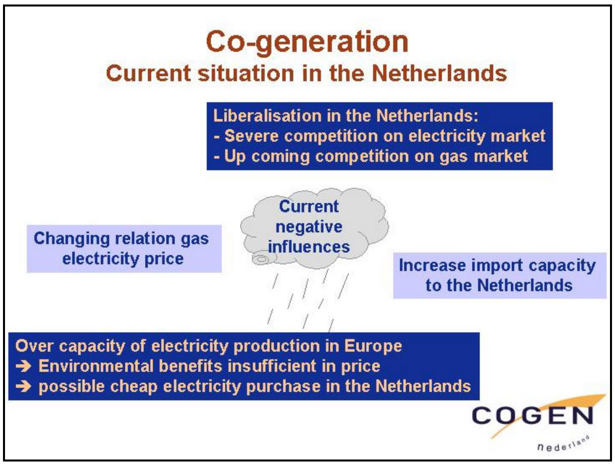


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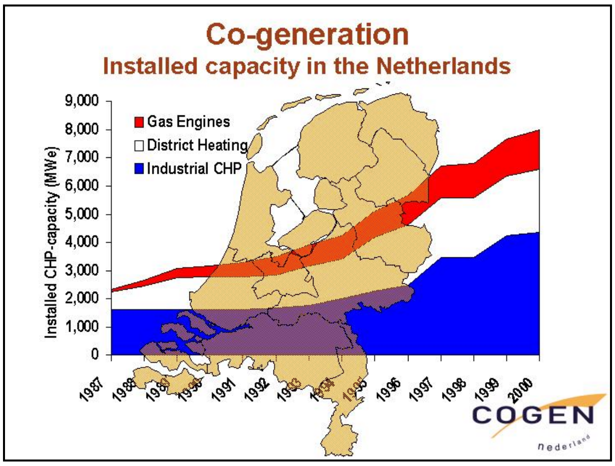


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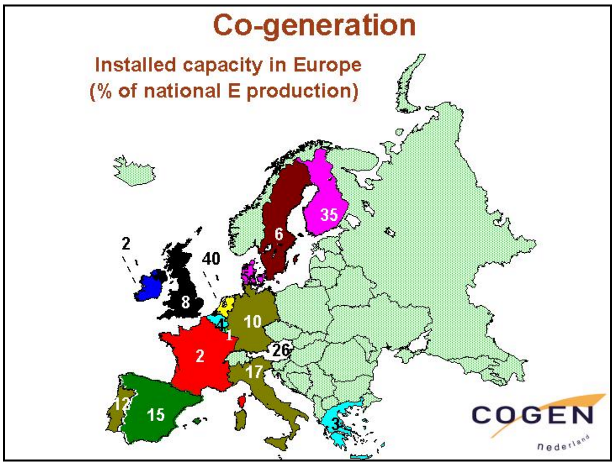


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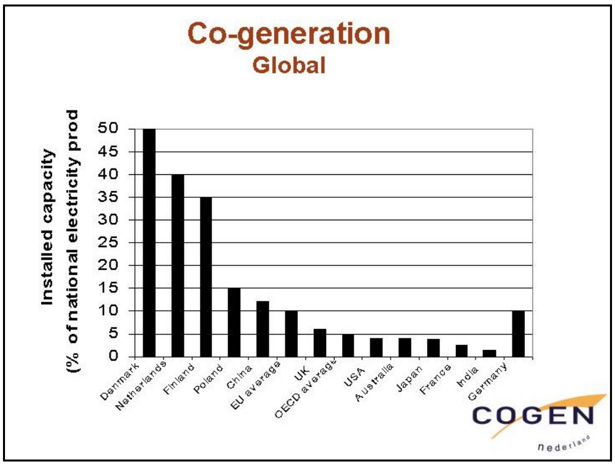


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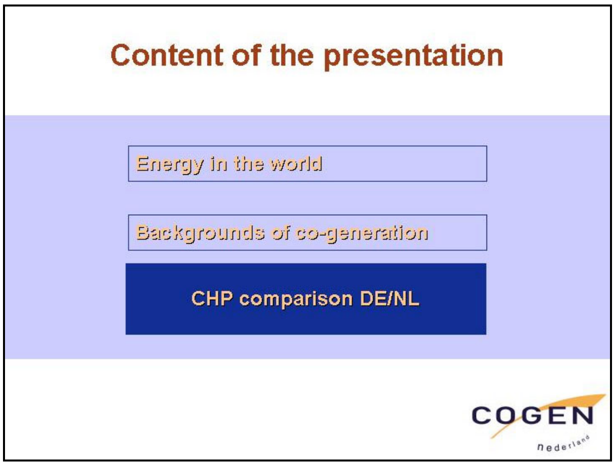


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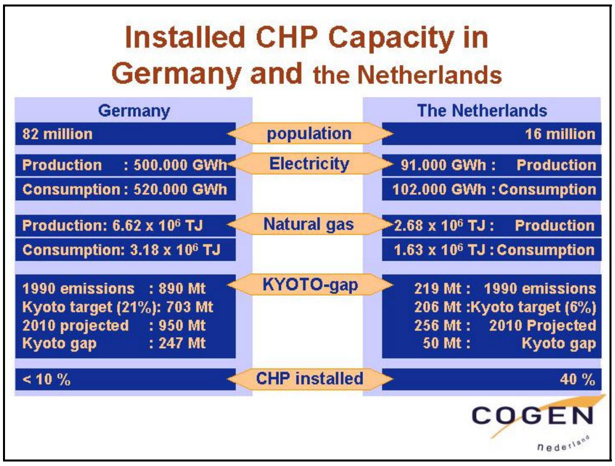


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# CHP Policy in Germany

**Dr. Hans-Joachim Ziesing**

Deutsches Institut für Wirtschaftsforschung, Berlin

In all relevant cases CHP plants are a very appropriate technique to improve energy efficiency as well as to reduce greenhouse gas emissions. Insofar CHP has to be a substantial element of each climate protection policy.

In the past CHP in Germany was supported mainly by subsidies for the expansion of district heating projects. So we had two investment programs in the 70th and 80th in West Germany and the Federal/Länder district heating modernization program for the new Federal in the 90th. At present the electricity production from CHP is about 50 TWh or roughly 10% of the total electricity production in Germany. Public utilities as well as industrial auto-producers contribute approximately one half each. The total connecting load of the district heating supply is 57 GW, and 79% of the heat comes from CHP production. And total district heating accounts for nearly 7% of the final energy consumption in the residential and service sectors.

With the liberalization of the electricity market in Germany, legally starting in the spring of 1998, there had been a fundamental change in the general conditions for CHP also. In consequence of the liberalization the electricity prices have decreased significantly. Together with rising decreased significantly. Together with rising prices for input fuels this affected the competitiveness of the CHP plants. Due to economical reasons some plants already had been shut down. To stop a further decline a law was passed on 18 May 2000 concerning the protection of electricity generation from existing CHP plants (the so-called "KWK-Gesetz" or "CHP law"). This law comprises mainly regulations concerning the remuneration of electricity to the grid.

This law will be replaced by a regulation to protect the existing plants as well as the modernization of older CHP plants. Primarily it was decided by the German Government to realize a quota system with tradeable certificates for cogeneration and a target of doubling the CHP electricity production by 2010. Due to a very effective opposition mainly of the big electricity companies this plan failed. Instead of such a quota system now a combination of a voluntary agreement and a regulation by law will be implemented with the target to reduce $CO_2$ emissions by 23 million tons in 2010 with the help of CHP.

The steps of the CHP policy in Germany will be discussed in general and the final decisions will be illustrated in detail

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# CHP policy in Germany

**Dr. Hans-Joachim Ziesing**
Deutsches Institut für Wirtschaftsforschung, Berlin
(German Institute for Economic Research)

CTI Capacity Building Seminar for CEE/FSU Countries
Climate Technology and Energy Efficiency
Disseminating „Best practice" Experience"
December 5-9, 2001 Ostritz, Germany

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## OUTLINE OF TALK

- The present status of CHP
- CHP policy in Germany in the past
- Impacts of liberalisation on CHP plants
- CHP policy within the climate protection strategy of the German government
- Different regulations to promote CHP
- Agreement between industry and government (status: June 2001)
- Law to protect the existence and modernisation of CHP plants (status: August 2001)

Slide 2

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## District heating's share in Germany, 1990-2000

| | 1990 | 1995 | 2000 |
|---|---|---|---|
| Final energy consumption | 4,0 | 3,9 | 3,6 |
| Services | 7,5 | 8,2 | 7,5 |
| Residential | 6,8 | 6,4 | 6,2 |
| Industry | 3,4 | 2,8 | 2,5 |

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## The status of district heating systems in Germany 1999

| | | |
|---|---|---|
| Companies | n° | 226 |
| Grid length | km | 17,949 |
| Substations | n° | 306,414 |
| Connecting load | MW | 57,382 |
| Delivery to grid | TJ | 331,370 |
| from CHP stations | % | 79 |
| Electricity from CHP | GWh | 33,249 |
| from own plants | GWh | 28,151 |
| installed capacity | MW | 10,675 |
| deliveries from external CHP | GWh | 5,098 |
| source: AGFW. | | |

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## Capacity and electricity production by industrial auto-producers in Germany, 2000

| | MW | GWh |
|---|---|---|
| Steam: total beckpressure turbine | 4124 | 14892 |
| Steam: condensing turbine with heat extraction | 2694 | 12383 |
| Steam: condensing turbine | 2999 | 14113 |
| Gas turbine with heat recovery | 1456 | 8160 |
| Internal combustion engine | 259 | 529 |
| Others | 152 | 769 |
| Total | 11684 | 50847 |
| source: Federal Statistical Office | | |

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## CHP electricity production in Germany, 1999

| | TWh |
|---|---|
| District heating | 28.2 |
| Industrial autoproducer | 29.6 |
| Total | 57.8 |
| In % of total electricity production | 10 |

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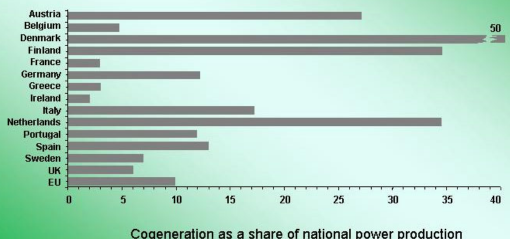
## Market Shares of Cogeneration in Europe

(Source: Cogen Europe)

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## Programs for promoting district heating in Germany ("old" Federal Laender)

- Future Investment Program I (ZIP I), 1977-1981
  0.7 billion DM (subsidising 35 % of investment costs)
  - induced investments (estimated): 3.7 billion DM
  - increase of heat connecting load: 6 000 MW
- Future Investment Program II (ZIP II), 1981-1987
  1.2 billion DM (subsidising 35 % of investment costs)
  - induced investments (estimated): 5.7 billion DM
  (2.5/3.2 billion DM production/ distribution)
  - increase of heat connecting load: 8 000 MW

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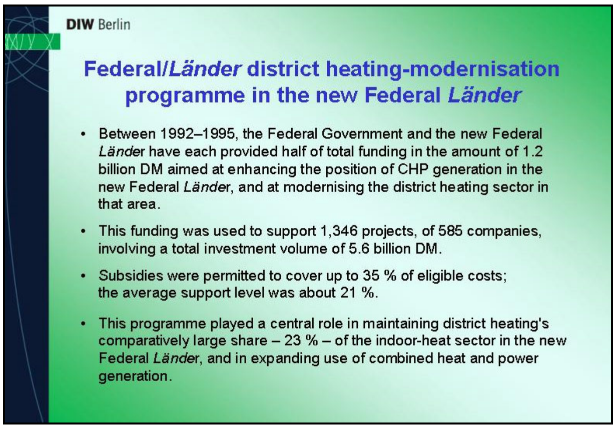


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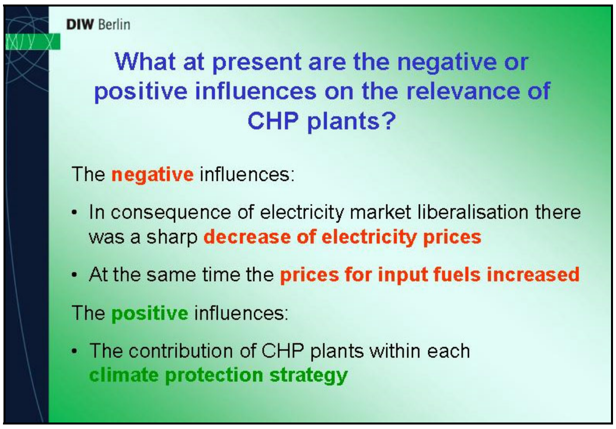


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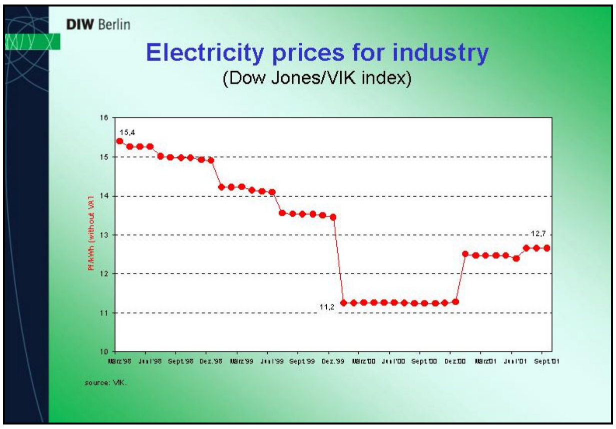


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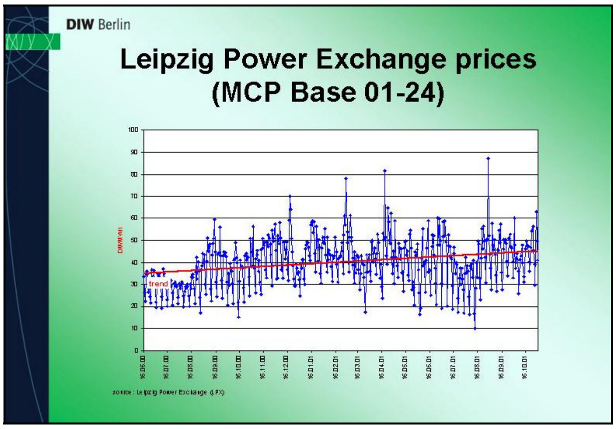


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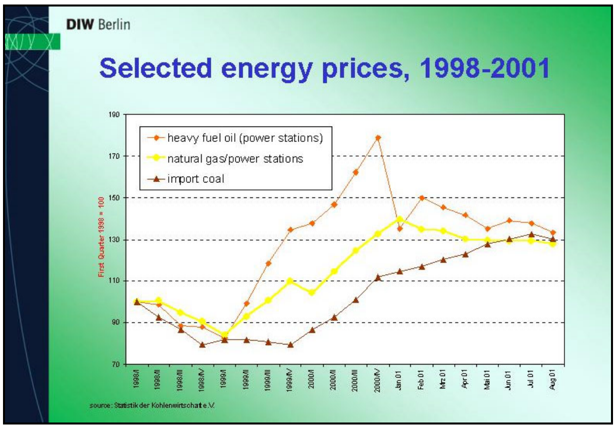


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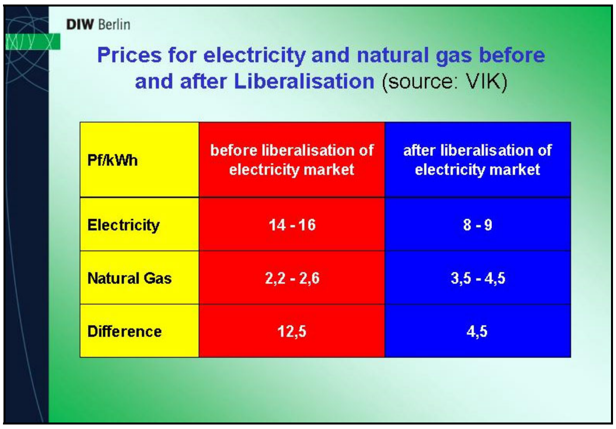


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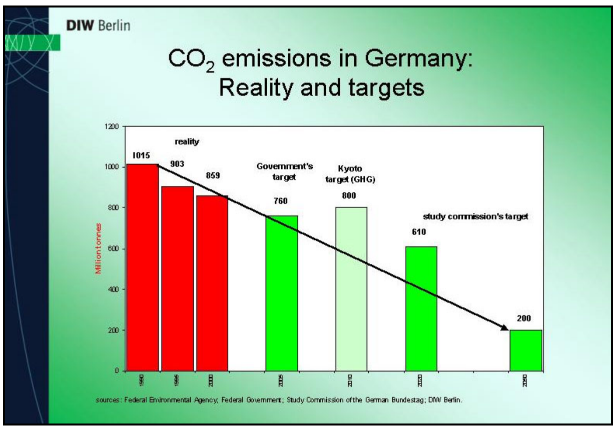


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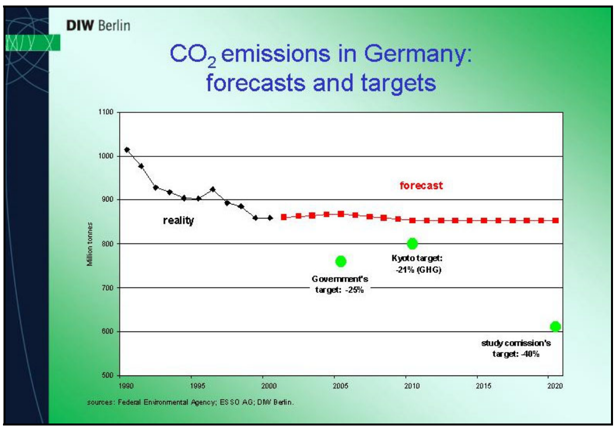


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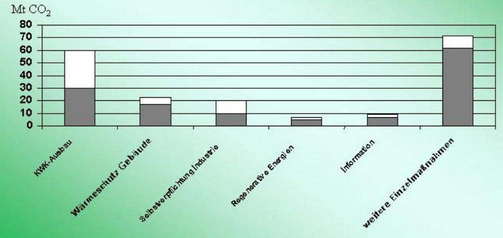
## Expected Contribution of Policy Measures to GHG Mitigation in Germany

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## Policy in favour for CHP plants in the last 2-3 years

- Implementation of an **ecological tax reform**
- but **no energy taxes for district heating**
- CHP systems with a yearly/monthly, efficiency of at last 70% are **completely free from the gas and oil tax**
- auto-producers with an electrical capacity of more than 2 MW are **exempt from electricity tax**
- support of CHP systems as far renewable energies are used via the **Renewable Energy Sources Act**
- introducing a CHP law in May 2000, which should **protect existing CHP plants** of public utilities

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## The CHP law from May 2000 (I)

- **Background:** adjust the distortions induced by the liberalised electricity market
- The law comprises mainly regulations concerning the remuneration of electricity from CHP delivered to the grid
- The law assures a minimum remuneration of 9 Pf/kWh CHP electricity at the beginning, if the installed CHP capacity is above 25% of its total installed generation capacity and the produced quantity of electricity are at least 10%
- The minimum remuneration is lowered each year by 0,5 Pf/kWh

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## The CHP law from May 2000 (II)

- The CHP law is a temporary one, it is terminated by the end of 2004

or

- until the date the planned CHP expansion and modernisation law will pass the German parliament

Two **main problems**

- industrial and other auto-producers are **not included** in the existing CHP law
- the total electricity produced in CHP plants is supported, not regarding if it is "true" CHP electricity or the **condensation share**

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## July/October 2000: Decisions by the German Government concerning the regulations to promote CHP plants

- Until the end of 2000 the German Government will present the elements of a **quota scheme** to support the **expansion** of co-generation
- **Targets:** reduction of $CO_2$ emissions in a magnitude of 10 million t by 2005 and 23 million t by 2010
- The respective law should come into force until the **midst of 2001** at latest
- Energy companies and associations should be involved in the evaluation of the concepts

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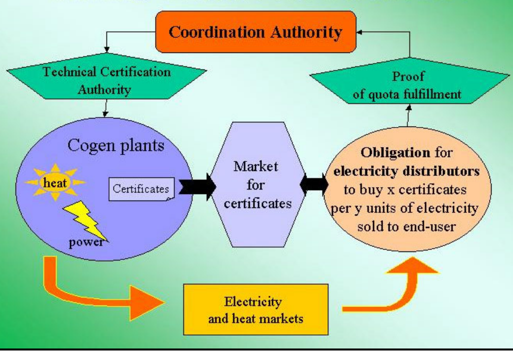
## Trading Scheme for Certificates

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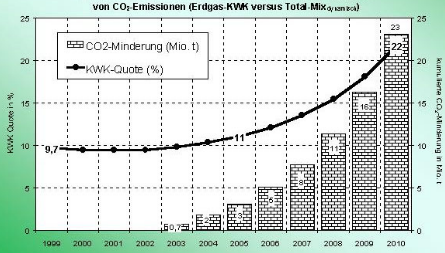
## Expected Market Share (1): Gas-fired Cogeneration

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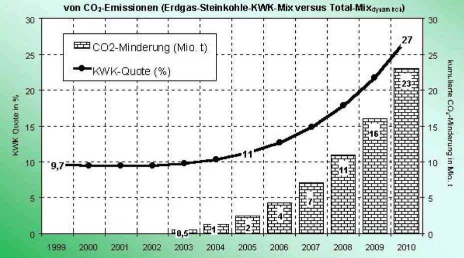
## Expected Market Share (2): Mix*of Coal- and Gas-fired Cogeneration




* 3/4 gas-fired, 1/4 coal-fired cogen

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### 25 June 2001 (I): Agreement between the German Government and the German Business with the purpose ...

... to reduce $CO_2$ emissions with the help of CHP plants

and

... to support the modernisation of existing CHP plants

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### 25 Juni 2001 (II): Agreement on climate protection between the German Government and the German Business

Reduction of $CO_2$ emissions:

- 10 Gt in 2005 and 23 Gt in 2010 by assuring the existence, modernisation and expansion of CHP plants
- A further reduction in a magnitude of 10 Gt in 2005 and 25 Gt in 2010 in other fields (e.g. residential heating; renewable energies, modernisation of power plants)
- this totals to 20 Gt in 2005 and up to 45 Gt in 2010

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### Obligations of the German Business within the June agreement

- The **electricity supply companies** and the **industrial auto-producers** committed themselves to assure the existence, the modernisation and the expansion of CHP plants
- The **electricity supply companies** committed themselves to modernise the existing power plants (condensation plants), to expand the use of renewable energies and to conduct efficiency campaigns
- The **oil and gas companies** committed themselves to improve the technique for heating and warm water

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### Obligations of the German Government within the June agreement

As far as the agreement will be successful

- the Federal Government will not start new initiatives to implement further measures to reach their climate policy targets
- the Federal Government will take care that the further steps of the ecological tax reform will not touch the international competitiveness of the German business

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### Elements of a common understanding of CHP policy between the German Government and German Business

- CHP plants of public utilities and auto-producers insofar they are delivering electricity to the grid shall be supported
- A bonus scheme within a limited period and with a continuously lowering the specific remuneration shall be established
- The period will be limited up to 2010
- The financial volume for supporting CHP plants will be limited to 8 billion DM.
- The economic conditions for CHP plants should be reviewed each two years

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### The new CHP law (I)

(status: 15 August 2001)

Purpose of the law

- Limited protection and modernisation of existing CHP plants
- Expansion of small CHP plants (2 MW and less)
- Introduction of fuel cells into the market

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### The new CHP law (II)

(status: 15 August 2001)

Scope of application

- CHP plants of public utilities and auto-producers insofar they are delivering electricity to the grid shall be supported
- CHP plants fired with hard coal, lignite, waste, biomass, gaseous and liquid fuels
- No support of CHP plants which could receive payments under the regime of the Renewable Energy Sources Act

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### The new CHP law (III)

(status: 15 August 2001)

Definitions of CHP process

- In contrast to the former CHP law there are clear minimum standards and requirements concerning the specific CHP process
- these standards in Germany are integrated as state of the art in the regulations of the District Heating Association (AGFW)

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## The new CHP law (IV)

(status: 15 August 2001)

**Obligation to purchase and pay compensation**

- Grid operators shall be obliged to connect to their grids CHP plants and to purchase electricity available from these plants
- The payment of the electricity available from CHP plants is the sum of the usual market price and an additional compensation
- The additional compensation depends on the type of CHP plant

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## The new CHP law (IV)

(status: 15 August 2001)

**There are 5 types of CHP plants**

- CHP plants installed at the end of 1989 at latest (**old existing CHP plants**)
- CHP plants installed between the first of January 1990 and the effectiveness of the new CHP law (**new existing CHP plants**)
- CHP plants which will be modernised by 2010 at latest (**modernised CHP plants**)
- **Small CHP plants** (2 MW or less)
- **Fuel cells**

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## The new CHP law (V)

(status: 15 August 2001)

**Modernised CHP plants**

- Modernisation of CHP plants will be accepted only if the modernisation costs amount to at least 50% of the investment costs required to built a completely new installation.

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## The new CHP law (V)

(status: 15 August 2001)

**Modernised CHP plants**

- Modernisation of CHP plants will be accepted only if the modernisation costs amount to at least 50% of the investment costs required to built a completely new installation.

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## What is wrong with the planned CHP law?

- The CHP law for itself will not assure that the $CO_2$ reduction targets (10 Gt 2005 and 23 Gt 2010) can be met
- The expansion of CHP plants is excluded (beside the small CHP plants and the fuel cells)
- Industrial and other auto-producers are not supported (beside deliveries of CHP electricity to the grid)

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## The crucial deficits of the planned CHP law?

- **The limitation of the supporting system to the period 2002 to 2010**
- **The fast lowering of the specific compensation year by year**

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## Results: What about the present CHP policy in Germany?

- The CHP law will help to **protect the existence of the installed CHP plants**
- But it is obvious that the CHP law **will not meet the emission reduction targets**
- and that is because the CHP law **will not induce the modernisation** to an amount which was announced by the German Government
- and there are no incentives for an expansion of CHP plants

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DIW Berlin

## Results: What do we need?

- **We need effective improvements within the present draft of the CHP law** if we will keep the chance to gain the contribution to a climate protecting policy the CHP plants are able to give
- Therefore we need **incentives for modernisation of existing CHP plants** as well as
- for an **expansion of new CHP plants**, and there are enough potentials to realise this

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# Design of CHP Incentives - Based on Achievements in Denmark

**Ture Hammar**

Danish Energy Agency

With the aim of identifying useful incentives to promote CHP, this paper presents the development of CHP in Denmark, also mentioning the recent Danish electricity reform, and seeks to give perspectives in a European context.

## 1. Introduction

Denmark is the best performing European country in CHP development. According to statistics from the Danish Energy Agency, cogeneration has a share of 50% of the electricity production. A rough estimate indicates national $CO_2$ emission reductions of 7-10 Mt per year, when compared to separate production of heat and power. This is more than one tenth of total $CO_2$ emissions in the country (being approx. 60 Mt per year during the 1990s).

The huge CHP coverage is the result of two to three decades of persistent governmental and local policies, including use of taxation, economic, and regulatory incentives.

Today, most of the Danish CHP potential seems utilized. Limited further potentials may be found in the industrial sector and by substituting outdated CHP stations with new high-efficient ones.

The conditions of this development have been very particular, especially when the energy markets are transformed. Nevertheless, elements may be generalized and combined with experience from other successful countries. To this end, Denmark has been very keen both nationally and on an EU level in promoting and maintaining CHP in its role as an important 'no-regret' option in climate policies, and in making room for CHP in electricity and gas market regulation.

In 1997, EU envisaged that it was possible to double CHP share of electricity market from 9% to 18% before 2010. This will lead to remarkable reductions in $CO_2$, CHP being perhaps the most important single contribution to GHG reductions. Corresponding options are at hand in Central and Eastern Europe and CIS, and probably in most UN/FCCC Annex I countries.

But it is still a question to which extent the countries will take the necessary measures to utilize these options.

## 2. The success story

So, how did this success story happen? Four important factors have helped:

- Existence of district heating network. This is something in common with other countries in the North of Europe and Central and Eastern Europe.
- Oil crisis at the beginning of the 70s. In 1973 Denmark was highly dependent on oil from abroad (93% of the entire fuel supply in the country). The willingness of the government to support CHP started with the purpose of ensuring security of supply. Nowadays, Denmark is self sufficient in oil and gas.
- Later on, during the 80s, environmental concerns played a major role in the continuing process, thus introducing natural gas, biomass, and waste as fuels in small scale CHP.
- From 1990, climate policies became the key driver, and extensive CHP schemes are now finalized. CHP is on the threshold of finding a major role in energy market and global climate policies.

The method used by the Danish government to promote CHP has been a combination of strategic work, regulation, taxation and economic incentives, voluntary agreements with the energy sector and other actors, and local energy planning. This combination has been evolving over the years. Three types of CHP exist in Denmark and their development has been chronological: First the large scale CHP in cities, next small and medium scale in district heating communities, and lately industrial CHP.

Recently the regulatory framework has been re-designed in the Danish electricity reform: This re-design implies rearrangements over the next 4-5 years including

- $CO_2$ reduction quota for the large plants,
- transitional protection of large scale CHP investments,
- load priority and price guarantees for medium and small scale CHP, and
- establishing a market for green certificates for renewable energy.

## 3. Large scale CHP with district heating

The use of CHP in the city-wide district heating schemes started to be developed in Denmark at the beginning of the century, but on a major scale during the 80s after the oil crisis. Condensing heat from existing and new central CHP stations was utilized in city-wide schemes and even connecting several cities and communities by heat transmission pipelines.

The main boost was the introduction of the heat planning system. Through this system, cities were divided into areas suited for district heating and areas more suited for individual supply of natural gas. District heating was made a local natural monopoly exempted from competition (natural gas or electric heating). Local municipalities, district heating utilities and power companies were heavily engaged in this, and economic (as subsidies, taxation, investment grants, etc.) and regulatory incentives (as governmental and municipal powers to regulate power stations and zoning of district heating) supported the implementation.

Denmark's ten major cities have city-wide district heating schemes where most of the heat (95%-98%) is produced in large coal- or gas-fired CHP plants and waste incineration CHP plants. All extra costs, investment and operating costs, as well as lost electricity production, have been paid by the heat consumers, who in turn have gained most of the advantages of the saved fuel costs. Taxation and subsidy schemes have also supported the development of these systems.

The upcoming opening of electricity trade will affect the large CHP by fluctuating electricity prices, which subsequently may impact district heat economies. The transformation of pricing, burden-sharing and taxation structures are being considered at the moment.

Furthermore, the large CHP stations will be subject to strict quota for $CO_2$ emissions from electricity production according to the recent electricity market reform. The emissions quota are reduced by approx. 5% each year. Unexplored emission quota may be transferred from one year to the next. Excess of the quota is punished by 0,0055 € per kWh. The CHP stations' quota may benefit from relief from emission reduction due to heat fuel savings.

Large-scale CHP stations are expected to remain competitive in a European electricity market. To secure them further they are protected by a load dispatch priority until 2006. At the same time, new CHP capacity may rely on natural gas and renewable fuels, and even integrated solutions with geothermal plants may be on their way. This will match the need for further reductions of $CO_2$ emissions.

## 4. Small-scale CHP with district heating

In Denmark, small-scale CHP are the schemes which are outside the centrally supplied areas. The largest has a capacity of 99 MWe (supplying the town Viborg), but many of them range from 0.5-10 MWe and supply small communities and institution-buildings. Most of them are natural gas-fired with a rather high power-to-heat ratio.

The first boost came in 1986, when the Parliament adopted a decision for the electricity sector to implement 450 MWe of small scale CHP based on indigenous fuels (natural gas, waste or biomass), first part of the program being demonstration projects. Due to disputes and reluctance from the electricity companies, major parts of the program were delayed, and municipalities and local utilities wanted to take part in the program.

This delay paved the way for subsequent development in a new Parliament decision in March 1990 to expand the capacity to 1,400 MWe (including industrial CHP). The development of the natural gas network was closely linked to the program. The decision was based on both socio-economic considerations and climate policies. CHP as the primary $CO_2$ emission reduction means was integrated in the energy strategy 'Energy 2000'.

The new program opened for municipalities, industry and local consumers to participate along with the electricity sector. This 'deregulation' showed up to be very helpful. The program was supported by heat supply planning, by close regulation of size, location and choice of CHP fuel and technology, and by economic incentives in taxation, subsidies, and in gas prices and electricity tariffs.

The 1,400 MWe program has now been implemented almost to its full extent. The investments in the program have been of the magnitude of approx. 1,5 billion €. The emission reductions may be roughly assessed to amount to 4 Mt $CO_2$ per year.

Small and medium scale CHP is exempted from the $CO_2$ quota regulation (size under 100,000 tons $CO_2$ per year). Further, they are given priority in load dispatch in a PSO arrangement, and they receive subsidies from energy and 'green' taxation.

## 5. Industrial CHP & green tax scheme

Denmark has little energy intensive industry, and industrial CHP developed later than district heating CHP. The technical potential was assessed to approx. 1,700 MWe in 1991.

In mid 1990s, new investment and price subsidies and electricity tariffs paved the way for new gas-fired industrial plants. This program had a very convincing start. But government realized that subsidy and tariff incentives were more than favorable, and it down-sized incentives. This meant an almost full stop to further CHP construction in industry, also in the light of upcoming competition in electricity prices, etc. Later on, the program has restarted as an outcome of new upsizing of investment subsidies. Today a total capacity of more than 450 MWe has been established, and more capacity is under construction.

This development of CHP may be seen in connection with the green tax scheme (cfr. reference 5). In 1995 Denmark decided on this scheme for commercial sectors and industry. The main purpose was to reduce $CO_2$ emissions and to stimulate employment by shifting a part of the tax on labor to a tax on energy. To overcome the competitive problem the tax revenue is recycled, and the tax is graduated. Energy intensive industries can get a reduced tax if they enter into a binding agreement on energy savings, including CHP, and for a period subsidies are given to adjust the technology and production to the new tax structure. An evaluation has now concluded, that the tax package results in a very considerable environmental impact in an economically efficient manner. The energy tax system is expected to lead to a 3.8% reduction in the total national $CO_2$ emissions from 1988 levels by 2005. Due to the recycling of increased taxes, the macroeconomic effect of the energy tax system has been very moderate. The experience shows it is possible to establish an energy tax system that lead to a reduction in $CO_2$ emissions, without causing a decrease in the competitiveness of industry and the commercial sector.

## 6. Markets for 'green' electricity

As part of the recent electricity reform a market for green certificates is being planned to go into full operation by 2003. This market has been designed to rely on a price floor of 0,012 € per kWh, and a price ceiling of 0,035 € per kWh. The market will be coordinated with possible markets in neighboring countries.

## 7. CHP development in Europe

EU policies in CHP have existed since 1979. This first recommendation - on promoting CHP by starting national co-operative work with energy sector and municipalities - was adopted in the council of ministers. In 1988, a recommendation on the protection and encouragement of small power producers (less than 25 MWe) was also adopted, and several member countries have since set up certain privileges for this group.

CHP gained new momentum after 1990 when a number of countries carried out national programs utilizing modern gas CHP. Especially UK, Netherlands and Denmark had adopted this policy, taking $CO_2$ reductions into consideration. But also other countries as Spain, Italy, Portugal and France have opened the door for gas-fired CHP, while countries as Sweden and Finland looked into biomass CHP.

This momentum was created in the early phases of energy market transformation. In the later phases of the liberalization negotiations, it became uncertain how for CHP to proceed. It is probably not incorrect to claim that the role of CHP, as well as renewable energy, is far from being perfectly defined until now, in spite of market directives for both electricity and gas, and in spite of many dedicated discussions and decisions in the council of ministers.

But CHP was also taken up from the environmental side, and in the preparations for the Kyoto meeting, CHP was out-mapped as a major element in the EU 'no regret' package. It was considered that CHP could cover 30-40% of future electricity demand, and that this would lead to reductions of approx. 10% of $CO_2$ emissions in EU.

The EU work also considered which policies and measures to implement. First of all, it was observed that

- CHP policies should be tailored to the fact that it is an integrated technology dependent on fuels, electricity and heat supply;
- district heating, local heat consumers and industry are three distinct applications of CHP, each with its own preconditions to policies and measures.

Consequently, CHP policies must start on a comprehensive strategic level, governments defining targets and space for the CHP, its fuels and sales of heat and electricity. This strategy should also take the necessary action to stop misleading development as e.g. erosion of district heat markets and construction of surplus condensing power capacity.

The integrated requirements of CHP have also led to an unpleasant and repeating work of identifying all the possible barriers to this technology, as lack of awareness and tradition, obstructive monopolistic behavior, and time-consuming bureaucracy.

National work on CHP should be supported by EU regulation, e.g. a CHP directive similar to that being considered for renewables.

## 8. Perspectives

- The design of CHP policies and measures could consist of a 'recipe' for each application of CHP:
- Both EU and national targets are necessary. Only few countries have defined such targets, though they have a quantified GHG reduction obligation.
- The real CHP potential must be analyzed in depth for integrating the '3 Ms', i.e. all three market categories: fuel, electricity, heat. This work should not be underestimated (EU has now spent 10 years analyzing it with sparse results), and many lessons could be learned from e.g. Denmark and the Netherlands.
- The market frameworks for all of the '3 Ms' must be supportive. Gas prices must be competitive at all times, electricity market must allow for CHP electricity at fair long-term conditions, heat market should be guaranteed and protected as a natural monopoly, etc.
- Governments must know their duties in setting regulation, prices, taxation, investment grants, etc. E.g., according to proposals in the EU large combustion plant directive (LCPD), no new condensing power capacity can be approved by government for efficiency and environmental reasons. Instead CHP should be established and located as the best technology. Taxation and pricing could be progressive, giving premiums to low-emission energy.
- The construction of CHP stations must be well organized if ever to happen. Local actors as industry, municipalities, suppliers of fuels, heat and electricity, and other parties, must be involved. Organization may be stimulated by local planning processes and consumer involvement, task forces and joint ventures, etc.
- Several promotional models may be created to attract and sustain CHP. Guaranteed subsidies and minimum tariffs e.g. by load priority and PSO arrangements or by state subsidies, investments grants, markets for 'green' certificates, $CO_2$ quota or trading, or central programs with fixed amount of subsidies and tendering procedures (e.g. the UK NFFO).
- In the operational phase, CHP must be given the right stimuli to maximize production and interact with other sources of 'cleaner' energy.

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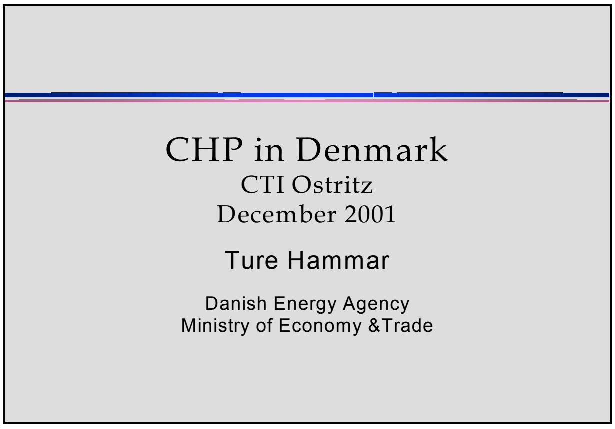


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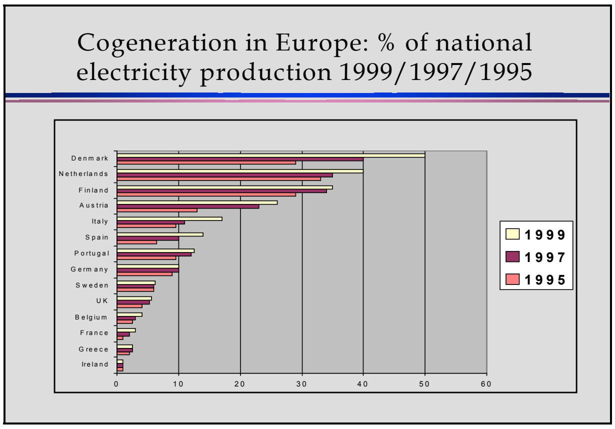


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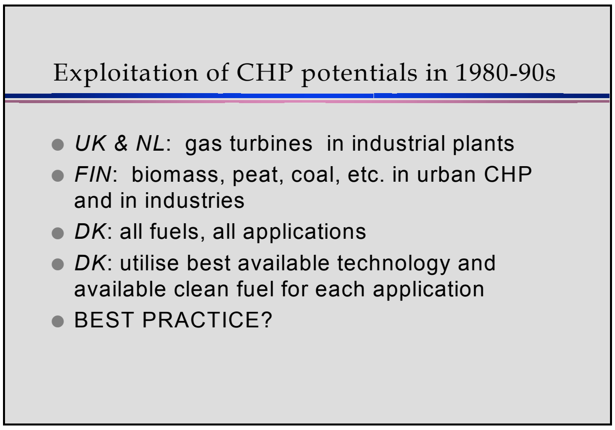


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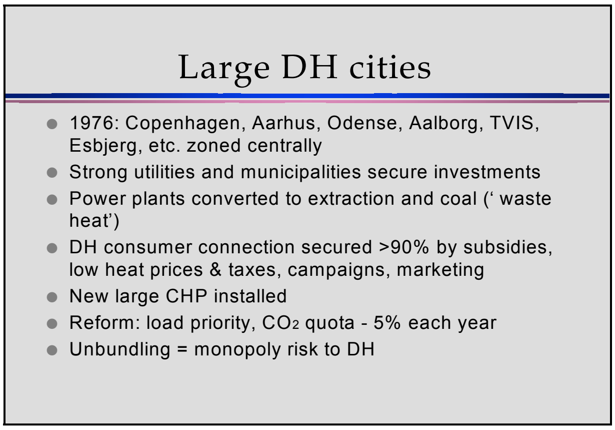


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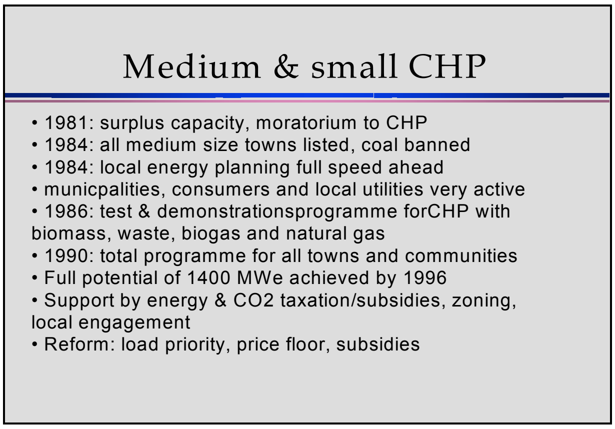


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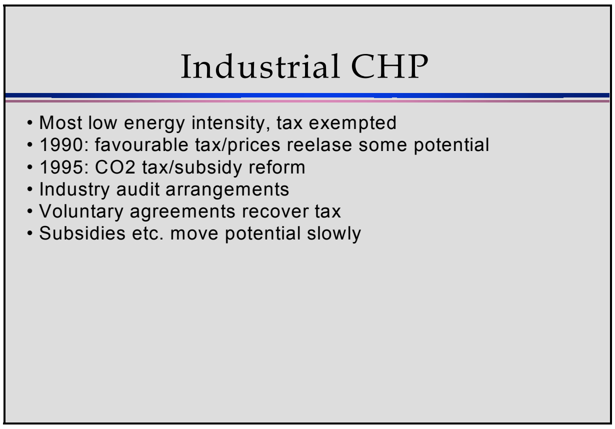


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## Results of R&D&D

- 10 biomass CHP and 2 biogas CHP operating since 5-12 years
- Best performance 32% electricity, average 25-30%
- Total efficiency average 90%
- Operation in 2000 average 5000-6000 hours, best 8500 hours
- New local NGCHP & new DH special case

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## Phases of Danish CHP

| | | |
|---|---|---|
| 1976-91 Central policies | Large plants converted to coal CHP | Urban DH expanded and interconnected |
| 1984-1997 Municipal policies | Town and community programme gas & biomass CHP | Municipal and local DH settled |
| 1995- Industry and local schemes | Industrial & local gas CHP | Industries, greenhouses etc. involved in energy efficiency schemes |
| 1981- R&D&D & individual schemes | biogas, gasification, fuel cells, biomass, multi CHP | New DH, micro CHP, heat pumps, geothermal, tech integration etc. |

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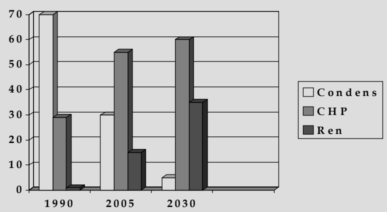
## % share of CHP & wind power versus condensing

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## Eletricity systems with high CHP & wind power shares

- Excess capacity happens cold/windy/winter/nights
- can be exchanged with hydropower
- technical fixes are also possible
- illustrates the need for a regional energy market
- Baltrel/Baltic Gas report foresees 47% new CHP

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## Examples of countries with DH&CHP opportunities

- Germany: DH potential
- Poland: Huge energy saving potential
- Lithuania: CHP least cost substitute to INNP
- Central & Eastern Europe: opportunities in DH

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## CHP in EU

- 1988 40 GWe(EU 12) = 6%
- 1994 67 GWe(EU 15) = 9%
- 1999 Eurostat = 11%
- 2010 EU target = 18%
- Potential 180 GWe + = 40%
- Similar or higher potentials in CEE & NDs

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## CHP $CO_2$Cost Guidance

*'No regret' in many cases:*

- Industrial CHP
- CHP in city wide DH
- CHP at large costumers/tertiary

*Sometimes cost effective when ranked:*

- CHP in new DH when infrastructure easy to establish

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## CHP $CO_2$ Reduction

*Depends on reference:*

- Coal Condensing + Oil Heating
- New Gas CC + Modern Gas Heat

*Estimates:*

- 0,15 - 1,00 t $CO_2$ per MWh
- Choice 0,60 t $CO_2$ per MWh
- Additional EU CHP potential **421 Mt/y** $CO_2$

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## Implementation of CHP

| Electricity Demand | Heat Demand | Industrial Processes |
|---|---|---|
| • MW targets<br>• Electricity Market<br>• Green Electricity<br>• NFFO Bidding<br>• PSO load priority<br>• Funding<br>• Taxation & subsidies | • Munic. cooperation<br>• Urban zoning<br>• Heat monopoly<br>• Marketing of DH<br>• Financing<br>• Taxation & subsidies | • Task forces<br>• Pay back shortening<br>• Joint ventures<br>• 3rd Party Financing<br>• Tradeable permits<br>• Taxation & subsidies |

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## Common Tasks to Implement CHP

- European & national targets for CHP & DH
- Funds must be allocated
- Internalisation of external costs
- CHP priority in new capacity
- CHP priority in operation
- Develop and use DH towards efficiency
- Electricity, heat and industrial market framework supportive, not destructive
- Modern dispatch & regional energy system

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## Conclusion

- CHP policies now widely discussed globally
- But many obstacles (vested interests, oligopolies, national complications, wrong market design etc.)

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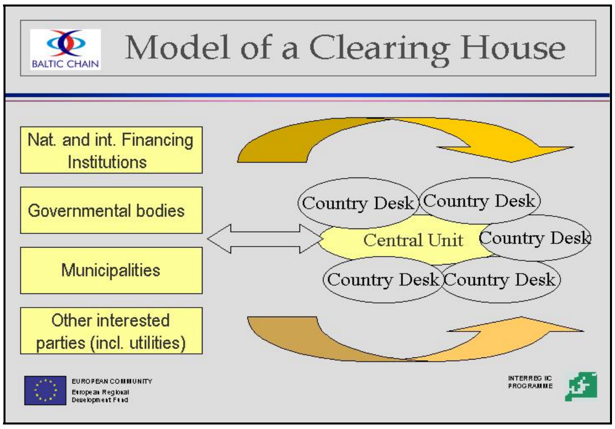


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# Overview of Slovak Energy Systems Regarding Cogeneration Technologies

**Ludovít Mikula**

Slovak Energy Agency


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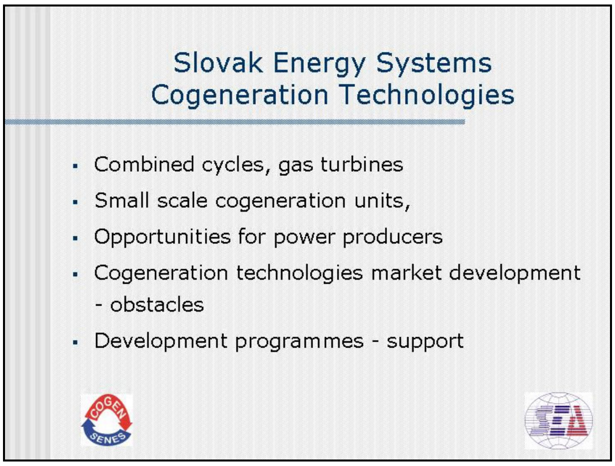


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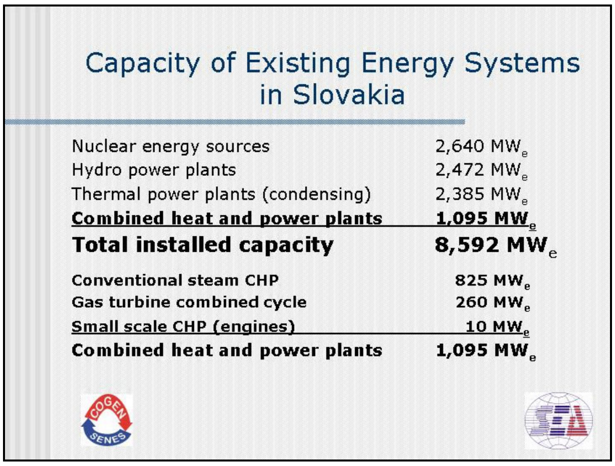


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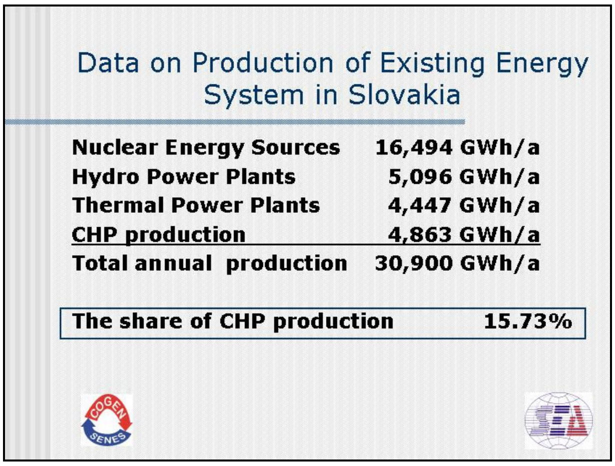


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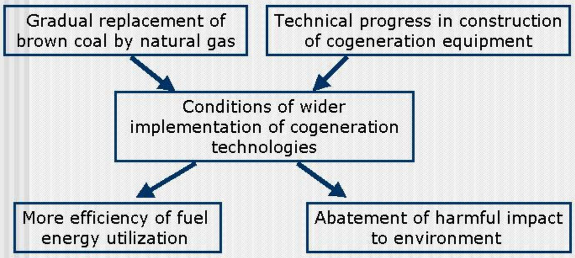
## Initiatives, Impulses and Expectations of Cogeneration Development

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## Possibilities for Next Cogeneration Technologies Development

**The analyses of existing heat sources in municipalities and industry provide following assumptions:**

- **Technical potential** **1,480 $MW_e$**
- **Economic potential** **660 $MW_e$**
- **Market potential** **430 $MW_e$**

**The projection of market potential for implementation:**

- **installation of 1,000 - 2,000 small scale CHP units**
- **installation of 80 - 100 gas turbines in combined cycles**

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## Combined Heat and Power Production Overview

**A. Conventional heat and power plants in steam cycle**

**Industry:** **around 40 plants in operation**
**total installed capacity** **780 $MW_e$**

**Municipalities: around 10 plants in operation**
**total installed capacity** **315 $MW_e$**

- **Machinery of these heat and power plants is obsolete.**
- **Gradual re-construction is expected as well as installation of gas turbines fueled by natural gas in combined cycle**

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## Combined Heat and Power Production Overview

**B. Gas Turbines - Combined Cycles**

**a.) Research and pilot projects:**

| Unit | Locality | Start |
|---|---|---|
| ST 1 MW | Tp Bratislava I | 1960 |
| ST 7 MW | Tp Bratislava I | 1964 |
| Foit Cycle - PPC (1+5 MW) | Tp Bratislava I | 1968 |
| LM A1-20; 2.5 MW | Tp Bratislava I | 1968 |
| "Energotrain" 2x2.5 MW | Komárno - railway | 1968 |
| ST 14 MW | Trnava | 1972 |
| LM ST 30 RDA 31 MW | Bratislava "Juh" | 1977 |
| ST 25 MW | TP Bratislava I | 1977 |

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## Combined Heat and Power Production Overview

**b.) Implementation projects in operation**

| Title of project | Locality | Start | Installed capacity power[$MW_e$] | Installed capacity heat [$MW_t$] |
|---|---|---|---|---|
| Biotika, a.s. | Slov. Ľupča | 1995 | 1 x 4 | 1 x 8.1 |
| PP, a.s. SCP | Ružomberok | 1998 | 2 x 14 | 2 x 38 |
| PPC, a.s. | Bratislava | 1998 | 1 x 218 | 1 x 150 |
| Amylum Slovakia | Boleráz | 1998 | 1 x 5.6 | 1 x 20 |
| CZT Radvaň | B. Bystrica | 1999 | 1 x 4.3 | 1 x 8.3 |

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## Combined Heat and Power Production Overview

**c.)Projects ready for implementation**

| Unit | Locality |
|---|---|
| **GTCC 70 $MW_e$/40(60)$MW_t$** *Fueled by natural gas mined near locality* | **Tp Michalovce** |
| **GTCC 70 $MW_e$/80 $MW_t$** *Start of operation is expected in 2004* | **Tp Nitra - Chrenová** |
| **GTCC 70 $MW_e$/20 $MW_t$** *Currently on hold* | **Tp Lučenec** |
| **GT 360 $Mw_e$** *Authorization of basic documentation* | **Malženice** |
| **GT 90 MW** *In preparation* | **VSŽ Košice** |
| **GT 2x7 $Mw_e$** | **SH Senica** |

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## Combined Heat and Power Production Overview

d.) Small scale CHP (engines)

Summary data (estimated)

| | | |
|---|---|---|
| Total amount of installed CHP units | | 130 engines |
| Amount of plants in operation | | 60 sites |
| Total installed output: | electricity | 12 $MW_e$ |
| | heat | 20 $MW_t$ |

The range of installed power outputs: 22 - 1,000 $kW_e$

CHP units are installed in sectors:

| | |
|---|---|
| - industry | 22% |
| - municipalities | 60% |
| - biogas utilization (agriculture, waste water treatment) | 18% |

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## Positive aspects for cogeneration in Slovakia

- Natural gas is a dominant fuel in Slovakia
- The country has good tourism conditions - good opportunity for small scale CHP
- In some regions the grids are overloaded - opportunity for decentralized power production
- The necessity to upgrade energy technologies in industry - chance for CHP implementation
- Exploitation of various biogases and waste gases
- Up to 90% of fuel sources is imported - obligation to find the best way of valorization - chance for CHP

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## Obstacles and Barriers for Cogeneration in Slovakia

- The prices of fuels and other energy carriers are still distorted
- Unclear privatization process - non-transparent relations
- The obsoleteness of technological equipment
- Legislative and regulatory framework
- Institutional barriers
- The lack of domestic investment capital
- Positive impact in $CO_2$ emission reduction is not included in legislation and promotional measurement
- Tax an fiscal policy is non-stimulating

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## International Co-operation in CHP Promotion

- Participation in promotional programmes of EU
- Establishment of professional group COGEN SENES and its membership in COGEN Europe association
- Co-operation in Dutch programmes AIJ and ERU - PT
- International co-operation COGEN associations in the group of V4 countries (Czech Republic, Hungary, Poland, Slovakia) is starting

Slide 16

## Conclusions

- Implementation projects of CHP are fighting with usual problems of new technologies, especially economic ones due to existing price distortion
- From technical point of view there are positive reasons for development of CHP
- Contemporary market opening and electricity price liberalization bring in matter a non-transparency, current prognosis are unclear
- Situation in fuel resources (strong dominance of natural gas) and general trend of decentralization are giving prospects to CHP implementation

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# The Austrian-Slovak Competence Centre for CHP Diffusion

**Vladimir Hecl**

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**The Austrian-Slovak Competence Centre for CHP Diffusion**

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**Energy Centre Bratislava**
**OPET Slovakia**

Slide 1

**Background**

- Combined production of heat and power (CHP) is the most efficient way of primary fuel utilisation and hence one of the main commercially viable means to achieve the Kyoto CO2 reduction targets

In the Slovak Republic:
- Technical potential for CHP 1.480 MWe
- Economic potential for CHP 656 MWe
- Market potential for CHP 430 MWe

Slide 2

**Barriers for CHP 1997**

- Distorted energy prices
- Lack of information on technology
- CHP had no position in the Slovak Energy Policy
- General preference of low cost investments
- Attitude of power distribution utilities towards independent power producers
- Frame conditions at Slovak capital market

Slide 3

**SEA -Cogeneration Centre**

- Project in frame of Austrian Slovak Energy Partnership
- Goal - Establishment of a coordination, information and consultancy centre for investors, technology providers, FIs, authorities and contracting companies
- Mission: Assistance to implementation of cogeneration technologies in Slovakia

Slide 4

**Main Activities of SEA-Cogeneration Centre**

- Spreading of information on technologies, legal, economic and financing framework
- Intermediation and co-ordination of contacts among project participants
- Competent, unbureaucratic and rapid support to project ideas in all phases of planing and implementation

Slide 5

**Support to project ideas**

- Elaboration of feasibility studies
- Preparation of public tender records
- Organisation and evaluation of public tenders
- Facilitating access to financing sources
- Participation on international projects aimed upon elimination of barriers to CHP
- Improvement of general framework

Slide 6

# Best Practice: The Case of Combined Heat and Power - Implementation of Small CHP Units in Bulgaria

**Violetta Groseva**

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**Basic information**

The Republic Bulgaria imports more than 70 % of the energy used. For this reason one of the main policy in the energy field is the energy efficiency.

Co-generation is one of the most effective technologies for the rational use of energy. The advantage of cogeneration is measured with the energy savings achieved when compared with the separate generation of electricity and heat. It is estimated that through the use of cogeneration systems the possible reduction of primary energy consumption is up to 35 %.

Large scale CHPs are implemented in Bulgaria for a long time. The overall objective is to demonstrate the economic and environmental benefits by using also small-scale CHP applications in the industry and in the building sector.

Sofia Energy Centre (SEC) in its effort to promote small CHP, selected four sites and for each of them a detailed pre-feasibility study has been performed. The results of this analysis are shown below:

| Site | Investment (k€) | Payback (years) | $CO_2$ emissions reduction (t/y) | $NO_x$ emissions reduction (kg/y) |
|---|---|---|---|---|
| Vitavel SC | 926 | 7,4 | 7464 | 17774 |
| Regional Hospital Lukovit | 254 | 8,7 | 1620 | 3851 |
| Regional Hospital Mezdra | 302 | 7,9 | 2166 | 5284 |
| Regional Hospital Novi Pazar | 376 | 7,9 | 2778 | 7191 |

Sofia Energy Centre as a Co-generation Centre in Bulgaria took part in implementation of a CHP unit in the district heating company of Pravets, Bulgaria.

**The site**

The DH Pravets is located in the small town of Pravets, Bulgaria, and it supplies thermal energy for space heating and hot water production to about 1,300 households and to industries and public organizations another 1,300 households. The company operates about 18 km network and 100 sub-stations. Near by there is a main gas pipeline. There is continuous though varying heat demand throughout the year.

**The project**

A modern CHP gas-fired unit was installed in the DH Company with 774 kW thermal and 526 kW electrical capacity. It is foreseen the unit to be in operation all year round, while during the peak season (winter) it will supplement the existing heat boilers, and during the summer it will operate alone to supply hot water to the DHC customers. About 15 % of the produced electricity is to be self consumed and the rest is to be sold to the utility.

**The investment**

The overall initial investment costs of the project are about 300,000 €. It has been realized under a JI scheme for co-operation between Bulgaria and Netherlands. The funds for project investments were provided as a grant by the Dutch Program SENTER, and there were about 10,000 € additionally provided by Pravets DH Company related to the necessary infrastructure and local connections provision.

**The equipment**

The CHP unit is manufactured by the company Dynaf Spruyt Group and is equipped with:

- a complete heat recovery system;
- a telemetric communication system;
- a sound reducing canopy.

It has been integrated in the existing infrastructure of the DH company.

**Expected benefits**

It is forecasted that at about 8,200 operational hours/year the annual primary fossil energy savings are about 2,280 MWh which makes annual net cost savings of about 50,000 €. At present conditions the expected pay-back period is about 6-7 years. The parameters derived from above concerning $CO_2$ emissions savings are some 800 tons a year.

**Main reasons for the project**

The economic and environmental benefits of CHP for small and medium industries in Bulgaria were to be demonstrated. The overall project target is to realize significant reduction of energy consumption and therefore also of greenhouse gases at the DHC Pravets. In the long run targets are also: development of knowledge, management capabilities and information in the field of energy efficiency and creation of sustainable cooperation between Bulgarian and Netherlands companies and organizations.

**Project sustainability and potential for domestic replication**

A market analysis was made within the project realization and it revealed that the replication potential of this type of projects is significant in Bulgaria. Similar projects can be realized in:

- Hospitals and other medical facilities;
- hotels and large buildings;
- greenhouses;
- small industries;
- heating companies, etc.

CTI Capacity Building Seminar, 5-9 Dec. 2001, Ostritz, Germany

## Implementation of CHP in Bulgaria

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*Sofia Energy Centre* 1

Slide 1

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## Current Situation

1. The first CHP "Sofia" was constructed in 1949
2. The installed capacities in CHP of the country are:

| | |
|---|---|
| Nuclear Power Plant | 3760 MW |
| Hydro Power Plants | 2407 MW |
| Thermal Power Plants | 6550 MW |
| incl. Co-generation | 2035 MW |
| Total | 12717 MW |

3. CHP accounts for 16 % of the total installed capacities;
4. CHP accounts for 31 % of TPP capacities.

*Sofia Energy Centre* 2

Slide 2

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## Implementation of Small CHP in Bulgaria

**Results of pre-feasibility studies (executed by SEC)**

| Site | Electric power (kW) | Thermal power (kWt) | Investment (kEuro) | Payback (years) | $CO_2$ emissions reduction (t/y) | $NO_x$ emissions reduction (kg/y) |
|---|---|---|---|---|---|---|
| Vitavel Lukovit | 1175 | 2275 | 926 | 7,4 | 7464 | 17774 |
| Regional Hospital Lukovit | 465 | 793 | 254 | 8,7 | 1620 | 3851 |
| Regional hospital Mezdra | 575 | 960 | 302 | 7,9 | 2166 | 5284 |
| Regional Hospital Novi Pazar | 799 | 1148 | 376 | 7,9 | 2778 | 7191 |

*Sofia Energy Centre* 3

Slide 3

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## CHP Installation for DHC Pravets

- CHP gas-fired unit with 774 kWt and 526 kWe;
- Investment costs – 300 000 Euro;
- JI scheme between Bulgaria and Netherlands;
- Expected benefits:
  - Energy savings – about 2280 MWh/year;
  - Pay-back period - 6-7 years;
  - CO2 emissions reduction – 800 t/year.

*Sofia Energy Centre* 4

Slide 4

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Combined Heat and Power Installation in DHC Pravets

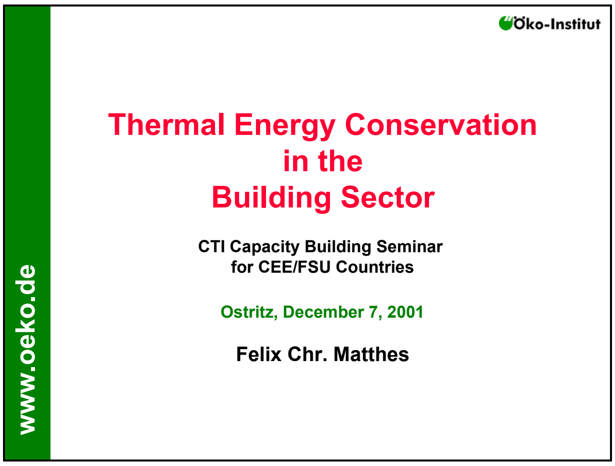
*Sofia Energy Centre* 5

Slide 5

# Thermal Energy Conservation in the Building Sector

**Dr. Felix Christian Matthes**

Öko-Institut, Berlin

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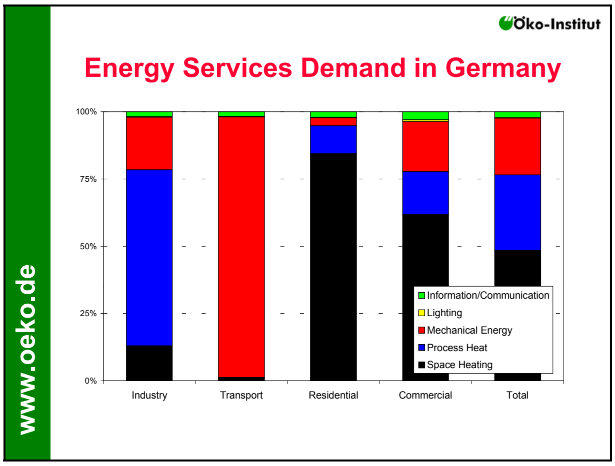


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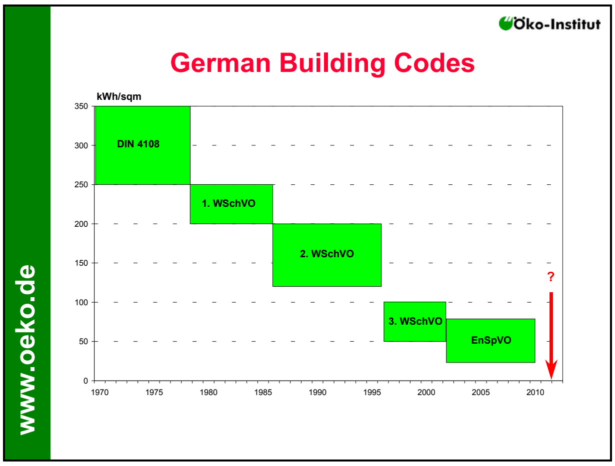


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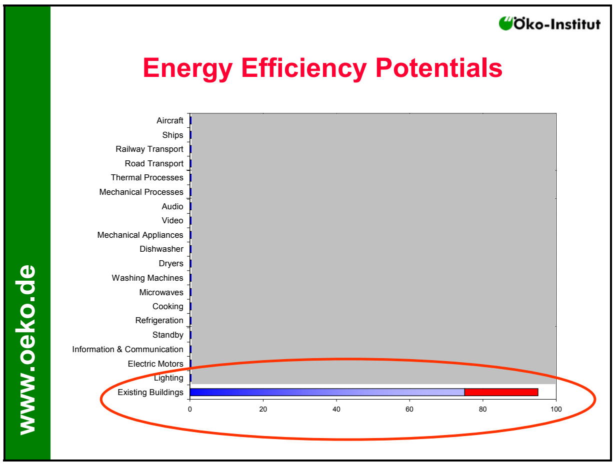


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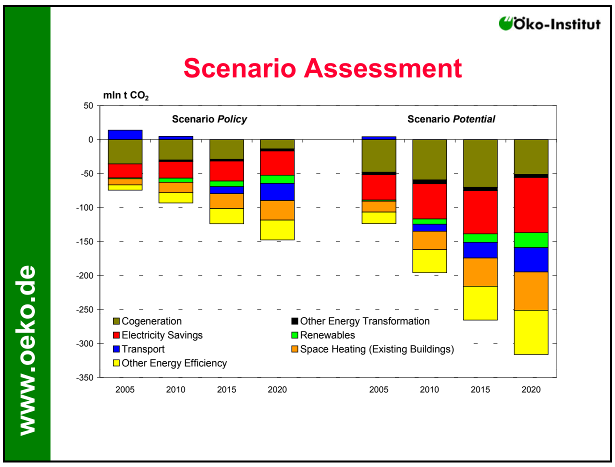


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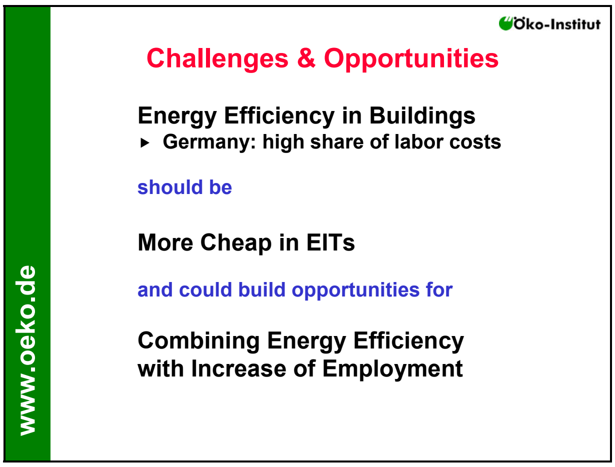


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# Implementation of Thermo-modernization Law in Poland

**Andrzej Szajner**

Baltic Energy Conservation Agency BAPE, Gdańsk, Poland

The new Thermo-modernization Law ("Law on Assistance in Thermo-modernization Projects") introduced in December 1998 and modified in 2001 has replaced state subsidies by financial support of feasible thermo-modernization projects.

The objective of the Law is to support of modernization projects aiming at:

- reduction of energy consumption in buildings, residential and public/ communal,
- reduction of energy losses in local heating networks and local HOBs <11,6 MW,
- conversion of conventional heat sources to non-conventional sources, incl. renewables.

Definition of the thermo-modernization project according to the Law:

a) modernization resulting in reduction of annual consumption of energy in buildings
   - when modernizing heating system only - min 10%
   - building thermo-modernization - min 15% or 25%

b) modernization of local HOB and local network, reduction of energy losses - min 25%

c) closing of local HOB and connection to DH system, reduction of heating costs - min 20%

d) conversion of conventional energy sources to non-conventional.

The necessary condition is to elaborate an ENERGY AUDIT – a pre-feasibility study, including costs and energy savings, assumption for technical design of modernization (verified), which shall include: information about buildings, local HOBs, network and owners, evaluation of technical conditions buildings, local HOBs and network, description of possible options of thermo-renovation and selection of the optimum option of thermo-renovation.

The special part of the law is a thermo-renovation bonus, 25% of the loan, which is granted if:

- loan ≤ 80% of investment
- pay-back time of the loan ≤ 10 years
- monthly payments (loan repayments with interest) ≤ monthly savings calculated in the energy audit;
- thermo-renovation project has been performed in accordance to the technical design and in time.

Financing is arranged by Bank Gospodarstwa Krajowego BGK (Bank of National Economy) through selected commercial banks.

From the principles of the Law it could be seen, that regulations are favorable to renewable energy sources together with thermo-modernization of buildings providing that the economy of the investment is good. The key factor of the Law are savings allowing for repayment the loan with interest within 10 years. Potential of savings means the difference between costs of energy in existing heating system and costs after thermo-modernization.

The staff of BAPE has already performed audits of a few hundred buildings. The big majority of buildings was built in prefabricated systems in the 70's and 80's, with big slabs of reinforced concrete. The audits confirm high annual energy consumption - 180-270 kWh/m2 - in prefabricated multistory apartment buildings. Typical scope of modernization includes insulation of walls and roof, modernization of heating installation and replacement of windows. Reducing energy demand of about 30% requires high investment expenditures, with SPBT often exceeding 10 years. Even then in many cases the indicator of seasonal energy demand is still higher than the today required 150 kWh/m2. Further reduction of energy consumption usually means replacing windows, which causes an increase of investment costs and makes it unprofitable.

The important role of building administration is to install heat meters or heat costs allocators as well as to encourage tenants to save energy and change bad habits. Till recently the Thermo-modernization Fund has been used at a much lower rate than anticipated. The system has been modified this year to stimulate substantial increase of thermo-modernization investments.

## Implementation of Thermomodernisation Law in Poland

Andrzej Szajner
Baltic Energy Conservation Agency
Gdańsk, Poland

Slide 1

## THERMOMODERNISATION LAW

("Law on Supporting Thermomodernisation Projects"):

- introduced in January 1999 and modified in 2001
- replaced state subsidies by financial support of feasible thermomodernisation projects
- loans („THERMO loans") given by commercial banks (all major banks)
- guarantee and supported - the state budget

Slide 2

## ASSUMPTIONS

- old - subsidised system of thermomodernisation
  - subsidies EUR 60 Million
  - own contribution EUR 30-50 Million
- new - THERMO Scheme
  - state input EUR 60 Million
  - own contribution EUR 250 Million

VAT, other taxes

> EUR 50 Million back to the state budget

Slide 3

## ASSOCIATED REGULATIONS AND TOOLS

- Energy Law
  - energy planning
  - heat and energy metering
  - heat and energy tariffs
- Environmental funds
- Third Party Financing

Slide 4

## OBJECTIVES OF THE LAW

- reduction of energy consumption in buildings (residential and public/ communal)
- reduction of energy losses in local heating networks and local HOBs <11,6 MW
- complete or partial conversion of conventional heat sources to non-conventional sources, incl. **renewables**

Slide 5

## DEMANDS

- modernisation resulting in reduction of annual consumption of energy in buildings
  - heating system only - min 10%
  - building thermo-modernisation - min 15 - 25%
- modernisation of local HOB and local network, reduction of primary energy losses - min 25%
- closing of local HOB and connection to DH system, reduction of heating costs - min 20%

Slide 6

## ENERGY AUDIT

- pre-feasibility study, including costs and energy savings, assumption for technical design of modernisation (verified)
- evaluation of technical conditions of buildings, local HOBs and network
- selection of the optimum option of thermo-renovation
- **setting** savings and THERMO loan

Slide 7

## Thermo-renovation bonus

- **25% of the loan**
- loan ≤ 80% investment (the remaining part – own contribution)
- pay-back time of the loan ≤ 10 years
- monthly payments ≤ monthly savings
- thermo-renovation performed in accordance with energy audit and technical design

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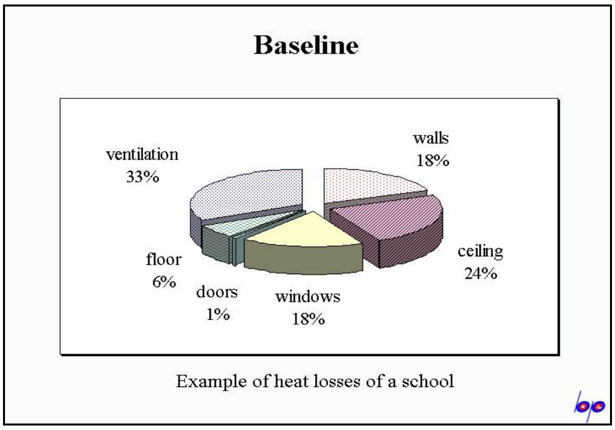


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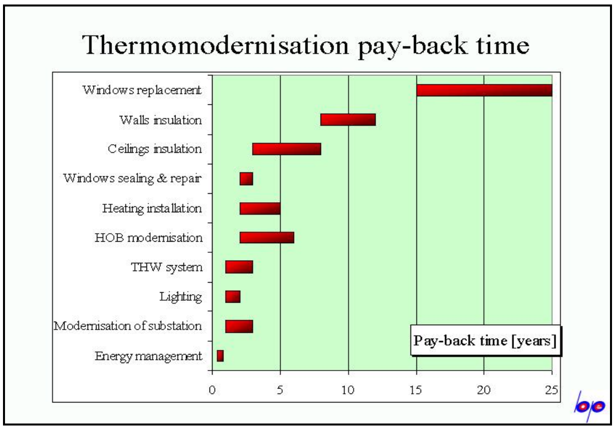


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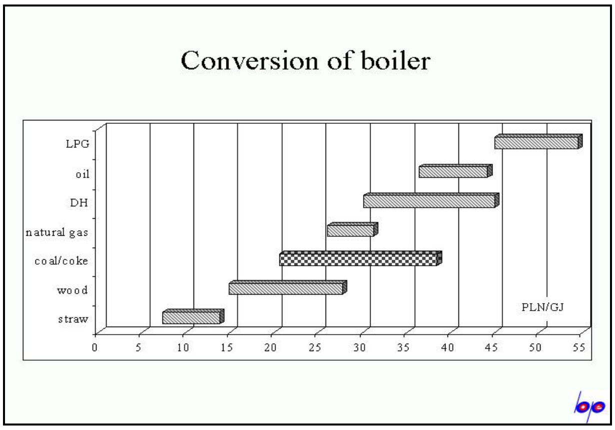


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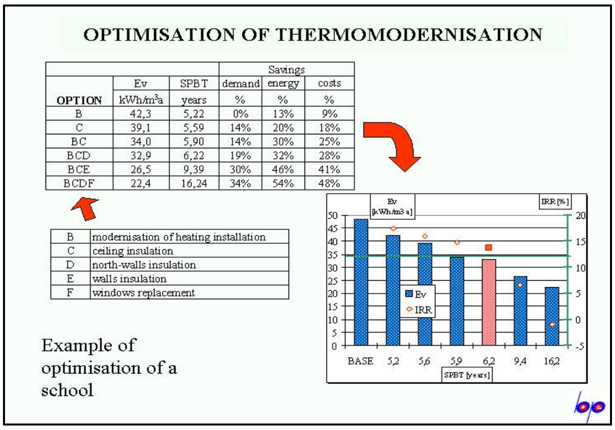


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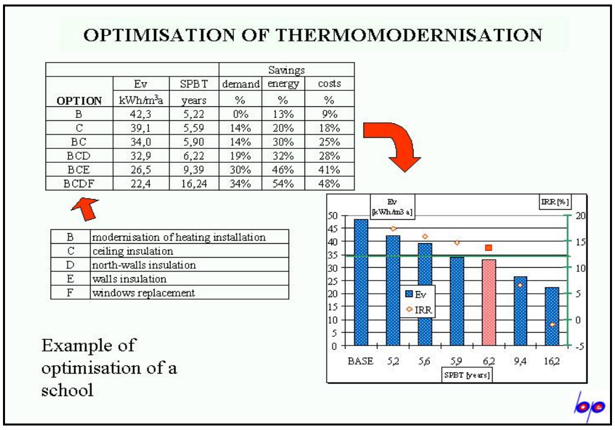


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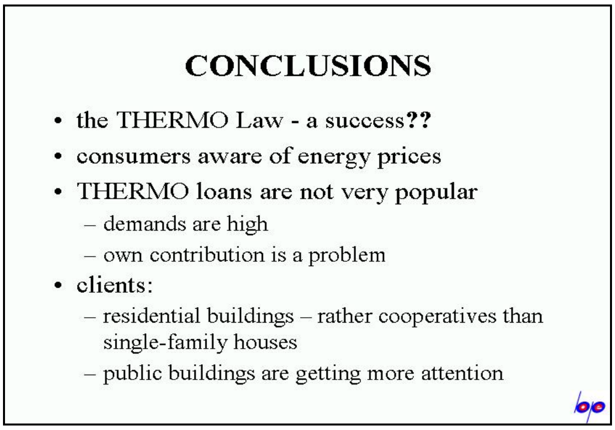


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# KfW-Housing Modernization Program
# - Experience with Refurbishment of Panel Buildings in Eastern Germany

**Georg Kraft**

Kreditanstalt für Wiederaufbau, Germany

### Data on flats in Eastern Germany

| | Number in Total | % |
|---|---|---|
| Flats total | 7,363 | 100 |
| *of which are in* | | |
| Old Houses (constructed up until 1948) | 3,393 | 46 |
| Panel Buildings | 2,127 | 29 |

- building modernization work to improve the functional value of individual flats (e.g. sound insulation, flat layout, sanitary installations)
- construction measures to improve the general housing conditions (e.g. communal facilities, construction or expansion of balconies (loggias)
- installation and upgrading of lifts
- measures for energy conservation or reduction of $SO_2$ and $CO_2$ emissions (e.g. replacement of windows, modernization of heating including changeover to fuels that emit less $CO_2$, installation of central heating, hot water supply and heat insulation)
- rehabilitation (repair and replacement of defective building components, e.g. roof, façade, windows, floors, stairs).

### Energy saving in the *Housing Modernization Programme*:

(Total including panel buildings)

- 50% of all credits
- 20% of volume
- Mainly change of heating systems/fuel change from high-emission coal to gas and oil
- Annual reduction of 6 mln t $CO_2$ (to reach the objective of the German government of a 25% $CO_2$ reduction in households in Germany, a reduction of 32 mln t $CO_2$ would be necessary).

### Credit requests for panel buildings

- Rehabilitation77 %
- Energy Saving10 %

Rehabilitation needed primarily because of bad construction performance.

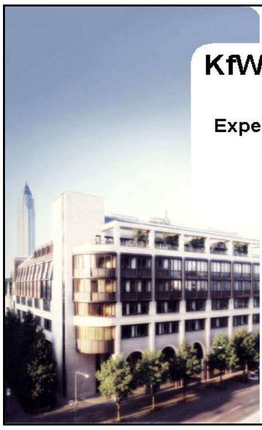
### Rehabilitation of panel buildings

- 1/3 of East German households live in Panel Buildings
- Rehabilitated Panel Buildings are more modern than flats in old houses
- Rent in Panel Buildings are lower than in new houses
- There are less empty Panel Buildings than other housing

### Program conditions

| | |
|---|---|
| Payment: | 100 % |
| Interest Rate (per Nov. 9, 2001) | 3,44 % (fixed for the first 10 years) |
| Repayment Period | 30 years |

Please find the actual interest rates on the KfW internet page http://www.kfw.de



# KfW-Housing Modernisation Programme

Experience with Refurbishment of Panel Buildings in Eastern Germany

**Georg Kraft**

CTI Capacity Building Seminar for CEE/FSU Countries

December 5-9 2001
Ostritz, Germany

KfW DEUTSCHLANDS GROSSE FÖRDERBANK

Slide 1

## KfW-Housing Modernisation Programme

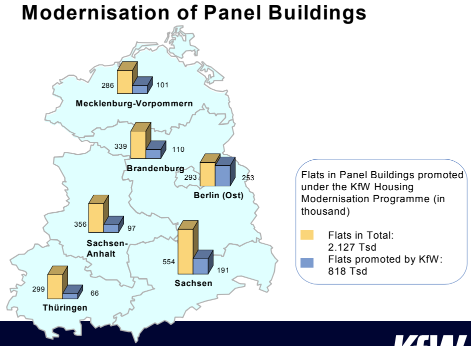
Data on Flats in Eastern Germany

| | Number in 1000 | % |
|---|---|---|
| Flats Total | 7,363 | 100 |
| Of which are in: | | |
| - Old Houses (constructed up until 1948) | 3,393 | 46 |
| - Panel Buildings | 2,127 | 29 |

KfW

Slide 2

## KfW-Housing Modernisation Programme
### Modernisation of Panel Buildings




KfW

Slide 3

## KfW-Housing Modernisation Programme

- building modernisation work to improve the functional value of individual flats (e.g. sound insulation, flat layout, sanitary installations)
- construction measures to improve the general housing conditions (e.g.communal facilities, construction or expansion of balconies (loggias)
- installation and upgrading of lifts
- measures for energy conservation or reduction of $SO_2$ and $CO_2$ emissions (e.g. replacement of windows, modernisation of heating including changeover to fuels that emit less $CO_2$, installation of central heating, hot water supply and heat insulation)
- rehabilitation (repair and replacement of defective building components, e.g. roof, facade, windows, floors, stairs)

KfW

Slide 4

## KfW-Housing Modernisation Programme

**Energy Saving in the Housing Modernisation Programme:**
(Total including Panel Buildings)

- 50 % of all Credits
- 20 % of Volume
- Mainly Change of Heating Systems/Fuel change from high-emission coal to gas and oil
- Annual Reduction of 6 Miot $CO_2$ (to reach the objective of the German government of a 25 % $CO_2$ reduction in households in Germany, a reduction of 32 Miot $CO_2$ would be necessary)

KfW

Slide 5

## KfW-Housing Modernisation Programme

**Credit Requests for Panel Buildings**

- Rehabilitation 77 %
- Energy Saving 10 %

Rehabilitation needed primarily because of bad construction performance.

KfW

Slide 6

## KfW-Housing Modernisation Programme

**Rehabilitation of Panel Buildings**

- 1/3 of East German households live in Panel Buildings
- Rehabilitated Panel Buildings are more modern than flats in old houses
- Rent in Panel Buildings are lower than in new houses
- There are less empty Panel Buildings than other housing

KfW

Slide 7

## KfW-Housing Modernisation Programme

**Programme Conditions**

- **Payment:** 100 %
- **Interest Rate (per Nov. 9, 2001):** 3,44 % (fixed for the first 10 years)
- **Repayment Period:** 30 years

Please find the actual interest rates on the KfW-Internet-Page http://www.kfw.de

KfW

Slide 8

# Best Practice: Thermal Energy Conservation in the Building Sector

**Tamuna Abazadze**

Georgian Operations Tebodin Georgia

**Project Title: Renovation of Heating and Ventilation System in TBILISI Opera and Ballet House**

In 1999-2000 in the framework of the TACIS program the pilot project at TBILISI Paliashvili's State Academic Opera and Ballet House was successfully completed. The aim of the pilot project was to renovate the old heating and ventilation systems.

Nowadays energy crisis showed the inefficiency of the present heating and ventilation system in TBILISI Opera House. The old system was designed during Soviet Union on a permanent consumption of diesel fuel. And the TBILISI Opera House as an architecturally unique building faced a huge heating problem.

Heating became a key problem for artists and musicians during the last 10 years. It was terribly cold inside of the building. According to the old design, during winter the heat flow was coming from the ceiling resulting in +13°C low temperature in auditorium, in orchestra ditch and stage. Artists and musicians suffering from the low temperature during performances, started leaving the Opera House - it was impossible physically to work during the winter season. The situation was so difficult that Mr. Lomidze, Director of Tbilisi Opera House, asked for help by TACIS.

The pilot project started in December 1999 by carrying out a comprehensive energy audit. Based on the results of the energy audit, it took a number of months work of TACIS expert Mr. Mircea Abrahamsson, Project Manager Ms. Tamara Abazadze and energetic input of Director of TACIS EEC Mr. Bernard Froelicher to find a correct technical solution: the solution mainly consisted in modification of airflow in auditorium and the other 14 modifications for increasing of temperature on the stage, in orchestra ditch, in foyers, in ballet rehearsal rooms and other places devoted to public and actors.

For the huge public auditorium (for 1,100 persons, area 550 m², volume 9,900 m³, height 18 m) was proposed a specific technical solution by reversing the airflow. For stage and orchestra ditch it was decided heating a volume under stage and orchestra ditch, to blow hot air to foyers, to make windows double-glazing in ballet rehearsal halls, as well as some other improvements for increasing the boilers´ efficiency.

For implementation of the 2nd phase - installation works – with an advertisement published in 3 local newspapers, 12 companies expressed a wish to participate in the project. The local Georgian company MRETSVENTILATCIA Ltd. has been sub-contracted.

The installation started in June 2000 in 2 phases: by local works and installation of supplied equipment from Western Europe. There were installed huge energy efficient air heaters and fans, gas burners for the boilers, double-glazing on windows, by-pass pipes, insulation etc. The heating system has been connected to the natural gas supply system. The Municipality of TBILISI provided the gas piping system and the US company CHEVRON paid for an amount of 180.000m³ gas for the whole heating season. Installation works were finished in October 2000.

Presently a new heating system provides heating to the auditorium where the average temperature is +25°C, stage and orchestra ditch are heated up to +20°C, enough to give a comfortable feeling to opera singers, ballerinas and musicians. Also nice warmth meets people in foyers and wardrobes. The climate in ballet rehearsal rooms is improved and temperature increased up to +23°C. Thanks to energy efficiency measures implemented and energy savings achieved, the whole system keeps warm inside this huge building by making nesting with all improved facilities. Energy efficiency of heat supply in the boiler has been significantly increased. The ventilation system is quite effective in the summer.

The final phase of the project – testing and monitoring - was completed in November 2000. At 9th of December 2001 it was organized a press conference and at the end an official inauguration of the new heating system took place with a special opera performance and gala concert. Besides, a videotape has been made during works performed.

The project has been successfully implemented through the grant assistance from European Union's TACIS Program for an amount of 34,142 $, project duration 1 year and payback time 3.25 months.

**Calculation of economic effect of new heating and ventilation system of the TBILISI State Academic Opera and Ballet House**

Current energy billing:

- Electricity consumed for lighting, all fans & equipment: 1,500GEL/month (750 $/month)
- For fuel (natural gas) consumed for permanent heating: 10,000GEL/month (5,000 $/month)
- Total monthly NEW Energy Billing: 11.500GEL/month (5,750 $/month).

The main achievement of energy efficiency in this project is that for heating of the huge building (total area 3,900 m², maximum height of building 30.6 m, volume 97,500 m³) it is necessary to switch on the new heating system 3 hours before performance to an average temperature in auditorium of +25°C, on the stage +20°C, orchestra ditch +22°C, ballet rehearsal rooms +23°C, in foyers +25°C.

The old heating & ventilation system did not give an opportunity to save energy and consequently also money for the reason that the old system was designed for a permanent use of fuel according to Soviet standards which nowadays is pretty expensive compared to fuel prices of Soviet times. Before renovation it was necessary to start heating in the building 3-4 days permanently (!) before each performance and a significant heat effect could not be achieved at all – the building was cold!

Past energy billing:

- Electricity consumed for heating system: 3,500 GEL/month (1,750 $/month)
- Fuel (diesel) consumed for building heating: 1.2 tons/day (2 boilers working full capacity, fuel consumption 50L/hr/boiler. Average monthly fuel billing: 35,000 GEL/month.
- Total monthly OLD Energy Billing: 38,500 GEL/month (19,250 $/month).

| | |
|---|---|
| Energy savings achieved | 13,500 $/month |
| Investment provided for heating system | 34,142 $ |
| Investment provided for gas piping | 10,000 $ |
| Total Investment | 44,000 $ |
| Payback period | 44,000/13,500 =3.25 month |

# Best Practice: Renovation of Heating and Ventilation System in Tbilisi Opera House

**Paata Janelidze**

National Agency on Climate Change at the Ministry of Environment of Georgia

**Tamuna Abazadze**

Georgian Operations Tebodin Georgia

**Climate Technology and Energy Efficiency – Disseminating "Best Practice" Experience**
**Ostritz, 5-9 December 2001**

**<u>BEST PRACTICE:</u> RENOVATION OF HEATING AND VENTILATION SYSTEM IN TBILISI OPERA HOUSE**

**ESTIMATION OF GHG REDUCTION**

**Paata JANELIDZE, Tamuna ABAZADZE**
**National Agency on Climate Change**
**at the Ministry of Environment of Georgia**

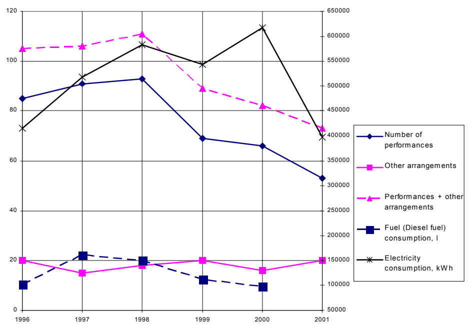
Slide 1

## GHG reduction is caused by:

- Thermal energy saving - 38% - due to the new heating and ventilation system;
- Electricity saving – due to the decrease of duration of ventilation;
- Fuel switch – Natural gas instead of Diesel fuel.

2

Slide 2

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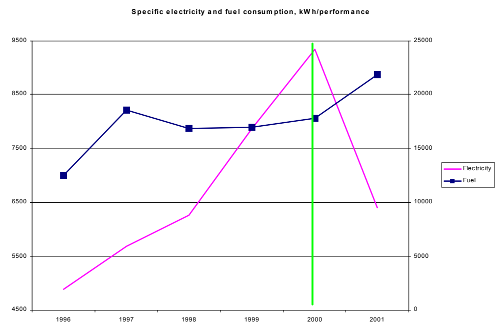


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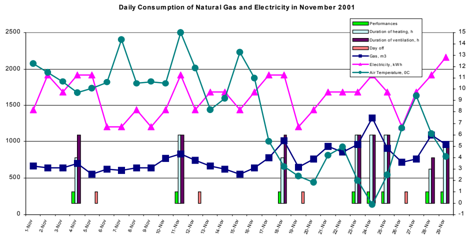


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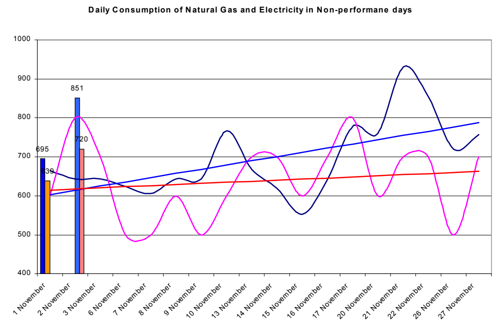


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## Assumptions

**Baseline**

- Energy demand will be met in 2007;
- Number of performances will be increased up to 120 by 2007;

**Project**

- Energy demand is met;
- Number of performances will be increased up to 120 by 2007;
- Natural gas daily consumption in non-heating season 80m3

**Emission Factor in Electricity Generation, kg C2/kWh**

| | Winter | Summer | Annual |
|---|---|---|---|
| 2001 | 0.347 | 0.154 | 0.257 |
| 2002 | 0.369 | 0.166 | 0.275 |
| 2003 | 0.371 | 0.157 | 0.268 |
| 2004 | 0.368 | 0.150 | 0.262 |
| 2005 | 0.365 | 0.147 | 0.258 |

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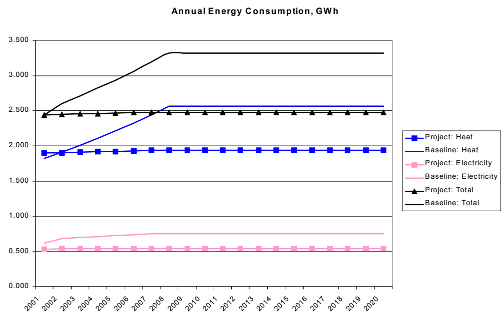


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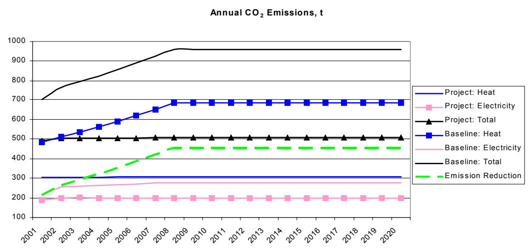


| | |
|---|---|
| Total investment: | 35,142 USD |
| Total emission reduction for 2001-2020: | 8,123 t CO2 |
| Emission reduction cost: | 5.43 USD/t |

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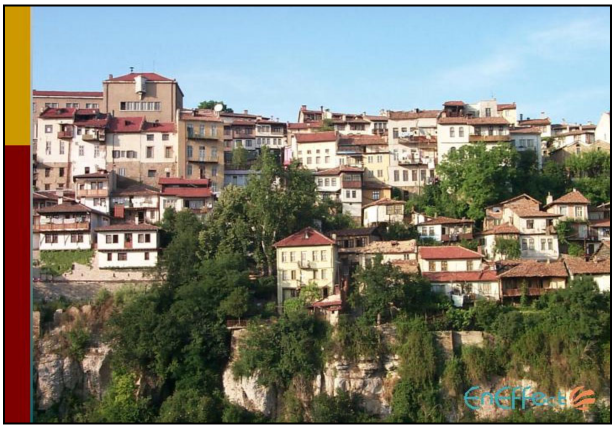
# Good Energy Efficiency Practices in Bulgaria

**Dr. Zdravko Genchev**

Center for Energy Efficiency EnEffect

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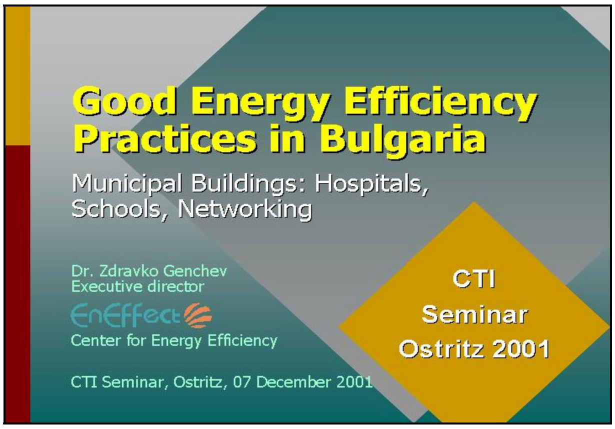


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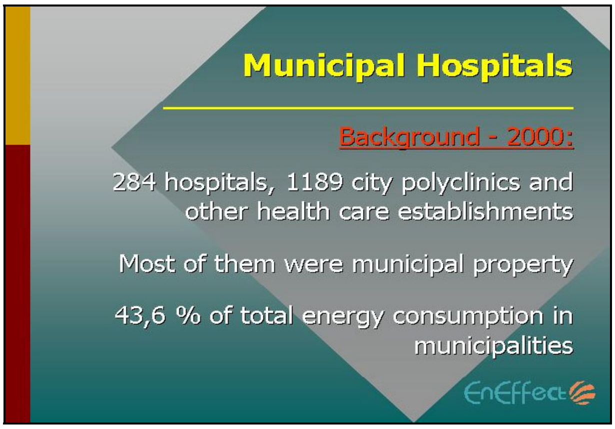


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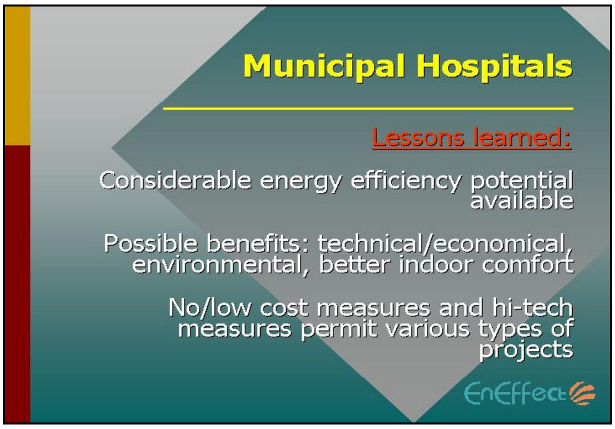


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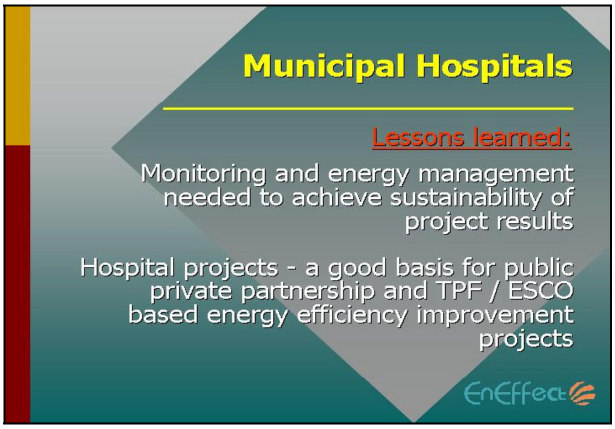


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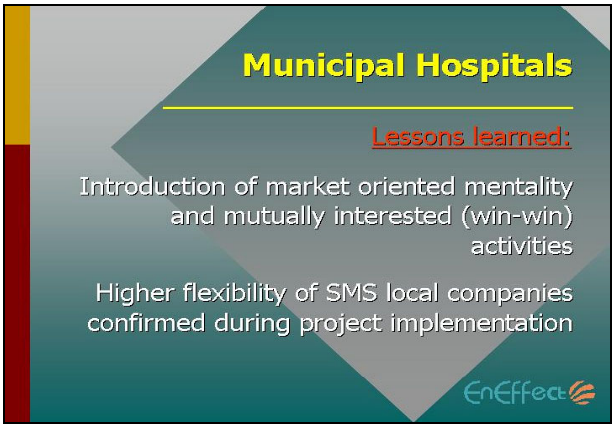


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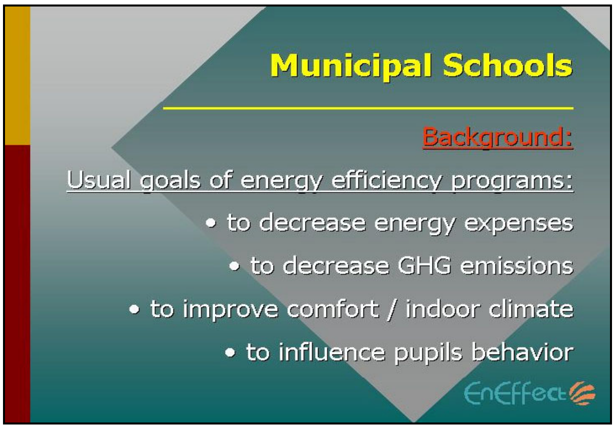


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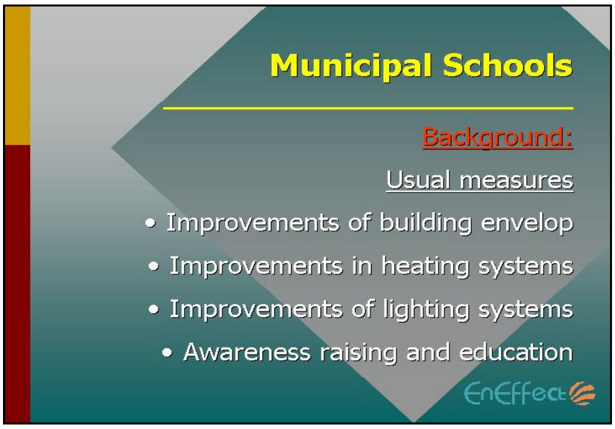


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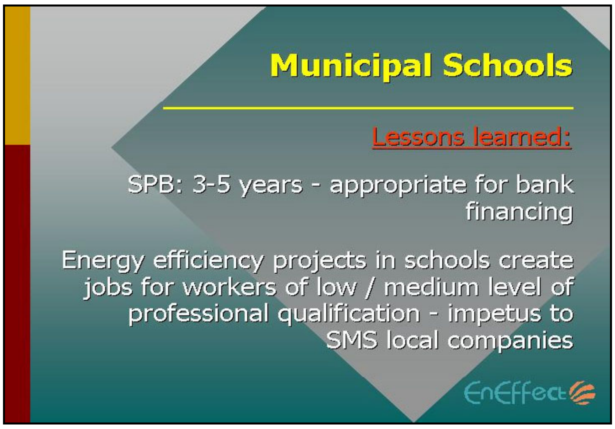


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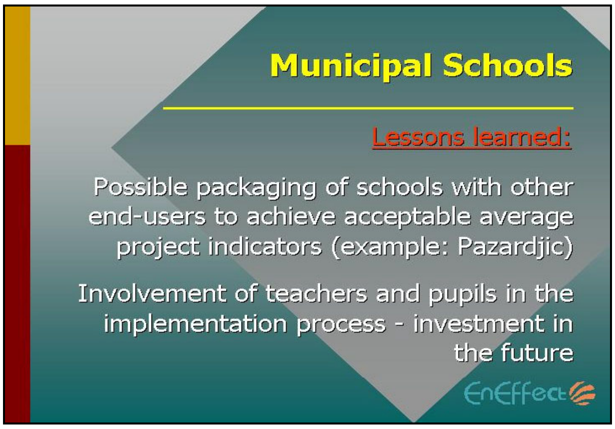


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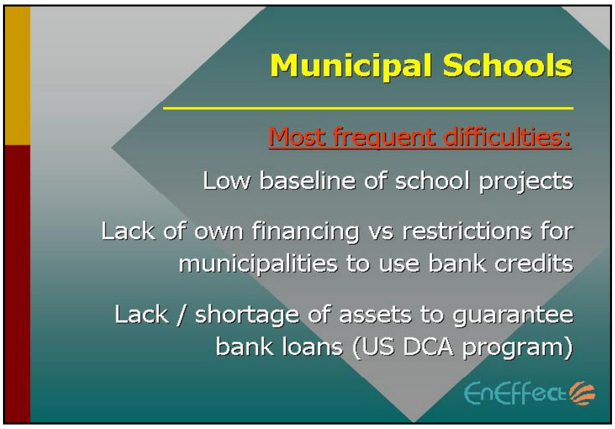


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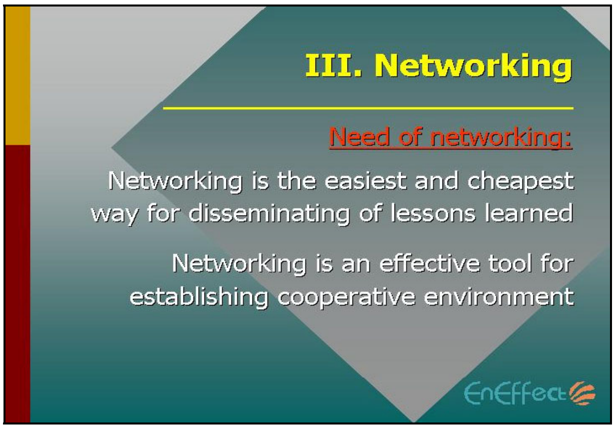


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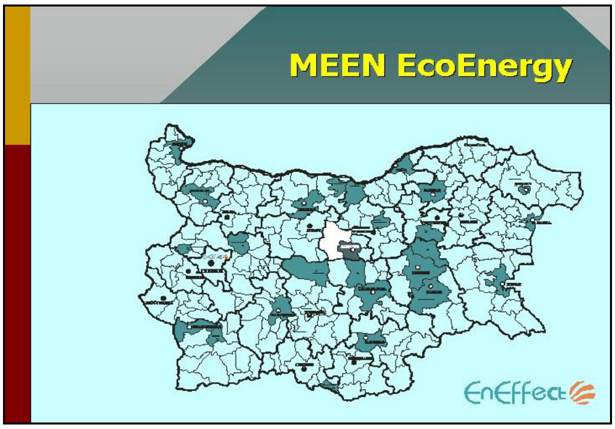


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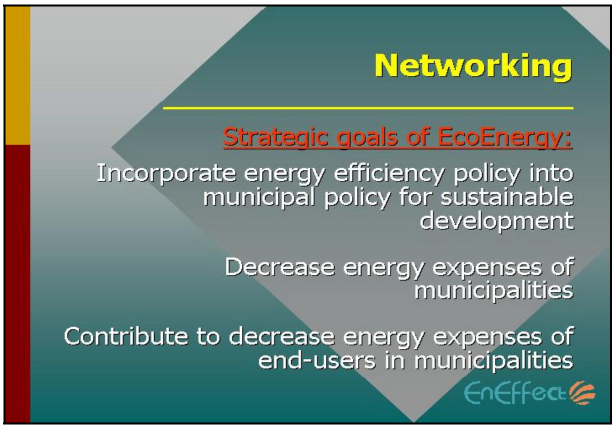


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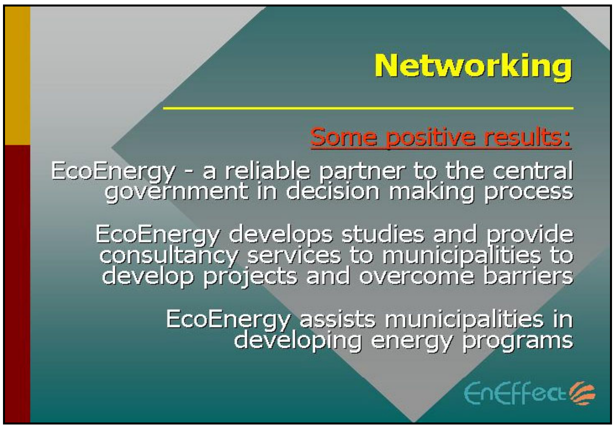


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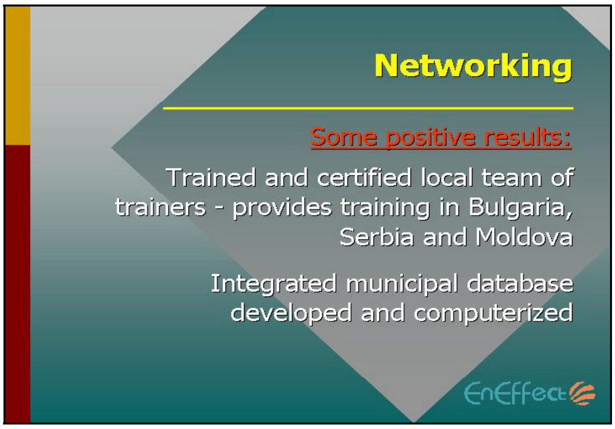


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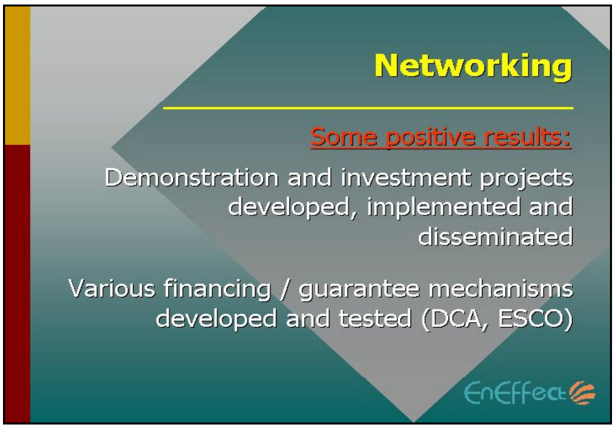


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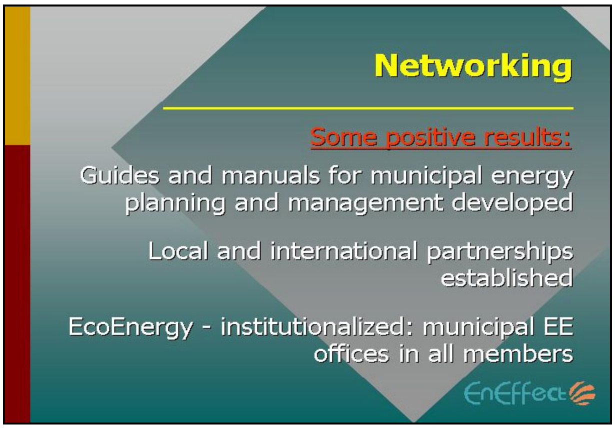


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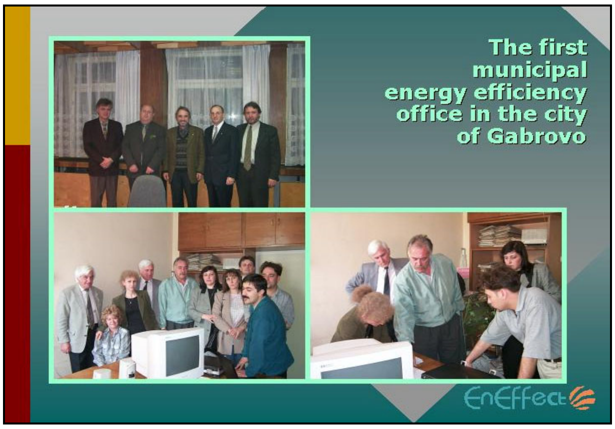


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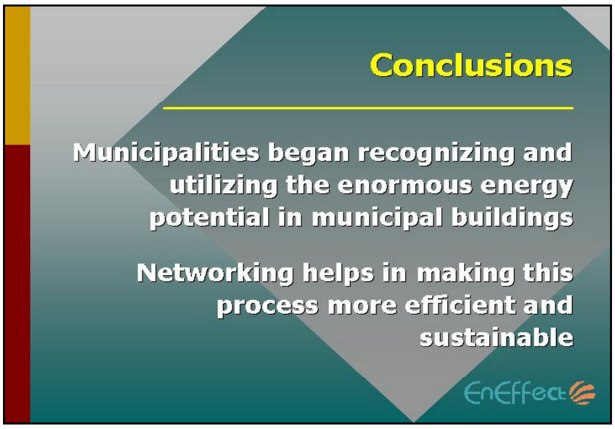


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# The Energy Efficiency Housing Pilot Project in Lithuania

**Eduardas Kazakevičius**

Housing and Urban Development Foundation Vilnius / Lithuania

## 1. Introduction

After the break-up of the Soviet Union, Lithuania inherited housing with space heating intensity significantly higher than that of the Western European countries. In an attempt to boost energy efficiency of residential and public buildings the Lithuanian government signed a loan agreement with the World Bank and started the Energy Efficiency Housing Pilot Project (EEHPP) in 1996. The project objectives were to: (a) support private initiatives to improve residential energy efficiency; (b) support public initiatives in improving energy efficiency in schools; (c) support the privatization of housing, enabling increased private initiatives in housing maintenance.

The project objectives should have been achieved through: (a) provision of loans for technically and economically attractive packages of energy efficiency measures; (b) introduction of the concept of long-term lending for housing improvement to the commercial banking sector; (c) development of energy consulting services and (d) support for municipalities in the energy efficiency rehabilitation of schools.

Out of the US$ 10 million World Bank loan, US$ 5.3 million was allocated for implementation of energy efficiency measures in residential buildings and US$ 4.7 million was allocated for municipalities to invest in public schools. The Lithuanian government agreed to provide 30 percent matching funds for the project.

The Danish Ministry of Housing and Urban Affairs and the Dutch Ministry of Economics provided the core technical assistance funds. The Housing and Urban Development Foundation was selected as the project management unit.

## 2. The project challenges

The project implementation started in the beginning of 1997. Funds for school renovation were channeled to participating municipalities via the Ministry of Finance of Lithuania. 12 municipalities benefited from the project and implemented energy efficiency measures in 54 public schools and kindergartens. Technical monitoring of two retrofitted secondary schools demonstrated a decrease in average calculated heat consumption by more than 40 percent. Successful implementation of public school renovation projects generated significant demand from the municipalities for further loans.

Much more challenging was the disbursement of loans for renovation of residential single and multifamily buildings. One of the project objectives was to advance the Lithuanian commercial banking system therefore residential loans to the final beneficiaries were extended via local commercial banks. Loans to homeowners' associations were furnished with a state guarantee due to numerous legal difficulties and high transaction costs related to mortgaging of separate apartments in multifamily buildings. In order to strengthen financial accountability the homeowners association law was amended. Failure by an association member to repay a state guaranteed loan could result in foreclosure of a debtor's property (i.e. apartment).

In the mid 1990s Lithuanian commercial banks lacked sufficient knowledge about this market segment. Lack of experience dealing with the commercial banks formed a significant barrier also for households to use bank loans for higher volume investments. There was a distinct need to increase awareness by the customer and the supply chain (including banks) to the attractiveness of this financing.

In the absence of mortgage, technical and financial risks associated with multifamily building renovations should have been partly mitigated by professional energy audits and thoroughly prepared investment projects. However, prior to the project commencement there was very limited understanding of the feasibility and savings potential of various energy efficiency measures in Lithuanian residential buildings. At the project commencement the capacity of local energy consultants was rather limited and in some smaller cities professional services were difficult to find. In addition numerous households did not realize the importance of professional energy consulting services and therefore demand for such services was low. Substantial efforts were needed to boost the capacity of the Lithuanian energy consultants and generate sustainable demand for their services.

Around 50 percent of homeowners' associations were re-registered former cooperatives, which had some traditions and skills needed for more substantial communal undertakings. The rest of the associations were formed by apartment owners who lived in the state or municipal owned buildings hence their experience with property management issues was quite limited. As a result, associations were very diverse in their sizes, performance and capacity to carry out building renovation tasks and implement energy efficiency measures. Significant support was needed to enhance household confidence in energy efficiency measures and support them in all stages of the project implementation.

## 3. The project development

Since the beginning of 1997, homeowners' associations and individual homeowners were able to apply for loans in local currency with 11% annual interest rate and maturity of up to 10 years. During 1997 and 1998 the Housing and Urban Development Foundation with Danish assistance established five regional advisory centers that quickly became "melting pots" for housing renovation and energy efficiency activities. In these centers households could get free advice on technical, financial, organizational and legal issues. Advisory center staff also carried out public information activities and assisted homeowners' associations in various phases of the EEHPP project.

Dutch support facilitated the development of energy consulting services in the country. From the project commencement till the second half of 1999 costs associated with preparation of energy audits and investment projects for homeowners' associations were paid from Dutch technical support funds. In addition Dutch and Danish experts conducted numerous training courses for local consultants, assisted in development of professional tools and helped with technical and social monitoring of performed projects. All these efforts substantially advanced awareness of Lithuanian homeowners about the project and its opportunities and initiated the first wave of the project participants in 1997 – 1998.

However a significant fraction of performed energy audits and prepared investment proposals did not result in signed loan agreements and implemented projects and loan disbursements fell behind the schedule in 1998. Numerous homeowners still perceived the loan as "too expensive" and associated with substantial transaction costs and therefore did not proceed beyond free energy audits.

In the second half of 1998 the project management unit proposed the introduction of a 30 percent grant for homeowners' associations participating in the project. The rationale was to improve affordability of loans for renovation of multifamily buildings and encourage formation of homeowners' associations in the country. This initiative was approved by the government and the grant scheme was available since the beginning of 1999.

During the first months of 1999 a more targeted information campaign was conducted. Almost every member of a homeowners' association in the country (around 200,000 households) was supplied with a newsletter that explained the new grant scheme, energy efficiency opportunities and provided success stories. Improved financial conditions together with an already developed support network resulted in a significant increase of loan applications since the beginning of 1999. An average loan size for homeowners associations increased from US$ 22,000 in 1997 to almost $50,000 in 2000. The range of energy efficiency measures implemented by homeowners' associations also considerably expanded.

As of 30$^{th}$ of June, 2001, 211 associations and 26 individual homeowners signed 260 loan agreements for the whole allocated amount. So far all participating homeowners' associations were very disciplined in loan repayments and numerous households repaid loans in advance. As of September 1, 2001 around US$ 2.4 million of the extended loans were already repaid instead of the scheduled $ 1.5 million.

In accordance with the signed agreement the loan repayment to the World Bank should last till the year 2016.

Therefore available funds repaid by participating homeowners' associations create a revolving fund thus enabling new homeowners' associations to improve energy efficiency of their buildings.

## 4. The project results

The project exposed a number of legal, economic and institutional barriers inhibiting wide scale implementation of energy efficiency measures in residential buildings. Removal of these barriers could increase the share of household investments spent for energy efficiency measures. Nevertheless the project demonstrated that active involvement of the banking sector and availability of long term financing opportunities are essential for the sustainable improvement of energy efficiency of Lithuanian housing.

Initial project evaluation was performed via the technical and social monitoring of 18 projects implemented in 1997 and 1998. Most of the monitored buildings belonged to the initial group of projects with rather limited scope of implemented energy efficiency measures therefore results of the performed monitoring cannot be mechanically applied for the whole project. Nevertheless they can illustrate some of the project accomplishments.

The monitored projects could be divided into two groups. The first group (14 buildings) usually included replacement of the heat substation and some other minor repairs, whereas the second group (4 buildings) also included roof and wall insulation, window repair or replacement, thermostatic valves and individual heat cost allocators. Average calculated heat consumption (assuming unchanged indoor temperatures of 18 degrees centigrade) in the monitored buildings decreased by approximately 20 percent but in individual cases heat savings varied from 5 to almost 50 percent.

Cost-effectiveness of the monitored projects was evaluated on the basis of the achieved energy savings. Only investments directly related to improvement of energy efficiency were used for calculations of simple pay-back periods. Investments for building repair or maintenance were excluded. The simple pay-back period of the monitored buildings varied from less than 4 to more than 16 years with an average value close to 8 years. It is important to mention that the second group of projects (with bigger investments) had payback periods close to the average due to higher savings.

The project significantly advanced the perceptions of the Lithuanian society regarding energy efficiency as well as borrowing, though to a limited extent, and demonstrated that joint efforts of capable private businesses, municipalities and homeowners can lead to successful renovation of residential and public buildings. The limited social survey results confirmed the importance of comprehensive assistance for homeowners' associations undertaking energy efficiency improvements. The social monitoring results indicated that around 90 percent of the surveyed households did not have significant problems with loan repayment and would recommend other associations to participate in the project.

## 5. Conclusions

Successful implementation of public school renovation projects generated significant demand from the municipalities' side for further loans. Municipal investments are mainly limited by scarce budgetary means. Implementation of the residential part of the Energy Efficiency Housing Pilot Project required integration of:

- a well tailored legal framework allowing homeowners' associations to obtain bank loans without mortgaging individual apartments thus reducing transaction costs and household reluctance;
- affordable financing of energy efficiency improvements that consisted of the long term loan and the state grant;
- comprehensive institutional support for homeowners via regional advisory centers;
- expanded and improved services of local energy consultants which ensured positive results of implemented renovations;
- enhanced public awareness on energy efficiency opportunities in residential buildings and benefits offered by the project.

Only synergy of all those stakeholders ensured success of the project. Designers of similar undertakings in other Eastern and Central European countries should explore all potential bottlenecks in their countries, be it low awareness, legislative hurdles, high transaction costs or insufficient capacity, and then plan a set of measures that could address all those problems. Any barriers, if not addressed properly, could obstruct development of the whole process. More could be done, for example, in reducing transaction costs, streamlining processing procedures and finding credit enhancements designed to attract local commercial lending to this market segment. Energy efficiency improvement in Lithuanian residential and public buildings gained a certain pace during the implementation of the EEHPP project. In the near future it is important to achieve sustainable progress with minimum and well-targeted state intervention.

## Lessons of the Energy Efficiency Housing Pilot Project in Lithuania

**LITHUANIAN HOUSING**


- More than 900,000 apartments in 30,000 multifamily buildings;
- Approximately 4500 homeowners' associations;
- Most of residential buildings were constructed according to the soviet norms and were poorly maintained;
- Average space heating intensity in 96 monitored buildings was 152 kJ/m2/degree-day.

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Slide 1

**ENERGY EFFICIENCY HOUSING PILOT PROJECT, OBJECTIVES**

- Support private initiatives to improve residential energy efficiency;
- Support public initiatives in improving energy efficiency in schools;
- Support the privatization of housing, enabling increased private initiatives in housing maintenance.

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**FUNDING**

- The World Bank US$ 10 million loan;
- Matching funds provided by the Lithuanian government;
- Technical support funds provided by Danish and Dutch governments.

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**CONSTITUENTS**

- Provision of loans for technically and economically attractive packages of energy efficiency measures;
- Introduction of the concept of long-term lending for housing improvement to the commercial banking sector;
- Development of energy consulting services;
- Support for municipalities in the energy efficiency rehabilitation of schools.

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**PUBLIC SCHOOL RENOVATION**

- 1997 - 2000: 12 municipalities implemented energy efficiency measures in 53 public schools and kindergartens with 27 thousand pupils;
- Monitoring of 18 renovated schools demonstrated average heat savings of 24 percent and significant increase of indoor comfort:

| | Before | After |
|---|---|---|
| "Vyturio" secondary school, Kaunas | 15° C<br>193 kWh/m2 | 18° C<br>117 kWh/m2 |
| Vilijampolė secondary school, Kaunas | 14°C<br>237 kWh/m2 | 16° C<br>128 kWh/m2 |

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**RENOVATION OF RESIDENTIAL BUILDINGS: CHALLENGES**

- Limited public awareness of energy efficiency opportunities;
- Limited financial and organizational capacity of Lithuanian homeowners to implement substantial communal undertakings;
- Undeveloped energy consulting services;
- Lack of relevant legislation;
- Immature banking sector.

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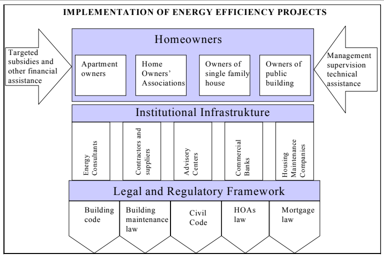
## APPROACH

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## MEASURES

- ❑ Targeted information campaigns on energy efficiency opportunities in multifamily buildings (more than 200,000 copies of a project newsletter distributed via direct mail);
- ❑ Five regional advisory centers consulting homeowners on technical, legal, financial and organizational issues and assisting them in all stages of the project;
- ❑ Comprehensive capacity building program for energy consultants;
- ❑ Amended Homeowners' Association Law, strengthening accountability of homeowners;
- ❑ 30 percent State grant for participating homeowners' associations and support scheme for low income families.

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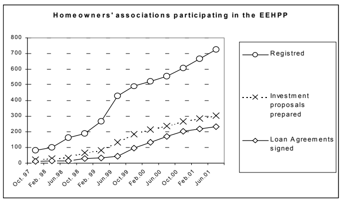
## DEVELOPMENT, 1997 - 2001




As of June 2001:

- ❑ More than 700 participants;
- ❑ More than 300 investment projects;
- ❑ More than US$ 8 million invested;
- ❑ 260 loan agreements with associations and individual homeowners

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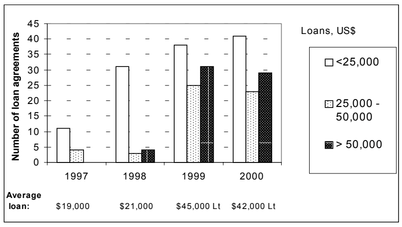
## LOANS, 1997 - 2000

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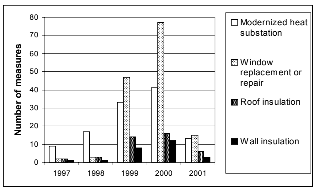
## IMPLEMENTED MEASURES, 1997 - 2001*




- ❑ 113 modern heat substations installed;
- ❑ Windows in 144 buildings replaced or repaired;
- ❑ Roofs of 41 multifamily buildings insulated;
- ❑ Walls of 25 multifamily buildings insulated.

* - as of June 2001

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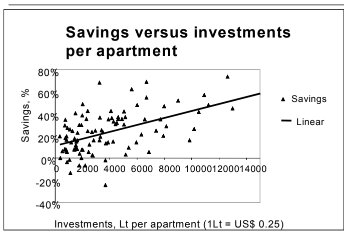
## MONITORING RESULTS OF 96 RENOVATED BUILDINGS




- ❑ Average comfort adjusted savings of 24 %;
- ❑ Annual savings in all renovated multifamily buildings around 23 GWh worth US$ 0.7 - 0.8 million;
- ❑ Annual reduction of CO2 emissions of 8,500 tons.

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## FINANCIAL AND SOCIAL ASSESSMENT

- ❑ Average simple payback period for 96 monitored buildings amounted to 10.5 years;
- ❑ More than 60 percent out of 250 surveyed families indicated that loan repayment represents an insignificant or negligible burden on their family budgets;
- ❑ No defaults, as of September 2001;
- ❑ US$ 2.5 million repaid instead of $1.5 million due, as of September 2001;
- ❑ 56% of the surveyed families indicated reduced expenditures for heat, 48% improved indoor comfort, 30% improved building appearance.

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## LESSONS

The EEHPP project success required integration of:

- ❑ tailored legal framework allowing homeowners associations to obtain loans without mortgage;
- ❑ affordable financing consisting of the long term loan and the state grant;
- ❑ comprehensive support via regional advisory centers;
- ❑ enhanced public awareness of energy efficiency opportunities;
- ❑ improved services of local energy consultants;
- ❑ heat tariffs reflecting real costs and effective collection of heating fees.

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# Regional Networking to Promote EU Accession Process –

# RENEUER

**Dr. Zdravko Genchev**

Center for Energy Efficiency EnEffect


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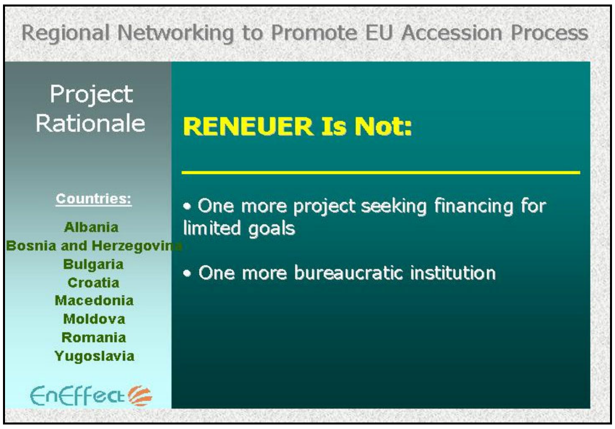


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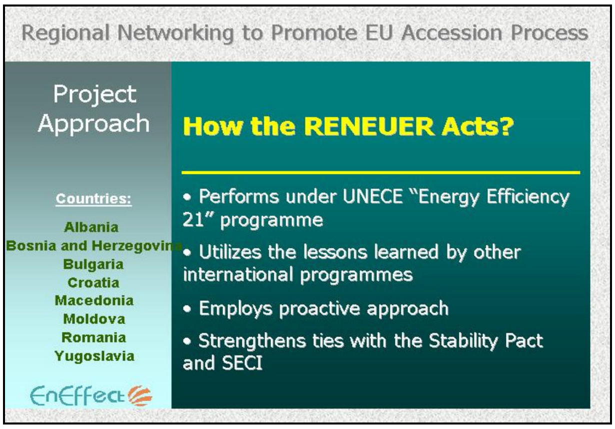


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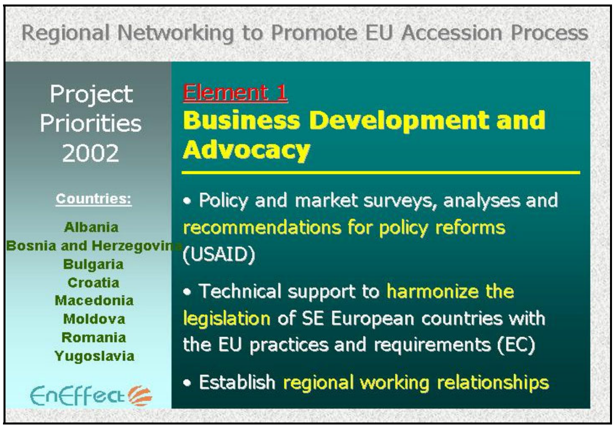


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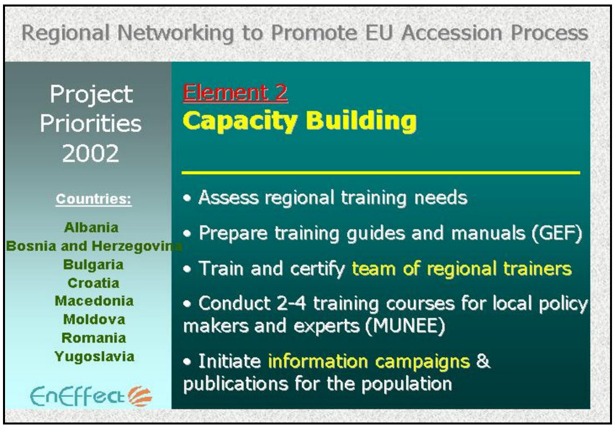


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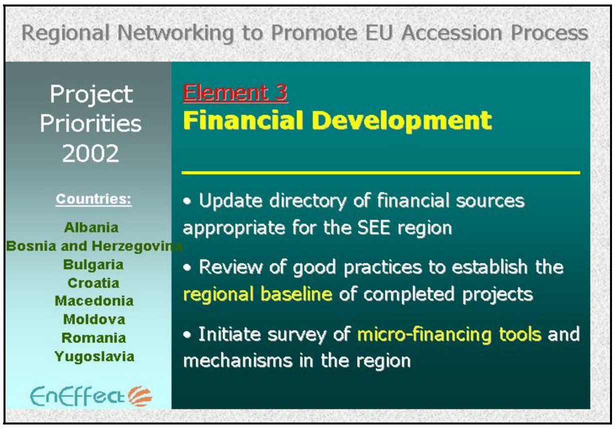


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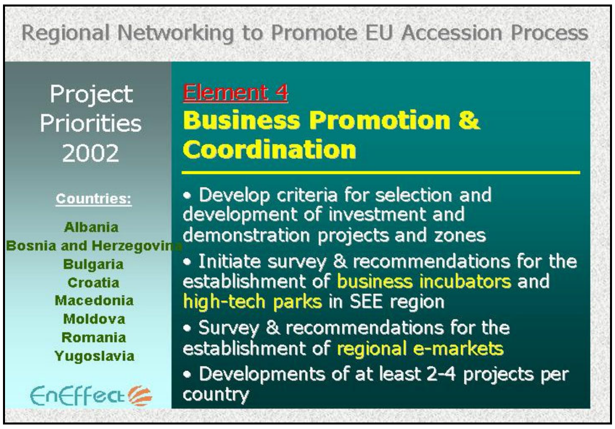


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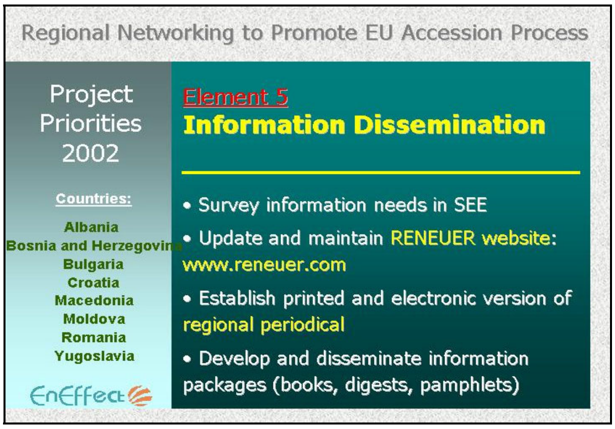


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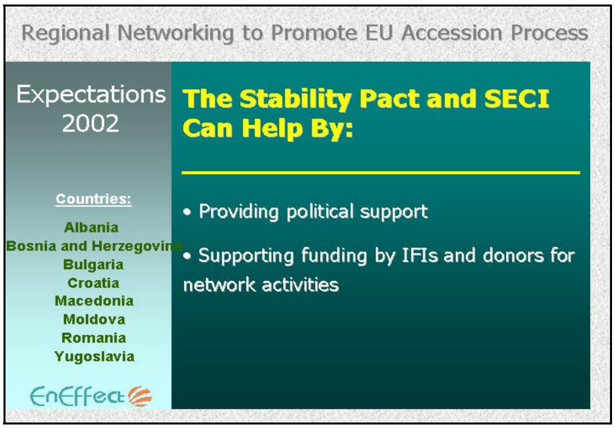


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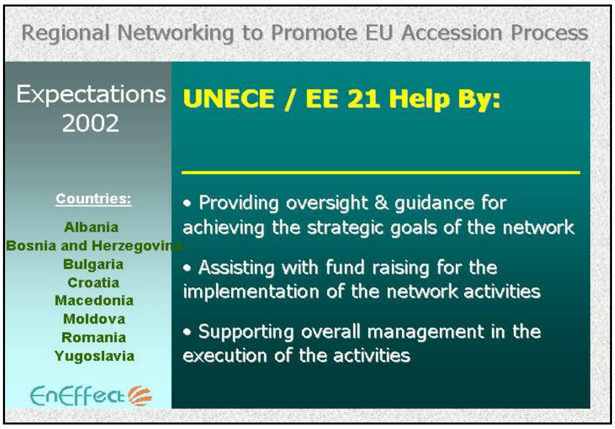


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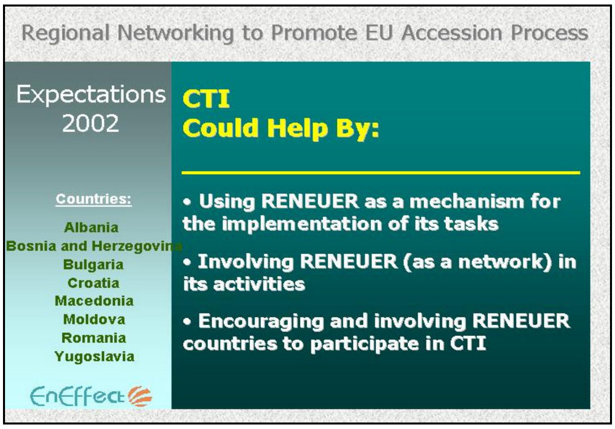


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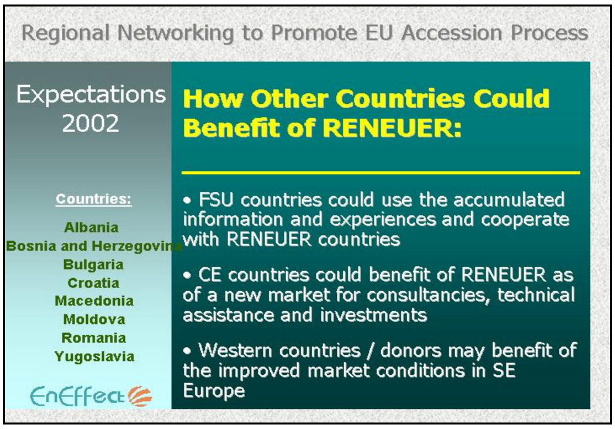


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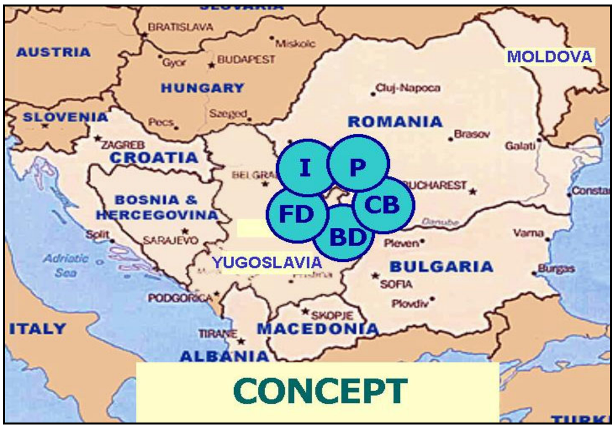


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# Discussant Notes

## Session: Thermal Energy Conservation in the Building Sector

**Dr. Igor Bashmakov**

Center for Energy Efficiency, CENEf

**Key issues**

- How is energy delivered to the building and at what costs?
- What are possible savings in buildings?
- Bad habits or bad incentives? Are we wise or otherwise?
- Absorptive capacity. Scale of implementation: how many replications are following the "best practices"?
- Economics of improvements
- Who and how benefits: whether capable have wishes and wishing have capabilities?
- Where financings are coming from and at what costs?
- The quantity of energy efficiency product
- What should be made for building sector swallow up "best practices"?

**How is energy delivered to the building, with what reliability and at what costs?**

Central heating from CHP – overall losses 40-65%
HOB – overall losses 40-50%
Individual heating – overall losses 1-10%

**Low quality of heat supply**

Many Buildings and flats are under-heated. In Vladimir

- 80% of residents are using electric heaters, 30% enlarge the radiator surface
- 50% use gas ranges for heating purposes, at the same time
- 40% of residents at spring and 10% at fall are complaining about overheating.

Heat costs vary from 4 to 70 $/Gcal in Russia

Residents are paying 60-100% of costs

Costs are questionable

**What are possible savings in buildings?**

- Present level of consumption
- Level of savings

**Absorptive capacity. Scale of implementation: how many replications are following "best practices"?**

Absorptive capacity is the function of

- Market transformation and creation of interested groups
- Appropriate incentives
- Affordable costs.

It takes time and money to build! In Lithuania in 1997-1998 only 18 projects were started. But in 1999-2001 after Absorptive capacity was developed this number grew up ten fold.
*There are no bad habits, but there are bad incentives and bad market structures!*

**Economics of improvements**

Cost per household

- 5,000 US$Latvia, households are ready to cover only 50% of costs through rent
- 1,000 US$WB Russia
- 70 US$CENEf Russia.

Cost per building

- 20,000-50,000 US$ - Lithuania.

Paybacks:

- Poland 10 years
- Latvia 10 years
- Lithuania 4-18 years with 8 years average.

High unit costs with long paybacks!

Russia – weatherization – 1 year payback with electricity savings
*Who and how benefits: whether capable have wishes and wishing have capabilities?*

Lithuania

- Homeowners associations
- Regional advisory centers
- Experts capable to conduct energy audits and develop investment projects
- Informational campaigns.

Russia

- Municipalities and heat supply companies have capabilities, but no wish to remove subsidies
- Residents with existing billing system have wish, but cannot benefit.

**Where are financings coming from and at what costs?**

**The quantity of energy efficiency product**

- Energy Audits
- Energy Attestats
- Energy Passports
- Affecting factors:
  - Whether conditions
  - Indoor comfort
  - Supply breaks
  - Occupancy
  - Other.

Need for clear savings accumulation procedures for revolving funds.

**What should be made for building sector swallow up "best practices"?**

- Tailored legal framework
- Affordable financing for EEMs
- Matching financing – soft loans and grants
- Comprehensive institutional support
  - Homeowners associations
  - Energy efficiency centers
  - Project implementation and monitoring units
- Qualified local experts capable to develop and implement EEMs
- Growing public awareness
- Educating local and foreign bankers on EE projects and country specific conditions
- Networking (MUNEE).

# Prospects of Performance Contracting in CEE Countries – Achieved Results and Future Strategies

**Ralf Goldmann**

Berliner Energieagentur GmbH

## Introduction

The energy intensity in the candidate countries is four times higher than in the European Union. The $CO_2$ emissions per unit GDP are five times higher than in the European Union. Major financial efforts in energy sectors will be needed over many years.

Without sizeable private investment it will hardly be possible to produce the necessary funding to speed up the economic and environmental modernization process. (2000 – Annual Energy Review, European Commission DG TREN; January 2001).

In the accession countries there exists a high demand for investment in energy efficiency measures. In order to explore the full energy and cost saving potential, the involvement of private capital is needed. Third Party Financing (TPF) is a frequent concept that ensures the involvement of private capital. This concept is usually implemented by Energy Service Companies (ESCO's), and has been already implemented on a broad scale throughout the EU. In Central and Eastern Europe - despite some positive projects, which have been implemented in the past - there are still certain barriers to overcome especially with regard to smaller projects in general and the application of Energy Performance Contracting EPC. One of the main barriers is the unfavorable ratio between the project development costs and the possible benefit from the project for the private investor. These transactions costs are considered too high for equity investors as well as for international finance organizations, which have set a minimum threshold for funding possibilities under their schemes.

Restrictions in know-how, money and juridical obstacles in the accession countries oppose in general the financing of energy efficiency measures and of small-decentralized energy production.

The TPF-approach is well developed in Germany and Austria, especially in the field of performance contracting, whereas energy saving investments in public buildings are refinanced through the energy savings achieved.

Performance Contracting aims at overcoming the barriers of financing energy efficiency investments and is one proven mechanism to involve private capital in these investments. With public buildings like schools, hospitals and other administrative buildings showing a significant need in the improvement of energy efficiency, one of the main areas where Performance Contracting can help to overcome budgetary barriers is the public sector.

## Examples for successful implementation of Performance Contracting

As one example for the broad successful implementation of performance contracting in the public sector the Energiesparpartnerschaft (Energy Saving Partnership) in Berlin has shown that the creation of building pools for performance contracting can lower the transaction cost and lead to interesting market possibilities for investors. Up to now 300 buildings in nine pools are covered by the model, with a total investment of 16 mln € by private investors in these buildings.

Within the TRANSFORM program, which is supported by KfW (bank under public law) and in order to help overcome the mentioned problems, the Berlin Energy Agency has been coordinating a consulting project for the development of the contracting market in Slovenia since the autumn of 1999.

Slovenia is one of the countries in Central and Eastern Europe that strives to join the European Union as one of the first candidate countries. Slovenia counts 1,98 mln inhabitants on a surface of 20,253 km². The gross domestic product per capita amounts to US $ 10,900 (as of 1999). Only 44.6% of the country's energy consumption is covered by domestic energy sources. The energy intensity is a factor of 1.4 higher than in the European Union. Compared to western European levels, Slovenia's energy prices are 15% lower whereas energy costs in the industrial sector exceed western European prices by 5%.

Within the project, a model contract for performance contracting under Slovenian framework conditions was developed and municipalities for possible pilot projects were identified. As a result of the analysis, pilot performance contracting projects were developed in two municipalities. The tendering procedures for future energy saving partnerships were then handled according to comparable projects in Berlin. In Slovenia, the tendering procedure must conform to EU law. This allows a comprehensible public tendering procedure for western European investors. Research has shown that due to relatively high energy prices, pre-conditions for the development of the contracting market in Slovenia are good.

A best practice project for performance contracting was realized with a building pool in the municipality of Kranj. The municipality of Kranj, an industrial center about 30 km north of the capital Ljubljana, annually consumes about 0.5 mln € worth of energy costs in a building pool of 14 buildings comprising administration buildings, schools and gymnasiums (as of 1999). The expected energy saving potential amounts to 20% of energy costs.

The contract for the building pool has been signed with a Slovenian contractor at the end of November 2001.

The project aims at the sustainable development of the performance contracting market. To this end, part of the project includes the qualification of the state-owned energy efficiency agency AURE as well as the Jozef Stefan Institute as local competence centers for performance contracting.

The main barriers for the successful implementation have been the development of an adapted model contract and the public procurement rules that have to be followed by the municipalities in awarding the contract to a private investor. Still possible foreign investors had to cope with administrative burdens in participating in the tender fulfilling the necessary requirements of the procurement law. After the successful conclusion of the first pilot project, in which no subsidies for the investment are given and all financing is based on commercial banks, the principal procedure has been elaborated and further projects are expected to be implemented. As one conclusion from the project local capacity building in order to moderate the implementation is crucial, and a local contact should be available to assist the municipalities in the implementation of the projects.

## Future outlook

On the initiative of the Berlin Energy Agency and the Energieverwertungsagentur, Austria, with partners from eight CEE countries, a project for co-funding under the SAVE-Program has been submitted and positively evaluated. Following the experience made it aims at the project development for Performance Contracting for all participating CEEC. The main task will be the establishment of a clearinghouse in Berlin and the development of competence centers in the respective CEE Country. Thus, common problems can be solved in an effective way, and access for private investors to the market in the CEEC will be facilitated through the clearinghouse with lower transaction costs for the investor. Given the differences in CEEC the clearinghouse might also help to create project bundles which subsume small projects and thus create funding opportunities for international funding organizations.

The overall objective of the project is to overcome the existing barriers to finance energy efficiency measures in the candidate countries of Central and Eastern Europe. One of the main tools to achieve this goal is Third Party Financing with two approaches, both Energy Performance Contracting and Delivery Contracting. As this tool is already implemented in the European Union, especially in Germany and Austria, the aim of the project is to transfer this model to the CEEC. The main target areas are energy efficiency measures in the public sector and financing Small-Scale CHP, whereas the relative transaction costs compared to the overall project volume hinder the allocation of private capital into these sectors. Thus the project will support the Community Policies in Energy Efficiency and the efforts in the enlargement process towards an increase in energy efficiency by facilitating the allocation of private capital in this sector.

The following activities will be performed in the project:

- Creation of a Clearing House for TPF-Projects in Berlin
- Establishment of a project evaluation steering committee
- Creation of national country contact points in CEEC.

The project will be divided in six international work packages and in eight national work packages in each of the CEE Countries, where based on a common approach, adapted national programs will be worked out.

In each of the participating CEEC a basic investigation on the bordering conditions will be performed and a country report on these conditions will be prepared.

Based on the results of the country reports, a common strategy will be developed for the introduction of TPF-schemes and Performance Contracting projects.

The common methodology will be based on the already existing experience from the introduction of PC in Slovenia. Special emphasis will be put on public procurement schemes allowing TPF projects for public bodies.

As a common working platform an Internet based meeting point will be created, where potential projects, model contracts, and legal obligations and other information of relevance for the potential contractors will be placed. On this platform virtual consultancy services will be performed, where experienced experts from Berlin and Vienna will be available for municipalities or project development companies to assist in the application of PC in their respective country.

The expected result of the action is the widespread uptake of the TPF approach and the development of concrete investment projects financed through this scheme.



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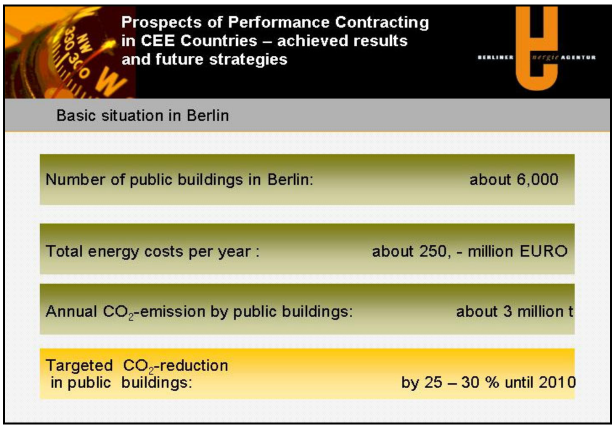


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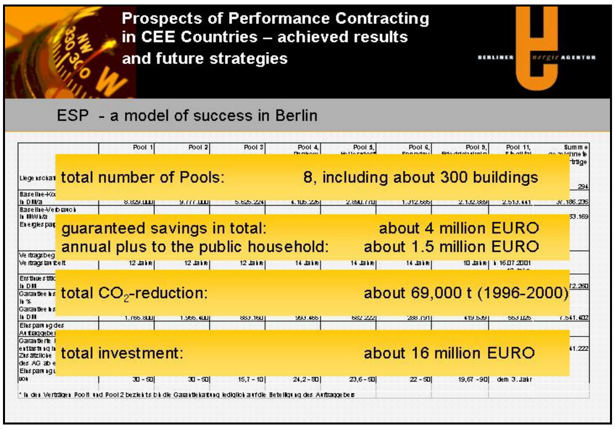


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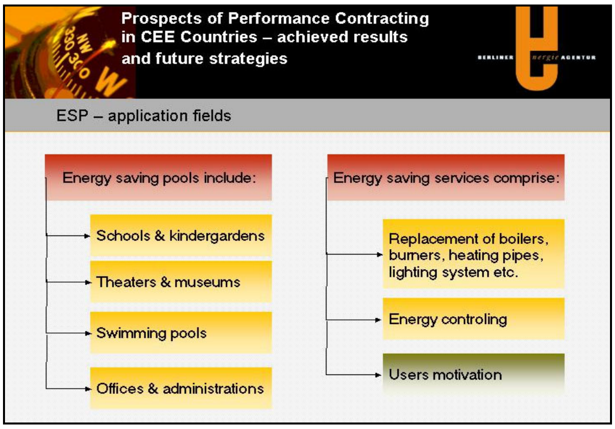


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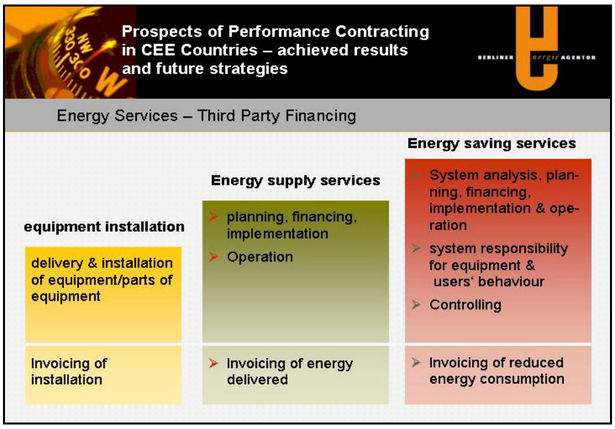


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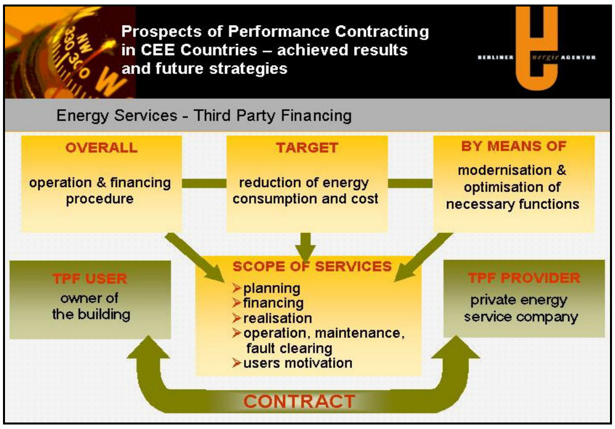


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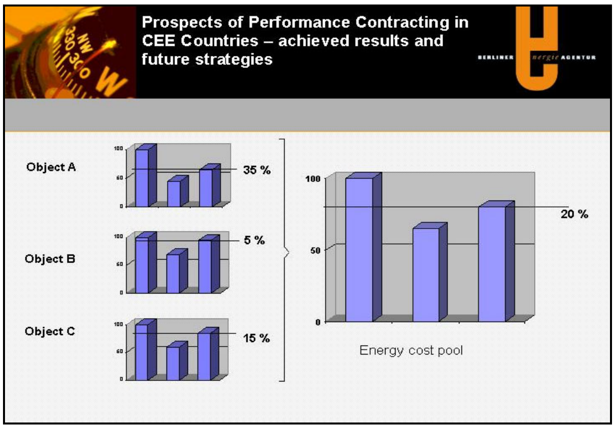


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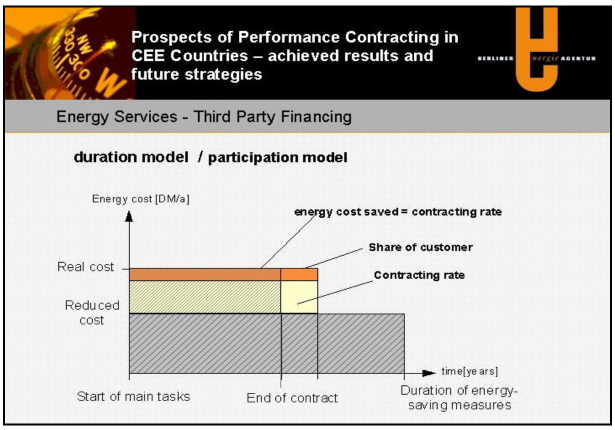


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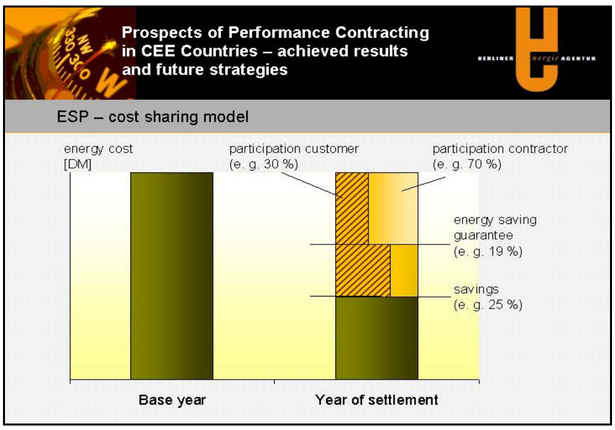


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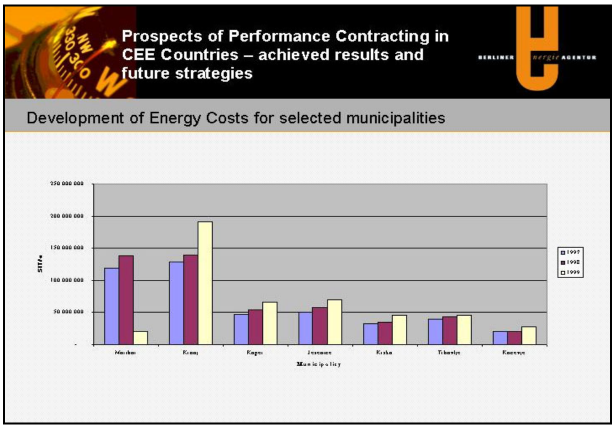


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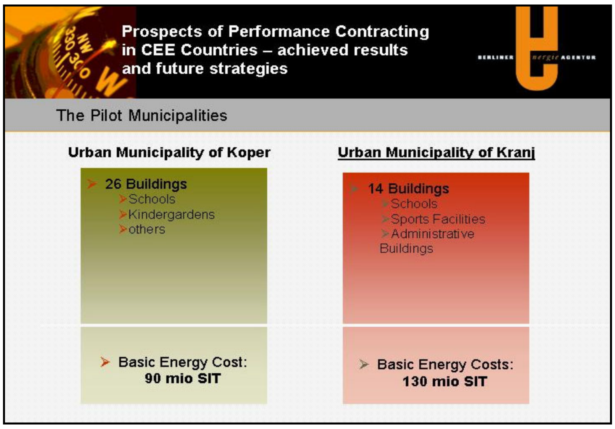


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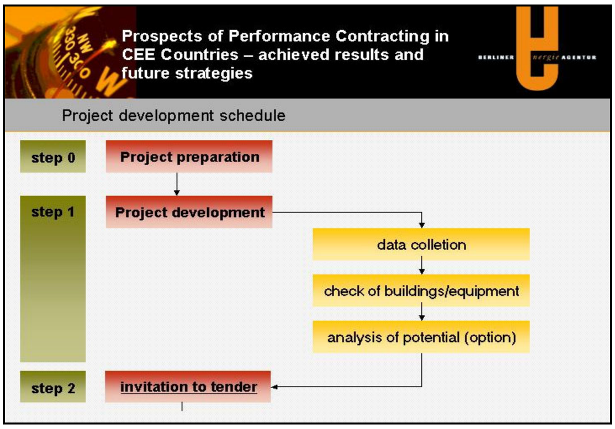


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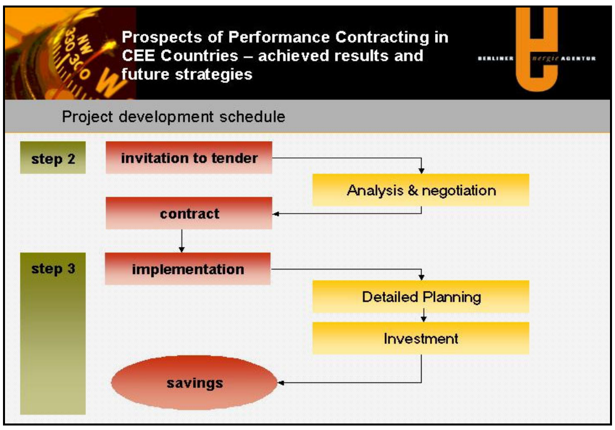


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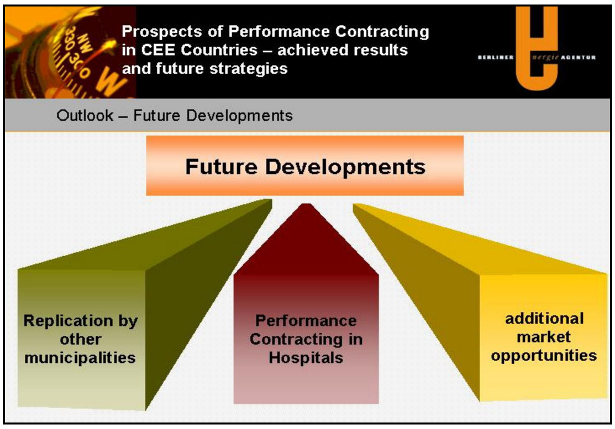


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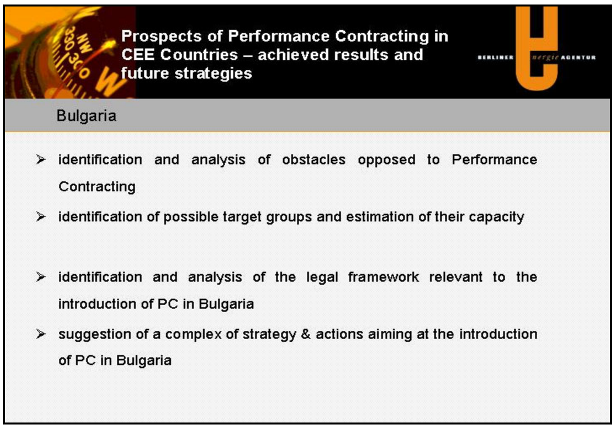


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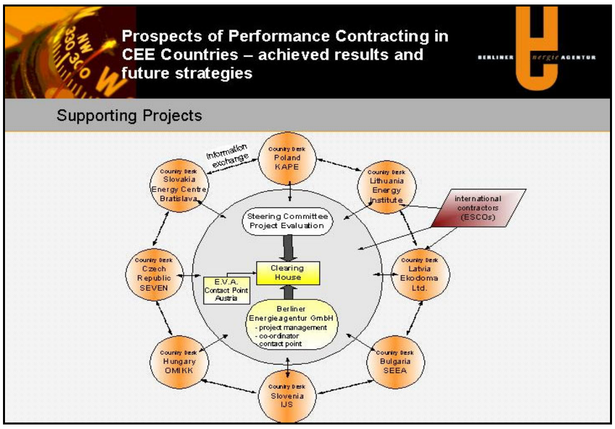


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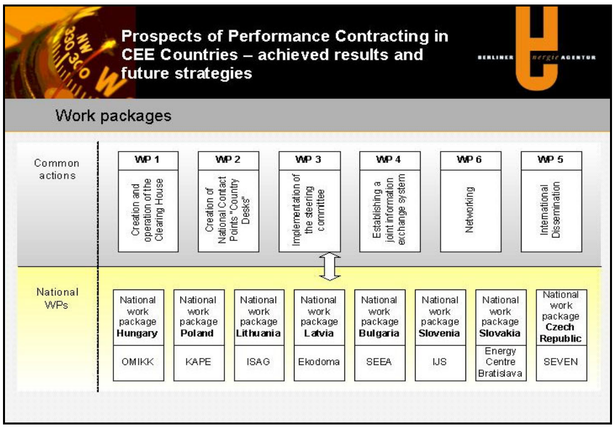


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# Best Practice: Energy Service Company (ESCO) in Tbilisi (Georgia)

**Tamuna Abazadze**

Georgian Operations Tebodin Georgia

**Basic information on the selected project**

Heating being destroyed in the city, the objective was to replace (or rebuilt) the central heating system by building a new one in total, or by building only a part of it when the construction itself would be too large. In a first approach, it appeared that a number of 40 flats at a site should be adequate. The heating chosen was a gas heating. The heating consisted in the installation of a new high quality boiler, new pipes and radiators, because it appeared that the use of the old installed system could provide more problems than advantages.

With the help of a TACIS project that financed equipment and manpower, an installation of (only) heating of 24 flats has been performed. The total cost of the project amounted to 35,000 $, the duration of installation took 1 year. The installation period was longer than scheduled due to some difficulties with the sub-contractor.

This first experiment gave the opportunity to check all the difficulties of this business. As the population was not enough rich to be able to buy a personal equipment, the project proposed to finance the full installation and reimburse afterwards, on a monthly basis during 7 to 12 years. But in Tbilisi did not exist such companies as ESCOs are in western countries. Consequently, the 24 end-users were asked to create a new association, to elect a president, and to manage this heating on a democratic basis.

The technical problems can be divided in two parts: a pure technical one, not very difficult linked with the computation of the power of the boiler, distribution of pipes, … and a more difficult one motivated by the slight modification of the building to install pipes and radiators (for instance some persons refusing heating also refused to cross their flats with pipes). This led to an enormous delay in implementation, and a first consequence was that it was not possible to heat during the winter 2000/2001.

Organization questions were more difficult and important. For instance, according to local regulations it was necessary to put the gas fired boiler outside of the building. This led to sophisticated problems with owners of the garage in the yard, with the town architect, cadastre, firemen, ministry of environment for the smoke, etc… All these questions have been solved finally, but motivated a lot of meetings, public explanations, sometimes hard discussion between neighbors, disputes.

Finally, a western boiler of 175 kW has been installed in the yard, in a private garage that has been given to the Association by his owner (free of charge). This boiler is gas fired but with a dual burner in case of gas shortage. The capacity of the fuel tank is 5,000 liters, enough for 1 month. Electricity is also a problem because the grid is not reliable. If this question becomes important, adding a little generator powered by gas will solve it.

**Main success indicators applied**

As this Georgian experience is brand new and the first one in the country, the principal success factor is that the customers agreed to create an association, to vote for a president and to pay the fees. This is the first time in Georgia that people agreed to co-operate on a voluntary basis. All other classical indicators will be computed after one year of experience.

**Results / impacts / side effects**

The main side effect is a decrease in electricity load because users were using electricity for heating.

**Realization problems and difficulties**

The main difficulty was to pursue users to create an association and to believe in their neighbors and give them confidence. Other problems were linked with corruption and unpredictable anarchical behavior of inhabitants and relevant public services.

**Duration follow-up / sustainability of the project**

This is very encouraging because all neighbors want to have the same heating, and a new pilot project 10 times more important is already scheduled as a first follow-up, as well as the creation of an ESCO, which will take in charge all the exploitation questions for the future big project.

**Case of domestic / international replication**

As for domestic replication, the success is already 100%. As for international replication, conditions in Georgia are so specific that it is a little bit difficult to extend this kind of project to other countries without sound study for each application.

**Main reason for project success**

Georgia is presently suffering from a severe energy crisis. Following the difficulties connected with the fuel supply a few years ago, practically all the heating organization downed. Heating being mandatory in winter, this decease is increasing strongly the difficulties of the electricity sector (and forestry as well) leading to a dead end if the heating questions are not quickly solved. End-users simply computed that the proposed system is more reliable and cheaper than electricity.

**Pre-requisites / recommendations for successful replication in other countries**

Comparing to other projects needing huge investments at country level it seems that a more simple attack of the market at the level of 30 to 50 users could be more successful.

# Main Principles of Activity of Ukrainian Energy Service Company (Ukresko)

**Sergiy Bevz**

The State Committee of Ukraine for Energy Conservation

The authorized capital of the UkrEsco makes more than 43 million grivnas. The state share in shares of the UkrEsco makes 99,7%. Financing of projects, which are introduced by the UkrEsco, is carried out due to the credit of EBRD for the sum of 30 million US dollars. Becoming and development of activity of the UkrEsco is carried out by means of the European Commission within the framework of TACIS program. The UkrEsco is the first in the FSU countries company, which unites financing and introduction of projects "on a turn-key basis". This superiority also explains so steadfast international attention to the UkrEsco.

Credit resources of EBRD are given for purchase of the energy saving equipment and granting of adjacent services in its delivery, installation and operation.

For today, cost of credit resources for clients of the UkrEsco makes 12-13% annual, the period of return makes from 3 till 5 years. Periodicity of return of the credit and interests get out the client and may be monthly, quarter or semi-annual. There is an opportunity of granting of a delay of the first return about 6 months from the moment of the first payment. For maintenance of a guarantee of return of the credit with the client the contract about a pledge which value should be not less than 140% of cost of the project subscribes, or the client gives a bank guarantee.

Purchase of the energy saving equipment and accompanying services is carried out on a competitive basis, according to rules of purchases of the goods, services and works of EBRD. Residents and not residents of Ukraine have the right to participate in tenders, thus equal conditions are given all participants of competition. It considerably enables to lower cost of contracts owing to a fair competition both between manufacturers of the equipment, and between the companies giving services.

Realization of projects by means of attraction of the UkrEsco enables clients to not withdraw from a revolution own means for purchase of the expensive equipment. The side benefit of cooperation with the UkrEsco is that return of the basic sum and interests begins only after input of the energy saving equipment in operation that is then, when the client receives real reduction of expenses by energy resources.

**The legislative and normative documents regulating activity of the company**

- Resolution of the Cabinet of Ministers of Ukraine of 20.12.97, No. 1422
- Order of the President of Ukraine of 09.05.98, No. 136/98-рп
- Project Agreement between EBRD and UkrEsco (Ukraine ESCO Financing) of 09.05.1998, No. 616
- Contract between UkrEsco and Econoler Development s.a. – Bechtel Limited Consortium of 21.10.98
- Sub-Loan Agreement between Ministry of Finance of Ukraine and UkrEsko of 28.10.1998, No. 22-04/22
- Law of Ukraine “About ratification of the Loan Agreement between Ukraine and European Bank for Reconstruction and Development (*Financing of Ukrainian Energy Service Company UkrEsko*)” of 13.05.1999, No. 0074.

# Energy Audits: Lessons Learned in the Czech Republic

**Jiří Zeman**

SEVEn

**History of energy auditing in the Czech Republic**

- Energy auditing in the pre-1989 period
- 1990s: Voluntary energy auditing program with financial support from the Czech Energy Agency
- 2000: New energy legislation and compulsory energy audits.

How effective are compulsory and voluntary energy audits? Compulsory energy audits:

☺ fast and wide dissemination of standardized energy audits

☺ faster and wider implementation of the recommended energy efficiency measures?

☹ energy auditor as a policeman, not a client's advisor

☹ energy audit as a must rather than an option

☹ motivation of clients to avoid/minimize spendings on energy audits

☹ focus on the required structure of the audit rather than real client's needs

☹ a risk of reducing energy audits to formal reporting rather than providing the necessary background information for a real management decision.

Examples of energy audits followed by project implementation

The role of energy audits in decision-making

- compulsory energy audits followed by compulsory energy efficiency project implementation require no management decisions
- energy audits are not sufficient background information material for investment decision making – no analysis of assumptions used, of associated risks and other project impacts
- an energy audit is only one part of a (pre-)feasibility study, i.e. an information source on opportunities for first-step decision-making; a feasibility study is needed before the final decision on project implementation.

## Energy Audits: Lessons Learned in the Czech Republic

Jiří Zeman, SEVEn, o.p.s.

CTI Seminar Ostritz

December 8, 2001

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## Contents

- Summarize energy auditing situation in the Czech Republic
- Highlight main problems, not best practice
- Specify and explain the major comments

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## History of energy auditing

- Before 1989
  - engineering checks, no formalized procedure
- 1990s - standardaized energy audits
  - financial support by the Czech Energy Agency
  - required for projects subsidized by CEA
- 2000 - compulsory energy audits
  - energy audits regulated by the new Energy Efficiency Act #406/2000

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## Energy Audits in the Energy Efficiency Act

- compulsory (but one-time) energy audits for facilities with consumption > 35000/1500 GJ
- licences for energy auditor/individuals
- „recommended“ energy efficiency measures
- in a public sector the State Energy Inspectorate may decide about implementation

- Draft:
  - compulsory implementation of recommended energy efficiency measures in a private sector

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## Compulsory Energy Audits

- Faster and wider dissemination of a standardized procedure +
- Faster and wider implementation of energy efficiency measures +/-
- Cost (in-)efficiency of compulsory audits -
- In-effectiveness of investment decisions based only on technical energy audits ---

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## Energy Audits Problematic Issues

- Technical energy audits (not a feasibility study) used as the only information source for energy efficiency investment decision making
- (Compulsory) standardized energy audits suitable for standardized situations - not always

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## How effective can be such an energy auditing procedure ?

- Is a energy audit sufficient information for a real investment decision making?
- Can investment decision making be driven by technical analysis without taking other aspects into concideration
- Can a technical energy audit make binding investment recommendation?

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## Contents of Czech energy audits

- Mainly technical analysis - technical options of energy efficiency measures
- (Rather simple) economic evaluation - investment costs, annual energy costs savings
- Recommendation of energy efficiency measures for implementation
- Technical, not complex financial evaluation

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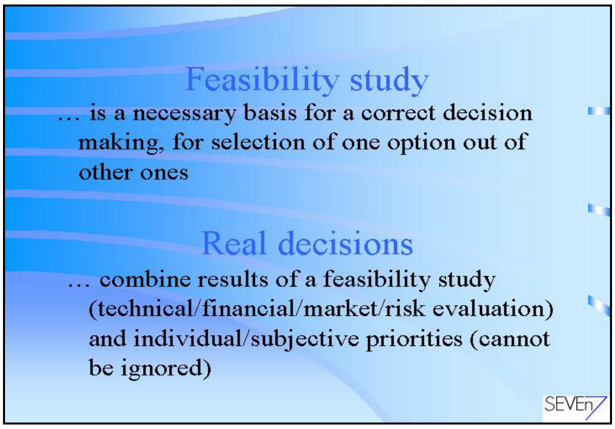

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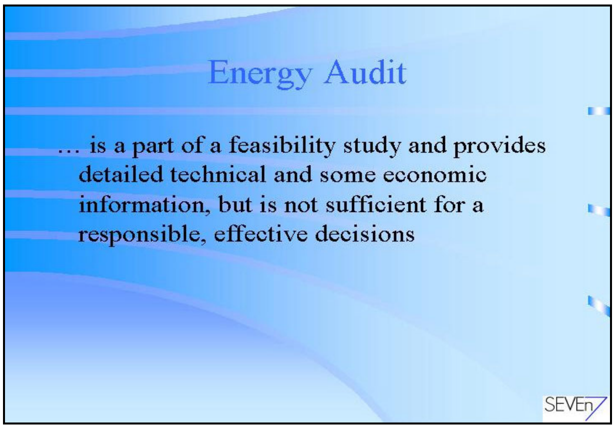

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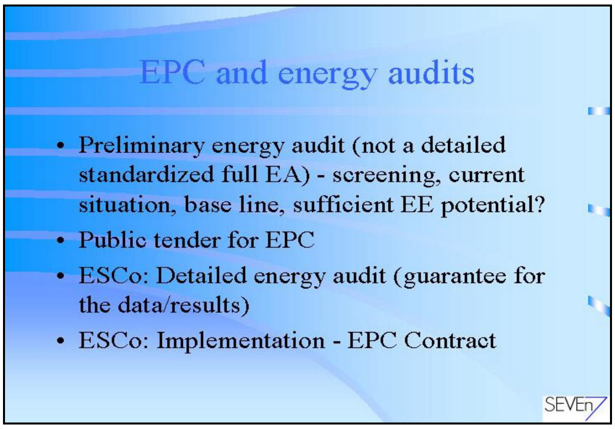

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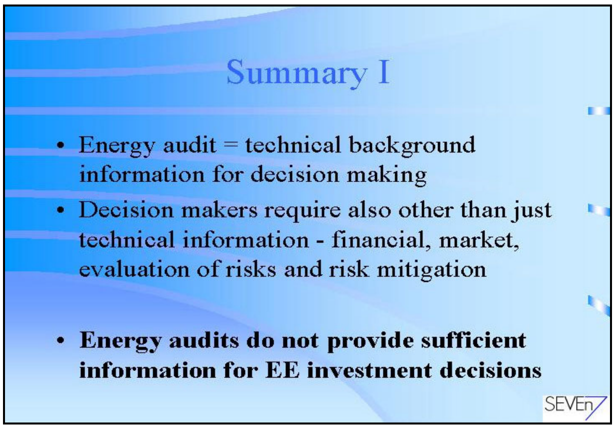

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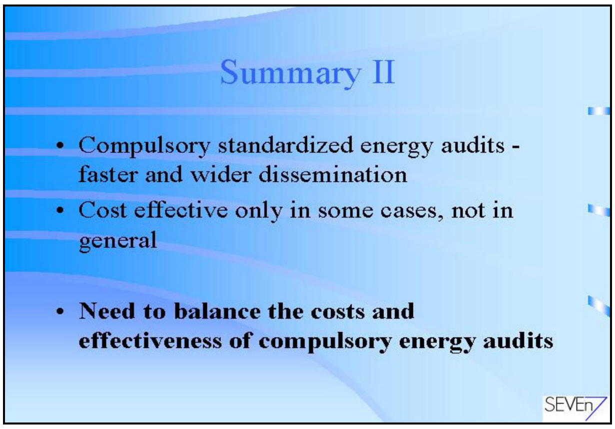

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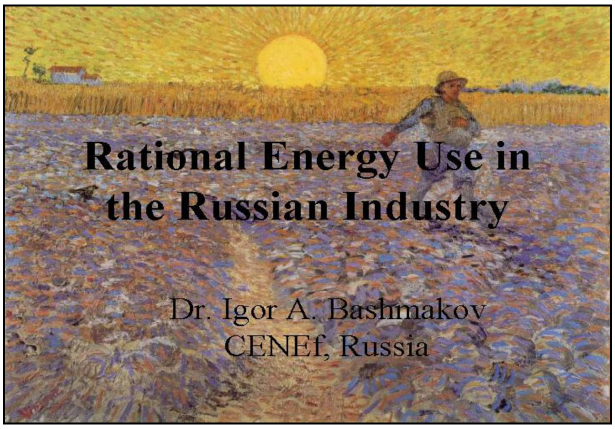
# Rational Energy Use in the Russian Industry

**Dr. Igor A. Bashmakov**

Center for Energy Efficiency CENEf, Russia



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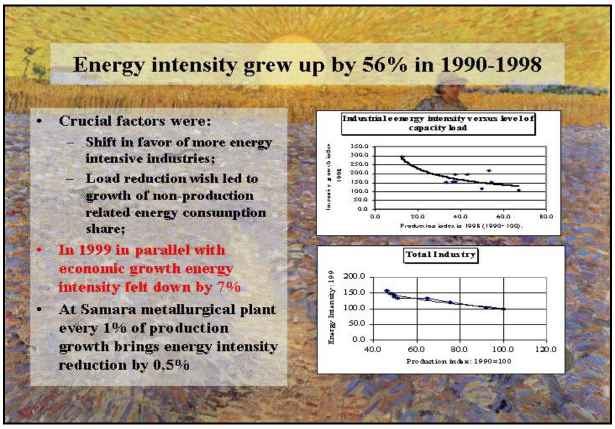

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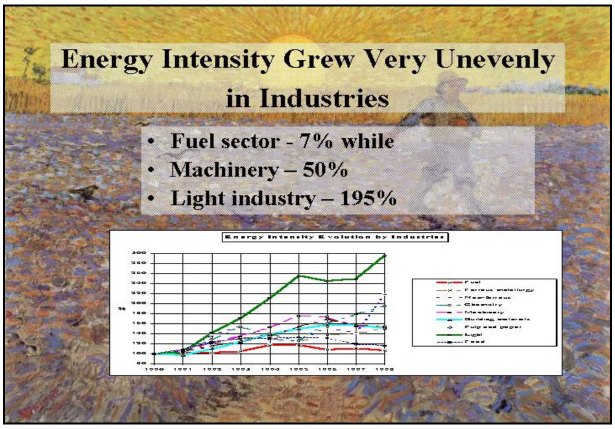

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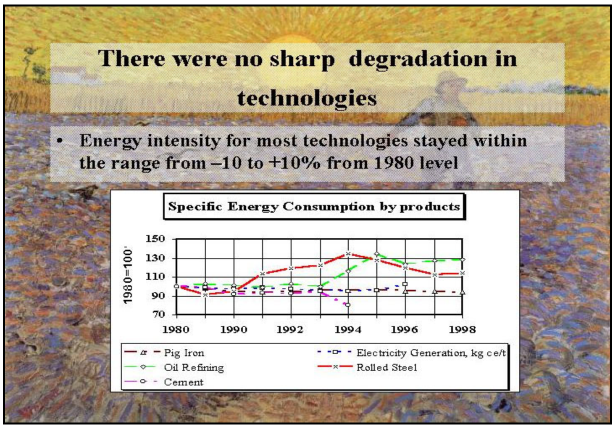

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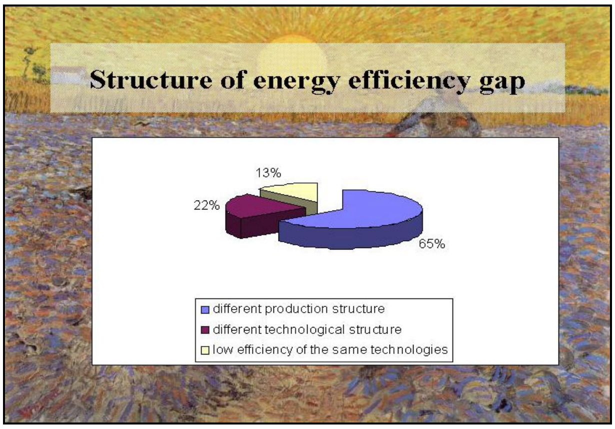

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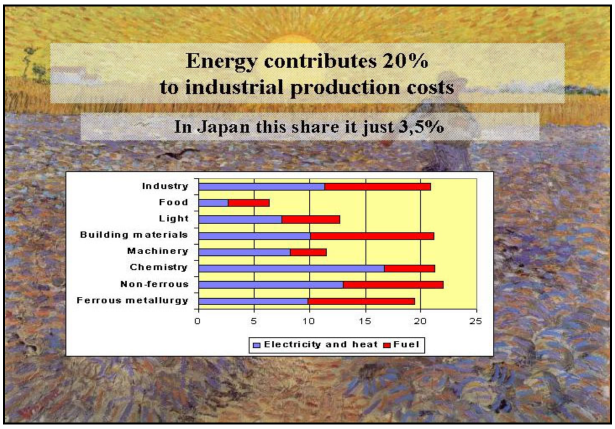

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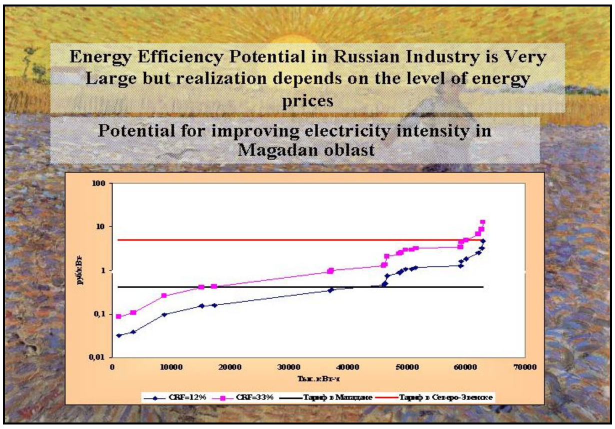

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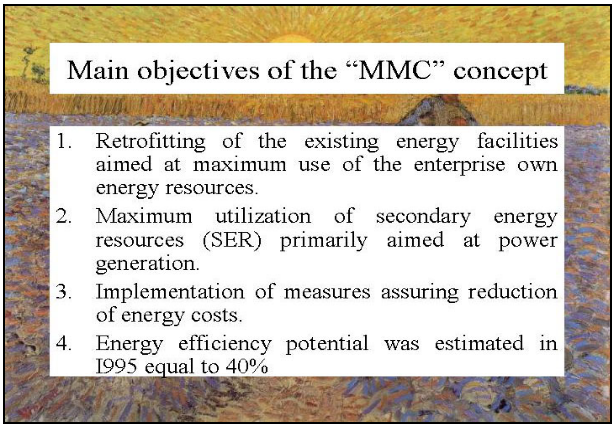


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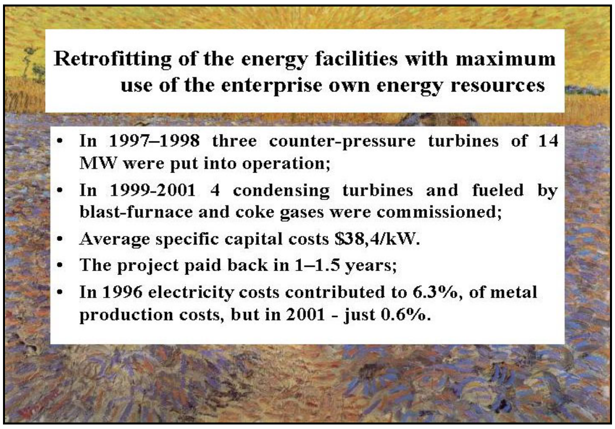


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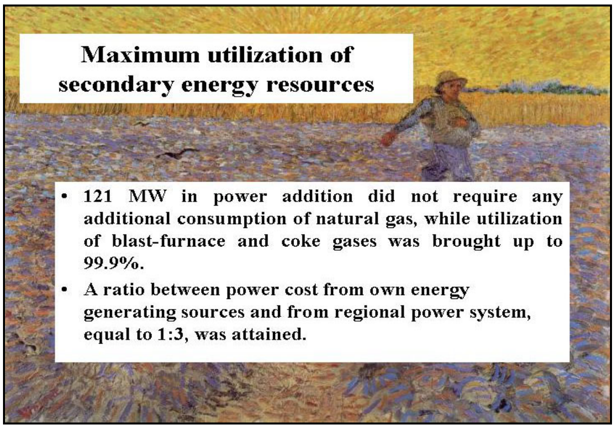


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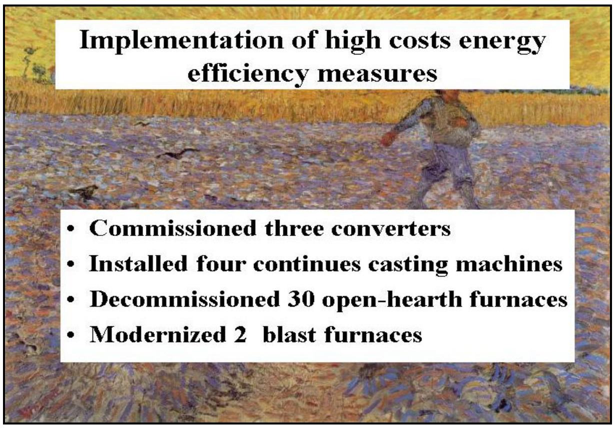


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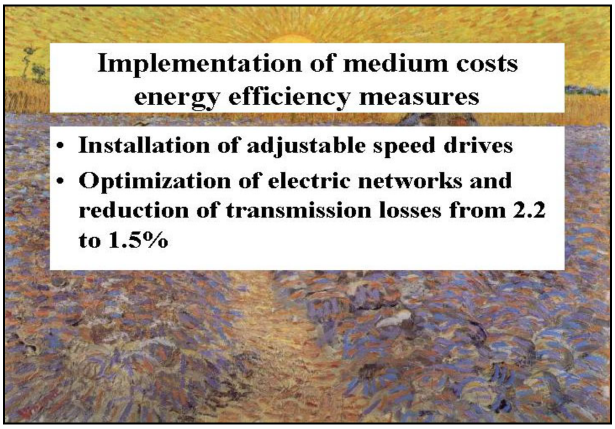


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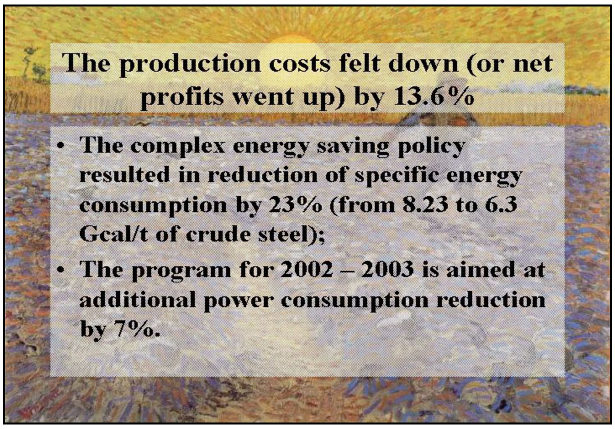


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# Energy Auditing in Estonia

**Dr. Villu Vares**
Estonian Energy Research Institute

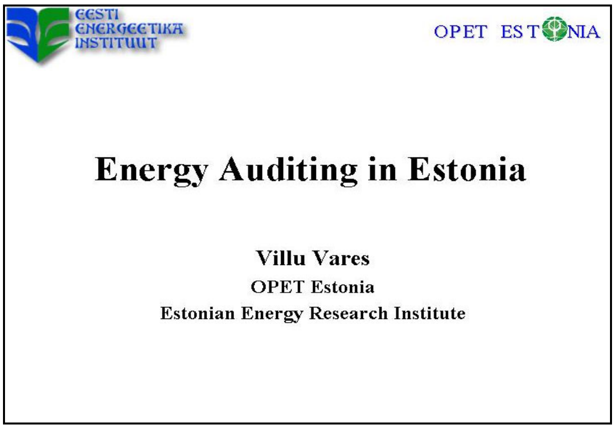
**Dr. Tiit Kallaste**
SEI-Tallinn, Estonia

As a result of successful implementation of market principles and new price policy in Estonia, considerable progress in reducing energy demand of buildings has been made. However, going on with the process and optimization of specific energy consumption requires a systematic approach, which anticipates energy certification of various buildings. Energy certification means defining the mode of energy supply and establishing energy consumption indices with entering the data in the technical passport of the building or the certificate. The data entered in the named document give information about the consumption level both for residents and owners of the building and allow designing optimal energy saving measures for the reduction of energy costs. The certificate can also be a basis for the valuation of building as an item of real estate. The developed auditing system and data bases would enable to develop typical solutions for energy saving and follow the actual impact of implemented measures on energy demand in various groups of buildings (different apartment buildings, private houses, public buildings, offices, etc.). International experience has shown that auditing is an excellent and inexpensive tool for rapid fostering of the initiatives of all parties (owners of flats, owners of buildings, municipalities, etc.). The Estonian Association of Housing Societies started with practical activities in this sphere already in 1999 since the need for establishing and comparing energy cost of buildings is growing quickly along with the increase of energy cost.

The implementation plan of *Estonian Energy Conservation Target Programme* anticipates activities for energy saving in buildings in the framework of two subprojects, which involve development of certification methods, establishing an organizational system and launching the certification process.

Energy auditing was included in the *Energy Conservation Programme* of 1992 already, but due to constant restructuring in the production sphere, changed ownership and lack of simple uniform methods, no regular auditing is carried out any more and thus the data on the energy intensity of production is mostly not available. In order to plan energy conservation measures both for certain industrial enterprises and industry as a whole, regular auditing based on standardized uniform forms and requirements is extremely essential since it is accompanied with the collection of data in the data base, analysis of the data and drawing of general conclusions for improving the situation both in enterprises, branches of industry and at the national level. Organizing energy audits in industry anticipates devising methods for energy auditing in industrial enterprises and development of the organizational system.

Working groups for developing the system of energy auditing, which include both Estonian and Danish specialists, are being established in Estonia and this work is supported by the Danish Energy Agency.

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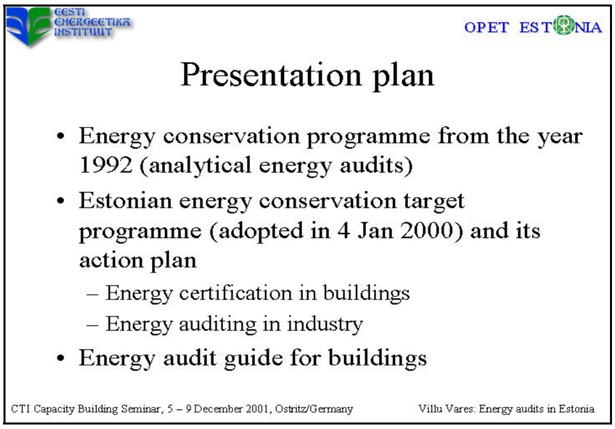


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OPET ESTONIA

## The first energy conservation programme in Estonia (1992)

- Reduction consumption of imported fuels up to 50% in 4-5 years
- Motivate people and consumers to save energy
- Energy audits in industry (analytical)
- Pilot renovation projects in residential building (audit, renovation, monitoring)

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OPET ESTONIA

## Energy certification in buildings (2001-2005)

- Preparation of methodology for energy certification of different type of buildings (residential buildings, one family houses, public and municipal buildings, schools, hospitals)
- Elaboration of organisational system for certification
- Introduction of certification process in practice
- Support of Danish Energy Agency (See Danish examples of certificate forms →)

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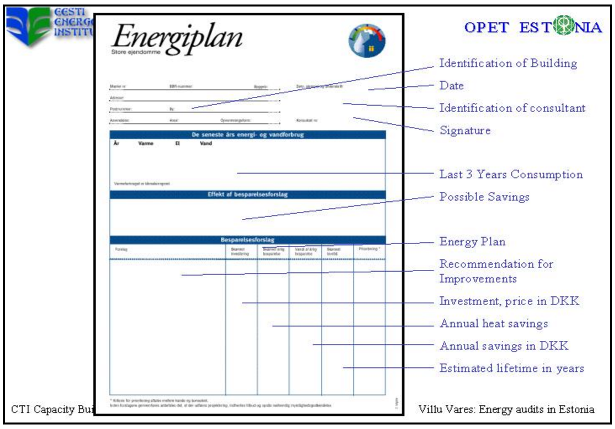


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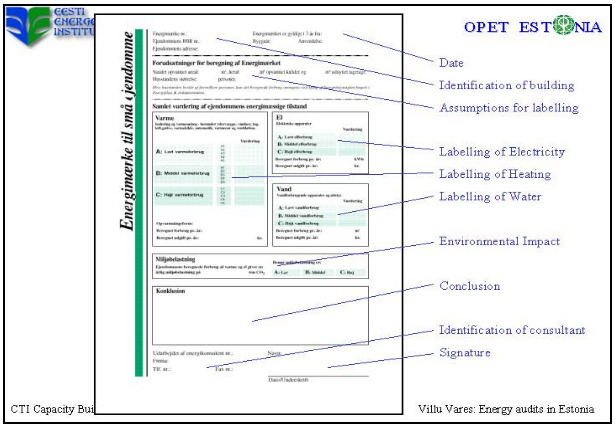


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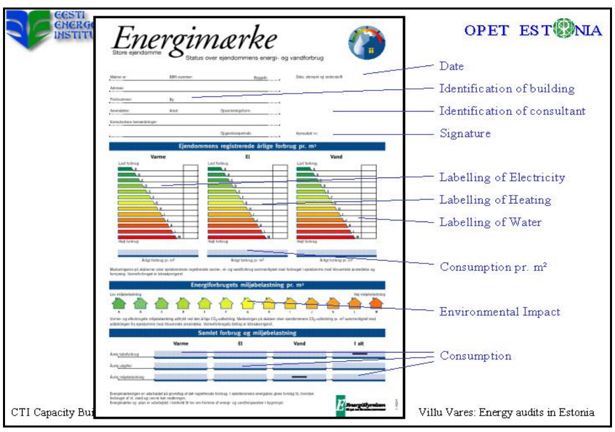


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OPET ESTONIA

## SAP scale

- Comparable between different dwelling sizes
- Non linear - greater cost change at lower SAP

| | | |
|---|---|---|
| 100 | Super warm | A high standard - upper limit of scale |
| 90 | Excellent | |
| 80 | Good new home | |
| 70 | Typical new home | |
| 60 | Typical older home | Transition point for building regulations |
| 50 | Needs improving | |
| 40 | Poor | |
| 30 | Very poor | |
| 20 | Appalling | |
| 10 | Ughh! | |
| 1 | ***** | A very poor standard - lower limit of scale |

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## Elemental Method - all UK

- U-values are higher if SAP is over 60

| Element | U-value for SAP 60 or less | U-value for SAP over 60 |
|---|---|---|
| Roofs | 0.2 | 0.25 |
| Exposed walls | 0.45 | 0.45 |
| Exposed floor and ground floors | 0.35 | 0.45 |
| Semi-exposed walls and floors | 0.6 | 0.6 |
| Windows, doors and rooflights | 3.0 | 3.3 |

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## Energy auditing in industry

- Elaboration of methodology
- Preparation of organisational system for the auditing process

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EESTI ENERGEETIKA INSTITUUT | OPET ESTONIA

## Important issues

- Legislative framework (in Estonia energy audits and certification of buildings are not obligatory)
- Audit models and tools, common forms
- Subsidy policy and subsidies
- Quality control, training and licensing of auditors
- Collecting data to database and analyse of energy consumption trends

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## Energy Audit Guide for Buildings

- Prepared by AXOVAATIO OY (Finland) in co-operation with Vides Project (Latvia) and OPET Estonia
- Financed by Finnish Ministry of the Environment
- Guides (equipped with country based examples) in Latvian and Estonian, also Russian+English version

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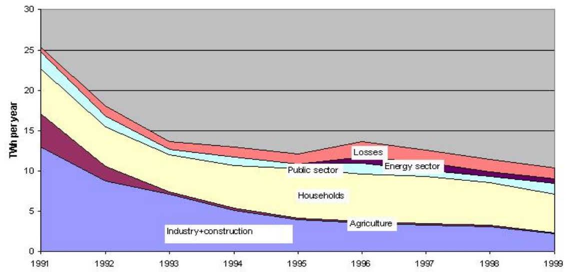
## Heat consumption

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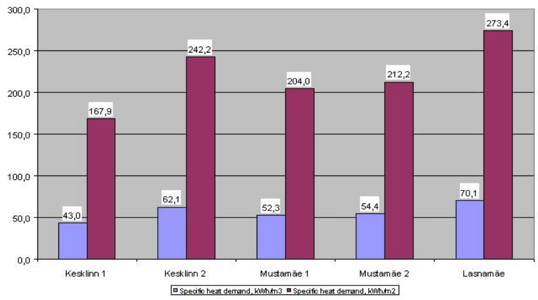
## Average specific heat demand in some Tallinn regions, the average by AXOVAATIO OY 73 kWh/m3 and 285 kWh/m2

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## Energy Audit Guide for Buildings (2)

- A statement of the energy quality of a building. A building energy certificate and energy labelling of the building are easily produced based on the audit reports. They are valuable for example when a building is for sale
- One outcome of an energy audit is a list of energy saving measures and ways to increase the energy efficiency of a building. A housing owner can reduce energy and other costs by applying these measures
- An energy audit may be advantageous when applying for a loan for a building renovation
- In future, $CO_2$ emissions are very likely to become more and more important. Energy audits will be one tool to abate $CO_2$ emissions

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# Efficient Lighting Initiative: Grassroots Approach in Residential Sector in Latvia

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**Andra Blumberga**
Ekodoma

**Ivars Veidenbergs**
Riga Technical University

### Background

The IFC/GEF Efficient Lighting Initiative (ELI) is a three-year program designed by the International Finance Corporation (IFC) and funded by the Global Environment Facility (GEF) to accelerate the penetration of energy-efficient lighting technologies into emerging markets in seven countries (Latvia is one of them). ELI has started in Latvia in March 2000.

Main goal of ELI Program is reduction of emissions of greenhouse gases by efficient use of energy in lighting. The ELI program elements were designed to generate market transformation effects and accelerate the growth of markets for efficient lighting technologies. ELI program in Latvia has included following activities:

- Organization of CFL campaigns in residential sector.
- Facilitation of development of efficient lighting standards and norms.
- Conducting of public education.
- Development of efficient street lighting projects in municipalities.
- Creation of lighting ESCOs in Latvia.

This presentation will be more oriented on activities in residential sector.

The ELI program started with investigation of efficient lighting market. The market study illustrated that CFLs are not well known: only 22% of inhabitants in Latvia are informed about energy saving bulbs. The ELI team has realized a pilot project of CFL Campaign in 8 small municipalities (1000 … 20,000 inhabitants) by use of "grassroots" market approach. The results of the pilot project have showed success obtained and therefore such type of action will be continued. Different activities are planned in bigger cities (70 000 … 100 000 inhabitants).

This paper will analyze of pilot phase of the ELI program in residential sector in Latvia. The pilot project of CFL campaign was realized in 3 municipalities: Broceni (3000 inhabitants), Dobele (10000 inhabitants), Ludza (10000 inhabitants) during October – December 2000, and follow up activity in 5 additional municipalities during March-April 2001.

## 1. Analysis of Strategy of Pilot Project

### Methodology

The analysis of the strategy of pilot projects is implemented by use of top-down ↔ bottom-up & supply side ↔ demand side methodology.

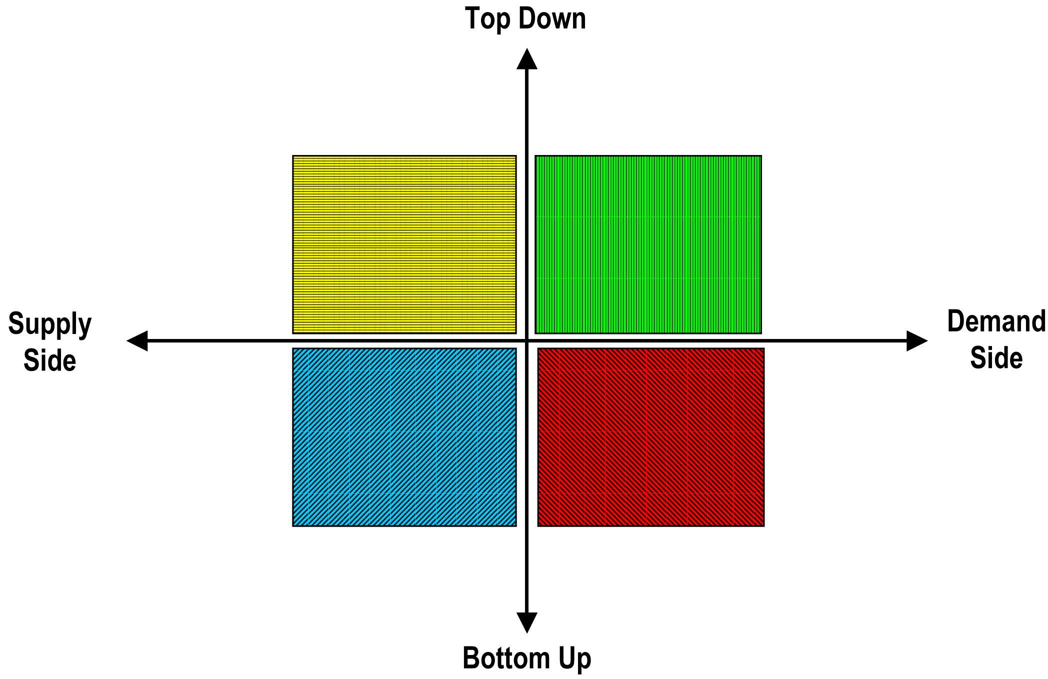
The pilot lighting project in residential sector will be analyzed as a combination of four approaches and it can be expressed in a Cartesian diagram where:

- X axis: supply side ↔ demand side;
- Y axis: top-down ↔ bottom-up.

The graphic view is given in figure 1. These four approaches can be described as follows:

- *Top-down approach* - Related mainly to the activity of governments and/or institutions when introducing new regulations, standards and policies.
- *Bottom-up approach* - Organizing the needs of a municipality and inhabitants preparing the documents and participating in activities which comply with these needs.
- *Demand-side approach* - Concerning the end-uses of citizens and their needs: economic opportunities, quality of life, housing etc.
- *Supply*-side *approach* - Refers to the capability of the market to organize the production of goods and technologies, which respond to consumers' needs.

*Figure 1: Combination of four approaches for the pilot project*




These four approaches can be equally significant and effective to seek objectives for energy efficient activities including energy use for lighting.

**Top-down approach**

- Develop national energy strategy.
- Support energy efficient lighting projects.
- Consider external environmental impacts and costs of the acquisition of new technologies.

**Bottom-up approach**

- Prepare local policies and plans to support environmentally adapted energy efficiency activities in municipality.
- Establish team for implementation of energy efficiency activities.
- Encourage the efficient use of resources by energy consumers.

**Demand-side approach**

- Promote residential development that is economically feasible, environmentally friendly and acceptable (with higher comfort level) for residents.

**Supply-side approach**

- Provide a range of high quality energy efficient lighting technology.

**Application of methodology**

The lighting pilot project in residential sector was promoted by three local governments: municipalities of Broceni, Dobele and Ludza. The proposal came from ELI Latvia team, which worked out the action plan of CFL campaigns in above mentioned cities. Main actors and innovative champions of CFL campaign were selected after investigation of several alternatives: electrical utility, banks, national telecommunication company, natural gas supplier and DH companies as well as municipalities.

**Top-down / Supply side**

New ideas for promoting new energy technologies and managing the introduction with new lighting technologies led this campaign. During pre-campaign period ELI team established good co-operation with the CFL manufacturers (Philips, Osram and GE). All three companies has representatives in Latvia. Philips, Osram and GE participated in certification process in ELI Program and different types of CFLs (from their production) have received ELI certificates.

The pilot project always has demonstrated means and ways focused on the implementation of innovative energy technologies. The approach is top-down because “know how” lighting technologies are worked out by top level of wellknown manufacturers. Top-down / Supply side attitude is illustrated as efficient lighting technology in figure 2.

*Figure 2: Role of manufacturers of efficient lighting technologies*

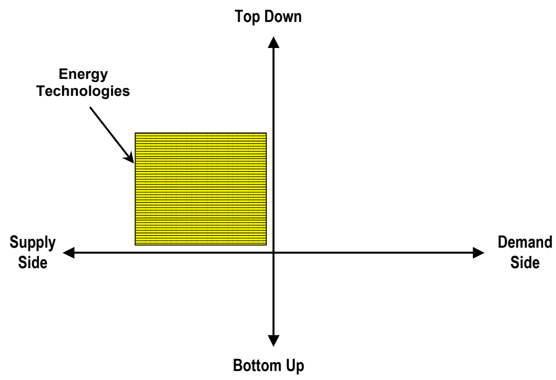



*Figure 3: Role of governmental energy efficiency startegy*

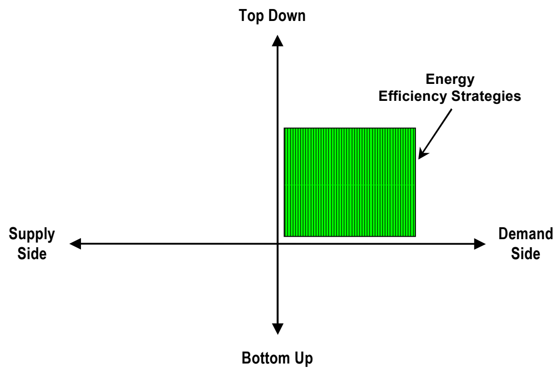
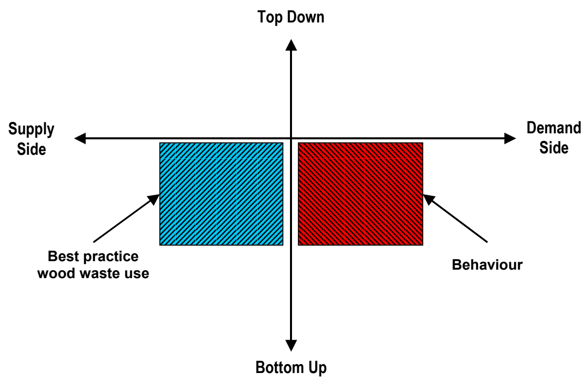



*Figure 4: Bottom- up approaches used for the pilot project*




**Top-down / Demand side**

The investigation of potential supporters of the efficient lighting initiative allows to define tasks and organizations which are taking care of energy efficiency measures. Different programs are estimating energy saving possibilities in the framework of activities of USAID, PHARE, EC OPET, GEF etc. Banks and foundations are providing loans. The Latvian government worked out several documents in connection with promotion of energy efficiency measures. The last one is the National Energy Efficiency Strategy (2000).

The pilot project fulfills tasks of governmental energy efficiency strategy and has demonstrated means and ways focused on the implementation of efficient use of energy for lighting on end user side. Top -down/ demand side approach is shown as governmental documents in figure 3.

**Bottom-up / Supply side**

The ELI team made the decision (September,2000) to test the CFL campaign in a small city and to involve Broceni municipality in the pilot project. ELI Latvia team invited them and Broceni City Council decided to participate in CFL campaign (October, 2000). Dobele and Ludza municipalities joined to this activity in November, 2000. The municipalities worked together closely. The ELI team assisted in the preparation of documents for the bulk purchase of CFLs, for the contract between municipality and CFL manufacturer (winner of competition) as well as the loan agreement between municipality and inhabitants. The pilot project allows to test the scheme of creditation of inhabitants by municipalities.

The campaign ended with a CFL sales procedure (three days before Christmas). The Broceni case was most successful: each second household purchased one CFL.

Municipalities played the significant role of innovation champion in the best lighting practice – the pilot project. Bottom - up/ Supply side approach is shown as best practice in figure 4.

**Bottom up / Demand side**

The pre-campaign period (October – December, 2000) was used for dissemination of information: leaflets, posters, survey of inhabitants, physics lessons in schools, competition of paintings and essays of school pupils, organization of specific information days, “Lighting Day” events etc.

Success of CFL campaign was ensured by specific behavior of people living in pilot project areas. Representatives of municipalities and inhabitants showed high interest and responsiveness in efficient lighting activities in their cities. Bottom – up / Demand side approach is presented as behavior in figure 4.

## 2. Follow up activities

The pilot project of the CFL campaign was finished in January, 2001 by analysis of results of activities. An evaluation of this stage of the CFL campaign was presented in a book (in Latvian) for replication of similar activities. Target group of this material are representatives of municipalities: potential users bottom- up approach for similar efficient lighting campaigns. The book presents an analysis of data and results of the CFL campaign in Broceni, Dobele and Ludza as well as includes a package of documents prepared during the campaign, which could be used in future activities.

The pilot project results were presented to 10 selected municipalities at the end of January, 2001. 5 municipalities expressed interest to participate in a follow up CFL campaign: Limbazi (10,000 inhabitants), Ogre (20,000 habitants), Valmiera (30,000 habitants), Madona (15,000 habitants) and Piltene (1000 habitants). They proved the grass root approach of the CFL campaign and used several elements of the pilot project case. Follow up activities were successful in three municipalities and showed less success in two cases because of starting of efficient lighting activities in a period of long days (end of April and beginning of May).

The second step of ELI Latvia activities in residential sector is a municipal CFL campaign in a large city in the light season 2001/2002 followed by a CFL campaign in the capital of Latvia in the light season 2002/2003. The large town campaign this light season has around 80,000 habitants. The capital of Latvia, Riga, has ten times more – around 800,000. The planned activities of ELI Latvia program will reach 30 to 40% of the inhabitants of Latvia.

## 3. Conclusions

(1) The market study of lighting technologies used in residential sector showed low awareness of CFL advantages in the residential market of Latvia today: only 22% of citizens are informed about CFLs.

(2) The main reason of success is ensured by municipal bottom-up approach, which combines the municipal interest in assisting the citizens with the ELI goal to increase CFL sales. The pilot project showed good local results. The Broceni case was most successful: each second household purchased one CFL.

(3) The major CFL manufactures are active partners in the programs (top-down approach). The CFL market is litlle developed with high CFL prices. The market is dominated by Philips, Osram and GE.

(4) The pilot project allows to test approach, schemes and documents worked out for efficient lighting campaigns. The pilot case was proved by follow up activities in 5 additional municipalities.

(5) More parties could be involved in future activities. Municipalities are showing increasing interest in participating in the promotion of the energy efficient lighting program for the residential and public sector. The electricity utility LATVENERGO is becoming more active to assist in similar CFL campaigns.

(6) The second step of ELI Latvia activities in residential sector is a municipal CFL campaign in a large city in the light season 2001/2002 followed by a CFL campaign in the capital of Latvia in the light season 2002/2003.


Slide 1


Slide 2

## ELI programme in residental sector in Latvia

Pilot project of CFL campaign was realised in three municipalities :
• Broceni (3000 inhabitants),
• Dobele (10000 inhabitants),
• Ludza (10000 inhabitants)
during October - December 2000 and follow up activity in 5 additional municipalities during March - April 2001.

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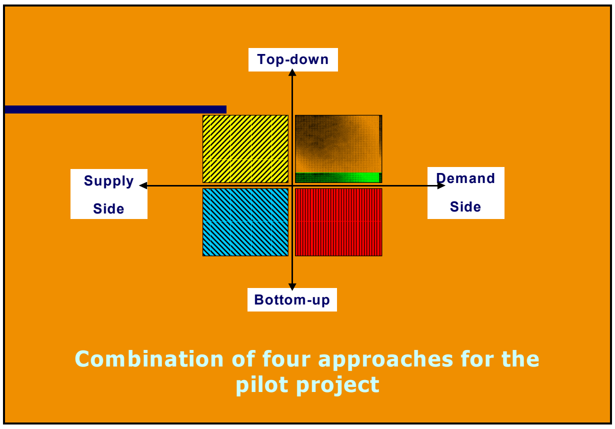


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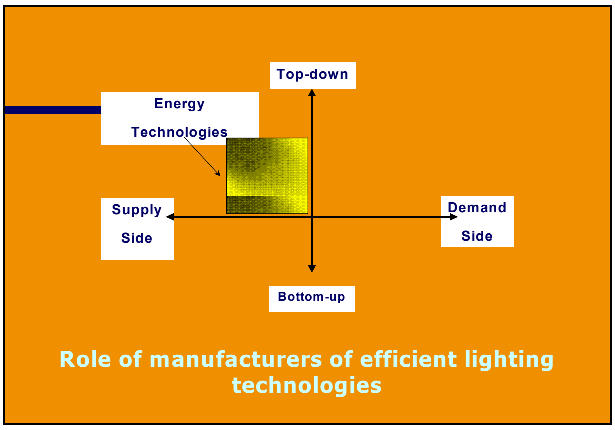


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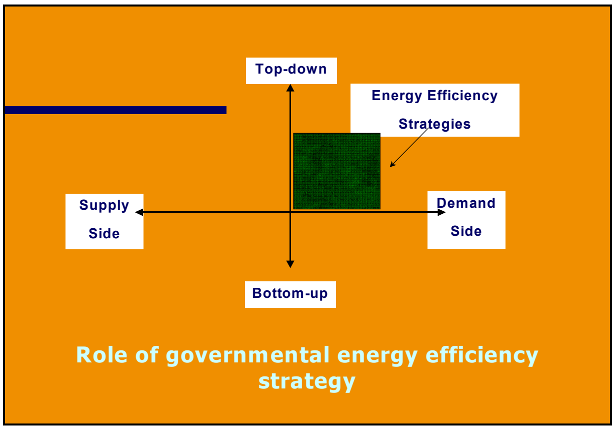


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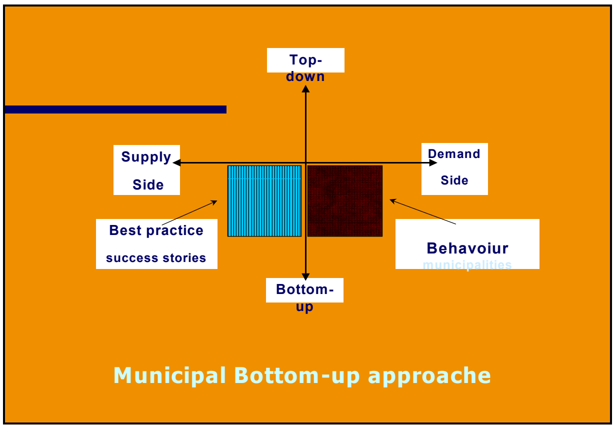


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## Conclusions

•1. Market study of lighting technologies used in residental sector showed low awareness of CFL advantages in the residental market of Latvia today: only 22% of citizens are informed about CFLs.
•2. The main reason of success is ensured by municipal bottom-up approach, which combines the municipal interest in assisting the citizens with the ELI goal to increase CFL sales. The pilot project showed good local results. Broceni case was most successful: each second household purchased one CFL.

Slide 8

## Conclusions

•3. The major CFL manufactures are active partners in the programmes (top-down approach). The CFL market is little developed with high CFL prices.The market is dominated by Philips, Osram and GE.

•4. Pilot project allows to test approach, schemes and documents worked out for efficient lighting campaigns. Pilot case were proved by follow up activities in 5 additional municipalities.

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## Conclusions

•5. More parties could be involved in future activities.Municipalities are showing increasing interest in participating in the promotion of energy efficient lighting programme for the residental and public sector. Utility LATVENERGO is becoming more active to assist in similar CFL campaigns.
•6. Second step of CFL Latvia activities in residental sector is a municipal CFL campaign in a large city in the light season 2001/2002 followed by a CFL campaign in the capital of Latvia in the light season 2002/2003.

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# Japanese Industry Efforts for Energy Conservation and Technology Transfer on Climate Change

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Policy Planning Department NEDO

## 1. Basic survey on JI/CDM

Under the Ministry of International Trade and Industry, the New Energy and Industrial Technology Development Organization has entrusted to the private sector the implementation of 5 feasibility studies in 1997, 40 in 1998 and 46 in 1999 for promoting application of Joint Implementation and CDM in Japan. The objective of this project is to identify potential projects and offer more incentive to Japanese companies which aim to realize the projects.

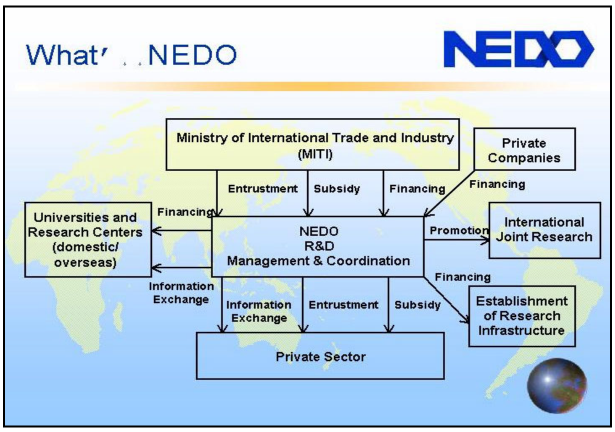
Among the feasibility studies, the "Introduction of Trolley Buses with Energy Conservation Improvement" implemented in Mexico in 1997 was realized as a project. In April 1998, an agreement on a bank loan of approximately 50 million US$ was concluded between official and private banks of Japan and an official bank of Mexico, and Mitsubishi Electric Corporation, which conducted the feasibility study, exported 200 energy-efficient trolley buses to the Traffic Bureau of Mexico city.

Another feasibility study entitled the "$CO_2$ Reduction by Easing Traffic Congestion at Intersections" was conducted by the Japan Automobile Manufacturers Association, and further technological cooperation is being carried out in Thailand.

## 2. Top target standards for energy efficiency Top Runner Program in Energy Conservation Law

The regulation of the Top Runner Program is to set the severest value in existing as the target value at levels somewhat exceeding average consumption efficiencies. Therefore, this is the severest target value in the world.

At present, target year and improvement of efficiency are regulated for 12 items based on Law Concerning Rational Use of Energy. In the near future, more items will be added to the Top Runner Program.

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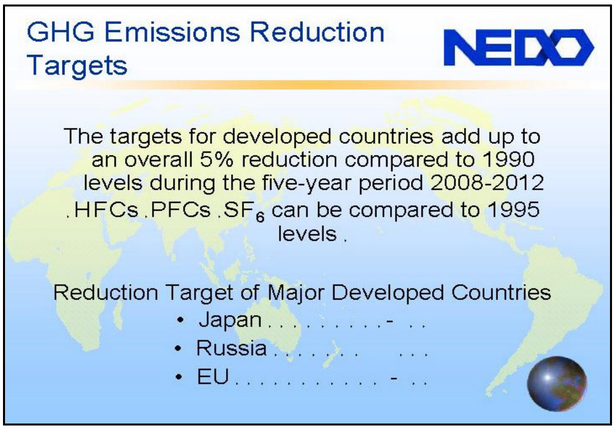


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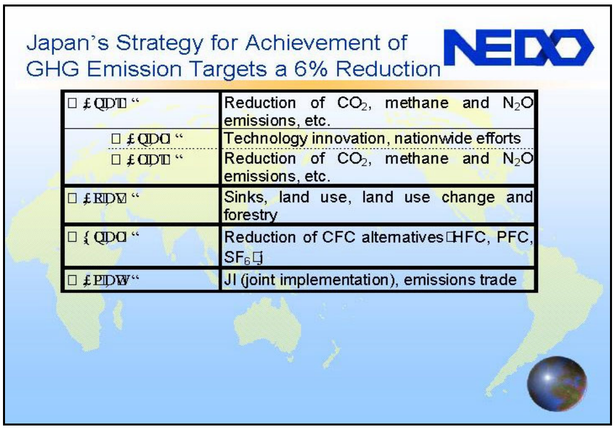


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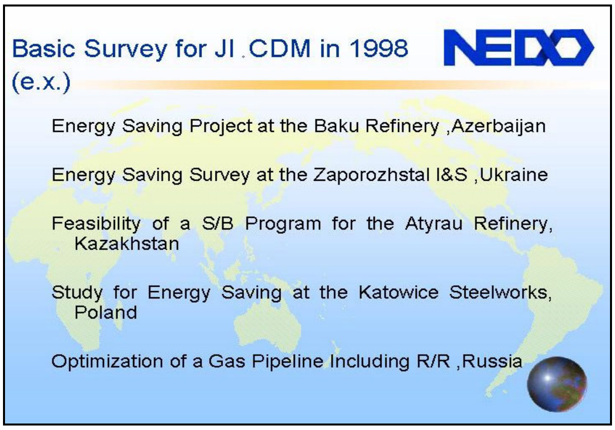


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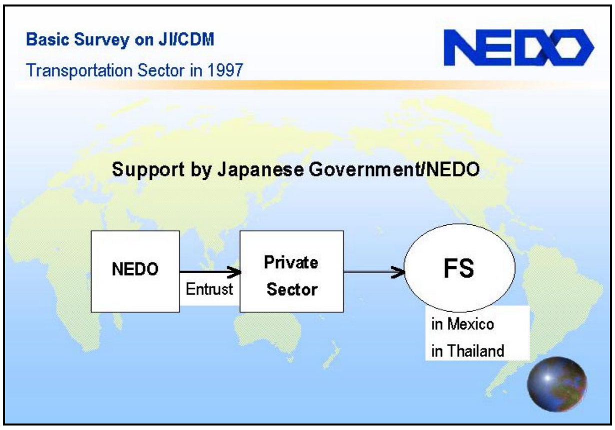


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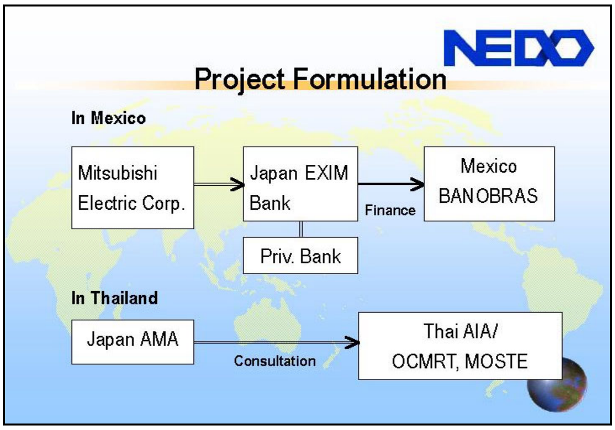


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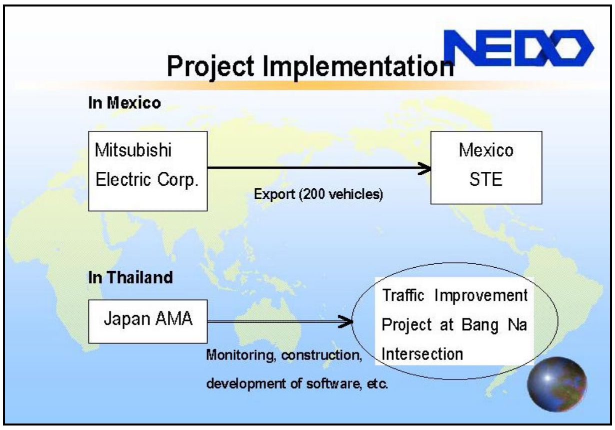


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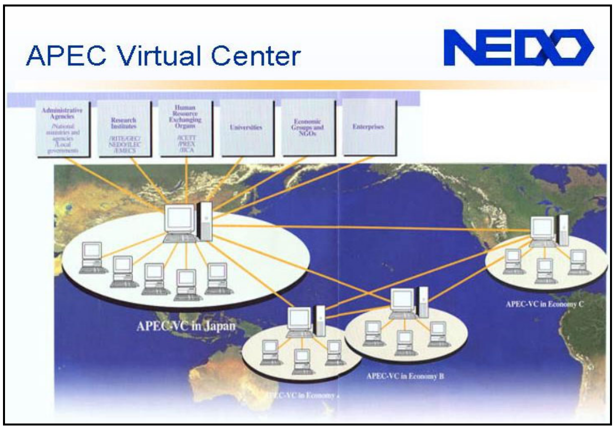


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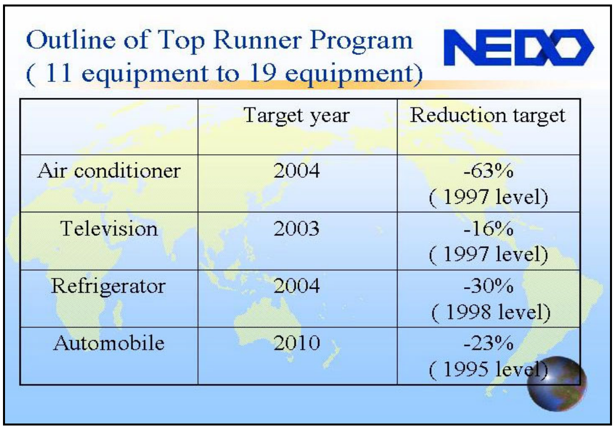


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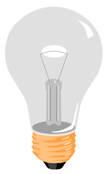
# Leaking Electricity? Standby Power Losses in Bulgarian, Romanian and Hungarian Residences

**Prof. Diana Ürge-Vorsatz**
**Kristina Stroukanska**
**Szilard Asztalos**

Central European University, Budapest

## Leaking electricity?

**Standby power losses in Bulgarian, Romanian and Hungarian residences**



**Diana Urge-Vorsatz**
**Kristina Stroukanska**
**Szilard Asztalos**

***Central European University***

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## Content

- **Background: Leaking electricity?**
- **Appliance energy efficiency in CEE**
- **Aims of research**
- **Methods**
- **Results**
- **Standby-related emissions and savings potentials**
- **Conclusions**

Slide 2

## Background 1.

- Some appliances consume power while performing no useful function (VCR, TV, extension cord, low-voltage lamps, transformers, etc.)
- This can amount to as much as 10% of household electricity consumption
- Residential standby losses can account for as much as 1.7% of total national carbon emissions (Aus)

Slide 3

## Background 2.

- The majority (80-90%) of these emissions can be saved at no compromise in energy services
- Technical solutions exist in the majority of cases
- Policies are required for overcoming market barriers
- The extent of losses is poorly understood for the CEE region

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## Appliance energy efficiency in CEE

- Post-socialist appliance stock legacy: few, mainly basic home appliances (fridge, TV, washing machine), but often inefficient
- Stocks of several "luxury" appliances (microwave, VCR, IT equipment, etc.) are starting to penetrate households, or are far from saturation levels
- stocks of other old appliances are rapidly turning over to "new", Western varieties (TV, fridge, phones, etc.)
- dynamic market turnover and unsaturated appliance penetrations create unique window of opportunity for leap-frogging:
- if progressive appliance policies introduced, stocks could reach efficiency levels higher than OECD averages.

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## Aims of research

- Understand the scale of standby power losses and related emissions in CEE countries
- estimate electricity and carbon savings potentials by introducing the 1-watt policy

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## Methods

- Standby power of appliances in 99 households in Bulgaria, Romania and Hungary have been measured
- The field measurement of standby power was conducted with watt meter - "Energy-Cost-Checker EKM 265" (± 1%± 3digit)
- Each household appliance susceptible of having standby power consumption was measured
- The standby power per household was calculated by summing the individual usage weighted standby consumption of each appliance (Ross&Maier 2000)
- The CO2 emissions from standby power were calculated applying electricity emission factor($gCO_2$/kWh) (Thomas *et al.* 2000; IEA 2000)
- The national level estimations are based on extrapolation of the results for the three countries on national level

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## RESULTS

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### Standby consumption and average number of appliances per household in CEE region

| Appliance | Number of appliances measured | Average number of appliances per HH | Average standby consumption (Wh/d) |
|---|---|---|---|
| **Video** | | | |
| TV set | 123 | 1.24 | 164 |
| VCR | 55 | 0.56 | 217 |
| **Audio** | | | |
| Hi-fi stereo | 43 | 0.43 | 191 |
| Tape recorder | 15 | 0.16 | 51 |
| Radio alarm clock | 23 | 0.23 | 47 |
| **IT** | | | |
| PC | 38 | 0.38 | 147 |
| Printer | 9 | 0.09 | 59 |
| **Communication** | | | |
| Phone/answering machine | 34 | 0.34 | 83 |
| Cell phone charger | 14 | 0.14 | 37 |
| **Kitchen products** | | | |
| Microwave | 13 | 0.13 | 38 |
| **Miscellaneous** | | | |
| Extension cord | 15 | 0.15 | 53 |
| **Total** | 382 | | 1087 |

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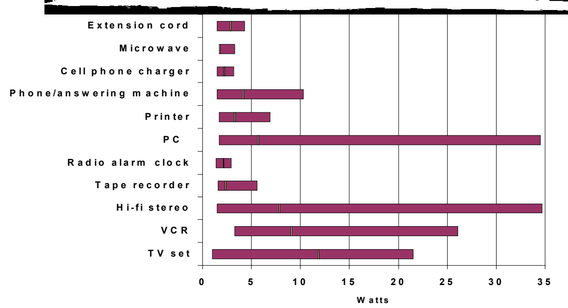
### Standby power ranges (minimum, median and maximum) of appliance types in CEE region based on the results in the three countries

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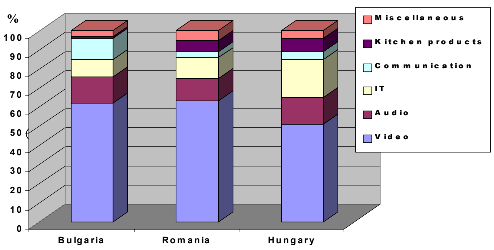
### Contribution of appliance categories to the total standby consumption in %(Wh/d)

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### Standby power loads per household

| Country | Average number of appliances with standby features in HH | Average standby power per HH* (W) | Average standby consumption per HH (Wh/d) |
|---|---|---|---|
| Bulgaria | 5 | 33 | 789 |
| Romania | 3 | 14 | 340 |
| Hungary | 4 | 30 | 709 |
| CEE | 4 | 26 | 613 |

*Usage weighted

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### Estimation of energy demand and $CO_2$ emissions from residential standby power

| Country | Number of HH (millions of units) | Average standby power (W/home) | Total standby power demand (MW) | Total standby energy (TWh/yr) | Total national electricity consumption 1998[1] (TWh/yr) | Resid. Standby as % of national electricity (%) | $CO_2$ emission ratio[2] ($gCO_2$/kWh) | National $CO_2$ emissions 1998[3] (Mt) | $CO_2$ from standby power (Mt) | Standby as % of national $CO_2$ (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Bulgaria* | 2.96[4] | 33 | 98 | 0.86 | 32.47 | 2.6 | 419 | 48.60 | 0.4 | 0.8 |
| Romania* | 7.4 | 14 | 104 | 0.91 | 47.43 | 2.0 | 304 | 94.59 | 0.3 | 0.3 |
| Hungary* | 3.85 | 30 | 116 | 1.01 | 33.01 | 3.0 | 362 | 57.42 | 0.4 | 0.7 |
| Germany | 36.03 | 44 | 1585 | 13.9 | 527 | 2.6 | 690 | 884 | 9.6 | 1.1 |
| Australia | 7.09 | 87 | 617 | 5.4 | 171 | 3.2 | 942 | 306 | 5.1 | 1.7 |
| Poland | 11.8 | 20 | 236 | 2.1 | 124 | 1.7 | 921 | 350 | 1.9 | 0.5 |
| OECD | 386 | 38 | 14,634 | 128 | 8362 | 1.5 | 530 | 12,235 | 68 | 0.6 |

Source: IEA 2001 (with amendments)

* Results from the present study

[1] Data source: IEA 2000
[2] Electricity emission factor. Data source: Thomas *et al.* 2000
[3] Data source: IEA 2000
[4] Data source: BNSI 1992

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### Household expenditure for standby power (per household and national)

| | Price (USD/kWh) | Household expenditure (USD/year) | Total household standby power cost (millions USD/year) |
|---|---|---|---|
| Bulgaria | 0.04 | 11.56 | 34.27 |
| Romania | 0.04 | 4.91 | 36.30 |
| Hungary | 0.08 | 21.02 | 80.94 |

- Electricity price for household is 0.07 leva/kWh in Bulgaria (December 2001)
- Electricity prices for households is 1200 Lei/kWh in Romania (July 2001)
- Electricity prices for households is 23 Forint/kWh in Hungary (December 2001)

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## Reduction of residential standby power consumption and $CO_2$ emissions after implementing the 1 Watt plan

| Country | Total annual standby power of HH (TWh/yr) | Average standby power per HH (W) | Average daily standby consumption per HH (Wh/d) | Total standby power saved (TWh/yr) | Total $CO_2$ emissions saved (Mt) |
|---|---|---|---|---|---|
| Bulgaria | 0.13 | 5 | 120 | 0.73 | 0.30 |
| Romania | 0.16 | 2.3 | 56 | 0.75 | 0.24 |
| Hungary | 0.12 | 3.5 | 84 | 0.89 | 0.30 |

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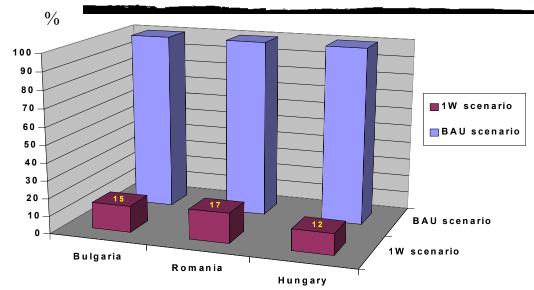
## Reduction of residential standby power in case of implementation of 1W plan

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## Conclusions

- The scale of standby power losses in CEE countries is significant
- There is a clear need of broader studies on CEE region
- After implementation of 1W standby power policy, standby power consumption and related CO2 emissions can drop by 80 - 90%
- Savings potentials are:
  - Bg: 0.3 Mt of CO2 and USD 29 million
  - Ro: 0.24 Mt of CO2 and USD 30 million
  - Hu: 0.3 Mt of CO2 and USD 72 million.

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## Acknowledgements

- International Energy Agency
- Peter Karbo of Danish Electric Utilities

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## Definition

Standby power (Watt) =(W x T)/24

W = the minimum power that the appliances draw when connected to the mains (Ross&Meier 2000)

T = time during which the appliance is in standby mode ($24-T_{\text{active mode}}-T_{\text{off mode}}$)

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## Standby power consumption of appliances in Bulgarian, Romanian and Hungarian households

| Appliance | Bulgaria | | | Romania | | | Hungary | | |
|---|---|---|---|---|---|---|---|---|---|
| | Number of appliances measured | Average number of appliances in HH | Average standby consum (Wh/d) | Number of appliances measured | Average number of appliances in HH | Average standby consum (Wh/d) | Number of appliances measured | Average number of appliances in HH | Average standby consum (Wh/d) |
| Video | | | | | | | | | |
| TV set | 39 | 1.30 | 173 | 46 | 1.53 | 103 | 38 | 0.97 | 215 |
| VCR | 23 | 0.77 | 170 | 12 | 0.40 | 199 | 20 | 0.51 | 217 |
| Audio | | | | | | | | | |
| Hi-fi stereo | 18 | 0.60 | 204 | 5 | 0.17 | 175 | 20 | 0.51 | 194 |
| Tape recorder | 11 | 0.37 | 57 | | | | 4 | 0.10 | 45 |
| Radio alarm clock | 7 | 0.23 | 48 | 11 | 0.37 | 48 | 5 | 0.13 | 46 |
| IT | | | | | | | | | |
| PC | 8 | 0.27 | 177 | 9 | 0.30 | 61 | 21 | 0.54 | 203 |
| Printer | 3 | 0.10 | 90 | 3 | 0.10 | 27 | 3 | 0.13 | 61 |
| Communication | | | | | | | | | |
| Phone/answering machine | 19 | 0.63 | 77 | 4 | 0.13 | 71 | 11 | 0.28 | 102 |
| Cell phone charger | 4 | 0.13 | 43 | 5 | 0.17 | 18 | 5 | 0.13 | 50 |
| Kitchen products | | | | | | | | | |
| Microwave | | | | 3 | 0.10 | 21 | 10 | 0.26 | 55 |
| Kitchen oven | 3 | 0.10 | 37 | | | | | | |
| Miscellaneous | | | | | | | | | |
| Extension cord | 7 | 0.23 | 38 | | | | 8 | 0.21 | 67 |
| Total | 142 | 4.73 | 1114 | 98 | 3.27 | 723 | 145 | 3.77 | 1255 |

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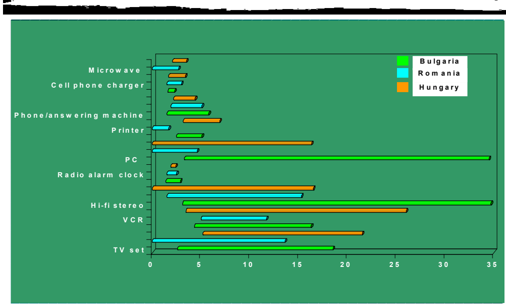
## Standby power ranges (minimum and maximum) of appliance types in the studied countries

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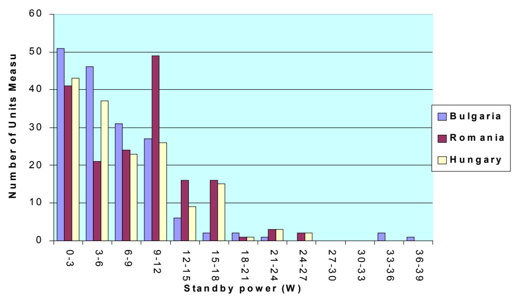
## Distribution of appliance standby power in Bulgaria, Romania and Hungary

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### Estimations by IEA (2000) for Hungary vs. study results

| Estimation | Average standby power (W/home) | Total standby power demand (MW) | Total standby energy (TWh/yr) | Standby as % of national electricity (%) | $CO_2$ emission ratio ($gCO_2$/kWh) | National $CO_2$ emissions 1998 (Mt) | $CO_2$ from standby power (Mt) | Standby as % of national $CO_2$ (%) |
|---|---|---|---|---|---|---|---|---|
| **Authors'** | **30** | **116** | **0.99** | **3.0** | **624** | **57.42** | **0.6** | **1** |
| IEA | 20 | 77 | 0.7 | 2.0 | 624 | 58 | 0.4 | 0.7 |

- Average standby power per HH is 33% more than IEA estimation
- Total standby energy (TWh/yr) is 30% more than IEA estimation
- CO2 emissions from standby power are 33% more than IEA estimation

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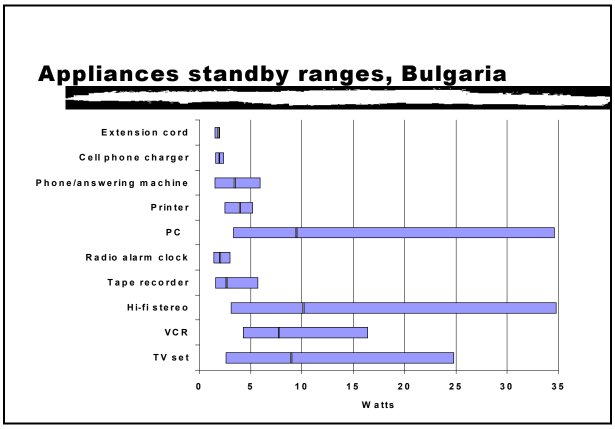


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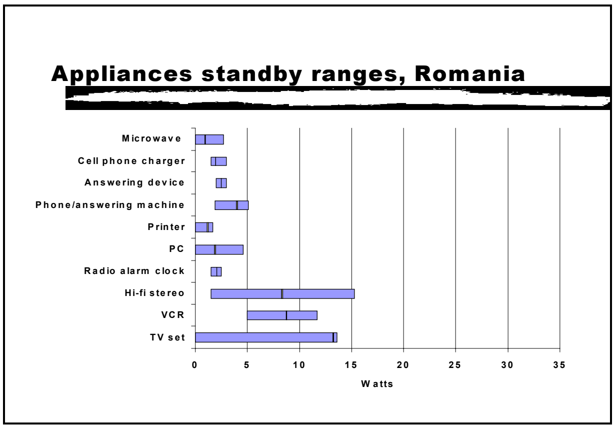


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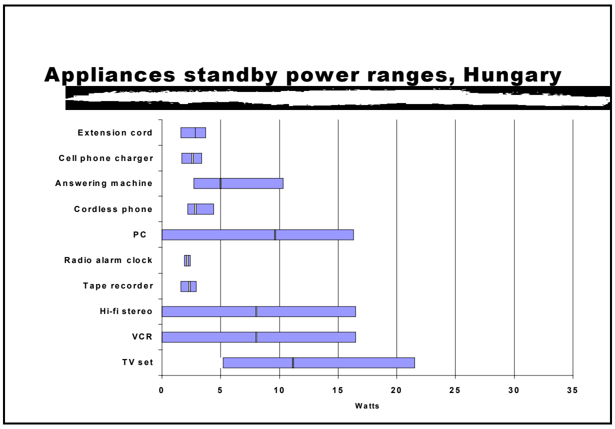


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# Really off? Stand-by Campaign by Energy Foundation Schleswig-Holstein, Germany

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Energiestiftung Schleswig-Holstein, Kiel, Germany

## 1. The story behind the campaign

In a study, 1997 performed on behalf of the German Federal Environmental Agency (Umweltbundesamt, see Rath et. al., 1997), all kinds of consumption of electric appliances and equipment in private households and the office sector in Germany, when not in use for their primary purpose, have been examined. These so-called no-load losses create some 14.4 million tons of $CO_2$ emissions per year. Around two thirds of this amount is due to stand-by-consumption. No-load modus is defined in this context as an operating modus of appliances and equipment when energy is wasted without any clear or considerable benefit, e.g. excessive use of energy for TV sets in stand-by position to receive remote-control signals, fax machines in ready position or transformers which cannot be disconnected from the power supply system due to their particular design as is the case with numerous printers or audio systems, for example.

In a next step, the Energy Foundation Schleswig-Holstein was participating in a follow up study concerning the development of a political strategy how to realize the calculated potentials that is how to turn the theoretical potentials into climate protecting reality. This follow up study (Umweltbundesamt, Rath et. al., 1999) showed clearly that campaigns to get consumers interested in low stand-by-consumption of their electrical equipment will be a necessary and important part of the solution. Interviews with representatives from different stakeholders in this area (from Greenpeace to the representatives of the electronic industry in Germany) revealed a multiple win-win-situation for consumers as well as for the industry, retailers and policy, if a successful campaign would lead to a demand modification of the consumers.

While the study developed proposals for the Federal government, it's conclusions have been also interesting for the Energy Foundation itself. Also in 1999, an institutional innovation for Germany, namely the establishment of a so-called Energy Saving Trust following British and Danish examples, has been proposed (Wortmann et al. 1999). To support energy efficiency through marketing activities was one of the main tasks of such organization. Thus, acting like an energy efficiency trust, the Foundation could make a two fold "proof of the pudding": To test the trust as well as the campaign - idea, originally developed for Germany, in the test-market Schleswig-Holstein.

Therefore, it was decided to spend a remarkable amount of money, about 0,75 million € for a professional energy efficiency campaign as a pilot- and demonstration project. Such had to have a clear impact on the consumer demand. Thus, not only „a" campaign, but a professional marketing approach with a clear goal (like in profit marketing) would be the preferred way to do it. And this makes an important difference to many other pro-environmental campaigns, showing nothing more than that there is a nice sender of a nice message, but with no measurable effect on impact on consumer demand.

In our contribution, we will briefly show the approach, then report results of a recently completed, very comprehensive evaluation. We will conclude, finally, with some policy considerations.

## 2. The „Off. Really off"-campaign

### Initial position

At first glance, the initial position to execute such a campaign is unfavorable. To save electricity is a topic in which only some are particularly interested. But there is a label (the European GEEA-label) which indicates efficient equipment concerning stand-by-consumption. But this is more or more or less unknown among retailers and consumers. Finally, the Energy Foundation as independent authority is so far only known among energy experts.

**Strategic approach of the campaign**

As main element the consumers are in the center of the campaign. But this part of the whole system of “producing” high or low stand-by-consumption is then used to exert influence also on other parts. The path of influence of different parts of the campaign is shown in figure 1:

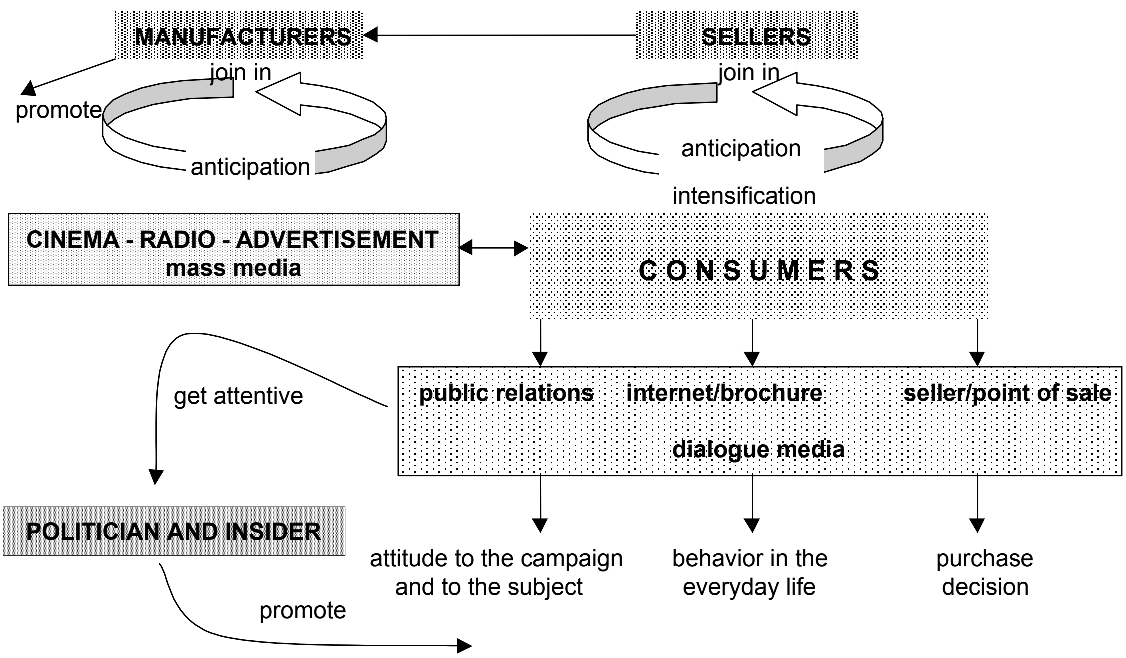
- The organized public awareness campaign takes place in the print media, in cinemas and in the broadcast. The advertisements, the cinema spot and the radio commercials are coordinated with each other in temporal waves.
- The increased demand of the consumers and the advertising effect of the mass media shall exert influence on the behavior of the sellers and manufacturers. Manufacturers whose devices have good efficiency values should be likely to support the campaign positively, e.g. by sponsoring.
- A positive reporting supported by PR-activities – as one of the dialogue-media - promotes the engagement of the consumer for the campaign.
- By internet and brochures more detailed information is passed on. This together with the mass media influence should help to improve the everyday behavior of the consumers. A behavior modification is often sufficient to reduce the electricity consumption of different equipment ("Really off!"). The comparison of the transmitted information with the conditions in the household influences the sensibility beyond the topic "stand by", e.g. for low consumption of white goods etc.
- Another important path of influence is the advice by the seller at the point of sale. The decision to buy an energy-saving equipment is finally made here. A seller informed and interested in the topic and as well supportive for the campaign is, therefore, a prerequisite of the campaign’s success. Therefore, all retailers in the state have been contacted before the official start of the public campaign. They have been invited to join a special “sellers' event”, where they have been informed about their possibilities to profit from the campaign (free point of sale-material, “go to your electrical shop for more information” as a central message of the campaign).

The dialogue media, particularly the PR-work also exert an effect on politicians and energy professionals. This effect is still strengthened by the representation in the mass media. Positive assessments of the politicians and “insiders” create a good base for further actions or campaigns of this kind.

**The communication approach**

The slogan "Off. Really off?" points to the central sales argument: Decide when you want to consume electricity and when not! The slogan puts a previous comprehensibility ("Off") in doubts ("Really off?").

*Figure 1: The strategic approach of the campaign*



The consumer reacts to the topic "switch off" emotionally and experiences an appeal to the autonomy of the individual. The slogan is in a direct connection to the scenes of the commercials and pictures. Everyday events in which something is "off", "out" or "over" are represented here. In German it means a pun: The one word "aus" describes these three words in English. Further arguments like money savings or climate protection are not in the center, but are also mentioned.

The campaign backs on fun instead of morals for an entertaining advertising. This is a contrast to the traditional pro-environmental communication. Such way to communicate with the consumer on the basis of his or her personal advantage even for ecological goals is necessary to reach many segments of the population and not only those who are already convinced. This attempt is therefore a novelty and a pilot project in which a new approach how to communicate a "dry" topic to a fun-seeking public is examined in a reality test.

The means of advertising can be divided into two groups: The ones draw the attention, the others inform. Cinema, radio and newspaper advertisements excite the attention with commercials and eye-catching pictures. The further information sources are pointed out to the public simultaneously. In the advertisements always striking motives from the daily life which are not in a direct context with the topic are used. The accompanying text and the campaign sign point to the topic and further information. The cinema and radio commercials are built up similarly: After a surprise effect of an "everyday" event the topic is mediated by a few sentences, the campaign's logo and the information on the web-site www.wirklich-aus.de.

The second group of the means of advertising contains the information passing on. A brochure which is displayed at the distributors is one of the media for deeper information. The sellers in addition get material with which they can refer to efficient equipment at the point of sale. For telephone inquiries, a hotline is established. An extensive multi-media internet presentation offers further information including a list for recommendable equipment following the GEEA-guidelines. Thus, this efficient equipment can directly be requested from a data base. The distributors who participate in the campaign are mentioned in the internet presentation, too.

**Time schedule**

The campaign was planned during summer 2000. The official start was November, 8, 2000 with the so called retailers' "event". The advertising in newspapers, cinemas and the radio started in January 2001, and the campaign has been running until June, 2001. It's prolongation starts just now (October 2001) as a reminder campaign in all newspapers in Schleswig-Holstein.

## 3. Evaluation results

The evaluation of the campaign is mainly based on an impact control carried out by an independent survey institute, paid by the German National Environmental Foundation (Deutsche Bundesstiftung Umwelt) because of the high interest of this organization to learn from this regional campaign for it's national stand-by-initiative which has been in preparation at that time. For the impact control, a public opinion poll was carried out using the computer-aided-telephone-interview (cati)-method with N = 1.000 individuals in each population sample and N = 100 retailers in Schleswig-Holstein and, as „quasi-control-group", in Niedersachsen (Lower Saxony). In general, the evaluation which has just been finished by the Emnid institute, revealed very positive results for the campaign. For example, 24 % of the population in Schleswig-Holstein (compared to 3 % before) relate now the term stand-by-consumption with wasting energy, respectively high electricity consumption. The rate of „don't know"-answers decreased from 22 % to 16 %. A similar tendency, but weaker could be observed in Lower Saxony. Generally, the campaign reached to put it into two words „more attention as well as more doubts" in Schleswig-Holstein compared to Lower Saxony, as the following results demonstrate further:

- 54 % in Schleswig-Holstein compared to 39 % in Lower Saxony, noticed the topic „stand-by-consumption" during the last month,
- more people in Schleswig-Holstein wish to have more information about the stand-by-consumption of electronic devices,
- less people feel sufficiently informed about electricity saving compared to the situation before (34 % compared to 38 %),

- more people say they put off (really off) their TV-equipment (57 % compared to 49 %),
- switchable power strips are more in use than before (from 35 % to 42 %).

The campaign, despite informing the public, led to more doubts among the consumers, but that is a precondition in this case to be really interested in more information. Other results show that retailers have more widely than before been used as information source and that the willingness to pay for “power savers” or for devices with low stand-by-consumption increased. Additionally, the communication strategy was confirmed by the observation, that more than 80 % in all four population samples said, that they would feel disturbed if their appliances could not really be switched off from the mains. Psychologically spoken, not pro-ecological attitudes but the fear to loose control about things in my personal environment can be regard as main motivation source. When the people were asked, why they feel disturbed, nearly 50 % say „just because off is not really off!“ (they don’t need more reasons). Looking at the retailers, similar positive results could be observed:

- 16 % (compared to 2 % before, in Lower Saxony 5 %) say that stand-by has something to do with wasting energy,
- 47 % (compared to 26 % before, in Lower Saxony 30 %) became active to look for more information about this topic,
- two thirds of all relevant retailers in Schleswig-Holstein (400 out of 700) ordered the campaign material, and know the campaign; nearly 80 % used the material in the shops and more than 80 % say the material is good,
- additional measures based on own activities claim 23%, 33 % say they are planning such activities and 13 % say that they even changed their range of products.

Many other positive results could be observed besides this survey, for example a very good reaction in the newspapers which helped to reach the goals of the campaign, co-operation projects with the consumer agency in Schleswig-Holstein and so forth. The survey report concluded that awareness and interest in the population and among the retailers have been reached, partially even some action, which is for such a campaign in this quite short time period a very positive result.

## 4. Policy lessons

The role of the consumer for energy efficiency measures has been underestimated in the past from our point of view, mainly due to the traditional roles in the energy sector, which are challenged not only for the former energy utilities, but also for energy efficiency advocates. Energy saving becomes a product to be sold effectively to the end consumer, when one follows the described approach. There are signs that Eco-Marketing in general has to overcome it’s “traditional” role as niche marketing for niche products. Instead it should attempt a mass marketing approach as described here (see Villiger et al., 2000). Criteria to distinguish pro-environmental marketing “beyond the eco-niche” are, for example:

- overall good quality of the product, not only environmental friendliness,
- products as cheap as possible (not high prices as signal for ecological value of this product),
- using all tools of professional persuasion, not only moral appeals or mere facts,
- compete with the conventional range of products, this leading, as a result, to
- attempts to reach market shares worth mentioning.

The idea of the individual as passive victim of powerful pressure groups is as misleading as the opposite idea of “only the free market solves any problem”. The promising path (and further development of this path in terms of it's conception, including marketing and other approaches is certainly needed) runs between these two extremes.

However, only out of a relatively independent and transparent position, a persuading marketing approach will work. As not only the consumer is important, but also the institutional framework for the campaign, this issue shall be considered in more detail. Based on our experiences so far, the following important framework conditions should be considered to secure real outcome:

**Relative independence of the institution**

That means in it’s core that a good campaign is hard to be carried out when many different interest groups try to secure their influence on the activity (that is and will be the normal case for most of the campaigns we know about in Germany).

**Clear institutional goal**

The task of the institution or at least this specific campaign has to be defined in a clear and transparent way in order to secure the trustworthiness of the communicator within the communication process, which is the most important variable of a successful persuasion or communication process as is well known from social psychology. A strict energy efficiency, respectively climate protection orientation of the institution and the obligation to follow this goal (and not many others at the same time) is therefore an important factor.

**Budget autonomy**

It will be difficult to lead a campaign over more than a year when it is unclear which budget can be spent for the purpose of the campaign from year to year - this is the normal situation for publicly funded institutions. An advantage for the energy foundation is it’s foundation status which allows for self financing of the own activities.

**Appropriate (sufficient) budget for the task**

A campaign costs money and no professional advertising agency will submit proposals when there is no fit between the task and the budget to solve it.

Under these preconditions it will be possible to build up new alliances on the market and by this, that is the whole activity, not only the communication approach, a real impact on the market is possible. Such an activity supports the energy political proposal by the Foundation for Germany, namely to follow the British or Danish example in building up an Energy Saving Trust (see Wortmann & Menges, 2000).

Even the “Negawatt costs” are supportive for a campaign as can be demonstrated by the following calculation: A stand-by-consumption of approx. 700 million kilowatt hours per annum is registered in Schleswig-Holstein. Nearly half of the consumption is approximately reducible. If the demand-side campaign with a volume of about 1 million € (covering all costs) affects successfully about 10% of the population, then the costs amount to 3 cent (0,03 €) per kilowatt hour. This value is within the range of electricity production costs.

This approach to use professional solutions also in the domain of communication, should be improved and refined by follow up campaigns. The Energy Foundation works into this direction with their next so called „Schlaulicht“-Campaign, using the same approach to market (still!) energy saving lamps because of their high climate protection potential and their as well high potential in terms of personal benefits for the consumers. Recent discussions with the RWI, the institute responsible for monitoring the commitment of German industry with the German government for special efforts for climate protection showed that it will be possible to use this kind of campaigns as a climate protection instrument and to give this instrument a certain quantitative $CO_2$ reduction value based on good and comprehensive evaluation data like the ones we have presented here. Thus, our recommended action is to use this successful form of public private partnership also on the national (may be even European) level and in the context of this commitment.

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## Really off? Stand-by campaign by the Energy Foundation Schleswig-Holstein, Germany

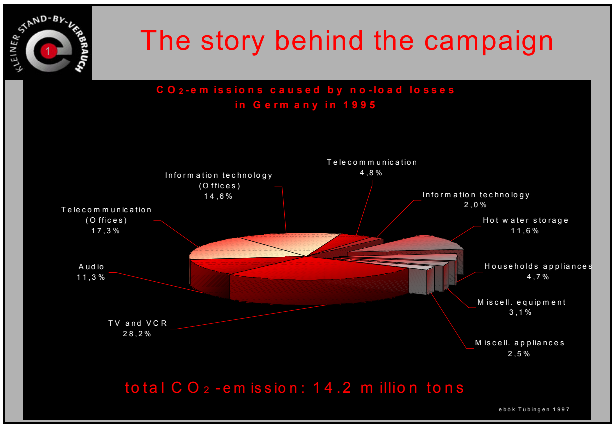
Holger Krawinkel
Energy Foundation Schleswig-Holstein, Kiel, Germany

CTI Capacity Building Seminar for CEE/FSU Countries

Climate Technology and Energy Efficiency - Disseminating "Best Practice" Experience

December 5-9, 2001 in Ostritz, Germany

Slide 1

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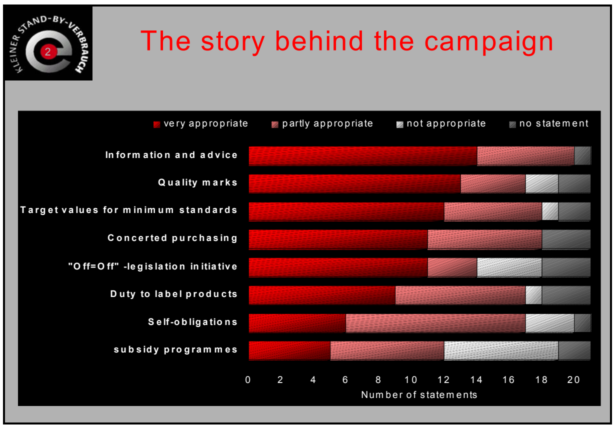



Slide 3

### The story behind the campaign

Energy Foundation´s interests

- Proposal for an Energy Saving Trust in Germany
  - Marketing activities as one of the main tasks
- Test of the trust-idea
- Test of the campaign approach
- Realisation of a pilot and demonstration project

Slide 4

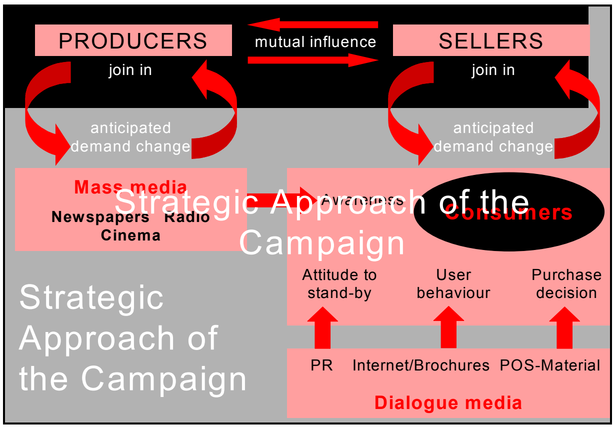
### The "Off. *Really* off?"- Campaign

**OBJECTIVES**

- Enhanced customer awareness and activity concerning stand-by consumption
- Stand-by consumption as example for pointless energy use
- Support for energy efficient devices
- Pilot project for modern forms of eco-marketing
- Impact Control

⇒ Assistance by advertising agency
⇒ Start in January 2001, duration of six months, continuation in autumn 2001 and spring 2002

Slide 5




Slide 6

### The "Off. *Really* off?"- Campaign

**COMMUNICATION APPROACH**

- Elicit awareness by using „trojan horses"

1 *Describing everyday life situations which are „off" (or „out" or „over")...*

2 *Asking if they are „really off" (or „out" or „over")*

3 *Explaining stand-by issue in small print with hint to the web-site and sellers of electronic devices*

4 *...have a smile on your face...*

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## Evaluation results

- Impact control by independend survey institute
  - paid by National Environmental Foundation
  - pre- and post-telephone interviews with representative samples of the population (N=1000) and electronic sellers (N=100) in Schleswig-Holstein and Lower Saxonia, results in August 2001
- Reactions of the public and among experts
- Media reports
- Web-site-visitors on www.wirklich-aus.de

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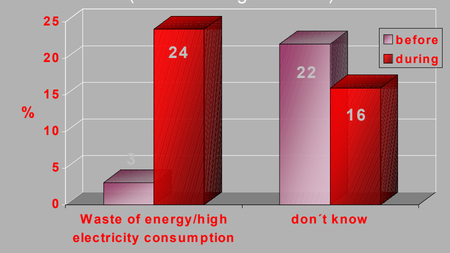
## Evaluation results

What does stand-by-consumption mean for you?
(In Schleswig-Holstein)




⇨ Similar tendency, but weaker, in Lower Saxonia

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## Evaluation results

**HIGHER AWARENESS, MORE DOUBTS**
than before in Schleswig-Holstein

- 54 % in Schleswig-Holstein compared to 39 % in Lower Saxony, noticed the topic "stand-by-consumption" during the last month
- more people in Schleswig-Holstein wish to have more information about the stand-by-consumption of electronic devices
- less people feel sufficiently informed about electricity saving compared to the situation before (34 % compared to 38 %)
- more people say they put off (really off) their tv-equipment (57 % compared to 49 %)
- switchable power strips are more in use than before (from 35 % to 42 %)

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## Evaluation results

Looking at the retailers

- 16 % (compared to 2 % before, in Lower Saxony 5 %) say that stand-by has something to do with wasting energy
- 47 % (compared to 26 % before, in Lower Saxony 30 %) became active to look for more information about this topic
- two thirds of all relevant retailers in Schleswig-Holstein ordered the campaign material
  - and know the campaign
  - nearly 80 % used the material in the shops
  - more than 80 % say the material is good
- additional measures based on own activities claim 23 %, 33 % say they are planning such activities and 13 % say that they even changed their range of products

Slide 20

## Evaluation results

**THE CAMPAIGN**

- already successful
- appears innovative and modern
- supports marketable solutions
- co-operates with market partners
- makes energy saving cheap
- to be repeated, expanded, supplemented

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## Policy Lessons

Criteria to distinguish pro-environmental marketing ”beyond the eco-niche” are, for example (See Villiger et.al., 2000)

- overall good quality of the product, not only environmental friendliness
- products as cheap as possible (not high prices as signal for ecological value of this product)
- using all tools of professional persuasion, not only moral appeals or mere facts
- compete with the conventional range of products, this leading, as a result, to
- attempts to reach market shares worth mentioning

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## Policy Lessons

**PRECONDITIONS**

- “good” products exist already
- independend and trustworthy campaigner
- relative budget autonomy of the campaigner
- low negawatt-costs (below 3 Cent, if only 10% reduce 50% of their stand-by-consumption as a consequence of the campaign)

⇒ act as an Energy Saving Trust!

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KLEINER STAND-BY-VERBRAUCH

Off. Really off?

[redacted]

Slide 24

# The Kyoto Mechanisms

The Situation after Marrakech – Opportunities for Infrastructure Investment in Central and East Europe – The Integration in the European and International Climate Protection Strategy

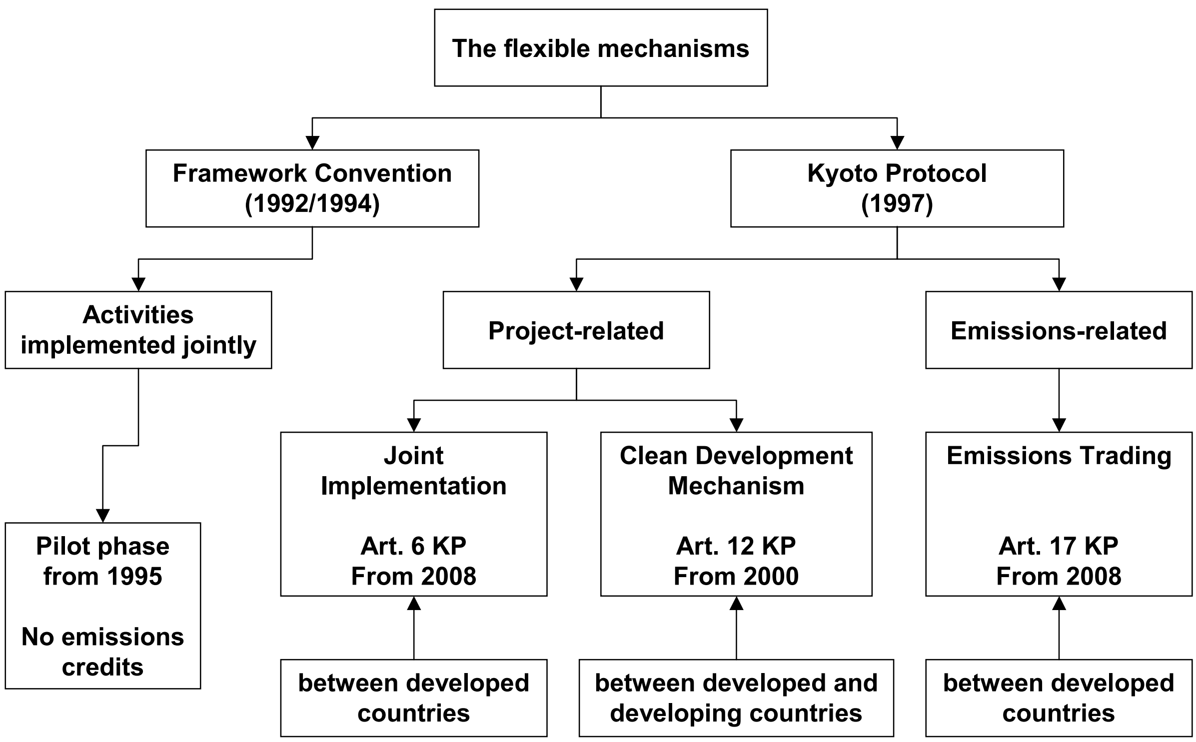
**Franzjosef Schafhausen**

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, Berlin

The issue of the greenhouse effect, its causes and the possibilities of countermeasures against it have been discussed in scientific circles, the business world, politics and society for 15 years now. Certainly, the intensity of the debate varies greatly from one world region to another. Whereas the small island nations, particularly in the Pacific (Alliance of Small Island States – AOSIS), that are the first to be affected by the climate change already underway are in the front line together with the European Union, the subject is virtually taboo in the USA. Nevertheless, an important step forward was taken in Marrakech with regard to an internationally agreed climate protection policy. Marrakech has created the preconditions to enable the Kyoto Protocol to come into force within a few months. As a result, the so-called Kyoto Mechanisms - Joint Implementation, Clean Development Mechanism and Emissions Trading - are also becoming more important. All three mechanisms are based on the intention to use the cost differences between various emitters of greenhouse gases to achieve global climate protection in an economically efficient way. Especially suited to that is the combating of the greenhouse effect, in which it is not a question of where on our planet emissions harmful to the climate are avoided, but that they are reduced.

The aim of my following remarks is to portray the current situation, to elaborate on the opportunities for investors and host countries offered by the Kyoto Mechanisms depicted in figure 1, and to point out the prospects.

*Figure 1: The flexible mechanisms of the Framework Convention on Climate Change and the Kyoto Protocol*



## 6. Brussels trends – The EU climate strategy

The activities of the European Commission during the last two years were characterized by the realization that in the "business as usual" case the EU as a whole would fall well short of the commitments it made in Kyoto in 1997. This was the finding of a scientific study presented at the beginning of 2000. The alarming statement at that time was: instead of having come very close to the target it took on in Kyoto - "Reduction of greenhouse gases by 8 per cent in the period 2008-2012 (base year 1990)" – the amount of greenhouse gases emitted from the territory of the European Union in 2012 will be about 1 per cent higher than its emissions in base year 1990 (see table below).

The European Commission's conclusion: since the EU member countries were obviously not in a position to realize the required reduction targets (see table below) by means of national policies and measures, further steps at Community level were essential.

*Table 1: Greenhouse gas reduction potential within the European Union under cost-efficiency criteria for all relevant sectors to 2012 (including implementation of the voluntary commitment of the European motor industry)*

| Marginal cost 20 \$/t $CO_2$ equivalents | GHG emissions 1990 or 1995 in megaton $CO_2$ equivalents | Baseline emissions 2010 according to "business as usual" | Cost-efficiency potential beyond the "business as usual" case |
|---|---|---|---|
| Energy supply | 1.422 | minus 6 % | minus 13 % |
| Industry | 757 | minus 9 % | minus 12 % |
| Transport | 753 | plus 31 % | minus 4 % |
| Households | 447 | plus/minus 0 % | minus 6 % |
| Small-scale consumption | 176 | plus 14 % | minus 15 % |
| Agriculture | 417 | minus 5 % | minus 4 % |
| Waste management | 166 | minus 18 % | minus 13 % |
| EU as a whole | 4138 | plus 1 % | minus 9 % |

This was the starting signal for the European Climate Change Program (ECCP). The concept was developed initially within the framework of an extensive process in which not only officials of the EU member country governments but also representatives of industry and environmental groups participated. Recommendations for the design of the European climate protection policy were drawn up from the spring of 2000 to July 2001. The results of this process focused on the sectors 'Flexible Mechanisms', 'Demand-related measures', 'Energy supply', 'Industry', 'Transport' and 'Fluoridated Gases'.

The result of the year-long, at times extremely contentious discussion process: 40 cost-efficient measures were identified. With a greenhouse gas reduction potential of 664-765 megaton $CO_2$ equivalents, the measures cover a potential of double the reduction target the EU took on in Kyoto. The European Commission calculated that the total costs of realizing the EU target with the most cost-efficient measures would in 2010 be 3.7 billion €s, or 0.06 per cent of the EU's gross domestic product.

*Table 2: EU burden-sharing, emissions development 1990 to 1999, and target achievement level of the individual EU member countries*

| EU country | Targets for the commitment period 2008–2012 according to the burden-sharing of 1998 | Emissions trends between 1990 and 1999 | Emissions reduction target to 2008-2012 |
|---|---|---|---|
| Belgium | minus 7.5 % | plus 2.6 % | minus 10.1 % |
| Denmark | minus 21 % | plus 4 % | minus 25 % |
| Finland | plus/minus 0 % | minus 1.1 % | Target achieved |
| France | plus/minus 0 % | minus 0.2 % | Target achieved |
| Germany | minus 21 % | minus 18,7 % | minus 2.3 % |
| Greece | plus 25 % | plus 16.9 % | Target achieved, but continuing upward trend |
| Ireland | plus 13 % | plus 22.1 % | minus 9.1 % |
| Italy | minus 6.5 % | plus 4.4 % | minus 10.9 % |
| Luxembourg | minus 28 % | minus 43.3 % | Target achieved |
| Netherlands | minus 6 % | plus 6.1 % | minus 12.1 % |
| Austria | minus 13 % | plus 2.6 % | minus 15.6 % |
| Portugal | plus 27 % | plus 22.4 % | Target achieved, but continuing upward trend |
| Spain | plus 15 % | plus 23.2 % | minus 8.2 % |
| Sweden | plus 4 % | plus 1.5 % | Target achieved |
| United Kingdom | minus 12.5 % | minus 14 % | Target achieved |
| EU as a whole | minus 8 % | minus 4 % | minus 4 % |

Source: European Commission, 2001

The measures focus on the following sectors:

- Introduction of EU-wide emissions trading
- Greater use of renewable energy sources
- Improving energy efficiency in buildings
- Tightening energy-saving standards for domestic appliances as well as communications and entertainment technology devices
- Energy consumption management
- More intensive use of cogeneration of power and heat
- Better control of fluoridated greenhouse gases by maintenance, leak tests and monitoring
- A more climate-efficient ‘modal split’ in the transport sector by improving infrastructure and levying fees and charges

Because of the currently very controversial discussion, which in part is being conducted with completely wrong arguments, and also because of the theme of my address, I would now like to pick out from the basket of proposals the introduction of an EU-wide trade in greenhouse gas emissions.

The basic structure of the proposed directive tabled by the European Commission on October 23, 2001; introducing EU-wide trading in greenhouse gases; arises from the following overview.

- Binding concept
- Installation-related (> 20 MW combustion installation input) or registration of the most energy-intensive sectors (Appendix I)
- Allocation of emissions allowances on the basis of absolute quantities
- Fundamentally all ‘Kyoto gases’ – start with $CO_2$ (Appendix II)
- Introduction phase 2005-2007
- Final phase 2008-2012 – after 2012, a five-year extension in each case
- Drawing up of national allocation plans for all sectors
- Allocation method: ‘grandfathering’
- Allocation rules (Appendix III) take account of technical possibilities, need/growth, newcomers and early action
- Burden-sharing of 1998 remains unaffected

- 46 per cent of the EU's estimated $CO_2$ emissions in 2010 is registered.

If one looks at the possibilities the Commission's proposal provides for in designing national allocation plans, it can be seen that all the alarmist claims which interest groups are presently disseminating are completely unfounded.

The fairytale of "a brake on growth" proves to be false if only because in the free-of-charge allocation of emissions allowances not only the technical potential of each installation can be taken account of, but also their need and so-called 'early action' – which against the background of the prompt reductions of greenhouse gas emissions already made by Germany and not least also by German industry – is extremely important.

The threat of job losses is also unconvincing because the "scientific studies" which are supposed to prove this assume a "worst case" scenario, which actually no-one in Germany is aiming at. At the same time, those who warn against the negative impacts of emissions trading evidently quite deliberately overlook the fact that in all probability Germany and German industry will be *sellers* of emissions allowances and not fuel the demand for emissions certificates.

In addition, the argument that emissions trading would in effect pay "closure bonuses" and drive German industry out of the country is actually so absurd that one should not even take notice of it. I can only say here that no rational economists and also no logical ecologists would dream of constructing such "closure bonuses" in the context of emissions trading

If one looks at the situation of German industry as a whole, one has to ask if the fundamental critics of emissions trading fail to take note of the facts, or whether their assessment benchmark has not in the meantime become completely unrealistic. For instance, Germany's popularity with foreign investors last year increased hugely. While Germany in 2001 posted growth in foreign investment, Britain and France suffered clear losses. (See: *Mehr Direktinvestitionen, in: Handelsblatt 11 April, 2002.*) At any rate, against this background it is difficult to imagine that foreign investors would put their money into a country where it was expected that the introduction of an environmental policy instrument would result in what the Morgenthau Plan intended after the Second World War: ridding Germany of all industrial structure.

The same applies to exports. In 2001, German industry achieved its second-best export result since the Federal Republic of Germany came into being in 1949. The forecasters at present expect a further increase in the export surplus during the course of this year. In 2001, Germany also for the first time posted another surplus in the chronically deficit balance of payments. (See: *Deutsche Exportwirtschaft kann ihren Anteil am Weltmarkt ausbauen, in: Handelsblatt 11 April, 2002.*) Also against this background, the argument that, of all things, trading in greenhouse gas emissions based on a free initial allocation of emissions allowances would ruin German industry's international competitiveness appears extremely odd.

Why, given this situation, the German chemicals industry is launching massive and expensive advertising campaigns against emissions trading instead of constructively getting to grips with realizing German interests within the framework of an EU-wide concept remains largely a mystery for outside observers.

The impression is hardening that the critics are not at all concerned about the instrument as such, but rather that the climate protection policy goals in general are unpopular. But it would seem that for some sections of German industry it is not proper to admit that.

In the end, the objectively unfounded opposition in German industry is strengthened by the conjecture of those who since the existence of the industry's declaration of voluntary commitment to climate protection have never tired of claiming that its targets are at best "business as usual", and that a thoroughgoing input to climate protection by German industry is out of the question. I must remark here that these comments come not only from the environmental movement, but also from senior representatives of German companies.

What must remain is:

- basic approval of the EU draft directive; and
- constructive participation in its development as well as seeking to anchor German concerns in the draft.

Fundamental opposition makes no sense, since both the Council of Europe and the European Parliament have given the ECCP a green light. In addition, the decision on whether to introduce EU-level emissions trading will be taken by a qualified majority vote (Art. 175.1 EEC Treaty). So assuming even that Germany wished to block a positive Council decision it could not do so.

From the German Federal government's point of view, this means working on the draft directive that is on the table with the following goals:

- creation of a voluntary pilot phase for the period 2005-2007, before the binding EU-wide emissions trading system comes into force in 2008;
- formulation of clear and transparent rules for the initial allocation of emissions allowances if only to prevent distortion of competition between the EU member countries;
- clarification of the interplay or relationship between EU-wide emissions trading and other instruments already in place, such as Germany's ecological tax reform, the climate protection agreement with German industry, the Renewable Energy Sources Act (EEG), the Act on Heat-Power Cogeneration (KWK-G) and the European Commission's Directive on Integrated Pollution Prevention and Control (IPPC) ;
- ensuring consistent monitoring and robust sanctions measures for cases where installation operators violate the agreed rules;
- inclusion of the project-related mechanisms Joint Implementation and Clean Development Mechanism from the start; and
- opening up the draft directive to other sectors and actors, such as private households and transport.

## 7. The status of international climate protection negotiations

The Seventh Conference of the Parties (COP7) to the UN Framework Convention on Climate Change, held in Marrakech, Morocco, from October 19 to November 10, 2001, took an important step forward in the international negotiations on climate protection after a lengthy process of conferences in:

- Rio de Janeiro 1992
- Berlin 1995 (COP1)
- Geneva 1996 (COP2)
- Kyoto 1997 (COP3)
- Buenos Aires 1998 (COP4)
- Bonn 1999 (COP5)
- The Hague 2000 (COP6)
- Bonn 2001 (continuation of COP6)

In the early hours of November 10, the conference adopted the Marrakech Accords *(available at UN Climate Secretariat in Bonn at http://www.unfccc.de/index.htm)* - due not least to the entirely positive engagement of the so-called 'countries in transition'.

That concretized the Bonn Agreement of 2001 *(available in German via homepage of Federal Environment Ministry: http://www.bmu.de/download/dateien/kyoto_Bonn.pdf)* and put it on an operational basis in such a way that the Kyoto Protocol can now be implemented.

It means the international community now has the principles, precise terms, processes, rules and guidelines with which the Kyoto Protocol can be implemented and realized. The industrialized nations (the so-called Annex I or Annex B countries) can now ratify the Protocol. All required detailed regulations are to hand. The national measures to implement the commitments accepted by the industrialized nations in Kyoto in 1997 to reduce or limit emissions are now becoming more and more recognizable.

So despite all misunderstandings and confusion along the way, 2001 was in the end a good year for international climate protection. For a long time before that things looked very different:

- the conference in The Hague produced no usable result;
- despite all prophecies of doom, the wreckage inherited from The Hague was glued together. Bonn delivered the political agreement which many no longer expected;
- on the other hand, everything looked like turning into waste paper again at the beginning of 2001 due to the blow the new US Administration under George W. Bush delivered to climate protection policy by rejecting the Kyoto Protocol;
- in sharp contrast to that are the ever louder warnings from the IPCC, which in its Third Assessment Report *('Climate Change 2001', available via the homepage of IPCC: http://www.ipcc.ch as well as of the Federal Environment Ministry: http://www.bmu.de/fset800.php)* calls for action in unprecedented clarity.

This means international climate protection policy is located in an area of tension between scientific warnings and a growing attitude of political refusal:

- the IPCC points out expressly that the upward trend of greenhouse gas emissions is all too clear and is caused by man;

- therefore the activities got underway by the industrialized nations to date are far from sufficient to reverse the trend and decouple economic growth and an increase in greenhouse gas emissions;
- in marked contrast to that is the attitude of rejection of the world's greatest emitter of gases harmful to the climate: the USA.

In this situation, the US government's blockading stance must be broken open and the gap between the technical and economic opportunities closed – at international, regional and national level. The efforts made in developing the rules of the Kyoto Protocol were also based on this aim. The goal - which is not always recognized by all participants in the negotiations - is to reconcile economic policy requirements with environmental policy concerns. The attempt to achieve symbiosis between ecology and economics - at a time of worsening world economic conditions - has become ever clearer the further away in time from Kyoto. All the valves offered by the Protocol have been opened, so:

- application of the rules on sinks;
- the so-called 'flexible' mechanisms: Joint Implementation (Art. 6 KP), Clean Development Mechanism (Art. 12 KP) and Emissions Trading (Art. 17 KP);
- reporting and monitoring (Art. 5,7,8 KP), and
- the compliance system (Art.18 KP)

have been used as far as possible. It must now be seen whether the rules also prove successful in practice, and whether the willingness to compromise shown in the successful conclusion in Marrakech has not smashed too much climate protection policy china.

The procedure, however, has faced the testing of the rules with another obstacle. The rules recommended by COP7 will not be able to be adopted until the first meeting of the Parties to the Protocol (the so-called MOP1). The result is that we shall not know finally what the rules for the Kyoto Protocol's first commitment period (2008-2012) look like until 2003.

Nevertheless, the decisions taken in Bonn and Marrakech have delivered clarity and legal certainty. They have also made clear that the great majority of the industrialized nations is meeting its responsibility, although the world's greatest emitter of greenhouse gases – the USA – continues to evade it and at best is prepared to implement somewhat more than "business as usual".

That means there is now a reliable foundation for designing the policies of both the industrialized and developing countries. It is a foundation which in the final analysis industry also needs to operate the instruments the Kyoto Protocol offers and use the business opportunities, for German industry in particular, that can be derived from an internationally agreed climate protection strategy.

**The negotiation poker game**

Marrakech showed even old hands at negotiations a thing or two. Until the end, and for purely selfish motives, Japan, Canada and Russia sought to delay the international climate protection convoy. That means three countries attempted to hold 187 others hostage. In the end, the negotiations were wrapped up between only the EU and those three nations. Canada turned out to be an especially tough 'hardliner'. It was not until the EU made a compromise deal with Japan, which meant that Russia and Canada risked ending up on their own in the pillory of world public opinion, that Canada softened its tone. In the final analysis, this was also due only to an alliance between the EU and the G77 states. Russia then forced the conference, under the threat of allowing Marrakech to fail, to agree to increasing the ceiling for its forest management sinks credit from 17.63 megatons to 33 megatons p.a. on a scale that is unjustified in scientific terms. *(According to FAO data, a maximum of 24.85 megatons would have been permissible.)*

Russia thereby brutally exploited its key position with regard to the Kyoto Protocol's coming into force and with the aid of some countries of the so-called Umbrella Group (led by the USA and including Canada, Australia and Japan) left the rest of the international community no choice. But on the other hand, this resulted in a strengthening of Russia's economic interest in the Kyoto Protocol.

**The developing countries' role**

The developing countries' positive general mood was of decisive importance for the results of Bonn and Marrakech. But their affirmative basic attitude also had to be bought with concessions by the industrialized nations – especially the EU. In Marrakech, the rules for the developing countries' national communications were further developed. In addition, a framework of action with further individual measures was laid down as part of agreement on the transfer of environmentally-compatible technologies to the developing countries.

### Compliance

Logically, compliance is a main item of the international climate protection regime. A relatively robust compliance concept was adopted in Marrakech. The system provides for binding consequences for failure to meet commitments. In addition, it contains detailed rules of procedure for decision-making. The following central points characterize the concept:

- the 'Enforcement Branch' – composed of six representatives of developing countries and four from industrialized nations – decides in cases of doubt on the fulfillment or non-fulfillment of commitments;

  The CDM Executive Board is constituted as follows:
  - one member from each of the five UN regional groups;
  - two members from each of the Annex I and Non-Annex I countries;
  - one member from a so-called 'Small Island State'.

  Fundamentally, decisions will be taken by consensus. In cases of doubt, a 75 per cent majority will suffice.
- the 'Facilitative Branch', made up of the same representative ratio, will tackle implementation problems beyond non-fulfillment;
- if reduction or limitation commitments are not met, the difference between them and actual emissions – plus 30 per cent ('compensation rate' of 1.3 times excess emissions) – will be deducted from the emission volumes permitted for the subsequent commitment period;
- in addition, countries which fail to fulfill their commitments can be excluded from using the Kyoto mechanisms (suspension of eligibility). In that case, it is planned that eligibility will be restored at the latest when the commitments for the second period are fulfilled; and
- as a sanction, the compliance system provides for an action plan if reporting obligations are not met or commitments are not fulfilled.

It was also agreed in Marrakech that failure to fulfill commitments accepted with ratification of the Kyoto Protocol can also be reported by other parties to the Protocol.

There is also a complaint procedure which enables appeals against 'Enforcement Branch' decisions, but which can only be successful if the decision process was not conducted according to the rules. An 'Enforcement Branch' decision remains in force while a complaint procedure is under way. The rules and processes adopted in Marrakech are open to the public.

### The 'flexible mechanisms'

Subsequent to COP7 in Marrakech, the newly-formed Executive Board of the Clean Development Mechanism met for the first time (see above). The chief task of this body is to register and review CDM projects. Its members include two representatives of the EU.

To be eligible to use the flexible mechanisms, the parties to the Kyoto Protocol must fulfill the following conditions:

- ratification of the Kyoto Protocol;
- commitment to the compliance system adopted in Marrakech, whereby participation cannot be withdrawn retroactively by the establishment of a system with binding consequences under international law;
- establishment of a national system to register emissions;
- punctual and correct presentation of annual greenhouse gas balance sheets and submission of sinks inventories;
- punctual and correct reporting on the carbon stored in sinks from the second commitment period (2013–2017). During the first commitment period (2008–2012) a qualitatively incorrect report will result only in the respective sinks being unable to generate emission credits.

In Marrakech, in addition to the three variants of emissions allowances or credits known since Kyoto a fourth – Removal Units (RMUs) – was established:

- Assigned Amount Units (AAUs): Emissions allowances to which the Annex I countries are entitled within the framework of the Kyoto Protocol for the period 2008-2012;
- Removal Units (RMUs): Emissions credits which a country receives when its national ecosystems absorb carbon from the atmosphere ('sinks function');
- Emission Reduction Units (ERUs): Emissions credits generated as part of Joint Implementation projects between industrialized nations according to Art. 6 of the Kyoto Protocol;
- Certified Emission Reductions (CERs): Emissions credits generated as part of Clean Development Mechanism projects implemented jointly by industrialized and developing countries.

The following possible applications are provided for:

- **All** emissions allowances can be used to fulfill emissions commitments.

- **All** emissions allowances may be traded freely between the Parties. This rule clearly increases the liquidity of the emissions market.
- Emissions allowances can be carried over (called 'banking') to future commitment periods as follows: AAUs without limit; ERUs and CERs up to a limit of 2.5 % of a Party's initial AAUs. RMUs: no banking.

These rules require a fully developed tracking system that can follow the path of the various emissions allowances in a thoroughgoing way.

**Emissions Trading**

With regard to emissions trading, it is clarified that Parties to the Kyoto Protocol can trade the four above-mentioned emissions allowances with each other. To prevent the non-covered sale of emissions allowances, every Party is obliged to hold a certain amount of its allowances in a Commitment Period Reserve (CPR). If a Party falls short of the required amount in the CPR it cannot sell any emissions allowances until it has realized the defined minimum amount again. Trades that take place regardless of that rule will be considered invalid in the context of commitment fulfillment according to the quantitative guidelines of Annex B of the Kyoto Protocol. They are thus worthless.

**Clean Development Mechanism**

The CDM Executive Board mentioned above was set up with the fact in mind that CDM projects could be implemented as early as the beginning of 2000. The Board decides on the functions, guidelines and methods which the actors must apply. Implementation of CDM projects by developing countries without the participation of industrialized nations (so-called 'unilateral projects') are not expressly prohibited and therefore are permissible. Sinks projects cannot be included in the CDM until the Executive Board has adopted guidelines for their implementation under this mechanism.

**Joint Implementation**

Climate protection projects between two industrialized nations are called Joint Implementation (JI). Emissions credits can be generated within JI, but they must be deducted from the host country's AAUs. ERUs can be used by the Parties to fulfill their own commitments or for sale. Basically, there are two ways in which JI projects can be recognized:

- **First track:** Provided the host country has met all the eligibility requirements for using the Kyoto mechanisms (see above), it can itself implement the registration and verification process.
- **Second track:** On the other hand, if a host country does not meet its reporting obligations, a JI project must be registered and subjected to international review by the newly-formed JI Supervisory Committee. The Committee consists of 10 members (plus 10 deputies) and is constituted as follows: three representatives of western industrialized nations, three from Central and Eastern Europe, and four from Non-Annex I countries including one seat reserved for a representative of the small island developing states. The voting procedure corresponds to that of the CDM Executive Board.

In the course of the Marrakech voting process compromises had to be made on various issues. In particular, the original German negotiating position was cut back considerably. Thus, the 'carry forward' of sinks activities to subsequent commitment periods (banking of RMUs) - as always called for by Germany - was formally excluded. But this still is possible via a 'RMU bypass' by which the corresponding Party carries forward other emissions allowances instead of RMUs and uses its RMUs to cover its emissions limitation commitment.

Furthermore, both Germany and the EU had demanded that the complete and qualitatively sufficient fulfillment of reporting obligations in the sinks sector belonged to the criteria of eligibility for using the flexible mechanisms in as early as the first commitment period and not - as adopted in Marrakech – only from the second period. Germany in the end also had to relinquish its call for a 'concrete ceiling', meaning a precisely quantified limit to which emissions credits from the flexible mechanisms could be used to cover a Party's own commitments.

**Reporting, monitoring and verification**

In the overall Marrakech Accords, the European Union had to make concessions to the Umbrella Group and G77 countries, but in countermoves it was also able to push through some significant concerns of its own. The most important point in the negotiations was the requirements and processes in reporting and the crediting of sinks according to Art. 3.3 and 3.4 of the Kyoto Protocol (reforestation, forest management and emissions reduction in agriculture). After the concessions made in Bonn with regard to carbon sink crediting, above all to the Umbrella Group, Marrakech had to demand sufficiently high requirements for reporting on sinks and provide incentives for good-quality sinks inventories. In the end, a compromise satisfactory to all sides was achieved here.

With regard to reviewing greenhouse gas inventories and other reports, so-called Expert Review Teams (ERTs) will be set up. In the case of poor reporting, these teams will be able to correct inventories and present reports which will form the basis for the compliance checks by the Compliance Committee. The issue of the selection criteria for technical review experts was solved in the end by reaching a compromise between technical expertise and a balanced international representation.

**When will the Kyoto Protocol come into force?**

The quorum requirements for the Kyoto Protocol contain two points, both of which must be fulfilled:

- it must be ratified by 55 Parties to the Convention; and
- they must include developed countries representing at least 55 per cent of the $CO_2$ emissions of the Annex I nations in 1990.

At present, about 50 countries have ratified the Kyoto Protocol. But developing countries currently still account for the great majority of the 'ratifiers'. Before Johannesburg, however, the politically potent block of the EU member countries and the European Commission will ratify the Protocol together. The path to that was smoothed in Brussels on March 4, 2002 by the decision of the EU Council of Environment Ministers. According to present planning, the European Union will deposit its ratification documents before the summer recess and thus make a contribution of 24.1 per cent to fulfillment of the quorum.

With regard to achieving the quorum of 55 per cent, Russia in particular (17.4 per cent) is still a 'shaky' candidate that holds the key to the Kyoto Protocol's coming into force. To all appearances it also does not wish to hand it over for the time being. Various actors in Russia still seem intent on landing more 'goodies' for their country. It must be expected that it will be some weeks and possibly even months before the Russian government and the Duma, the Russian Parliament, have got their act together. In the final analysis, however, the economic incentive of the Kyoto mechanisms is so great for Russia that it will ratify the Protocol in order to benefit from its blessings. This is already being emphasized by the relevant government departments in Moscow.

## 8. Conclusion and prospects

Marrakech has made the Kyoto Protocol suitable for ratification. That also brings into sharper focus the opportunities offered by the project-related mechanisms Joint Implementation and Clean Development Mechanism. For the Central and East European countries, consistent use of joint implementation gives them the opportunity to attract investment to improve their energy supply infrastructure, which as a rule is no longer up-to-date. For western countries, joint implementation enables them to fulfill their Kyoto commitments at much lower cost than they would incur by implementing purely national measures. Building new power plants and rehabilitating existing ones, optimizing transport power line energy, measures to improve energy users in the end-consumer sectors of industry, trade and private households, cogeneration of power and heat, using renewable energy sources, vigorous rehabilitation of old buildings and the building of efficient new houses, using domestic appliances and communications and entertainment technology with a lowest possible consumption of energy, use of state-of-the-art metrology and control engineering, improving transport infrastructure and deployment of low-fuel vehicles – the list of the opportunities goes on and on.

Hopes are also raised by the fact that the Confederation of German Industry and various important industrial branches have declared that they view the project-related mechanisms Joint Implementation and Clean Development Mechanism as more important than emissions trading. But JI and CDM will play a significant role as instruments of climate protection and technology transfer only if it is possible to:

- put the information flow on a broader basis;
- eliminate misunderstandings;
- curb unrealistic expectations;
- create the infrastructure required for implementation both in investor and host countries;
- put in place the preconditions which the Kyoto Protocol, the Bonn Agreement, and the Marrakech Accords demand (above all, reporting and monitoring); and
- offer not only technical solutions, but put together full-solution packages (including maintenance, spare parts supply, concepts for financing, and insurance services).

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**The Kyoto Mechanisms**

**The situation after Marrakech – Opportunities for infrastructure investment in Central and East Europe – For integration in the European and international climate protection strategy**

by

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Berlin

on the occasion of the

BMU/CTI – Workshop

in December 2001

in Ostritz

Slide 1

**What has the aij pilot phase achieved?**

- aij projects meet with coolness in the host countries
- In the introductory phase, aij projects need massive assistance from the investor countries – political, technical and economic barriers have to be overcome
- The level of information on aij projects and their implementation is very low in both investor and host countries
- A lack of institutional, technical and financial capacities, above all in the host countries, impede aij projects
- Development and implementation of aij projects could be facilitated by bilateral or multilateral framework agreements (memoranda of understanding)

Slide 2

**What has the aij pilot phase achieved?**

- Considerable consultancy for all actors (companies and governments) is required
- Only with growing familiarity with projects will the need for consultancy and thus transaction costs reduce
- Project-related funds can reduce transaction costs, above all for interested small to medium-sized businesses – the Netherlands' experience with ERUPT and CERUPT should be used
- General, internationally accepted rules would facilitate the development and implementation of aij projects

Slide 3

**What has the aij pilot phase achieved?**

- The government must ensure the ecological integrity of the projects ("Golden Standard" – positive list)
- The government must ensure timely climate bookkeeping/ emissions inventories
- The government must ensure no deviation from the target corridor (monitoring, sales approval, right of first refusal)
- The government must put regulatory frameworks in place (e.g. to prevent distortions of competition)

Slide 4

**Challenges following Marrakech**

- Ratification of the Kyoto Protocol
- Creation of institutional and organisational capacities (designated national authority – DNA)
- Rules for recognition of JI and CDM projects
- Presentation of reports to the UNFCCC (Art. 5.7 and 8 KP) and national reports (Art. 12 KP) in conformity with requirements – currently considerable shortfalls in Germany
- Creation of structures to use ERUs (JI) and CERs (CDM)

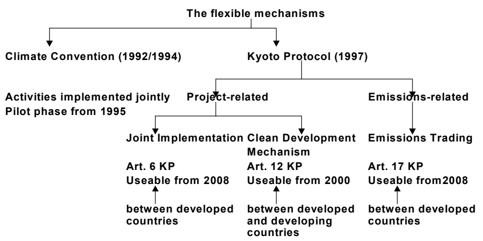
Slide 5

**Preconditions for use of the Kyoto Mechanisms**

- Ratification of the Kyoto Protocol
- Commitment to the compliance concept adopted in Marrakech
- Establishment of a national system to register emissions
- Punctual and correct presentation of annual greenhouse gas balance sheets and submission of sinks inventories
- Punctual and correct reporting on the carbon stored in sinks in the second commitment period (2013-2017)

Slide 6

**The flexible mechanisms**




Slide 7

**Status of the preparations I**

- Ratification of the Kyoto Protocol: European Commission and EU member countries before Rio+10 in Johannesburg, August 26-September 4, 2002
- DNA – enhancement of capacity of the Joint Implementation Coordination Office (JICO) located at the Federal Environment Ministry
- Development of practical support (JI and CDM guides for users)
  - Project development according to flow chart
  - Early examination of suitability and climate protection input
  - Reduction of transaction costs
  - Facilitation of investment decisions
- Project Design Document (PDD) as basis for recognition

Slide 8

**Status of the preparations II**

- Forwarding to and clarification by the Executive Board in the case of CDM projects
- Forwarding to and clarification by the Supervisory Committee in the case of JI projects
- Project guide as test of suitability

Slide 9

**Status of the preparations III**

- Use of ERUs and CERs:
  - implications of national commitments and the objectives of industry, energy supply, private households, small-scale consumption and transport
- Integration in the EU-wide trading of greenhouse gas emissions (Draft European Commission Directive of 23 October 2002)
- Use of alternative instruments with comparable results (voluntary commitment declaration, eco-tax, Renewable Energy Sources Act (EEG), Heat-Power Cogeneration Act (KWKG), and the EU Directive on Integrated Pollution Prevention and Control (IPPC)
- Funds for implementation of JI and CDM projects
- Sales to third parties or their inclusion (e.g. brokers, project developers)

Slide 10

**Project development and implementation process**

- Project guide as support for the entire project cycle
- Development phase: the project is given a brief scrutiny (self-evaluation?)
- Early agreement between investors and DANN in investor countries
- Option: advance notice and rough examination at DNA
- Drawing up of the project design document by the certification office (designated operational entity)

Slide11

**Project guide**

- Basic knowledge – JI and CDM categories
- Validity check
- Development of the project design document (PDD)
- Monitoring concept
- Verification and validation
- Technical installations

Slide 12

**Objectives of the validity check**

- Alignment of project development on the JI and CDM characteristic
- Validity check to assess at a very early point in time the project idea's prospects of success
- Minimising of transaction costs
- Abridged documentation as the basis for initial agreement with
  - the designated operational entities (DNAs) of investor and host countries
  - the designated operational entities, and
  - possibly also the investors or sponsors
- Option: advance notice – goal: creation of investment certainty

Slide 13

**Tasks of the validity check from the companies' point of view**

- Lowering the recognition threshold
- The check offers early orientation and certainty
- Potential clarification of the use of ERUs and CERs in Germany
- Advance notice serves at the same time as the basis for developing the project design document (PDD)
- Abstaining from a validity check and initial agreement with a designated national authority increases later scrutiny costs

Slide 14

**Tasks of the validity check from the point of view of the government**

- Early ensuring of the ecological integrity of German JI and CDM projects ("Golden Standard" – positive list)
- Prevention of misunderstandings – minimising of conflicts
- Gaining of experience for the further development of the Kyoto mechanisms
- Control possibility with regard to realising national climate protection targets
- Early participation of the public
- Acceleration of the recognition process based on the project design document

Slide 15

**Abridged documentation**

- Information on all project participants
- Technical description of the project, identifying the interfaces and the system's limits
- Suitability of the project as a JI or CDM project
- Quantification of the estimated emissions reduction / initial validity check of the baseline
- Project planning and financing
- Assessment of the project risks

Slide 16

### Reporting system during the project cycle

| Validity check → | PDD → | Monitoring → | Verification |
|---|---|---|---|
| will be drawn up by the project participants | will be drawn up by designated operational entities | can be done by project participants | will be drawn up by designated operational entities |
| DNA | Executive Board | Executive Board | Executive Board |

Slide 17

### Reporting system II

- Identical certification facility (DOE) can upon inquiry of the project participants submit the project design document to the Executive Board for verification
- After acceptance by the designated national authority, the Executive Board deals with the project design document
- Public participation (at short notice)
- The designated national authority reacts to monitoring and verification reports within the set timeframe

Slide 18

### Conclusion I

- Structures and processes will be developed step-by-step in 2002 and 2003 and be available when the Kyoto Protocol comes into force
- Planning for JI and CDM projects can begin immediately
- For CDM, however, Executive Board decisions are still necessary
- JI and CDM assume the existence of a workable emissions trade in order to be able to turn ecological inputs into economic dimensions
- Before 2008, JI can be used in economic terms only in combination with emissions trading

Slide 19

### Conclusion II

- The project guide and validity check will be available from summer 2002
- The Federal Environment Ministry and its Joint Implementation Coordination Office (JICO) should be called in early to clarify the process
- Negotiations are already under way on bilateral arrangements – but conclusion only according to need

Slide 20

### Conclusion III

- Priority projects:
  - rational and economical use of energy
  - renewable energy sources
- Restraint on sinks projects – rules are to be expected at the earliest for COP9 – COP/MOP1, probably in 2003
- Rules for small-scale projects are to be adopted by COP8 in New Delhi in 2002

Slide 21

### Climate glossary

- **aij** activities implemented jointly (pilot phase for JI and CDM)
- **BMU** Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
- **CER** Certified Emission Reduction (emissions credit from CDM projects)
- **EB** Executive Board – body for formulating the rules for CDM projects and recognising such projects
- **DNA** Designated National Authority (in Germany: BMU)
- **DOE** Designated Operational Entity (accredited certification office)
- **ERU** Emission Reduction Unit (emissions credit from JI projects
- **JIKO** Joint Implementation Coordination Office in the BMU, Arbeitsgruppe Z II 6
- **KP** Kyoto Protocol of 1997

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### Climate glossary II

- **MoU** Memorandum of Understanding (agreement as basis for JI and CDM projects, binding under international law)
- **PDD** Project Design Document (basis for recognition by EB und SC)
- **PP** Project participants
- **PUB** Public participation
- **RL** Directive
- **SC** Supervisory Committee (JI supervisory body)
- **SV** Climate protection agreement of German industry of November 9, 2000
- **UNFCCC** United Nations Framework Convention on Climate Change
- **WSSD** World Summit on Sustainable Development (Johannesburg)

Slide 23

# CTI Capacity Building Seminar in Ostritz 2001
# Recommendations derived from the seminar discussions

## 1. Co-operation items and projects

- Co-operation projects with countries in transition should focus on the regional and municipal levels in order to secure efficiency by defining appropriate projects adapted to local conditions
- Existing networks in the CEE countries (e.g. Municipal Energy Efficiency Network MEEN EcoEnergy in Bulgaria) should be developed into a nucleus for future co-operation on climate protection; the Climate Alliance (Klimabündnis e.V.) should try to improve networking with CCE cities
- Future seminars should focus on demonstrating successful projects suitable for adoption by CCE countries
- Kyoto mechanisms and their impact on the CEE countries' policies should be discussed at the follow-up seminar
- Biomass should be a key issue to be discussed at a follow-up seminar
- Energy efficiency should be the driving force for project development
- Financial engineering for projects which takes into account the different sources of monies (national environmental funds, donations, loans, credits, subsidies, problems of profitability/payback times of CHP after electricity market liberalization) should be a key issue in the future
- When promoting biomass use the positive socio-economic side effects and public welfare effects should be communicated (benefits such as increasing (local) tax revenue, forest technology innovation, job creation, air pollution reduction).

## 2. Framework conditions

- Legal and institutional framework conditions (e.g. home owner association law, ownership issues, mortgage markets) must be in place as a pre-requisite for successful financing and implementation of projects
- Demonstration projects carried out at municipal level are an essential factor for further success in climate and energy savings policies
- CTI should change its focus from technology to policy
- Market transformation programs and instruments and the "creation" and strengthening of interest groups for energy efficiency are necessary.
- A mechanism of low cost project replication should be implemented.

## 3. Proposals for future seminar tasks

- Answer the questions of the coherence of driving forces, especially of economic restructuring and active energy efficiency policies, but also decarbonization etc.
- Remove numerous market barriers in transition countries by generating interest among stakeholders and networks
- Discuss legal and institutional pre-requisites for long-term strategies in the energy system
- Clarify the policy instrumentation e.g. the coherence and consistency of the policy mix, efficiency threshold and orientation of instruments
- Demonstrate successful projects in CCE countries and communicate to others.

# COUNTRY REPORTS

# Country Report: Armenia

"Climate Technology and Energy Efficiency – Disseminating 'Best Practice' Experience"

**Svetlana Ganjumyan**

Energy Strategy Center

## 1. Overview

The world experience shows that the Least Cost Development Plan of the Energy Sector does not fully satisfy the actual requirements for energy security and independence. According to the International Energy Agency (IEA) most of the countries found their energy policy on the principles of secure energy supply and the increasing of the role of the liberalized market. Armenia having gone through a severe energy crisis 1993-1995 tested in practice the results of the loss of energy security. The following examples show the importance of ensuring the balance between utilization of energy resource, energy supply and environmental issues in Armenia. The hydro potential of the unique Sevan Lake was intensively exploited for energy purposes during the period of the energy crisis which raised the risk of negative impact on the regional climate conditions. Outflows from the lake have been reduced over the last years to just cover the irrigation needs of Armenia, but at the same time this results in a proportional reduction of hydro power generation to about 500-600 GWh/year. Another example is linked with the absence of full-scale heat supplies to the household sector. Under existing conditions the population looks for alternative heat sources and generally uses wood stoves. Armenia is a country with very limited timber resources and deforesting with the purpose of personal heat provision also may result in negative impacts to the environment. That impact effects deforestation of the country and soil corrosion, as well as the increasing of $CO_2$ emissions as a result of uncontrolled combustion processes. The new State Energy Policy of the Republic of Armenia for ensuring Energy Security is based on:

- Three-level energy diversification policy based on using all type of generation plants, utilization of different kinds of fuel and ensuring fuel transportation.
- Rational use of energy including priority development of domestic renewable energy resources, energy conservation and climate technology.
- Regional co-operation.

In this report a few important projects are described which are dedicated to the problem of energy efficiency and climate technology in Armenia.

## 2. TACIS Project: Reconstruction of district heating

The main aim of reconstruction of district heating in Armenia is to restart the high quality and reliable heat supply to the household sector of the cities. In this area the most critical elements that should be taken into account while operating in this field are:

- the actual economical situation in Armenia, recently improved, but not completely restored after the energy crisis of the 1993-1995;
- it is accepted that the supply of heat for the population in the cold season must take into consideration the related social impact;
- the lack of heating supply by the municipality forces the residents to identify and apply alternative sources. One of the most common is the use of wood, which arises a great concern from the environment point of view.

These conditions were taking into account for developing the Pilot Business Plan for the reconditioning of the District Heating System (DHS) of Yerevan carried out by the TACIS Project 98.0358 and co-realized by the parties of Italian G&FInt and ESC. In this project there has been put up the hypothesis to recondition the DHS in two stages: the first aimed at the recondition of the system in order to achieve an efficient and reliable heat supply for the customers, the second aimed at a better control of heat production and supply. The two stages have been identified not only from the technical and economical point of view, but have also taken into consideration issues related to the social conditions. The project has been evaluated on the basis of the saving arising from the reduced consumption of natural gas and the expected increase of percentage of payments from the users. The first stage refers to:

- Complete reconditioning of the transmission (main) and distribution heating network;
- refurbishing of the equipment of the central district heating plant, installing the urgently needed instruments for the monitoring and control of the heat release, control of fuel burning regimes, removal of interplant heat losses;
- refurbishing of the equipment of the boiler houses installing the urgently needed instruments for the monitoring and control of the heat transfer to the buildings, removal of water leakage and losses of heat from pipelines and heat exchangers.

It is expected that the reconditioning works of the first stage could be completed in a period of 2 years.

The second stage refers to the optimization of the heat supply process and control. The main interventions will concern:

- To equip the central boiler houses and boiler houses with the facilities necessary for automation and control of thermal power production and distribution;
- to optimize the buildings´ structure installing metering and control equipment;
- to completely reconstruct the indoor systems of hot water supply;
- to perform energy saving interventions by improvement of thermal insulation of the apartments.

The works of the second stage require longer time and are connected to the control and accounting of the real thermal power consumption by the customers.

The Pilot Business Plan was focused only on a first stage and as an example was taken the district heating plant N 11-Avan. The total actual losses in the selected district heating system were estimated to be at a level of 49.6%. The main sources of losses are the bad condition of the district heating plant, water leakage, and heat loss in primary circuit, heat losses in substation, water leakage and heat losses in secondary circuit.

The overall cost for the complete reconditioning of the district heating system of DHP N11-Avan has been calculated on the base of a detailed analysis and summarized as shown in the following table:

| thousand US$ | First Year | Second Year | Total |
|---|---|---|---|
| Central Boiler House | 23.5 | | 23.50 |
| Primary Circuit | 585.8 | | 452.80 |
| Substations | 41.4 | | 41.40 |
| Secondary Circuit | | 567.45 | 567.45 |
| Total | 517.7 | 567.45 | 1085.15 |

To perform feasibility analyses of the Reconditioning Project it has been utilized the software "A computer support calculation method for the preparation of financial statement for feasibility studies of investment projects". The calculations have been made with the following assumptions:

| Year | 1st | 2d | 3rd | 4th | 11th |
|---|---|---|---|---|---|
| Losses reduction to the level: | | | | | |
| Central Boiler House | 15.0% | 15.0% | 3.0% | 3.0% | 3.0% |
| Transmission Network and Substations | 14.0% | 3.0% | 3.0% | 3.0% | 3.0% |
| Distribution Network | 12.0% | 11.0% | 11.0% | 11.0% | 11.0% |
| TOTAL | 41.0% | 29.0% | 17.0% | 17.0% | 17.0% |
| | | | | | |
| Unit Cost of Gas, US$/1000 cub. m | 65.9 | 65.9 | 65.9 | 65.9 | 65.9 |
| Heat Tariffs, US$/G cal | 17.1 | 17.1 | 18.6 | 18.6 | 24.6 |
| Rate of Payments | 35.0% | 60.0% | 90.0% | 98.0% | 98.0% |
| Operating Costs | They will remain almost constant, with minor variations due to the maintenance costs, which will decrease in the first years and increase slowly after the seventh year. | | | | |

The study shows a break even point, which is reached at the 11th year after the start of the activities and an internal rate of return equal to 8.1%.

During the next stage of the study the main potential sources of risks have been identified and analyzed, based on the "**GUIDE TO ENERGY EFFICIENCY BANKABLE PROPOSALS"** jointly published by the European Commission (DGXVII, THERMIE and SYNERGY Programs) and the EBRD. In particular, the study was focused on estimation of negative impact of sponsor, pre-completion, completion, technology, input or supply, operating, regulatory and environmental

as well as sales risks. The analysis shows that as the main critical element of the project must be considered the rate of payment. Along with that the analysis shows that a small increase of the heating period may give to the project a margin that may put the project in a safer condition to afford the other risks.

For completion of the study the environmental aspects of reconditioning of the district heating system have been analyzed. For this purpose an **Environmental Manual** software developed by GTZ was used to identify the emissions´ results in rehabilitation and reconstruction of the district heating system. The following table shows the results of the possible scenario analysis:

| **Generic** | **Airborne emissions (t)** | | **GHG emissions (t)** |
|---|---|---|---|
| Options | $SO_2$ | $NO_x$ | $CO_2$ |
| Before reconstruction | 6.2 | 12.9 | 2868 |
| After the first stage | 5.7 | 11.8 | 2620 |
| Completely rehabilitated | 5.3 | 11.0 | 2467 |

The described Pilot Business Plan was the base for developing a pre-feasibility by ESC study for rehabilitation of seven DHPs with connected heat supply systems under contract with the District Heating Authority of the Municipality of Yerevan.

The main results of this study were also taken into account by the ongoing World Bank Project "Urban Heating Strategy". The overall purpose of this project is to develop feasible technical and economic options for urban heating supply systems in four selected cities in Armenia, taking into account the basic heating needs, fuel supply and affordability criteria.

The project consists of following tasks:

- To estimate roughly the economic and financial costs of the developed heat supply options, including the potential for low cost weatherization measures in buildings and expected benefits;
- to develop different options for pilot projects in the four sample cities, including a cost-estimate;
- to determine the requirements to be set for the development of gas supply systems with respect to heat supply;
- to broadly define the institutional and legal requirements and approaches of the heating options, taking into account the scope for commercialization of heating services and the potential for competition to regulate price and quality of service;
- to present a first outline of an Urban Heating Strategy at a workshop in order to select the main supply options for further investigation.

At present investigations by Urban Heating Strategy selection are carried out on the basis of the following scenarios:

- Representing areas, which presently are supplied from CHP;
- representing areas, which presently are supplied from large heat boilers;
- representing areas, which presently are supplied from small heat boilers;
- representing areas which used to be connected to CHP or heat boilers but today are disconnected but could be reconnected at relatively small costs (i.e. there are boilers that can be put back into operation, most of the main DH pipes are intact and most buildings still have more or less intact internal heat pipe system and radiators);
- representing areas with multistory buildings that cannot be connected to an existing CHP or heat to boilers at relatively moderate costs.

## 3. Armenian-Netherlands Project: ArmNedWind

According to the Memorandum of Understanding the Netherlands PSO program facilitates the execution of the Armenian - Netherlands Wind Energy Program (PSO 98 /AM/2/1, ArmNedWind Project) started in 1999.

E-Connection Project BV Company (Holland), Riso Laboratory (Denmark) and Energy Strategy Center (Armenia) accomplished the ArmNedWind Project. The main aim of the ArmNedWind Project was to answer the most important question of grid-connected wind farm development:
"Whether there is enough wind resource potential in Armenia, which can be efficiently used to produce electricity reliably".

Five modern wind energy-monitoring complexes were successfully installed in the preliminarily chosen and prepared different perspective sites of Armenia. For a more comprehensive assessment of wind power resources, it was necessary to compare the short-term (12 months) and accurate monitoring data with the meteorological long-term, but less accurate data. The obtained results were summarized in special reports. The results allowed fulfilling the correction of wind speed and direction according to the results of correlation analysis for the Pushkin and Karakhach Passes.

The three-dimension model of wind flow in the five sites was created within the study. The modeling was accomplished by the Project specialists according to the WAsP-7 software, with the support of Dutch experts. In order to carry out the modeling, the three-dimension topographic and roughness maps of the terrain were created. The main result of the Project was the definition of annual electricity output volumes of wind turbines in the certain sites under study and grid-connected wind-farms.

In order to fulfill the feasibility study more comprehensively, the Armenian specialists carried out special calculations of the distribution of capacities of Armenian Power System and the static stability of the power system. During these investigations seven options of wind power installation were calculated. In the worst option, the installation of 50 MW wind power capacity was observed, while in the best case this index was 250 MW.

At present all the activities, calculations and investigations of the above mentioned phases are successfully completed. At the main “success” indicators could be mentioned that from the realization of 175 MW total installed capacity wind farm in the northwestern part of Armenia 2.9 billion kg of $CO_2$ emission per year could be saved. An essential side effect of the wind project implementation in Armenia would be creating of more than 700 men/year permanent and 28,000 men/year temporary jobs.

The pilot project for a 80 kW wind-turbine is carried out to define what scope is delivered from Netherlands and what is to be done by Armenian counterparts. In July or August of next year, the 80 kW wind-turbine will be transported and installed. Till the end of 2001 a legal entity, operating as independent power producer, will be established in Armenia. This entity will start the licensing and land lease agreements as well as will support the environmental impact assessment preparation in accordance to the rules and regulation of RA.

## 4. Armenian-Netherlands Project: ArmNedSun

The consortium of Ecofys, Econosto and FACET is carrying out a two-year project “ArmNedSUN” aiming at the introduction of a thermal energy system in Armenia. The project is sponsored by the Netherlands Government (PSO) and supported by the Armenian Ministry of Energy. The project is being implemented since 1 January 2000 until 31 December 2001 and consists of a variety of activities, all aiming to facilitate the introduction of solar water heaters.

One of the first activities was the development of a business plan, based upon a proper market survey, for the marketing and sales of solar water heaters in Armenia. Next to the commercial business plan, a more general promotion awareness plan was developed and implemented. Promotional activities include seminars and symposia, special promotional gadgets, advertising, commercials, documentaries, etc.

15 demonstration projects with a solar heater were installed in 2000 to show the benefit and to demonstrate the functioning of the systems. These demo-boilers are of Dutch origin, manufactured by Econosto, but adapted to Armenian circumstances. Thanks to the Netherlands the firm presently sells the SWHs with a discount of 50%. The

main consumers of SWHs are the owners of private houses, boarding–houses, hospitals and top-floor dwellers. One standard SWH saves 1000 and more kW electricity annually, i.e. expenses on a SWH are compensated for a few years, and its exploitation period is more than 25 years. In conditions of Armenia SWH completely operates during 9-10 months and only in winter its efficiency descends till 20%.

The demonstration projects are monitored in detail for a year to investigate the efficiency of the adapted system. The Armenian solar irradiation is measured too.

The SunEnergy Joint Venture between Econosto and Technokom is established and in full operation. SunEnergy produced and installs solar water heaters in Armenia for household use as well as for industrial use. SunEnergy is the market leader in Armenia.

A subsidy fund is developed to lower the high initial investment barrier for the clients of solar water heaters. Lobbying at government institutes takes place during the whole project period to place solar energy on the political agenda. The goal was to sell at least 50 SWHs during the project period. The internal goal is to sell more SWHs during the project term to bring overhead costs to a reasonable level. It is expected that a couple of years after the project, the sales volume will grow to 500 – 1000 units per year. This will lead to the creation of jobs for Armenians, both directly and indirectly.

## 5. Hydro energy projects

The development of hydro energy projects is a main priority for Armenia, because water is the largest indigenous source of energy. The economically feasible new hydro potential of Armenia has been estimated to be at a level of 250 – 300 MW.

Under the new economical conditions, the ways of private capital involvement in hydro energy were being searched. For that purpose, the system of licensing of construction and exploitation of small hydro power plants (SHPP) is regulated in a legal act in Armenia since 1992. Also new provisions for all purchased electricity generated at SHPPs and other renewable sources of energy within the next 15 years are ensured by the “Energy Law” of RA adopted in March 2001.

In 1997 a SHPP was constructed on the drinking water pipeline near the Gyumri city. There are 2 two-stage pumps used as a turbine with a capacity of 350 kW. Two asynchronous motors are used as a generator. The increase of a capacity up to 500 kW is foreseen. In 1997 Ger-Ger SHPP with 1.2 MW capacity was commissioned. 2 turbines with 600 kW capacity, 2 asynchronous generators, produced by "Armelectromash", are installed in the SHPP.

In 1997 a SHPP was commissioned on Yerevan lake with a capacity of 750 kW; in 1998 the Avan SHPP on a drinking water pipeline with a capacity of 200 kW; in 1999 two SHPPs on the Aparan-Yerevan drinking water pipeline with 500 kW capacity each were constructed and commissioned. In 2000 two more SHPPs on the same drinking water pipeline with 500 kW capacity each were constructed and commissioned. These 4 SHPPs and Avan SHPP were constructed at the expense of private investment of "Energy" Ltd.

In 2000 the first unit of SHPP with a capacity of 1000 kW on Kotayk irrigation canal was commissioned. Hydro pumps were used as hydro turbines. It is foreseen to enlarge the plant, increasing the installed capacity up to 2000 kW.

In 2001 two SHPPs on Kamenka-Amrakits irrigation canal with a total capacity of 1200 kW were constructed. One HPP was constructed on the basis of a pump station. Hydro pumps were used in both HPPs as hydro turbines.

Four SHPPs are in the phase of construction.

At present, mainly the legal basis is elaborated in Armenia that is promoting the development of hydro energy. Limitation of financial means is the main factor, determining the construction of SHPPs. This compels to reduce as much as possible the cost of construction, e.g. at the expense of the use of hydro pumps with asynchronous motors instead of hydro turbines with asynchronous generators.

Experience of the use of pumps instead of hydro turbines is well known. In spite of the fact, that the efficiency of the pump in reverse regime is lower than hydroelectric aggregate for 25%-30%. Its price is much lower which gives a sound argument for their application. Besides, the pumps meet ecological and sanitary requirements.

## 6. OPET Project: Organizations for the Promotion of Energy Technologies

The OPET Network is an initiative of the European Commission, which aims at dissemination of information on the benefits of new innovative energy technologies and promotes them. These energy technologies cover the areas of renewable energy sources, rational use of energy in industry, buildings and transport, solid fuels and hydrocarbons. The OPET Network is supported by the Enterprise Directorate-General, under the Innovation Program, in collaboration with the Energy Directorate-General, under the demonstration component of the JOULE-THERMIE Program. The Network members have access to a wealth of information and experience on new, innovative energy technologies, which exists as a result of EC Programs, and international energy programs.

There were two main objectives at building an OPET Network in the Caucasus Region with the Energy Centers of the three Caucasian Republics - Armenia, Azerbaijan and Georgia:

Provide a focal point and a relevant process of dissemination of information concerning energy in the Caucasus Region and links with European OPET Network.

Provide opportunities of European co-operation according to the real needs of market actors in this region in terms of clean and effective energy and corresponding technologies.

The representative of OPET-Caucasus Armenia partner is the Energy Strategy Center. Last years project consisted of two different objectives: information about objectives and concrete energy field actions tailored in five work packages.

This year the dissemination of the relevant information has been carried out via mass media. Two TV programs have been shown on TV promoting the benefits of wide scale utilization of renewable energy sources.

Institutional and pre-feasibility studies of SHHPs are carried out in the sector of SHHPs. Our representatives took part in presentations and seminars.

In the framework of the OPET project the activities of “ArmNedWind” and “ArmNedSun” are promoted. Information about this projects has been put on OPET Web Side and the

A Business Plan for a 20 MW wind farm was represented to the Armenian Investors Conference held in New York.

Other current OPET activity: the illustrated Dictionary-Handbook will be produced and disseminated in the South Caucasus Region, translated into Russian, with references to renewable energy terms in three national languages of the region.

In the Work Package “Efficient and Clean Energy Supply Chains for Natural Gas” a preliminary plan for a regional gas distribution network, a regional assessment study, an analysis of the proposed gas technology pertaining to European supply chains and a preliminary assessment of the ecological,, economic, and geopolitical impact on new regions will be carried out.

# Country Report: Belarus

Selected “Best Practice” Projects and Measures in The Republic Of Belarus

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## 1. Section

One of priority directions in the Republican energy saving program for 2001-2005 is the usage of renewable non-conventional energy sources, including biomass.

In the Republic of Belarus usage of biomass is planned and is realized on the following directions:

- Usage of lignin;
- cultivation and usage of quickly growing timber;
- implementation of the program of growing usage of timber and wood waste for heat supply and hot water facilities.

Examples of using lignin are energy technological complexes for incineration of lignin on hydrolyzing factories. As a result of implementation of these projects up to 35 thousand tons of fuel equivalent imported in the republic will be substituted by lignin, which previously accumulated in pit bings of hydrolyzing factories. The program of peat briquettes production from peat and lignin at enterprises of Belenergo concern has also been developed aiming to achieve the volumes of production of 50 thousand tons of briquettes annually to use them as fuel for domestic consumers.

An example of realization of the second direction are the first plantations of quickly growing timber (Sakhalin cane, etc.), which will be used as fuel oil.

The realization of the third direction boosted in 1998, when according to the governmental order the Program of timber use for production of thermal energy was developed. The program demonstrated that the summary effect for the country from substitution of fuel import accompanied by additional use of timber in the amount of 641 thousand tons of fuel equivalent constitutes about 21 million US dollars. As it was noted by the authors in the previous report, big assistance in the development of programs for using wood waste was received from EEC UN and UNDP office in the Republic of Belarus during realization of the project «Rational use of wood scraps and reduction of harmful discharges in the environment through their utilization to produce heat energy» (1998-1999). As a result of successful implementation of the project in 2001 GEF issued a grant for the project «Removing barriers to greenhouse gas emissions reducing through the use of wood wastes for municipal heating of Belarus». During realization of the project the evaluation of the full potential of energy saving in the Republic of Belarus was performed for the usage of biomass as energy source for heating and hot water facilities, the technical and economic potential of using wood scraps was evaluated with allowance to available expertise and know-how. Special attention was paid to the problems of gathering, transportation and preparation for incineration of wood scraps remaining in forests after planned cutting of trees. A program of production of the necessary equipment and mechanisms on the basis of available industrial potential of the country was prepared.

One of the most successful projects for the use of biomass wastes is the national children sanatorium “Solnyshko” in Slutsk district, where retrofit of the heating system was performed and the boiler burns local fuels. To achieve this, two boilers working on furnace oil were substituted by one boiler “Vertical SN-250” produced by a joint Belorussian-French enterprise “Komkont” and burning wood scraps (splinter, sawdust). The boiler was commissioned in 1998. The pay-back period for the project was 1.9 years, and economic effect – 85 tons of fuel equivalent per year.

## 2. Section

Systems of centralized heat supply and production of thermal energy at CHPs remains the guideline in heat and electrical power supply in large cities of the country. In the Republic of Belarus more than 50% of electric energy is produced at CHPs and, accordingly, big attention is paid to optimization of modes of joint production of heat and electric energy and implementation of new technologies.

One of the most interesting examples of application of new technologies is the retrofit of Orsha CHP. Orsha CHP was commissioned in 1961 and first worked on peat, then on boiler oil, and since 1995 on gas.

The basic reason for retrofit of Orsha CHP was physically and morally obsolete machinery, resulting in considerably growing calorific and electrical loads of the city. In these conditions the options of retrofit of the CHP were considered with regard for application of modern know-how. CHP retrofit with usage of steam and gas boilers was found to be the most expedient solution.

In December 1993 the government of the country signed a loan agreement with EBRD for 48.6 million US Dollars for retrofit of Orsha CHP. An international tender was announced. After technical and economic evaluation of bids the evaluation commission announced the winner - the French firm GEC Alsthon (bidder price - 37.609.893 US Dollars). Implementation of construction works and purchasing of a part of electro-technical machinery was executed at the expense of the investment fund of Belenergo concern. The construction works were executed by Belinvestenergostroy concern, which has allowed to considerably reduce expenditures for retrofit. Table 1 contains main technical and economic indices of the CHP before and after the retrofit.

In general, after retrofit the overall technical and economic characteristics of power plant operation will considerably improve:

*Table 1 Basic technical and economic indices of Orsha CHP.*

| Index | Existing part | Retrofitted part – steam and gas unit | CHP in total after retrofit |
|---|---|---|---|
| CHP Capacity: | | | |
| - electric, MW | 6.0 | 69.4 | 74.4 |
| - heat, GCal/h | 381.2 | 78.3 | 459.5 |
| Equipment: | | | |
| Steam turbines, MW | 6.0 | 12.0 | 18.0 |
| Gas turbines, MW | - | 2x28.7 | 57.4 |
| Steam boilers, t/h | 4x70 | - | 280 |
| Boiler-utilizers, t/h | - | 2x42.7 | 85.4 |
| Hot-water boilers, GCal/h | 2x100 | - | 200 |
| Production volume | | | |
| Annual production of electric energy, million kWh | 30,3 | 540,6 | 587,3 |
| Annual consumption of electric energy, million kWh | 16,2 | 511,0 | 555,0 |
| Annual heat consumption, thousand GCal | 424,3 | 523,5 | 1052,5 |
| Fuel | | | |
| Main | gas | gas | |
| Reserve | fuel oil | gas | |
| Emergency | - | fuel oil | |
| Fuel consumption, thousand toe/year | 75,7 | 210,2 | 309,5 |
| Electricity consumption for own needs, % | 46,6 | 5,5 | 5,5 |
| Fuel rate for electricity production gfe/kWh | 188,2 | - | 196,4 |
| Total number of staff | 226 | 112 | 338 |
| - incl. maintenance | 153 | 58 | 211 |
| Staff rate, men/MWfe. | 25,5 | 0,84 | 2,84 |
| Cost of retrofit, million USD | | 45,996 | 54,064 |
| Specific investments, USD/kWfe | | 662 | 726,6 |
| Sources of funding: | | | |
| Investment fund of Belenergo concern, USD | | 5.33 | 13.398 |
| EBRD loan (for purchasing equipment), USD | | 37600 | 37600 |
| EBRD loan for consulting services, million DM. | | 3,066 | 3,006 |

- annual volume of electricity generation will increase by 34 times;
- consumption of electric energy for own needs will considerably drop - from 46,6% to 5,5%;
- specific number of factory personnel will decline from 25,5 people to 2,84 people per MW of installed power. The specific number for steam and gas part will constitute 0,84 people/MW, which is comparable to indices of power stations of large single power (1 million kW and higher).

Specific fuel consumption for electric energy will slightly grow (by 4%). However, this growth is a consequence of methodical incomparability of steam and steam and gas cycles. For definition of actual efficiency of fuel use it is necessary to compare not specific consumption for electric energy, but general fuel consumption in the energy system in conditions of identical volumes of production of electrical power and heat.

A comparison of the specific investments in retrofit of Orsha CHP demonstrates that the retrofit has allowed to considerably reduce investments as compared to global levels.

In global practice specific investments in creation of high-power steam and gas devices constitute 800-850 USD/KW, and for steam and gas devices similar to those at Orsha CHP investments reach up to 1100-1200 USD/KW.

At Orsha CHP the economy of investments is reached at the expense of using during construction local construction staff and building materials, and at the expense of using a proportion of auxiliary objects of the operating CHP (water treatment facilities, engineering networks, auxiliary services, etc.).

The second direction for implementation of new know-how for combined generation of electrical power and heat is the construction of mini-CHPs on the basis of existing boiler-houses. The republican program of energy saving for 2001 - 2005 envisages the implementation of a number of large energy efficiency projects in this field. In particular, the program of development of electricity generating capacities on the basis of steam turbine, gas turbine and steam and gas devices has been designed with creation of small CHPs in 2001 - 2005. This program roughly evaluates the possibility of installing electricity generating capacities at the boiler houses of the republic with a capacity up to 150MW with annual fuel conservation up to 120 - 150 thousand tons of fuel equivalent. In 2001 it is planned to commission turbine generators with the summary capacity 18,5MW, of which turbine generators with the summary capacity 13,5MW have already been commissioned. In 2002 the crucial activity according to the program will be the creation of an energy technological complex on the Belorussian cement works with commissioning of two gas turbine devices with a capacity of 32MW, which will bring annual savings up to 40 thousand tons of fuel equivalent. Feasibility studies for installing steam and gas devices on a number of major boilers with using heat of exhaust gas after combustion turbine, both in the work cycle and in steam and hot water boilers – utilizers are now conducted.

Among the operating objects mini-CHPs on the basis of turbines P-0.75MW ensuring annual fuel economy of 1120 tons of fuel equivalent are of interest (boiler-house of a paper factory "Albertin", Slonim), as well as 3 mini-CHPs on the basis of district boiler-houses "Vostochnaya" (Vitebsk), “Severnaya” (Grodno) and № -1 (Molodechno), with turbine generators P-3.5 MW each. The fuel economy at each of the above boiler-houses is 3100 tons of fuel equivalent annually.

## 3. Section

One of the main directions of energy saving in the Republic of Belarus is heat rehabilitation of living and communal buildings. The first project in this direction was realized by specialists of the French firm BCEOM and the Belorussian enterprise BelVIEC within the framework of EU THERMIE program. In four flats of one of the houses in Minsk energy saving measures were introduced. During the heating season of 1992/1993 several parameters were measured in these flats and in reference flats. On the basis of these measurements conclusions were made about the possibility of saving up to 50% of thermal energy in an average flat in Minsk. The results of the project promoted the development of various projects for heating retrofit of buildings and separate flats.

For instance, the following works for heating retrofit of buildings were conducted in Minsk from 1997 to 2000 in the apartment houses at the expense of energy saving resources:

- Façades of apartment houses completely insulated - 16
- pieces of façades (butt ends, separate parts) insulated – 45,494 sq.m.
- roofs insulated - 42000
- separate flats insulated - 1156.

As a result of operations for heating retrofit of apartment houses in Minsk executed in 1999, in the heating season of 2000 (January - April, October - December) 157 tons of fuel equivalent were saved. As a result of operations for heating retrofit of apartment houses in Minsk executed in 2000, in the heating season of 2001 (January - April) the economy of 82,6 tons of fuel equivalent was obtained.

One of specific and interesting projects for heating retrofit of buildings in the Republic of Belarus is a demonstration project within the framework of EU TACIS program in 1997-1999 (leader of the consortium - German company Consult Team, budget - 1.3 million US dollars).

Full scale heating retrofit of an apartment house in Matusevicha street 11 in Minsk was held on following directions:

- insulation of outside walls (with combined mineral wool with polystyrene, thickness - 6-8 cm);
- triple glazing of windows;
- glazing of balconies;
- substitution of the roof and its insulation;
- installation of individual gas meters and meters of hot and cold water;
- installation of thermostatic valves on heating batteries;
- installation of heat evaporators on each battery;
- installation of automatic heat consumption control systems at heat substations;
- Installation of heat metes, meters of hot and cold water and gas in buildings;
- overall repair and insulation of buildings.

As a positive result of work it should be noted that all civil and erection works on the demonstration objects have been executed by Belorussian firms.

The results of comparative monitoring of energy consumption in the demonstration building on Matusevicha street 11, where heating retrofit has been performed and in the reference building on Zhudro street 32, where such works have not been performed, we can make the following conclusion:

- the reduction of heat consumption in the heating system of the demonstration building constitutes about 40 - 43% from the level of heat consumption in the reference building.
- energy consumption for hot water supply was reduced from 0,34 to 0,174 GCal per capita per month or nearly twofold. The consumption of hot water has declined from 5,02 to 3 cubic meters per capita per month.

As the result of the executed projects the World Bank has issued a loan to the Republic of Belarus in the amount of 22.8 million USD for implementation of energy saving measures in the social field – in schools, hospitals and other social objects. For the period from 2001 to 2005 it is planned to implement these activities at 600 social objects. Within the framework of the loan four demonstration zones in the cities of Minsk, Vitebsk, Baranovichy and Borovlyany have been set up. At the present time business plans are being prepared for the demonstration zones with the purpose to ensure the most efficient investment of funds.

## 4. Section

In the Republic of Belarus there are no companies such as ESCO. Since December 1, 2001 the project UNDP/EECUN /GEF "Removing Barriers to Implementation of Energy Efficiency Improvements in Belarus", aimed at the creation of the first municipal ESCO company in the country is being implemented.

In the previous report we reviewed the sources of funding of energy saving activities and projects in the Republic of Belarus. In the present report we analyze the structure and volumes of using the sources of funding for implementation of the specific regional energy saving program for Minsk.

More than 3 million USD are spent annually in Minsk for funding the energy saving program. Table 2 lists the main sources of finance of the 2000 program in percent.

The main source of funding of the municipal energy saving program in 2000 was the innovation fund of Belenergo concern, which covered over a half of spent funds. A considerable fraction, almost one third of funding of energy saving activities was covered from own funds of enterprises. The remaining sources were relatively insignificant. For instance the share of local budgets actually amounted to less than 8%.

It is necessary to pay attention to the appearance of such source of funding as energy and resource saving funds of enterprises. The relative share of this source was very small - only 0,08%. In the long term the importance of this source should essentially increase.

*Table 2 Main sources of finance of the 2000 program*

| № | Source | relative involvement in % | |
|---|---|---|---|
| | | planned | Actual |
| 1 | Innovation fund of Belenergo concern | 58,5 | 59,67 |
| 2 | Own funds of enterprises | 28,4 | 22,96 |
| 3 | National budget | 2,3 | 3,67 |
| 4 | Local budget | 10,8 | 7,69 |
| 5 | Loan | - | 5,93 |
| 6 | Enterprise funds for energy and resource saving | - | 0,08 |
| | Total | 100 | 100 |

## 5. Section

Big attention in the Republic of Belarus is paid to lowering of fuel and energy resources consumption at industrial enterprises. All industrial enterprises annually develop programs of energy saving which are considered and approved by the Committee on energy efficiency under the Council of Ministers of the Republic of Belarus. For each year the enterprises receive target indices on energy saving. The regulation of the government is currently in force, according to which the enterprises should have funds of energy and resource saving. These funds should be used for funding of energy efficiency projects and creation of financial incentives for implementation of energy efficiency projects. Most of the significant and efficient energy efficiency projects of industrial enterprises are funded from sectoral, regional and national energy saving programs.

Over the last years large attention was given to implementation of large-scale energy efficiency projects at a number of large industrial enterprises of the country. Given high investment attractiveness of such projects the enterprises expect to attract investments of international financial institutions. In this direction large assistance is provided by the European Economic Commission of the United Nations within the framework of the international project "Energy Efficiency Investment Project Development for Climate Change Mitigation (Belarus, Bulgaria, Kazakhstan, Russian Federation and Ukraine)".

One of the most interesting projects is realized at Vitebsk television sets factory producing modern TVs "Vityaz" and other electronics. The factory's products are in great demand in countries of CIS and in Belarus. In 2000 179,000 TVs and 18,000 other electronic devices have been produced.

For covering own technological needs and heat supply of the living area "Yug" the Vitebsk television sets factory has its own boiler-house "Yuzhnaya". The boiler-house has the following boiler units installed: 3xGM-50 (steam mode) and KVGM-100 and 5xPTVM-100 (water-heating mode). The main fuel is natural gas. Heat generation - 790388 GCal, specific fuel consumption for heat generation - 159, 61 kg of fuel equivalent/GCal.

Five main activities are realized in the frames of the above mentioned large-scale energy efficiency project:

- installation of two steam turbines with the capacity of 3,5MW and drive turbine of the network pump;
- retrofit of fuel and energy resources metering system;
- optimization of combustion regime;
- decentralization of the compressor station;
- installation of thermo-compressor.

The realization of the above measures will allow:

- to reduce energy consumption and accordingly to reduce harmful emissions in the atmosphere;
- to completely cover own needs of the boiler house and by 75% the electricity demand of the Vitebsk television sets factory;
- to ensure high reliability of electricity supply;
- to ensure automatic regulation and keeping up at a given level of pressure in the feeding mainline of network water;
- to efficiently use main production assets of the boiler house - steam boiler units.

Basic activities – saving of fuel and energy resources:

- Installation of one 3,5 MW turbine will allow to save 3720 tons of fuel equivalent, installation of turbine drive - 517 tons of fuel equivalent;

- metering of fuel and energy resources and installation of a gas analyzer will allow to save 777 tons of fuel equivalent;
- installation of modern air engines will allow to save 500 tons of fuel equivalent and to liquidate constant noise effects at the compressor station situated in the center of a living area of the city;
- installation of a thermal pump will allow to save 164 tons of fuel equivalent and to improve the quality of casting.

Basic expenditures under the project are 2,068,000 US dollars. As a result of project implementation the following ecological advantages (see Table 3) will be obtained

*Table 3 Reduction of harmful emissions, t/year*

| Energy efficiency measure | Saving, t.f.e. | $CO_2$ | $SO_2$ | $NO_x$ | CO |
|---|---|---|---|---|---|
| Installation of two 3,5 MW steam turbines and network pump turbine | 6817 | 18815 | 0,7 | 6,8 | 0,07 |
| Modernization of fuel and energy resources metering system | 367 | 1013 | 0,04 | 0,4 | 0,004 |
| Optimization of combustion mode | 410 | 1131 | 0,04 | 0,4 | 0,004 |
| Decentralization of compressor station | 1000 | 2760 | 0,1 | 1 | 0,01 |
| Installation of thermo-compressor | 164 | 452 | 0,02 | 0,16 | 0,002 |
| **Total reduction** | **8758** | **24172** | 0,9 | 8,76 | 0,09 |

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# Country Report: Bulgaria

Selected "Best Practice" Projects and Measures in Bulgaria

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## 1. Best Practice: the case of biomass utilization Combustion of sunflower husks in industrial steam generators

### Introduction

The Bulgarian energy balance shows that more than 70 % of the energy consumption is based on imported fuels. The rest is from local energy resources, which are low grade coal and RES (limited hydropower, solar energy, and biomass).

Biomass overall theoretical potential vary between 3.5 and 5 million toe./year. The economical potential is assessed to about 0.7-0.8 million toe. /year.

The use of agricultural wastes for energy production is an important RES. Traditionally most of these wastes have been either left to decompose naturally or removed and spread directly on land where they have some benefits as a fertilizer. For some wastes an increasingly important alternative is to recover the energy present in these wastes by using them as RES. This is the case with sunflower husks.

During the sunflower oil production and depending on the technology used, sufficient quantities of sunflower husks are one of the by-products, which can be an important energy resource for the enterprise. The technologies for the husks´ utilization as a fuel are mainly combustion in grate boiler or refurbished one with pseudo-fluidized bed combustion.

The technical solution designed by Energoconsult company consists of incorporating a special cyclone chamber with highly efficient operation and small size and so provides a feasible solution for refurbishment of in these enterprises existing steam generators producing steam over 5 t/h and using liquid fuel and/or gas.

### Installation

The project has been implemented in 1999 via retrofitting of existing boilers (two steam generators PKM - 6.5, burning oil from Shabla deposits) in the steam station of Papas Oil enterprise – Balchik branch.

Pneumatically, the sunflower husks are fed into the bunkers for fuel storage (each with volume 34 $m^3$) of the corresponding boiler. This volume provides for 6 hours of operation. Below the bunkers the feeding system is situated leading to the cyclone chamber. The husk quantities are controlled via multi-camera counter whose revolutions are regulated by the frequency. The transportation of the husks to the burner is done via air ventilator. The length of the cylinder part of the cyclone chamber is 1 500 mm, the inner diameter – 900 mm. The furnace is insulated with fireproof bricks and is cooled via separate water flow. The cooling of the connection between the cyclone chamber and the furnace of the steam generator is integrated within the water shell of the boiler. The air coming into the furnace is primary (through the husk burner); secondary - above the husk burner and tertiary - through the heavy fuel oil burner. At the exit of the steam generator, a flue gas ventilator is mounted to transmit the gases to a cyclone dust cleaner.

### Operation results

The average heat value of liquid fuel is 9 445 kcal/kg and that of the sunflower husks vary between 3 485 kcal/kg and 3 750 kcal/kg, so it has been proved 68,78 % of oil savings at an average steam generation of 4,6 t/hour. It must be noted that during the efficiency testing, the air temperature varied between -1 °C to +3 °C.

The installation burns simultaneously liquid fuel and sunflower husks. The liquid fuel consumption in nominal regime of operation is 70 – 110 kg/hour and sunflower husks 900 - 1 200 kg/hour. Unburned liquid fuel (rated towards the husks) is not over 4 – 6 %, and dust emission levels vary between 145 – 160 mg/m$^3$. Heat surfaces are clean and no dust is observed on the flue gases track.

The counter and the sunflower husks feeding system operate stable, but they are sensitive regarding the purity of the husks. Additives like paper, chips longer than 4 cm and others result in engorgement of the burner. The solution is a preliminary processing and sifting out the sunflower seed before feeding into the husk room and also designing proper outlets to clean up the track from the feeding fan to the burner.

**Investment**

Total investment for both boilers´ refurbishment and renovation, installation, start-up period, a twelve months maintenance guarantee, as well as staff training, etc. amounted to 157 000 €. It has been calculated that the payback period should be 1 1/2 year at the fixed price of the liquid fuel of 100 €/ton (1999). However, even with the increase of the price of the liquid fuel to 150 - 180 €/ton and depending on the load of the installation, it is considered that the payback period should be nearly 2 campaigns.

**Conclusions**

The operation during the first year of this system has proven the capacity and the investment benefits for the proprietor - Papas Oil Ltd. The experience provides the opportunity to improve system components, in respect of changes in the specific reaction surface of the husks and also related with the partial automation of the process management.

From the implementation of the project several conclusions can be drawn. They are valid not only for biomass but for all RES. The following conclusions should be underlined:

- The renewable energy (biomass) in some cases is still more expensive than the consumer price of heat and electricity;
- there are no state funds in Bulgaria for the development of RES (incl. biomass) utilization;
- the Energy and Energy Efficiency Law (1999) treats only generally RES. Renewables are still not considered a priority in legislation and there are no incentives for their utilization;
- decentralization of the state regulation and larger autonomy of the local and regional authorities leads to the development of their natural resources as they see triple dividends: environmental improvements, economic development, and increased employment.

The biomass utilization as an energy source is a new philosophy in our country and requires a new way of thinking and a new approach for development. Joint efforts are necessary, both on the part of state with its regulatory functions, and on the part of the entrepreneurs and financing institutions. Regional and national information campaigns are needed, showing the advantages of biomass utilization for the energy savings and for the environment.

## 2. Best Practice: the case of combined heat and power (CHP) Implementation of small CHP units in Bulgaria

**Basic information**

Bulgaria has limited energy resources. For this reason one of the main policies in the field of energy is the energy efficiency. Co-generation is one of the most effective technologies for the rational use of energy. The advantage of cogeneration is measured with the energy savings achieved when compared with the separate generation of electricity and heat. It is estimated that through the use of cogeneration systems the possible reduction of primary energy consumption is up to 35 %.

Large scale CHPs are implemented in Bulgaria for a long time. The overall objective is to demonstrate the economic and environmental benefits by using also small-scale CHP applications in the industry and in the building sector.

Sofia Energy Centre (SEC) in its effort to promote small CHP, selected four sites and for each of them a detailed pre-feasibility study has been performed. Sofia Energy Centre as a Co-generation Centre in Bulgaria took part in implementation of a CHP unit in the district heating company of Pravets, Bulgaria.

| Site | Investment (k€) | Payback (years) | $CO_2$ emissions reduction (t/y) | $NO_x$ emissions reduction (kg/y) |
|---|---|---|---|---|
| Vitavel SC | 926 | 7,4 | 7464 | 17774 |
| Regional Hospital Lukovit | 254 | 8,7 | 1620 | 3851 |
| Regional Hospital Mezdra | 302 | 7,9 | 2166 | 5284 |
| Regional Hospital Novi Pazar | 376 | 7,9 | 2778 | 7191 |

**The site**

DH Pravets is located in the small town of Pravets, Bulgaria, and it supplies thermal energy for space heating and hot water production to about 1300 households and to industries and public organizations equivalent to another 1300 households. The company operates about 18 km network and 100 sub-stations. Nearby there is a main gas pipeline. There is continuous heat demand though varying throughout the year.

**The project**

A modern CHP gas-fired unit was installed in the DH Company with 774 kW thermal and 526 kW electrical capacity. The unit is foreseen to be in operation all year round, so during the peak season (winter) it will supplement the existing heat boilers, while during the summer it will be operated only to supply hot water to the DHC customers. About 15% of the produced electricity is to be self consumed and the rest is to be sold to the utility.

**The investment**

The overall initial investment costs of the project are about 300 000 €. It has been realized under a JI scheme for co-operation between Bulgaria and the Netherlands. The funds for project investments were provided as a grant by the Dutch Program SENTER, and there were about 10 000 € additionally provided by Pravets DH Company related to the necessary infrastructure and local connections provision.

**The equipment**

The CHP unit is manufactured by the company Dynaf Spruyt Group and is equipped with:

- a complete heat recovery system;
- a telemetric communication system;
- a sound reducing canopy.

It has been integrated in the existing infrastructure of the DH company.

**Expected benefits**

It is forecasted that at about 8 200 operational hours/year the annual primary fossil energy savings are about 2 280 MWh which makes annual net cost savings of about 50 000 €. At present conditions the expected pay-back period is about 6-7 years. The derived from above parameters $CO_2$ emissions savings are some 800 tons a year.

**Main reasons for the project**

to demonstrate the economic and environmental benefits of CHP for the small and medium industries in Bulgaria. The overall project target is to realize significant reduction of energy consumption and therefore – of greenhouse gases at the DHC Pravets.

In the long run targets are also: development of knowledge, management capabilities and information in the field of energy efficiency and creation of sustainable cooperation between Bulgarian and Netherlands companies and organizations.

**Project sustainability and potential for domestic replication**

A market analysis was made within the project realization and it revealed that the replication potential of this type of projects is significant in Bulgaria. Similar projects can be realized in:

- Hospitals and other medical facilities;
- hotels and large buildings;
- greenhouses;
- small industries;
- heating companies, etc.

## 3. The project for investment in schools – investment in the future

The costs of schools in Bulgaria are covered entirely by the local authorities. For this reason the issue of how to reduce the energy costs for space heating and lighting in school buildings is an issue of major concern for municipal administrations. At the same time, heating and lighting in many schools is below the modern norm requirements. In its capacity of the Secretariat of the Municipal Energy Efficiency Network EcoEnergy, the Center for Energy Efficiency EnEffect implements a number of projects in Bulgarian schools. These projects are financed through different international programs, having their specific objectives and tasks, and may be grouped in three major directions: (a) reduction of municipal expenditure for covering the energy costs of school buildings; (b) reduction of GHG emissions and improvement of the indoor climate in school buildings; (c) impact on public behavior.

The project *"Energy Efficiency Strategy to Mitigate GHG Emissions. Energy Efficiency Demonstration Zone in the City of Gabrovo, Republic of Bulgaria"*, financed by GEF/UNDP, is a specific laboratory for new ideas and solutions. In its framework a demonstration project for retrofit of a school building has been implemented and later this experience was replicated many a time in other municipalities. On the grounds of the lessons learned from these retrofits several summary conclusions may be made, the most significant among them being as follows:

**Main components of the projects**

Projects for school buildings retrofit have been developed and/or implemented in Bulgarian municipalities that differ broadly in terms of characteristics or capacity. The state of the buildings and their technical equipment also vary within broad limits. Nevertheless, there is great similarity among the measures applied in this multitude of projects and they may be combined as follows: (a) measures on the building envelope; (b) measures on the space heating systems; and (c) measures on the lighting systems. The most frequently applied technical measures are repair and weather-stripping of windows and doors, rehabilitation of space heating yards and introduction of automation, fitting of devices for individual control of heat supply, partial insulation of different premises and installation of reflector screens behind the radiators, replacement of the low-efficiency lighting fixtures and luminaries in the study rooms by highly efficient ones. In certain sites new types of heating equipment (storage heaters, etc.) are installed or a shift of the traditional fuel base is effected (gas-fired heating). Systems for modern energy management are demonstrated and/or activities aimed at involving pupils in energy conservation through games, contests and other appropriate forms are organized.

**Financing opportunities and schemes**

The local authorities' capacity to finance energy efficiency projects in schools are very limited. For this reason, although this type of projects are paid back within acceptable time limits by the achieved savings, municipalities rely in the first place on external grant financing under international programs. In the recent time there is a growing number of initiated projects whose financing is procured through bank loans. An option of particular interest among municipalities is the application of financing schemes based on "third party financing" through energy services companies (ESCOs), as well as the use of the Development Credit Assistance (DCA) mechanism of the US Government.

**Several lessons learned from implemented projects**

Despite the variety of specific conditions under which energy efficiency projects in school buildings are implemented, there are several common conclusions that may be made from them:

(a) Investments for the majority of energy efficiency projects in Bulgarian schools feature a payback period of 3 to 5 years. This makes them in general suitable for bank crediting.

(b) In many schools, in which projects are implemented, the rooms were heated and lighted far below the norm requirements. For this reason, although in the majority of cases the applied heating and lighting systems and components are effective *per se*, the relative energy costs are low. This is a low baseline that deteriorates the economic indicators of the projects and has a negative impact in case of application for bank crediting.

(c) A serious barrier to this type of projects are the enforced legal restrictions to bank crediting of municipalities. Municipalities face problems mainly in two aspects - shortage of equity funds and inability to provide collateral on bank loans. The projects implemented in Bulgaria with the use of the specific mechanism for partial guarantee on bank loans (DCA), offered by the US Government, have proven the benefits of such an instrument.

(d) Good opportunities are offered by packaging energy efficiency projects that feature a different degree of cost-effectiveness. A skillful combination of such projects may help implement a broader range of measures, some of which could not have been implemented in isolation. A good example in this respect is the combined project for energy efficiency retrofit of school buildings and street lighting in the city of Pazardjik.

(e) Since schools belong to the public sector, and in view of the very limited possibilities for return on investments for improvement of their infrastructure through their primary activity (the teaching process), financing of school projects falls mainly within the scope of responsibility of social funds. This limits severely the opportunities for initiation of new projects outside the support through international programs. That is why the use of the mechanisms and practices of public-private partnerships is of particularly great interest.

(f) A significant achievement of the demonstration project in the city of Gabrovo was the involvement of both teachers and pupils in the process of implementation and monitoring of the project. The substance and importance of energy efficiency have been elucidated through elaboration of adequate information, teaching and entertainment materials and aids, while games and other enticing occupations helped influence the awareness and behavior of the young people. This is undoubtedly an achievement with a forward-looking reach.

(g) The energy efficiency projects in Bulgarian schools offer broad opportunities for creation of new jobs for employees with not very high qualification level, who are often employed in small and medium-size companies. The implementation of these projects provided conditions for involvement of a considerable number of private companies.

## 4. Energy efficiency retrofit of existing hospital buildings in Bulgaria Energy consumption in hospitals as a burden on the budgets

Currently there are 284 hospitals in Bulgaria. The majority of their buildings are constructed prior to World War II under conventional-type projects and through application of almost identical construction methods. The energy consumption of hospitals in 2000 accounted for 43.6% of the total energy consumption in municipalities. This acts as an incentive to seek for opportunities to reduce their energy consumption and thus save costs that would allow redirection of the limited budget funds to the provision of medical services.

**Introduction to the project for retrofit of hospitals**

In its efforts to assist hospitals and municipalities to reduce their energy costs, the Center for Energy Efficiency EnEffect has implemented a project on *Energy Efficiency Retrofit of Existing Hospital Buildings in Bulgaria*. The project comprises two phases: working out of a pilot project for energy efficient retrofit of a hospital building and replication of the experience accumulated during the pilot project in other hospital buildings throughout Bulgaria. During the first stage of the project an energy efficient retrofit of the “Dr. Tota Venkova” Regional Hospital in the city of Gabrovo was implemented. The hospital is a typical representative of regional hospitals in the majority of medium-size cities in Bulgaria. The building features inadequate thermal and physical characteristics, considerable heat losses and indoor climate that is below the norm requirements. The demonstration project has been implemented thanks to the grant financing and support by the US Agency for International Development (USAID) in the framework of the *Municipal Energy Efficiency Initiative* Project.

**Project objectives**

The main objectives of the project were: reduction of the energy component in the total of hospital expenditures; demonstration of the process of implementation of an energy efficiency project; demonstration of a financial mechanism for financing and distribution of the savings; identification of the real energy conservation potential; demonstration of conventional and innovative energy conservation technologies; creation of prerequisites for introduction of energy management in the hospital; dissemination of the experience accumulated during the demonstration project.

**Energy efficiency measures**

As a result of an energy audit, energy saving measures were proposed, divided into three groups:

Group I: Energy conservation measures on the boiler yard
Group II: Measures on the building envelope
Group III: Measures on the in-house systems

One of the principal implemented measures was the installation of a new air conditioning system in the surgery unit. Besides energy savings, it led to the improvement of the indoor climate and attainment of the conditions prescribed by the standard requirements for a surgery ward. The new system, Model EPCH 5 of SEMCO Inc., USA, is both an established and at the same time innovative technology, which is the first of its kind applied in Eastern Europe. It ensures 100% fresh air supply at exhaust heat/cooling recuperation efficiency rate of 80% via a regeneration heat exchanger with specific coating of 3 Angstrom (1 Angstrom = $1x10^{-10}$ m) molecular network, protection of air mixing and facilitated humidity control. The respective third stage of high-grade filtration (HEPA filters having 99.99% efficiency) in the pressurizing pipeline has been duly replaced and restored. The high and stable coefficient of efficiency of the system reduces energy consumption at heating/cooling duty and thus leads to reduction of energy costs. The advantages of the selected technical solution are in the reduced installed capacity of the cooling aggregate and about 50% lower prices of the equipment of the cooling loop.

**Main benefits from the project**

The principal benefits for the hospital in Gabrovo as a result of the applied measures were as follows:

- Reduction of the annual consumption of heavy oil by 36% and of electricity by 15%;
- considerable reduction (by 37%) of the annual energy costs of the hospital under a situation of budgetary shortage and growing energy prices;
- improvement of the comfort in the hospital building;
- attainment of the standard levels for indoor climate in certain specific hospital wards;
- considerable reduction of local environmental pollution - 30% reduction of $CO_2$ emissions and 26% reduction of $SO_2$ emissions.

**Financial indicators**

The total value of the project amounts to USD 355,927. The Hospital and the Municipality of Gabrovo contributed through their internal funds and their participation in project implementation, as well as with some additional energy conservation activities that were realized during that period.

The achieved savings amount to 481 tons of heavy oil and 186,670 kWh of electricity per annum. The energy costs of the hospital have diminished by USD 92,210 per annum, that makes savings of the range of 37%. The simple payback is 3.9 years. A physical expression of the good financial results of the project is the fact, that thanks to the achieved savings the hospital succeeded to finance with its own funds the repair of the gullies and rehabilitation of the surgery ward through replacement of the joinery.

At the request of the donor, an agreement for distribution of the savings between the Municipality of Gabrovo and the Hospital was signed. In view of the grave financial state of Bulgarian hospitals, the larger portion of the monetary savings (70%) has been allocated to the hospital budget. 30% shall be retained in the budget of the municipality, whereat the municipality commits itself to use its share for implementation of other energy conservation projects.

**Dissemination of the results**

The results from the Gabrovo project have been presented at the regular Annual Conference of the Municipal Energy Efficiency Network (MEEN) EcoEnergy, in which the Municipality of Gabrovo is a member, by the MEEN Secretariat CEE EnEffect. Three hospital retrofit projects were initiated following the example of Gabrovo: the regional hospitals in Stara Zagora and Varna (project of USAID), and the municipal hospital in St. Ivan Rilski hospital in Gorna Oryahovitsa (Ecolinks Program).

The project has won the 1998 International Energy Project of the Year Award of the Association of Energy Engineers, Atlanta, USA - one of the most prestigious awards for international projects.

## 5. Municipal Energy Efficiency Network EcoEnergy

**General review**

The Municipal Energy Efficiency Network (MEEN) EcoEnergy is a non-formal voluntary non-profit association of Bulgarian municipalities, founded in 1997 by the Mayors of 23 municipalities. Currently its membership comprises 35 municipalities and 4 associations of municipalities, representing more than one half of the country's population. The strategic objectives of the Network are as follows: (a) to integrate energy and water efficiency in the policy for sustainable development of municipalities; (b) to contribute to reduction of the energy costs of municipalities; (c) to contribute to reduction of the energy costs of energy end-users.

The founding and activity of MEEN EcoEnergy were supported by two international projects: the *Municipal Energy Efficiency Initiative* Project of the US Agency for International Development and the GEF/UNDP-funded project *Energy Efficiency Strategy to Mitigate GHG Emissions. Energy Efficiency Demonstration Zone in the City of Gabrovo, Republic of Bulgaria*. Several Network member-municipalities (Stara Zagora, Rousse, Varna) have created energy agencies, which in co-operation with the Network and other interested organizations on the area of the respective municipalities, implement a large variety of activities to the benefit of the respective municipality.

**Some more noteworthy outputs and lessons learned**

Four and a half years after the founding of the Network, the below listed more important outputs and lessons learned from its activities may be reported:

EcoEnergy has established itself as a respected association of municipalities, acting as a partner of state institutions and public organizations in decision-making related to municipal policies in the fields of energy and water resources. It conducts its own studies and renders advisory services to municipalities.

For a first time specialized Energy Efficiency Offices were set up within the municipal administrations as local subdivisions of the Network. Their major task is to create municipal energy information systems (databases), to develop energy programs and plans, to identify and develop projects for energy conservation in municipal sites.

Key thematic studies have been conducted on the most typical barriers to energy efficiency in Bulgarian municipalities and recommendations on how to overcome them have been formulated. Concrete proposals on how to resolve urgent issues of the energy reform in municipalities.

For a first time in Bulgaria realistic long-term energy programs and annual action plans have been worked out for Network member-municipalities. To this end a genuine methodology and a guide to energy planning and management have been elaborated. Currently, training of Bulgarian, Serbian and Moldavian municipalities is conducted on this basis. The programs, worked out in the framework of the Network, have already been approved by the Municipal Councils of several municipalities now.

Considerable advance has been achieved in the development of an integrated municipal energy database for the Network member-municipalities. This database provides valuable historical and up-to-date information about the state of the energy sector in municipalities, the energy consumption of the sites whose costs are covered by municipal budgets and the potential for implementation of programs and projects for energy and water conservation. The database is developed on the basis of a specifically designed computerized software, interest in which has already been manifested by several countries of the region of Southeast Europe. An active website of the Network is maintained in Internet.

Through EcoEnergy and with the assistance of international experts a certified team of trainers on energy planning and management has been trained. These trainers, on their turn, are currently realizing an ambitious long-term training program for Network member-municipalities, as well as for municipalities of other countries from Southeast Europe.

Several demonstration projects have been implemented in the framework of the Energy Efficiency Demonstration Zone in the city of Gabrovo (rehabilitation of the systems of district heating and street lighting, retrofit of the regional hospital, a school building, a residential building and an industrial building). The outputs and lessons learned from these projects are being evaluated, summarized and disseminated among the rest of the Network members.

Energy efficiency investment projects have been worked out jointly with the Network in the majority of the member-municipalities. Part of these have already been implemented, others are underway and yet others are in the process of search of funding. The most typical projects are those for upgrading of municipal energy end-use sites - street lighting, hospitals, schools and kindergartens. Certain projects are being implemented in the residential sector as well - apartment blocks, in which the dwellings are privately owned. Part of the projects have been identified and worked out in the framework of the training programs, conducted by the Network.

Also in the framework of the Network there have been implemented projects, through which innovative for the Bulgarian practice mechanisms for financing and/or guaranteeing of bank loans for energy efficiency projects are being tested. Thus, for instance, projects with the use of the credit guarantee mechanism Development Credit Assistance (DVA) have been worked out and are being implemented in the cities of Pernik, Pazardjik and Silistra. In others, third party financing is realized with the participation of local and foreign ESCos.

Another attractive mechanism for project financing, based on partnership between municipalities and private US companies, is contained in the Ecolinks Program of the US Agency for International Development. On this basis a project for retrofit of the hospital in Gorna Oryahovitsa has been developed.

Guides on accessible financial sources and financing mechanisms have been developed for use by Bulgarian municipalities wishing to implement energy efficiency projects. The model of EcoEnergy and the accumulated experience are being used in the development of the Regional Network for Efficient Use of Energy and Water Resources (RENEUER) for Southeast Europe.

# Country Report: Czech Republic

Selected Best Practice Projects and Measures

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## 1. Biomass energy portfolio

*The use of biomass energy is becoming a more and more attractive option for the local authorities of Czech towns and villages as they look for ways to bring finances and employment opportunities into the region. Although there is a National support program providing subsidies of up to 80 % of eligible investment costs, many municipalities are unable to raise the remaining funds due to their very limited budgets and the lack of sufficient assets usable as guarantees. This situation (the possibility of state financing to cover a large proportion of the investment costs) is therefore an attractive option for JI activities (as the JI investor gets emission reductions at minimal cost) which could provide the financial help required to put these projects into practice. This potential has been recognized by the Dutch company BTG which has recently started a nation-wide project in the Czech Republic (calling it Biomass energy portfolio) which aims to assist in the implementation of 28 projects related to biomass use especially in the municipality sphere. Such co-operative arrangements could lead to an increased number of implemented projects for the benefit of local inhabitants and sustainable living.*

The current use of biomass for energy purposes in the Czech Republic is at present estimated at 1,5-2 million tons per year (dry matter), mostly in the form of **firewood** (used as a fuel in individual ovens/boilers especially in rural areas) and **residues from wood processing** (sawdust, wooden chips etc.) usually partially burnt at the place of origin (at sawmills, joiner's workshops and other wood-processing facilities).

At various wood-processing enterprises there are at present 100-150 medium- (hundreds of kilowatts of heat energy output) and large-scale (units of MWs of thermal output) boilers in operation, burning wood waste originating from the processing of wood. They usually only produce heat which is used for the drying of rough timber and/or the heating of companies' premises, but there are also several installations with steam turbines (and one pilot project with a wood-gas generator) allowing for the production of electricity as well.

In addition, more than 10 municipal biomass-fired boiler houses (with a heat output of 1 - 10 MW) have been constructed in the last ten years to produce heat delivered via a central heating distribution system to local inhabitants. The fuel they use is mostly sawdust, shavings and other wood-processing residues, sometimes complemented or substituted by woodchips made from logging residues and optionally, where technology allows, also grain/rape straw.

As far as the residential sector is concerned, although most of the biomass burnt in local ovens or boilers is firewood, a significant market share has been achieved by wood-gas producing/burning small boilers (heat capacity 15-50 kW) for family houses, 40,000 of which, according to estimates, have already been sold on the Czech market, and the market is growing every year by several thousand units (practically all made by local manufacturers of which the most successful are ATMOS and VERNER). As these small boilers require a fuel (wood) with a very low moisture content (less than 20 %), this creates a growing demand for higher quality bio-fuels such as wood/straw briquettes and pellets.

An even more rapidly expanding market sector, however, is that of fire-place stoves. Whereas last year only roughly 15,000 wood stoves were sold on the domestic market, this year sales are expected to increase dramatically to 20 000 units (this market is also dominated by another Czech manufacturer ABX Rumburk).

As the table below shows, however, the current and future energy potential of biomass in the CR is much greater, especially in agriculture, where, thanks to rising production intensity, it is expected that up to 500,000 hectares of the existing arable land (more than 15 %) will not be needed in the next few years for agricultural purposes, thus it will be possible to use them for growing other (energy) crops.

*(The energy yield from one hectare of the fastest growing energy crops can reach 300 GJ which is well enough for meeting the annual heating demands of up to three family houses.)*

*Table 1 The potential of bio-fuels in the Czech Republic to 2020 (million tons of dry mass)*

| Bio-fuel | Source | Years | | |
|---|---|---|---|---|
| | | 2000 | 2010 | 2020 |
| Wood, bark | *residues from logging, wood-processing* | 2,6 | 3 | 4 |
| Grain straw | *25-40% of crop with 4-5 t of straw per ha* | 1,6 | 2,2 | 3 |
| Rape straw | *90-100% of crop with 3,5-4 t of straw per ha* | 1 | 1,2 | 1,5 |
| Hay, reed | *from 20% of persistent plant cover with 2-3 t of hay per ha* | 0,8 | 1 | 1,2 |
| Energy crops, SRF* | *plantations of fast-growing plants/trees* | 0 | 4 | 6 |
| Wood waste, coverings | *waste from construction industry, municipal waste and coverings* | 0,6 | 1 | 2 |
| **Total** | | **6,6** | **12** | **17,7** |

**) short rotation forestry*

Although the subsidies provided at present by the State Environmental Fund (SEF) to towns and villages for the installation of biomass boilers in centralized heat delivery systems and hot water preparation can reach as much as 80% of the investment costs of selected projects (max. 50 % in the form of a grant and the rest as a zero interest loan, according to the current rules), many municipalities are still unable to invest in new bio-energy installations because of their very limited annual budgets.

And, as it is impossible for most Czech municipalities to get a loan from a bank because they are often unable to provide a sufficient guarantee, and the possibility to use the planned investment itself as a guarantee (collateral) is not accepted by Czech banks, a lot of projects never get past the planning phase.

However, an illustration of how these barriers can be overcome has recently been provided by the Dutch company BTG (Biomass Technology Group B.V.), which, within the framework of Joint Implementation activities financially supported by the Dutch government, has launched a JI project in the Czech Republic on the promotion of the wider use of biomass especially in the municipal sector.

**Biomass energy portfolio**, as it is called, is not actually a single project but consists of a portfolio of (currently) 28 individual biomass energy installations to be implemented in various places across the country. These projects mainly consist of the replacement, renewal, extension or new construction of municipal heating systems, where biomass (wood and straw) boilers will replace old coal or gas-based boiler systems. The owners of the systems are mainly municipalities, two of them are private companies. In a few projects a co-generation system is to be installed for the production of heat and power. The thermal capacity of the installations ranges from 600 kWth to about 24 000 kWth. The total thermal capacity of the 28 projects amounts to 130 MWth.

The projects in the portfolio vary in their level of development. The first are planned to be implemented in 2001 and the last in 2003.

The company's role in these projects is to supplement the municipalities' funds and the national support program (managed by SEF). It is supposed to provide a maximum of 10 % of the planned investment which is, however, often crucial for the realization of the project.

For this, the company will be then assign claims on emission reductions (counted in so-called emission reduction units – ERUs, where 1 ERU is equal to 1,000 kg of $CO_2$ equiv.), which will come from these projects in the future, if they are realized.

The preliminary estimates of the company are that the volume of ERUs „produced" by all these projects combined could, in the key years 2008 to 2012 (the time when the Kyoto obligations should be fulfilled) reach a minimum of 0.5 million, with an optional additional volume of 0.7 million if all the planned projects are well implemented and running. The maximum emission reduction potential of the projects as a whole is thus 1.2 million tons of $CO_2$.

These ERUs (in reality claims on ERUs, as only countries - Parties to the Kyoto Protocol - can own ERUs) will be then purchased in a tendering procedure by a Dutch company Senter, which is in charge of running a national program on $CO_2$ reduction called Carbon-credits on behalf of the Dutch government.

The BTG company has recently registered this project in the JI sub-program of Carbon-credits called ERUPT, which opened the first tender for ERUs purchasing at the beginning of December, and it is offering Senter the above stated amount of $CO_2$ carbon savings for the price of 9 EUR/ERU. Since the price per ERU Senter expects is however much lower (2-5 €), the final price will depend on the bids (ERU amounts and prices) offered by other competitors (investors in JI projects).

If the offer made by BTG is accepted, the company promises that any possible profit would be then re-invested in further bio-energy projects in the Czech Republic.

## 2. Fuel-switching, district heating reconstruction, and combined heat and power generation in city of Decin, North-West Bohemia

The city of Decin was one of the pioneering projects co-financed under the Joint Implementation Initiative. The project with investment costs of 230 million CZK (7 million €) included fuel switch from coal to natural gas (11 MW), upgrade of distribution network, and installation of combined heat and power units (5 MW el, 7 MWth). The investment costs were financed by 75% with a subsidy from the Czech State Environmental Fund, 9% was a donation from Danish government, 6% own capital of the City of Decin, and 8% was a zero interest loan from US utilities (owners of emission credits under JI agreement). The project demonstrated contractual arrangements for JI projects, however, due to its high costs of the technology used it is not replicable on a commercial basis without subsidies.

**Detailed project description**

The city of Decin, due to its location (in a deep valley in a heavily industrialized part of North-West Bohemia) and its energy dependence on lignite coal (extracted on a large scale from the nearby North Bohemian Brown Coal Field), experienced one of the highest concentrations of sulfur dioxide, dust, and other pollutants in the Czech Republic. For this reason, the first democratically elected leaders of the town after the collapse of the Communist regime immediately began to take action to improve the local environment. One of the measures proposed at this time was the reconstruction of one of the most inefficient heating plants in the town supplying the city's Bynov district.

The underlying reason for the reconstruction of the Bynov district heating plant was that, due to its low combustion efficiency (below 63%), this 19.6 MW facility had annually to consume around 12 800 tons of lignite (170 000 GJ of the primary energy content in the fuel) to cover a heating demand from the district which was then on average 107 000 Gigajoules (GJ) per year.

Thus, emissions from the plant were extremely high. In addition to $SO_2$ (over 68 tons/year) and airborne dust (3,190 tons/year), the Bynov plant was also producing around 19,582 t of $CO_2$ every year (calculated on the basis that the average carbon content of North Bohemian lignite is 41.8%)

After several unsuccessful efforts to find the necessary funds, the city's representatives finally decided that the reconstruction of the Bynov heating plant should be proposed as a pilot project for the then nascent Joint Implementation Initiative. In this they were successful: with the aid of the Center for Clean Air Policy, they managed to obtain an interest-free loan of 0.6 million USD for the conversion of the district heating plant from a coal (lignite) burning to a natural gas-fired facility which would provide both heat and potable hot water to local apartment blocks. In return for providing the funding, the three American utilities will (under JI rules) gain recognition for the carbon dioxide reductions achieved on-site by the project.

However, due to lengthy negotiations over the means of verifying reductions in real emissions and their recognition, and thanks to the provision of further financial support by the Danish Government and the Czech State Environment Fund, extensive modifications to the original project were made over the course of time. The project was gradually extended to also include energy efficiency measures in the distribution network, and ultimately four co-generation units were installed as the major producers of both heat and electricity thus changing the new gas boilers` role as only peaking sources. (The inclusion of co-generation units was required by the Danish government as a condition for the provision of their grant.)

The construction phase of the project began in 11/1995 and in less than one year (09/1996) it was finished. The whole project in the end consisted of:

- the replacement of the existing coal-fired boilers with two gas-fired boilers (produced by the Danish manufacturer VOLUND) with a common heat accumulator and total thermal output of 11 MWth,
- the switch from steam to hot-water heat distribution (with the installment of pre-insulated hot-water pipelines), and the construction of new heat transmission stations,
- the construction of a new facility to house four DEUTZ gas engines with a combined capacity of 5.2MWe and 7.1 MWth.

**Project financing**

| Investors | *Total* mln € | Grant mln € | Equity mln € | Debt mln € |
|---|---|---|---|---|
| Czech State Environmental Fund (SFZP) | 5,2 | 2,6 | | 2,6* |
| Danish Ministry of Environment and Energy | 0,6 | 0,6 | | |
| Three American Utilities (ComEd, NIPSCO, WEPCo) | 0,56 | | | 0,56** |
| City of Decin | 0,45 | | 0,45 | |
| Sum | cca 7 | 3,2 | 0,45 | 3,16 |

*Exchange Rate: 1 € = 33 CZK*
**) an 8-year loan with interest rate of 0%*
***) a 25-year loan, also at 0% interest*

**Project results**

The results of the project, after nearly five years in operation, brings mixed results. From the ecological point of view, the project is undoubtedly a success. Thanks to co-generation, not only on-site (due to fuel-switch), but also off-site emission reductions are reached by the project.

However, as the original projections of heating consumption were too "optimistic", the real emission reductions are lower than estimated. None the less, with a real annual combined production of between 80 000 and 90 000 GJ of heat, and around 15 000 MWh/year of electricity (meaning that an average energy production efficiency of approximately 87% is being achieved), the carbon dioxide on-site emission savings (against the reference scenario *) amount to 6,000 tons/year, and together with off-site emission reductions made due to co-generation, the total emission savings reach nearly 18 000 tons of $CO_2$ every year

If future heat demands (= production) do not differ greatly from current levels, then with an anticipated project lifetime of 25 years the total $CO_2$ savings will probably range between 400 000 and 450 000 tons. That, translated into $CO_2$ abatement costs, would mean approximately 530 CZK or 16 € per ton of $CO_2$ reduced.

** It is assumed in the reference (baseline) scenario that the plant will produce the same amount of heat as was produced by the reconstructed plant in the year 2000, with the same heat production efficiency (i.e. 63 %) as before, and from the same lignite coal as before (i.e. with an average heat value of 13.28 MJ/kg, carbon content of 41.8%, and thus an emission factor of 0.115 t $CO_2$ per GJ of energy contained in the fuel).*

| The Bynov District Plant | Heat demand | Electricity produced | Coal / Nat.Gas consumed | Energy Content of Fuel (Coal/Gas)* | CO2 emiss. | CO2 savings (due to fuel change) ** | CO2 savings (due to cogen.) *** |
|---|---|---|---|---|---|---|---|
| | GJ / year | MWh / year | t,mln.m3/year | GJ / year | t / year | t / year | t / year |
| BEFORE | 107,000 | 0 | 12,800 | 170,000 | 19,582 | - | - |
| AFTER (est. 2001) | 96,000 | 24,137 | 6,210 | 207,476 | 12,187 | 5,373 | 19,068 |
| AFTER (year 2000) | 81,238 | 14,663 | 4,588 | 153,285 | 8,763 | 6,066 | 11,584 |

**) The heat value of the lignite used in the plant was on average 13.28 MJ/kg, while natural gas has a heat value of 33.41 MJ/m3*
***) $CO_2$ savings due to fuel change were calculated using an emission factor of 0.115 t $CO_2$/GJ of energy content of the lignite coal (with energy production efficiency of approx. 63 %) and 0.058-9 t $CO_2$ /GJ of natural gas*
****) The emission factor for electricity from the grid is 0,79 t $CO_2$/MWh*

# 3. Energy performance contract project in Bulovka Hospital, Prague

The Teaching Hospital Na Bulovce represents one of the first and also largest EPC projects implemented so far in the Czech Republic in the public sector. The project investment costs reached more than 70 million crowns (appr. 2 million €) and were financed on a commercial basis through the ESCo. The project also received a minor financial support from the Czech Energy Agency (5 million CZK or 0,15 million €). The actual heating cost savings reached nearly 40 % (24 million CZK or 0,7 million €) and heat consumption decreased by 46 % (104 000 GJ/year). The project has a simple pay-back period of 4,2 years and the Energy Performance Contract has been signed in 1994 for 8 years.

**Detailed project description**

Located in the northern part of the Czech capital, Prague, the state-owned Na Bulovce Teaching Hospital with its 1 650-bed capacity is one of the largest healthcare facilities in the Czech Republic. The hospital comprises around 20 buildings, with a total floor area of some 80 000 m2.

Before the project, all of the hospital buildings were connected to a hot-water or steam distribution system that supplied them with heat produced in the hospital's own boiler house, which ran on light fuel oil (LFO).

This situation, however, gave rise to major problems for which the hospital's representatives had to find a solution; the heat distribution system was in a poor state (given that much of the indoor and outdoor distribution piping dated back to the hospital's founding in the 1930's), the price of LFO was high, and the hospital was required to pay air pollution fees (170 000 CZK/year).

A solution was suggested by one of the first ESCO firms in the CR, EPS ČR Ltd., the Czech subsidiary of U.S. firm PECO Energy Co. The company proposed a plan for the complete reconstruction of the distribution system, to be realized as an EPC contract, thus sparing the hospital's financial budget from any capital expenses. Once the hospital's representatives had been advised as to the magnitude of the annual savings that could be achieved by the project, they readily accepted it.

The basic measure proposed and put into practice by EPS ČR Ltd. was to make use of the district hot-water heating and natural gas mains pipelines which ran immediately adjacent to the hospital.

The hospital's primary steam heating distribution infrastructure was thus replaced by pre-insulated hot-water pipelines and connected to the urban heat distribution grid of the Pražská teplárenská joint stock company; furthermore, new individual exchange stations were constructed in 14 buildings. The heat and hot utility water distribution networks in all of the buildings were also renovated, and the distribution system was equipped with a central monitoring and regulation supervisory system.

As far as the LFO-fired boiler house is concerned, it was not shut down, but was converted to run on natural gas fuel; it will serve in future only as a reserve source, however.

Beyond these measures, the project also included the installation of a new medium-pressure steam gas boiler to meet requirements for technological steam, and measures for the recuperation of heat within the buildings by way of air-conditioning were also implemented.

The total project costs were 72 million CZK, and EPS ČR Ltd. served both as general contractor and major investor in the project (the other investor was the Czech Energy Agency, which contributed a 5 million CZK subsidy). Engineering works constituted the smaller part of the project budget (8.4 million CZK), the majority (63.6 million CZK) being spent on technological equipment.

A contract for "Energy Services" between EPS ČR Ltd. and the Hospital was signed in March 1994 (to run for 8 years) and two months later the first works began. The whole reconstruction project took twelve months to complete, and the project was officially commissioned into service in December 1995. The project thus described consisted of:

- the connection of the hospital facilities to district heating and gas main pipelines,
- the construction of 14 new heat exchange stations in individual buildings,
- the reconstruction of the heat and hot utility water indoor distribution system,
- the installation of a central system of measurement and regulation,
- the gasification of the existing steam boiler plant,
- the installation of a new medium-pressure steam gas boiler for covering technological steam requirements,
- the implementation of heat recuperation measures.

**Project financing**

| Investors | mln € | Grant mln € | Equity mln € |
|---|---|---|---|
| Na Bulovce Teaching Hospital | - | - | |
| EPS ČR, Ltd. | 2,03 | | 2,03 |
| Czech Energy Agency | 0,15 | 0,15 | |
| Sum | cca 2,2 | | |

*Exchange Rate: 1 € = 33 CZK*

**Project results**

The reference heat consumption (i.e. heat consumption before the project) was agreed in the EPC contract to be 192,500 GJ/year. The projections were that, thanks to the reconstruction annual heat consumption would decrease by at least 35-40%, thus saving around 17 million CZK per year. This would mean a simple payback period of roughly 4.2 years.

The reality has brought these results. According to the data provided by MVV EPS, Ltd. (formerly EPS ČR, Ltd.) for the last year, heat consumption in the year 2000 was approximately 104 TJ, i.e. nearly 90,000 GJ (or 46%) less than in the baseline. Expressed in terms of $CO_2$ emission reductions, the project saves nearly 1,700 tons of $CO_2$ every year.

As far as costs are concerned, comparison of the energy costs for heating before (39.32 million CZK in the reference scenario) and after (23.88 million CZK in the year 2000) the project reveals that the financial saving last year was more than 15 million CZK (i.e. 39%). If all of the benefits resulting from the project are considered (e.g. the elimination of air pollution payments), then the savings in financial terms, according to the MVV data, reached nearly 22 million CZK - well over 50% of the original costs - last year.

| Na Bulovce Teaching Hospital | Heating Costs mln CZK / year | Heat Consumption GJ / year | $CO_2$ emiss. t / year |
|---|---|---|---|
| BEFORE | 39.325 mln CZK | 192,495 GJ | 17,211 |
| AFTER (projected) | (savings ≈ 43 %) | (savings 35–40 %) | |
| AFTER (year 2000) | 23.884 mln CZK (savings ≈ 39 %) | 103,743 GJ (savings ≈ 46 %) | 15,523 |
| *Source: MVV EPS, Ltd.* | | | |

## 4. Low-energy, low-cost residential buildings in the Czech Republic

*The low energy efficiency of buildings actually adds to the deterioration of the environment. However, due to high costs additional thermal efficiency measures often prove to be uneconomical. For existing buildings, it is the price we have to pay for the mistakes of the past. But why make the same mistakes today as well? For this reason, SEVEn, together with local partners of the same persuasion and with the financial help of the UNDP and GEF, has started a project whose aim is to facilitate the application of the principles of energy efficient architecture in residential building in the Czech Republic. To prove that such an approach to civil engineering does not necessarily have to be more expensive, one of the major outputs of the project will also be the demonstration(s) of low energy residential houses constructed at no higher-than-usual investment costs. Three projects aimed at the development of the first low-energy/investment cost apartment buildings in the country are already nearing the construction phase.*

The project: „Low-energy, low-cost residential buildings in the Czech Republic“ is a three-year program running from 1999-2002 and financed by The Global Environment Facility (GEF) through The United Nations Development Program (UNDP). The project is managed by The Energy Efficiency Center (SEVEn) under the patronage of The Charles University Environmental Center (CŽP).

The project itself focuses on these three major themes:

- Improving the energy efficiency of newly-built buildings in the Czech Republic,
- drawing up an implementation design for low-energy, low-cost housing constructions,
- information and practical experience sharing among professionals as well as the public.

In connection to these activities, the project outputs will also include:

- An evaluation of the potential for the construction of low-energy/cost houses in the CR,
- verification of the mechanism for financing the construction of these types of residential houses,
- revision and recommendation for thermal-technical norms, with respect to their harmonization with EU standards,
- the proposal of a national program for low-energy building construction promotion.

The most "visible" result of the project is to be, however, a construction of the first real low-energy/cost residential buildings in selected towns across the country to demonstrate that such an architectural design can be not only operational but also investment cost effective and thus very attractive for investors.

To make it happen, the Czech municipal authorities, which are, thanks to the current legislation, the biggest actual investors in this building sector (the municipalities are the only eligible recipients of state subsidies for residential building), have been addressed and invited to participate in the project.

So far, three towns have expressed their „serious“ interest in building such a residential building and becoming partners in the project. For them, local architects, with the help of experts in energy efficient architecture, designed, under the condition of not higher-than-usual investment costs, residential houses whose projected energy consumption for heating meets the criteria for low-energy buildings (£ 55 kWh/m2/year)

| Town | Investment Costs Budget<br>*CZK/EUR per m2*<br>*of residential area* | Heating and Air Conditioning<br>Energy Consumption<br>*kWh/m2/year of heating area* |
|---|---|---|
| Humpolec | 17 500 / 530 | 35/55* |
| Železný Brod | < 19 000 / 575 | 45,6 |
| Sušice | 15 000 / 455 | 55 |
| Common residential building in the CR | 16-19 000 / 485 - 575 | 100 - 120 |

*Exchange Rate: 33 CZK/EUR*
**) with/without solar gains*

*Figure 1: Low cost, low energy residential building for the town of Sušice*

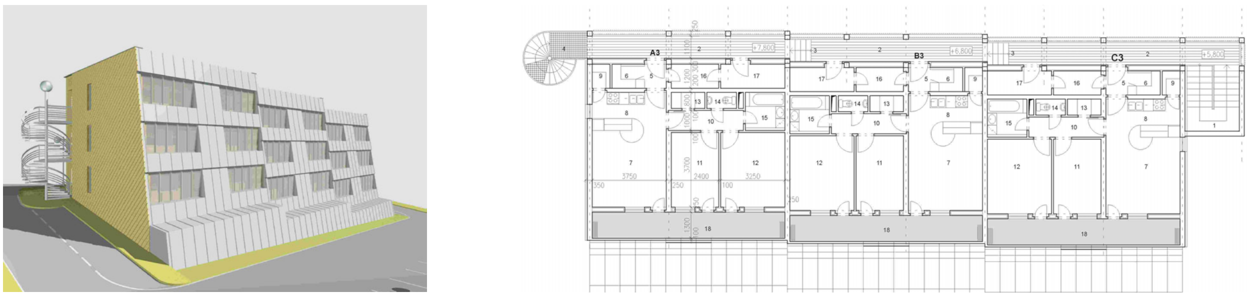


*Figure 2: Low cost, low energy residential building for the town of Humpolec*

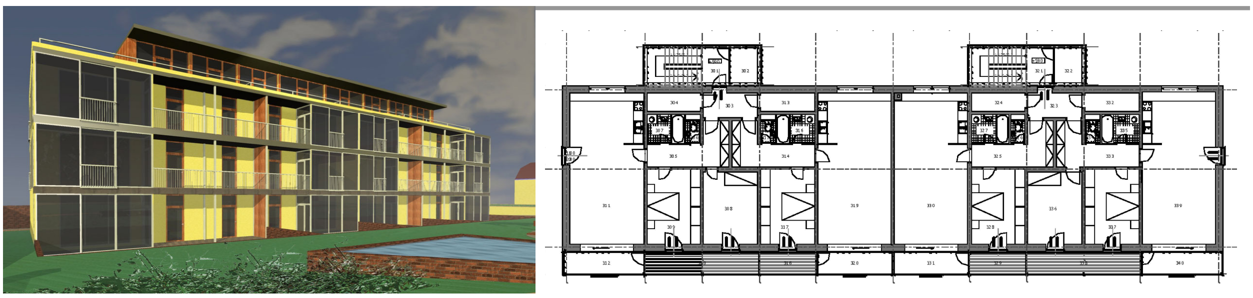
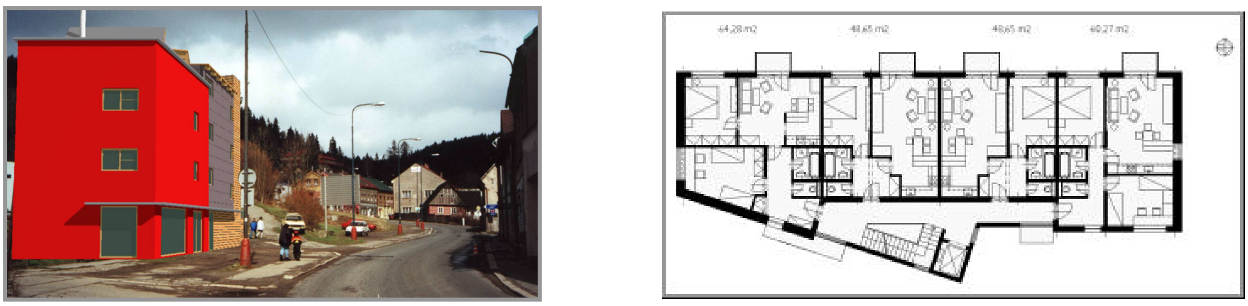


*Figure 3: Low cost, low energy residential building for the town of Železný Brod*



## 5. Efficient Lighting Initiative - Promotion of rational energy use in industry and household appliances

The Efficient Lighting Initiative, or ELI, is a program initiated by the International Finance Corporation (IFC) from the World Bank Group with the aim to promote energy-efficient lighting technologies on those markets, where local conditions prevent from their wider use. Because it is also the case of the Czech Republic, a special Czech ELI program has been designed. It is now underway and concentrates mainly on promotion of CFLs for the residential sector, municipal street lighting systems, and training of professionals and businesses engaged in lighting technologies.

**Detailed project description**

Transitional and developing countries with their immature markets often show similar market barriers to the increased penetration of energy-efficient technologies. High initial costs, lack of consumer knowledge, and low electricity prices due to subsidized or distorted tariff structures are the most common ones.

In response to this problem IFC developed with funding from the Global Environment Facility (GEF) a three-year program called **The Efficient Lighting Initiative** (**ELI)**, to accelerate introduction of energy-efficient lighting technologies by lowering these barriers in those countries where such market failures still exist.

Seven countries have been identified as suitable for ELI Program, and among them the Czech Republic as one such country (besides ČR also Argentina, Peru, South Africa, the Philippines, Hungary and Latvia).

Even though the market barriers in all the countries are of the same kind, with respect to different local conditions there has not been designed one universal program, but for each country has been appointed a local manager who, together with an assigned advising consultant, is responsible for preparation of a specific national program. The basic elements of all the national programs are however the same.

All seven ELI country programs last two years and are being implemented in two tranches over a three-year period. The ELI program for the Czech Republic (and for the other three European ELI countries) is in tranche 2 which began in June 2000. The Czech program manager for ELI is SEVEn (advised by Danish Power Consult) and the ELI budget for the Czech Republic is $1 250 000. The ELI Program in the Czech Republic focuses on three main areas:

**Residential CFL promotion**

The countrywide campaign (top down/bottom up) started in October 2001, with completion planned for February 2002. The campaign has following main goals:

- To raise consumers knowledge and awareness about CFLs,
- to change consumer behavior and stimulate them to buy CFLs,
- to promote the ELI logo.

The campaign is using a variety of channels, such as two national TV stations (30´, 20´ and 10´ spots), print advertisements in 4 dailies and their supplements and in many magazines. There are also billboards (300 throughout the ČR). PR activities are also important, including the publishing of a number of PR articles and stories. The selected Ads agency engaged at present recommended presenting the media ELI campaign as a social campaign, so the original budget of 8 million CZK (210 th. USD) was enhanced by free space in the media and other benefits to the value of 20 million CZK (526 th. USD).

ELI has co-operated closely with major manufacturers (Philips and Osram). The ELI campaign was actually supported by their own campaigns (PHILIPS print ads., OSRAM billboards), for which SEVEn coordinated the placing of ads etc. The manufacturers are using the ELI logo in their activities (where appropriate). The main area of cooperation is in the POS materials. ELI developed the materials (leaflets, POS stickers etc.) and the manufacturers produced it at their cost and delivered it to the POS site.

The ELI campaign received the "Gold Stone Award" at the end of October, a prize given by the Czech Association of Advertising Agencies for the most creative spot of the year.

The ELI mass media campaign is supported by other activities such as an Educational Program for Primary Schools (currently 160 schools have participated) and a Contest for Designers on the design of luminaries compatible with CFL. There is also a local web page running - www.uspornazarivka.cz

**Municipal Street Lighting Program**

Street-lighting activities focus on encouraging municipalities to retrofit their street-lighting systems and supporting installation companies in offering energy services.

As one of the first steps ELI prepared a "Street lighting manual", a book for municipal decision-makers about the management of STL systems. In the manual we described the process of preparing retrofit projects, the tender procedures, methods of financing and other things. The manual is the first detailed material about STL under Czech conditions. The manual was delivered directly to all Czech cities above 5000 inhabitants (250) and to another 100 smaller cities and companies.

Based on interest from the cities and our own activities ELI is working with cities and ESCOs on the preparation of feasibility studies and public tenders for STL systems retrofits. Currently we have two of them approved by City Councils and another 10 are in various stages of preparation. In addition we are co-operating with banks to develop special financial products for financing STL retrofit projects.

Co-operation with ESCOs/installers to ensure implementation capacity is the third key activity in this area. ELI is outlining for them the key factors required to be a successful ESCo, helping them in preparing the projects and in offering their services to customers

**Commercial and industrial lighting**

The activities in this field are currently in development. We have planned the training of ESCOs and activities for raising user awareness. There will be also professional training programs for installers and one plan is to have a Transaction Fund for supporting the implementation of EE lighting retrofit projects.

*Figure 4: Official logo of ELI*

The ELI Program as a whole is expected to yield significant energy savings and environmental benefits. Participating countries are expected to avoid almost 3000 Gigawatt-hours of electricity consumption and the emission of 15 million tons of $CO_2$ over a ten-year period. As far as our republic is concerned, it is still too early for a full assessment, with the ELI program now running at full speed. The first resounds are however positive. *(Further information on ELI can be found at www.efficientlighting.net)*

*Figure 5: The leading spot of the Czech CFL campaign ("Do you know how much your bulb is eating?")*

# Country Report: Estonia

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**Dr. Tiit Kallaste**

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## 1. Best Practice: Boiler conversion from heavy fuel oil to biomass combustion in the Kalevi DH Boiler Plant, Kuressaare Municipality, Saare County, Estonia

**Basic information**

Kuressaare is a city with a population of about 16 000 in the southern part of the biggest Estonian island - Saaremaa (Ösel). About half of the inhabitants of Kuressaare live in multi-storied residential buildings, which are connected to the DH network. District heat is supplied to the Kuressaare City from the Kuressaare District Heating Company (Kuressaare Soojus Ltd).

Before this project was started, 4 boilers with the total capacity of 31 MW had been installed in the Kalevi boiler plant: oil fired hot water boilers DKVR-10 and GTP-10, a container boiler plant with a Witermo type boiler and a biomass boiler (a Saxlund/Tamult prefurnace and 5 MW Danstoker hot water boilers). The new investment will add to the production capacity 7 MW and after the implementation of this project the total capacity will reach 38 MW.

*Table 1 Data on heat production*

| Year | Total production, MWh | Production of the existing wood fired boiler, MWh | Production of the new wood fired boiler, MWh |
|---|---|---|---|
| 1999 | 80 800 | 27 550 | - |
| 2000 | 74 400 | 35 600 | - |
| 2001 (forecast) | 76 500 | 36 000 | 2 000 |
| 2002 (forecast) | 77 000 | 36 000 | 18 000 |

The main objective of the project was to avoid rapid increase of heat price through burning a less expensive fuel. It should also reduce the atmospheric pollution by sulfur oxide emissions.

The planned total investment cost is 6 million kroons, including 4.5 million kroons for the wood fired boiler, 1 million kroons for oil boiler and 0.5 million kroons for the extension of the building of boiler plant. The bank loan of 4.7 million kroons from the Eesti Ühispank was used for funding the project. The rest was covered by the company's equity. No subsidies or grants from abroad were used for the implementation of the project.

**Main project components**

Acceptable fuels for the converted boiler: woodchips as a main fuel with a moisture content of 30-50%, bark, sawdust, plane shavings, sawdust briquettes and sod peat.

- Prefurnace and grate– designed by AS Tamult (main contractor, Estonia) in co-operation with the Saxlund AB (Sweden) and Thermal Engineering Department of Tallinn Technical University, produced and installed by AS Tamult. The capacity of the converted boiler with the moving grate is 7 MW.
- Conveyors – designed by Saxlund AB (Sweden), produced and installed by AS Tamult.
- Fuel bunker – produced and installed by AS Tamult.
- Fuel push-bottom feeder –produced and installed by AS Tamult, patent of the Saxlund AB.
- Fans – produced by ABB (Finland), installed by AS Kuressaare Soojus.
- Hydraulics – supplied by AS Baltfleks (Estonia), installed by AS Tamult.
- Multicyclone – produced in Latvia, type MC-36, installed by AS Tamult.

- Ash disposal system – produced and installed by AS Tamult.
- Installation of electrical and automatic devices – AS Kuressaare Soojus.
- Extension of the building of boiler house – designer OÜ Kuressaare Kommunaalprojekt (Estonia), builder AS Lääne Ehitus (Estonia).

**Main "success" indicators and results**

The loan will be paid back from savings based on burning a less expensive fuel in the converted boiler. The estimated annual saving will be about 1.5 million kroons (in calculations present prices on oil and wood fuel were used). As a result of boiler conversion to wood combustion, the annual consumption of heavy fuel oil will decrease for about 2000 tons. Since the company has used Russian heavy fuel oil with the sulfur content of 2.3%, the emission of sulfur oxides will decrease by 90 tons per year. The emission of carbon dioxide will also be reduced for about 5 000 tons per year.

Time schedule of the project:

- March 2001 – Call for tenders for the construction work;
- April 2001 –Evaluation of proposals, selection and contracting;
- May–November 2001– Building activities;
- November-December 2001 – Adjustment of the equipment and commissioning.

## 2. Best Practice: Small-scale CHP plant at Põlva

**SSCS in the DH system of Põlva municipality as a DH demonstration project, Estonia**

**Basic information**

The unit is installed in an existing boiler house and supplies base load heat to the neighboring district heating network and electricity to local industrial consumers. The Dansk Energy Management AS supervised the project. The unit comprises a gas engine with a 3-phase synchronous generator of 0.4 kV. The generator is connected to the grid through a 0.4/10 kV transformer. The return DH water is heated to 90°C. This level can be reached with the heat from the flue gas heat exchanger, combustion air intercooler, lube oil cooler, engine jacket and high-temperature flue gas heat exchangers. The unit is installed in a noise resistant room with a ventilation to control the internal temperature and gas detector for safety reasons.

The performance of the unit is controlled and monitored by a computer system. It is also possible to operate the system through a telephone network. The control system is interconnected with the existing boilers; when heat demand is increasing, an additional boiler is started. In December 1998 the test runs were completed and since then the plant has been in continuous operation with only minor stops for maintenance and repairs.

The Põlva Municipality has owned the plant since July 1999. It has rented the boiler house and DH network to a private company Põlva Jõujaam AS. They sell electricity via the grid to 6 industrial enterprises at 3-5% lower prices than those charged by the Utility Company. They also sell heat to DH consumers. The transmission fees are paid to the Utility Company and they also purchase all the excess electricity. The Manufacturers' representative in Estonia - Filter AS is responsible for the maintenance of the unit. The staff of Põlva Jõujaam carries out minor and routine service. The maintenance cost is less than 6 € / working hour.

**Main success indicators**

The rated efficiency of the unit is 92%. The energy output from the plant is sufficient enough to replace electricity demand otherwise supplied from Estonian oil-shale fired power plants and that of heat, which otherwise would have been generated in the oil fired boiler house owned and operated by the Põlva Jõujaam.

| Energy output in the first half of 1999 | |
|---|---|
| Heat | 5300 MWh |
| Electricity | 3750 MWh |
| Fuel consumption | 1.07 Mln Nm$^3$ |
| The actual total efficiency is around | 90-92%. |
| These indices are close to the design conditions. | |

The Põlva Jõujaam AS supplies heat to the consumers at the price of 325 EEK/MWh (20.75 €/MWh). This is lower than the average price of heat in Estonia of 360 to 400 EEK/MWh.

| Reduction of emissions during 09/1999 until 09/2000 | |
|---|---|
| Emission | tons per year |
| $CO_2$ | 7 849 |
| $SO_2$ | 111 |
| $NO_x$ | 3.2 |
| Solid particles | 60 |
| Ash | 5 551 |

## 3. Best Practice: Energy Service Company

**Basic information:**

| | |
|---|---|
| Name of organization: | TAMULT AS |
| Address: | KIVILA RD.12,<br>HAABNEEME, VIIMSI MUNICIPALITY<br>74001 ESTONIA<br>Email: astamult@hot.ee; Homepage: www.hot.ee/tamult<br>Tel.: 372 6090 716; Fax. 372 6090 021 |
| Contact person and title: | JÜRI TAAL, Director |

AS Tamult is a privately owned company found in 1992. There are 30 employees (8 engineers of various specialties: such as mechanics, heat and electrical engineering and automation). They are all graduates of the Tallinn Technical University and have wide experience in their specialty. The welders of the company have licences to weld boilers, pressure tanks, pipes, etc. Other specialists are turners, millers, locksmiths, electrical workers and potters.

AS Tamult operates on 3 main activity areas:

- heat production
- managing of water supply systems
- designing, manufacturing, mounting and repairing of heat equipment and automatic systems.

**Main services**

- Manufacturing of pre-furnaces with a capacity of 0.3 – 10 MW for firing woodchips, sawdust, bark and peat;
- Manufacturing of bio-fuel conveyors and building of automatic bio-fuel storages;
- Designing, manufacturing, installation and repair of automatic control systems;
- Thermal insulation works;
- Masonry and refractory works;
- Selling, mounting, adjustment and maintenance of Danish, Swedish and Latvian hot water- and steam boilers.

**Main achievements**

Since in 1994 one 6 MW boiler was converted to burning woodchips in the boiler house of AS Tamult within the framework of the Swedish EAES project. AS Tamult started active co-operation with the Swedish company SAXLUND AB who had delivered them combustion equipment. The co-operation of companies includes implementation of combustion equipment (grates, fuel conveyers, etc.) and technological know-how of SAXLUND AB in the projects of boiler conversion to bio-fuel combustion, both in the Baltic states and Russia. The main contractor of boiler conversion has become AS TAMULT whose best side includes highly valuable experience as a main contractor, experience in building and operating wood fuelled boilers, long term experience of the work in Russia and Baltic states and reliable relations with sub-contracting builders.

AS TAMULT has won most of the competitive tenders for building wood fuelled boilers and boiler houses where they have participated. Presently about 25 wood fuelled boilers built by AS TAMULT are operated in Estonia, in addition 5 units have been completed in Russia, 5 in Latvia and 2 in Lithuania.

**Problems and difficulties**

Most of the problems for AS TAMULT emerge from the seasonality and wide geography of their activities. The company has won a number of competitive tenders where actual granting of credits for the construction work is extensively delayed. Therefore several projects pile up to be completed promptly and it becomes impossible to keep to the planned internal schedule of the company. So the company can perform certain responsibilities with difficulties and highly qualified specialists participating in the projects are now and then either overloaded with work or having no work at all.

**Main contributors to the success of the company**

The success of a company is directly related to its reliability. Implementation of SAXLUND technology in the projects in Russia and Baltic states has improved the technical level and reliability of built boiler houses significantly. At the same time many sided knowledge of the local situation and good experience in project management have allowed to reach to good results at the price level of 40% lower than that of competitors.

Reliability is even higher due to the availability of exceptionally operative and unconditional guarantee maintenance that can be considered unique under conditions in the Baltic States.

# 4. Energy audit in industry: Study of energy process in the Tarmeko furniture factory

**Basic information**

Tarmeko Ltd is one of the largest industrial enterprises in Estonia. The company is specialized in the production of furniture and saw material. Some key numbers for illustrating the performance of the company:

- The company employs 1500 people today.
- The annual output is 220 mln EEK (= 27.5 mln DM).
- The amount of purchased round beams – 100 000 $m^3$s per year.
- The amount of produced wood waste – 37 000$m^3$s per year.
- The annual electricity consumption – 9 000 MWh.
- The annual heat consumption – 57 000 MWh.
- The company owns a boiler house with two 6.4 MW steam boilers fuelled with wood waste (about 7,000 MWh of heat per year is sold to the municipal DH network). The technology used in the boiler house is obsolete and technological improvements are necessary.

The study was initiated and is coordinated by the OPET Estonia while carried out by the Jyväskyla Science Park Ltd, ELOMATIC OY and Central Finland Forestry Centre (Finland).

**Main project result**

Three alternatives were studied for the company:

**Alternative 1**. Energy production will be continued with the technique based on steam production. The boiler systems and heat distribution systems will be renewed with the minimum investment costs (boilers will be modernized by installing a grate in them). The fuel handling system will also be modernized. For this alternative there is no need to the fuel supply from outside, because wood waste from the sawmill and factory premises provides sufficient supply.

**Alternative 2.** Hot water boiler technique will be introduced for energy production. Heat substations in all buildings will be renewed. The fuel handling system will be modernized. New district heating pipelines will be built, if necessary. All steam pipelines will be closed.

**Alternative 3.** Energy production system will be converted to that of a CHP plant based on a new boiler system. The fuel handling system will be modernized and additional fuel supply from outside will be organized. The heat distribution system will be modernized.

*Table 2 Main indicators of the alternatives*

| | Present situation | Alternative 1 | Alternative 2 | Alternative 3 |
|---|---|---|---|---|
| Boiler house | old boiler | old boiler (renovated) | 13 MW hot water boiler | 12 MW/ 2 $MW_e$ |
| Heat production, MWh/y | 38 370 | 35 632 | 68 777 | 64 860 |
| Electricity production, MWh/y | 0 | 0 | 0 | 9 000 |
| Investment, mln EEK/ mln DM | - | 7.55 / 0.944 | 43 / ~5.4 | 83.95 / ~10.5 |
| Savings of costs compared with present, (mln EEK/y)/(mln DM/y) | | | | |
| Operating costs | - | 2.9 / 0.36 | 3.53 / 0.44 | 0.54 / 0.07 |
| Heat sell and electricity savings | - | 0/0 | 6/0.75 | 10.95 / 1.37 |
| Total savings, | - | 2.9 / 0.36 | 9.53 / 1.19 | 11.49 / 1.44 |
| Repayment period (simple), years | | 2.6 | 4.5 | 7.3 |

**Project time schedule**

| | |
|---|---|
| Feasibility study | 09/1999 - 02/2000 |
| Preparation financial options for the project | 2001-2002 |
| Implementation | 2002-2003 |

**Problems and difficulties**

- CHP solution depends very much on national energy policy and possible changes in the legislation and electricity price.
- Credit guaranties to get loan might be problematic and depends very much on furniture market conditions.

**Success factors**

International actions based OPET network and bilateral co-operation between Finland and Estonia and JI financial scheme should be the main factors to get the best final result for the company.

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# Country Report: Georgia

Climate Technology And Energy Efficiency – Disseminating "Best Practice" Experience

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Climate technologies i.e. energy efficient and renewable energy technologies could play a very important role in the development of Georgia. Although interest has been shown among various actors, only a few projects have been implemented. Some key barriers that have been identified are as follows:

- Relatively small size of the projects, which makes them less attractive to big, international financing organizations (high transaction costs);
- high perceived risks of developing and financing projects in Georgia, leading to high interest rates, short pay-back periods and difficulties in getting access to finance in general;
- weak financial status of the local energy companies and problems in meeting the strict guarantee and collateral requirements of the possible financers;
- lack of experience of the local SMEs to professionally manage and supervise investment projects in the fields of energy efficiency and renewable energy through the development, procurement and commissioning stages;
- lack of an adequate legal and regulatory framework to support energy efficiency and renewable energy investments;
- lack of strategies and master plans at the government level for a long term, sustainable development of energy supply services, by applying integrated resource planning principles;
- low solvency of the population, which in the absence of long term and low costs financing mechanisms promotes the solutions with low investments costs, but higher operation and often also higher life-cycle costs.

Due to the mentioned barriers the implementation of EE projects is possible in most cases only in the presence of grant financing (partially or totally).

## Best practices

## 1. Renovation of heating and ventilation system in Tbilisi Opera House

In 1999-2000 in the framework of the TACIS program the pilot project at Tbilisi Paliashvili State Academic Opera and Ballet House aiming at the renovation of the heating and ventilation system has been successfully implemented.

An architecturally unique building, the Opera House faced a huge heating problem. The ongoing energy crisis in the country has clearly revealed the inefficiency of the heating and ventilation system in Tbilisi Opera House existing before the project, which was designed on a permanent consumption of diesel fuel. (*The boiler house has been built in 1995 and launched in early 1996. Before that Tbilisi Opera House has been connected to the centralized heating system, which is destroyed since 1993*). Because of this, even if the administration of the Opera House could find finance for purchasing of fuel and operate boilers, it was quite cold inside the building including auditorium, orchestra ditch and stage. The government was unable to provide any support and the director of Tbilisi Opera House asked TACIS for assistance.

The pilot project started in December 1999 by carrying out a comprehensive energy audit. Based on results of this audit, the TACIS expert Mr. Mircea ABRAHAMSSON, Project Manager Miss Tamuna ABAZADZE and the Director of TACIS EEC, Mr. Bernard FROELICHER, worked out a technical solution for temperature increase in the auditorium, orchestra ditch, foyers, ballet rehearsal rooms, on the stage etc.

A specific technical solution reversing airflow was proposed for the huge auditorium (for 1100 persons, area 550 m², volume 9900 m³, height 18 m). For stage and orchestra ditch it was decided to heat the space under stage and orchestra ditch, to blow hot air to foyers, to double-glaze windows in ballet rehearsal halls and to propose some improvements for increasing boilers´ efficiency.

A local company, selected on a competitive basis, has performed the installation works. The following works were executed: installation of energy efficient huge air heaters and fans, gas burner for boiler (all the equipment has been delivered from Western Europe); double-glazing on windows, by-pass pipes, insulation etc. The Opera House has been connected to the municipal natural gas network. The municipality of Tbilisi financed and executed gas piping and the company CHEVRON prepaid 180,000-m³ natural gas needed for a whole heating season. The installation works have been finished in October 2000 and on the 9th of December the official inauguration of the new heating system with a special opera performance and a gala concert took place. Besides, a video-film has been shot during works performed.

The new heating system provides heating to the auditorium up to a temperature of +25°C, stage and orchestra ditch +20°C, ballet rehearsal rooms +23°C; nice warmth people find in foyers and wardrobes. Thanks to the energy efficiency measures implemented and energy savings achieved, the whole system keeps warm inside this huge building. Boiler's efficiency has been significantly increased. The ventilation system is quite effective in the summer as well.

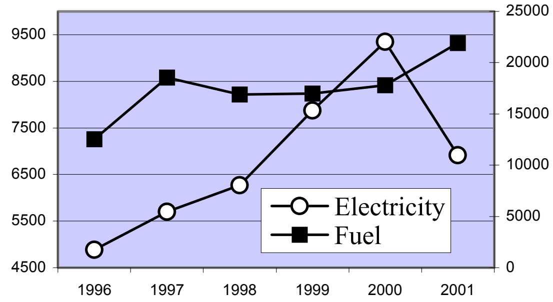
The project has been implemented owing to grant of TACIS Program in amount of 34,142$. In addition the municipality of Tbilisi has spent about 10,000$ for gas connection.

**Economic and environmental benefits of the project**

The old heating and ventilation system was designed for a permanent use of fuel according to Soviet standards that nowadays is pretty expensive compared to fuel prices during Soviet time. Before renovation it was necessary to start permanent heating at least 2 days before (!) performances but heat effect could not be achieved at all – the building was cold! After retrofitting the new heating system needs only 3 hours switching on before the performance.

For evaluation of energy savings, the specific electricity and fuel consumption has been calculated on the basis of 1996-2001 data. Knowing the total annual consumption, and knowing that about 90 performances are given each year, the kWh/performance is simply the division of total annual consumption by the number of performances. Consequently, the heat (radiators, heat water) consumed between performances is integrated in the kWh/performance.

*Figure 1: Specific electricity and fuel consumption, kWh/performance*




As it is shown in the figure, a sharp decrease of the electricity consumption is observed after project implementation. Taking into account that at present the annual amount of performances equals to about 90, annual savings can be estimated as approximately 220,000 kWh or 22,000 GEL (11,000 $). As for the specific fuel consumption, it has increased because in previous years, due to the permanent lack of finances the Opera House was not provided with the necessary amount of diesel fuel. Assuming that (a) the energy demand for heating and hot water has been met in 2001 (the necessary amount of natural gas was gifted by Chevron) and (b) 30% of energy saving was reached in accordance of experts' estimations, the annual energy saving would be equal to 970,000 kWh (80.6 t of diesel fuel – 31,300$).

The annual $CO_2$ reduction due to electricity saving equals to 80 t (national emission factor for electricity generation in winter - 0.365 kg $CO_2$/kWh) and due to fuel saving - 258 tons. Additional 198 tons $CO_2$ emission reduction is caused by the fuel switch. The total emission reduction equals to 536 tons $CO_2$ annually.

For better evaluation of the results of the project, a monitoring during the 2001-2002 heating season has been planned. However the absence of corresponding financial resources makes carrying out the comprehensive monitoring a little bit complicated.

## 2. Installation of a heating system in a residential building by an Energy Service Company

In Tbilisi, capital of Georgia, the central heating system is destroyed since 1993. The objective of the project was to replace (or rebuilt) this central heating, but at the residential building level. For the pilot project, a 40-flat residential building has been selected, in which the owners of 24 apartments agreed to install a new heating system.

The new system consists of a new high quality gas boiler, new pipes and radiators, because the use of the existing old system would create more problems than advantages.

The installation of the heating system in selected flats was performed by the assistance of a TACIS project that financed equipment and manpower. The total cost of project amounts to 35,350$, among them a 34,000$ grant provided by TACIS and the rest was covered by the owners – for getting an ecological license, connection to the municipal gas network and internal facing of garage, where the boiler has been installed etc. The duration of the installation (1 year) was longer than scheduled due to some difficulties with the contractor. The boiler installed for 24 flats (around 80 m$^2$) is a 185 kW De DIETRICH 307; the burner is an ECOFLAM Dual 3P (combined gas and fuel), 83 cast iron radiators totaling 740 sections, and the relevant pipes. A 5000 liters fuel tank gives security in case of shortage of gas.

This first experience gave the opportunity to check all the difficulties of this business. Initially it was planned to finance the full installation and get the financing back through an ESCO on a monthly payment basis during 7-12 years. But in Tbilisi such company did not exist by that time. Therefore the 24 end-users have been asked to create an association, elect a president and manage the operation of the heating system.

Technical problems can be divided in two parts: relatively simple ones, related to the determination of the boiler capacity, distribution of pipes etc., and more difficult ones conditioned by slight modifications in the buildings to install pipes and radiators (some apartment-owners refusing heating also refused to install vertical bi-pass pipes in their flats). This led to an enormous delay in implementation and a first consequence was that it was not possible to heat during the winter 2000/2001.

Organization issues appeared more difficult and important. For instance, according to local regulations it was necessary to put the gas fired boiler outside the building. This led to sophisticated problems with owners of the garage in the yard, with the town-architect, firemen, Ministry of Environment etc. All these questions have been also solved, but motivated a lot of meetings, public explanations, and - sometimes - hard discussions between neighbors.

Finally, the boiler was installed in the yard, in a private garage that has been given to the Association by his owner (free of charge). This boiler is mainly gas fired but with a dual burner in case of gas shortage; the security given by the fuel reserve is about 1 month.

As this experience is brand new and the first one in the country, the principal success factor is that the customers agreed to create an association, to vote for a president and to pay the fees. All other classical indicators will be evaluated after one year of experience.

The main difficulty was to convince people to create an association and to believe in their neighbors and give them confidence. Other problems were linked with corruption and unpredictable anarchical behavior of contractor, inhabitants and relevant public services. Mainly, the anarchical behavior of the contractor leads to the suppression of the creation of an ESCO, which was scheduled at the beginning as an important part of the system. Without ESCO, it is not possible to put in operation the process of investment and reimbursement of the loan. This is not very important in the present pilot project, because the investment made by TACIS could be never be reimbursed, but it is damageable for the ESCO because the potential company lost a first possibility to create a revolving fund. Moreover, without ESCO, the Association of Users must collect money and pay cash each expense that occurs: paying insurance, buying the fuel reserve, eventually pay consequences of a technical incident and especially potential water damage.

Never mind, this pilot project is very encouraging because all neighbors want to have the same heating, so there is already a new pilot project scheduled, 10 times more important as a first follow-up, and the effective creation of an ESCO, which will take in charge all the exploitation questions for the future big project, as well as the creation of a revolving fund.

If this second more significant pilot project turns out to be a success, it is already scheduled to continue with new projects of 1000 flats each, which will be financed by private Western and Georgian banks.

As for domestic replication, the success is already 100% and for international replication, conditions in Georgia are so specific that it is a little bit difficult to extend this kind of project to other countries without sound study for each application.

Finally, comparing to other projects this district heating projects needing huge investments at country level, it seems that a more simple attack of the market at the level of 30 to 50 users could be more successful.

## 3. Construction of small-scale biogas installations in rural areas

Securing energy supply in the rural areas of Georgia is a very important task. In most cases firewood serves for the rural population as the only available energy resource. The increased use of wood on its turn leads to uncontrolled forest felling. Therefore the development of local energy resources is of great importance. Biogas production from domestic animal manure (live-stock, pigs, poultry) could play a significant role in the solution of the mentioned problem.

BIOENERGIA Ltd. has about 10 years experience in development of biogas installations (methane-tanks) in Georgian environment. Different programs of international donor organizations have supported research and design activities. First **successful** biogas installations have been constructed in the framework of the WB program in 2000-2001. This program included construction of four pilot installations, among them 2 by BIOENERGIA Ltd.

The main problem for an all-the-year-round efficient operation of biogas installations in Georgia is that a soil temperature above +15$^0$C is observed only 6 months a year. Therefore special attention had been paid to the thermal insulation.

After selection of individual farms in TERJOLA district (about 200km from Tbilisi to the West) specially to the local conditions adapted methane-tanks have been designed. For one of them the installation of an additional heat source – a solar collector - was planned. After completion of the engineering design in August-December 2000 biogas installations have been constructed and launched (01/ 2001).

Unfortunately monitoring and evaluation of the project have not been executed at the necessary level. It was only fixed that the daily production of biogas even in the winter exceeded 2 m$^3$. In summer, it is 2 or 3 times more.

The total cost of two biogas installations (volume of each – 7m$^3$) amounted to 1800$; 1500$ were provided by the WB program and 300$ by BIOENERGIA Ltd. In addition, farmers provided manpower free of charge during the construction.

The successful operation of this pilot biogas installations has increased the interest of other neighboring farmers in construction of similar installations. The importance of this project is conditioned also by the fact that it can be easily replicated for neighboring areas (for other regions of Georgia with different climate, additional investigations and fieldwork would be necessary). But unfortunately, due to the low affordability of the population in rural Georgia, especially in rural areas, and because of limited access to the small-size crediting, makes the development of biogas production at the necessary level problematic.

This project represents “best practice” from the point of view of public awareness rising and disseminating experience gained. The brochure on recommendations for construction of biogas installations has been published [1] by the authorship of the president of BIOENERGIA Ltd., designer of biogas installation, Mr. A.BITSADZE with financial support of TACIS. Along with general information (development history, biogas parameters, potential of biogas production for different animal manure etc.) design drawings and detailed photographic material (65 photos showing all the steps of construction of pilot installations) are presented.

Supposing that a biogas installation is able to give permanently 3 $m^3$ of biogas each day, this leads to a yearly production of about 1100 $m^3$. The methane component is 550 $m^3$. Taking into account methane density of 0.71 kg/$m^3$, methane production will be 390 kg. This amount of methane would be emitted in the atmosphere in absence of biogas installation, i.e. 0.39 t methane or 9,555 t $CO_2$ equivalent emissions are avoided. The specific heat of biogas is approximately 22.5 MJ/$m^3$. Annual bio-energy will reach 24.75 GJ. This energy, produced by biogas combustion, provides 0.757 t C (emission factor of biogas - 30.6 t C/TJ) or 2,776 t $CO_2$. The same amount of energy produced by kerosene provides 0.485 t C or 1.779 t $CO_2$. Total emission reduction equals to 9.555 + 1.779 – 2.776 = 8.558 t $CO_2$ equivalent

The cost of this gas is presently in Georgia 0.125 \$/$m^3$. The yearly income is 125\$. For a pilot investment of 900\$, the rough payback return is 7.2 years. This value is only an indication because, on one hand the price of a bioreactor must strongly decrease with the number of equipment manufactured, and on the other hand the real production in cubic meters per year must be known precisely.

Besides these questions, very important side effects are already known:

- To improve insulation, special bricks are in process of development. These bricks will have a coefficient of transmission 20 times better than the bricks usually used for construction in Georgia. These new bricks could be used for insulation in the future construction; this will lead to a decrease of energy at the household level.
- Generalization of bio-reactor using manure will decrease the emission of methane. This will be computed when the exact production of a bioreactor is known.
- Generalization of bio-reactor using manure will protect the underground water against pollution.
- Bio-reactor using manure produces clean fertilizer for farmers. This also makes savings for them.

The considerations above are not presently priced. So, it is difficult to know exactly the payback return for bioreactors. More over, for the farmers, it is necessary to put in operation a creative system of finance. This is the follow-up of this “best practice”, which is only at its beginning.

## 4. The use of geothermal energy potential for hot water supply in the Saburtalo pilot district

This pilot project has been prepared (but not implemented yet) on the basis of UNDP/GEF Government of Georgia project “Removing Barriers to Energy Efficiency in Municipal Heat and Hot Water Supply in Georgia“ (PDF-B Grant), implemented in 1999-2000.

The pilot project is prepared for Saburtalo district of Tbilisi and in its development besides UNDP/GEF National Agency on Climate Change, Geothermia Ltd., Ministry for Fuel & Energy, Ministry of Building and Urbanization, Municipality of Tbilisi were involved.

Implementation of this project will generate benefits: firstly $CO_2$ emission reduction, part of which can be used as credits and secondly the use of local geothermal recourses instead of imported natural gas. In the project increase of thermal water capacity (geothermal energy potential) in Lisi thermal water deposit (very close to Saburtalo district) is planned by creation of the Geothermal Circulation System (GCS) in the Middle-Eothen thermal water horizon on the basis of existing wells and artificial increase of the productive wells’ debit by compulsory pumping up of water using sunk pumps and re-injection of waste geothermal water.

At present there exist six productive wells, the total capacity of which equals to 167 $m^3$/h. The main flow of this amount is delivered to the communal sector of Vake and Saburtalo administrative districts of Tbilisi for hot water supply. Thermal water is supplied during the whole year.

The prime cost of delivered geothermal water is 0.13 GEL/$m^3$ and its selling price is 0.32 GEL/$m^3$.

The average payment is estimated as 20%, although it should be mentioned that in those areas where the water is supplied systematically with relevant temperature the payment is about 80-100%.

In the III micro-district of Nutsubidze Plateau, which is also supplied with geothermal water, a public organization “III micro-district” is founded. The responsibilities of this organization includes the collection of total communal taxes, among them the geothermal hot water fee. 20 buildings (3000 residents) of this district are supplied with hot water.

In the other districts commissioners are selected (and agreed with the residents) by the hot water distributor company in each building. The commissioners are supplied by hot water free of charge.

For the construction of GCS 4 existing wells, technical condition of which are rather better than other wells and correspondingly they do not need the significant rehabilitation works, have been selected. For re-injection wells being presently conserved will be used.

The total capacity of GCS equals to 200m$^3$/h of 65$^0$C thermal water; installed thermal capacity would be equal to 10.6 MW in case of re-injection into the well of 20$^0$C water.

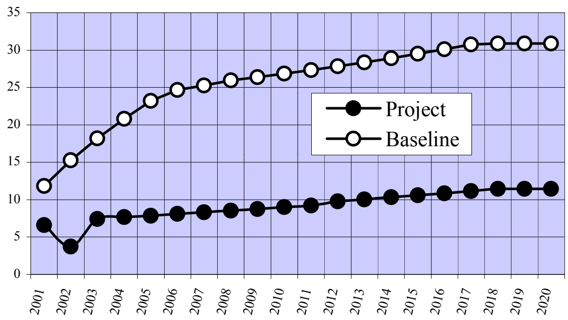
Total investment equals to 3,937,000$ including 1,052,000$ for geothermal energy generation, 1,635,000$ for energy distribution and 892,000$ for energy consumption.

As the next step to the pilot project heat supply by autonomous boilers is considered (investments needed equal to 4,665,000$).

**Environmental assessment**

In case of project implementation the fuel consumption will be reduced, that will abate greenhouse gas emissions in the atmosphere. An estimation of the amount of GHG and other air pollutants during the consumption of different kinds of fuel is possible directly by measuring their average concentrations and indirectly by calculations using accepted methodologies. In both cases, to determine how much satisfies the project its target (GHG reduction), it is necessary to estimate the mitigation of environmental impact. For this purpose the baseline and project emissions have been estimated, which are based on the assumption, that energy demand will be met by the year of 2018 (due to low affordability of the population, it is not met at present) with annual growth of consumption by approximately 5%. The fuel switch is also supposed in energy demand model, in particular it is assumed that every year about 15% of consumers will purchase and install natural gas stoves instead of wood-, electric- and kerosene stoves [2].

*Figure 2: Baseline and project emissions for heating and hot water supply pilot project in Saburtalo, thousand tons*




Total baseline emissions for a 20-year period (project lifetime) are estimated at 513,890 t of $CO_2$ equivalent (including heating by autonomous gas boilers); project emissions at 182,265 t; consequently emission reduction makes 331,625 t of $CO_2$ equivalent.

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# Country Report: Hungary

Selected „Best Practice" Projects and Measures in Hungary

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## 1. Best practice: The case of biomass utilization

The biomass has the greatest potential among the renewable energy sources in Hungary. Despite the favorable conditions the biomass utilization for power production has been very seldom. This short study aims to give an overview of the present situation and tries to find those obstacles that should be eliminated in order to increase the present share of the biomass utilization.

Hungary is quite rich in renewable energy sources, especially in biomass. According to estimations of various experts altogether 477 PJ biomass is available for energy production per year. This can be divided into the following groups:

- Primary biomass (agricultural by-products): 251 PJ
- Secondary biomass (waste of animal breeding): 91 PJ
- Tertiary biomass (waste of the processing): 105 PJ.

The use of the biomass for energy production started in the end of the 1970s in Hungary. In those times several biomass projects received government support. As a result of this more biomass and biogas reference plants were built, but there was no real interest in operating these plants, because the oil prices were very low that time. Because of these reasons the first reference plants were closed quite soon in most of the cases.

The economic transition of the 1990s and the radical increase of the energy prices did not improve the situation basically. Although there are some positive signs for this such as the approval of the *Energy Saving Strategy and Action Programme* in 1999 what allocates financial support for the extended use of the biomass in the energy production.

In Hungary the use of the biomass means first of all the use of the waste wood, woodchips, firewood. The vast majority of this is firewood, 1 980 thousand t/year mainly used in the households. The other significant sector is the forestry and the wood processing industry, they use altogether 420 thousand t/year. The agricultural and manufacturing industry use altogether 150 thousand tons of organic waste per year for energy production purposes. Unfortunately the firing equipment being in operation is rather obsolete. Biomass firing projects applying modern, highly efficient, easily operable and environmentally sound technologies are rather low in number. According to estimations approximately 30 % of the total installed capacity over the 1 MW range can only be considered as representing up-to-date technology.

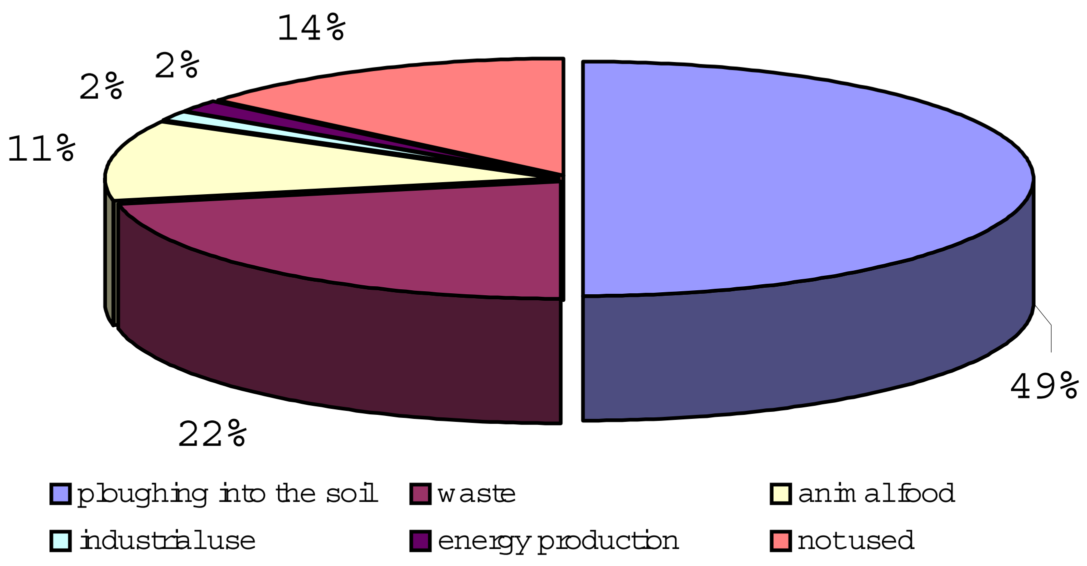
The Figure 1 shows the utilization of the agricultural by-products, and it can be seen that almost half of the total available quantity is ploughed into the soil, and only 1-2 % is used for energy production. Among the biomass-fired plants over the 1 MW total capacity the wood and woodchip dominate in use comparing to agricultural by-products produced also in big quantity.

The other tendency of the last years is that growing of energy plants is on the political agenda. The governmental support of the energy plantations and the use of oil seeds as bio-fuel became quite significant in the last years.

**Projects implemented in the past years**

The projects using biomass for energy production can be divided into two main groups:

*Figure 1: Utilization of the agricultural by-products (according to Zsuffa, 1997)*




- The plant uses its own by-products for energy production purpose. This solution is generally applied, the majority of the existing projects belongs to this group.
- The biomass is purchased by the plant from a contractual supplier and it is transported to the site. This version is not so popular since usually the transportation cost makes the fuel very expensive.

One of the successful projects was the extension of the District heating plant in Tata. The investment was implemented in 1994-95. The main parameters are the followings:

- Old boilers (1986): 2 x 3.5 MW
- New boilers (1995): 1 x 5 MW
- Used fuel: woodchip, wood waste
- Annual consumption: 13 800 t
- Number of heat supplied flats: 1936
- Annual sold heat (1996): 123.661 GJ

Reduction in emission of GHG and pollutants:

- $SO_2$: 23.8 t/year
- $CO_2$: 3280 t/year
- Dust: 13.8 t/year

**Realization problems and difficulties**

- The project became a target of the political debates in the city and some people would have liked to prove that conversion to natural gas could offer a better solution (later the city was connected to the natural gas network).
- The financial situation of the municipalities is rather bad and in this case it was even worse, since it was further loaded with the bank loan for the investment. Unfortunately, the city did not get enough money to perform the necessary energy saving measures connected to this investment and therefore could not step out from this circle. The idea to extend the range of district heat consumers, and to decrease the prices by better utilization of existing capacities was not accepted at all. Like in many other Hungarian cities there is a number of public institutions and houses situated in a few meter distance from the DH pipeline which implemented their own boiler house or individual heating system instead of using the DH.
- Because the transportation cost of the biomass is quite high therefore significant savings in fuel prices cannot be achieved when the biomass has to be transported to long distances. So the present circumstances are not really favorable to the long-term supply contracts.

Finally, summing up the pros and cons, the project was considered by the supporting government organizations and the Danish partners as a successful one.

## 2. Best practice: The case of combined heat and power (CHP)

The first gas engine CHP was installed in Hungary 11 years ago and since that time several investments have been realized in this field mainly in district heating, hospitals, wastewater treatment plants and in some buildings and industrial plants. Until the end of 2000 altogether 61 gas engine CHP were installed in 46 places; the total installed electrical capacity is more than 35 MWe, the thermal capacity is almost 47 MWth. This short study aims to give an overview about the investments realized till this time and tries to estimate the future trends.

The realized investments can be divided into five main groups:

- District heating: The produced heat is sold to the consumers, the electricity is partly for own use and the majority is for the grid.
- Biogas utilization: Use of the biogas produced in wastewater treatment plants and in landfills partly for own electricity supply and partly for the grid.
- Industry: Heat and electricity production for own use and in some cases for selling it to the grid.
- Buildings energy supply: Heat and electricity for own use, frequently for air conditioning in summer (tri-generation).
- Hospitals: heat and electricity for own use.

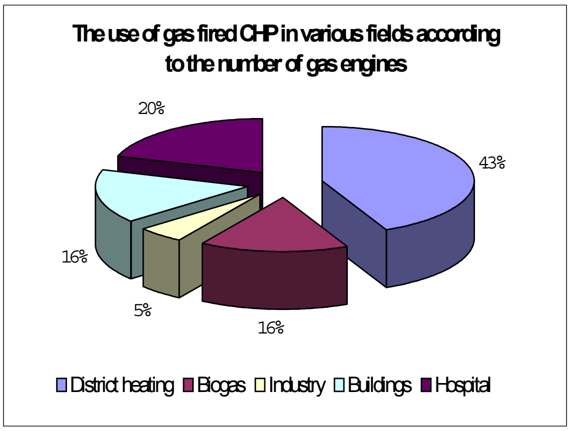
The majority of the investments (60%) was realized in the district heating sector in the countryside, altogether 6 gas engines were installed in the biogas utilization and 7 gas engines in hospitals. There is only one gas engine CHP in the industrial sector in Gyöngyös (implemented in 2 phases in 1995 and 2000) for the energy supply of the local meat factory. In Budapest the CHP is mainly used for energy supply of buildings, and there are some examples in hospitals (4 gas engines) and in wastewater treatment plants (4 gas engines).

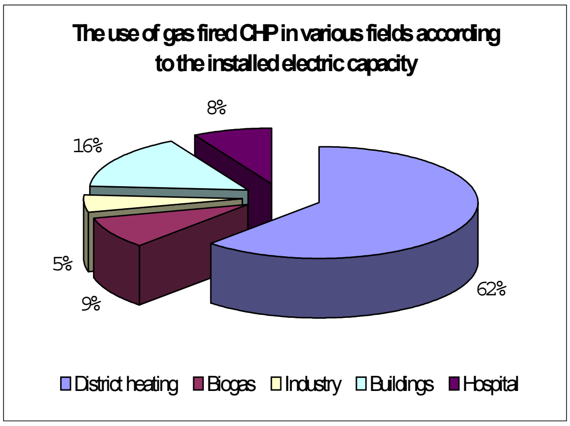
**Trends in the gas engine installation**

In the period of 1989-1994 only 6 gas motors were installed with 1,7 MWe total installed electric capacity. The first real development was in 1995 when 10 gas motors were installed with almost 3,5 MWe electric capacity. In the following two years some decrease was experienced regarding the total investments in this field. The next milestone was 1998 when the number of installed engines reached the 1995 level and in terms of installed electric capacity the development was even more considerable (5,3 MWe). In 2000 altogether 11 gas fired CHP were installed with more than 9 MWe electric capacity. The development is continuous regarding the number of the installed engines and total electric capacity.

Investigating the fields of application regarding the total installed capacity and the number of gas engines the vast majority of the CHP is operating in the district-heating sector. Based on the number of gas engines the hospitals are in the second place (Figure 2:).

*Figure 2: The use of gas fired CHP in various fields*




**Financing of the investments**

Concerning the financing of the investments there are two different solutions, which are the followings:

- The investor (local government, firm, owner of the building, hospital, etc.) uses his own resources or bank loans (commercial loan or preferential loan) and in some cases they use non-reimbursable grants.
- The investor (local government, firm, owner of the building, hospital, etc.) gives the task to a third party includ-

ing the financing. In this case the entrepreneur arranges the project financing (with his own resources or bank loans). There are several examples that the ownership of the project is given to the investor after a certain period (in general 10 years). The third party financing was introduced in 1995 and till this time 30% of the projects were financed in this construction.

**Conclusions**

Comparing the number of CHP installations in Hungary to those in the European Union it can be stated that we have a lot to do in order to increase the investments in this field. As a general trend the present shares of the various sectors will remain the same in the close future.

In Budapest several large real estate investments are expected and therefore it would be very practical to solve their energy supply on the basis of the tri-generation. Based on the present legislation the district heating will remain a dominant part of the CHP investments and this is also reflected in the present projects. In order to increase the present share of the CHP it is necessary to improve the regulatory environment, the institutional background and finalize the process of unbundling.

## 3. Best Practice: Thermal energy conservation in the building sector

**Energy Saving and Energy Efficiency Action Programme**
**The experiences of the first year in the thermal energy conservation**

The Government adopted the *Energy Saving and Energy Efficiency Action Programme* in the end of 1999 and the implementation started in 2000. The program covers the domestic, public and business sector equally and makes possible to realize energy efficiency investments in every sector of the economy. The general objectives of the program are the following till 2010:

- Energy intensity has to be reduced with 3,5% per year;
- Saving of 75 PJ/year (thermal equivalent) primary energy sources;
- 50 kt/year $SO_2$ reduction;
- 5 Mt/$CO_2$ reduction;
- 50 PJ/year renewable production.

The financial sources available for the program in year 2000 were ten times more than in the previous years, so the possibilities for the energy efficiency investments extended dramatically. The tendency for the coming years is that based on the results of the program the Government will further increase the financial sources. This means that for the year 2001 the budget of the program will be five times bigger than in 2000 what means also the extension of the actions for other areas and applying new methods based on the requirement of the recipients.

The *Energy Saving Strategy and Action Programme* itself can be characterized as being an intersectoral “umbrella” type of program covering every relevant sector and being flexible enough to follow the real needs of the recipients. The approval of this new program also required the establishment of a uniform institutional background instead of separated institutions working on similar fields of the energy efficiency. The crucial step in reforming of the institutional framework was the establishment of the new Energy Centre who became responsible for implementation and co-ordination of every energy efficiency related projects and programs.

**Heating reconstruction, additional insulation of residential buildings as part of the program**

This non-reimbursable grant is provided for the population for energy efficiency investments such as the insulation of residential buildings (façades, roofs, cellars, doors and windows) and modernization of internal heat supply systems. Grants can be obtained for 30% of the total investment cost but as a maximum HUF 200 000 per household. The grant is provided for the following objectives:

- Additional insulation or change of the doors and windows (k=1,51-1,8 W/m$^2$K);
- Additional insulation of the walls, roofs and cellars;
- Energy efficient modernization of the heating and hot water supply;
- Combination of the heating reconstruction, additional insulation and changing of the windows and doors.

In the framework of the energy efficiency grant for the households the Centre received more than 500 applications for heating reconstruction, additional insulation and changing of the windows and doors. This covered almost 4000 households and resulted in saving energy of 37, 5 TJ/year PES and the saving of 2,7 kt $CO_2$ emission. The total budget available for this part of the program was HUF

100 million, but the Ministry of Economic Affairs increased it to HUF 150 million since the program was very popular among the people who wanted to modernize their heating systems. The governmental support generated altogether more than HUF 500 million energy efficiency investments on national level.

*Table 1 The results Energy Efficiency Programme in the residential sector in 2000*

| Type of application | Number of applications | Number of successful applications | Received support | Total volume of the investments | Number of the supported households | Total energy saving | $CO_2$ emission reduction |
|---|---|---|---|---|---|---|---|
| | Number | Number | million HUF | million HUF | Number | TJ / year | kt |
| Changing of the windows | 149 | 95 | 14,96 | 53,31 | 1348 | 2,184 | 0,154 |
| Reconstruction of the heating and hot water supply | 181 | 91 | 37,76 | 133,74 | 859 | 17,091 | 1,444 |
| Additional insulation | 144 | 66 | 37,3 | 129,79 | 1259 | 9,086 | 0,688 |
| Combination of the investments | 59 | 40 | 59,93 | 205,11 | 386 | 9,140 | 0,458 |
| **Total** | **533** | **292** | **149,94** | **521,95** | **3852** | **37,501** | **2,744** |

*Source of data: Energy Centre, 2000*

As the figures indicate the most significant energy saving was achieved with the reconstruction of the heating and hot water supply systems. The 25 % of the total available support was allocated to this and finally resulted in almost half of the total savings. The same amount was allocated to the additional insulation but this achieved only 9 TJ energy saving what is only half of the previous result. The application framework supported also the combination of the different investments, this was 40% of the total sum and resulted in the 25% of the total savings.

**Conclusions**

The results of the program were rather good and the program was very popular in the residential sector therefore the Government decided to increase the available support in the next year. This means that in 2001 already HUF 500 million was allocated to this program.

## 4. Best practice: Energy service companies (ESCOs) and third party financing

Third Party Financing exists in Hungary since the mid 1990s and there are already some good examples of successful implementation. In the following a short summary of a third party financing project can be found.

**Preparations for the project**

The MÁV (Hungarian Railways) started to negotiate with one of the Hungarian ESCOs in June 1995, and then received a proposal for the implementation of a joint project in the April of 1996. The contract was signed in the end of 1996 and then after the energy audit of the plant and other preparations the implementation started in 1997.

**The situation before the implementation of the TPF project**

The modernized plant of the MÁV (called MÁV KŐDECO ’96 Kft) was supplied with heat from the Kőbánya Power Plant. The steam was used for technology purposes, heating and hot water supply. The used steam was measured only in one point, therefore special, detailed data of the consumption were not available. The plant paid a considerable amount of fines because of the condensation losses. For a long time it was not possible to measure the real water consumption, therefore they paid after an average consumption. The plant paid the electricity bill based on a special haulage tariff.

**The implemented technology**

The preliminary energy audit examined two alternative versions from technological point of view. The first was the total separation from the power plant and the other was the partial separation when the steam would have been further supplied by the power plant. Finally, based on the negotiations the MÁV decided to separate the energy supply totally.

Because of the low haulage tariff the ESCO could not suggest other solutions for the reduction of the electricity costs. After the modernization the heating supply from the power plant was stopped and a new, separate gas based heating supply was installed. This new heating system ensures the control and the metering requirements in each of the buildings and technologies. The building control (monitoring) system provides the following services:

- Operates the equipment. Starts, stops and regulates them according to the given parameters
- Gives a signal in case of errors and when there is a deviation from the given parameters. The signal can be in printed form, can be a voice in a modem or an alarm.
- A statistical module collects the data of the given parameters.
- Optimize the operation based on energy saving.

**Savings**

There was a considerable energy saving because of ceasing the steam system since this way there was no more pipeline loss and condensation loss. The control (what was missing before) made possible to reduce the heating in the nights and in the weekends. The energy saving can be seen in the following two figures (Figure 3, 4). A considerable energy cost saving was achieved, since the primary energy source (natural gas) is significantly cheaper than the steam. The costs of maintenance also decreased because of the new installations.

**Conclusions**

This project has a reference value from the point of view of the MÁV and also as a TPF project. The implemented technology coincides with the long-term development strategy of the MÁV: This project made possible to indicate real consumption data and based on that to estimate saving potential within the company. From the cost of the savings the MÁV could achieve a considerable development and install a XXI century technology. This project has proved that it is worth implementing this construction in other places since the project can be financed from the savings and a high-level technology can be installed.

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*Figure 3: Energy saving in the MÁV TPF project*

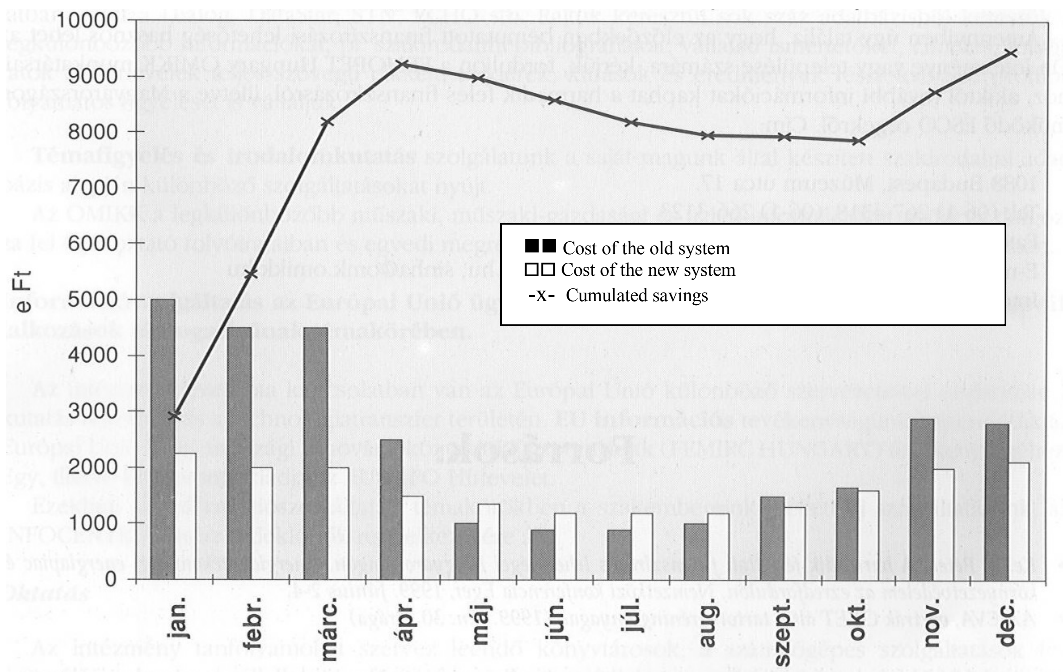
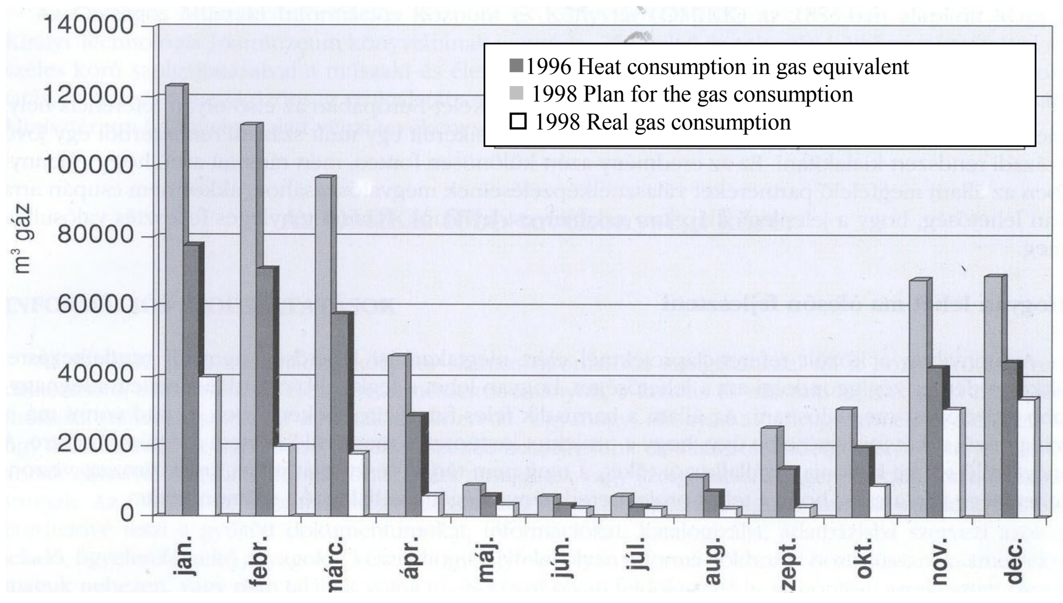



*Figure 4: Energy cost savings in the MÁV TPF project*



# Country Report: Latvia

Selected "Best Practice" Projects and Measures in Latvia

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## 1. Best practice: The case of biomass utilization in Broceni

**Basic information on the project**

The Broceni heat supply solution has been one of the first bio-fuel activities in Latvia. Old, heavy fuel oil (masut – heavy black oil derived from petroleum crack processes), has been replaced by a more environmentally friendly fuel: wood chips, sawdust and sawmill waste.

**Main project components**

During the implementation of the project the heat exchangers have been dismounted in the old boiler house and two new boilers have been erected, one with a pre-furnace for bio-fuels firing for the base load and one natural gas fired boiler for peak load. It is now also possible to supply the consumers with hot water during the whole year. The main contractor has been KMW from Sweden. The installations consist of combustion equipment, automatic fuel storage, fuel handling equipment, flue gas cleaning equipment and heat exchangers. Following are listed the main technical data of the project.

| Item | Data |
|---|---|
| Gas boiler, capacity | VEA UNIVVEX HVSG 5.0 H-6, 5.0 MW |
| Gas burner | Weishaupt G60/2-A, ZM |
| Bio boiler, capacity | VEA UNIVEX HVV 4.5 H-6, 4.5 MW |
| Prefurnace | Inclined moving grates, TRF 4/17 |
| Fuel storage capacity | 220 $m^3$ |
| Main fuel storage capacity | 800 $m^3$ |
| Fuel type | wood chips, 35-55 % RH, Natural gas |
| Bio boiler | 22 500 MWh |
| Boiler plant | 29 000 MWh |

**Main successes of the project**

The project has given good results both environmentally and economically. In Table 1 and Table 2 are shown these features by a comparison between the situation before and after the project implementation.

*Table 1 Environmental comparison before and after the project implementation*

| | | Before | After | | Reduction |
|---|---|---|---|---|---|
| | | HFO | Wood | Gas | |
| Annual heat output | *GWh* | 32 | 22.5 | 6.5 | 3 |
| $CO_2$ | *t/year* | 10,300 | - | 1,700 | 8,600 |
| $SO_2$ | *t/year* | 167 | 7.0 | - | 160 |
| $NO_x$ | *t/year* | 18.0 | 10 | 2.6 | 5.4 |
| Dust | *t/year* | 12.1 | 5.2 | - | 6.9 |

*Table 2 Economical comparison before and after the project implementation*

| | | Before | After |
|---|---|---|---|
| Energy | MWh/a | 35000 | 31500 |
| Steam price | *USD/MWh* | 22,3 | - |
| Biofuel (wood) price | *USD/MWh* | - | 10,7-14,7 |
| Gas price | *USD/MWh* | - | 23,27 |
| Average energy price | *USD/MWh* | - | 15,1 |

**Results, impact, side effects**

The project has been a success not only from an environmental point of view (emission reduction), but economically feasible as well. The new technologies applied and the lower fuel costs have increased the level of comfort for the inhabitants. In addition, this design has been a solution for the surrounding sawmill waste disposal problem.

Ground work, civil works, electrical installations and the assembly have been performed by local companies.

**Realization problems and difficulties**

One problem has been the short time for decision makers, indeed after the cement factory shut down it has been necessary to find a solution in brief time. The municipality has had a fast understanding of the situation and about the importance of an efficient solution.

**Duration and sustainability of the project**

The project implementation, from the tender documentation to the operation phase, has taken 8 months. The life time of the BH is estimated around a 15 years period. The project has a high sustainability given by RES and high efficient energy technology applied.

**Cases of domestic replication**

Following several other bio-fuel projects have been taken off in Latvia. The response has been impressive; the workshop following the project implementation has had many participants. More than 10 projects (in Latvia) have followed the Broceni one.

**Main reasons for project success**

The boiler house in Broceni was built in 1953 and as a boiler plant was used for a very short life period. Indeed after two years of operation the boilers were taken away and the BH was converted into a heat exchanger station. The station was supplied with steam through a 2 km long pipeline coming from the cement factory.

After the collapse of the Soviet Union, the cement factory lost almost all its customers. An additional problem was detected in winter time, when the cement demand sharply decreases, but the boilers has to work in order to supply Broceni with heat and also to keep the masut heated at the combustion temperature. Furthermore, the steam pipeline had large heat losses. In conclusion, the heat price for Broceni inhabitants was very high. The implementation of the project was an urgent need that the municipality has understand in time.

**Pre-requisites/limits/recommendations for successful replication in other transition countries**

If there is a plant that has been visited, that is Broceni BH, the project shows that easy ideas are often the best practice.

## 2. Best practice: The case of small scale CHP in Adazi

**Basic information on the project**

Adazi is a small municipality where investments in modern boiler house technology using natural gas fired high efficiency and small co-generation systems have been made. The boiler house supplies heat to the public district heating network. The production facilities also produce electricity for sales to Latvenergo. In order to give an idea of the investment made, in 0 are proposed the main economical data. In general the municipality of Adazi is saving € 60 500 per year in heat energy costs.

**Main project components**

The system is located in a building and it comprises one co-generator and two boilers. By means of a heat exchanger the heat is transferred into the district-heating network of Adazi. The thermal power is 3.6 MW. The co-generator produces electrical power with a maximum of 350 kW. This electricity is delivered to the grid of Latvenergo. The thermal capacity of the co-generator is about 2 GJ / h.

*Table 3 Economical data for SSCHP in Adazi*

| | | |
|---|---|---|
| Project development costs | € 92 700 | |
| Capital costs | € 560 000 | Loan 7% |
| Installation costs | € 26 400 | |
| Operational and maintenance costs | 0.01386 € / kWh el | |
| Other costs | € 9 000 | |
| Revenues (estimated) | € 260 000 | |
| Pay back period (estimated) | 5 years | |

The co-generator is designed for ease access and maintenance. The boilers have a capacity of 1725 kW each. In case the circulation pumps of the heating network fail due to a black-out, the co-generator will supply electricity to them. The system is monitored by means of a telemetry system, which uses a dedicate telephone line.

**Main successes of the project**

The introduction of new and efficient technologies as the SSCHP plant in Adazi represents a wave of innovation for Latvia and an aperture towards sustainable energy use; therefore these projects have the effect of transferring knowledge and technology in Latvia, related to introduction of modern energy production systems. The main environment benefit is the reduction of the national emissions and in Table 4 are proposed the main figures. Also the landscape has been improved due the to lower chimney stacks.

*Table 4 $CO_2$ emission reduction (in metric tons of $CO_2$)*

| Year | Baseline scenario | Project scenario | Projected real, measurable and long-term $CO_2$ emission reductions |
|---|---|---|---|
| 11/1997 | 1472 | 750 | -722 |
| 1998 | 5145 | 2602 | -2543 |
| 1999 | 5369 | 2522 | -2847 |
| 2000 | 5188 | 2357 | -2831 |

**Results / impact / side effects (e.g. employment effects)**

The introduction of the SSCHP in Adazi has benefited the consumers expenses, whereas the prime cost upon both hot water and electricity furniture are decreased. Moreover a regular and stable delivery of heat and hot water for Adazi citizens has been guaranteed.

So far, the new plant has delivered around 12 000 MWh per each heating season and figures between 800 and 1000 MWh of electrical power per year.

**Realization problems and difficulties**

The main difficulty encountered has been with Latvenergo for the connection to the grid network and the dealing operation for the electricity tariffs. *(Latvenergo is the Latvian state electricity company.)*

**Duration and sustainability of the project**

Life time has been estimated between 10 and 13 years. This has a high sustainability in relation to rational energy use in cogeneration plants and the high energy production.

**Cases of domestic replication**

The project has had a follow up activity in Lielvarde, where another SSCHP has been made. A big constraint to domestic replication is the problem with the connection to the grid network and for the sale tariffs.

**Main reasons for project success**

Latvia has experienced, caused by general transition processes, a remarkable economic decline between 1991 and 1995. The decline of industry and agriculture has led to a situation where the installed heat generation and transmission capacities in Adazi were much bigger than necessary and therefore were operating below the designed efficiency. Besides, the heat production installations were too obsolete to be eligible for future use. Therefore the Municipality of Adazi has decided to outsource the heat production.

In 1997 the Council of Adazi has entered into a “Heat Energy Supply” agreement with the company Essent Baltic (Edon Latvia). This agreement has set terms and conditions under which Essent Baltic has to operate and maintain the production of heat energy and electricity, further terms and conditions for heat energy supply and purchase. The agreement has 15 years duration time.

**Pre-requisites / limits / recommendations for successful replication in other transition countries**

The main recommendation is a good awareness about the connection obligation. In free market economy there are very good possibilities, while in cartel and monopoly economy conditions for tariffs and connection have to be carefully analyzed.

# 3. Best practice: Thermal energy conservation in the building sector in Latvia. Audits. Tools. Monitoring

Three different projects are briefly described for thermal conservation in buildings. Each project addresses a particular topic that taken together make a coherent policy, as:

- Energy audit
- Tools
- Social Monitoring

**Basic information on the projects / policy**

**Audit in schools and a hospital in Ventspils**

The aim of the energy auditing in Ventspils municipality has been to set the priorities for energy efficiency measures, according with the technical situation of the buildings where the schools and the hospital were. The project has shown that it was possible to save between 24% and 42,6% of heat energy. Then the project implementation has provided several recommendations, elaborated from measurements, technical calculations and data gathered, for to improve the energy situation of the buildings. After that the schools have obtained a loan from the World Bank.

**Tools, computer aids for optimization problems**

After energy auditing, as down stream activity, consumption of dwellings and optimal set of energy efficiency measures, as upstream activity, are the main concerns for energy conservation in buildings. Given the vast amount of data, the upstream part is made by computed aids, and a dedicated software tool, Māja ©, has been employed *(in English, the Latvian word Māja means house. Māja has been developed from Andra Blumberga and it is currently used and owned by Ekodoma, Ltd.).*

This software is a quasi-static, one zone optimization model, which uses two optimization criteria: equivalent annual net cost and $CO_2$ emission reduction. Māja is a particular design for Latvian conditions (weather, buildings materials, etc.).

Tool Māja has been already used in Kuldigas, Ventspils, Riga and Aizkraukle, by achieving outstanding results and optimal solutions.

**Social monitoring in Ludza municipality**

In the framework of the PSO program of the government of the Netherlands, energy efficiency increasing measures have been carried out in two dwelling houses in Ludza municipality. Heating substations have been repaired, risers have been balanced, circulation pumps have been installed, windows have been partly replaced, the ventilation system has been partly repaired and thermostats have been installed in order to regulate the temperature in the rooms. Social monitoring has been implemented following five steps:

- Preliminary investigation phase, questionnaires have been provided in two dwelling buildings before the reconstruction project.
- Data processing.
- Workshops and meetings, presentation and discussion about the earlier results.
- Second investigation phase, collection of further information from municipality and by direct meetings with the inhabitants. Inspection of the buildings after the reconstruction.
- Final data processing.

As general conclusion from the social monitoring, the inhabitant involved are now more conscious about the important meaning of energy efficiency and savings. A great part of the recipients have affirmed that they will implement further energy efficiency measures in their flats.

**Main successes of the project / policy**

Energy audit, tools and social monitoring have a common success, they all increase the awareness of the recipients about energy efficiency and energy savings, with a positive feed back for implementing new energy efficiency measures.

**Realization problems and difficulties**

The main problem are the financial resources for this policy

**Sustainability of the project / policy**

Energy efficiency in building is directly connected to sustainable buildings and therefore with a high sustainability

**Cases of domestic / international replication**

Tool Māja has been object of several local and international offers.

**Main reasons for project / policy success**

In Latvia, many buildings have been constructed with former USRR standards and regulations with low concern for energy efficiency and environmental issues. Therefore, Latvia is faced with a general bad situation in energy consumption in buildings. Furthermore, energy inefficiency in a building denotes less comfort for its tenants. Social monitoring and the demand side management meet consumer needs with market conditions and project objectives.

Often, project realization is endangered by insufficient information for recipients concerning the objectives, their gains and reasons for implementing certain measures.

Social monitoring is a method that allows to understand changes in people's attitude following some process execution. Thus, social monitoring supplies answers about as how to implement better certain measures and what kind of preliminary deeds are necessary. Social monitoring is meanwhile a sort of information dissemination practice that, in this case, divulges information about energy efficiency measures.

**Pre-requisites / limits / recommendations for successful replication in other transition countries**

As in Latvia, this kind of projects can be implemented in all the transitional countries where buildings have similar conditions.

## 4. Best practice: Energy service companies (ESCOs) and third party financing in Latvia

**Basic information on the policy**

The transitional economic situation in Latvia supports the initiation of new activities in the field of energy and recommendations on energy efficiency, as well as environmental policies. A special interest is concentrated upon the financial and economical measures, which can promote the implementation of projects like CHP, district heating and other projects concerning energy efficiency.

The overall risk factors of energy projects is minimized by rigorous technical and economic appraisal at the feasibility stage or by using innovative financing strategies, such as third party financing or Energy Supply Companies (ESCOs), to by-pass the risk through a more specialized operator.

In accession countries like Latvia exists a high demand for investment in energy efficiency measures and small-decentralized energy plants. In order to explore the full energy and cost saving potential, the involvement of private capital is needed. Third Party Financing is a frequent concept that ensures the involvement of private capital. This concept is usually implemented by Energy Service Companies (ESCOs), and has been already employed on a broad scale throughout the European Union.

Direct foreign investments play an important role for facilitating the development of the national economy. Indeed, besides that they provide additional external funds they also introduce advanced technologies and new equipments. Co-operation with international financial institutions and direct foreign investments brings a substantial enhancement to the national economy in addition to national sources.

**Main policy instruments**

Energy service companies work following three financial alternatives, where the third one is a combination of the other two. These alternatives are here listed:

- Payment for energy service, for example the typical scheme includes energy produced and supplied. (most popular in Latvia)
- Payment from energy saved, for example an ESCO realizes several energy efficiency measures and the payment comes from the consequent money savings (one project has started a few weeks ago for efficient lighting in a sport hall).

**Main success of the policy**

A small scale CHP in Lielvarde has been a big successful case, following ESCO financial scheme. Now the municipality is saving about € 14 000 per year in heat energy costs. Moreover the quality of the service has extremely incremented. In this case payments are achieved by a combination of payments from both energy saving and energy services.

**Results / impact / side effects**

Using Energy service companies and third party financing it will be possible to implement several energy projects, which otherwise would not take off. The example of Lielvarde epitomizes these concepts and now the municipality benefits from the project results.

**Realization problems and difficulties**

TFP and ESCO are commercially viable in Latvia. Nevertheless very few companies have tried to act as ESCOs. On the other hand, those that have attempted, have found big difficulties to convince clients, mainly due to their lack of information and knowledge. Further, other important problems and barriers are: there are no models for performance contracting (PC), there is not a clear legislative background, an unfavorable ratio between the project development costs and the possible benefit from the project for the private investor, and the transaction costs and risks are considered too high.

**Sustainability of the policy**

The use of TFP and ESCO is addressed to EE projects and therefore towards sustainable development.

**Cases of domestic / international replication**

At the moment there is only a high potential for domestic replication, on the other hand TFP and ESCO have been already employed on a broad scale throughout European Union.

**Main reasons for policy success**

This policy allows to explore the full energy and cost saving potential, to minimize the overall risk factors of an EE project through a more specialized operator (ESCOs), and to find financial and economical supports.

**Pre-requisites / limits / recommendations for successful replication in other transition countries**

It is important to deeply explain the concept of TFP because often the mechanisms behind are not understandable to everybody.

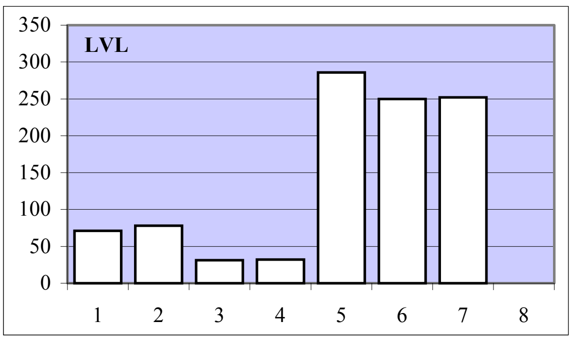
## 5. Best practice: Rational electricity use for lighting in bakeries in Latvia. Benchmarking.

**Benchmarking, energy audit for Latvian bakeries**

An energy audit in bakeries was part of a program for energy saving in food industry, financed by the Danish Energy Agency and The Netherlands government. Audits in eight bakeries have been made for working out a set of measures for energy savings and costs reduction. The energy audit was on energy efficiency measures and especially focused on the lighting.

**Basic information on the selected policy**

*Figure 1: Investments in EE lighting measures (1 LVL= 0,568 €)*



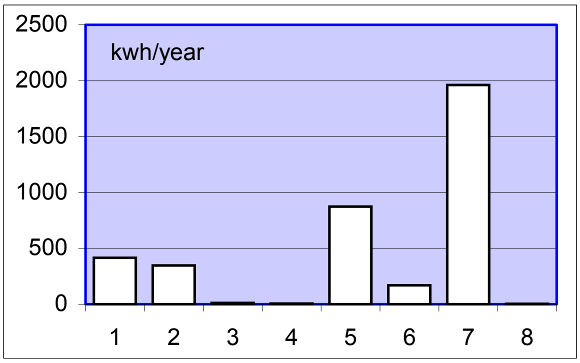

The first project using benchmarking methodology and a final workshop have allowed to compare energy consumption in eight bakeries over the Latvian territory. It has been detected that the electricity consumption for lighting of the eight bakeries was higher than in Denmark and The Netherlands. Only in one bakery data were comparable. In figure 1 are shown the investments held in each of the eight bakeries for efficient lighting.

**Main project policy instruments**

The benchmarking, deriving from the energy audit carried out in the bakeries, includes several recommendations:

- switching off all sources of light not necessary;
- regulate lighting corresponding with needs;
- use energy efficient lamps and ballasts;
- use appropriate sources of light;
- use surface tones that are favorable for lighting;
- use daylight;
- clean lighting sources regularly;
- long-term investments in energy efficiency measures.
- select places where the largest economy can be obtained ignoring EE measures that give small energy economy;
- point to obvious EE measures;
- sometimes ignore EE measures if more detailed analysis is needed for defining them.

*Figure 2: Reduction of electrical energy consumption due to lighting measures.*




**Main success**

The main success is represented for the potential savings deriving from efficient lighting. The histogram in figure 2 gives an outline obtained from the analysis made over the eight bakeries. Savings between 100 and 2000 kWh per year have been achieved. These data highlight as lighting has to be taken into account when energy efficiency measures are undertaken.

**Results / impact / side effects**

Management level and decision makers get aware about energy efficiency and efficient lighting. They know about the possible range for energy savings, they just have to implement the measures.

**Realization problems and difficulties**

Often lighting, if compared with other energy efficiency measures (like investment in new technologies), is considered and only rarely there are resources for this subject available.

**Duration/follow-ups / sustainability of the project / policy**

High sustainability as energy efficiency measure.

**Cases of domestic / international replication**

There is a high possibility for replication, in particular if the entire food industry is going to be involved.

**Pre-requisites / limits / recommendations for successful replication in other transition countries**

Everybody interested can implement efficient lighting projects, the results are good. ESCOs can be as well used. Benchmarking does not have any negative feed back.

# Country Report: Lithuania

"Best Practice" Projects and Measures in Lithuania

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**Vygintas Jarašunas**
Energy Efficiency Center
**Dr. Romualdas Škema**
Lithuanian Energy Institute

## 1. Thermal energy conservation in the building sector

### Project No. 1: Energy Efficiency Pilot Project in Lithuania: Residential part

**Objectives**

- Support private initiatives to improve residential energy efficiency;
- support the privatization of housing, enabling increased private initiatives in housing maintenance.

**Financing**

Out of the US$ 10 million World Bank loan, US$ 5.3 million was allocated for implementation of energy efficiency measures in residential buildings. The Lithuanian government agreed to provide 30 percent matching funds. The Danish Ministry of Housing and Urban Affairs and the Dutch Ministry of Economics provided the core technical assistance funds.

**Organization**

In order to advance the Lithuanian banking system, residential loans to the final beneficiaries (homeowners' associations and owners of individual houses) were extended via local commercial banks. The Housing and Urban Development Foundation was selected as the project management unit. Five regional advisory centers were established in 1997 and 1998 to provide advice to homeowners on technical, financial, organizational and legal issues. The advisory center staff also carried out public information activities and assisted homeowners' associations in various phases of the EEHPP project.

**Project components**

- Provision of loans for technically and economically attractive packages of energy efficiency measures;
- introduction of the concept of long-term lending for housing improvement to the commercial banking sector;
- development of energy consulting services.

**Success indicators**

Disbursement of the allocated funds, energy savings in renovated buildings, increased awareness on energy efficiency issues, developed energy consulting services.

**Results**

As of July 1, 2001 211 associations and 26 individual homeowners signed 260 loan agreements for the whole allocated amount. Technical monitoring of 96 implemented projects revealed comfort adjusted heat savings of 23 percent in average. An average simple payback period for the monitored projects amounts to 7 years. Due to high cost-effectiveness of investments around US$ 2.4 million of the extended loans were already repaid instead of the scheduled $ 1.5 million, as of September 1, 2001, with no defaults. Total annual savings in 211 renovated multifamily buildings would amount to 23 GWh worth some US$ 750,000 at the current heat tariffs. With Dutch and Danish support 150 individual consultants were trained of which around 20 were given an opportunity to work on the project. They prepared more than 300 energy audits and investment proposals. Conducted social surveys indicated increased awareness on energy efficiency issues. As result, more than 700 homeowners associations were involved in the project activities.

**Realization problems and difficulties**

- Lithuanian commercial banks lacked sufficient knowledge about the residential market for home improvement loans;
- households lacked experience dealing with the commercial banks and using bank loans for higher volume investments;
- in the absence of mortgage, technical and financial risks associated with multifamily building renovations should have been partly mitigated by professional energy audits and thoroughly prepared investment projects, however, prior to the project commencement there was very limited understanding of the feasibility and savings potential of various energy efficiency measures in Lithuanian residential buildings and the capacity of local energy consultants was rather limited;
- homeowners' associations were very diverse in their sizes, performance and capacity to carry out building renovation tasks and implement energy efficiency measures, therefore significant support was needed to enhance household confidence in energy efficiency measures and support them in all stages of the project implementation.

**Sustainability of the project**

The project created a mechanism for renovation of multifamily buildings with developed institutional infrastructure and workable legal framework. Future sustainability will depend on successful transition from the state supported to solely private financing of energy efficiency undertakings in the residential area. More will have to be done in reducing transaction costs, streamlining processing procedures and finding credit enhancements designed to attract local commercial lending to this market segment. For the next few years the involvement of multilateral financial institutions could help to bridge this gap.

**Cases of domestic and international replication**

Experience and lessons gained during the implementation of the Energy Efficiency Housing Pilot Project were used for similar undertakings in Latvia and Estonia.

**Main reason for project success**

A well tailored legal framework allowing homeowners' associations to obtain bank loans without mortgaging individual apartments thus reducing transaction costs and household reluctance;

- affordable financing of energy efficiency improvements that consisted of the long term loan and the state grant;
- comprehensive institutional support for homeowners via regional advisory centers;
- expanded and improved services of local energy consultants which ensured positive results of implemented renovations;
- enhanced public awareness on energy efficiency opportunities in residential buildings and benefits offered by the project. Only synergy of all those stakeholders ensured success of the project.

**Recommendations for successful replication in other transition countries**

Designers of similar undertakings in other Eastern and Central European countries should explore all potential bottlenecks in their countries, be it low awareness, legislative hurdles, high transaction costs or insufficient capacity, and then plan a set of measures that could address all those problems. Any barriers, if not addressed properly, could obstruct development of the whole process.

## Project No 2: : Energy Efficiency Pilot Project in Lithuania: Municipal part

**Objective**

Support municipal initiatives to improve energy efficiency in public schools.

**Financing**

Out of the US$ 10 million World Bank loan, US$ 4.7 million was allocated for implementation of energy efficiency measures in public schools. The total investments including municipal funds amounted to approximately US$ 5.9 million.

**Organization**

In order to lower the borrowing costs, municipal loans were channeled to the final beneficiaries via the Ministry of Finance. The Housing and Urban Development Foundation was selected as the project management unit.

**Project components**

- Provision of loans for technically and economically attractive packages of energy efficiency measures;
- support for municipalities in the energy efficiency rehabilitation of public schools.

**Success indicators**

Disbursement of the allocated funds, energy savings in renovated buildings, enhanced capacity of Lithuanian municipalities to implement energy efficiency projects.

**Results**

As of July 1, 2001 43 schools and 10 kindergartens from 12 municipalities were renovated. Close to 27 thousand pupils were impacted by the project. The Housing and Urban Development Foundation organized 4 seminars for the staff of participating municipalities and 1 seminar for involved energy consultants. The HUDF staff also assisted municipalities in various phases of the school renovations. Technical monitoring of 18 implemented projects revealed actual average heat savings of 24 percent. Indoor temperatures in renovated buildings increased by 4 degrees centigrade. An average simple payback period for the monitored buildings amounted to 12 years.

**Realization problems and difficulties**

- Lack of experience of municipalities with the World Bank procurement procedures;
- lack of experience of energy consultants and contractors regarding feasibility and savings potential of various EE measures in Lithuanian public buildings.

**Sustainability of the project**

The project enhanced the capacity of Lithuanian municipalities to implement energy efficiency projects. Future investments in energy efficiency of public buildings depend on the financial capacity of municipalities (budgetary funds and borrowing limits) as well as on availability of alternative financing mechanisms, such as the third party financing or master lease.

**Cases of domestic and international replication**

Experience and lessons gained during the implementation of the municipal part of the Energy Efficiency Housing Pilot Project were used for preparation of a public school renovation program implemented in 2001. The Municipal Infrastructure Development Program funds were used to implement energy efficiency measures in 120 schools located in all 60 Lithuanian municipalities.

**Main reason for project success**

- Affordable financing of energy efficiency improvements;
- comprehensive support for participating municipalities;
- well coordinated efforts of the implementing agency, the World Bank, the Lithuanian Ministry of Finance, the participating municipalities and private contractors and consultants.

**Recommendations for successful replication in other transition countries**

Sufficient capacity of participating municipalities is essential for success of similar undertakings in other Eastern and Central European countries.

## 2. Rational energy use in industry.

**Vygintas Jarašunas**

Energy Efficiency Center

### Project No. 3: Recommendations for improving energy efficiency in the Lithuanian industry

**Objectives**

To estimate the energy consumption divided into electricity and heating consumption for each trade and energy technology; to give more detailed overview over energy saving potentials in the Lithuanian industry.

**Project organization**

The project was financed by the Danish Energy Agency and carried out by Danish and Lithuanian experts. The structure, composition and energy consumption of Lithuanian industry has been stated from Lithuanian statistics, industry and energy department of Ministry of Economy. Each trade has been considered with regard to the financial circumstances of the companies, commercial outlets and investment level necessary for becoming a competitor in an international market. On a weighted basis the companies were selected from the following industrial target sectors: textiles and clothing; wood industry (wood processing and furniture); food; chemicals and pharmaceuticals; electronics, instruments; construction materials. The selection of the companies has been made to represent the best possible picture of the Lithuanian Industry.

## Results

On the basis of the walk-through energy audits, which has been carried out in 20 different enterprises the energy consumption and saving potential has been estimated. The main figures are shown in the table on the right column.

More detailed energy consumption and energy saving potential in the Lithuanian industry divided into electricity and heating consumption for each trade and energy technology are shown in the table below.

| Electricity consumption (GWh) | Electrical saving potential (GWh) |
|---|---|
| **2850** | **384 or 13,5%**<br>(Pay back period < 5 years) |
| Heat consumption (GWh) | Heat saving potential (GWh) |
| **20260** | **3700** or **21,3%**<br>(Pay back period < 5 years) |

| | Energy in MWh | Electrical consumption per technology | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Electricity total MWh | Compressed air | Cooling | Ventilation | Pumps | Proces blowers | Proces heating | Light | Machinery | | Misc. |
| ***All manufacturing*** | *Consumption-total* | *2.851.825* | ***185.789*** | ***480.682*** | ***184.121*** | ***177.623*** | ***340.694*** | ***391.180*** | ***209.739*** | ***801.137*** | ***0*** | ***80.861*** |
| | *Part of industrial production* | *2.665.719* | ***173.664*** | ***449.313*** | ***172.105*** | ***166.032*** | ***318.461*** | ***365.652*** | ***196.051*** | ***748.856*** | ***0*** | ***75.584*** |

| | | Electrical consumption per technology | | | | | | | % of total consumption | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Electricity total MWh | Compressed air | Cooling | Ventilation | Pumps | Proces blowers | Proces heating | Light | Machinery | | Misc. |
| ***All manufacturing*** | *Consumption-total* | *2.851.825* | ***6,5*** | ***16,9*** | ***6,5*** | ***6,2*** | ***11,9*** | ***13,7*** | ***7,4*** | ***28,1*** | ***0,0*** | ***2,8*** |
| | *Part of industrial production* | *2.665.719* | ***6,5*** | ***16,9*** | ***6,5*** | ***6,2*** | ***11,9*** | ***13,7*** | ***7,4*** | ***28,1*** | ***0,0*** | ***2,8*** |

| | | Consumption per energy source | | | | | | | HEAT consumption | HEAT savings | HEAT savings |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *Total* | Coal | Oil | Natural gas | Other fuel | Electricity | Heat | Total | Total | Total % |
| ***All manufacturing*** | *Consumption-total* | *20.261.127* | *151.211* | *8.142.926* | *2.384.542* | *537.783* | *2.851.825* | *6.192.840* | ***17.409.302*** | ***3.704.917*** | ***21,3*** |
| | *Part of industrial production* | *12.847.591* | *36.872* | *3.186.153* | *960.136* | *183.781* | *2.665.719* | *5.814.930* | ***10.181.872*** | ***2.166.830*** | ***21,3*** |

| | | Electrical savings per technology | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Electricity total | Compressed air | Cooling | Ventilation | Pumps | Proces blowers | Proces heating | Light | Machinery | | Misc. | TOTAL |
| ***All manufacturing*** | *Consumption-total* | *2.851.825* | ***25.682*** | ***60.035*** | ***34.020*** | ***25.015*** | ***63.537*** | ***78.712*** | ***50.563*** | ***46.694*** | ***0*** | ***0*** | ***384.257,0*** |
| | *Part of industrial production* | *2.665.719* | ***24.006*** | ***56.117*** | ***31.800*** | ***23.382*** | ***59.391*** | ***73.576*** | ***47.263*** | ***43.647*** | ***0*** | ***0*** | ***359.181,0*** |

| | | Electrical savings per technology | | | | | | | Estimated % | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Electricity total MWh | Compressed air | Cooling | Ventilation | Pumps | Proces blowers | Proces heating | Light | Machinery | | Misc. | TOTAL |
| ***All manufacturing*** | *Consumption-total* | *2.851.825* | ***0,9*** | ***2,1*** | ***1,2*** | ***0,9*** | ***2,2*** | ***2,8*** | ***1,8*** | ***1,6*** | ***0,0*** | ***0,0*** | ***13,5*** |
| | *Part of industrial production* | *2.665.719* | ***0,9*** | ***2,1*** | ***1,2*** | ***0,9*** | ***2,2*** | ***2,8*** | ***1,8*** | ***1,6*** | ***0,0*** | ***0,0*** | ***13,5*** |

## Realization problems and difficulties

The main impressions from the 20 simple walk through energy audits in industry is that the infrastructure for most of the enterprises is very typical for enterprises that have been static since they were built. That is, the production and distribution of all auxiliary services is done in a centralized manner. Typically, there is no energy management at the enterprises or the knowledge of how to start it. There is no mapping over energy consuming equipment and the documentation in the form of plans and data of the equipment are typically missing or not updated. Many enterprises are connected to district heating systems, which supply steam and heat, but in consequence of decreased production – and thus the need for heat and steam - or conversion to natural gas, the heat losses from poorly insulated pipe systems now account for a greater part of the total consumption. This means, that every kWh consumed at the enterprise becomes more and more expensive. We have seen examples of enterprises which may “raise” the temperature on the hot water by help of steam during the summer. Some enterprises have not even made any attempts to change or reduce the production, e.g. to move the necessary production equipment to one workshop and maybe let out the rest of the buildings. We have seen one example of an enterprise, which only utilizes 1-3% of the total production capacity, another only 20%.

**Recommendations for activities improving energy efficiency in Lithuanian industry**

- Development of scheme of registered energy management consultants.
- Organizing training courses for energy responsible persons from Lithuanian enterprises.
- Awareness campaign towards the industry. Simple improvements, which industries can initiate / carry out themselves;.
- Development of catalogues with trade specific standard solutions, both improving and renewing technology, including operational efficiency and behavior.

## 3. Biomass utilization

**Dr. Romualdas Škema**

Lithuanian Energy Institute

Lithuania has very limited primary energy resources. Although the use of indigenous and renewable energy resources requires significant investments, and energy produced using these resources is not cheap, this will stimulate a local production, reduction of hard currency spending, increase of employment, and reduction of environmental pollution. Therefore, utilization of these resources is preferential.

In 1999 indigenous energy resources (wood, peat, hydro) represented about 8% in the primary energy balance. Their share during the period 1990 – 1999 increased more than 4 times. During the last 5 years the major efforts were aimed at drafting the bio-fuel (wood, straw, biogas).

**Wood**

Wood constitutes a considerable share of local fuel resources. About 30% of the country's territory is covered by forests. As a fuel, not only the firewood can be used but also, certainly, wastes from forest felling, making sparse growth of trees and waste from wood processing industries.

The annual potential of wood fuel amounts to approx. 3 million of solid $m^3$. It consist of 1.4 million solid m3 of wood waste in forest felling places, 0.6 million solid m3 of wood waste from wood processing industries and 1.0 million solid $m^3$ of firewood. If utilized for energy needs, this potential could meet 7% of the country's energy balance.

Practically, there was not a single wood-chip-fuelled boiler 5 years ago in Lithuania, but the support by PHARE program and the governments of Sweden, Denmark and other countries changed the situation rapidly. At present the total capacity of wood-chip-fuelled boilers has reached 160 MW. If heavy fuel oil were burnt instead of wood chips, it would account for 123 000 tons and would entail considerable emissions to the atmosphere: 396 000 tons of $SO_2$, 1000 tons of $NO_x$ and 110 tons of solid particles. In addition to environmental benefit the import of heavy fuel oil would decrease by 11 million USD. Last but not least, a benefit would be the establishment of new jobs for collection, transportation and preparation of wood waste.

The local participants actively engaged in the project are JSC "Kazlu Rudos metalas" (Kazlu Ruda town), "singaras" (Vilnius), the design company "Ardynas" (Kaunas), the Lithuanian Energy Institute and others.

**Straw**

The total production of straw is approx. 4.5 million tons per year in Lithuania. The percentage available for fuel needs is approx. 10% (0.5 million tons) which contribute to the reduction of imported fuel by 1.5%.

According to the RE project the pilot straw-fuelled boilers have been installed in the country in 1997. At present there are 15 boilers of such a type with a unit capacity not less as 0.5 MW, the total capacity being 10 MW. The reduction of emissions, as compared to heavy fuel oil, is 28 300 tons of $CO_2$, 30 tons of $NO_x$, 8 tons of solid particles. Given a 10 MW total capacity of boilers, the equivalent demand of heavy fuel oil is 8 800 tons at the cost of 0.8 million USD. Several Lithuanian companies manufacture the straw combustion equipment. Such equipment is imported from Denmark and other countries too. Furthermore, new straw combustion technologies are also developed in Lithuania and local manufacture of equipment is in progress.

**Biogas**

The sources of organic materials appropriate for the recovery of biogas are steadily produced and renewed in the agricultural technologies and waste treatment plants. The major sources are the manure of animals and waste from food industries. Nevertheless, a profitable treatment of organic waste is possible only in big production companies. The annual energy potential of manure waste from large pig-farming companies is estimated to be 15 million m$^3$ biogas and that of cow and cattle farms 65.2 million m$^3$ biogas. Considering the potential of small farms of individual farmers, extra 7.2 million m$^3$ biogas can be added. Total potential of all farms as mentioned above equals 87.4 million m$^3$ per year or, in energy terms, 0.52TWh.

During the last 2.5 years, 3 demonstrational biogas plants have been installed and are operated in Lithuania, 2.1 MW of total capacity:

- Ethyl alcohol company "Sema" in Panevezys city, biogas plant capacity 1.5 MW, recovering biogas from alcohol and yeast production wastes.
- Waste water treatment company in Utena town, biogas plant capacity 0.3 MW, recovering biogas from waste water sludge.
- Pig-farming company "Vycia" in Kaunas region, biogas plant capacity 0.3 MW, recovering biogas from pig manure.

The main of these demonstration plants is the biogas plant in the pig-farming company "Vycia" The project was performed during four years between early 1996 and early 2000. The main purpose was to demonstrate the prospect of modern Danish biogas technology and to transfer the technology to Lithuanian enterprises for further market development. Danish biogas technology was transferred by the Danish Folkecenter for Renewable Energy. The total project budget is 4.44 million DKK, the simple payback time is between 4 and 4.5 years. The total Danish public funding was 3.8 million DKK.

The primary result of the project was the projecting, installation, implementation, and initial operation of a biogas plant with the aim to supply the farm with electricity and heat.

The Vycia farm has been supplied with electricity from the Ignalina nuclear power plant. All heat consumption, including heating of the stables, has been covered by electricity. The total annual electricity consumption at the farm has been 3 700 MWh; 2 300 MWh or 62% has been used for simple heating and only 38% for electricity. In the farm PP were established 2 cogeneration units of 110 and 75 kW; in total 185 kW electrical power and twice as much kW of thermal power.

The project was successful, and it is hoped that this demonstration project will be the starting point of a large-scale biogas development in Lithuania.

After implementing the renewable energy projects, Lithuania reduced its heavy fuel import by 140 000 tons and saves about 12.6 million USD. The release of emissions is reduced as well (compare table below).

*Current state of implementation of renewable energy projects and their impact on reduction of emissions.*

| Sort of RES sources | Rated power of installed equipment MW | Substitution of heavy fuel oil (tons) | Cost saving for purchase of heavy fuel oil (million USD) | Reduction of emissions from combustion of heavy fuel oil if substituted by RES (tons) | | | |
|---|---|---|---|---|---|---|---|
| | | | | $CO_2$ | $SO_2$ | $NO_x$ | Solid particles |
| Wood chips | 160.0 | 123000 | 11.00 | 396000 | 600 | 1000 | 110 |
| Straw | 10.0 | 8800 | 0.80 | 28300 | 430 | 30 | 8 |
| Biogas | 2.1 | 1800 | 0.16 | 5800 | 90 | 6 | 2 |
| Small hydro | 8.0 | 7000 | 0.60 | 22500 | 300 | 24 | 6 |
| Total | 180.1 | 140600 | 12.56 | 452600 | 6820 | 1060 | 126 |

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# Country Report: Poland

Selected “Best Practice” Projects and Measures in Poland

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**Dr Andrzej Szajner**
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## 1. Best practice: The case of biomass utilization – straw boiler for district heating

**Selected project: *Straw boiler 1 MW in rural area***

**Basic information on the selected project**

The first bigger straw boiler was constructed in Poland in Zielonki near Małbork, 26th October 1996. The capacity of the boiler is 1 MW connected to the district heating system of the village with 150 flats and a total heated surface area of 7 600 m$^2$. It was the substitution of the old coal boiler, reducing emissions and decreasing the price of the heat. The investment cost was 2 000 000 PLN. According to the first year of work 1996/97 the avoided cost of black coal was 169 000 PLN, but the cost of straw was 57 000 PLN, which means three times less. The tariff for heat from straw was kept the same as before for black coal during 4 years and 1/3 of the payment was covering the expenses to buy straw, but 2/3 of income were covering the cost of credit for the investment. During 4 years the total financial balance was completed. The pay-back period was 4 years here. After 4 years it was possible to reduce greatly the tariff of the heat supply.

**Main project components**

Poland is producing about 25 mln tons of straw (equivalent to 12.5 mln tons of black coal). Taking 16% of the annual Polish production for energy (like in Denmark) gives the energy resources equivalent to 2 mln tons of black coal per year. This potential is stimulating the quick development of straw fired boilers on the Polish market. Poland is producing the small farm straw boilers 45-60 kW, medium size 0.25 MW and big units 0.5-3.5 MW. In the case of Zielonki near Małbork it was possible to have full utilization of the local resources of straw, about 500 t per heating season. The price of straw in bales was stabilized up to 50-70 PLN/t. The price of heat was reduced after 4 years of exploitation. Straw was supplied in bales 2.0 x 1.2 x 0.85m and weight 250-320kg. It was automatic straw supply here, and the straw was cut into small units. The mineral content of straw is 3-4% and the ash is used as a fertilizer in the local agriculture.

**Main “success” indicators applied**

The reduction of the emissions because of the substitution of the coal by straw was for dust emission 14 t/year, sulfur oxide 20 t/year, nitro-oxide 6 t/year, carbon mono-oxide 27 t/year. The costs of the district heating are about 80 000 PLN/year, while using black coal they would be 200-220 000 PLN. An employment effect in the boiler station was the reduction of employment from 4 to 2 workers, but indirect employment for straw supply was 4-6 workers.

**Realization problems and difficulties**

Most of the components of the boiler were imported from Denmark, but mounted by a Polish construction company. The old coal boiler had a capacity of 1.2 MW and the new straw boiler 1 MW. It would be possible to change the heat demand by proper insulation of buildings and exchange of windows, and to reduce the heat demand to the level 0.64 MW in the future. Now the low price of the cheap straw is compensating the higher heat demand and heat losses in the buildings and flats.

**Duration / follow-ups / sustainability of the project / policy**

System works endure 5 years according to the expectations. It was found that the boiler is very sensitive towards the quality of the straw. The water content of the straw should be always below 20%. For higher values the system works badly. It was found that gray straw is much better than yellow straw. The straw of wheat and rye works well, but the best result gives straw of rape seed, full of oil and useless for agricultural purposes.

**Cases of domestic replication**

After the first straw boiler the next investments were made, indicating high replication potential. We may indicate straw boilers in district heating systems in Poland: Grabowiec 0.8 MW, Wieniec 0.5 MW, Czerniń 2 MW, Krąg 0.5 MW, Pruszcz Gdański 0.5 MW, Kamiennik Wielki 0.5 MW, Starogard Gdański 1 MW, Cieszymowo 1 M, Lubań 1 MW. New district heating systems were constructed recently with new boilers in Czerniń 3.5 WM and in Lubań 2 x 3.5 MW.

**Main reasons for project success (“success factors”)**

The main reason of project success was energy efficiency, economics and ecology. Straw is available in many regions of Poland and the price of heat in PLN/GJ is 3 times lower from straw than from coal, 5 times lower than from natural gas and 6 times lower than from oil. One ton of straw is able to substitute 0.5 t of black coal. Emissions from straw are much lower than from coal. During the first year 1996/97 the costs for the straw were at 82 000 PLN/year, while the income of the payment for heat was at 127 000 PLN/year, which meant a surplus of 35 000 PLN/year. Taking the costs for black coal of 203 000 PLN/year and an income 127 000 PLN/year, this gives a deficit of 76 000 PLN/year. During the second year 1997/98 the costs of straw were 80 000 PLN/year, the income from inhabitants 141 000 PLN/year, the surplus was 61 000 PLN/year, but the costs of black coal would be 220 000 PLN/year, income 141 000 PLN/year, and the deficit of the coal boiler would be 79 000 PLN/year. During the third year 1998/99 the costs of straw were 77 000 PLN/year, income 141 PLN/year, surplus 63 000 PLN, but in the case of black coal the price of coal would be 212 000 PLN/year, income 141 PLN/year and deficit 71 000 PLN/year. The substitution of coal by straw had changed the deficits to economic surpluses of the district heating plant.

**Pre-requisites / limits / recommendations for successful replication in other transition countries**

Straw boilers may be implemented in many rural areas. The condition is to have dry straw and to build simple straw boilers, fed by hand two times per day, without full automatic equipment. The optimal size seems to be 0.25 MW per unit, located in the same building with the conventional coal boilers.

## 2. Best practice: The case of combined heat and power (CHP)

**Title of the selected project:**
***Combined heat and power plant CHP using wood residues in Jeziory***

**Basic information on the selected project**

A small pilot power station was installed, with electrical power 50 kW(e) and heat power 190 kW(t). For this location the electrical energy will be produced only from wood, creating an ecological island inside the forestry. The first step would be gasification of the wood. Wood gas, generated in IMBERT installation, is utilized to supply the gas engine, which in turn drives the generator of the electric current. Produced electric energy is utilized and its surpluses are transmitted to the power network. Project costs may be evaluated by comparison of the investment and maintenance costs of different solutions. This system of wood gasification and heat and power plant would cost 760 PLN/kW with comparison to the investment of oil boiler with costs of 329 PLN/kW. Maintenance costs for wood gasification would be 45 PLN/kW, and for oil boiler 157 PLN/kW. The comparison of the investment and maintenance costs is indicating that the utilization of wood would be much cheaper in the longer run than the utilization of oil.

**Main project components**

The project is located in a nature reserve, an area of high ecological values, and is directed at the ecological demands of the local children’s hospital in this forest. The conventional coal boiler or oil boiler will not meet the environmental emission standards of flue gases released into the atmosphere.

**Main “success” indicators applied**

A comparison of the possible emissions is very important here. Conventional coal boilers would emit 420 mg $SO_2$/MJ while wood boilers would emit only 10 mg $SO_2$/MJ. The emission of $NO_x$ from coal boilers would be 60 mg/MJ, from wood boilers 80 mg/MJ. The dust emissions from coal boilers would be 50 mg/MJ, from wood boilers 80 mg/MJ. The emissions of CO from coal boilers would be 1000 mg/MJ and 40 mg/MG for wood boilers. The emissions from the system of gasification and production of heat and power using gas engines would be 7 mg/MJ for $SO_2$, 54 mg/MJ for $NO_x$, 0 emissions from dust, and 22 mg/MJ for CO emission. It is difficult to evaluate the payback time and cost-benefit ratios, but it is a very ecological solution, with a pay-back period of few years.

**Results / impact / side effects**

The unit is very small, in the scale of a single school or a small hospital, and the full impact effect is not visible yet.

**Realization problems and difficulties**

The project was realized with the financial support of the Vojevodship Fund of Environmental Protection in Poznań. It was granted as a demonstration solution, without commercial aspects. It has rather the character of a prototype than that of a commercial implementation, but it works full scale under real conditions, with supervision by the Institute of Heat Technology of the Technical University of Poznań (dr B. Deptula). The village Jeziory is located in the area of the Wielkopolski National Park i.e. in a forest region. The main goal was to work with renewable resources (solar energy cumulated in wood) and without waste production, limiting emissions of flue gases, ashes and slung. The installation was constructed during the year 1997, and is operating in exploitation since 1998, according to the design parameters.

**Duration / follow-ups / sustainability of the project**

The development of gasification technologies is especially important for Central Europe, where no network of gasifiers exists to exploit the energy potentially available through the large quantities of agricultural residues produced. On the other hand, the infrastructure of the countries does not allow the installation of large plants because of the difficulties of feedstock collection and transportation. Thus this project is concerned with gasification of wood for decentralized heat and power production. The project is unique in Polish conditions. It works during the last years, but without a real demonstration program, even if it is a success story.

**Cases of domestic / international replication**

There is a great interest in the technology of gasification of biomass, production of electricity and heat energy (CHP) in many countries. Several prototypes were made, but it is not close to the full replication of such solutions. In Polish conditions gasification of wood started in some factories, but the wood gas production, driving engines and production of electricity is still in the initial stage.

**Main reasons for project / policy success ("success factors")**

This solution of gasification of wood and production of power and heat (CHP) was implemented, giving very low emissions of flue gases to the environment and competing economically with oil or coal boilers. The location of the solution in the children's hospital in the nature reserve area of the deep forest was very proper. Ecological, economical and energy efficiency arguments are supporting such a solution for the longer run. The system was before 1995 using a coal boiler with high emissions of dust, sulfur and mono-oxides. Renovation of the coal boiler was not possible and a new boiler was needed.

**Pre-requisites / limits / recommendations for successful replication in other transition countries**

This solution may be directly transferred to other locations. Development of gasification of organic materials is more and more popular. It is important to mention the solution of gasification of the mixture of wooden chips with sewage sludge, and to burn the gas from this gasification for heating purpose. It was implemented in several locations in Polish wastewater treatment plants, giving very positive ecological, economical and technological effects. May be the replication potential of gasification of wood with sewage sludge will be much higher than the gasification of pure wood or straw briquettes. Polish solutions are oriented towards the utilization of waste resources, like waste wood, waste straw and waste sewage sludge. Utilization of more sophisticated resources like biogas from anaerobic digestion, bio-liquids from fermentation and pyrolitic gas from gasification of solid biomass are still waiting for full recognition and use. The pilot plant of wood gasification in Jeziory is just the first case of more advanced technologies, but it is not replicable yet.

## 3. Best practice: Thermal energy conservation in the building sector

**Title of the selected program: *Implementation of Thermo-Modernization Law in Poland***

**Basic information on the program**

The Thermo-Modernization Law (*Law on Assistance in Thermo-Modernization Projects*) introduced in December 1998 and modified in 2001 has replaced state subsidies with financial support of feasible thermo-modernization projects. The objective of the Law is to support modernization projects aiming at:

- reduction of energy consumption in buildings, residential and public/ communal,
- reduction of energy losses in local heating networks and local HOBs <11,6 MW,
- conversion of conventional heat sources to non-conventional sources, incl. renewables.

Definition of the thermo-modernization project according to the law:

| | | |
|---|---|---|
| a | Modernization resulting in reduction of annual consumption of energy in buildings: | |
| | • when modernizing heating system only | - min 10% |
| | • building thermo-modernization | - min 15% or 25% |
| b | Modernization of local HOB and local network, reduction of energy losses | - min 25% |
| c | Closing of local HOB and connection to DH system, reduction of heating costs | - min 20% |

Financing is arranged by the Bank Gospodarstwa Krajowego BGK (Bank of National Economy) through selected commercial banks. The Bank is responsible for verification of energy audits.

**Main project components / policy instruments**

The law has been supported with the secondary legislation, updated during development of the program. Promoting of the program, verification of energy audits and offering funds to cover thermo-modernization bonuses have been supported by the state budget.

It could be seen from the law, that its regulations are favorable for renewable energy sources together with thermo-modernization of buildings providing that the economy of the investment is good. The key feature of the law is that savings must allow for repayment the loan with interest within maximum 10 years. The potential of savings means the difference between costs of energy in the existing heating system and costs after thermo-modernization.

The big majority of buildings undergoing thermo-modernization were built in prefabricated systems of big slabs of reinforced concrete from the 60's to 80's. Energy audits performed till now have confirmed high annual energy consumption - 180-300 kWh/m$^2$ - in multistory apartment buildings. The typical scope of modernization includes insulation of walls and roof, modernization of heating installation and replacement of windows.

The important role of the building administration is to install heat meters or heat costs-splitters as well as to encourage tenants to save energy and change bad habits, like controlling temperature in flats by window opening.

**Main "success" indicators applied**

The main success indicator is successful operation of a revolving-type fund supporting thermo modernization. The second one is introduction of an energy audit as the demand for allocating of funds.

The implementation of the Thermo-Modernization Law requires a big group of energy auditors. The system of training energy auditors has been introduced and developed with support of Danish - Polish projects. A group of a few hundred energy auditors has been trained. Over one hundred of them successfully passed through examination by the National Energy Conservation Agency.

The system of state support to energy conservation projects based on verified energy audits has set a new standard for modernization investments.

**Results / impact / side effects**

The system requires operating on the market of building materials and services. This stimulates more activity on this market, higher production of insulation materials and higher employment. Taxes and VAT paid to the state budget match the money allocated by the state for thermo-modernization bonuses.

### Realization problems and difficulties

Till recently the Thermo-Modernization Fund has been used with a much lower rate than anticipated. One of the obstacles was that the thermo-modernization bonus was paid after repayment of 75% of the loan with interest. The other one was the condition of positive value of NPV for the investment.

The system has been modified this year to stimulate substantial increase of thermo-modernization investments. The thermo-modernization bonus is offered after completion of the investment and thus reduces the thermo-modernization loan. The necessity of positive NPV was cancelled.

### Duration / follow-ups / sustainability of the program

The program is supposed to be sustainable for the whole period of its operation of more than 20 years. It has been expected that investments of state, communal and private funds shall reach a few hundred million € annually. Cases of domestic/international replication

The whole concept based on the revolving fund energy conservation projects financed by savings shall prove to be successful and could be replicable in other CEE countries.

### Main reasons for program success ("success factors")

The main success factors are as follows:

- the practice of state subsidies to heating costs and modernization has been replaced by the system of supporting feasible thermo-modernization projects based on verified energy audits;
- demonstration of possibility of financing energy conservation from savings;
- presentation that thermo-modernization of a building is most efficient when combined with replacing of coal boilers with DH network, natural gas and especially renewable energy (biomass);
- increasing awareness among building administrations, housing cooperatives and local authorities.

### Pre-requisites / limits / recommendations for successful replication in other transition countries

The major demand and precondition for initiating a revolving-type fund supporting thermo modernization program is the establishment of a system of energy auditors. Based on that a program of financial support of thermo-modernization measures can be introduced.

## 4. Best practice: Energy service companies (ESCOs) and third party financing

**Title of the selected projects:** ***Introduction of ESCO in bigger scale in cities***

### Basic information on the selected projects

ESCO and third party financing (TPF) concepts have been introduced and tested in Poland in numerous cases. Typically they comprise one or few buildings (a school, a hospital or military barracks) and are financed by different ESCO- and TPF-type companies. Representative purchaser of service is a municipality. One of biggest TPF companies BIO-ENERGIA ESP specializes in conversion of fossil fuels to renewables. However ESCOs are often seen only as an external provider of funds oriented at achieving too high profit.

Two new big projects have been under development in Poland, supported by big international financial institutions - World Bank and EBRD - and aiming at launching of ESCO organized and financed projects in much bigger scale, namely hundreds of buildings. Both projects require financial support of these banks. The specific feature of both projects is involvement of cities in establishment and development of ESCO acting on their areas.

Thanks to previous activities the Energy Service Company in Kraków has been established with active participation of the DH Company. The objective of the WB project is to enhance the possibility of ESCO to considerable increase of financing of energy efficiency measures.

The objective of the EBRD supported project is to provide the City of Łódź with means for making demand-side energy efficiency investments in Municipality owned facilities (i.e. schools, office buildings, sports and training centers and cultural buildings etc.) without the need for increasing its budget expenditure. This will require the establishment of a new Municipal ESCO (*Mun*ESCO) with participation of the Municipality, EBRD and external sponsors.

**Main projects components**

The Kraków Energy Efficiency Project aims at improving the efficiency of the city's district heating (DH) systems, decrease heat energy consumption by improving energy efficiency at the end-user level, and develop knowledge-based mechanisms to finance energy efficiency projects. The project components will support strategic and development ecological investments through connections to DH network, finance investments by sequentially discontinuing current coal-fired heat-only-boilers (HOBs). A certain amount of HOBs will be converted to gas or oil-firing, co-financed by a grant from the Global Environment Facility (GEF). Finally financing of heat efficiency investments will be provided. Funding for the Energy Service Company capitalization will be provided, to balance its business development.

The Łódź *Mun*ESCO will recover its investments and a profit margin through the savings that its investments generate for the city. The expected benefits for the city include a potential share of the energy cost savings during the term of the *Mun*ESCO, an improved level of service to building users, professional management of the energy efficiency investment process, optimal supply and utilization of energy, avoidance of ongoing capital improvement on thermo-modernization and energy management, off budget financing of municipal infrastructure investments and mitigation against energy price increases effects. Under this program the city will enter into an Energy Service Performance Contract (ESPC) with MunESCO for implementation of energy investments, provision of energy service and energy management. There are a number of types of ESPCs that could be employed, e.g. shared savings, guaranteed savings, value based approach with no guarantees.

**Main "success" indicators applied**

In both cases certain initial steps have been undertaken. Energy audits have been conducted on the agreed sample of buildings and results of introduction of energy efficiency measures have been monitored. The main success indicator is the resulting decrease of energy consumption, energy costs and environmental impact of energy system.

**Results / impact / side effects**

The first implemented projects have been verified to compare assumed and achieved benefits of the modernization. Based on readings of energy consumption seasonal savings of energy consumption have been calculated.

The reduction of heat consumption by consumers has been already achieved. Reached reductions of heat consumption are close to estimated and predicted values. Further reduction of energy consumption is achievable as the result of proper maintenance of substations, raising awareness among consumers and introduction of energy management in buildings.

**Realization problems and difficulties**

There are some obstacles preventing wider spreading of ESCO concept in Poland. Firstly public procurement procedures limit the period of contracts to three years and can be extended only when justified. Secondly the rules of the Energy Law result in keeping heat prices at the lowest levels within approved tariffs and a recovery of invested capital by the ESCO is in many cases difficult. Finally the high interest rate has reduced borrowing possibilities.

**Duration / follow-ups / sustainability of the projects**

Both projects are after initial stages of implementation and are set for successful sustainable operation.

**Cases of domestic / international replication**

Many of the big cities in Poland consider implementation of similar schemes within their premises.

**Main reasons for project / policy success ("success factors")**

Both projects have involved cities and big financing institutions in order to solve energy efficiency projects in big scale. In the general opinion dedicated, Municipal ESCO is the most suited to run energy efficiency activities. The companies develop the best strategy of activities to be performed, within available finances and Company assignment. The success depends on cooperation with the city administration in areas of planning, implementation and operation.

**Pre-requisites / limits / recommendations for successful replication in other transition countries**

The concept of Municipal ESCO is recommended to be implemented in other transition countries.

# 5. Best practice: Rational energy use in industry

**Title of the selected project: *Energy self-audit scheme in Polish industry***

**Basic information on the selected project**

There have been already a few projects with foreign support aiming at energy conservation in industry in Poland. Those worth mentioning are the Japanese Project on Energy Conservation in Polish Industry, with participation of over 20 companies from the main branches, the Norwegian Clean Production project with many medium and big companies participating. The latest program has been initiated and organized by KAPE (National Energy Conservation Agency) with NOVEM within the SAFE program.

The primary objectives of the pilot scheme have been achieved namely to develop a scheme, which would encourage companies to publicly commit to energy efficiency, to implement an energy efficiency strategy and to insure that energy efficiency is a priority with top management and employees alike. It is important that the staff feel they are part of the process of addressing energy efficiency, and that the key to its success lies in their knowledge and experience.

The Scheme offers the opportunity for companies to enhance their energy management efforts by providing the incentive of the public commitment along with knowledge sharing and networking for the actual energy managers.

**Main project components / policy instruments**

The participating 25 companies from different industries across Poland committed themselves to join the scheme in the beginning of 2001. The major steps undergone during the project have included training of energy managers, an energy audit in the company, introduction of basis of energy management with systematic self-audits, preparation of an action plan and elaboration of feasibility of energy conservation investments. The energy-responsible staff has been equipped with supporting software, allowing for analysis of the dynamics of specific energy consumption.

Proper energy efficiency is much more than technology; it is all the people elements of energy use - policy, awareness, maintenance, diligence and responsibility. A formal way of managing energy is through *monitoring and targeting*, which uses a system, computer or manual, to record energy usage at many points in the plant in order to find areas that use most energy and also to record energy trends over time and set targets for future improvement. However, such an approach does not have to be based on expensive metering and computer systems, the important element is the awareness of how energy is being used and how improvements can be made. This knowledge has been presented during seminars and discussed during site visits to plants.

**Main “success” indicators applied**

Energy efficiency also means reduced input costs, better quality, and improved competitiveness. The membership of the Annual Self Audit Scheme gives a branding of being proactive in energy and environment, which can help in the market place. Energy efficiency should not be seen in isolation, but as an important element of a well run, environmentally sound, competitive plant.

Conserving energy produces direct environmental benefits through lower emissions of polluting gases, and many indirect benefits if saving energy relates to reduced materials or water consumption, or lower levels of waste.

All companies have selected specific Energy Performance Indicator (EPI) and environmental figures related to production. These factors have been already tested, with reduced energy consumption represented by EPI already down by 1-5% during the first year of the Scheme. The reduced emission indicators are even greater thanks to the switch to less-polluting fuels and connection to DH networks.

**Results / impact / side effects**

The participation by companies has involved a number of simple steps, which in order are:

- Commitment and Registration;
- Energy Audit and Annual Self Audit;
- Statement of Energy Accounts.

Having registered to or committed themselves to the scheme, companies are then obliged to meet these requirements. Realization problems and difficulties

The difficult situation of Polish finances and the slowing growth of economy have brought additional problems on the whole industry and participating companies. However benefits from the introduction of low-cost energy measures are clearly seen and companies have already introduced steps with a pay-back time of few months.

**Duration / follow-ups / sustainability of the project / policy**

The scheme has been developed under auspices of the Ministry of Economy and will be advised to be transferred to other industries. The Scheme is offered as one of voluntarily commitments undertaken by the industry, in line with environmental management systems. The National Conference on Energy Efficiency in Industry presenting the outcomes of the Scheme is hold in December 2001.

**Cases of domestic / international replication**

The project is presented at pages of KAPE (kape.gov.pl) and interested companies can join the Scheme. The industrial energy conservation schemes are known from different countries.

**Main reasons for project / policy success ("success factors")**

The participating companies have already proven achieving a measurable reduction of energy intensity by a few percent. The staff responsible for energy management has been given knowledge and tools to control the energy consumption for technology and other demands. The management of the companies has been informed of the importance of energy flow and use in companies and the possibilities of reduction of costs and environmental impact.

**Pre-requisites / limits / recommendations for successful replication in other transition countries**

Industries entering the international market tend to put in order their energy systems as natural action thanks to competition and marketing rules. The necessary condition is to have real energy prices at the market.

# Country Report: Romania

Selected "Best Practice" Projects and Measures in Romania

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**Introduction: The energy background**

The Romanian government recently approved a medium-term National Strategy for the power sector (Ordinance No 647/12 July 2001). The main objectives are to develop efficient energy markets, to ensure higher quality and security of supply and to comply with EU standards regarding the rational use of energy and environment protection. Modernization of obsolescent thermal power plants, introduction of efficient technologies for heat supply, including co-generation, construction of the second unit at Chernavoda nuclear power plant are listed as the main immediate concerns. In its present format, however, the Strategy does not spell out clearly defined targets, financial resources, responsibilities and completion deadlines in specific sub-sectors.

The process leading to a competitive energy market in Romania began in July 2000 with the unbundling of CONEL, the former integrated power and heat monopoly. The basic laws governing the energy sector are the Power and Heat Law (Government Ordinance 63/1998) and the Energy Efficiency Law (99/Nov.2000), plus the relevant provision in general legislation dealing with natural resources, environment and commercial company operation.

A regulatory frame for Independent Power Producers (IPPs) is in place. It is supplemented by secondary legal disposition such as the Government Decision 567/1999 setting the standards for licenses and authorizations in the heat and power sector, and the regulatory body ANRE guidelines 36/Aug.1999 regarding the framework contract for the purchase of power from independent power producers. In early 2001, ANRE issued a set of technical codes for transport and distribution grids. The existing legal and regulatory framework thus ensures access to the grid for any producer or consumer on the rTPA basis (regulated Third Party Access).

The fact remains that an agreed comprehensive and detailed medium and long-term strategy on environment related energy policy has not yet become fully operational. Political changes and fluctuations of managerial staff have also affected the consistency of forecasting and forward planning exercises. A lack of adequate transparency on the part of government agencies has been compounded by unclear allocation of responsibilities among various departments, poor co-ordination of strategies at a macro level and weak feedback from major stakeholders because of a constant failure to secure active involvement of the civil society, the business community and other stakeholders in policy making.

It should be noted that Romania has been commendably eager to sign the principal international agreements on environment protection and climate change mitigation, including the Kyoto Protocol (Law 3/2001), the first country in continental Europe to do so. The follow-up measures, however, have been hesitant and slow to come.

The general legal, political, technological and commercial environment in Romania is therefore congenial to the implementation of an environment-friendly energy policy relying more heavily on energy efficiency and wider use of renewable sources for power and heat generation.

# 1. Biomass utilization: Wood waste for district heating

**Basic information: objectives, organization, cost and financing**

In Romania, today some 740 thousand cubic meters of wood waste are in no way valorized and are simply thrown away, polluting the environment.

The objectives of the project were:

- Energy conservation through utilization of wood waste instead of fossil fuels for heat generation;
- reduction of environment pollution due to the dumping of this residue to the rivers;
- reduction of costs for heat generation in public buildings and dwellings.

The beneficiary of this project is the Câmpeni town with a population of 10,000 inhabitants, placed at the feet of Apuseni Mountains. Here, an old thermal unit producing hot water for heating of blocks of flats by using liquid fossil fuel, was modernized with new boilers using as fuel the wood waste.

Project funding: PHARE funds: 100,000 € and local funds: 20,000 €. The technical consultant to the project was the National Institute of Wood.

**Components and policy instruments**

Selection criteria for this location were:

- high amount of wood residues from the Aries Forest Basin - about 54,000 tons/year;
- high cost of heat generation by liquid fuel burning and the increased level of State subventions;
- high pollution level of Aries River by dumping of wood residues and sawdust resulted from wood processing units.

The funding by PHARE grant was essential for the implementation of this demo project, selected as a priority within the Strategy for renewables development in Romania, drawn up by experts from Romania and EU.

*Photo: The sawdust: why polluting the river instead of fueling DH thermal units ?*

**Success indicators and results**

Situation after modernization: Old boilers were replaced by two boilers made in Romania by an original concept, running on sawdust with calorific power of 2,100 Kcal/kg. The efficiency of the boilers measured after the test period is 83%, producing 4,087 Gcal/year, that is 88% higher than the old thermal power station operated in 1998. Moreover, the boilers are each provided with a spare burner on liquid fuel being completely automated. This thermal power station is provided with all new systems suitable for wood waste burring: unloading platform, silo, inclined belt conveyors, exhaust plant, ash evacuation and automation.

Energy savings and reduction of fuel costs are presented below:

| Project features | Initial situation | After modernization | Differences % |
|---|---|---|---|
| Calorific power of fuel Hi [Kcal/kg] | Liquid fossil fuel | Sawdust 2100 | -78 |
| Specific consumption -ecc/Gcal- | 0.204 | 0.172 | -15,6 |
| Heat generation -Gcal/an- | 2175 | 4087 | +88 |
| Cost of heat generation - €/Gcal - | 26.45 | 15.7 | -40 |
| Subvention -€/Gcal- | 18.0 | 3.3 | -81 |

Reduction of environmental pollution:

- Utilization of about 2,345 t wood waste/year;
- reduction of $CO_2$ emission released when burning fuel oil by some 1,000 t/year;
- reduction of $SO_2$ emissions in the open by some 14.5 t/year.

Other advantages:

- The increase of available heat in the thermal station with about 88% represents a significant improvement of population living standard;
- a substantial reduction of subventions from the local council for the covering of heat costs of about 81%;

- the reduction of pollution due to the previous dumping of wood residues in the rivers will increase the tourism potential and consequently will help the economic development of this area;
- the use of equipment designed and produced in Romania reduces the investment costs.

**Difficulties**

Some technical difficulties were encountered regarding the quality of the used sawdust and the prevention of the wood waste to be mixed with other different particles.

**Cases of domestic replication**

The unit is successfully operating since its commissioning in December 1998. This project demonstrates its technical and economic advantages from wood waste utilization as fuel for district heating. The project has also a large potential of replication in a large number of urban areas with woodworking industries and district heating systems: Nehoiu, Busteni, Vatra Dornei, Câmpulung Moldovenesc, Abrud, Bicaz, Tg. Neamt, Gura Humorului, Câmpina, etc.

**Main reasons for success**

Deep concern and cooperation of local authorities represented by the Câmpeni Town Council and the Prefect's Office of Alba County as well as by the local DH company for the project implementation.

West European expertise for the unit concept and design.

**Recommendations, limits for other countries**

This technology may be applied everywhere the wood waste resource exists. In Romania, a specific advantage is the fact that the wood waste fuel is still available at no cost.

## 2. Combined Heat and Power: small CHP unit within a maternity hospital

**Basic information**

Small size cogeneration technology starts to be implemented in Romania, taking advantage of the need of decentralized heat sources, the quite extensive natural gas distribution network, the relative low gas energy and the gas and electricity market opening. One of the first applications was the small unit installed in the maternity hospital of the Ploiesti town, some 60 km far from Bucharest. Output electricity and heat is used on-site, although excess electricity can be exported to the distribution grid.

Technical data are:

- Internal gas combustion engine: CAT 3516 SITA HR
- Heat output: 6 bars steam / hot water for heating purposes at 90/70 $^{o}$C / domestic hot water
- Power supply at 0.4 and 20 kV voltage
- Rated capacity: 1,033 kW electricity/ 1,352 kW heat
- Rated gas consumption: 2,703 kWh/h
- Global efficiency: 88.2
- Operating hours per year 7,800
- Power output 8,057 MWh /year
- Heat output 10,545 MWh/year
- Annual O&M costs: 140,000 €

The unit was commissioned in 1998. The manufacturer was ENERTRAC SRL, a caterpillar dealer in Romania.

**Components and policy instruments**

Because the investment costs were too high for the local utility, the project was developed under a leasing financial scheme between the manufacturer dealer and the utility.

**Success indicators and results**

The energy bill (heat and electricity) was reduced with some 27%. The investment is to be returned within a 6 years period.

**Difficulties**

Cogeneration in Romania is entirely associated with the district heating sector, which currently has a penetration of 31% of the heat market in the country. Small CHP, as IPPs, are still at the beginning on the market, even if the regulatory body prepared the basic legislative framework.

This project was confronted with the following difficulties, in fact general barriers for all CHP potential projects:

- Legislation changes very frequently. This makes it unstable and unpredictable;
- the current legal framework is still unfinished;
- there are no policies for cogeneration nor incentives to encourage its development;
- heat prices are still subsidized.

**Cases of domestic replication**

The success of this project encouraged the unit manufacturer to develop another similar small CHP unit in the town of Sibiu.

**Main reasons for success**

The barrier of high investment costs was overcome by the leasing scheme.

## 3. Thermal energy conservation: rehabilitation of the Giurgiu district heating system

**Basic information**

The main goal of this project was to create the technical possibilities for each heat consumer to decide by himself about the thermal comfort in his own apartment and to pay for the real heat consumption. The DH consumers had no means of regulating their heat consumption and no individual consumption based billing.

In this respect, the municipality of Giurgiu town and the local heat utility started the rehabilitation of the obsolete and low efficient local DH system. The concept was to decentralize the former distribution system by providing a thermal station in every residential district and the installation of automated thermal substation for each building (block of flats).

The project was realized with the financial support of the Danish Environment and Protection Agency – DEPA - through the Ramboll company.

The project was developed in an area covering 22 blocks of flats, 787 apartments with 1980 inhabitants, a hospital, and a school. 18 substations for heat and domestic hot water were built in the basement of every block of flats. For two blocks (60 flats) there were installed balancing valves on the risers, thermostatic valves on the radiators, evaporation heat meter on the radiators and energy meters for the building blocks.

The corresponding substation was equipped with variable speed pumps. As an additional source of heat there were mounted thermal solar panels on the buildings.

The total cost of the project was about 1,150,000 €:

- Domestic financing 30,5 %:
- Danish financing 69,5 %;
- project duration was 24 months, ending in autumn 2001.

**Components and policy instruments**

The pilot project for rehabilitating the DH system was initiated following a request from the city of Giurgiu to the Danish Government. The project consists of two main components: a rehabilitation part (two substations, network and consumers installations in two building blocks) and in an organizational part (technical and general conditions for DH supply, consumption based billing, statutes for housing associations). The project consisted of various tasks: conception, design, equipment procurement, a measuring program, an energy saving campaign and rising the public awareness.

**Success indicators and results**

- The reduction of water and heat waste in the distribution system;
- the reduction of distribution costs and obtaining some economies;
- the training of executive and maintenance personnel;
- the protection of the environment.

The total energy economy for the retrofitted area is estimated to be about 1,454 MWh/year.

The fuel consumption reduction is estimated to be: 228 t/year for coal and 13 t/year for liquid fossil fuel.

Estimated reductions of pollutants are:

- $CO_2$ reduction: 9 - 12 tons/year
- $SO_2$ 0 - 0.27 tons/year
- $NO_x$ 0 - 0.008 - 0.27 tons/year
- particles: 0 - 0.14 tons/year

**Difficulties**

An essential and difficult part of the project consisted in the training of the involved local team in respect to their position within the project.

**Cases of domestic replication**

There is a huge replication potential in the country. Heat is the main problem for the domestic consumers in Romania. One of the objectives of the project was exactly to disseminate information on the experience gained to municipalities, building cooperatives and DH companies in other parts of Romania.

The number of utilities supplying district heating is approximately 200, almost totally municipally-owned. In larger cities district heating is supplied through district heating companies, independent from other municipal utility activities. At present, there are two main competitors in the space heating market: the district heating and CHP plants owned by the TERMOELECTRICA Electricity Company and the independent district heating plants (usually municipally-owned). The large majority of the DH systems are obsolete and have large losses.

Several local heat utilities introduced rehabilitation measures, similar to the Giurgiu ones: Fagaras, Timisoara, Bucharest etc.

**Main reasons for success**

The project received massive and targeted support from Romanian stakeholders, from the DH company, supplemented by the participation of a local adviser, a representative of the consumers as well as the full back-up of the Mayor of Giurgiu. One principal supportive factor was Romanian financing of the detailed design and implementation of the equipment supplied. The lack of local capital funds was covered by a West European grant.

## 4. Energy Services Companies: Still efforts to build the capacity and the market

**Basic information**

ENERO - the Center for Promotion of Clean and Efficient Energy in Romania is, among other objectives, focusing on the promotion of the ESCO and TPF concept in Romania. There are not yet concrete examples in Romania on the ESCO and TPF mechanism application. The ENERO work program, oriented towards ESCO promotion in 2001, included:

(a) Info-Guide for “bankable” documentation necessary for financing of RUE projects in public buildings.

The ENERO efforts were targeted at establishing structures for financing the RUE projects in public buildings and the basic components of bankable proposals. The representatives from municipalities, market operators and end users requested basic information as: who is making the application for funding, how to identify the suitable buildings, the type of financing required, the amount required, and a simplified cash flow analysis with energy savings estimates. The guide presents an “Introduction to Business” (the lender must understand the strengths and risks, the current situation and future plans of the client’s business) and the potential benefits - energy savings/environmental improvements, project costs, energy consumption, basis for the cost estimate. Another part of the guide offers the key regulations required for the project from public authorities as well as environmental regulations. Also, examples of successful European projects and experiences were offered.

(b). Workshop “Promotion of Energy Efficiency Projects and Third Party Financing in Public Buildings”, Bucharest, Romania, April 2001.

The main target groups were municipalities, public building administrators, energy companies, NGOs, financial organizations, universities, research bodies. The representative from the Agency EVA-OPET Austria presented the report “Energy Performance Contracting – Experiences in Austria”, which has shown successful examples and results in terms of economic as well as $CO_2$ savings. These presentations were followed by an open debate.

A SWOT analysis on the ESCO promotion in Romania:

Strengths

- The general legislative background exists: the Energy Law, The Energy Efficiency Law and also other norms as the Governmental Ordinance OG292000 on the thermal rehabilitation of buildings and thermal energy savings;
- there is a positive attitude of the regulatory bodies as: the Romanian Agency for Energy Conservation - ARCE, the Romanian Authority on Heat and Power – ANRE;
- the market potential is huge, with large reserves for energy savings.

Weaknesses

- The secondary legislation is not complete;
- bureaucratic difficulties to apply the existing legislation;
- the energy cost is still low;
- lack of information about ESCOs and the adjacent financial mechanisms;
- The thermal energy is subsidized;
- suspicious attitude of potential users;
- the banking system is not prepared;
- investments have a rather high period of return.

Opportunities

- Quite numerous opportunities to attract international funds;
- the rising trend of the energy cost;
- several private Romanian ESCOs are ready to open the market;
- the political commitment to adopt the *acquis communautaire*: for example the SAVE directive.

Threats

- The disrespect of the norms and market mechanisms, up to the non-payment of energy;
- difficulties in monitoring and certification of the energy savings;
- the users do not know who to contact for an energy audit or a performance contract;
- instability of the energy prices;
- the complexity of the ESCO mechanism.

## 5. Rational energy use in households appliances: Labeling and certification of domestic appliances

**Basic information**

The aim of this project is the harmonization of the Romanian legislation with the European one, regarding the labeling and standardization of energy efficiency of domestic appliances. In order to underline the importance of the project in respect with the domestic appliances market, linked with some 7 million households in Romania, some statistics are presented here.

| | % |
|---|---|
| Refrigerators and fridge/freezers | |
| Less than 5 years | 15,1 |
| From 5 to less than 10 years | 18,3 |
| From 10 to less than 15 years | 25,4 |
| More than 15 years | 41,3 |
| Freezers | |
| Less than 5 years | 33,7 |
| From 5 to less than 10 years | 28,3 |
| From 10 to less than 15 years | 27,5 |
| More than 15 years | 10,5 |
| Washing machines | |
| Less than 5 years | 23,4 |
| From 5 to less than 10 years | 17,3 |
| From 10 to less than 15 years | 23,9 |
| More than 15 years | 35,4 |

As may be seen, many appliances are old machines with low efficiency. They have to be replaced soon by a new generation. It is important to control and promote on the market only efficient machines. This is why it was necessary to develop norms and the technical tools for the labeling and certification of domestic appliances

In this respect, the National Institute of R&D ICEMENERG built the first laboratory of tests for certification. The laboratory is composed of: a test room for cooling household appliances; a control room for data gathering and processing; a test room for washing household appliances. The laboratory's endowing and arrangement was made using public and European (PHARE-TTQM) funds. The test and measure equipment are in concordance with SR EN 153.

Energy efficiency certification means the validation, through application of the mark (stamp) by the certified authority, of data/elements written in the label of the model/type of domestic appliance made ready to be offered for sale/rent.

The results obtained after the validation tests, made in standard conditions, are compared with those noted by the producer/supplier in the label after the house tests made in the same conditions. In the case of the validation of the comparative results, the authority applies the mark. The potential clients of the laboratory can be local and foreign producers of cooling household appliances, as well as the importing firms of such household appliances.

The participants of the project were: the National Institute of R&D ICEMENERG, the Romanian Agency of Energy Conservation ARCE and the Institute of Quality Certification - IMQ-Italy. The total costs of the project are: 174,000 €. Project duration was from January 1997 to December 2000.

| | | |
|---|---|---|
| ➢ Acquisition of equipment: | 107,000 € | public R&D funds and 26,000 € PHARE funds |
| ➢ laboratory arrangement | 36,000 € | PHARE funds |
| other activities | 2,500 € | other funds |
| ➢ RENAR certification | 2,200 € | PHARE funds + other funds. |

**Components and policy instruments**

In a first stage of the project, ICEMENERG has achieved the norms for cooling household appliances-CHA (refrigerators, fridge/freezers and freezers), in concordance with the valid European legislation. The decision HG 573/14 June 2001, published in Official Journal, took over the decisions of the Directives referring to the CHA and stipulated that on the market there are accepted only the CHA with smaller or equal energy consumption to the maximal accepted consumption, adequate for the class of efficiency from the respective category, and are accompanied by:

- a label with the inscription ENERGY where it is written the class of efficiency, the energy consumption, the level of noise;
- a file with information about the domestic appliance;
- an EC mark.

Also within this project, ICEMENERG elaborated the norms for washing household appliances (washing machines), which became the Governmental Decision HG 598/21 June 2001, concerning the labeling for washing household appliances.

In this context, the Ministry of Industry and Resources and the Romanian Agency for Energy Conservation decided to build the first laboratory of tests for certification of domestic appliances efficiency.

**Success indicators and results**

The laboratory was completed and is now ready to perform the required tests.

The usual yearly domestic consumption is estimated to be almost 8 TWh, including:

- CHA 2,345 GWh;
- washing machines 782 GWh;
- domestic lighting 3,126 GWh.

The energy labelling of the domestic appliances will lead to a reduction of the consumed power with at least 5%, which means 0.4 GWh/yearly.

Other positive impacts:

- Stimulation of the ortopraxy – the best utilization of the domestic appliances from the ecological point of view;
- rising the quality services of the appliances, with lower energy costs;
- improving the competitiveness of the indigenous manufactures, in view of European integration.

**Difficulties**

The recent elaborate Energy Efficiency Law has no secondary legislation, thus the specific regulations to impose the labeling are not operational.

**Main reasons for success**

The position document, issued in May 2001 by the Romanian government, states clearly that “Romania accepts the acquis communautaire on Chapter 14 Energy. Romania will apply the acquis communautaire on energy upon the date of accession.” This commitment led also to the interest in the adoption of the labeling and certification of domestic appliances according to the European norms.

# Country Report: Russia

Climate Technology and Energy Efficiency - Disseminating Best Practice Experience

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The positive history of energy efficiency improvements and GHG emissions mitigation can be reflected both by a set of specific indicators and by so called "success stories" or "best practices". While indicators are providing just the result of activities, those stories or practices provide in addition details on how positive results were achieved. Below five examples of "best practices" are presented. They are reflecting five directions of energy efficiency improvements and GHG emissions mitigation ranked by their importance to Russian Federation: energy efficiency improvement in industrial sector; energy efficiency improvements in buildings; combined heat and power; ESCOs experience, and biomass use. "Best practices" described below are disseminated by a number of informational instruments: "Energy efficiency" and "Energy manager" bulletin published by CENEf, MUNEE newsletter, CENEf's internet site, publications in Russian energy efficiency literature.

## 1. Energy efficiency improvement in industrial sector. Magnitogorsk metallurgical combine

At Magnitogorsk metallurgical combine specialists of the Chief Energy Manager Board (CEB) have developed the "Concept of OAO "MMC" Energy Efficiency Development in 1997-2005" based on a comprehensive, systematical approach to the enterprise's energy efficiency improvement. *(for more details see: G. Nikiforov. Experience in complex approaches to introducing energy efficient equipment at an industrial enterprise. "Energy Efficiency". №32).* In line with the approach mentioned the following main objectives were formulated in the OAO "MMC" concept:

- Retrofitting of the existing energy facilities aimed at maximum use of the enterprise's own energy resources
- Maximum utilization of secondary energy resources (SER) primarily aimed at power generation
- Implementation of measures assuring reduction of energy costs.

To run the program at the Combine a special structure was created – the Center for Energy Saving Technologies, which employs over 170 people and is responsible for planning, management and control over energy balance and its use for optimization and improving the efficiency of the enterprise. For implementation of energy-efficient projects OAO "MMC" uses various financing schemes. Six frequency shifters were acquired through a leasing scheme.

By 1996 the energy-generating equipment at the Combine exhausted its service life. Annual repairing expenses amounted to 35% of new equipment costs, while repair duration exceeded the standard one by a factor of 2-3. In 1997–1998 three counter-pressure turbines of 14 MW total capacity (two 4 MW and one 6 MW) were put into operation. In 1999-2001 three condensing turbines (12, 25 and 30 MW), and one for 40 MW fueled by blast-furnace and coke gases were commissioned with average specific capital costs of $38.4 thous./MW.

121 MW in power addition did not require any additional consumption of natural gas, while utilization of blast-furnace and coke gases was brought up to 99.9%.

The project paid back in 1–1.5 years. In 1996 electricity costs contributed to 6.3% of metal production costs but in 2001 - just 0.6%. A ratio between power cost from own energy generating sources and from regional power system, equal to 1:3, was attained.

All the above-mentioned suggests an unambiguous conclusion: power generation at a metallurgical enterprise is both advantageous and advisable from the energy security standpoint. This conclusion in many cases can be extrapolated to other profile enterprises.

An energy audit conducted by specialists of the Center for Energy Saving Technologies (CEST) revealed rather high potentialities for power saving in this mill. For two years regular efforts were made for:

- Installation of step control of speed for fans operating in the winter-summer modes and in inter-seasonal periods with loads differing in the range up to 50%;
- installation of pliant startup of drives for cooling water supply to the mill;
- estimation of operation modes of the main drive fans with their potential switching to one or two, depending on the main drive loading and temperature schedule;
- introduction of automated system of excitation current reduction in the main drives, when the mill is halted for more than 30 s;
- review of all 10/0/4 kV indoor networks, bearing in mind optimization of the transformers load, without impairing the system reliability as a whole.

These measures permitted to reduce the electricity consumption by 12% or about 75 MW by the "2000" mill. Similar efforts are undertaken in other flatting mills.

The complex energy saving policy resulted in reduction of specific energy consumption by 23% (from 8.23 to 6.3 Gcal/t of crude steel), while the production costs fell down (or net profits went up) by 13.6%. The program for 2002-03 is aimed at additional power consumption reduction by 7%.

## 2. Energy efficiency improvements in buildings. City of Cherepovets

Housing reforms in the city of Cherepovets started at 1995. *(see T. Tasenko. Municipal heat and water supply: experience in transformations in the city of Cherepovets in Vologda region. "Energy Efficiency", № 32.)* Housing divestiture was initiated, and 4.5 million sq. meters of living space, obsolete heat networks were also divested. Only 10.5 percent of facilities to be transferred to municipalities were equipped with water meters. Housing and communal costs in the municipal budget increased from 12.3% to 31.1% because of housing divestiture while residents' payments covered only 5-7% of housing costs and payments' collection did not exceed 60%. The municipal budget failed to bear such a burden, and its debts skyrocketed. The city administration launched the Program of Housing and Communal Services Reform. The program of energy efficiency improvement in housing sector was a main component of that Program.

The success of the ***Residential Heat- And Water Efficiency Program*** implemented in Cherepovets is primarily determined by:

- a sound tariff policy, which not only saves municipal utilities from financial loss, but also provides funding for equipment renovation and upgrade (wear of water pipes has decreased from 75 to 25 percent);
- introduction of a dual tariff (network charge plus actual consumption payments) that improved and stabilized the financial situation of municipal utilities;
- restructuring public subsidies which has provided a social support to the least-paid population;
- growth of the number of municipal facilities equipped with heat- and water meters;
- gradual improvement of market environment in the municipal housing and public utility services sector through tenders for renovation of engineering systems in public buildings and for technical maintenance of residential buildings;
- foundation of six acting ESCOs, who are eventually expanding their activities;
- receiving a World Bank loan under the Housing Divestiture Project and successful implementation of this project being at this point the leader in terms of spent funds and debt service discipline;
- development of a monitoring system for this project.

Heat and water payments by residents of buildings owned by the municipality are currently made through a billing & information center. The payment discipline of the population has significantly improved (63 % in 1995 versus 97.5 % in 2001). Since July 1, 2001, residential heat and water tariffs are equal to those for the industrial sector and residents are covering 100 percent of their utility costs. There are still barriers on energy efficiency improvements which are not Cherepovets specific, but rather typical for all Russian cities. The major problems are non-involvement of residents in the program and lack of competition. The following table provides a brief description of the municipal energy efficiency program implemented in Cherepovets.

| Country: Russia | | Region: Vologda Oblast | | City: Cherepovets | |
|---|---|---|---|---|---|
| **Program targets**: | | | | | |
| Energy efficiency project | ☑ | Public subsidies restructuring | ☑ | Other | ◇ |
| District heating reform | ◇ | Setting up energy efficiency fund | ◇ | | ◇ |
| Water utilities reform | ◇ | Housing reform | ☑ | | ◇ |

EFFECT: payments discipline improvement; subsidies restructuring; energy service companies activity expansion; intense replacement of water pipelines resulting in abrupt decrease of their deterioration level; tariff design based on heat and water metering; financial improvements in heat- and water utilities due to the introduction of a dual tariff.

**PROGRAM SUCCESS CRITERIA**:

| Indicators | Before the program | After the program |
|---|---|---|
| *Level of energy passport compilation:* | | |
| boiler-houses | 47% | 100% |
| heat mains and heat distribution networks | 13% | 100% |
| storm drain network | 0% | 100% |
| residential buildings (dwelling passports) | 12% | 100% |
| residential buildings (energy passports) | 3% | 37% |
| public buildings | 4% | 45% |
| Share of municipal facilities equipped with fuel, energy, heat, and water metering devices | | |
| *Boiler-houses:* | | |
| natural gas meters | 80% | 100% |
| heat meters | 56% | 100% |
| *Residential buildings (inlets):* | | |
| water meters | 12% | 100% |
| heat meters | 0,1% | 6% |
| natural gas meters | 3% | 7% |
| separate heat metering *(space heating and hot water supply metered separately)* | 0% | 2% |
| *Public buildings:* | | |
| water meters | 15% | 100% |
| heat meters | 7% | 34% |
| natural gas meters | 0,5% | 100% |
| separate heat metering *(space heating, ventilation and hot water supply metered separately)* | 0% | 5% |
| Contracting public buildings renovation financed from the city budget | Contractor is appointed by the city administration | Contractor is identified based on the tender results |
| Number of energy service companies | 0 | 6 |
| Financial savings resulting from projects implemented by ESCOs in schools, (mln. rubles / year) | - | 1.2 |
| Water supply network depreciation | 75% | 25% |
| Residents' payment discipline (the ratio of payments collected to energy bills) | 63% | 97.5% |
| Setting up housing associations (% of total living space) | 0% | 3% |

## 3. Combined heat and power

Russia is well known for a very high share of cogeneration both in electricity generation and in heat production. This brings in many cases not only benefits but also creates a lot of problems, and it does not just improve energy efficiency but also often leads to substantial heat losses. Among multiple reasons is this one which determines the efficiency of cogeneration. Its efficiency in Russia always was estimated based on efficiency at power and heat production points, while it should be relative to final consumption efficiency.

For some large systems with very high cogeneration ratio energy efficiency deteriorates. For example in “Mosenergo” – the largest Russian power utility – generating 69 billion kWh and 69 million Gcal annually since 1998 the specific fuel consumption per 1 kWh grew up by 6.4 gce/kWh in 1998, by additional 5.2 gce/kWh in 1999 and by 4.3 gce/kWh in 2000. Reduction of electricity generation in cogeneration mode was partly responsible for such a growth. This reduction in turn is result of a pricing policy forcing many industrial enterprises to switch from central heating to own boiler houses and all consumers to use less heat. That is why “Mosenergo” launched an energy efficiency improvement program (For more details see “Energy Efficiency”. №31, 2001).

Another example is the unrealized efficiency potential from cogeneration from the city of Omsk. If three large cogeneration plants would work in parallel with industrial boilers, then it would be possible to switch 50% of industrial boilers´ load to cogeneration units with growing of overall fuel use efficiency from 61.5 to 67.5 percent, and fuel savings would approach 630,000 tce per year.

Therefore, today in Russia not technical progress, but rather corrections of pricing policies and creation of effective power and heat market structures are necessary to realize full benefits from cogeneration.

There are some discussions on how to improve tariff policies, but not much progress in real changes was made.

Technological progress in improving efficiency of cogeneration plants can be illustrated based on several examples.

**Combined cycle cogeneration plant North-West CHP**. The first phase started when this facility was commissioned in late December 2000 in Sankt Petersburg. Owners of this power plant include RAO “EES Rossii”, “Gasprom”, “Lenenergo”, “Lentraansgas”, Sankt Petersburg city administration. Installed capacity of the first phase is 450 MW. Total installed capacity will be 1800 MW. The specific fuel consumption of North-West CHP is down by 25%. After fully commissioned and replacing loads of municipal boilers reduction of $NO_x$ and $CO_2$ emissions would reach 25%.

**Gas turbines CHPs.** Today the major tendency in Russia is not to build large-scale very capital-intensive cogeneration plants, but rather upgrading or replacing industrial and municipal boilers and transforming them into small CHPs.

Several gas turbines CHP (GTU-CHP) with the gas turbines GTU-4P already were commissioned: in the settlement of Bolsheust’ikinskoe in the Republic of Bashkortostan, in industrial OAO “Surgutneftegaz”, in OAO “Perm Motor Plant” and in other places.

In the Perm Regional Energy Program up to 2010 installation of such CHPs is planned for 63 boiler houses with a heat capacity over 10 Gcal/h each including 33 municipal boiler houses, and 30 industrial and agricultural ones. Average fuel efficiency for each unit is expected to be over 65%.

After the program is completed the installed electric capacity will reach 328 MW, fuel savings are expected to be 0.7 million tce per year.

## 4. ESCOs experience

There are only small scale ECSOs established in many Russian regions. This business is only at initial stage. Main regulatory issues are to be resolved until it will grow up significantly. Below the recorded experience of ESCOs in Cherepovets is discussed.

There are six private ESCOs operating in the city. They are basically involved in installation and maintenance of heat and power meters and energy efficiency improvements. Five ESCOs work only with commercial firms, the sixth company, “Yana”, also works with public buildings (primarily with schools and kindergartens).

The energy efficiency measures include installation of heat meters, renovation of the heating system, installation of automation systems to bring down heating at nighttime; improving thermal performance of buildings, introduction of façade heating regulation, etc.

Since 1995, 15 projects of installation of heat meters in schools have been implemented in the city. The project-monitoring group estimates an average annual effect at 400 thousand rubles per project (13 thousand USD). The mechanism of financial savings accumulation developed by CENEf is used in Cherepovets to reveal, estimate and accumulate municipal budget savings (see *Energy Efficiency Bulletin No.24 July-September, 1999, p. 8-10*).

Two types of cooperation between ESCOs and municipality (namely education department) are in use:

**Type 1.**

- The city budget includes funds for renovation of a number of schools. This budget specifies, which schools will be renovated, and allocates funds for upgrading engineering systems, including installation of heat meters and renovation of their heating systems.
- The municipal tender commission announces a tender.
- An ESCO submits a proposal to the tender commission.
- The ESCO, which wins the tender, signs a contract with the city education department and becomes the general contractor.
- signs a contract with the municipality for the maintenance of installed equipment.
- Energy savings are evaluated.
- Financial savings are accumulated in the municipal budget.
- The ESCO gets the profit from the budget allocated for the buildings maintenance.

**Type 2.**

- A tender is announced for the implementation of energy efficiency measures in a school to achieve estimated (planned) energy resource savings.
- The ESCO which wins the tender receives municipal funds, according to the proposed budget, in the form of an interest-free loan.
- After the project is implemented and commissioned, both municipality and ESCO monitor its effect and identify financial savings generated by the project.
- If the actual financial savings are larger than previously estimated, the equivalent of identified excess is paid to the ESCO as a bonus.

The second algorithm motivates the ESCO to get larger savings.

## 5. Biomass use. Licino forest college boiler house

Licino settlement is located 60 km from Sankt Petersburg *(for more details see "Novosti Teplosnabgenia". №4, 2000 and №3. 2001)*. The forest college boiler house possesses 90 thousand hectares of forests with the potential to collect 30 thousand m3 of wood, sufficient to generate 45 thousand Gcal of heat annually, but was fueled by heavy oil – masut. The annual heat demand for teaching and living facilities as well as for residential houses, public buildings, and small houses is equal to 10 thousand Gcal with 14 percent of that number coming for hot water.

In the framework of the Swedish assistance program NUTEC (presently STEM), a project to switch this boiler house to fuel wood was implemented. The old boiler house (total capacity 3,2 MV) was equipped with three masut fired boilers and one fueled by fuel wood with manual load. Boiler modernizations included the replacement of the old wood fueled boiler by a new one using wood chips and bark. That boiler covers 80% of the heat demand in the settlement with the rest provided by masut boilers left to cover the peak demand. All processes in the boiler house are automated.

The boiler is in operation for over 4 years. Energy efficiency of the new wood fueled boiler is 80 to 85%. Wooden chips are just 3 $ per m3. Some pulp and paper enterprises sell chips for 5-10 US$/m3. With such prices the fuel cost component of generated heat is 1.5-3.5 US$/Gcal comparing with the masut case – 13 US$/Gcal, and with the natural gas case – slightly lower 3 US$/Gcal. Keeping in mind the dynamic growth of domestic prices for natural gas in Russia, wooden fueled boilers can become even more economically viable than natural gas powered boilers. The reduction of fuel cost is the main component of fuel switching economic effect.

The payback is estimated equal to 5-6 years. Facility owner's net profits after debt service for 15 years are 0,5 million US$. There is a substantial reduction in emissions.

*Reduction of emissions associated with fuel switch at Licino boiler house (t per year)*

| Emissions of | Fuel | | Emission reductions |
|---|---|---|---|
| | Masut | Wood chips | |
| $SO_2$ | 60,6 | 1,0 | 59,6 |
| $NO_x$ | 6,6 | 4,0 | 2,6 |
| Particles | 7,7 | 3,1 | 4,6 |
| $CO_2$ | 3960 | 0 | 3960 |

Ash generated by boiler is in high demand for fertilizations of vegetable gardens of local residence.

Generally newly installed equipment proved to be reliable and simple to manage. But there were some technical problems with serving this boiler and with getting spare parts and failed sensors in the process of repairing and maintenance, partly due to the lack of companies specializing on servicing such type of equipment. Once the frequency regulator for the boiler's secondary blowing fan with adjustable speed drive failed. It was delivered to Moscow "Siemens" office and answer was given that such devices are not under production any more.

There already are a number of replications. Another wooden fueled boiler house was constructed in the settlement of Krasnii Bor not far from Lysino with a credit provided by the Swedish government. It is in operation for already 2 years. There were already a number of masut and natural gas boilers switched to wooden fuels base on Russian made equipment (Biisk Boiler Manufacturing Plant) with an efficiency about 80%. "Lesenergo" alone installed over 20 of them with the one at Ulianovsk Forestry Industrial Combine. Many Russian regions are presently considering switching masut powered boilers to wooden fuels and to peat.

# Country Report: Slovakia

Cliomate Technology Initiative – Disseminating “Best Practice” Experience

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## 1. Biomass utilization in Slovakia

Biomass is currently one of the most important RES in Slovakia. Forests cover forty-two percents of Slovakia’s surface and another 35% are used for farming. The main utilization of biomass is expected on a regional level and depends on the development of each region and implementation of regional energy plans in the future. Total energy capacity of biomass in Slovakia is shown in table 1.

*Table 1 Total exploitable capacity of biomass in Slovakia*

| Type of biomass | Exploitable capacity (t/y) | Energy equivalent (TJ/y) |
|---|---|---|
| **Forest biomass** | | |
| Thin branches up to 7 cm | 250 740 | 2 383,05 |
| Thick branch waste | 76 200 | 724,00 |
| Waste produced by handling/processing wood | 110 590 | 1 050,69 |
| Fuel wood | 323 900 | 3 079,81 |
| Bio-mass from thinning of forests | 14 300 | 138,58 |
| Stumps and roots | 23 500 | 223,25 |
| Waste produced by mechanical processing of wood | 103 800 | 1 170,00 |
| Total | 903 030 | 8 769,38 |
| **Agriculture biomass** | | |
| Grain straw | 272 700 | 3 861,00 |
| Rape and sunflower straw | 161 300 | 2 223,30 |
| Waste from orchards and vineyards | 50 400 | 528,60 |
| Biogas | 43 530 | 972,50 |
| Biofuel | 5 500 | 214,50 |
| Total | 489 900 | 7 799,90 |
| **Waste from wood processing industry** | | |
| Piece waste | 483 000 | 5 680,10 |
| Fine grained waste | 322 000 | 3 741,70 |
| Liquid waste | 460 000 | 6 440,00 |
| Total | 1 265 000 | 15 861,80 |
| Dregs from the sewage tanks | 31 022 [1)] | 682,50 |
| **Communal waste** | | |
| Communal waste | 177 000 | 1 062,00 |
| Wood communal waste | 133 200 | 1 466,00 |
| Total communal waste | 310 200 | 2 528,00 |
| TOTAL | 2 968 130 | 35 641,58 |
| [1)] $10^3$ $m^3$, tables do not include energy crops | | |

### Forest biomass

Statistics on wood bio fuel production are shown in table 2. The annual thick branch amounts gives table 3. Annual wood fuel production is given in table 4. Technically exploitable energy value potential of wood biomass is shown in figure 1.

*Table 2 Annual thin branch amounts*

| Thin branches | Annual amounts | | |
|---|---|---|---|
| | After felling | After limiting factors taken into account | |
| | | Biological | Biological and technological |
| | (t/year) | (t/year) | (t/year) |
| From conifers | 223 400 | 158 100 | 79 300 |
| From deciduous | 429 200 | 340 600 | 171 440 |
| Total | 652 600 | 498 700 | 250 740 |

*Table 3 Annual thick branch amounts*

| Thick branches | Annual amounts | |
|---|---|---|
| | After felling | After biological and technological limitations taken into account |
| | (t/year) | (t/year) |
| From conifers | 66 100 | 30 680 |
| From deciduous | 88 550 | 45 520 |
| Total | 154 650 | 76 200 |

*Table 4 Yearly wood fuel production*

| Yearly wood fuel production (t/year) | |
|---|---|
| From conifers | 89 300 |
| From deciduous | 234 900 |
| Total | 324 200 |

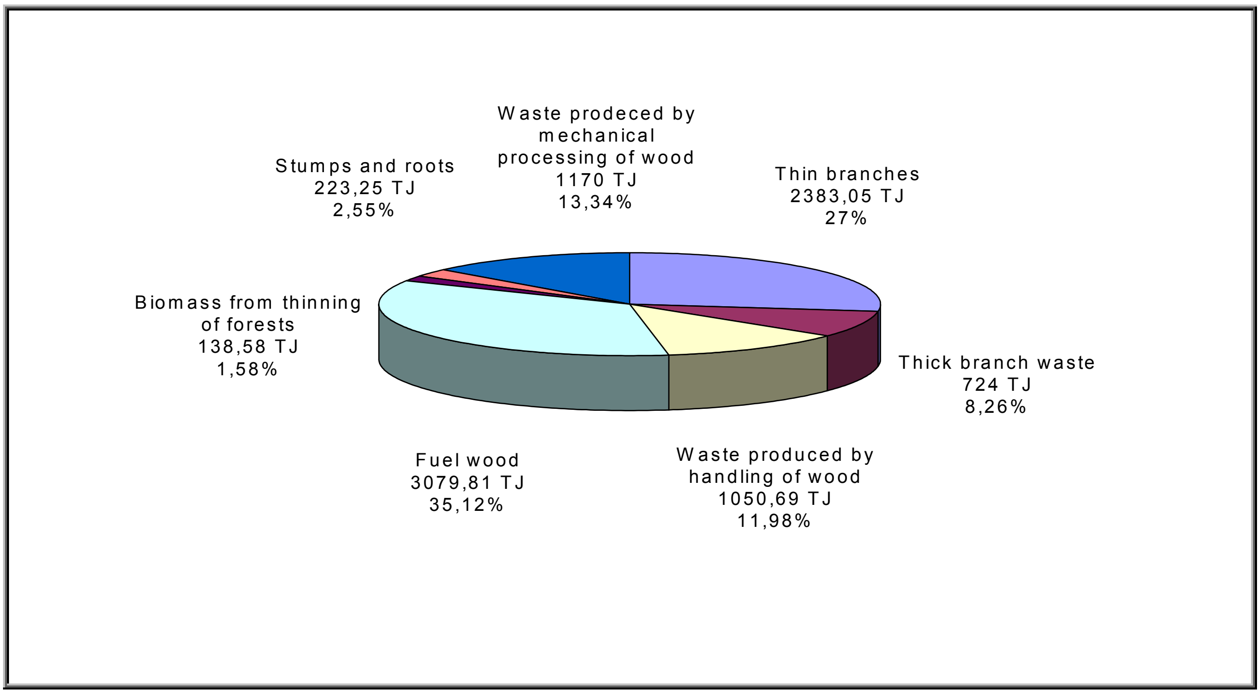
### By-products from wood processing industry

There are 150 small and 21 medium and large enterprises in the wood processing industry of the Slovak Republic. With an annual production capacity of $2{,}9.10^6$ $m^3$ of wood, $1{,}265.10^6$ tons of by-products biomass is produced. Out of this amount, almost two thirds are by-products resulting from mechanical wood processing and one third is so-called black lye. The amounts of wood waste from the wood processing industry is shown in table 5.

*Table 5 Amounts of wood by-products from the wood processing industry*

| Type | | Yearly amount (t/year) | Energy value (TJ/year) |
|---|---|---|---|
| **Piece waste** | wet | 321 000 | 3 040 |
| | dry | 162 000 | 2 640 |
| **Fine waste** | wet | 221 000 | 2 090 |
| | dry | 111 000 | 1 650 |
| **Total** | | 805 000 | 9 420 |
| wet waste: more than 30% moisture content;<br>dry waste: 8-12% moisture content | | | |

*Figure 3: Technically exploitable energy value potential of wood biomass*

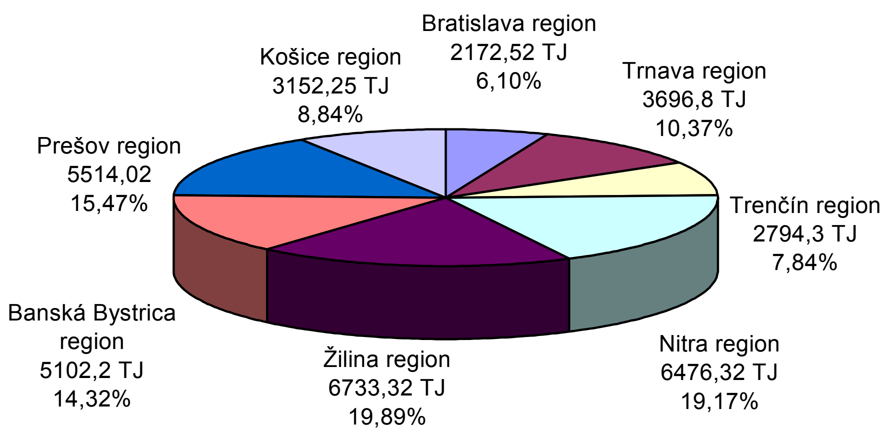


The energy exploitation of black liquor is both location-wise and time-wise dependent on wood processing enterprises in Ružomberok, Vranov nad Topľou and Štúrovo.

**Communal wood residuals**

In figure 2 is shown the exploitable potential of the communal wood residuals by region in Slovakia.

*Figure 4: Energy potential of communal wood remaining by region in Slovakia*




## 2. Energy-environmental relations in Slovakia (cases of particular project solutions)

Relations among energy sources, their exploitation and impacts to environment have specific features.

Slovakia has not own significant fuel-energy sources. Sources of low caloric coal are small with negative impact to environment and that is a reason the mining is in ceasing regime.

Almost 90% of fuel-energy sources are imported, particularly natural gas, crude oil, black coal and nuclear fuel elements. On the other hand must be stated that the renewable energy sources are exploited in smaller scale than it could be appropriate and desirable. The reason of this status is an unprepared base for collection, treatment and technological processing of biomass, and also unsuitable conditions for solar and wind energy utilization. Currently the share of renewables utilization is 3.5% only. From this a major share is represented by small hydro power stations, the biomass is accounting one-third, geothermal energy is only a small fraction and the rest of renewables forms are negligible or even zero.

Total primary energy sources are represented in value of 754 PJ/a and electricity consumption is close to 30 TWh/a.

Total installed electricity capacity of all sources is around 8,500 MW, the largest item is represented by nuclear power stations - 2,640 MW. In the last years higher attention is paid to cogeneration technologies. The total installed capacity of CHP technologies (all categories) is 1,905 MW, classified to:

- 825 MW in conventional (steam) H&P plants;
- 260 MW in gas turbine combined cycle;
- 10 MW in small scale cogeneration units.

With the aim to reduce a negative impact of the energy production on the environment the trend of CHP implementation is visible especially in gas turbine cycle category.

In the next part the particular solutions as "best practice" projects are introduced. From this point of view one can see a better attitude to more effective conversion of fuel to energy and more rational energy management. The subjects of that are as follows:

- Best practice: Gas turbine combined cycle Bratislava
- Best practice: Utilization of unconventional waste gases via cogeneration units in Komarno town

- Best practice: Hydraulic balancing and thermostatic control adjustment of heating systems at company OSBD Martin
- Best practice: Replacement of old, unsuitable boilers with biomass boilers in Bučina company, Zvolen
- Best practice: Modernization of energy system in Žilina hospital
- Best practice: Solar collectors – possible supplementary renewable energy source for preparation Domestic Hot Water (DHW).

**Gas turbine combined cycle Bratislava**

The high power energy source "Gas turbine combined cycle Bratislava" was designed and implemented as the first project of the new energy conception of Slovakia. Within the scope of this it was considered to use more effective sources fueled by natural gas.

The implementation of this project started in 1995 and it was put in operation in 1998. Shareholders companies were established, created from Slovakian power plant and gas companies as members. In competition of several submitted offers the proposal of the German company SIEMENS was chosen. There was chosen a "turn key" mode for providing the project implementation. The total investment costs amounted to 155 Mio. DM.

| Basic parameters of the project: | |
|---|---|
| power capacity | 218 MWe |
| heat supply capacity | 186 MWt |
| there of capacity: in hot water<br>in steam | 157 MWt<br>29 MWt |
| efficiency of electricity production (at terminal of generator): | 46.2% |
| electricity self-consumption at nominal output, maximum: | 4.2 MWe |
| $NO_x$ volume in flue gas, at output ranges 50 - 100% | 51.7 mg/Nm3 |

**Short characteristic**

The gas turbine combined cycle (GTCC) consists of two autonomous thermodynamic cycles:

- gas cycle: compressor, combustion chamber gas turbine
- steam cycle: feed pump, boiler, steam boiler, condenser.

By way of connection/combination of both cycles a higher efficiency of fuel energy conversion into electricity and heat is achieved. It is effected due to higher parameters of working medium and better utilization of energy value.

| The parameters of working medium are as follows | |
|---|---|
| C inlet temperature of medium at gas turbine | 1,060° |
| inlet pressure of medium at gasturbine | 1.05 Mpa |
| outlet temperature | 550°C |
| outlet pressure | 0.103 Mpa |
| inlet temperature at steam turbine | 520°C |
| inlet pressure at steam turbine | 7.9 Mpa |
| outlet temperature of steam | in range 85 - 120°C |

The heat (enthalpy) of steam at turbine outlet is utilized in heating systems (commercial purposes) or in case of non off-take must be degraded by condensation. There is an air-cooled condenser installed. The power and heat production is controlled in such a way, that a maximum of heat supply could be compensated by a small decrease of power production.

GTCC is over-connected to the public grid and to the district heating system "Bratislava - East". Power production is managed via instructions of the Central Dispatching Board in accordance to the course of electricity peaks. Thermal loading and heat supply depend on climate conditions.

It was proved as great advantage, that this GTCC unit is flexible and dynamic, despite of combination of two cycles. That is a reason for classification as a "dispatching source reserve". The gas turbine has an attribute of high acceleration: from zero loading it is able to run to full output (157 $MW_e$) during 10 minutes.

The indicators of operation quality after overcoming the initial problems are stabilized and could be assessed as positive.

At parameters of electricity production efficiency 47% and total energy conversion efficiency 86% a specific consumption of fuel energy with the value of 7.79 GJ/MWh was achieved. For comparison must be noted that the average value of that indicator at other thermal power stations represents 10.75 GJ/MWh.

Concerning to $NO_x$ emissions at permanent, stabilized operation the value 52 mg/Nm$^3$ was achieved. By governmental decree is determined a value of 300 mg/Nm$^3$.

Certain problems, which are occurring, are market-commercial ones. The district heating system in Bratislava has a surplus of heat sources and total heat supply to system due to rational activities has a decreasing tendency. From this reason the advantage of GTCC cannot be utilized in full range.

Besides of the above mentioned good results in efficiency GTCC has a significant employing as peak source and this fact is projected to economy, has a positive influence to pay-back money. The financing model is considering in the first decade of operation the income of peak electricity sale prevailingly. Later it is expected that the income of heat supply will be more important.

Entirely, the GTCC project is appreciated as example one. Experience from construction and operation could be employed at implementation of the next GTCC units.

**Utilization of unconventional waste gases via cogeneration units in Komarno town**

The municipality enterprise of tourism in Komarno has in its competence hotel, camping, geothermal drill, swimming pool as well as wastewater treatment plant and some boiler rooms. Main activity of them is a service for tourists but they have some special problems. With the operation of the thermal swimming pool it was found out that from geothermal drill a mixture of water and gas is flowing. After separation the gas fraction was analyzed. Analysis results:

- $CH_4$ 71.56%
- $C_2H_6$ 0.01%
- $N_2$ 13.8%
- $CO_2$ 14.63%.

For security reasons arose a necessity to solve this problem and to use that gas because free discharging to atmosphere is not allowed. Degasification of water was suggested, by a cascade system of buffer over-connection, and controlling of constant level as well as constant pressure of separated gas.

Next step towards a solution is the suction of separated gas by two units of CHP, type TEDOM 22A. By this way gas is utilized for production of power of heat. Both, power and heat are consumed in neighboring buildings and facilities of a sports area. Economic analyses give interesting results:

- annual exploitation (operational time) 8,300 h/a
- annual power production 157,700 kWh/a
- annual heat production 1,195.2 GJ/a.

The financial evaluation represents savings of non bought electricity from the grid and saved fuel in the value of 454,583 SKK/a. The investment costs of this project are around 600,000 SKK, simple pay-back money time is around 1.3 years.

Because of the specific characteristic of the problem, the project was declared as research task, particularly from the point of operation security.

A similar project of cogeneration unit employing was implemented at a municipal wastewater treatment plant. In this case biogas is utilized arising at organic matter decomposition. In 1999 two CHP units of the type TEDOM 22A PLUS were installed. The composition of biogas is as follows:

- $CH_4$ 67%
- $CO_2$ 32.5%
- $O_2$ 0.5%.

In comparison to geothermal gas there is a disadvantage because this biogas contents sulfur compounds. These have a harmful corrosive impact to equipment. The corrosive protection rises operational costs, despite of it a shorter life-cycle must be considered. Some of the measures carried out are introduced as follows:

- Treating of suction of pipeline of CHP unit;
- modification of heat exchanger (replacement of some parts for stainless steel), construction adjustment for removing of acid deposit from flue gases;
- adjustment of flue gas silencers;
- changing of desulfurization catalyst more frequently;
- modification of cylinder heads at motors with insert elements from “stellit” material.

Due to the above-mentioned measures the operation reliability was improved. The technical-economic parameters are proportionate and projected to economy in a positive way. In the next part the comparison of capacity parameters and efficiencies between natural gas and biogas are introduced.

| | Natural gas | Biogas |
|---|---|---|
| Max. power output ($kW_e$) | 22 | 20 |
| Consumption of natural gas at maximal output | 8.2 | 11.2 |
| Max. thermal output | 45.5 | 43.0 |
| Efficiency of power prod. (%) | 28.4 | 26.7 |
| Efficiency of heat prod. (%) | 58.8 | 57.3 |
| Total efficiency (%) | 87.2 | 84.0 |

Average biogas production per day represents an amount of 6,160 $Nm^3$/day. This is enough for an operation period of 14 hours daily (average). Power production is around 550 kWh per day.

Investment costs of two CHP units amount to 1.4 mln SKK. The simple pay-back money period is 4.48 years.

Like as in the previous case the experience of implementation and operation shows that the projects are repeatable and could be utilized in other cases too, so for geothermal water use as well as at waste water treatment plants.

**Hydraulic balancing and thermostatic control adjustment of heating systems at company OSBD Martin**

The dwelling heating represents a significant item in total heat consumption. Heating systems, especially at enlargement of these ones became sometimes over-dimensioned or under-dimensioned. This fact has an impact on unsteady flowing of heat carrier and heat itself. The result of it is, that in some parts the heating system is overheated and in others there occurs a heat deficit. Similarly, the same situation is at heating corpses - radiators.

There is a necessity to remove these shortages. It is possible to do this via hydraulic balancing and thermostatic control of radiators.

An important project of this kind was the implementation of these methods in heating systems of the company OSBD Martin. The heating systems provide heat supply for 3,639 flats.

Basic data for this project were gained via audit of heat plant and heat distribution net. Investment costs accounted for 17,965,000 SKK, represented a modification of systems, searching and monitoring of hydraulic and thermal relations in systems and hydraulic balancing gradually in all parts. At radiators thermostatic control valves were installed, so correct heating temperature was achieved.

The project has gained also a financial support in the scope of the State Supporting Fund at an amount of 3,000,000 SKK. The following audit and evaluation have shown heat savings of 33,040 GJ per year, which is equal to 9,912,000 SKK. It a simple pay-back period of the investment of 2.06 years.

The project and experiences with hydraulic balancing and thermostatic regulation are valid generally and it is possible to apply them in similar cases.

**Replacement of old, unsuitable boilers by biomass boilers in Bučina company, Zvolen**

In February 1999, there was a heat production recovery contract signed between SES Tlmače and Bučina Zvolen companies. It was a contract for supply of complete technology appliance for energy exploitation of waste biomass from production process. Bučina Zvolen is a well-known wood processing company in Slovakia. Wood is therefore used as a fuel.

Project realization: 1999-2000

| Basic parameters of project | |
|---|---|
| installed boiler name-plate rating | 16t/h |
| temperature of supply water | 105°C |
| fuel | wood waste in pieces (rind, shreds) and fluffy wood waste |
| low fuel heat value | 11-17 MJ/kg (wood waste in pieces) 17,6 MJ/kg (fluffy wood waste) |
| boiler effectiveness at name-plate rating | 84% |
| kind of fuel | wood waste in pieces (rind, shreds) fluffy wood waste |

**Short characteristic**

Wood waste is divided according to its size into wood waste in pieces and fluffy wood waste. Waste in pieces is once again sorted in sorter into bigger pieces and the rest. Then it is crunched in low-speed grinder and it is transported to processing storage. Also the fluffy wood is transported there from storage towers. Mixed fuel then goes from processing storage to boiler's storage chambers.

**Evaluation of project**

There is a significant amelioration in compare to original condition:

- better manipulation and effectiveness increase concerning wood waste exploitation;
- there is a complete combustion of combustion gasses with minimum emissions depended on combustion;
- amount of emission is less than legally permitted maximum.

**Modernization of energy system in Žilina hospital**

<table>
<tr><th colspan="3">Basic parameters of project</th></tr>
<tr><td colspan="2">start date</td><td>September 1998</td></tr>
<tr><td colspan="2">contract duration</td><td>6 years</td></tr>
<tr><td colspan="2">number of estates</td><td>22</td></tr>
<tr><td colspan="2">baseline costs</td><td>17.15 mln per year</td></tr>
<tr><td colspan="2">guaranteed savings</td><td>30,230 GJ/year;<br>2,360,000 kWh/year</td></tr>
<tr><td colspan="2">portion of sponsor at guaranteed savings</td><td>0%- firmly assigned budget for supplier's duties</td></tr>
<tr><td>bonus rule</td><td colspan="2">When guarantee promise is broken, sponsor will obtain 100% of energy savings</td></tr>
<tr><td colspan="2">investment amount</td><td>app. 77 mln SKK</td></tr>
<tr><td>supplier's duties</td><td colspan="2">Management of energy system, financing and implementation of energy saving measures, realization of payment process, maintenance and monitoring</td></tr>
</table>

**Implemented measures:**

- new steam boiler
- 2 co-generation units
- complex operation system and dispatching
- 8 compact heat exchange stations
- modernization of lighting
- hydraulic regulation and thermosetting
- operation system of electric energy demand – ¼ maximum
- heating technology reconstruction in rehabilitation swimming pool.

**Solar collectors**
**possible supplementary renewable energy source for preparation of domestic hot water (DHW)**

**Short characteristic:**

Conversion of solar energy received at the earth's surface in the form of electromagnetic valves into heat performs in a solar collector on the basis of absorption principle. Absorbed heat energy is transferred by a medium (water and glycol) which goes through an absorber directly or through a heat exchanger to a consumer.

One of the most common ways of using solar energy is the preparation of DHW. Solar collectors can play an important role in meeting hot water needs of the public sector. Buildings such as schools, health clinics or pensioner houses, as in our case, often have a constant need for hot water supply all year round, which means that the solar collectors work with maximum efficiency throughout the entire year.

The Institution of Social Care for Old People in Nesluša community is a facility for mental disturbed women. There are 10 women in the facility. The government finances the Institution. The installation of the solar collectors has partially reduced energy costs. The money saved from the state budget can be used now for the improvement of material supply of the facility, level of nursing, and living standards of the inhabitants of the facility.

<table>
<tr><th colspan="3">Basic parameters of project</th></tr>
<tr><td colspan="2">total annual electric energy demand to supply DHW</td><td>18,958 kWh,<br>what is 1,234,47 €</td></tr>
<tr><td colspan="2">total annual coke demand for heating</td><td>9,170 t,<br>what is 810,37 €</td></tr>
<tr><td colspan="2">total annual $CO_2$ emissions from combusting of coke</td><td>28,885 t</td></tr>
<tr><td colspan="2">type</td><td>Heliostar 200</td></tr>
<tr><td colspan="2">solar absorbate</td><td>min 0.94</td></tr>
<tr><td colspan="2">thermic emisivity</td><td>max. 0.16</td></tr>
<tr><td colspan="2">optical efficiency</td><td>80 %</td></tr>
<tr><td colspan="2">max. tention of thermal liquid work</td><td>600 kPa</td></tr>
<tr><td colspan="2">total area</td><td>2.03 $m^2$</td></tr>
<tr><td colspan="2">absorbent area</td><td>1.76 $m^2$</td></tr>
<tr><td colspan="2">energy gains</td><td>700-930 kWh/year</td></tr>
<tr><td>disposition</td><td colspan="2">set up on the south wall with the angle of 45° between the wall and a collector</td></tr>
<tr><td>production</td><td colspan="2">annual surplus of energy produced by solar collectors is 2,200-3,000 kWh/year</td></tr>
<tr><td>savings</td><td colspan="2">solar collectors cover 75% cost for heat water needs in summer time (May-September)</td></tr>
<tr><td colspan="3">annual saved cost using current prices is 0,065 €/kWh, what represents 195,34 €/year savings</td></tr>
<tr><td colspan="3">realization cost: 3020 €</td></tr>
</table>

**Date of realization:**

Implementation of one demonstrative project of using of RES in a selected community in Slovakia is a component part of the project. In terms of climate, technical, time and financial conditions we consider the implementation of the project of the use of solar collectors for heating water as a proper type of using RES.

The solar collectors were installed at the beginning of October 2001.

# Country Report: Slovenia

Climate Technology and Energy Efficiency - Disseminating "Best Practice" Experience

Selected "Best Practice" Projects and Measures in Slovenia

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Energy Restructuring Agency ApE

## 1. Best practice: the case of biomass utilization

**Title of selected policy / project: *Wood Biomass District Heating in Gornji Grad***

**Basic information on the selected project**

Gornji Grad is a town with around 800 inhabitants situated in the mountains north east of Ljubljana. There are around 250 apartments and individual homes, various public buildings, industries, enterprises and sports centers and leisure centers serving the growing tourism. The area is densely forested. The biggest industry, the factory Smreka, which produces prefabricated wooden houses and other timber products, is the major consumer of heat and also the main supplier of wood waste. Smreka has been burning coal for heating and drying wood in old boilers, which needed replacement. Individual households have been using a variety of fuels for heating (coal, light oil, gas and wood). The change of fuel from coal to wood waste and a number of individual boilers to district heating system represented an important contribution to improvement of air quality in the area. The use of wood waste also solved the problem of land filling.

Investments in district heating system totaled SIT 628 mln (1998 prices). Of these, about 65% were spent on the network including substations. Approx. 30% of the total investments were provided as grants by the Ministry of Economic Affairs, EU (PHARE), the Austrian Eco Fund, and other donors. The rest was financed by loans through the Slovenian Eco Fund. The tariffs are comprised of a fixed part and a variable part.

The district heating enterprise ENGO d.o.o. is formed as a private shareholding company owned by the municipality of Gornji Grad (75%) and Smreka (25%). ENGO owns the production facilities, the transmission and the distribution network. The substations are owned by the consumers.

There are 226 individual households in the town and it was expected that 199 of these households would be connected to the district heating network. The heat demand for these houses was estimated to a total of 8,775 MWh per year. SMREKA is estimated to have an annual consumption of 2,250 MWh per year. The other large consumers are estimated to 3,465 MWh per year with a further expansion to 7,680 MWh per year in 2004. The heat loss is estimated to approximately 20%. A maximum heat load of 8 MW was calculated and it was decided to install a bio-fuelled boiler with a capacity of 4 MW. The two step grate boilers, each of 2 MW, have been delivered and installed by KIV Vransko, a Slovenian producer. They are designed for a mixture of dry sawdust and wet wood chips. They are equipped with multi-cyclones for cleaning of the flue-gas and designed to an efficiency of 85%, which should give a basis for installing a flue-gas condenser in the future. The storage is 6m wide, 8m long and 4m high. The wood fuel is removed from the storage by scraper conveyors that feed the wood fuel to a system of screw conveyors.

**Main project components**

The initiative to study possibilities for using the wood waste for the supply of process and space heat was given by Smreka in the early nineties. The municipality was also very interested, so a feasibility study was made, which showed that the project is feasible. Afterwards started the activities to implement the project: project planning, design of the system, searching financing solutions etc.

**Main "success" indicators applied**

The project in Gornji Grad will over the next 20 years also reduce the emissions. Compared to the original individual heating scheme as follows: 83.000 tons of $CO_2$, 100 tons of particles, 230 tons of $SO_2$, and 50 tons of $NO_x$.

One of the unique details of this project is the synergy between a local industry and the municipality. SMREKA is acting as fuel supplier and as well as heat consumer. Apart from SMREKA, a number of residential and municipal consumers are connected to the district heating network and as SMREKA is not able to supply sufficient wood waste for the total heat demand, a number of external fuel suppliers deliver wood waste.

In order to keep the fixed costs low, the main part of activities are outsourced to external parties. The operation and maintenance are contracted to the municipal company Komunala d.o.o. Further, a number of suppliers have entered into a service agreement with ENGO d.o.o. The external accountant is taking care of the billing of the consumers and the general accounting. In relation to legal matters as contracting, ENGO is assisted by an external lawyer. The only permanent staff of the company is the managing director which also is the mayor of the municipality.

**Results / impact / side effects**

The biomass district heating is a welcome addition to the scheme of Gornji Grad as an ecologically sound town, which already includes separate waste collection and some other projects (wastewater treatment plant etc). The green image will help Gornji Grad in developing eco-tourism and production of healthy food. The heat from district heating will also be used for heating the new tourist settlement and greenhouses for production of vegetables.

**Realization problems and difficulties**

The heat sales are the only income for a district heating plant, and the price charged for the heat plays a key role in the budget. The price must be sufficiently low to make it feasible for the consumers to connect and sufficiently high to cover all costs for the plant (operation and maintenance costs, including the repayment of the investment). The tariff level for heat is designed in a way, that households in Gornji Grad should pay 90% of the recent expenses on fuel oil.

The cash flows are investigated every year for a period of 20 years (expected lifetime of the plant). They show that the company runs a deficit the first five years of operation (heavy initial investments). The boiler itself is one of the large parts of the total costs. For Gornji Grad, the price of the boilers were approx. SIT 25 mln per MW. However, this is only a part of the total costs. The district heating system consumes approx. 50-70% of the total investments. In Gornji Grad, the price of the network was approx. SIT 35 mln per km exclusive the substations.

The implication of phase 2 will increase the number of connections to the system, as well as further loan financed investments in the network. In 2004, it is planned that some new large consumers are connected to the system, which will impact positive on the cash flow. An increase in the energy prices in the future could facilitate a rise in the heat price. In general, a district heating system for less densely populated areas can be expensive. A biomass fuelled district heating system will generally rely on grants (between 30% and 50% of the investments) to make it economically feasible.

**Duration / follow-ups / sustainability of the project**

The construction of the district heating plant began in 1998 and it was built to almost full capacity from the start in 1999, whereas the network was projected to be developed in phases. The first phase included SMREKA, some large consumers and a fairly limited number of individual households and it has been already finished. The second phase, which will take place in the near future, foresees the connection of most households and additional large consumers.

**Cases of domestic / international replication**

The biomass district heating systems are going on well in some EU countries such as Austria, Denmark etc. The first information and practical experiences were obtained on the visits of similar systems in Austria. The engineering company from Austria also collaborated at design of the plant. There are going on the activities for another two new projects of biomass district heating systems in Preddvor and Logarska dolina. These two projects were inspired by the Gornji Grad case.

**Main reasons for project success**

It is usually necessary to finance between 30% and 50% of the investments with grants and soft loans. Several institutions are offering grants to projects where the switch to cleaner energy production technology is in focus and this was also the case in Gornji Grad. Since biomass-fired boilers are producing less greenhouse gases than fossil fuel alternatives, there are a number of funds and institutions, both Slovenian and international, e.g. the Slovenian Eco Fund, which is a non-profit oriented financial organization that provides loans for environmental protection investments at favorable interest rates, the World Bank or European Bank for Reconstruction and Development (EBRD), programs of the European Commission (EC) etc., that can help financing biomass projects.

**Pre-requisites / limits / recommendations for successful replication in other transition countries**

This project gives a lot of information and experiences which are welcomed for the development of similar projects in our country and in other transmission countries. The decision to implement a similar project must be done on the analysis of each country's conditions (policy on the use of renewable sources, policy regarding reduction of green house gases, public awareness of benefits of such projects and similar issues). Very important for successful implementation of similar projects is the creation of a positive climate between different actors.

## 2. Best practice: the case of combined heat and power (CHP)

**Title of selected project:** *Co-generation plant in ELAN LINE*

**Basic information on the selected project**

The company ELAN was founded in 1945 to produce alpine skis. During a period of over 50 years the company has grown into an international leisure product manufacturer and became an indispensable companion of physical culture in Slovenia, former Yugoslavia, and in Eastern Europe. Consumption of electricity in ELAN ranges between 7000 and 8000 MWh per year (72 % of total energy costs), while natural gas consumption is app. 13,000 MWh per year (28 %). 600 tons of wood waste from production processes are also consumed each year. Besides space heating and hot sanitary water supply a large share of heat is consumed by the ski gluing presses. In addition to the heat and electricity demands the CHP unit was selected with regard to the existing gas and heat distribution systems in the machine room, investment costs and energy savings and the possibility of quick construction. The selected and installed CATERPILLAR CHP unit was supplied by AMMANN. The gas engine produces nominal outputs of 770 kW electric power and 1,090 kW heat. Hot water is produced with separate high, middle and low temperature circuits. The generator complies with the protection regulations of the power utility company. The CHP plant operation is between 6,000 and 6,800 hours per year. The electricity generated is mostly consumed in the ELAN factory, although occasionally surplus electricity is sold to the utility company. Capital cost for CHP plant were €O 640,000 (1998 fixed prices) and annual savings are estimated €O 245,000 which implies a payback period of 2.6 years.

**Main project components**

The first feasibility study for the CHP plant was made in 1987, but the situation in that time was not favorable for installation. Ten years later a new feasibility study revealed the achievement of substantial energy costs savings, reliability of power supply and efficient use of primary energy sources. With the benefit of a favorable loan the CHP project began in 1997. Project documentation and permits were prepared at the beginning of 1998, when the supplier was selected. Site engineering and equipment installation was completed in December 1998, followed by a commissioning period.

**Main "success" indicators applied**

Constant process heat consumption and unreliable power supply were the main reasons for introducing cogeneration in the company. The CHP unit resulted in substantial energy costs savings, reliability of power supply and efficient use of primary energy sources. In the table are shown data for the eight months period.

During the period of operation the electricity price went down and the price of natural gas went up, resulting in lower net savings and longer PB period. The main savings are due to the reduced use of peak price electric power.

| Operation period January 1999 -August 1999 | | |
|---|---|---|
| *Production & consumption* | | |
| Operation time hours | 5 100 | |
| Electricity generated MWh | 3 100 | |
| Heat generated MWh | 4 000 | |
| Gas consumed Nm³ | 855 000 | |
| *Basis of Analysis (fixed prices)* | *1998* | *1999* |
| Sold generated electricity | 42 000 € | 35 000 € |
| Consumed generated electricity | 136 000 € | 81 000 € |
| Generated heat | 118 000 € | 118 000 € |
| *Costs* | | |
| Maintenance | 24 000 € | 24 000 € |
| Gas | 110 000 € | 131 000 € |
| Net savings over 8 months | 162 000 € | 79 000 € |
| annualized | 245 000 € | 120 000 € |
| Capital cost | 640 000 € | 686 000 € |
| Simple payback period (years) | 2.6 | 5.7 |

**Results / impact / side effects**

The difficulties with reliability of power and heat supply have been successfully overcome. At the same time the CHP plant solved the problem with emergency powering of the most important process consumers. It has also proved to be very successful reducing peak power consumption from the network and supplying adequate heat to the company. It is also important that ELAN can sell its surplus power to the utility company, which makes possible the optimal operation of the CHP unit according to the heat load.

The on-line computer monitoring of the most important operational parameters of CHP unit makes it possible to compare planned and actual monthly results. A thermal efficiency of between 85% and 95% is achieved. Environmental benefits are also recognized.

The benefits of the CHP plant will be even more outstanding when other measures for the efficient use of energy are carried out in the company.

**Realization problems and difficulties**

Despite the undisputed advantages of co-generation, numerous obstacles were encountered, which affect the economics and consequentially deter potential investors. As an important obstacle we must consider the non-existence of long-term stability in prices, price control and the discrepancy between the prices of electricity and those of fuels. This is connected to non-stable profits and problems with long-term contracts with the utilities. Poorly defined legal framework of operation of co-generation plants may also be enumerated among significant obstacles. An obstacle is also the availability and high costs of capital. Except for the option of achieving a soft-loan or grants through the public tenders initiated by the Ministry of economic affairs (Agency for Efficient Use of Energy), there are practically no other options to the potential investors for low costs capital. In Slovenia the main economic, institutional, regulatory, and information barriers, which prevent the wider use of co-generation are:

- low and unstable electricity prices, high subsidies for energy utilities,
- no environmental factor in energy prices,
- high interest rates,
- lack of private/foreign investment,
- lack of legislation and regulatory framework,
- lack of supportive involvement of the electricity sector,
- lack of information for small and medium scale CHP,
- few local CHP plants.

**Duration / follow-ups / sustainability of the project**

Overall, it took nearly two years (1997 - 1998) to implement the CHP plant from concept to operation.

**Cases of domestic replication**

The Slovenian Government has stated that it wishes to promote and support the further development of CHP in Slovenia. Past estimates suggest that the potential market for cogeneration in Slovenia is in the order of 140MW$_e$ (capacity) supplying approximately 3 PJ$_e$/year of electricity (840 GWh/year). The Energy Conservation Strategy for Slovenia suggests these estimates to be conservative and identifies a longer term potential of 660MW$_e$ in three areas:

- replacement of heating systems within existing DH schemes to use gas turbine technology,
- expanding industrial CHP capacity to its cost effective limit at 1993 fuel prices,
- expanding DH schemes with associated increases in CHP.

Of these measures, the most cost effective area is CHP in industry and compares very favorably with investment costs of CHP in existing DH schemes.

**Main reasons for project success**

The economic and energy savings and the reliability of electricity supply as well as the provision of high quality heat were the facts which finally convinced the management of the Elan to invest in CHP. The very high power peaks and their costs were also a problem, which was avoided with the CHP.

**Pre-requisites / limits / recommendations for successful replication in other transition countries**

The project is a good example of CHP unit installation in Slovenia and can be taken as the best case for similar investments in some other transition country. Very important base for a development of such projects is that a country states its support to CHP and has an energy policy that puts incentives on investments in energy efficient systems.

## 3. Best practice: thermal energy conservation in the building sector

**Title of selected policy / project:** *Encourages of measurers for energy efficiency in households: Subsidies for energy efficient windows and glasses renovation in the year 2000*

**Basic information on the selected policy / project**

In the year 2000 there was the third public call for allocation of subsidies for building in energy efficient windows and glasses. On the base of results of public calls from previous years, it was noticed a tendency that more and more applicants decided to build in energy efficient products, which accord with criteria of previous public calls. The cause of this tendency is a possibility to submit an application form for subsidies.

Encourages of measurements in households have a great effect on the decision to invest in energy efficiency and on selection of appropriate materials, products and technologies. Before this project there have been subsidies mainly for less costly investments with shorter pay back period (setting up and control of oil burners, insulation of attics, windows and doors sealing, distribution of energy efficient electric bulbs, etc.).

The project was carried out by AURE (Agency for Efficient Energy Use) which is part of the Ministry of Environment and Spatial Planning. The budget for this project was 50 mln SIT (230,000 €).

**Main project components / policy instruments**

The objective of this project is stimulation of usage of energy efficient glasses and windows. The policy instrument used in this project are subsidies, which represents a compensation for an investor who decided to invest in glasses and windows with better thermal characteristics. Criteria for allocation of subsidies were:

| | Investment | Subsidy amount | Calculation of subsidy |
|---|---|---|---|
| A | glass exchange | 3.000 SIT (13,64 €)/m2<br>max 30.000 SIT (136,4 €) per household | glass area without window frame |
| B | new windows for new buildings | 3.000 SIT (13,64 €)/m2<br>max 30.000 SIT (136,4 €) per household | windows area and factor 0,8 regarding the relation glass area window area |
| C | new windows for old buildings | 5.500 SIT (25 €)/m2<br>max 66.000 SIT (300 €) per household | windows area |
| D | windows frame exchange | 5.500 SIT (25 €)/m2<br>max 66.000 SIT (300 €) per household | windows area |

There was a general condition regarding the fact, that the applicant can submit an application form only for an investment that has been already done.

**Main "success" indicators applied**

It was expected that something more than 500 households would reply on the public call and send their application form. At the end the figure almost doubled: 1,123 households replayed on that call. The rate of subsidies approved was a little bit more than 80%. This means that 1,034 households got the subsidy from 1,123 households that had sent the application form.

On the base of formally complete application forms there have been signed contracts in the amount of app. 47,8 mln SIT (217.000 €). Average subsidy per applicant was app. 46.260 SIT (210 €). Average subsidy/investment rate was 6,7%.

Results of project (taking into consideration only 1,034 households who received subsidy):

| | |
|---|---|
| windows and glass built in | 15.458 m2 |
| energy savings (quantity) | 4434 MWh/year |
| energy savings (value) | 34,12 mln SIT (155.000 €) |
| $CO_2$ savings | 939 t $CO_2$ |
| pay back period for subsidy | 1,4 year |
| total investments | 720 mio SIT (3,3 mio €) |
| total subsidies | 47,8 mio SIT (217.000 €) |
| subsidy rate | 6,7% |
| average subsidy per applicant | 46.260 SIT (210 €) |

**Results / impact / side effects**

Rapidly increasing of energy efficient windows and glassing, estimated of 3% in the year 1998 to near 50% in the year 2000.

The project is an important factor at improving a pay back period for this kind of investment. Estimation of the pay back period for investment in energy efficient windows and glasses is 15-20 years without subsidies. Taking into consideration app. 7% of subsidy, the pay back period is lower for 2-3 years.

The project had a special positive promotion effect on the general application of energy efficient use in households and on the use of energy consultancy services for households, because the network of energy consultancy offices in Slovenia was included in the preparation of application forms (investment in windows and glass renovation, planned by households, had to be approved by energy consultants before the submittal of application form). Indirect result of this project is the increased awareness of energy consultancy network and recognition of its services.

**Realization problems and difficulties**

The project leaders dealt with a very wide range of documentation, because of the high number of application forms. Over 50% of received documentation was incorrect and had to be improved in correlation with corresponding conditions and regulations.

There were also some problems with misunderstanding when some media did not check the time schedule or verify the information about project status and then gave the wrong information to the public.

**Duration / follow-ups / sustainability of the project / policy**

There were 3 separate actions in the years 1998,1999 and 2000. A comparison of effects of up to day actions to encourage energy efficiency savings in households shows:

| | | 1998 | 1999 | 2000 | Total |
|---|---|---|---|---|---|
| Heating area | M2 | 3.854 | 8.977 | 15.458 | 24.435 |
| Savings | MWh | 814 | 1.653 | 4.434 | 6.087 |
| Number of subsidies | | 289 | 673 | 1034 | 1.707 |
| Value of subsidies | Mio SIT | 11,5 | 30 | 47,833 | 78,433 |

Extended renovation of windows process is still not in progress in correlation to the great efficiency potential. Additional state action is estimated to be useful and the measures of thermal standard regulations will be followed.

**Cases of domestic / international replication**

First case of adequate action of Municipality in the year 2000.

**Main reasons for policy / project success**

Successful information dissemination to customers, commercial energy efficiency windows offer improved, quality regulated system has been established on the market.

**Pre-requisites / limits / recommendations for successful replication in other transition countries**

Subsidizing scheme developed, investment capital insurance, transparent objective criteria use, quality verification support institutions (public quality insurance system).

## 4. Best practice: energy service companies (ESCOs) and third party financing

**Title of selected project:** *Support for the promotion of Third Party Financing of energy efficiency investments in Slovenia*

**Basic information on the selected policy / project**

Slovenia has, similar to other transformation countries, a considerable economically detectable energy saving potential in industry, service, and building sector. Only in the public sector the total energy saving potential is assumed to be 34% of consumed energy, which amounts to 17 million €O. The disclosure of this potential asks for extensive investment and operation modernization, but financing of energy saving investments is often opposed by restrictions in money and juridical obstacles.

The currently on-going project *"Support for the Promotion of Third Party Financing of Energy Efficiency Investments in Slovenia"* within the Transform Program in the frame of the bilateral co-operation between Slovenia and Germany is aimed at supporting the sustainable increase of energy efficiency in Slovenia by overcoming the above mentioned restrictions to financing of energy saving investments. The main overall objective of the project is to promote third party financing *(TPF)* as an appropriate and powerful financing instrument for efficient energy use in Slovenia. Further overall objectives are to improve the competitiveness of the Slovenian economy, support its integration into the €opean structures, and to protect the environment.

**Main project components / policy instruments**

The project, which started in the year 1999, is divided into three phases. Within the first phase the basic conditions for TPF in Slovenia have been evaluated. As an appropriate target group of TPF users the non commercial public sector, known for its lack of money for financing necessary energy saving investments out of the public budget, has been identified, and enterprises which offer investment goods or services for energy saving have been seen as potential TPF providers. It was also established that several laws and administration directives are not suitable to the demands of TPF projects.

The second phase of the project is aimed at the promotion of performance contracting *(PC)* as a suitable instrument for organization and financing of the realization of rational energy use in the Slovenian public sector. The emphasis is on making potential providers and users aware and informed about PC and motivate them for the realization of the TPF projects. The PC model contracts were revised and adopted to Slovene conditions and a pilot project of PC in one of Slovene municipalities has been initiated and is currently in the phase of negotiations.

Simultaneously with the second phase of the project is already on-going also the third phase. The aim of this phase is to promote another TPF method, energy supply or delivery contracting *(DC)*, and to offer an awareness campaign for the broader implementation of the PC and DC schemes in Slovenia. Following the successful promotional workshop held within the second phase another workshop is going to be organized and promotional brochures on PC and DC are going to be published.

**Main "success" indicators applied**

The main success indicator of the project is the promotion of TPF through the pilot project, which is not yet finished, the number of municipalities interested in carrying out similar projects by themselves and a number of participants attending the promotional workshops. The pilot project is currently in the phase of negotiations and at least one other municipality is showing a substantial interest in carrying out a PC project. While the first workshop was attended by over 40 potential TPF users in public sector and potential TPF providers, the second workshop is still going to be organized.

**Results / impact / side effects**

With the adaptation of the PC model contract to Slovene conditions and a successful promotional workshop on TPF and especially PC with participation of over 40 potential users in public sector and potential providers, a considerable interest for TPF was raised. Out of the 50 biggest Slovene municipalities invited to participate in the project, 9 municipalities showed interest for implementing the PC model and 3 were chosen for a detailed analysis of the energy supply and use. As a pilot project one of these municipalities has successfully carried out the tendering procedure and is now in the phase of negotiations with the TPF provider.

**Realization problems and difficulties**

Introducing of TPF as a new financing tool in Slovenia needs a considerable support from the state, which was partly hindered by the Government instabilities in the year 2000, and resulted in the need for the prolongation of the project, which was also partly caused by the time consuming adaptation of the PC model contract to Slovene legislation. A lack of experiences about TPF and PC on all sides caused a lot of problems in the phase of preparing the tender documentation and carrying out the tendering procedure. Because of the uncertainties and risks connected with TPF on the providers side, some more time is going to be needed for more Slovene providers to offer this service. One of the major problems for the providers showed up to be especially a poor overview of the supply and use of energy in the public sector, which makes an estimation of the energy reduction potential difficult.

**Duration / follow-ups / sustainability of the project / policy**

The project started in 1999 and it is going to be finished at the beginning of 2002. For the further promotion of TPF in Slovenia and support of the pilot project and other TPF users in public sector it is essential to continue the work started in this project. The Agency for Efficient Use of Energy within the Ministry of Environment and Spatial Planning has therefore decided to support another project in this area for the next 2 years, which is overall aimed at the improvement of energy efficiency in Slovenia by using innovative financing schemes. With the fulfillment of the main objectives of this coming up project, further promotion of TPF, continuous fostering and support of the new investments in energy efficiency or decentralized energy production using TPF schemes, stimulation of EU and local TPF providers to enter the Slovenian market, and the development of the national TPF program, represent a new project in a logical continuation and gives an additional value to the work already done.

**Cases of domestic/international replication**

Experiences learned through the first pilot project are going to be used for improving the whole approach to TPF and PC in Slovene public sector. More information and easier TPF procedure are going to contribute to the replication of the first pilot project on PC in other bigger Slovene municipalities, hospitals and perhaps also in smaller and medium enterprises. The experiences gained are also going to be exchanged with other countries within the coming up project.

**Main reasons for policy / project success**

The main task of the project, promotion of TPF through the pilot project, is not yet finished, which makes it difficult to already measure the final success of the project. Until the end of the project there are foreseen also the organization of another promotional workshop and the publication of promotional brochures about performance and delivery contracting.

**Pre-requisites / limits / recommendations for successful replication in other transition countries**

With the transfer of the foreign experiences, models, and approaches, especially if they are so closely related to different legal and financial aspects as TPF is, it is essential not just to transfer the existing models and approaches but to adopt them to the specific country conditions. The replication of the Slovene project is therefore possible also abroad, but only by taking into account other countries´ particularities.

## 5. Best practice: Rational energy use in industry and household appliances

**Title of selected policy/project:** *Energy Saving Fund for Energy Efficiency Investments in Slovenia*

**Basic information on the selected policy / project**

To realize the goals from the National Energy Strategy in terms of improving energy efficiency, supporting of energy efficiency investments is crucial. Therefore, an energy efficiency investment fund was established. The fund goal is to provide the industrial enterprises, institutions and building managers with financial resources under attractive interest rates, and thereby to decrease energy costs in the long term.

The fund is not organized as a legal entity, therefore an innovative organization scheme had to be developed. With a joint effort of European Commission, Ministry of Finance, and Ministry of Economic Affairs, the organization is optimized in a manner, that rational granting of loans is secured.

**Main project components / policy instruments**

The Fund is supplied from a mix of financial sources. The commercial part of the Fund is provided by the fund manager in a value of 10 million €O. An attractive all-in interest rate on the level of 60% of commercial interest rate is achieved by a grant from the national budget of the Republic of Slovenia in a value of 300 mln SIT for interest rate subsidy and by a zero-interest loan granted by the European Union PHARE Program in a value of 2 million €O. This is an advantage of this fund in comparison to other Slovene funds.

The blending of the funds is the responsibility of the bank awarded the contract of managing the Fund. The values of the elements of the total endowment and its employment allow an interest rate 40% lower than commercial interest rates. The amount of any loan is limited to the minimum value of €O 50,000 and to the maximum value of €O 500,000. The maturity of any loan is limited to the maximum of 8 years including a grace period of maximum 2 years for the commencement of principal repayment.

Following the main purpose of the Fund, the most important criteria for the projects is, that the direct energy savings resulting from implementation of the investment which forms the object of the loan should, in monetary terms, be projected to provide at least half the return on the investment share financed by the loan.

**Main "success" indicators applied**

The relatively high cost-effective saving potential of 20% in the industry and 30% in the buildings implicating an amount of close to 200 millions €O of investments in the industry and 800 million €O of investments in the building sector, requires a comprehensive approach to stimulate energy users for energy savings and to create a proper environment for energy efficiency investments.

Till the end of the second quarter of 2001 the Fund has granted 1,751 mln SIT of loans for energy efficiency projects. Loans were granted to 21 applicants for 24 projects. 20 of these projects are already in function and operating.

**Results / impact / side effects**

The Energy Saving Fund has a unique organizational scheme in the Slovene funds field. The most important advantage is, that the fund is not a legal person, but just a logical organizational scheme with minimum operational costs.

Experiences given from the evaluation procedures of the projects submitted to the Fund, confirm that the projects of the borrowers, which were included in the supporting programs, particularly those with performed energy audits, passed the evaluation procedures smoothly and with high cost benefit ratio, while for others improvements were required or they were rejected.

**Realization problems and difficulties**

The Fund itself is not sufficient to increase energy efficiency investments. To assure a successful operation of the Fund, a number of complementary measures were developed and supported from the governmental budget. Among all, the most important are: energy advising for large industrial energy consumers, an energy audit supporting scheme, a feasibility studies supporting scheme, demonstration projects for energy efficiency investment. With those activities we succeed to create a good environment for energy efficiency investments.

**Duration / follow-ups / sustainability of the project / policy**

The Fund was established in December 1997 and it started with operation in beginning 1998. It operates on a revolving principle. The planned term of fund operation is ten years.

**Cases of domestic / international replication**

Not known.

**Main reasons for policy / project success**

Successful operation of the Fund for energy efficiency investment is not only depending on its attractive interest rate and longer repayment, but also on other supporting programs, starting from education, information, and awareness building to stimulating preparatory activities for energy efficiency investments.

The overall success of such an approach can only be achieved if some state institution (like the Agency for Energy Efficiency of the Republic of Slovenia) is responsible to harmonize the design, scope and timing of the fund activities and the supporting programs.

**Pre-requisites / limits / recommendations for successful replication in other transition countries**

This Slovene project can be replicated in other transition countries, but it is necessary to take into account the specific country's conditions.

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# Country Report: Ukraine

Selected “Best Practice” Projects and Measures in Ukraine

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## 1. $CO_2$ reduction and energy saving in wood processing industry of Ukraine

**Basic information**

Ukraine has a rather big potential of wood biomass that can be used as fuel – about 1.1 mtoe/year. A big amount of wood residues (0.206 mtoe/year) is generated at timber and woodworking enterprises and can be used at zero cost. The most reasonable way of wood residues utilization is direct combustion. This idea was demonstrated in the Netherlands-Ukraine technical assistance project “$CO_2$ reduction and energy saving in wood processing industry of Ukraine” supported by PSO-program. The project was carried out in 1999-2001. The main goal of the project lay in demonstration of economically efficient implementation of modern boiler equipment operating on wood biomass.

Involved parties were Senter Internationaal (the Netherlands) - financing, KARA Energy Systems (the Netherlands) – equipment supplier, TNO-MEP (the Netherlands) – project manager, “Odek Ukraine” Ltd. (Ukraine) - recipient, Scientific Engineering Centre “Biomass” (Ukraine) – local project manager. Capital investments came to about 500,000 $ of Dutch grant plus 20,000 $ of recipient’s contribution.

**Activity on the project**

Activity carried out within the frame of the project included: delivery and installation of 5 MW steam wood-fired boiler at “Odek Ukraine” – veneer plant in Orzhiv, Rivne oblast; starting-up and adjustment of the boiler equipment; training course for boiler operators; dissemination of knowledge and project results.

**Success indicators**

Put into operation in August 2000 the steam boiler covers 70% of the veneer plant’s demand in process steam. That gave an opportunity to take gas boilers out of operation. Tthe technical and economic parameters of a 5 MW wood-fired boiler demonstrated during one-year operation are presented below.

| Technical parameters | Economic parameters |
|---|---|
| Nominal thermal capacity, MW 5 | Capital costs, thous. $ 520 |
| Operation time, hr/year 8000 | Operational costs, thous. $ 93 |
| Steam production, t/year 7.8 | Fuel cost, $/t 0 |
| Steam pressure, bar 10 | Prime cost of heat, $/GJ 0.9<br>$/MWh 3.3 |
| Furnace type moving grate | |
| Fuel consumption (50%), t/year 15750 | Saved natural gas, thous. $/yr 224 |
| Heating value of fuel, MJ/kg 8 | $CO_2$ emission reduction costs, $/t 4.6 |
| Heat production, GJ/year 100800 | Payback period 2.3 |
| Saved natural gas, mill $m^3$/yr 2.8 | |
| Reduction of $CO_2$ emission, thous. t/yr 9.8 | |

**Impact / Side effects**

Putting into operation of a new 5 MW wood-fired boiler let the enterprise enlarge production of finished product and plan further development.

**Realization problems and difficulties**

The only serious problem connected with project realization lay in passing of the foreign boiler through certification procedure in Ukraine. Due to differences in Dutch and Ukrainian rules on boiler construction, it took much time and efforts to adjust the design of boiler installation to Ukrainian rules. There was also one technical problem connected with the fact that the enterprise had wood wastes with 50% average moisture content but with moisture fluctuations from 30% to 60%. Operation of the furnace on dry wood fuel during long time causes the increase of temperature inside the furnace and may lead to melting of firebricks. Special adaptation of automatics and control system was done to avoid this problem.

**Follow-ups**

The project results have been published in several papers. A final seminar devoted to detail statement of project results was held after the end of the project. Now follow-up activity is aimed at looking for potential investors/financing to replicate the project or to launch the production of wood-fired boilers in Ukraine.

**Cases of domestic replication**

Within the frame of the same The Netherlands-Ukraine technical assistance project the second steam wood-fired boiler of 1.5 MW capacity was installed at Malin timber enterprise (Ukraine). Besides that, so far there is not any case of project replication in Ukraine. Potential of wood residues available at timber and wood processing enterprises of Ukraine let install about 180 boilers of 1.5 MW average capacity.

**Success factors**

Main reasons for project success are as follows:

- Zero cost of the fuel for wood-fired boiler.
- Replacement of natural gas by wood residues that results in good economic indices.
- All-the-year-round consumption of produced steam that results in good economic indices.

**Recommendations for successful replication**

It should be mentioned that only equipment delivered within the frame of technical assistance projects is free from custom duties and VAT. In other cases when purchasing equipment abroad, custom duties are 25% of equipment cost and VAT is 20%. Because of that, the final cost of the equipment increases significantly and such conditions are hardly acceptable for most Ukrainian enterprises. So it is reasonable to establish joint ventures for production of wood-fired boilers in Ukraine. In that case the price of equipment will be much less as compared with foreign boilers, and it will encourage implementation of the boilers at Ukrainian enterprises.

Another important factor influencing project replication is that a lot of Ukrainian timber and wood working enterprises have self-reconstructed wood-fired boilers. Such boilers were originally designed for coal and oil combustion and later on converted to wood combustion by the enterprises' strength. As a rule such boilers have fixed grates, batch fuel loading, low efficiency and high emission. But they are cheap and suit the enterprises. Therefore, wood-fired boilers that will be produced in Ukraine must be competitive not only with expensive foreign equipment but first of all with existing self-converted wood-fired boilers. Thus, conditions for successful replication of the project are as follows:

- An enterprise has enough amount of free of charge or cheap wood residues.
- An enterprise has the whole-year consumption of produced heat/process steam.
- An enterprise is financially stable and has good prospects for development.
- The best economic indicators will be in the case of fossil fuel (as a rule gas or oil) replacement.

## 2. Implementation of CHP plant on the basis of "Yuzhnaya" boiler house, Zaporizhzhia, Ukraine

**Basic information**

The project is based on a new approach to CHP production - building of CHP plants on the basis of existing thermal-technological processes (boilers, kilns and other equipment operating on natural gas). Thermal equipment is overbuilt by gas turbine or gas reciprocating power units. Advantages of such scheme are as follows: guaranteed heat consumption, up to 40% fuel saving as compared with separate heat and power production, high coefficient of fuel use – 0.8-0.92, positive environmental effect. Efficiency of driving engine is not so important for such kind of CHP plants (it influences mainly the produced heat and power ratio). This fact creates wide opportunities for applying out-of-date gas-turbine units, which are available in big amount in Ukraine. These units are much cheaper than modern ones and as a rule have long enough life time. Especially it concerns mobile gas-turbine power plants of PAES-2500 type manufactured by the enterprise "Motor-Sich" (Zaporizhzhia). Based on the powerful and distributed district heating network existing in Ukraine, it is economically reasonable to build CHP plants on the basis of steam and hot-water boilers. Thus, the main goal of the project is demonstration of successful operation of such type CHP plant constructed on the basis of "Yuzhnaya" boiler house intended for hot water supply of Zaporizhzhia. According to CHP plant flow-sheet diagram, exhaust gases from the 2.5 MW gas-turbine power generator AI-2500 (updated by ZMKB "Progress") come to boiler-utilizer providing 5.38 MW thermal capacity. Then the gases are directed into three KVGM-6.5 hot-water boilers, in which additional fuel is combusted. Contact heat exchangers (scrubbers) are installed after the boilers for deeper utilization of flue gas heat. The heat is spent in water-water heat-exchanger for preheating of water from the hot-water supply system. Application of deep cooling of flue gases results in 13-15% fuel saving and 10-12.5% increase of boiler efficiency, which after modernization comes to 19.3 MW. The next parties are involved in the project: OJSC "Rassvet" (Zaporizhzhia, Ukraine) and the Institute of Engineering Thermophysics of the National Academy of Sciences of Ukraine (Kyiv, Ukraine). Capital investments on the project are 1,300 US$ (financing is realized through commercial credit taken by "Rassvet").

**Success indicators**

Technical and economic parameters of CHP plant are presented in the table below.

**Activity on the project**

Activity planned within the frame of the project is as follows: development of CHP plant design; installation of 2.5 MW gas turbine power generator at "Yuzhnaya" boiler house; starting-up and adjustment of the plant; test operation and operational monitoring; dissemination of knowledge and project results. The CHP plant has been commissioned in November 2001.

**Impact / side effects**

After-burning of exhaust gases from the gas turbine in hot-water boilers reduces the $NO_x$ emission by 30-50% as compared with operation of the gas turbine without after-burning. Another side effect of CHP plant is connected with new jobs creation both on the place of exploitation and at gas-turbine manufacturing plant.

**Realization problems and difficulties**

Project realization was not connected with essential problems. The main difficulty lay in carrying out all necessary activities within the limits of available financing. Some administrative problems were connected with the necessity to obtain permission for supplying power to the grid.

| **Technical characteristics** | **Operation program** |
|---|---|
| Power capacity 2500 kW<br>Thermal capacity 71.2 GJ/hr<br>Gas consumption in gas turbine 1108 nm$^3$/hr<br>Gas consumption in boilers 1570 nm$^3$/hr<br>Gas consumption in boilers<br>Before reconstruction 2670 nm$^3$/hr | Operation time 8000 hr<br>Power production 18 mill kWh/yr; 347 thous. $/yr<br>Heat production 569840 GJ/yr; 1399 thous. $/yr<br>Total 1746 thous. $/yr |
| **Operating costs** | **Economic parameters** |
| Total gas consumption 21.4 mill. m$^3$/yr<br>Gas costs 959 thous. $/yr<br>Other costs 323 thous. $/yr<br>Total 1282 thous. $/yr | Capital investments 1308 thous. $<br>Specific capital investments 500 $/kW$_e$<br>Prime cost of electricity 0.016 $/kWh<br>Prime cost of heat 1.86 $/GJ<br>Saving of natural gas 14 mill m$^3$/yr;<br>**Payback period 2.8 years** |
| Avoidance of $CO_2$ emission 27.5 thous. t/yr<br>Costs of $CO_2$ emission reduction 2.4 $/t $CO_2$ | |

**Follow-ups**

The CHP plant at "Yuzhnaya" boiler house is the first operating plant of such type in Ukraine. The plant will demonstrate to general public and potential customers the big economic advantages of combined heat and power production based on existing thermal generators operating on gas fuel.

**Cases of domestic replication**

Now there are no examples yet of replication of such a project in Ukraine. There are about 20 potential clients waiting for first results of "Yuzhnaya" CHP plant exploitation.

**Success factors**

Main reasons for project success are as follows:

- Low specific capital investments (500 $/kWe).
- Existing all-the-year-round heat consumption (boilers KVGM-6.5 for hot water supply).
- Short payback period (2.8 years).
- All components of equipment are of Ukrainian manufacture.

**Recommendations for successful replication**

The project has good prospects for replication. Ukraine has a powerful and distributed heating network operating on natural gas. From technical and economic point of view it is reasonable to construct CHP plants on the basis of standard (most common used) hot-water boilers PTVM-30. Such boiler installation can be built with a 2.5 MW gas-turbine unit. Preliminary calculations show that the specific fuel rate for power production in that case is 98-133g of oil equivalent per kWh which is 2-2.5 times less than the indicator for a typical power plant of the condensation type. Another big niche for implementation of CHP technologies/replication of project results would be enterprises with available natural gas and powerful heat-generators (for instance, kilns for baking of claydite or cement kilns). Introduction of CHP plants at the enterprise lets reduce prime cost of the end product due to generation of own cheap electricity. Thus, the best places for successful replication of the project are the following:

On the basis of standard gas-fired hot-water boilers for district heating and hot water supply.

On the basis of industrial powerful heat-generators operating on natural gas with long operation period.

Complex implementation of such type CHP plants in Ukraine can result in gas saving of about 25,000 mln $m^3$/yr, $CO_2$ emission reduction – 17 mln t/yr, electricity production – 116,271 mln kWh/yr, savings on costs due to reduction of gas consumption – 1,123 mln $/yr.

## 3. Kiev public buildings energy efficiency investment project

The government of Ukraine, through the State Committee for Energy Conservation (State Committee) has confirmed the possibility of implementing energy efficiency measures in state and municipal public buildings in the city of Kiev. The State Committee entered into an agreement with the U.S. Department of Energy to assess the efficiency potential in the public buildings sector in Kiev. Results of this assessment were used to support a loan of the World Bank for financing of the Kiev public buildings energy efficiency investment project .

The advantage of public buildings with respect to implementing efficiency improvements are presence of only one owner, which allows using only one set of equipment, and occupancy schedule that allows reduced temperatures during nights, weekends and holidays.

The prepared investment project covers more than 1,300 buildings of hospitals, polyclinics, kindergartens, schools, cultural institutions, with total annual heat consumption of more than 1 million Gcal. Quick-return measures were selected for implementation, such as upgrading building substations with installation of heat meters and consumption controls, weatherization of windows and doors, installation of radiator reflectors, faucet aerators and low-flow shower heads, installation of hot water heat exchangers and hot water controls in individual substations. Estimated heat energy savings from recommended measures make up about 27% of baseline consumption, or 298 Gcal/year.

The program also included an assessment of lending and implementation schemes. The demonstration project in four Kiev schools targeted at finalizing technical aspects of the implementation process and verifying the cost and performance of the ECOs was implemented.

The estimated energy efficiency potential improvements can result in the reduction of heat consumption by approximately 25%, which translates into about $8.5 million of annual budget savings. Total investment requirements make $38 million. The internal rate of return, by major building category, ranges from 13% to 32%, with a weighted average of 29%. The proposed project also would have secondary benefits including reduced air pollutant emissions, increased employment, reduced energy imports, and development of energy services infrastructure that could be replicated in other sectors of economy.

The assessment was conducted by the Pacific Northwest National Laboratory (PNNL) and its subcontractors, Tysak Engineering, a U.S.-based engineering consultancy; and the Agency for Rational Energy Use and Ecology (ARENA-ECO), a Ukrainian non-governmental organization that specializes in energy efficiency assessments.

**Indicators:**

| | |
|---|---|
| Total investments | $ 30.4 million |
| Implementation period | 5 years |
| Average annual costs savings | about $ 4.1 mln/year |
| Net present value (discount rate 10% | $ 3.7 mln |
| Internal rate of return | 13%; |
| Payback period | about 7 years |
| Fuel savings | 58.1 thous. t.c.e./year |
| Emissions reduction | $NO_x$ – 238 t/year; $SO_2$ – 166 t/year; $CO_2$ – 61,183 t/year |

**Sources of financing:**

World Bank (loan $18.3 million),
Kiev Municipality (internal financing $ 10.1 million),
Swedish agency SIDA (grant $ 2 million).

**Stage of the project cycle:** implementation.

## 4. Energy efficiency in residential buildings

There exists a substantial cost-effective potential for energy efficiency improvement related to heat consumption in Ukrainian buildings.

On initiative of Swiss Agency for Development and Cooperation (SDC) and with support of the State Committee of Ukraine for Energy Conservation, the Agency for Rational Energy Use and Ecology in cooperation with INFRAS consulting firm is implementing a project on energy efficiency improvement in residential buildings.

The project preparation phase determined low-cost energy efficiency measures in cooperatively owned residential buildings as the primary target for sustainable financing. Investment-grade energy audits were implemented in several typical buildings and most feasible efficiency measures were identified. They include building-level heat energy and water metering, apartment-level hot water metering, heat consumption regulation, installation of radiator reflectors in apartments, heat insulation of pipes and balancing of building heating system, and offer attractive returns in terms of overall energy cost savings. The pilot implementation of efficiency measures was performed on two residential buildings in Kiev (9-storey and 12-storey high with more than 150 apartments owned by housing cooperatives) under joint financing of local authorities and SDC.

The major focus of the project is on developing and staring sustainable mechanism for financing energy efficiency in residential sector. Based on discussions with local authorities, the idea of a special-purpose revolving fund was suggested as the most viable fund. This scheme is being tested now on the pilot buildings and includes shared-savings contracts with housing cooperatives (owners of the buildings) together with the procedure for determining energy savings. Performance guarantee is a part of the contracts to ensure that the cooperatives are able to meet their repayment commitments to the revolving funds. Initial capitalization for the fund as the pilot phase has been provided both from the local authorities (the city district administration) and SDC.

**Indicators:**

| | |
|---|---|
| Total project cost | $ 103,000 |
| Implementation period | 1year |
| Actual heating cost savings in the range | 15-25% |
| Payback period | 4 years |
| Average annual fuel savings | 126 thous. t.c.e. per year |
| Average annual $CO_2$ emissions reduction | about 204 tons per year |

**Sources of financing**

Moskovsky district administration of the city of Kiev (23% of investment),
Swiss Agency for Development and Cooperation (77% of investment)

**Stage of the project cycle**

Monitoring and evaluation of results.

# 5. Development and operation of a Ukraine Energy Service Company

**Basic information**

One solution to the problem of financing for energy efficiency projects is the use of Energy Service Companies (ESCOs), i.e. companies that invest directly in the client's premises and are reimbursed from the realized energy savings. This approach is now particularly relevant in the Ukraine where energy saving needs are so great but few organizations have the financial, legal and technical know-how to implement such projects.

The Joint Stock Company "Ukraine Energy Service Company" (UkrEsco) was founded by the Government of Ukraine in collaboration with the European Bank for Reconstruction and Development ("EBRD") and Commission of the European Communities DG 1A, the latter representing the European Union.

Finance for UkrEsco was provided as follows:

- by way of a sovereign guaranteed loan from the EBRD of $ 30 million;
- by way of a grant from TACIS of ECU 3 million to act as an incentive for Ukrainian enterprises that sign an energy performance contract with UkrEsco (through a 10% subsidy of the contract price); and
- by way of technical assistance from TACIS of ECU 3 million for UkrEsco to operate UkrEsco over the initial two-year period (Project Management Unit).
- UkrEsco initially has a joint-stock company majority owned by the State. It is intended that control of UkrEsco will later be transferred to the private sector.

The selected western company has become the Project Management Unit ("PMU"), which helped to launch and now operates UkrEsco. The PMU was composed of operational staff including both Ukrainian and Western European experts. At the end of the two years PMU's Ukrainian staff in principle has become UkrEsco staff.

Primary objects solved by UkrEsco are: Project identification; energy auditing; client due diligence; technical auditing; financial analysis of projects; marketing and information dissemination; procurement in accordance with EBRD rules; project implementation; monitoring of the realized energy savings and taking corrective action as necessary.

**Activity on the project**

UkrEsco carries out studies of the market on services in the savings of energy. Financial, power and legal audit for more than 100 enterprises are carried out. Now the company is at the stage of signing and realization of projects on a total sum of $ 2,000,000. The list of projects which are at the stage of implementation can be divided into three categories: (1) Already realized or being at the stage of purchases; (2) Already signed or being authorized for signing; (3) Preliminary coordinated with customers.

| | Company | Scope of Work | Cost $ |
|---|---|---|---|
| | | Category 1 | |
| 1 | Gostomel glass works | Replacement of compressors | 195,000 |
| 2 | Freedom Farm | Agricultural equipment | 204,140 |
| 3 | Vinnitsa meat plant | Replacement of compressors | 300,000 |
| 4 | Shostka milk | Replacement of boiler-house for increase of a production efficiency and transfer pair | 390,000 |
| | | Category 2 | |
| 1 | Cherkassy food | Thermal treatment equipment | 350,000 |
| 2 | Kharkov machine-building factory | Modernization of system of manufacture and distribution of compressed air | 250 000 |
| 3 | Coctebel winery | Boilerhouse / Condensate return / Bottle washing machine / Lighting | 200,000 |
| 4 | Metallurgical equipment factory Dneprotjasmah | Modernization of the automated system of the commercial account and the technological account of power resources | 200,000 |
| | | Category 3 | |
| 1 | Gostomel glass works | reconstruction of the furnace for cooking a glass | 800,000 |
| 2 | Bilosvit milk plant | CHP 0.5 MWt | 500,000 |

**Realization problems and difficulties**

- Unfortunately, the majority of them are not capable to provide appropriate returning of the proceed of credit, given by Bank.
- Energy saving is not the primary 'driver' for many projects undertaken 'in the name of energy efficiency'. This is primarily due to the prevailing low prices of energy, and additional problems associated with poor payments by companies for energy supplied to them. In many cases the primary drivers relate to technical refurbishment and upgrading of outdated equipment, improvements in equipment reliability, improvements in product quality, and security of energy supply.
- The interest rate offered by UkrEsco (12%) is not particularly attractive to the 'prosperous' companies noted above, who have access to cheaper international capital. This means that, in general, it is the smaller and medium sized companies (who by nature may have less opportunities for energy saving) who are attracted to the UkrEsco financing mechanism. Hence the level of the UkrEsco interest rate may be contributing to the difficulties of finding 'creditworthy' companies and companies with real energy saving potential.
- While the initial intention was to target reasonably large projects (approx. $1mln investment), the projects that are now materializing with companies are smaller in size. This may be due to a number of factors. Projects with reasonable energy saving components may be smaller in terms of investment levels. Also, given the traditional shortage of capital, companies have undertaken such projects in an incremental approach, and may still be more comfortable with this approach even with UkrEsco financing.

**Recommendations for successful replication in other transition countries**

Prepare a business plan ESCO, to provide a clear vision of the future prospects for the company.

All parties should agree on the interest rate to be charged, including the mechanism by which a grant provides an incentive to the client.

Key barriers to operation, emerging from the initial contracts, should be quickly resolved.

All parties should be comfortable with the nature of the ESCO business in the country's current economic and regulatory environment. Many projects will initially be 'infrastructure development loans with an energy saving component'. As prices rise to market levels with market reform, the energy saving component will grow.

## 6. Industrial energy efficiency in Ukraine

Ukraine is one of the most energy-intensive countries of the world. Thus, before becoming independent Ukraine had one of the highest energy intensity indices – 3.25 t of oil equivalent per $1000 of gross domestic product (GDP). Over the ten last years this index has reduced to a certain extent, but presently specific energy consumption in Ukraine per unit of GDP is extremely high, and makes 2.4-2.8 t of oil equivalent per $1000 of GDP, but in Western Europe it makes on average 0.22 t of oil equivalent per $1000 of GDP.

The significant energy efficiency potential of Ukraine might to its economic growth, competitiveness, and at the same time to reduction of environmental pollution.

Under the urgent energy assistance program to help Ukraine shut down the Chornobyl reactors, the U.S. Department of Energy (DOE) has asked the Pacific Northwest National Laboratory (PNNL) and the Ukrainian Agency for Rational Energy Use and Ecology to identify and apprise industrial energy efficiency projects in Ukraine.

The key objective of the Program is to provide assistance in improving industrial energy efficiency of Ukraine by developing energy efficiency projects for the most promising enterprises and companies, and in obtaining over $100 million financing means for this purpose. It builds on a several-years effort that has already developed a $30 million financing scheme for efficiency improvements. This effort supports the shut down of the dangerous Chornobyl power plant by helping provide electricity alternatives. Background of the project:

- Industry accounts for about 60% of overall Ukraine's energy consumption;
- high potential for industrial energy efficiency improvements;
- energy prices in Ukraine have grown close to the world level;

- industrial enterprises do not have enough financing means for energy efficiency improvements;
- managers lack skills on business planning and developing investment projects which makes it difficult to attract external financing for project implementation.

11 Ukrainian industrial enterprises have participated in the program since 1997, investing over $1.5 million of their equity in energy efficiency. Energy audits aimed at energy and cost efficiency measures were conducted at all these enterprises.

Implementation of energy efficiency measures results both in reduction of energy consumption and GHG emissions. Participation in Activities Implemented Jointly (AIJ) and emission trading will allow to attract financing for energy efficiency projects. Ukraine is one of the largest GHG emitters in the world, therefore the developed countries are likely to cooperate with Ukraine on climate change mitigation. Enterprises and main data on developed energy efficiency measures are listed in the table below.

| **Enterprises and main developed energy efficiency measures**<br>Brief information on the measures | Annual energy savings | | | Imple-mentation costs | Annual savings | Simple payback period | GHG emission reduction |
|---|---|---|---|---|---|---|---|
| | Natural gas | Heat | Electricity | | | | |
| | 1000 $m^3$ | 1000 GJ | mln kWh | $1000 | $1000 | years | $CO_2$ in t/a |
| JSC “Gostomel Glass Plant”, Kyiv oblast | | | | | | | |
| $750 thousand of equity financing and $3.88 million of Western NIS Enterprise and UkrESCO investments in energy efficiency measures were attracted. All measures identified for the first stage were implemented: installed a new furnace, heat recovery boilers, efficient compressors etc. The Association of Energy Engineers awarded this project its prestigious International Energy Project of the Year Award in 2000. | 2,060 | - | 4.9 | 1,542 | 367 | 4.2 | 7 680 |
| JSC “Avdeevka Coke Chemical Plant”, Dontesk oblast | | | | | | | |
| Measures for cogeneration system including utilization of excessive coke gas for gas turbines (capacity of 15 MW) and utilization of waste gas heat in heat exchangers were developed. Over $370 thousand was invested in upgrading steam pipelines, heat insulation and efficient lighting. | - | 2,363 | 142.85 | 13,610 | 5,238 | 2.6 | 281 389 |
| JSC “Stalkanat”, city of Odessa | | | | | | | |
| Energy efficiency measures for $790,000 and estimated upgrades of wear production were identified. UkrESCO board has agreed to provide financing for several measures. | 4,555 | - | 2.14 | 1,455 | 522 | 2.8 | 10 125 |
| JSC "Rosich" Bila Tserkva, Kyiv oblast | | | | | | | |
| Rosich has implemented all but one of the energy audit recommendations with the assistance of the local energy service company. Now these measures are saving to Rosich over $12,000 annually. | 106 | - | 0.1 | 19.1 | 15.3 | 1.3 | 275 |
| JSC “Zaporizhzhya Abrasives Plant” | | | | | | | |
| The company has invested $232,500 in compressors, lighting and other equipment based on the project energy audit. The company is also discussing a larger investment in a power plant with EBRD. | 1,800 | - | 9.76 | 812 | 710 | 1.1 | 11 031 |
| JSC “Rosava” Bila Tserkva, Kyiv oblast | | | | | | | |
| The project energy audit revealed $4 million of cost-effective energy efficiency opportunities. UkrESCO has agreed to finance these investments in two stages with the first $1 million installment in 2000 or early 2001. Rosava is also working with its new Austrian investor on a $75 million modernization effort | - | 306 | 17.33 | 4,128 | 1,632 | 2.5 | 35 517 |
| JSC “Kyiv Khlib”, Bakery 1 | | | | | | | |
| Identified cost-effective energy efficiency measures for amount of $58,000. Kyiv Khlib has committed to invest half of these measures and to look for financing sources for the rest. | 548 | - | 0.03 | 58.3 | 22.8 | 2.6 | 1 039 |
| JSC “Sevastopol Marine Plant” | | | | | | | |
| Measures on heat supply system retrofit including installing cogeneration units in two boiler plants for $3.4 million were developed. Other cost-effective energy efficiency measures for the total amount of $229,000 were identified. The plant’s owner, SGMA Group has committed to finance most measures identified in the energy audit. Besides, the Defense Enterprise Fund and UkrESCO have expressed interest to participate in financing | -391 | - | 22.2 | 3,656 | 810 | 4.5 | 16 782 |
| JSC «Zaporizhzhya Ferroalloy Plan” | | | | | | | |
| Cost-effective measures for the total cost of $2.9 million were identified. JSC «Zaporizhzhya Ferroalloy Plan” has committed to implement majority of these measures using equity financing and look for additional financing sources, if necessary. | -2,568 | 135.7 | 39.6 | 2,869 | 1,590 | 1.8 | 36 160 |
| Close company «Kostopil Glass Plant » Rivne oblast and JSC “Gostomel Glass Plant”, Kyiv oblast | | | | | | | |
| Energy efficiency measures in compressed air system and measures on energy cost reduction were developed. | - | - | 4.3 | 593 | 150 | 4.0 | 3 391 |
| JSC «Kramatorsk Cement and Asbestos Sheeting Plant – Pushka”, Donetsk oblast | | | | | | | |
| Energy efficiency measures for overall cost of $2 million and estimated improvements of rotary kiln burners for clinker production were identified. UkrESCO expressed interest in co-financing of the measures. | 8,547 | - | 5.6 | 2,089 | 535 | 3.9 | 20 248 |
| Total | 14,657 | 2,804.7 | 247.8 | 30,831.4 | 11,592.1 | 2.7 | 423 637 |