| SUSTAINABILITY |

SUSTAINABLE CONSTRUCTION AND HOUSING

– a needs based approach for the future

Umwelt Bundes Amt
Für Mensch und Umwelt

EDITORIAL INFORMATION

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PREFACE

Our way of constructing our buildings, our life-style, our housing patterns, as well as our mobility habits, increasingly place stress on the environment and endanger the basis of existence of many living creatures on this planet. Mankind can carry on ignoring the limits of tolerance of their natural environment. However, they must then learn to cope with increasing damage caused by natural catastrophes to which they have contributed.

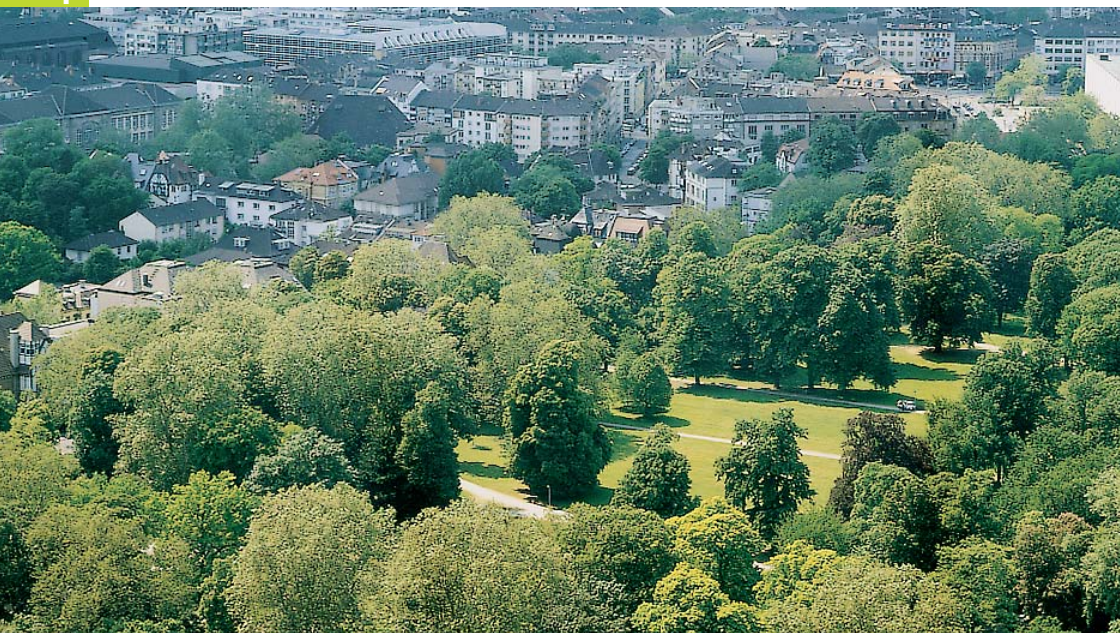
Our extensive use of raw materials pushes the limits as well. Peak-Oil will soon be reached, although the demand for oil will continue to increase strongly. Therefore, we have to dismiss our wasteful technologies, architecture, living standards and housing patterns, established during the 'fossil age'. Construction, development, use, modernisation and repair of buildings and infrastructure take up an unacceptably large amount of surface area and cause a major part of the demand for energy and raw materials in Germany.

There are excellent and worthwhile alternatives to the common and familiar habits, patterns and designs. This brochure indicates how sustainable alternatives can be found in the construction and housing sector.

A compilation of alternatives – the so-called 'Sustainability scenario' – provides an excellent overview of the amazingly wide spectrum we have to satisfy our housing requirements at a high level and – at the same time – wasting considerably less natural resources. The supposed measures follow the principles 'Return from greenfield to central urban areas' and 'Rather improve the fabric of existing buildings than construct new ones'. The first principle also links to other measures for a mobility less depending on oil and less harmful to our climate.

Politicians, leaders of the construction and housing industry, architects, home owners and tenants can positively shape the presented spectrum. By abolishing the home building subsidy and by promoting the energy saving refurbishment of buildings, the German Federal Government has set the first important impulses for a sustainable development of the construction and housing sector. The Federal Environment Agency wants to encourage consistent progress through this brochure. I wish you an inspiring read..

Jochen Flasbarth
President of the Federal Environment Agency



1. ENCOURAGING A NEEDS BASED SUSTAINABLE DEVELOPMENT APPROACH

1.1 Population needs and natural resources

Human beings have many different needs such as eating, drinking, sleeping, living, working and communicating. In order to satisfy these needs, business activities are initiated which create work and prosperity, but also pose demands on the natural environment and its resources.

Natural resources are all components of nature: renewable and non-renewable raw materials, the environmental media (soil, water, air), the physical space (land) as well as flow resources, for example geothermal, wind, tidal and solar energy (EU 2003, EU 2005).

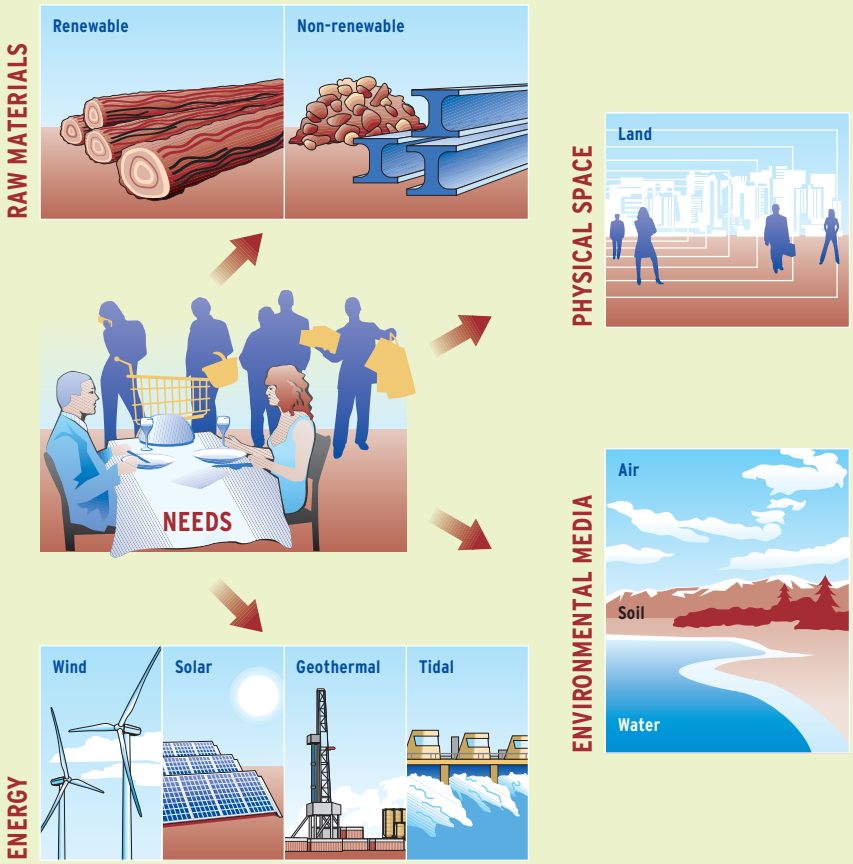


Fig. 1 Needs and natural resources

Nature is the source and home of all life. Not only does it provide our habitat, but food, energy and raw materials too, it absorbs pollutants and wastes and stabilizes the climate. With its many facets, nature contributes to our joy of life and the fulfilment of our needs. The satisfaction of these needs and the high and constantly rising demands of people inevitably lead to competition for the finite natural resources as well as to a substantial impact on environment and human health. These endanger not only the prosperity of our generation, but also the basis of our and our children's and grandchildren's existence.

1.2 Sustainable development

'You should only cut as much wood as can re-grow.'
This maxim is based on the knowledge that predatory exploitation of natural resources has only a very short-term benefit and causes irreversible damage over the long term. It originated in forest management about three centuries ago and applies today more than ever to almost all fields of business. Forests – just like the whole environment – must have the ability to regenerate so that our basis of life is maintained. In sustainable forestry the key issue is therefore not only to limit the quantity of felled wood but also to cut wood in an environmentally friendly manner. And at least when we develop sustainable alternatives, we must always ask the question, are there other ways available that satisfy the actual need and in addition, enable a better use of natural resources?

Sustainable management doesn't mean living from nature's capital but from its interest.

Wood only represents one range of raw materials that we extract from nature today, but wood has the advantage that it regenerates within one or two generations. However, we also use other raw materials, like oil, which might only regenerate over centuries, thousands of years, millions of years or never. It is obvious that if we extract and use raw materials, we have to also use land, material and energy and produce pollutants. Therefore, although the term 'sustainability' can be demonstrated by the example of renewable raw materials, we should consider all natural resources and find an acceptable way of managing them over the long term.

Our actions invariably have economic, social and ecological effects. Ecology specifies a kind of framework, comparable with buoys on a waterway which define the channel for ships. Transferring this idea to sustainable development means no long-term and socially compatible management is possible without an intact natural basis of life. Sustainable development is environmentally compatible over the long term. The Federal Environment Agency (UBA) illustrates these ideas in a picture:

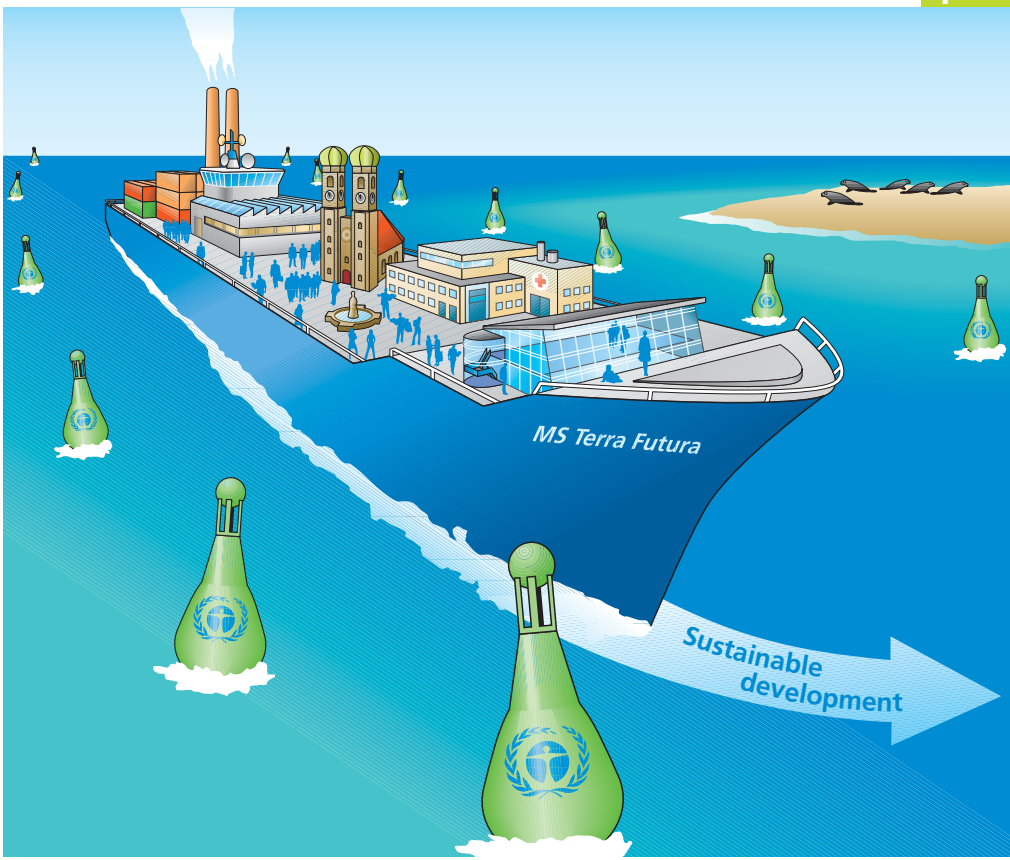


Fig. 2 Sustainable development

The limiting factors in nature are like buoys on a waterway. They specify the channel that the ship of economic and social developments may travel without endangering our natural foundation of life.

The Federal Government published its fundamental goals for sustainable development in Germany in its strategy on sustainability in April 2002, which, in addition to social and economic goals, covers important objectives for the protection of our natural foundations of life.

1.3 The needs based approach

For a sustainable development, we must satisfy our needs in such a way that the environmental impact is minimised over the long term. In order to assess the demands on the environment and find a suitable approach for change, all activities initiated by satisfying the various needs must be tested, where possible, for their environmental influences.

In the case of such an investigation the following questions must be clarified:

- What is the current extent of the environmental impact?
- Are the actions already being taken sufficient to achieve a sustainable development or must we do more?
- To what extent are individual actions able to reduce the environmental impact within the analysed range?
- Which stakeholders are responsible for implementing the actions?
- How can obstacles be overcome by implementing the actions?
- How much can the environmental demand be reduced in an ideal case?

In order to answer these questions, the Öko-Institut (Institute for Applied Ecology), commissioned by the Federal Environment Agency, has developed a new method, the material flow analysis based on the area of need. This method takes into account both human needs and the potential for their satisfaction. So the substantial 'set screws' can be identified both for demand and supply in order to reduce the use of natural resources.

An **area-of-need** covers all activities that are connected with the satisfaction of a need.

It is thus possible to establish bridges between human needs, economic interests and ecological requirements to a certain extent and submit acceptable suggestions for actions in their everyday life. As a German proverb says, one cannot calculate the rent without the landlord. This means: it is important to include all stakeholders who play a role in this area of need in the analysis. In order to reduce environmental impacts by construction and housing, we must convince politicians, leaders of the building and housing industry, architects, home owners and tenants.

The material flow analysis based on the area of need comprises two main steps: the appraisal and the scenario calculations. The analysis shows at which points the environmental impacts in this area can and should be reduced. Based on this, a third step should follow which shows the stakeholders how to implement the recommendations in practice. So the necessary components for a material flow management based on the area of need are available (see Fig. 3).

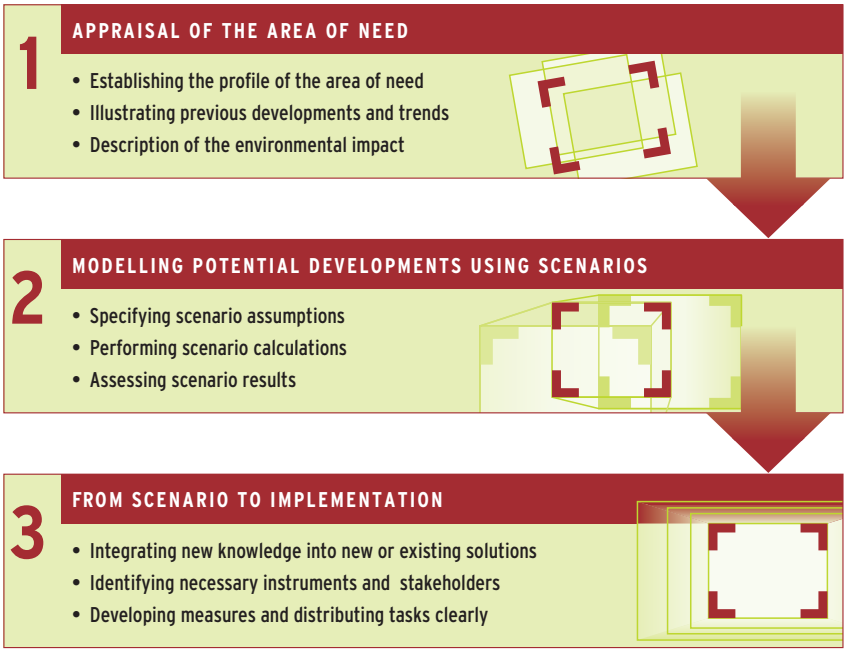


Fig. 3 Steps for the material flow management of an area of need

The 'construction and housing' area of need is particularly important for climate and resource protection. Heating systems produce vast amounts of carbon dioxide; new buildings require a lot of natural resources and demolition generates a large part of the total wastes produced annually in Germany. Using the example of this area of need, the following chapters will show how recommendations for actions can be obtained from the three steps.

2. THE 'CONSTRUCTION AND HOUSING' AREA OF NEED

He who wants to do something for the environment and climate, cannot ignore the 'construction and housing' area of need. For instance, heating systems use one third of the entire energy in Germany (VDEW 2005). 85 % of all mineral raw materials used in Germany are converted into building materials and building products (StBA 2007). Over the last few years the residential areas and associated roads in this country on average grew daily by 113 hectares. This forms more than 150 football pitches and about half of it has disappeared under asphalt or concrete (UBA 2008). And the environment will again be polluted when the buildings and roads, built at high costs, will one day be demolished, creating more building and demolition wastes. These wastes (with road construction waste but without soil excavation) make up approximately one quarter of the total waste produced in Germany (UBA 2008).

Buildings and infrastructure use a large part of the available natural resources in Germany in terms of **land, energy and raw materials**. In addition, construction, refurbishment and, finally, demolition of buildings and roads also generate large **quantities of waste**.

2.1 Profile

In the 'construction and housing' area of need all activities that accompany the need 'living' are initially summarised in general terms: people select a place of residence, establish their homes and heat them. Man develops the residential environment, builds and refurbishes buildings and infrastructure or demolishes them.

This area of need is very complex. In order to carry out an investigation, it must be limited spatially and in terms of time, and the variety of buildings, infrastructure and activities must be reduced (see Section 3.2).

The scenario calculations performed (see Section 3.2) have taken into account the entire life cycle of residential buildings and the infrastructure necessary for the internal development of residential areas, such as roads and streets, supply and disposal pipelines and all associated material flows in Germany. Starting with raw material extraction through raw material treatment and subsequent processing and production of components right up to construction, refurbishment and demolition of buildings and infrastructure including the amount of energy required to heat residential buildings.

2.2 Previous developments

After the end of the Second World War the key objective of the German building politics was to build as many residential buildings and as fast as possible. The main task was to provide a constantly growing population with living space and eliminate war damage. Focused investments and government subsidy politics encouraged the construction industry to produce new buildings. A second boom in building activity developed in the 1990s: the western federal states* (Länder) experienced a lot of immigration. Simultaneously the

* The term 'federal state' (Land, plural: Länder in German) is used for the 16 Federal States (e.g. North Rhine-Westphalia, Bavaria, Lower Saxony etc.) constituting the Federal Republic of Germany.

housing subsidy politics encouraged the construction of multi-storey blocks of flats in East Germany, while many people were finally able to achieve the long held desire for a detached house.

Subsequently the situation in Germany has changed: the population has been declining since 2003 because birth rates have been dropping, the number of immigrants from foreign countries has also been on the decline and many people leave Germany for other countries. In the eastern federal states a substantial drift has been recorded since the 1990s. Above all young people usually migrate toward the western federal states. These developments contribute to changing settlement structures: on the one hand new development conurbations with strong economies – such as Munich, Hamburg or the city of Leipzig – still undergo a further influx of people but receive a generous assignment of development land to create a third ring around the large cities. On the other hand an increasing number of living and commercial buildings in shrinking regions – e.g. Uckermark, Lausitz and even Saarland – stay empty. While downtown areas of individual cities and municipalities are being deserted, the trend towards small houses in greenfield locations continues. Thus urban areas are increasing and the associated infrastructure, such as traffic routes, disposal facilities and utilities infrastructure (e.g. electricity, water and data) keep growing.

Based on the number of their inhabitants, detached houses and semidetached houses require energy, land and raw materials well above the average. And because the owners of detached houses hardly ever reduce their living space after their children have moved out on achieving adulthood, young families must create new dwelling habitats of their own. This development is accompanied with further urban expansion. This leads to urban expansion and reduction of open space, generates higher energy and raw material consumption and puts additional burdens on the infrastructure.

Increasing life expectancy, low birth rate and migration change the population structure and the people's way of life in Germany and thus lead to a **demographic change**:
We are getting older, fewer and, in terms of the nationalities living here, 'more diverse'.

Despite a decreasing population and a gradual relaxation of the housing market, a demand situation can be expected for the next 10 to 15 years to be shaped by further living space consumption and elevated requirements for quality of life. This means that the environmental impact by construction and housing remains in all probability at a high level – unless it is consistently offset by suitable controls.

2.3 Environmental impact

In 2000 we used over 130 hectares every day for towns and roads growth in Germany. That corresponds to more than 180 football pitches! The largest part, about 40 %, of it was taken by 'living space'. Although land use decreased to an average 115 hectares per day due to an economic slump between 2001 and 2004, the contribution of living space to further urban expansion remained very high (UBA 2003a). The increased area taken by settlements and traffic obstructs natural soil functions such as storage and filtration of water and destroys biodiversity. Crossing the landscape with traffic routes, e.g. roads and railway lines, and their use by people not only obstructs our own recovery, for instance by traffic noise, but it also destroys important habitats for plants and animals. Local climate changes, for example overheating, cold air traps or reduced air humidity, lead to undesired effects on biotopes and disrupts the natural variety of plant and animal species. Isolation and building on natural flood plains impairs the water balance and contributes to aggravating the effects of floods. Besides, large areas of fertile soil are lost which could have been used for food or renewable raw material production.

In 2000, construction and civil engineering, i.e. buildings, roads, parking lots, supply and disposal pipelines 'locked up' approximately 50 billion tons of **primary raw minerals** (lime, gypsum, shale, gravel, sand, clay, etc.) in Germany. This might increase to about 60 billion tons by 2010 (UBA 2001b). In 2005 alone, companies in Germany used about 551 million tons of primary raw minerals for the production of building materials and products amounting to 85 % of all mineral raw materials used (StBA 2007). The materials used for construction, reconstruction, modernisation and refurbishment consume about eight times as much material than is recovered in demolition wastes at the other end. The annual **amount of mineral construction waste** (without soil excavation) amounted to about 72 million tons in Germany in 2004. About 69 % of it was suitable for processing and reuse as recycling building material (ARGE KWTB 2007).

Because of a higher demolition and refurbishment rate which can be expected in the coming years due to the age and structure of buildings and infrastructure and about 40,000 old flats demolished annually within the 'City Recovery East' programme, the quantity of demolition waste (without soil excavation) might rise to about 100 to 130 million tons up until 2010 (UBA 2001b). The conclusion is that from the point of view of raw materials economy, the existing buildings and infrastructure represents an enormous materials store which we should use efficiently in order to save our raw materials and reduce the amount of demolition wastes.

A large amount of **energy** is necessary to produce building products such as bricks, cement and steel, transport building materials, build new houses, to refurbish buildings and, finally, to provide heat and light. Room heating in private homes amounted to 23 % of the entire total energy consumption in Germany in 2003 (VDEW 2005). Building and heating of residential buildings generated about a quarter of the climatically harmful carbon dioxide emissions in Germany in 2003. About 80 % of these emissions resulted from heating residential buildings (UBA 2004a, StBA 2006b). This proves that the 'construction and housing' contributes significantly to **climate change**.

3. SCENARIOS – MODELLING POTENTIAL DEVELOPMENTS

The needs of people are not static and change with time. The needs change the demand, the demand changes the supply and the supply changes the production .

Some ways of living come into fashion and others end. The market share of a heating system – such as oil or gas heating – may shift in favour of another. The same applies to certain building components and materials. Technical progress also has an important influence. Thus one will presumably be able to use a higher amount of crushed concrete in the manufacture of new concrete in a few years.

Some factors that affect these developments, such as age distribution of the population will be difficult to change. However, others such as political conditions may be influenced.

The scenarios help illustrate the developments that we expect, hope for or fear. So we can show the stakeholders where and how they can intervene and what consequences their actions – or non-actions – will have.

3.1 Scenario assumptions

Scenario assumptions represent the 'set screws' for different developments. Therefore, depending upon assumptions, the scenario calculations provide different results (Fig. 4).

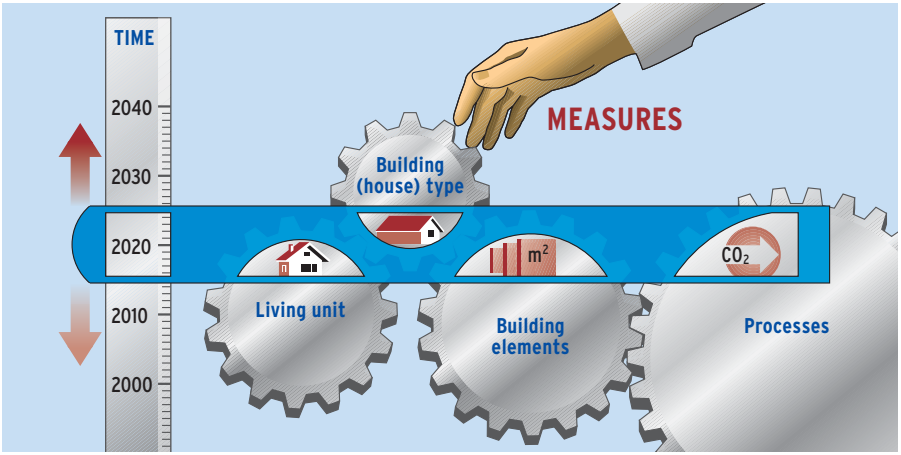


Fig. 4 What happens if...
Scenario assumptions as 'set screws' for different developments

Assumptions range from the decision about certain building methods and building materials through preferences for different forms of living up to the priority of internal or external development as well as refurbishment or new building. Since one cannot 'turn' these 'set screws' in practice at will, the affected stakeholders must be included in the development of realistic assumptions.

To establish the scenarios, scientists, representatives of German federal and state ministries, trade unions and environmental associations, credit system experts, housing industry and urban land-use planners brought together their knowledge in workshops. They showed how the central environmental political challenges can be met in this area of need (Fig. 5).

In order to achieve practical scenarios, the specialists established a set of quantifiable assumptions for the individual approaches. For example, to what extent brownfield sites are available for inner city development, or to what degree existing buildings can be better insulated. Based on the approaches discussed and the identified assumptions, they have established two scenarios: the reference and the sustainability scenario.

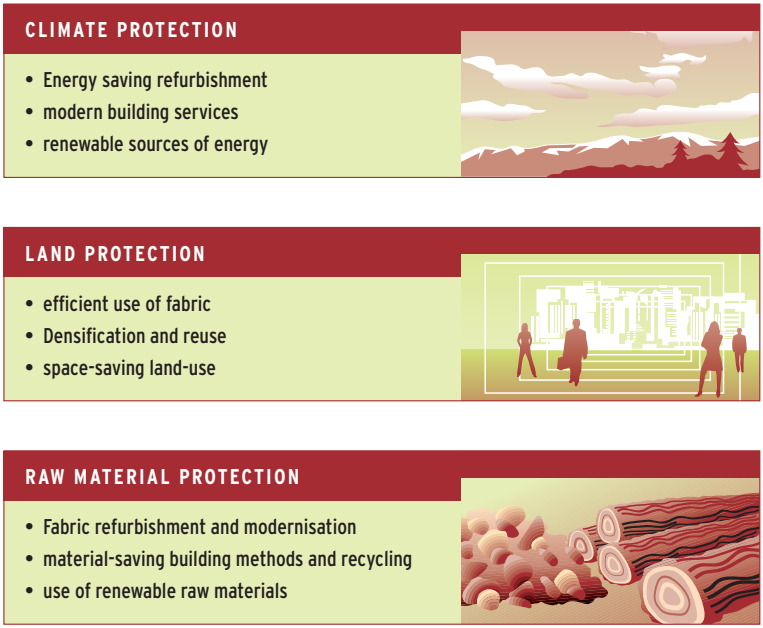


Fig. 5 Solutions for central environmental political challenges

Characterisation of the two scenarios

The **'reference scenario'** is based on the current situation in the 'construction and housing' area of need. In simple words: everything remains as it has been. The stakeholders hardly change their behaviour and do not accept the proposed solutions (Fig. 5) or only partially implement them. The 'little house in the green field' remains popular.

On the other hand, the **'sustainability scenario'** assumes that the proposed solutions (Fig. 5) are well accepted and implemented: an increasing internal development of the cities and villages – for example using space-saving design and reducing building gaps and using brownfield land –, increased refurbishment and a high quality residential environment with sufficient green spaces and good infrastructure result in an increasing attractiveness of town centres and buildings. In consequence, less will be built on 'greenfield sites'.

The sustainability scenario also assumes that the passive-house standard will become better established in the market, and that the use of renewable resources like wood pellets for heating will increase. It is also assumed that the use of recycled building materials such as crushed concrete aggregate and sand as well as renewable raw materials like wood will increase.

Although the term **'low-energy building'** has been widely used for years, there is no standardized definition available for it to date. The Quality Association 'Low-energy buildings' (Gütegemeinschaft Niedrigenergie-Häuser e.V.) identifies it as a building, which exhibits about 30 % less heat loss than in the Energy Saving Bill (Energieeinsparverordnung, EnEV). According to this, multi-occupancy houses designed to a low-energy standard should not exceed an annual heat energy requirement of 50 to 60 kilowatt-hours (kWh) per square metre living area, approximately 70 kWh for single family houses.

Passive houses are a further development of low-energy buildings. With an annual heat budget requirement of only 15 kWh per square metre of living space they get by with almost no active heating or cooling systems. They achieve the low energy requirement by sophisticated passive techniques, e.g. very good thermal insulation, multiple glazing, solar energy use and heat recovery (UBA 2003b).

From 1995 to 2004, the living space of the population increased by about 13 % despite a stagnating total population (StBA 2006d). In the next twenty years – even with a declining total population – we must still expect an increasing number of households and a rise in living space consumption in Germany. Therefore both scenarios assume that the living space consumption per head continues to grow. While the reference scenario expects the growth of detached-house developments on 'greenfield sites', the rise in the sustainability scenario concentrates on medium size flats in areas with existing infrastructure.

The values of the scenario assumptions and their detailed reasoning can be found in the UBA text 1/2004 'Sustainable construction and housing in Germany' (Nachhaltiges Bauen und Wohnen in Deutschland).

3.2 Scenario calculations

The 'BASiS-2.0' software links the base data of the area of need with the scenario assumptions and calculates current and future material flows over a certain period of time (Fig. 6).

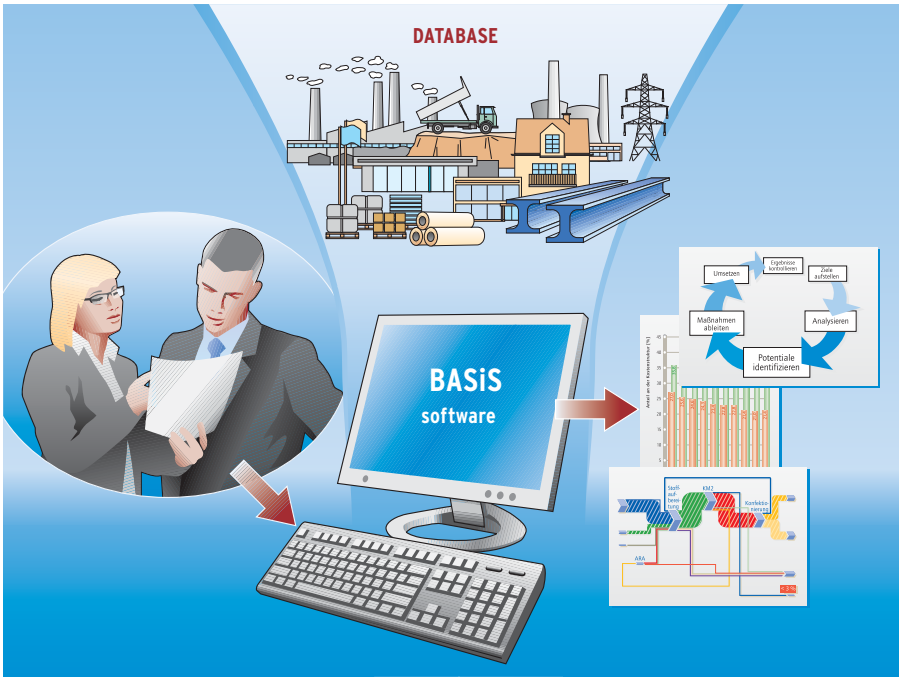


Fig. 6 'BASiS-2.0': Need-linked analysis tool for material flow in scenarios

The **'BASiS-2.0'** software (**B**edarfsorientiertes **A**nalysewerkzeug für **S**toffströme **i**n **S**zenarien i.e. Needs based analysis tool for material flow in scenarios) enables the calculation as to how the actions reduce – individually or combined – the environmental impact on the 'construction and housing' area of need.

In order to model the housing fabric, it is first necessary to classify the housing units in Germany – about 37 million in 2000 –, the building components used in the numerous different buildings and the building materials, from a limited but nevertheless representative number of house types (detached

and semi-detached houses as well as terrace and multi-occupancy houses) in different areas e.g. town centres, suburban and rural areas. For the modelling of new building activities further building types are added such as low-energy buildings and passive buildings. Material composition and the number of building types depend on the assumed growth of demand. Each type of building is associated with certain production steps and building activities, which again impose a certain environmental impact. The combination of building types determine what resources are used and to what extent, and the amount of CO_2 emissions generated. BASiS-2.0 can combine the individual variables as building blocks and illustrate different developments in the area of need modelled. Thus changed life-styles, new buildings, preservation and modernisation processes can be included in the calculations and their effects on the environment determined.

The scenario period modelled for this investigation covers the period 2001 to 2025. The base year is 2000. From the abundance of results so far, the findings from problematic fields of carbon dioxide emissions, land use and raw material consumption will be presented in the following sections.

3.3 Scenario results

Carbon dioxide emissions

The emissions of carbon dioxide (CO_2), the most important greenhouse gas harmful to the climate, are reduced both in the reference scenario and in the sustainability scenario up to the year 2025. In the reference scenario the annual CO_2 emissions decrease by about 20 % up until 2025, principally because existing buildings will be refurbished to save energy at a rate of about one per cent of total per year. In the sustainability scenario the annual carbon dioxide emissions will be reduced by more than 50% in the same period (see Fig. 7). The markedly lower CO_2 values in the sustainability scenario can be attributed to a more extensive energy saving refurbishment programme – 2.5 % of the total per year, to more intense use of wood heating and a higher fraction of local and district heating for flats.

The Enquete Commission 'Sustainable energy supply under the conditions of globalisation and liberalisation' of the 14th German Federal Parliament (Bundestag) has identified reduction objectives for man-made greenhouse gas emissions. The UBA – just as the German Council for Sustainable Development established by the German Government – has included the objectives in its climate protection concept and translated these goals to CO_2 emissions which constitutes the majority of the environmentally harmful greenhouse gases. The CO2 emissions in Germany should be reduced by 40 % by 2020 (compared to1990) (UBA 2007). The Federal Government feels obliged to achieve this goal (BMU 2007a).

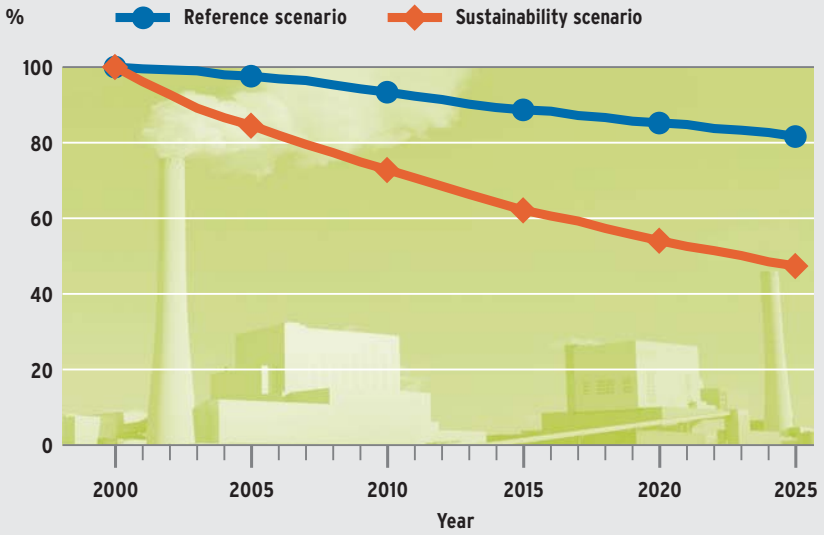


Fig. 7 Potential change of carbon dioxide emissions by 'construction and housing' (UBA 2004)

The Federal Government appointed the **German Council for Sustainable Development** in April 2001 and included 15 people from public life. The Council drafts papers to implement the national sustainability strategy, identifies firm areas of work, suggests projects and makes sustainability an important public issue. More information about the mission of the Council and its members is available at http://www.nachhaltigkeitsrat.de.

The scenario results cannot be directly compared with this climate protection objective because the base year of the Federal Government's climate protection goal is 1990 and it applies to all sectors. Considering that CO_2 emissions in Germany decreased by 15 % from 1990 to 2000 (UBA 2005b) and this decrease – in addition to serious changes in the eastern federal states' economy – can be mainly attributed to CO_2 emission reductions by industry in the western federal states (by energy efficiency, fuel change etc.), it is obvious that further reduction potentials must be activated in order to achieve the climate protection goal. The scenario results indicate that residential development possesses important CO_2 reduction potentials, which, if everything continues as before, would remain unexploited.

Land use

The scenarios take into account the square meterage of the residential property as well as traffic zones for internal development of residential areas. Areas for secondary development attached to residential areas, ancillary facilities such as kindergartens or schools, commercial areas and higher-ranking traffic areas, such as motorways or high-speed railways are not included.

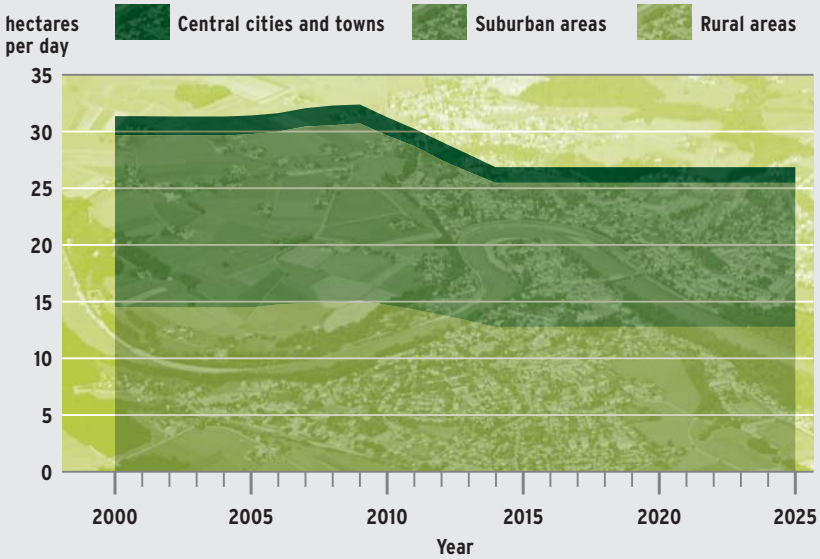


Fig. 8 Reference scenario: additional land use by 'construction and housing' (UBA 2004)

The daily land use for housing only slightly decreases in the reference scenario from about 31 hectares (ha) per day in the initial year 2000 to about 27 ha per day in 2025 (see Fig. 8). The decrease is due to an assumed somewhat lower rate of new building activity in 2025 as expected by experts due to the demographic changes in Germany (UBA 2004a).

In the sustainability scenario the daily land use decreases noticeably up to 2025 to about 5 ha (see Fig. 9). Much less land will be used in the suburban area of cities and in rural areas because the settlements will be developed more inwardly and the owners will upgrade the existing housing fabric.

A stated goal of the German sustainability strategy is to limit the increase of development and traffic areas in Germany to a maximum of 30 ha per day by 2020. Based on the actual use that was approximately 130 ha per day in 2000, this would be a reduction of 77 %.

Applied to the areas considered here, the objective of the Federal Government corresponds to a reduction in the land use of approximately 7.5 ha per day in 2020 – an objective exceeded by the sustainability scenario and noticeably missed by the reference scenario.

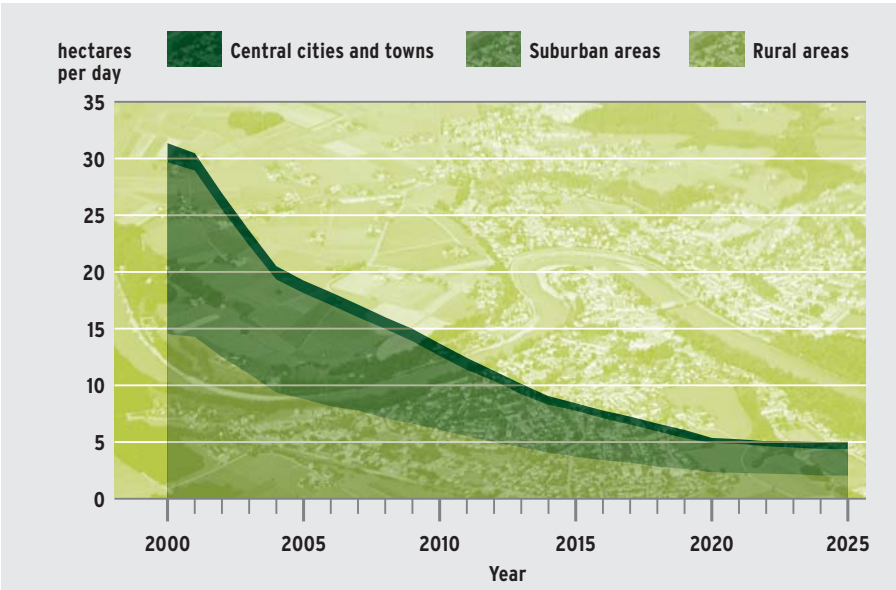


Fig. 9 Sustainability scenario: additional land use by 'construction and housing' (UBA 2004)

Raw material consumption

The 'construction and housing' area of need differs from others particularly in terms of the large quantity of raw mineral materials needed for the building and repair of residential buildings and for the inward development of residential areas (roads, sewers etc.). Sand, gravel, clay, limestone, natural stone and gypsum belong to the mineral raw materials type. A requirement of 269 million tons of these raw mineral materials was obtained in the year 2000 for the scenarios.

In the reference scenario the consumption of raw mineral materials decreases by 8.5 % up to 2025. This is essentially due to the demographic change and the anticipated decrease in new building activities. Consumption in the sustainability scenario decreases in the same period by 33 %, (about four times more than in the previous scenario, see Fig. 10). The increase in attractiveness of existing buildings – assumed in the sustainability scenario – is crucial for this decrease as a result of high-quality refurbishment. In such a way, the construction of new buildings can therefore be avoided to reasonable extent.

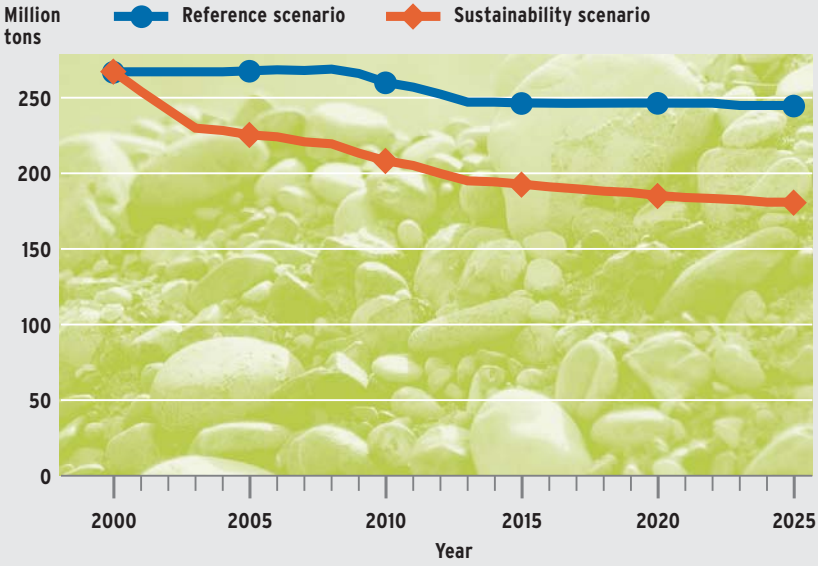


Fig. 10 Potential change in consumption of mineral raw materials by 'Construction and housing' (UBA 2004)

One aspect, important for future developments in the view of raw mineral material consumption, is that consumption of raw materials for infrastructure – unlike for residential buildings – does not noticeably decrease in either the reference or in the sustainability scenarios.

This is caused by new buildings using far more raw materials than the repair of existing residential buildings, so equating to: 'less new buildings = less raw material consumption'. In the case of infrastructure the largest part of raw mineral materials are used not for additional infrastructure, but for refurbishment.

As far as raw material consumption is concerned, construction of new buildings should in principle be avoided. Since an expansion of a town area is always accompanied by an expansion of the infrastructure, the need for raw mineral materials inevitably increases. Each new metre of infrastructure in the future brings a metre more aftercare requirement and in tandem more raw material consumption. Thus an increasing ecological and economic mortgage would develop for the future generations.

Summary of the scenario results

The figures from the **reference scenario** clearly indicate: if the current trend continues, the additional land use due to further urban expansion would scarcely be reduced. The mineral raw material consumption would also barely decrease and the possibilities of reaching medium- and long-term CO_2 emission targets would remain unexploited.

On the other hand, the **sustainability scenario** indicates that solutions aimed at climate protection by the same token cause a reduction in raw material consumption and land use - and vice versa. Various synergies can be attained using the correct 'set screws'. If the assumptions of the sustainability scenario were implemented in practice, the additional annual land use requirement for living space would decrease by 84 % by 2025 (based on 2000 figures), and the annual consumption of raw mineral materials in the same period would be reduced by about one third and the annual carbon dioxide emissions reduced by more than 50 %.

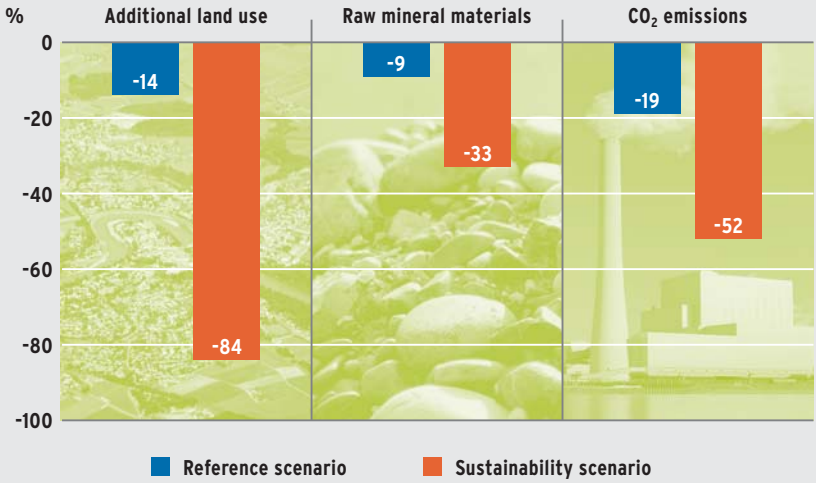
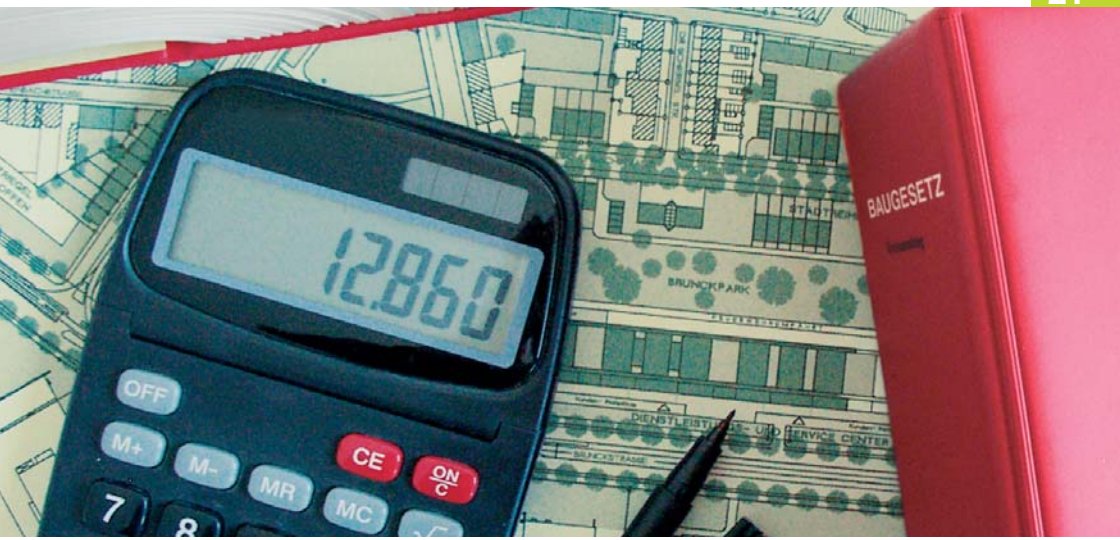


Fig. 11 Potential reduction of environmental impact in the 'construction and housing' area of need for 2025 as a percentage change in relation to the base year 2000 (UBA 2004)



4. FROM SCENARIO TO IMPLEMENTATION

The solutions assumed for the sustainability scenario indicate the direction in which actions for sustainable construction and housing should go. The two principles can be summarised as follows:

'Return from greenfield to central urban areas' and
'Rather improve the fabric of existing buildings than construct new ones'.

This means in detail upgrading buildings by refurbishment and modernisation to increase the attractiveness of town centres with the help of a refurbished residential environment and preventing houses from standing empty unnecessarily. In order to keep within the limits of new building activities and an accompanying increasing urban expansion of the landscape, new developments should be channelled toward existing brownfield sites within the city boundaries – i.e. areas previously used by commerce, industry, military, railway etc. – or little used housing estates. Different legal, economic and informational tools are available to help achieve this goal.

4.1 Tools – routes to implementation

Legal tools

Federal and state legislators can support a long-term environmentally compatible development in the 'construction and housing' area of need using legal tools in regional planning, building, tax and rental law. They must change regulations with negative environmental effects, maintain positive regulations and, if necessary, further develop them or introduce new ones. The following examples illustrate the scope of action for this area of need.

Bodies responsible for regional planning (states and regions) and land-use planning (municipalities) should save remaining undeveloped areas from development more consistently and simultaneously make better use of the potential of land already released for building purposes. They can introduce obligatory regulations for more vigorous internal development of town centres using available tools such as regional planning programmes, regional development plans, regional plans, municipality land-use plan, allocation plan, etc. This is also required by the so-called soil protection clause in the Federal Building Code (Baugesetzbuch). That slows down the urban expansion of the landscape (Example 1). Municipalities allocating new development land should ensure that compensation for developing new areas and other interventions into the ecosystem is achieved by cleaning up land at other places in accordance with the environmental protection intervention regulations in building law.

Using changes to the income tax and rental law, the legislator could transform the legal conditions in such a way that investments for energy saving refurbishment of existing buildings become more rewarding and attractive

for the owners than previously. In addition, the provisions of the Energy Saving Bill (EnEV) for new buildings should go beyond the provisions of the climate protection programme of the Federal Government adopted in Meseberg. This programme envisages that the energy requirement of buildings be reduced by 30 % on average by 2009 and 2012 in each case. New buildings however offer the technical potential of passive house standards and this should be gradually designed in. Making sure implementation of the two-stage decrease in energy requirement for existing buildings is key. The passive building level is technically feasible not only for new buildings, but also for existing buildings and is in principle worth aiming at.

However, it is not sufficient to adapt regulations and standards without monitoring whether they are observed because, according to experience, some vendors of building services gain competitive advantages by ignoring regulations and standards. It is a major problem that many local building authorities who approve passive and low-energy buildings for example, are lacking the necessary personnel to supervise adherence to regulations in buildings (Öko-Institut 2006). An appropriate quality assurance in terms of building technology is a prerequisite for adherence to the EnEV and subsidy conditions, in addition to the existing accountabilities that are limited to invoices and other evidence. Independent experts may provide a means of closing the gap between intention and practice. For example, energy consultants supported by the government can monitor the entire building project and provide information to the owner or builder ahead of construction – unlike current practice.

Example 1: Regional planning

Principles laid down in the Federal Regional Planning Act (Raumordnungsgesetz, ROG) of the Federal Government have to be cemented by federal state regional planning schemes (land development plans) and region plans. These plans differentiate between residential, commercial and infrastructure areas in which building is permitted and open areas in which – apart from a few exceptions – building is generally prohibited. The plans specify the boundaries between conurbations, densely populated areas and rural areas.

In an ideal case the regional planning schemes contain firm numbers about maximum settlement area requirements and the desired building density in residential areas to ensure that the areas are managed economically by the municipalities and the allotted areas used efficiently.

If the federal states specify such numbers as regional planning objectives, municipalities are obliged to adapt their building guidance plans i.e. the land use plan and allocation plans accordingly. For conurbations specification of a medium to high building density of about 50 to 100 flats per hectare in order to sufficiently use the capacity of the infrastructure is recommended.

High building densities serve to slow down the urban expansion of the landscape and to keep land use and raw material consumption of new buildings and roads as low as possible. Healthy housing conditions and sufficient free space in town centres must be maintained.

Economic tools

Economic tools use financial incentives to guide the behaviour of consumers and producers. To maintain a sustainable development in the field of 'construction and housing' it is necessary to check tools such as taxes or subsidies to see whether or not they send the wrong signals. The abolishment of the home building subsidy and the reduction of commuters' travel distance subsidy are positive examples because they work against a progressive urban expansion. In order to continue the actions begun consistently, UBA suggests abolishing the house building bonus, which amounted to about 500 million euro in 2006 (BMF 2007), and stopping the preference for the building savings within employees' savings subsidy. The public purse should not provide regionally undifferentiated incentives for additional house building. The funds saved could thereby be used for financing ecologically reasonable supporting measures, for example energy saving refurbishment of the building fabric.

The rearrangement of the income tax law mentioned in the section 'Legal Tools' is not only a legal but also an economic tool because it favours reasonable investments in existing buildings (Example 2).

Town planning, housing and industrial subsidy should also be more readily based on a sustainable settlement policy. This would ensure an effective use of building fabric and would avoid unnecessary new buildings as well as land use generated by it.

Building on undeveloped areas should not in principle be supported and the consumption of natural resources caused by the new building be completely charged to those undertaking it. Environmental protection intervention regulations and building planning intervention regulations should be applied more stringently. The consequences of land development should be compensated for by consistently cleaning up other areas i.e. removing bitumen or concrete from the ground at other places. In addition, it is conceivable that a land development tax could be introduced and to change land purchase tax. The latter should be arranged in such a way that the acquisition of a vacant undeveloped site would be more heavily taxed than the acquisition of a previously developed site.

Example 2: Income tax

According to income tax, costs that arise for repair and modernisation in the first three years after acquisition of an existing residential building are considered as 'acquisition-linked production costs'. The income tax payer may only amortise these expenditures over a very long period – usually 50 years. That has the consequence that in the long term buildings in great demand of refurbishment are not bought, refurbished and used and buildings in less demand of refurbishment are bought, but not refurbished or only as an interim measure.

Although the buyer of an existing property is ready to invest into the building at the time of acquisition, the long depreciation time deters him. He first refurbishes only the most essential parts and postpones an energy saving refurbishment to a later time: an ailing façade will be painted, but no sufficient heat insulation applied. The aesthetics are fine, but the energy balance is not.

In order to stop this tendency, it is necessary to change the income tax law in such a way that energy saving repairs and modernisation measures do not rank among the 'acquisition-linked production costs'. Thus the investor would have the possibility of off-setting them immediately in the form of operational expenditure or tax allowable expenses or distributing them over a two-to-five-year period. The financial incentive would encourage more investment, create jobs and accelerate the refurbishment of building fabric.

Information tools

Information tools supplement and support the other tools. Special education initiatives on 'Future-oriented construction and housing' in the technical division of schools, in the upper classes of High Schools, in universities and universities of applied sciences – together with an improved training of craftsmen, engineers and architects – should provide the knowledge base for environmentally compatible building. It is also helpful when consumers learn to reconsider their activities on their own. Therefore, generally accessible information about the state of the art and about solutions in the 'construction and housing' area of need should be provided – for instance via a citizen-friendly internet platform.

Actions that have already proved successful, like energy counselling, information campaigns on correct heating or information about existing financing models, can also support environmentally compatible developments in the future.

Competitions and marketing campaigns that publicise the slogan 'Living in existing buildings', offer various possibilities of making existing buildings more interesting by referring to social, ecological and economic advantages.

The Federal Government has introduced an amendment to the Energy Saving Bill which includes an obligatory energy ID for existing residential buildings by 2009 at the latest. This is an important basis for characterisation of the energy saving aspects of buildings (Example 3). The energy ID contains the energy requirement or energy consumption of a building. In addition, the energy ID gives practical tips for energy modernisation measures.

In the discussion whether the ID should display energy consumption or energy requirement, UBA supports the latter because it is not influenced by user behaviour. It is more user-friendly than the energy consumption ID because it yields information about the energy needs of the building or flat. Tenants and landlords, owners and potential buyers can consider this ID when taking decisions over purchase, building, modernisation or refurbishment issues. The energy ID should be followed by the development and introduction of a building passport as a 'whole of life' object document of the building. The building passport records all work undertaken on the building from planning and building to demolition, the materials and structures used as well as the wastes generated. This enables adequate management of the building under health, environmental and economic points of view.

Example 3: Energy ID

Page 2 of the energy ID for residential buildings illustrated below shows the calculated energy requirement of the building. The energy requirement is represented in the energy ID by the annual primary energy requirement and the final energy requirement. The final energy requirement shows the amount of energy needed annually for heating, ventilation and water heating. In addition to the final energy, the primary energy requirement includes the so-called 'upstream chain' (investigation, extraction, distribution, transformation) of the particular source of energy used in each case (e.g. fuel oil, gas, renewable energies). Additionally, the CO_2 emissions of the building connected with the primary energy requirement may be voluntarily indicated.

The building in this example with a final energy requirement of 228.4 kilowatt-hours (kWh) per square metre heated floor space per year lies in the medium scale range.

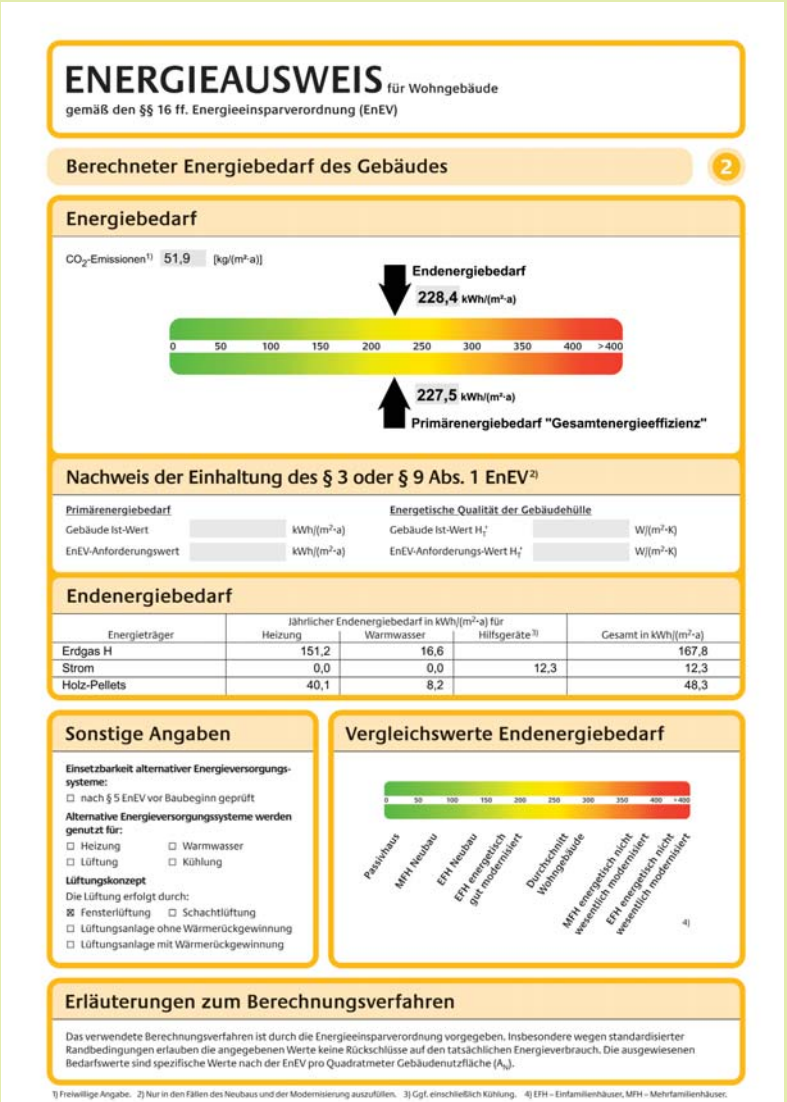


Fig. 12 Energy ID for residential buildings (dena 2008)

4.2 Stakeholders – from federal level to implementation on site

In the preceding sections we have shown the actions necessary and a whole set of tools in the 'construction and housing' area of need. But who are the real stakeholders in politics and industry and what options do they have?

Federal Government

Although the sole responsibility of non-governmental stakeholders gains in importance, the Federal Government with its legal, economic and information tools plays an important role. It can set the framework for a long-term environmentally compatible development. It creates the legal basis through laws and regulations, provides financial incentives using taxes and subsidies, sets quality levels by supporting research and technical development, education, marking as well as monitoring and fulfils its task of information provision. In everything it does or omits, the Federal Government has a model function and sets standards. If the environmental demand in the area of need investigated should be lowered on a long-term basis, it is now time to turn at the crucial 'set screws' as the Federal Government can exert considerable influence.

The Federal Government has the opportunity to:

- abolish **subsidies** that are counterproductive under environmental criteria – for example the house building bonus – and maintain positive subsidies such as the town planning subsidy east and west. In addition, it they can ensure that other schemes do not provide further subsidies for new buildings e.g. 'Riester's pension*. The new Private Home Pension Law (Eigenheimrentengesetz), which integrates a residential property used by the owner in 'Riester's pension', subsidises purchase, building or debt relief of a flat or house and the acquisition of shares in housing societies. Thus the Private Home Pension Law provides undifferentiated new incentives for home building country-wide and may thus contribute to further urban expansion. From the environmental protection's point of view – in the interest of a feasible pension scheme over the long term and an efficient use of public funds –, the homes subsidised by the Private Home Pension Law must be scrutinised whether they really provide age and environmentally compatible living conditions in terms of place, size and building properties.

* Riester's pension is a voluntary private pension scheme supported by the German State. It was Walter Riester, then Federal Minister for Labour and Social Order, who suggested supporting a voluntary pension scheme.

- lead a dialogue with the federal states about **land purchase tax** so that they favour the acquisition of previously developed industrial land and, conversely, more heavily tax the acquisition of virgin development land.

- amend the **real estate tax** in co-operation with federal states and municipalities in such a way that it encourages a space-efficient use of properties according to the slogan: 'rather high than wide', which discourages excessive covering of the ground and, in addition, contributes to the stabilisation of local finances. In view of the relatively low municipality tax and a prevailing competition between the individual municipalities which mutually undercut themselves by lower and lower tax rates, the real estate tax will then only have a noticeable effect on property users and serve its purpose when the Federal Government achieves it through a dialogue with the municipalities to equalise their municipality tax and introduce a uniform minimum tax throughout the country.

- change the **income tax law** (Example 2) with regard to acquisition of existing real estates in such a way that costs of energy-saving-relevant repairs and modernisation may be amortised immediately or over a two- to five-year period.

- **financially support the establishment of an ecological rent index** within a support programme. Thus the Federal Government would contribute to overcoming the financial obstacles that obstruct the introduction of an ecological rent index at the local level (see also 4.3 Impartial implementation example).

- increase the provisions of the **Energy Saving Bill (EnEV)** for new buildings to go beyond the 'Meseberg resolutions' of the Federal Government toward the passive house level and to guarantee the implementation of the 'Meseberg resolutions' in existing buildings (see Section 'Legal tools').

- introduce the **Energy Requirement ID** (Example 3) as an obligating document for all buildings.

- continue the successful and well accepted **programmes of the Reconstruction Credit Institute (Kreditanstalt für Wiederaufbau, KfW)** (Example 4) for energy saving refurbishment in existing buildings beyond 2011.

Example 4: KfW-CO_2 building refurbishment programme

The Federal Government and the Reconstruction Credit Institute initiated the 'KfW CO_2 building refurbishment programme' in 2001 in order to provide house owners and investors with financial incentives for refurbishing their buildings' energy saving characteristics. The programme assigns favourable credit interest for energy saving refurbishment in existing buildings. From 2007 the KfW has also approved capital investment grants, thus a subsidy is also possible without raising credit. The climate protection programme of the Federal Government adopted in Meseberg intends to carry on with the KfW CO_2 building refurbishment programme up until 2011 with an annual cost of approximately 1 billion euro (BMU 2007b).

In 2006 the Reconstruction Credit Institute issued a 3.4 billion euro loan. The energy saving refurbishment of 13 million m2 living space inspired by this has led to savings of approximately 700,000 million tons of CO_2. Simultaneously, the investments initiated by the subsidy secured and created 65,000 jobs in 2006 (BEI 2007).

More information about the CO_2 building refurbishment programme and other programmes such as 'Invest socially', 'Municipality credit', 'Home modernisation' or 'Ecological building' are available from the KfW Website: http://www.kfw foerderbank.de

Federal states

Just like the Federal Government, the federal states have the possibility of shaping the 'construction and housing' area of need by legal, economic and information tools. The federal states participate in federal legislation within the Federal Council (Bundesrat). The Federal Council can submit legislative proposals to the German Parliament (Bundestag). The federal states implement the federal laws. In areas not expressly assigned to the Federal Government by the constitution, for example education politics, the federal states have their own legislative competence.

In order to encourage a long-term environmentally compatible development in this area of need, **the federal states have the options of**

- favouring the acquisition of industrial brownfield land by advantageous **land purchase tax** and more heavily taxing the purchase of virgin development land for building purposes.

- amending the **real estate tax** in co-operation with the Federal Government and municipalities in such a way that it encourages a space-efficient use of properties suitable for building, discourages excessive covering of the ground and contributes to the stabilisation of local finances. In view of the often low municipality tax the real estate tax can contribute to its goal i.e. to reduce the residential area and that of traffic only if the municipalities equalise their municipality tax and introduce a uniform minimum municipality tax throughout the country.

- adapting their **development plans** (Example 1) to the sustainability goals of settlement policy (internal development preferred to external) and establish an obligatory level of building density.

- applying the **needs based approach** at federal state level – as in Schleswig-Holstein – (Example 5) in order to determine the available relief potential for the environment and identify key actions.

- concentrating the development within existing town centres with the help of the persistent use of **regional housing and industrial subsidies**.

- linking **town planning subsidy** to the fulfilment of firm goals of environmentally compatible building (saving natural resources, adopting recycling, long-life schemes, repair-friendly etc.) and establishing a residential environment worth living in.

- devising the **municipality financial compensation scheme** in such a way that municipalities who provide development land do not receive compensation, and municipalities that refrain from external development in the interest of the environment, receive compensation.

- consistently compensating for damage to the ecosystem, particularly natural soil functions, within the execution of the **environment protection intervention regulation** of the building law when settlements are expanded. For this purpose the states should issue guidelines for the local authorities to enable adequate execution of the intervention regulation.

- shaping their **education politics** in such a way that aspects of a sustainable development become more commonplace.

Example 5: Sustainable construction and housing in Schleswig-Holstein

Applying the needs based approach at the federal state's level, Schleswig-Holstein showed a good example early on in 1999 and initiated the 'Sustainable construction and housing in Schleswig-Holstein' project.

The Schleswig-Holstein Ministry of Interior and Environment, together with the relevant stakeholders, developed a federal-state-specific database as well as scenario assumptions that took into account the situation and the building characteristics of Schleswig-Holstein (for example a high fraction of clam-shell masonry). A comparison of the scenario results with the reference and sustainability scenarios has indicated that there is substantial potential to reduce the environmental impact in the 'construction and housing' area of need at both Federal and state levels.

During the following implementation dialogue process, individual topics were discussed and action plans following the sustainability scenarios were developed. The following belong to the tools already applied:

- advanced subsidy programmes to encourage energy saving measures concentrating on heat insulation in existing blocks of flats and passive house standards in new buildings,
- development and test of a building passport as a voluntary tool for quality assurance in house building and as a supplement to the energy ID,
- initiation of a continuous monitoring process 'Sustainable construction and housing'
- execution of a national competition for energy-conscious building modernisation and
- establishing the concept of an interdisciplinary master course 'sustainable construction' at the Faculty of Building Industry of the Kiel University of Applied Sciences.

In its Agenda 21 and Climate Protection Report 2004, the Schleswig-Holstein Government – together with the Innovation Endowment, the Working Group for Modern Building and the Energy Agency of the Investment Bank – committed itself to advancing energy saving modernisation in existing buildings. Based on the calculated scenario results, the Schleswig-Holstein Government

proposed a realistic reduction in CO_2 emissions in the 'construction and housing' area of ten per cent by 2010 and 30 per cent by 2020 as compared to 1998 level.

In Schleswig-Holstein, using the needs based approach and scenario calculations not only identified practical and attainable goals to reduce the environmental impact in the area of need investigated, but also helped to establish them politically (Schleswig-Holstein 2000, Schleswig-Holstein 2004a).

Regions

Regional administrations, for instance districts or government boroughs, have a mediating function between the federal state's stakeholders and the municipality. This function varies from federal state to federal state and is different depending upon region. This is the distinguishing importance of the region in relation to the municipalities and the accompanied competences that determine the value and the success of actions for a sustainable development. The regional level can achieve a lot in order to promote the cooperation of the municipalities and cleverly combine their interests.

The regions have the opportunity to

- develop a **regional land-use plan** which considers both the provisions of the land development plan and the special features of the region and the individual municipalities and uses them optimally from the environment protection's point of view.

- improve communication and cooperation of the municipalities in the region by **regional management** (Example 6), for instance with the help of existing or newly created planning and commercial associations.

- harmonise the establishment of rent indices. The involved stakeholders – municipalities, home owners and tenants – can compile comparable so-called **ecological rent indices** for the municipalities of a region through a coordinated procedure (see also 4.3 Impartial implementation example).

Example 6: Regional management

Municipalities often attract people, companies and thus tax funds by favourably allotting development land and industrial areas without properly considering the long-term social, ecological and economic effects of their actions for neighbouring municipalities and the region. Therefore, in addition to formal planning in land development plans and regional plans, a regional management would be useful to coordinate the development within the region better and distribute existing money appropriately within the region. In some regions, for example Freiburg in Breisgau (Baden-Württemberg) and the surrounding area have introduced increasingly successful approaches for regional cooperation in the form of inter-municipality industrial parks and coordinated land development.

Municipalities

In addition to government and federal state levels, municipalities equipped with planning and budget sovereignty enjoy a key importance in terms of implementation. The challenge is to increase the attractiveness of the towns and villages, promote a sustainable development in built-up areas, i.e. improve the residential environment, strengthen local public transport (LPT) and make life less dependent on the car, expand green areas as well as consistently use brownfield sites. The European Union Directive of Environmental Impact Assessment (2001/42/EG) may provide an additional 'motivational thrust' in the future (Example 7).

The municipalities have the opportunity to

- amend the **real estate tax** in cooperation with the Federal Government and states in such a way that it encourages a space-efficient use of urban land and discourages an excessive covering of the ground. Mutual undercutting of the real estate tax rates ('tax dumping') in order to lure away inhabitants and companies from other municipalities should stop. For this purpose – in addition to the introduction and observance of minimum tax rates – a cooperation of the municipalities in the region is required.

- record the current situation of land and the building fabric in the municipalities in a **land register**, establish reliable **population prognoses** taking into account the demographic developments, identify economic strengths and weaknesses using an **analysis of potentials** and obtain information about possible developments with the help of simulation models – for instance using the **needs based approach**.

- channel **town development, land-use and allocation plans** according to the principle 'internal before external development'.

- develop **demolition, building gap and brownfield programmes** for the municipality.

- use the prescribed or recommended **building densities** of the regional development plans and **upgrade town centres**, for example with green areas and traffic-calmed zones, and thus protect the surrounding countryside from further urban expansion.

- convert the existing rent index into a so-called **'ecological rent index'** (see also 4.3 Impartial implementation example).

- publish a local **heat index** that details the energy saving quality of existing buildings within the municipality

- offer **energy counselling** to consumers.

Example 7: Environmental audit

The European Law Implementation Act for Building Industry (Europarechtsanpassungsgesetz Bau, EAG Bau) that came into force on 20 July 2004 and is based on the European Union Directive of Environmental Impact Assessment of certain plans and programmes (2001/42/EG), implements new legal provisions into the German building law (BauGB). According to this, all urban land-use planning that prioritises the use of external areas must be accompanied by an environmental audit which determines and evaluates the environmental impacts of the plans. With this action the environmental aspects of buildings gain a higher priority within land-use planning.

At the beginning of 2007 the Federal Government amended the Federal Building Code and strongly limited the obligation to an environmental audit when planning for internal development in order to provide an additional incentive for internal development to the municipalities. In cases where an audit is not obligatory, it is possible for the municipalities to accomplish an environmental audit voluntarily.

Architects, building and housing contractors

Architects, building and housing contractors can promote sustainable building methods in new or existing buildings in various ways because this group shapes the future housing conditions. Their ideas and visions determine trends and their practical actions create evidence that considerably affects the 'construction and housing' area of need over the long term. In view of the rising number of single households and the trend toward an aging population in Germany, more flexible living forms are in demand which makes an adjustment of the living space possible both to increasing and shrinking households.

Architects, building and housing contractors have the opportunity to

- establish user-friendly and **flexible plans and designs adapted to needs**.
- further develop their **specialist ecological competence**.

- think of the later use and utilisation of components, products and materials before building starts, and therefore choose **environmentally friendly, long-lived and re-usable products and materials**.
- plan and build buildings in such a way that they **use as little land, energy and raw materials** over their entire lifetime (construction, use and demolition) **as possible**.
- advance **market exploitation** persistently **using resource-saving building methods** (Example 8).
- support the introduction of **whole of life documents** – such as building passports – for their buildings, in addition to the power requirement ID.
- strengthen **quality assurance** of building performance.

Example 8: Energy-saving buildings

Passive houses (or other energy-saving building variants – such as the three-litre house which to start with offers a very high standard of comfort and secondly requires only minimum heating costs. Since a Japanese manufacturer renamed his solar houses from 'zero-energy houses' to 'zero-energy-cost houses', the demand keeps increasing markedly (Photon 2006). Such a strategy could also work for German companies. If architects and building contractors would advertise the long-term cost savings of energy-saving houses and energy-saving building methods more forcefully, they could advance the market exploitation and promote a positive development in sales.

Home owners and managers

In addition to planning, development and supply of new or existing buildings, someone must take care of their management. Either the owner does this himself or employs a caretaker. The caretaker can pass on suggestions about improvements to the building fabric or the residential environment to the responsible persons (for example owner, municipal administration). Due to their direct contact with the tenants, caretakers are able to help people when they move to new homes by providing assistance during the move and to increase environmental awareness – for example for climate protection.

House owners and caretakers have the opportunity to

- perform and optimise the **refurbishment and modernisation** of buildings (Example 9)
- **inform tenants** about construction measures which would be reasonable from the environment's point of view, **and let them participate** in the implementation.
- cooperate with national stakeholders in order to achieve **an improvement of the basic conditions** – for example for future town development.
- offer useful **living services**, for example a concierge service or establish contacts to service providers (e.g. beverage delivery service).
- simplify **flat exchanges** in order to use the floor space of the buildings more effectively. It should be taken into account that tenants would only change their flats if the living costs did not rise or the rent increase was in appropriate relationship to the floor space gained or for improved living comfort.

Example 9: Energy provider contracting

If the financial means or the necessary knowledge for an energy saving refurbishment was missing, an 'energy provider contracting' is an interesting service for house owners. An 'Energy provider contracting' means that specialist companies, so-called contractors, offer to replace an old, ineffective boiler with a new one or to install another energy-saving heating system and adjust it in a user-friendly way. The contractor takes on the costs of the replacement. In response, the tenants pay a monthly amount to the contractor for heating their flats over an agreed period of time. The building owner can thus increase the energy saving quality of his building without carrying the capital outlay. In order to use the potential of energy saving in the building, the contracting should progressively deal with more improvements in the building shell: improved heat insulation, removal of thermal bridges (places with high heat loss), installation of windows with high-quality thermal protection glazing etc.

Home owners and tenants

Changes on the demand side, consciousness and behaviour of people as users of living space and infrastructure, induce changes on the offer side. The users of buildings and flats thus have the responsibility of acquiring information and contributing to the decrease of demand on the environment in the 'construction and housing' area of need.

Home owners and tenants have the opportunity to

- adapt the **flat size** to their own needs and, if necessary, consider a move.
- prefer **local residences** e.g. close to their work place, shops, leisure offers and have good connections to public transport.
- select **flats or houses** with as low heating costs as possible.
- inquire about an **energy requirement ID** and suggest the introduction of a **building passport**.

- inquire about an **ecological rent index** (see also 4.3 Impartial implementation example) and thus suggest the improvement of the rent index.
- inquire about the energy saving quality of the building with the help of a local **heating index** and compare this with other buildings.
- use **energy counselling**.
- support initiatives for sustainable **repair and modernisation** of flats as well as for **improving the residential environment** or – if none is available – initiate one.

4.3 Impartial implementation example: how the 'investor user dilemma' can be converted to a 'win-win situation'

The preceding sections have shown that each stakeholder can contribute to shaping the 'construction and housing' area of need in a sustainable way. However, it is important in a number of the courses of action illustrated for the partners to cooperate in order to implement the courses of action. Such a cooperation is also necessary to overcome the so-called 'investor user dilemma'.

A large obstacle in the energy saving refurbishment of existing buildings is the so-called **'investor vs. user dilemma'**. Landlords are often unwilling to carry the investment costs for an energy saving refurbishment since – according to their estimates – they would not profit sufficiently from it. However, the tenants, as users of the building, would profit from energy saving refurbishment via decreasing heating costs without bearing the cost of the refurbishment. Thus beneficiaries and investors of a refurbishment are not identical – a situation typical for rented flats. The consequence is that overall economically advantageous refurbishments are omitted since they are not worthwhile to the landlord.

An example of the 'investor user dilemma' is the often lacking willingness of landlords to exchange an old and inefficient heating system for a modern device. A modern, more efficient heating system would reduce energy consumption and heating costs. However, it is primarily the tenants and not the landlord who would benefit from the lower heating costs, but the landlord would have to carry the capital outlays.

With a comprehensive energy saving refurbishment of the existing residential buildings in Germany it would be possible to considerably reduce the energy consumption and the associated climate-damaging CO_2 emissions in the 'construction and housing' area of need within the next few years. Although the technical tools are available and there are several national subsidy programmes for energy saving refurbishment, the refurbishment rate is still very low. What is the reason for this?

If a building owner wants to invest in his real estate, the financial expenditure must be worthwhile for him – either he lives in the building and benefits from the lower energy costs and the improved housing comfort or he may gain new tenants. Additionally, it is often necessary for the landlord to transfer the refurbishment costs into the rent, so that the refurbishment pays for itself. The legislator has already created the possibility in § 559 of the Civil Law Code a long time ago for adding a maximum of 11 % of the modernisation costs to the annual rent.

If landlords would like to increase the rent based under this regulation, they must verify that they have performed an actual modernisation, and not just repairs to the existing, to the tenants. Since this distinction is often difficult and would not stand up to a complaint by the tenants in court, the investors are often frightened off from doing the reallocation. In consequence they either bear the cost of the refurbishment themselves, usually of low quality,

or do without a refurbishment all together. Thus the question arises, what is an appropriate way of passing on the costs of an energy saving refurbishment to the tenants who would benefit from the energy savings – less energy consumption means less costs.

In order to moderate this dilemma, the municipalities should include the thermodynamic properties of a building as a criterion into the rent index and thus introduce an obligatory 'ecological rent index'. The development of such a rent index requires the cooperation of municipalities, house owners and tenants. Darmstadt has already been successful in introducing an 'ecological rent index'. This rent index resulted in the landlords of energy saving refurbished buildings being able to take a significant additional average charge of 0.37 euro per m^2 to the cold rent* (Darmstadt 2003). However, the introduction of an 'ecological rent index' not only offers an advantage to landlords by being able to require higher rents for energy-saving flats, the tenants also benefit from its introduction since they obtain a more objective comparison of rents.

Energy requirement IDs facilitate the provision of ecological rent indices since they provide the necessary database. They moderate the 'investor user dilemma' directly since they identify energy saving possibilities from the actual condition of the building and recommend refurbishment measures. This information is based on a calculation model for the energy requirement of residential buildings stipulated by the Energy Saving Bill. Thus the building owner, using the data calculated for the power requirement ID, can in many cases verify that the refurbishment is a modernisation whose costs he may pass on to the tenants. In addition, the energy requirement ID provides

* Term used in Germany for the rent not including heating and hot water costs.

proof for classifying their flats into the category ‘good thermodynamic properties’ of an ‘ecological rent index’ to the building owners. The energy requirement ID therefore brings numerous advantages for the building owner as well.

The suggested tools for overcoming the ‘investor user dilemma’ increase the incentive for investors to provide money for energy saving refurbishment of their buildings. For the protection of the tenants, the increase in the cold rent, as a consequence of an energy saving refurbishment, should, if possible, not lead to a higher warm rent (warm rent neutrality). The tenants of energy-saving refurbished buildings save money over the long term due to the tendency for energy prices to continue to rise. In order to make energy refurbishment acceptable, all those involved must be informed in time, comprehensively and with certainty.

The investors and users are not the only winners, the environment also wins because energy conservation provides a double ecological dividend by preserving raw materials which are becoming increasingly scarce and reducing the emissions of greenhouse gases.

5. PERSPECTIVES

We cannot cancel the developments of the past decades and the associated effects on our environment. But we can meet them with properly developed, modern technology as well as changed behaviour. The scenario results reveal substantial causes for the rising environmental impact in the 'construction and housing' area of need and indicate which 'set screws' must be turned to create a sustainable development within this field. New buildings take up valuable land and large quantities of raw materials, existing buildings need unnecessarily large amounts of energy and thereby cause emissions damaging to the environment. A change of direction from new buildings to the maintenance of existing buildings and a return from the greenfield to central urban areas result in alternatives worth pursuing compared to our past living forms and relieve the environment substantially. We can advance this directional change – whether as frame-setting stakeholders, vendors or users of construction and housing services. There is a large number of actions available.

Further information for sustainable construction and housing can be found on the UBA website (www.umweltbundesamt.de) and in the following brochures:

- „Gesünder Wohnen – aber wie?“ (UBA 2005a)
- „Nachhaltiges Bauen und Wohnen in Deutschland“ (UBA 2004)
- „Reduzierung der Flächeninanspruchnahme durch Siedlung und Verkehr“ (UBA 2003a)
- „Das Energie-Sparschwein“ (UBA 2003b)
- „Blauer Engel – Umweltfreundlich Bauen“ (UBA 2003c)
- „Hilfe! Schimmel im Haus“ (UBA 2003d)
- „Energiemanagement in Wohnungsunternehmen“ (UBA, GdW 2003)
- „Managementleitfaden für regionale Kooperation“ (UBA 2002b)
- „Umweltzeichen für ökologische Bauprodukte“ (UBA 2001a)

These brochures can be ordered free of charge from UBA – either on the internet or from the central Information Centre of UBA for Inquiries on Environmental Protection:

Address: Wörlitzer Platz 1, D-06844 Dessau-Roßlau
Phone: +49 340 2103-2130, -2135, -2136, -2174, -2400, -2689
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