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**Symposium on Disaster Resilience and Built
Environment Education Celebrating project successes**

Scientific and methodological aspects of the training module "Renewable Energy Sources"

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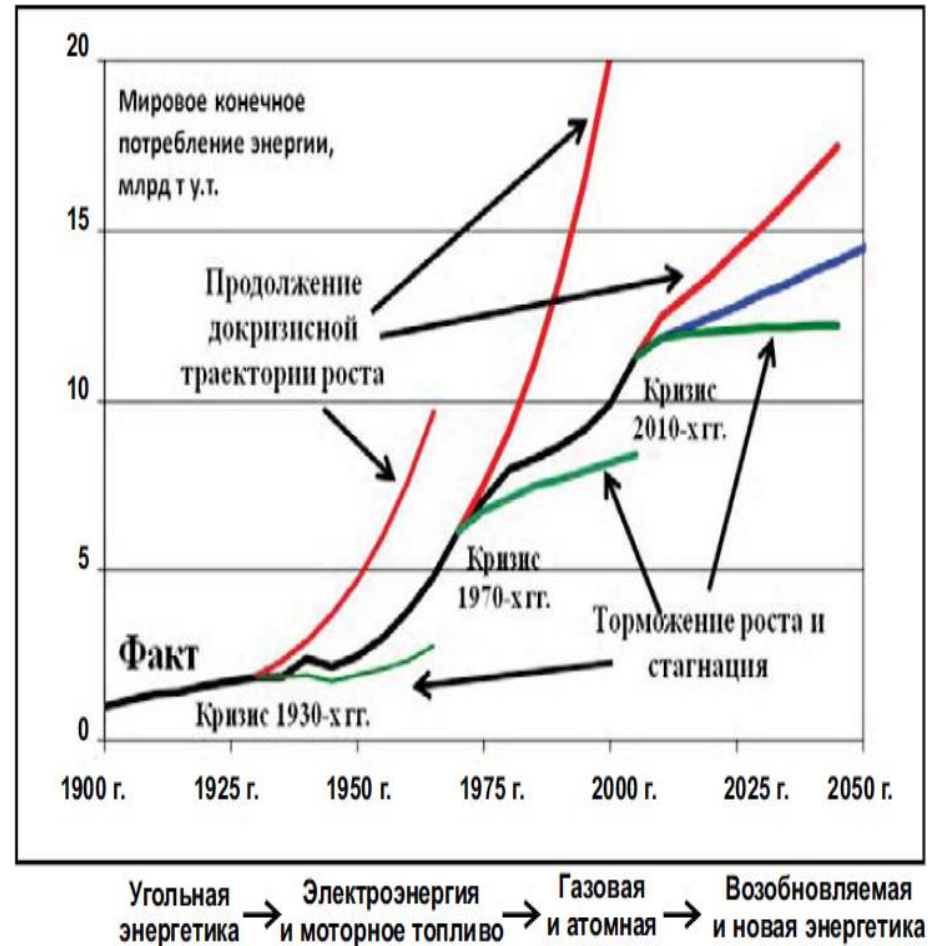
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The main objectives that were set during development of the study module:

- students getting the knowledge and understanding of the ecological and energy problems of the world economy;
- getting research skills to prepare and conduct experiments on a given methodology, analysis and evaluation of the results of research involving the appropriate mathematical apparatus;
- mastering of specific social skills on RES;
- the development of personal qualities such as: development of module self-study approach, participation in group discussions and preparation and presentation of the abstract presentation on a given topic;
- understanding of the political framework conditions aimed at promoting of renewable energy and the application of knowledge in the calculation of economic efficiency of the use of renewable energy.



The paradigm of the global economy development

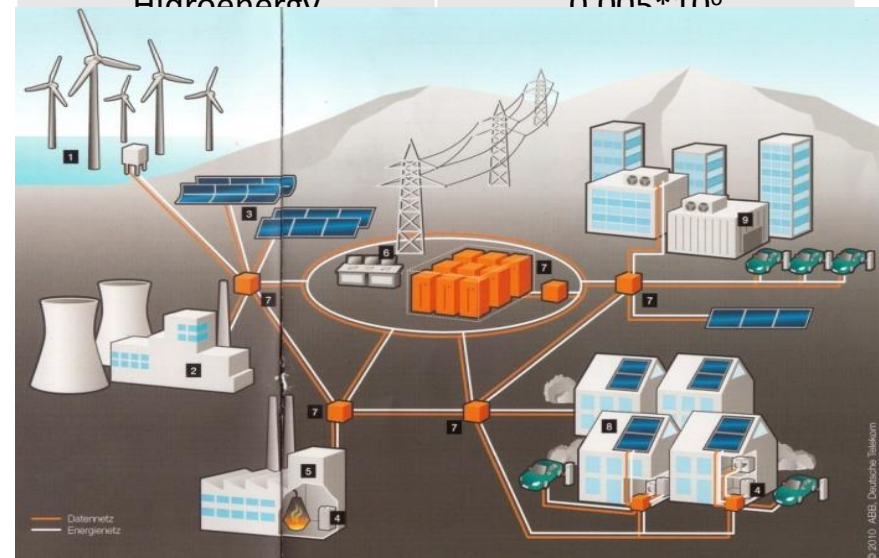
Lecture 1. Renewable energy - energy of the future for the life cycle of the built environment.

Author - Beley Valeriy, prof. , Dr.Sc., KSTU

The purpose of training on this subject is to develop the students' evaluation of the effectiveness of the global economy and the life cycle of the built environment by using the technologies based on RES. Learning outcomes are acquired knowledge on: the potential of non-renewable energy sources and the environmental consequences of its use; the main problems of the world economy and the life cycle of the built environment with the use of technologies based on RES, the formation of ideas about the theoretical, technical and economic potentials of RES.

Theoretical resources of RE in the world

Energy sources	Resources. mil. ton of reference fuel
Solar energy	$130 \cdot 10^6$
Wind energy	$0,2 \cdot 10^6$
Geothermal energy (up to 10 km depth)	$4800 \cdot 10^6$
World ocean energy	$0,25 \cdot 10^6$
Bimass energy	$0,1 \cdot 10^6$
Hydroenergy	$0,005 \cdot 10^6$

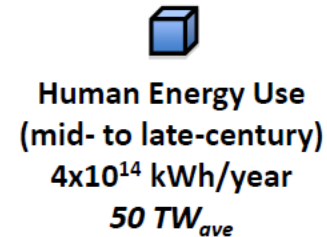
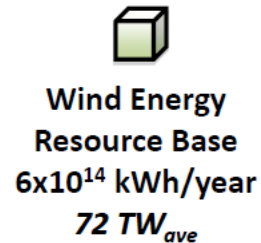
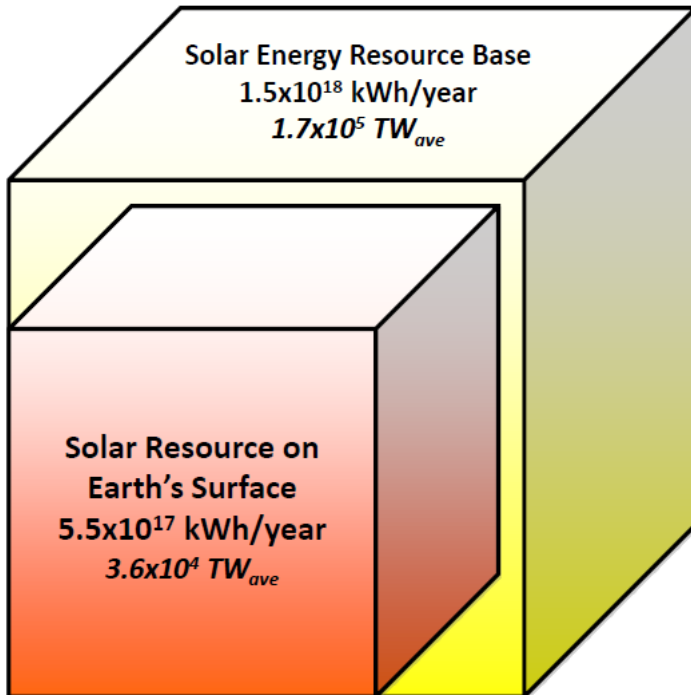


Smart Grid

Lecture 2: Solar energy technologies.

Authors: Nikishin Andrey, Associate Professor, Dr.Eng., KSTU;
Solovey Alexander, Associate professor, Dr.Eng., NTU "KhPI»

Section introduces the assessment of the potential and prospects of solar energy use in the world, , classification and the main types of solar power plants, the methods of calculating of their power. The main schemes of direct use of solar energy are given. The environmental aspects of the solar power plants impact on the built environment and economic aspects of their use in this environment are stated.



The resources of solar energy

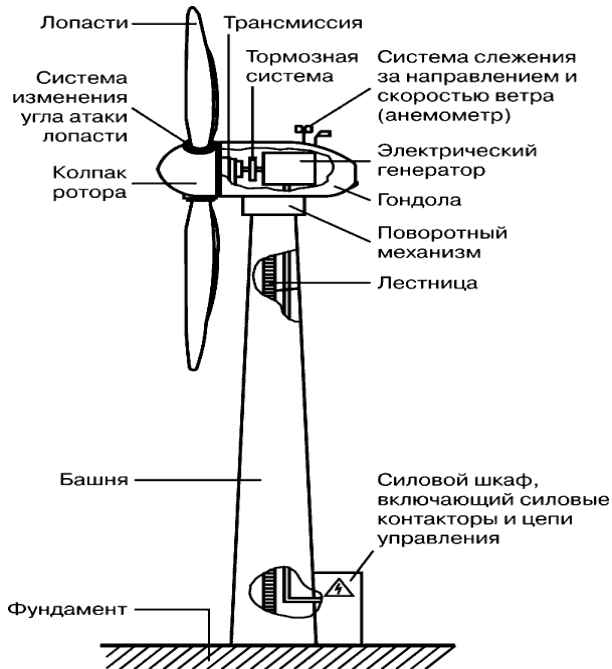
Lecture 3. Technologies of wind energy use.

Authors: Beley Valeriy, prof. , Dr.Sc., KSTU; Zadorozhniy Andrey, Phd student, KSTU.

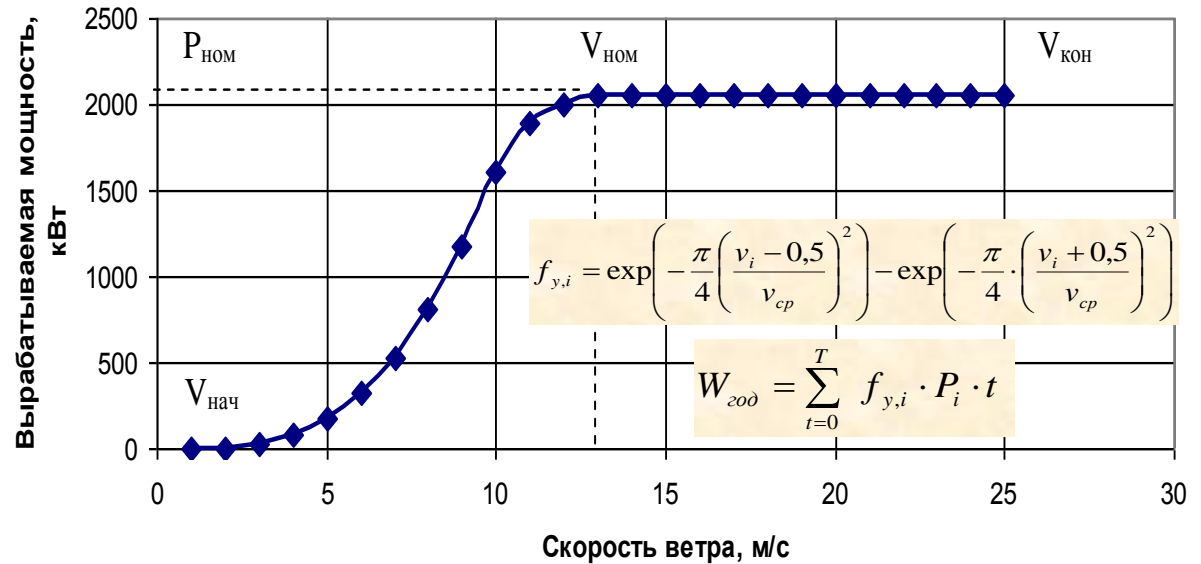
The lecture outlines the basic knowledge about the wind and its energy potential, which forms the students' understanding of the physics of the processes and the possibility of using wind energy for practical purposes. The main stages of development of wind turbines (WEC) development from the first installations to the modern are analysed.



A wind turbine of Paul Kura (1891)



Engineering method of annual wind turbine electricity generation calculation



The construction of a grid connected wind turbine with a horizontal axis of rotation

Lecture 4: Technologies of water power use.

Authors: Beley Valeriy, prof. , Dr.Sc., KSTU; Selin Viktor, prof. , Dr.Eng., KSTU.

To technologies that use water power, correspond the energy sector, which uses the energy of falling water (hydropower). This energy is converted into mechanical or, most often, electrical.



The most powerful hydroelectric plant in the world, Three Gorges (China), $P=22,5\text{GW}$

← A full-scale prototype of the Pelamis P-750

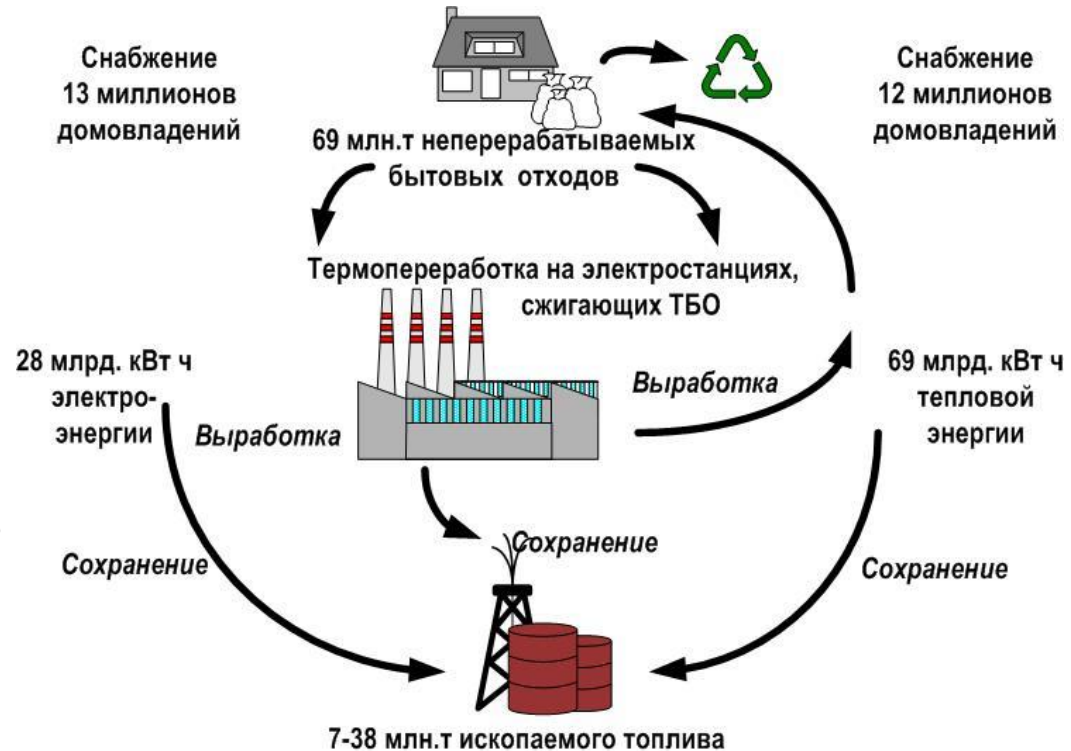
The lecture introduces students to the basic types of hydroelectric power plants, the method of their power calculation. The main schemes of use of water energy are given. Environmental aspects of the impact of hydropower plants are stated. The result of study is to obtain information about the possible use of water power in the present and in the future; environmental technologies for water power use in the existence of the built environment.

Lecture 5: Technologies of bioenergy use.

Authors: Selin Viktor, prof. , Dr.Eng., KSTU.

The main results of study are:

- data about the characteristics of different types of biofuels;
- information on the priority kinds of biomass for use in regional energy balances;
- mastering the methods of calculation of bioenergy plants, and their technical and economic efficiency;
- acquaintance with the principles of calculation and thermal schemes biogas generators, bioenergy plants;
- acquaintance to the dynamics of the implementation of bio-energy in the energy mix in different countries.



In Europe 69 million tons of MSW annually burned and more than 28 billion kWh of the electric energy and about 69 billion kWh of thermal energy is generated. It allows to save up to 38 million tons of fossil fuels and prevent emissions of greenhouse gases (in terms of CO_2) up to 37 million tons per year.

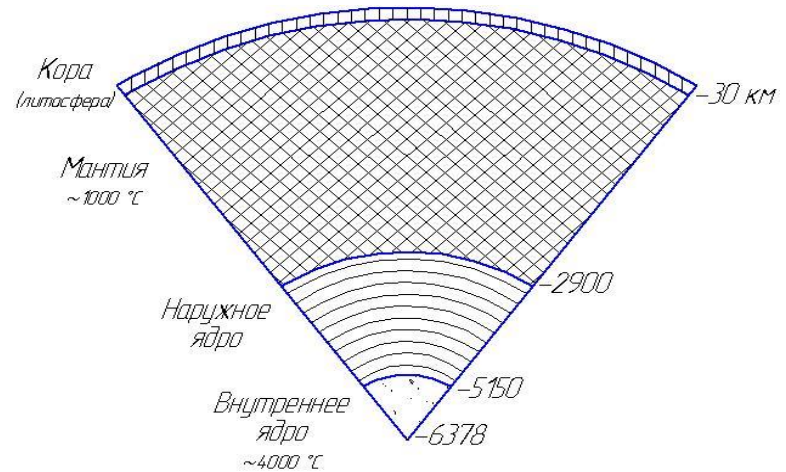
Lecture 6: Technologies of geothermal energy use.

Authors: Selin Viktor, prof. , Dr.Eng., KSTU.

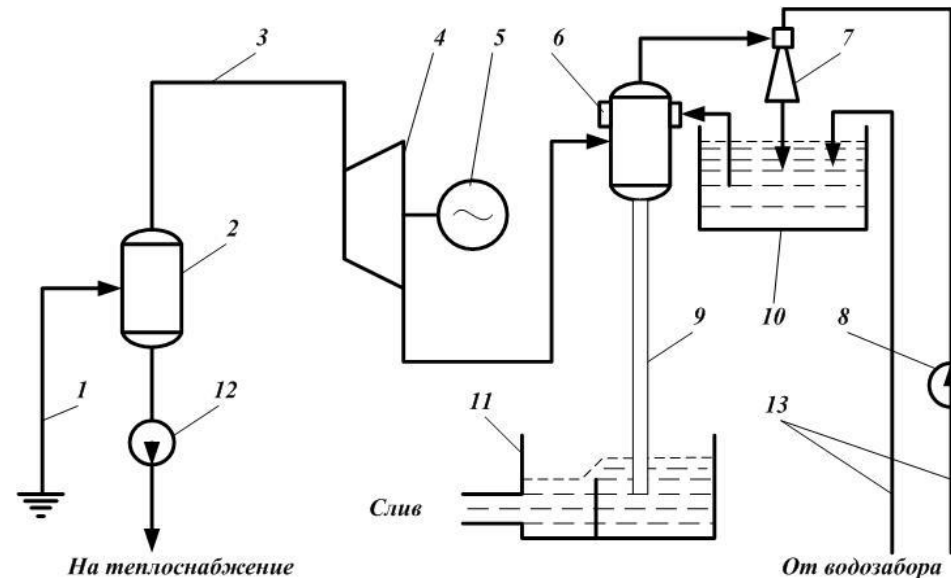
The purpose of training is to study the technology of geothermal energy to produce electricity and heat, as well as commercial products from the mineral substances contained in geothermal fluids.

Learning outcomes can be:

- evaluation of the economic feasibility of the use of regional geothermal resources for power generation;
- evaluation of the economic feasibility of the use of regional geothermal resources for use in balneology and heating and ventilation systems,
- assessment of the possibilities of regional geothermal resources in the systems of heat pump installations;
- mastering the assessment methodology of the heat capacity and the geothermal array time constant.



Structure of internal mass of Earth



Scheme of Pauzhetsky geothermal power plant

Lecture 7: Political framework conditions of legislation in the field of renewable energy

Authors: Elagin Nikolay, Associate Professor, Dr.Eng., KSTU.

The training purpose of a subject is acquaintance to the frame conditions of the standards and legal base of various countries aimed at the development and support of use of renewable power:

- analysis of the framework conditions for the creation of the legal framework in the field of renewable energy;
- basic data for analysis and selection of the most effective solutions for making legislative initiatives;
- example to illustrate the effectiveness of policy in the field of renewable energy.

The basic materials of study module are: lecture notes and teacher assignments uploaded to the Moodle platform.

They include interactive tasks for an intermediate assessment of knowledge by the teacher, and the student (self-assessment). Students are offered links to additional materials on the Internet, such as databases, including ScienceDirect, Scopus, electronic libraries, and so on. Additionally, on the TEMPUS project site (<http://www.ceneast.com/>) links to open source videos and methodological materials provided by the best universities module are submitted. Students are encouraged to perform the abstract, including elements of research on the topic essay.

The thesis of Teplyakov M. M.: "Design of biopower plant in the Kaliningrad region (biofuel — a fast-growing willow)", which was presented at Ministry of Education and Science of the Russian Federation competition of diploma works, was chosen as the best in the one of the nominations of "Use of RES

Белей В.Ф. Возобновляемые источники энергии: справочник модуля /под ред. В.Ф.Белея , В.В.Селина, А.О. Задорожного ,А.Ю.Никишина, Н.Н. Елагина, А.В. Соловья. –Калининград: ФГБОУ ВПО «КГТУ», 2015.- 184с.