

# ENERGY CONSERVATION WAY OF WORLD DEVELOPMENT

*Dmitry Vavrovskiy*

Saint-Petersburg State University of Aerospace Instrumentation,  
Saint-Petersburg, Russia  
[Dima\\_vavrovskii@mail.ru](mailto:Dima_vavrovskii@mail.ru)

## III. FOREIGN EXPERIENCE

### I. INTRODUCTION

In far 1968 there was rather significant event. The group of scientists and businessmen of the different countries of the world established international non-governmental organization, called "The Roman club". The primary goal of the organisation – studying of mankind's global development problems and finding the ways to solve them.

In 1997 report named "the Factor Four" was presented. The main idea of the report was that existing practice of energy and other resources usage has no future. Over wastefulness not only exhausts our planet, but also has no historical prospect. As examples, multiple cases of unreasonable resources usage were brought to the table. Carried out researches have shown that it is possible to achieve wealth doubling, using for this purpose twice less resources. And it is hard to disagree with these statements. So, members of the Roman club have developed appropriate recommendations to the Governments of different countries.

### II. ENERGY CONSERVATION

The Austrian physicist Ludwig Boltzman, who lived in 19th century, had entered the concept of entropy. Conditionally it is an indicator of modern civilization energy "dissipation" level, the characteristic of that part of energy which cannot be transformed into work. However, at that time his researches didn't receive proper attention, because of a general productivity and economic efficiency pursuit. Because of numerous wars, presently this problem was lifted only at the end of 20 century. Power conservation means realization of the legal, organizational, scientific, industrial, technical and economic measures aimed at effective (rational) use (and economical consumption) of fuel and energy resources and at involving of renewable energy sources in economic circulation.

Now the most vital are the household energy saving, energy saving in a sphere of housing, communal services, agrarian and industrial complex.

After the 1973 Energy Crisis in Japan and USA these countries decided to create special centers and their initial goal was to decrease dependence on foreign power resources. With the lapse of time spheres of their activity became much wider, and they began to engage in many aspects of energetics, including energy conservation and energy safety. They were named the Japanese Energy Conservation Center and the United States Department of Energy, and after some time other countries realized the existence of this problem and similar centers began to appear in other states.

Stimulation of energy conservation technologies implementation demands complex approach in which it is necessary to take into account economic interests equally with creation of legislative standards. All developed countries of the world began to understand this basic moment.

German experience of increasing of energy conservation stimulation in housing can be an example. Grants for houses reconstruction aimed at energy consumption decrease in Germany made up about 1.5 billion Euros. For housing owners, planning to make reconstruction of their houses aimed at increase of heat engineering characteristics, 20 % decrease of the tax burden is provided. Also bank credits with lowered interest rate are admitted as quite good incentive.

Similar mechanisms are applied in other countries. For example, in Switzerland investors who put means in making houses with low energy consumption receive the state grant. In France to owners, who warm the houses, which were built till 1977, tax credits at a rate of 40 % are applied. In USA power companies set reduced rates for energy payments for power efficient buildings. At the same time, besides effective financial mechanisms of house owners and investors stimulation, in Europe and USA there are also legislative regulations determining rigid standards of energy consumption for new housing, systems of energy conservation monitoring and penalties for standards violation.

## IV. EUROPEAN UNION

Since January, 1st 2007 Germany started to preside over European Union. Chancellor A. Merkel

has already declared that working out the all-European energy policy is her priority. The European Union speaks about maintenance of long-term power safety, search of new suppliers and reduction of dependence. EU is one of the biggest fuel importers (82 % of oil and 57 % of gas at the moment are imported and only 3 % of the uranium used in nuclear power plants is extracted in Europe) and therefore energy conservation and alternative energy sources researches are its major goals necessary for development, economic growth and safety.

Modern obligatory principles of the united European energy policy were developed and accepted on October, 27th 2005 in London. In total several draft laws were accepted, and basic provisions include:

1. A cut of at least 20% in greenhouse gas emissions from all primary energy sources by 2020 (compared to 1990 levels).
2. A cut of up to 50% in carbon emissions from primary energy sources by 2050 (compared to 1990 levels).
3. A minimum target of 10% for the use of biofuels by 2020.
4. The development of new technologies in areas including renewable energy, energy conservation, low-energy buildings, 4th generation nuclear power, clean coal and carbon capture.
5. Improving energy relations with the EU's neighbours, including Russia.

EU develops the seventh Framework Program. During last years the energy strategic plan had further development: the new "Green" document about energy efficiency (Green Paper on Energy Efficiency), and other urgent documents were issued, like the Strategic Energy Technology Plan. More and more commitments, connected with increase of energy conservation are gradually imposed on EU Member States. The SET plan (Strategic Energy Technology Plan) includes:

#### 1. European Wind Initiative

Speech first of all goes about wind turbines installation. Wind turbine is a huge column with a rotor and a huge propeller usually with 3 blades on its top, turned to a wind and connected to a generator. Wind activates the propeller, and at the expense of rotation electric power is produced in the generator. In this area the leaders are Germany and Spain (Table 1). At the moment there are more than 20000 wind turbines in Germany with total capacity 26 thousands Megawatt (which produce 6,6% of electricity supply).

Table 1

Wind Power Capacity Increase, per year,  
EU Top 5 (MW)

Country	2006	2007	2008	2009	Total
Germany	2,233	1,667	1,656	1,917	25,777
Spain	1,587	3,522	1,609	2,459	19,149
United Kingdom	634	427	852	1,077	4,051
France	810	888	950	1,088	4,492
Portugal	694	434	712	673	3,535

Spain is on the second place – 19 thousands Megawatt (14 % of country's requirements). On November, 8th, 2009 owing to a strong wind Spanish turbines showed record productivity – 11,5 thousands Megawatt (53 % of country's requirements). Also it is necessary to note Denmark, where total capacity is about 3,125 Megawatt, but it makes up 20 % of the electric power produced in the country and it is the highest rate in the world. It is Denmark which was at the beginning of the wind turbines, and today about half of such facilities in the world are made in Denmark.

At the moment EU investments into this sphere make up approximately 10 billion Euros annually, after 2020 it is planned to lift this figure to 20 billion. Present days more than 110 thousands people work in this field. It was counted by the EWEA (European Wind Energy Association) that with 152 billion Euros investments the project will give a 328,5 billion benefit by 2020 because of fuel usage reduction (with oil prices set at 90\$ for barrel).

#### 2. Solar Europe Initiative

Solar energy usage is yet not so extended, as wind energy. It is connected with complexity and high costs of devices, small efficiency, and also with high prices of received electric power (it is 2-3 times expensive, than wind energy). In this area Germany is the leader again with its solar power stations with 8 Megawatt capacity and a total area of 11,3 million square meters. Then with big lag go Austria, Greece, France. The total area of photocells in Europe is about 30 million square meters. Recently the EU has begun to look into developing a €400 billion solar power plant based in the Sahara with energy transmission to the different countries and Europe.

Solar batteries are the big surfaces covered with special materials, absorbing solar radiation and transforming it into energy. Usually devices of 2 types are used:

a. Based on solar thermal energy (STE). It is a technology for harnessing solar energy for converting into thermal energy (heat). The most popular application of the technology – water heaters.

b. Photovoltaics are arrays of cells containing a solar photovoltaic material that converts solar radiation into direct current electricity.

#### 3. Bioenergy Europe Initiative

Bioenergy is a renewable energy made from materials derived from biological sources. In its most narrow sense it is a synonym to biofuel, which is fuel derived from biological sources. In its broader sense it includes biomass, the biological material used as a biofuel. Biomass is any organic material which stores sunlight in the form of chemical energy. As a fuel it may include wood, wood waste, straw, manure, sugar cane, and many other byproducts from a variety of agricultural processes. Also there are second generation biofuels – various types of fuel, which are the result of decomposition of a biomass made with the help of various methods, or other types of fuels which are distinct from methanol, ethanol, biodiesel and third generation biofuel – the fuel made of seaweed.

Generally, this product is used in cars working on biofuel (their share in 2007 year – 2,6 %). According to the plan, gradual appliance of biofuel will allow to reduce emission of greenhouse gases up to 80 % by 2050 and should provide 200 thousands workplaces. The European commission set the aim to use alternative energy sources at least in 10 % of vehicles by 2020, and biofuel should become competitive. In November 2007 the Renewable Fuels Agency was established in Great Britain. Its objective is to supervise bringing into service requirements of renewed fuel usage.

#### 4. European CO2 capture, transport and storage initiative

High hopes of EU are placed on Zero Emission Fossil Fuel Power Plants (ZEP) projects. It uses special technology, allowing to put exhausted gases deeply under the ground, in places, from which they came to us in the form of oil, gas and coal. The bowels of the earth which suit certain conditions are needed for it, for example used oil and gas fields. Also "Euro" automobile exhaust standards are brought into service and they are becoming tougher and tougher. Also there are several important standards:

#### 5. Low-energy houses

In Germany a "Low Energy House" or "Passivhaus" has a limit equivalent to 7 litres of heating oil for each square meter of room for space heating annually. Low-energy buildings typically use solar power, high levels of insulation, energy efficient windows, low levels of air infiltration and heat recovery ventilation to lower heating and cooling energy. These homes may use hot water heat recycling technologies to recover heat from showers and dishwashers.

In 2000 – 2001 14 housing developments were built, resulting in a total of 221 homes constructed to the Passivhaus standard (CEPHEUS project). 84 were in Austria, 72 in Germany, 40 in France, 20 in Sweden and 5 in Switzerland.

#### 6. EU Energy Label

According to several different EU Directives most goods, light bulb packaging and cars must have an EU Energy Label clearly displayed when offered for sale or rent. The energy efficiency is rated with a set of energy efficiency classes from A to G on the label, A being the most energy efficient, G the least efficient. The labels also give other useful information to the customer as they choose between various models. The information should also be given in catalogues and included by internet retailers on their websites.

As we see, the European Union has already realized the necessity of energy saving technologies.

It intends to cover 20 % of the power balance with renewable energy sources by 2020 (so-called «project 20-20»). In Europe many projects in various areas of power efficiency and energy conservation are started, and that in long run will allow EU to get rid of oil dependence.

## V. USA

For the last two decades in the USA several federal laws regulating energy sector also were accepted; at the moment one of the most known is the Energy Policy Act of 2005. It regulates development of various energy conservation systems, alternative energy sources, governmental grants and awards for the given branches. The U.S. Department of Energy categorizes national energy use in four broad sectors: transportation, residential, commercial, and industrial (Table 2).

Table 2  
US Energy Usage, by Sector

Sector	US Energy Usage, %
Transportation	28
Residential	21
Industrial	33
Commercial	17

After Energy Crisis in 1975 the federal Corporate Average Fuel Economy (CAFE) program was created, which required auto manufacturers to meet progressively higher fleet fuel economy targets. The next decade saw dramatic improvements in fuel economy, mostly the result of reductions in vehicle size and weight which originated in the late 1970s, along with the transition to front wheel drive. Sport utility vehicles, pickup trucks and minivans became popular. A "gas-guzzler" tax has been assessed on manufacturers since 1978 for cars with exceptionally poor fuel economy. Currently it generates very little revenue as overall fuel economy has improved. Since 2002, electric hybrid vehicles have tax credits. Also 6,9 billion Dollars were assigned for Federal Department of Transportation for transferring to local public transport departments and aimed at investing into energy conservation projects and expansion of public transport capabilities.

#### 1. Low-Energy Houses

In this field for many years there has been a consecutive development. Some of measures, aimed at energy conservation increase:

- 5 billion dollars were assigned to the Fund of the Home Insulation program. This program already exists for 30 years, and it helps families with low income to repair their houses using energy conservation technologies. More than 5,6 million families with low income received services with the help of this program. It raises the comfort level of houses and cuts electric power expenses of families in long-run;

- 4,2 billion dollars were assigned to USA General Services Administration (GSA) for upgrading the buildings belonging to the Federal Government into high-efficient ecological buildings;

- 4 billion dollars were assigned for modernization of the state housing which are managed by USA Department of Housing and Urban Development (HUD), aimed at energy conservation increase.

Also the "Energy Star" program is operating, devices and buildings, carrying the Energy Star logo,

generally use 20%–30% less energy than required by federal standards.

About 12 percent of new housing in the United States is labeled Energy Star, also more than 40,000 Energy Star products are available in a wide range of items. The Environmental Protection Agency (EPA) estimates that it saves energy for about \$14 billion per year.

#### 2. Wind Power

The USA along with the European Union are the firsts in wind power use. The USA is known for its huge wind turbines complexes. At the moment its share in the electric power produced in the country is about 1,7%. Also it is planned to achieve growth of this indicator up to 20% by 2025 and various projects and building of new objects are being undertaken for it (30% annually growth for the last few years), there are also various programs – for example, in the State of Colorado, farmers, with no investment on their part, typically receive \$3,000–5,000 per year in royalties from the local utility for siting a single wind turbine.

#### 3. Solar Energy

The solar energy is not so widely used, as wind power (its share – 0,02 % – Table 3), but active work in this area is in progress. For the last 8 years capacity was increasing approximately by 40 % per year. By 2015 it is planned to reach equalities in the price of solar energy and traditional. 3 world's largest solar energy stations are situated in USA, the largest – in California, its capacity is about 354 Megawatt. However, for America it is a drop in the ocean, but active developments take place and new projects are being built, various grants and tax privileges are being offered, and by 2025 it is planned that solar stations can provide up to 10% of the country's requirements.

Table 3

Net Generation by Other Renewables in USA, 2009  
(Thousand Megawatthours)

Wind	70,761	1,79%
Solar Thermal and Photovoltaic	808	0,02%
Wood and Wood-Derived Fuels	36,243	0,92%
Geothermal	15,210	0,04%
Other Biomass	18,093	0,46%
Total (Other Renewables)	141,115	3,57%
Total	3,951,117	100%

#### 4. Geothermal Energy

Also the USA develops geothermal energy – special plants which transform heat power, stored in the Earth, into electric power. The first U.S. geothermal power plant was built in 1960 in California and nowadays it continues to operate successfully. Share of geothermal energy – about 0,3 % (Table 3).

As we can see, USA realized importance of energy conservation and make huge steps in that direction.

## VI. RUSSIA

Today energy conservation and power saving are included into 5 strategic directions of the priority technological development named by the president of Russia Dmitry Medvedev at session of the Modernization and Technological Development of Russian Economy Commission, which took place on June, 18th.

This theme was continued by the president at the expanded session of the State Council presidium on July, 2nd, 2009 in Arkhangelsk. Among the basic problems marked by Medvedev, — low energy conservation in all spheres, especially in budgetary sector, housing and communal services, influence of the energy carriers prices on the output self-cost and its competitiveness.

One of the major strategic aims of the country, raised by the president (Decree № 889 from June, 4th, 2008) — reducing the energy intensity of national economy by 40 % by 2020. To accomplish this Decree, decision to transformate Federal Government Agency "Rusinformresource Association" into the Russian Energy Agency, with entrusting it with corresponding functions was accepted.

For the present power saving and alternative energy sources development goes in Russia mainly as experiments and aren't widespread. For example, in wind power sphere Russia takes only 52 place with 16 Megawatts capacity though the first wind turbine was constructed in 1931 in Yalta.

#### 1. Wind Power

The most known Russian wind turbines: 21 turbines are located near Kulikovo village of the Kaliningrad region, with general capacity 5,1 Megawatts. On the Bering island of Kamchatskaya region – 2 turbines 250 KW each. Around village Tupkildy of Tujmazinsky area of Bashkortostan Republic 4 turbines were built with 550 KW capacity each.

#### 2. Geothermal power

Present days there are 3 geothermal power plants operating in Kamchatka: Pauzhetsky, Verhne-Mutnovsky and Mutnovsky. Total capacity of these geothermal power plants makes up more than 70 MW. It provides 25 % of region's needs and helps to weaken dependence on deliveries of expensive black oil.

#### 3. Solar Energy

Solar power devices for heating received the greatest development in Krasnodar territory and Buryatiya Republic. In Buryatiya solar collectors with productivity from 500 to 3000 litres of hot water (90-100 Celsius degrees) per day are installed in various industrial and social objects - hospitals, schools, factories etc., and also in private buildings.

Unfortunately, there are no accepted laws, stimulating power savings and energy conservation yet. But the fact that Russia's tops realized gravity of this problem is important itself. So, according to the President of Russia D.Medvedev's words:

“In 2010 we will start realization of projects which will increase energy conservation in many city districts. Municipal networks will be modernized, service fee systems, which properly take into account consumption and levels of families’ incomes will be applied. New power service contracts, which allow achieving considerable economy, will be introduced. First of all power efficiency programs will be realized in state sector, it is a place with lots of work to do. I urge all Russian regions to take part in such projects.”

## **VII. ENERGY CONSERVATION VS INCREASED CONSUMPTION**

Countries, who will make a bid for energy saving and alternative energy sources, will win, and those, who will continue to use old high-consumptive technologies, will lose. And it is great, that leaders of world’s biggest countries understand that. So, we have a hope, that our future could be clear and bright!

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