Resource and Energy Efficiency: Essential Prerequisites for Competitiveness

The accelerated execution of Presidential Directive No. 3 becomes increasingly urgent today

Mikhail MYASNIKOVICH, Chairman of the Presidium of the National Academy of Sciences of Belarus

Directive No. 3 of the President of the Republic of Belarus of June 14, 2007, titled "Economy and Thrift – the Main Economic Security Factors of the State" is a system-based document aimed at making the use of all types of resources from primary products, materials and fuel to finance, land and intellectual resources more efficient. In fact, the directive is a strategy for growing the factor productiveness and, consequently, the competitiveness of the national economy. The accelerated execution of this document becomes increasingly urgent during this time of the global economic downturn sparked by the world financial and economic crisis and the growing price competition in many countries which used to be traditional sale markets for Belarusian producers.

To Reduce Production Costs

The only way to save work teams, maintain the nation's industrial potential and ensure export growth is to pursue a system-based policy aimed at reducing production costs. In 2008 the material intensity of the Belarusian economy, which is calculated as a share of companies' intermediate consumption in the selling price without taxes on products, was at the same level as 20 years before (Picture 1).

To reduce material intensity and imports is not an end in itself but a real opportunity to expand the share of domestic added value in products, which is a source of profits for producers, the population and the national budget. In addition, the reduction of the share of primary goods in the structure of costs can give Belarusian producers the room they need to make their prices more competitive, and thus contribute to national economic security both at the level of individual companies and the country as a whole. The structure of material costs of the Belarusian economy by element in 2006 and 2008 is shown in Picture 2.

The reduction of imports in the structure of material costs is one of the priorities of the Belarusian government's economic policy during this time of the world economic crisis. The current slowdown in economic activity in all commodity markets has triggered related price adjustments. In Picture 3 you can see energy price dynamics in 1992-1999 – oil, natural gas, coal, – measured as against one energy unit, a barrel of oil equivalent (bbl). The most expensive energy resource up until September 2008 was oil. In July 2008 it reached its price peak of $133.9/bbl (Brent), but no later than in March 2009 its price was already $46.9/bbl (thrice as less) which proves there was a "substantial contribution" of the speculation factor to the spiral growth of oil prices in 2007-2008 (Picture 3).

But here one should also take into consideration the fundamental factors shaping the balance of demand for and supply of oil in the world market. These are the low flexibility of demand for oil caused by the absence of

substitutes of the oil products used in the transport sector, and a marked deterioration of the geological conditions of oil production in new promising oil fields.

To Adapt the Economy to Energy Shocks

The explosive growth of energy prices in 2007-2008 and their plummeting in late 2008 – early 2009 have pushed to the forefront the issue of resilience to energy shocks. An economy's ability to adapt swiftly to changes in energy prices has become critical for national energy security and competitiveness.

Over the last 10 years (as against the level of 1998), Belarus' GDP grew 2.05 times, while the gross consumption of energy and fuel resources increased by mere 7.1% (the energy intensity of GDP reduced by 48.0%). If we took the year 1996 for comparison (when the energy efficiency policy became a national priority in Belarus), the results would look even more impressive: once being among the group of the most energy intensive economies in the world, Belarus advanced to the middle group. But if compared with the average European indicators, we do see a significant room for cutting the economy's energy intensity.

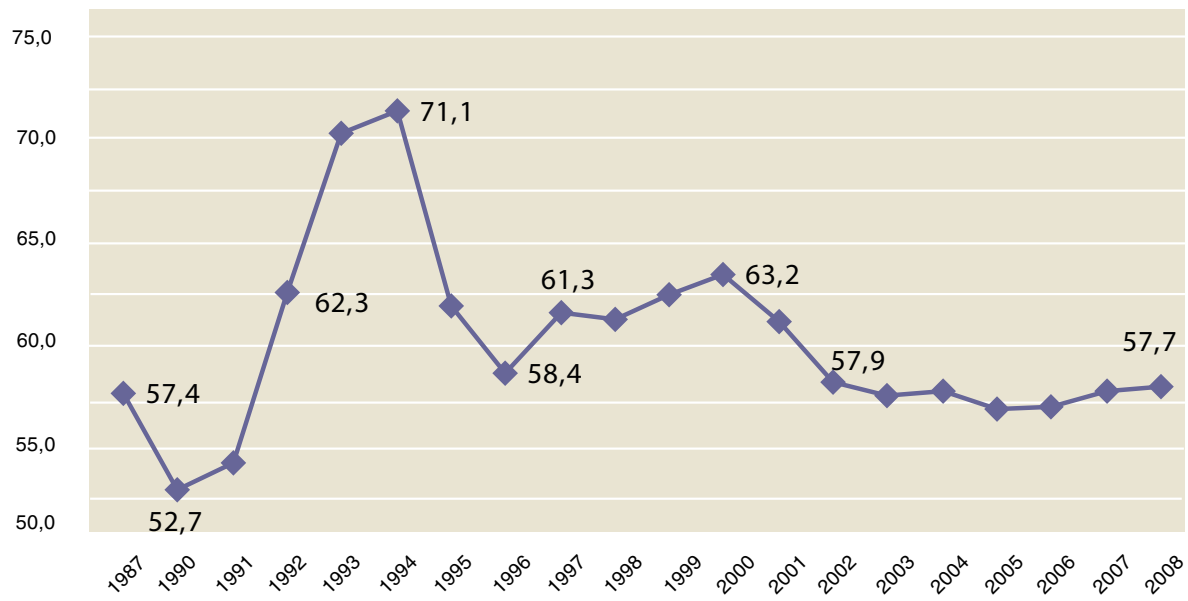
Belarus President Alexander Lukashenko visits the United Energy and Nuclear Research Institute Sosny. May 2009

To see how much Belarus can reduce the energy intensity of its GDP and domestic demand for energy, let us take a look at the countries that are small in terms of population and similar to Belarus in terms of climate conditions (according to data for the year 2006 provided by the International Energy Agency, Table 1).

The specific per capita energy consumption in Belarus is slightly higher than that in the neighboring countries (Latvia, Lithuania, Poland), but smaller than in Estonia and economically developed countries. Specifically, we lag far behind in terms of electricity consumption.

It is a well-known fact that energy intensity of an economy depends not only on the structure of the economy itself, but also on the structure of energy consumption by type of energy resources. Electricity is the most civilized form of energy which allows controlling the process of energy consumption with great precision and computerizing it.

Picture 1 – Material intensity of the economy of the Republic of Belarus in 1987-2008, percent against price

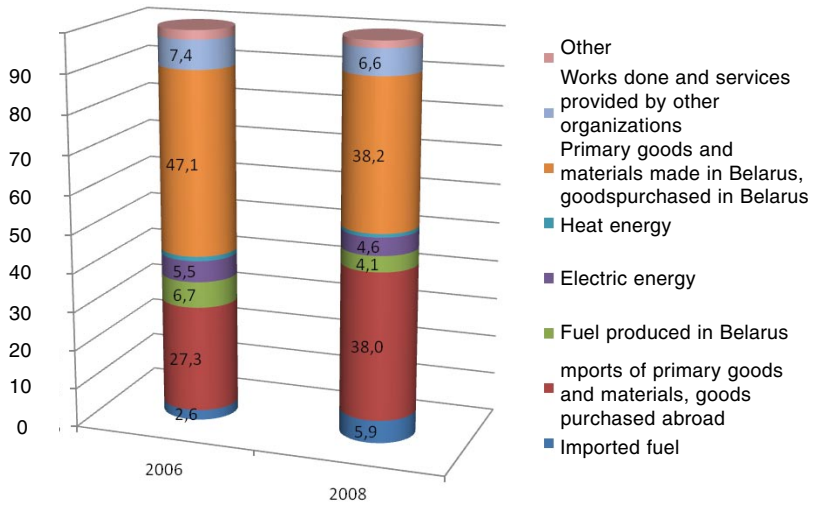


A whole range of technologies featuring electricity (heating with high-frequency currents or in a micro-wave oven, etc.) makes it possible to reduce the loss of energy several times comparing with the use of solid, liquid and gaseous fuels.

In order to ensure economic growth in Belarus during this time of external energy threats and the world financial crisis, it is planned to reduce energy intensity dramatically, increase the share of electrical energy in the general structure of national energy consumption, pursue a vibrant structural economic policy and raise specific energy consumption to the level of developed countries. The history of transitional economies shows that the contribution to the realization of the energy saving potential comes in the following proportion through a variety of actions:

- 20% - improvement of organizational mechanisms of encouraging energy saving;
- 50% - implementation of the latest developments in science and technology, efficient energy- and resource-saving technologies;
- 30% - structural reorganization of the economy and implementation of the economic mechanisms geared towards boosting the less energy intensive economic sectors, the services sector, etc.

Picture 2 – The structure of material costs of the Belarusian economy by element in January-September of 2006 and 2008



A considerable effect that we have got from leveraging organizational and target-programme mechanisms of energy saving has enabled us to achieve a sustainable growth in the energy efficiency of the economy. The effect of the mobilization methods subsides over time, and they should be replaced with mechanisms of structural and technological policy and economic stimulation which are usually responsible for as much as an 80% improvement in resource- and energy-saving.

Comprehensive Scientific Support

As a rule, to reduce the resource intensity of production, you need to go down the road of comprehensive technological modernization. It is a very science intensive and complicated task that can be accomplished provided there is comprehensive scientific support. The National Academy of Sciences can now provide this type of service to a concerned customer: from technological audit (including energy audit) to specific projects of a

Table 1. Specific energy consumption indicators by country, 2006

Nation	Gross consumption of energy resources, t.o.e. per capita	Electricity consumption, thousand kWt per capita	GDP energy intensity, t.o.e. / $1,000 of GDP	GDP energy intensity against PPP, t.o.e. / $1,000 of GDP against PPP
Belarus	2.94	3.32	1.42	0.38
Austria	4.13	8.09	0.16	0.13
Denmark	3.85	6.86	0.12	0.12
Norway	5.60	24.29	0.14	0.14
Finland	7.11	17.18	0.26	0.24
Sweden	5.65	15.23	0.18	0.18
Latvia	2.02	2.88	0.36	0.15
Lithuania	2.52	3.23	0.48	0.18
Poland	2.56	3.59	0.46	0.20
Estonia	3.64	5.89	0.52	0.23

turn-key basis.

Nearly all the innovation technologies developed by the National Academy of Sciences of Belarus are resource saving (in 2008, 155 advanced production technologies were developed at the Academy, or 41% of the total number developed in Belarus; of these, 133 are new in Belarus, 19 are new abroad and three are fundamentally new), but the priority is given to large-scale innovation projects bringing a system-based effect and contributing to the export potential of the country.

Specifically, we are speaking about the modernization of foundries, metallurgical furnaces, thermal and galvanic manufactures. The Academy has put forward the solution to this issue in Belarus, having acted as the main developer of the related program and providing scientific support in the course of its realization. Our researchers have come up with technological solutions regarding the modernization of the three main types of furnaces used in the Belarusian industry: chamber furnaces, through-type furnaces and shaft furnaces. Nearly 70% of them run on natural gas and have the operation life of more than 25 years, and a total of furnaces used in the industry are more than 1,500 units. According to the estimates of researchers, there is a potential of a two-fold improvement in the energy efficiency of furnaces.

The prototypes of shaft furnaces featuring modern-day lining and heat-isolation materials, which were created at the Academy of Sciences of Belarus on the basis of the latest achievements of Belarusian and foreign scientific schools in the fields of thermal physics and metallurgy, make it possible to save up to 40% of natural gas, reduce the size of furnaces, ensure a tenfold reduction in the mass of lining, shorten the period of reaching the designed operation capacity to 1.5-2 hours instead of the former 8-10 hours. The use of modern flat-flame, impulse or acoustic gas-running burners designed at the Academy ensures a better and fuller burning of natural gas and saves 10% to 15% of fuel.

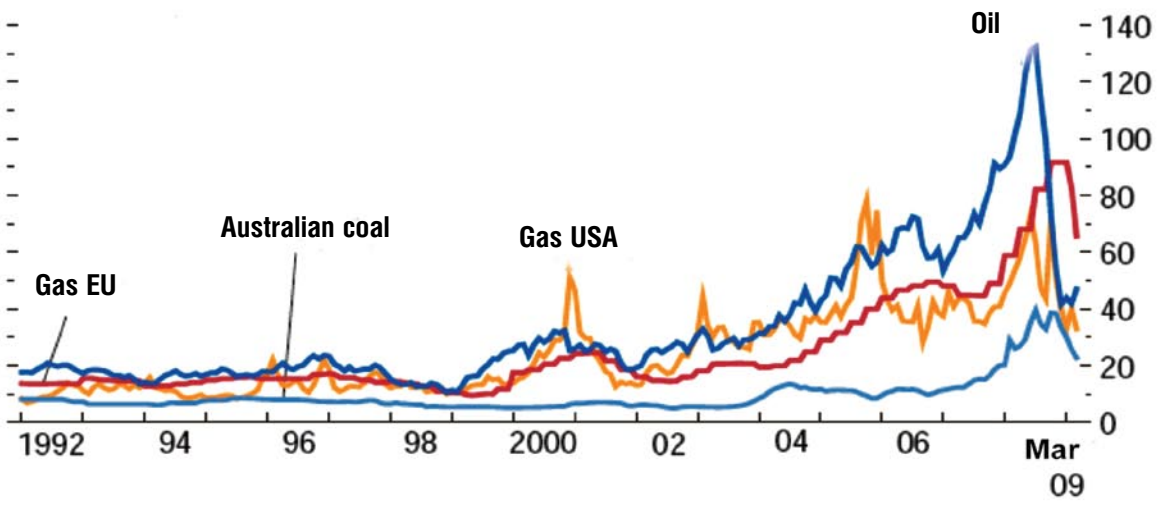
A pilot turn-key project realized by the Academy jointly with ZAO Atlant (Baranovichi Machine-Tool Plant) resulted in the achievement of a complete innovation cycle: from the initial idea and design work to modernization and sending in operation in 2008 of a 100-percent Belarusian-made production piece of a computerized thermal annealing furnace, to normalization of deliveries (Picture 4).

The modernized furnace is one of the biggest in size that are utilized in the country. The fulfilment of the project has resulted in a 4-5 time decrease in the factual consumption of natural gas during thermal treatment of metal (before the modernization it was 250 kg of equivalent fuel per tonne and after 40-60 kg of equivalent fuel per tonne), and the efficiency of the furnace for the nominal charge weight is 45-50% which meets the best world analogous. Equal effect can be obtained at other analogous facilities in Belarus where through-type furnaces and shaft furnaces are used.

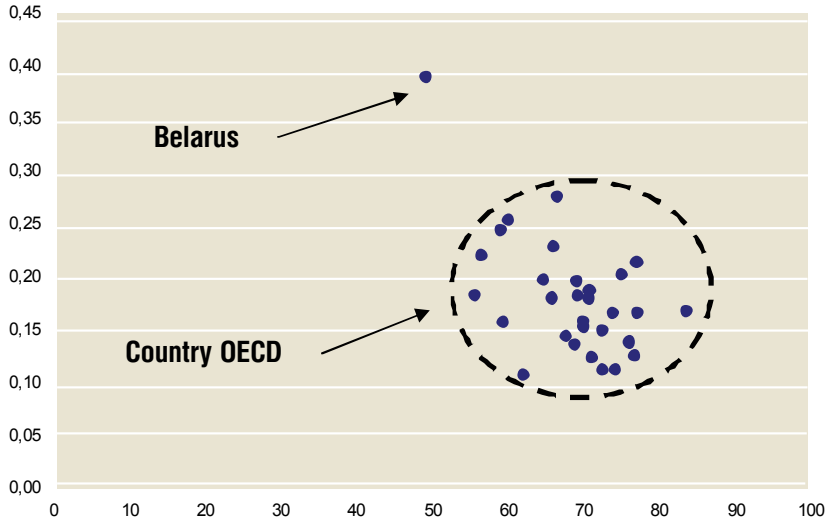
The modernization of the through-type furnace at MAZ is being carried out by specialists with Heat and Energy Research Institute. The designed efficiency of the furnace is over 50% and the specific economy per tonne of heated metal is 25.8 USD/t.

The technological solutions put forward by Belarusian researchers regarding chamber and through-type furnaces can be applied in modernization of

Picture 3 – Prices for energy commodities (in US dollars per barrel of oil equivalent)



Picture 4 – GDP energy intensity based on PPP and share of services in GDP (%), OECD member states (excl. Iceland), 2005



shaft furnaces too. A company's objective here (which was successfully accomplished by ZAO Atlant (Baranovichi Machine-Tool Plant) is to purchase the equipment and materials and carry out the installation work. The record of accomplishment at ZAO Atlant (BMTP), MAZ and Zhodino Blacksmith Factory makes it possible to apply this approach all across the country, and start to export the engineering services at some point in the future. For example, at ZAO Atlant (Baranovichi Machine-Tool Plant) it is possible to set up one's own production facilities to manufacture Belarusian industrial furnace equipment. The markets of Belarus, Russia and Ukraine with their technologically advanced foundries and steel mills are very promising in this respect.

The Light Effect

There is another example – organization of manufacture of LED products and its components, application of energy-efficient technologies in lighting systems. According to estimates of the International Energy Agency (IEA), the lighting sector is one of the most energy intensive due to the wide use of glow lamps. In these lamps, as little as 5% of the electric energy consumed is transformed into light, while the rest 95% is transformed into heat. Besides, as a rule, the operation life of glow lamps does not exceed 2,000 hours. In a larger estimate, the IEA says no less than 38% of all electric energy used in the world for lighting can be saved. Considering that other light sources (halogen lamps, sodium vapor lamps and luminous tube lamps) are not widely used in residential houses due to the inadequate perception of light by the human eye and their expensiveness, LED light sources are the best alternative to the traditional sources.

They are more efficient, reliable, sustainable, and their operation life ranges between 50,000 to 100,000 hours (between five to 11 years of non-stop performance). The world market of LED products is one of the fastest growing despite the global economic slowdown. The Academy of Sciences of Belarus has become the initiator and the customer and the main contractor of the project involving the construction of a LED plant, a company of the 6th technological level (Picture 5).

The project was started with the involvement of the world leader in the field, Philips. The project will be carried out in three stages. At the first stage (approximately 2009-2011), the manufacture of LED products is launched in Belarus through cooperation between the organizations attached to the Academy and other Belarusian companies fulfilling orders related to development and production of main component parts and assembly of the articles. At the second stage (2012), it is planned to expand the range of LED products manufactured in Belarus. At the third stage (2013-2015), plans are to organize the production of mounted light-emitting diodes by using imported crystals (chips), and by 2015 to set up the production of crystals in Belarus.

The effect from the production and use of LED products in 2010-2015 is expected to come in the form of electricity-saving amounting to 1.1 billion kilowatt per hour ($113.5 million). Beginning 2015, the annual economy of funds on electricity bills will be no less than $50 million. The export potential of the new products is also deemed considerable.

The energy and technology-related benefits from the production and use of LED products will not only be the reduced consumption of energy per product item and attraction of advanced foreign technologies to the Belarusian science and technology sector and their adaptation to the local environment. The mass use of LED energy-saving equipment across the national economy sectors will help dramatically reduce the load on the generating facilities of the Belarusian energy system, which will lessen the investment needs of the electrical power sector and stop the operation of the least economical units.

Potash Resource

For Belarus, potash fertilizers have always been and will remain one of its main exports. Considering the strategic importance of this economy sector, the National Academy of Sciences has created a system of scientific support for it. Today's innovation-based development of Production Association Belaruskali almost

fully relies on Belarusian resource-saving technologies.

The Academy has developed technologies of selective mining of thin layers of potassium salt of complex structure which application has helped increase the extraction of ore by 30-40% in comparison with traditional technologies, reduce the extraction costs 1.5-2.0 times and improve mining security. The Academy has also designed and applied technologies and reagents based on domestic primary goods for conditioning fine-grained and granulated potash fertilizers, which meet the world's best analogues (Picture 6).

These innovations have helped expand exports, including to countries with tropical climate. The economic effect from the use of these new Belarusian technologies in the mining business in recent years has amounted to nearly Br30 billion, that with respect to chemical reagents Br11 billion. The extensive expertise and experience of Belarusian researchers in the domestic market can become a driving force behind the export of engineering services.

In this respect it is necessary to note that collaboration with the leading producers and advancement to world markets require intensifying the engineering elaboration of projects, and coordinating the design, research and technological work. In other words, we are speaking about a rounded service.

In 2008, following the developments of the Academy, the second mine management department of Production Association Belaruskali began installing the technological line of an experimental machine for the production of granulated potash fertilizers by utilizing the method of roll briquetting. The implementation of the new granulation technology will help save 25% of the raw materials and energy used in the process compared with the traditional technology. Approximate estimates show that the production of 250,000 tonnes of rounded granules per year makes their prime cost 1.4 times lower than that of pressed granules. Due to the scientific developments of Belarusian researchers, in 2009 the Belarusian agricultural sector will be fully supplied with Belarusian-made granulated potash fertilizers.

For Needs of Agricultural Sector

Innovation technologies and cutting edge equipment are key to efficient agricultural production. The National Academy of Sciences of Belarus has masterminded a new approach to production of domestic farming machines, which is to design tools for cultivation of specific crops rather than for performing specific operations. Thus, Belarusian farming tools designers develop technologies to cultivate a specific crop (flax, rape, etc). This approach helps optimise the designed functional characteristics of the farming equipment which in turn helps reduce energy consumption. The target for new plant cultivation tools for 2006-2010 is 424 items. As of March 1, 2009 over 65% of new machines were designed (Pic. 7).

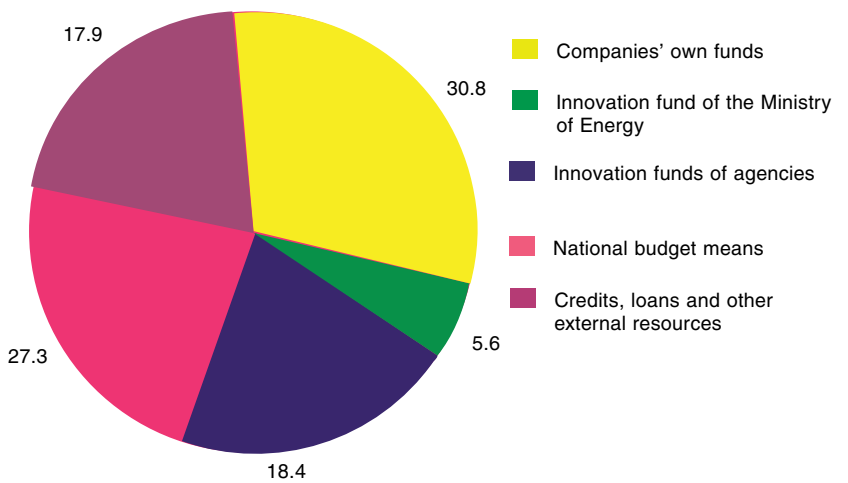
New innovation technological solutions will reduce material consumption while the strategy of multifunctionality (combined operations of cultivation) will reduce fuel consumption and increase operational life of equipment. Development and production of plant cultivation machines will save about $96.5 million by 2010. At the same time, the average annual consumption of tractor and boiler fuels will be down 8% to 10%, that of metal and electric power – 12% to 15%, labour intensity will be reduced by 20% to 25%. On the whole, energy saving technologies and machines included into the programme of the development of the above-mentioned tools will allow cutting energy consumption 1.2-1.3 times.

Economical Construction

One of the most material and energy consuming sectors of the national economy of Belarus is industrial, housing and road construction. When it comes to the production of building materials, energy resources account for about 40%-60% of the prime cost of certain products.

I would like to note that as a rule resource-intensive industries benefit greatly from solutions offered by our scientists. The National Academy of Sciences of Belarus in partnership with branch institutes has developed and introduced new energy and

Picture 5 – Energy saving investments portfolio, Belarus, 2008, %



resource-saving technologies in the road industry with the use of bitumen emulsion and modified bitumen. Large-scale introduction of new technologies in road construction helped significantly reduce consumption of gravel chippings, bitumen, electric and heat power, boiler fuel, hence greatly reducing the construction cost. The cost of surface works fell by 35%; that of membrane technologies – by 30.8%; emulsion gravel mixtures – by 21.5%; asphalt surfaces – by 47.7% per 1 square meter. All in all, the savings will approximate Br5 billion a year.

However, we can increase benefits of energy and resource-saving technologies based on bitumen emulsions by starting using Belarus-made chemical reagents (bitumen emulsifier and adhesive additives). Production of these chemicals will save at least $3 million a year. The works on launching the production of the reagents are now in progress.

Accountability and Control

The National Academy of Sciences of Belarus regularly conducts energy audits of the country's manufacturing giants that consume more than 50,000 tonnes of fuel equivalent. In 2008, two energy audits were completed. Now audits of seven companies are under way. The solutions offered by specialists of the National Academy of Sciences after comprehensive energy audits are projected to save about 500,000 tonnes of fuel equivalent.

Energy audits as a tool to raising efficiency of fuel consumption should become an important part of the comprehensive technological audit of manufactures. Its purpose is to streamline consumption of all resources in line with a company's development strategy. Technological audit at large companies should be conducted by a specially selected team of scientists, economists, in-house manufacturing engineers, and other specialists. It was suggested to include this tool into the industrial policy system of Belarus.

As we can see from comparison of various countries (Pic. 8), it is extremely difficult for an industrially developed country to reach post-industrial targets of the GDP energy intensity. As we see in Picture 8 the analysis of statistics of the OECD member states (but for Iceland which is not taken into account due to its climate peculiarities) shows that the share of services in GDP varies from 55.4% in Norway (GDP energy intensity is 0.183 tonnes of oil equivalent per $1,000 based on PPP) to 83.4% in Luxemburg (0.168). In Canada the figures are 66.3% and 0.276; Denmark – 74% and 0.112; Sweden – 70.6% and 0.186, Finland – 65.8% and 0.228. In Belarus, the correlation between the services and GDP energy intensity is 49% and 0.39. Thus, in order to achieve energy efficiency targets of the developed countries it is necessary to speed up the development of non-energy intensive production. This is our top priority in the next ten years.

The recommendation of the National Academy of Sciences to strengthen control over consumption of all types of resources has proved right. Metering systems pay out very quickly and guarantee good results, given they are reasonably priced. According to the rational consumer effect, a well-known fact from the theory of consumers' behaviour, the fact that somebody keeps record of energy consumption engenders consumption frugality. The results received by the country's municipal economy shows that same factors influence decisions of consumers everywhere. For instance, when the government announced its intention to stop subsidising water bills of the households that did not have water meters installed starting May 1, 2009, 94% of them arranged for the meters to be installed. This is approximately the same number as in most West European countries. Owing to the installation of water meters, water consumption fell by 140 million cubic meters in the last two years, which in turn helped save energy resources necessary for water extraction and supply.

The same principles will be adopted in the power engineering. Many Belarusian producers are believed to improve control over energy consumption when automated metering systems are introduced. It is necessary to improve the tariff policy for households as well, i.e. it is advisable to fit them with the latest digital electric power meters.

Wider Use of Economic Leverages

The policy of energy efficiency at the current stage of the country's development envisages a wider use of economic mechanisms and stimuli, modern forms of partnership between the private sector and the state in the energy area. It becomes clear when we look at investments in the energy saving solutions in Belarus in 2008. The share of own funds of companies remains insignificant,

COOPERATION

Germany's Remondis is interested in creating a high-technology broken glass recycling facility.

The project was discussed during a visit of a Remondis delegation to Belarus. When in Minsk, the foreign specialists presented modern-day energy-saving and eco-safe German technologies which can be used in the project and got familiar with national innovations in waste recycling and reclamation. The new waste glass recycling facility will be set up in Minsk.

Remondis is one of the world's largest water and environmental service companies operating more than 480 branches and affiliate businesses in 21 European countries as well as in China, Japan, Taiwan and Australia. Year on year, Remondis collects, processes and markets 25 million tonnes of recyclable materials and feeds them back into the economic cycle. Remondis supplies high calorific fuels, which substitutes such traditional fossil fuels as coal and gas.

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Atlant intends to produce refrigerators in Uzbekistan.

The future facility in Uzbekistan is expected to produce 250,000 refrigerators a year. Atlant can supply its equipment and technologies to Uzbekistan.

The negotiations are underway with the government of Uzbekistan on a feasibility study of the project.

A similar project can be implemented in Kazakhstan as well. The next fives years has been declared the period of innovation development in Kazakhstan. In this connection the project of Atlant, which has a great technological potential and its own know-hows, is of great interest for Kazakhstan.

while direct investments from the country's budget and innovation funds account for the half of all the investments in the area (51.3%). The main reserve for boosting private investments in the energy sector today is to develop institutional mechanisms of the partnership between private and state sectors in the power engineering together with the development of decentralised sources of energy, efficient tariff policy and long-term energy delivery contracts concluded with independent producers. It is believed that all these areas can be developed owing to the liberalisation of the national economy.

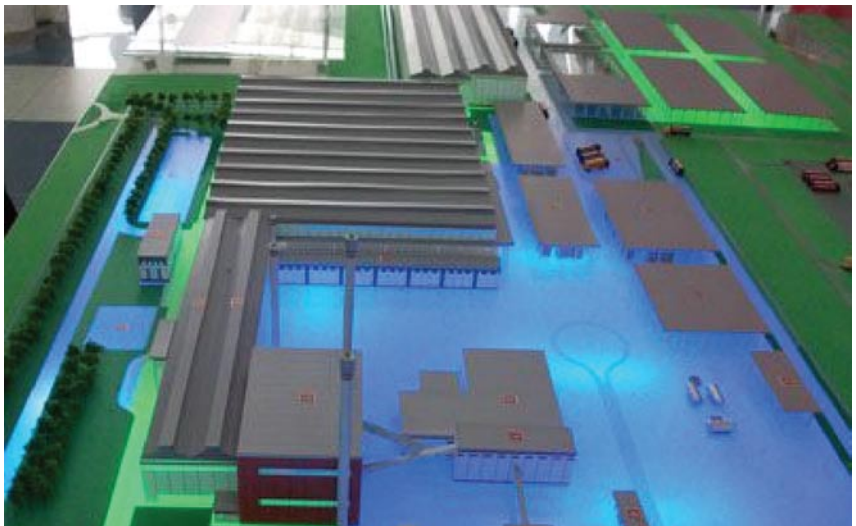
Despite the world economic slowdown and hence constantly narrowing investment opportunities, non-traditional renewable sources of energy and projects for energy export within the East-West Energy Bridge remain quite attractive for foreign investors. There is still some room for development of Belarusian transborder energy corridors and diversification of energy supplies. The energy security concept of Belarus sets the goal to cut the share of the dominating energy supplier down to 75-77%. So far, we have not been even close to these figures. To reach the goal it is necessary to look for alternative sources of energy taking into account their feasibility.

Boosting the share of local energy resources in the country's energy balance is none the less pressing. In 2008, local and secondary energy resources accounted for 18.4% of the total. By 2010 and 2012 this share of local resources should reach 22.5% and 25% respectively.

The National Academy of Sciences of Belarus believes there are some drawbacks in this issue: although we gained some experience in gas supply technologies, liquid and gas fuels, recycling of pellets, briquettes and other solid fuels, these technologies are still at the development stage and are not ready to be put in operation. Creation of domestic biogas technologies need to be sped up too. In the next two years we will be ready to construct 125kW biogas plants. The country's demand for these plants is estimated at 650 units.

Development of own biofuel and biodiesel is promising too. This work is covered by the Bio-Energy sub-programme of the National Innovation Biotechnologies Programme developed by the National Academy of Sciences. By 2015, the share of biofuel will be increased from virtually zero to 12% in the total petrol consumption of Belarus; that of biodiesel should reach 8% of the total diesel consumption. All these measures will enhance the energy safety of Belarus.

Consistent implementation of Directive No. 3 of the President of Belarus along with the energy security concept of the Republic of Belarus and its action plan, will make a solid foundation for raising competitiveness of the Belarusian economy during the global economic downturn. ■



A mock-up of the plant for the production of LED equipment