CEDE 11.12.2017 | Central European Day of Energy

Visegrad Fund

Policy Paper

The Sustainable Development of the Lithuanian Energy Sector

December 2017

The measures implemented by the Lithuanian government and the initiatives of the private sector have undoubtedly contributed to the breakthrough of the Lithuanian energy sector. The visible synergy conditions, the integration of renewable energy sources, digitalisation projects in the energy sector and ambitious plans that increase the energy efficiency are currently being implemented.

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The country's policy towards energy innovation

The policy of energy innovations of the country is ensured by the Ministry of Energy of the Republic of Lithuania, the Ministry of Environment of the Republic of Lithuania, and the Ministry of Economy of the Republic of Lithuania.

The Ministry of Environment is the main managing authority of the Government of the Republic of Lithuania which forms the country's state policy of environmental protection, forestry, use of natural resources, geology and hydrometeorology, territorial planning, construction, provision of residents with housing, utilities and housing, and also coordinates related implementation.

The Ministry of Environment is the main coordinating institution responsible for the development of national climate change management policy that aims at achieving national GHG reduction and adaptation to climate change goals and objectives. It has an overall responsibility for the National System of GHG inventory and is in charge of the legal matters.

The Ministry of Energy of the Republic of Lithuania forms the country's policy in the energy sector and organises, coordinates and controls its implementation. Its mission is to ensure a smooth and transparent operation of the energy market and implement strategic projects by ensuring a best ratio of price and use for users. Based on the said functions, the Ministries establish the standards accepted and regulations in the guidelines of the National Strategies.

The Ministry of Economy is responsible for handling issues related to the business development, improvement of the investment environment, attraction of foreign investor, and investments to the development of high value added products. It administers the major share of support from the EU structural support funds to such sectors as business, energy, research, and tourism. In pursuit of strategic goals of the Lithuanian economy and implementation of the of the Ministry of Economy, the main focus falls on promoting innovation, improving the management of the EU structural funds, developing small and medium business, ensuring energy security, implementing energy efficiency projects.

In its National Environmental Protection Strategy up to 2030, the Ministry of Environment establishes four main areas of a long-term environment protection policy: sustainable use of natural resources and waste management, improvement of the quality of the environment, maintenance of ecosystem stability, and climate change mitigation and adaptation to the environmental changes caused by climate change. The main attention is drawn to the latter priority, therefore, in attempt to implement the established short-term (by 2020), indicative mid-term (by 2030 and 2040) and long-term (by 2050) goals of climate change management, Lithuania has prepared the National Strategy for Climate Change Management Policy for the period of 2013-2050 and its execution plan. The main focus falls on the installed eco-innovative technologies, increase of energy generation and consumption and the use of renewable energy sources (hereinafter – RES) in all economy sectors of the country. Moving towards the established goals of increasing energy efficiency, in 2013 the Ministry of Environment initiated the programme of reconstructing (modernising) apartment buildings. 1,786 buildings were reconstructed since then, 495 are currently undergoing reconstruction and 458 buildings have completed investment plans. A big part of the promotional measures implemented by the Ministry and investments dedicated to them are intended for the promotion of the use of renewable energy sources and installation of environmentally

friendly technologies, including the generation of efficient energy by cogeneration.

The order of 26 May 2017 on the use of funds from the specific program on climate change places emphasis on the measures of the construction of biofuel boilers, modernisation of education institutions, the use of RES in public and residential (individual) houses, etc. The funds of the specific program on climate change can be used by natural persons and business or public sector representatives. For the period of 2011-2016, it is estimated that approximately more than 2,200 projects were implemented under the financial measures of the Climate Change Special Programme and the invitations of the Lithuanian Environmental Investment Fund (LEIF). The estimated amount of subsidies reaches 89.78 mln. EUR. The funds of the Climate Change Special Programme have also been used to subsidise the renovation projects of apartment buildings as follows: 2012 – 0.15 mln. EUR, 2013 – 0.54 mln. EUR, 2014 – 3.34 mln. EUR, 2015 – 20.34 mln. EUR, 2016 – 46.72 mln. EUR, total – 71.08 mln. EUR.

The Ministry of Energy set the main guidelines of executing the energy policy in the National Energy Independence Strategy (hereinafter – Strategy) that was approved in 2012 and is currently being considered over again. The Strategy of 2012 established the main goals of the Lithuanian energy sector and their implementation guidelines until 2020; the Strategy establishes the principles of energy independence, sustainable development and competitiveness. The measures initiated by this Strategy conditioned the executed structural reforms and projects of the energy sector that diversified the directions of energy supply and resources, as well as decreased the prices of energy resources to consumers. The strategic energy projects, such as LitPol Link, NordBalt and connection to the networks of continental Europe for the work in a synchronous mode or the terminal of liquefied natural gas (LNG) paved the road to a fundamental reconstruction of the Lithuanian energy sector, in attempt to increase the energy independence of the country and promote its new development opportunities.

The currently implemented measures fund the projects of increasing the efficiency of energy consumption, such as the energy efficiency in public state buildings or efficiency increase in energy generation in households. The mentioned measures correlate with the government-initiated Smart Specialisation Strategy of 2014-2020 that emphasises the priority of energy and sustainable environment and the funding mechanism of related projects. It is worth mentioning that the reconsidered Strategy that provides the essential directions and implementation measures for 2030 and the vision for 2050 emphasises a higher business involvement in the activities of the energy sector – a further development of energy infrastructure is planned with a closer partnership between the private and public sectors. The agreements on energy savings and changes on laws on renewable energy are introduced that improve the conditions for the consumers that generate the electric power for their own needs.

EU structural support funds represent a significant assistance in modernising and developing the Lithuania's economy. In 2014-2020, the Ministry of Economy administers 1.025 billion Eur which are aimed at promoting research and development (R&D), innovations, the competitiveness of small and medium-sized businesses, improving the energy efficiency of companies, etc. In implementing the planned strategy, the Ministry of Economy has highlighted the priority of "Promoting Energy Efficiency and Renewable Energy Production and Utilization". The goal of this priority is to reduce the energy consumption in industrial enterprises, as well as carry out the energy audit and construct cogeneration power plants. The financial measures established in 2014-2020 are as follows:

- Audit for Industry LT is designed for energy audit in industrial enterprises. Applicants must be micro, small and medium-sized enterprises. It is estimated that the value of 36 signed contracts is 388,637.86 EUR. The total amount dedicated to this measure is 855,781.00 EUR.
- Renewable energy sources for Industry LT are dedicated for the installation of energy generation capacities using RES, design and implementation of technologies of a more efficient use of RES in industrial enterprises in attempt to use energy for self-needs and, if possible, supply the excessive energy to other industrial companies or centralised energy networks. Applicants may be small and medium-sized and large enterprises. 41 contracts have been signed for this moment with a combined value of 9.51 mln. EUR. In total, over 19 mln. EUR of EU structural funds have been designated for this measure.

Innovation-driven growth

A proper political environment, as well as accepted laws and promotional measures, conditions not only the changes in energy sector, but also creates a favourable climate for sector innovation. One of the biggest energy companies in the Baltic states, the government-controlled company Lietuvos Energija, in its strategy places innovation as one of the most important components of successful operation. While achieving the goals established in the strategy of 2014–2020, the company group undertook energy saving activities (ESCO model) that include the increase of energy consumption efficiency and development of renewable energy sources in Lithuania and beyond. Together, the Lithuanian 'Green Protocol' was launched—the only agreement of the country that promotes a rational and sustainable consumption of electric power among business representatives. Upon promoting innovation, Lietuvos Energija established start-up accelerators and a fund that invests in energy start-ups. Also, last July, the company initiated a 10-year-long obligation emission worth €300 million, where the funds attracted will be used to execute green energy projects. The mentioned measures will enable the business representatives to receive important investments for the development of the experimental activities of energy technologies and implementation of the energy projects of green distributed generation and digital solutions.

The innovation-driven development of companies is conditioned by the priority areas established in the Smart Specialisation Strategy of 2014–2020:

- Smart systems for energy efficiency, diagnostic, monitoring, metering and management of generators, grids and consumers;
- Energy and fuel production using biomass/waste and waste treatment, storage and disposal;
- Technology for the development and use of smart low-energy buildings—digital construction;
- Solar energy equipment and technologies for its use for the production of electricity, heat and cooling.

These available tools help to get the necessary investments for the development of experimental activities and the discovery of new innovation potential of companies. Hence, in their mission statements, and strategic plans, energy companies identify innovation as an essential condition for progress. Already, with use of EU and state funds, private sector companies create and implement innovation based on smart technologies and energy digitalisation. The innovation includes smart energy accounting and management systems, as well as smart meters that allow energy companies to receive data on a number of energy generation and consumption aspects that will form an overall picture of an energy consumer. These data will enable the companies to discover new innovation to create better energy services. These technologies are

already being implemented by the company Energijos Skirstymo Operatorius (ESO) with the pilot project of 3,000 smart meters and the cost-benefit analysis of the implementation of smart meters which revealed that, after the introduction of smart accounting, the residents would be able to save electricity at least 7% of energy per year. It is estimated that the 4-year project investment valued at €219 million would generate €88 million of a common economical value: the financial benefit for Lithuania could reach over €160 million and the estimated value of social benefit could be €335 million. This is also conditioned by the invitation of the Lithuanian power transmission operator to the consumers to become the active members of the electricity market, that way contributing to a more efficient control of the electric power system.

The development is also seen in the RES area. Since 2007, the share of RES in the overall final energy consumption increased by 9.16%. For example, in 2015, the share of RES in the total energy balance of the country reached up to 25.86% (a 2.2 p.p. increase compared to 2014): electricity sector – 15.55% (+ 1.85 p.p.); heating and cooling sector – 46.17% (+ 5.54 p.p.); and transport sector – 4.56% (+ 0.23 p.p.). According to the data of the Lithuanian Department of Statistics, the share of RES in the electricity sector was 1.740 GWh in 2015. Energy was mainly generated in the wind plants, which accounted for 48% and hydropower plants, 24.6 %. The rest of the energy was generated in the following: biofuel plants (23.2%) and solar power plants (4.2%). As of 7 June 2017, Lithuania has 2,653 power plants installed and holding permits to generate electricity from RES. The total installed capacity of these plants is 812.589 MW: 2,340 solar plants – 73.68 MW; 163 wind plants (farms) – 511 MW; 12 solid biomass power plants – 64.95 MW; 39 biogas plants – 35.05 MW; 99 hydro electric power plants – 127.909 MW.

The mentioned measures promote the innovation potential of companies that contributes not only to the efficiency and economical indicators of the companies, but also to the goal of Lithuania of becoming the country that exports technologies with a high added value to the energy sector.

Examples of best practices

The priority areas established in the strategies approved by the Ministry of Environment and the Ministry of Energy of the Republic of Lithuania, along with the support of EU structural funds and initiatives carried out, enabled the changes that are currently happening in the Lithuanian energy sector.

The initiatives of increasing energy efficiency, RES integration and management of climate change have gained a tangible form. One example is the project implemented by Kaunas University of Technology. This project corresponds to the goals established in the National Environmental Protection Strategy and the National Energy Independence Strategy in the following aspects: it contributes to ensuring an appropriate air quality and generation using renewable energy sources, that way contributing to the execution of long-term tasks—reducing pollution and emissions that cause the greenhouse effect for a unit of generated energy and reducing the country's dependency on fuel import, that way increasing the generation using renewable and waste energy resources. The aim of this project is to design an innovative energy generation and accumulation system. During this project, the system will be designed with the following components: 380 kW solar power plant, system of 150 kW heat pumps 'soil-water' and accumulator of heat energy in water.

After the project is complete, it will cover up to 20% of the energy demand of the building and two-thirds of the heat demand (heating area >14,000 m^2) and it will reduce the CO_2 emissions by > 6,000 t. The estimated payback period is 8.39 years.

It is worth mentioning that the project deals not only with the generation of energy, but also with the use of energy that up until now has been wasted. The system will also be subject to development by integrating it in other modern renewable energy systems and introducing new management solutions. The collected best practice will enable the activities of society enlightenment and implementation of real projects based on sustainable energy.

Other projects with potential that receive a partial or full funding from the EU, such as a smart system of efficiency evaluation, accounting and control of energy consumption, smart energy accounting systems, design of the new technology of diagnosing and auditing construction state by using a 3D thermovision integrated system, implementation of R&D for development of microgrid control systems, research and design of technologies to increase efficiency in biofuel use and pollution reduction, design of smart HVS and LVS systems or new innovative product for transport, place focus on the initiatives of the companies to create technological solutions that would enable the increase of energy consumption efficiency, development of smart grids, monitoring the parameters of an electrical network, ensuring an efficient control of the power transmission system, or designing prototypes of new eco-innovative products used for biofuel, etc.

The attention dedicated to the technologies of the smart grid is reflected in the project coordinated by the Lithuanian Energy Institute. The aim of this project is to design, develop and test a novel, scalable, sustainable and cost-competitive flow battery based on organic redox active materials. A 100 kW redox flow battery with a capacity of 350 kWh will be constructed and equipped with an interoperable Battery Management System enabling plug and play integration into a Smart Grid. Communications architecture, grid control and demand side management systems will be designed and implemented in order to demonstrate the added value of using energy storage systems to provide ancillary services to the distribution grid. The developed technologies will be integrated with real RES (Renewable Energy Sources), Electric Vehicle chargers and variable power consumption demonstrated at the ACRRES test site.

The projects of AB Vilniaus Šilumos Tinklai have an equal value, some of which are as follows: construction of new biofuel power plants, implementation of nitrogen oxides reduction equipment, installation of smart remote district heating meters at consumer site. Also, it is worth mentioning the project by AB Axis Industries of a smart lighting and monitoring system ENCO LIGHT that is designed for automatic remote control of public place lighting using PLC (power line communications) and 868 MHz radio communication. The system allows programmable dimming and switching on and off, monitoring of energy consumption parameters and indication of lamp working status.

All of the mentioned projects are initiatives with a real added value that reflect the changes happening in the world energy sector. The projects promote the technological advancement of the country and the innovations implemented ensure the country's competitiveness. The energy competencies and knowledge acquired during these activities enable the reach for ambitious goals in developing the technologies of the renewable energy generation and distributed generation, ensuring a reliable and effective energy supply and use of energy, as well as the digitalisation of the energy sector.

Future perspectives

The positive changes in the Lithuanian energy sector enable the continuity of the policy in the future, increasing the attraction of investments, installation of modern technologies, innovation in the energy sector, and the guarantee of energy advancement. Nonetheless, it has been noticed

that meaningful challenges have been faced. Market integration, digitalisation, the demand for a higher efficiency of energy consumption, development of generation from renewable energy sources and technology development of the distributed generation technologies highlight the areas for improvement: insufficient and still uncompetitive local generation, physically and technologically outdated generation equipment (major part of the equipment used for the generation of electric power and part—for the generation of heat power), strong reliance on the import of energy resources, and price jumps of the imported energy resources.

In an attempt to promote the development of innovation in the country and the synergy of public and private sectors, there is a vast potential of increasing the efficiency of energy generation and consumption and the level of transport electrification by rationally using local and (or) renewable energy sources in DH systems. That way, the demand for import of primary energy resource may be further decreased. Moreover, it is important to mention the increase of industry competitiveness by optimising the policy of energy rates, a proper innovation ecosystem and Lithuanian energy products for the realisation of technologies and competences.

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