



## THE IMPACT OF EU ENERGY POLICIES ON TECHNOLOGICAL PERFORMANCE OF LITHUANIAN MANUFACTURING ENTERPRISES

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**Abstract.** Due to the ambitious targets of EU energy policies, changing environmental priorities and industrial progress, the development of new technologies and their implementation in the industry has become one of the most significant factors of various Lithuanian strategic documents, determining the speed and results of the economic-social development. After introduction of the taxes on natural resources and pollution of environment, and following the requirements of EU regulations not to exceed the allowable pollution standards, the requirements for the efficiency of Lithuanian industrial production as well as for economical use of energy resources and eco-efficiency have significantly increased. Due to the conditions of modern business, the development of Lithuanian industry is an integral part of sustainable social, economic development and implementation of energy-saving technologies in manufacturing enterprises. This paper presents the analysis of energy-saving policy objectives and instruments in EU and Lithuania highlighting the priority of implementation tools in the industry, also evaluation of the impact of EU energy policies on technological performance of Lithuanian manufacturing enterprises.

**Keywords:** EU energy policy, manufacturing, energy-saving technology, energy efficiency, environmental protection.

**JEL classification:** O25, O31, L6.

### 1. Introduction

The EU is often referred to as the leader of sustainable development because compared with any other region in the world it has made more significant progress in this field. Due to the fact that in the process of integration the legal systems of all countries, including protection of natural resources and environment, are harmonized in respect of the legal framework of the EU, environmental policy of the EU tends to be an example for all countries. The EU has already made significant efforts to promote sustainable development both in Europe and all around the world, however sustainable development shouldn't cover only Europe, because its dimension is global.

Political changes in Lithuania coincided with evolution of the idea of sustainable development. Lithuania had an opportunity to take advantage of integrating this idea to the economic, political, social and environment policies. Movement towards democracy and market economy provided Lithuania with an opportunity to make fundamental reformation of environmental policy, however in comparison with Western Europe countries, which experienced upswing of environmental protection

during the time of economic growth, Lithuania in one important regard didn't have such advantageous conditions, in 2008 have faced economic downturn, right at the time when they started to implement the first programs of environmental redevelopment. On the other hand, the results of Evaluation of implementation of environment protection requirements in Lithuania (2011) indicate that the positive changes of many indicators of economic and social development, efficiency of natural resources consumption, environmental pollution in Lithuania are unfolding more rapidly in comparison with the average of the EU countries, and according to some indicators the situation in the country is even better in comparison with the average of the EU. According to the official data of the Statistics Lithuania during the period between 2011 and 2013 was rapidly growing GDP per capita, expenditure on scientific researches and technological development (R&D), productivity of various companies, however due to excessive gap the level of socio-economic development will not quickly reach the EU average.

The EU along with Lithuania face quite important problems caused by the increasing dependence on energy import, scarce energy resources,

economic instability. The efficiency of energy consumption could be a valuable tool for solution of these problems. The efficiency of energy consumption could contribute to economically efficient reduction of emissions of gases that cause the greenhouse effect and thus mitigate climate changes. The shift to more energy-efficient economy should also accelerate the development of innovative technological solutions and to increase the industrial competitiveness in promoting economic growth.

These relevant issues gained response among different scientific fields. In the studies of industrial energy efficiency of different countries, Martinez (2010) in accordance with the Kemal (2004), Kalliala and Talvenmaa (2000) tried to explain the differences in energy efficiency between the industries of a developed and a developing countries. The results of this research revealed that, in developed countries industrial improvements in energy efficiency are achieved mainly through changes in energy prices and investments, whereas in the industry of developing countries, energy efficiency performance is achieved through changes in productivity and implementation of new technologies. The scientific literature recognises technology as one of the main strategic resources in any enterprise, and technological strategy of an enterprise is considered to be a functional strategy, determining the position of the enterprise in respect with technological changes. The importance of technologies as the tool of strategic industry performance has been stressed by many scientists (Carr *et al.* 2010; Ürü 2011; Citroen 2011; Vecchiato 2012). Other industrial studies also highlight the importance of technology, economies of scale, and energy efficiency-oriented policies and management strategies in improving energy efficiency within the industry (Lu *et al.* 2013; Wiesenthal *et al.* 2012; Worrell *et al.* 2010; Fri 2003). The issues of the Lithuanian manufacturing sector environmental problems, objectives and perspectives are analysed by Lithuanian authors (Streimikiene *et al.* 2012; Miskinis *et al.* 2011; Saboniene 2003, 2010; Vasauskaite 2013). The studies of the impact of EU energy policy instruments on the energy use and energy efficiency at different industry sectors are made by various research groups (Thollander *et al.* 2013; Ericsson *et al.* 2013; Hepsbali *et al.* 2007), etc.

The main objective of this research – to evaluate the impact of EU energy policies on technological performance of Lithuanian industrial enterprises. The evaluation methodology included quantitative and qualitative research methods: the analysis of primary and secondary sources of information. At the beginning of evaluation were

identified relevant and available primary and secondary sources of information that were related with the object, was gathered important factual and contextual information associated with the management of the EU energy policy instruments, implementation of action programs, national and foreign requirements of environment protection, the tendencies of socio-economic and industrial development alternation. Information that was needed for evaluation was collected from the strategic documents, statistical data sources, evaluations that were previously accomplished in the fields of environment protection and energy efficiency and other sources. During evaluation was carried out the content, comparative, statistical analysis of gathered primary and secondary information.

## 2. EU energy saving policies

Implementing the European Energy Efficiency plan (COM(2011)0109), the Kyoto Protocol of the United Nations Framework Convention on Climate Change (UNFCCC) and the goals of energy saving “20-20-20” until 2020, the European Commission and the Council are increasingly focusing on legislation that regulates promotion of the measures of energy efficiency increase. The most important for industrial enterprises are:

- *directive 2012/27/EU* (on energy efficiency) – this document is treated as obligation to encourage investment in low-carbon dioxide technologies, especially in those industrial sectors which are characterized by a high risk of carbon dioxide leakage; to carry out energy consumption audits in the companies; to increase the part of cogeneration during production of heat, coolness and electricity;
- *directive 2010/31/EU* (on the energy performance of buildings) – this document is treated as obligation to establish requirements of energy efficiency applicable for buildings maintaining the balance between investment and saved expenses for energy during the whole life-cycle of the building; to install advanced measuring/control systems in the buildings;
- *directive 2010/30/EU* (on the indication by labelling and standard product information of the consumption of energy) – this document is treated as obligation to mark products providing information about consumption of energy and other important resources; to change classification of marking in accordance with technological advancement and energy saving potential.

- *directive 2008/98/EU* (on waste and re- pealing) – this document is treated as obligation to ensure prevention of pollution encouraging application of the principles of electric and electronic equipment, natural resources prevention, handling and their safe disposal;
- *directive 94/62/EC* (on packaging and packaging waste) – this document is treated as obligation to reduce the quantities of all kinds of packages and packages waste encouraging their re-use, recycling and other forms of use of packages waste;
- *directive 2008/1/EC* (concerning integrated pollution prevention and control) – this document is treated as obligation to establish measures for integrated prevention and control of pollution; to establish a strict procedure of permissions for the emission issuing to companies and to ensure coordination of the process.

Implementation of advantageous technologies in production, management and control processes of industrial companies in all above mentioned documents is named as one of the most important priorities. Requirements of these directives are transferred in short form into international and national European legislation. We have to admit that in Lithuania there are quite a lot of problems and gaps which are encountered during implementation of this legislation. The main reasons indicated in the literature sources are the lack of administrative competence and organizational resources.

In the strategic documents of the EU and Lithuania in regard of industry are also raised the requirements of efficient energy consumption, search for green manufacturing solutions in order to increase enterprises competitiveness in the global context. For example, in *The Strategy Europe 2020* it is intended to prepare the basis of the modern industrial policy that will be applied for promotion of enterprise and assistance for industrial sectors in order to prepare to meet these challenges, also to promote competitiveness of European sector of primary production, manufacturing and services, to help them to take advantage of the benefits of globalization and sustainable economics.

Hereinafter are listed the main documents at the national level which are associated with the issues of sustainable consumption of energy:

- National strategy of sustainable development (was revised in 2009);
- National energy strategy (2012);
- National energy independence strategy (2012 and previous versions).

The latter document emphasizes three the main closely interdependent strategic objectives: energy supply safety (using local and diversified energy resources), competitiveness of the energy sector (reforming the existing monopolies of the energy sector) and sustainable development of the energy sector (increasing the efficiency of energy production, transfer and consumption).

Looking ahead at the perspectives of the energy policy of the EU countries, various political institutions of the EU are currently coordinating the goals of climate change and energy policy for the period between 2020 and 2030, however the key decisions will be taken during the meetings of the European Council. During these meetings Lithuania, like other EU countries, will have to present its goals. Lithuania’s position determining the strategic goals of climate change and energy use for the year of 2030 currently is under active consideration.

The European Commission and the European Parliament have already expressed their position on this issue, however according the opinion of Lithuanian and EU non-governmental organizations, the proposed suggestion isn’t sufficiently ambitious (Table 1). Considering recent scientific studies it is obvious that in case of such strategic goals of climate change and energy usage it wouldn’t be possible to stabilise climate change at the safe limit of 2°C. Therefore it is essential that the EU would make final decision to achieve more ambitious science-based goals of climate change and energy policy which would be effective measure indicating political direction for those who invest in the field of energy and would ensure competitiveness of the EU countries in climate-sensitive political and economic environment.

**Table 1.** Summary of the EU strategic goals of climate change and energy use for the year of 2030 (source: compiled by authors)

	Suggestions for the period 2020-2030			
	EU 2020	European Commission	European Parliament	Non-governmental organization
Reduction in greenhouse gas emissions (GHG) from 1990 level	20 %	40 %	≥40 %	55 %
Raising energy consumption produced from renewable resources	20 %	27 %	30 %	45 %
Improvement in the energy efficiency from 2005 level	20 %	-	40 %	40 %

For the incentive of environment protection and management are applied various sanctions: legal, administrative, economic, environmental education and etc. EU energy policy instruments are categorized into economic policy instruments like taxes, duties, subsidies, financial incentives, etc., administrative policy instruments like rules and regulations, acts of parliament, etc., and informative policy instruments like information campaigns/programmes. Energy policies directed at industry, in turn, may take a number of different forms such as price-based and fiscal instruments, regulations and voluntary approaches like LTAs (Long-Term Agreements) and energy audit programmes (Rohdin *et al.* 2007).

The economic levers of environmental protection management which are applied in Lithuania can be divided into three groups:

- the funds of environmental financing which are used for implementation of general (national) measures of environment protection. The main funds are intended for the funding of the projects of industrial enterprises: COSME – for promotion of corporate competitiveness, growth and entrepreneurship; Horizon 2020 – for the funding of scientific researches and innovations; Lithuanian Environmental Protection Fund (LEPF) – for the projects of environmental protection, rational use of natural resources, climate change, waste management; the Program of Green Industry Innovation – for the projects of implementation of innovative environment protection technologies and creation of green products.
- regulatory sanctions of economic environmental benefit (performance standards, quotas, product bans, rates for the damage that is done to nature);
- fiscal instruments for environmental pollution and natural resources (emission taxes, fuel taxes, tradable permit systems). Pollution taxes induce each polluter to reduce the pollution up to the point where the marginal cost of pollution abatement is equal to the tax. In this way the costs of reaching a given environmental target are minimized;

The advantage of fiscal instruments compared to regulatory instruments is often their efficiency and the fact that they can raise revenues that can be used to reduce distorting taxes elsewhere in the economy. Root taxation often proves to be superior to regulation when environmental damages are not location-specific and do not vary with the source of pollution. However, achieving the EU targets with respect to energy savings and reductions of greenhouse gas emissions requires coordinated efforts in a number of

policy areas. Fiscal instruments can play an important role in reaching these goals, alone or in complement to other market based instruments and regulatory measures implemented in the EU (Kosonen, Nicodème 2009).

Summarizing the results of the EU and Lithuanian documents' analysis it follows that the main requirements of environment protection and energy consumption regarding the industry are:

- reduction of environment pollution through the usage of renewable and waste energy resources in production; recycling and safe management of waste (especially hazardous waste);
- implementation of advanced energy efficient, more environmentally friendly technologies (of production, lighting, heating, freezing, ventilation systems) in the companies, for example: implementation of co-generation power-plants; adoption of economical manufacturing system “Lean”;
- saving of energy resources and efficient consumption through more intensive implementation of energy usage audit and monitoring in the companies applying advanced organizational systems, for example: implementing in the companies different management standards – Energy Management (ISO 50001), Products Quality Management (ISO 9001) or Environmental Management (ISO 14001);
- application of the principles of staff training, motivation to safe energy, inducement of general and personal skills – knowledge of foreign languages, organization of production and quality management, also initiative – among staff members;
- production of eco-friendly, high quality products, compliance with standards of international eco-labelling.

### **3. Energy efficiency development in Lithuanian manufacturing enterprises**

Upon establishment of economic market relations, imposition of taxes on natural resources and environmental pollution, implementing the EU requirements not to exceed permissible levels in accordance with the indicators of environmental pollution, have increased requirements regarding production efficiency of Lithuanian industry entertainments, economical use of energy resources, eco-efficiency of activity. Under the conditions of modern business Lithuanian industrial development is inseparable from sustainable socio-economic development and implementation of energy-saving technologies in production.

Energy-saving technologies, including technical and scientific solutions, such as electrotechnics, automation, information and communication technologies, are increasingly becoming the part of industrial and manufacturing spheres. Considering technological advancement, global competition, increasing environmental requirements, industrial companies must carefully consider strategic actions which are targeted towards taking of competitive position, formation and maintaining of long-term competitive advantage in order to achieve favourable financial results in the particular market or industry. While planning implementation of advanced energy-saving technologies should be evaluated many internal and external factors of the company. Some of them are related to the overall political, economic, social, environmental, technological environment. Other factors better reflect inner aspects of implementation of technologies in the company: change of energy sources using a wider range of equipment, shortening of production cycle, reduction of resources consumption and production costs, improvement of production quality. These factors complement and compensate one another, and they strongly influence strategic decisions of the enterprise.

Many Lithuanian manufacturing companies are technologically backward, a relatively high amount of primary and final energy, raw materials and water is still consumed for production. According to the data of the Statistics Lithuania and Lithuanian Energy Institute report, in 2012 the final energy consumption of Lithuanian manufacturing sector were distributed as follows: the largest part takes manufacture of chemicals and chemical products (342 thousands of t.o.e.); the second consecutive is – manufacture of non-metallic and mineral products (196 thousands of t.o.e.); following – manufacture of food products (183 thousands of t.o.e.); manufacture of wood and paper products (129 thousands of t.o.e.); manufacture of furniture (35 thousands of t.o.e.); manufacture of textiles (31 thousands of t.o.e.). On the other hand during the recent years it is observed the increased interest of business enterprises, manufacturers, building administrators in the solutions of energy efficiency and saving. Overall expenditure of Lithuanian industrial companies on environment protection in 2012 amounted to 816,7 million of LTL (operating costs amounted to – 243,8 million of LTL, costs on investment to improve processes of the companies amounted to – 572,9 million of LTL) and in comparison with 2011 have decreased by 9.3%, but in comparison with 2010 they were bigger by approximately 11% (Fig.1).

Evaluation of expenditure of Lithuanian industrial companies on environment protection in

2012 in accordance with the types of environment protection activities revealed that: costs on protection of water resources amounted to the biggest part of the expenditure intended for environment protection – 489,7 million of LTL (60% of all costs of industrial companies intended for environment protection); the industrial companies have allocated 191,3 million LTL for the costs on atmosphere protection (23.4%); for the costs on waste management – 102,5 million of LTL (12.5%), for the costs on other activity of environment protection – 33,2 million of LTL (4.1%).

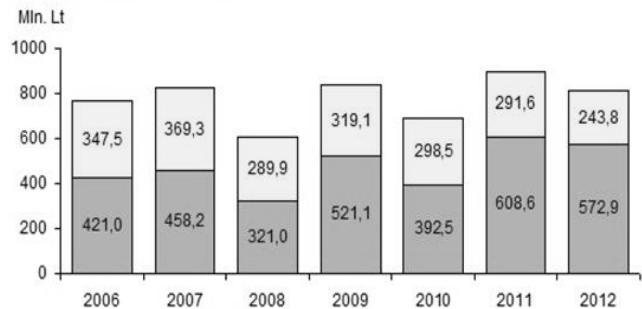


Fig. 1. Expenditure of Lithuanian industrial companies on environment protection during the period between 2006 and 2012. (source: Statistics Lithuania)

As shown in the Table 2, the biggest part of investments of the manufacturing sector companies was directed to technological infrastructure, equipment, and software.

Many industrial companies associate their development with modern technological equipment and automation of production process. Among the planned to be implemented technologies dominate computer-aided production planning and control systems, technologies of automation of technological process and modern technological equipment. Since productivity is associated with modernization of production, therefore demand to provide training to the staff will inevitably increase.

Table 2. Technological innovation expenditures by kind of expenditures (million of LTL) (source: Statistics Lithuania)

	2004	2006	2008	2010	2012
<b>C Manufacturing enterprises</b>					
Total of expenditure	640,4	379,9	720	409,1	877,3
Intramural research and development	163,6	105,5	82,5	75,7	96,9
Extramural research and development	18,8	10,4	21,9	9,4	18,6
Acquisition of machinery, equipment and software	445,1	251,6	601,1	314,9	699,5
Acquisition of other external knowledge	12,9	12,4	14,5	9,1	19,1
Other innovation activity	..	..	..	..	43,2

It is expected that average monthly gross salary should also grow and this should create more attractive conditions to work in the industrial companies. The increasing prices of raw materials and energy resources can negatively influence turnover and export extent. Development of clustering and new business models, efficient logistics systems could help to reduce the negative effect. It is also very important to ensure the efficiency of resources consumption by industrial companies. This would allow to reduce the costs of production and those costs which are associated with environment protection, also self-cost of production and to increase the competitiveness of companies, thus there's big potential in the future to enhance competitiveness.

**Table 3.** The objectives of technological innovation implementation of manufacturing enterprises (% of all technological innovation enterprises) (source: Statistics Lithuania)

The objectives of implementation of technological innovation	2008 – 2010 %
Increase range of goods and services	44,1
Replace outdated products or processes	44,4
Enter new markets or increase market share	46,3
Improve quality of goods or services	56,1
Improve flexibility for producing goods or services	37,4
Increase capacity for producing goods or services	38,4
Reduce labour costs per unit output	31,1
Improve health or safety of your employees	27
Reduce material and energy costs per unit output	25,3
Reduce environmental impacts	24,6

From the results in Table 3 it can be seen, that so far Lithuanian manufacturing enterprises pay insufficient attention on the aspects of sustainable development and environmental impacts: many materials which are hazardous for environment and human health are used in production, only some companies use secondary raw materials. This is influenced by external (the issues of environmental laws implementation, prices of raw materials) and internal company factors (lack of information, avoidance of changes).

The main problems which are identified in the literature sources are listed below:

- increase of energy vulnerability due to growing prices of energy resources (over the past 6 years the heating prices in Lithuania have increased by 91%, the electricity prices have increased by 36%);
- the lack of competent, qualified and motivated employees, the lack of production organization professionals is particularly high;

- the lack of current assets and the increasing liabilities often constitute the major obstacle of decision-making regarding implementation of technological innovations in the companies;
- more and more strict requirements of the EU regarding the industrial companies' impact on environment and the quality of products;
- difficulty/cost of obtaining information about the energy use of purchased equipment.

A framework for assessing these barriers would need to go far beyond the analysis of financial support to energy research, but might include an assessment of institutional capacities, policies and measures and their use and interplay (Fri 2003). An integrated approach would also be needed due to the fact that technological innovation comprises various distinct steps. However, the innovation process should not be understood as a linear process but rather as a cyclical process with various feedback loops between the different phases (Wiesen-thal *et al.* 2012). Through the application of new solutions in business can be minimized formation of waste and by-products during production process or such waste and by-products can be reused during production in the form of raw materials.

The results of prepared analysis, illustrating eco-innovation performance across the 27 EU countries – Eco-Innovation Scoreboard (2012), shows that Lithuania ranks last among 27 member states of the EU in terms of implementation of environment friendly innovations. Capacity and demand of Lithuanian industry to develop and implement environment friendly innovations are weak. Therefore in prospect it is especially important to ensure that business orientation towards environmental sustainability, environment friendly innovations and green market would become not only an obligation, but also common practice when developing the higher added value products and services.

#### 4. Conclusions

The results from this study show that among the most important strategic priorities of Lithuanian industry sustainable development are corporate social responsibility, sustainable consumption and production, sustainable use and management of energy resources. Implementation of these goals is sought through change the approach to business, industrial processes and energy efficient consumption, implementing the measures of sustainable industry development: improving production processes, projecting the products in accordance with the principles of cleaner production.

Industry is at the centre of the new growth model for the EU economy as outlined in the Europe 2020 Strategy. This document therefore proposed a new approach to industrial policy, which integrates energy and climate change policy package, including the so-called 20-20-20 % strategic goals, which in the near future will be followed by even higher EU goals of climate change and energy policy for the 2030. The EU has increasingly favoured economic or market-based instruments – such as regulatory sanctions of economic environmental benefit, fiscal instruments for environmental pollution and natural resources – for such policy purposes.

However, EU patterns of production and consumption are not yet to be considered as sustainable. Due to over and over increasing costs of energy (electricity, gas, heating), materials and carbon dioxide quotas, forecasted lack of resources and increase of their price the industrial companies are forced to look for new solutions regarding achievement of maximum results through energy savings at minimal costs.

Efficient and reliable management of energy resources has become a very important task of Lithuanian industrial companies. Here is meant not only the need to reduce energy consumption in order to cheapen the cost of production, but also gaining of competitive advantage by the companies when competing with the advanced production companies of Western Europe. Lithuanian manufacturing enterprises have two possibilities to reduce the negative impact of higher energy prices. One possibility is to negotiate a lower price from the energy supplier, while the second option is to work internally at the company on energy use, where energy efficiency, load management, conversion of electricity to other energy carriers, utilization of excess heat, as well as internal production of electricity and heat, are examples of possible areas to work with. To obtain the benefits of an economy of scale, capital investments are required; this includes investing in modern technologies that could increase production levels. Furthermore, new technologies, as a rule, are able to produce larger quantities with improved energy efficiency and lower costs. Different studies show how both cogeneration and high technology can improve the use of energy and decrease environmental impacts.

### Acknowledgement

This work was supported by a grant from the Research Council of Lithuania, the European Union Structural Funds project “Postdoctoral Fellowship Implementation in Lithuania”.

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