

# ENERGY INTENSITY OF GDP IN THE LIGHT OF ENERGY POLICY OBJECTIVES IN POLAND UNTIL 2030

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**Abstract:** This article attempts to present both theoretical and empirical aspects of the changes in energy intensity of GDP in Poland in relation to the European Union. The paper also discusses the objectives, activities and achievements in support of reducing the level of energy intensity of GDP. The study argues that the reduction of energy consumption in the economy should be treated as a priority and a key element of energy policy, because such conduct will support the implementation of its other goals, as well as play a key role in improving the economic efficiency of the economy and positive impact on its competitiveness on the international stage.

## **1. Introduction**

At the moment of the accession to the European Union, Polish energy sector faced many significant challenges, because the increase in energy demand as well as disproportionate level of infrastructure development in the sector of energy, high dependence on external supplies of natural gas and oil, and environmental commitment, determine the need to take appropriate measures to counter the deterioration of the situation of the fuels and energy consumers [6, 3]. In recent years the world economy encountered a number of adverse events, such as the dynamic change of energy prices, increased demand for energy from developing countries, serious failures of power systems, as well as increased levels of environmental pollution requires the need for a new dimension of energy policy. The increase of the level of investment in the areas of energy efficiency and renewable energy sources, should lead to the creation of new jobs, and also contribute to increasing innovation and strengthen the knowledge-based economy in the European Union [4, 372].

## **2. Aim, methodology and the research area**

The purpose of this paper is to present both theoretical and empirical aspects of the changes in energy intensity of GDP in Poland in relation to the European Union. The study argues that the reduction of energy consumption in the economy should be treated as a priority and a key element of energy policy, because such policy will support the implementation of its other goals. The article discusses the theoretical determinants of energy intensity of GDP, as well as specific goals and actions in support of energy policy for energy efficiency. The achievements in reducing energy

intensity of Polish GDP have also been presented. In the empirical part, the average annual pace of change in energy intensity indicators of Polish GDP has been presented, and also the changes pace of primary and final energy intensity of GDP in Poland in comparison with EU countries. The empirical data presented in the study come from the Central Statistical Office and the French Agency for Environment and Energy Management (ADEME).

### **3. Theoretical determinants of energy intensity of GDP**

Production energy intensity is defined as the energy consumption in the production process, company, industry and national economy, related to a specific volume of production, in which it is involved [8, 25-26]. According to the criterion of how to measure the energy input in the process of creating a production volume, the direct energy consumption and accumulated energy consumption are distinguished. Energy intensity of the direct energy consumption is brought directly to the process for manufacturing a specific product [1, 37]. However, one should understand the energy intensity as the cumulative energy consumption necessary to produce a product or a service covering the total amount of primary energy, which was actually consumed in all the processes of conditioning sequentially the manufacturing of a product or service, therefore the total energy consumed to produce the raw materials, semi-finished products and energy carriers. Typically, in studies of energy consumption, the following factors are being used [7, 15]:

1) Energy intensity indicator:

$$e = \frac{E}{D}$$

where:

E - the amount of energy consumed,

D - the value of national income;

2) incremental elasticity index, called the index of elasticity of energy consumption:

$$e' = \frac{E}{E} : \frac{D}{D}, \text{ czyli } e' = \frac{E}{D} \times \frac{1}{e},$$

where:

$\Delta E, \Delta D$  - energy consumption increases and national income increase;

3) rate of energy consumption per 1 inhabitant:

$$e = \frac{E}{L},$$

where:

L - population.

The incremental elasticity indicator  $e''$  expresses the marginal energy intensity. If it is greater than unity, it means that the increase in income is more energy intensive than the entire income and *vice versa* – the indicator that is less than unity means that the increase in income is less energy intensive than the entire income.

#### **4. The level of energy intensity of GDP in the 1990-2008 in relation to the European Union**

In relation to the developed countries, the Polish economy is characterized by excessive consumption of energy, raw materials and materials in the generated national income [9, 5]. However, the energy intensity of GDP, defined as the quotient of primary or final energy intensity and the value of GDP, is successively improved. In making the analysis of changes in energy intensity of GDP, one has to bear in mind the situation which took place in the early 90s of the 20<sup>th</sup> century in the countries of Central and Eastern Europe, including Poland [3, 19]. In the economies based on central planning, energy prices were low, leading to high wastage, sometimes even amounting up to 60-70% of total consumption, which also gave the opportunity to make important savings. The decrease in energy intensity in the last decade of the 20<sup>th</sup> century in Poland was a simple consequence of the use of these reserves.

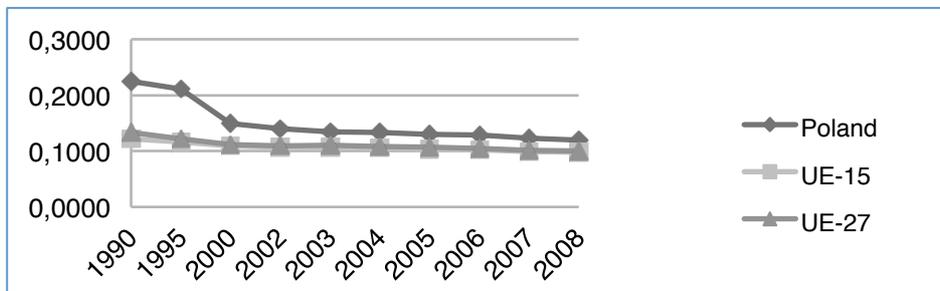
**TAB 1. The average annual pace of change in energy intensity indicators of Polish GDP (% per year)**

pace of change	1990-1993	1993-2000	2000-2008	1993-2008	1990-2008
primary energy intensity GDP	3.46	-7.16	-2.71	-4.81	-3.48
final energy intensity GDP	0.84	-6.77	-2.94	-4.75	-3.84

source: [2, 17]

In Poland, as a result of relatively stable energy consumption and GDP growth, a decreasing primary and final energy intensity of GDP has been observed [3, 575]. After a initial increase in the energy intensity of GDP by 1993, in subsequent years there was a dynamic period of improvement which lasted until 2000. Since then, the gradual improvement in energy intensity of the average annual pace of 3% has been observed. Primary energy consumption of Polish GDP, expressed in constant prices and purchasing power in 2008 amounted to 0.1784 koe / € 05P and was higher than the European average by more than 16%. Note the high (37%) reduction in energy intensity over the years from 1990 to 2000 contrasts with the relatively small improvement among Member States of the EU-15. Final energy intensity of GDP in Poland, expressed in constant prices and purchasing power in 2008 amounted to 0.1194 koe / € 05 and was higher than the European average "only" about 8%. This results from the fact that the ratio between final consumption and the original in

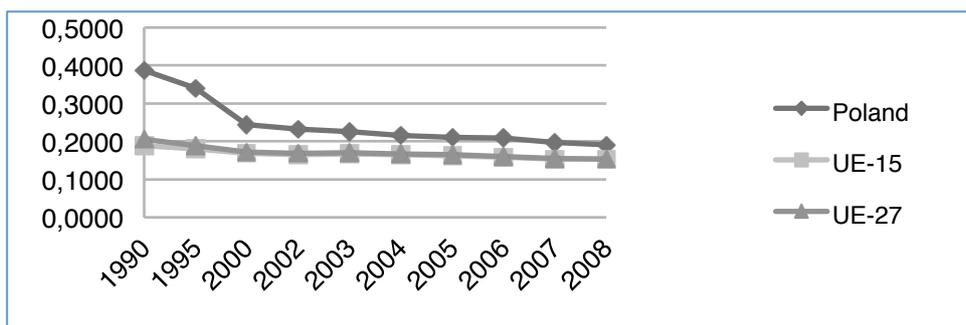
Poland is lower than the EU average. That relation has been directly affect by the change of efficiency of energy conversion and the growth in electricity consumption. In the graph (chart 1) the primary energy intensity of the Polish economy is compared with the European Union average, the exchange rate of purchasing power parity (PPP) was adjusted by constant euro prices from 2005 (euro05p).



**Chart 1. Changes in primary energy intensity rate of GDP**

source: [10] and author's calculations (access on 18.02.2011)

The chart below (chart 2) compares the final energy consumption in Polish economy and the



European Union average, the exchange rate of purchasing power parity (PPP) in constant euro prices from 2005 (euro05p).

**Chart 2. Changes in final energy intensity rate of GDP**

source: [10] and author's calculations (access on 18.02.2011)

## 5. The objectives and actions supporting the reduction of the level of energy intensity of GDP

Objectives and directions of activities to support reductions in the level of energy consumption of domestic product in Poland have been defined in the document "Polish Energy Policy until 2030" adopted by the government on 10 November 2009. Reducing energy consumption in the economy in this document has been treated as a priority [4, 369]. The main objectives in this area are striving to maintain zero energy growth and gradual reduction in the level of intensity of the Polish economy to the level of EU-15. Specific objectives in the area of energy efficiency improvements include the following [6, 7]: increase the efficiency of electricity

production, the increase in electricity produced in highly efficient cogeneration technology, reducing the index level of network losses in transmission and distribution, increase end-use efficiency and increase in the ratio of annual demand electricity to the maximum power demand at peak load.

The efforts to improve energy efficiency include the following [6, 7-8]: determination of the national objective to improve energy efficiency, encouraging the development of cogeneration, the imposition of the obligation to use energy performance certificates for buildings and homes, the imposition of obligation as the energy intensity of appliances and products that consume energy, introduction of minimum standards for energy consuming products, committing the public sector to provide a model role in the rational and cost-effective energy management, to support investment in energy savings through the preferential loans and grants from domestic and European funds, to provide support for scientific research on new solutions and technology, leading to a reduction in energy, techniques for energy demand management, conducting information and education campaigns that promote efficient energy use and implementation of the indicative, under 2006/32/EC Directive, according to which by 2016 9% energy savings are to be achieved in relation to the average level of final energy consumption in the years 2001-2005 (53 452 GWh) [6, 8].

## **6. Achievements in reducing the level of energy intensity of GDP**

During the year 2010, among the goals and actions to improve the energy efficiency of the Polish economy, the following assumptions have been accomplished [5, 9]: Directive 2004/8/EC on the promotion of cogeneration has been implemented, the analysis has been prepared on the review of energy consumption in the chosen sectors of the economy and opportunities to reduce energy loss in the national electricity system, the Ministry of Economy has begun an information campaign on energy efficiency use. The Directive 2002/91/EC on the energy performance of buildings has been implemented and the efforts to implement Directive 2006/32/EC on energy end-use and energy services have been made. The National Action Plan on energy efficiency has been developed, a draft law and assumptions prepared on energy efficiency, energy audits have been prepared and pro-efficiency measures in the areas of industrial plants, and also secured funds to support investments in energy efficiency in the economy.

## **7. Conclusions**

Further to the analysis of the indicators of changes in the primary and final energy intensity of GDP, and the assessment of objectives and actions which support the reduction of the level of energy intensity of GDP, as well as on the basis of its achievements in that reduction, the following conclusions can be drawn:

1. Over the last two decades, Poland has made a major progress in reducing the level of energy intensity of GDP. In the years 1990-2008, the energy efficiency of the economy increased by about

70%, although there is still a lot to be done, especially if one takes a lot less energy-intensive economies of the EU-15 into consideration.

2. As a result of the economic development, the popularization of new technologies that require higher consumption of electricity has developed, with a relative decline in demand for other forms of energy. With the gradual adaptation of the proposed actions, an important increase in energy efficiency of the Polish economy can be observed, thereby improving the energy security of the country. As a result of the energy intensity reduction in economy, a reduction of the emissions, which positively affects the environment has been noted. The investments in modern and energy efficient technologies and products have also effected the growth of Polish economy. Reducing energy consumption is crucial in improving the economic efficiency of the economy and its positive impact on international competitiveness.

3. It seems necessary to continue the long-term energy policy of the country, whose key objective should be to ensure national energy security. In the future, further mechanisms should be implemented to support action on the efficiency of production, transmission, distribution, and efficient use of fuels and energy.

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