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Paulina Szyja

Uniwersytet Pedagogiczny w Krakowie
Wydział Politologii
Katedra Ekonomii i Polityki Gospodarczej
paulinaszyja@wp.pl

THE ROLE OF THE STATE AND THE MARKET IN THE DEVELOPMENT OF ENERGY EFFICIENCY

Summary: The article addresses the issue of shaping energy efficiency as an element of transformation to a low-carbon economy. The term – especially in time of economic downturn – is very important for government, sectors of economy as a whole, enterprises, and households. Last economic crisis of 2008-2010 was particularly important in the discussed area, due to the role of the public policy to increase energy efficiency. The aspects taken into consideration were not only the prices of energy carrier (crude oil), but also the need to cut down emission of carbon dioxide and to overcome the climate change. It is important to diagnose the role of the state and the market in implementation of energy efficiency practices. The study takes into account data, examples of regulations, funds on the level of the European Union and in Poland, and analysis of literature.

Keywords: state, government, market, energy efficiency.

JEL Classification: Q41, Q43, Q48.

Introduction

The issue of energy efficiency gains importance whenever it concerns possible financial benefits. To understand its role, it should be clarified what energy efficiency is, who takes attempts to create energy efficiency, how it can be managed, what kind of initial costs have to be incurred, and what kind of profits (not only financial) may be achieved. Finally, the role of the state and the market in implementation of those practices should be considered.

The purpose of the study is to diagnose the role of the state and the market in the implementation of practices aimed at increasing energy efficiency. The question is: how do the mentioned entities influence actions for energy efficiency?

The analysis of the problem in this paper will take into account data, literature, and examples of governmental policy and regulations. Thus, one should take a look at the role of the main energy carriers and factors, both those of a state and a market nature, which may and do determine the practice of energy efficiency.

Energy efficiency gains its role whenever there is a change in the prices of energy carriers. So it was especially during the so-called oil shocks in 1970s [van de Ven, Fouquet, 2017]. But first, all the actions taken then were strongly related with a transition, which was based mainly on changes in sectors of economy. For example, in Japan it was connected with manufacturing shifting away from heavy materials-based industries primarily toward electronics and other high-tech industries. At the same time, efforts were made to increase energy conservation [JCR, 2012].

In the period of 2008-2010, there was a serious real economy crisis, which was preceded, with only a few month break, by an increase in oil prices (Table 1). It should be highlighted that in 2009 the prices decreased; however, from 2011 to 2014, they were on a higher level than in 2008 (during the crisis already).

Table 1. Europe Brent Spot Price FOB (USD per barrel)

Year	2000	2004	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Price	28.66	38.26	65.16	72.44	96.94	61.74	79.61	111.26	111.63	108.56	98.97	52.32	43.64

Source: EIA [s.a.].

As a result, actions related to increase energy efficiency were taken on governmental level. They were based on the European Union strategies – A European Economic Recovery Plan (EERP) and then EUROPE 2020, and its programs – The European Energy Programme for Recovery (EEPR) and update to the Energy Efficiency Directive. All these documents are related to the idea to carry out structural changes aimed at achieving the following goals: increasing energy efficiency and the share of energy from renewable energy sources, thus increasing energy security. These activities concern the need to reduce greenhouse gas emissions, carbon dioxide in particular, and conduct productive and service activities which are more environmentally friendly. The program of these changes is known as a low-carbon economy [OECD, 2015].

A common denominator of all the mentioned documents and regulations are goals which the EU have set itself with the time limit of 2020, changed later to 2030. Firstly, the aim of energy efficiency was established on the level of 20%

by 2020. In 2016, it was amended to 30% for 2030, and finally, on 14th June, 2018, a political agreement on energy efficiency was reached, setting the EU's target at 32.5% for 2030, with a clause for a further revision by 2023. To improve the realization of the mentioned goals, the EU has adopted specific measures such as: (1) an annual reduction of 1.5% in national energy sales; (2) energy efficient renovations to at least 3% of buildings owned and occupied by the EU countries' central governments per year; (3) preparation of National Energy Efficiency Action Plans every three years by the EU countries; (4) large companies' obligation to conduct energy audits at least every four years, protecting the rights of consumers to receive easy and free access to data on real-time and historical energy consumption [*Energy Efficiency*, s.a.].

All actions related to improvement of energy efficiency, in accordance with the abovementioned goals of EU-28, should be taken within public sector (e.g. public buildings, public business), private sector (companies, buildings), and households. Detailed range of operations deals with technological modernization in factories, upgrade of machines and equipment, processes of thermo-modernization, changes in production, organization and management processes, and changes in habits related to using households appliances, ecological cars, using public transport, etc. Initial costs of these praxis involve money (public, private, of local authorities, foreign funds, or bank loans), innovation (technological, organizational, and in commodities), and individual commitment. An appropriate system of regulation and control may be a supporting instrument. Benefits possible to achieve include: savings (lower energy bills), streamlining production processes, improvement of working conditions (i.a. by modern energy efficiency technologies), and improving living and environment quality.

Energy efficiency is strongly related with changes in ways of using energy. What encourages, forces or obliges people to implement those activities? Factors can be divided into those of macro- and micro-nature. In the first case, they include prices of energy carriers and public regulations. In the second one, they are related mainly to innovation and technological progress [Arvanitis, Ley, 2013], possible savings, quality, and products competition (Figure 1). In the case of the macro-level, we deal with a top-down factors, independent of individual entities. The situation may change if a larger group of entities (energy companies, industry, enterprises from various sectors) starts to affect the demand and supply of energy carriers. On the micro-level, factors are a bottom-up.

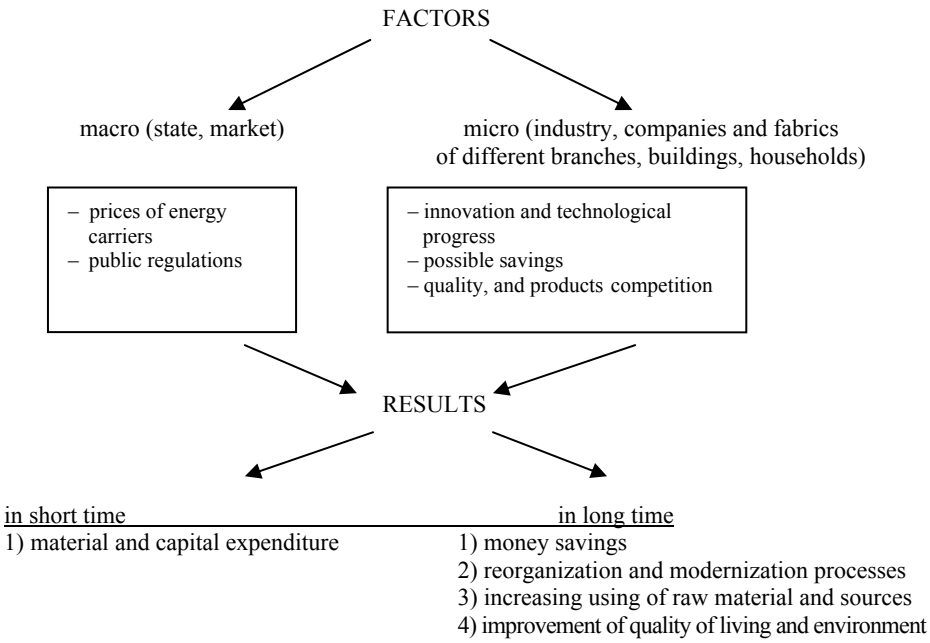

Figure 1. Factors that imply energy efficiency practices and it results

The purpose of the publication is to answer the following question: is the implementation of efficiency solutions a result of legal and financial instruments implemented by the government, or are we dealing with the energy efficiency market and bottom-up actions taken by enterprises and households? The axis of considerations will be last crisis of real economy and actions taken to create a low-carbon economy in the European Union.

This article contains a review of the literature, and then an analysis of selected data in comparison to public activities (regulations, financial support) and market prices of energy in the period 2006/2008-2016. Further part provides conclusion and remarks for further research.

1. Literature review

The issue of energy efficiency is defined on the level of the European Union as the ratio of output of performance, service, goods or energy, to input of energy [EC, 2012]. In praxis, it means doing more with less [ADB, 2015, p. 2]. Moreover, the directive includes terms such as energy efficiency improvement and energy savings. The first one means an increase in energy efficiency as a result

of technological, behavioural, and/or economic changes. In turn, "energy savings" is defined as an amount of saved energy determined by measuring and/or estimating consumption before and after implementation of an energy efficiency improvement measure, whilst ensuring normalisation for external conditions that affect energy consumption [EC, 2012]. It should be pointed out that energy saving does not have to be related to efficiency practices [Gillingham, Newell, Palmer, 2009, pp. 1-2]. Energy efficiency can be related to features of products [Gillingham, Newell, Palmer, 2009, pp. 1-2] or constructions [WEC, 2004]. However, it is more often defined by activities in some areas [WEC, 2004], sectors, or in economies in general.

In praxis, energy efficiency is strongly based on supply-side improvements measures, such as:

- increasing generation efficiency by rehabilitating, replacing, or expanding generation plants;
- reducing technical losses by rehabilitating, replacing, or expanding transmission lines and networks.

It should be also pointed out on demand side energy efficiency measures, taking into account sectors:

- residential (thermo-modernization, energy efficiency standards for electrical appliances),
- commercial (energy performance standards),
- industrial (standards of efficiency of equipment),
- agriculture (energy efficiency in farm machinery) [ADB, 2015, pp. 2-3].

Taking into account the issue related to economy as a whole and its sectors, or socio-economic development, we find statements saying that energy efficiency helps to create new jobs [Constantini, Crespi, Paglialunga, 2018], new kinds of business, and innovative industries [Yan, Chien, 2013], as well as to ensure energy security [IEA, s.a.], reduce greenhouse gas emissions [BGS, s.a.; Schulze, Heidenreich, Spieth, 2017], and overcome the possible depletion of fossil energy resources [Schulze, Heidenreich, Spieth, 2017].

Practices aimed at energy efficiency are being introduced in public buildings, various industries (particularly energy and heavy industry), manufacturing plants, rationalization commercial buildings, and households [Burnett, Madariaga, 2018], also product rationalization [Górzyński, 2017]. Mainly, they are related to technological changes [Lingbo, Ali, Lynn, 2016].

In the literature, there is a discussion on factors which determine practices of energy efficiency on operational level, which means production [Patange, Khond, 2016; Jianglong, Boqiang, 2017], transport (both production and use of

vehicles) [Oh, Hildreth, 2014], design and construction of buildings [Huovila, Tuominen, Airaksinen, 2017; Reddy, Vijay, Tapas, 2017], and using energy at home [Burnett, Madariaga, 2018]. There are no studies on the role of the state and the market in the mentioned area, which would compare their effectiveness, and also analyze the role of the market itself. There are some studies which present the involvement of governments and role of the market separately. In the first example, the authors take into consideration the issue of "government effectiveness" [Chang et al., 2018], public regulations related to energy efficiency [Arimura, Tariu, 2017], government-funded research programs [Du, Wang, Zhang, 2018], energy subside [Barkhordar, Fakouriyan, Sheykhha, 2018], and energy efficiency market [Bukarica, Tomšić, 2017]. In the second one, the highlighted issue is the role of energy efficiency in capitalisation of prices of apartment and rents [Kholodilin, Michelsen, Mense, 2017], so actions not determined by market prices of energy carriers, but by attractiveness of a building for a customer. Moreover, there are no papers which would present analysis of the "invisible hand" of market with prices taken into consideration.

Analyzing the role of the state and the market is important to answer the following question: "what stage of ensuring energy efficiency are we dealing with on domestic level?", it means: transformation in economy or sectors of economy in direction of energy efficiency, improving or increasing energy efficiency (Figure 2).

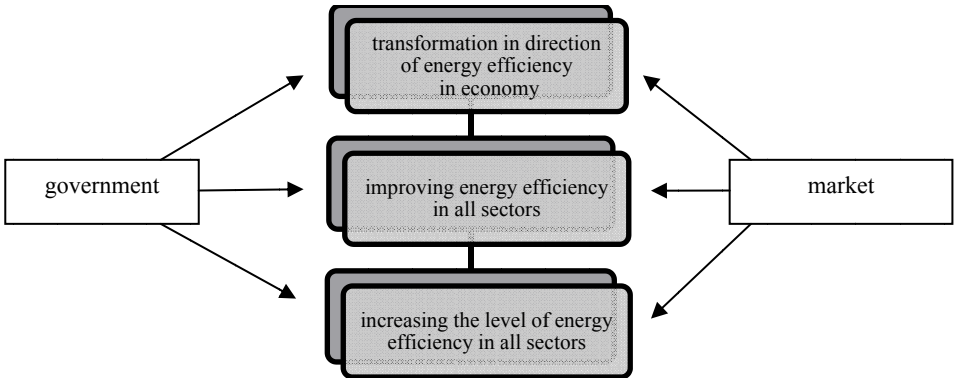

Figure 2. Stages of creating energy efficiency and the relation to the state and the market

With no doubt, the role of the state at each of these stages is important. Primarily it is strongly related to adoption of appropriate legal regulations, development, and implementation of sectoral policies (for example energy policy) [Bukarica, Tomšić, 2017; Chowdhury et al., 2018], programs [Arimura et al.,

2012] or strategies, establishment of appropriate institutions on supply or/and demand side [Berg, 2015]. Taking into account institutional dimension, it should be pointed out on its role in "enhancement of conditions and measures for rational use of energy and fuels" [Kovačić, 2012, p. S23]. Moreover, the role of special funds or subsidies and engagement of local authorities should be highlighted. Other important aspects include education to change citizens' habits, encouragement of R&D and innovative technologies, and inclusion of other stakeholders.

The role of the market is strongly related to energy carriers prices, product/service competition, and quality competition [Cohen, Glachant, Söderberg, 2015]. The first of those aspects particularly affects manufacturing cost, which in turn is associated with the final price of a product.

Further part of the paper presents some data on energy efficiency and its comparison to the time of the crisis, regulations adopted on the level of the European Union and Poland, and special funds. The main goal is an attempt to indicate any relation.

2. Analysis of data and government's regulation, and funds related to energy efficiency

Primary energy consumption in the EU-28 in the period 2005-2016 decreased by 0.9%. There was a decrease in consumption of energy of majority of energy carriers (the highest decline was observed in oil and petroleum products), and an increase in consumption of energy of renewable sources and others. Taking into account final energy consumption, the situation was quite similar, except for electricity, which was on the same level in 2005 and in 2016; between those years, there were fluctuations [*Energy Saving Statistics*, 2018].

Prices of electricity for medium-size households in the EU-28 in the period 2008-2017 achieved the highest level in 2015: 0.2090 EUR/kWh, and the lowest in 2008: 0.1583 EUR/kWh. The Table 2 presents data for the EU-28 and selected Western and Eastern European countries.

Table 2. Electricity prices in medium-size households in EU-28 and selected countries (EUR/kWh) in 2008-2016

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016
EU-28	0.1583	0.1641	0.1678	0.1803	0.1884	0.2000	0.2040	0.2090	0.2052
Germany	0.2148	0.2282	0.2375	0.2528	0.2598	0.2919	0.2981	0.2951	0.2969
France	0.1213	0.1206	0.1283	0.1383	0.1393	0.1524	0.1585	0.1676	0.1685
Denmark	0.2635	0.2699	0.2670	0.2908	0.2997	0.3000	0.3042	0.3068	0.3088
Poland	0.1259	0.1131	0.1341	0.1471	0.1418	0.1480	0.1421	0.1444	0.1332
Czech Republic	0.1401	0.1455	0.1496	0.1659	0.1664	0.1681	0.1388	0.1385	0.1420
Hungary	0.1548	0.1483	0.1701	0.1682	0.1549	0.1397	0.1202	0.1127	0.1114

Source: *Electricity Prices by Type*… [s.a.].

In turn, energy prices for medium-size industries increased during the period of the crisis (2008-2010) and then until 2013 for the EU-28 (Table 3).

Table 3. Electricity prices in medium-size industries in the EU-28 and selected countries (EUR/kWh) in 2008-2016

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016
EU-28	0.0875	0.0950	0.0911	0.0926	0.0960	0.0942	0.0924	0.0877	0.0819
Germany	0.0929	0.0975	0.0921	0.0900	0.0895	0.0860	0.0844	0.0809	0.0788
France	0.0599	0.0667	0.0687	0.0722	0.0809	0.0781	0.0765	0.0776	0.0714
Denmark	0.0707	0.0610	0.0721	0.0784	0.0645	0.0661	0.0654	0.0609	0.0602
Poland	0.0814	0.0857	0.0929	0.0963	0.0869	0.0883	0.0777	0.0833	0.0762
Czech Republic	0.1095	0.1057	0.1022	0.1097	0.1028	0.1012	0.0819	0.0761	0.0720
Hungary	0.1119	0.1221	0.1037	0.0978	0.0888	0.0904	0.0836	0.0778	0.0729

Source: *Electricity Prices in Medium-size*… [s.a.].

Therefore, it is evident that the growth of electricity prices for households should encourage energy efficiency practices. Prices for industry were lower; however, its demand is absolutely higher than that of households.

Taking into account energy productivity in the EU-28, it should be pointed out that it increased year by year; however, in 2010 there was a decline. In turn, in individual member states the situation was diverse. Among Western European countries, those with the highest level of energy productivity in 2006 were Denmark (11.9 KGOE), Ireland (11 KGOE), and Italy (8.8 KGOE). The lowest level in the mentioned area was achieved by Finland (5.0 KGOE) and Belgium (6.0 KGOE). In Finland, this is the results of a greater commitment to develop renewable energy sources and cut down emission of greenhouse gases. Furthermore, some experts underline "a lack of awareness among consumers" [*Energy*

Efficiency in Europe…, 2013b]. In Belgium, there is a little progress inter alia because of too few additional policies [*Energy Efficiency in Europe*…, 2013a]. Whereas, in Central and Eastern Europe the highest level of energy productivity in 2006 was observed in Slovenia (4.8 KGOE) and Latvia (4.3 KGOE), and the lowest one – in Bulgaria (1.7 KGOE), Romania (2.9 KGOE), and Poland and Slovakia (3.1 KGOE). In 2016 situation was as follows: the countries with the highest level of energy efficiency were: Slovenia (5.6 KGOE), Latvia and Lithuania (4.9 KGOE), and Slovakia (4.8 KGOE) and those with the lowest – Bulgaria (2.4 KGOE) and Estonia (2.9 KGOE) [*Energy Productivity*, s.a.]. In Bulgaria, one of the most important things, which impedes practices for energy efficiency, is low price of energy. At the same time this country has the highest level of energy poverty in the EU [Centre for the Study of Democracy, 2010]. In Estonia, one of the reasons of low energy productivity is outdated infrastructure, especially in housing [Ministry of Economic Affairs and Communication, s.a.]. Western European Countries with the highest level of energy productivity were: Ireland (17.0 KGOE), Denmark (15.1 KGOE), Malta (12.3 KGOE), Luxembourg (11.4 KGOE), and Italy (10.2 KGOE). In turn, those with the lowest level were Finland (5.5 KGOE) and Belgium (6.8 KGOE). Thus, Eastern European countries achieved lower growth in energy productivity than the Western ones. The highest level in Eastern European countries is comparable to the lowest for the Western ones. On that account, Poland, Hungary, and others should take actions for improvement of energy productivity. It will not be facile due to energy prices (which are on a quite similar level for medium-size industry), but also some structural underdevelopment (Table 4).

Table 4. Energy productivity in the EU-28 in period 2006-2018 and selected countries (euro per kg of oil equivalent, KGOE)

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
EU-28	6.9	7.2	7.3	7.4	7.3	7.7	7.7	7.8	8.3	8.3	8.4
Germany	7.2	7.8	7.8	7.8	7.8	8.5	8.5	8.3	8.8	8.9	9.0
France	7.2	7.5	7.4	7.6	7.5	7.9	7.9	7.9	8.3	8.3	8.5
Denmark	11.9	12.3	12.7	12.6	12.1	13.2	13.7	14.0	15.0	15.3	15.1
Poland	3.1	3.4	3.5	3.7	3.6	3.8	4.0	4.0	4.3	4.4	4.3
Czech Republic	3.2	3.4	3.5	3.6	3.4	3.6	3.6	3.6	3.8	4.0	4.2
Hungary	3.7	3.8	3.9	3.8	3.7	3.9	4.0	4.2	4.4	4.3	4.3

Source: *Energy Productivity* (s.a.).

Paying attention to energy productivity and electricity prices in medium--size households and industry and energy productivity, the conclusion can definitely be drawn that along with the increase of prices the productivity increases. It is obvious that both households and industry, trying to avoid any energy cost, take up activities related to energy efficiency. However, when prices are falling, we have to deal with two phenomena. In the first case, the level of energy efficiency falls, and in the second one it increases or stays stable. For example, in the Netherlands, in the period 2009-2010, the energy prices in medium-size households decreased from 0.198 EUR/kWh to 0.177 EUR/kWh (in medium-size industry: 0.096 EUR/kWh in 2009 and 0.086 EUR/kWh in 2010) and energy productivity decreased as well, from 7.8 KGOE to 7.4 KGOE. However, in the following year it was on the level of 8 KGOE and the prices increased. An example of the second case was Ireland. In the period 2008-2011, the energy prices in medium-size industry decreased and energy productivity stayed stable on the level of 11 KGOE (in reference to medium-size households the prices fluctuated from 0.177, through 0.203, to 0.18 EUR per kWh). These are only exceptions. In most cases in a short period, taking into account data, energy productivity is increasing in a stable way. This is the result of several factors. First of all, the implementation of energy efficiency practices requires technological (appropriate machines, equipment), organizational (changes in work time), and structural changes in industry and respective sectors of economy and habits in households. Once introduced, such changes guarantee long term results. But at the same time the payback and renouncement period also prolong the time. The higher the costs of changes (due to, for example, the necessary structural changes), the longer the payback period is. This, in turn, does not encourage changes, especially when prices of energy are low. In addition, if the level of prices is low, the possible changes in energy efficiency are not high, though the prices are gradually increasing in the long run like in Poland [*Electricity Prices by Type*…, s.a.; *Electricy Prices in Medium-size*…, s.a.; *Energy Productivity*, s.a.].

The structure of final energy consumption in Poland, by sector, in 2016 was as follows: households, transport, industry, services, agriculture. According to Statistics Poland [2018], the primary intensity of GDP decreased in 2016 by about 28%, compared to 2006, and final intensity in the same period by about 24% (Table 5).

Table 5. An average annual rate of changes in GDP energy intensity indicators (% per year) in Poland

An average annual rate of changes	2007-2009	2010-2016	2007-2016
Primary intensity of GDP	5.28	–2.26	–3.18
Final intensity of GDP	–5.25	–2.20	–3.13

Source: Statistics Poland [2018, p. 16].

Statistics Poland [2018] presents some very important data for the analysis of the sectors of economy and its energy intensity. Final energy consumption in the industry achieved the highest result in 2007 – 15 Mtoe, the lowest in 2009 – 13 Mtoe, and in 2016 it was 14.8 Mtoe. Fundamental changes are related to using liquid fuels – decline by 53%, warmth – by 38% and coal – by 21%. However, at the same time the consumption of electricity rose by 21% and that of other energy carrier – by 115%. The most energy-intensive branches of industry are metallurgical, chemical, and mineral industries [Statistics Poland, 2018].

In turn, in households those are the changes in energy use, according to Statistics Poland (Table 6).

Table 6. Structure of energy consumption in households by end use (%) in Poland

Specification	2002	2009	2012	2015	2016
Total	100.0	100.0	100.0	100.0	100.0
Space heating	71.3	70.2	68.8	65.5	66.4
Water heating	15.0	14.4	14.8	16.2	15.8
Cooking	7.1	8.2	8.3	8.5	8.0
Lighting	2.3	1.8	1.5	9.8*	9.7*
Electrical appliances	4.3	5.4	6.6		

* Jointly lighting and electrical appliances.

Source: Statistics Poland [2018, p. 22].

In 2016, the share of respective carriers was as following: coal – 33%, heat – 20%, natural gas – 18%, electricity – 13%, others – 14%, and liquid fuels – 3% [Statistics Poland, 2018]. In transport, 94% energy in 2016 was used in road transport. The energy consumption increased by 36% in comparison to 2006 (not taking the air transport into account) [Statistics Poland, 2018].

When analyzing factors which determine all kind of activities related to energy efficiency, there is a need to point out primarily the prices of energy carriers. For the purposes of this study, we will look at the prices of electricity and diesel oil, as main carriers in Poland, taking into account energy consumption in households, transport, and industry. Respectively, electricity prices for households increased between

2006 and 2016 from the level of 0.088 in 2006 to 0.108 euro00/kWh in 2016. A slightly different situation occurred in industry. Electricity prices reached the highest level in 2009, above 0.07 euro00/kWh whereas in 2016 it was 0.058 euro00/kWh. Prices of diesel oil were the highest in 2012 and reached 1.00 euro00/l, and then in 2016 they were at the level of 0.73 euro00/l [Statistics Poland, 2018]. Compared to other Member States, energy prices in Poland are on an average level. However, in 2016 in medium-size industry they are higher than in Denmark, Sweden, Finland, Slovenia, Romania, Austria, Netherlands, Hungary, France, or Estonia [*Electricity Prices in Medium-size*…, s.a.]. Therefore, there is an area to implement practices of energy efficiency.

And what about energy efficiency regulation and its role in increasing energy efficiency? Table 7 and 8 present the most important documents and regulations adopted at the EU level and in Poland during and after the crisis.

Table 7. The most important regulation, plans, and strategies in the European Union related to the issue of energy efficiency

Date	Document
13.11.2008	Communication from the Commission – Energy efficiency: delivering the 20% target
13.07.2009	European Energy Programme for Recovery
21.10.2009	Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products
19.05.2010	Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings
10.11.2010	Energy 2020. A strategy for competitive, sustainable and secure energy
08.03.2011	Energy Efficiency Plan 2011
08.03.2011	A Roadmap for moving to a competitive low carbon economy in 2050
28.03.2011	WHITE PAPER Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system
15.12.2011	Energy Roadmap 2050
25.10.2012	Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency
16.04.2013	An EU Strategy on adaptation to climate change
22.01.2014	A policy framework for climate and energy in the period from 2020 to 2030
28.05.2014	European Energy Security Strategy

Table 8. Polish regulation related to energy efficiency

Date	Document
15.04.2011	The Act of 15 April 2011 on energy efficiency
10.08.2012	Regulation of the Minister of Economy of 10 August 2012 on the detailed scope and method of preparation of the energy efficiency audit, template of the energy efficiency audit certificate and methods for calculating energy savings
21.12.2012	Decree of the Minister of Economy of 21 December 2012 on a detailed list of undertakings aimed at improving energy efficiency
15.04.2014	Strategy of Energy Safety and Environment
29.08.2014	Act of 29 August 2014 on the energy performance of buildings
15.07.2015	National Action Plan on energy efficiency for Poland 2014

It needs to be highlighted that the above planning and strategic documents on the EU level were adopted during or after the crisis. This was related to the need for action to overcome the crisis. It should be mentioned that duty in this matter of thing was delegated to the state. Moreover, before and after the collapse, international organizations, scientific research institutions, as well as individual experts put emphasis on the need to take action that would allow structural changes in economies so that they would become more competitive, but also and perhaps above all, with a careful care for the natural environment. Due to a relatively low business' interest in the latter issue, as well as the imperfection of the market mechanism itself, it became necessary to involve the state. Low-carbon economy programs gained importance, with one of the pillars being energy efficiency. The scope of objectives and actions defined in the EU's documents requires serious structural changes in economies, their sectors, production plants, enterprises, and households. This, in turn, takes time. The same applies to the Polish regulations or planning documents.

Beyond the abovementioned documents and regulations, the funds should be taken into consideration. In 2011 the European Commission, the European Investment Bank (EIB), the Cassa Depositi e Prestiti (CDP) and Deutsche Bank established European Energy Efficiency Fund (EEEF) to "provide market-based financing for commercially viable public energy efficiency and renewable energy projects within the European Union" [EIB, 2011]. The total volume of the Fund was on the level of 265 million EUR with a target to increase it to 800 million EUR. The EEEF investments include encouraging projects related to energy saving and energy efficiency, especially "public and private buildings incorporating energy efficiency solutions; high energy efficient combined heat and power (CHP) including micro-co-generation and district heating/cooling networks; street and traffic lighting, electricity storage solutions, smart metering

and smart grids" [Interreg Europe, 2018]. The Fund pursues two types of investment: direct investments (projects from project developers, energy service companies – ESCOs, small scale renewable energy, and energy efficiency service and supply companies), investments into Financial Institutions (in local commercial banks, leasing companies, and other selected financial institutions that either finance or are committed to financing projects of the final beneficiaries meeting the eligibility criteria of EEEF) [EEEF, s.a.].

Taking into account Poland and other EU member states, there is also a possibility to gain some financial support through:

- Connecting Europe Facility (with the amount of 33 billion EUR),
- Horizon 2020 (5.9 billion EUR),
- European Regional Development Fund,
- European Investment Bank.

In Poland, National Fund for Environmental Protection and Water Management [NFEPWM, s.a.] is involved in energy efficiency projects through financial support for public buildings, enterprises, and housing. The first contest for energy efficiency projects was announced only in 2016, so the effects of these undertakings will be visible in a few years, taking into account the time necessary to prepare technical implementation of the projects and then their realization.

The article undertakes the issue of reasons which contribute to increase energy efficiency practices, but the barriers which can occur should also be mentioned. For example, in industry, S. Arvanitis and M. Ley [2013], on the basis of Dutch firm studies by de Groot, Verhoef and Nijkamp [2001], pointed out: compatibility with existing technologies, organizational problems, lack of internal financing, lack of public subsidies, and no need for further increase of energy efficiency [Arvanitis, Ley, 2013]. Then, costs of similar projects for both enterprises and households should be pointed out. These are related to the prices of technological solutions, appropriate equipment, machinery, or building materials (if we talk about thermo-modernization). The demand for such products and supply which influences their price on the market should be taken into account as well. There is also the following question: to what extent this demand and supply will be the result of appropriate state regulations and certain funds allocated for these purposes? These are issues related to bottom-up activities by stakeholders.

3. Discussion

Analyzing the issue of activities to increase energy efficiency during and after the real economy crisis, we should point out several aspects. First of all, in a short period of time it is difficult to see significant quality changes on the level of energy productivity and dependence on electricity prices due to no data which could unambiguously ascertain what is related to energy efficiency practices and not energy saving. Secondly, taking into account statistical data (2006-2016), energy productivity increases regardless of crisis and energy prices. Thirdly, energy efficiency practices need time for implementation because of structural changes. The same is connected to the results of governmental policy and funds. Moreover, it seems that energy prices are fundamental to introduce any regulation changes and incentive instruments on domestic level. Without that, private sector takes its own attempts to increase energy efficiency. Next, the government policy is particularly important if the rate is to introduce structural changes aimed at creating a low-carbon economy. Finally, there is an urgent need to speed up the actions in Central and Eastern Europe.

In conclusion, the actions should be undertaken to increase energy efficiency independently from the market, due to the fact that these practices need long time. The short time effects are that energy-saving practices are more effective and cheaper.

Conclusions

During and after the real economic crisis (2008-2010), the European Union encouraged Member States to increase energy efficiency by special documents, regulations, and funds under the aegis of a low-carbon economy program. This analysis proves that at the same time prices of electricity increased. An increase in energy efficiency was also noted, and it is still increasing. It cannot be unequivocally determined whether this is a direct result of the increase in energy prices. It is related to long-term activities undertaken on operational level. The recent involvement of the state in this field is undoubtedly the effect of prices and the implementation of a low-carbon economy.

Further research should concentrate on analyzing the increase of energy carriers prices, factors which determine them, and practices of energy efficiency. The latter should be studied with the issue of demand on technological energy efficiency solution and involvement of government taken into account. The first

two elements are strongly related as governmental policy can increase demand for efficiency technology and lower the prices of energy carriers. However, it could also paradoxically increase energy consumption.

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PAŃSTWO, RYNEK A WYDAJNOŚĆ ENERGETYCZNA

Streszczenie: W artykule poruszono kwestię kształtowania efektywności energetycznej jako elementu tworzenia gospodarki niskoemisyjnej. Zagadnienie to jest istotne zarówno dla rządów państw, poszczególnych sektorów gospodarki, jak i przedsiębiorstw oraz gospodarstw domowych. Ostatni kryzys gospodarczy z lat 2008-2010 był istotny, biorąc pod uwagę omawiany temat, z uwagi na rolę polityki państwa w zwiększaniu efektywności energetycznej. Problematyczne były bowiem nie tylko ceny nośników energii (ropy naftowej), ale także konieczność ograniczenia emisji dwutlenku węgla w kontekście przezwyciężenia zmian klimatycznych. Celem opracowania jest zdiagnozowanie roli państwa i rynku w realizacji praktyk ukierunkowanych na zwiększenie efektywności energetycznej. W artykule uwzględniono dane, przykładowe regulacje, środki zadysponowane na poziomie Unii Europejskiej i w Polsce, oraz dokonano analizy literatury.

Słowa kluczowe: państwo, rynek, rząd, efektywność energetyczna.