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THE EFFECTIVENESS OF GREEN CERTIFICATES – EVIDENCE FROM POLAND[1]

1. Introduction

Reconciliation of economic targets with environmental policy goals requires the separation of economic growth from its negative consequences: extensive use of natural resources and the GHG emission. This is particularly important for those countries, whose development objective is to lower the economic gap. One of the solutions is the development of clean energy technologies. However, due to relatively early stage of development, the use of renewable sources is currently not cost competitive with long-established fossil fuel-based energy technologies [IEA 2011]. Therefore, the question is: how public policies can foster technological progress in the field of clean energy technologies [REN 21, 2015; Hoppmann at al 2013; Mowery et al. 2010].

The paper focuses on the effectiveness of green certificates in transforming Polish electricity system and fulfilling the requirements of climate policy. The remainder of this paper is structured as follows: Section 2 provides an overview of the literature and past studies dealing with the path dependency, technology and carbon lock-in as well as innovation effect of deployment policies. Furthermore, the initial theory framework of the study is presented. Sections 3 and 4 introduce the research case of Poland. The discussion of implications for theory and policy makers is presented in Section 5.

2. Path dependency, technology and carbon lock-in

Path dependency implies that the economics of future technology – related decisions depend crucially on previous decisions and investments [North 1990; Arthur 1989]. The path dependency in the electricity sector is the result of many factors. Firstly, specific effects connected with the implementation of energy technologies exist. These are [Foxon 2002; Unruh, 2000; Sorrell and Sijm 2003]

– economy of scale and learning effect – originating as a result of lowering fixed costs together with the increase in production volume and business experience,

– adaptive expectations – as a result of which, the production growth is followed by the lower level of uncertainty concerning quality, functioning and durability of technology,

– network or coordination effects – occur as a result of cooperation between companies adopting the same technologies.

The review of organization, institutional and transition theory has addressed lock-in mechanism form different point of view and distinguish other explanations for it. The main rationales are [Klitkou et al. 2015; Van den Bergh and Oosterhuis, 2008; Foxon 2002]:

– informational increasing returns – occurring because the adoption of a technology is followed by greater attention which in turn stimulates other users to adopt it;

– technological interrelatedness – occurring because the adoption of a technology favours the development of complementary technologies, decreases technological uncertainty, while potential users may adapt their expectations regarding quality, endurance and the performance of the technology. Technologies which are incompatible with the dominant technological regime are, however, locked out;

– collective action – refers to the emergence and subsequent reproduction of societal norms, customs, consumption patterns and formal regulation through coalition building in associated networks of individuals and organisations;

– institutional learning effects – concerning the outcome of the increased adoption of institutions, which makes them rather complex and difficult to change, while at the same time providing improved coordination and adaptive expectations;

– asymmetries of power – strong political actors can impose rules on others and force changes to the rules to enhance their power. Within lock-ins, institutions and organisations develop symbiotic relationships and favour incremental instead of radical changes.

The above mentioned phenomena decide, that production of energy in the frame of fossil-fuel technologies is economically more profitable than RES-E technologies. Additionally, the existence of path dependency creates increased tendency for investment in existing technologies. Due to this fact, enterprises using fossil-fuels will be more willing to undertake investment in such sectors [Lehman and Gawel, 2013; Acemoglu et al.,2012] and the sector will show a tendency to preserve the energy-mix. Because of this, the market forces, without the support from the State, may appear insufficient to conduct significant technological changes and stimulate RES deployment [Marschinski and Schmidt, 2009].

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The second factor influencing the creation of path dependency in the electricity sector is the big scale of investment and long investment period. This concerns both, the construction of power plants, as well as transport and transmission infrastructures [Matthes, 2010; Neuhoff, 2005; Sorrell and Sijm,2003]. What is important, many of these investments are of difficult irreversible decisions, which means the lack of possibility to recover invested capital and increased investment risk. Moreover, electricity is a homogeneous good. Therefore, energy produced in traditional technologies and alternative sources will be almost a perfect substitute. Due to this fact, new energy technologies can compete with the traditional ones only on the price level.

Thirdly, technological path dependence is strengthened by the development of institutions, understood as sector rules, originating and evolving together with the energy system. This phenomenon is described as techno-institutional complex [Geels, 2004; Unruh, 2000].

3. Transition towards the low carbon economy in Poland

There is a broad consensus that an internationally coordinated response to the threat of climate change is needed and that a lack of action will impose very high costs, especially on poorer countries. European Union has taken a proactive stance within the international community's ongoing negotiations by setting a unilateral target of a 20 percent reduction in emissions by 2020. EU members therefore face specific obligations for climate action and Poland faces a particular challenge in CO_2 mitigation because of its heavy reliance on domestic coal.

Transformation of Polish economy allowed for a strong decrease in the level of emissions (fig. 1). This was, most of all, the result of a restructuring process and the increase in industrial efficiency, technological development as well as an increase in the efficiency of energy processes. However, the link between growth and

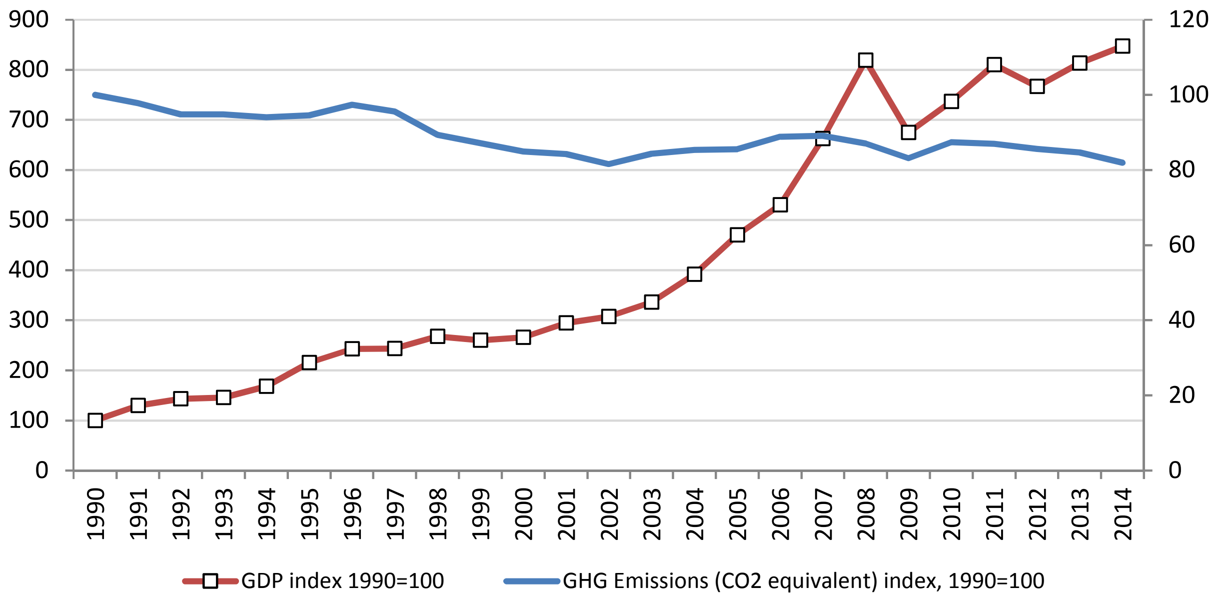

Fig. 1. Economic growth and the GHG emissions in Poland, 1990-2014

Source: Eurostat 2015a, World Bank 2015, own calculations.

emissions has re-emerged in recent years. This results, among others, from the fact that energy efficiency, besides significant increase, still remains on the level lower than the EU average.

The factor which most significantly influences the level of emissions in the Polish electricity sector is the strong dependence on coal. Over 80% of energy is generated from coal and lignite, which distinguishes Poland among European States (fig. 2) [EU Energy in Figures, 2015]. Taking into consideration the specificity of Polish energy sector, the 20-20-20 package requires Poland's energy-intensive sectors to contribute to the EU target of a 21 percent reduction (compared with 2005). In Poland, approximately 60 percent of CO_2 emissions in 2005 were generated in the ETS sectors (compared with about 40 percent in the EU as a whole). For the less energy-intensive non-ETS sectors, the package requires a reduction in emissions by 10 percent compared to 2005 in the EU27, while allowing emissions from Poland's non-energy sectors to increase by 14 percent. The road map for fulfilling this requirements indicates the need for wider use of low-carbon energy sources. So far, most of policy measures were focused on deployment of renewable energy sources. The potential of Poland in the scope of RES development covers energy from direct use of solar, wind, geothermal sources, water as well as energy produced from solid biomass, biogas and liquid biofuels.

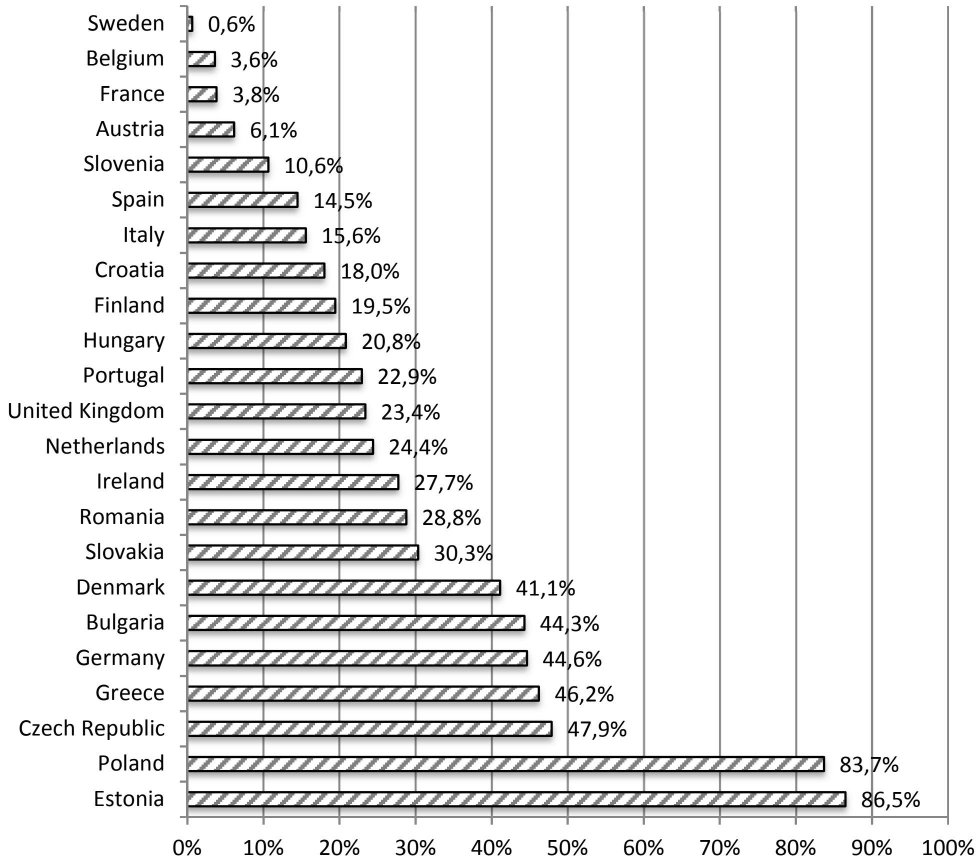

Fig. 2. Electricity generated from coal in the EU Member States, 2013

Source: EU Energy in Figures 2015, own calculations.

High growth dynamics was reached mainly as a result of the obligations to purchase energy and heat from renewable energy sources as well as providing the support for investment in the renewable energy sector. In the 2005-2016, the main tool for support was the system of obligation quota, together with the system of tradable certificates of origin – so called green certificates. These mechanisms covered the electricity and fuel(biofuel) sectors.

The system of obligation quota imposes the obligation on the energy supplier to sell energy from renewable sources to the end customers. In case of not managing the right amount of renewable energy produced in own power plants, the energy companies can purchase certificates of origin (green certificates) on the Polish Power Exchange or make a 'compensation payment'. The level of the compensation payment is fixed once a year by the energy market regulatory. Energy companies, which do not fulfill their obligations to purchase green certificates or pay substitutionary fee, are imposed with financial penalties, which are transferred to the National Fund for Environmental Protection and Water Management. Until the end of 2009, such financial means could only be spent on investment support in the scope of renewable energy sources, however, from 2010 they can also be dedicated to other projects.

Other mechanisms of support for the development of RES in Poland include:

– loans and grants dedicated to renewable energy sources projects,
– obligation to purchase all electricity produced from renewable energy sources,
– subsidizing costs of the connection to the grid,
– exemption from concession fees,
– exemption from the excise tax.

This system appeared to be effective in stimulating investment in the most developed and economically attractive technologies connected with renewable energy, allowing Poland to increase share of renewable energy sources in energy balance in the most cost-effective way (fig. 3). It should be underlined, that the balance for renewable energy sources in Poland is not balanced, and the RES supply is dominated by biomass (in 2013 80,0% of supply of renewable energy originated from this source) [GUS, 2014]. This situation is conditioned by the selection of instruments supporting the development of renewable energy sources. The key mechanism so far – system of green certificates – can be effective in the scope of stimulating development of sources with the highest level of technological advancement, that is biomass combustion and on-shore wind farms.

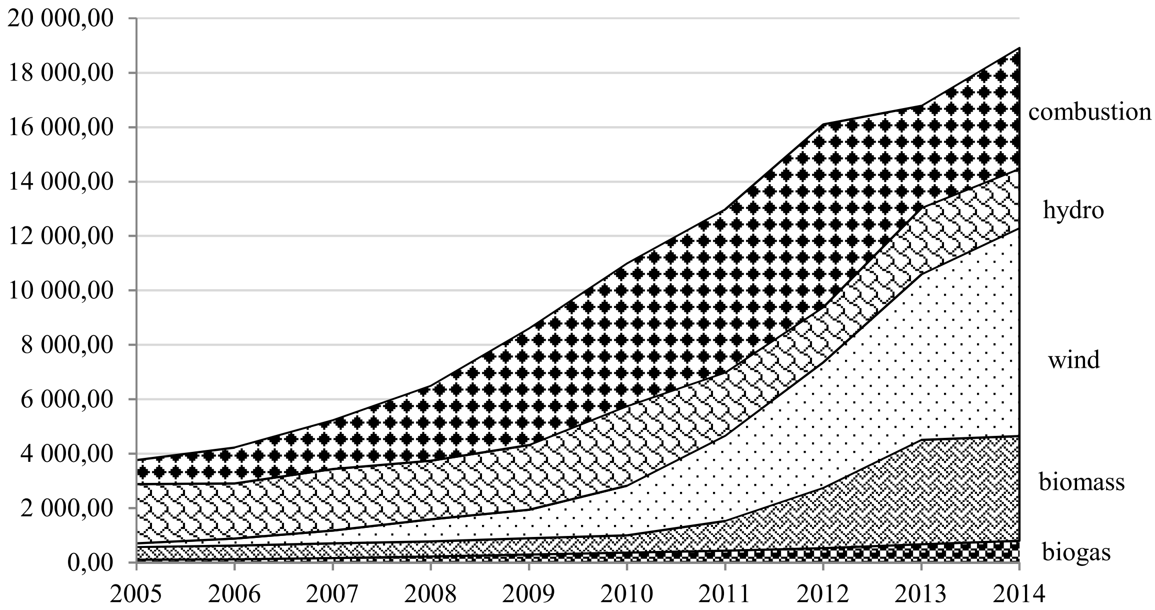

Fig. 3. RES capacity installed in energy sector in Poland, 2005-2014

Source: URE 2015, own calculations.

4. Effects of technology lock-in on the green certificate market in Poland

The aim of policy is to create competitive pressure on renewable energy producers and stimulate the improvement in energy efficiency. Poland chose and implemented a system of certificates of origin and tradable 'green certificates'. We should remember, that this market was not created spontaneously, but was organized by the public authority as a highly regulated market. Entities operating on the market for green certificates were forced to participate in it by the means of administrative force, although without the exclusion of economic bill (enterprises can pay a substitutive fee). It was assumed, that together with the increase of competitiveness in renewable technologies, all form of support for technologies with business applications would be withdrawn from the market. All the same, the market for certificates would become a fully competitive towards different technologies.

Applied mechanisms initially functioned acceptably, shaping conditions for the development of renewable energy sector in Poland and allowing changes in the energy mix. This situation changed suddenly in 2011, when the first serious crisis in the renewable energy sector took place. Prices for green certificates started to decrease rapidly and this situation lasted until the beginning of 2013. These changes created sudden drop in the profitability of investment projects and put on hold the realization of several projects (fig. 4).

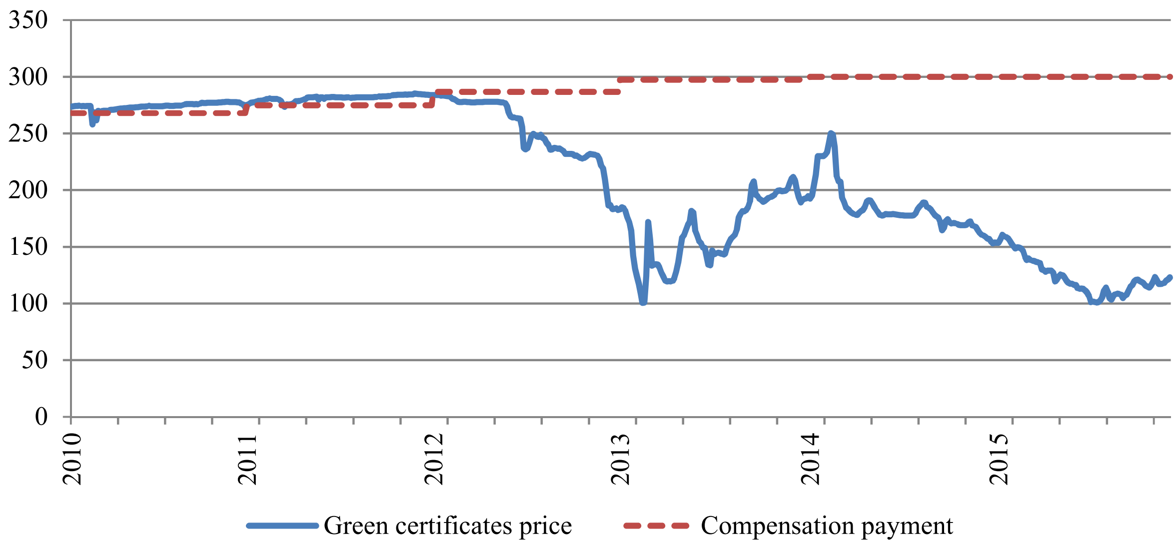

Fig. 4. Green certificate prices and compensation payment in Poland

Source: Polish Power Exchange, Energy Regulatory Office, own calculations.

The reason for the collapse of prices for green certificates was a specific structure in the RES use, what means the common use of coal and biomass in the co-firing processes. The main reason for the development of this technology (44% of energy produced in 2012) is the fact, that its use with previous producers was relatively cheaper than the construction of new installations using single renewable source (wind, solar energy). With co-firing, the required investments concerned modernization and adaptation of existing systems and infrastructure. What is more, both: new and modernized production units, were entitled to the certificates of origin. Considering the development of renewable sources, this situation makes it difficult to increase effectiveness in the use of renewable source potential and create actual technological break-through in energy sector. This can be recognized as the mechanism of lock-in related to the economies of scale as well as learning effects. The result of technology dominance using co-firing was hampering the development of classical, homogeneous technologies using RES due to their lower competitiveness.

The co-generation technology had also an influence on the functioning of green certificates result. In this market segment, big producers have an advantage over the smaller players. This concerns both experience advantage, as well as the method of organization. As a result, big electricity enterprises are the main market players, which can influence on the trade conditions with their decisions. The increased use of co-generation technology contributed to the creation of surplus in the amount of energy classified as 'green' and the collapse of certificates of origin in 2011.

The reason for the lack of effectiveness on the green certificates market is also related to the institutional lock-in resulted from the network externalities and informational increasing returns. The lack of diversity in green certificates depending on the technology applied in the production of energy in RES and supporting co-firing technology led to the increase of biomass import. Due to limited possibilities to obtain this raw material in natural way (e.g. from forestry), incentives for biomass producers from energy cultivations or wastes and left-overs from agricultural production were introduced. However, in reality, the demand of domestic market extorted the import of biomass. In the face of the green certificate market collapse, agreements with domestic producers of biomass were terminated. The effect of such activities were the protests of growers and the threat of bankruptcy of several agricultural farms. Subsidizing co-generation disrupted in this case the competition between conventional and dispersed energy, creating unjustified pressure on the increase of prices for energy end users, who bear the final cost of supporting RES.

Smaller producers are in a relatively worse situation, operating outside energy groups, unconnected with long-term contracts for the acceptance of energy as well as investors, who have not completed the process for starting energy installations yet. The most endangered groups are here small investors, whose activity is financed from own sources, supported by subsidies from environmental funds, requiring the guarantee of investment permanence.

5. Implications for policy makers

The problem of technology lock-in acquires a particular importance in the context of influence of technology choices on the natural environment. The case of Poland indicates implications for the policy of limiting CO_2 emissions through the development of renewable energy sources. Fundamentally, one can conclude, that deployment policies are effective instruments to stimulate investment. The system of green certificates is not, however, the mechanism that could effectively stimulate the development of more expensive technologies in the scope of renewable energy sources. What is more, the instability of prices for green certificates creates barriers for small entities, which finance investment projects according to commercial rules. The complex deployment of renewable energy sources requires greater support for less developed technologies and the elimination of main investment barriers.

Current technologies, using fossil fuels, have benefited from a long period of increasing returns. This development created the occurrence of a lock-in phenomenon, which involves different but interrelated rationales: (1) an institutional rationale that has legal and political dimensions and (2) a technical rationale that has technological and economic dimensions. However, this can also provide some clues about the policies to unlock the development of new, more sustainable technologies. An unlocking impetus can come from a change in legislation, such as when the EU and national legislation stress the importance of emission reduction and decarbonization of the economy. Also state policies that can act to promote the increasing returns in more sustainable technologies have the potential to stimulate the development and take up of those technologies much more rapidly than would otherwise be the case. The impetus can also come from changes in the political orientation of ruling parties or changes in the political majority that displace the order given to economic and ecologic preferences [Corvellec at al. 2013]. It can come from economic changes such as an increased demand for non-fossil fuels for electricity or heating systems. Renewals and transformations make it possible to introduce new technologies.

The main justification for intervention in the process of technology diffusion is the greater ability of the state to coordinate technological choices undertaken in the frame of market mechanism. Another element is the possibility to reach environmentally superior timing [Carillo-Hermosilla 2006]. Besides keeping policy-induced market growth at appropriate levels, policy makers can design deployment policies in a way that staggers incentives according to different technologies [Hoppmann 2013]. Providing greater support to promising, but less mature technologies can favour the building of portfolio for alternative sources of energy, which with time can outperform current technologies. Financial incentives can take here the form of capital subsidies, tax credits or hypothecated revenues [Foxon 2002]. These instruments reflect different stages of technological development. Capital subsidies are more appropriate for technologies that are still at the demonstration stage. Tax credits may be more appropriate to help overcome the barriers that prevent the take up of cost effective technology improvements (e.g. split incentives, limited access to capital) for decision-makers acting under bounded rationality, as they provide both a direct financial incentive and a signal to look for other cost savings. Hypothecation involves the revenues from standard environmental policy instruments - tradable permits and regulation - to support environmental innovation.

However, according to the "paradox of entrenchment", the conditions for the lock-in of a desired new technology must be created in order to overcome the lock-in of an incumbent one [Walker 2000]. This suggests the challenge for policy makers, as it is necessary to change the structuring context in which the current energy system exists and create conditions to facilitate the realization of the new system [Lee and Gloaguen 2015].

Lock-ins are matters of co-evolutions [Geels 2005] and in order to overcome lock-in, the policy makers should reorient an array of interrelated factors [Mattauch 2015; Könnölä et al. 2007; del Río and Unruh 2006]. Understanding the reasons for the formation of lock-out effect is the key to undertake efforts aimed at streamlining the development. The policies, laws, plans, and programs need to acknowledge the local practices and the local lock-ins that hamper sustainability.

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Мазуркєвич І. Ефективність зелених сертифікатів – дані щодо Польщі

У статті розглядається роль технологічного та інституційного «блокування вуглецю» в якості бар'єру для впровадження інновацій в енергетичному секторі, які сприяють сталому розвитку, з подальшим визначенням і пропозицією адекватних політичних заходів. Проаналізовано взаємодію чинника «блокування вуглецю» та чинників інноваційного сталого розвитку в контексті соціально-технічних і технологічних трансформацій. Дано рекомендації, що передбачають внесення змін і доповнень до нормативно-регуляторної бази (на прикладі Польщі), відповідно до сучасних вимог ринкової системи, що забезпечують ефективне функціонування останньої, за умови прагнення досягнення поставлених стратегічних цілей сталого економічного розвитку.

Ключові слова: поновлювані джерела енергії, взаємозалежність факторів у розвитку, блокування вуглецю, енергетичний сектор, сталий економічний розвиток, зелені сертифікати, ефективність.

Мазуркевич И. Эффективность зеленых сертификатов – данные относительно Польши

В статье рассматривается роль технологической и институциональной «блокировки углерода» в качестве барьера для внедрения инноваций в энергетическом секторе, способствующих устойчивому развитию, с последующим определением и предложением адекватных политических мер. Проанализировано взаимодействие фактора «блокировки углерода» и факторов инновационного устойчивого развития в контексте социально-технических и технологических трансформаций. Даны рекомендации, предусматривающие внесение изменений и дополнений в нормативно-регуляторную базу (на примере Польши), в соответствии с современными требованиями рыночной системы, обеспечивающими эффективное функционирования последней, при условии стремления достижения поставленных стратегических целей устойчивого экономического развития.

Ключевые слова: возобновляемые источники энергии, взаимозависимость факторов в развитии, блокировка углерода, энергетический сектор, устойчивое экономическое развитие, зеленые сертификаты.

Mazurkiewicz J. The effectiveness of green certificates – evidence from Poland

The paper examines the role of technological and institutional lock-in as a barrier to more sustainable innovation in the energy sector, and the implications of this to for determining appropriate policy responses. The paper, with theoretical input from path-dependency, technology and carbon lock-in as well as innovation effect of deployment policies, presents a qualitative study of the factors that influenced the evolution of tradeable green certificates in Poland.

The path dependency has been reinforced by the lock-in mechanisms: economies of scale, economies of scope, network externalities and informational increasing returns. Hence, the characteristics of current regime set the conditions for the development of new transition pathways. The incumbent socio-technical regime is not just fossil-based, but may also include mature niches specialised in the exploitation of renewable sources. This implies a need to distinguish between lock-in mechanisms favouring the old fossil-based regime, well-established (mature) renewable energy niches, or new pathways. It also provides the justification for intervention in the process of technology diffusion: the greater ability of the state to coordinate technological choices undertaken in the frame of market mechanism.

Keywords: renewable energy sources, path dependency, carbon lock-in.

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