

Energy Economics and Policy of Renewable Energy Sources in the European Union

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ABSTRACT: European Union adapted the policy of reducing its carbon footprint and embarked on the journey to shift to renewable energy sources in the early 1990s. The whole process started with implementations of binding rules that set up indicative targets for the EU Member States. However, this process had to go hand in hand with high energy costs charged to the consumers. This paper defines various types of renewable sources in the EU and analyses European legislation on renewable energy sources. In addition, it deals with the current situation regarding the energy policies in the European Union and outlines its main criticisms and prospects. The results and conclusions might be of some value for EU main energy providers as well as for the EU partners in the world.

Keywords: Energy economics; renewable energy; energy providers; economic forecasting; EU

JEL Classifications: F40; F50; Q20; Q47

1. Introduction

In the recent human history has many times shown that a sole dependence on fossil fuels can be risky and can bring unpredictable results (see e.g. Anisimova, 2013; Mariasiu, 2012; Dua et al., 2012). The two oil shocks that took place in the 1970s are a suitable example. The negative supply shock followed by the growth of crude oil prices led to the shortages and showed problems of the dependence on imports of fossil fuels. The electricity generation was historically based on the combustion of biomass (in this context mainly wood), coal and natural gas (or biogas); from the beginning of nineteenth century complemented by hydroelectric power and from the 1950s in developed world by nuclear power (see e.g. Dua et al., 2012; or Boluk, 2013). The states were often highly reliant on imports. Both world wars and subsequent crises exposed the problems and possible solution could have been a nuclear power. However, limited applicability as other source than base load, also problematic mining and sources in some states showed characteristic constraints. The disaster in Chernobyl in 1986 (and the recent catastrophe in Fukushima Daiichi plant) shook the nuclear energy to its foundations. It was also important argument for anti-nuclear movement traditionally very strong in Austria or Germany. All of the above mentioned conditions helped to create a framework utilizing development of alternative energy sources.

The renewable energy sources (RES) have been attracting more and more attention in the developed states since the Second World War. The RES are able to endorse independence, security, employment and inherently improve environment (see e.g. Romano and Scandurra, 2011). However, it is often forgotten, that they also generate additional costs that have to be taken into account. It is generally assumed that the costs are in medium term internalized thanks to the economies of scale and development of technology. Nevertheless, this assumption seems at least to be vague. The costs have to be born mainly by consumers and a problem, how to promote the RES in an effective way, still

prevails. The policy measures should be adjusted permanently because the sector is steadily developing.

This paper is structured as follows. At first, the term RES is defined. The second part sums up the legislation of the European Union (EU) that enabled the massive deployment of renewable energy sources. The third part briefly outlines the categories of the RES. Furthermore, it also focuses on the current situation in the EU. The fifth part of the paper describes the criticism and focus on the prospects. Finally, the main conclusions are provided.

2. Renewable Energy Sources (RES)

A general definition says that the renewable energy sources are non-depletable and non-fossil fuels. The availability of renewable sources is limited by the geographical location. For example, the use of photovoltaic and solar thermal power is more economical in the states of southern Europe, or Turkey, while the wind power is more competitive along the shores and on the mountain ranges (see e.g. Boluk, 2013). Nevertheless, we can divide the RES into main types:

- Biomass and biogas,
- Geothermal energy,
- Hydropower,
- Photovoltaics,
- Solar thermal power,
- Wind power,
- Other renewables (bioliquids, municipal and other organic waste, hot dry rock technology, tidal energy etc.).

Mostly exploited (mainly for the electricity generation and heating) was historically the biomass used for combustion. It was gradually complemented by the hydropower plants at the turn of the 19th century. A main development of the other categories dated from the second half of the 20th century. The biomass is generally an organic mass that is biodegradable and usable for combustion, gasification, cogeneration or production of bioliquids. The problem of utilization of biomass is that it is not fully ecological. The process always produces either oxides of carbon or sulfur or other gases and solid wastes. Another problem is that it poses a threat to food security because a significant share of biomass comes from the fields formerly used for crops cultivation.

The important subgroup of biomass is category of biofuels. The predominating are biodiesel and bioethanol that are traded and subject to EU-regulation.¹ This factor was crucial for the Commission's decision from the November 2012, which limited the share of food crop based biofuels (European Commission, 2012).

The geothermal energy has been traditionally used in the volcanic areas where it was gradually used for electricity production. It can be also utilized in almost all European countries as the HDR (hot dry rock) technology, however, it is very expensive and it takes an ecological risk when running the technology.

The hydropower is considered to be a cleanest source because it does not produce any emission. However, it is problematic in terms of the necessity to adjust the riverbed and it can have negative impact on the ecosystem of the river. The advantage is that large hydropower plants reach competitiveness. As a source, it is mostly abundant in the mountainous regions (e.g. the Alps in Austria).

Another resource is the use of solar energy. Solar energy is abundant in almost unlimited amount for majority of people all over the world. In the countries of southern Europe, it has been conventionally used for heating and water heating. However, recently the solar power was linked to the photovoltaic sources that were loudly discussed in the European Union. The photovoltaic sources were highly promoted after the Directive 2001/77/EC was issued. They underwent excessive growth predominantly in Spain, Germany and the Czech Republic and brought massive costs that will have to be paid for a long period. Even though the policies were limited in the years 2008-2012, the costs for built plants will last for a long time (the guaranteed feed-in tariffs and green bonuses range between 15 and 20 years).

¹ For the standards, see White Paper on Internationally Compatible Biofuel Standards (European Commission, 2007).

The source, which is often compared to photovoltaics, is the wind energy. The wind energy has some shortcomings in common with photovoltaics. The problem is that it is hardly predictable. It is determined by the current state of the atmosphere and cannot be used as a base load. The problem recently became obvious from the problems of the Czech grid that is threatened in the windy days by inflows of energy from Germany. These costs should be encompassed to the generation costs.

The municipal and other organic waste is also generally considered as a renewable source. It can be effectively used for combustion, gasification or fermentation when the ecological rules are obeyed. One of the other sources is the tidal energy. It is from its nature limited to the coastal states.

3. Renewable Energy-Related Legislation: European Context

The Treaty of Rome brought some principal definitions for the European Economic Community implicitly including the sustainability. However, a general framework for supporting mechanisms was not created. Some states acquired their own support mechanisms mainly in the period after the oil shocks in the 1970s, but a unifying system was created as late as in the second half of the 1990s. The pioneering states were represented by Germany (before unification with its western part - Federal Republic of Germany) and Denmark. These states created their own support mechanisms and they facilitated for example unique development of wind power farms. A conference, that influenced the European strategy for RES, was the United Nations Conference on Environment and Development held in Brazilian Rio de Janeiro in 1992. This conference brought essentials for the targets set by the widely-known Kyoto protocol. Industrialized and developed countries agreed to cap and reduce their emissions. The European Union played a leading role during the negotiations and tried to compel other developed countries to follow it. Nevertheless, nowadays the efforts to persuade United States of America or China seem to be vain.

The process of implementation of legislation for the RES followed general proceedings typical for the European Union. The first document, that awakened an interest in the RES, was the Commission Green Paper on RES (European Commission, 1996). The paper set four distinct targets: to double the contribution of the RES on the gross inland energy consumption by 2012 to 12 %; to promote and enhance competition among the member states; the third one was to facilitate the development of the RES and help to remove the barriers to a bigger use of the RES; the fourth aim was to create the strategies for the assessment and monitoring of the set targets.

After negotiations, the Commission White Paper on RES (European Commission, 2007) continued and extended the Green Paper. It took the initial target of 12% of gross inland energy consumption from the RES and 22.1%² of electricity from RES in the total electricity consumption for the EU-15 by 2010. It evaluated the share of renewables as strongly insufficient. It assessed the RES as essential for internal security, diversification, and environment. The positive impact of the RES on social and economic cohesion and regional development was also underlined. The White Paper preceded the directive for the RES and worked as template.

Directive 2001/77/EC of the EP and the Council on the promotion of electricity produced from RES in the internal electricity market was adopted on September 27, 2001 (European Commission, 2001). It set the different binding targets for member states (borrowed from the White Paper) and defined national indicative targets for member states according to their initial position and a structure of economy. The Directive further defined the term RES. It appealed to promote legislative frameworks for the markets with renewables and specified systems of tradable green certificates and certificates of origin. It also underlined the need for the support mechanisms ensuring the growing share and competitiveness of the electricity from the RES. The growing share should have been reached without affecting the stability of the grid and in effective way. The RES were assumed to reach competitiveness and in medium term reduce the need for public support (through economies of scale and thanks to the technological innovations).

The subsequent directive that changed the legislation was the Directive 2003/30/EC of the European Parliament and of the Council on the promotion of the use of biofuels or other renewable fuels for transport (publicly known as “biofuels directive”) (European Commission, 2003). It defined the minimal share of biofuels and other renewable fuels for member states and set reference values.

² This target was adjusted after the EU-25 enlargement to 21%. After the EU-27 enlargement it remained in absolute numbers the same.

They should have accounted for 2% of petrol and diesel for transport purposes by December 31, 2005. By the December, 2010 the share should have increased to 5.75%.

The fragmented legislation regulating the RES was unified by the Directive 2009/28/EC of the European Parliament and of the Council on the promotion of the energy from renewable sources (European Commission, 2009). The directive amended Directive 2001/77/EC and Directive 2003/30/EC and extended reference targets by 2020. It set the overall '20-20-20' target³ for the Community by 2020. It set the target of 10% of final energy consumption in the transport sector by 2020. The Directive changed the system of objectives regarding the use of biofuels in transportation towards the binding targets. The 10% share by 2020 of the biofuels became obligatory for each member state. The reduction of consumption of oil products in transportation should considerably reduce greenhouse gases. The directive accented biofuels and bioliquids and stressed cooperation among the member states. The significant difference from the past directives was that the Directive 2009/28/EC enabled possible cooperation with third countries. However, under the current poorly performing system of tradable certificates it does not seem so important.

The important change occurred on October 7, 2012 when the Commission amended the Directive 2009/28/EC and limited of the food crop based biofuels (European Commission, 2012b). The reason was that the emissions from the biofuels from indirect land-use vary between feedstocks and the greenhouse gas savings do not ensure to outperform fossil fuels. The Proposal underlined the protection of the current investments but it asked for the decrease of the share of conventional biofuels and bioliquids from food crops. It stressed the need for improvement of reporting, increasing the minimum greenhouse gas savings threshold and for enhancing incentive schemes. The Proposal will undoubtedly compound the development towards the 20% target of the RES in gross final energy consumption by 2020.

4. Renewable Energy in the EU

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The share of renewable energy was doubled between 1990 and 2010 even after the EU-enlargements. But the further targets will be even harder to meet. With the onset of the global financial crisis the propensity to further comply with costly emissions targets and ecological rules decreased. The fundamental question, whether the EU-members are able to bear the cost of the green high-tech technologies without losing their competitiveness, still remains.

Nevertheless, the negotiating position of the EU improved after the last round of United Nations climate talks in Doha in December 2012. The EU, Norway and Australia signed the amended version of Kyoto protocol. However, the United States and China still stays apart (Harvey, 2012).

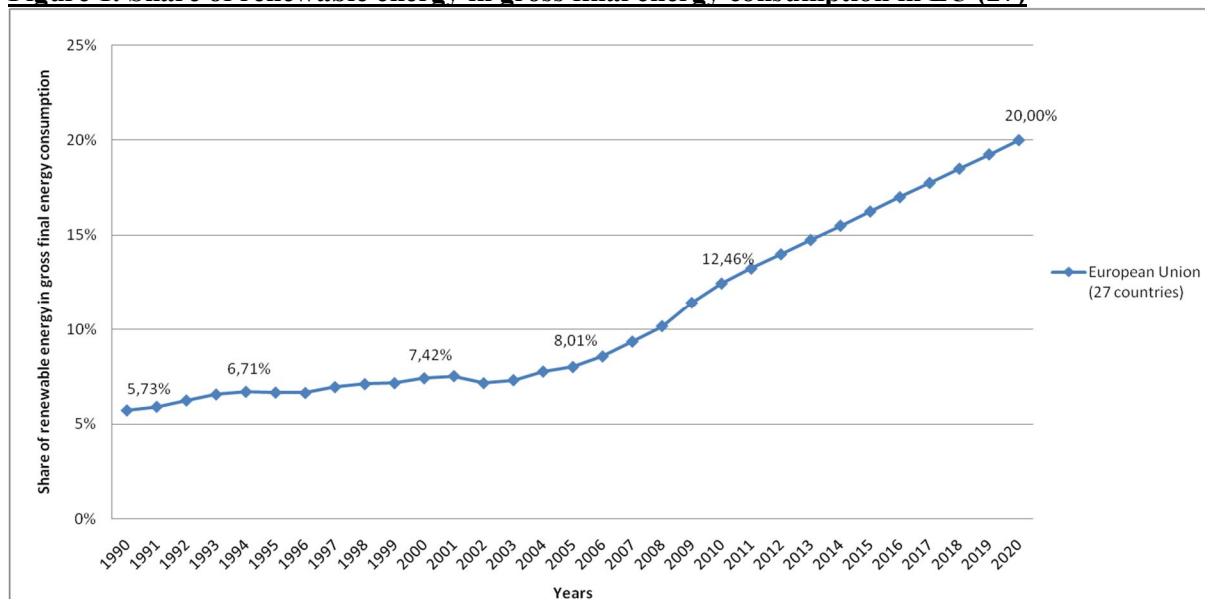
The target given by the White Paper and subsequently codified by the Directive 2001/77/EC was to double the 1990 share of renewable energy in gross final energy consumption in the EU (27) by 2010. It was met as is illustrated in the Figure 1; however the current financial crisis will probably make the future development more difficult.

The share of biofuels in fuel consumption of transport did not meet the 5.75% target by 2010. However, as I mentioned before, the future growth will be undoubtedly compound by the limit of the share of food crop based biofuels. The development of advanced biofuels that do not require more land cannot be considered as comparable in terms of increasing savings. The one of the main aims is to reduce greenhouse emissions without threatening the food supply. The share of biofuels was 4.7% (Eurostat, 2013) in 2010 and under current circumstances it is not likely to reach the 10% target by

³ The '20-20-20' represents three objectives for EU by 2020: a 20% reduction of greenhouse gas emissions from the 1990 levels; 20% share of energy consumption from RES and 20% rise of energy efficiency (European Commission, 2003).

2020. The transportation sector is responsible for more than 30% of the EU energy consumption and it is dependent on fossil fuels by 98% (Cansino et al., 2012).

Figure 1. Share of renewable energy in gross final energy consumption in EU (27)



Source: own results based on (European Commission, 2012a)

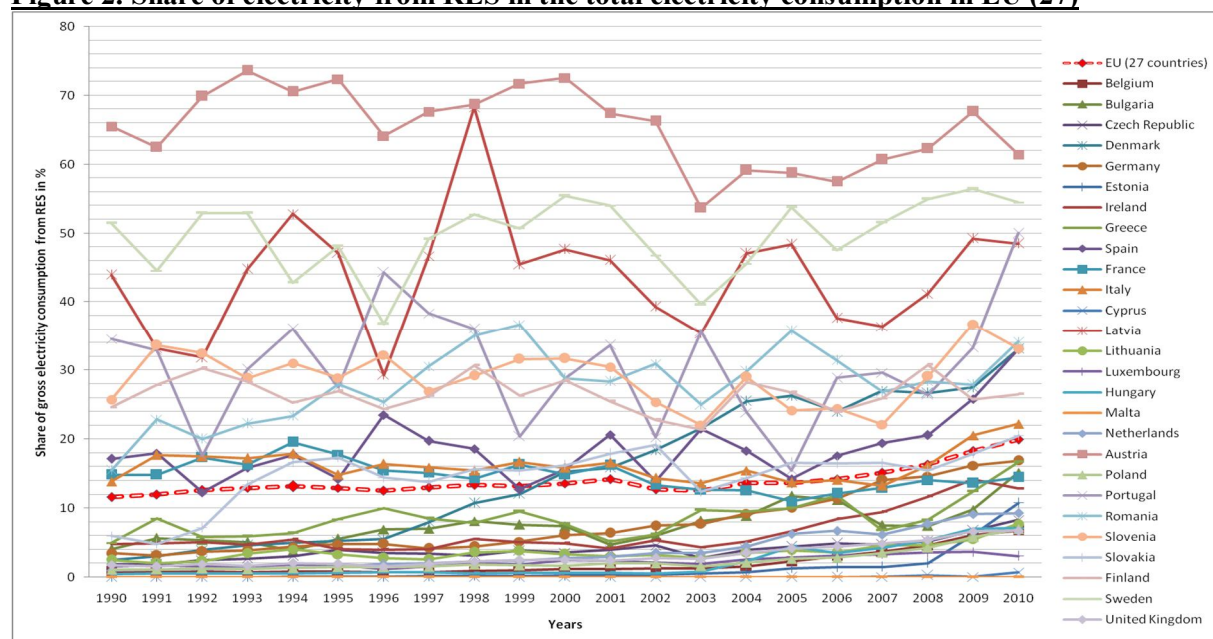
The great contribution was made thanks to an increase of electricity generation from the RES. There are significant differences across the member states that are determined by the path-dependency, structure of the economies and also geographical location (see the graph 2). The overall target from the Directive 2001/77/EC was almost met (20% instead of 21%); however, many states did not significantly fulfill their commitments. An explanatory example can be France that reached instead of 20% only 21%, Great Britain 6.7% instead of 10% or Greece 17% instead of 20%. Austria which missed the objective by 17% (61% instead of 78%) appears as a hypocrite because it has been systematically fighting against nuclear power while defaulting on its own commitments.

Nonetheless, some states went far beyond their targets. For example Germany that exceeded the target (12%) by 5%, Portugal with 50% instead of 39% or Denmark with 33% instead of 29%. All of the EU members have shown significant improvements in the promotion of the RES. A remaining question, however, is whether the consumers and producers are able to bear all of the costs. The fundamental idea of the Directive 2001/77/EC and all of the succeeding directives was to combat the global warming, greenhouse gases and pollution on a sustainable path. The aim was also to support independence and energy security. With the lapse of time, the decrease of emissions or strengthening the heterogeneity of energy sources could be appreciated. But many problems and unanswered questions arose.

5. Criticism and Prospects: Renewable Energy in the EU

The Commission White Paper on RES supposed and anticipated the creation of the new green jobs in line with the promotion of the RES. A positive impact on employment was challenged by many authors. Alvarez et al (2009) concluded that the promotion of green jobs has adverse effects on labor market. They computed that creation of each green job leads to a destruction of more than two other jobs. The numerical results of this study can be disputed but the authors showed shortcomings of the short-term supporting programs. The suitable illustration can be the Spanish photovoltaic market where after restriction of government support more than 20 000 jobs were destroyed (IEA PVPS Programme, 2009). To guarantee the creation of the new jobs, it is crucial to prevent the offsetting of the production outside the EU.

Figure 2. Share of electricity from RES in the total electricity consumption in EU (27)



Source: own results based on (Eurostat, 2013)

The German researchers (Lehr, U. et al., 2012) performed a comprehensive cost analysis of the transition to the RES energy mix. They concluded that in Germany in the period 2008-2011 the benefits outweighed the costs. However, they put an emphasis on the hardly measurable benefits of innovations. Some of their results could be also challenged because the growth of electricity prices has multiplicative effects. The similar analysis was done by Böhringer et al (2013) who assessed the employment and welfare impacts of promotion of renewable energy. The authors challenged the costs that are often proclaimed as strictly lower than benefits. The paper showed that the effects on employment are highly dependent on the type and size of the subsidies. The subsidies financed by labor taxes create negative effects; positive effects can be reached via feed-in tariffs and electricity taxes. The excessive feed-in tariffs, however, result in high welfare and unemployment losses. This situation is obvious from the Czech experience. The feed-in tariffs that were not limited during 2012 together with excessive growth of photovoltaic installations caused in the Czech Republic costs that will last for at least 15 years.

Many authors (see e.g. Frondel et al. (2010), Ghobadi (2012)) investigated the effects of the promotion of renewable sources. They mentioned positive effects on energy independence but they stressed the negative effects that weaken it - the problem that is so apparent nowadays in Germany. A German chancellor, Angela Merkel, committed in 2011 to withdraw all nuclear plants in the country by 2022 (The BBC, 2011; Wiesmann, 2011). But the conventional sources have to be replaced by suitable base-load plants. There are, in general, only two possibilities how to replace them – either with coal or gas power plants. But the reserves of coal and hard coal are limited in the EU and the gas resources are low. The indigenous gas resources cover only 35% of the EU-27 consumption (Eurogas, 2012). The RES should increase the independence but the case of Germany shows that the rapid growth could further fortify the dependence on imports mainly from Russia. Moreover, the RES create additional demand for balancing sources that could be constituted mainly by gas plants or pumping plants that have unquestionable negative effects on environment. The energy independence was undoubtedly reinforced by biofuels. The EU is almost solely dependent on imports of crude oil and the increasing share of biofuels in transportation is meritorious. The remaining question is whether the trade-off is not too large.

The EU pinned its hopes on the RES to reinforce the security. Wider energy mix is desirable but a majority of the RES has a principal thing in common. They are hardly regulable and predictable. The hydropower, photovoltaics, solar thermal power and wind power cannot be used as a base load. And from its definition also biomass and biofuels are highly dependent on a weather that influenced the crops. A volatile production than poses a threat to the grid and can lead in an extreme case to a black-out.

Problematic is still active prevalence of support mechanisms. The EU in the directives favors the system of tradable green certificates and the Emissions Trading System (ETS) as a suitable tool to reduce emissions. Regardless of the problems of the EU ETS during the crisis, the system is working. The system of tradable green certificates in the electricity sector is more complicated and has proven as less effective. For example Great Britain, that has been running it for more than 10 years, did not meet the targets and Germany, as a pioneer of the system of feed-in tariffs and green bonuses went far beyond the objectives (see the values in the Figure 2). The prevalent ambiguity in support mechanisms on the electricity field should be solved according to the EU ETS system or based on the system of feed-in tariffs and green certificates.

The funds invested in the development should have been paid back thanks to the decrease of the costs. The negative externalities of the conventional resources were expected to be internalized with a gradual slump of their usage. These visions of the Commission's White Paper on RES were; however, many times challenged. It is indisputable that the promotion of the RES generates additional costs that have to be somehow incorporated. But who bears a burden of the costs? Traber and Kemfert (2007) showed that the costs included in the price of electricity are held both by producers and consumers, but under the current structure of the electricity markets it is at least questionable. The costs of the biofuels have to be paid mainly by consumers as well as the electricity costs. In the October 2012, the German government realized the significant value of the contribution for the RES and exempted producers from paying it (Reuters, 2012; Spiegel, 2012). The risk of losing competitiveness is during the period of economic problems very present. The German voters have to decide in this case, how much they want to pay for the closure of nuclear facilities.

6. Conclusions

In our paper we defined the term "renewable energy sources" and complemented on the possibilities and shortcomings of renewable energy policy with a special focus on EU and its partners. It becomes apparent that the key European Commission's document, the Directive 2001/77/EC, introduced the compulsory targets for the member states by 2010 and defined the support mechanisms. In 2003, the promotion of the biofuels was regulated with the Directive 2003/30/EC that defined the binding objectives for biofuels by 2010. The Directive 2009/28/EC than interconnected both preceding directives and set the binding targets for 2020.

The European Union was from the beginning of the 1990s pioneering in the efforts to promote renewable energy sources and to combat global warming. It institutionalized the development and set the binding targets by 2010 and more recently by 2020. The support mechanisms and promotion of the RES, nonetheless, form costs that have to be paid. Many authors have cast doubts upon the positive effects resulting from the promotion of the RES. The EU is gradually persuading more countries of the need to combat the climate change and global warming and to reduce detrimental emissions. The crucial thing in the future will be whether the public will remain in favor of the further development and whether the targets will be met. It will be shown in the following years.

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