The promotion of renewable energy sources: European experiences and steps forward

Promovarea surselor regenerabile de energie: experienţe europene şi paşi înainte

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Abstract

This study investigates the instruments used by governments in order to support renewable energy sources in the European Union. The findings of this study reveal that policy goals could be achieved by using a large variety of instruments and renewable energies could be better promoted if policy instruments are harmonized. The study was carried out by combining a wide variety of sources, such as strategies, reports, regulations, and European experiences in promoting renewable energy sources. The methodology and the results reported in this research may be used for designing new, harmonized policy instruments to support renewable energy sources in the European Union.

Keywords: *renewable energy sources, environmental protection, policy instruments, supporting schemes, harmonization*

Rezumat

Acest studiu investighează instrumente utilizate de guverne pentru a sprijini sursele regenerabile de energie în Uniunea Europeană. Concluziile acestui studiu arată că obiectivele politice ar putea fi realizate printr-o mare varietate de instrumente şi energiile regenerabile ar putea fi mai bine promovate, dacă instrumentele politice sunt armonizate. Studiul a fost efectuat prin combinarea unei mari varietăţi de surse, cum ar fi strategii, rapoarte, reglementări şi experienţe europene în promovarea surselor regenerabile de energie. Metodologia şi rezultatele înregistrate în această cercetare pot fi utilizate pentru proiectarea de noi instrumente politice de sprijinire a surselor regenerabile de energie în Uniunea Europeană.

Cuvinte-cheie: *surse regenerabile de energie, protecţia mediului, instrumente politice, scheme de sprijinire, armonizare*

JEL Classification: Q42, Q48, Q56, Q58

Introduction

This study investigates how the governments could better promote the use of renewable energy sources. The manner in which renewable energies are supported is a highly debated issue these days because of renewable energies' role within the energy scenario. Policy goals could be achieved by using a large variety of instruments. Moreover, renewable energies could be better promoted if policy instruments are harmonized.

The research was conducted using a wide variety of sources, such as strategies, regulations, road map, as well as articles, reports, and European experiences in supporting renewable energy sources. In order to answer the research question it was needed to outline the background of the European context regarding renewable energy and policy instruments for its promotion. Furthermore, the progress on renewable energy generation in the European Union, policy instruments used for renewable energy promotion and policy instruments harmonization are investigated in this paper. The research question was answered by analyzing published sources, evaluating and interpreting evidence. Answering the research question was difficult because some policy instruments used in several countries in order to support renewable energy generation are still too young to be evaluated.

Background of the European context

Electricity is today at the heart of the Europe's well-being, playing a very important role in day-to-day life. It is a force for the economic activity and has much influence on the quality of living environment (Wang et al., 2006). Hence, competitiveness blended with a more flexible and efficient electricity industry is one of the trends that reflect the rapid transformation of the electricity field (Ucenic, 2006). This change could be faced by combining action at the European Union's level as well as at the Member States' level, to put in place an integrated energy policy (Krope & Krope, 2007). The national regulators should foster environmentally sustainable energy markets. They shall promote further research and innovation to meet demand and the development of renewable and low carbon technologies, in both the short and the long term (Commission of the European Communities, 2007a, 2007b).

There are at least four reasons for valuing renewable energies:

- First, society relies mainly on fossil fuels, which are limited and non-renewable;
- Second, fossil fuels will be exhausted in a foreseeable future;
- Third, the use of fossil fuels has generated environmental effects that negatively affect social well-being beyond acceptable limits;

- Fourth, renewable energy sources could satisfy the needs of modern society in terms of consumption and environmental impact.

Renewable energies promise some strategic improvements in the security of supply, reduce the long-term price volatility to which the European Union is subjected as a price-taker for fossil fuels and could offer an enhanced competitive edge for the European Union energy technology industry. In addition, renewable energies reduce air pollution and greenhouse gas emissions. They also facilitate improvement in the economic and social prospects of rural and isolated regions in industrialized countries and help meet basic energy needs in developing countries (Commission of the European Communities, 2006). Sustainable development is possible only when it is based on the real type of economic progress in harmony with the limitations in nature, especially the amount of natural sources and the regeneration and neutralization capabilities of the biosphere combined with human-made emissions (Pozeb & Krope, 2007). Therefore, the main research and development priorities are the development of renewable electricity, cost reduction and research on environment issues, as well as the need to adapt the electricity networks to new technological, economic, environmental and political realities (Kjaer, 2006).

The development and implementation of green electricity policies have evolved differently in European Union's member states. The current revenues expected for renewable electricity are largely dependent on the variety of national support systems. The revenues will be determined by market conditions, whereby competition between technologies determines the prices.

The European Union established an objective of delivering 20% of energy supplies from renewable sources by 2020. Currently, only 6.5% of the European Union's energy is generated from renewable sources. Achieving this ambitious target may lead to import dependence and greenhouse gas emissions diminution (Zervos, 2007), and in this context member states' support systems for renewable electricity production may be really important.

European Union is applying a range of policy instruments to encourage electricity from renewable energy sources and to bring nature closer to an environment friendly consumption (Gan et al., 2007; Pozeb & Krope, 2007). According to Gan et al. (2007), a general tendency in European Union is that policies shift emphasis from research and development stimulation towards dissemination and market application of renewable energy technologies.

The instruments used to promote renewable energy sources are usually grouped in more categories, the most widespread formula being direct and indirect instruments (figure 1). Direct instruments could be financial measures or regulations, while indirect measures are represented by actions taken in other sectors that could influence the use of renewable energies, such as: education, information, standards. Taxes, subventions, environmental product marking, and green certificates are only some examples of such environmental instruments.

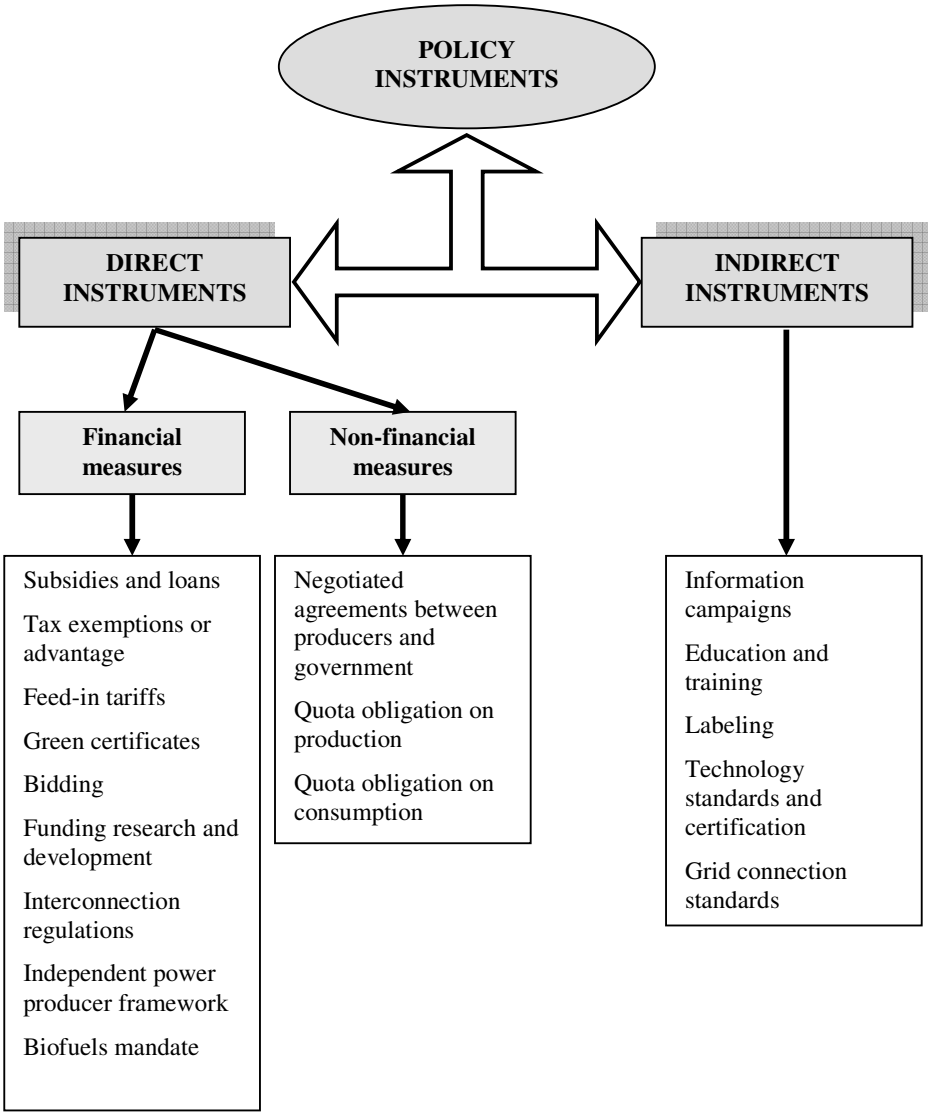

Figure 1 Policy instruments for renewable energy sources promotion

The decision on what kind of instruments should be used is a very important one, as the instrument to be used will influence the outcome and the public expenses. How the decision is taken depends on the criteria used for the evaluation of the policy instruments. Generally, several criteria are used, and the final decision depends on how much weight is given to each criterion.

Progress on renewable energy generation in the European Union

Renewable energy sources are currently unevenly and insufficiently exploited in the European Union. Although many of them are abundantly available, and have real economic potential, renewable energy sources make a disappointingly small contribution to the European Union's overall gross electricity generation (Table 1 and Figure 2).

In European vision, for framing a source of energy in the category of renewable resources, the natural products and processes should meet two basic conditions: they must have energetic potential and they can be converted in energy by using technologies that are accessible today. Accordingly, there are defined (Directive 2001/77/EC) as being renewable the following category of energy sources:

- Solar energy;
- Wind energy;
- Geothermal energy;
- Wave energy;
- Tide energy;
- Hydro energy;
- Biomass;
- Warehouse gas (gas that outcomes from the offal's fermentation);
- Energy contained in gases that outcome from the fermentation process of the mud in the installations for purging worn-out waters;
- Biogas.

The elements that differentiate those sources from the conventional ones is their strong spread of the exploitable potential over quite extended areas and the immediate dependence of the season and weather conditions, excepting geothermal power.

Gross electricity generation from renewable sources in the European Union (GWh)

Table 1

Country	2000	2001	2002	2003	2004	2005	2006
Austria	43570	42049	41708	34906	39449	39251	39800
Belgium	1334	1424	1584	1674	1982	2630	3726
Bulgaria	2688	1737	2194	3029	3169	4342	4258

Country	2000	2001	2002	2003	2004	2005	2006
Cyprus	0	0	0	1	1	1	1
Czech Republic	2280	2572	2992	1884	2750	3140	3526
Denmark	6027	6445	7412	8731	10171	10621	10056
Estonia	19	19	37	46	60	97	128
Finland	23297	21687	20582	19386	25701	23564	22513
France	71527	79340	66015	64979	66026	58444	63518
Germany	38788	38555	46856	48600	58616	64662	74126
Greece	4144	2932	3577	5892	5917	6406	7862
Hungary	178	310	265	369	962	1929	1587
Ireland	1186	1027	1382	1122	1377	1873	2474
Italy	51213	55102	47977	46949	55010	49751	52092
Latvia	2823	2839	2484	2338	3196	3414	2786
Lithuania	339	328	358	332	428	460	436
Luxembourg	199	220	202	169	239	239	272
Malta	0	0	0	0	0	0	0
Netherlands	4230	4414	4037	5331	6671	8918	9512
Poland	2331	2782	2767	2249	3074	4166	4310
Portugal	13125	15996	9994	18089	12576	8555	16015
Romania	14778	14923	16049	13262	16517	20213	18361
Slovak Republic	4726	5081	5420	3594	4141	4701	4827
Slovenia	3904	3868	3415	3079	4215	3575	3701
Spain	36036	49975	34742	57435	51344	43927	51757
Sweden	83247	83424	71295	59226	68916	82045	71920
United Kingdom	10383	10008	11333	11207	14660	17480	18783
TOTAL EU-27	**422372**	**447057**	**404677**	**413879**	**457168**	**464404**	**488347**

Source*:* European Commission, Directorate-General Energy and Transport, 2008

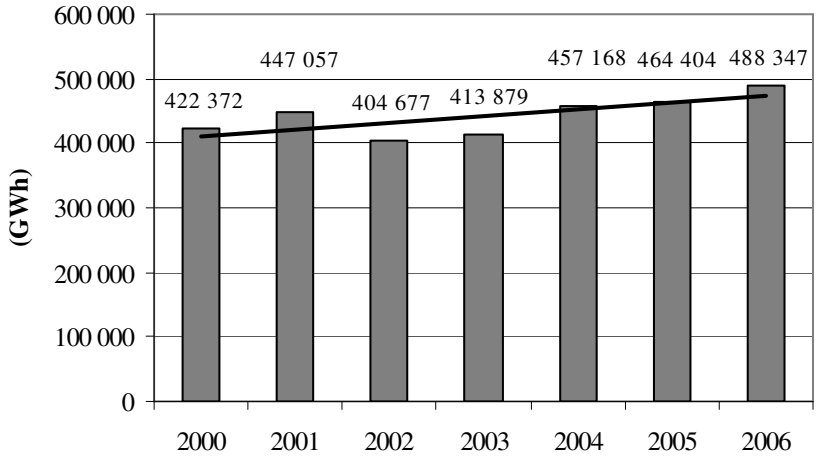

Figure 2 Evolution of total gross electricity generation from renewable sources in European Union

Total gross electricity generation from renewable energy sources had a positive evolution during 2000-2006 period of time, but the situation is not the same if we consider various types of renewable energy sources (table 2 and figure 3).

Gross electricity generation from different types of renewable energy sources (GWh)

Table 2

Energy source	2000	2001	2002	2003	2004	2005	2006
Hydro	354715	372812	315402	305980	323274	306970	308372
Wind	22250	26977	35710	44370	58815	70486	81960
Biomass	40504	42463	48526	57636	68833	80098	89908
Solar	118	193	281	462	725	1455	2495
Geothermal	4785	4612	4758	5431	5521	5395	5612
Total EU-27	**422372**	**447057**	**404677**	**413879**	**457168**	**464404**	**488347**

Source*:* European Commission, Directorate-General Energy and Transport, 2008

Gross hydro electricity generation has reduced in 2006 compared to 2000 in absolute values on one hand. On the other hand, the contribution of gross hydro electricity generation to the total gross electricity generation decreased from 83.98% to 63.15%. Gross electricity generation from renewable energy sources

except hydro has increased during the analysed period of time. Furthermore, the contribution to the total gross electricity generation from renewable energy sources has increased during 2000-2006 period of time from 5.27% to 16.78% in case of wind, from 9.59% to 18.41% in case of biomass, and from 0.03% to 1.15% in case of geothermal source of energy.

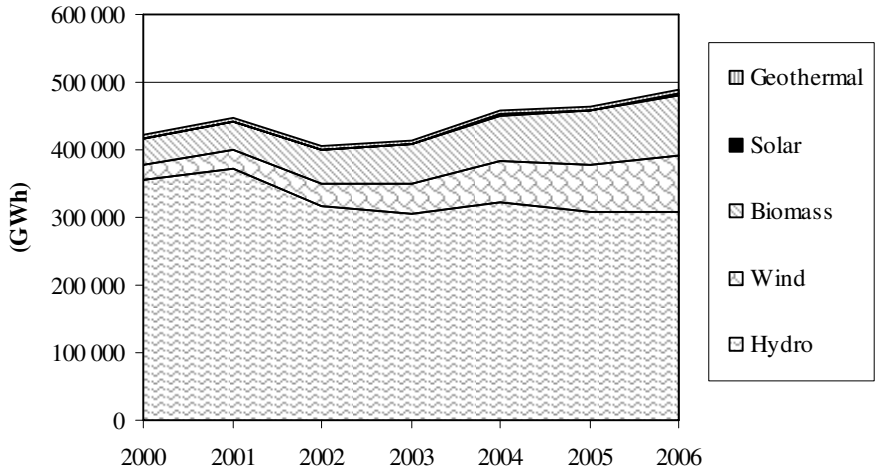

Figure 3 Evolution of gross electricity generation from different types of renewable energy sources

One reason for this evolution of gross electricity generation from different types of renewable energy sources could be cost reduction. Current trends show that considerable technological progress related to renewable energy technologies has been achieved over recent years. Costs are rapidly dropping and many renewable sources, under the right conditions, have reached or are approaching economic viability (figure 4). Some technologies, in particular biomass, small hydro and wind, are currently competitive and economically viable compared to other decentralised applications. Solar photovoltaic, although characterised by rapidly declining costs, remain more dependent on favourable conditions. Solar water heaters are currently competitive in many regions of the European Union.

Under prevailing economic conditions, a serious obstacle to greater use of certain renewable sources has been higher initial investment costs. Although comparative costs for many renewable sources are becoming less disadvantageous, in certain cases quite markedly, their use is still hampered in many situations by higher initial investment costs as compared with conventional fuel cycles (although operational fuel costs are non-existent for renewable sources with the exception of biomass). This is particularly the case due to the fact that energy prices for

conventional fuel cycles do not currently reflect the objective full cost, including the external cost to society of environmental damage caused by their use.

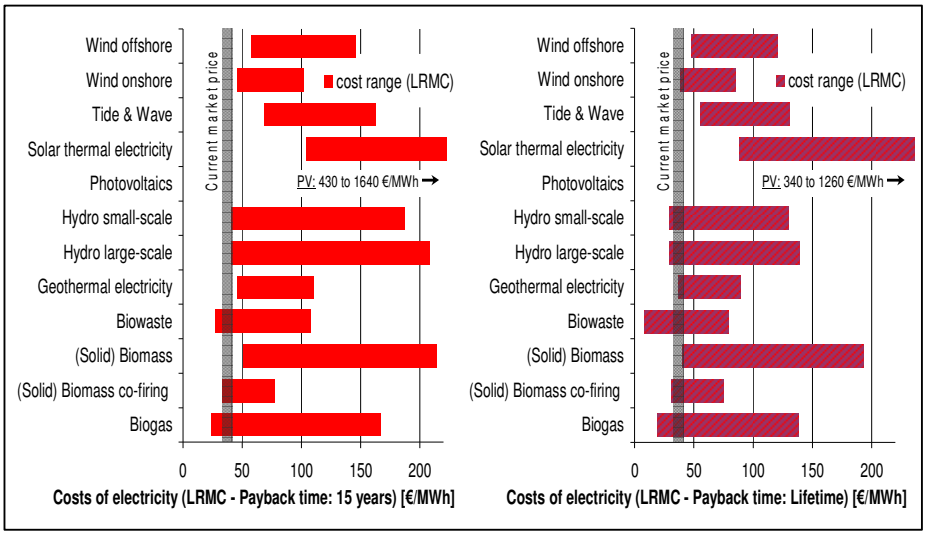

Figure 4 Long-run marginal generation costs for renewable energies
Source: Auer et al., 2007: 9

A further obstacle is that renewable energy technologies, as is the case for many other innovative technologies, suffer from initial lack of confidence on the part of investors, governments and users, caused by lack of familiarity with their technical and economic potential and a general resistance to change and new ideas.

Policy instruments to promote renewable energy sources in the European Union

Electricity generation from renewable energy sources is promoted within the European Union by using different groups of support systems: feed-in tariffs, quota often combined with tradable green certificates, tender, and tax incentives or investment grants (Ragwitz et al., 2004; Pfaffenberger et al., 2006; Ragwitz et al., 2006; Swedish Energy Agency, 2008; Valle Costa et al., 2008).

Policy instruments used to promote different renewable energy sources in the European Union

Table 3

Country	Wind onshore	Biogas	Biomass	Small hydro	Solar
Austria	■	■	■	■	■
Belgium	■ □ ○	■ □ ○	■ □ ○	■ □ ○	■ □ ○

Country	Wind onshore	Biogas	Biomass	Small hydro	Solar
Bulgaria	■	■	■	■	■
Cyprus	■	—	—	■	■
Czech Republic	■ ○	■ ○	■ ○	■ ○	—
Denmark	■	■	■	■	■
Estonia	■	■	■	■	■
Finland	○	○	■ ○	○	○
France	■ ●	■ ●	■ ●	■ ●	■ ●
Germany	■	■	■	■	■
Greece	■ ○	■ ○	■ ○	■ ○	■ ○
Hungary	■	■	■	■	■
Ireland	■	—	■	■	—
Italy	■ □ ○	■ □	■ □	■ □	■ □ ○
Latvia	■ □	■ □	■ □	■ □	—
Lithuania	■	■	■	■	■
Luxembourg	■ ○	■ ○	■ ○	■ ○	■ ○
Malta	○	—	—	—	■ ○
Netherlands	■ □ ○	■ □ ○	■ □ ○	■ □ ○	■ □ ○
Poland	□ ○	□ ○	□ ○	□ ○	□ ○
Portugal	■	■	■	■	■
Romania	□	□	□	□	□
Slovakia	■	■	■	■	■
Slovenia	■ ○	■ ○	■ ○	■ ○	■ ○
Spain	■	■	■	■	■
Sweden	□ ○	□ ○	□ ○	□ ○	□ ○
United Kingdom	□ ○	□ ○	□ ○	□ ○	□ ○

Legend:

■	Feed-in tariff
□	Quota/Tradable green certificates
●	Tender
○	Tax incentives/investment grants
—	No instrument

It is to mention that policy instruments used to support renewable energies do not make any difference among various types of renewable energy sources. In order to emphasise this idea I created table 3, based on various sources: Commission of the European Communities (2005), Ragwitz et al. (2006), Howley et al. (2008), Swedish Energy Agency (2008), Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) (2008) and Valle Costa et al. (2008).

Table 3 shows that there are countries in the European Union where only one instrument is used to support wind onshore, biomass, biogas, small hydro and

solar energy. For instance, Austria, Denmark, Estonia, Portugal, Spain, Hungary and Lithuania use feed-in tariff as the only instrument to support all five renewable energy sources. In addition, table 3 shows that for these renewable energy sources different instruments are used in different countries and all instruments could support each one of the renewable energy sources. However, some instruments are more suitable than others for different renewable energy sources. For example, feed-in tariffs are the only appropriate instruments in case of photovoltaic energy (EPIA, 2007). Each country could choose any instrument or mix of instruments to promote renewable energy sources, taking into consideration the local conditions of renewable energy sources, the costs and the target for market penetration.

The use of renewable energy sources is stimulated in most countries by more than one instrument. This statement is based on surveying the support schemes applied by the different European Union countries to stimulate renewable energy development. National support is essential in order to ensure the development of renewable energy sources. A wide range of policy instruments are mixed support schemes, which vary among member states. Generally, a mix of instruments is essential and a key to success.

The dominant instruments for promoting the generation of electricity by renewable energy sources have been feed-in tariffs and quota with green certificates. These two instruments were also found as having high effectiveness (Dijk et al., 2003).

Feed-in tariffs

Feed-in tariffs are used by a majority of European Union's member states for promoting electricity generation from renewable energy sources. For instance, in Germany, Spain and Denmark they have been successful in supporting the expansion of wind, biogas and solar power production (Ragwitz et al., 2004; Ragwitz et al., 2006; Swedish Energy Agency, 2008).

According to Ragwitz et al. (2006), this system allows independent electricity generators to sell green electricity at a fixed tariff for a determined period of time. The main advantages of feed-in tariffs system are the long-term certainty about receiving support, which may significantly reduce investment risks, and the possibility of early market diffusion of less mature technologies, which may reduce costs for society in the long term. However, the system of feed-in tariffs was frequently criticised for not stimulating competition among electricity generators to a sufficient degree to bring down the costs of renewable energy technology investments (Ragwitz et al., 2004).

Green certificates

Green certificates or electricity certificate systems or quota obligations are used in several countries within the European Union (such as Sweden, Romania, Belgium etc.) and are based on the principle of imposing minimum shares of

renewable electricity on consumers, suppliers or producers (Ragwitz et al., 2004; Ragwitz et al., 2006; Swedish Energy Agency, 2008).

Compared to feed-in tariffs, quota systems are strongly market-oriented policy systems (Ragwitz et al., 2006), based on the interaction between the supply and demand of certificates. The producers receive additional revenue from certificates, in addition to that from the sale of electricity.

A tradable green certificate is a market-oriented instrument, meant to achieve targets for renewable electricity generation in deregulated electricity markets (Ford et al., 2007). The basic idea of green certificates is to create a support system where the market decides the level of support given to electricity generated from renewable energy sources. In a green certificate system, producers of renewable electricity receive a certificate for each pre-defined unit of produced electricity (Nilsson and Sundqvist, 2007). Such a certificate represents the societal or environmental value of the electricity generated from renewable sources in general terms.

This support system encourages expansion of the most efficient types of renewable electricity generation (Swedish Energy Agency, 2008), but there is a risk of supporting only lower-cost technologies, as forecasting the price of green certificates over a long period of time is difficult.

A particular case in the European Union is Latvia which uses a quota system without certificates that includes elements of quota system and tenders. The Latvian system is based on quotas established yearly, determining the amount of installed capacity from renewable electricity that may be produced within the country.

Tender scheme

The tender scheme, that has been used in the United Kingdom and Ireland and is still used only in France, is a quantity-driven mechanism (Ragwitz et al., 2006), meaning that the state calls for offers from companies wanting to supply renewable electricity on a contract basis at a particular price. The company submitting the most competitive tender receives the contract, and the consumers who purchase the electricity have to pay a fee element covering the additional costs arising in connection with production of the renewable electricity (Swedish Energy Agency, 2008).

The main advantage of the tender system is related to the awareness of renewable energy investment opportunities (Ragwitz et al., 2004). Nevertheless, the market uncertainty and the risk of not covering the cost of electricity production through tenders lead to a much lower penetration of renewable energy sources than expected.

Tax incentives

Tax incentives form a group of policy measures that include tax relief, exemptions from energy tax, grants and investment support (Ragwitz et al., 2006;

Swedish Energy Agency, 2008). Frequently, these mechanisms are used in order to complement other types of policy measures for promoting renewable energy sources. For that reason it is difficult to evaluate the results of the tax incentives as instruments for promoting renewable energy sources.

Policy instruments harmonization

The current support systems for renewable electricity production throughout the European Union differ from one country to another due to various factors, such as electricity markets specificities, labour markets, regional development, and barriers (physical, financial, administrative, and commercial barriers) in the way of increasing the amount of renewable energy production (Swedish Energy Agency, 2008).

The market penetration of renewable energy sources depends on their different costs, due to the resource-specific conditions and the technological options available.

The resource-specific conditions, such as potential, intermittency or effective power, lead to different investment and generation costs from one source to another (Auer et al., 2007) and influence the level of support for renewable energy sources (European Commission, 2005).

The technological options available also have an influence on the cost of renewable electricity generation. According to Auer et al. (2007), comparing the generation cost and the current market price, some renewable energy sources are already competitive (biowaste, biogas, hydro small-scale and large-scale, biomass co-firing, geothermal and wind onshore), but solar thermal electricity, tide and wave electricity, and also wind offshore have generation costs above current market price, being uncompetitive.

We can conclude that energy policies could use a mix of harmonized instruments to promote renewable energy sources so that the gap between market prices and costs is covered. Furthermore, the instruments used to support renewable energies could be differentiated taking into consideration the various levels of technological development, the technological options available, and the country-specific cost-resource conditions.

In order to increase the use of renewable energy sources, many barriers have to be overcome and each instrument has its limits in surmounting a barrier (Kofoed-Wiuff et al., 2006; Pfaffenberger et al., 2006). For instance, technological barriers are overcome by investing in research and development, subsidies and loans, and technology standards, while market barriers are overcome by tax advantage, quota on consumption and by providing more information on renewable energy sources. Therefore, stimulating the use of renewable energy sources has to rely on a mix of harmonized policy instruments.

An objection to policy instruments harmonization for stimulating renewable energies is that it is not possible to establish which system would be best

suited for use within the European Union in an economically efficient manner. Moreover, national support systems are often designed to suit the terms and conditions within the country and a common support system might hinder regional development potentials within specific technologies (Swedish Energy Agency, 2008). However, the European Union's member states may cooperate across national borders (Spain, Germany and Slovenia already successfully cooperate on feed-in tariffs). A solution could be reducing the number of various support systems combined with cooperation between countries. This could lead to large scale economic benefits, transparency for investors and a more cost effective way of achieving the aim of increasing renewable energy production.

Conclusions

The study reveals that policy goals in the renewable energy field could be achieved by using a large variety of instruments and additionally, renewable energies could be better promoted if policy instruments are harmonized. This conclusion is based on the premises that:

1. The local conditions of renewable energy sources, the costs and the target for market penetration influence one country's option for one instrument or a mix of instruments;
2. Various instruments are used in different countries and all instruments could support each one of the renewable energy sources;
3. Countries with more experience in this field use a variety of supporting schemes;
4. The market penetration of renewable energies is influenced by many factors;
5. There are different types of barriers to be overcome;
6. Policy instruments complement each other in achieving the energy policy objectives; and
7. European Union's member states may cooperate across national borders.

The findings of this study could justify the effort invested in designing a new, harmonized policy instrument. This could be helpful in order to better address the problems encountered in supporting the use of renewable energies.

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