

# MIXED INSTRUMENTS IN PROMOTING RENEWABLE ENERGY SOURCES: LESSONS FROM THE EUROPEAN EXPERIENCE

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*Abstract: This study explores the means by which governments could support the use of renewable energy sources. Our conclusion justifies the effort invested in designing new policy instruments and also has relevance for policy making in a very sensitive sector to accomplish sustainability goals – the use of renewable energy. It has been concluded that renewable energies could be better promoted if a mix of policy instruments is applied. The study was conducted using the knowledge base built up through research of literature and national experiences in promoting renewable energy sources. It has demonstrated the necessity of developing complex support schemes by identifying logical connections between the instruments used in different countries and the use of renewable energy sources.*

*Key Words: renewable energy sources, policy instruments, supporting schemes*

## **Introduction**

This study investigates how the use of renewable energy sources could be better promoted by government support (legislative, financial etc.). The manner in which renewable energies are supported is highly debated and is a leading point on the political agenda.

We consider that renewable energy sources (RES) could be promoted by using a mix of policy instruments. The study is based on evidence provided by a set of policy documents (road map, regulations, position papers etc.), as well as articles and research reports. Some instruments are still too young to be evaluated and criteria for evaluation are not yet unified. Analyzing and evaluating evidence and interpreting and reorganizing concepts answered the research question. Computing empirical data through mathematical models could be another way of approaching this question. Answering the research question was difficult, due to the variety of approaches, concepts, definitions, criteria, and classifications employed.

## **Background**

Renewable energy is a highly debated topic nowadays. Contemporary society acknowledges both the value of this energy and the challenge of its use. 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, RES could satisfy the needs of modern society in terms of consumption and environmental impact. Using RES is challenging because it has some very serious drawbacks. Among these, low economic competitiveness is the most important.

Governments around the world are now investing a lot of effort in supporting the use of renewable energies. Public policies in many countries (the Netherlands, the UK, the USA, Ireland, Sweden, Spain, China etc.) address this issue and allocate significant amounts of money.

Policy goals can be achieved by using a large variety of instruments. These are usually grouped in more categories, the most widespread formula being: direct and indirect instruments. Direct instruments could be

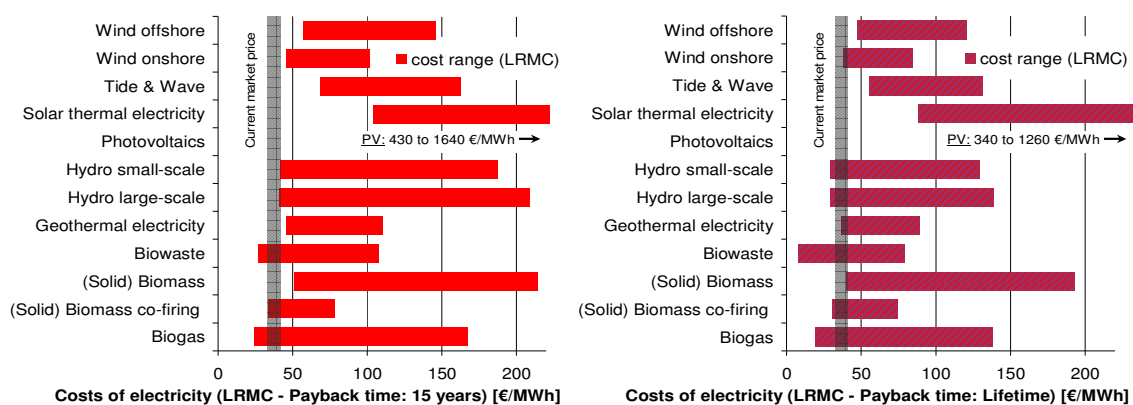
financial measures or regulations, while indirect measures are represented by actions taken in other sectors that could influence the use of renewable energies (e.g. education, information, standards).

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. Usually, several criteria are used, and the final decision depends on how much weight is given to each criterion.

## Factors of influence for market penetration

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

The RES-specific conditions, such as potential, intermittency or effective power, lead to different investment and generation costs from one source to another. As shown in Figure 1 (Auer et al., 2007) the generation cost for different renewable energies is in a broad range. For instance, generation costs for onshore wind power are in the range of 40-64 Euros/MWh. The lower value corresponds to investment cost of 1150 Euros/kW at an average wind speed of 9.5 m/s. The higher value is for 800 Euros/kW at 6 m/s. The cost range for offshore wind energy amounts to 71-96 Euros/MWh, for projects of 1800 Euros/kW at windy sites. In this case wind speeds are between 8 and 10 m/s. Near-shore projects in sheltered waters have lower investment costs, between 1250-1400 Euros/kW (EWEA, 2005). In case of photovoltaic energy, which is the most expensive at the moment, the generation cost varies from 340 Euros/MWh up to 1260 Euros/MWh (Auer et al., 2007). However, the cost of solar photovoltaic systems has decreased by over 60% since 1990 (European Commission, 2006). The differences among RES types in terms of investment and generation costs could be an important element to support their market penetration through a mix of policy instruments.



**Figure 1 Long-run marginal generation costs for renewable energies**

Source: Auer, H., Obersteiner, C., Pruggler, W., Weissensteiner, L., Faber, Y., Resch, G. (2007), *Action Plan, Guiding a Least Cost Grid Integration of RES-Electricity in an extended Europe*, Energy Economics Group (EEG) Vienna University of Technology, Austria, viewed 8 Dec. 2007 <www.greennet-europe.org> p. 9.

The technological options available also have an influence on the cost of RES. For instance, co-firing plants for biomass and small-scale plants for biomass have different costs (Auer et al., 2007). Figure 1 (right) reveals that some RES are already competitive (if we compare their generation cost and their current market price). These are: biowaste, biogas, hydro small-scale and large-scale, biomass co-firing, geothermal and wind onshore. On the other hand, solar thermal electricity, tide and wave electricity, and also wind offshore, have generation costs above current market price, being uncompetitive (Auer et al., 2007). The different country-specific cost-resource conditions influence the level of support for RES (European Commission, 2005). We can conclude that energy policies could use a mix of instruments to promote RES so that the gap between market prices and costs is covered. Furthermore, the instruments used to support RES could be differentiated taking into consideration the various levels of technological






development of RES, the technological options available, and the country-specific cost-resource conditions.

On the other hand, policy instruments used to support renewable energies do not make any difference among RES types. In order to demonstrate this issue, we created table 1, which shows that there are countries in the EU where only one instrument is used to support wind onshore, biomass, biogas, small hydro and photovoltaic. For instance, Austria, Germany, Portugal, Spain, Estonia, Hungary and Lithuania use feed-in tariff as the only instrument to support all five RES. Also, table 1 shows that for the RES studied different instruments are used in different countries, and all instruments could support each one of the RES.

**Table 1 Instruments used to promote different RES in Europe**

Country	Wind onshore	Biogas	Biomass	Small hydro	Photovoltaic
Austria	Blue	Blue	Blue	Blue	Blue
Belgium	Blue, Maroon	Blue, Maroon	Blue, Maroon	Blue, Maroon	Blue, Maroon
Denmark	Blue	Blue	Blue	White	Blue
Finland	Orange	Orange	Orange	Orange	Orange
France	Blue, Green	Blue, Green	Blue, Green	Blue, Green	Blue, Green
Germany	Blue	Blue	Blue	Blue	Blue
Greece	Blue	Blue	White	Blue	Blue
Ireland	Green	Green	White	White	White
Italy	Blue, Maroon	Blue, Maroon	Blue, Maroon	Blue, Maroon	Blue, Maroon
Luxembourg	Blue	Blue	White	White	Blue
Netherlands	Blue, Maroon	Blue, Maroon	Blue, Maroon	Blue, Maroon	Blue, Maroon
Portugal	Blue	Blue	Blue	Blue	Blue
Spain	Blue	Blue	Blue	Blue	Blue
Sweden	Orange, Maroon	Orange, Maroon	Orange, Maroon	Orange, Maroon	White
UK	Blue, Green	Blue, Green	Blue, Green	Blue, Green	Blue, Green
Cyprus	Blue	White	White	White	No available data
Czech R.	Blue, Maroon	Blue, Maroon	White	Blue, Maroon	No available data
Estonia	Blue	Blue	Blue	Blue	No available data
Hungary	Blue	Blue	Blue	Blue	No available data
Latvia	Blue, Maroon	Blue, Maroon	Blue, Maroon	Blue, Maroon	No available data
Lithuania	Blue	Blue	Blue	Blue	No available data
Malta	White	White	White	White	No available data
Poland	Maroon	Maroon	Maroon	Maroon	No available data
Slovak R.	Blue	White	Blue	Blue	No available data
Slovenia	White	Blue	Blue	Blue	No available data
Bulgaria	Blue	Blue	Blue	Blue	Blue
Romania	Maroon	Maroon	Maroon	Maroon	Maroon

Legend:

	Feed-in tariff
	Quota/Tradable green certificates
	Tender
	Tax incentives/investment grants
	No instrument

Source: Commission Staff Working Document, Annex to the Communication from the Commission, The support for electricity from renewable energy sources, Impact Assessment, Brussels, 7.12.2005, SEC (2005) 1571, pp. 32-46.

However, some instruments are more suitable than others for different RES. 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 RES, taking into consideration the local conditions of RES, the costs and the target for market penetration.

### **Variety of supporting schemes for the use of RES**

The use of RES 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 RES. 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 (World Watch Institute, 2004).

In each European country the use of RES is supported through various policy instruments or schemes. In 2002 a European Commission study have made an inventory of the national support available for promotion of RES in 15 EU member states regarding price support, tax measures, subsidies and loans (European Commission, 2002). According to this study, in the United Kingdom the policy instruments are: price support (renewable electricity obligation); tax measures (fossil fuel levy or Climate Change Levy Electricity); subsidies, loans (capital grants for renewable energy technologies). Since Valle Costa et al. (2008) consider UK as country where the use of RES is advanced we could conclude that a mix of instruments is essential to promote renewable energy.

The dominant instruments for promoting the generation of electricity by RES have been feed-in tariffs and quota with green certificates. Pfaffenberger et al. (2006) carried out a study regarding the main instruments for the promotion of electricity from RES in 22 countries. They found that feed-in tariffs are used in 14 of these, while quota with certificates is used in 6. These two instruments were also found as having high effectiveness (Dijk, van et al., 2003).

### **Surmounting barriers for RES use**

In order to increase the use of RES, many barriers have to be overcome (financial barriers, administrative barriers, geographic barriers etc.) and each instrument has its limits in surmounting a barrier. In support of this statement, we have compiled information from different studies (Menanteau et al., 2001; Dijk, van et al., 2003; Beck, Martinot, 2004; Kofoed-Wiuff et al., 2006; Pfaffenberger et al., 2006) and established a correspondence between RES barriers and the most used instruments. These relations are presented in table 2.

**Table 2 Correspondence between RES barriers and policy instruments**

Barrier	Policy instruments		
	Direct instruments		Indirect instruments
	Financial measures	Non-financial measures	
High investment	Subsidies and loans Tax exemptions or advantage	Negotiated agreements between producers and government	Project sitting and permitting standards
High generation cost	Feed-in tariffs Green certificates Bidding	Quota obligation on production	
Market	Tax advantage	Quota obligation on consumption	Information campaigns Education Labeling
Low performance technology	Funding research and development Subsidies and loans		Technology standards and certification
Administrative	Interconnection regulations		Information campaigns
Geographic	Differentiated subsidies		
Infrastructure related	Independent power producer framework Biofuels mandate Tax exemptions or advantages		Grid connection standards
Perceived risks	Feed-in tariffs Quota with green certificates		
Lack of renewable energy skills			Education and training

The use of more than one policy instrument can overcome a barrier, with two exceptions, such as geographic barriers and lack of renewable energy skills. On the other hand, most policy instruments (tax advantage, education, information, feed-in tariffs, subsidies and loans etc.) address more than one barrier. For example, 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 RES. Therefore, stimulating the use of RES has to rely on more than one instrument.

## **Complementarities of policy instruments**

### ***Reaching stakeholders***

Using a mix of policy instruments for stimulating RES is supported by the fact that this way more stakeholders could be reached. In order to explain how policy instruments are complementary in this respect we will consider two categories of stakeholders: producers and consumers. The interest of

producers in using RES could be stimulated by feed-in tariffs, quota with green certificates, and investment support. On the other hand, investing in education, information and communication could influence consumers. Nevertheless, one of the instruments, namely the quota system, could envisage producers and also consumers. In this case, the government establishes the amount of energy to be transacted on the market by specifying either or both the quantity to be produced and/or the quantity to be consumed (Menanteau et al., 2001; Dijk, van et al., 2003). Using different types of policy instruments allows governments to obtain the desired result by converging means.

#### ***Providing equal opportunities for generators***

Another reason for stimulating the use of RES by a mix of policy instruments is that the instruments should stimulate small, medium and large companies that generate electricity from RES. As it is stated in the literature (Agnolucci, 2008), policy instruments should not be used in order to create some concessions to certain generators, but to give these equal opportunities. Such equal opportunities are needed more intensely by small companies that do not have sufficient investment funds of their own and also face barriers to obtaining funds when entering the renewable market. Based on this evidence, we could say that there is a need for promoting the use of RES by using instruments that stimulate the investments of all generators, regardless of their size.

#### ***Achieving performance***

The different policy instruments could be complementary in reaching performance indicators. A range of criteria that indicate how well they perform evaluates the instruments used for stimulating RES. Such criteria are effectiveness, cost effectiveness, transparency, market conformity (van Dijk et al., 2003) or conformity with objectives such as increase in RES energy production, reduction of RES prices, reduction of carbon dioxide emissions, acceleration of the implementation of RES (Espey, 2001). Every policy instrument has a different potential in terms of performance. The survey conducted by van Dijk et al. (2003) revealed that in terms of market conformity quota systems are the most appropriate, while subsidies have the potential to distort the market. According to Espey (2001), feed-in tariffs are very successful in terms of stimulating the production of energy from RES, but they have little influence on reducing the price of RES. By using a mix of policy instruments, the shortcoming of these instruments could be avoided. We also noted that various studies evaluate policy instruments according to different, or at least differently nominated, criteria.

#### **Impact on investors**

An objection to applying a mix of policy instruments to stimulate renewable energies is that it could confuse the investors. For instance, the complexity and diversity of the instruments used in Netherlands confused investors, as they fear lack of security in the long term (Do Valle Costa et al., 2008). The long-term stability of the instruments (that is, the system used and the level of support) could lead to market stability and security for investors (EREC, 2007). If policy makers diversify their instruments over some limits, then the reverse could obtain, namely a lack of interest in generating electricity from RES. However, the confusion of investors could be avoided through information campaigns, and also through the stability of regulations, which could guarantee the security of the investments in the long term.

#### **Conclusions**

The study reveals that the use of RES could be better supported if a mix of policy instruments is applied. This conclusion is based on the premises that (1) the market penetration of renewable energies is influenced by many factors, (2) countries with more experience in this field use a variety of supporting schemes, (3) there are different types of barriers to be overcome, and (4) policy instruments complement each other in achieving the energy policy objectives.

Our findings could justify the effort invested in designing new policy instruments. This could be helpful in order to better address the problems encountered in supporting the use of renewable energies.

Policy instruments have diversified greatly in the last decade, and the same holds true for evaluation procedures. Therefore, a normative conclusion as the one presented here could usefully guide policy making.

Further research could focus on identifying the mix of policy instruments which would present an optimal complexity level, which would not hinder the attractiveness of RES for investors. At this stage, the development of a unified system of criteria for evaluating policy instruments for RES would also be useful.

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