FINGER, Matthias; TREVINO, Luis

Power Regulatory Framework & Opportunities for Self Supply

Chair Management of Network Industries (MIR)
CDM Working Papers Series

January 2008 MIR-WORKINGPAPER-2008-001

Article Paper presented on the 10th International Conference on technology Policy and innovation: Energy and Sustainability, ICTPI – Norway 2007

Keywords: electricity market, infrastructure, liberalization, self supply, renewables

Abstract

The intention of a single energy market in Europe is to have a sustainable, competitive, and secure supply of energy. However, the current rise in the cost of electricity supply is affecting the competitiveness of large industrial users. This has led large electricity consumers to look for new ways to supply themselves with electricity. An important alternative to reduce power cost and avoid using electricity from the grid is self generation from a renewable energy source. The proposed paper will critically assess the adequacy of the current European regulatory framework when it comes to the use of renewable energy sources for self-producing firms. Building on such an assessment, the paper will propose modifications to the current market design, which would reduce the uncertainty for investors in RE projects and allow electricity to be self-supplied in a sustainable and cost effective ways. The regulatory framework needed for this new market design will be discussed, and special attention will be paid to self generation projects and supply management options such as distributed generation and load management.

Table of contents

INTRODUCTION

European energy policy pursues three main objectives: the sustainable, competitive and secure supply of energy[1]. The EC intends to reach these goals with the creation of a single energy market and a liberalization process that obliges member States (MS) to open their national electricity supply market to allow more competition. The addition of competition in the market will give customers more and better options for electricity access. However, this restructuring process is far from giving the results that the European authorities have claimed it will give, both in terms of creating a single electric market and of supplying electricity in a sustainable and cost-effective way.

The creation of the single European internal electricity market (IEM), made possible by the opening of all member states' markets, is in question. The restructuring process has led to the creation of fragmented national markets, each liberalized to a different degree and following different market restructuring policies. The supposed benefits of the liberalization process such as competition, unbundling, market access, market opening, and cross-border trade are in some cases not very visible. Some authors argue of a soft restructuring and a deficient market design and regulatory framework that have not led to a competitive European-integrated market and lower electricity prices that will benefit the industrial user.

This apparent lack of competitive IEM can lead large electricity users to look for new ways to supply themselves. An important alternative to reduce power cost is self generation, in particular from a renewable energy source. As will be shown, industrial users have plenty of reasons to employ renewable energy (RE), but it is important to note that RE can be considered as an option to supply the energy needs since in this way a CO_2-free source is employed and under some regulatory conditions it might be the most cost-effective way.

However, renewable energy still faces significant impediments for its deployment. The higher up-front capital costs and the perceived investment risks for RE projects undermine their potential growth and negatively affect investors' decisions. In addition, the intermittency of renewable sources and the need for supply storage or backup systems in order to have a continuous supply of electricity are also other problems. Current legislation, both at the European and national levels, does not encourage enough options or incentives to provide firms with the ability to use or produce electricity from renewable energy sources (RES) in all MS, and this is why the progress on RE is seen in just a handful of countries. Infrastructure barriers and reduced subsidies and R&D budgets for RE in comparison to traditional power sources hinder its development and deployment.

The purpose of this paper is to critically assess the adequacy of the current European regulatory framework when it comes to the use of renewable energy sources for self-generating firms. Building on such an assessment, this paper will propose modifications to the current market design and regulatory framework, which would reduce the uncertainty for investors in RE projects and allow electricity to be self-supplied in a sustainable and cost effective way.

---

1 As stipulated in the 1995 White Paper of the European Commission (EC).

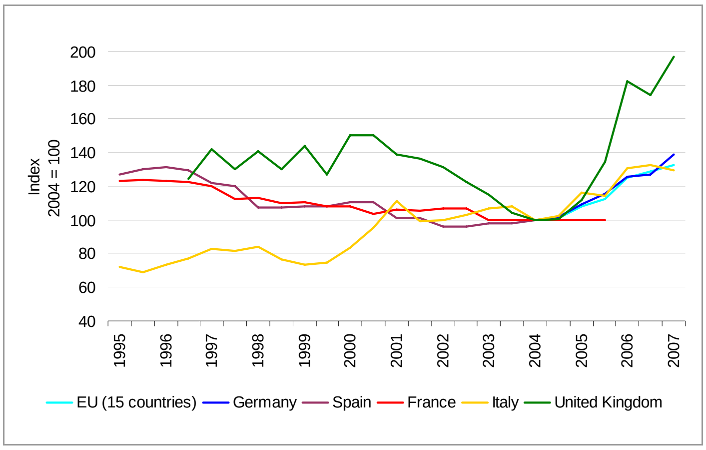
1. THE ENERGY INDUSTRY IN EUROPE TODAY

The conditions with the energy industry in Europe give strong reasons to electricity users to search new options to obtain their power needs. The degree of competition and market fairness to new power producers in many countries is debatable. Many authors and the EC itself recognize that there is still no existence of a unified European electricity market. The European Renewable Energy Foundation (EREF) states that the energy market is still a myth, hampered by increasing oligopolies (Point Carbon Conference March 2007). As L. Hancher has put it, "it would seem possible for the determined anti-market countries to avoid introducing any meaningful degree of competition at all". The electricity prices are increasing and affecting the performance of electricity users. In addition, new targets on CO_2 reductions in each country and the benefits given to consumers of RE are also strong incentives to consider a change in energy supply.

1.1 Electricity Prices

One of the goals of the liberalization process is to achieve lower electricity prices. However, the opposite is happening. The current rise in the cost of electricity supply is affecting the competitiveness, profit margins, and performance of large industrial users. Electricity prices for large industrial users have been rising in the last years; in many countries they are higher than ten years ago, as shown in Figure 1.

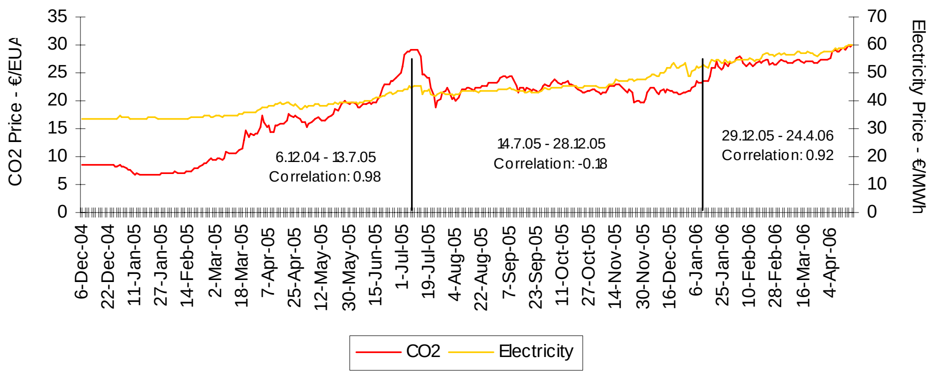
These price increases are attributed to higher fuel costs and to a new variable cost in the form of CO_2 emission allowances that the EU ETS introduced since the beginning of 2005. The correlation between the rising price of CO_2 allowances and the rising electricity price since the beginning of 2005 is evidence of the influence of the EU ETS in higher electricity prices, as seen in Figure 2. The correlation is only weak from July to December 2005 when CO_2 prices remained constant.



Source: Own elaboration with data from Eurostat

Fig. 1. Electricity Prices for large industrial standard consumers 2004 prices, excluding taxes.

Certainly other conditions, such as the weather and concerns about possible reduced availability of plant might affect the electricity price. However, the correlation between the CO_2 and power prices gives good evidence of the influence of the first on the second.



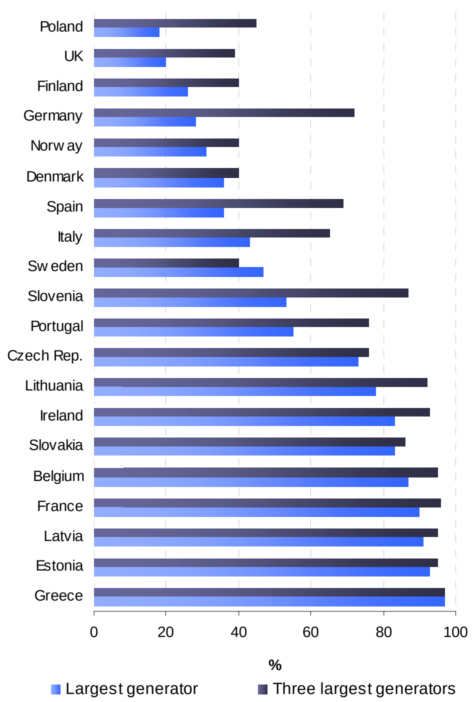
Source: Own elaboration with data from Point Carbon and EEX

Fig. 2. Correlation between prices of electricity and CO_2 allowances.

Furthermore, the volatility of electricity prices is an indication of level of risk added by the electricity market to both producers and customers. Investors, buyers, and traders need insight into future electricity prices and an assessment of the risks of buying and selling electricity at the forecast prices because a fast change in the price of electricity could upset the costs of any user and ultimately the profit margin. With high price volatility electricity users face uncertainty in the prices of electric power and their planning decisions become more difficult. CO_2 prices and their associated volatility may have participated in increasing the electricity price volatility (Reinaud, 2007).

1.2 Unbundling and Market Power

Today, new entrants to the electricity sector face difficult competition in concentrated markets with vertically integrated companies. Figure 3 shows how in some MS, the generation and/or supply of electricity remains a monopolistic or oligopolistic. In most countries the largest generator has a market share greater than 50%. In some cases a single generator has a market share of more than 90%. Under European Union competition law, a market share above 40% is usually considered dominant (Boisseleau and Hakvoort, 2003).



Source: Eurostat and EC

Fig. 3. Market Share of Generators in Countries, 2004.

The European market structure is characterized by consolidation and re-verticalization and the industry has moved from a situation with one national champion per country to a situation with a few big players in several countries (Meeus et al, 2005). Supply liberalization shortens contract lengths, as suppliers fear losing customers if subsequent wholesale prices fall. The short duration of contracts makes financing investment potentially risky and “the natural response to this increased risk is for incumbents to vertically and horizontally integrate to better manage risk, deter entry, manage the capacity margin, and hence restore prices to profitable levels” (Newbery, 2002).

Since the market share of generation is concentrated in the hands of a few giant companies and these companies sometimes act as transmission system operators (TSOs) as well, it is difficult for new participants to enter the market[2]; competitive prices are thus limited. In fact, the European Commission recognizes that the EU is far from being able to guarantee to any company the right to sell electricity in any country on equal terms with the existing national companies without discrimination or disadvantage (EC, 2007).

1.3 RE targets

Energy policy in Europe has been influenced in the last few years by the environmental issue. The use of renewable energy and its growth is encouraged by the European authorities, who have established a Directive on the promotion of renewable energy[3] giving targets to each MS to base their electricity consumption on a percentage coming from RES. The objectives do not take into consideration hydroelectric production coming from pump-storage installations functioning with power grid electricity. These targets, which can be seen in Table 1, and the obligation of MS to reach them are changing the energy industry in Europe. The increase in RE consumption is as important a priority as the creation of the IEM. Important mechanisms, programs, and incentives are changing the attention of every player in the industry towards RE. More importantly, the industry participants are seeing the importance in the use of RE. These will be analyzed in a following section.

Country	RES-E % in 2010	Country	RES-E % in 2010
Austria	78.1	Germany	12.5
Sweden	60	UK	10
Latvia	49.3	Netherlands	9
Portugal	39	Czech Republic	8
Slovenia	33.6	Poland	7.5
Finland	31.5	Lithuania	7
Slovakia	31	Belgium	6
Spain	29.4	Cyprus	6
Denmark	29	Luxembourg	5.7
Italy	25	Estonia	5.1
France	21	Malta	5
Greece	20.1	Hungary	3.6
Ireland	13.2	EU-25	21

Source: EC

Table 1. National MS RES-E % Targets.

[2] According to a EC study, “wholesale electricity prices are significantly higher than would be expected on perfectly competitive markets”. In fact, on December 2006, EU regulators carried out surprise raids on electricity companies in Germany, looking for evidence in an antitrust investigation. A Commission spokesman on competition said that “In the case of Germany … the results of this study have confirmed our suspicions that all was not well” and suggested that other anti-trust cases could follow.

[3] Directive 2001/77/EC.

2. THE ARGUMENTS FOR SELF-SUPPLY

Under the current energetic situation, self-supply of electricity is an important option. For the large industrial users, self generation is a way of accessing a lower cost supply of electricity that does not affect their competitiveness. With self supply transmission losses are reduced because electricity can be produced close to where it is needed. Electricity users have the option of getting their electricity needs from the grid or from their own sources. If the latter is the case, then the user can avoid transmission costs, which amount to around 30% of the total electricity cost, according to the International Energy Agency.

Furthermore, self supply options increase reliability. The electricity user must not depend only on “outside” sources to receive electricity; by supplying its own electricity it has a reliable power supply and even the option to sell unconsumed power by placing it in the grid. On-site generation can also reduce risk of disruptions in fuel supplies in case of problems in transportation difficulties and can provide backup power in case of electricity blackouts. Additionally, the user has a stable power cost and might not be subject to the variations of market price.

Industrial users can also take advantage of the incentives that several governments give to self-generators through tax reductions or capital subsidies for plant constructions. In Germany, the Law establishes an exemption from the tax on electricity for those self-generators with capacities below 2 MW (10 MW for small hydro plants). In Denmark there is legislation for non-utility wind turbines. For those commissioned after the year 2000, they receive a subsidy of 5.8 ct/kWh for the first 22,000 full-load hours. These incentives may prove to be less costly to the firm than depending on electricity from the market.

Self-generation technologies give the choice of supplying electricity from fossil fuel sources or from RES. Fossil fuels were normally seen as a cheaper generating option than renewables since they have the advantage that investment costs are usually lower. However, operational costs for fossil fuel technologies might be higher because of the fuel component.

Fossils, which include coal, CHP, gas, and oil, are technologies suitable for large scale. These are well proven technologies that have a reliable fuel supply. However, the price volatility of fuels, the emission of CO2, and the fact that they are mostly larger projects are some disadvantages of fossil fuels. Renewables include wind, waste, biomass, and solar sources, and on the other hand, are not subject to the European Transmission Scheme and CO2 costs, are supported by mechanisms which make their use more cost effective, and their smaller size is suitable for industrial sites. Still, as mentioned before, the investment costs are higher and have variable output.

In the next section the advantages for generating RES-E will be analyzed, and will show that there is currently a good opportunity for large industrial consumers to supply themselves with RE.

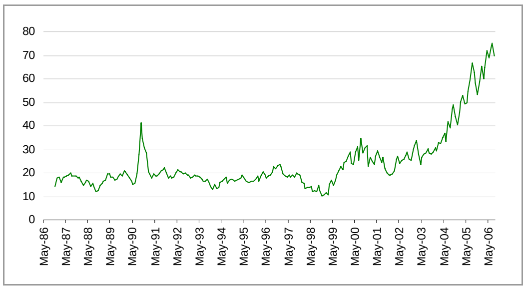
2.1 Self supply with RE

Although self supply of electricity is an important first option for the electricity user to secure a competitive and reliable power source, he can further decide between two options of energy supply – fossil fuel or renewable sources.

Electricity generated from RES (RES-E) has been growing in recent years. It is the most dynamic sector of the global energy market. The renewable sources of geothermal, solar, wind, tidal and wave energy will grow faster than any other energy source, at an average rate of 6.2% per year in the period from 2003-2030 (World Energy Outlook 2005). The installed capacity is expected to more than double from

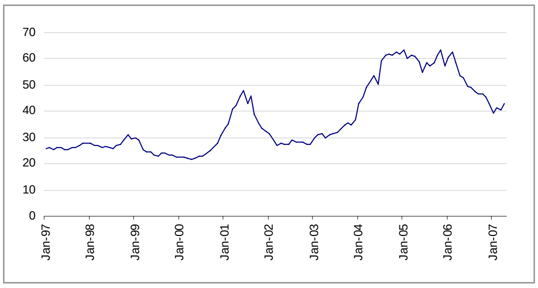
2003 to 2013, from approximately 130 GW to 300 GW. RE technologies "have made strong progress – with substantial cost reductions and rapid market expansion" (Gross et al, 2002).

Several factors have led to an increase in the use of RE, and continue to act as important incentives for the electricity consumer to use RES-E. First of all, the prices of fossil fuels have increased, making an impact on the costs of firms. The prices of oil, coal, and natural gas continue on a rising trend since the start of the decade, as illustrated in Figures 4-6. Consequently, the gap of generation costs between conventional generation and renewable generation has been reduced.



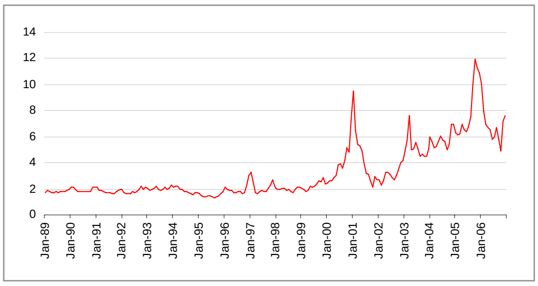
Source: Bloomberg

Fig. 4. Brent Crude Oil Prices in USD/barrel.



Source: Bloomberg

Fig. 5. Coal Costs in USD/short ton.



Source: EIA

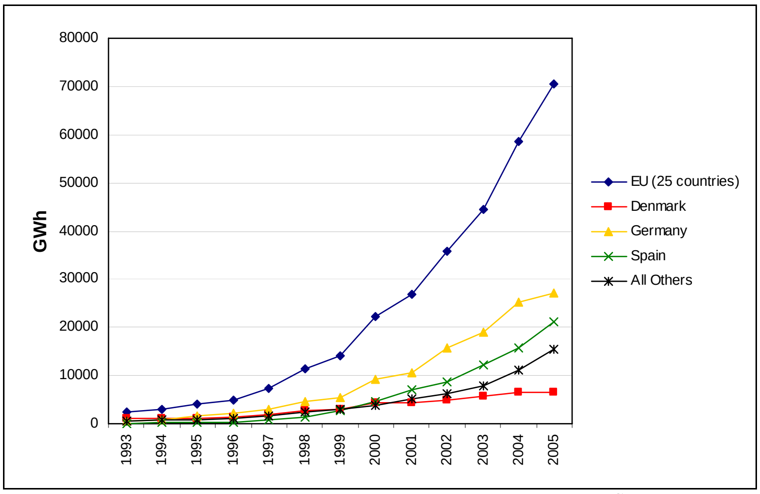
Fig. 6. U.S. Natural Gas Import Price in USD/tcf.

Renewable energy can be a hedge against price volatility. RE can mitigate risk in two ways, according to Wiser and Bolinger (2004). First, it provides electricity purchasers with a long-term fixed price source of supply. Secondly, the authors explain that a number of studies show that aggressive RE penetration may put downward pressure on fossil fuel prices by lowering demand for these.

With the start of the EU ETS program in 2005 in order to comply with the reduction of greenhouse gases objective of the Kyoto Protocol, now several industries add an additional cost element to their production processes in the form of CO_2 emission allowances. With self owned renewable energy, firms can avoid paying the market for emission allowances.

Renewable energy has also benefited from the technological developments and increase in efficiency. Such is the case of wind power. Over the last 20 years the annual energy output per turbine has increased 100-fold. The weight of wind turbines per KW has halved, the sound level has also halved and from 1992 to 2002 installed capacity increased ten-fold. Cost per unit of electrical output, according to Gross et al, fell fourfold in the 1980s and halved in the 1990s. In general, all renewable energy technologies have become more cost-effective.

In addition, there are support mechanisms implemented by MS that promote investments in renewable energy and allow for a profitable generation. Under the requirement from the Renewables Directive, the national governments use these mechanisms to make it more feasible for companies to produce RES-E. Such is the case of feed-in tariffs, which have been implemented in Spain, Germany, and Denmark and have proved successful for the development of wind technology and the increase in the electricity generation by wind in the last years. This is illustrated in Figure 7.



Source: Eurostat

Fig.7. Electricity Generation by Wind.

Other support mechanisms include tendering systems, tradable green certificates, and tax incentives. Even though the mechanisms have definitely been effective in making renewable energy more accessible, the results of these in different countries are mixed. An analysis in a subsequent section will illustrate this.

Most importantly, besides considering the arguments mentioned above that give large users reasons to consider their supply from RE, the thought of the environment and of sustainability are strong points for RE. Renewable technologies do not have a negative effect on the environment since they do not emit greenhouse gases into the atmosphere and therefore have no influence on the climate change. Only through RE will the CO_2 emission reduction targets stipulated by the Kyoto Protocol and the EC be reached. This requires employing greater amounts of renewable energy sources and reinforcing the support that these technologies receive from the governments.

3. BARRIERS FOR RE SELF SUPPLY

Despite the advances in RE in the last years and the benefits that it offers to the electricity users, there are still significant barriers that limit the penetration of renewable energy in the market and its deployment. The power regulatory frameworks in many MS have failed to address the barriers that create an unleveled playing field between conventional and renewable energy sources. These barriers can be grouped under four categories: financial, operational, infrastructure, and barriers in the regulatory framework.

3.1 Financial barriers

Renewable energy still faces significant impediments for its deployment. The high up-front capital costs relative to competing technologies undermine its potential growth (Sonntag-O'Brien and Usher, 2004). From all renewable technologies, onshore wind projects need the smallest capital investment, and they can be sometimes less expensive than some conventional technologies, depending on which type of plant is compared. The costs can be seen in Table 2. Based on analysis from different sources, the capital costs of a wind onshore plant can be around €890-€1100/kW, while for an offshore plant they can be €1590-€2070/kW. Other renewable technologies have higher costs, with different ranges depending on the type of plant: biogas €1430-€4500; biomass €550-€4230; geothermal €2000-€3500. Solar energy is practically an option that cannot be considered by industrial users. The capital costs for a PV plant are in the range of €5080-€5930. In comparison, a pulverized coal combustion plant has capital costs of around €1100/kW and a CCGT plant has costs of only around €550.

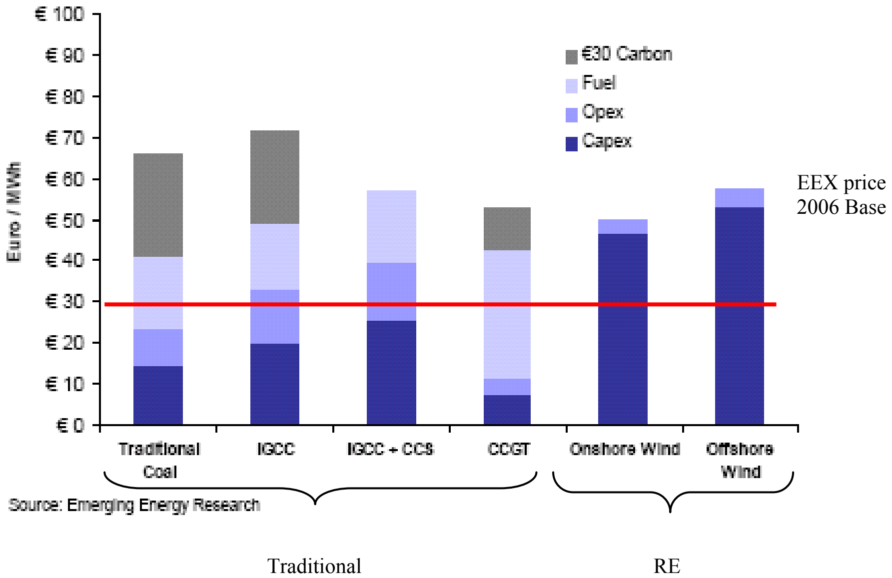


Table 2. Costs of different generating technologies.

Besides the higher investment needed for renewable projects, these technologies also have perceived investment risks that hinder faster growth. The funds for capital-intensive RE projects are currently relatively expensive and difficult to obtain, even if they are expected to produce more cost-effective power than fossil plants over their lifetimes (UNEP). In an analysis of the United Nations Environment Program (UNEP, 2004) barriers associated with investment in RE projects were categorized. Some of the different barriers are:

- Cognitive barriers, which relate to the low level of awareness, understanding and attention afforded to RE financing and risk management instruments.
- Political barriers, associated with regulatory and policy issues and governmental leadership.
- Market barriers, associated with lack of financial, legal and institutional frameworks to support the uptake of RE projects in different jurisdictions.
- Administrative barriers**,** associated with operating under / complying with new policy frameworks which support RET and emissions trading markets.
- Legal & Tax barriers**,** which generally relate to lack of clarity in property rights, legal and tax systems.

Respondents to a questionnaire made by the UNEP mentioned lack of confidence in regulatory policies because of changing national and international prerogatives as a big barrier. Sometimes governments change regulation so fast that investors face uncertainty and are discouraged to invest fearing that fast change in legislation will affect their investments, as will be shown in another section. "The fundamental concern (of regulatory risk) relates to the fact that any investment made under a policy regime is exposed to the numerous reviews and potential changes which may take place between the time the investment is made and the time at which invested capital is fully repaid from project cash flows".

Other important risks include the often-small scale of projects, technology efficacy risk, resource availability, supply risk[4], and construction delays. RE technologies are more time-intensive and difficult to execute than conventional energy projects. It even states that many insurance practitioners highlight that with the exception of onshore wind energy there is a limited understanding of most RE projects and associated risks because the development of these technologies has been slower than that of onshore wind technology. Karlynn S. Cory of the National Renewable Energy Laboratory (NREL) argues that the financial community prefers commercial, not emerging technologies, and is stricter with renewables.

The financial structure and scale of renewable technologies pose a challenge to investment in them (Sonntag-O'Brien and Usher, 2004). Since most RE projects are of smaller scale, the transaction costs (feasibility analysis, legal and engineering fees, consultants, etc.) are disproportionately high, since they do not vary with the size of the project. Additionally, RE technology projects are usually unattractive prospects for commercial lenders and insurers because the administrative costs associated with risk assessments, loan processing and insurance for such projects are high and the returns are low. These administrative costs will be analyzed in another section, but also include the complex legislation in spatial planning laws and complex planning procedures.

3.2 Operational barriers

The supply reliability was mentioned as one of the advantages of renewable energy. However, abundant supplies of renewable resources do not guarantee abundant supply of affordable energy (National Center for Policy Analysis – H. Sterling Burnett, 2005). Some renewable technologies are intermittent in the sense that the electricity generation is variable because of the variability of wind speeds and sunlight, for example. A user that receives its electricity supply from a wind farm can be affected if wind speeds lower, since the wind turbines will not be able to generate electricity. Solar power is variable as clouds can block the sunlight that generates the electricity, besides the fact that nighttime also prevents the generation of electricity.

The variable and diffuse nature of these sources and the fact that they cannot be controlled to provide directly either continuous base-load power or peak-load power when it is needed make their use all the more difficult. Therefore, the intermittency of renewable sources creates a need for supply storage or backup systems in order to have a continuous supply of electricity. If they could be stored efficiently then their contribution to supplying energy would be much greater. However, electricity storage is currently not widely available or practical and this creates a problem for backup capacity.

An industrial user that is self-supplied but not connected to the grid will have variable electricity generation that will affect its production by not having available power whenever it needs it. On the other hand, a user that is self-supplied but has also connection to the grid can access another source of power, thus preventing a loss of electricity because of intermittent sources. However, as more RE plants are built and the contribution of renewables to national supply increases, intermittency can become a problem for the grid. Intermittency creates a difficulty for a network that relies on the constant balancing of supply and demand. RES are limited to some 10-20% of the capacity of an electricity grid (UIC, 2007) before they inflict additional costs on the grid operator, which has to find additional ways to maintain reliable supply through grid extensions and additional balancing and back-up capacity.

---

4 Either in terms of assessing the resource or contracting the supply.

According to a 2006 report by the UK Energy Research Centre (UKERC), which draws on over 200 international studies, the introduction of significant amounts of intermittent generation will affect the way the electricity system operates and will increase the costs of electricity. The report mentions two main categories of impact. The first is the system balancing impacts, which relates to the relatively rapid short term adjustments needed to manage fluctuations over the time period from minutes to hours. System balancing produces costs which are passed on to electricity consumers. Intermittent generation adds to these costs. For penetrations of intermittent renewables up to 20% of electricity supply additional balancing reserves due to short term (hourly) fluctuations in wind generation amount to about 5-10% of installed capacity. Several studies estimate that associated costs are less than £5/mWh of intermittent output. In the case of the UK, they are £2-£3/mWh.

The second impact is termed "reliability impacts", which relates to the extent to which there can be confidence that sufficient generation will be available to meet peak demands. A system margin (the amount by which the total installed capacity of all the generating plant on the system exceeds the anticipated peak demand) is needed to cope with unavailability of installed generation and fluctuations in electricity requirements. Intermittent generation can introduce additional uncertainty because it increases the size of the system margin required to maintain a given level of reliability. This is because the variability in output of intermittent generators means they are less likely to be generating at full power at times of peak demand. Increasing the margin means that additional capacity must be built, and this capacity has a high cost. The authors calculate the system reliability costs as the difference between the contribution to reliability made by intermittent generation plant and the contribution to reliability made by conventional generation plant. The report informs that the cost to maintain system reliability lies within a range of £3-£5/mWh for British conditions. This is also assumed for an electricity supply of around 20% for well dispersed wind power; larger penetrations cause bigger costs.

In total, intermittency costs for Britain are around £5 to £8/mWh. Other reports draw similar conclusions. Smith et al. (2004) assess additional wind integration costs in a range between €1.13-€4.22/mWh. Auer et al. (2004) establish a cost range of €7 to €9 at a 20% market penetration of wind power.[5] All prospective costs come from additional response and reserve to manage unpredicted short term fluctuations; from additional fuel burn due to increased variation in the output of load following plants; and conventional plant retained or new plant constructed to maintain reliability at peak demand.

It is important to distribute renewable technologies geographically and diversify into different energy technologies. However, another barrier arises here, and is that the development of RE technologies is unleveled. At present only wind technology is competitive with conventional technologies. A lack of several factors has prevented other renewable technologies from becoming more cost effective. It will be difficult then, to diversify into different RE technologies if other barriers are not addressed first.

3.3 Infrastructure barriers

Infrastructure barriers refer to the difficulties of renewable generators to connect to the grid; the costs for grid connection that they must pay; and the regulation for planning procedure of RE projects.

A generating unit may be built on an industrial site primarily to supply the site itself. It will nevertheless probably want a network connection that functions in two directions, to sell surplus output to the network when price and circumstances are favorable, and to take electricity from the network if the on-site

---

[5] Both Smith et al (2004) and Auer et al (2004) were found in the Variability of Wind Power and other Renewables report of IEA, 2005.

generating unit is out of service. The problem with this is that RE projects need new grid infrastructure. New overhead lines are necessary to transport electricity to and into these new plants (ETSO, 2005). Besides, as mentioned before, the contributions from intermittent technologies must be balanced with other back-up generation capacity located elsewhere. This also requires grid reinforcements. According to the European Transmission System Operators (ETSO) in Germany, for example, in 2005 850 km of new 380-kV-lines were needed in the coming ten years to integrate the wind farms expected to be built.

A 2005 report by EWEA on the integration of wind to Europe's grid network mentions that the barriers to wind power penetration are not technical but mainly a matter of regulatory, institutional and market aspects. In other words, larger scale penetration of wind does face barriers; not because of its variability, but because of grid codes and other technical requirements in the regulation that are constantly changing, making it difficult for the producer to follow them. In addition, they are often introduced on short notice and contain very costly and challenging requirements. Furthermore, the requirements and regulations are often developed by vertically-integrated power companies, in ways that are not very transparent. This has led to situations, in Spain, for example, where project developers connect directly to the transmission grid instead of the distribution grid. This will help to avoid a long complex authorization procedure with the DSO, but will bring more technical challenges and costs.

This situation, however, has to do with the fact that unbundling of DSOs is low in Europe. The EC in its 2005 Benchmarking Report publishes little encouraging results. Less than half of the MS have failed to implement the basic requirements of unbundling. In addition, project developers in France and Spain have highlighted that it is impossible for project developers to know the available grid capacity, and therefore they cannot verify technical and cost data of the grid connection presented to them by the grid operator. These barriers are also highlighted by the OPTRES Report (Resch et al, 2006) and ECOFYS (2005).

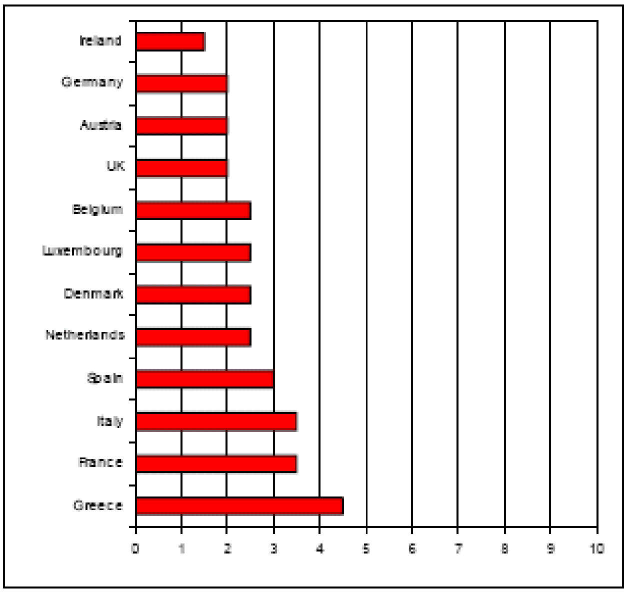
Another problem related is the insufficiency of grid capacity available for the connection of large-scale RE power plants. The OPTRES Interim Report suggests that grid expansion and reinforcement is urgently needed; it is necessary that future renewable energy projects are taken into consideration with this expansion. Reiche and Bechberger (2004) also assess the grid capacity as a very important obstacle. They claim that France, Spain, Portugal, Greece and the UK have to reinforce their grids. The EWEA (2005) mentions several studies for various MS in which it is determined that the additional grid extension/reinforcement costs caused by wind integration are in the range of €0.1 to €4.7/mWh. The higher value corresponds to a wind penetration of 30% in the UK system.

Furthermore, the grid connection costs can be very high, hindering sometimes the realization of RE projects. At times these costs are to be paid completely by the RE project developer and can be exaggerated by the DSO. In Belgium the grid operator imposes high grid and connection costs as well as a high balancing tariff of €0.02/kWh (Coenraads et al, 2006). On the other hand, in Spain only the generators above 10 MW are obliged to pay balancing costs. In Germany renewable generators are freed from paying for balancing the fluctuations and upgrades of the network. Some of the countries with the highest share of RE penetration, like Denmark and Germany, have established rules of good practice in relation to the sharing of the costs of various investments that have to be made in the grid. These allow the implementation of shallow connection cost, instead of deep connection cost.[6]

[6] Under deep connection costs generators or customers are required to pay not only for the cost of the local connection but also for the incremental investment made on the wider system to accommodate the additional generating capacity or load. Under shallow connection costs, generators and customers are required to pay only for the local assets specifically required to connect them to the grid. The costs of reinforcing the system beyond the connection assets are recovered through use of system charges. (Scheepers and Wals).

3.4 Legal barriers

As mentioned before, the administrative barriers that RE project developers face hinder their development by preventing further infrastructure from being built. Among the barriers is the high number of authorities involved in the permission procedure for RE projects. Several authorities at local, regional, and national level for authorization and financial support make the process too long and delayed. There is also lack of coordination between different authorities. Project developers need to submit similar information multiple times to different authorities. The long lead times to obtain the necessary permits can take many years. Additionally, the lack of spatial planning in some MS hinders the development of renewable energy projects. The processes vary from one MS to another, and even in some regions within a MS. The average lead times for the planning phase of DG in Europe are between 1.5 years and 4.5 years, as illustrated in Figure 8.



Source: Skytte et al, 2003

Fig. 8. Average planning time (wind power) in years.

The EC in a 2005 report gave the Czech Republic, France, Greece, Hungary, Italy, Latvia, Portugal, and Slovenia the worst ratings on the administrative barriers to RE deployment. The Italian Wind Energy Association recognized that its market could be seriously hampered by a number of uncertainties, including a lack of details for an authorization process. In the Italian island of Sardinia in 2005 the local government voted on a moratorium on wind farm construction. Up to 1000 MW projects were put on hold. In France, the size of eligibility projects for the tariff system is limited to a maximum size of 12 MW. In the three windiest regions in France the application refusal rates were 50% in 2005. In Greece the bureaucracy also slows the expansion of RE. "The licensing and grid connection hold-ups are the main roadblocks to increased wind energy development" (EWEA, 2005). RES installations require the agreement of more than 35 public sector entities at central, regional, and local level. In addition, they need to conform to four national laws and seven ministerial decrees. The case of Belgium is similar, where up to recently, there were low deployment rates in renewable energy projects due to extensive and non-transparent administrative procedures (FORRES, 2005). In Netherlands and Scotland, according to the EC, the time needed to obtain the necessary permits can take 2-7 years.

The incentives given to renewable projects in Germany on the other hand, the country with the highest installed capacity of wind energy in the world, are much different. Municipalities have to show in their spatial planning where it is feasible to build wind plants, making it easy for investors to find lands for development. It has also created a "one-stop authorization agency", which is in charge for the coordination of several administrative procedures, instead of having interested parties deal with different levels of administrations. This is also the case of Denmark, and these changes have helped to facilitate the planning process considerably, since administrative procedures are concentrated only at a single level, reducing the time and permits necessary to develop a project.

3.5 Regulatory Framework

Renewable sources are in disadvantage against conventional technologies. Some of the inherited barriers of RES analyzed before, such as the higher capital costs, the intermittency in some technologies and the investment risks in "emerging" technologies cause RE to be in an unleveled position with conventional technologies. To make it feasible for generators to produce RES-E, national governments must support its development, just as is required by the Renewables Directive.

However, the additional support that governments give to renewables is far from enough. The EC gives national governments the liberty to establish their own implementation strategies and methods as a means of achieving the energy sector restructuring. The progress that RE has seen has been thanks to just a few committed MS that have created the necessary conditions to give RE the support that it needs to be feasible for companies to produce electricity out of RES. The EC recognizes that $1/3$ of the MS do not sufficiently support wind energy, $1/2$ of them do not do the same for biomass forestry, and $2/3$ of the countries do not give enough support to biogas. To help meet the RES-E and CO_2 emission reduction targets, the MS should increase the help that they give to renewable technologies. This aid comes in the forms of subsidies, R&D funds, and support mechanisms.

3.5.1 Subsidies

The subsidies given to the conventional energy sources (fossil and nuclear) are an important obstacle to the deployment and development of RE; these amount to US$250 billion worldwide per year (EREF). They can take a variety of forms, including: direct support to consumers, direct payments to investors in large and capital intensive projects, tax exemptions, price caps or ceilings and more subtle and indirect forms such as transmission grid support, regulatory hurdles for small and distributed power and agreements on formulas for risk calculation that emphasize volume of electricity rather than the security of fuel inputs (Pershing and Mackenzie, 2004).

According to The Economist[7], more than half of the subsidies (in real terms) ever given to energy by OECD governments have gone to the nuclear industry alone. Fossil fuels and nuclear energy have historically received subsidies from governments to promote their development. Renewables, however, have not received the same help. In the US, for example, wind, solar, and nuclear power received around $150 billion over fifty years, of which 95% was directed to nuclear power. In terms of kilowatt-hour generated, nuclear energy received far higher levels of support early in its history than did solar or wind. As shown in Table 3, between 1947 and 1961, commercial, fission-related nuclear power development received subsidies worth $15.30 per kWh. On the other hand, between 1975 and 1989 solar energy received subsidies of $7.19 per kWh and wind only 46¢/kWh. In their first 15 years, nuclear and wind technology produced similar amounts of energy (2.6 billion kWh nuclear and 1.9 billion kWh wind) but the subsidy to nuclear outweighed that to wind by a factor of over 40[8].

---

[7] The Economist, Nuclear Power out of Chernobyl's shadow, May 6th 2004.

[8] Goldberg, 2000.

Category	Nuclear	Solar	Wind
15 years of subsidies	1947-61	1975-89	1975-89
Cumulative Subsidy (bill. 1999 dollars)	$39.4	$3.4	$0.9
Cumulative Generation (billion KWh)	2.6	0.5	1.9
Subsidy per KWh (1999 dollars)	$15.30	$7.19	46¢
25 years of subsidies	1947-71	1975-99	1975-99
Cumulative Subsidy (bill. 1999 dollars)	$76.0	$4.4	$1.2
Cumulative Generation (billion KWh)	114.6	8.6	32.9
Subsidy per KWh (1999 dollars)	66¢	51¢	4¢

Source: Goldberg, 2000

Table 3. Comparison of Cumulative Electricity Generation Subsidy Costs.

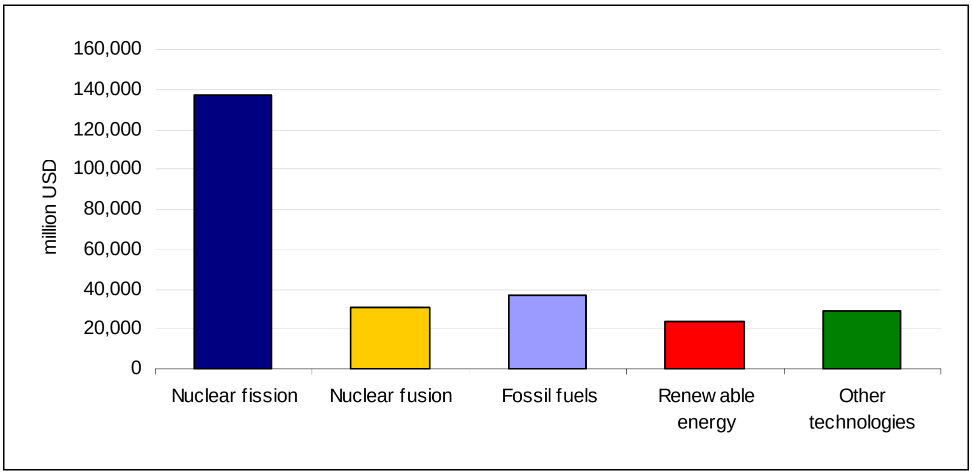
Clearly RE cannot compete with conventional sources with such an unleveled playing field. Government support for nuclear power and fossil fuels has far surpassed support for renewable technologies and this imbalance has resulted in unequal technology development and commercialization.

3.5.2 Research and Development

Renewable technologies become more cost competitive through technology and innovation and learning curves (Gross et al., 2002). In this case market penetration and increased production reduces costs. Subsidies are an important aspect of the learning curves because they will make it more feasible for organizations to employ technologies that are not cost competitive and in this way these technologies can penetrate markets and reduce their costs with economies of scale. Research and development, on the other hand is an important factor for technology innovation.

While wind energy can already be cost competitive with newly built conventional plants at sites with good wind speeds, according to EWEA (R&D for Wind Energy) significant further cost reductions are necessary through market development and R&D. Some 60% of cost reductions in the last two decades are estimated to be the result of economies of scale brought about by increased market volume, in just a handful of MS. The remaining 40% of cost reductions can be directly attributed to research and development.

According to IEA (Renewable Energy, Market & Policy Trends; 2004) out of the total energy research budget of IEA countries between 1974-2002, i.e. 291 billion USD, only 8% was spent on RE. Nuclear fission received 47% of the budget and fossil fuels 13% (Figure 10). The EC has stated that only 10% of government energy R&D budgets are related to renewable energy compared to more than 50% for conventional.



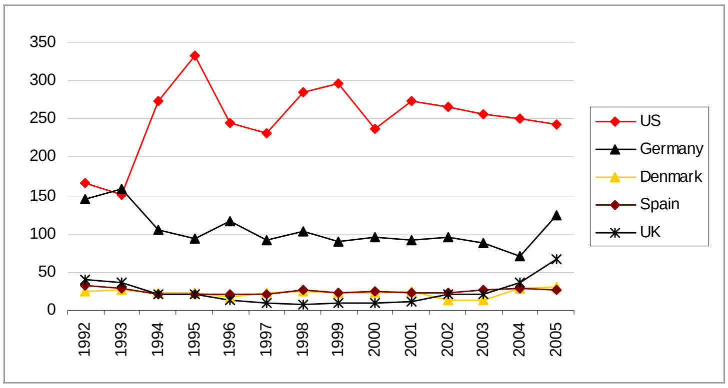
Source: IEA-Renewable Energy Market & Policy Trends in IEA Countries

Fig. 10. Government Energy R&D Budgets in IEA Countries, 1974-2002.

In the longer term – by 2020 and beyond – if technologies that are currently immature must also become important, the process must be facilitated with adequate support for research and development. In European countries this is not happening, as the spending on renewable R&D is too low compared with US standards, shown in Figure 11.

3.5.3 Support Mechanisms

The third form of support is support mechanisms. They are largely responsible for the deployment of RE in Europe, as they ensure stable investment conditions that act as incentives to increase investments on renewable energy technology. Without such support RES-E would not be cost-effective for energy producers. However, the large penetration of RE has just happened in a few countries. These are the same countries that have implemented adequate support schemes to reduce investor uncertainty and have given more incentives to companies to produce RE.



Source: Own elaboration with data from IEA

Fig. 11. Spending on renewable R&D Million USD
(2005 Prices and exchange rates).

As mentioned before, there are four types of support mechanisms: feed-in tariffs/premiums, tax incentives, green certificates, and tendering systems. The first two are fixed price systems, where the government dictates the electricity price (or premium) paid to the producer and lets the market determine the quantity. The last two are quantity systems, where the government dictates the quantity of renewable electricity and leaves it to the market to determine the price. There is no consensus on which system works best. Past experience has shown that policies based on fixed tariffs and premiums can be designed to work effectively. However, introducing them is not a guarantee of success. Almost all countries with experience in mechanisms to support renewables have at some point in time used feed-in tariffs, but not all have contributed to an increase in RES-E.

The long-known countries that have established sufficient incentives to the renewable sector are Denmark, Germany, and Spain. These three countries have used feed-in tariffs to promote wind energy, specially. However, the tariff has not been the only element in the successful policy. Other countries have used feed-in tariffs but have not had the same success, as will be shown.

Both feed-in tariffs and obligation certificates have advantages and disadvantages. In the case of the former, its perceived advantages are the attractive tariffs and long-term stability and transparency. However, it is not thought of as being cost effective for the government. In the case of the latter, it is perceived positively because it is market-based (cost effective) but lacks a long-term price stability since the value of the certificates can be deterred if the total generation of renewable energy exceeds the target, especially if a new, lower cost renewable source gets quick success. It also requires an enforcement of penalties when countries do not produce the renewable quota that they are supposed to, and it supports only the most cost competitive technologies, in this case in a large part wind energy.

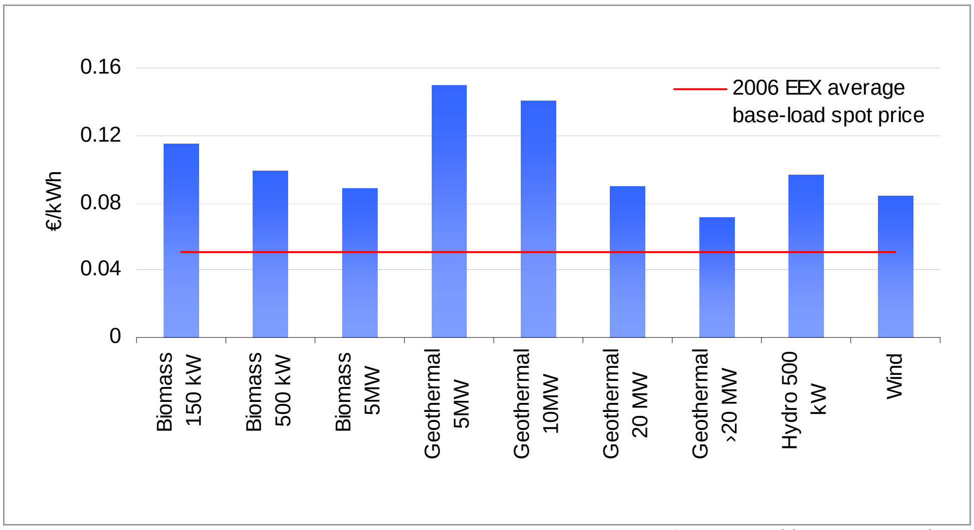
The results of these two support schemes in MS with different technologies are mixed. No one scheme gives always better results than the other. “Renewable energy sources are diverse, not only in their technologies, but also in their economics, stage of development, and other factors, and this means that different support schemes may be appropriate at different times” (EC- Electricity from Renewable Energy Sources). This section argues that it is rather the design of the mechanism, in combination with other supportive government policies that provide long-term security that determines the success of RE deployment.

In the European Union most of the countries do not support RE adequately. In the three successful countries mentioned above (Germany, Denmark, and Spain), strong political commitment to wind power has translated into measures to ensure grid access, lower administrative barriers, and in particular, to create a stable environment into MW of green electricity. Stability is in fact the number one characteristic that investors and project developers wish support schemes have (ECOFYS – Renewable energy markets in the EU-15).

Germany

Germany is the country with the highest installed wind energy capacity in the world. It is the second country with the highest solar PV generation capacity worldwide (first European), and the country with the highest growth in this same sector. It is also a European leader of solar thermal installations and biofuel production. In biomass it is the second highest producer and from 1997 to 2002 doubled its production of electricity in this sector. The question of course, is how has Germany achieved this? A big part of this success is the stable and predictable policy framework that it has created through the Renewable Energy Sources Act. This law has created conditions favorable to RES penetration and growth.

First of all, the law shifts obligation to give grid access to renewable energy plants and purchase electricity at premium prices from the utilities to grid operators. Equally important is the fact that tariffs are set for each individual technology. This aspect is very important because it will give incentives to producers of using different technologies and not just those that are less costly. Wind power production, for example, receives a tariff of €0.084/KWh over a twenty year lifetime, while biomass receives a tariff of €0.115/KWh for a plant up to 150KW, €0.099/KWh for up to 500KW and €0.089/KWh for up to 5 MW capacity. Geothermal, hydro, and solar plants also have different tariffs depending on the plant capacity size. On the European Energy Exchange (EEX) in Germany, spot prices in 2006 (base load) averaged €50.8/mWh, compared with €46.0/mWh in 2005.



Source: World Resources Institute

Fig. 12. Tariffs for individual renewable technologies.

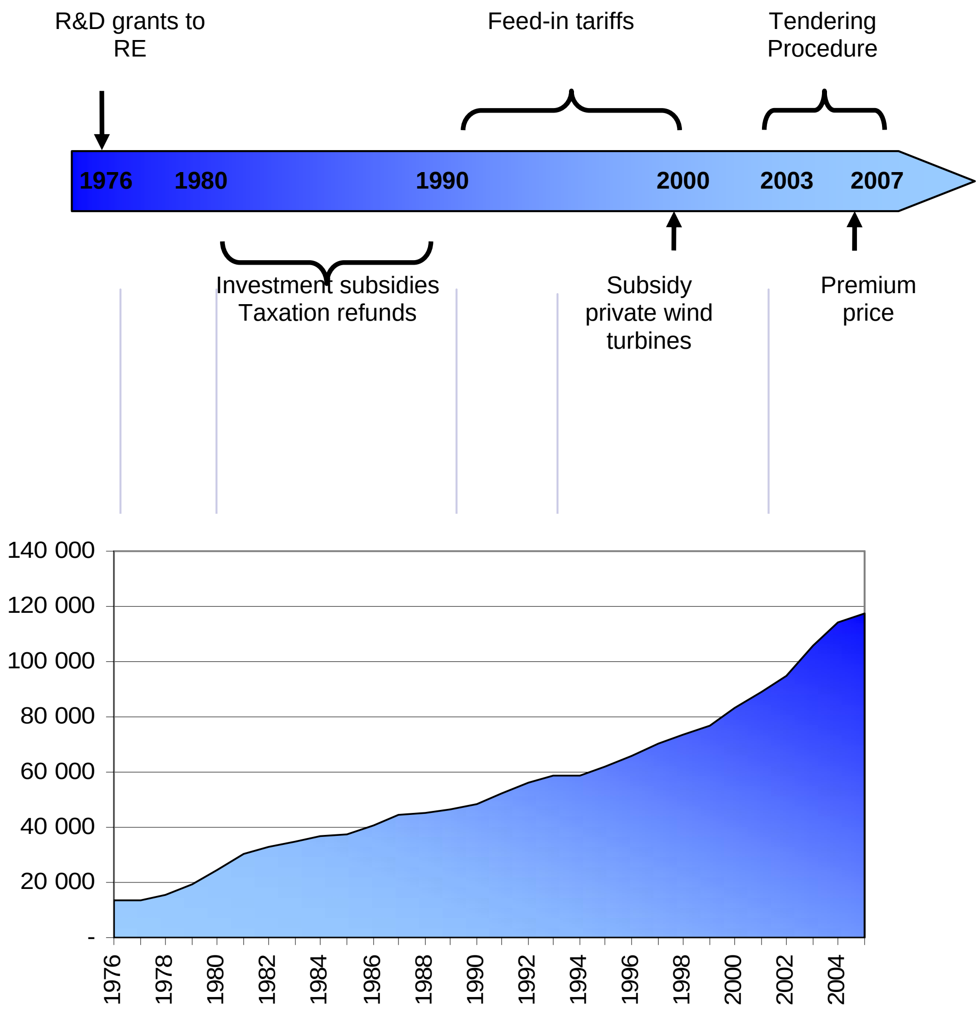
Another important aspect is that several German incentives are administered at the state level. Almost all states offer incentives of special tariffs and reductions in investment costs.

Denmark

Denmark has seen a large increase in wind power capacity, although because of its small size it does not have as much as other countries. However, its growth in offshore wind capacity is the highest in the world and in per-capital levels in Europe as well. Its production from biomass tripled in the period of 1997-2002. Denmark subsidizes 15-30% of the construction projects for standard renewable energy equipment, or up to 50% for development projects. A big incentive for self-generators is the subsidy for electricity production from biomass and private wind turbines. Non-utility wind turbines commissioned before the year 2000 received 8.1 ct/KWh until a certain "full-load hour ration" had been used up. After that they received 5.8 ct/KWh until the turbine reached ten years of age. Electricity from biomass-based plants continues to receive a fixed price of 8.1 ct/KWh. After the successful feed-in tariff system Denmark introduced a premium system that compensates for balancing costs (€13/MWh) for 20 years for new onshore wind farms.

The Danish energy policy has supported RE technologies through various stages of their development, and according to ECOFYS, this has been helpful. It started with strong R&D support, and then offered tax incentives, followed by high feed-in tariffs and finally a premium system (Figure 13). The successful energy policy has given Denmark good results in its RE production. Unfortunately, many investment subsidies were cut in 2002 and after the feed-in tariff was ended the government introduced a tendering procedure.[9] The political uncertainty in the introduction of the new system has hindered new renewable energy investments.

[9] Under a tendering procedure, the state places a series of bidding processes for the supply of RES-E, which is then supplied on a contract basis at the price resulting from the process.



Source: Coenraads, n.d., Damsø Pedersen, 2005, Danish Energy Authority

Fig. 13. Danish Energy Policy Instruments and Production of Renewable Energy in Denmark, TJ.

Spain

The other successful country, Spain, has installed capacity growing since 1997, when the first piece of legislation to support renewables was passed. The incorporation of renewables' production to the main electricity trading market and a reasonable rate of return on investment has given confidence to investors. There are a number of barriers that still stand in the way of RE expansion, such as the excessive administrative process, with up to 60 regulations and 40 proceedings in force at a local, regional, and central government level, as well as grid issues.

However, the Spanish success is thanks to a stable policy framework that establishes important rights (EWEA – Spanish Wind Market). These rights include the right to connect renewable installations to the grid; the right to transfer their output to the grid; and the right to receive in return a remuneration consisting of the hourly price set in the spot power market supplemented by a premium. Producers can opt for a fixed price to guarantee annual revenues or the spot price plus the premium. The legislation improved shortcoming of former payment framework by guaranteeing the new tariffs for whole lifetime of plants. Like Germany, it gives different tariffs to different technologies and provides long-term stability by assuring tariffs for many years. In the case of solar thermal, generators receive a fixed tariff of

300% of the reference price (€0.21/KWh) during the first 25 years after start-up and 240% thereafter. The government also offers corporate tax deductions for investments in RES. These are not eligible, however, for wind power equipment.

As the EC in its publication "Electricity from Renewable Energy Sources" says, in Spain, the drive to wind power is guided by national policy and implemented at regional level. Several states administer programs and incentives such as investment subsidies. This is similar as in Germany and permits companies accessing for funds at the local level as well.

The majority of the MS has a large potential in increasing RE production, but have not addressed the issue correctly. Such is the case of Greece, which had a reasonable tariff and guaranteed 10-year contracts. Nevertheless, the problems derived from the lengthy and bureaucratic process of negotiating the procedure for a production, installation, and operation license. Until very recently the feed-in tariffs were uniform. However, they are now technology-specific and a guarantee of 12 years is given. In Netherlands, the framework suffered too many changes. In 2000 the government started a certificate system, which was changed to production subsidies which excluded hydro in 2002. A year later it finalized the production subsidies and the tax exemptions that were offered were halved. In 2004 tax exemptions were once again halved and in 2005 and 2006 there have been four tariff changes. Furthermore, in August 2006 most of the feed-in tariffs were set at zero due to budgetary reasons.

In the Czech Republic, despite the government support, the latest figures show that in the first half of 2005 the share of renewables on electricity production decreased by 5.8%. The main cause was the decline in co-firing of biomass and coal (70% less compared to figures from 2004) by leading power producer CEZ. CEZ responded to the reduction of feed-in tariffs set by the state energy regulatory authority. In Hungary, although several sources say that the price is guaranteed until 2010, the Law actually does not say for exactly how long the price is insured. The Law says that permission to operate should be given for a period that allows a payback period of the investment with a decent profit under efficient operation. These terms are ambiguous and lead to confusion.

The FORRES 2020 Report supported by the EC claims that several countries have used high support tariffs, like the Dutch green electricity support in 2001-2002 or the Portuguese feed-in tariff scheme. Others, like the Irish tender scheme have provided strong investment conditions. However, these three countries have lacked a long-term certainty and good investor security like the German support system. France is also one of the countries that although it offers high or fair tariffs (0.0838 cts./KWh), the problem is in the design of the support mechanism. For all technologies the size of eligibility projects qualifying for buy-back rates is limited to a maximum size of 12 MW. Additionally, from 2003 onwards the payments are reduced by 3.3% per year.

Another example is presented by the situation of Austria. Austria had during both 2003 and 2004 a surge of wind power activity. In the first year a total of 276 MW was connected to the grid, which almost tripled the country's installed capacity. In 2004, 192 MW were further added. The reason for this boom was the adoption of a feed-in system, making it mandatory for suppliers to purchase green electricity and with the price guaranteed for thirteen years. However, the boom has been hindered by troubles with the system. Besides the lack of a fast track procedure for renewable electricity producers and no clear and transparent rules governing the procedure for grid connection, producers have to bear all the costs of grid connection or reinforcement.

The most important problem, however, is that the feed-in law was blamed for the high cost of electricity. In May 2006 there was a decision taken by the authorities to decrease the total budget available for the purchase of electricity at the established price to just €17 million. About five times as much as this had been paid out in 2004. The Austrian Wind Energy Association concluded that with the proposed changes only 30 MW of new projects can be possible each year.

Before these changes were approved, a vote in the Austrian parliament to determine precisely this new legislature rejected them. At the same time that the vote was taking place, the initial period of operation of the feed-in law came to an end. Approval was needed by the Minister for the Economy for the level of payments to be made to fresh projects applying for support after the end of December 2004. The new legislation was approved until mid-2006. Meanwhile, there was no certainty at all to what was going to happen.

The two Belgian regions, Flanders and Wallonia, each have a green certificate market with obligatory targets. There is a relatively high financial support, since in Flanders the average price during the first half of 2006 was around €110/MWh and in Wallonia it was around €92/MWh the first three months of the same year. The existing deployment rates are low however, due to extensive and intransparent administrative procedures. Furthermore, the penalty rates that prevail at the moment for those who do not meet the obligatory targets are so low that it is more favorable to pay penalties than to use the certificates. Thus, little trading has taken place so far.

As is shown in the previous country-specific examples, there are both cases in which countries with both feed-in/premium systems and with green certificates show good signs of progress and of failure as well. The important conclusion is not that a specific support mechanism acts as a barrier in the deployment of renewable energy, but that the barriers are found in the level of support that the government gives to RE producers and the lack of stability in the design of the mechanisms. }

4. PROPOSAL

Under the self-generation options renewable energy represents one of the best alternatives. However, serious limitations in the support at a national and European-level, as well as on the market design and infrastructure harm the access of large industrial users to a self supply of renewable energy. Although the production and consumption of RE has grown and continues to increase at fast rates, and there has been an effort from the European authorities in creating the right conditions to support RES, the fact is that most countries are behind their RES-E targets. The partial success that the renewable energy sector has had is in great part due to the development and deployment of wind energy alone. The Directive’s target of meeting 21% of Europe’s electricity consumption from renewable sources depends heavily on a significant contribution from wind power (EC-Electricity from RES, 2004). As of 2005, five years before the target dateline, only 13.6% of the electricity consumption came from RES-E.

The investment costs of wind plants are the most competitive with those of conventional technologies. This, however, has happened because of continued support from a few committed MS whose successful policies and R&D support have helped in the technical development of wind turbines and market penetration. Despite this achievement, the potential of wind energy in Europe is far from reached. The other renewable technologies have also a big potential. European authorities and national governments must continue to improve the policies implemented to make renewable energy more accessible and reach the target of electricity consumption from renewable energy. Particularly, the European Commission needs to send a strong signal to the private sector by removing barriers and supporting investment decisions.

4.1 Infrastructure and market

The success of electricity users in accessing RE to supply their own electricity will depend to a large extent on the removal of the barriers analyzed before. There is a need of improvement on the network infrastructure so that the self generators that wish to have access to the grid can do so. Several studies have already concluded that there is no risk in connecting large amounts of renewables to the grid (UKERC, 2006). What is true, however, is that grid systems have been underinvested for many decades, and to support a larger penetration of renewables, especially intermittent, there needs to be an upgrade of the grid, taking into account all technologies. An expansion of interconnections as well, will reduce the balancing costs caused by higher penetration levels of renewables. The situation with grid codes in various MS needs to be improved to arrive at technically and economically justified requirements.

Perhaps a European-level independent regulator could monitor and develop the requirements for grid connection. The grid codes, however, must not be harmonized as it could lead to the implementation of the most costly requirements all over Europe. This can be gradually prepared by an independent regulator or the EC itself.

Connection costs can be sometimes a big barrier to connect renewable plants to the grid. It will be important to establish shallow connection costs so that the project developer does not pay for all costs. They should be fair and transparent; the cases of good practice in the sharing of costs of Denmark and Germany can be taken as examples. The complex authorization procedures, the involvement of several authorities and the long lead times in planning procedures should all be simplified to allow for a faster development of RE projects. One-stop authorization agencies are a solution also implemented in Germany and Denmark. This will let the coordination of several administrative procedures be concentrated at a single level, which in turn will reduce the time and permits necessary to develop a project. Equally important is to include in the spatial plans of municipalities where RE projects can be developed. If this is the case, the start of the development process is faster and beneficial for interested parties.

4.2 Regulatory Framework

Improving the infrastructure and market design is only a first step to improve the access to renewable energy. The support that RES receive from subsidies, R&D, and support mechanisms will ultimately be the deciding factor in the creation of a more reliable and cost effective power supply.

Lowering the unit costs of renewable technologies requires experience – which comes from building or operating plants, and/or technology. However, few energy technologies have reached maturity without substantial public sector investment (Pershing and Mackenzie, 2004). In the mid-1800s the UK government subsidies to coal contributed to its rapidly increasing use, and helped fuel the industrial revolution. Similar levels of government support have been found in subsequent energy transitions, “including those driving oil and natural gas production and use, as well as nuclear power”, where governments not only directed financial aid, but also paid for the research and development needed to overcome technical barriers to implementation.

Even though fossil fuels and nuclear power are fully developed technologies and have reached their deployment and development potential, they still receive far more subsidies than any renewable technology. A subsidy reform that rebalances the financial support to energy fuels is necessary. This trend has to change especially in the case of capital flows for new power plants. Subsidies need to support capital investments of new plants, since such investments are a big barrier of RE projects.

As Pershing and Mackenzie comment, an important aspect is how to overcome the political barriers to realize these changes, since the political impediments to enact such changes remain high. It is clear though, that the European-level authorities must drive for enforcement at the national level. In particular, the Subsidiarity Principle of enabling national governments to procure their own strategies and methods, although to an extent understandable, could be amended at certain levels. MS need clear guidelines that in some cases should be required to do. In the case of subsidies, the EC should push for a legislation that entails MS to give more obligatory financial support to RE.

The same applies to the case of the support to R&D. Although the amount allocated to R&D of RES has increased in the last years, reaching higher levels than those of fossil fuels in IEA member countries, it is just 28% of the amount given to nuclear fission and fusion. Furthermore, the amount of RES consists of all renewable technologies, including solar energy, wind energy, ocean energy, bio-energy, geothermal energy, hydropower, and other renewables. If these individual categories are analyzed, only the R&D budget of total solar energy reaches the same levels of those of oil and gas or coal. However, solar energy also comprises more specific technologies like "Solar Heating and Cooling", "Photovoltaics", and "Solar Thermal Power and High Temperature Applications".

The budget allocated to each individual renewable technology is too small. The technology developments that could reduce capital costs depend in large part to these R&D budgets. It is necessary to increase funds to all RE technologies, particularly to those less developed and with great potential like marine and tidal projects. It is difficult to understand why energy R&D budgets in IEA member countries and in the EC Framework Programmes have been reduced. Europe claims to be the leading region in terms of renewable energy, but such a claim is not implemented at the researching level.

With respect to support mechanisms, as has been said before, this paper does not suggest that applying one mechanism over the others renders better results. All depends on the different conditions within every country. A successful mechanism is one that above all is stable, and provides long-term investment security to affected parties. The duration of the schemes must be known, and in the case of tariffs and premiums must be guaranteed for several years to allow recovering investment. Private investors must be given better visibility in the marketplace. This also means facilitating access to the market to self-generators who wish to have a connection to the grid and be able to sell or buy electricity from it.

Equally important is to give to every renewable technology its importance. Future energy scenarios in Europe require an equal share of the market of every technology. The IEA has mentioned that a diverse mix of technologies harnessing different resources will help with problems of intermittency and the EC has stated that encouraging technology diversity is important. Europe disposes of the resources to support energy from several technologies. Regulation must ensure that support schemes are technology differentiated, with the level of support varying between technologies, reflecting differences in cost structures.

Renewable energies have increased their contribution by 55% in absolute terms in a decade, when the EU started working towards a target of a 12% share of renewable energy in its overall mix by 2010.

The EC estimates that this share is unlikely to exceed 10% and won't be enough, as well, to reach the target of 21% RES-E for EU-25. The partial success of RE penetration has been because of the success of wind energy. But the other technologies have not had the same achievements, although they have a big potential.

Subsidies, R&D, and support mechanisms need to be directed to all renewable technologies. These technologies depend on site and resource availability, so companies willing to invest in a specific plant find the correct incentives and support from its government to develop this plant. If a great technological diversity can be fomented, then self generators will have more options to develop plants. This is precisely what is needed to access that reliable and cost-effective supply that electricity consumers need.

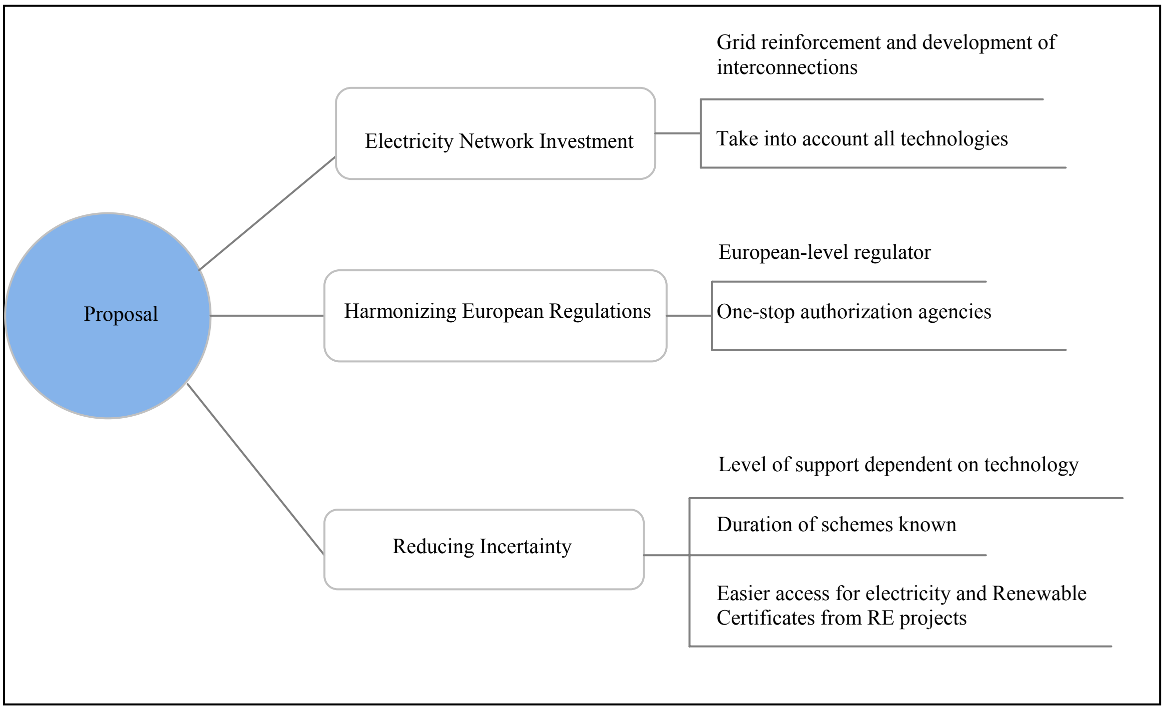


Fig. 15. Proposal for modifications in regulatory framework.

5. CONCLUSION

Energy policy in Europe is gaining unprecedented levels of importance. Access to a cheap and reliable supply of electricity is key in the success of any firm. However, the internal electricity market in Europe today is not delivering the results that electricity users need.

The option of self supply is an important alternative to the large industrial user that must be considered, as was explained before. Self generation, however, renders different possibilities. Given the prevalent conditions of higher fuel prices, price volatility and the approach given to renewable energy in the last few years, self supply through renewable energy is a serious choice for a cost effective and reliable power supply.

Renewable energy, despite the support it is receiving, faces crucial barriers to its deployment and development. Financial, operational, and infrastructure barriers, as well as some in the regulatory framework impede successful access to RES.

The purpose of this paper was to make a proposal to adjust the regulatory framework to incentive renewable generation, especially through self supply. By proposing changes in the market, infrastructure, and regulatory frameworks at national and European level, the industrial user might improve its power supply.

It has been highlighted that to promote full potential of renewable energy, the policy has to address all renewable technologies. It is equally important to have the circumstance of each particular country in mind, and take into consideration all factors that give each MS a distinct situation. However, even after considering these elements, it is crucial to say that most member states do not support renewable energy in the way that a few of them successfully have. It is imperative that the European authorities promote the mentioned changes at the national level. In this way only will the regulatory framework evolve to one that provides certainty to investors and promotes opportunities for self supply in order to deliver the objective of a competitive supply of energy.

REFERENCES

BOISSELEAU, F.H.A.R. AND R.A. HAKVOORT, 2003. *The liberalisation of the European electricity market(s): an unstructured restructuring process?*

COENRAADS, Roger (n.d.). *Renewable energy markets in the EU-15 Support schemes and barriers*, Ecofys, Energy and Climate Strategies.

COENRAADS, Roger, 2006. *Analysis of barriers for the development of electricity generation from renewable energy sources in the EU-25*, OPTRES Report.

CORY, Karlynn S., 2005. *State Approaches to Financing New Renewable Energy Projects*, Energy Analysis Office – NREL. Presented at Green Power Marketing Conference.

DAMSØ PEDERSEN, Camilla, 2005. *EU Renewable Energy Policy*, Master Thesis for Department of Environment, Technology and Social Studies Roskilde University.

DANISH ENERGY AUTHORITY. *Annual Energy Statistics 2005*, http://www.ens.dk

EC, 2005. *Communication from the Commission – The support of electricity from renewable energy sources* {SEC(2005) 1571}. Commission of the European Communities.

EC, 2007. *Communication from the Commission to the Council and the European Parliament – Priority Interconnection Plan*. Commission of the European Communities.

EC, 2004. *Electricity From Renewable Energy Sources – Encouraging Green Electricity In Europe*, Commission of the European Communities.

ECOFYS, 2005. *FORRES 2020: Analysis of the renewable energy sources' evolution up to 2020*, Final Report.

EIWEN, 2004. *Policy Paper on Collaboration between European and Indian Wind Energy Sector & Opportunities and Threats for Wind Energy in a Privatized Sector in India*, Report Prepared under EU – India Wind Energy Network (EIWEN) Project.

EREF,2007. *Renewable energy: The answer to Europe's problems*, Dr. Dörte Fouquet – Point Carbon Conference.

ETSO, 2005. *Integration of Renewable Energy Sources in the Electricity System –Grid Issues–*, European Transmission System Operators.

EURROSTAT – Environment and Energy Statistics, http://ec.europa.eu/eurostat

EWEA, 2003-2004. *Wind Energy – The Facts*, European Wind Energy Association and Directorate General for Transport and Energy.

EWEA, 2005. *The Spanish Wind Market – Dynamic and Focused*, European Wind Energy Association.

EWEA, 2006. *Focus on 2030*, European Wind Energy Association.

EWEA, 2005. *The second wave: Europe's growing markets*, European Wind Energy Association.

EWEA, 2005. *Large Scale Integration of Wind Energy in the European Power Supply: analysis, issues, and recommendations*, European Wind Energy Association.

GLACHANT, J.M. AND F. LÉVÊQUE, 2005. *Electricity Internal Market in the European Union: What to do Next?*, SESSA research project on European electricity regulation.

GROSS, R., M. LEACH, and A. BAUEN, 2002. *Progress in renewable energy*, Environ. International.

HANCHER, L, 1997. *Slow and not so sure: Europe's long march to electricity liberalization*, The Electricity Journal , 92-1001.

IEA, 2005. *Variability of Wind Power and Other Renewables: Management Options and Strategies*, International Energy Agency.

INFORSE-EUROPE, 2006. *Study of the Introduction of Renewable Energy in the EU*, International Network for Sustainable Energy.

KLEIN, Alex ,2007. *Comparative Costs of Energy in Europe 2007*, Emerging Energy Research.

KUECK, J.D., B.J. KIRBY, J. ETO, R.H. STAUNTON, C. MARNAY, C.A. MARTINEZ, and C. GOLDMAN, 2001. *Load as a Reliability Resource in Restructured Electricity Markets*, ORNL/TM2001/97 and LBNL-47983. Oak Ridge, Tennessee: Oak Ridge National Laboratory.

MEEUS, L., K. PURCHALA, R. BELMANS, 2005. *Development of the internal electricity market in Europe*, Electricity Journal, Vol. 18, No. 6, pp. 25-35, ‹http://www.esat.kuleuven.be/electa›

NEWBERY, D., 2002. *Mitigating Market Power in Electricity Networks*, mimeo, Department of Applied Economics, Cambridge University.

NOORD, M. DE, L.W.M. BEURSKENS, AND H.J. DE VRIES, 2004. *Potential and Costs for Renewable Electricity Generation*, ECN-C--03-006.

PATTERSON, Walt, 1998. *Electricity: Network Futures, Energy and Environment*, Royal Institute of International Affairs, Transforming Electricity, Working Paper 4.

REINAUD, Julia, 2007. *CO2 Allowance & Electricity Price Interaction – Impact on industry's electricity purchasing strategies in Europe*, IEA Information Paper.

RESCH, GUSTAV, THOMAS FABER, REINHARD HAAS, MARIO RAGWITZ, ANNE HELD, INGA KONSTANTINAVICIUTE, 2006. *Potentials and cost for renewable electricity in Europe*, OPTRES: Assessment and optimization of renewable support schemes in the European electricity market. Report of the IEE project.

ROPENUS, S. and K. SKYTTE, 2005. *Regulatory Review and Barriers for the Electricity Supply System for Distributed Generation in EU-15*, Riso National Laboratory.

R&D FOR WIND ENERGY – THE EUROPEAN WIND ENERGY TECHNOLOGY PLATFORM, 2007 from European Wind Energy Association Web site: http://www.ewea.org/index.php?id=198

SCIENCE AND TECHNOLOGY – FOURTH REPORT, 2004. Science and Technology Committee Publications of the House of Lords.

SDC, 2006. *Meeting the challenge: energy policy for the 21st Century*, Sustainable development commission submission to the DTI energy review.

SKYTTE, K., P. MEIBOM, M. UYTERLINDE, D. LESCOT, T. HOFFMANN, and P. DEL RIO, 2003. *Challenges for Investment in Renewable Electricity in the European Union*, Background Report, ADMIRE REBUS Project.

SONNTAG-O'BRIEN, VIRGINA and ERIC USHER, 2004. *Mobilising Finance for Renewable Energies*, Thematic Background Paper for the Renewables 2004 Conference in Bonn.

UIC, 2007. *Renewable Energy and Electricity*, Nuclear Issues Briefing Paper 28, Australian Uranium Association.

UKERC, 2006. *The Costs and Impact of Intermittency: An Assessment of the evidence on the costs and impacts of intermittent generation on the British electricity network*, Report of the Technology and Policy Assessment Function of the UK Energy Research Centre.

UNEP, 2004. *Financial Risk Management Instruments for Renewable Energy Projects – Summary Document*, United Nations Environment Programme Division of Technology, Industry and Economics.

WALS, A.F., E. CROSS, and E.J.W. VAN SAMBEEK, 2003. *Review of current electricity policy and regulation*, Energy research Centre of the Netherlands (ECN).

WISER, RYAN and MARK BOLINGER, 2004. *The Value of Renewable Energy as a Hedge Against Fuel Price Risk*, Submitted for Publication: Proceedings: World Renewable Energy Congress VIII.

WORLD RESOURCES INSTITUTE, 2002-2007. Green Power Market Development Group – Europe. http://www.thegreenpowergroup