RENEWABLE ELECTRICITY
AND
LIBERALISING MARKETS
(REALM)

Working Group III:

How to improve the framework and design of national policies for the promotion of renewable electricity

Observations on Germany, the Netherlands and the U.K.

Final Paper

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1 INTRODUCTION

Most renewable energy options are not competitive under today's national regulatory frameworks. Yet, they are politically preferred for a number of reasons. The threat of global warming, other environmental hazards and resource depletion might be the dominant arguments for the promotion and support of renewable energy sources in most countries. However, other political goals often play an important role as well, for example security of supply, agricultural development, expansion of domestic industry sectors, etc.. Much of the political debate hinges on differing perceptions of the rationale for support of renewables. Governments and institutions should clearly define and weigh their objectives before implementing regulatory frameworks and policies. A focus on environmental goals leads to a different mix of optimal policy measures than an emphasis on the goal of job creation or industrial policy. Definitely, not all objectives can effectively and efficiently be achieved with only one instrument.

In the following, we simply assume that the main policy end is a large-scale market penetration of renewable sources of energy in the EU in the medium run (e.g. to reach the European Union's indicative target of doubling the share of renewable sources by 2010 [CEC 1997]), to make our energy systems sustainable in the long run. This implies that we are not aiming at analysing regulatory frameworks and other policies for greenhouse gases reduction, as the REALM project has an explicit focus on electricity and on renewable sources of energy. We are aware of the fact that renewable energy installations in the electricity sector might not in any case be the most cost-efficient options for reducing CO_2 emissions. However, we start from the assumption that there are, in addition to CO_2 reduction goals, other reasons for a government or a society which can justify the direct support and use of renewable energies.

In the past, companies and governments have created and implemented many different instruments for the promotion of electricity generation from renewable energies. Now in liberalising markets, the issue of (new competition-based) incentive schemes for renewable electricity has again been put on the political agenda in many EU member states and on the EU level. In Working Group 3 of the REALM project, we describe and evaluate the three types of support schemes that have recently been discussed most [also cf. Kühn 1999]:

- quota-based systems (with Green Certificates trading),
- bidding or tender-based systems and
- guaranteed feed-in tariff schemes.

We try to do the analysis from a scientific point of view to add another, but the utility perspective to the project. The assessment from a utility perspective has already been carried out in Working Groups 1, 2 and 4. Moreover, we would like to show that not all strengths, weaknesses and pitfalls currently discussed and stressed from the respective stakeholders are intrinsic in the respective category of incentive scheme, but are also due to the particular policy design and other circumstances in the countries usually referred to. An exact categorisation of support systems is difficult anyhow. In practice, there are different combinations and modifications to all three mechanisms. On the other hand, evaluation and success of support schemes for the promotion of renewable energies do not entirely depend on implementation details.

In a first step, selected national support measures are described and evaluated. Then, issues important for the functioning of all schemes under analysis are discussed. Finally, recommendations are given how the reviewed national incentive schemes for electricity generation from renewable energies could be improved and some of the problems faced could be resolved.

2 SELECTED NATIONAL SUPPORT SCHEMES

2.1 Non-Fossil Fuel Obligation in England and Wales

History and design

The origin of the Non-Fossil Fuel Obligation (NFFO) for renewable energy could almost be seen as an accidental by-product of the nuclear industry.

The electricity industry was privatised and liberalised in 1990/91, following the passing of the Electricity Act in 1989. One of the key purposes of the privatisation was to bring private investment into the sector. However, early in the privatisation process it became clear that the size of the decommissioning liabilities attached to the nuclear plants would make them extremely unattractive to the private sector. After much political debate, it was decided that the nuclear power stations owned by the old vertically-integrated monopoly the 'Central Electricity Generating Board' (CEGB) would be retained in public ownership. This still meant that funds had to be secured to pay for their eventual decommissioning.

To meet this cost, the Electricity Act therefore defined the Non-Fossil Fuel Obligation, whose purpose was to raise funds to meet the future costs of decommissioning the nuclear power stations which had not been privatised. The civil servants responsible for supporting renewable energy were able to argue that, by being a 'non-fossil fuel' obligation, it could be applied equally to renewable energy as much as nuclear electricity. This point of view was accepted, and in the first years of the NFFO, the non-fossil fuel levy which was applied to electricity consumers was about 10% of the total cost of electricity, of which less than 1% was for the renewable energy support.

NFFO is a statutory obligation upon the Public Electricity Suppliers (PESs) which requires them to buy specified amounts of renewable energy according to Orders set by government, at a premium price. The cost of purchasing this renewable energy is funded by the levy on electricity consumers.

The renewable energy projects from which the PESs buy renewable energy are those which compete successfully in a tendering process which leads to contracts for the most competitive producers in each of the technologies specified by the Government. Initial contracts (NFFO-1 and NFFO-2) were awarded with power purchase agreements (PPAs) that were time-limited, and expired at the end of 1998. Later ones (from NFFO-3 onwards) were set for a duration of 15 years from the date of commissioning.

The NFFO mechanism achieves competition between renewable energy developers through a bidding process. The steps of the process are as follows.

1. The responsible Minister announces that a new non-fossil fuel order will be set, and invites bids from renewable energy developers, in certain 'tranches' or 'bands' of technology. A deadline for receipt of these bids is fixed, and detailed instructions to bidders are issued.
2. Developers prepare their bids and submit these. Considerable technical and commercial effort is usually involved in preparing a bid. Bids provide significant detail in terms of price, energy technology, environmental impact, electrical connection details, and local authority planning application.
3. Bids are received centrally and ranked in order of price.
4. Bids are furthermore filtered by the so-called 'will secure' test. This test is designed to filter out those bids that are unlikely to result in a viable project, even if offered a contract. This filtering takes account of technology risk, conflict with planning guidelines and other

factors.

5. Once the full range of bid prices of viable projects is known, the government takes a political decision to set the order at a particular size in terms of installed capacity in MW, in each technology band.
6. In setting the order, the cheapest bids in each technology band are accepted in preference. The last bid in the band (i.e., the marginal bid) is therefore most expensive, and sets the final price paid for the whole band.
7. All projects that fall below the final price are offered contracts at the band price.
8. In the case of the NFFO 3-5 orders, the obligation lasts for 20 years. Power Purchase Agreements (PPAs) are available for up to 15 years, and are index-linked to proof them against inflation. Therefore there is a 'window' of five years in which projects may be built. They can still be built after this 'window', but they will then receive the preferential price for less than 15 years.

Development

The following table shows the size of orders made, and the scale of project implementation to date, for the five non-fossil fuel orders in England and Wales.

Table 1: Status of NFFOs at March 31, 1999

Order	Order date	Projects contracted		Projects commissioned		Completion rates		Average prices in p/kWh	Average prices in cEURO/ kWh
		Number	MW	Number	MW	Number	MW		
NFFO1	Sept-90	75	152	61	145	81%	95%		
NFFO2	Oct-91	122	472	82	174	67%	37%		
NFFO3	Dec-94	141	627	68	244	48%	39%	4.35	6.7
NFFO4	Feb-97	195	843	32	66	16%	8%	3.46	5.4
NFFO5	Dec-98	261	1,177	3	5	1%	0%	2.71	4.2
Total of all NFFOs		**794**	**3,271**	**246**	**634**	**31%**	**19%**		
		Completion rates excluding NFFO5:				46%	30%		

Sources: DTI (1999), OFFER (1998)

It is instructive to examine the NFFO-5 round to illustrate how the process works. Following announcement of the new round, the government received bids from 408 projects with a total capacity of 2,579 MW, located throughout England and Wales, plus one in Scotland. The majority of projects involved landfill gas or wind generation, and scheme size ranged between less than 1 MW to over 25 MW. The average bid prices in the technology bands lay between 2.63p/kWh and 4.43p/kWh, significantly lower than under the previous NFFO-4 Order.

The outcome of the NFFO-5 round is shown in the table above. 261 bidders were offered contracts (or 64% of total bids), with a total capacity of 1,177 MW (or 45% of total bids).

Overall assessment of strengths and weaknesses

These data illustrate some important points about bidding systems in general and about the NFFO scheme in particular.

Price reductions. The NFFO has certainly been successful in reducing the price of renewable power. This can be seen as a measure of the economic efficiency of the instrument.

Yet, it should be noted that it is not accurate to compare the prices in the first two NFFO 'rounds' with the three latest ones, since the first rounds had much shorter PPA lives, and this reflects straight through to price, since the developer has fewer years in which to achieve a return on the assets.

Furthermore care must be taken in comparing prices between different NFFO rounds, since each round defined a different mixture of technologies (i.e., the banding was different). Nevertheless, accepting these qualifications, the last three NFFO rounds show a consistent fall in price (4.35 p/kWh in NFFO-3, 3.46 p/kWh in NFFO-4 and 2.71 p/kWh in NFFO-5).

To indicate how close these bids are getting to 'conventional' generation, note that the average bid price under NFFO-5 was only about 0.1 p/kWh above the reference 'Pool Purchase Price' (PPP) which represents the bulk supply tariff of the conventional generation mix.

The reasons for these price reductions can be debated. However, technology maturity and cost, and the cost of finance have contributed significantly.

- Technology is becoming more competitive as world markets mature. This can be seen clearly in wind energy, where the cost per installed kW has fallen over recent years.
- Financial institutions are beginning to view renewables projects as more 'mainstream', now that many have been built and have operated successfully for many years. The perception of risk on the part of financiers is dropping, and this is underpinned by increasingly confident performance guarantees, technology guarantees and bonds offered by the major wind turbine manufacturers. This reduced perception of risk reduces the cost of finance.

Conversion of contracts into new projects. This is where the main criticisms are levelled at the NFFO mechanism. This is effectively the measure of economic 'effectiveness'.

The table above tells the story of effectiveness. In gross terms, out of over 3.2 GW of NFFO contract offers made to developers in the five rounds to date, only 246 schemes (31%) have been built, representing only 634 MW (19%) of capacity. It is fair to remove NFFO-5 from this comparison, since the order was laid only in December 1998. However, even excluding NFFO-5 shows only 46% of schemes commissioned, equal to about 30% of capacity.

The reasons for this apparent lack of effectiveness can be debated. However one of the most important factors is the planning process in the UK. When a bid is made under a NFFO round, it is not necessary to have planning permission approved. In other words, the chances of achieving planning permission are assessed in broad terms in the 'will secure' test, but bidders do not have to achieve planning permission before bidding. This is rational, since the cost of achieving planning permission would be prohibitive at the time of bidding.

The 'battles' between wind developers and objectors have been well documented in the UK. A well-organised anti-wind lobby group called 'Country Guardians' has successfully defeated many wind proposals, and has helped to propagate some quite unsubstantiated, and occasionally outrageous, claims about the environmental impact of wind farms on the local population. However, other planning proposals relating to biomass schemes have been similarly unsuccessful. It is clear that there is often a very conservative reaction among especially rural populations, to new developments, and this has made the development of wind power and other renewables very difficult.

It is important to note that this effectiveness issue is not automatically a criticism of bidding systems per se, since the same problems with planning could well occur in the UK under alternative systems, such as a feed-in law. However, the cost of bidding to NFFO is relatively high, and this will naturally promote larger companies as the main bidders, instead of small local ones. This fact could possibly account for some of the resistance by rural populations.

Costs and risks to bidders. This is an important aspect of the NFFO process, and needs to be examined in order to fully understand the NFFO mechanism.

Bidders into the NFFO mechanism face a number of risks. These risks are not necessarily reflected in the cost of capital for the projects, and these additional costs to society of the NFFO scheme are effectively hidden.

Preparing a NFFO bid can be expensive. It is necessary to spend considerable time and direct cost to produce a bid that is sufficiently robust and well-prepared to easily pass the 'will secure' test applied by the government. In most cases it is necessary to enter negotiations with planning authorities and the local community, undertake a detailed environmental impact assessment, as well as preparing the technical proposal, defining the financial plan, defining the bid price, and making initial contact with financial institutions. This all represents effort 'at risk' for the developer. Note that in the NFFO-5 round, 408 bids were received, of which 261 were accepted. Therefore 147 bids were rejected, representing a 'sunk cost' for these developers.

The second major risk for bidders who are offered a contract is non-completion. As explained already, planning can be a major hurdle to new projects, and the number of schemes that are built is relatively low compared to the number that are offered contracts. Between being offered a contract and failing to achieve planning permission, a project developer is likely to incur significant additional costs. Once a project fails due to planning, these costs are again sunk costs for the developer, and are not reflected in the apparent costs of the NFFO mechanism.

2.2 The Dutch Green Label System[1]

The Dutch Green Label System is the first experiment in Europe with a (in this case voluntary) obligation on a specific group of the electricity supply industry (in this case on distribution companies) and green certificate trading.

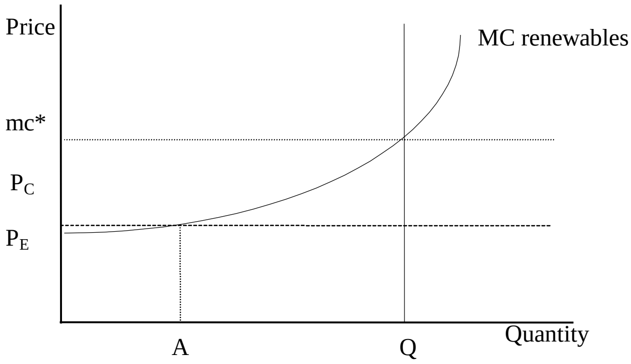
The basic idea of Green Certificates

The main objective of a system of tradable green certificates is to stimulate demand (instead of supply) of renewable electricity. The basic feature of a green certificate system is the separation of the 'greenness' of the electricity produced by renewable electricity sources from the electricity itself. Thus, the electricity should be sold and traded on the 'normal' electricity market, and should receive normal electricity prices. The 'greenness' however is incorporated in the green certificate. This certificate is given to the producers of green electricity for each predefined unit of electricity produced (in the Dutch case for each 10,000 kWh). This certificate can be regarded as the 'proof' of a certain amount of electricity being produced by renewable energy sources. The certification serves two purposes. It functions as an accounting system to verify whether a demand for renewable electricity, e.g. in the form of an obligation on consumers, or in the form of voluntary demand from customers, has been met. Furthermore certificates can be traded. This means that the demand for renewable electricity can be met cost-efficiently by buying certificates instead of producing or buying the renewable electricity itself.

[1] Refer to Schaeffer et al. (1999), a publication that is also partly based on the activities in Working Group 3 of the REALM project, for further details.

The price for green certificates will depend on demand and supply. With low supply of green certificates, price will be high, which will be an incentive to produce renewable electricity (RES-E). In theory, renewable energy will be provided in an efficient way because low-cost producers will be able build their plants and to sell their certificates first. The market determines which renewable plants to build, where, and for what price. This is illustrated in Figure 1. MC renewables is the marginal production cost curve of RES-E. The target is set at Q, with corresponding marginal cost mc*. Given an electricity commodity price of P_E, the certificates will be sold for P_C = mc*-P_E. Note that part of the renewable electricity (up to A) would be produced even without a green certificate system. For these producers, the green certificate system creates additional profit (the difference between mc* and P_E). Total profit for renewable producers from the sale of electricity and green certificates is equal to the area between the mc* line and the marginal cost curve, MC renewables.

Figure 1: The two variables: quantity and price



Background to the Dutch system

The new Dutch Electricity Act of 1998, implementing EU directive no. 69/92 concerning the internal market for electricity, contains three measures aimed at promoting renewables. First, producers and distributors should in general stimulate efficient and sustainable energy production and consumption (public service obligation). Large firms are required to report their activities every two years. Second, a fixed tariff is set for which small producers of RES-E can sell electricity to the grid[2]. So these producers do not yet compete on the 'normal' electricity market. For this RES-E, the network provides for a priority dispatch. Third, the possibility to enforce a RES-E target was introduced by the government. If the Green Label system implemented voluntarily by the energy industry did not prove to be successful by the end of 2000, the government could set a minimum share of RES-E for all electricity transmitted through the grid. This mandated share would apply to final delivery, thus not for distribution companies as in the current system. The government would announce a minimum share for a five-year period. In parallel with the Electricity Act, the new Gas Act, which is now discussed in Parliament, provides for a similar certificate system for green gas.

The first practical experience with a green certificate system was initiated by the Dutch energy industry. This Green Label system started in January 1998 and aims to increase renewable electricity production from 0.9 TWh in 1997 to 1.7 TWh in the year 2000. The main reason to

[2] This definition of small producers includes electricity from a CHP, hydropower or biomass plant (the latter without co-firing) that has a capacity of maximum 2 MW. In addition, this definition covers wind and solar power with a maximum capacity of 8 MW in the period until 31/12/2001 and a maximum capacity of 600 kW from 2002 until 31/12/2006.

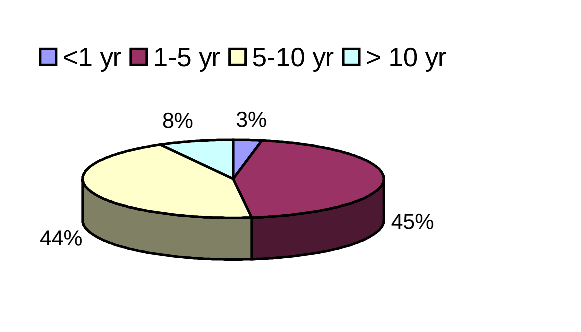
create the Green Label system was to share the burden of increasing renewable electricity production equally among the different distribution companies. In that way, the regionally operating distribution companies are no longer restricted by technical possibilities in their own region[3]. In the Green Label system, each energy distribution company is allotted a minimum target (quota) for RES-E to be accomplished by the end of the year 2000. No intermediate targets are defined. The company-specific targets are based on their electricity sales volumes in 1995, thus every company has its own quota. Companies that cannot fulfil their quota in 2000 are forced to purchase the shortfall in Green Labels at a price of about fifty per cent above the going market rate.

EnergieNed, the Association of Electric Utilities, issues the Green Labels. A producer receives one Green Label for every 10,000 kWh RES-E delivered to the grid. Green Labels are issued for those renewable electricity options that are exempted from the regulating energy tax (REB) payments to the government: solar and wind power, small-scale hydro-power (< 15 MW), electricity from land-fill gas and from biomass gasification.

Development

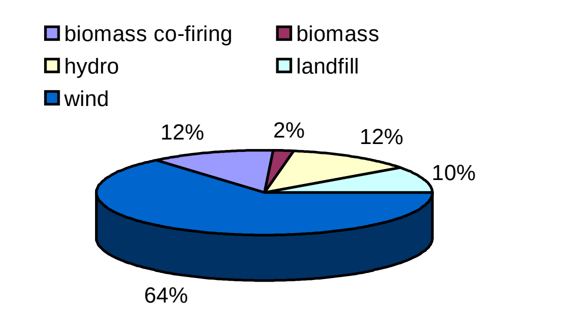
The present market value for electricity produced in the Netherlands is 0.036 Euro/kWh[4]. Final consumers in addition have to pay the regulating energy tax, which is currently between 0.015 and 0.023 Euro/kWh. The tax is collected by the supply companies and remitted to the government. Part of the tax (1.5 Eurocents/kWh) collected from renewable electricity does not have to be remitted to the government, but is paid directly to the renewable electricity producers. Thus, with the tax exemption for renewable electricity of 0.015 Euro/kWh, all renewable electricity production that is cheaper than about 0.05 Euro/kWh is economical. It is expected that the generation cost of the last economic option to fulfil the 1.7 TWh quota of renewable electricity will be around 0.07 Euro/kWh, which means that a Green Label should have a value of around 0.02 Euro/kWh. It is therewith not surprising that in early 1999 the price of a Green Label – representing 10,000 kWh of renewable electricity – was about Euro 230. Note that the Dutch system is a mixed system and that the regulating energy tax increases the market value of electricity from renewable sources and therewith decreases the value of the Green Labels. This logic in fact holds for all fiscal measures that influence the relative market price of electricity from renewable sources.

Figure 2: Remaining contract period for Green Labels as of May 1999



Source: EnergieNed (1999)

Figure 3: Production of Green Labels by source as of May 1999



Source: EnergieNed (1999)

[3] In the Netherlands, distribution companies used to be restricted to supplying customers in their own region. With the implementation of the Electricity Act 1998, this restriction is gradually abolished until in the year 2007 all customers are free to choose their supplier.
[4] Figures in this paragraph are calculated with the official exchange rate (1 EURO = 2.20371 DFL) and rounded.

Although the Green Label system has been introduced more than one and a half-year ago, there is still not much trade in Green Labels. The largest part of the Green Labels is traded on the basis of long-term contracts. Figure 2 shows that the majority of the contracts has a remaining validity of over five years. Trade on the spot market represents only a fraction of the total trade (less than 3%). Figure 3 illustrates that most Green Labels issued so far represent electricity generation from wind power. The total amount of Green Labels issued (i.e. RES-E production) in 1998 was 96,759 of which about 90,000 are traded, showing most distribution companies are behind their schedule of obtaining in total 170,000 Green Labels before the year 2001. At the end of 1998, only three out of nineteen participating companies were on schedule. Ten companies had bought almost no Labels yet [EnergieNed 1999]. It is expected that trade in Green Labels will become more active in the year 2000, when the target becomes binding.

Overall assessment

Strengths

Since the Dutch Green Label system has only been put in place for one year, it is not straightforward to assess the strengths on the basis of experience. In theory there are many advantages for this system (see also Working Group 2 report). It is a market-conform system in two senses. In the first place electricity produced by renewable energy sources can be sold and traded in the same way and on the same market as conventionally produced electricity. However, in the Dutch case this is only true for projects above 2 MW and 8 MW respectively, for which an electricity price has to be negotiated, just like is being done for other electricity producers. In the second place the level of ambition of policy targets/obligations is reflected in the market price for green certificates. This has become clear in 1998, when producers of renewable electricity received more revenues for the electricity and certificates produced per kWh, than in foregoing years. During 1999 a lot of new projects have been undertaken in the area of biomass co-firing, one of the least expensive options to produce renewable electricity. It is a clear system for the individual actors. In theory it is an effective and efficient system. Whether it is an effective system in reality remains to be seen, and can only be judged after the year 2000.

The Dutch Green Label System is relatively easy to monitor. System Operators have already installed kWh-meters and they just have to report this to the Green Label registrar (currently EnergieNed). There will be a sanction per Label of shortage of 150% of the average market price in 2000. The advantage of this relative fine is that there is never a maximum price for certificates, so that there is always an incentive to fulfil the obligation. A disadvantage is that currently there is not much insight in market prices because of the lack of transparency, and this can cause doubts among outsiders (e.g. independent producers) whether the fine level is set at an accurate price or not.

The challenge for a renewable energy developer will be to find a market party who is willing to purchase all green certificates produced by the generator. It could quickly turn out as an advantage of a green certificate system that this type of competitive market is more attractive for the finance sector as well. The forward market with long term contracts could play a role in a green certificate system. Another instrument is the use of financial options. For instance, through the issuance of put-options with a guaranteed price for which generators may, but do not have to, sell their electricity [Van der Tak 1998]. Crucial for these instruments is that counterparts can be found who are willing to take up the risk of a long-term green certificate obligation. Future expectations of the green certificate price are important in this regard.

Weaknesses

At the moment the system lacks certainty, since it is not sure which targets or measures will be set after the year 2000. The system as a whole is complex and often difficult to grasp for outsiders. Probably this will disappear as experience grows. Currently there is not much transparency in the market, since most trade is bilateral and there is practically no spot market. Also the relative small numbers of market players does not encourage spot market trade. The price for Green Labels in the year 2000 is highly uncertain and might be very volatile. Since the Labels are only valid for the year in which they are produced, climate factors such as variability in wind or solar irradiation, may have a large impact on the Label price.

With regard to fairness it must be noted that large consumers are excluded from the MAP-levy and that some utilities will fulfil their obligation by selling green electricity to consumers that are willing to pay a premium for renewable electricity. The Green Label system tends to deploy those renewable energy sources that are currently most economical, and have a rather low potential to get to lower costs in the future (e.g. biomass co-firing). These low-cost low-promising options might push higher-cost more-promising options (like wind) out of the market. Of course the extent to which higher cost options are pushed out of the market depends on the potential of the low-cost options and the height of the target.

Another weakness of the Green Label system is that registration and verification is not performed by a truly independent organisation. This could cause mistrust in the market and insecurity whether targets are really reached.

As a last aspect we mention the relation between the Green Label and the regulating energy tax (REB). Green Labels are issued for those types of renewable electricity generation that receive a rebate from REB payments. In fact, the REB collected from renewable energy is paid directly to the renewable energy producers. This means that the level of the REB directly influences the value of electricity from renewable sources. Every increase in the REB tariff decreases the value of the Green Labels and therewith distorts the market for Green Labels, in particular when international trade in Green Labels is introduced. This will make Dutch Green Labels cheaper than its international equivalents. In other words, the REB system would subsidise the market for Dutch Green Labels. The solution to this problem is to refund the REB at the moment that the Green Label is used. In that way, the REB would only be a 'floor price' of the Green Label and would not distort the Green label market itself. This solution would require another approach for the verification of Green Labels, which at the moment is based on the verification of the REB system.

2.3 The German Electricity Feed Law

Like many EU Member States, Germany has been using a system of fixed feed-in tariffs for the promotion of renewable generated electricity.[5] There are two key elements which all of the national systems of guaranteed feed-in tariffs have in common: first, the purchase obligation ('Abnahmeverpflichtung') on network companies or systems operators and second, the legally guaranteed fixed (minimum) premium per kWh electricity produced from renewables and fed onto the grid ('Vergütungsverpflichtung'). In fact, both, the purchase obligation and the guaranteed fixed tariffs, are also elements of a bidding system a la NFFO. Though, the main difference between the two mechanisms is that the level of the power purchase prices guaranteed is the result of competitive tenders – and not of a government regulation – in the latter system. Moreover, in the regulatory setting of fixed tariff systems, it is the purchase price, and not the

[5] These other Member States have for example included Austria, Belgium, Denmark, Greece, Italy, Spain, and Portugal. Yet, several of these countries are in a period of transition to altered regulations.

amount of electricity to be supported under the renewable energy policy scheme, that is determined by government. This is the other way round under the two schemes discussed in the previous sections. In theory, all three approaches could lead to the same outcome, at least from a static perspective.

To illustrate this with Figure 1: the legislator could set the guaranteed purchase price at p* what corresponds to marginal cost mc*. In an ideal world, this would lead to the electricity quantity Q – the quantity defined as target under the NFFO and the Green Label system. The feed-in tariff is fixed at a certain level above the electricity commodity price of P_E for conventional sources to stimulate and enable supply of electricity only producable at higher cost. An electricity quantity beyond Q will not be reached with the premium fixed at p*.

Design

The German Electricity Feed Law (EFL - StrEG)[6] for renewable sources of energy was introduced in December 1990 and came into effect on 1 January 1991. Its second and latest revised version came into force on April 29, 1998 when the German electricity market was opened to all customers. The law regulates the purchasing of electricity generated in the territory of the Federal Republic of Germany from specified renewable sources (hydropower, wind and solar energy, sewage and landfill gas as well as biomass). Excluded from the EFL are installations using sources other than wind or solar energy that have an installed capacity of more than 5 MW.

Table 2: Feed-in tariffs (in Pf/kWh and EuroCents/kWh*) for electricity from renewable energy sources paid each year under the German EFL

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Wind / Solar	16,61	16,53	16,57	16,93	17,28	17,21	17,15	16,79	16,52	16,10
	8,49	8,45	8,47	8,66	8,84	8,80	8,77	8,59	8,45	8,23
Biomass / Hydro, sewage and landfill gas (< 499 kW)	13,84	13,78	13,81	14,11	15,36	15,30	15,25	14,92	14,69	14,31
	7,08	7,05	7,06	7,21	7,85	7,82	7,80	7,63	7,51	7,32
Hydro, sewage and landfill gas (500-4999 kW)	11,99	11,94	11,97	12,23	12,48	12,43	12,39	12,12	11,93	11,63
	6,13	6,10	6,12	6,25	6,38	6,36	6,33	6,20	6,10	5,95

* Values are given in terms of the respective year. The exchange rate of 1,95583 DM/EURO is used throughout.
Source: IWR (1999)

The EFL obliges the grid companies to buy the electricity and pay fixed feed-in tariffs to the eligible electricity producers. For hydropower, sewage and landfill gas plants up to 5 MW the tariff is set at minimum 65%, for biomass as well as hydro, sewage and landfill gas installations under 500 kW at minimum 80%, and for wind and solar power at minimum 90% of the average utility electricity rates for consumers. The tariffs are fixed by the regulatory authority for a one-year period based on the value of the average utility revenue per kWh sold. This value is drawn from an official statistic and has to be the value for the last calendar year but one. Table 2 shows the feed-in tariffs subdivided into the three technology categories and con-

[6] Law on feeding electricity from renewable energy sources into the public grid (Electricity Feed Law (EFL) – Stromeinspeisungsgesetz (StrEG)) of 07/12/1990, Bundesgesetzblatt 1990, I, S. 2633, latest revision through Art. 3 of the Law on New Regulation of the Energy Sector Law of 24/04/1998.

secutive years. The categories and percentages for sell-back rates have slightly changed from EFL amendment to EFL amendment.

Installations in which the Federal Republic of Germany, a federal state, a public electric utility or their subsidiaries hold shares of more than 25% are not qualified for these output subsidies under the EFL. Moreover, the EFL does neither provide for a time limitation nor for a gradual degression of the payments to eligible generators.

In the EFL amendment of 1998, some important changes were made, mainly driven by the financial burden issue. §4 StrEG introduces a cap of five percent. If the amount of electricity which has to be supported under the EFL surpasses five percent of the kWh delivered by an electric utility in one calendar year, the 'upstream' network company is required to reimburse the additional costs to that electric utility until it also reaches the five percent ceiling in its grid area. This basically means that for a share of RES-E above five percent a utility has no purchase obligation any more. Since usually two network levels are affected, the regulation is also called the double ceiling rule.

In the PreussenElektra grid region, the second ceiling is claimed to be exceeded this year. According to the EFL, the PreussenElektra Grid company is not obliged to reimburse electricity generated from additional renewable energy plants from beginning of next year on. To avoid a halt of the dynamic development especially in the wind energy sector, the government has been working on another amendment of the EFL. They are planning to pass the EFL revision early next year. Declared goals of the third revision are to get rid of regional distortions in competition caused by the financing mechanism, to take account of falling electricity prices for conventionally generated electricity what will soon make the feed-in tariffs fall as well, and to make the EFL more market-conform. The details of the next amendment should become available in early November 1999 (also cf. Section 4.3 and the German Action Plan in REALM).

Development

In particular the 'Stromeinspeisungsgesetz', but also preferential planning guidelines, lower interest rates granted by the DtA (German Ausgleichsbank) for part of the loans, and other support programmes in various German states, have brought Germany into the world-wide number one position in wind energy capacity (cf. Figure 4). In 1998, some 1,000 new wind turbines with an overall electric power of some 800 MW were set up. So the total capacity installed almost reached 3,000 MW (2,875 MW) at the end of 1998. Already in the first 6 months of 1999, more than 500 additional MW of wind power were installed – a new record.

Other renewable sources of energy have not had a comparable boom. Electricity from hydropower, sewage and landfill gas plants has had a pretty stable share in electricity consumption throughout the nineties. Yet, the share of electricity from biomass has also started to grow. In 1998, the installed capacity was about 410 MW (1992: 230 MW), only 62 MW (1992: 40 MW) of which belong to public electric utilities. Although the share of photovoltaic in total electricity production is below 0.01%, this technology has gained very high growth rates in recent years, among both groups, public utilities and independent power producers.

The EFL has been based on a rather broad consensus in the political arena, but has been heavily criticised by German industry as being discriminatory and harmful for competitiveness. Especially the electric utilities located in the Northern part of Germany have brought several actions against the EFL to Courts, as they were affected disproportionately by the regulation. Under the EFL, the big majority of new renewable generation units has been built in the North. In Schleswig-Holstein for example, the most Northern state of Germany, the share of wind energy in total electricity consumption has risen to around 15% from almost zero in the past 10 years. So far the lawsuits have not been successful, some of them are still pending, one at the European Court of Justice.

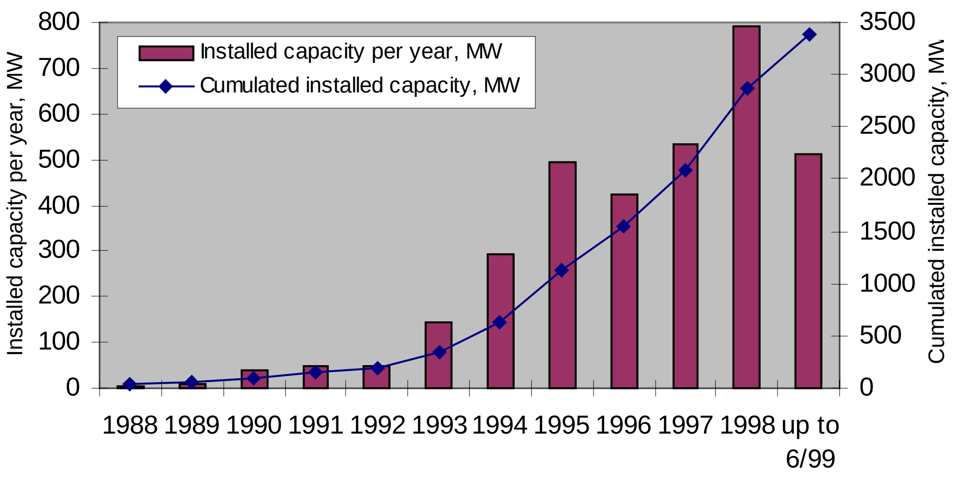


Figure 4: Development of wind power capacity in Germany

Sources: BWE (1999), IWR (1999), Rehfeldt (1999)

Overall assessment of strengths and weaknesses

Effectiveness. In general, fixed feed-in tariff systems have proven very effective. Denmark's wind power capacity, for example, has dramatically increased over the last decade under both, a feed-in tariff scheme and other favourable regulatory and political frameworks. It should be clear that the amount of RES-E triggered by fixed output subsidies very much depends on the level of the tariff. In the German and Danish system, the price offered to RES-E producers is relatively high.

On the other hand, the success of the EFL must be relativised somewhat. First of all, no quantitative policy target (in terms of Figure 1, only p*, but not the corresponding Q) has been defined. The standard is missing. Second, not looking at the absolute figures, but taking account of the size of the country, the German position is ultimately average only. It is still a long way to go before the unofficial, indicative political target for 2010 of a 10% share of renewable sources in electricity supply can be met in Germany. Wind power plants still only account for about 1% of total electricity generation in Germany. The share of hydropower has remained at about 3.5% over the past years and the share of other renewable sources was still below 0.5% in 1998. This made 5.2% in total in 1998, up from 4% in 1990. Would a target or an obligation of an additional 1.5 to 2% RES-E have been accepted as sufficient 10 years ago ?

Administration. An apparent advantage of the German feed-in tariff system has been the low bureaucracy and administrative costs. Even differentiated tariffs for different technologies, and thus asymmetric promotion of technologies or energy resources like under NFFO, can be and are included in such a system without really complicating it. Yet, the difficulty is to determine the 'correct' subsidy level to stimulate supply of all renewable technologies wanted and to reach a certain amount of or a set target for these technologies. Although there is no explicit target in the German system – for what reason its effectiveness should not be judged conclusively, technology targets are implicitly set by determining the level of the feed-in tariffs.

Efficiency and market-conformity. Several decisive disadvantages are intrinsic in fixed price systems. Competition is not encouraged among the investors in renewable sources of power plants, let alone with fossil-fuel fired plants. The mechanism does not ensure that renewable electricity is generated and sold at the least social cost possible (no cost-effectiveness), i.e. the guaranteed or 'market' prices do not reflect the true specific generation costs. This makes a feed-in system an expensive system for society compared to other, more efficient systems. Likewise, the incentive for technological development and innovation is insufficient under the German EFL, thus, there is a lack of dynamic efficiency in the system, as tariffs have remained on the same level over years and have not been intended to be reduced (ever).

In general, this type of mechanism fails to establish competition and a functioning market and thus to attain the objective of a large-scale market penetration and competitiveness of renewable energy technologies in the medium and long run. For a low-level market take-off and to reach a critical scale of renewable generation units, it may be an appropriate mechanism. Under guaranteed feed-in tariff schemes, investors have a high level of planning and investment certainty and this makes the start-up easier. Total costs of the support policy can still be controlled and are still comparatively low.

Transparency. The costs of the public support systems discussed here are generally carried by the electricity consumer through higher electricity prices or higher transmission and distribution tariffs. The funding works either directly, as with the levy on electricity prices in the UK, or indirectly, as under the current German and the current Dutch system, where the incremental cost of supporting renewable electricity is placed on the grid companies, that can then try to pass their financial burden on to their consumers. Direct burdening is preferable in the light of the transparency criterion.

Funding. The financing model has turned out to be the most controversial parameter of the German fixed tariff system. Prior to April 1998 when the new Electricity Law was launched, the electricity utilities were organised as regional monopolies. The electric utility (and their captive customers) obliged to buy the renewable electricity at a fixed price also had to carry the financial burden, effectively subsidising utilities and ratepayers with little environmentally friendly generated electricity. The German support scheme for renewable sources of energy did not affect any public budget, however. Now the distribution or transmission company can shift the additional cost to the transmission and distribution tariffs for its wires. But there is still no other regional cost balancing or compensation mechanism. In a competitive market, the inhomogeneous regional distribution of the additional cost associated with renewable electricity may cause substantial market distortions in the medium run. Therefore, other funding schemes are discussed (see below) and have also been implemented in other countries. In the 'old' Danish system, for example, the guaranteed tariff has been supplemented with state subsidies per kWh delivered to the grid. Thus, one must acknowledge that competitively neutral financing models are available even for regulated feed-in tariff systems. However, such more centrally managed solutions induce higher administrative costs as well.

Acceptance. Finally, it has often been claimed that local involvement, and therefore acceptance is particularly high under fixed feed-in systems [cf. e.g. Wagner 1999]. On the other hand, the fact that public utilities have been excluded from the German support mechanism has definitely contributed to their resistance and permanent action against the EFL. If the main objective of public policy is to promote the market penetration of renewable energies to a large(r) scale for environmental reasons, there is no obvious reason why to discriminate against any market player. It is very hard to imagine that in Germany renewable sources of energy can achieve a share in electricity generation of more than 10% without the involvement of larger companies.

3 GENERAL POLICY DESIGN AND IMPLEMENTATION ISSUES

One conclusion which should be drawn from the preceding chapter is a rather simple, yet in public debates often ignored fact. Many decisions on policy goals and design usually have to be made in addition to the decision on the basic support mechanism when a new policy is implemented. Neither one of the national support systems under analysis here is a pure system or the one and only way to design the respective type of incentive scheme. Moreover, the general legal and regulatory framework as well as other related policies also influence the failure and success of a particular instrument. Therefore, it is very important to keep in mind that not all strengths, pitfalls and weaknesses discussed are intrinsic in the basic mechanisms of the support schemes, but rather a result of objectives, policy design and implementation issues.

To illustrate these arguments, in the following examples of issues that have to be settled rather independently of the support system are discussed (Chapter 3) and recommendations are made how to change and improve the national policy instruments evaluated here (Chapter 4).

Policy objectives, targets and framework setting

For sustainable energy systems to become an interesting area of business activity for market players, long-term energy policy objectives and targets, a stable and consistent regulatory framework and a clear commitment on behalf of governments and politicians are needed. Otherwise it is very unlikely that any support mechanism will be successful.

Long-term policy objectives (as e.g. to establish a sustainable economy) should be translated into clear long-term targets for emissions reductions etc.. However, to keep markets liquid, it is necessary to bridge the time to the long-term targets by translating them into intermediate targets from start-up. Recurrent government interventions usually distort the market dynamic. A reliable planning framework is an important condition to stimulate investments of market participants. For quota-based as well as bidding systems, annual or even half-annual targets seem to be appropriate. Both, time frame and target level, should be predetermined at the beginning.

It can be seen in the UK, for example, that the renewables industry is currently facing great uncertainty after the announcement of the NFFO-5 order, since the industry cannot be sure when (and even if) there will be another NFFO round. The unpredictable nature of the NFFO system has meant that renewables developers have treated the market in an opportunistic way, treating each project effectively as a venture. Those well-established companies that have a number of NFFO contracts and have submitted several bids in each round, are forced to follow a cyclical business cycle (bidding followed by planning followed by development) which does not make the company efficient. Also in the Netherlands, potential investors complain about the uncertainty on the question what will happen after the end of 2000, when the voluntary obligation will have to be met. In Germany, new investments in wind turbines dropped abruptly in 1996 when the future of the German Electricity Feed Law was unclear due to pending court decisions and law amendments. According to the latest figures from the German wind industry, investments are still rising at a high speed at the moment, even though there has again been quite some uncertainty for investors due to European Union policy, ongoing trials, impacts of liberalisation and the reaching of the 5% ceiling. Yet, the German government has clearly emphasised its willingness to continue the support scheme despite all the criticism; the opposition parties do not question the law, either. The EFL has had to cope with many attacks in the past and has so far always survived. The more wind turbines are installed, the stronger the industry can argue in the political debate. These observations might partly explain the lasting boom even in this period of time.

Definition of renewable sources of energy and green electricity

Another issue to be settled for all renewable energy policies alike independent of the incentive mechanism is the definition of renewable energy sources and technologies and the determination of those eligible for public policies, e.g. whether to include waste incineration or not. There has been controversy about the renewable value of waste for many years. Moreover, based on the policy objectives a decision must be made whether large renewable power plants, and existing plants are qualified for participation in the support system or not. For example, the European Commission used to assume that electricity generated by large hydropower plants is, in general, competitive and should therefore be excluded from the scope of additional support. This definition is based on costs and not on the principle of hydro being a renewable source. Others also advocating for the exclusion of hydro argue that large hydropower plants do not provide the range of public benefits as do other renewables.

Question of technology diversity and bands

Each renewable source of energy has its own combination of attributes and also financial support requirement to survive in the market, i.e. renewable technologies do not each provide the same mix of benefits, and some technologies are less mature and more expensive than others.

Technology banding is central to the UK's NFFO system. This betrays the roots of the NFFO scheme. The NFFO scheme was a market enablement mechanism that grew on the back of a historical programme in the UK of research and development, and NFFO therefore carried some of the objectives of the R&D programme, in terms of stimulating technologies that were not close-to-market.

If technology banding were removed from the UK NFFO the cost efficiency of the measure would certainly rise. The technologies supported would first probably reduce to a smaller number, specifically waste technologies (notably landfill gas generation) and wind. Without any doubt most biomass projects would not be supported. Furthermore the current idea of creating an off-shore wind NFFO band would have to be dropped, and off-shore wind would only become viable after many years.

Non-technology-specific RES-E incentive schemes first promote an increase of investments in the least expensive technologies that are nearly marketable (e.g. wind turbines). As a consequence of that, the improvement and development of emerging and more expensive technologies as biogas and PV installations can be hampered. At the time the market 'needs' these technologies, they could still be very expensive due to a lack of learning experience or missing economies of scales. The introduction of technology bands is one way to counteract this risk. A separate policy for far-market technologies is another. However, the decisive point here is that technology bands are not an intrinsic part of bidding schemes. Besides, they can be introduced in a fixed feed-in tariff system through differentiated tariffs and in quota-based green certificate trading systems either by differentiated quotas/ obligations per technology or by weighing the value of a green certificate differently depending on its source. In all cases, the introduction of technology bands would have negative impacts with respect to overall cost efficiency and bureaucracy. Additionally, the risk of distorting government interventions increases, as more parameters have to be fixed by government and can be attacked frequently by the respective lobby groups.

External issues

'External' factors can cause the inability to expand the capacity of renewable energy. Such inability could be caused by the limitation in national potentials (biomass, onshore wind), or by financial and institutional barriers. Grid access and tariff regulations also influence the performance of renewable energy technologies in liberalised markets. Only two of these issues are outlined here.

Planning. Planning procedures and barriers relating to the siting of the installation should be taken into account when implementing a regulatory framework for the electricity sector, since they can be essential factors for the 'failure' of any incentive scheme. In the Netherlands, for instance, the expansion of onshore wind power is barred by the unwillingness of local governments to grant licenses for developing wind energy. Obtaining planning permission for new projects has been a major barrier to renewables development in the UK, as discussed in earlier sections. On the other hand, simplified planning procedures in Germany and Denmark have eased the implementation of renewable projects. Local authorities have been obliged to design eligible areas for wind turbines.

Access to finance. A specific market barrier well known in renewable energy development is the access to finance. The NFFO experience has learned that market-based renewable energy development meets some difficulties. These problems are due to the newness but also to specific characteristics of renewable energy technologies, which do not match the requirements of the private sector financial system [cf. Mitchell 1995]. One of these aspects is the relative high proportion of initial investment required for renewable energy technologies. To reduce risk for investors and facilitate the access to credit, contracts are demanded to ascertain purchase of electricity.[7] Under a stable framework with priority dispatch and purchase obligations, this is less of a problem. In more competitive markets this problem could grow.

European / International Expansion

Internationalisation of a certain type of support mechanism usually makes the policy less contestable, can cut down government interventions and reduces trade distortions. The support schemes discussed in Chapter 2 are so far internal schemes only. Each of these renewable energy policies could be implemented on a European scale. Yet, internationalisation is most reasonable, almost inherent in a tradable Green Certificate system.

Internationalisation would increase the number of market actors involved in the system. Within this system, EU Member States could realise their policy targets on RES-E by domestic policy measures or by buying certificates on the international (or European) market. As pre-condition, agreements must be reached on issuance, certification and validation of the certificates, as well as on the target specified for each Member State.

Internationalisation of the system would open up the possibility of international trade and redistribution of the financial burden to meet differences in economic, geographical, financial and social circumstances. Each country or region has different possibilities to produce renewable electricity and could have different targets. This implies different values of RES-E in each country, implying trading opportunities. International trade without trade barriers and with perfect competition would imply achieving cost effectiveness on a European scale. The combination of national targets and the respective supply curves also determines the total cost burden in each country. Analysis on the consequences of burden sharing and target setting of different burden sharing rules[8] shows that the costs per Member State could largely vary with different burden sharing rules. It is an important political discussion how cost can be equally

[7] Refer to Hunt and Shuttleworth (1996) for further information on contractual relations to cover producer risk

[8] Burden sharing rules could, for instance, be based on equal costs per capita, equal costs per GDP, corrected for purchasing power parity (or not), including or excluding the costs of certificate trading. Schaeffer et al. (1999) show that significant differences in costs can occur when different burden sharing rules are implemented. This is especially important when large differences occur between parties involved in the trading system, such as welfare differences among current and future Member States.

shared among the Member States of the European Union and what different approaches of equal burden sharing would mean for national target setting.

It does however not seem necessary to completely harmonise individual support mechanisms in different EU Member States. Respecting the subsidiarity principle, it would be possible to leave the choice of specific supporting schemes up to the Member States themselves. But to realise an integrated EU system, the effects of individual systems that influence the price of the tradable green certificates should at least be transparent.

4 POSSIBLE IMPROVEMENTS

Based on the above analyses, we suggest the following modifications to overcome some of the weaknesses of the systems operating and to improve some of the specific disadvantages of the basic type of support scheme.

4.1 Non-Fossil Fuel Obligation in England and Wales

The suggestions for the NFFO system will be based on timing (frequency of order), reliability of the will-secure test, linking the orders to changes in the planning system, and other factors.

The fundamental concept of bidding systems is realistic and workable, and is consistent with the need to achieve economic efficiency, since it introduces an element of competition between generators. It furthermore has the benefit of being a fairly 'sharp instrument' that government can use to promote the development of particular types and (in theory) certain amounts of renewable technology.

However, the NFFO system suffers badly from poor conversion of contracts into projects, and from the stop-go nature of market development. It is possible to alter the framework within which NFFO operates to partially overcome these.

Target setting. If the NFFO mechanism were set in a clearly defined, long-term strategic framework, it would be possible to increase its efficiency significantly. In order to provide a working market, the time horizon for the instrument should be in line with the time horizon of the contracts offered - i.e., 15 years. The ultimate objective of the NFFO instrument should be stated in terms of MW installed capacity over that period, and a provisional schedule of orders announced, by which the overall objective will be reached.

Mechanism and frequency of orders.

- The schedule of orders would be known, and their predicted size announced into the medium term (at least over a five year period).
- Individual orders would then be announced every six months, on the basis of bids received up to a certain number of months before each order.
- Bids may be submitted at any time up to each cut-off date (i.e. the cut-off date recycles every six months, in phase with the orders).
- Bidders state the validity period of the bid, which cannot be less than 18 months. This means that unsuccessful bids in one order are kept live for at least one more order, before they lapse. Bidders may choose to make bids valid for a longer period, if this is advantageous to them. This 'roll-over' process helps to stop large developers 'cornering the market', i.e. submitting only a small number of high-cost bids in one order, in the hope of receiving

higher value contract offers.

- Successful bidders will be offered contracts that must achieve commissioning in a limited but realistic period (perhaps three years). Any contract undeveloped after this time is 'recycled' and added to the size of subsequent orders. This is not the same as applying sanctions for non-completion, but does at least mean that the contract offer is not 'lost', and also promotes the fast development of new schemes. The un-developed bid may also be recycled by the developer, i.e. re-entered into the scheme with a different price.
- The planning process would be integrated more completely with the revised NFFO scheme. A unified planning process would be developed, and assistance given to bidders to submit their application according to this standard process. Basic criteria for the award of planning permission would be agreed at a national level, leaving an appropriate degree of decision making to the local level (subsidiarity).

Monitoring and sanctions

At first sight, imposing sanctions would be a way of improving the effectiveness of the NFFO mechanism. However, there are various reasons why this would actually not increase the effectiveness very much, while at the same time would reduce the efficiency of the measure.

It is important to analyse the decision making of the economic operators involved. A renewables scheme developer will only prepare a bid for the NFFO process if he assesses that there is an adequate balance between risk and reward. At present, the risk-reward balance is sufficient for developers, despite the falling prices of the bids. Sanctions imposed on developers for non-completion would merely serve to amplify the risk side of the risk-reward equation, and the bid prices would have to rise substantially in order to cover this risk. Even if the non-completion risk was laid-off to an insurance scheme, the cost of insurance would be high, and would reflect through to the bid price.

More serious is the possibility that the risk would simply be too high for developers to bear. As already stated, the main problem with getting NFFO projects built is planning. The planning process is largely outside the control of the developer, and hence this major aspect of risk is outside their control. Uncontrollable risks with large financial consequences would not be acceptable to developers.

Lastly, imposing sanctions may well not actually improve the completion rate anyway. Since planning is the block, no amount of sanctions will break through the barrier. What is needed is a more integrated planning environment for renewables in the UK.

4.2 Dutch Green Label System

All market actors involved in the European electricity market generally acknowledge the importance of learning from the Dutch Green Label system, being the first practical example of a green certificate market in Europe. But, as is often the case with new experiences, a number of design and market imperfections still exist. Below we discuss conditions for a properly functioning green certificate system. In this, we focus on conditions that are unique to a (government) created market, like the green certificate market, leaving aside general market conditions such as a sufficient number of suppliers and demanders, market transparency, negligible transaction costs and the absence of entry barriers.

Target and framework setting. The Dutch Government of the Netherlands has acknowledged the prerequisite of having a clear consistent government policy to provide stability to the green certificate system. Therefore, it has announced that in case a governmentally initiated green certificate system will be implemented the green certificate target will be announced for five succeeding years. The question remains whether five years form a period sufficiently long to give investors the investment security they wish.

Validity of certificates. The Green Labels issued by EnergieNed are only valid in their year of issuing. This means that the Labels produced in a certain year are worthless once all distribution companies have settled their obligation for that year. When in general the supply of green certificates is larger than the targeted demand, the price of certificates will decrease. Given this situation, the prices will even reduce to zero at the end of the target year. To stabilise the system, the validity of green certificates should be extended. Each limitation to the validity of green certificates would mean that they would become more heterogeneous, which might lead to price differentiation and thus to a lower liquidity of the markets. Therefore, it is recommended to extent the validity of green certificates, i.e. to make banking of certificates possible.

Besides extending the validity of certificates to subsequent years, the validity of green certificates could be extended to meet targets before actual production of the green certificate has taken place, i.e. borrowing of certificates. This means that the expected green certificates to be generated in the next period (which can be purchased through forward contracts) can be used to meet today's obligations. This measure would also enhance supply side flexibility on the green certificate market in a number of ways. First, in case of shortage, the price will not reach the penalty rate, but instead market participants will purchase forward contracts to meet their obligations. Second, this measure will automatically correct for stochastic climate factors that increase the uncertainty in RES-E and therewith the supply of green certificates. Third, the extra demand for forward contracts resulting from this set-up, will help renewable energy developers to secure finance from finance institutes. It seems reasonable to restrict borrowing to a specified time period.

Technology-mix. The experiences in the Dutch Green Label system shows that most Labels are issued for low-cost or nearly competitive RES-E technologies, i.e. wind power and biomass. Clearly, promising high-cost technologies such as solar PV systems are not supported by the system. One solution would be that governments provide a very long-term framework for renewable energy development, i.e. setting targets to 2050 and beyond, and leave the development and promotion to market players. This would, however, restrict the involvement of industries to large multinationals or idealistic companies, since most industries have a much shorter business horizon. Another solution would be that governments continue to play a role in promoting and developing the high-cost technologies, for instance by subsidies or special bidding offers for those long-term promising options.

Monitoring and sanctions. Within the Green Label system it is EnergieNed themselves, supported by the Kema company, that issues, registers and verifies the certificates. Whereas for RES-E investments financed by the Dutch green tariff system (i.e. voluntary demand) the system is monitored by WWF, there is yet no independent of government-linked organisation that it involved in monitoring the Green Label system.

If there is no penalty for failing to meet the target, a green certificate system will not work. In order to be effective, the penalty should be higher than the market price of green certificates. There are different possibilities to set up a sanctioning system. For example, the penalties for actors with a deficit could be paid to the fiscal administrator or to a fund that stimulates projects in the field of renewable electricity.

Internationalisation. Internationalisation of the Green Label system matches the description of internationalisation of support mechanisms as described in the section general issues. A larger number of international participants would require a more transparent system and setting clear rules on issuance, certification and validation. Increased trade and improved transparency would in turn reduce price volatility. Enlarging the number of participants in the Green Label system is discussed within the Renewable Electricity Certificates (RECs) Group, an initiative of EnergieNed that brings together a number of European utilities to discuss international trade in green certificates.

4.3 German Electricity Feed Law

The German Electricity Feed Law is under revision by government at the moment. A new, the third amendment is expected early next year. Draft amendments by the governing parties take account of some of the criticism the EFL has been confronted with.

Competitive neutrality would require that the EFL applies equally to all market players of the electricity sector. In addition to independent power producers, the established electric utilities must get access to public support/ fixed output subsidies for renewable electricity projects.

The incremental cost of the renewable support programme must be spread evenly and in a transparent way. Grid companies (and their ratepayers) in areas with higher potentials for renewables are currently paying a more-than-proportionate share of the national renewable energy politics. Acceptable solutions for the financing mechanism have recently been discussed in reports for the German Ministry of Economic Affairs [cf. Bohnenschäfer et al. 1999] and for the German Ministry of the Environment [DLR et al. 1999]. They include the voluntary or legally regulated balancing of additional costs between grid operators as well as the setting up of a nation-wide fund fed by a levy on electricity or a grid charge. Some lawyers have already warned that the funding scheme could be declared unconstitutional depending on the precise reasoning and design which will be chosen in the end.

Efficiency. Possible modifications to lessen some of the major shortcomings of fixed price systems, in particular in the light of liberalisation, include 1) the restriction of the price subsidy for an individual project to a fixed period, and 2) the decrease of the guaranteed tariffs in the course of the public programme. However, the information necessary to determine the 'correct' price levels over time are hard to get for a regulator. The frequency of regulatory interventions to change subsidy levels might grow what in turn leads to higher uncertainty in project calculations of potential investors.

Market conformity. The EFL is not conform to the idea of a liberalised power market. In the first place, it does not even create a separate competitive market for renewable sources of energy. In the second place, the purchase obligation on network companies is an infringement of the system, as under the EFL it is his job to supply and sell the green electricity to consumers and not the job of the generator or supplier [cf. also Menges 1999]. The latter argument is also valid in the current Dutch and English system, by the way. The network companies are obliged to purchase electricity generated in specified renewable energy plants. The explicit separation of the physical value of the electricity produced and the value of the 'greenness' associated with the renewable electricity in public calculations would be a first step to improve the transparency of the German system. Then the tariff for the 'greenness' could remain legally fixed and could be financed from public budgets. However, the renewable generator would have to sell his electricity on the market. Priority dispatch for renewable generated electricity would remain part of the legal framework and the government or regulator would have to make sure that the electricity is not discriminated against by transmission and distributions rules and tariffs.

The type of support scheme just outlined is not a traditional fixed feed-in tariff system any-more, but the main element from an economist point of view, i.e. the fixed price is still maintained. The proposed modification could make the German support scheme more compatible with a liberalised electricity market and with schemes discussed and designed in neighbouring countries without making it a quota-based or bidding system.

5 CONCLUSIONS

We hope to have demonstrated that not all strengths, weaknesses and pitfalls currently discussed and stressed from the respective stakeholders are linked with the individual category of incentive scheme. The failure or success of regulatory policies for the large-scale promotion of renewable energies is likewise a result of the general policy objectives, the regulatory framework and the implementation design chosen in the countries often referred to when comparing support schemes.

In particular in the last section, we have given examples how each regulatory framework under analysis should be improved to make the uptake of renewable sources of energy more effective and efficient in a competitive electricity market.

Carefully designed, a (European-wide) system in which green certificates are issued and traded, seems to be the most market-conform and promising mechanism, it is a system with opportunities and risks for all players. Only green certificate trading can ensure the level playing field wanted to create a large(r) market for nearly commercial renewable sources of energy. Note that green certificate trading is only seen as the basic mechanism here, which still leaves certain options for Member States how to regulate the details of their national frameworks.

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