REVIEW REPORT ON

PROMOTION STRATEGIES FOR ELECTRICITY FROM RENEWABLE ENERGY SOURCES IN EU COUNTRIES

Compiled within the cluster „Green electricity“
cofinanced under the 5th framework programme
of the European Commission

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PREFACE

The EU 5th Framework Program emphasises the need for efficient and effective strategies to disseminate renewable energy technologies and to increase their implementation. This can be seen from the funding given for the following projects associated with the supply of electricity from Renewable Energy Sources (RES):

InTraCert, ReCert and ElGreen.

Close co-operation between these projects has been encouraged by the EC project officers and has led to the creation of the “Green Electricity Cluster” of all three programmes. This review report has been compiled in the project ElGreen with contributions from participants of the projects ReCert and InTraCert.

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1 INTRODUCTION

Generating electricity from Renewable Energy Sources (RES) has a high priority in the energy policy strategies of the European Commission. The *White Paper on Renewable Sources of Energy* and the *Proposal on the promotion of electricity from RES*, published by the European Commission, set challenging goals to double the share of renewables in the energy mix of EU countries[1,2]. A comprehensive range of measures is proposed to overcome barriers to the development of renewables and to redress imbalances. In order to achieve this goal, increased co-operation is needed within, and between, all Member States. Financial incentives for the development of new industries also play a key role.

The great importance of electricity from RES is due to the considerable associated benefits, namely:

- reduction of greenhouse gas emissions;
- increases in local employment and income;
- enhanced local tax revenues;
- a more diversified resource base,
- avoided risks of disruption in fossil fuel supply and association price instability
- provision of infrastructure and economic flexibility by modular, dispersed and smaller scale technologies;
- the potential to greatly reduce, and perhaps eventually eliminate pollution associated with electricity services
- contribution towards sustainability.

However, to facilitate a breakthrough for RES, barriers have to be overcome. These barriers are the economic, institutional, political and legislative hindrances to the market penetration of RES. They include problems arising from lack of awareness. Also there are social and environmental barriers, which may result from a lack of experience with planning regulations, which curtail the public acceptance of a new technology. To overcome these barriers, careful strategies have to be applied. Currently, a range of national and regional strategies exist, so allowing analysis of the differences across Europe. In this context, two objectives of the EC Directive are important[3] with respect to "green electricity":

- to evaluate the major features of the present varied strategies;
- to harmonise a set of such strategies for all EU countries.

These objectives are common to all the programmes of the Green Electricity Cluster, namely RECert, InTraCert, and ElGreen. Hence a review of present promotional strategies for electricity from RES is an element of all three projects. The results of this review are summarised in this report.

The major objectives of this report are therefore:

- to summarise the current state-of-the-art of the use of renewables for electricity generation in EU member states and to document the current generation costs;
- to provide a general overview of the potentials for different technologies in different countries;
- to review past and present promotional strategies in different Member States;
- to relate the above to the supply of "green electricity".

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[1] "The Commission takes the view that a doubling of the share accounted for by these energy sources by 2010 (from 6% to 12%) could be an ambitious but realistic

[2] "Member States will therefore have to set and meet national targets for the domestic future consumption of RES-E which are consistent with the White Paper on renewables and national commitments to reduce greenhouse gas emissions in the light of the Kyoto obligations" (European Commission, 2000).

[3] "The Commission has concluded that insufficient evidence exists to provide, at this stage, for the introduction of a harmonised Community wide support scheme setting the price for RES-E through community-wide competition between RES-E generators, in particular with regard to direct price support being the most important form of support in practice. Nevertheless, the Commission believes that this should remain the objective since its achievement is likely, in the medium term, to reduce prices of RES-E and increase the penetration of RES-E in the internal market" (European Commission, 2000).

1.1 Historical background

This study considers the growth of commercial electricity supply from renewables that has arisen from considerable technical research, development and demonstration, as encouraged by the EU, national and other grants. However dissemination strategies for commercial electricity from RES have included various rebate programmes as major incentives, whereby purchasers of renewable energy generating plant could claim back (i.e. be rebated for) part of the costs by a government grant or from a government legislated levy. The most influential rebate programmes were (a) the wind promotion programme in Denmark, and (b) the German "1000 Roofs Programme" for promoting photovoltaic (PV) power, and the tendering programme within the Non-Fossil Fuel Obligation (NFFO) in UK. Moreover, rebates played an important role in increasing market penetration of wind energy in Denmark and Sweden.

In the early 1980s financial incentives, in the form of capital grants, loans or reduced taxes, were also popular to encourage installation of generating plant. The most successful examples were in Germany and Denmark, where, for instance, it was possible to obtain preferential real estate loans for wind turbines.

In the mid-1990s, in various European countries, promotional programmes based on regulated tariff rates for the purchase of electricity from specified renewable sources became more common and were enhanced. The most important models in this context were enhanced feed-in tariffs and rate-based incentives, as for all RES generators at fixed values in Denmark, Germany, Italy and Spain, and against competitive tendering in the UK.

An increasingly popular mechanism is Green Electricity Pricing. Within these programmes, supply companies and utilities offer electricity from renewable sources within special tariffs of more liberalised electricity supplies. Generally these tariffs are at an enhanced price to cover increased generation costs. By giving customers the opportunity to choose the "brand" of electricity according to their willingness to pay, public funds may not be necessary to increase the use of renewables.

Perhaps the most significant opportunities for electricity from RES are coming with the ever-increasing liberalisation of electricity markets across Europe. Dissemination programmes for RES are being designed especially to fit within this liberalisation.

Table 1.1 summarises the most important historical steps for such promotional strategies within the EU.

Table 1.1: Promotion strategies for electricity from RES in European countries

Year	Country	Type of strategy	Programme name	Technologies adressed
1978-1985	DK	Rebate		Wind
1989-1993	DE	Rebate	"1000-Dächer-Programm"	PV
1990-1999	UK	Bidding	NFFO / SRO / NI-NFFO	Selected technologies
1990-present	DE	Regulated Rates	"Einspeisetarif"	PV, Wind, Biomass, Small hydro
1991-present	SE	Labelled "Green Electricity"	"Bra Miljöval"	PV, Wind, Biomass
1992-1994	AT	Rebate	200 kW PV-Program	PV
1992-2000	IT	Regulated Rates	"CIP 6/92"	All technologies
1991-1996	SE	Rebates/Tax relief		Wind, Solar , Biomass
1992-1997	DK	Rebate/Tax relief		Wind, Biomass
1992-1999	DE, CH, AT	Regulated Rates	"Kostendeckende Vergütung"	PV
1994-1999	GR	Rebates	"Operational Programme for Energy"	PV, Wind, Biomass, Small hydro
1994-present	ES	Regulated Rates	"Royal Decree 2366/1994" resp. "R.D. 2818/1998"	All technologies (except Large hydro)
1996-present	DE, CH, NL, AT, UK	Green tariffs	Various brands	Selected technologies
1996-present	CH	Trading	"Solarstrombörse"	PV
1998-present	DE	Labelled "Green Electricity"	TÜV, Grüner Stromlabel e.V., Öko-Institut	PV, Wind, Biomass, Small hydro
1999-present	DE	Soft loans	"100,000 Dächer-Programm"	PV
1999-2000	NL	Green certificates		All technologies (exempt municipal waste incineration)
2000-present	DE	Regulated Rates	"Renewable energies law"	Selected technologies

1.2 Organisation of this report

This report is organised as follows: Section 2 documents the current state-of-the-art and the potentials of RES in EU member countries. Section 3 provides a survey of different types of promotional strategies for electricity from RES. Sections 4 to 9 give examples of programmes. Section 9 is a critical evaluation and review of the various strategies. Finally, in section 10, important conclusions are derived.

2 CURRENT STATE-OF-THE-ART AND POTENTIALS OF RES IN EU MEMBER COUNTRIES

2.1 Electricity generation from RES

Fig. 2.1 compares, for each EU country in 1998, (a) the total electricity consumption, and (b) the amount of electricity generated from RES. In Fig. 2.2, the countries are ranked by the share of electricity from RES. Three countries, Austria, Sweden and Portugal, generate more than a third of electricity from these sources.

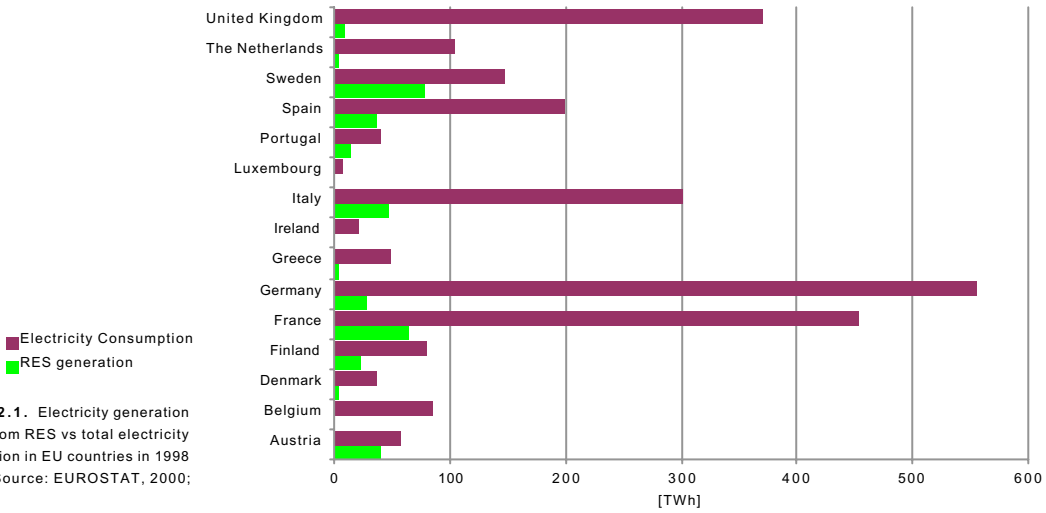


Figure 2.1. Electricity generation from RES vs total electricity consumption in EU countries in 1998 (Source: EUROSTAT, 2000;

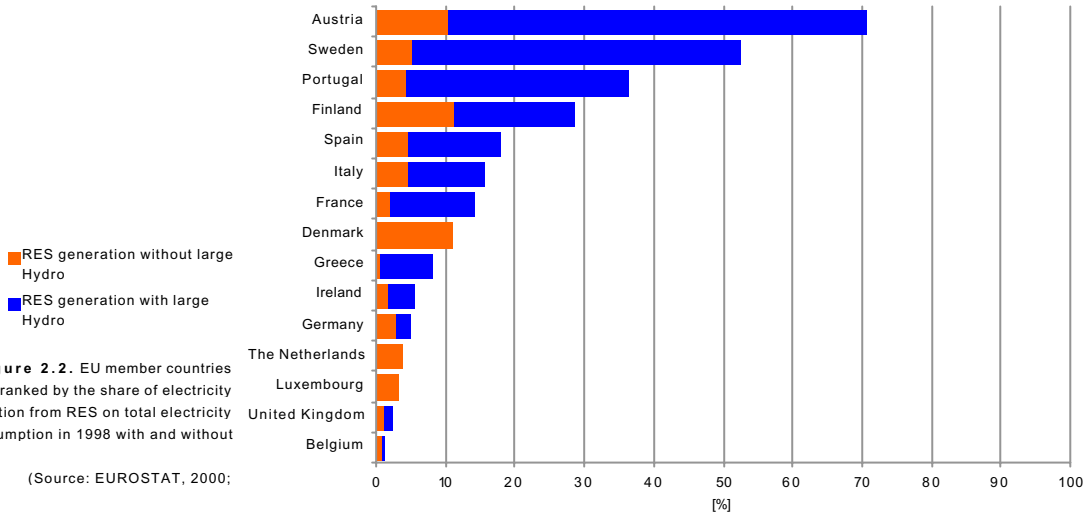


Figure 2.2. EU member countries ranked by the share of electricity generation from RES on total electricity consumption in 1998 with and without

(Source: EUROSTAT, 2000;

The largest share of RES is still 'large' (> 10 MW) hydropower, see Fig. 2.2. Such plant was mostly established before the post-1970's 'new renewables'. The shares of the other technologies are depicted in detail in Fig. 2.3. It shows that small hydro, biomass, and wind are the most important.

Of interest, are (i) the large proportions of wind power in Denmark, Spain, and Germany, (ii) the significant contribution of geothermal power in Italy, and (iii) high proportion of power generated from biomass in the UK (including landfill gas, municipal waste and sewage gas), Finland, Sweden and Germany. Fig. 2.4 and Fig. 2.5 show the development over time, with and without hydropower.

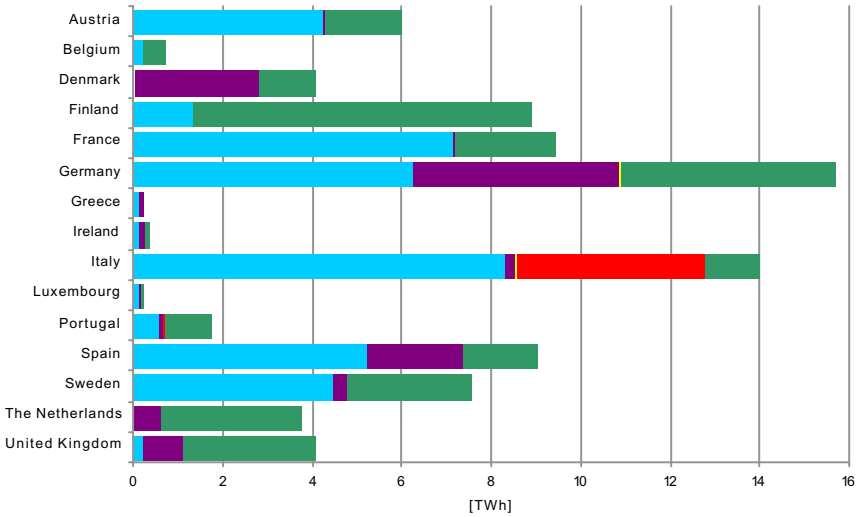


Figure 2.3. Electricity generation from various RES in EU countries in

(Source: EUROSTAT, 2000)

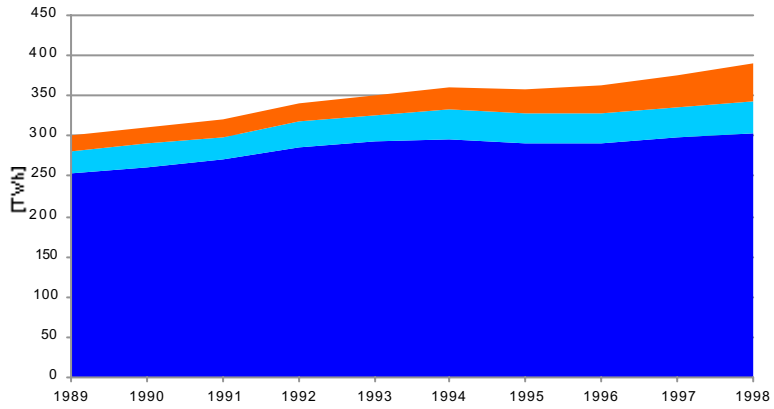


Figure 2.4. Electricity generation from RES in EU countries from 1989 to 1998 - including hydro (Source: EUROSTAT, 2000)

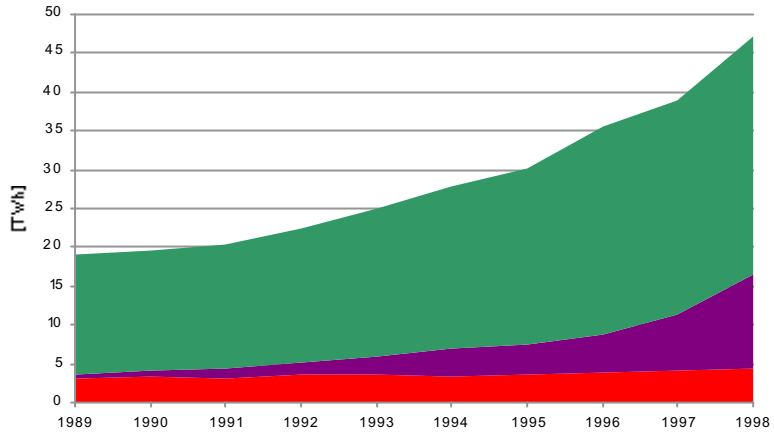


Figure 2.5. Electricity generation from RES in EU countries from 1989 to 1998 - excluding hydro (Source: EUROSTAT, 2000)

2.2 Cost of electricity generation from RES

The high capital investment costs of RES have been a major impediment to broader market penetration. These costs are shown in Fig. 2.6 for various types of RES from 1980 to 2000. All cost curves of the new technologies have decreased over time.

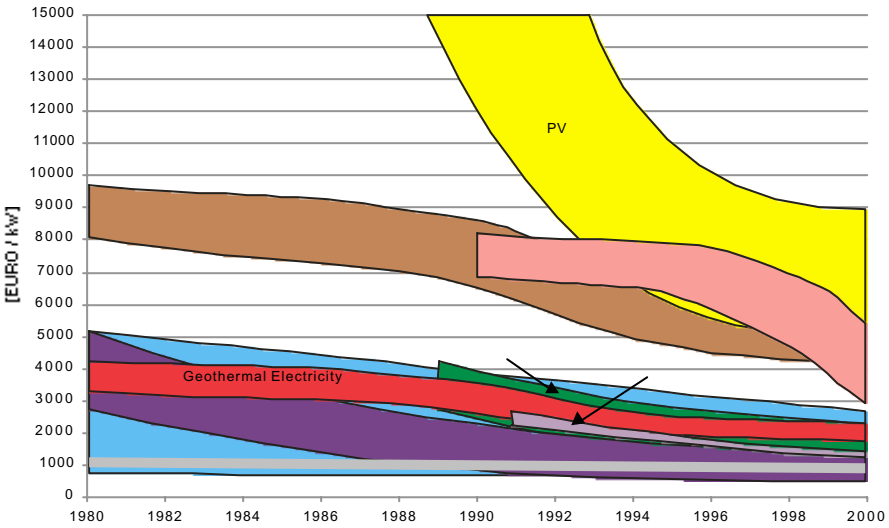


Figure 2.6. Development of investment costs of RES for electricity generation in EU countries from 1980 to 2000 (Source: ETSU / DGXVII, 1997)

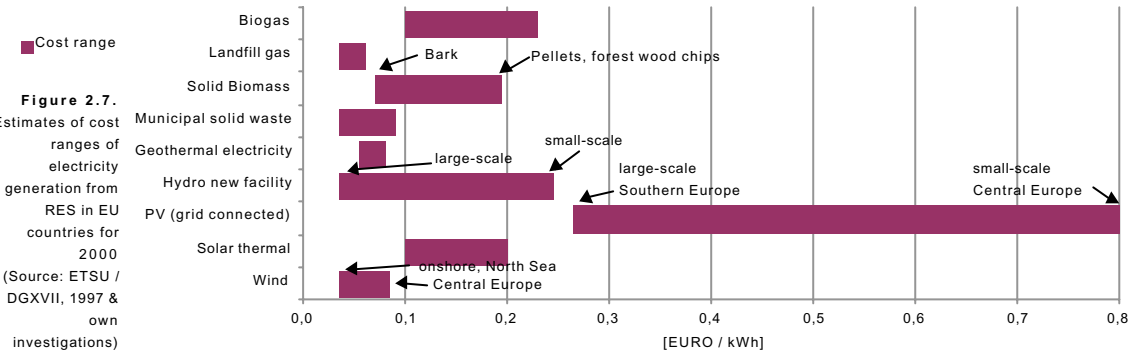


Figure 2.7. Estimates of cost ranges of electricity generation from RES in EU countries for 2000 (Source: ETSU / DGXVII, 1997 & own investigations)

2.3 Potential of electricity generation from RES

One set of authoritative estimates of the preliminary technical potential of electricity generated from different RES in EU member countries is documented in Figure 2.8 (see next page), which includes commercial and developmental technologies. Note that the quantification of the "technical potential" and the definitions of biomass, biofuels and wastes may not be uniform for all countries.

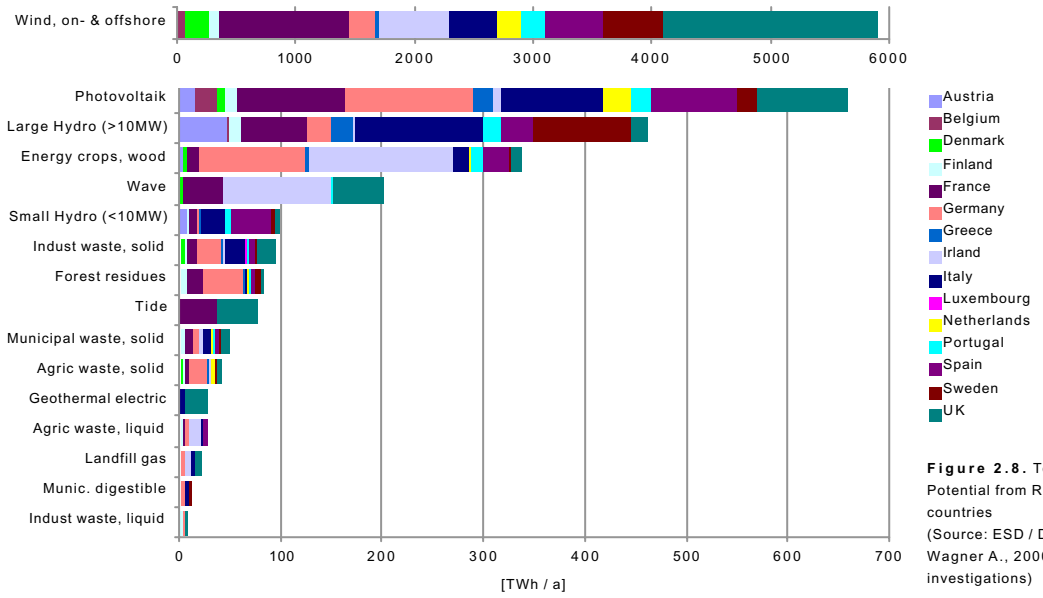


Figure 2.8. Technical Potential from RES use in EU countries
(Source: ESD / DGXVII, 1996; Wagner A., 2000 & own investigations)

Fig. 2.9, (a) compares the 1998 total electricity generation for the whole EU with the forecasted 2010 total demand, (b) the actual 1998 and forecasted generation from RES, with and without large hydro, and (c) the RES technical potential summed from Fig. 2.8. Note that the renewables potential alone equates to more than double of the total forecasted demand for 2010.

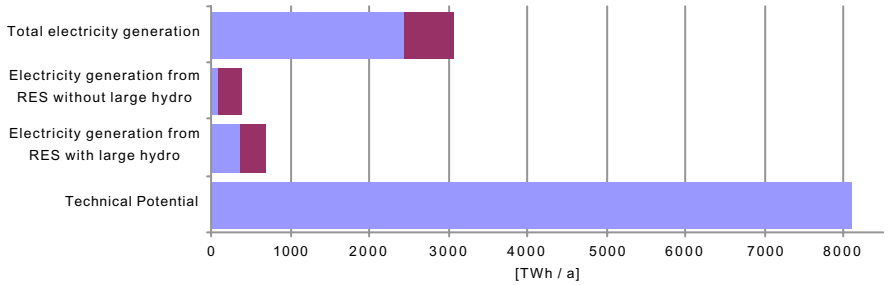


Figure 2.9. Electricity generation and potential for electricity from RES in EU countries
(Source: EUROSTAT, 2000; E.C. "Proposal on the promotion of electricity from RES", 2000; ESD / DGXVII, 1996; Wagner A., 2000 & own investigations)

3 TYPES OF PROMOTION STRATEGIES

Table 3.1 is a classification of the existing strategies for encouraging electricity generation from renewables. The terminology is explained below and in the Glossary.

Table 3.1. Fundamental types of strategies

		Direct		Indirect
		Price-driven	Capacity-driven	
Regulatory	Investment focussed	• Rebates • Tax incentives	• Quotas (RPS) / TGC • Bidding	• Environmental taxes
	Generation based	• Feed-in tariffs • Rate-based incentives		
Voluntary	Investment focussed	• Shareholder programmes • Contribution programmes		• Voluntary agreements
	Generation based	• Green tariffs		

Voluntary approaches

This type of strategy is mainly based upon the willingness of consumers to pay premium rates for renewable energy. There are two main categories:

- Investment focused:
  Shareholder programmes, donation projects and ethical thrusts.
- Generation based:
  Green tariffs, with and without labelling.

Financial Incentives

Generators of electricity from RES receive financial support in terms of a subsidy per kW capacity installed or a payment per kWh produced and sold.

- Investment focused
  Rebates and tax incentives.
- Generation based
  Feed-in tariffs and rate-based incentives ("Kostendeckende Vergütung" for PV in Germany, Austria and Switzerland).

Regulatory capacity driven strategies

In this case the strategy is based on a government decision on the desired level of generation or market penetration of electricity from RES. The price is in principle set through competition between generators.

- Non-tradable quotas
  Tendering/bidding, quotas, Renewable Portfolio Standards and Obligations
- Tradable quotas
  Electricity or CO_2 based certificates

Environmental pricing

RES can also be promoted by means of indirect strategies, for example CO_2 taxes or removal of subsidies given to fossil and nuclear generation.

In Table 3.2 an overview is provided listing countries, strategies and the technologies addressed.

Table 3.2. Current promotion strategies for electricity from RES in EU countries

Strategies / Member State	Voluntary Approaches		Regulatory, Price Driven		Regulatory, Capacity Driven		
	Investment focussed	Generation based	Investment focussed	Generation based	Bidding / Tendering Programmes	Non-tradable quotas	Tradable certificates
	Participation / shareholder / donation programmes	Green Pricing	Rebates & tax incentives	Feed-in tariffs		Renewable Portfolio Standards / Quotas	Electricity-based
Austria	PV		All technologies	Wind, PV, Biomass, Biogas, Landfill gas, Sewage gas, Geothermal		All technologies	Start 10/2000; small Hydro
Belgium			All technologies	Wind, PV, small Hydro, Biomass, Biogas, Geothermal		Planned 2001; all technologies, no Waste	
Denmark	Wind		Wind, Biomass, Biogas, Wave	Wind, PV, small Hydro, Biomass, Biogas, Geothermal		Planned 2002; Wind, PV, small Hydro, Biomass, Geothermal, no Waste	
Finland		Wind, PV, old Hydro, Biomass	All technologies				
France			Small Wind, PV, small Hydro, Biomass	Small Hydro, Biomass	Wind		
Germany	Wind, PV (donation programmes especially for schools)	Wind, PV, small Hydro, Biomass, Waste	Wind, PV, small Hydro, Biomass, Biogas, Geothermal	All technologies, no Waste, no large Hydro	PV (Berlin)		
Greece			Wind, PV, small Hydro, Biomass, Biogas, Geothermal	Wind, PV, small Hydro, Biomass, Biogas, Geothermal			
Ireland			Wind, Hydro, Biomass, (Solar projects)		AER; Wind, Hydro, Biomass, Biogas, Waste, Wave		
Italy			Small Hydro	Wind, PV, Hydro, Biomass, Waste, Geothermal		Planned 2002; all technologies(incl. Large Hydro), facilities not older than 10 years	
Luxembourg			Wind, PV, Biomass, Biogas	Wind, PV, Biomass			
Portugal			Wind, small Hydro, Biomass, Geothermal	Wind, PV, small Hydro, Biomass, Geothermal			
Spain			Wind, PV, small Hydro, Biomass, Waste, Geothermal, Solar thermal	Wind, PV, small Hydro, Biomass, Wave, Tide, Geothermal, Solar thermal			
Sweden		Wind, small Hydro, Biomass	Wind, Biomass	Wind, Biomass			
The Netherlands[4]		Wind, PV, small Hydro, Biomass	All technologies (municipal waste: 50 %)			Voluntary since 1998	
United Kingdom	Wind	Wind, PV, Small hydro, Biomass, Waste	Planned 2001: Climate Change Levy		NFFO, SRO, NI-NFFO: Wind, Hydro, Biomass, Waste, Sewage Gas, Landfill Gas, Wave	Planned 2001: all renewables except Large Hydro and Municipal Waste Incineration	

[4] From 2001: Green pricing based on certificate scheme and energy tax exemption.

4 VOLUNTARY APPROACHES

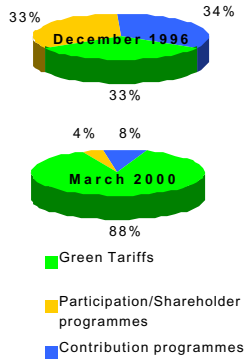


Figure 4.1. Percentages of the different types of voluntary programmes in Germany – December 1996 versus March 2000 (Source: Markard, 1998;

Voluntary approaches are based on the "willingness to pay" of private individuals or organisations, and commercial or industrial companies .

Nowadays "Green Tariffs" (see section 4.2.1) are the most common voluntary approach to promote electricity from RES. For example Fig. 4.1 shows the development of the offered types of voluntary programmes in Germany, hte majority of which require the consumer to pay a surcharge.

The most successful programmes of all the different types of voluntary approaches are briefly described below, according to investment focused and generation based programmes.

4.1 Investment focussed

4.1.1 "Participation/Shareholder programmes" (Capacity-based)

This has attracted attention mainly in Germany. The idea is to sell shares of a RES plant to private customers, for example in blocks of 100W plant capacity, with the customer becoming a shareholder of the company owning the renewable plant. An example is the "Bürger für Solarstrom" programme of "Bayernwerke" utility. Table 4.1 lists some features of these programmes.

Table 4.1: Private Shareholder programmes

Utility	Technologies	Time period	Status	Costs (EURO/W)	Total number of participants	Local participation rate (%)	Installed capacity (kW)	Money per participant (EURO)
Bayernwerk	PV	1994-96	Completed	6.63	101	0.01	50	3290
Konstanz	PV	1995-97	Completed	7.29	200	0.57	63	2300

4.1.2 Contribution programmes

Within contribution or donation programmes, subscribers contribute to a fund for renewable energy projects. It is an approach common for the promotion of PV systems in the public sector, e.g. schools. The projects developed are unrelated to the subscriber's electricity usage.

4.1.3 Ethical trusts

Shares are issued to subscribers by a company committed to funding specified renewable energy plants or other commercial renewables activities. "Triodos bank" and the UK "Wind Fund" are examples.

4.2 Generation based

4.2.1 Green Electricity Tariffs

Consumers choose to either buy electricity at a utility "green tariff", or from a "Green Electricity" supplier (if the customers are eligible). Usually the major feature of this type of financing program is that participants willingly pay a premium (i.e. a surcharge) per kWh above regular tariff rates. The extra payments to the suppliers are passed to the renewable energy generators to meet the extra costs of generation, which are particularly associated with capital costs of the new plant.

Green tariffs have become popular in Germany, The Netherlands and the USA, but they are also offered in Austria, Finland, Sweden, Switzerland and the UK. In most of these countries the number of companies offering green tariffs is increasing rapidly, sometimes correlated to the liberalisation of the electricity market and/or the introduction of "green labels" (described in the following section 4.2.2). Fig. 4.2 shows this development for Germany.

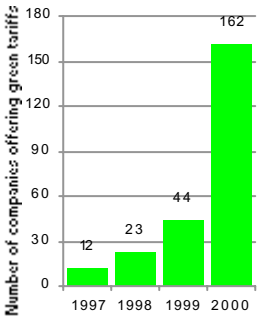


Figure 4.2. The number of companies offering green tariffs (DE) in the period 1997 – 2000 (Source: VDEW, 2000)

Umwelttarif" (RWE)

One of the most popular "Green Pricing"-programmes has been the "
from RWE (DE). The programme was started in June 1996 and is currently still running. The following technologies are included: PV, wind and hydropower. Customers choosing the "Umwelttarif" pay a premium of about 10 EUROcent/kWh in order to be supplied with green electricity from new installed plants. Fig. 4.3 shows the number of consumers participating each year. Growth in participation was high initially, as influenced by advertising (mailing). The maximum number of participants was reached two years after the start of the programme: 16000 participants, approx. 0,5% of the total number of tariff-customers. Nowadays the participation-rate of this scheme is slowly decreasing, influenced by offers of other new green tariffs arrangements (incl. green labels). The programme led to the installation of new capacity, namely 1031 kW PV, 1600 kW wind and 12 kW hydro.

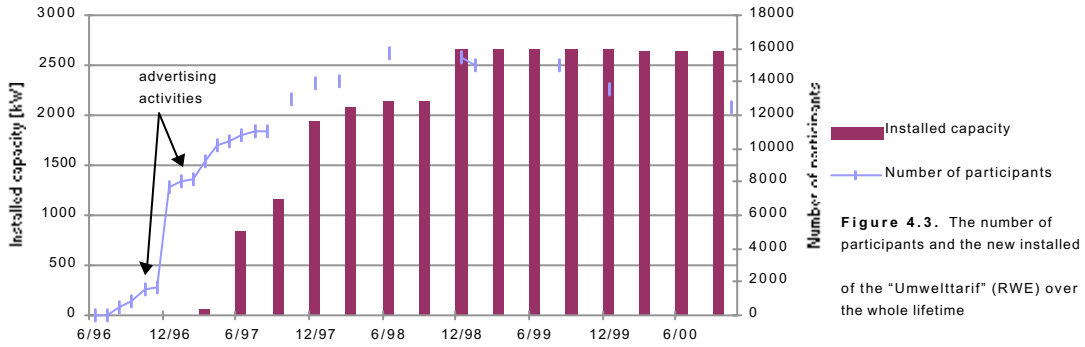


Figure 4.3. The number of participants and the new installed of the "Umwelttarif" (RWE) over the whole lifetime

Green Pricing activities in The Netherlands are described in detail in section 7.1.

4.2.2 Green Electricity Labels

Green electricity labels are being used in several European countries to accredit green tariffs. They provide consumers with reassurance that the accredited tariffs do indeed utilise renewable energy and have beneficial environmental impact. However, with over 10 different and independent labels being promoted in Europe, sometimes within one country, there is concern that consumers may be confused.

There are two main types of tariffs accredited under the various labelling schemes:
(1) Those ensuring that a certain percentage of electricity from renewable energy sources is supplied to a customer, and (2) those that charge a premium for the supply of electricity from conventional sources, with the premium being invested in a fund for new renewable energy capacity.

Table 4.2 provides details of some of the labels being promoted in Europe. Most labels accredit tariffs that provide electricity from wind turbines, photovoltaic panels, geothermal plant, and specified scale of hydropower and types of biomass and wastes plant. Some labels also accredit (i) electricity from combined heat and power (CHP), (ii) supplies of heat from renewables and (iii) provision of energy efficiency measures. Other criteria cover such aspects as the location of the generation and the environmental credentials of the supplier. The "clean coal" and nuclear industries also aspire to have their products labelled as 'green', but as yet no green label specifically relates to output from such plant.

Table 4.2: Green electricity labels

Country	Finland	Germany									Norw
Issuing Body	**Suomen luonnonsuojeluliitto**	**German TÜV**					**Grüner Strom Label e.V.**		**Öko-Institut, Germany**		**Norge Naturvo forbun**
Label – Name	Ekoenergiaa	Renewable Energy EE01	Hydro Energy EE02	Renewable Energy VdTÜV1303	Environmental-ly Friendly Energy UE01	Environmental-ly Friendly Energy UE02	Golden Label	Silver Label	Regenerativ	Effectiv	Bra Miljø
Scope	Tariffs & suppliers	Facilities, tariffs & suppliers					Facilities, tariffs, suppliers & customers		Facilities & tariffs		Tariffs
Requirement	100% renewable	100% renewable	100% hydropower	100% renewable	Minimum 50% renewable, remainder must be co-generation		100% renewable, minimum 1% PV	Minimum 1% PV & minimum 50% renewable with remainder being co-generation	100% renewable, minimum 1% PV	Minimum 1% PV & minimum 50% renewable with remainder being co-generation	100% renewa
Permitted sources											
Photovoltaics	Yes	Yes	No	Yes			Yes, minimum 1%		Yes, minimum 1%		Yes
Wind	Yes	Yes	No	Yes			Yes		Yes		Yes
Biomass	Yes (also district heat from biofuels)	Yes	No	Yes			Yes, criteria specifies ecological cultivation		Yes, but only chemically untreated wood, and organic wastes & biofuels only from certified ecological cultivation		Yes, with to be retu to the le
Municipal waste	No	No					No		No		No, unle organic co is at least
Biogas	Yes	Yes	No	Yes			Yes – but sewage gas presently suspended		No		Yes
Landfill gas	Yes	No	No	No			No		No		Yes
Geothermal	Yes	Yes	No	Yes			Yes		Yes		Yes
Hydro	Yes - facilities contructed prior to 1996	Run-of-the-river & pump-storage using electricity from renewables					Less than 10 MW		Yes, new run-of-the-river capacity permitted, but only improvement & rennovation of dam projects		Yes, but new plan only facil that were before 1
Wave	Not at present	Not at present					Not at present		Not at present		Not at pre
Tidal	Not at present	Not at present					Not at present		Not at present		Not at pre
Co-generation	No	No			Maximun 50%, must have efficiency above 70%		No	Maximum 50%, must have efficiency above 70%, no brown coal fuel	No	Yes, maximum of 75% and efficiency minimum of 1 kWh heat for each kWh of electricity	No
Requirements Product											
New facilities	No requirements	Minimum of 25% of production has to come from new facilities	No requirements	Minimum of 25% production from new or feed-in tariff facilities, 'significant' share of profits to be reinvested in new plants	Minimum of 25% of production has to come from new facilities	No requirements	Minimum 10% of production per year		New plants required to meet greenhouse-gas reduction targets	Minimum of 25% of plants built since 1998	No requirem
Energy balancing	Annually	Bi-annually	Hourly	Bi-annually	Hourly	Bi-annually	Quarterly		Annually		Annua

The main differences between the labels concerns the eligibility of energy-from-waste, landfill gas, large hydropower, and certain types of biomass and co-generation plant "co-

As well as accrediting the tariffs, some labels also accredit suppliers, and maybe consumers, who may then use the label in their advertising.

It would be advantageous to harmonise the labelling for common recognition across Europe. Such a framework would facilitate market transparency, which should lead to enhanced consumer demand. Moreover, there are increasing proposals for disclosure of information to customers concerning the emissions from all forms of electricity generation. Thus labelling would be a common requirement for all forms of generation. At present, renewable energy generators are presently being burdened with the additional cost of accreditation to prove their benign environmental impact, whereas generators using conventional energy technologies are not so required to declare their impact, especially of harmful emissions.

4.2.3 Green Electricity Stock Exchanges

Another initiative, which has attracted attention, mainly for the construction of PV systems, is the so-called "Solar stock exchange". The concept is that electricity is generated from privately owned PV systems and fed into the public grid. Consumers in the "stock exchange" buy this electricity at a special tariff rate corresponding to the PV production costs. In effect, this is a co-operative facilitated by the local grid operator. Only the most cost-effective generation is selected, perhaps by a bidding process.

The grid operator utility acts as a "power exchange". That is to say it organises the balance between supply and demand over specified time periods. Usually, the utility bears the administration costs but has no other expenses.

The advantages of this strategy are:

- customer willingness to pay is fully satisfied;
- efficient operation is ensured;
- competition ensures that the private "green" PV plant is the best available.

This idea was firstly developed for the city of Zurich in Switzerland and has since attracted attention in other cities. Table 4.3 includes the most important features of the programme in Zurich.

Table 4.3: The Solar Stock Exchange model of the municipal utility (ewz) of Zurich

Utility (country)	Time period	Status	Costs	Total number of participants	Participation rate	Total PV capacity installed (kW)	Total electricity generated (MWh)	Money raised per partici-pant	Total money from partici-pants
ewz	1996 –12/1999	Ongoing	0.78 EURO / kWh	4480	3.8 %	1600	1021	77.52 EURO	347287 EURO

5 REGULATORY, PRICE DRIVEN STRATEGIES

Regulatory strategies, perhaps with financial incentives, aim to make investment in renewables more economically attractive. Fundamentally, there are two approaches to the provision of financial incentives: (i) investment in new capacity, and (ii) funding towards each unit of electricity produced.

5.1 Investment focussed

To provide incentives for investment, two types of strategies are popular: rebates and tax incentives.

5.1.1 Rebates

Two large-scale rebate programmes for PV and two large-scale rebate programmes for wind energy have been implemented in the EU. For PV: the "1000 roofs programme" in Germany and the 200 kW_p rooftop programme in Austria. For wind: the combined rebate and tax incentive programmes to promote wind energy introduced in Sweden and Denmark, see section 7.

The German "1000 roofs" programme

The first comprehensive international dissemination programme was the German "1000 roofs programme", launched in 1990 and completed in 1995. A total of 2250 roofs in Germany were equipped with PV systems, having an average size of 2.6 kW_p, and a total capacity of about 6 MW. System investment costs were 16700 EURO/kW_p on average, of which the average rebate capital-subsidy payment met 70% of this. During this demonstration programme, and also in the aftermath, comprehensive investigations on the technical and sociological aspects of the installations were undertaken. The main conclusions were (a) PV systems reached a good standard of technical reliability, (b) per unit PV system cost decreased , and (c) the acceptance of the technology increased considerably (Genennig and Hoffmann, 1996; ISE, 1994). Moreover, experience gained in the programme was used for similar activities in Austria and Japan.

The Austrian "200 kW rooftop" programme

In 1991 the Austrian Ministry for Economic Affairs launched a promotion programme for small decentralised PV systems - the 200 kW_p PV-rooftop programme. Implemented between 1992 and 1994, the programme subsidised approximately 100 small residential grid-connected systems with funding from the utilities and governmental authorities. The total installed capacity was 203.6 kW_p and the average capacity 2.28 kW_p. Average system costs were approximately 17800 EURO. About 58 % of the investment costs were subsidised by authorities and electric utilities (Haas et al, 1999).

5.1.2 Investment-based Tax Incentives

Several different options have been used to promote the generation of electricity from RES with fiscal instruments:

- lower VAT-rate applied for RES-E systems;
- dividends from RES-Investment made exempt from income taxes.

Both options have similar impact, acting as investment subsidies for new installations. Table 5.1 (see next page) gives an overview of existing investment-based tax incentives in EU countries.

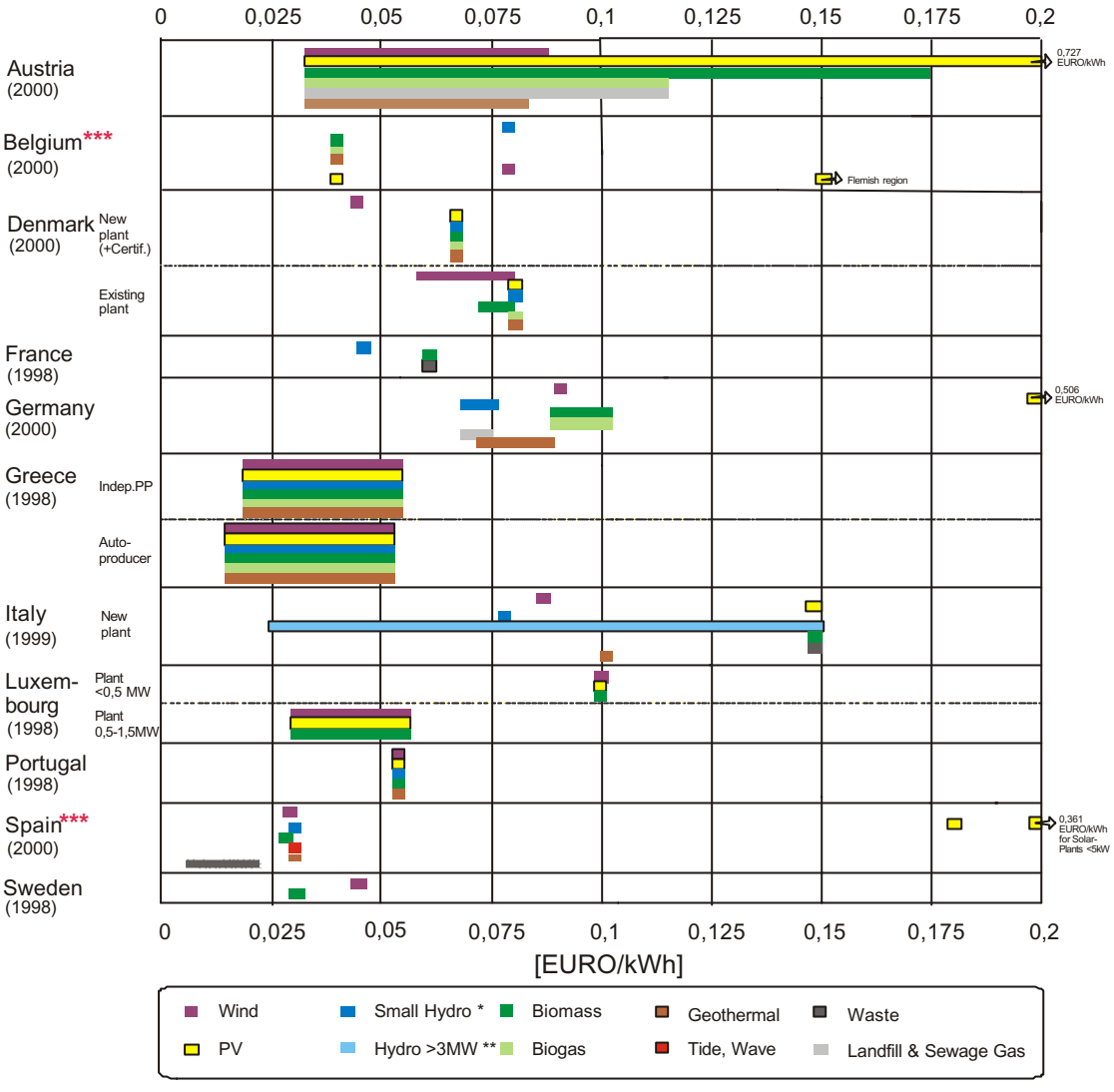
Table 5.1: Tax incentives in various EU countries

Country	Investment-based tax incentives
Austria	Private investors get tax credits for investments in using renewable energies (personal income tax)
Belgium	13.5 – 14% of RES-investments deductible from company profits, regressive depreciation of investments
Greece	Up to 75% of RES-investments can be deducted
Ireland	Tax relief for certain RES-investments
Italy	Up to 50% of RES-investments can be deducted over a period of two years
Luxembourg	Tax deduction for RES-investments
The Netherlands	VAMIL scheme: RES-investors (specific renewable technologies) are allowed to offset their investments against taxable profits EIA scheme: RES-investors (same technologies as VAMIL) are eligible for an additional tax deduction against their profits (from 52.5% to 40% depending on sum of the investment) Lower interest rates from Green Funds: RES-investors can obtain lower interest rates (up to 1.5%) for their investments
United Kingdom	Reduction of VAT (5% rather than 17.5%) on domestic PV and wind generating capacity cost

5.2 Generation based

5.2.1 Feed-in Tariffs

This promotion strategy has attracted attention since the late 1980s especially in Denmark, Germany, Italy and, in the 1990s, Spain. A feed-in tariff is the price per unit of electricity that a utility or supplier has to pay for renewable electricity from private generators (also called "producers"). Thus, a federal (or provincial) government regulates the tariff rate. Such schemes may limit the offer to a certain total capacity for the whole programme. Currently the highest "feed-in" prices in Europe are in force in Italy, Germany Denmark and Spain, see Figure 5.1. Note that any intending producer is guaranteed the feed-in tariff for each unit of electricity exported to the grid if his form of generation meets the stated criteria; no bidding process or tendering is involved. This 'open' procedure without tendering contrasts with "obligation" programmes, e.g. the NFFO in the UK, where increased tariffs are only available to the selected 'winners' after competitive tendering. The feed-in tariffs attract much capacity, since the export price is guaranteed, as long as the unit price is set at a high enough level (e.g. the substantial growth of wind power in Denmark, Germany and Spain in the past years – see section 9).



* Italy <3MW, other <10MW ** Italy ***only premium (full feed-in-tariff = market price + premium)

(....) … Year of validity

Figure 5.1. Feed-in tariffs for electricity generation from different types of RES in EU member countries (to be compared with payments to conventional large scale generators from fossil fuels of around 0.03 EURO/kWh). (Source: Own investigations)

5.2.2 Rate-based Incentives

In the early 1990s in Switzerland and in Germany, solely to promote PV generation, programmes called "Kostengerechte Vergütung" ("full cost rates", as tariff rate-based incentives) were instigated. Consequently the public utilities had to buy PV electricity at (almost) the full production costs. This is different to feed-in tariffs, which are not specifically cost-oriented, but pay producers a fixed price per unit of electricity generated. Such schemes have gained attention mainly in cities where municipal utilities are responsible for power supply and where local politicians have the power to put these "full cost rates" into practice. Recent feed-in tariff rates vary between about 0.7 EURO/kWh and 1.0 EURO/kWh.

6 REGULATORY, CAPACITY DRIVEN

Regulatory strategies using obligated quotas to introduce a certain amount of green electricity fall into two categories (1) those based on competitive tendering and trading, and (2) those without specified competitive trading.

6.1 Tendering/Bidding: e.g. the Non-fossil fuel obligation (NFFO)

Tendering systems used to promote RES have been used in France (for wind energy only), Ireland and the UK. The most well known of these promotion strategies is the NFFO in England and Wales. Similar schemes have been set up for Scotland (Scottish Renewables Order - SRO) and Northern Ireland (NI-NFFO). The UK strategy has recently been changed and renamed so as to increase the amount of renewables capacity.

The objective of the NFFO (before the recent enlargement) was to achieve an installed capacity of 1500 MW_e by the year 2000. The core principle of the tendering-system was to invite developers to tender to construct a certain amount of renewable energy capacity. If the proposals were considered viable and competed successfully on price terms with other tenders within the same technology band, they are awarded a contract. The contracts were for a relatively long period (up to 15 years) to facilitate bank finance. For those schemes contracted and operating, a guaranteed surcharge per unit of output was guaranteed for the whole contract period. The difference between the surcharge paid to NFFO generators (premium price) and a "reference price" (Pool Selling Price) is financed by a levy on all electricity sales of licensed electricity suppliers. The cost of this levy is passed on to consumers (Mitchell, 1996). The levy remains now only to continue the previously contracted arrangements.

The five successive Orders in England and Wales resulted in 880 contracts being awarded. Table 6.1 gives details of the contracts for NFFO 1-5. Due to competition on the supply side (bids), prices declined significantly and rapidly over the time. Since the first Order was made in 1990, the average prices paid to projects awarded contracts have decreased from 6.5 p/kWh to 2.71 p/kWh in England and Wales. Lower prices, to less than 2 p/kWh, were obtained in Scotland for wind power; being cheaper than electricity from coal, oil, nuclear and some gas. It can be concluded that bidding systems leads to economically cost effective prices, but only for limited capacity at the 'best' locations.

However, not all projects that were awarded contracts have been implemented. As at 31st March 2000, only 36% (283 projects) had been developed. Reasons include the submission of unrealistic bid prices in order to secure a contract and failure to obtain planning and other consents. Therefore in some respects, tendering systems are deficient as compared with other promotion strategies. For instance: (a) extremes of environmental impact may result, e.g. wind turbines in upland areas, and (b) self-funded developers have

an advantage over local community schemes requiring high interest rate loans. Nevertheless, the difficulties of obtaining local Planning Permission would have been met whatever the promotional scheme. Fig. 6.1 relates to wind energy, showing the fall of contracted prices at each successive Order, and the failure to increase installed capacity to the capacity expected.

Table 6.1: Status of NFFO contracts (31st March 2000)
(Source: Offer, 1998; DTI, 2000)

	NFFO1	NFFO2	NFFO3	NFFO4	NFFO5
Period of guaranteed contract price	1990-1998	1991-1998	1994-2009	1997-2012	1998-2013
Determination of contract price	Bid price	Marginal price of technology band	Bid price	Bid price	Bid price
Number of projects contracted	75	122	141	195	261
Projected capacity [MW]	152,1	472,2	626,9	843,1	1177,0
Number of projects developed as at 31/03/00	61	82	73	51	16
Installed capacity [MW]	144,5	173,7	250,8	113,1	23,3
Average price [p/kWh]	6,5	6,61	4,35	3,46	2,71
Pool Selling Price [p/kWh]	1,71	2,17	2,39	2,51	2,67

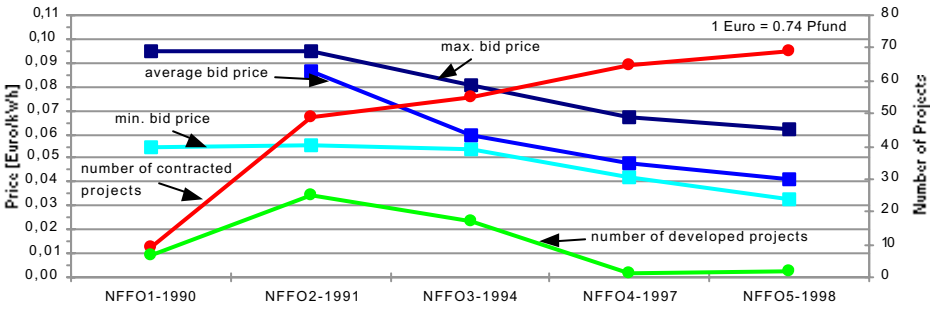


Figure 6.1. The development of wind energy prices and number of projects in the NFFO in UK from 1990 to 1998

Note: Price correction for a homogenous depreciation time of fifteen years

(Source: Offer, 1998; DTI, 2000)

6.2 Non-tradable Renewable Portfolio Standards / Quotas

Within this strategy the distribution companies or utilities are obligated by government to generate a certain amount of electricity from new renewable energy sources. This can either be done with the use of certificates (see below), or by generating the required amount of electricity from their own or independent power producers (IPP) sources.

Due to the non-tradability of the quota, this system leads to market distortions among the utilities, depending on the geographical conditions of the company. Nevertheless, especially if there is only a low quota to be met, administration costs can be much lower than under a certification system where the certificates are traded.
Non-tradable quotas are currently only used in Austria, where the utilities have to meet a quota of 4% with “new” renewables by 2007.

6.3 Tradable Certificates

Tradable Green Certificate programmes work as follows: The generators (producers), wholesalers, retailer or consumers (depending who is obligated in the electricity supply chain) are obligated to supply / consume a certain percentage of electricity from renewable energy sources. At the date of settlement, they have to submit the required number of certificates to demonstrate compliance. Those obligated obtain certificates in three ways:
(1) they can own their own renewable energy generation, and each defined amount of energy (e.g. 10,000 kWh in the Dutch system) produced by these facilities would represent one certificate;
(2) they can purchase electricity and associated certificates from another renewable energy generator.

(3) they can purchase certificates without purchasing the actual power from a generator or broker, i.e. purchasing certificates that have been traded independently of the power itself.

Due to competition on the supply side, this system of tradable certificates leads, under the assumption of perfect market conditions (perfect price signal), to minimal generation costs from renewable energy sources. Of course, this happens only if there is a surplus of renewables generation above the demand for certificates. A voluntary system of trading renewable electricity certificates was implemented in the Netherlands. The initiative was taken by the electricity sector on a voluntary basis in 1998. The first binding target in the Netherlands was set for the end of 2000 (Schaeffer et al, 1999). Presently, the introduction of a tradable renewable certificate system is being proposed or implemented in Austria (only small hydro), Belgium, Denmark, Italy, Sweden and the UK. Table 6.2. summarises the most important features of the proposed trading systems in EU countries.

Table 6.2: Survey on proposals for trading renewable electricity certificates in EU countries

	Austria	The Netherlands**	Denmark	UK	Belgium (Flemish region)	Belgium (Wallon region)	Italy
Period	start 2001	1998 – 2000	start 2002	start 2001	start 2001	Start 2001	start 2002
Obligation	8% small hydro (<10 MW)	1.7 billion kWh	20% by end 2003 (postponed by 2 years)	5% in 2003, 10% in 2010	3% in 2004	3% (2001), 4% (2002), 5% (2003), 6% (2004)	2% in 2002
obligation on	end-user	Supplier	end-user	Supplier	supplier	Supplier*	supplier
technology bands (baskets) within overall quota	two groups (new renewables, small hydro)	No	No	No	yes, planned	n.a.	no
involved technologies	small hydro (<10 MW)	all renewables	small hydro, wind, bio-mass, solar -, geothermal energy, no waste	small hydro, wind, biomass, solar -, geothermal energy, no waste	all renewables, no solid municipal waste	all renewables, no incineration	all renewables (incl. large hydro), facilities not older than 10 years
international trade allowed	no	yes, but only in exchange with physical electricity	Yes	n.a.	no	No	yes, but only in exchange with physical electricity
price restrictions (min., max. price)	not planned, max. price according to penalty	not planned, max. price according to penalty	min.= 0.014 EURO/kWh max.= 0.037 EURO/kWh	not planned, max. price according to penalty	yes, planned	n.a.	n.a.
Penalty	yes, according worst technology	150% of market price	fix price, 0.037 EURO/kWh	fix price, 0.048 EURO/kWh	fix price, 0.12 EURO/kWh	n.a.	n.a.
trading scheme	open	stock exchange, mostly long term contracts	stock exchange	stock exchange, development of spot, forward and derivate market planned	stock exchange	Open, trading and direct support	open

*consumers buying at least 50% from renewables are immediately eligible for the equivalent of the whole amount of green electricity consumed, producer are eligible for the purchase of peak and back-up electricity, for their self-consumption as for their clients up to the level of green electricity produced.
** The Green Label system (an initiative of the energy sector) will end by the end of 2000.

7 MIXED STRATEGIES

7.1 Renewables in the Netherlands

In the Netherlands, a mix of different strategies to promote renewable energy existed until 2000. A generator of electricity from RES received generation-based revenues from the following sources:

- Feed-in tariffs by the distribution utility (Standaard Teruglever-Vergoeding - STV), this guaranteed that the feed-in price, set by EnergyNed, could only be received by an independent power producer.
- A payment from the revenues of the Regulatory Energy Tax (Regulerende Energiebelasting – REB, 3.5 EUROcent/kWh in 2000) for energy generated by renewables and delivered to the public grid (for biogas, if delivered to the public gas grid a similar payment is made (10.44 ct/m^3). Heat from biomass via CHP also receives support (3.54 NLG/GJ)).
- Revenues from the purchase of green certificates (Groen Label) which are bought by suppliers of electricity to comply with the voluntary agreement between the suppliers and the Ministry of Economic Affairs.

Additionally, generators can receive the following investment-based support:

- Energy Investment Relief Scheme. Investments in defined renewable energy technologies may be offset against taxable profits at a rate from 40% till 52% of the total investment [5] (Schaeffer et al., 1999).
- Investors in renewable energy projects are eligible for reduced interest rates (about 1.5%) from Green Investment Funds, which are recognised by the government.

[5] Maximum tax relief: 22.5 Mill. EURO per investment

- An accelerated depreciation of Environmental Investments (Vervroegde Afschrijving Milieu-Investering Regeling – VAMIL scheme). This allows investors to offset their investments freely against taxable profits, so producing an interest benefit for the investors.

In addition to the generation-based approach, another part of the Dutch renewable energy policy focuses on increasing demand. Consumers can opt for the green electricity programme of their energy supplier. They pay an additional tariff when they buy "green electricity", but in return the consumers are exempted from paying the energy tax.

Presently, tariffs vary between 2.7 and 4.5 EUROcent/kWh. Depending on the supplier, green electricity is cheaper, or about as expensive, as the gross price of regular electricity (for which the tariff includes the energy tax). The conditions and composition of "green electricity" vary between suppliers. In 2000 about 650 GWh of green electricity was sold to households, services and industry (total renewable production, electricity from municipal waste not included, was around 1150 GWh in 1999). Due to the structure of the green pricing programmes and its short history, it is difficult to estimate how much new capacity has been, or will be, installed by these programmes. Success for new capacity is however expected. During 2000, some suppliers succeeded in shifting more than 10% of their total customer base to green tariffs (the average is around 2%). The total number of green-tariff customers was around 155.000 at the end of 2000. However, the greatest difficulty encountered by suppliers is not attracting customers to their programmes, but obtaining new renewables capacity, a challenge made difficult by a whole range of obstacles in obtaining permits. Indeed, some suppliers have stopped advertising for new 'green' customers.

The Minister of Economic affairs announced that in 2001 the market for "green electricity" would be fully liberalised for all users, irrespective of their size and consumption. This market 'opening' is ahead of the market opening of regular electricity, planned later for medium (2002) and small users (2004). From 2001, users have free choice in their supplier of (green) electricity. To facilitate this market, a legally based system of certificates will be put in place. These certificates indicate the source of origin of the electricity. Users (or their retailer) can claim the energy tax reduction based on these certificates. In addition to the opening of the market and the introduction of the legal certificate system, the level of the energy tax will be increased for all users. For small users (up to 10,000 kWh) the tax rate will increase from 3.7 EUROcent/kWh to 5.8 EUROcent/kWh. For most green products offered on the market, the price, net of the rebated tax, will then be lower, possibly substantially lower, than regular electricity.

With the introduction of the certificate system and the free market, voluntary agreements between government and the electricity industry on generation based targets will disappear. However, all tax instruments to support the investor will remain in place.

7.2 Wind energy in Denmark

Incentives for wind in Denmark vary either
(A) according to ownership (which can be divided into two categories; (1) energy co-operatives, and other private individuals or organisations, and (2) utility)
or (B) the date of erection.

Private power plants erected before the year 2003 receive a fixed feed-in tariff of 0.33 DKK/kWh (4.4 EUROcent/kWh) for 10 years.
In addition, these plants receive two running cost subsidies for:
(1) a general incentive to expand electricity produced from renewables (RES subsidy 0.17 DKK/kWh (2.3 EUROcent/kWh));
(2) the internalisation of the external costs of fossil fuels (CO_2-tax exemption 0.1 DKK/kWh (1.3 EUROcent/kWh)).

For private wind turbines erected after 1 January 2001, the RES subsidy will be replaced by the grant of extra green certificates with a maximum value of 0.27 DKK/kWh (3.6 EUROcent/kWh) (AGORES, 2000a).

Furthermore, individual persons who participate in wind energy co-operatives ("Bürgerwind") can own shares in a co-operative worth up to 20,000 kWh/year, of which the first 400 EURO/year of income are tax-free (and the remainder taxed at a 60%-rate). To the extent that the wind-power-purchase contracts increases the cost of electricity, these costs are passed on to utility consumers. Lastly, any grid reinforcement which may be required as a result of non-utility wind power installations are paid for by the utilities (Helby, 1995; Morthorst, 1998).

In general, utility-owned power projects do not benefit either from subsides (e.g. from the CO_2-tax exemption and the RES subsidy) or from fixed feed in tariffs. The only exceptions are utility owned offshore wind turbines erected during 2000 - 2003. They receive a fixed price of 0.33 DKK/kWh (4.4 EUROcent/kWh) over 10 years. In addition, to support the less mature technology, electricity from offshore wind turbines can be allowed extra green certificates. Nevertheless, incentives to build new capacity are less for utilities than for co-operatives and private owners (AGORES, 2000a).

7.3 Wind, small-scale hydro-power and biomass in Sweden

For the period between 1 July 1997 and 30 June 2002 investment grants administered by the Swedish National Energy Administration are available for electricity from wind power, small-scale hydro plant and biomass. The highest investment grants are available for biofuel-fired CHP. Subsidies of 3000 SEK/kW capacity (358 EURO/kW) are granted for investments that provide a new contribution to electricity generation, but may not exceed a maximum of 25% of the investments. Grants for wind power plant are available amounting to 15% of the investment for new facilities over 200 kW capacity. For environmentally friendly small-scale hydro plants grants amounting to 15% of the investment have been made available. (AGORES, 2000b).

In addition, two other primary mechanisms exist for supporting small renewable energy projects within the liberalised Swedish electricity market. The first is guaranteed power purchase contracts with local utilities. Prior to electricity market reform, holders of regional power concessions were required to purchase electricity at the utility's avoided cost from all small power projects with generation capacities of up to 1500 kW. This requirement continues to exist under the new law, in which local distribution utilities must still purchase all electricity generated by projects of less than 1500 kW within their service territories. The price now paid to small generators is equal to the residential tariff plus a credit for reduced transmission and distribution losses minus reasonable costs for utility administration and profit. However, this power purchase requirement for small generators is limited in duration to 5 years, and thereafter all power producers are expected to compete on the open market. Whether small power producers will continue to survive at that time remains to be seen (Helby, 1998).
The other support mechanism is an environmental bonus paid from the government. Small-scale RES-based electricity production is favoured by lower or zero energy taxation. In addition biofuels are exempted from sulphur taxation.

8 INDIRECT PROMOTION STRATEGIES

Aside from strategies which directly address the promotion of one (or more) specific renewable energy conversion technologies there are other strategies which have an indirect impact on the dissemination of renewables.
The most important are:

- Ecotaxes on electricity produced with non-renewable sources;
- Taxes/Permits on CO_2 emissions;
- Fossil and nuclear subsidy reduction.

To promote RES via energy or environmental taxes, two options exist:

- Electricity from RES can be exempted from taxes (energy taxes, sulphur taxes etc.);
- If there is no exemption for RES, taxes can be (partially or wholly) refunded.

Both measures lead to an improved competitiveness for RES on the market and apply for old and new plants.

A short summary on existing indirect strategies in EU member countries is given in Table 8.1.

Table 8.1: Energy taxation with exemptions for RES in various EU countries

	Taxation with exemptions for RES
Denmark	Carbon-based-, sulphur- and energy-taxation: Existing RE-plants (wind, biomass, biogas) are exempt from the CO_2-taxation (0,013 EURO/kWh)
Finland	Carbon-based environment tax in force since 1990: The tax is refunded to the producers which use wood-based fuels, wind- and small-scale hydro power
Germany	1999, „Ökosteuerreform": Energy tax (0,01 EURO/kWh, increasing) – revenues of taxing RES are being used for a special RES support program DM Förderprogramm")
Sweden	Carbon-based-, sulphur- and energy-taxation: Small-scaled RES-based electricity production is favoured by lower or no energy taxation. Biomass (incl. waste) is not levied with CO_2-taxation. Biofuels are exempt from sulphur taxation.
The Netherlands	Users of green electricity are exempted from paying the energy tax (0,037 EURO/kWh in 2000; 0,056 EURO/kWh in 2001) Producers of green electricity receive a payment from the energy tax (0,016 EURO/kWh in 2000; 0,019 EURO/kWh in 2001 for electricity – similar rates for producers of biogas and for heat from biomass-CHP)
United Kingdom	Climate Change Levy (CCL): The new tax is to be levied on business customers with effect from April 2001. A recent pre-budget announcement (Nov. 1999) stated that renewable generation would be exempt from it.

9 EVALUATION AND CRITICAL REVIEW OF VARIOUS STRATEGIES

The core question is 'which of the strategies described above attract most attention and which are the most successful ones?' Here success is defined as implementing the largest amount of electricity from renewables and hence the greatest abatement of fossil fuels, and not the cheapest form of generation. Table 9.1 provides an overview on the major strategies currently implemented in EU countries and also on additional instruments applied.

Table 9.1: Current promotion strategies for electricity from new RES in EU countries

Country	Major strategy	Additional instruments
Austria	RPS (4% "new" renewables, 8% Small Hydro by 2007)	Rebates and feed-in tariffs for Biomass, PV and wind
Belgium	Feed-in tariffs (Brussels) / Tradable Green Certificates (Wallonia, Flemish region)	Rebates, Investment-based tax deductions
Denmark	Feed-in tariffs	Tax relief e.g. CO_2 tax, income tax exemptions
Finland	Tax relief	Rebates
France	Tendering (for wind energy)	Grants for PV, biomass and wind in rural areas (stand alone systems)
Germany	High feed-in tariffs	Soft loans, Local rebates, Green tariffs
Greece	Feed-in tariffs	Subsidies and tax deduction
Ireland	Tendering	Tax incentives, subsidies
Italy	High feed-in tariffs	RPS
Luxembourg	Feed-in tariffs	Investment subsidies
Portugal	Feed-in tariffs	
Spain	High feed-in tariffs	Funds
Sweden	Rebates and tax relief	Feed-in Tariffs for small generators
The Netherlands	RPS (3% by 2000)	Complex strategy (green labels, tax refunds and Feed-in Tariffs), target programme for PV
UK	RPS (10% by 2010), Tradable Green Certificates	Pollution tax relief, Green tariffs

It can be seen from this table that feed-in tariffs are currently the prevailing instrument, followed by tax incentives, rebates, obligated supplies, tendering systems, and green tariffs.

Voluntary approaches

Voluntary approaches like green tariffs and green shareholder programmes are based on a high consumers' willingness to pay for "green electricity". Hence, they depend very strongly on the credibility of the organisation that offers it.
Moreover, acceptance of green tariff programmes need much public relations effort by the utility (e.g. the RWE programme in Germany). Nevertheless in most cases, if they are not accompanied by an attractive Green label scheme, they lose attraction after some time and so no more additional capacity is installed. Some programmes in Austria and Germany has been terminated, because of a lack of participants.

Rebates

Rebates are in general an effective tool to enhance the market penetration of renewables in a nascent market, as can be seen for wind energy in Denmark and Sweden (Figure 9.2) and for PV systems in Austria and Germany (Figure 9.1). Rebates on investments do not ensure an optimal performance of the system over its lifetime due to the lack of incentive to run the installation properly after the subsidy has been paid. Hence rebate programmes have to be accompanied by monitoring programmes and supervision ensuring a system performance as high as possible.
Moreover, rebates cannot be considered a sustainable promotion instrument. They are useful to support an emerging technology. Yet, they should be replaced as soon as possible by other strategies which are based on incentives per kWh generated and relief from pollution taxation.

Tax incentives

Tax incentives in both forms (deduction of income tax and relief from electricity generation tax) are important instruments that support and complement rebates, as can be seen from the Danish and Swedish examples.

Enhanced feed-in tariffs

The major advantages of enhanced feed-in tariffs are:

- They are effective in the sense that they trigger substantial instalments of new RES;
- They ensure technically efficient operation of the plant;
- The transaction costs and the administration costs are low.
- They provide an assured aspect of business plans for new investment
- They allow small co-operative groups and companies to participate

The major points of criticism with respect to feed-in tariffs are:

- They provide subsidies;
- They do not ensure that the economically most efficient plant is installed;
- They do not encourage competition between generators.

Tendering / bidding systems

Regarding tendering or bidding systems the empirical evidence shows the following advantages:

- High economic efficiency in driving down costs;
- No market distortion due to generally available subsidies.

Yet the disadvantages are prevailing:

- High administration and transaction costs, including the costs and risks of tendering;
- Low dissemination effectiveness;
- Capacity restrictions;
- Difficulties for small, or local, developers.

Tradable Green certificates

Comparing TGC with other instruments, there is less experience so far for in-depth evaluation. The major arguments in favour of TGC are:

- High economic efficiency;
- A market for best-practice in the environment is created;
- No market distortion due to fixed subsidies;
- The market determines the magnitude of the subsidy.

Possible setbacks are:

- Administration and transaction costs[6];
- Uncertainty about actual investment;
- Unpredictable (volatile) revenues.

[6] Experience from the Netherlands shows that these costs are in the order of 2% of the price paid for a certificate. When the volume traded will increase, this rate is likely to decrease, because a large portion of the costs is associated with fixed costs and start-up of the system.

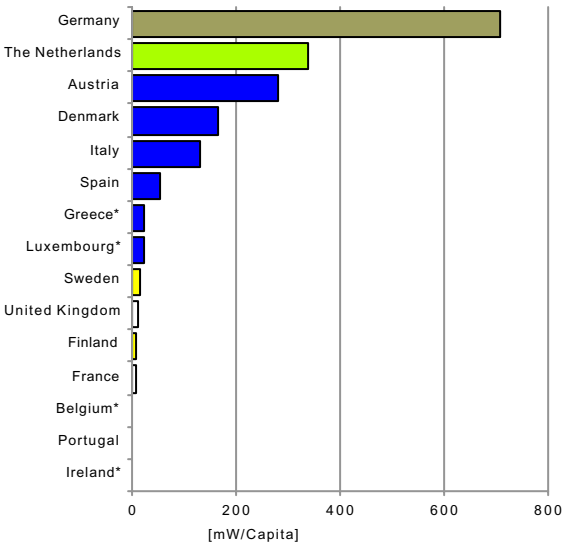


Figure 9.1. Comparison of installed PV (on-grid) capacity per capita in EU countries - Date: End of 1999 resp. for countries marked with * 1998
(Source: IEA, 2000; Eurostat, 2000)

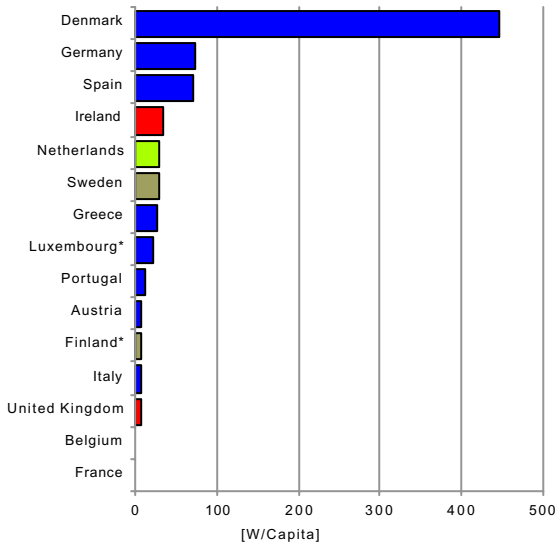


Figure 9.2. Comparison of installed Wind capacity per capita in EU countries
Date: End of 2000 resp. for countries marked with * 1999
(Source: Eurostat, 2000; Madsen & Krogsgaard, 2001))

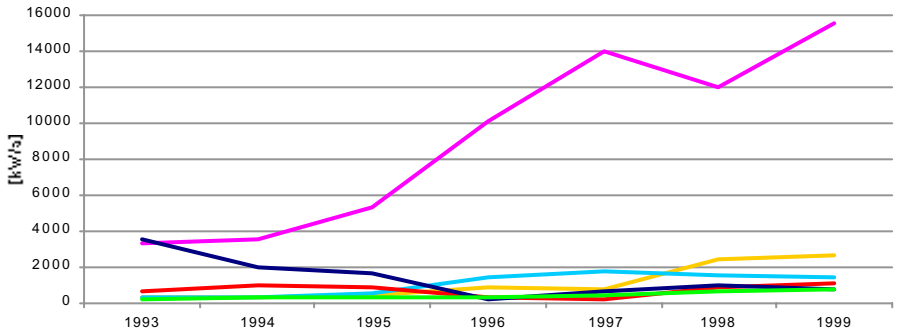


Figure 9.3. Annual installations of PV power in EU countries
- from 1993 to 1999
(Source: IEA, 2000)

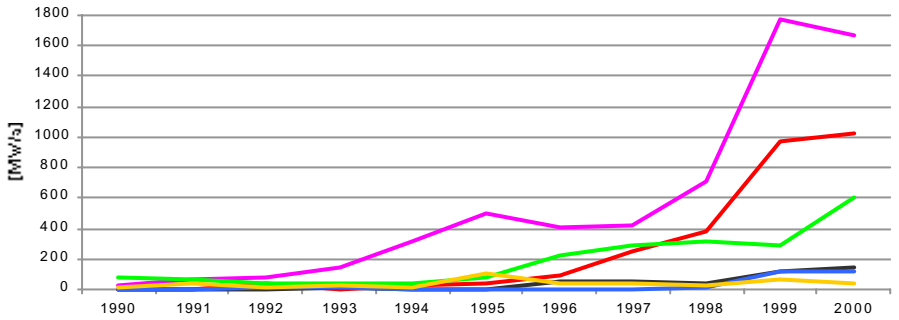


Figure 9.4. Annual installations of Wind power - from 1990 to 2000
(Source: Eurostat, 2000; Madsen & Krogsgaard, 2001)

Table 9.2 summarises the major features of the most important dissemination strategies as discussed above.

Table 9.2: Features of major dissemination strategies for electricity from RES

↓STRATEGY REQUIREMENT→	Dissemination Effectiveness	Administration Efforts	Economic Efficiency	Enhance Competition
Regulatory and Price Driven:				
Rebates, Investment subsidies	High	Medium	Medium	No
Feed-in Tariffs	High	Low	Medium	No
Regulatory and Capacity Driven:				
Tradable Green Certificates	Depending on quota	Medium	High	Yes
Bidding	Low	High	High	Yes
Voluntary and Price Driven:				
Green Tariffs	Low	Medium	High	Yes
Regulatory and Indirect Focus:				
Environmental Pricing (e.g. CO_2-taxes)	Low	Low	High	Yes

10 CONCLUSIONS AND OUTLOOK

This review of promotional strategies for electricity from RES shows that there is a wide range of possibilities to increase their dissemination. Yet, there are considerable differences in these strategies with respect to technical and economic efficiency, as well as with respect to their success in triggering a substantial number of new installations.

The most important conclusions of this review are:
Regardless of which strategy is chosen, the following basic criteria for success should apply:

- A clearly defined time horizon and predictability, as well as continuity over time.
- Credibility of the institution which launches the strategy.
- Strategies to promote RES have to maximise fund effectiveness, by including efficient information distribution mechanisms and criteria that minimise administrative costs.
- The strategy should trigger and enhance competition between generators, as well as between manufacturers. It should encourage renewable electricity suppliers to improve operation performance and technology efficiency.

Some instruments, e.g. enhanced feed-in tariffs, have already proved their effectiveness, whilst some other promising tools still have to be proven, e.g. Tradable Green Certificates (TGC). Yet, currently, TGC looks to be a promising competition-compatible instrument for reaching a specified quota.

GLOSSARY

Embedded Generation Electricity generating equipment connected to the local distribution network.

External Costs Costs resulting from a process which are not included in the monetary price of that process, e.g. damage from pollution associated with electricity generation.

Feed-In Tariffs A statutory arrangement regulating the price paid to generators for electricity. In Germany, for example, feed-in tariffs encourage the development of renewable energy by providing a price above that paid to electricity generated from conventional sources of energy.

Green Certificate An official record proving that a specified amount of green electricity has been generated. Green certificates represent the environmental value of renewable energy production. The certificates can be traded separately from the energy produced.

Green Electricity Labels Green electricity labels demonstrate that an electricity tariff meets certain independently assessed environmental criteria. Independent accreditation may be offered by official bodies (e.g. government agencies) or by non-governmental-organisations (e.g. WWF).

Green Electricity Electricity generated from renewable energy, or other *clean* energy sources.

Green Tariffs Electricity tariffs that either guarantee to provide a certain percentage of electricity from renewable energy sources, or guarantee that a certain percentage of the money paid for the tariff will be invested in new renewable energy capacity.

Rebate Money paid to an electricity generator, distributor, supplier or consumer to account for a perceived benefit, e.g. abatement of pollution.

Renewable Energy In general 'energy obtained from persistent and continuing flows of energy occurring in the environment'. EU countries have historically taken differing approaches to defining which technologies are classified as being renewable. This particularly applies to sources linked to wastes and to large hydro plant. Likewise categorisation of the many forms of agricultural 'biomass' and '
countries. These decisions have partly been dependent on government policy objectives and public perceptions in each given country. Discussions concerning the possible implementation of an EU-Directive which would include a definition of renewables have focussed upon the following technologies and issues:

Biogas - Agricultural, sewage, landfill and industrial organic wastes produce a methane gas that can be collected and burnt to produce electricity. Several EU countries exclude landfill gas and sewage gas from their renewable energy support programmes.

Biomass - Forestry and agricultural residues can be used as a fuel to produce electricity and heat. In addition, energy crops are grown specifically to be used as a fuel. Use of biomass does not add any extra carbon dioxide into the atmosphere, as plants absorb carbon dioxide when they grow and this is then released when the plants are burnt. All EU countries consider biomass as being renewable, though several impose conditions before granting support.

Geothermal - Geothermal energy, coming from hot underground rocks is accepted as being renewable in all EU countries. In some places steam comes to the surface naturally, whilst in others water can be pumped down and heated by the rocks to produce steam. Geothermal energy is most often used to provide hot water and heating for buildings.

Hydro - Hydropower schemes can either use a dam or use the natural flow of water in a 'run of the river' system to generate electricity. It is widely recognised that large hydro schemes can have a significant impact on the local environment, and as such many countries do not permit hydropower schemes above a certain size, typically 10MW, to benefit from renewable energy support programmes. However, some countries only recognise old plants in order to discourage further hydro development. Most large hydro schemes have been in operation for many years, and do not need additional support to enable them to be financially viable. Even small hydropower schemes are often subject to a variety of conditions concerning their environmental impact.

Municipal Waste – Municipal waste can be used as a fuel to produce electricity and heat. Few countries consider electricity generated from the burning of municipal waste to be renewable. However, the organic content of municipal waste is itself from a renewable resource, and in some countries the organic portion of the waste resource is eligible for support.

Peat - Peat is included in the definition of renewables in some EU countries, under certain conditions.

Solar - A solar photovoltaic (PV) panel generates electricity directly from light. PV panels can be integrated into buildings or used in a variety of other applications. All EU countries consider PV to be a renewable energy technology. Also, active and passive solar technologies that utilise the energy from the sun to produce heat are also widely supported in Europe.

Wave and Tidal Energy - The energy in waves can be captured in a number of ways. One method is to funnel the waves into a vertical column, then the motion of the waves forces air back and forth over a bi-directional turbine to produce electricity. Power from such devices is already sold commercially to the grid in Scotland. Several other types of wave energy device are currently under development. Tidal energy can either be captured by storing water behind a barrage at high tide and releasing it at low tide, or by using underwater turbines, which can also extract energy from other marine currents. Several EU countries have small support programmes to encourage the development of wave and tidal systems.

Wind - Wind turbines, which capture the energy from the wind to produce electricity, have been developed for various purposes, from large groups of grid connected wind turbines, both on-shore and off-shore, to very small autonomous turbines used for battery charging. Currently all EU countries accept wind as being a renewable energy source worthy of support.

Tendering

The process of offering a formal contract (a tender), e.g. for the generation of green electricity. The tendering process usually has a requirement for the acceptance of the lowest priced tender, subject to authenticity and reliability.

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