Review of support mechanisms for generating electricity from renewable energy sources in Germany, Spain and Great Britain.

Applying European emissions trading and renewable energy support mechanisms in the Greek electricity sector (ETRES)

Report for Task 1: International developments in emissions trading and renewable energy support mechanisms

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1. Introduction

This report is a contribution to the project "Applying European emissions trading and renewable energy support mechanisms in the Greek electricity sector (ETRES)". ETRES is being undertaken from 2003 to 2006 by a consortium of Greek organizations: the Centre for Renewable Energy Sources (CRES – the coordinator), the Regulatory Authority for Energy (RAE), the Greek Association for Renewable Energy Investors (GARI) and the National Technical University of Athens (NTUA). The project is co-funded under the European Commission LIFE-Environment fund (LIFE03ENV/GR/000219). The aim of the ETRES project is to make steps to apply EU climate change and renewable energy (RE) policies and measures in the Greek electricity sector.

The project comprises several tasks. Task 1 is titled "International developments in emissions trading (ET) and renewable energy (RE) support mechanisms". This task reviews current and anticipated developments in emissions trading and RE support to achieve understanding and knowledge that assists the ETRES team's work with respect to the Greek electricity sector in subsequent tasks.

Prior to this review, a database was compiled which gives an overview of ET and RE support schemes (see www.cres.gr/etres). The ETRES team chose to review support for electricity from renewable energy sources (RES-E) in three European countries, namely Germany, Spain and Great Britain. These were selected because of the differing - and broadly successful - approaches to supporting RES-E. In Germany and Spain, RE is supported by a feed-in system. The German feed-in is the longest-running in Europe and was the basis for the system that exists in Greece. Germany and Spain have the highest installed wind energy capacities in Europe, and Germany is world-leading in other RE technologies. UK has had a mixed history with a bidding system recently replaced by an obligation on utilities combined with tradable certificates. The RE industry in UK, specifically the on-shore and off-shore wind industry, seems to be on the cusp of sizeable expansion. Further detail on the diverse ways that these three countries are achieving successes in RE development is contained in this report and should be a useful reference in its own right as well as valuable input to the ETRES project.

This report gives consideration to the implementation of Directive 2001/77EC. The stated purpose of this Directive is "to promote an increase in the contribution of renewable energy sources to electricity production in the internal market for electricity and to create a basis for a future Community framework thereof."

The Directive requires Member States to establish national indicative targets for RES-E, to report the measures planned to reach these targets and to submit two-yearly reports that analyse progress towards these targets. The Directive requires Member States to establish processes enabling renewable energy generators to receive Guarantees of Origin (GO), ie evidence that electricity produced is generated from renewable energy sources. The Directive also requires Member States to evaluate their administrative procedures for renewable energy plants, and furthermore to take action where necessary to streamline, make transparent etc such procedures. Finally, the Directive also outlines requirements for grid system issues, such as making it necessary for transmission system operators (TSOs) and distribution system operators (DSOs) to charge fees, in a transparent manner, to renewable energy producers that reflect realizable cost-benefits. These complex issues clearly all impinge upon the success or otherwise of the support mechanisms in place nationally in the EU. Detailed examination of these issues is beyond the scope of this report but, where possible, observations are made

within the report. The report draws also on other reviews – for example, a recent EC Altener-supported project that examined the implementation of systems of GO (IT Power et al, August 2004).

All RE sectors are covered by this report with particular detail presented on the wind energy sector in each of the three countries. European policy maker's attention has recently focused on the biomass energy sector because market developments have not matched policy maker's sizeable targets for this sector. Large hydro is typically the largest RE sector in terms of current installed capacity but there is little unexploited potential for further growth in Europe. Wind energy is thus arguably the most significant RE sector in terms of current installed capacity and future potential growth in the three study countries and also in Greece. Focus on one sector allows better comparisons to be made than more general information for many technologies.

2. Germany

Overview of RES-E

Directive 2001/77/EC: indicative target and Guarantees of Origin

According to the RES-E Directive, Germany's national indicative target is to increase the share of gross electricity consumption from renewables from 4% in 1997 to 12.5% by 2010. The Government's goal is that RES-E should reach at least 20% by 2020. More broadly, by the middle of the century, RES should account for around half of gross energy consumption according to the German environment ministry (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, March 2003).

The main support mechanism provided for RES-E in Germany is a feed-in tariff system, legislated by the Act on Granting Priority to RES / Renewable Energy Sources (Erneuerbare-Energien-Gesetz, EEG), which was enacted in April 2000. The EEG is described and discussed in the sections below. GO have been integrated into the revised EEG which came into force in August 2004.

GO in Germany include more detail than the minimum specified by the RES-E Directive. For example, GO specify the installed capacity for all plant (the RES-E Directive requires specification of capacity only for hydro plants). Most notably, GO are "earmarked" to record whether the RES device has received the feed-in tariff. The revised EEG states that plant operators that receive the feed-in tariff under the EEG may not pass on GO. Vice versa, if an operator passes on GO, then the feed-in tariff may not be claimed.

Current installed capacity and forecast

RES-E capacity in Germany is increasing rather rapidly. The table below shows a time series of data indicating a doubling in RES-E from 4% of gross national consumption of electricity in 1997 to 8% in 2003.

RES-E in Germany (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, October 2003)

	1997	1998	1999	2000*	2001*	2002*	2010
Total consumption (TWh)	549.9	556.7	557.3	576.4	580.5	581.7	-
RES-E share (%)	4.0	4.6	5.3	6.3	6.7	8.0	12.5

*provisional

The development of energy supplies from RES up to the year 2002 is shown in the table below. The largest share of electricity generation from RES is accounted for by hydropower with 53%, followed by wind energy with 38% (figures for 2002). It was expected that electricity generation from wind energy would overtake hydroelectric power in 2003.

Evolution of renewable energy in Germany (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, October 2003 and European Renewables Energy Federation, March 2004)

	1998	1999	2000	2001	2002	2003

Wind	Installed capacity (MW)	2875	4444	6112	8754	12001	
	Power generation (GWh)	4489	5528	9500	10456	15856	18500
Hydro	Installed capacity (MW)	4601	4547	4572	4600	4620	
	Power generation (GWh)	19215	21798	25141	23570	23824	20350
Biomass	Installed capacity (MW)	409	448	585	825	900	
	Power generation (GWh)	1050	1170	1625	3785	4467	5140
PV	Installed capacity (MWp)	52	67	111	179	262	
	Power generation (GWh)	37	48	71	116	176	332
Solar heat	Installed capacity (1000m^2)	2191	2638	3283	4207	4754	
	Heat generation (GWh)	855	1036	1278	1627	1955	
Geothermal*	Heat generation (GWh)				113	113	

*At present no electricity is generated from geothermal energy in Germany. However, the first plant was scheduled to start operating at the end of 2003. Heat generation data obtained from EurObserv'ER 2003.

More than one third of the electricity generated from wind energy worldwide, and about half the figure for the EU, is produced in Germany. In 2002 wind energy contributed around 3% of total electricity generation in Germany. By the end of September 2003 around 13,400 MW of wind energy were installed. With continued good framework conditions, a further expansion of installed wind power capacity is considered possible by German environment ministry. Even though onshore locations with high wind volumes are becoming fewer, more potential will be tapped by developing good inland sites and by replacing older, smaller wind farms with modern and more powerful systems (repowering). There are limits to wind energy utilization on land. In January 2002, the Federal Government submitted a strategy for utilizing wind energy off-shore. Under current conditions, 500 MW can be established in an initial phase up to 2006. Around 2,000 to 3,000 MW by 2010 is a realistic possibility. If investors and the utility companies create favourable conditions for offshore wind, a capacity of up to 25,000 MW will be possible within 25 years.

Biomass currently contributes around 1% to gross power production (plus around 3.5% to the thermal energy supply). At the end of 2002 there were some 100 CHP plants operating with an electrical output of around 400 MW. Also at the end of 2002, there were some 1,900 biogas systems with an electrical output of around 250 MW. This is three times as many biogas systems as at the end of 1999. The long term potential of biomass in Germany represents a share of around 10% of power production (plus around 20% of heat generation). To what extent this potential can be tapped will depend on how quickly the various technologies for biomass utilization become competitive.

Although electricity generation from solar energy has developed rapidly in Germany in recent years, its contribution to total electricity generation was still relatively low in 2002, at around 180 million kWh or 0.03%. But the solar electricity sector expects a continued growth rate of around 20% to 30% annually in the coming years. For 2003 the German Solar Industry Association anticipated market growth of 50%, to give total installed capacity c. 350 MWp.

Hydroelectric plants have been operating for about a century in Germany and currently account for more than 50% RES-E. In 2002, hydro generated 24 TWh, representing 4% of total electricity supply. The number of large installations has remained constant in recent years, but the Electricity Feed Act in 1991 and the RES Act in 2000 have led to an upturn in the number of small hydro plants. Around 75% of hydro potential in Germany is exploited.

There are 34 sizable plants in Germany supplying some 1,050 GWh of heat per year. In November 2003, the first plant transforming deep earth heat into electricity went into operation. Even though this form of power generation still requires a great deal of RD&D and

introduction in the market, studies have shown high theoretical potentials (up to 320 TWh electricity and 700 TWh heat).

Support schemes

The German federal government, as well as the state and district governments, has put in place a number of measures for promoting RES. The main financial promotion measure on national level is the Act on Granting Priority to RES (Renewable Energy Sources Act / Erneuerbare-Energien-Gesetz – EEG). The act entered into force in April 2000. The predecessor to the EEG was the Electricity Feed Act in 1991 (Strom-Einspeisungs-Gesetz – StreG). Both these are feed-in tariffs.

The Renewable Energy Sources Act – EEG

The EEG regulates the feeding into the grid and compensation of electricity from hydro, wind, solar, geothermal, landfill gas, sewage treatment plants, mines and biomass.

The EEG obliges grid operators to purchase electricity generated from RES and to pay minimum compensation to the generators of the RES-E. Compensation aims to facilitate the economic viability of RES-E installations and compensation rates are based on assumed costs of RES-E. The minimum compensation depends on energy source, on electrical capacity of installations and, in the case of wind, on location. Compensation generally extends to 20 years from the year of commissioning.

The tariffs decrease over time by a set percentage. This is termed degression. The decreasing compensation system is designed to encourage generators to continuously improve the economic efficiency of the production process and the installation.

Two tables below show rates for the period 2000-2003 and new and more extensively defined rates announced in April 2004.

Compensation rates for renewable energies from 2000 to 2003 (Association of German Network Operators).

	2000 (cents/kWh)	2001 (cents/kWh)	2002 (cents/kWh)	2003 (cents/kWh)	Annual reduction from 1.1.2002
Hydro (<500 kW)	7.67	7.67	7.67	7.67	0%
Hydro (>500 kW)	6.65	6.65	6.65	6.65	0%
Biomass (<500 kW)	10.23	10.23	10.1	10.0	1%
Biomass (<5 MW)	9.21	9.21	9.1	9.0	1%
Biomass (>5 MW)	8.70	8.70	8.60	8.50	1%
Geothermal (< 20 MW)	8.95	8.95	8.95	8.95	0%
Geothermal (> 20 MW)	7.16	7.16	7.16	7.16	0%
Wind (<5 years)	9.10	9.10	9.0	8.9	1.5%
Wind (>5 years)	6.19	6.19	6.1	6.0	1.5%
PV	50.62	50.62	48.1	45.7	5%

Compensation rates for renewable energies for 2004 (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, April 2004)

	2004 (cents/kWh)

Hydro (≤500 kW)	9.67
Hydro (>500 kW≤5 MW)	6.65
Hydro (≤ 10 MW)	6.65
Hydro (≤20 MW)	6.10
Hydro (≤50 MW)	4.56
Hydro (>50<150 MW)	3.70
Biomass (≤ 150 kW)	11.50
Biomass (≤ 500 kW)	9.90
Biomass (≤ 5 MW)	8.90
Biomass (< 20 MW)	8.40
Renewable raw materials (≤ 150 kW)	17.50
Renewable raw materials (≤ 500 kW)	15.90
Renewable raw materials (≤ 5 MW)	12.9
Wood burning bonus	2.5
CHP & Innovation (≤ 150 kW)	13.50
CHP & Innovation (≤ 500 kW)	11.90
CHP & Innovation (≤ 5 MW)	10.90
CHP (< 20 MW)	10.40
Geothermal (≤ 5 MW)	15.00
Geothermal (≤ 10 MW)	14.00
Geothermal (≤ 20 MW)	8.95
Geothermal (> 20 MW)	7.16
Wind (<5 years)	8.70
Wind (>5 years)	5.50
Offshore wind (initial rate-plants commissioned before 2011)	9.10
Offshore wind (final rate)	6.19
PV (<30 kW rooftop)	57.40
PV (<100 kW rooftop)	54.60
PV (>100 kW rooftop)	54.00
PV (<30 kW cladding)	62.40
PV (<100 kW cladding)	59.60
PV (>100 kW cladding)	59.00
PV (freestanding)	45.70
Landfill, Sewage & Mine gas (≤ 500 kW)	7.67
Landfill, Sewage & Mine gas (≤ 5 MW)	6.65
Mine gas (>5MW)	6.65

The EEG, in contrast to its predecessor StreG, prescribes a nationwide balancing of the costs resulting from the electricity feed and compensation system among grid operators and thus an equal distribution of the costs for the electricity fed into the grid over the entire electricity consumption. All end utilities and traders receive a uniform quota of EEG electricity at a nationwide uniform average compensation rate.

For 2001, the Association of German Network Operators listed a total volume of approximately 17.820 billion kWh for EEG electricity feeding, with around € 1.54 billion in compensation payments. Average compensation was €86.4 per MWh. For 2002, the Association announced provisional total volume of around 24.600 billion kWh and around € 2.187 billion in compensation payments, or average compensation € 88.9 per MWh.

Electricity Feed Act - StreG

The Electricity Feed Act operated from 1991. The EEG was specifically designed to make the following main improvements (Sijm 2002):

- Tariffs in the StreG were linked to average consumer prices; tariffs under the EEG are designed to be tied to generation costs.
- StreG excluded installations >5MW except wind and solar, and installations in which the Federal republic of Germany, a federal state, a public electricity utility or one of its subsidiaries held shares of more than 25%. There are no such exclusions under EEG.
- StreG tariffs did not account for differences in technology. EEG has an extensive array of different tariffs per technology and per capacity.
- EEG tariffs are degressive ie decline year on year by a predetermined amount.

Grants and Loans

In addition to the EEG, there are a range of investment funding measures and provisions that support the expansion of renewable energies.

100,000 Roofs Solar Power Programme. This was launched in January 1999 with the goal of achieving an additional PV capacity of 300 MW by the end of 2003. Under the programme, the Kreditanstalt fűr Wiederaufbau (KfW- Reconstruction Loan Corporation) gave low interest loans. The programme came to a successful close after the target was achieved in mid-2003.

Market Incentive Programme for renewable energies. This programme offered grants and loans at favourable rates with focus on thermal energy. These financial supports are also available via KfW. Around €550 million were allocated from the Federal budget for this programme at its launch in September 1999. By May 2002, grants totaling over €228 million for around 156,000 projects had been paid out for solar panels, small solid biomass burning installations, heat pumps and energy saving measures in buildings. In addition, 880 loan approvals with a volume of over €195million had been issued for biogas installations, large solid biomass burning installations, deep geothermal energy installations and small hydro plants.

There are a number of other funding programmes. For example, PV installations can be supported to a limited degree within the framework of the KfW CO2 remediation programme for buildings constructed prior to 1979 and within the KfW CO2 reduction programme. The Federal States also have their own programmes of supplementary funding measures for RE technologies.

Recent developments

Amendments to the EEG were announced in April 2004 (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, April 2004). A table summarising the tariffs is presented above. Some notes on salient aspects for selected RE technologies are presented below.

The tariff rates for onshore wind energy have been reduced in the recent amendments. The ministry states that, given the rapid pace of development of the technology, it is expected that the onshore wind energy sector will expand despite these reductions.

There are several ways in which the tariffs are being reduced. Electricity produced by wind farms is paid over a period of 20 years under the EEG and, during that 20 year period, there is a relatively high initial rate and a lower final rate. The initial rate is paid for at least 5 years

but, depending on the plants yield, the period for the initial rate can be extended. Under the April 2004 amendments, the tariffs are being reduced through:

- Reduction in the initial rate (from Euro cents 8.9 per kWh to Euro cents 8.7)
- Reduction in the final rate (from Euro cents 6.0 per kWh to Euro cents 5.5)
- Increase in the rate of digression (from 1.5% to 2%)
- Reduction in the period for which plants will be eligible for the higher initial rate (by approximately 12%).

Conditions for offshore wind have been improved by the April 2004 amendments:

- Higher initial rate and final rate for offshore generation have been introduced (Euro cents 9.1 per kWh and Euro cents 6.19 per kWh respectively)
- The period of eligibility for the initial rate for offshore has been extended (from 9 to 12 years)
- Degression is delayed for offshore plant (it will start in 2008)

There are several changes and innovations for biomass installations. A new smaller capacity band has been introduced with a relatively high rate (installations <150kW have rate Euro cents 11.5 per kWh). The rate of degression has been increased for biomass installations (from 1% to 1.5%) but there are several new bonuses:

- A bonus for renewable raw materials. This is attracted for installations that use defined biomass materials, which exclude biowastes and waste wood. The bonuses are substantial (additional Euro cents 4-6 depending on capacity).
- A bonus for burning wood (for installations between 500kW and 5MW, this bonus is Euro cents 2.5 per kWh)
- A combined heat and power / innovation bonus. This bonus is for plants that are CHP or use novel technologies including gasification, fuel cells, gas turbines etc (the bonus is Euro cents 2 per kWh).

The amendments also contain rules that clarify grid connection. Grid operators are required to upgrade the transmission system where necessary for connection to new RES-E plant, as long as the cost is “economically reasonable” (the exact meaning of this has yet to be determined in the courts). If connection is refused, evidence to support the refusal must be provided within four weeks. In this way, the amendments aim to make connection charges more transparent.

Conclusions

The feed-in law has brought about a marked increase in the utilization of RES for electricity generation. While this is particularly true for wind energy, the RES Act has also brought about substantial improvements in the conditions for biomass, PV, hydropower and geothermal energy. The German government estimates that there are around 120000 to 135000 jobs in the renewable energy sector in Germany (around 46000 in the wind energy sector alone) and the sector has an annual turnover of approximately Euro10billion.

The German environment ministry declared that “the EEG is one of the most effective and efficient climate protection instruments in Germany”. The ministry declared the use of RES delivered CO_2 savings of approximately 53 million tonnes in 2003, with the EEG accounting for approximately 23 million tonnes. The EEG is expected to reduce emissions of CO_2 by at

least 40 million tonnes in 2010 (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit, April 2004). Thus, the EEG plays a significant role in Germany's commitment to 21% reduction under the EU's Burden Sharing Agreement (BMU October 2003).

Some observers have suggested that employment statistics have been over-stated by the German government. There is also a question mark about how cost-effective renewable energy is in mitigating greenhouse gas emissions. For example, figures from a study by Eurelectric (cited in CEER, 2004), indicate costs exceeding Euro 100 per tonne CO2 for the average RES-E support via feed-in tariffs in the EU. This figure greatly exceeds many energy efficiency and other measures for mitigating emissions.

The rates offered to support the German wind energy sector have declined markedly over the years, giving a clear illustration of how the sector has developed. The following table reproduces figures from Bundesverband Wind Energie, the federal wind association, published in WindPower monthly (May 2004), including the associations forecasts to 2015 given the tariff structures announced in April 2004.

Evolution of wind energy tariffs in Germany (WindPower Monthly, May 2004)

Year	Wind energy tariff rate Euro per kWh
1991	0.1837
1995	0.1177
2000	0.0910
2004	0.0823
2004 (amended April 2004)	0.0787
2005	0.0756
2010	0.0618
2015	0.0505

It is evident from the amendments announced in April 2004 that the policy makers have clear goals with respect to promoting technology diversification, use of different fuels etc, and that they believe that industry can be encouraged to develop to achieve these goals if the correct price signals are put in place. A previously short list of tariffs has been replaced by an extensive array of tariffs. An innovation introduced in April 2004 is the use of bonuses for particular fuel types and for particular innovative technologies.

It is also interesting to note that there is a mixture of rate increases and decreases as well as some rates remaining unchanged. Onshore wind tariffs are being reduced; while the ministry says that development is expected to continue there is reference to avoiding over-production is some areas. Offshore wind is being encouraged with higher rates. Biomass is being encouraged with generally higher rates. It is noted that small plants were not being developed so a new band with high rates has been created. The bonus system is designed to encourage a shift from cheaper waste materials to dedicated wood and energy crops. There is also attention given to the environmental benefits of CHP. There is a wish to nurture new technology development.

There have been few reports about German industries reaction to the changes to the EEG. The wind industry has reacted positively, the amendments bring to the end a period of some

uncertainty during which some dramatic changes were tabled, that would have made low wind speed sites unviable. The coming months will doubtless bring further detailed responses.

There are grid areas in Germany with very high penetration rates by wind capacity and some have been the subject of heated debate. For example, in eastern Germany the grid area operated by the company E.dis has, in theory, up to 83% peak load wind energy (installed capacity of wind energy is 1920MW and peak load is 2300MW). RES-E accounted for 22% of sales for that area in the year 2003. Reports in the media (WindPower Monthly May 2004) indicate resistance to further connections to RE plant by the company.

3. Spain

Overview of RES-E

Directive 2001/77/EC: indicative target and Guarantees of Origin.

The EU Directive indicative target for Spain is 29.4% of gross electricity consumption from renewables by 2010. The Spanish Electricity and Gas Infrastructures Plan 2002-2011 adopts the target 30.6% by 2011. However, this target relates to electricity production rather than consumption. Specific targets have also been established for renewable energy technologies.

A Royal Decree (Real Decreto) has been drafted to transpose the RES-E Directive into Spanish law, and this includes details on the proposed GO system. GO will be issued by the National Energy Commission (Comisión Nacional de Energia, CNE) and this organization will also manage a national register. It is intended to make GO compatible with the existing feed-in tariff support system but details of how this will be done are not yet determined.

Current installed capacity and forecast

RES-E capacity in Spain is increasing. The table below shows a time series of data indicating a rise in RES-E from 19.9% of gross national consumption of electricity in 1997 to 23.3% in 2003. The year to year variation in RES-E is notable, however, and this is because of the large contribution from hydro power (eg 78% of total RES-E in 2001).

RES-E in Spain (reported in Bustos 2004 from various sources)

	1997	2000	2001	2002	2003*	2011
Total consumption (TWh)	187	206	227	233	236	304
RES-E consumption (TWh)	37	38	54	39	55	93
RES-E share (%)	19.9	18.4	23.7	16.7	23.3	30.6

*provisional

Wind power is developing rapidly in Spain, with almost 4000MW installed in the three year period 2001-2003. At the end of 2003, Spain had the third largest national installed wind capacity in the world, just behind the United States in second place, and Germany in first place (Windpower Monthly, March 2004).

Large hydropower is not expanding and is not expected to do so in the future. All other technologies are growing at slow rates. The statistics for all RE technologies are shown below with national 2011 targets.

Evolution of renewable energy in Spain (Bustos 2004)

		2000	2001	2002	2003	2011
Wind	Installed capacity (MW)	2502	3337	4825	6202	13000
	Power generation (GWh)	4797	6689	9602	11371	28600
Large hydro	Installed capacity (MW)	16220	16378	16378	16399	16571
	Power generation (GWh)	32079	23580	27356	38991	31129
Small hydro	Installed capacity (MW)	1548	1582	1619	1655	2380

	Power generation (GWh)	4419	4449	4872	na	7376
Biomass	Installed capacity (MW)	196	218	349	361	3176
	Power generation (GWh)	1131	1297	na	na	23330
Solar	Installed capacity (MW)	9	12	16	21	344
	Power generation (GWh)	14	18	23	na	677
MSW	Installed capacity (MW)	94	94	94	94	262
	Power generation (GWh)	660	667	667	na	1846

na = not available

Support schemes

Feed-in tariff

Spanish government policy, established by the 1997 Electricity Sector Law, is for the tariff paid to power from renewables to be in the range 80-90% of the pre-tax consumer price of electricity, with the exception of photovoltaic power.

A feed-in scheme has been in place from 1999. DSOs are obliged to buy all electricity generated from renewables. DSOs pass the extra cost of the power to CNE. The cost of the power from renewables is applied to all consumers through an additional charge on bills.

Until March 2004, Spanish RE generators were able to choose from two alternatives, and switch from one option to another annually. One option was a technology-specific fixed premium (*la prima*), intended to reflect RE's environmental benefit, plus a rate based on the hourly pool electricity price (pool price is used as a marker because renewables do not trade on the market). Alternatively, generators could take a fixed price based upon the premium plus an expected pool price. Most generators have opted for market plus the *prima*, which showed greater volatility but higher remuneration (Standard and Poor's, November 2003).

Spanish central government adjusts both premiums and fixed prices annually in line with variation in average electricity retail sale price. More fundamental reviews are undertaken every four years. The upper size limit for support is 50MW for single RE plants. The table below shows fixed prices over a five year period. The breakdown of 2003 prices into premium and expected pool price is shown.

Evolution of RES-E prices (Euro cents per kWh) in Spain (APPA 2004)

	1999	2000	2001	2002	2003		
	Fixed price	Fixed price	Fixed price	Fixed price	Fixed price	Premium price	Expected pool price
Wind	6.62	6.26	6.26	6.28	6.21	2.67	3.54
Small hydro	6.73	6.36	6.36	6.38	6.49	2.95	3.54
Energy crops	6.50	6.15	6.15	6.17	6.85	3.32	3.54
Biogas, biomass residues	6.28	5.94	5.94	5.96	6.05	2.51	3.54
Solar PV*	39.6	39.6	39.6	39.6	39.6	36.16	3.54

* prices are lower for installations over 5kW

A new tariff model was approved on 12th March 2004 (by the government that subsequently lost the election two days later). The most important change is that there are now three tariff options, including trading power from renewables on the wholesale power pool market, and requirements for forecasting output. The three options now available are:

Market rate. Operators give up the right of being classed as prioritized production, which allows them to sell all power that they generate to DSOs. The pool price is received. In addition, a production incentive is received, calculated as 50% of the average electricity sector billings, termed Average Electricity Tariff. Such generators have the same conditions as conventional generators alongside whom they will be playing the market, namely very low / zero tolerance for imbalances caused from output differing to forecast.

Fixed tariff. The tariff is a fixed percentage of the AET and reduces over time. For wind energy, the tariff is 90% of AET for the first five years, 85% for the next ten years, and 80% thereafter.

Transition option. Operators receive a fixed premium plus a rate based on the hourly pool electricity price. This is similar to "la prima" plus "market rate" available previously (see above). Under this option, generators can switch to one of the two other alternatives but cannot switch back again. This option will exist until 2007.

Under all three options, plant operators must introduce production scheduling by 2005. Both the transition and fixed tariff options allow production to vary by 20% either side of the 24 hour forecast, and operators may vary forecasts up to one hour before electricity dispatch. Imbalances will be fined at rate Euro 7 per MWh. The conditions are more restrictive for operators choosing the market rate option – as described above – but the penalty is lower, around Euro 3 per MWh.

Another new development announced in March 2004 was with regard to grid support provided by wind operators. Providing reactive power control and adding equipment that enables wind plant to ride through grid faults, rather than tripping off the system, will earn extra incentives. For ride through capability, an incentive of 5% AET is on offer for the first four years of providing such grid support.

Grants and Loans

Instituto de Cridito Oficial (Official Credit Institute) and Instituto para la Diversicacion y Ahorro de la Energia (Institute for Energy Saving and Diversification) have a finance line for investment projects in renewable energy and energy efficiency. The finance line operates within the Plan to Promote Renewable Energy 2000 – 2010, the aim of which is to ensure that by 2010 12% of primary energy consumption in Spain comes from renewable energy sources.

The total finance available was Euro 179.7m in 2003. From this, an amount of Euro 34.7m was available in 2003 to discount interest rates for all types of projects and provide direct support for solar heating and solar photovoltaic projects. Each investor can apply for loans up to Euro 6.3m, for up to 70% of the eligible costs of the project. Solar projects may be financed up to 96%. Loans are offered for 5, 7 or 10 years, with maximum of 2 years payment holiday. Solar projects have holiday period of 7 years. The interest rate is variable fixed to the Euribor for six months plus 1%. A discount of 3.5% is applied to renewable energy projects so the final interest rate is Euribor minus 2.5%. Eligible renewable energy projects in 2003 were: self consumption wind power (<4MW); biomass; mini-hydro (<1MW); thermal, photovoltaic and thermoelectric solar energy; biogas; energy from waste.

Recent developments

The most significant recent development has been the new feed-in tariffs announced in March 2004. Three new tariff options now exist – these are described above. It is unclear what options will be chosen by renewables operators. The wind group Plataforma Eólica Empresarial (PEE) suggests that, for wind operators, the market option should be financially attractive based on its estimates. PEE believes that aggregation of production schedules from wind energy plant across Spain (permitted under the market option) will consolidate wind as a mainstream power sector. Spain's renewable's group Asociacion de Productores de Energias Renovables (APPA) is less certain of the benefits. APPA suggests that forecasting by wind operators is in early days and the penalties may prove a costly burden. An important trade-off decision faces Spanish wind energy operators: giving up the right to sell to the grid for the opportunity to be rewarded for playing the market.

Over 6000MW of wind energy online makes up around 8% of installed power capacity and 5% of all power generation in Spain. As a consequence, REE was becoming increasingly fearful of integrating ever larger amounts of an intermittent energy source (WindPower Monthly, December 2003). The new market tariff structure announced in March 2004 should bring significant benefits to REE. All renewable operators, regardless of the option chosen, will have to forecast output. Wind energy operators will have good incentives to provide grid support. And many renewable operators may trade on the market and obey market laws of supply and demand. Taken together, this should help reduce some of the tension between the renewables energy sector, primarily wind energy, and the grid operator.

Spanish utilities Iberdrola and Endesa are taking active roles in trading of Renewable Energy Certificates. To avoid the "green value" being sold twice, RECs are not issued to power from that already received premium prices under Spanish law. The idea has been muted that it may be beneficial to forego wind tariffs and to sell the power on the open market plus export the RECs, for example to Italy where prices are currently high. In the words of WindPower Monthly (May 2004) "it seems the fast maturing Spanish wind energy sector is open to new earnings opportunities".

Conclusions

There has been a significant rise in the share of RES-E in gross national electricity consumption – from 19.9% in 1997 to 23.3% in 2003. Despite this progress, it appears that the 2011 target (30.6% RES-E share in gross national consumption) is ambitious and may not be met. The Spanish Renewable Energy Association (APPA) estimates that RES-E will contribute 24-25% in 2011 (assuming average level of generation from hydro plants).

APPA considers that a combination of three factors have enabled rapid development of wind power in Spain:

1) the stable legal framework, ie feed-in tariff, in place over many years in Spain
2) the favourable tariff for electricity from wind turbines
3) Regional government development plans

Wind power is on track to reach its 2011 target. Large hydropower is not expected to grow significantly by 2011. Other RE technologies are not developing as quick as necessary to reach their respective targets. Although the situation with wind power is relatively good, APPA warns that additional efforts will be required to reach its target, including additional financial support and addressing grid and administrative issues.

4. Great Britain

The report below focuses on England, Wales and Scotland ie Great Britain. It excludes Northern Ireland.

Overview of RES-E

Directive 2001/77/EC: indicative target and Guarantees of Origin

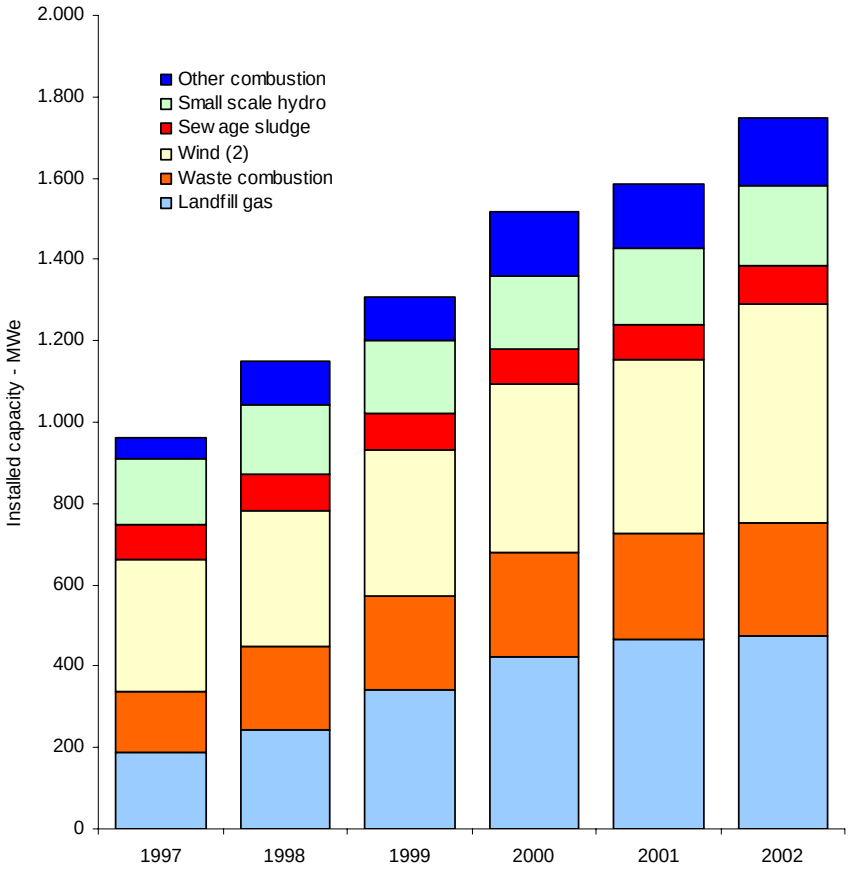
The EU Directive indicative target for UK is 10.4% of gross electricity consumption from renewables by 2010. The government has declared an "aspiration" of 20% for 2020. The government also aspires to a 60% reduction in CO_2 emissions by 2050 (DTI, April 2004).

GO came into force in Britain on the 27th October 2003 via Statutory Instrument. Ofgem, the energy markets regulator in the UK, has been appointed as the issuing body and will also maintain a registry of GO. GO will be issued on request and will be free of charge. In addition to the minimum requirements established by the Directive, GO will identify whether the originating plant is accredited for the Renewables Obligation (RO) or the Climate Change Levy (CCL) scheme. However, the GO will not record whether a Renewables Obligation Certificate (ROC) or Levy Exemption Certificate (LEC) was issued for the same unit of electricity to which the GO covers. More details on the RO and CCL are given below.

Installed capacity

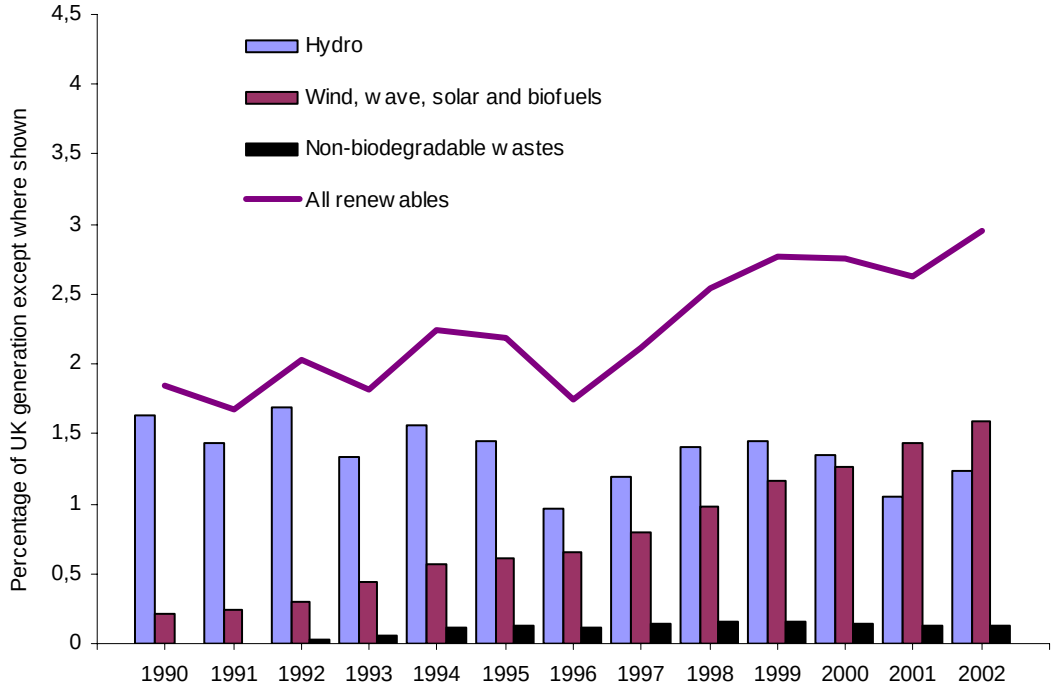
The most recent data for installed capacity of electricity generation from renewables dates from 2002 (DTI, 2003) and is shown on the graph below. The graph excludes large scale hydro capacity which was 1,383 MWe in 2002. Wind includes both onshore and offshore and also includes solar photovoltaics (4.2 MWe in 2002). The total installed RES-E capacity from was around 1800MWe in 2002.

Electrical generating capacity of renewable energy plant (excluding large scale hydro)



The graph below shows steady increase in the generation of electricity from renewables over the period 1990 to 2002, albeit the overall percentage contribution remains very low. Large hydro fluctuates from year to year, according to climate. Waste combustion and, in particular, landfill gas, grew substantially during the 1990s but these are rather static from 2000. Current growth is principally wind energy.

Growth in electricity generation from renewable sources since 1990



Support Schemes

Renewables Obligation

The Renewables Obligation (RO) came into effect in England and Wales on 1st April 2002. There is an equivalent system in Scotland – the SRO. The RO/SRO are the main support mechanisms for RE in the UK, replacing the Non-Fossil Fuel Obligations (see below). The scheme places an obligation on all suppliers (retailers) to source a percentage of their total sales of electricity from whatever eligible renewable sources. The obligation increases annually. The stepped increase in obligation was originally fixed to 2010/11. In November 2003, the obligation was extended to 2015/16 (see table below). The RO is guaranteed in law to run until 2027.

Period	Estimated supplies in GB (TWh)	Total Obligation (TWh)	Total obligation as % of sales
2001/02	310,9		
2002/03	313,9	9,4	3,0
2003/04	316,2	13,5	4,3
2004/05	318,7	15,6	4,9
2005/06	320,6	17,7	5,5
2006/07	321,4	21,5	6,7
2007/08	322,2	25,4	7,9
2008/09	323,0	29,4	9,1
2009/10	323,8	31,5	9,7
2010/11	324,3	33,6	10,4
2015/16			15,4

Compliance with the Obligation is demonstrated by presenting Renewables Obligation Certificates (ROCs) to the regulator Ofgem at the end of each one year period. One ROC is issued by Ofgem for each MWh of eligible renewable electricity generated within the UK, its territorial waters and continental shelf, from RES stations built or refurbished after 1 January 1990, and physically supplied to customers in Great Britain. Suppliers have three options for fulfilling their obligation and can use any combination of these:

1) purchasing ROCs with the power from a generator accredited by the regulator Ofgem.
2) buying ROCs on the market separately from the power.
3) paying to Ofgem a "buyout price', set initially at GBP 30 per MWh and rising to GBP 30.51 in 2003-2004.

The buyout price is effectively the floor price for ROCs, providing the target has not been met. The buyout funds are returned by Ofgem to suppliers who fulfill their obligation in proportion to the number of ROCs that each presents. Hence ROCs trade on the market at rates that reflect the buy out price plus the expected recycle funds rate.

Suppliers are able to bank ROCs for use only in the period after they have been issued, and there is a limit of 25% on supplier's use of banked ROCs to fulfill their obligation.

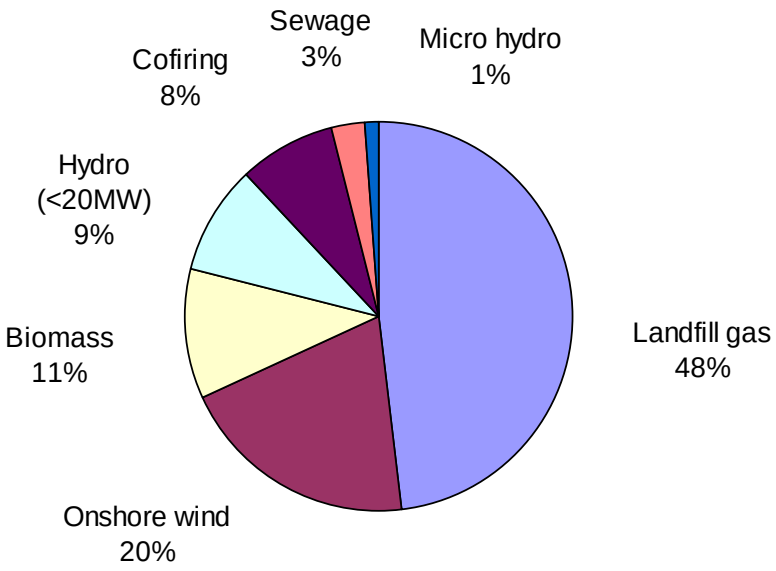
There are no technology bands in the Obligation, there is a single ROCs price. The eligibility of technologies is shown in the tables below. There are caps on the eligibility of ROCs from cofiring: 10% on an individual supplier from 2006 to 2011 and 5% from 2011 to 2016.

Source	**Eligibility**
Landfill gas	Yes
Sewage gas	Yes
Hydro >20MW	Only stations commissioned after 1st April 2002
Hydro <20MW	Yes
Onshore wind	Yes
Offshore wind	Yes
Cofiring of biomass	Yes until 31st March 2016
Other biomass	Yes
Geothermal power	Yes
Tidal & tidal stream	Yes
Wave	Yes
Photovoltaics	Yes
Energy crops	Yes

	Mixed waste	**Waste which is purely biomass**	**Energy crops, agricultural waste & forestry material**
Incineration	Ineligible	Eligible	Eligible
Pyrolysis, gasification, anaerobic digestion	Only non-fossil fuel derive energy is eligible	Eligible	Eligible
Co-firing	Ineligible	Any biomass until 31st March 2009 with no minimum % of energy crops; 25% must be energy crops from 1st April 2009 to 31st March 2010; 50% for the year thereafter; and then 75% until 31st March 2016. Cofiring ceases to be eligible for ROCs after this date.	

The chart below shows that landfill gas generation attracted almost 50% of the certificates issued in the first period in Great Britain (England, Scotland and Wales), with on-shore wind generation being the next largest technology. England accounted for 73% of all the certificates issued. In Scotland and Wales, on-shore wind was the largest originator of certificates.

ROCs and SROCs issued by technology in the first year of operation (2002-2003). (Ofgem 2004)



The first year showed suppliers using all three options of meeting their obligations. In England and Wales, out of 38 supply companies who had an obligation, 12 met their obligation wholly through the production of ROCs, and 9 suppliers paid 100% buyout. In England and Wales, 23 suppliers received buyout redistribution totaling GBP79m. There was a similar situation in Scotland (Ofgem 2004).

The price of ROCs was around GBP46/MWh in January 2004, ie the market valued the recycle value at around GBP16/MWh. As a market-based mechanism, with substantial numbers of sellers and a significant number of buyers, the price varies over time. Various observers produce price outlooks with different scenarios (eg Platts Power UK, February 2004). The price is subject to market “shocks”. Several suppliers have become bankrupt in the time since the introduction of the RO. These bankruptcies have caused failure to honour commitments to the RO and shortfalls in the buyout funds. For example, the defaults by the bankrupted companies TXU Europe and Maverick during 2003 are reported to have cut ROC prices by GBP2-3.

The financial community views the value of ROCs up to the value of the buy out price as a bankable commodity but consider the recycle value to be risky, as illustrated by the example above. This causes some difficulties for developers of renewables seeking funding.

To date the RO target has not been met. During the first year of operation (2002/03), the target was 3% and actual production from renewables was 1.8% (DTI & Carbon Trust February 2004). The current Renewables Obligation is 4.3% and it is reported that total available generation is around 3% (WindPower Monthly April 2004). While recent government review anticipates that the target 10.4% by 2010 will be met (DTI & Carbon Trust February 2004), recent interviews of industry suggests that a total of 7-8% may be met by 2010 (Energy Economist March 2004).

Climate Change Levy

The Climate Change Levy came into effect on 1st April 2001 and applies to energy used in the non-domestic sector (industry, commerce, and the public sector). The aim of the levy is to encourage these sectors to improve energy efficiency and reduce emissions of greenhouse gases.

The levy is a tax on business energy use from which renewable energy sources are exempt. Rates of levy are 0.15p/kWh for gas, 1.17p/kg (equivalent to 0.15p/kWh) for coal, 0.96p/kg (equivalent to 0.07p/kWh) for liquefied petroleum gas (LPG), and 0.43p/kWh for electricity. Typically the levy adds 15% to business energy bills, though this depends on whether the business is part of a levy exemption agreement in return for an agreed programme of energy efficiency measures. The levy is avoided for any power sourced from renewables (and also "good quality" combined heat and power).

Capital Grants

Grants are available for offshore wind and biomass demonstrations with the aim of helping to reduce costs and risks involved in such developments.

For offshore wind there have been three rounds of competitive bidding during the period September 2002 to December 2003. A total of GBP117m has been awarded to 12 projects.

A "Bioenergy Capital Grants Scheme" released £66m for 10 new plants (also clusters of smaller plants) fuelled by energy crops, wood and agricultural by-products in England, £7m for plants in Scotland, and £2m for a wood fired CHP plant in Northern Ireland (NATTA 2003). The biomass plants were CHP, electricity-only and heat-only, and ranged in size up to 23MWe.

An energy crops scheme was launched by the Department of Environment, Food and Rural Affairs (DEFRA) in 2000 and will run until 2006. The scheme gives grant-aid to landowners growing energy crops (such as short rotation coppice and Miscanthus) who possess a contract with an energy plant. The scheme has had GBP 29m available.

A "Major Photovoltaics Demonstration Programme" was launched in 2002. GBP 20m was available over period 2002-05 to provide 50% grants to individuals and organisations installing solar photovoltaics on homes and other buildings.

Under the "Clear Skies Initiative", GBP 10m is available to homeowners (grants GBP 500 – 5000) and community organisations (up to GBP 100,000 for grants and feasibility studies).

In addition to capital grants, research grants can be substantial in size. For example, the Scottish Executive and the Department of Trade and Industry recently announced a grant worth almost GBP400k to an industrial consortium proposing to develop deepwater offshore wind farm in the North Sea. The grant will be used to develop plans for two full scale demonstration turbines. The ultimate goal is to build a 1000MW plant comprising 200 turbines, which will require some GBP1b investment (WindPower Monthly October 2003).

Non-Fossil Fuel Obligation

This was the government's major instrument for encouraging growth in the renewable energy industry, prior to the establishment of the RO. The NFFO covered England and Wales with similar schemes in place in Scotland and Northern Ireland. It assisted industry by providing premium payments for renewables generated electricity over a fixed period, with contracts being awarded to individual generators. NFFO was funded by a Fossil Fuel Levy, charged to all final electricity consumers.

In England and Wales, there were in total five NFFO Orders, with the first in 1990 and the last in 1998. Each order distinguished between technologies both by allowing different price premiums for the electricity generated and by supporting different levels of new capacity from each technology. A key term was "convergence", with electricity prices from renewables expected to drop over time and converge with conventional generation. Potential renewables generators were required to compete for contracts with the schemes offering the lower bid prices being awarded contracts. The contract was for the purchase of electricity at the final bid price (index-linked) over a period up to 15 years. Any generation outside the agreed capacity (submitted in the bid) would be sold outside the NFFO arrangements. Contract-winning generators would still have to achieve financing, planning permission and get a licence to generate – success with these steps were not guaranteed by the NFFO contract.

Electricity trading

New electricity trading arrangements (NETA) came into force in England and Wales in March 2001. Central to NETA is the balancing mechanism, by which generators must offer their power to potential buyers some time ahead of dispatch (the so-called period to gate closure) and, if their output does not match their offer exactly, they incur a penalty. NETA creates challenges for small and intermittent generators. The risks for operators of turbines relying on wind forecasts are clear. NETA is highly complex and the rules are essentially created by larger companies. Changes to NETA are only brought about if one of the signatories to the balancing and settlement code (BSC), the rules governing the balancing mechanism, proposes a modification – and most of the signatories to the BSC are large players.

The situation created by NETA in the months after its introduction was very difficult for renewable energy generators. There was great volatility in the power market and very large spread between buy and sell prices. The period to gate closure was 3.5 hours. It is reported that output from renewable energy generators fell by 25% and revenues fell by 33% in the months after March 2001 (Wind Power Monthly February 2004). The situation has improved, with lower spread between buy and sell prices and reduction in gate closure to one hour. Also, the introduction of the RO and CCL changed the situation dramatically. Suppliers now compete to buy up electricity produced from renewables, since the imbalance costs are more than outweighed by the income gained from the associated renewable obligation certificates

(ROCs) and Climate Change Levy exemption certificates (LECs). Such suppliers can also aggregate the power from different renewable energy generators and so mitigate imbalances. Nonetheless, observers still believe that NETA works inherently against small and intermittent generators.

Recent Developments

Wind energy, both onshore and offshore, is on the cusp of substantial development in the UK. The British Wind Energy Association reported that there will be 1000MW built during 2004 and 2005 (WindPower Monthly April 2004) – almost twice the capacity installed in the previous decade or so.

With the RO and the availability of substantial capital grants, there is strong interest in the development of off-shore wind plants. Projects are on the scale of conventional energy generation and are being proposed by large multinational companies. The results of the second round of bids for site licences for off-shore wind energy farms, announced in December 2003, are illustrative. Fifteen licences were awarded totaling some 7.2GW of capacity. The licences include a 1200MW proposal comprising 250 turbines - the world's largest proposed offshore wind farm. Parties to the winning consortiums include major companies such as UK gas supply giant Centrica, ScottishPower, oil company Total, Powergen, Shell etc.

All observers – industry, government – note that wind power is the technology of choice for new investments (eg. Platts report March 2003, DTI & Carbon Trust February 2004) and there are limited commercial developments in other renewables. Although landfill gas accounts for largest proportion of ROCs, there are very few remaining undeveloped sites for landfill gas.

In response to the fact that wind energy alone is attracting investor interest, the government recently announced changes to the RO with regard to cofiring biomass (DTI, December 2003). The eligibility of ROCs from cofiring was extended from 2011 to 2016 and the requirements to use energy crops reduced. As an accompanying measure, caps on the use of co-firing were adjusted downwards to ensure that the market is not flooded with ROCs from cofiring. The aim of this measure is intended to "establish a second front (after wind) to contribute to delivery of the 10% target and beyond". It is estimated that cofiring ROCs could amount to 3,36TWh in 2010/11, which would halve in the following five years. In fact many UK coal plant operators have been undertaking trials with biomass fuels, in order to assess this as an option of generating ROCs. One plant recently announced that full commercial operations would commence with around 200,000t pellet wood and straw burnt pa (Reuters, March 2004). Another plant is taking material from willow plantations established for a failed 7MWe wood gasification plant (BBC, March 2004).

While the RO appears to have been broadly successful (for wind energy in any case), there is debate about the political risk and concern about risk in the medium term. A recent study (reported in the Energy Economist March 2004) found that many utilities, developers and investors had calculated that, beyond 2004, the period of subsidized returns from the RO was too short for projects to be economic. The study was undertaken when the RO target was 10.4% by 2010. The government has recently extended the RO to 15% by 2015 and this move was designed to give added security over a longer term. However, stakeholders still consider that there is a high degree of political risk. A common view is that the government may

remove the targets if they come under pressure from public who consider that they are paying too much to support renewables. Also, there are great uncertainties about how the RO will interact with greenhouse gas abatement and emissions trading. One view is that renewables are not the cheapest form of abating greenhouse gases and that there may be a shift in political focus away from renewables.

Several RE sectors are of course hindered by the fact that they are less commercially developed than wind but are competing for ROCs at a market-determined price. Thus industry associations (eg RPA, 2004) are lobbying for ways in which the RO could be modified so that greater diversity of technologies are supported including wave, solar etc.

Historically, there has been very strong debate about wind power in Great Britain. A great proportion of proposed wind developments have not received planning permission because of opposition by local inhabitants, by government organizations that must be consulted as part of the planning process, and by non-government organizations which often make presentations to public hearings.

Media has recently reported (Wind Power Monthly April 2004) a seemingly stronger stance against wind power by Britain's Royal Society for the Protection of Birds, which has a very large membership (circa 1 million) and is very influential. The RSPB have voiced concerns about the effect of proposed off-shore developments on bird populations. However, RSPB have to date taken a pragmatic approach to wind power developments and have objected to a relatively small number of on-shore and off-shore schemes which they have considered of significant potential harm to important wildlife areas.

The UK Ministry of Defence objects to proposed wind farms that it considers will interfere with air defence and civil radar. The statistics are alarming: out of 2872 proposals since 1996, the MoD have objected to 1319 (Wind Power Monthly 2004). However, the MoD argues that these numbers are misleading. The vast majority of the projects to which MoD have not objected have not been built and MoD argues that many proposals are not viable on many grounds, not radar issues alone. MoD argues for fewer, better quality, better sited proposals. There appears to be some scope for technical solutions. The MoD also aims to reduce the period in which it returns its responses to developer's inquiries, which is currently between 3-6 months.

A significant element in the improved environment in the UK for RE is the ongoing review of planning consent process. For the past decade or so, Planning Policy Guidance (PPG) note 22 has been local authorities main reference document for renewables. The draft of a new document, Planning Policy Statement (PPS) 22, was issued in November 2003 and was open to public consultation until January 2004. PPS22 is intended to be in line with the ambitious Energy White Paper "Our energy future – creating a low carbon economy" published in February 2003. Thus, PPS22 is designed to further government objectives of stimulating development of renewables and give greater clarity and focus than PPG22 which it replaces. Key principles for PPS22 include: promoting and encouraging rather than restricting; setting out explicit criteria for planning assessments; giving consideration to wider environmental and economic benefits of renewables etc (Energy Saving Trust, December 2003).

Related to the above, there has been a move to decentralise responsibility for RE. During 2000-2003, each region in GB undertook an assessment of renewable energy sources and set

regional targets. Each assessment included public consultation. These assessments were aimed at encouraging a more strategic approach to planning at regional and local levels.

Conclusions

The NFFO was successful in establishing some cheap sources of RE, principally the widespread development of land fill gas, and initiating developments in other sectors, such as wind industry. Failings of the NFFO are well documented. An undetermined timetable of calls for proposals, uncertainty about which technologies would be eligible for the calls and, of course, price uncertainty, led to great investor risk and a lot of resources being spent on unsuccessful proposals.

From 2000 or so, there has been a "step change" in the environment for investment in RE in Great Britain, that includes the following elements:

- There has been an increase in the importance of RE in the electricity sector, through the mandatory RO on suppliers. The RO has also given greater uncertainty and a longer horizon for RE.
- Sizeable grant aid has been available, most notably for off-shore wind but also biomass, energy crops and PV.
- Alongside energy efficiency and combined heat and power, RE is a component of the UK government Energy White Paper 2003 that sets an ambitious vision for a low carbon future.
- Planning policy is undergoing changes to create more favourable conditions for the development of RE plants.
- There is a process of decentralization of the responsibility for RE, notably in the development of regional RE plans during the period 2000-2003.

The RO is undoubtedly the main instrument promoting commercial RE developments in the UK. Although the RO has only been in place from April 2002, it has clearly stimulated high interest in RE. The RO acts through a market-determined price signal with no difference between RE technologies. The RO has given strong incentive to wind energy investments but, to date, has not encouraged other RE sectors. Changes to the RO announced by the government in December 2003 seem certain to create investments in the co-firing of biomass in several UK coal-fired power plants.

5. Remarks and comparisons from the review.

This section offers some remarks from the review of the three countries.

Progress to indicative target

The European Commission has recently issued a Communication on the share of renewable energy in the EU (EC, May 2004). The conclusion is that EU targets for 2010 – for RES-E, for the share of RE in gross energy consumption – are unlikely to be met. The RES-E Directive 2001 sets the target to increase the share of RES-E in total electricity consumption from 14% to 22% by 2010. In its recent communication, the Commission estimates that, given current progress, it is likely that 18-19% total electricity consumption in 2010 will be produced from RE. The Commission roughly divides EU countries into three groups:

- Germany, Spain, Finland and Denmark have initiated energy policies that should allow them to achieve their national targets.
- United Kingdom, Austria, Belgium, France, Ireland, Netherlands, Sweden have started to implement appropriate policies that could allow them to reach their objectives.
- Greece and Portugal need to reassess their policies if they also wish to be on track.

The Europe-wide picture is that strong growth of wind power means it can be expected to contribute 50% of the increase needed to achieve the target set for RES-E,but biomass RES-E is growing only in a few countries and this sector is falling far short of its estimated potential and its anticipated share of RES-E growth to 2010. One of the Communication's main conclusions is the need to promote biomass, for electricity and also for modern heating applications and liquid fuel for transport.

The European Renewable Energies Federation has also estimated progress to the RES-E targets in EU.

	Status 2003	**Target 2010**	**Anticipated 2010**
Germany	7.9%	12.5%	12.5%
United Kingdom	2.9% (in 2002)	10.4%	7-8%
Spain	23.3%	29.4%	24%

While the UK government anticipates that the 10.4% target will be met, reviews of industry and a report by the European Renewable Energies Federation (March 2004) suggest that a total of 7-8% may be met. EREF indicates that Germany should achieve its target. Under an optimistic scenario, the target may be exceeded. Analysis by the Spanish Renewable Energy Association indicates that the target set for Spain will not be achieved – although wind energy is growing at a rapid rate, consumption rates for power are also increasing at high rates relative to rest of Europe. A similar situation is evident in Greece too, of course. Percentage targets are a moving and difficult goal in these countries.

Comparison of rates of support

Average compensation under the German EEG, including all RES-E sectors, was Euro 86.4 / MWh and Euro 88.9 per MWh in 2001 and 2002 respectively. The average tariff under the

German EEG in 2004 for electricity from wind was Euro 82.3 / MWh. These rates compare with the price of British ROCS in January 2004 which was Euro 69 / MWh (GBP46 / MWh). It is well-known that this ROCs price is attracting new investment in wind energy only. The Spanish feed-in tariff in 2003 for wind energy was Euro 62.1 / MWh – so this was the lowest in the three countries studied.

Conclusions cannot be drawn from simply looking at these figures. Considering wind energy alone, it seems the German feed-in tariffs system pays a high price in comparison to Britain and Spain. Of course, the German scheme is encouraging the fastest rate of expansion of wind energy. It is also notable that British developers focus only on the best sites (>7m/s) whereas German wind farms have been developed on sites with much lesser resource (6m/s).

There are important questions, related to the above. How much are Spanish, German and UK governments paying for abatement of greenhouse gases (especially CO2) via their support of RES-E? How do these abatement costs compare with the costs of demand side measures? These are interesting questions in the context of this project (the aim of which is to make steps to apply EU climate change and renewable energy policies and measures in the Greek electricity sector) and require further work.

Evolving feed-in tariff systems

The German EEG feed-in tariffs are based upon estimated generation costs whereas the predecessor StreG offered tariffs as a fixed percentage of the consumer price. As such, there is considerable diversity in the tariffs offered to different technologies and for different ranges of capacity within technology bands. German bonuses for different fuel types, advanced technologies such as gasification and combined heat and power are an innovative approach for a feed-in tariff. These show the desire to achieve the development of diverse sources of RE and environmental and energy efficiency goals via the feed-in tariff system. The Greek feed-in system is based on the old StreG and appears rather dated in comparison to the EEG.

New tariffs announced in Spain in March 2004 include a market-based option which offers operators of RES-E plant higher remuneration but under which they must give up their classification as prioritized production. Operators taking this option will trade on the wholesale market. These operators will face the same penalties for imbalances as conventional generators. Initial reaction by associations suggests that many operators will choose to play the market because rewards should be greater than risks. It appears that the Spanish government may have found an innovative way to tackle the perennial problem of TSO concerns with intermittent wind power on the grid – future experience will show if this is successful.

The amendments announced in Spain in March 2004 also include making available financial incentives to wind operators who provide grid support (reactive power control and capability to ride-through grid faults). This is another measure to tackle the conflict between TSOs and wind operators – evident in Spain and elsewhere including of course Greece.

Scale of wind energy development

Boosted by substantial capital grants, the British off-shore wind sector seems poised for substantial development. The sector has received considerable attention from business, environmental and general public media in Britain. The developments are, without doubt, a

step change in terms of RE in Britain - companies involved are major multinationals and projects are similar in size to conventional power projects if not larger. Including both on and off-shore wind, it is expected that 1000MW of capacity will be installed over the two year period 2004-2005, representing a very substantial increase from current installed capacity around 650MW. However, comparison of wind energy capacity and rate of growth in Britain with Germany and Spain illustrates how these countries have achieved much more growth. Germany and Spain have current wind energy capacity 14000MW and 5800MW respectively. Over the two year period 2002-2003, capacity totaling 5200MW and 2450MW were installed respectively.

Strong preference for wind energy

Investors in the three countries studied showed clear preference for wind energy. This is becoming a problem because wind alone cannot deliver the EU Directive targets. An RE sector that comprises wind energy alone is structurally narrow. Also, many options are being foregone that are environmentally beneficial and will contribute to energy security. It is evident that more efforts are being devoted to promote RE technologies in addition to wind in the three countries studied. A key sector after wind is biomass because of the large potential.

In Spain, until 2003, RES-E from energy crops were offered a lower tariff than wind energy. The 2003 tariffs were Euro 68.5 / MWh and Euro 62.1 / MWh for energy crops and wind respectively – so the energy crops tariff became slightly higher. The 2003 tariff for biogas and biomass residues was Euro 60.5 / MWh so it remains lower than wind. Although subsidized loans are available for biomass projects (and not for wind except self-consumption) it is unsurprising that the biomass sector is static. These small changes to tariffs are not expected to alter the situation.

Much more substantial changes have been announced recently in Britain. Changes to the eligibility of ROCs from cofiring biomass – including extending the period of eligibility and reducing the requirements to use energy crops – are expected to lead to commercial cofiring in several coal-fired power plants. ROCs from cofiring have a cap and will not be eligible after 2016 but it is thought that the supply chains, knowhow and infrastructure that are developed via cofiring could “spin-off” biomass-only electricity and CHP plants.

In Germany, announcements in April 2004 included a new band for small biomass plants (<150kWe) with a high rate (Euro 115 per MWh). Even higher rates can be received if non-waste biomass is used (eg Euro 175 per MWh for a plant <150kWe). There is also a wood burning bonus (Euro 25 per MWh). There are also higher rates for CHP and advanced technologies. The upper limit for biomass plant is 20MWe. Evidently, the approach being taken in Germany is different to the UK, with support aimed at smaller biomass-only plants. Historically, Germany has had greater success with installing biomass and biogas plants, both electricity-only and CHP.

Planning and permitting

The report has given limited consideration to the issues of planning, permitting including grid connection etc. These requirements may be equally important to the support offered, having a huge influence on projects through the rate of success/failure and the length of time that is needed. Some data were collected (and are available as an Annex to this report). However,

these issues are highly complex and often regionally or locally defined. A separate and large study would be required to examine these.

A small study was done by Skytte et al (2003) who interviewed developers from across Europe (Greece was excluded). The following table shows duration of planning phase, including pre-feasibility, technical and environmental studies, public consultation, and administrative approvals such as permits for building and grid connection. It excludes the construction and commissioning phase, which is comparatively short and well understood by developers. There is some evidence that Spanish developers, in response to problems in gaining approvals and because of anticipated delays, put forward a relatively high number of proposals, including projects that are not fully economically feasible. This is a type of negative-feedback system which creates long lead time statistics. The statistics given in the table below may be compared with lead-times in Greece.

Planning lead times (years) for RE developments in Spain (Skytte et al 2003)

		Average	Minimum	Maximum
Spain	Wind power	3	1	8
	Small hydro	6	1	8
Germany	Wind power	2	0.5	4
	Small hydro	2	0.5	4
United Kingdom	Wind power	2	0.5	5.5
	Small hydro	3	0.5	5.5

Note that this data is based on a very limited questionnaire so provides an indicative comparison not statistically significant quantitative data

Guarantees of Origin

The EC intends that GO should serve to facilitate trade in RES-E and increase transparency for consumer's choice between electricity from non-RE and RE sources. The Directive provides limited rules or guidance on how GO should or could be implemented, so it is not surprising that countries have different approaches to GO (IT Power et al, August 2004). Most concerning is the fact that systems may be open to fraudulent multiple selling of the "greenness" from one specific unit of electricity. Efforts are being made for a harmonised approach, notably the European Energy Certificate System (EECS) being developed by RECS International and its members. To date six countries have signed up to EECS.

The complexities are exemplified by Germany. Although Germany has signed up to EECS, there are weaknesses in the GO system that is being developed. GO has been incorporated into the revised German RE law (EEG). GO will specify several details that are additional to the minimum requirements of the RES-E Directive. Notably, GO must declare if the operator has received feed-in tariff, and operators cannot pass on GO for electricity that has been supported by the feed-in tariff or, if GO is passed on then the tariff cannot be claimed. It appears that the system-design is weak and could be open to abuse. While multiple selling of GO will be illegal, the legislation does not foresee the creation of a central registry in Germany. GO issued in Germany do not have a standardised size nor time period and their validity is theoretically infinite – these aspects will not help the creation of a straightforward system. The German GO system foresees no regulations how to handle cross-border trade of GO. At present there is no real mechanism in place to stop RE plant operators from applying for fraudulently applying for GO at more than one accredited auditor and offering the greenness of one unit electricity to several customers. The lack of a central registry is seen to be a particular problem.

While Great Britain and Spain both have national registries for GO, there are problems. For example, in Great Britain, it appears that an operator could sell a GO for the same unit of electricity that has also receive support via the Renewables Obligation (or its predecessor the Non Fossil Fuel Obligation) and the Climate Change Levy. It could be argued that the greenness would thus be sold three times.

Greece is culprit of moving very slowly with the development of GO. There is a proposal for GO to be issued on the national level by the TSO for the Greek interconnected mainland by the DSO for Greek island autonomous systems. The Regulatory Authority for Energy will be responsible for supervising the GO system. There has been no decision on whether or how GO will be integrated with the existing Greek feed-in tariff system. Of course, the delay to implementation in Greece does have the benefit that Greek authorities can observe and learn from the ways in which other countries are implementing GO and their experiences.

The EC's recent Communication (May 2004) provides limited clarification on import and export of electricity. The Communication states that national indicative targets may be met by importing RES-E from other EU countries, although not from outside the EU. In theory, countries with RES-E "surplus" to targets could transfer to those with a "shortfall". In practice, there appears to be very limited reason why this should take place – there are no financial penalties associated with missing targets.

The Communication mentions that Guarantees of Origin can be used to prove the import takes place and that the electricity will not also be used to count towards the exporting countries' target. However, it is still uncertain if electricity has to be physically imported alongside the GO or if the GO can be imported independently from the electricity. The discussion above highlights some of the complexities in issuing and transferring these within a country let alone between countries.

A substantial industry with important benefits

To conclude the report it is worthwhile reiterating the statistics presented by the German government in April 2004, which illustrate the scale of the industry in that country, its importance in terms of jobs, and the contribution that it makes to curbing greenhouse gases. The German government estimates that there are around 120000 to 135000 jobs in the RE sector in Germany (with 46000 in the wind sector alone) and that the sector has an annual turnover of approximately Euro 10 billion. The use of RES delivers savings of approximately 53 million tonnes of CO_2 in 2003 – or approximately half the total national emissions in Greece.

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