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The share of renewable energy in the EU

Country Profiles
Overview of Renewable Energy Sources in the Enlarged European Union

{COM(2004)366 final}

TABLE OF CONTENTS

FOREWORD

The promotion of renewable energy has an important role to play in addressing the growing dependence on energy imports in Europe and in tackling climate change. Since 1997, the Union has been working towards the ambitious target of a 12% share of renewable energy in gross inland consumption by 2010. In 1997, the share of renewable energy was 5.4%; by 2001 it had reached 6%.

This Staff Working Document gives an overview of the different situations of renewable energy sources in the European Union. It includes part of the formal report that the Commission is required to make under Article 3 of Directive 2001/77/EC on electricity from renewable energy sources, and it completes the overall picture with information at a country level on the heat produced from renewable energies and biofuels in the transport sector. This Staff Working Document complements the Communication on "The share of Renewable Energy sources in the EU".

Data is based on different sources. Firstly, on the reports from Member States on national progress in achieving the targets on electricity from renewable energy sources (Article 3 of Directive 2001/77/EC). These reports can be found in the web site of Directorate General for Energy and Transport[1]. Secondly, on a study launched by the Commission on the evolution of renewable energy sources[2]. And thirdly, on a variety of sources like the European Barometer of renewable energies[3], data from the industry, etc.

With the enlargement of the European Union, the new Member States are required to adopt the RES-E Directive by 1 May 2004. In the accession treaty, national indicative targets are set and the overall renewable electricity target for the enlarged Union will therefore be 21% of gross electricity consumption by 2010.

The Commission has the legal obligation to report on the degree of achievement of new Member States' targets by 2006. Although it is too early to assess RES-policy in the new Member States due to very recently adopted regulations, this document also includes national information on the States now joining the European Union[4]. This Staff Working Document aims to give an overall picture of the situation and the potentials of renewable energy sources in the enlarged European Union.

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1 http://europa.eu.int/comm/energy/res/legislation/index_en.htm

2 FORRES 2020 : Analysis of the Renewable Energy Sources, evolution up to 2020. Contract N° 4.1030/T/02-008.

3 EurObserv'ER, the European Barometer of renewable energy sources. Pdf documents can be found at http://europa.eu.int/comm/energy/res/publications/barometers_en.htm

4 In the case of the EU15, the Directive requires the Commssion to adopt a first progress report during 2004. In the case of the new Member States, the Commission report on the assessment in achieving the targets is not due until 2006.

National indicative RES-E targets 2010 for Member States[5]

	RES-E % in 1997	RES-E % 2010
Austria	70	78
Belgium	1.1	6
Denmark	8.7	29
Finland	24.7	31,5
France	15	21
Germany	4.5	12,5
Greece	8.6	20.1
Ireland	3.6	13,2
Italy	16	25
Luxembourg	2.1	5.7
Netherlands	3.5	9
Portugal	38.5	39
Spain	19.9	29.4
Sweden	49.1	60
UK	1.7	10
Cyprus	0.05	6.0
Czech Republic	3.8	8.0
Estonia	0.2	5.1
Hungary	0.7	3.6
Latvia	42.4	49.3
Lithuania	3.3	7.0
Malta	0.0	5.0
Poland	1.6	7.5
Slovakia	17.9	31.0
Slovenia	29.9	33.6
EU 25	12.9	21.0

[5] The percentage contributions of RES-E are based on the national production of RES-E divided by the gross national electricity consumption. For the EU15, the reference year is 1997. For the EU10 (Czech Republic, Estonia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Slovenia and Slovakia), the reference year is based on 1999-2000 data.

AUSTRIA

1. Summary of RES markets and policy

Background

The feed-in tariffs introduced in January 2003 represent the major modification of the Austrian RES policy. These tariffs included in the Renewable Energy Act are expected to stimulate significant growth especially for wind, biomass electricity and small hydro power. However, the instrument is so far only effective for new installations getting all permissions by December 2004 and finished before June 2006. In December 2003 the contracting of RES-E plants was stopped and the processing of the Ökostromverordnung was set out. This decision was only lifted in March 2004 and caused great insecurity among investors.

RES targets

The RES-E target to be achieved by Austria in 2010 is 78% of gross electricity consumption.

Status renewable energy market

The production of renewable energies in Austria is dominated by large hydropower and biomass for heat generation. The fastest-growing renewable energy source over the last decade was solar thermal energy. There is wide variety of policy measures for the support of renewable energies in Austria not only at the federal level but also at the provincial level. Stimulated by the new feed-in tariffs steady growth is also expected in the sectors of wind energy, biomass electricity as well as small hydro installations.

Main supporting policies

The main promotion schemes for RES in Austria are the following.

Feed-in tariffs

Small hydro:

3.15-6.25 € cents /kWh

PV systems:

60 € cents /kWh for plants < 20 kW_{peak} ,47 € cents /kWh for plants > 20 kW_{peak}

Wind systems:

7.8 € cents /kWh for new plants

Geothermal energy:

7.0 € cents /kWh for electricity fed into the grid

Solid biomass and waste with large biogenic fraction:

10.2-16.0 € cents /kWh (10-2 MW), 6.5 € cents /kWh (hybrid plants)

Fuels including biogenic wastes:

6.6-12.8 € cents /kWh (10-2 MW) 4.0-5.0 € cents /kWh (hybrid plants)

Liquid biomass

< 200 kW 13.0 € cents /kWh; > 200 kW 10.0 € cents /kWh

Biogas

10.3 – 16.5 € cents /kWh

Sewage and landfill gas

3.0 - 6.0 €cents /kWh

Investment subsidy

Subsidy of about 30% of the investment costs for solar thermal, biomass, geothermal, wind, hydropower on project basis

Tax reduction of biodiesel: approximately 95% tax reduction on biodiesel
Key factors
The relatively high feed-in tariffs combined with reasonable investment subsidies has generated large growth rates over the recent past. Continuity could be a problem due to the short operational period (until end of 2004) of the present feed-in tariffs. The possible refusal of the provincial governors to raise the cap on the electricity price caused by RES can create great uncertainty as was seen in early 2004. For PV an upper limit of 15 MW has been set, which will jeopardise further growth.

2. Current status and potentials of RES

2.1. Current penetration

The production of electricity from RES showed moderate growth during the second half of the 1990s. The relatively limited growth has to be seen in correlation with the high overall production and share of RES-electricity dominated by large hydropower. The total RES electricity production (compare Fig. 1 and Fig. 2) grew from slightly below 35 TWh in 1990 to about 40 TWh in 2002 (only 30 TWh in 2003 due to an extremely bad hydraulic year!). The largest share of this growth is attributed to production from **large hydro**. The electricity produced from large hydropower grew from 29.0 TWh in 1990 to 35.3 TWh in 2002. The installed large hydro capacity grew by only 0.7 GW during this period, which corresponds to an additional power production of about 3TWh. A major part of the increase in RES-E generation is therefore due to the annual volatility of large hydropower. Especially when judging the figures for 2001 it has to be taken into account that the year 2001 was a very good hydraulic year allowing above-average hydroelectricity production. The growth of **small hydro** electricity generation (4.0 TWh in 1990 to 4.2 TWh in 2002) is more or less in line with the increase of capacity (816 MW in 1990 to 843 MW in 2002). In fact, the development of small hydro lagged far behind the potential that is seen for this source in Austria.

The installed capacity for electricity generation from **solid biomass** was almost doubled in the period from 1993 to 2002 (414 MW to 750 MW). The electricity generated grew approximately at the same rate (from 984 GWh to 1 750 GWh). A major share (1400 GWh) of the biomass electricity is attributed to industrial wastes, especially in the paper industry. The remaining 202 new biomass plants produce only a minor share of 350 GWh annually. The biomass plants based on industrial waste are not considered for the purposes of the quota in the Austrian Renewable Energy Act.

Only RES such as PV and wind energy where the use started basically from scratch could achieve significantly higher growth rates. In the case of **wind energy** a very strong growth occurred in 2003 as a result of the feed-in tariffs that were introduced. The installed capacity grew by almost 200% to about 415 MW in 2003 compared with a growth of only 40% in the year before. Even in absolute terms this growth is rather impressive. It is, however, highly questionable whether it will continue in 2004 owing to the decision by the Verbund APG AG to stop awarding feed-in contracts for new renewable plants, which was only revoked in March 2004 and caused great uncertainty.[6]

[6] The resulting additional costs due to the promotion of 'new' RES are partly paid by all consumers in form of an additional charge per kWh. Of importance in this context is the fact that the law explicitly contains a budget restriction – i.e. the charge is capped to initially 0.22 €cent/kWh. Due to the

Table 1 shows the electricity generation from RES for the years 1997 and 2002 as well as the average annual growth during this period. It can be seen that very high growth rates are obtained only by the new RES-E biogas, wind and PV. However, since the Austrian RES-E sector is mainly dominated by large hydropower, which is hardly growing at all, the total growth of RES-E in Austria is also very limited. Based on total demand, the **share of RES** electricity in Austria amounted to **68%** in 2002 compared with **70%** in 1997.

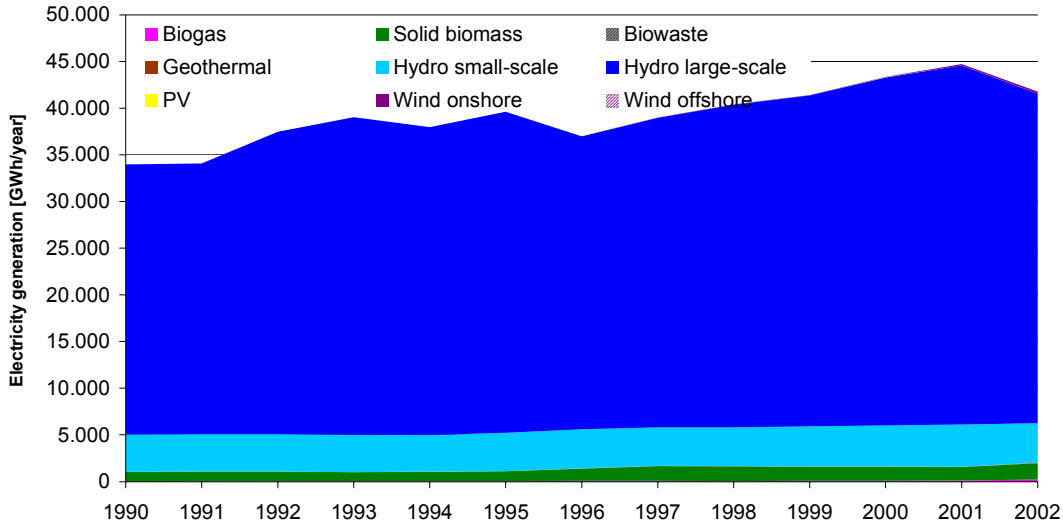

Figure 1: RES electricity production in Austria up until 2002[7]

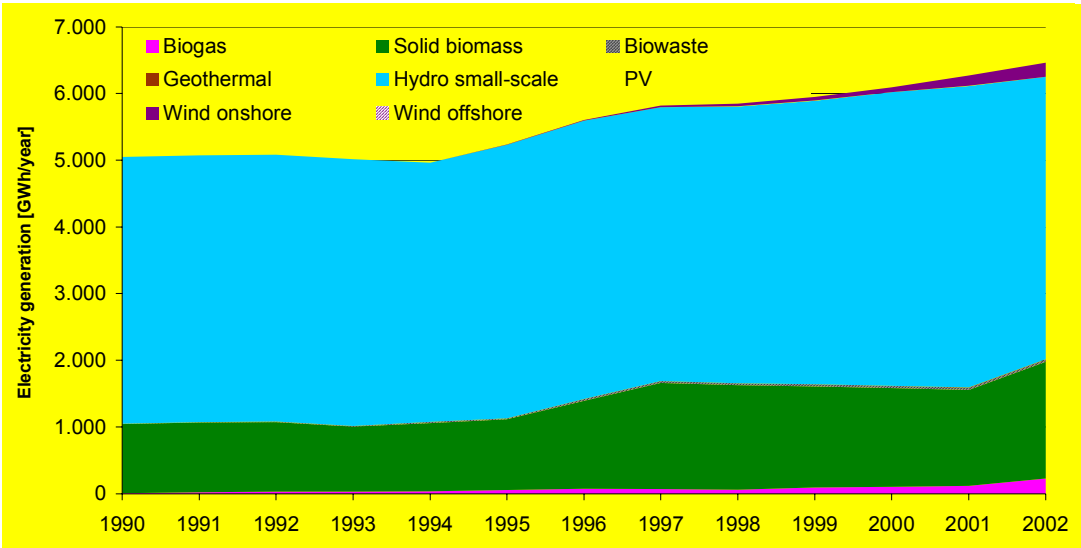

Figure 2: RES electricity production in Austria up until 2002 excluding large hydro

prospering development of new RES-E in 2003 a need to increase the cap occurred. Hence, no approval to do so was given before March 2004. As a consequence high uncertaintyprevailed.

[7] Based on EUROSTAT data, which are up-to-date only until 2001. For many RES, e.g. wind-onshore and PV more recent data from sector organisations and national statistics have been used

Table 1: RES-electricity production in 1997 and 2002 in GWh

RES-E Technology	1997 [GWh]	2002 [GWh]	Av. Annual growth [%]
Biogas	70	227	26%
Solid biomass	1,590	1,750	2%
Biowaste	29	32	1%
Geothermal electricity	0	7	
Hydro large-scale	33,186	35,315	1%
Hydro small-scale	4,107	4,234	1%
Photovoltaics	1	7	45%
Wind on-shore	20	209	60%
Total	**39,004**	**41,780**	**1%**
RES-E share	**70%**	**68%**	
RES-E excluding large hydro (GWh)	5,818	6,465	

The RES **heat sector** shows a somewhat ambiguous picture. Whereas the penetration of biomass heat production was decreasing over recent years, heat production from solar thermal heat and from geothermal heat including heat pumps increased (compare Table 2). But even though the use of biomass heat was falling slightly, it is still by far the most important source for RES-heat, making a contribution of 2.4 Mtoe in 2001. The strong position in absolute figures is due to the continued and widespread use of traditional biomass-based heating. The installed collector area for solar thermal heat generation in Austria grew from 433 thousand m^2 in 1990 to 2.66 mill. m^2 in 2002. Even higher growth was reached for geothermal energy.

Table 2: RES-heat production up until 2002

	Penetration 1997 [ktoe]	Penetration 2001 [ktoe]	Growth rate since 1997 %
Biomass heat	2 540	2 373*	-2
Solar thermal heat	48	74,3	9
Geothermal heat incl. heat pumps	5	80	74

* Biomass heat only until 2001

The use of liquid biofuels increased by an average of 17 percent in the period from 1997 to 2002 (compare Table 3), reaching a level of 26 ktoe. In the light of this very moderate absolute contribution to the fuel use, the growth rates could be judged as not very high. The biodiesel production capacities amount to 45 ktoe in 2003 and 90 ktoe in 2004.

Table 3: RES-biofuel production up until 2002

	Penetration 1997 [ktoe]	Penetration 2002 [ktoe]	Growth rate since 1997 %
Liquid biofuels	13	26	17

2.2. Mid-term Potentials

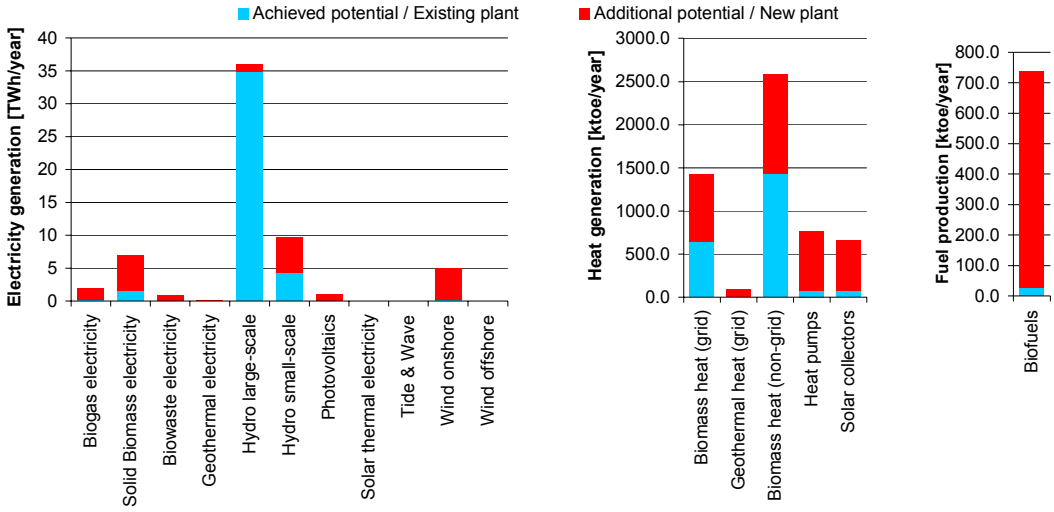

Figure 3: Mid-term potentials of RES electricity, heat and transport in Austria

Table 4: Policy assessment for RES – Austria

RES-type	Wind onshore	PV	Biomass electricity	Hydro - small	Hydro - large	Geoth. electr.	Biomass heat	Solar thermal	Geothermal heat	Biofuels
Dominating instrument	Renewable energy act	Renewable energy act	Renewable energy act	Renewable energy act	n.a.	Renewable energy act	Environmental support programme	Environmental support programme	Environmental support programme	Tax reduction for biodiesel.
Type of instrument	Feed-in tariff	Feed-in tariff	Feed-in tariff	Feed-in tariff	n.a.	Feed-in tariff	Investment subsidy	Investment subsidy	Investment subsidy	
When implemented	2003	2003	2003	2003	n.a.	2003	1993/97	1993/97	1993/97	
Key factors	Short Operational Period Long-term guaranteed tariff	Maximum level set already reached; Long-term guaranteed tariff	Security of feedstock supply Long-term guaranteed tariff	Long-term guaranteed tariff		Price	Security of feedstock supply, convenience issues in small scale domestic applications	Continuous promotion scheme	Continuous promotion scheme	More than 95% tax reduction on biodiesel.
Degree and duration of support	●●●●●	●●●●	●●●●●	●●●●	n.a.	●●	●●●	●●●●●	●●●●	●●●●
Non-economic factors	●●●●	●●●●●	●●●●	●●●●	n.a.	●●	●●●	●●●●●	●●●●	●●●●

	Sufficiency to promote RES
•	Hardly any or no support
••	Little support
•••	Moderate support
••••	High support
•••••	Very high support

BELGIUM

1. Summary of RES markets and policy

Background The three regions of Flanders, Brussels and the Walloon region implement the national energy policies. It is because of this distribution of implementation that the support differs per region. The Flanders market has been fully opened for competition. In the Walloon region households are only free to choose their supplier when they are supplied exclusively by green electricity suppliers (who have to sell a minimum of 50% of electricity from renewable sources).
RES targets The RES-E target to be achieved by Belgium in 2010 is 6% of gross electricity consumption. The target in the Walloon region equals 7% for 2007, for renewable electricity and CHP. In 2005, targets for the period Jan 2008 onwards will be decided. In Flanders the target is 6% for 2010. In Brussels proposed green electricity targets for electricity suppliers are 2% for 2004, 2.25% for 2005 and 2.5% for 2006.
Status renewable energy market Three different green certificate markets have started, one in Flanders, the Walloon region and the Brussels region. Because of the possibility of banking of certificates and increasing penalty rates and a shortage on certificates not much of trading has taken place, it is more favourable of paying penalties the first year and use the certificates in later periods. The three regional different systems complicate the implementation of RES-E market.
Main supporting policies The main promotion schemes for RES in Belgium are Green certificate system with mandatory demand or minimum feed-in tariff. Minimum prices are: **Wind offshore:** 9 € ct/kWh **Wind onshore:** 5 € ct/kWh **Solar:** 15 € ct/kWh **Biomass and other RE:** 2 € ct/kWh **Hydro**: 5 € ct/kWh A second main driver for RES investments is the set of investment support schemes available.
Major issues Flanders and the Walloon Region introduced a green certificate system in 2002. The development of RES-E is up to now shy. The year 2004 is crucial for completing the analysis of this country.

2. Current status and potentials of RES

2.1. Current penetration

Development of the **renewable electricity production** in Belgium over the last decade is shown in Figure 1. **Hydropower electricity** accounts for the largest contribution to total renewable electricity production, with a stable annual production of around 330 GWh over the last decade, corresponding to a share of

31% of the total RES-E production in the year 2002. The share of electricity from **biomass (**biogas, biowaste, and solid biomass) shows an increasing trend in the last years. Wind energy had a low installed capacity of 34 MW in 2002 and 68 MW in 2003. For achieving the 6% target by 2010, the average annual growth has to increase (acceleration of current RES-E measures) and efficiency instruments are needed for controlling the electricity demand.

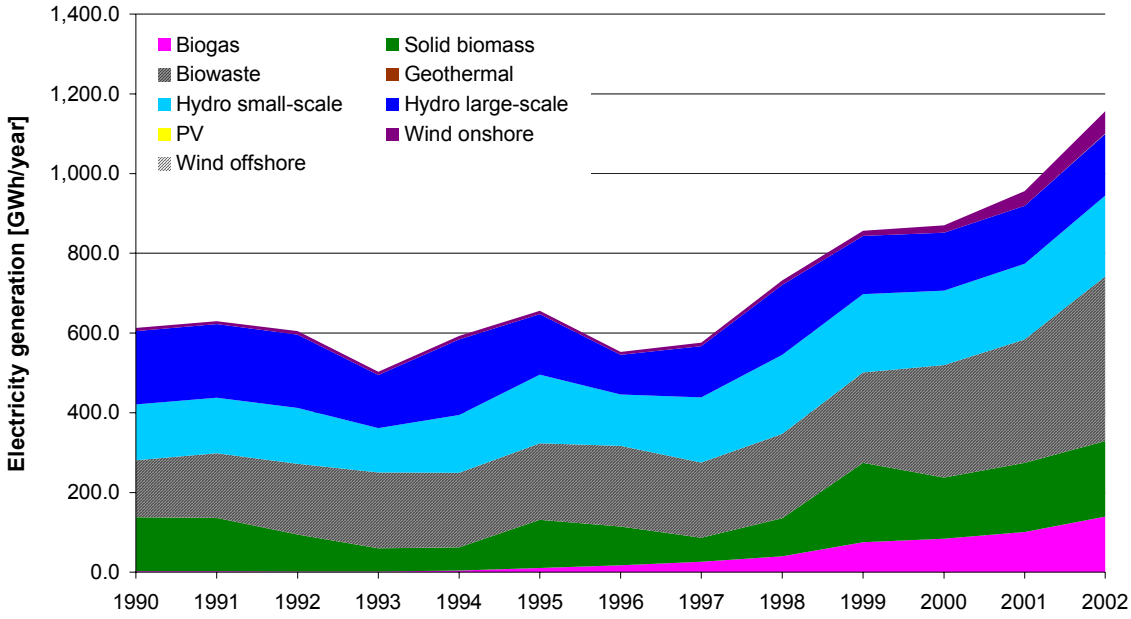

Figure 1: RES-electricity production up until 2002[8] in Belgium

Table 1: RES-electricity production in 1997 and 2002 in GWh

RES-E Technology	1997 {GWh]	2002 [GWh]	Av. Annual growth [%]
Biogas	27	140	39%
Solid Biomass	60	189	26%
Biowaste	188	413	17%
Geothermal electricity	0	0	
Hydro large-scale	129	155	4%
Hydro small-scale	164	203	4%
Photovoltaics	0	0	56%
Wind onshore	8	56	48%
Total	**576**	**1,156**	15%
Share of total consumption [%]	1.10%	1.4%	

[8] Based on EUROSTAT data, which are up-to-date only until 2001. For many RES, e.g. wind-onshore and PV more recent data from sector organisations and national statistics have been used.

Table 2 shows that also the **RES-heat** production has grown, although to a lesser extent than the RES-electricity production. **Biomass heat** is by far the major source of RES-heat, but it can be seen that the increase of **solar thermal heat** and **geothermal heat** has been more pronounced over recent years.

Table 2: RES-heat production up until 2002

	Penetration 1997 [ktoe]	**Penetration 2002 [ktoe]**	**Average growth rate since 1997 [%/year**
Biomass heat	295	384*	5
Solar thermal heat	1	1	-
Geothermal heat incl. heat pumps	0	6	-

* Biomass heat only until 2001

The biofuel sector in Belgium is virtually non-existent, as can be seen from Table 3.

Table 3: RES-biofuel production up until 2002

	Penetration 1997 [ktoe]	**Penetration 2002 [ktoe]**	**Growth rate since 1997 %**
Liquid biofuels	-	-	-

2.2. Mid-term Potentials

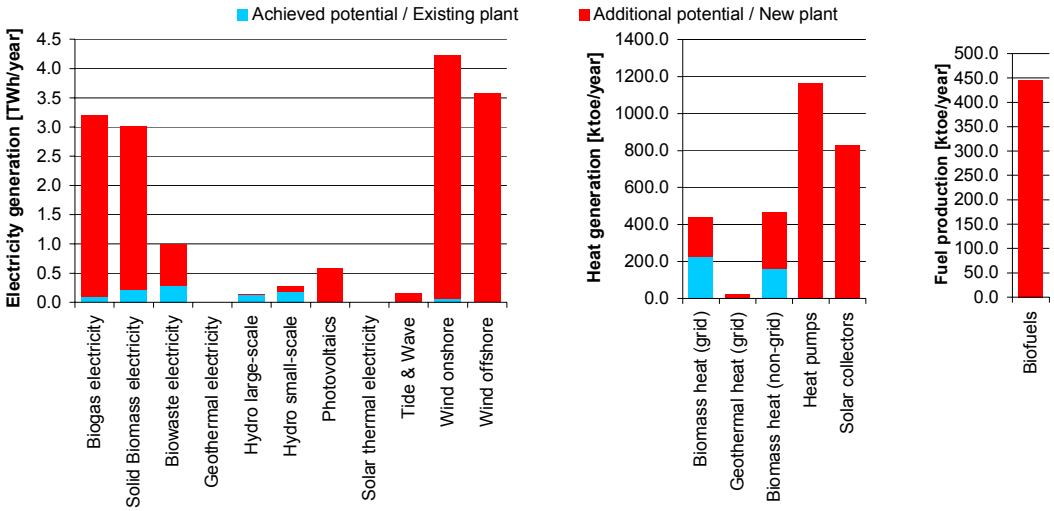

Figure 2: Mid-term potentials of RES electricity heat and transport in Belgium

Table 4: Policy assessment for RES – Belgium

Belgium is divided in three regions Flanders (F), Wallonie (W) & Brussels (B). Federal supports can be recognized by Fed

RES-type	Wind onshore	Wind offshore	PV	Hydro - small	Hydro - large	Wave & Tidal	Biomass electricity	Geoth. electr.	Waste Incin.	Biomass heat	Solar thermal	Geoth. heat	Bio-fuels
Dominating instrument	Green certificate with guaranteed minimum price plus tax compensation scheme.	As wind onshore	F: Subsidy Scheme	As wind onshore		As wind	As wind	As wind	Fed: company tax deduction W: investment subsidy scheme	W: investment subsidy scheme	W: Solar thermal support programme	Investment subsidy scheme and company tax deduction scheme	
Type of instrument	Green certs, fiscal instrument and investment compensation scheme		Investment compensation scheme	As wind		As wind	As wind	As wind	Fiscal instrument and investment compensation	Investment compensation scheme	Investment compensation scheme		
When implemented	Since 1995, updates 1998, 2003		(see wind)	(see wind)		(see wind)	(see wind)	(see wind)	(see wind)	(see wind)	(see wind)	(see wind)	
Major issues	Certificate market is rather small due too regional implementation, only cost-efficient technologies profit from this support High targets & penalties plus minimum tariffs generate favourable and reliablerevenue		Uncertainty over duration program and capacity limits Simple & transparent system	See wind		See wind	See wind	Although in principle this technology is eligible, it is not expected to develop	Allowable rate of deductions can vary annually. Uncertainty factors linked to eligibility.	Uncertainty in duration of program, strict eligibility requirements for certain technologies	Subsidies are paid after installation, causing high administrative costs plus uncertainty		
Degree and duration of support	●●●	●●●●●	●●	●●●		●●●	●●●	●●●	●●	●●	●●●	●●	●●
Non-economic factors	●●●	●●●	●●	●●		●●	●●	●●	●●	●●	●●●	●●	●

Elaboration of support									
	●	Insufficient support or very strong barriers	●●	Little support or significant constraints	●●●	Moderate support or acceptable market conditions	●●●●	High support or good market conditions	●●●●●	Very high support or very good conditions

CYPRUS

1. Summary of RES markets and policy

Background
Cyprus is almost totally dependent on oil imports for its energy supply accounting for 91% of the primary energy supply. The burden of cost of energy imports on the economy of Cyprus is considerable.
RES targets
The RES-E target to be achieved in 2010 is 6% for Cyprus.
Status of the renewable energy market
Cyprus plans full liberalisation of the electricity market to achieve until 2005. There is no electricity import or export. Almost all energy is produced from imported oil and diesel. The Electricity Authority of Cyprus (EAC) plans to invest in a new fossil fuel power plant, which would lead to an excess capacity for the next few years, being a major barrier for renewable development. Solar thermal energy is the major available renewable energy in Cyprus, and it is traditionally used by hotels and households for thermal purposes. The Government has recently adopted the "New Grant Scheme For Energy Conservation and the Promotion of the Utilization of Renewable Energy Sources" effective from 2003 to 2007.
Main supporting policies
The "New Grant Scheme For Energy Conservation and the Promotion of the Utilization of Renewable Energy Sources" provides financial incentives in the form of governmental grants (30-40% of investments) for investments in wind energy systems, solar thermal, PV, biomass, landfill and sewage waste using RES. There is a fixed purchase price for RES by EAC which is 6,3 € cents/kWh (3,7 cyp. cent/kWh). In addition to that EAC pays a special premium depending on the technology used from a Special Fund, financed by a levy on electricity consumption. The feed-in tariffs are as follows: Wind: first five years: 9,2 € cents/kWh (5,4 cyp. cent), for the next 10 years: 4,8 € cents/kWh to 9,2 € cents/kWh (2,8 to 5,4 cyp. cent/kWh) according to the mean annual wind speed. Biomass, landfill and sewage: 6,3 € cents/kWh (3,7 cyp. cent/kWh) PV up to 5 kW: 20,4 € cents/kWh (12 cyp. cent/kWh)
Key factors
Although the government intents to make Cyprus less dependent on imported energy, the energy infrastructure in Cyprus is set up for fossil fuel generation.

2. Current status and potentials of RES

2.1. Current penetration

Virtually all electricity in Cyprus (around 99%) is produced with oil and diesel. There is very small amount of electricity from renewable energy, either **solar, small-hydro** or **biomass**. Wind is not used up to now for electricity generation.

However, the total energy consumption is slightly different. 3.6% energy is provided by **solar thermal**. At the moment 92% of all houses and 50% of the hotels have installed solar water heaters. Cyprus has more solar collectors per capita installed than any other country in the world.

Table1: RES-electricity production in 1997 and 2002 in GWh

RES-E	1997 {GWh]	2002 [GWh]	Av. Annual growth [%]
Total	0	0	0

Table 2: RES-heat production up until 2001

	Penetration 1997 [ktoe]	Penetration 2001 [ktoe]	Annual growth rate since 1997 %/year
Biomass heat	n.a.	2.5	n.a.
Solar thermal heat	18	28.7	12
Geothermal heat incl. heat pumps	0	0	0

There is no biofuel production in Cyprus.

2.2. Mid-term potentials

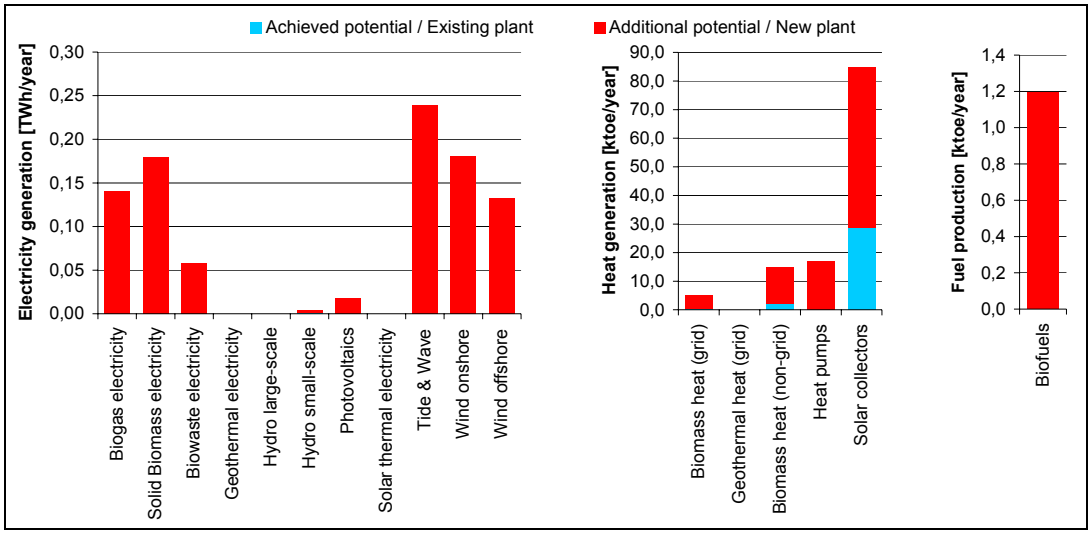

Figure 1: Mid-term potentials of RES electricity, heat and transport in Cyprus

CZECH REPUBLIC

1. Summary of RES markets and policy

Background

The Czech Republic as many other central European countries has a good supply of cheap coal and lignite based energy. However there have been serious efforts made to increase the share of renewable with own windmill design, numerous solar thermal installations, biomass and an extended system of small hydro.

RES targets

The RES-E target to be achieved in 2010 is 8% for the Czech Republic.

Status of the renewable energy market

The significant excess of generated electricity of around 27,000 GWh/year with the full commissioning of the Temelin Nuclear Power Plant is a major barrier for renewable electricity development for at least another decade. Poor reputation of wind energy caused by premature sales of prototypes to clients. Biomass and hydro are far the most utilised renewables. Geothermal is mainly utilised for balneological and swimming purposes.

Main supporting policies

The main supporting policies in the Czech Republic are:

Minimum feed-in-tariffs annually adjusted. Minimum prices for 2003:

Wind onshore:	9.6 € ct/kWh
Geothermal:	9.6 € ct/kWh
Biomass and biogas:	8 € ct/kWh
Small Hydro:	5 € ct/kWh
PV:	19.2 € ct/kWh

Tax incentives:

There is an exemption from property tax for five years for conversion of building heating systems from solid fuel to renewable energy. Also there is a tax relief up to five years (concerning income and property) for investment in renewable energy. The import duty on renewable-energy-equipment is reduced.

Low VAT rate (5% instead of 22%) for small facilities (hydropower: 0.1 MW, wind: 0.075 MW, all solar and biomass units).

Reduced VAT rate of 5% paid by final consumer of biomass fuel and heat. Exemption from excise duty for biodiesel fuel.

Key factors

Existing overcapacity on electricity production has historically hampered the development of renewables.

A new Renewable Energy Act is being prepared and should enter into force the first half of 2004.

The Energy Regulatory Office role for setting prices is unclear. This has resulted in large market uncertainty and investors and financiers have consequently held back on new RES-E investments.

Other issues

The present structure of the power production system is a result of the abundant and cheap supply of coal and especially of lignite.

Lack of capital

2. Current status and potentials of RES

2.1. Current penetration

Hydropower and **biomass** are for the moment the only two renewables contributing to RES electricity. Wind energy potential is for the moment nearly unexploited (around 8 MW currently installed). The utilisation of **photovoltaic** systems is also very limited.

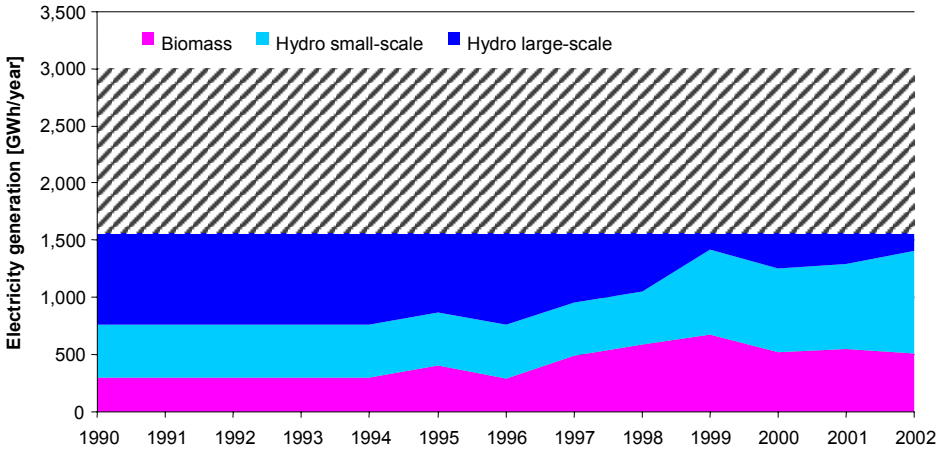

Figure 1: RES electricity production up until 2002[9] in the Czech Republic

In 1999 about 1.6 million tons of dry **biomass** were used for energy purposes. Other renewable resources of thermal energy were much less significant. The total production of heat from biomass grew from 358 Mtoe in 1997 to 432 Mtoe in 2001. Energy recovery of biogas exploitations has started in the recent years. Even though this shows a great shift in a five-year period, it is only 10% of the real potential of biomass. **Geothermal** heat is utilised for domestic and swimming pool heating as well as for some small industries. Moreover about 380 geothermal heat pumps have been installed until 2002. In 2002 there were 100,000 m^2 of **solar** collectors in operation.

Table 1: RES-electricity production in 1997 and 2002 in GWh

RES-E Technology	1997 {GWh]	2002 [GWh]	Av. Annual growth [%]
Biogas	1	133	203%
Solid Biomass	497	514	1%
Biowaste	0	0	0
Geothermal electricity	0	0	0
Hydro large-scale	1.234	1.597	5%
Hydro small-scale	465	894	14%
Photovoltaics	0	1	n.a
Wind onshore	15	16	1%
Total	**2.195**	**2.757**	4%

[9] Based on EUROSTAT data, which are up-to-date only until 2001. For many RES, e.g. wind-onshore and PV more recent data from sector organisations and national statistics have been used.

Share of total consumption [%]	3.7%	3.9%	

Table 2: RES-heat production up until 2001

	Penetration 1997 [ktoe]	**Penetration 2001 [ktoe]**	**Annual growth rate since 1997 %/year**
Biomass heat	358.2	432	5
Solar thermal heat	2.6	3.3	6
Geothermal heat incl. heat pumps	0.7	3.9	53

In 2001, biofuels already amounted to 1.3% of all automotive fuels.

Table 3: RES-biofuel production up until 2001

	Penetration 1997 [ktoe]	**Penetration 2001 [ktoe]**	**Annual growth rate since 1997 %/year**
Liquid biofuels	45.4	60.83	7.6

2.2. Mid-term potentials

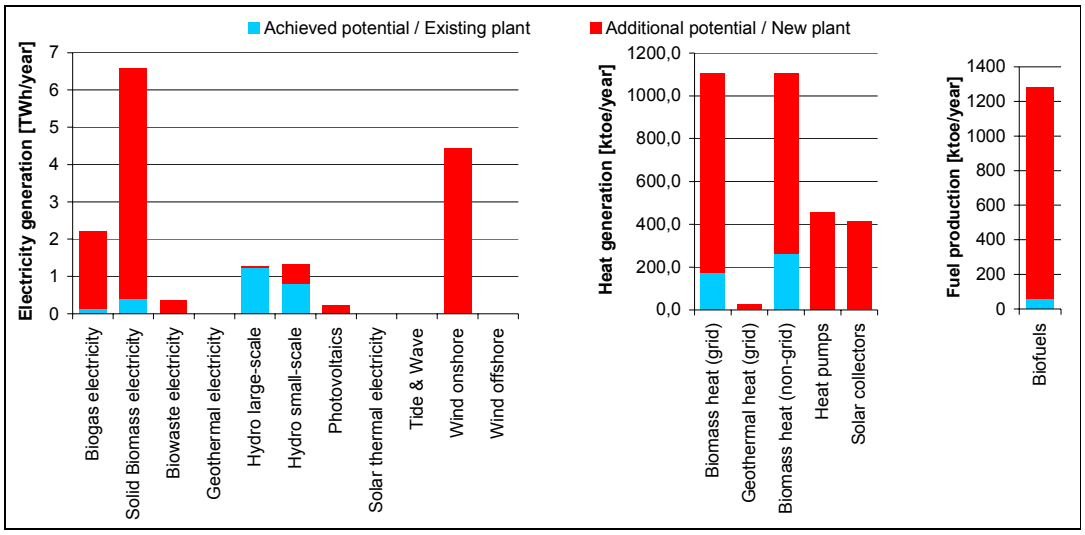

Figure 2: Mid-term potentials of RES electricity, heat and transport in the Czech Republic

DENMARK

1. Summary of RES markets and policy

Background With the election of the new government at the end of 2001 fundamental changes were made to existing energy policies and targets. Most of the favourable promotion schemes for RES have been abolished. The introduction of a green certificate market has been announced but has not been implemented so far. Except for two offshore wind parks, which were already in an advanced planning phase, the strong RES development observed in the 90's has stopped.
RES targets The RES-E target to be achieved by Denmark in 2010 is 29% of gross electricity consumption.
Status renewable energy market The renewable energy market has dramatically declined over the last two years.
Main supporting policies The main promotion schemes for RES in Denmark are the following. Act on payment for green electricity – settlement price instead of formerly high feed-in tariff **Wind onshore:** New installations receive spot price plus (on a monthly basis) an environmental premium (maximum of 1.3 € cents/kWh) plus a compensation for offsetting costs (0,3 € cents/kWh), in total limited to 4.8 € cents/kWh. Turbine owners are responsible for selling and balancing the power. The tariff can be well below the 4.8 € cents/kWh in times of a low spot price. The tariff is insufficient to attract new investments. **Wind offshore:** New installations receive spot price plus (on a monthly basis) an environmental premium (maximum of 1.3 € cents/kWh) plus a compensation for offsetting costs (0,3 € cents/kWh), in total limited to 4.8 € cents/kWh. Turbine owners are responsible for selling and balancing the power. The tariff can be well below the 4.8 € cents/kWh in times of a low spot price. Tendering procedure planed but conditions are currently under discussion. **Solid Biomass:** A settlement price of 4 € cents/kWh is guaranteed for a period of ten years. Additionally and as a guarantee these plants receive 1 € cent/kWh in compensation for an RE certificate. **Biogas:** A settlement price of 4 € cents/kWh is paid **Waste:** A settlement price of 1 € cent/kWh is paid
Key factors Termination of the originally high feed-in tariffs. Delay of the implementation of a green certificate scheme. In the new Danish political climate change renewables are of less importance. The feed-in tariffs applied at present are insufficient to attract investments comparable to the development of the last decade.

2. Current status and potentials of RES

2.1. Current penetration

Due to a focus on environmental issues during the 1980s and 1990s by the Danish governments and the energy administrations renewable energy is already widely used. More than 20 % of the electricity supplied in Denmark is currently based on renewable energy and RES cover approximately 9% of the country's primary energy consumption.

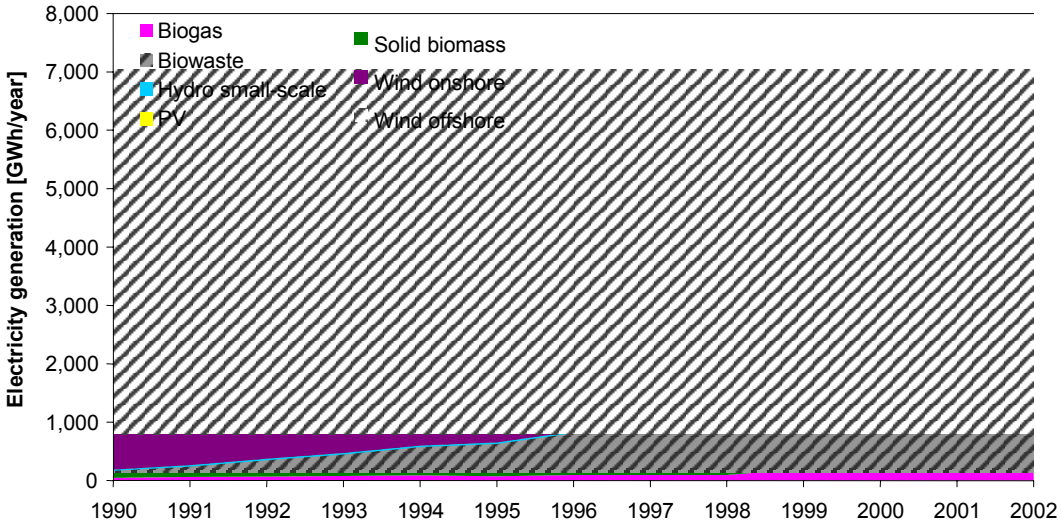

Figure 1: RES electricity production up until 2002[10] in Denmark

The current penetration in terms of the actual power generation is shown in Figure 1. The highest penetration rate as well as the highest growth during the last decade has been achieved by **wind onshore**. About 5000 GWh electricity was produced by wind onshore power plants in 2002. Up until 1999 economic conditions for wind energy were very stable. All wind generated power was delivered as prioritised dispatch and a feed-in system with a general tariff of approximately 8 € cents/kWh. However, over the last few years the situation has changed markedly due to a number of changes to the support schemes. In 2000 the annual installed wind power capacity peaked over 500 MW, but in 2001 only 115 MW was established. In 2002 the installed capacity increased again due to favourable re-powering conditions. Currently the figures for new wind on-shore capacities are very small (about 50 MW in 2003). There was major development with regard to **off-shore wind** energy in the years 2002 and 2003. In 2002 the off-shore wind park in Horns Rev (160 MW) was completed and in 2003 the large wind farm in Nysted (165.6 MW) as well as three smaller parks went on-line. Accordingly the total installed capacity of off-shore wind energy is about 425 MW. **Biomass**, especially **biowaste,** but also

[10] Based on EUROSTAT data, which are up-to-date only until 2001. For many RES, e.g. wind-onshore and PV more recent data from sector organisations and national statistics have been used.

solid biomass and **biogas,** has the second largest RES-E share. The detailed figures can be seen in Table 1. Only very little growth occurred in the biomass sector during 2002 and 2003 because the earlier favourable promotion conditions for biomass were, like those for wind energy, no longer available.

Table 1: RES-electricity production in 1997 and 2002 in GWh and average annual growth since 1997

RES-E Technology	1997 {GWh]	2002 [GWh]	Av. Annual growth [%]
Biogas	93	233	20
Solid Biomass	314	875	23
Biowaste	461	1,017	17
Geothermal electricity	0	0	
Hydro large-scale	0	0	
Hydro small-scale	19	32	11
Photovoltaics	0	1	
Wind	1,934	4,877	20
Total	**2,822**	**7,035**	**20**
Share of total consumption [%]	8.70	20	

In the **heat sector** the dominant renewable energy carrier is biomass, but since 1997 the market has been declining (see Table 2). Geothermal heat, including heat pumps, has shown the highest growth rate over the last few years.

Table 2: RES-heat production in 1997 and 2002 in ktoe and average annual growth since 1997

	Penetration 1997 [ktoe]	Penetration 2002 [ktoe]	Av. Annual growth [%]
Biomass heat	957	891*	-2
Solar thermal heat	6.6	9.9	8
Geothermal heat incl. heat pumps	1.2	15.7	67

*Biomass heat only up until 2001

Despite the rather low liquid biofuel production up until 2002 shown in Table 3, Denmark reached a biofuel production capacity of 36 ktoe in 2003. This figure is attributable to a number of experimental pilot plants currently being operated. It is not clear whether or not Denmark will launch commercial production of biofuels. If so, biodiesel seems to be the most likely option.

Table 3: RES-biofuel production up until 2002

	Penetration 1997 [ktoe]	Penetration 2002 [ktoe]	Growth rate since 1997 %
Liquid biofuels	0	10	

2.2. Mid-term Potentials

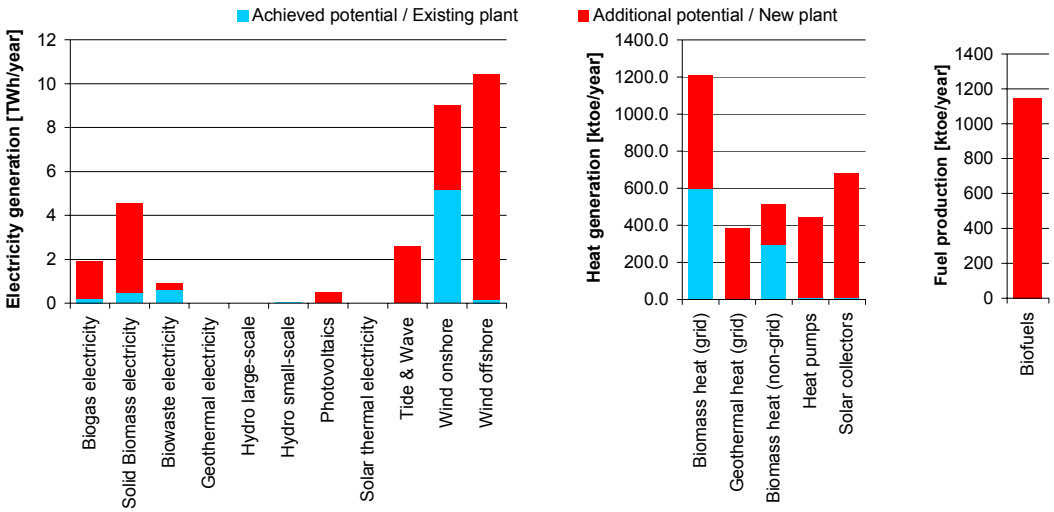

Figure 2: Mid-term potentials (2020) of RES electricity heat and transport in Denmark

Table 4: Policy assessment for RES - Denmark

RES-type	Wind onshore	Wind offshore	PV	Hydro - small	Hydro – large	Wave & Tidal	Geothermal electricity	Biomass electricity	Waste	Biomass heat	Solar thermal	Geoth. heat	Biofuels
Dominating instrument	Act on payment for green energy	Act on payment for green energy						Act on payment for green energy	Act on payment for green energy	Act on utilisation of renewable energy	Solar heating obligation in new buildings	Act on utilisation of renewable energies	Demonstration projects
Type of instrument	Feed-in tariffs	Feed-in tariffs				n.a.		Feed-in tariffs	Feed-in tariffs	Investment compensation schemes	Standards & regulations	Investment compensation schemes	R&D
Time of implementation	2003	2003				n.a.		2003	2003	1981/97	1999	1981/97	
Key factors	Instability of political environment Support too low. Formerly: Long-term guaranteed high tariff	Instability of political environment Support too low Tenders for new parks expected				n.a.		Instability of political environment Support too low Formerly: Long-term guaranteed high tariff	Instability of political environment	Support too low	Price High Social acceptance		Major tax incentive missing
Degree and duration of support	••	••				n.a.		••	••	••	••	•••	••
Non-economic factors	••••	••••				n.a.		••••	•••	••	•••	•••	••

	Sufficiency to promote RES
•	Hardly any or no support
••	Little support
•••	Moderate support
••••	High support
•••••	Very high support

ESTONIA

1. Summary of RES markets and policy

Background
Estonia has one of the lowest penetration of RES in the region with an extended oils-shale based energy production employing 10,000 people in this relatively small country.
RES targets
The RES-E target to be achieved in 2010 is 5.1% for Estonia.
Status of the renewable energy market
There are low opportunities for solar and geothermal. However there is considerable potential in wind and biomass as well as hydro power. The biomass installations need high investment and though there are several wind projects in the pipeline the feed in tariff is hardly more than half of the amount the developers would favour.
Main supporting policies
Electricity Market Act (EMA): electricity price for renewable energy 1.8 times the residential price, so the price for renewable energy is: 5,2 € cents /kWh. This price is paid for 7 years for biomass and hydro and for 12 years for wind. The EMA has come into force on July 2003.
Sales Tax Act: 0% VAT for renewable energies
Key factors
Extensive reserve of domestic fuel (10,000 people working in oil shale industry in the country with very high unemployment rate).
Changes in Energy Law open the possibilities for producing wind energy profitably and start manufacturing wind generators and their components in Estonia.

2. Current status and potentials of RES

2.1. Current penetration

The share of **renewables** is 0.2%, because of the huge and cheap supply of electricity from oil shale. This source dominates the Estonian electricity production. Currently there is one **wind**-farm operational with a total capacity of 1.8 MW. Several projects with a total of 76 MW installed capacity were identified. In Estonia, at present only one 1.2 MW **hydro** plant exists. The utilization of solar energy in Estonia has no noticeable spreading both for electricity production and heat supply.

Figure 1: RES electricity production in Estonia up until 2001

The current penetration of **biomass** is not exactly known but very small. The area occupied by forests constitutes 22 thousand km^2 that exceeds a half of the country territory, thus forest residue presents the highest biomass potential.

Table 1: RES-electricity production in 1997 and 2001 in GWh

RES-E Technology	1997 {GWh]	2001 [GWh]	Av. Annual growth [%]
Biogas	0	0	
Solid Biomass	8	11	8%
Biowaste	0	0	
Geothermal electricity	0	0	
Hydro large-scale	0	0	
Hydro small-scale	3	7	24%
Photovoltaics	0	0	
Wind onshore	0	2	
Total	**11**	**20**	**16%**
Share of total consumption [%]	0.1%	0.2%	

Table 2: RES-heat production up until 2001

	Penetration 1997 [ktoe]	Penetration 2001 [ktoe]	Annual growth rate since 1997 %/year
Biomass heat	530	398	-7
Solar thermal heat	0	0	0
Geothermal heat incl. heat pumps	0	0	0

There is no liquid biofuel production in Estonia.

2.2. Mid-term potentials

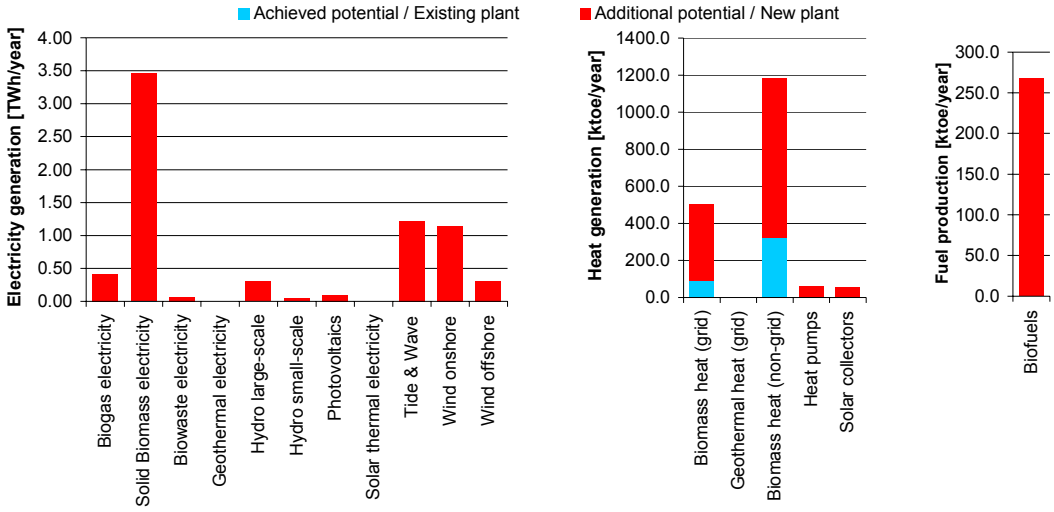

Figure 2: Mid-term potentials of RES electricity, heat and transport in Estonia

FINLAND

1. Summary of RES markets and policy

Background

The main core of Finnish renewables policy is defined in the *Action Plan for Renewable Energy*. The most important objective is to increase the competitiveness of renewable sources for the future. The plan has a strong emphasis on R&D activities to achieve this result in the long term. Energy taxation of fossil fuels forms the main instrument for implementation of renewables in the short term.

RES targets

The RES-E target from the EU directive for Finland is 31.5% of gross electricity consumption in 2010. A national target for 2025 has been set which is aimed at increasing the use of renewable energy by 260 PJ.

Status renewable energy market

Renewables currently cover around 28% of the Finnish total electricity consumption supplied by two key sources: hydro power (70%) and biomass (30%). Over the past decade a significant increase has been achieved in the deployment of biomass, in particular in the form of CHP and district heating systems.

Main supporting policies

Exemption from energy tax for renewable electricity. Unlike electricity from fossil or nuclear sources renewable electricity is exempted from the Finnish energy tax paid by end-users. This brings the following benefits for renewables:

wind	69 € /MWh	
biomass / mini-hydro	42 € /MWh	
biomass heating fuels	1 € /GJ	(compared to natural gas)

Investment subsidies are available for new investments which receive a subsidy of 30% (wind: 40%).

Key factors

Subsidies provide absolute certainty regarding lower investment costs. Tax exemptions help to bridge gap with fossil and nuclear competitors. Nevertheless in the case of wind energy, available support is not enough to plug the gap. The existing support systems have allowed a substantial increase to be achieved in the use of biomass for electricity production and district heating.

Political changes and some uncertainty about future energy support programmes have resulted in new renewable energy investments being withheld.

Other issues

The value of total available support does not completely plug the price gap with fossil or nuclear based competitors. This holds in particular for wind energy.

2. Current status and potentials of RES

2.1. Current penetration

The development of the **renewable electricity production** over the past decade has resulted in a 30% increase since 1990. In absolute figures **bio-energy** showed the strongest growth due to a strong expansion of biomass-fueled CHP and district heating. By its efforts Finland is now the largest generator of electricity from biomass within the EU. Nearly 10% of the domestic electricity demand is now met by biomass. **Hydro power**, however, still remains the largest source of renewable energy in Finland. The use of **wind power** and photovoltaics is still in its early stages in the Finnish electricity market. In 2002 a total of 51 MW was installed.

The current penetration in terms of the actual power generation is shown in Figure 1 up to 2002 from Eurostat data. The fluctuations reflect the volatility in the supply of hydro power due to variations in weather conditions from year to year. Recent figures for 2002 indicate that electricity from biomass reached a level of 10 TWh. A similar amount was produced by hydro power in 2002. According to the total demand the **share of RES** electricity in Finland amounted to **25%** in 2002 compared with **25%** in 1997.

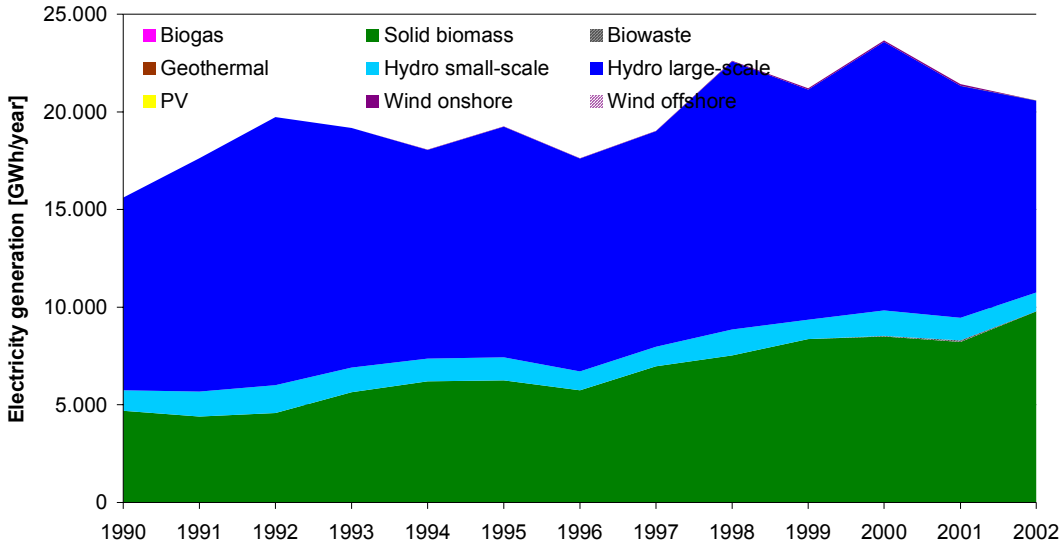

Figure 1: RES electricity production up until 2002[11] in Finland

[11] Based on EUROSTAT data, which are up-to-date only until 2001. For many RES, e.g. wind-onshore and PV more recent data from sector organisations and national statistics have been used.

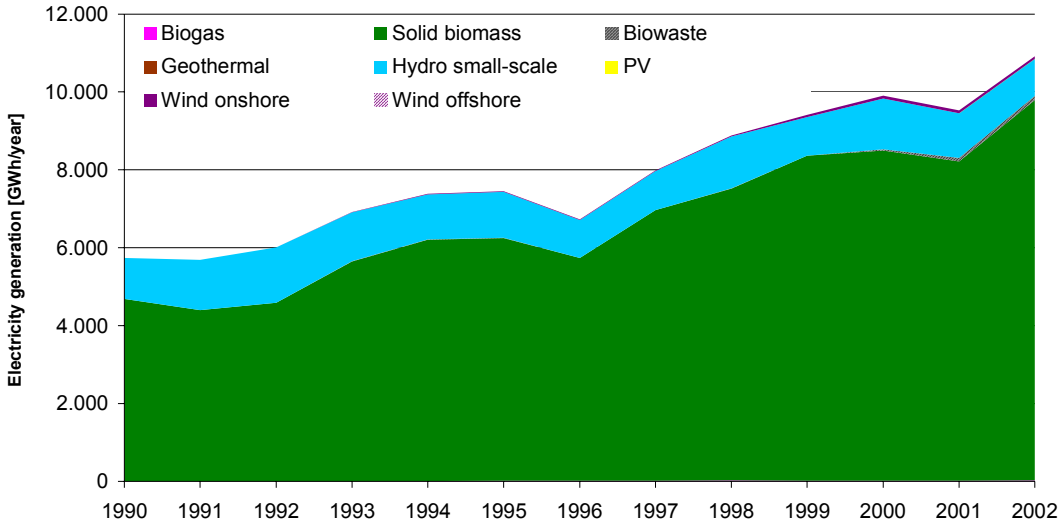

Figure 2: RES electricity production in Finland up until 2002 without large hydro

Table 1: RES-electricity production in 1997 and 2002 in GWh

RES-E Technology	1997 [GWh]	2002 [GWh]	Av. Annual growth [%]
Biogas	24	26	1%
Solid Biomass	6,941	9,762	7%
Biowaste	3	109	109%
Geothermal electricity	0	0	
Hydro large-scale	11,039	9,840	-2%
Hydro small-scale	1,003	952	-1%
Photovoltaics	0	0	27%
Wind onshore	17	63	30%
Total	**19,027**	**20,753**	**2%**
Share of total consumption [%]	24.70%	24.72%	
Non-hydro RES-E (GWh)	6,985	9,961	

In the **heat sector** the use of biomass, in particular in new CHP and district heating installations, has grown substantially over the past decade (by nearly 50% compared with 1990). This substantial growth rate has fallen somewhat of late. With the use of biomass for heating purposes, Finland has become one of the leading Member States within the EU when it comes to the share of heat from biomass in the total energy demand for heating purposes. Solar thermal collectors and heat pumps have been introduced in Finland, but their contribution still remains small.

Table 2: RES-heat production up until 2002

	Penetration 1997 [ktoe]	Penetration 2002 [ktoe]	Growth rate since 1997 [%}
Biomass heat	4290	4818*	3
Solar thermal heat	0.3	0.8	22
Geothermal heat incl. Heat pumps	7.3	45.9	44

* Biomass heat only until 2001

Biofuel for transport has not reached any significant level so far in Finland.

Table 3: RES-biofuel production up until 2002

	Penetration 1997 [ktoe]	Penetration 2002 [ktoe]	Growth rate since 1997 %
Liquid biofuels	-	-	-

2.2. Mid-term Potentials

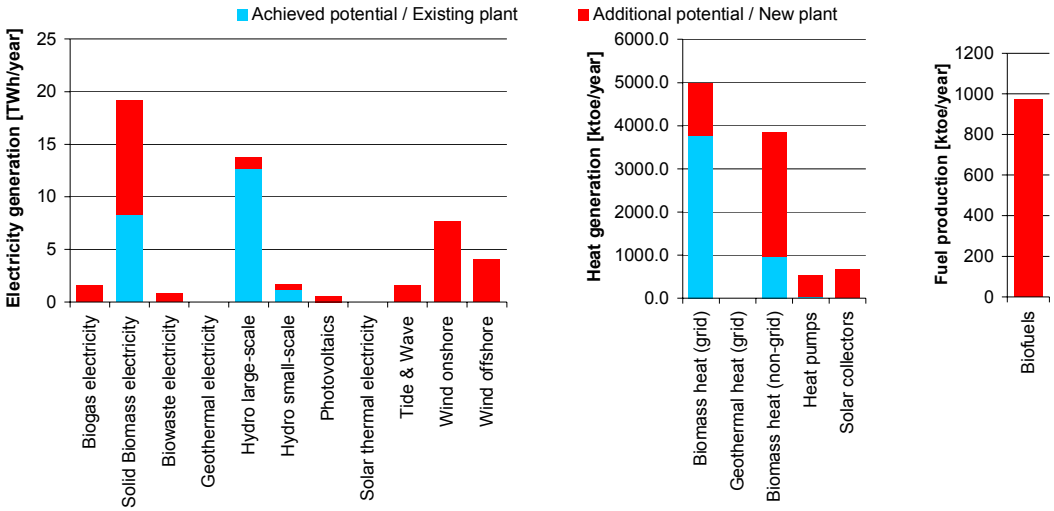

Figure 3: Mid-term potentials of RES electricity heat and transport in Finland

Table 4: Policy assessment for RES - Finland

RES-type	Wind onshore	Wind offshore	PV	Biomass electricity	Hydro – small	Hydro - large	Geoth. electr.	Biomass heat	Solar thermal	Geoth. heat	Biofuels
Dominating instrument	Energy tax exemption	n.a.	n.a.	Energy tax exemption	Energy tax exemption	n.a.	n.a	Energy tax exemption	n.a.	n.a.	n.a.
Type of instrument	Energy or environmental tax incentives	n.a.	n.a.	Energy or environmental tax incentives	Energy or environmental tax incentives	n.a.	n.a.	Energy or environmental tax incentives	n.a.	n.a.	n.a.
When implemented	Since ±1990			Since ±1990	Since ±1990			Since ±1990	Since ±1990		
Key factors	Tax support not enough to stimulate new capacity	Few resources	Few resources	Resource availability Tax support may be not enough to achieve competitiveness	Planning price	n.a.	n.a.	Resource availability. Tax support may be not enough to achieve competitiveness	Few resources	n.a.	n.a.
Degree and duration of support	••	•	•	•••	••••			•••	•		–
Non-economic factors	•••	•	•	••••	••••			••••	•		–

	Sufficiency to promote RES
•	Hardly any or no support
••	Little support
•••	Moderate support
••••	High support
•••••	Very high support

FRANCE

1. Summary of RES markets and policy

Background

France has introduced legislation which provides a strong financial support scheme for renewable energy based on feed-in tariffs. These measures took effect in 2001 and 2002. Before this change, implementation was dependent on modest subsidy programmes.

RES targets

The RES-E target from the EU directive for France is 21% of gross electricity consumption in 2010.

Status of the renewable energy market

Renewables cover currently around 16% of the French total electricity consumption. This supply is met mainly by hydro power. Despite significant resources wind, biomass and geothermal energy currently play an insignificant role in the electricity sector. The current use of heat from RES amounts to approximately 6,0 Mtoe which covers 7% of the domestic energy consumption for heating purposes. The use of biomass forms the main source for renewable heat and is relatively stable in size.

Main supporting policies

Feed-in tariffs:

For renewable energy installations up to 12 MW, guaranteed for 15 or 20 years. Tariffs depend on source type and may include a premium for some sources. Rates are adjusted for inflation.

PV-Systems: 15 € cents/kWh

Hydro: Standard rate of 6 € cents/kWh, premium up to 7,5 € cents/kWh

Biomass: Standard rate of 4,9 € cents/kWh, premium up to 6 € cents/kWh

Sewage and landfill gas: Standard rate of 5,5 € cents/kWh, premium up to 6 € cents/kWh

MSW: Standard rate of 3,5 € cents/kWh, premium up to 4 € cents /kWh

Wind:

8,5 € cents/kWh for the first 5 years after installation, then 6,5 € cents up to 10 years after installation and 3€ cents/kWh for a further 5 years.

A tendering system is in place for renewable energy installations > 12 MW. Tenders follow an open bidding procedure, where the winner is awarded a guaranteed-price contract. The tariff contracted depends on the bid. Calls for projects have published for biogas, wind onshore and wind offshore with a total power capacity of 250 MW.

Key factors

The level of the tariff is clearly high enough to only attract small and medium wind-energy projects. Tariffs for other renewables seem relatively low or moderate. Guaranteed periods under the new scheme are sufficiently long to secure investments.

Administrative and grid barriers persist.

Uncertainty in winning a bid for projects larger than 12 MW due to the tendering procedure.

Other issues

The new feed-in tariffs may provide a strong incentive if major obstacles like administrative and grid barriers can be removed.

2. Current status and potentials of RES

2.1. Current penetration

The development of **renewable electricity production** over the past decade has resulted in a 14% increase since 1990. This increase is almost entirely due to more **hydro power** production. Existing installations in particular have increased their output as there was only a modest growth in new capacity. **Biomass** is the second-largest source of renewable electricity and its use has also risen over the past decade. However, its contribution to the total renewable electricity generation is small (5%). The use of **wind power** and **photovoltaics** is still in its early stages in France. France has a considerable **geothermal** potential.

Current penetration in terms of the power actually generated is shown in Figure 1 up to 2002 (Data from Eurostat). The fluctuations reflect the volatility in the supply of hydro power due to variations in weather conditions from year to year. In 2003 installed wind power increased by 91 MW to total 239 MW. Photovoltaic solar power rose by 3 MW to a total capacity of 17 MW.

On the basis of total demand the **share of RES** electricity in France amounted to **14.4%** in 2002 compared with **15%** in 1997.

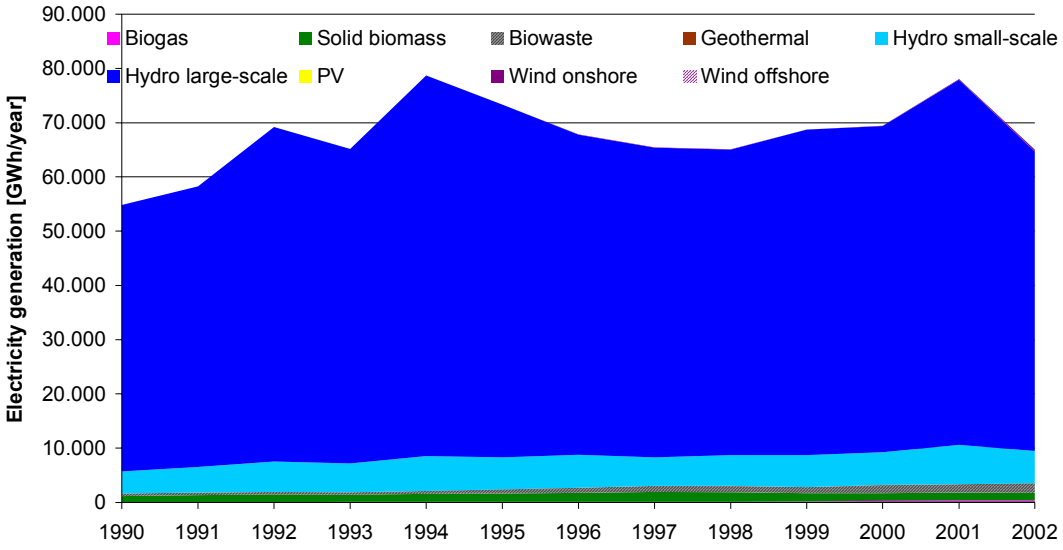

Figure 1: RES electricity production up until 2002[12] in France

[12] Based on EUROSTAT data, which are up-to-date only until 2001. For many RES, e.g. wind-onshore and PV more recent data from sector organisations and national statistics have been used.

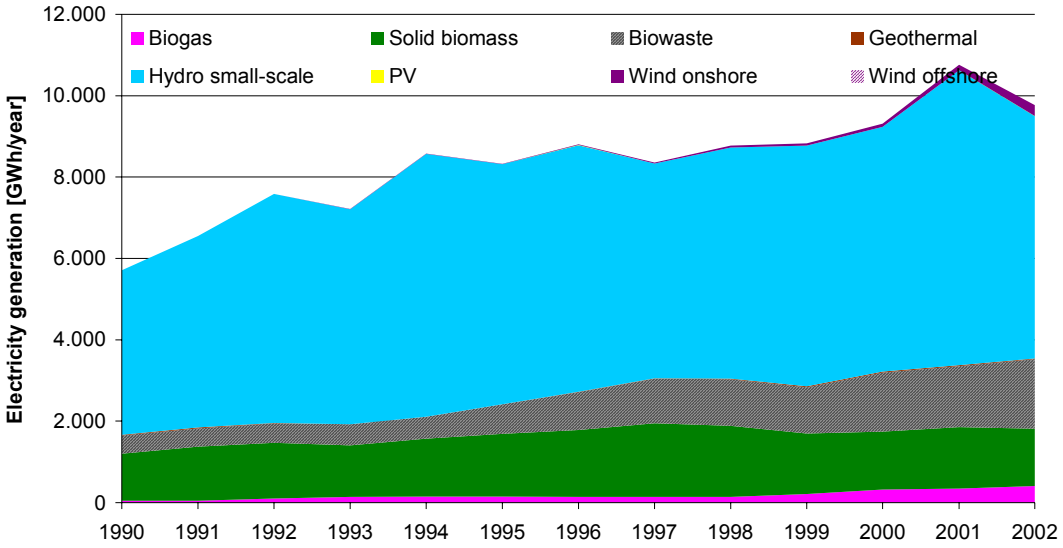

Figure 2: RES electricity production in France up until 2002 without large hydro

Table 1: RES electricity production in 1997 and 2002 in GWh

RES-E Technology	1997 {GWh]	2002 [GWh]	Av. Annual growth [%]
Biogas	144	406	23%
Solid Biomass	1,807	1,405	-5%
Biowaste	1,099	1,714	9%
Geothermal electricity	3	21	50%
Hydro large-scale	57,052	55,244	-1%
Hydro small-scale	5,278	5,956	2%
Photovoltaics	0	1	62%
Wind onshore	25	265	60%
Total	**65,408**	**65,012**	**0%**
Share of total consumption [%]	15.00%	14.4%	
RES-E excluding large-scale hydro (GWh)	8,356	9,768	

Unlike renewable electricity, the **heat sector** has remained more or less stable over the past decade. The current use of heat from RES amounts to approximately 10 Mtoe, which covers 7% of the domestic energy consumption for heating purposes. The use of biomass forms the main source of renewable heat and is relatively stable in size. The largest contribution comes from wood-firing in households, which covers 90% of the heat production from RES. Geothermal heat is the second-largest form of heat in France. Like biomass, its contribution has remained stable over past years. The figures for recent years demonstrate that solar thermal collectors and heat pumps have attracted sizeable investments especially from private households. A total collector area of about 0,7 Mio. m^2 was installed by the end of 2002.

Table 2: RES-heat production up until 2001

	Penetration 1997 [ktoe]	Penetration 2002 [ktoe]	Annual growth rate since 1997 [%]
Biomass heat	9153	9567*	1
Solar thermal heat	16,2	37	18
Geothermal heat incl. heat pumps	122	196	10

*Biomass heat only up until 2001

France is within Europe one of the leading Member States in the production and use of biofuels for transport. Production levels are similar to Germany's.

Table 3: RES-biofuel production up until 2002

	Penetration 1997 [ktoe]	Penetration 2002 [ktoe]	Annual growth rate since 1997 [%]
Liquid biofuels	306	466	9

2.2. Mid-term Potentials

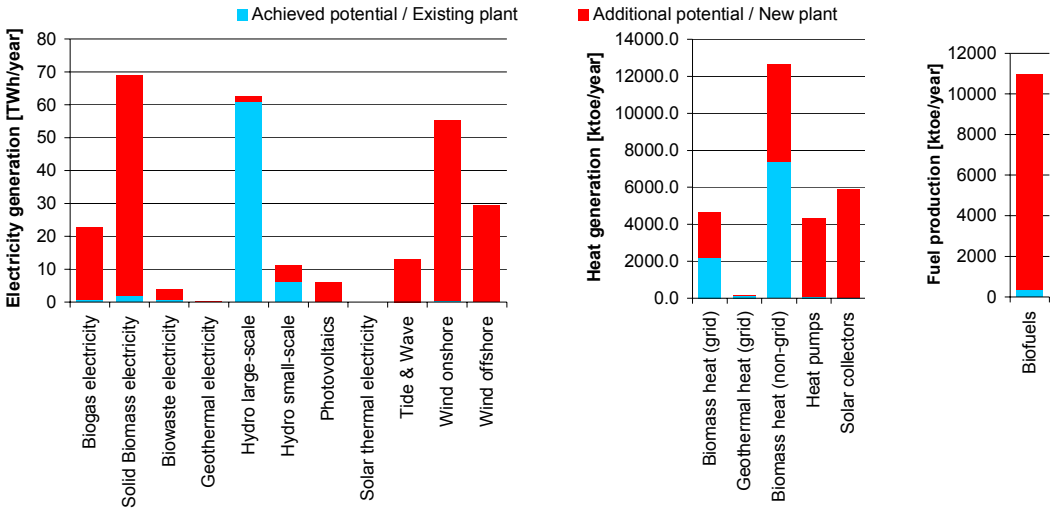

Figure 3: Mid-term potentials of RES electricity heat and transport in France

Table 4: Policy assessment for RES - France

RES-type	Wind onshore	Wind offshore	PV	Biomass electricity	Hydro - small	Geoth. electr.	Waste Incin.	Biomass heat	Solar therm.	Biofuels
Dominating instrument	Feed-in tariff < 12 MW Tender & feed-in tariff > 12 MW	Tender & feed-in tariff > 12 MW	Feed-in tariff < 12 MW Tax deduction for RE investments Lower VAT on RE investments	Feed-in tariff < 12 MW Tender & feed-in tariff > 12 MW	Tender & feed-in tariff > 12 MW	Feed-in tariff < 12 MW Tender & feed-in tariff > 12 MW	Feed-in tariff < 12 MW Tender & feed-in tariff > 12 MW	Tender & feed-in tariff > 12 MW	Helios 2000 – 2006 Tax deduction for RE investments Lower VAT on RE investments	
Type of instrument	Feed-in tariffs Tendering schemes	Feed-in tariffs Tendering schemes	Feed-in tariffs Investment compensation schemes	Feed-in tariffs Tendering schemes Investment compensation schemes	Feed-in tariffs	Feed-in tariffs	Feed-in tariffs	Investment compensation schemes	Energy or environmental tax incentives Investment compensation schemes	Energy or environmental tax incentives
Time implemented*	Since 2001	Since 2001	Since 2001	Since 2001	Since 2001	Since 2001	Since 2001	n.a.	More than 5 years	unknown
Key factors	Planning permits Grid connection Attractive long-term guaranteed tariff	Tender Planning Grid connection Long-term guaranteed tariff	Long-term guaranteed tariff	Feed-in tariffs alone maybe not enough to stimulate new capacity Long-term guaranteed tariff	Planning permits and environmental restrictions Attractive long-term guaranteed tariff	Feed-in tariffs alone maybe not enough to stimulate new capacity Long-term guaranteed tariff	Competition with land fill Attractive long-term guaranteed tariff	Local partnership key in policy and support to create demand Local partnership	Support not enough to stimulate new capacity	Price
Degree and duration of support	●●●●●	●●●●	●●●	●●●	●●●●	●●●	●●●●	●●	●●●●	●●●
Non-economic factors	●●●	●●●●	●●●●	●●●	●●	●●●	●●●	●●●	●●●●	●●●

* Time implemented, duration of support and operational period are specified for the main instrument supporting the deployment of the selected renewable energy technology. The main instrument is indicated as the first instrument in the first and second row of the table.

Elaboration of support: 1) Degree and duration of support 2) Non-economic factors (e.g. grid constraints, social constraints and administrative barriers)	
•	Insufficient support or very strong barriers
••	Little support or significant constraints
•••	Reasonably sufficient support or acceptable market conditions
••••	High support or good market conditions
•••••	Very high support or very good conditions

GERMANY

1. Summary of RES markets and policy

Background

The stability of political support has stimulated continuous and high levels of growth especially in the case of wind energy, PV and solar thermal installations over the past decade. But the sectors of liquid biofuels, heat pumps and to a lesser extent biomass electricity, and biomass heat have also shown relevant growth rates. A new feed-in tariff system is proposed that will lower the tariffs for wind on-shore, increase tariffs for biomass electricity, geothermal electricity and introduce a feed-in tariff for the refurbishment of large hydro.

RES targets

The RES-E target to be achieved by Germany in 2010 is 12.5% of gross electricity consumption (in 2020 10% of total energy consumption and 20% of electricity consumption).

Status of the renewable energy market

The renewable energy market in Germany is mature and showing large growth rates even at high penetration rates. Biomass might be considered as the only source that is significantly lagging behind expectations.

Main supporting policies

The main promotion schemes for RES in Germany are the following.

Renewable Energy Act – feed-in tariff (present scheme) (proposed new law to be implemented in 2004)

Wind: 9 € cents/kWh for at least five years after installation. Reduction of tariff to 6 € cents/kWh depending on yield of system. Yearly reduction of tariff by 1.5%.

Biomass: up to 500 kW: 10 € cents/kWh, up to 5 MWp: 9 € cents/kWh, up to 20 MWp: 8,6 € cents/kWh,

Hydro, landfill gas, sewage gas: up to 500 kW: 7,7 € cents/kWh, form 501 kW to 5 MW: 6,6 € cents/kWh

PV: 48 € cents/kWh, yearly reduction of tariff by 5%. Starting in 01/2004 FIT of 59 € cents/kWh.

(Proposed new law to be implemented in 2004 will contain different tariffs)

Market Incentive Program: Investment subsidy for most sources except wind

Income tax regulations on wind energy investments

Environment and Energy Efficiency Programme: subsidised loans for major share of wind investments

Full exemption from mineral oil tax and environmental tax for all pure liquid and solid biofuels in heat and transport.

Key factors

Partially exploited potentials and limited grid capacity in the northern parts of Germany are currently hampering the growth of onshore wind energy for much of the market. Offshore wind energy is developing more slowly than expected due to high costs and unsolved technical problems (long distance from land and deep water). Biomass development is slower than expected due to fuel price uncertainty and high infrastructure costs. Most of the low-cost potentials (wood wastes) have already been exploited. The proposed new renewable energy act will have a major impact on wind, biomass and large hydropower. The current relatively high feed-in tariffs combined with reasonable investment subsidies and loans has generated a considerable RES market. The termination of the 100 000 roofs programme would have led to a significant slowdown of PV development, however this is now being compensated by higher feed-in tariffs as from in January 2004.

2. Current status and potentials of RES

2.1. Current penetration

The developments in **renewable electricity production** have been very dynamic in Germany over the recent years. In absolute figures **wind energy** showed the strongest growth reaching the combined generation potential of large and small hydropower at the end of 2003 of about 25 TWh. The actual generation of wind energy in 2003 was lower at about 18.5 TWh due to a wind year that was 16% below average as well as due to the fact that most wind turbines are installed at the end of the year. About 50% of the European wind energy capacity is installed in Germany. **Hydropower** has the second-largest RES-E share, but it has not been showing any significant development over the last five years. **Biomass electricity**, including the biodegradable fraction of municipal waste, is the third most important RES-E source with about 6.2 TWh of electricity production in 2002. Strong growth rates have also been achieved in the area of **photovoltaics,** reaching an installed capacity of 258 MW and a generation potential of about 190 GWh in 2002 and about 260 GWh in 2003.

Penetration in 2001 in terms of actual power generation is shown in Figure 1. For wind and hydropower in particular this graph does not truly reflect the development of the installed capacities because of the volatility of power output over the year. In Table 1 electricity generation from RES is shown for the years 1997 and 2002 as well as the average annual growth during this period.

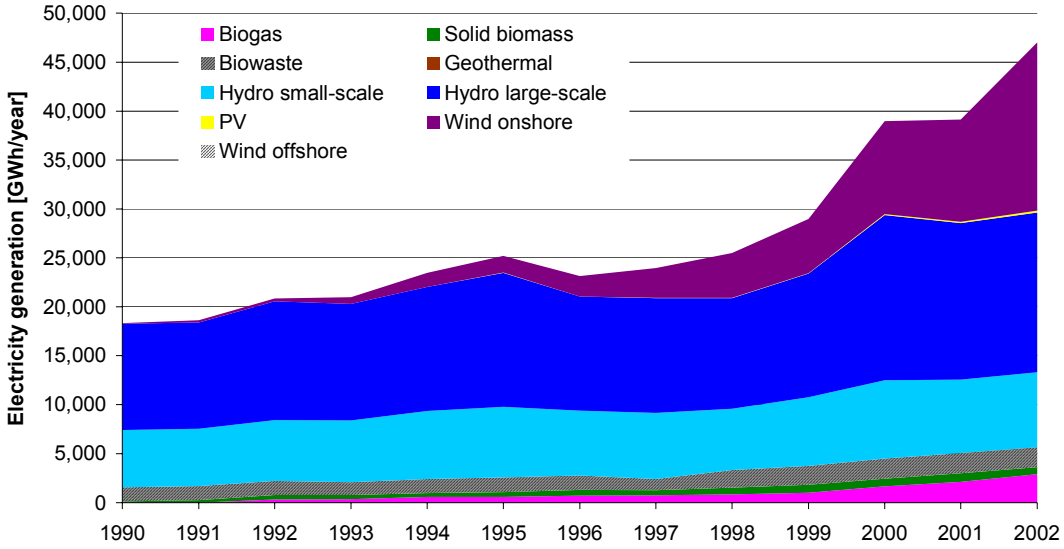

Figure 1: RES electricity production up until 2002[13] in Germany

[13] Based on EUROSTAT data, which are up-to-date only until 2001. For many RES, e.g. wind-onshore, hydro power and PV more recent data from sector organisations and national statistics have been used.

Table 1: RES-electricity production in 1997 and 2002 in GWh

RES-E Technology	1997 {GWh]	2002 [GWh]	Av. Annual growth [%]
Biogas	746	2,913	31%
Solid Biomass	505	700	7%
Biowaste	1,168	2,035	12%
Geothermal electricity	0	0	
Hydro large-scale	11,696	16,340	7%
Hydro small-scale	6,772	7,660	2%
Photovoltaics	27	176	45%
Wind onshore	3,034	17,200	41%
Total	**23,948**	**47,024**	**14%**
Share of total consumption [%]	4.50%	8.1%	

In the **heat sector** the growth was less rapid than in the electricity sector although solar thermal collectors and heat pumps have attracted sizeable investment especially from private households. A total collector area of about 5 million m^2 was installed by the end of 2002. Biomass heating is largely dominated by wood and wood-waste applications in households and a growing share of biogas, accounting for about 13% of the biomass heat consumption by the end of 2001. The production of heat from wood in households remained quite constant over recent years.

Table 2: RES-heat production up until 2001

	Penetration 1997 [ktoe]	Penetration 2002 [ktoe]	Growth rate since 1997 [%/year]
Biomass heat	4279	5480*	6,3
Solar thermal heat	68	158	18
Geothermal heat incl. heat pumps	9	65,2	49

*Biomass heat only up until 2001

The biofuel sector bas been growing very rapidly over the last 10 years, showing a doubling of production every two years. The existing biofuel mix is based almost entirely on biodiesel produced from rapeseed.

Table 3: RES-biofuel production up until 2002

	Penetration 1997 [ktoe]	Penetration 2002 [ktoe]	Growth rate since 1997 %
Liquid biofuels	86	520	43

2.2. Mid-term Potentials

The mid-term potentials[14] of RES in the sectors of electricity, heat and transport are shown in Figure 2.

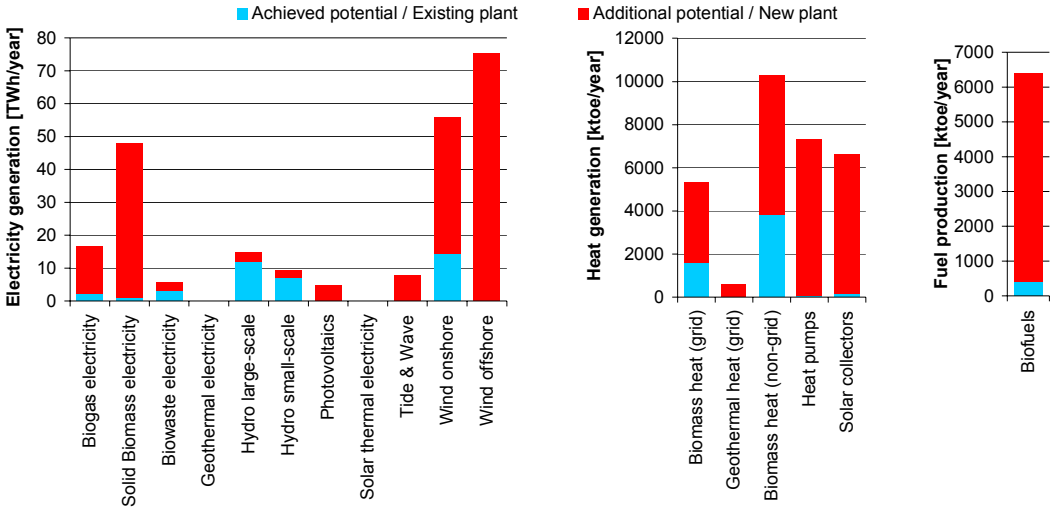

Figure 2: Mid-term potentials of RES electricity heat and transport in Germany

[14] The exact definition of the "mid-term potential" can be found in Annex I – Methodologies of the final report. Compared with the technical potential the mid-term potential represents the so-called realisable potential, taking into account socio-economic restrictions, maximum annual growth restrictions, capacity of RES production industry, etc.

Table 4: Policy assessment for RES - Germany

RES-type	Wind onshore	Wind offshore	PV	Hydro - small	Hydro – large	Wave & Tidal	Geoth. electr.	Biomass electricity	Biomass heat	Solar thermal	Geoth. heat	Biofuels
Dominant instrument	Renewable Energy Act	Renewable Energy Act	Renewable Energy Act	Renewable Energy Act	Renewable Energy Act (New proposal Dec 03)	n.a.	Renewable Energy Act	Renewable Energy Act	Market Incentive Program	Market Incentive Program	Market Incentive Program	Tax exemption
Type of instrument	Feed-in tariffs	Feed-in tariffs	Feed-in tariffs	Feed-in tariffs	Feed-in tariffs	n.a.	Feed-in tariffs	Feed-in tariffs	Investment compensation schemes	Investment compensation schemes	Investment compensation schemes	Tax incentives
Time of implementation	2000	2000	2000	2000	2004	n.a.	2000	2000	1999	1999	1999	1993
Key factors	Saturation of potential Long-term guaranteed tariff	Technical feasibility Long-term guaranteed tariff	Price Long-term guaranteed tariff	Saturation of potential	Refurbishment for plants up to 150 MW in new FIT	n.a.	Price	Security of feedstock supply is a problem Long-term guaranteed tariff		Price High Social acceptance		Infrastructure Price High tax incentive
Degree and duration of support	●●●●●	●●●●●	●●●●	●●●●	n.a.	n.a.	●●●	●●●●	●●●	●●●●	●●●	●●●●●
Non-economic factors	●●●●●	●●●●	●●●●●	●●●	n.a.	n.a.	●●	●●●●	●●●	●●●●	●●●	●●●●●

* Environment and Energy Efficiency Programme of "Deutsche Ausgleichsbank"

	Elaboration of support
●	Insufficient support
●●	Little support
●●●	Reasonably sufficient support
●●●●	High support
●●●●●	Very high support

GREECE

1. Summary of RES markets and policy

Background

The current development of RES in Greece showed the first significant growth in the field of active solar thermal systems stimulated by a deduction of the taxable income for final users. However, this measure is temporarily on hold for budgetary reasons. Law 2244/94 on Electricity from Renewables has played a decisive role in starting the large-scale development of RES through private investments The combination of feed-in tariffs (introduced by 2244/94) and subsidies in the order of 40% of the investment cost (provided either through the development law or the 3rd Community Support Framework-CSF) created a large measure of interest among investors. Most of the activity has been concentrated on wind energy and active solar thermal systems. Administrative barriers represent the major constraint to further growth.

RES targets

The RES-E target to be achieved by Greece in 2010 is 20% of gross electricity consumption.

Status of the renewable energy market

Greece has a mature RES market especially for active solar thermal systems, hydro and geothermal installations in the heat sector. The general promotion schemes have been in place for a considerable time already and have undergone only slight change (degree of support) of late. A recent inter-ministerial decision is aimed at reducing the administrative burden affecting RES installations, as well as some geothermal projects.

Main supporting policies

The main promotion schemes for RES in Greece are the following.

Law 2244/94 (feed-in tariff) and Law 2773/1999 (liberalisation) (Feed-in tariff of a bout 7,8 € cents/kWh on the islands and 7 € cents/kWh on the mainland)

Development Law 2601/98. The Law supports investment activities (including energy investments) of private companies (investment subsidy of about 30%).

The Operational Programme 'Competitiveness' of the Hellenic Ministry of Development is part of the 3rd Community Support Framework (State aid for RES investments, ranging from 30 to 50%).

Law 2364/95 introduces a reduction of the taxable income of final users installating renewable energy systems in private buildings (75% of costs for purchase and installation is tax-deductible).

Key factors

The big danger is that the construction and upgrading of the grid lines will be delayed, postponing as a consequence the development of RES. This fact, in combination with the administrative difficulties and grid connection obstacles causing problems with obtaining construction permits for wind and biomass power plants constitutes the biggest barrier. However, according to the latest inter-ministerial decisions, the licensing procedure for RES power plants will be streamlined and made more efficient. It remains to be seen over the next months how effective this decision proves to be. With regard to the upgrading and extension of power transmission lines, which also contribute to the further deployment of RES, expropriation procedures are being shortened and simplified to speed up implementation for the 2004 Olympics.

The Greek Government has also established a set of rules for the rational use of geothermal energy in line with the Community's view. Any geothermal field is considered to be a single-entity deposit, and a-source that cannot be split up. A specific bidding procedure has been established for the whole range of products, by products and process residues obtained from a geothermal source.

2. Current status and potentials of RES

2.1. Current penetration

The current status and development in the **renewable electricity production** in Greece is mostly dominated by traditional RES-E sources such as **large-scale hydropower.** A major part of the RES-E output is effected by annual fluctuations of precipitation. In 2002, the electricity generated by hydropower accounted for around 2.7 TWh (excluding pumped storage hydro energy). The utilisation of **small-scale hydropower** has increased moderately over the last 6 years.

Wind energy has been growing modestly since 1997, reaching about 375 MW or 0.5 TWh in 2002. As explained in the policy summary, particular non-technical barriers such as obtaining installation permits for electricity generated by wind turbines, have hindered its development to some extent. In accordance with approved Ministerial Decision 1726/2003.[15], the Greek Government decided to streamline and speed-up its licensing procedure for RES power plants. As a result of these actions, it can be expected that the wind sector will grow more dynamically over the coming years.

Table 1: RES-electricity production in 1997 and 2002 in GWh

RES-E Technology	1997 {GWh]	2002 [GWh]	Av. Annual growth [%]
Biogas	0	79	
Solid Biomass	0	0	
Biowaste	0	0	
Geothermal electricity	0	0	
Hydro large-scale	3,756	2,612	-7%
Hydro small-scale	149	107	-7%
Photovoltaics	0	1	35%
Wind onshore	37	540	71%
Total	**3,942**	**3,338**	**-3%**
Share of total consumption [%]	8.60%	5.8%	
Non-large hydro RES-E	186	726	

[15] 2nd National Report Regarding Penetration Level of Renewable Energy Sources in the Year 2010, Page 6, Athens, October 2003.

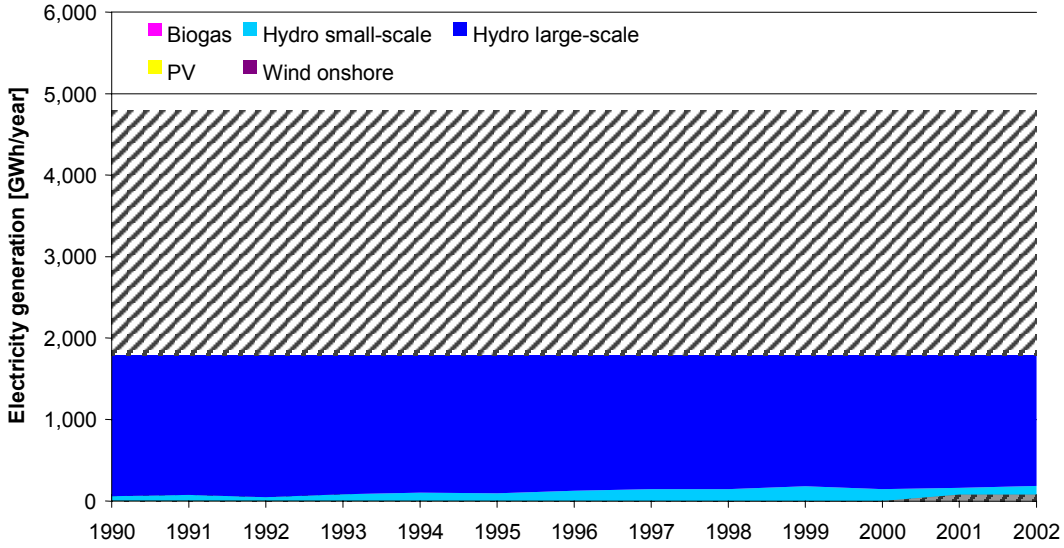

Figure 1: RES electricity production up until 2002[16] in Greece.

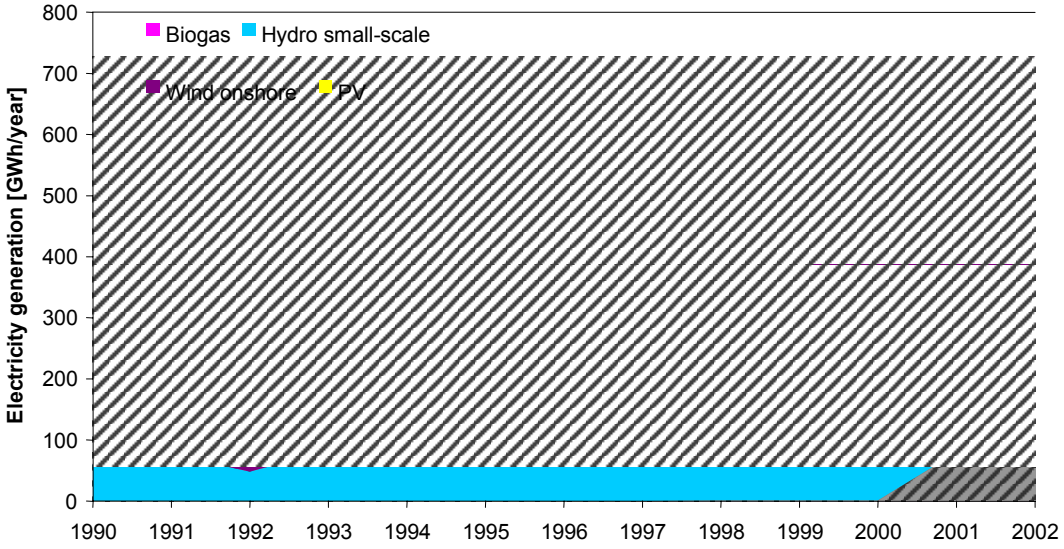

Figure 2: RES electricity production in Greece up until 2002 without large hydro

With regard to the **heat sector,** Greece has increased considerably its national geothermal heat capacity (by about a factor of three) since 1997. This increase resulted from the installation of different projects accounting for approximately 80 MWth in 2002. The Greek Government has established a set of rules for the rational use of geothermal energy. A specific bidding procedure was established for the whole range of products, by-products and process residues obtained from geothermal sources.

16 Based on EUROSTAT data, which are up-to-date only until 2001. For many RES, e.g. wind-onshore and PV more recent data from sector organisations and national statistics have been used.

With respect to other technologies, **solar thermal panels** show a moderate 7 percent growth rate from 1997. As a result of tax incentives in this sector, the total cumulative capacity for solar thermal systems increased up to 2.8 million m^2 in 2002, with Greece now being the second country in Europe after Germany. However, these support mechanisms are temporarily on hold for budgetary reasons and a future prospects look gloomy.

Table 2: RES-heat production up until 2002

	Penetration 1997 [ktoe]	**Penetration 2002 [ktoe]**	**Growth rate since 1997 %**
Biomass heat	910	962*	1
Solar thermal heat	113	146	5
Geothermal heat incl. heat pumps	2,3	11,9	39

* Biomass heat only up until 2001

With regard to **liquid biofuels** production, Greece has been a dynamic country at the experimental stage with several pilot projects related to the different technologies for the production of biofuels. However, currently there is no commercial-scale production. The pilot projects tested so far, looked at the production both of biodiesel and bioethanol fuels for transportation purposes derived from various traditional crops such as wheat, corn, fried and waste oil, sunflower and rape seed. If these attempts prove to be cost–effective in the long run, major support mechanisms for the industry are expected to be implemented in the coming years.

Table 3: RES-biofuel production up until 2001

	Penetration 1997 [ktoe]	**Penetration 2002 [ktoe]**	**Growth rate since 1997 %**
Liquid biofuels	0	0	0

2.2. Mid-term Potentials

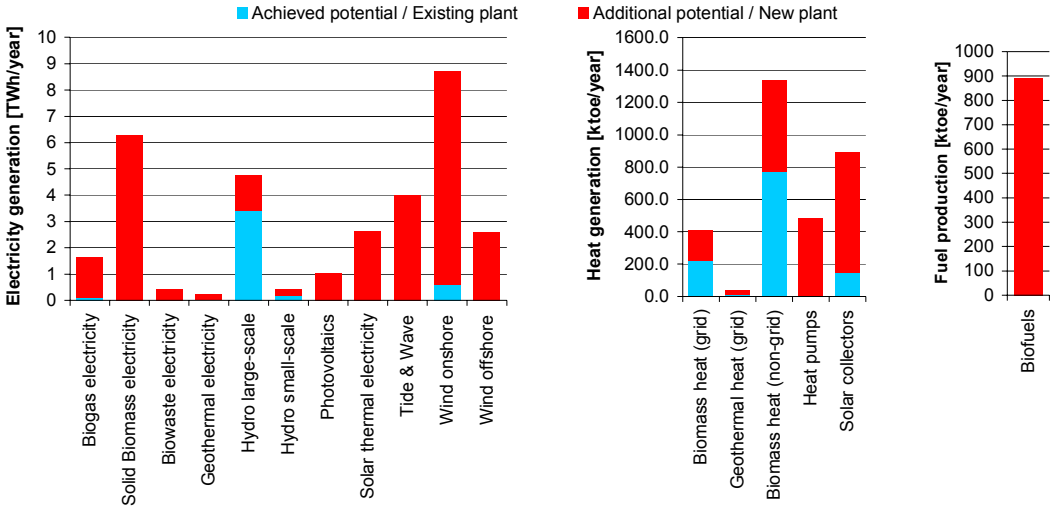

Figure 3: Mid-term potentials of RES electricity, heat and transport in Greece

Table 4: Policy assessment for RES – Greece

RES-type	Wind onshore	Wind offshore	PV	Biomass electricity	Waste	Hydro - small	Hydro - large	Wave & Tidal	Geoth. electr.	Solar thermal heat	Geothermal heat	Biomass heat	Biofuels
Dominant instrument	Law 2244/94 and Law 2773/1999	Law 2244/94 and Law 2773/1999	Law 2244/94 and Law 2773/1999	Law 2244/94 and Law 2773/1999	n.a.	Law 2244/94 and Law 2773/1999	n.a.		Law 2244/94 and Law 2773/1999	Investment Subsidies for renewables and Law 2364/95	Investment Subsidies for renewables	Investment Subsidies for renewables	n.a.
Type of instrument	Feed-in tariffs	Feed-in tariffs	Feed-in tariffs	Feed-in tariffs	n.a.	Feed-in tariffs	n.a.	Feed-in tariffs	Feed-in tariffs	Investment compensation schemes Tax incentives	Investment compensation schemes	Investment compensation schemes	n.a.
Time of implementation	1994	1994	1994	1994	n.a.	1994	n.a.		1994	1998	1998	1998	n.a.
Key factors	Regulation Long-term guaranteed tariff	Regulation Long-term guaranteed tariff	Price Attractiveness of technology	Fuel supply None	n.a.	Long-term guaranteed tariff	n.a.	Tariffs too low None	n.a.	Interruption of instrument Early promotion	n.a.	Fuel supply Steady promotion	n.a.
Degree and duration of support	●●●●	●●●	●●●	●●●	n.a.	●●●●	n.a.	●●	n.a.	●●●●●	●●●	●●●	n.a.
Non-economic factors	●●	●	●●●	●●	n.a.	●●●	n.a.	●	n.a.	●●●●	●	●●	n.a.

Sufficiency to promote RES	
●	Hardly any or no support
●●	Little support
●●●	Moderate support
●●●●	High support
●●●●●	Very high support

HUNGARIA

1. Summary of RES markets and policy

Background
Hungary is net importer of energy. 70% of the total energy demand of Hungary is covered by import. The energy policy does not include significant actions towards renewable energy sources.
RES targets
The RES-E target to be achieved in 2010 is 3.6% for Hungary.
Status of the renewable energy market
There would be good opportunities for biomass, solar, geothermal and some wind energy development, although the investment climate was not favourable until now and only very few investment has taken place with different multilateral funding.
Main supporting policies
Ministerial Decree 56/2002: Guaranteed feed in tariff (on indefinite term), beginning in January 2003, all energy generated from renewable energy resources must be purchased between 6 and 6,8 € cents/kWh, not technology specific.
Key factors
No coordinated national action for RES penetration. Insufficient investment climate, although various funds available.

2. Current status and potentials of RES

2.1. Current penetration

The penetration of the **renewable energy** sources in the Hungarian primary energy production is relatively small, 3.6 per cent. The share of RES in electricity production is even lower, 0.6 per cent. However due to the building of large hydropower plants in the 1970s on the Tisza river and several small hydro power plants (built in 1930-60) the hydropower has a notable share among the renewable sources. The capacity of the three largest **hydropower** plants is 43.8 MWe. They provide about 200 GWh of electricity annually. The installed hydro power capacity has been not increased in the last 30 years and further penetration of the hydropower – excluding the refurbishment of the old plants - is unlikely as it faces opposition. **Photovoltaic** applications have been implemented on an experimental basis in the telecommunications and other sectors, but this technology has not yet reached wide scale of commercialization in Hungary. Wind energy has for the moment a symbolic representatition (2 MW).

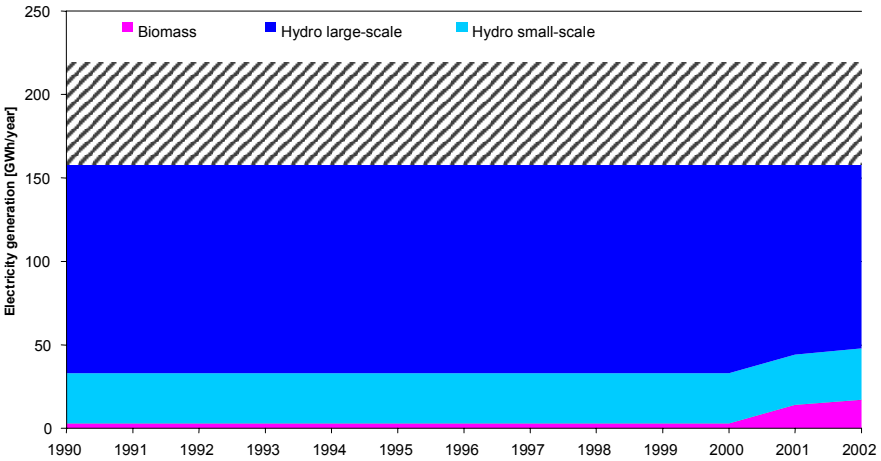

Figure 1: RES electricity production up until 2002[17] in Hungary

Biomass accounts for the largest share of Hungary's renewable energy consumption. Currently fuel wood combustion is the primary use of biomass. Forestry wastes and sawmill by-products are currently burnt in furnaces to provide heat for the forestry industry or briquetted for retail sale. Nearly 40 percent of the round wood production is used for energy purposes. Consumption of biomass heat in 2001 amounted to 302 Mtoe mainly based in solid biomass uses. One of the largest exploited renewable energy resources in Hungary is **geothermal** energy with approximately 350 MW of installed capacity for heat generation. The geothermal energy and thermal water is used mainly for balneological purposes and for heating of the bath facilities. In the last 10 years there were several projects completed in the south-eastern part of Hungary for district heating and greenhouse heating. The penetration of **heat pumps** is proceeding only slowly – however there are several residential and office buildings heated with this technology - because of the high investment costs and that it is relatively unknown. Limited use of **solar** energy for water and space heating has been observed, based on flat plat collectors.

Table 1: RES-electricity production in 1997 and 2002 in GWh

RES-E Technology	1997 {GWh]	2002 [GWh]	Av. Annual growth [%]
Biogas	0	0	
Solid Biomass	3	17	41
Biowaste	0	0	
Geothermal electricity	0	0	
Hydro large-scale	186	163	-3
Hydro small-scale	30	31	1
Photovoltaics	0	0	
Wind onshore	0	2	
Total	**219**	**213**	**-1**
Share of total consumption [%]	0.7%	0.6%	

[17] Based on EUROSTAT data, which are up-to-date only until 2001. For many RES, e.g. wind-onshore, hydro power and PV more recent data from sector organisations and national statistics have been used.

Table 2: RES-heat production up until 2001

	Penetration 1997 [ktoe]	Penetration 2001 [ktoe]	Annual growth rate since 1997 [%]
Biomass heat	250	302	5
Solar thermal heat	0.1	0.1	0
Geothermal heat incl. heat pumps	71.6	98.4	8.0

A National **Biodiesel** Programme has been launched some years ago with some pilot factories started but due to discontinuous support, the programme has not given any important results.

Table 3: RES-biofuel production up until 2001

	Penetration 1997 [ktoe]	Penetration 2001 [ktoe]	Annual growth rate since 1997 %/year
Liquid biofuels	0	1.41	n.a.

2.2. Mid-term potentials

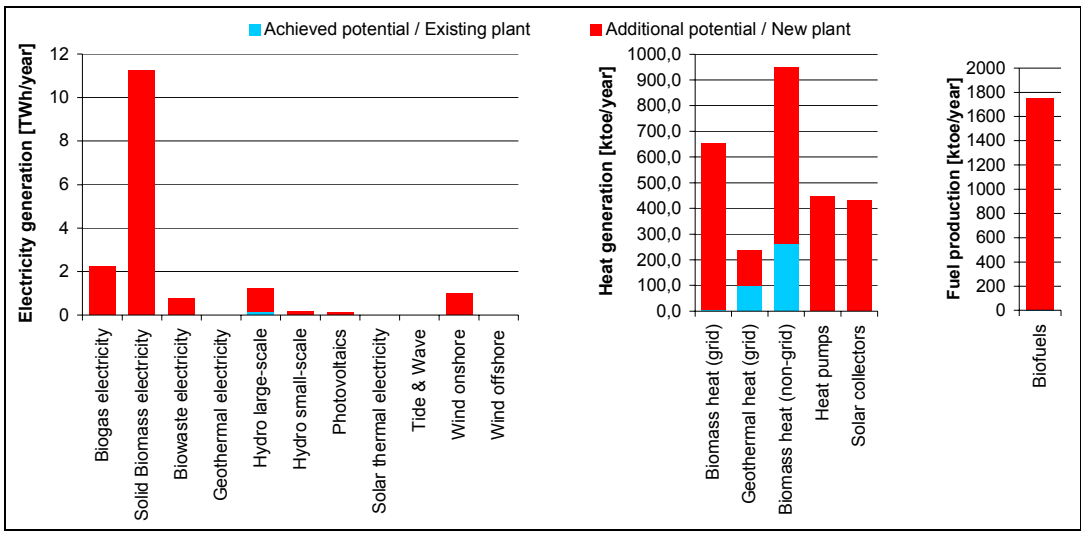

Figure 2: Mid-term potentials of RES electricity heat and transport in Hungary

IRELAND

1. Summary of RES markets and policy

Background

Ireland is the last EU country that uses a tendering scheme as the main instrument in supporting renewable energy. The Alternative Energy Requirement (AER) is a competition for investors in which the lowest bidders are offered a Power Purchase Agreement of up to 15 years. The first four competitions were held between 1995 and 1998. Rounds 5 and 6 were held in 2003. The market for household and small industrial consumers is open only for 100% green consumers, resulting in new market entrants that offer competitive green power contracts and investments in commercial wind parks (i.e. not funded through AER).

RES targets

The RES-E target to be achieved by Ireland in 2010 is 13.2% of gross electricity consumption.

Status of the renewable energy market

AER round 6 closed in April 2003. In Ireland there is no real voluntary market for renewable electricity.

Main supporting policies

The Alternative Energy Requirement (tendering scheme) is the main support instrument. Targets and purchase prices specified for the technologies are shown below. No support is provided for renewable heat and biofuels except promotional projects for biofuels that may receive tax exemption.

Technology	Support level (€ct/kWh)	Specifics
Large-scale wind	5.216	up to 400 MW
Small-scale wind	5.742	up to 85 MW
Offshore Wind	8.4	up to 50 MW; indicative price cap only
Biomass	6.412	up to 8 MW
Biomass-CHP	7.0	up to 28 MW
Biomass-anaerobic digestion	7.0	up to 2 MW
Hydro	7.018	up to 5 MW

Key factors

- The tender is a stop-start programme where the future of target-setting is unknown (both levels and technology preferences).
- The AER tends to lead to relatively poor quality of equipment as the lower-price bids win the competition.
- No stimulation is provided above the targets set.
- Projects eligible may not exceed certain capacity levels which may lead to a certain inefficiency of the project design.
- A lack of co-operation exists in the Irish RE industry as a direct result of the tendering scheme.
- Long-term certainty of supply contract (up to 15 years, for biomass–CHP only 10). A market-based instrument that includes element of competition.

Other issues

An official consultation document on future renewable energy policies is currently being prepared.

2. Current status and potentials of RES

2.1. Current penetration

Traditionally, **hydropower** is by far the most important **renewable electricity** source in Ireland, though in recent years production from other RES-E such as **wind** and **biogas** has been increasing. In 2002 the combined production of small-scale and large-scale hydropower stations was 912 GWh, which corresponds to 73% of the total RES-E production for that year.

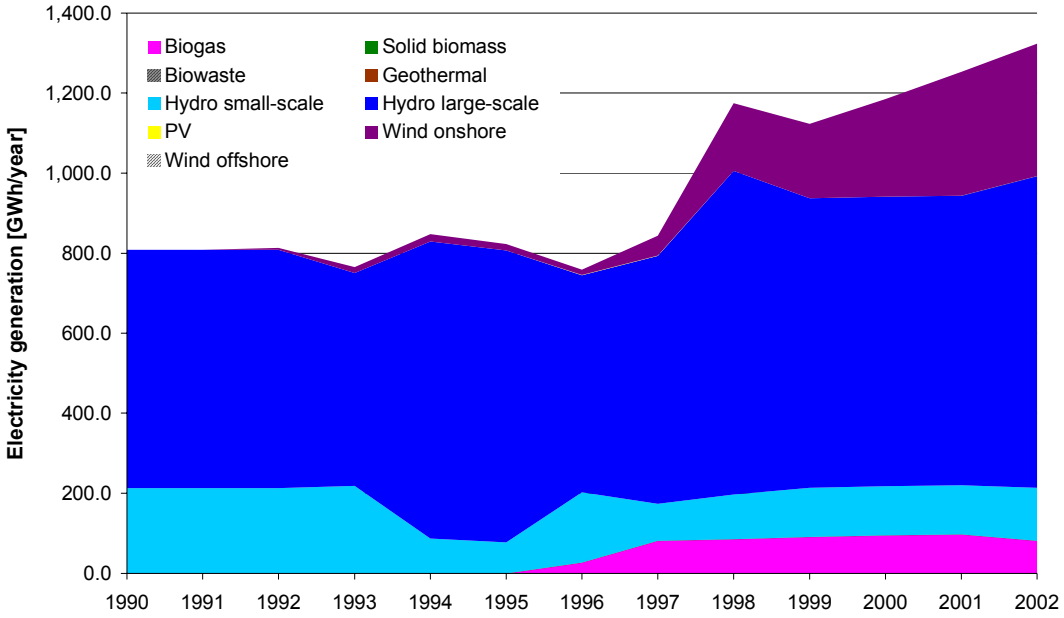

Figure 1: RES-electricity production up until 2002[18]

Figure 1 shows that electricity generation from wind has increased from 0.2 GWh in 1990 to 330 GWh in 2002. The contribution of wind power to overall electricity generation from RES in 2002 was 27%. Installed wind power capacity at the end of 2002 was 137 MW. In 2003 installed wind power capacity increased by 49 MW up to 186 MW at the end of 2003. Electricity production from biogas in the year 2002 was 81 GWh, accounting for a contribution of about 7% to the overall electricity generation from RES. Finally, it can be noted that in Ireland there is virtually no RES-E production from **solid biomass**. The **share of RES** electricity in overall electricity consumption in Ireland increased from 3.6% in 1997 up to 5.1% in 2002, as shown in Table 1.

[18] Based on EUROSTAT data, which are up-to-date only until 2001. For many RES, e.g. wind-onshore and PV more recent data from sector organisations and national statistics have been used.

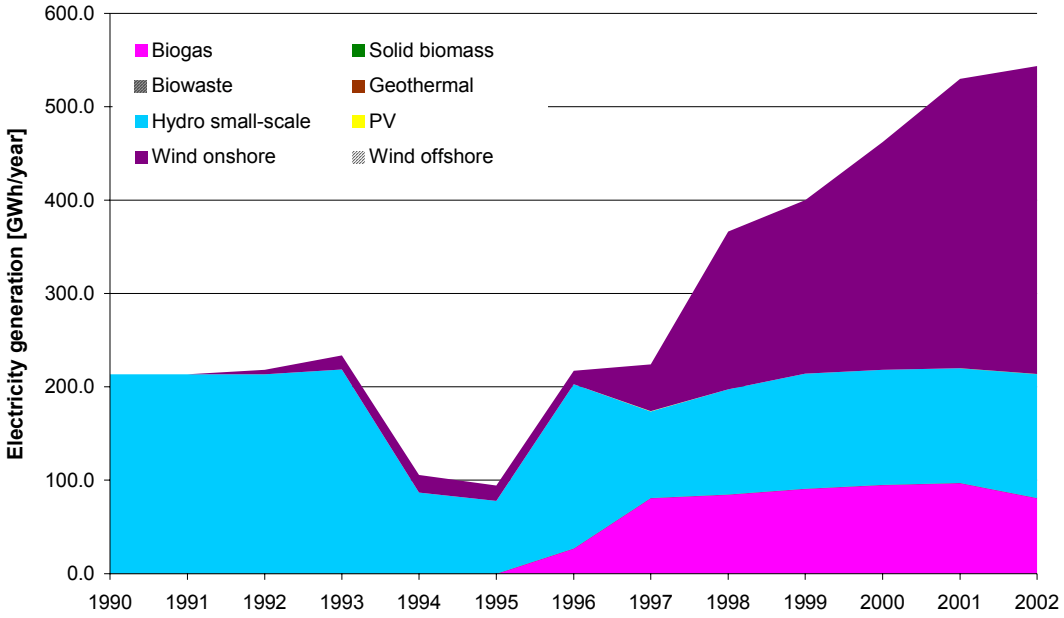

Figure 2: RES-electricity production in Ireland up until 2002 without large hydro

Table 1: RES-electricity production in 1997 and 2002 in GWh

RES-E Technology	1997 {GWh]	2002 [GWh]	Av. Annual growth [%]
Biogas	81	81	0
Solid Biomass	0	0	
Biowaste	0	0	
Geothermal electricity	0	0	
Hydro large-scale	620	779	5
Hydro small-scale	93	133	7
Photovoltaics	0	0	0
Wind onshore	50	330	46
Total	**844**	**1,323**	**9**
Share of total consumption	3.60%	5.1%	

Table 2 shows data regarding the penetration of **RES-heat** in Ireland. **Biomass heat** production over the last few years has been increasing at an average rate of 8% per year. Total biomass heat production in 2001 was 145 ktoe. It can be seen that **solar thermal heat** and **geothermal heat** production is still relatively small-scale compared with biomass heat.

As can be seen in Table 3, the **biofuel** market is virtually non-existent in Ireland.

Table 2: RES-heat production up until 2002

	Penetration 1997 [ktoe]	Penetration 2002 [ktoe]	Growth rate since 1997 [%]
Biomass heat	114	145*	6
Solar thermal heat	0.1	0.1	-
Geothermal heat incl. heat pumps	0.05	1.3	92

*Biomass heat only up until 2001

Table 3: RES-biofuel production up until 2002

	Penetration 1997 [ktoe]	Penetration 2002 [ktoe]	Growth rate since 1997 [%]
Liquid biofuels	0	0	-

2.2. Mid-term Potentials

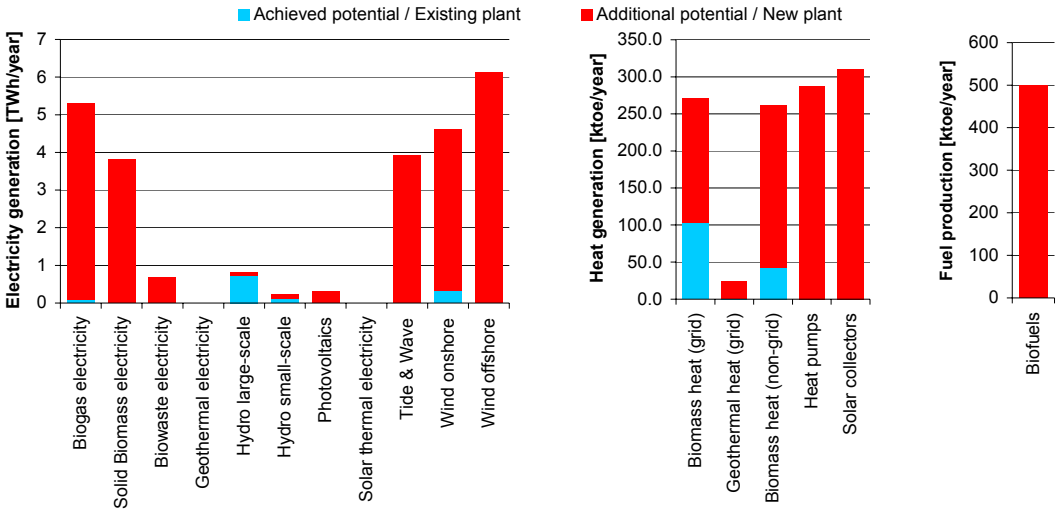

Figure 3: Mid-term potentials 2020 of RES electricity, heat and transport in Ireland.

Table 4: Policy assessment for RES - Ireland

RES-type	Wind onshore	Wind offshore	Biomass electricity	Waste Incin.	Hydro - small	Wave & Tidal	Biomass heat	Solar thermal	Geoth. heat	Biofuels
Dominant instrument	Alternative Energy Requirement	Alternative Energy Requirement	Alternative Energy Requirement	Waste management policy	Alternative Energy Requirement	Renewable Energy RD&D	None	None	None	None
Type of instrument	Tendering schemes	Tendering schemes	Tendering schemes	Standards & regulations	Tendering schemes	Investment compensation schemes				
When implemented	1994	1994	1994	1998	1994	1994				
Key factors	Stop-start nature; resulting relatively poor quality technologies High targets; long-term certainty of contracts		See wind	Only indirect support. Strong legislation	See wind	n.a.				
Degree and duration of support	●●●●●	●●●●●	●	●●	●	●				
Non-economic factors	●●●●	●●●●	●	●●	●	●●				

Sufficiency to promote RES	
●	Hardly any or no support
●●	Little support
●●●	Moderate support
●●●●	High support
●●●●●	Very high support

ITALY

1. Summary of RES markets and policy

Background The Italian RES policy is an integral part of CO_2 reduction policies. In 2001 the main support program CIP6 was replaced by a green certificate system with binding targets. Certificates are issued for plants commissioned after April 1 1999 and only for the first 8 years of operation. The certificate system's overall target of 2% was not reached in the first full year of operation. Decree 387 of December 2003 that implements the EU Renewable Electricity Directive increased the target set for 2004-2006 by 0.35% per year.
RES targets The RES-E target to be achieved by Italy in 2010 is 25% (76 TWh) of gross electricity consumption.
Status of the renewable energy market Obligatory demand for producers and importers. The GRTN, Italy's Independent System Operator, may sell certificates produced at eligible RES-E plants under the former CIP6 support scheme at a fixed price and only if the market is short to prevent excessively high prices on the market. Voluntary demand for green electricity may be included in the certificate system. The implementation of the Guarantee of Origin will make the voluntary market more transparent and open.
Main supporting policies - Certificate system with mandatory demand - Carbon dioxide tax with exemption for RES (biofuels) - Funds for specific technologies and/or municipalities
Key factors - Relatively favourable certificate prices up to 8.4 €ct/kWh. - Certificates are issued only for plants producing more than 50 MWh per year. - The major problem with developing new production capacity seems to be problems in obtaining authorisation at local level and the high cost of grid connection. - The carbon tax is relatively high, which offers competition benefits for renewables.

2. Current status and potentials of RES

2.1. Current penetration

Development of the **renewable electricity production** in Italy is shown in Figure 1. **Hydropower** represents around 85 – 90% of Italy's RES-E production, with a total production of 41 TWh of both small-scale and large-scale hydropower stations in 2001. Electricity production from renewable energy sources other than large hydro is detailed in Figure 1. **Geothermal** electricity is the second most important RES-E source, representing 8% of the RES-E production. Worth mentioning is also the strong growth of the installed **wind** power capacity, with a factor of 270 in the period from 1990-2002, up to 785 MWe in 2002. In absolute terms the Italian wind market is however still small in size. Installed **PV** capacity grew by 600% in the same period, up to an installed capacity of 23 MWp in 2002. According to the total

electricity demand the share of RES electricity in Italy increased slightly from 16% in 1997 to 16.8% in 2002.

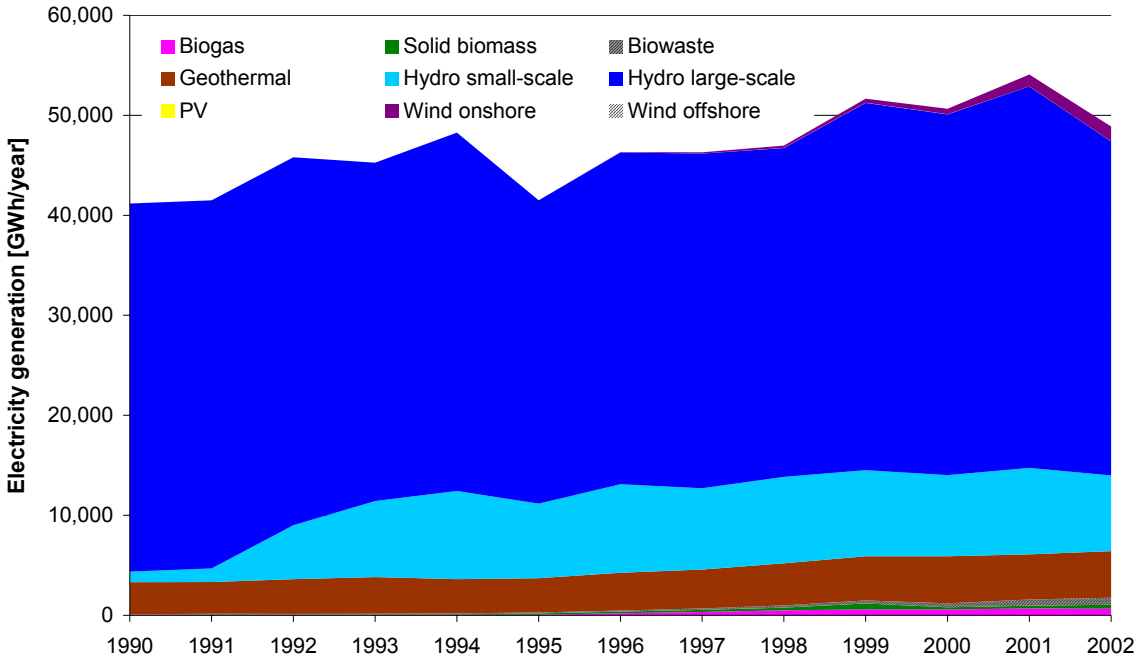

Figure 1: RES-electricity production in Italy up until 2002[19] in Italy

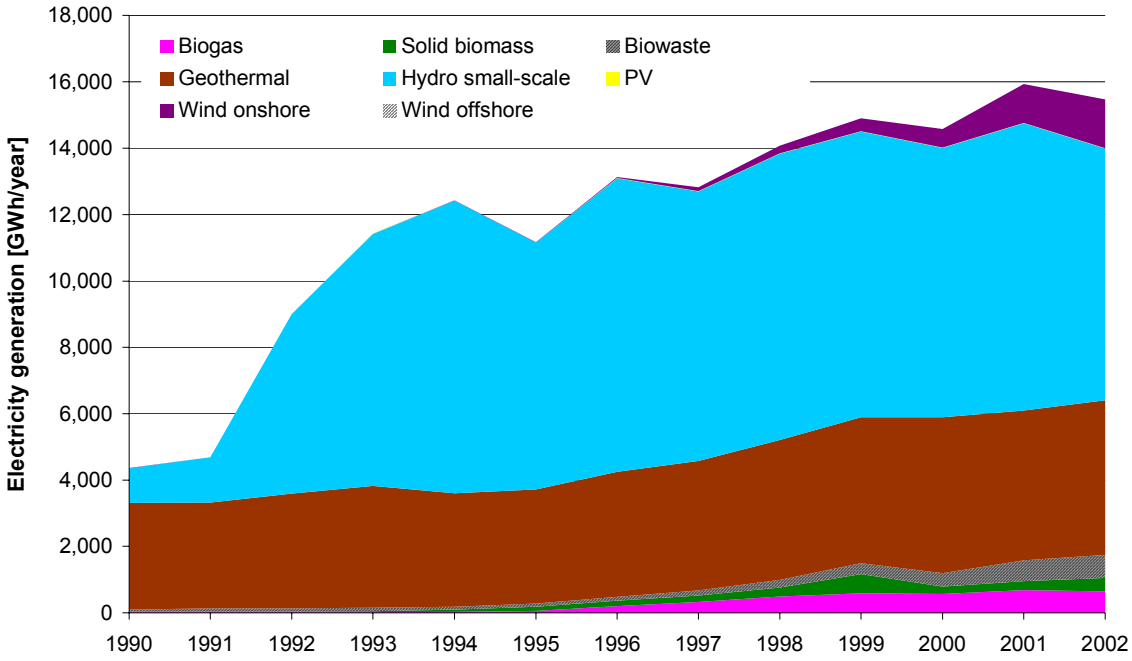

Figure 2: RES electricity production in Italy up until 2002 without large hydro

Table 1: RES electricity production in 1997 and 2002 in GWh

RES-E Technology	1997 [GWh]	2002 [GWh]	Av. Annual growth [%]
Biogas	330	650	15
Solid Biomass	195	400	15
Biowaste	146	700	37
Geothermal electricity	3,905	4,660	4
Hydro large-scale	33,475	33,412	0
Hydro small-scale	8,124	7,581	-1
Photovoltaics	6	10	9
Wind onshore	118	1,470	66
Total	**46,299**	**48,883**	**1**
Share of total consumption [%]	16.00	16.8	

Data showing the **RES-heat** production in Italy can be found in Table 2. **Biomass heat** and **solar thermal heat** show strong growth rates of 9% and 21%, respectively. As with RES-E, the contribution of **geothermal** to RES-heat is substantial, with 213 ktoe produced in 2002.

The production of **biofuels** in Italy also shows an upward trend, as shown in Table 3. Average growth rate for the production of liquid biofuels since 1997 is 32% per year.

Table 2: RES-heat production up until 2002

	Penetration 1997 [ktoe]	Penetration 2002 [ktoe]	Growth rate since 1997 [%]
Biomass heat	4545	5613*	9.2
Solar thermal heat	7	17.1	20
Geothermal heat incl. heat pumps	213	213	-

*Biomass heat only up until 2001

Table 3: RES-biofuel production up until 2001

	Penetration 1997 [ktoe]	Penetration 2001 [ktoe]	Average growth rate since 1997 [%/year]
Liquid biofuels	45	136	32

[19] Based on EUROSTAT data, which are up-to-date only until 2001. For many RES, e.g. wind-onshore and PV more recent data from sector organisations and national statistics have been used.

2.2. Mid-term Potentials

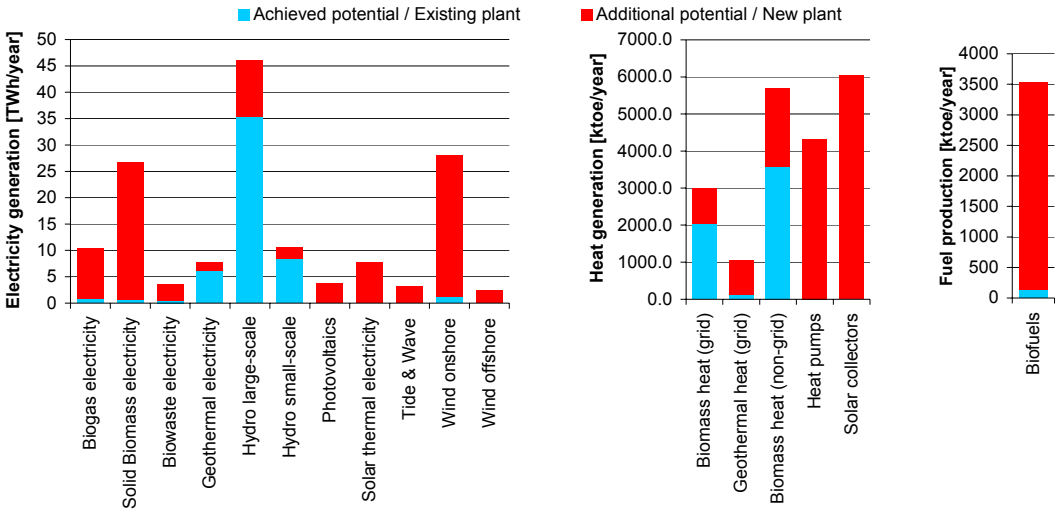

Figure 3: Mid-term potentials of RES electricity heat and transport in Italy

Table 4: Policy assessment for RES - Italy

RES-type	Wind onshore	Wind offshore	Hydro - small	Biomass electricity	Geoth. electr.	PV	Wave & Tidal	Biomass heat	Solar therm.	Geoth. heat		Biofuels
Dominant instrument	System of tradable green certificates	System of tradable green certificates	System of tradable green certificates	System of tradable green certificates	System of tradable green certificates	National 10000 PV roofs and facades program	System of tradable green certificates		Lower VAT rates, tenders			Tax exemption
Type of instrument	Tradable Green Certificates	Tradable Green Certificates	Tradable Green Certificates	Tradable Green Certificates	Tradable Green Certificates	Rebates	Tradable Green Certificates		Fiscal instruments (other than tax incentives), tendering schemes			
When implemented	1999	1999	1999	1999	1999	1999	1999		1991			
Key factors	Grid connections/ planning procedures/ for >> 50 MWh only Targets are relative high; certificate prices are favourable		See wind	See wind	See wind	Lot of paper-work applies. Simple, transparent scheme that provides clear incentives and business certainty	See wind		Technical specs are set; little poss. for other technical solutions Fixed budget available; clear technical specification set			Tax exemption not high enough. Clear, simple, transparent measure
Degree and duration of support	●●●●●	●●●	●●●●	●●●●	●●●●	●●	●●●	●●	●●●●			●●
Non-economic factors	●●	●●	●●	●●●	●●●	●●●●	●●	●●●	●●●			●●●

Elaboration of support									
	•	Insufficient support or very strong barriers	••	Little support or significant constraints	•••	Moderate support or acceptable market conditions	••••	High support or good market conditions	•••••	Very high support or very good conditions

LATVIA

1. Summary of RES markets and policy

Background
Imported energy resources account for 65-70 % of the total energy consumption in the primary energy resource balance of Latvia. Therefore the primary reason for supporting renewable resources in energy generation is security of supply and creation of new jobs. Wood and wind are the most prioritized from renewable energy resources for use in electricity generation.
RES targets
The RES-E target to be achieved in 2010 is 49.3% for Latvia.
Status of the renewable energy market
From 1996 to 2002, Latvia experienced significant growth in renewable energy projects as developers took advantage of the so-called double tariff, phased out the 1st January 2003. Latvia had a unique feed-in tariff, which was double the average electricity price for a period of eight years after grid connection for wind and small hydro power plants (less than 2 MW). Annual production at small hydropower plants increased from 2.5 to 30 GWh, while output from windpower plants built during the last three years increased to about 50 GWh.
The plan to build an undersea cable from Finland to import cheap energy may jeopardize RES development. The political support of RES has decreased in Latvia since January 2003. The cheap production of electricity from large-hydro and the low regional import electricity prices are obstacles for further RES development.
Main supporting policies
Law on Energy: With the amendment adopted in 2001 that phased out the so-called double tariff by 1st January 2003, regulations fixing the total capacity for installation and specific volumes for next year are annually published. The annual purchase tariff for small hydro power as well as for power plants using waste or biogas is set at the average electricity sales tariff, while tariffs for wind power plants are approved on a case-by-case basis by the regulator.
Other issues
Long-term loans on favourable conditions for projects in private and public sectors
Owners of buildings and other facilities have the right to choose the most cost-efficient type of energy supply.

2. Current status and potentials of RES

2.1. Current penetration

The **hydroelectric** facilities provide about 75% of electric generation in Latvia, however, the supply reliability is complicated due to frozen rivers during very low winter temperatures. Total installed **wind** energy capacity in Latvia is currently very small (about 22.8 MW).

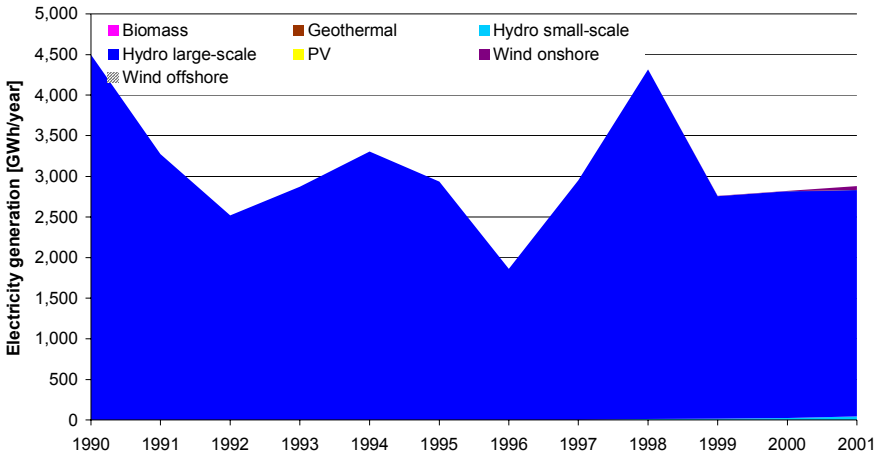

Figure 1: RES electricity production up until 2001[20] in the Latvia

The **biomass** energy is mainly used as firewood in small and, as a rule, low-efficient boilers in the private household utilities. Solar energy is practically not used for heat production.

Table 1: RES-electricity production in 1997 and 2001 in GWh

RES-E Technology	**1997 {GWh]**	**2001 [GWh]**	**Av. Annual growth [%]**
Biogas	0	0	0
Solid Biomass	0	0	0
Biowaste	0	0	0
Geothermal electricity	0	0	0
Hydro large-scale	2.951	2.803	-1%
Hydro small-scale	3	30	86%
Photovoltaics	0	0	
Wind onshore	2	46	109%
Total	**2.955**	**2.879**	**-1%**
Share of total consumption [%]	50.1%	48.0%	

Table 2: RES-heat production up until 2001

	Penetration 1997 [ktoe]	**Penetration 2001 [ktoe]**	**Annual growth rate since 1997 %/year**
Biomass heat	744	592	-6
Solar thermal heat	0	0.0	0
Geothermal heat incl. heat pumps	0	0.0	0

[20] Based on EUROSTAT data, which are up-to-date only until 2001. For many RES, e.g. wind-onshore and PV more recent data from sector organisations and national statistics have been used.

Table 3: RES-biofuel production up until 2001

	Penetration 1997 [ktoe]	Penetration 2001 [ktoe]	Annual growth rate since 1997 %/year
Liquid biofuels	n.a.	1.96	n.a.

2.2. Mid-term potentials

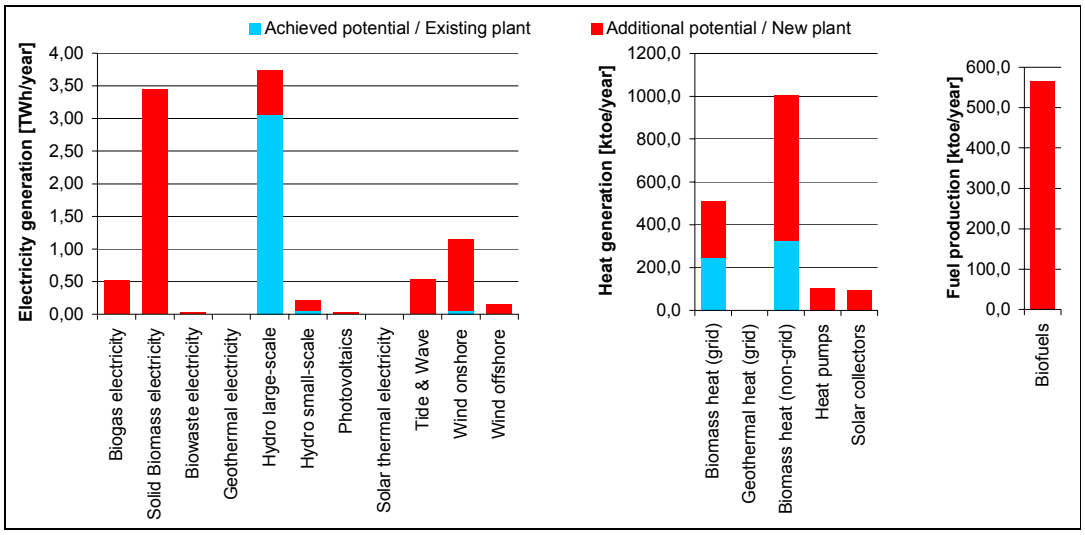

Figure 2: Mid-term potentials of RES electricity, heat and transport in the Latvia

LITHUANIA

1. Summary of RES markets and policy

Background
Lithuania has the highest dependence on nuclear power in its electricity supply of any country in the world, supplied by a single nuclear plant, Ignalina. However, the first of two reactors should be decommissioned in 2005 and the second in 2009. The decommissioning of the nuclear power plant Lithuania should prevent turning back towards fossil fuels as the main source for the electricity production. One of the strategic objectives in the Energy Strategy, 2002 is to strive for a share of renewable energy resources of up to 12% in the total primary energy balance by 2010.
RES targets
The RES-E target to be achieved in 2010 is 7% for Lithuania.
Status of the renewable energy market
Especially biomass supply is growing (wood and straw-firing boilers). There is still an important hydro potential. A big investment has been made in 2002 in geothermal energy. Although Lithuania has very good wind potential, there is no development of this energy up to now.
Main supporting policies
Resolution No. 1474 of 5 December 2001: Procedure for promotion of purchasing of electricity generated from renewable and waste energy sources. Average energy prices since February 2002: **Hydro**: 6.9 €c/kWh, **Wind**: 7.5 €c/kWh, **Biomass** 6.9 €c/kWh
Key factors
There are feed in tariffs since February 2002 with no guaranteed time. There exist delays in supporting secondary legislation (biofuel).

2. Current status and potentials of RES

2.1. Current penetration

Large hydro installed capacity was to 112 MW; small hydro to 15 MW. Recently the pump-storage plant Kruonis with 800 MW has been put into service. No **wind** turbines operate in Lithuania, only a 4 MW demonstration wind project is on the drawing board for a site at Butinge on the Baltic Sea coast.

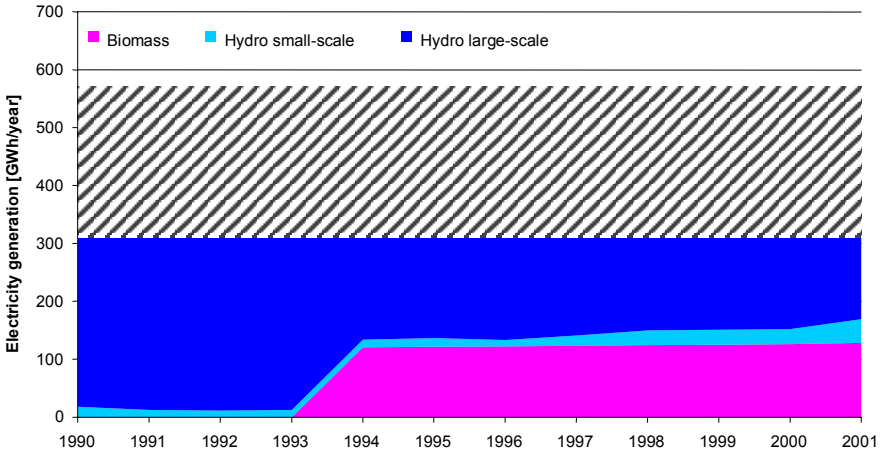

Figure 1: RES electricity production up until 2001[21] in Lithuania

Recently **solar** energy has been utilized for hot water supply, space heating of premises and drying of agricultural production. Among the **biomass** energy sources wood was used in Lithuania for space heating of individual houses by burning in stoves with small efficiency. In 1994 waste wood and specially prepared wood chips were started to be used burning them in district heating boilers with higher capacity (> 1 MW). Now the totally installed capacity of such combustion wood boilers achieves around 120 MW. In accordance with the statistic data of 1998 the consumption of wood fuel was equivalent to 571 ktoe. The using of straw fuel in Lithuania was started since 1996. The total installed capacity of straw-fired boilers makes up about 5 MW. Approximately 7500 t of straw is burned annually in these boilers. This amount is equivalent to 2.5 ktoe of primary energy. There are 6 individual **geothermal** plants with the total capacity of 114 kW. The construction of Vydmantai geothermal plant in Kretinga region has recently started. 41 MW geothermal plant is build in Klaipeda. In the year 2002 this power plant was not yet working in its full capacity, however produced 180 000 kWh thermal energy.

Table 1: RES-electricity production in 1997 and 2001 in GWh

RES-E Technology	1997 {GWh]	2001 [GWh]	Av. Annual growth [%]
Biogas	0	0	
Solid Biomass	123	128	
Biowaste	0	0	
Geothermal electricity	0	0	
Hydro large-scale	277	285	1%
Hydro small-scale	18	41	23%
Photovoltaics	0	0	
Wind onshore	0	0	
Total	**418**	**454**	**2%**

[21] Based on EUROSTAT data, which are up-to-date only until 2001. For many RES, e.g. wind-onshore and PV more recent data from sector organisations and national statistics have been used.

Share of total consumption [%]	4%	4.6%	

Table 2: RES-heat production up until 2001

	Penetration 1997 [ktoe]	Penetration 2001 [ktoe]	Annual growth rate since 1997 %/year
Biomass heat	455	574	6
Solar thermal heat	0	0.0	0
Geothermal heat incl. heat pumps	0	14.3[22]	n/a

There is no biofuel production in Lithuania.

2.2. Mid-term potentials

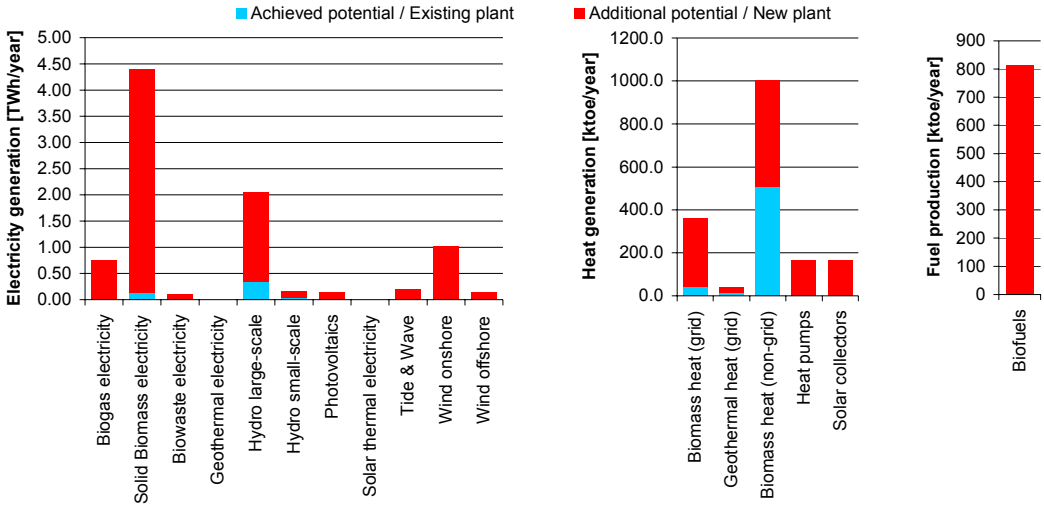

Figure 2: Mid-term potentials of RES electricity, heat and transport in Lithuania

[22] 29.8 ktoe in 2002

LUXEMBOURG

1. Summary of RES markets and policy

Background

The 1993 Framework Law is the basis of two main regulations. The ongoing nature of the framework law creates a stable environment and investor confidence. Subsidies are granted to enterprises and companies for investments in eligible technologies, which include solar, wind, biomass, geothermal. Preferential tariffs are given for electricity produced from RES.

RES targets

The RES-E target to be achieved by Luxembourg in 2010 is 5.7 % of gross electricity consumption.

Status of the renewable energy market

The national energy supply company Cegedel just started this year with selling green electricity. The latest support program is limited to 5 years, and there is a limit on RES resources for creating new capacity. Development therefore seems to be restricted.

Main supporting policies

Feed-in tariff:	tariff in € ct/kWh	conditions
Wind, hydro, biomass, biogas:	2.5	up to 3 MW, 10 years
PV for municipalities	25	up to 50 kW, 20 years
PV for non-municipalities	45 – 55	up to 50 kW, 20 years

In addition investors can receive investment subsidies totalling up to 40% of investments.

Key factors

- RES has to compete with combined-cycle technology, a technology enabling the achievement of similar environmental objectives as RES, but more economically.
- Limitations on eligibility and budgets.
- Guaranteed market for electricity from RES provides certainty for investors.
- Broad range of support measures which may be used cumulatively.

Other issues

Some of the support measures seem to have had no or only limited effect. Support measures in general aimed at municipality-level or specific technologies have not resulted in the promotion of RES-E.

In February 2004, the national Parliament approved a modification to the Framework Law for transposing Directive 2001/77.

2. Current status and potentials of RES

2.1. Current penetration

Development of the **renewable electricity production** in Luxembourg over the last decade is shown in Figure 1. **Hydropower** accounts for the largest contribution to the overall renewable electricity production, with a share of around 65-70% over the last few years. **Wind** makes a small contribution of 27 GWh in 2002. Production of electricity from **biowaste** shows more stability over time. In the period 1990-2002 electricity production from biowaste was around 23 GWh per year. In Table 2 the electricity generation from RES is given for the years 1997 and 2002, as well as the average annual growth during this period. It can be seen that the contribution of renewable energy sources to the overall electricity generation in Luxembourg was 2.1% in 1997 and 2.2% in 2002.

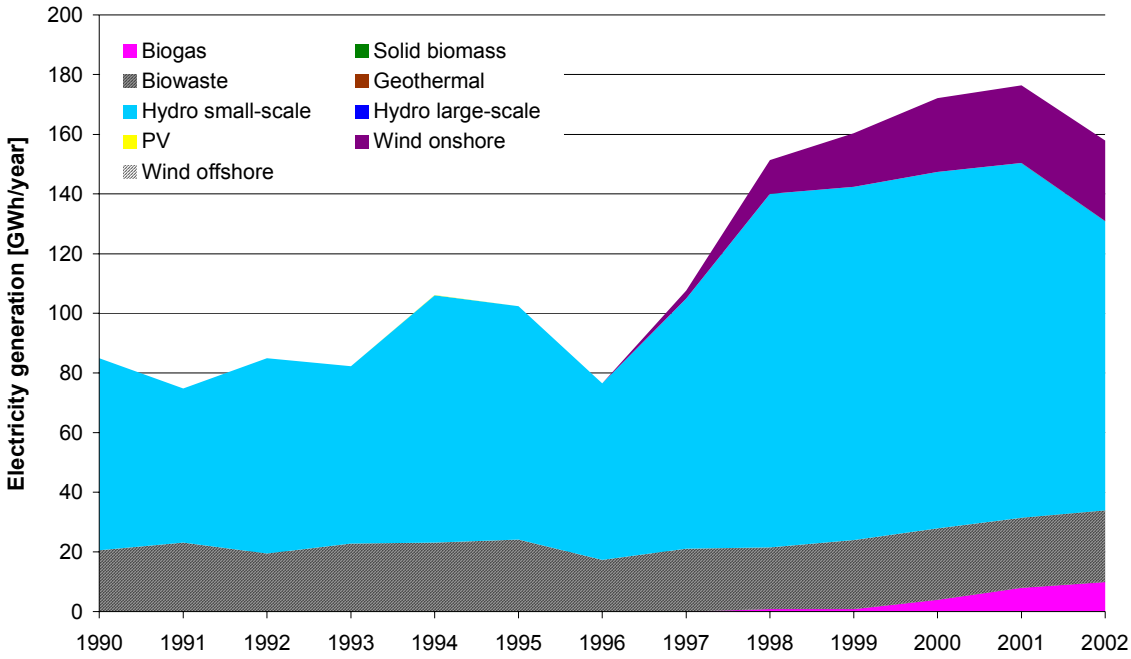

Figure 1: RES-electricity production in Luxembourg upuntil 2002[23]

Data covering **RES-heat** production in Luxembourg are shown in Table 2. Only **biomass heat** contributes to RES-heat production in Luxembourg with 25 ktoe in 2001. Production from **solar thermal** and **geothermal** sources in 2001 and the years before has been virtually zero. In Table 3 it can be seen that the same is true for the production of liquid biofuels.

[23] Based on EUROSTAT data, which are up-to-date only until 2001. For many RES, e.g. wind-onshore and PV more recent data from sector organisations and national statistics have been used.

Table 1: RES-electricity production in 1997 and 2002 in GWh

RES-E Technology	1997 {GWh]	2002 [GWh]	Av. Annual growth [%]
Biogas	0	10	
Solid Biomass	0	0	
Biowaste	21	24	2%
Geothermal electricity	0	0	
Hydro large-scale	0	0	
Hydro small-scale	84	97	3%
Photovoltaics	0	0	
Wind onshore	3	27	58%
Total	**108**	**158**	**8%**
Share of total consumption [%]	2.10%	2.2%	

Table 2: RES-heat production up until 2001

	Penetration 1997 [ktoe]	Penetration 2002 [ktoe]	Growth rate since 1997 [%]
Biomass heat	15.5	24.6*	26.3
Solar thermal heat	0.0	0.1	-
Geothermal heat incl. heat pumps	0.0	0.0	-

* Biomass heat only until 2001

The biofuel sector in Luxembourg is virtually non-existent. No production data are available.

Table 3: RES-biofuel production up until 2001

	Penetration 1997 [ktoe]	Penetration 2001 [ktoe]	Growth rate since 1997 [%]
Liquid biofuels	0	0	-

2.2. Mid-term Potentials

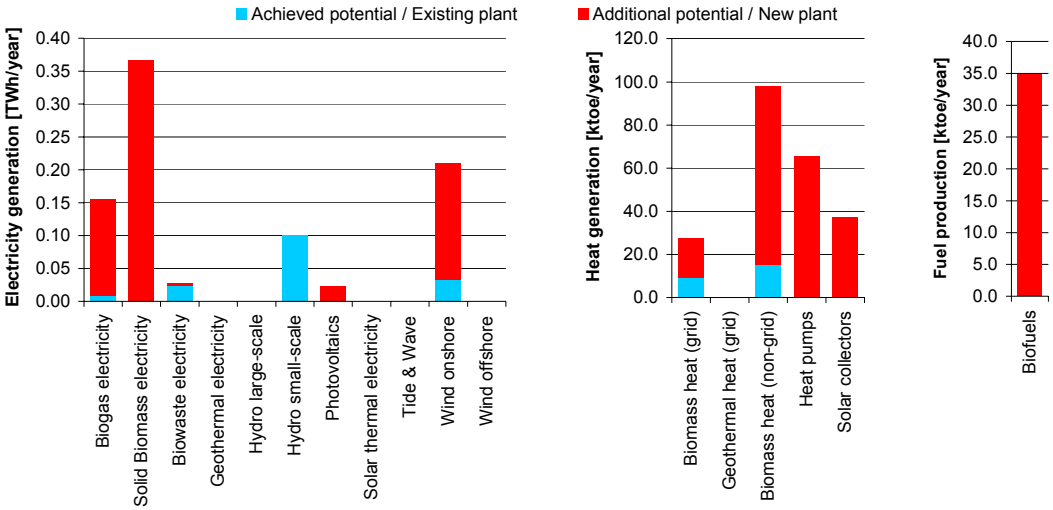

Figure 2: Mid-term potentials of RES electricity, heat and transport in Luxembourg

Table 4: Policy assessment for RES - Luxembourg

RES-type	Wind onshore	Wind offshore	Hydro - small	Biomass electricity	PV	Biomass heat	Solar therm.	Biofuels
Dominant instrument	Special Tariffs and Connection Conditions for Electricity Produced from RES, subsidies	n.a.	Special Tariffs and Connection Conditions for Electricity Produced from RES	Special Tariffs and Connection Conditions for Electricity Produced from RES, subsidies	Special Tariffs and Connection Conditions for Electricity Produced from RES, subsidies	Special Tariffs and Connection Conditions for Electricity Produced from RES, subsidies	Funding Provisions under the PEEC to Solar Thermal Projects, subsidies	None
Type of instrument	Feed-in tariffs, investment compensation schemes		Feed-in tariffs	Feed-in tariffs, investment compensation schemes	Feed-in tariffs, investment compensation schemes	Investment compensation schemes	Investment compensation schemes	
When implemented	1994		1994	1994	1994	1994	1994	
Key factors	Support system might be subject to change due to liberalisation. 10-year certainty, simple and transparent.			Support system might be subject to change due to liberalisation. 10-year certainty, simple and transparent.	Feed-in tariffs alone are not enough to stimulate new capacity. Combination of support seemed to have fulfilled all demands.	See biomass electricity	Programme is only for 5 years. Some limitations on eligible capacities. All demands seemed to have been supported. Impact appears reasonable.	
Degree and duration of support	●●●		●	●●	●●●●	●●	●●●	●
Non-economic factors	●●●●		●	●●●●	●●●●●	●●●●	●●●●	●

Elaboration of support

●	Insufficient support or very strong barriers
● ●	Little support or significant constraints
●● ●	Moderate support or acceptable market conditions
●●●●	High support or good market conditions
●●●●●	Very high support or very good conditions

MALTA

1. Summary of RES markets and policy

Background
Energy utilisation in Malta is characterised by a total dependence on imported petroleum products and fossil fuels, low efficiency utilisation and no penetration of alternative sources.
Efforts are being directed towards the identification and utilisation of appropriate alternative sources of energy, including solar energy.
RES targets
The RES-E target to be achieved in 2010 is 5% for Malta.
Status of the renewable energy market
No commercial utilisation of renewable energy. The Institute of Energy Technology and others have undertaken pilot projects and studies to assess the potential and applicability of renewable sources, mainly wind and solar power.
Main supporting policies
5% VAT (instead of 15%) on solar applications.
At present Malta is formulating a strategy for renewable energy for the Maltese Islands.
Key factors
Energy infrastructure up to now has been oriented to subsidised oil products although the existing potential for renewable energy sources.

2. Current status and potentials of RES

2.1. Current penetration

The penetration of the **renewable** energies in Malta is practically zero. **Photovoltaic** applications in Malta that were so far restricted to research and demonstration systems will soon be available for everyone to install, according to the regulations to be set by the Malta Resources Authority.

Table 1: RES-energy production in 1997 and 2002

	1997	2002	Av. Annual growth [%]
RES-E (GWh)	0	0	0
RES-Heat (ktoe) (in 2001)	0	0	0
RES-biofuel (ktoe) (in 2001)	0	0	0

2.2. Mid-term potentials

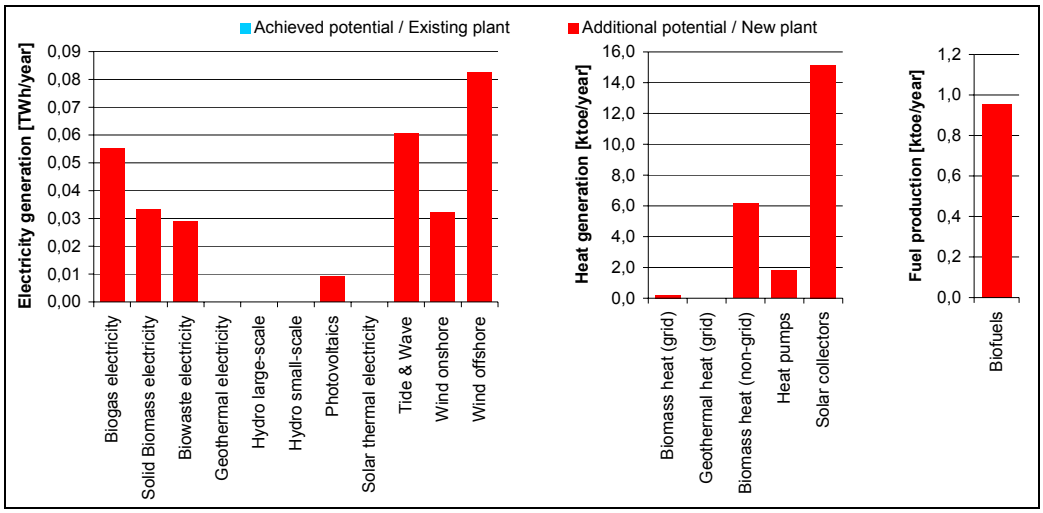

Figure 1: Mid-term potentials of RES electricity, heat and transport in Malta

NETHERLANDS

1. Summary of RES markets and policy

Background

Major support measures and market openness resulted in much higher green power consumption, a large surplus of certificates. However, there were no new RES installations. The policy support scheme was criticised and accordingly revised. The new support scheme has been in operation since July 2003 (see below).

RES targets

The RES-E target to be achieved by the Netherlands in 2010 is 9% of gross electricity consumption. A target of 10% total renewable energy by 2020 has been set with an interim indicative total RES target of 5% by 2010.

Status of the renewable energy market

Early in 2004 the total amount of green power supplied to consumers reached 2.4 million. Competition in green pricing and green power supplies has been fierce in the wake of the opening-up of the green power market in July 2001. Investments in renewable energy have been slowing down over the past few years because of political uncertainty about renewable energy support.

Main supporting policies

The new policy programme MEP to support renewable energy investments has been in operation since 1 July 2003. See underneath the subsidy in €ct/kWh. The 2005 subsidies are higher because of the phasing out of the ecotax).

Technology source	Tariff 2004(*)	Tariff 2005
Mixed biomass and waste:	2.9	2.9
Wind on-shore	6.3	7.7
Wind off-shore	8.2	9.7
Pure biomass large scale:	5.5	7
Small-scale biomass < 50 MWe	8.2	9.7
PV, tidal, wave and hydro	8.2.	9.7

(*) from 1 July 2004 onwards

Key factors

Budget constraints caused uncertainty about future energy support programmes with a consequent withholding of new renewable energy investment. A new system, the MEP scheme, has improved investment conditions, although the short duration of the tariffs scheme provided has been criticised.

The opening-up of the green power market for small consumers has resulted in strong competition among utilities for green power products. Combined with a relatively high degree of support for energy-tax exemptions and feed-in tariffs for green power, this has led to large increase in the amount of green power consumed.

Other issues

The system for Guarantee of Origin has been launched by renaming the former certificate system a GoO system. Imports are still allowed (foreign GoO), but are not eligible for the MEP subsidy.

2. Current status and potentials of RES

2.1. Current penetration

Renewable electricity production in the period 1990-2002 in the Netherlands is shown in Figure 1. It can be seen that in this period annual RES-E production increased from 0.7 TWh in 1990 to around 3.6 TWh in 2002. **Solid biomass** is the most important RES-E source and accounted for around 35% of the annual RES-E production in the Netherlands in 2002. The second most important RES-E source is generation by **on-shore wind**. In 2002 installed wind capacity was increased by 40% to 677 MW, corresponding to a production level of 0.9 TWh in the same year.

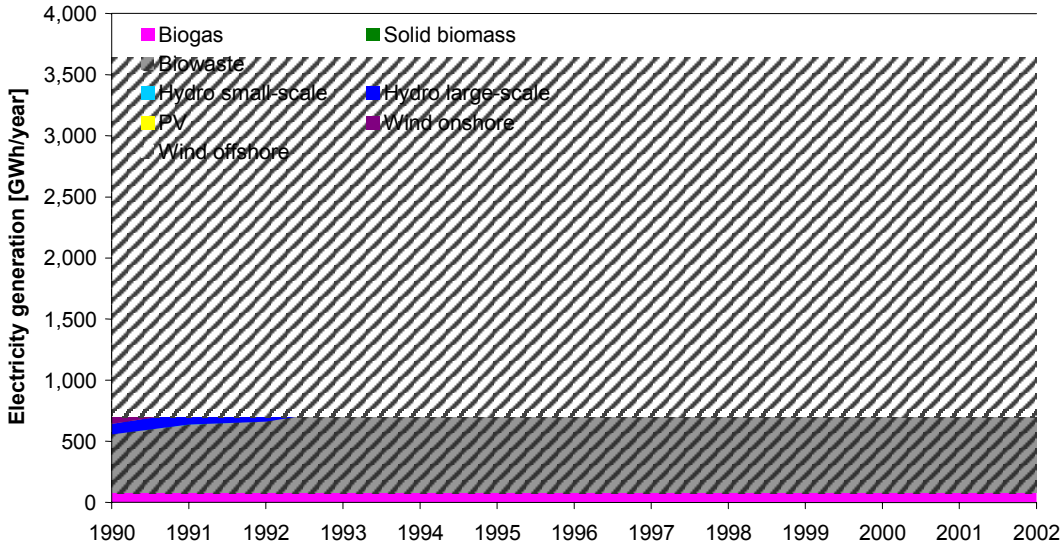

Figure 1: RES-electricity production up until 2002[24]

Table 1 shows the data for electricity generation from RES in the Netherlands for the years 1997 and 2002, as well as the average annual growth during the intervening period. Figures for RES-E penetration in 1997 have been adjusted from 3.5% (including non-biodegradable waste) to 1.8% (excluding biodegradable waste). The overall amount of renewable electricity production is clearly increasing, but faster development is still needed for achieving the 9% target.

[24] Based on EUROSTAT data, which are up-to-date only until 2001. For many RES, e.g. wind-onshore and PV more recent data from sector organisations and national statistics have been used.

Table 1: RES-electricity production in 1997 and 2002 in GWh

RES-E Technology	1997 [GWh]	2002 [GWh]	Av. Annual growth [%]
Biogas	251	304	4%
Solid biomass, incl. cofiring	42	1,260	97%
Biowaste	873	971	2%
Geothermal electricity	0	0	-
Hydro large-scale	91	123	6%
Hydro small-scale	1	1	3%
Photovoltaics	1	17	86%
Wind on-shore	475	910	14%
Total	**1,734**	**3,586**	**16%**
Share of total consumption [%]	1.80% *(Directive ref was 3.5% due to definition)*	3.4%	

Table 2 and Table 3 show data indicating the penetration of **RES-heat** and **RES-biofuel**, respectively. **Biomass heat** production in 2001 was 324 ktoe. **Solar thermal heat** production is still relatively small compared with biomass heat, but an average annual growth rate of 17% since 1997 has been reported for this technology. Production of **geothermal heat** and **biofuels** is still a very small market in the Netherlands, with production figures of virtually zero.

Table 2: RES-heat production up until 2001

	Penetration 1997 [ktoe]	Penetration 2001 [ktoe]	Growth rate since 1997 [%]
Biomass heat	325	324	0
Solar thermal heat	5.5	11.3	15
Geothermal heat incl. heat pumps	0	7.9	-

Table 3: RES-biofuel production up until 2002

	Penetration 1997 [ktoe]	Penetration 2002 [ktoe]	Growth rate since 1997 [%]
Liquid biofuels	0	0	-

2.1. Mid-term Potentials

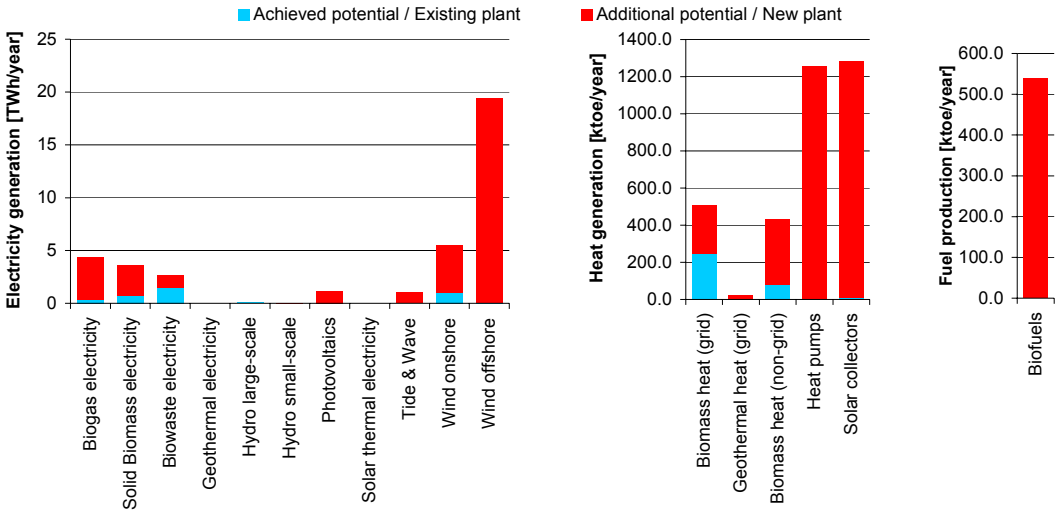

Figure 2: Mid-term potentials of RES electricity heat and transport in the Netherlands

Table 4: Policy assessment for RES - Netherlands

RES-type	Wind onshore	Wind offshore	PV	Biomass electricity	Hydro - small	Wave & Tidal	Waste Incin.	Geoth. electr.	Biomass heat	Solar thermal	Geoth. heat	Bio-fuels
Dominant instrument	Environmental Quality of Power Generation (MEP), tax deduction for renewable energy investments (EIA)	Environmental Quality of Power Generation (MEP), tax deduction for renewable energy investments (EIA)	Energy Bonus Regulation (future uncertain), Environmental Quality of Power Generation (MEP)	Environmental Quality of Power Generation (MEP)	Environmental Quality of Power Generation (MEP)	Environmental Quality of Power Generation (MEP)	Environmental Quality of Power Generation (MEP)	(c)	EIA, CO_2 reduction plan (a)	Energy Bonus Regulation for solar thermal systems, Regulating energy tax	(c)	(b)
Type of instrument	Feed-in tariff, Fiscal instruments	Feed-in tariff, Fiscal instruments	Investment compensation schemes, Feed-in tariff	Feed-in tariff	Feed-in tariff	Feed-in tariff	Feed-in tariff	N.a.	Investment compensation schemes	Energy or environmental tax incentives, Investment compensation schemes	N.a.	None
When implemented	2003	2003	2003	2003	2003	2003	2003	N.a.	2003	1997	N.a.	N.a.
Key factors	Instability of political environment Formerly: high tax exemption	Instability of political environment Long-term guaranteed tariff	Low price Attractive-ness of technology	Instability of political environment Formerly: high tax exemption	(see wind)	Tariffs too low	(see wind)	N.a.	No uniformity of policies; intransparent. Uncertainty of future policies	Low price Support programmes	N.a.	N.a.
Degree and duration of support	●●●●●	●●●●●	●●	●●●●	●●●●	●●	●●		●●	●●●		
Non-economic factors	●●●●	●●●●	●●	●●	●●●	●●	●●●		●●	●●		

The Netherlands

(a) Largest current incentive from MAP funds (Environmental Action Plan).

(b) Biofuels have been stimulated so far only by R&D funds. At the end 2003 policies are expected to be formulated for biofuel support in the Netherlands.

(c) Geothermal energy is not used in the Netherlands (note that this definition excludes heat pumps).

Elaboration of support	•	Insufficient support or very strong barriers	• •	Little support or significant constraints	•• •	Moderate support or acceptable market conditions	••••	High support or good market conditions	•••••	Very high support or very good conditions

POLAND

1. Summary of RES markets and policy

Background Coal-fired power and cogeneration plants dominate electricity generation in Poland. However, more than half of the capacity was built in the 1970's and significant investment in new generation and modernization of existing generation is required. Poland requires that electric utilities maintain a renewable energy portfolio of at least 2.4 percent in 2001 (2.5% in 2002; 2.65% in 2003, etc., 7.5% in 2010 and in the following years) and has established a target of 7.5% of primary energy production from renewable sources by 2010 and 14% by 2020. However, these targets have not yet been enforced, discouraging large scale renewable development. The key resource for achieving the target is likely to be biomass, mainly forestry and agricultural residues and energy crops.
RES targets The RES-E and primary energy target to be achieved in 2010 is 7.5% for Poland.
Status of the renewable energy market Biomass covers more than 98% of renewable energy production. Biomass is considered to be the most promising renewable energy in Poland, for both electricity and thermal energy production. This is because of the abundant potential of straw and wood resources in Poland and maturity of this technology. At present there are 200 ha energy crops grown and estimations indicate that 1,5 million ha of arable land is available for energy crops. Polish hydro power has chances for development as neither the big hydro power plants are fully used (due to antiquated equipment) nor the small plants. There is also a considerable wind energy potential with developments in recent years.
Main supporting policies Green Power Purchase Obligation. Law on biofuels
Key factors No clear enforcement mechanism.
Other issues There are environmental funds on all levels of administration supporting development of RES with grants or soft loans as well as an organisation called ECOFUND that support environmental protection projects, including RES. In addition, low interest credits are available from banks when the money is used for environmental projects.

2. Current status and potentials of RES

2.1. Current penetration

The total installed capacity of large hydro-electric power stations is around 630 MW, and of the small ones 160 MW. In 2000 33 MW of **wind** capacity were installed with another 40 MW project under construction (at the beginning of 2003, 57 MW wind capacity were installed). In Poland 30% of the land surface is economically suitable for wind turbine applications, 5% very favourable. Poland has a good technical potential for wind energy development and local manufacturing. **Photovoltaic** cells are virtually not used in Poland.

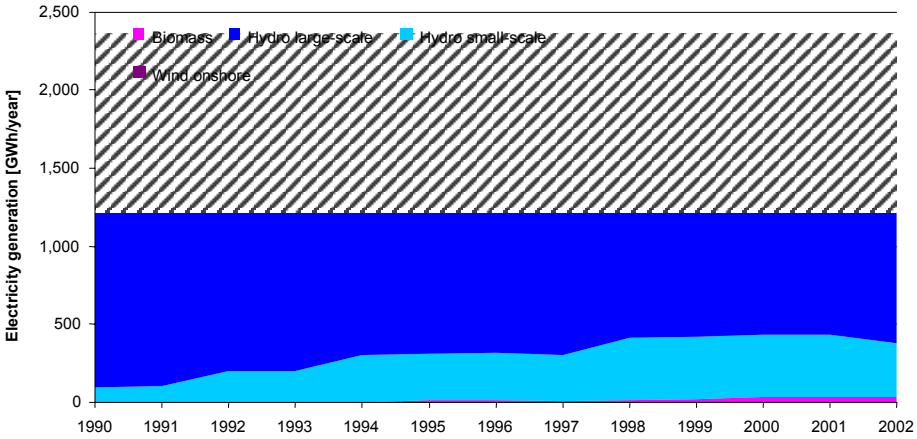

Figure 1: RES electricity production up until 2002[25] in Poland

In solar thermal applications, both liquid and air **solar collectors** are used in a few areas in Poland. The total number of air collectors is estimated at 50-60 units, and their surface area at 6,000 m^2. Around 1,000 solar installations for the heating of usable water have been installed in Poland with the total surface area of the collectors exceeding 10,000 m^2. **Biomass** covers over 98% of renewable energy production. Biomass is considered to be the most promising of renewable energy in Poland. Current installed capacity using **geothermal** energy is approximately 68.5 MWt, of which 26.2 MWt is from heat pumps, which collectively generate 0,02 Mtoe of energy on an annual basis.

Table 1: RES-electricity production in 1997 and 2002 in GWh

RES-E Technology	1997 {GWh]	2002 [GWh]	Av. Annual growth [%]
Biogas	0	0	
Solid Biomass	6	31	38
Biowaste	0	0	
Geothermal electricity	0	0	
Hydro large-scale	1.661	1.676	0%
Hydro small-scale	300	348	3%
Photovoltaics	0	0	
Wind onshore	2	60	97%
Total	**1.963**	**2.084**	**1%**
Share of total consumption [%]	1.6%	2.0%	

[25] Based on EUROSTAT data, which are up-to-date only until 2001. For many RES, e.g. wind-onshore and PV more recent data from sector organisations and national statistics have been used.

Table 2: RES-heat production up until 2001

	Penetration 1997 [ktoe]	Penetration 2001 [ktoe]	Annual growth rate since 1997 %/year
Biomass heat	2591	2539	-1
Solar thermal heat	0.3	0.5	14
Geothermal heat incl. heat pumps	17.7	17.7	0

Table 3: RES-biofuel production up until 2001

	Penetration 1997 [ktoe]	Penetration 2001 [ktoe]	Annual growth rate since 1997 %/year
Liquid biofuels	55.6	25.89	-17

2.2. Mid-term potentials

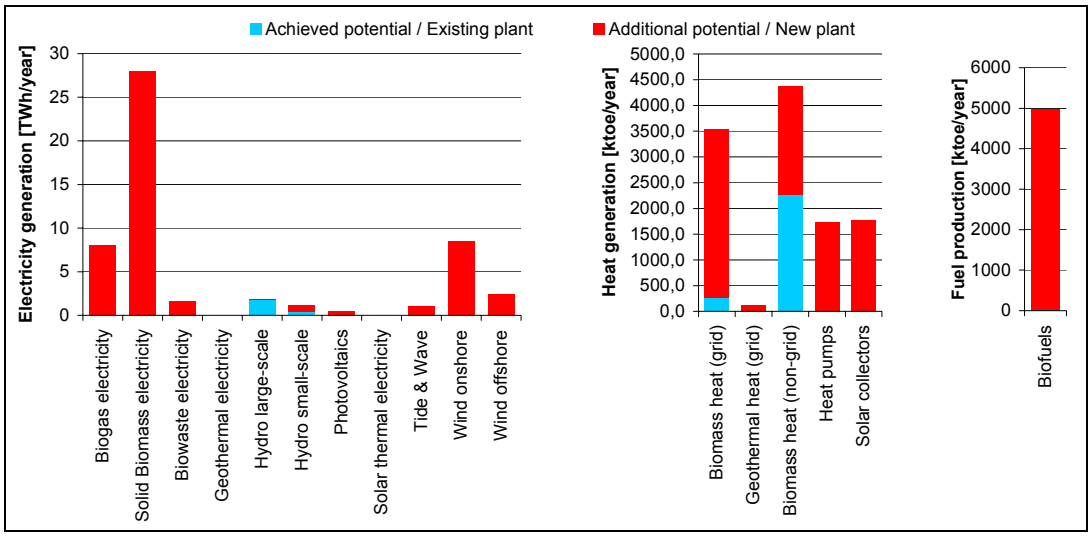

Figure 2: Mid-term potentials of RES electricity, heat and transport in Poland

PORTUGAL

1. Summary of RES markets and policy

Background

Extreme dependence on external energy sources has pushed the Portuguese Government to launch several energy plans and financing measures in order to promote RES-E development. Incentives for renewable electricity mainly comprise investment subsidies and RES-E production incentives (through the establishment of a feed-in tariff scheme consisting of a fixed tariff per kWh for each RES technology).

RES targets

The RES-E target to be achieved by Portugal in 2010 is 39.0% of gross electricity consumption.

Status of the renewable energy market

In the recently approved energy policy, the Portuguese Government has set goals for the development of RES-E, giving special attention to wind power (with an expected capacity of 3.750 MW by 2010) and small hydro (400 MW). For the implementation of the guarantee of origin the grid operator REN is designated as the issuing body.

Main supporting policies

Feed-in Tariffs for 2003		in € cents /kWh
Photovoltaics	< 5kW	41.0
	> 5kW	22.4
Wave		22.5
Small hydro		7.2
Wind	Beyond 2600 hours	4.3
	From 2400 to 2600 hours	5.1
	From 2200 to 2400 hours	6.0
	From 2000 to 2200 hours	7.0
	First 2000 hours	8.3

In addition, investment subsidies and tax deductions are used to support renewable energies.

Key factors

Feed-in structure delivers investment certainty. The tariffs differ for different technologies. The various support measures are all part of one national strategy and work well together. A monitoring system will guard the process of RES development

The tax measures may change with government structure or budget.

Other issues

The analysis of the Portuguese target must take into account the important variability of large hydro. Grid capacity problems hamper a larger uptake of renewable electricity in some Portuguese regions. Complex and slow licensing procedures have resulted in long lead times for new renewable installations.

2. Current status and potentials of RES

2.1 Current penetration

The production of **renewable electricity** in Portugal is dominated by **hydro large-scale** projects, as can be seen in Figure 1. In 2001 85% of Portugal's RES-E production was from this RES-E source, while in 2002 the share of large hydro of the overall Portuguese RES-E production decreased to 72%. In the period from 1990 to 2002 large-scale hydro power production varied between 4.9 TWh (1992) and 14.2 TWh (1996), with a production of 7.5 TWh in 2002. These variations complicate the monitoring of Portugal's efforts in meeting its renewable electricity target for 2010 (see further sections). Other important RES-E sources are **small-scale hydro** and **solid biomass**, with a production of 706 GWh and 1.2 TWh in 2002 respectively. Electricity production from **biowaste** and **wind** has started to grow over the last few years. In 2002 Portugal's installed wind power was increased by 43% up to 179 MW, accounting for 362 GWh generated electricity. Since 1997, the non-large-hydro RES-E passed from 1.76 TWh in 1997 to 2.9 TWh by 2002.

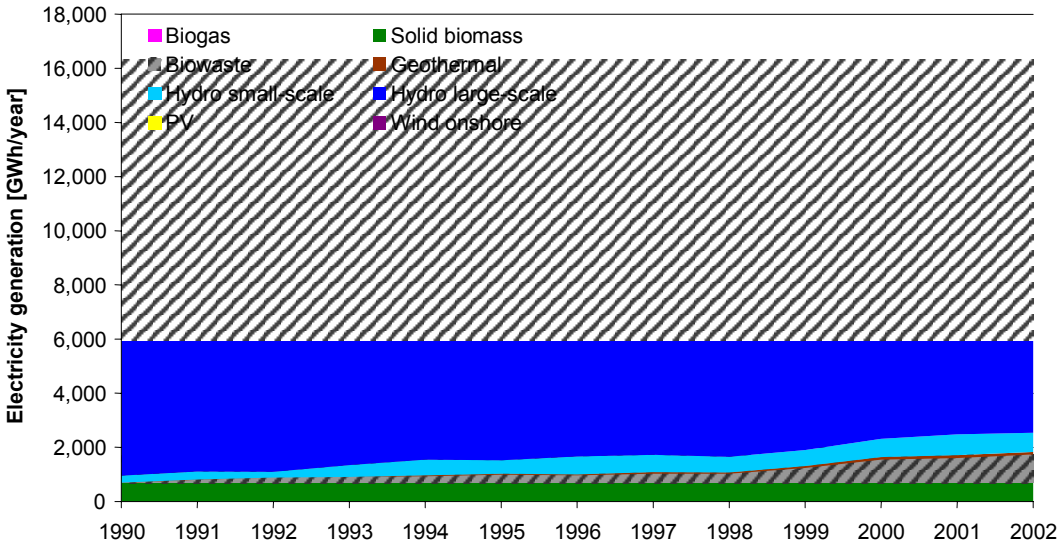

Figure 1: RES-electricity production up until 2002[26] in Portugal

[26] Based on EUROSTAT data, which are up-to-date only until 2001. For many RES, e.g. wind-onshore and PV more recent data from sector organisations and national statistics have been used.

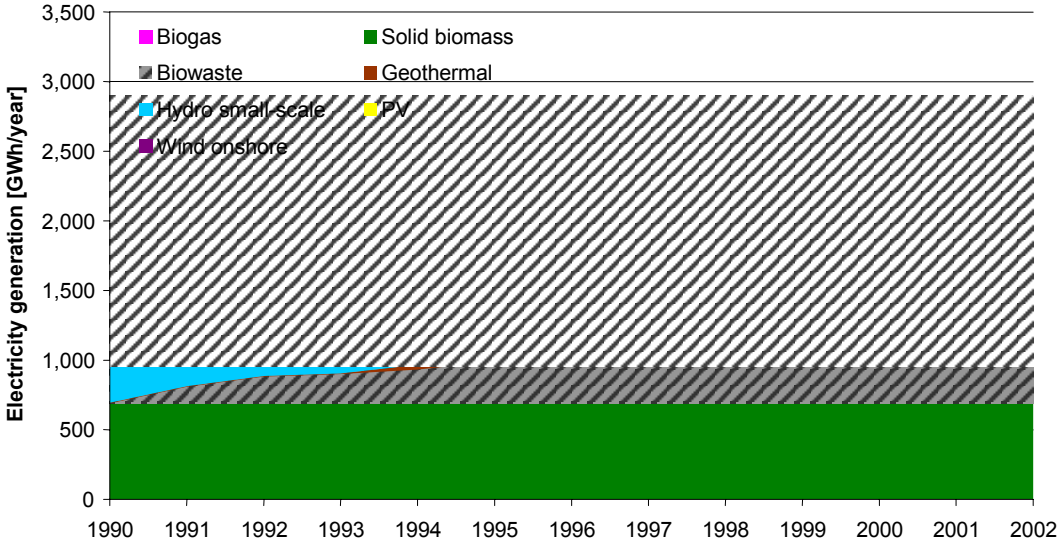

Figure 2: RES electricity production in Portugal up until 2002 without large hydro

Table 1 shows the electricity generation from renewable energy sources in 1997 and 2002, as well as the average annual growth during the intervening period. Due to the wide fluctuations in electricity generated from hydro, the share of RES electricity in 2002 was only around 22% compared with 39% in 1997.

Table 1: RES electricity production in 1997 and 2002 in GWh

RES-E Technology	1997 [GWh]	2002 [GWh]	Av. Annual growth [%]
Biogas	1	2	15
Solid Biomass	1.035	1.210	3
Biowaste	0	521	
Geothermal electricity	51	96	13
Hydro large-scale	12.537	7.551	-10
Hydro small-scale	638	706	2
Photovoltaics	0	1	-
Wind onshore	38	362	57
Total	14.300	10.449	-7%
Share of total consumption [%]	38.50%	21.8%	
RES-E excluding large-hydro	1.763	2.898	

Table 2 and Table 3 show data indicating the penetration of **RES-heat** and **RES-biofuel** respectively. **Biomass heat** production over the past few years has been stable at around 1900 ktoe per year. **Solar thermal heat** and **geothermal heat** production is still relatively small compared with biomass heat, showing a contribution of 19 ktoe and 90 ktoe respectively. Geothermal heat production showed a very strong increase in 2001, due to a new large demo plant on the

Azores. As shown in Table 3, production of **biofuels** is still a very small market in Portugal, with production figures of virtually zero.

Table 2: RES-heat production up until 2001

	Penetration 1997 [2001]	**Penetration 2002 [ktoe]**	**Growth rate since 1997 [%]**
Biomass heat	1860	1885*	0.3
Solar thermal heat	16	19	4
Geothermal heat incl. heat pumps	47	90	14

*Biomass heat only up until 2001

Table 3: RES-biofuel production up until 2002

	Penetration 1997 [ktoe]	**Penetration 2002 [ktoe]**	**Growth rate since 1997 [%]**
Liquid biofuels	0	0	-

2.1. Mid-term Potentials

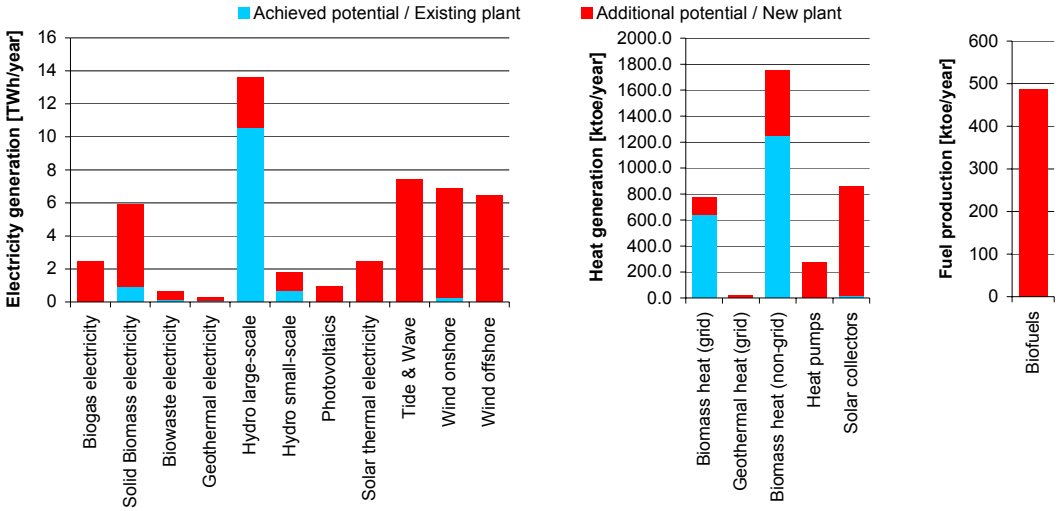

Figure 3: Mid-term potentials of RES electricity heat and transport in Portugal

Table 4: Policy assessment for RES - Portugal

RES-type	Wind onshore	Wind offshore	PV	Biomass electricity	Hydro - small	Hydro - large	Waste Incin.	Wave & Tidal	Biomass heat	Solar thermal	Geoth heat	Biofuels
Dominant instrument	Feed-in tariffs, Use energy potential and streamline consumption (MAPE in POE)	Feed-in tariffs, Use energy potential and streamline consumption (MAPE in POE)	Feed-in tariffs, Use energy potential and streamline consumption (MAPE in POE)	Feed-in tariffs, Use energy potential and streamline consumption (MAPE in POE)	Feed-in tariffs, Use energy potential and streamline consumption (MAPE in POE)		Feed-in tariffs, Use energy potential and streamline consumption (MAPE in POE)	Feed-in tariffs, Use energy potential and streamline consumption (MAPE in POE)	Use energy potential and streamline consumption (MAPE in POE)	Tax incentives, Use energy potential and streamline consumption (MAPE in POE)		
Type of instrument	Feed-in tariffs, rebates	Feed-in tariffs, rebates	Feed-in tariffs, rebates	Feed-in tariffs, rebates	Feed-in tariffs, rebates		Feed-in tariffs, rebates	Feed-in tariffs, rebates	Rebates	Rebates, Fiscal instruments (other than tax incentives)		
When implemented	2000	2000	2000	2000	2000		2000	2000	2001	2000		
Key factors	Different support schemes not accumulative for same types of eligible costs Revenues certainty.	See wind Revenues certainty	See wind Revenues certainty	See wind Revenues certainty	See wind Revenues certainty		See wind Revenues certainty	See wind Revenues certainty				
Degree and duration of support	••••	•••	•••	••	••••		••	••••	••	••••		
Non-economic factors	•••	•••	••••	•••	••		••	•••	•••	••••		

Elaboration of support		
•	Insufficient support or very strong barriers	
• •	Little support or significant constraints	
•• •	Moderate support or acceptable market conditions	
••••	High support or good market conditions	
•••••	Very high support or very good conditions	

SLOVAKIA

1. Summary of RES markets and policy

Background
The Slovak Republic is a net importer of relatively cheap energy from the Czech Republic and Poland. In 1999, energy imports provided approximately 85% of Slovakia's energy supply. An extensive development of small-hydro energy is going on.
RES targets
The RES-E target to be achieved in 2010 is 31% for Slovakia.
Status of the renewable energy market
There is no specific support for wind and solar energy. A very small portion of the biomass potential is used and the government's priority is to use this source only in remote, mountainous, rural areas, where natural gas is not available. For small hydro there is an extended development programme with 250 selected sites for building small-hydro. Geothermal is extendedly used for bathing purposes.
Main supporting policies
Energy Strategy and Policy of the Slovak Republic up to the year 2005 (1993)
Energy Act No.70/1998 (2001)
Key factors
Current low energy prices.
An extended development of the hydro potential is going on.
The government does not recognise opportunity in wind and solar.
The government support only biomass investments in remote, mountainous, rural areas.

2. Current status and potentials of RES

2.1. Current penetration

With the exception of the hydro power the share of the **renewable energy sources** did not grow significantly in the last decade in Slovakia. Only the **hydroelectric** capacity has grown significantly in the first half of the 1990s, due to the building of the Gabcikovo hydro power plant with a capacity of 720 MWe on the Danube. As of 1999, Slovakia had approximately 2,500 MWe of installed **hydroelectric** capacity. It is expected that 300 MWe of **small hydro** capacity may be needed from a large number of smaller facilities. There are currently approx. 180 small hydropower plants with the total installed capacity of more than 60 MW in operation in Slovakia. There are no large scale **wind** turbines up to now. There are installed 40 pairs of **photovoltaic** panels to 400 kV transmission line poles between Slovakia and Poland since 1998.

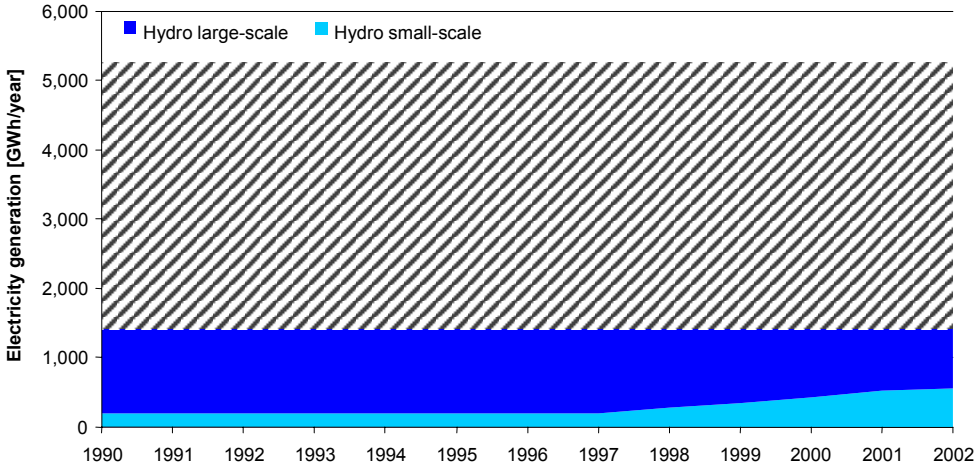

Figure 1: RES electricity production up until 2002[27] in Slovakia

Geothermal waters in the Slovak Republic are being utilised on 35 locations offering an aggregate heating capacity of 75 MW and generation of 0,05 Mtoe to heat structures, swimming pools, greenhouses (at the town of Galanta it heats 1,240 flats and a hospital). In present, **biomass** provides only 0.2 % (0,1 Mtoe) of energy, although biomass represents the largest potential of renewable energy of Slovakia.

Table 1: RES-electricity production in 1997 and 2002 in GWh

RES-E Technology	1997 {GWh]	2002 [GWh]	Av. Annual growth [%]
Biogas	0	0	
Solid Biomass	0	0	
Biowaste	0	0	
Geothermal electricity	0	0	
Hydro large-scale	3.935	4.704	4%
Hydro small-scale	202	557	22%
Photovoltaics	0	0	
Wind onshore	0	0	
Total	**4.137**	**5.261**	**5%**
Share of total consumption [%]	15.9%	20.2%	

Table 2: RES-heat production up until 2001

	Penetration 1997 [ktoe]	Penetration 2001 [ktoe]	Annual growth rate since 1997 %/year
Biomass heat	50	103	20
Solar thermal heat	2.4	2.4	0

[27] Based on EUROSTAT data, which are up-to-date only until 2001. For many RES, e.g. wind-onshore and PV more recent data from sector organisations and national statistics have been used.

Geothermal heat incl. heat pumps	46.4	50.6	2

Table 3: RES-biofuel production up until 2001

	Penetration 1997 [ktoe]	**Penetration 2001 [ktoe]**	**Annual growth rate since 1997 %/year**
Liquid biofuels	n.a.	31	n.a.

2.2. Mid-term potentials

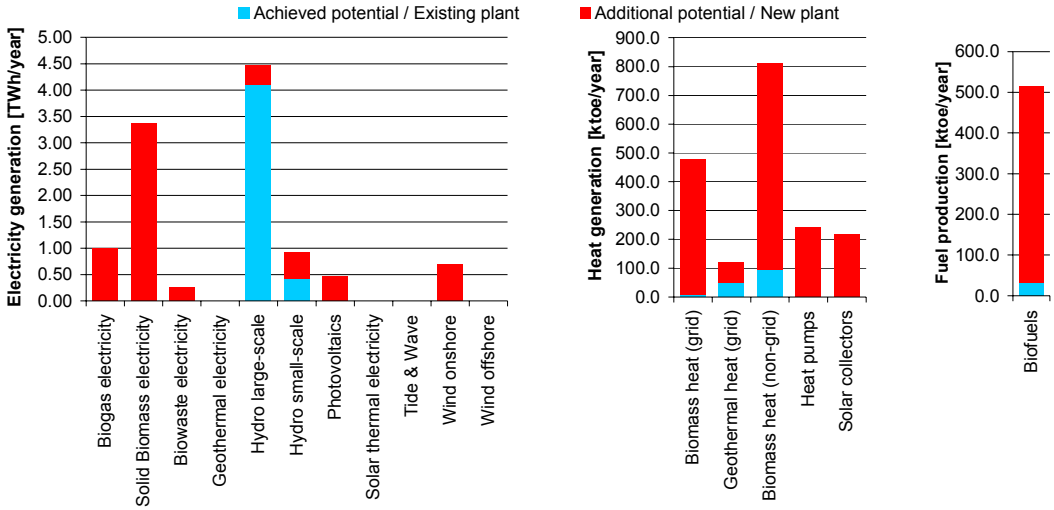

Figure 2: Mid-term potentials of RES electricity, heat and transport in Slovakia

SLOVENIA

Summary of RES markets and policy

Background
The new Energy Act substituting the Act on Energy Economy from 1986 was promulgated in September 1999. It gives priority to efficient use of energy and renewable energy sources over supplying from non-renewable sources. According to the law, a national energy programme shall be drawn up every five years. The programme shall promote investing into renewable energy sources and efficient use of energy. Hydropower supplies about one-third of Slovenia's electricity generating capacity. However, many of the smaller hydro plants are very old (pre-World War II) and will need to be refurbished to remain operational.
RES targets
The RES-E target to be achieved in 2010 is 33,6% for Slovenia.
Status of the renewable energy market
Renovation of hydropower plants will increase the efficiency of these units, and could add as much as 150 MWe in generating capacity. Refurbishment of existing small scale hydropower as well as increasing the capacity of the large-scale units is part of the Government's renewable energy strategy.
Main supporting policies
Feed-in tariff:
Hydro up to 1 MW: 6.11 €c/kWh; Hydro 1 to 10 MW: 5.89 €c/kWh
Biomass up to 1 MW: 6.98 €c/kWh; Biomass above 1MW: 6.76 €c/kWh
Wind up to 1 MW: 6.33 €c/kWh; Wind above 1 MW: 6.11 €c/kWh
Geothermal: 6.11 €c/kWh
Solar up to 36 kW: 27.85 €c/kWh; Solar above 36 kW: 6.11 €c/kWh
CO_2 tax introduced in 1996 amounts to 15 €/t CO_2.
Key factors
The Regulation provides the framework for contractual relations between the network manager and the qualified energy producer including a contract for a period of 10 years.
Complicated procedures for acquiring the administrative permissions.

2. Current status and potentials of RES

2.1. Current penetration

The share of renewable energies in Slovenia's energy sector is constant since the beginning of the '90ies. The mostly utilised renewable energy source in Slovenia is **hydro-power**. It supplies about one-third of Slovenia's electricity generation (3300 GWh/year). Besides the larger hydroelectric generating units, there are approximately 40 very **small hydro** units with less than 500 GWh/year electricity generated. There are no **wind** power plants installed in Slovenia. The **photovoltaic** peak power installed is very low - about 100 kWp. Photovoltaic applications have been implemented on an experimental basis in the telecommunications and other sectors. Biomass has a minimal penetration in electricity production.

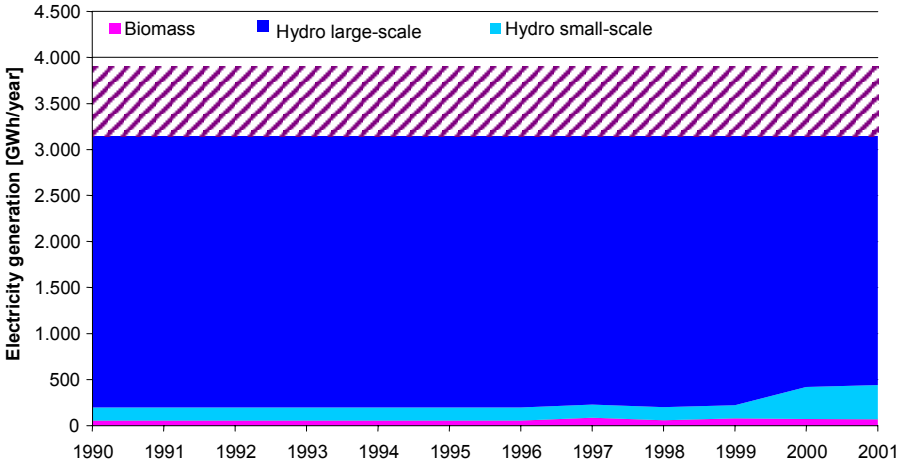

Figure 1: RES electricity production up until 2001[28] in Slovenia

Table 1: RES-electricity production in 1997 and 2001 in GWh

RES-E Technology	1997 {GWh]	2001 [GWh]	Av. Annual growth [%]
Biogas	0	0	
Solid Biomass	86	69	-5
Biowaste	0	0	
Geothermal electricity	0	0	
Hydro large-scale	3,092	3,429	2.6
Hydro small-scale	142	371	27
Photovoltaics	0	0	
Wind onshore	0	0	
Total	**3,320**	**3,869**	**3.9**
Share of total consumption [%]	31.1%	30.4%	

Biomass, **solar** and **geothermal** installations have just a minimal share in the heat production. Wood is an important fuel for space heating, particularly in the residential sector. Forest residues supply about 359 MWth. The existing capacity of geothermal resources in Slovenia amount to about 103 MW of heat plant providing heat to health spas, agriculture and institutions.

[28] Based on EUROSTAT data, which are up-to-date only until 2001. For many RES, e.g. wind-onshore and PV more recent data from sector organisations and national statistics have been used.

Table 2: RES-heat production up until 2001

	Penetration 1997 [ktoe]	Penetration 2001 [ktoe]	Annual growth rate since 1997 %/year
Biomass heat	178	383	21
Solar thermal heat	n.a.	4.8	n.a.
Geothermal heat incl. heat pumps	28.4	42.1	10

There is no biofuel production is Slovenia.

2.2. Mid-term potentials

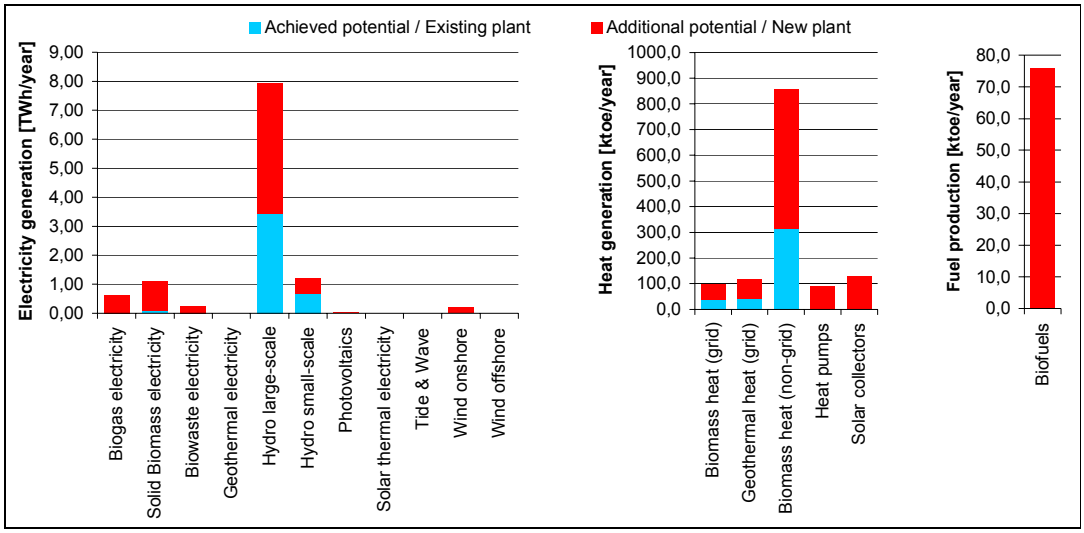

Figure 2: Mid-term potentials of RES electricity, heat and transport in Slovenia

SPAIN

1. Summary of RES markets and policy

Background

In 1997 Spain introduced a substantial programme to support RES, which has resulted in an enormous growth in new capacity, mainly wind power. Feed-in tariffs and premiums provided high transparency and certainty in the market and are therefore the main driver for this growth. After Germany Spain is the most favourable country for wind investments.

RES targets

The RES-E target to be achieved by Spain in 2010 is 29.4% of gross electricity consumption.

Status of the renewable energy market

Wind power has developed impressively. The biomass sector still needs an integrated policy which recognises the added value of environmental and rural development . Small hydro needs to overcome the administrative barriers.

Main supporting policies

RES producers may choose between a fixed preferential tariff or a (variable) premium price on top of the market price. Investment support is also provided. Tariffs are specified for plants ≤ 50MW.

Tariffs specified for 2003:	**premium (€ct/kWh)**	**feed-in (€ct/kWh)**
Solar PV (< 5kW):	36.0	39.6
Solar (other installations):	18.0	21.6
Solar thermal-electric:	12.0	
Wind:	2.66	6.21
Small Hydro (≤ 10MW):	2.94	6.49
Primary Biomass:	3.32	6.85
Secondary Biomass:	2.51	6.05
Geothermal, wave and tidal:	2.94	6.49

Key factors

- Transparent support schemes and the high feed-in tariffs deliver high investment certainty.
- Feed-in tariffs are decreased and might become too low to induce new investments.
- Changes due to liberalisation of the sector cause uncertainty.
- Biomass feed-in tariffs were up-to-now too low to develop new capacity.

Other issues

The system for Guarantee of Origin has not been implemented yet. A draft has been formulated within the Ministry of Economy. Some electricity companies have started to sell green power.

2. Current status and potentials of RES

2.1. Current penetration

The production of **renewable electricity** in Spain is shown in Figure 1. It can be seen that **hydro** generated electricity is by far the most important RES-E source, with a contribution of around 16 TWh in 2002, which corresponds to 41% of the total RES-E production for that year. Strong growth in the electricity production by **on-shore wind** parks can be observed. Spain achieved 4.100 MW at the end of 2002 (more than 6.000 MW at the end of 2003, similar to the total wind capacity installed in USA) producing 9.6 TWh in 2002. On the other hand it should be noted that the production of RES-E from **solid biomass** was 2.9 TWh in 2002. This accounted for 8% of the total RES-E production in that year.

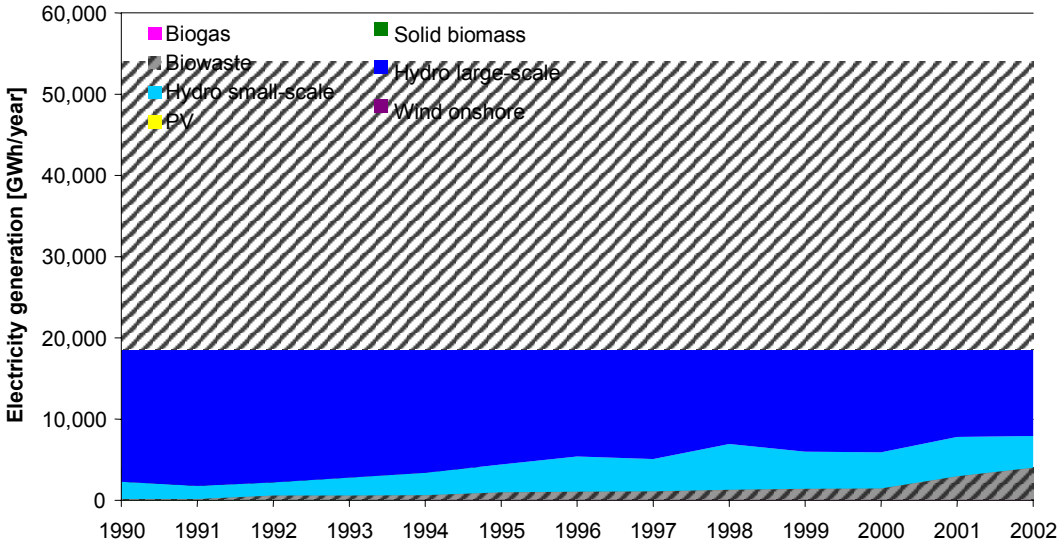

Figure 1: RES-electricity production up until 2002[29]

[29] Based on EUROSTAT data, which are up-to-date only until 2001. For many RES, e.g. wind-onshore and PV more recent data from sector organisations and national statistics have been used.

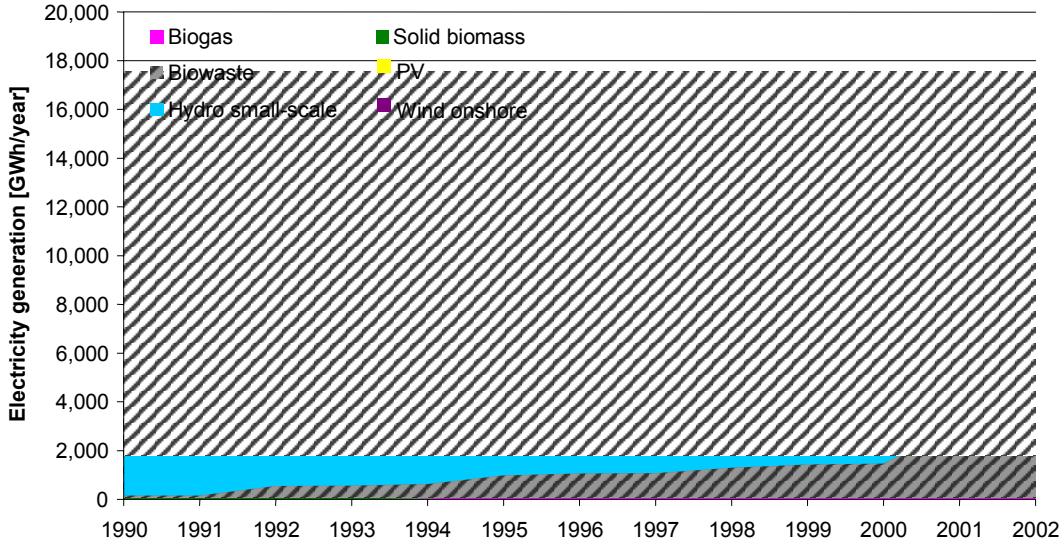

Figure 2: RES electricity production in Spain up until 2002 without large hydro

Table 1 shows an overview of the electricity generation from renewable energy sources in Spain in 1997 and 2002, as well as the average annual growth during the intervening period. The electricity generation from RES expressed as share of the overall electricity consumption was 20% in 1997, while it was only 16.2% in 2002.

Table 1: RES electricity production in 1997 and 2002 in GWh

RES-E Technology	1997 [GWh]	2002 [GWh]	Av. Annual growth [%]
Biogas	139	418	25%
Solid Biomass	672	2,949	34%
Biowaste	273	648	19%
Geothermal electricity	0	0	-
Hydro large-scale*	30,349	12,147	-17%
Hydro small-scale*	4,007	3,895	-1%
Photovoltaics	1	5	38%
Wind onshore	717	9,564	68%
Total	**36,158**	**29,626**	**-4%**
Share of total consumption [%]	19.90%	12.6%	
Non-large hydro RES-E	5,809	17,479	

* Spain uses a definition for small and large-scale hydro power capacity that is different from the commonly adopted EU definition. In Spain all production capacity lower than 50 MW is considered to be small-scale production capacity.

Table 2 shows data indicating the penetration of **RES-heat** in Spain. **Biomass heat** production over the past few years has been stable at around 3300 ktoe per year. **Solar thermal heat** production is still relatively small compared with biomass heat,

but an average annual growth rate of about 10% since 1997 has been reported for this technology.

As can be seen in Table 3, the **biofuel** market has grown strongly over the past few years. In 1997 virtually no biofuels were produced, while for the year 2002 a production of 119 ktoe was reported.

Table 2: RES-heat production up until 2002

	Penetration 1997 [ktoe]	**Penetration 2002 [ktoe]**	**Growth rate since 1997 [%]**
Biomass heat	3269	3383	0.7
Solar thermal heat	25	35	7
Geothermal heat incl. heat pumps	6.5	8.0	4

Table 3: RES-biofuel production up until 2001

	Penetration 1997 [ktoe]	**Penetration 2002 [ktoe]**	**Growth rate since 1997 [%]**
Liquid biofuels	0	119	-

2.1. Mid-term Potentials

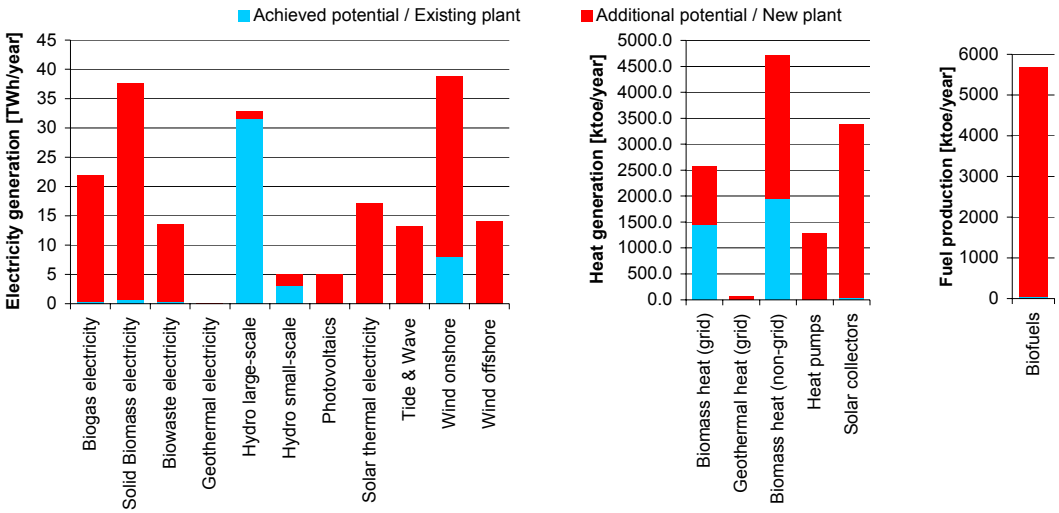

Figure 3: Mid-term potentials of RES electricity heat and transport in Spain

Table 4: RES-Policy assessment Spain

RES-type	Wind on-shore	Wind off-shore	PV	Biomass electricity	Hydro - small	Geoth. electr.	Waste Incin.	Wave & Tidal	Biomass heat	Solar therm.	Geoth. heat	Biofuels
Dominant instrument	Regulation Governing RES in the Electricity Market, Energy Saving and Efficiency Plan, Plan de Fomento de las Energías Renovables		See wind	Energy Saving and Efficiency Plan, Plan de Fomento de las Energías Renovables	See wind	Regulation Governing RES in the Electricity Market, Energy Saving and Efficiency Plan	See wind	See wind	Plan de Fomento de las Energías Renovables	See wind	Regulation Governing RES in the Electricity Market, Energy Saving and Efficiency Plan	Tax exemption, Plan de Fomento de las Energías Renovables
Type of instrument	Feed-in tariffs, Investment compensation schemes, Fiscal instruments		See wind	See wind	See wind	Feed-in tariffs, Investment compensation schemes	See wind	See wind	Fiscal instruments	Investment compensation schemes, Fiscal instruments	Feed-in tariffs, Investment compensation schemes	Energy or environmental tax incentives
Implemented	1997		1997	1997	1997	1997	1997	1997	1997	1997	1997	1997
Key factors	Feed-in tariffs have provided enough economic incentives..		Formerly: high administrative burden. Transparent incentive system, design of instrument is expected to be successful	Tariffs and support are increased but might not be enough. Transparent incentive system	Level & duration of support uncertain	Level and duration of support uncertain	Public opinion not always in favour. Simple and transparent incentive system	Level and duration of support uncertain	Tariffs and support are increased but might not be enough. Transparent incentive system	Small instable market. Technology had bad reputation. Transparent incentive system with good promotion and training	Level and duration of support uncertain	Tax regime may be subject to yearly budget changes. Simple & transparent incentive system
Degree and duration of support	••••	•••	•••	••	••	••	••	••	•••	••••	••	•••
Non-economic factors	••••	•••	•••	••••	•••	••••	•	••••	•••	••••	••••	•••

Elaboration of support										
	•	Insufficient support or very strong barriers	• •	Little support or significant constraints	••	Moderate support or acceptable market conditions	••••	High support or good market conditions	•••••	Very high support or very good conditions

SWEDEN

1. Summary of RES markets and policy

Background
Sweden has followed the route of promoting new renewable sources by a combination of energy taxation and environmental bonus schemes up to early 2003. Since May 2003, however, a major policy change has been implemented by introducing a tradable certificate scheme in order to achieve the cost-effective and market-oriented promotion of renewables.
RES targets
The RES-E target from the EU directive for Sweden is 60% of gross electricity consumption in 2010. Sweden has set up the national target in absolute values (10 TWh additional RES by 2010) together with a 17% obligation of non large-hydro RES-E for end users by 2010.
Status of the renewable energy market
Renewables currently cover approximately 50% of Sweden's total electricity consumption. This supply is covered mainly by hydro power. The use of biomass has increased substantially over the past decade, but its share is still relatively small. Wind capacity installed in Sweden is relatively low although the wind resource in the south of the country is comparable to Denmark's. When the new certificate scheme was drawn up by the Government, market parties expressed fear and reluctance to invest.
Main supporting policies
Electricity certificates for wind, solar, biomass, geothermal and small hydro were introduced in May 2003. The system has created an obligation for end-users to buy a certain amount of renewable certificates as part of their total electricity consumption (increasing to 17% in 2010). Non-compliance leads to a penalty which is fixed at 150% of a year's average price. To secure a smooth transition, price guarantees are available for producers up to 2007. Within the system prices will be settled by supply and demand. Forecasts show expected prices in the range of 1,3 – 1,6 € cents/kWh for certificates traded. For wind energy investment grants which offer 15% reduction of costs will remain available. As a transition measure, an environmental bonus for wind will also be available. This bonus has a value of 1,9 € cents/kWh this year and will gradually decline to 0 in 2007 Furthermore exemptions for renewables on environmental taxes are applicable, which provide a benefit of around 1,79 € /toe for renewables used for transport or heat supply.
Key factors
The certificate system will form an incentive to invest in the most cost-effective options. Guarantees have been built into the system to secure a smoother transition from the previous system into the new situation. The environmental tax benefits can make some biomass CHP systems competitive. Under the certificate system, prices may fluctuate from year to year depending on production and new investments. This holds for certificates as well as the commodity price of electricity. Both elements form a source of uncertainty for investment decisions.
Other issues
Since the certificate system is in its start-up phase, the effects are as yet difficult to assess. It may result in a cost-effective development of renewables (thereby excluding some sources from the market). The Government has declared that in the (near) future the certificate system may be opened up for imports. This market opening may pose a threat to investments in new renewables in Sweden.

2. Current status and potentials of RES

2.1. Current penetration

The development of the **renewable electricity production** over the past decade has resulted in a modest increase of 7% since 1990. The most important growth has occurred in the application of **bio-energy** which grew by a factor of 2.5 in volume from 1990. The current level is now around 4 TWh. **Hydro power** still remains the largest source of renewable energy in Sweden, but only a very limited growth in capacity occurred. In 2002 hydro generated 66 TWh. 2003 was a very bad hydraulic year with a total production of 53 TWh. **Wind power** started recently in Sweden (both on-shore and off-shore) and has a reached level of around 0,6 TWh in 2002. By the end of 2003 the installed wind power capacity was 399 MW.

The current RES-E penetration is shown in **Figure** 1. The fluctuations reflect the volatility in the supply of hydro power due to variations in weather conditions from year to year. According to the total demand the **share of RES** electricity in Sweden amounted to **46%** in 2002 compared to **49%** in 1997.

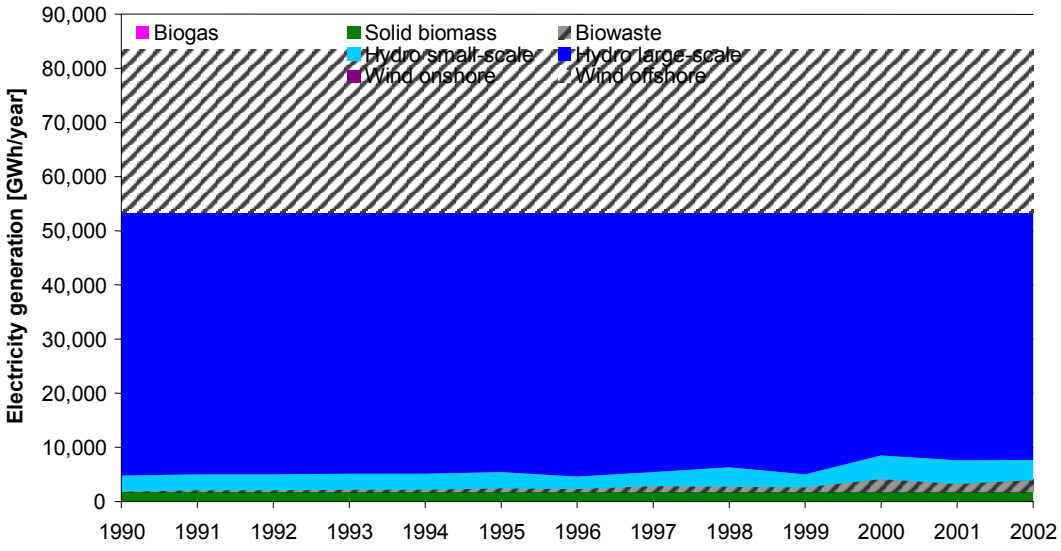

Figure 1: RES electricity production up until 2002[30] in Sweden

[30] Based on EUROSTAT data, which are up-to-date only until 2001. For many RES, e.g. wind-onshore and PV more recent data from sector organisations and national statistics have been used.

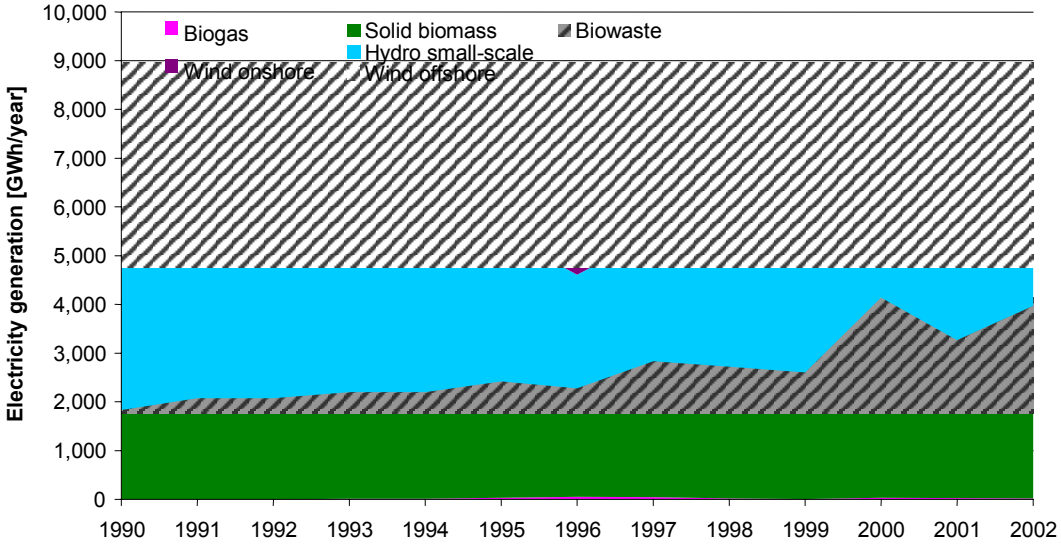

Figure 2: RES electricity production in Sweden up until 2002[31] without large hydro

Table 1: RES-electricity production in 1997 and 2002 in GWh

RES-E Technology	1997 [GWh]	2002 [GWh][32]	Av. Annual growth [%]
Biogas	46	17	-18
Solid Biomass	2,685	3,775	7
Biowaste	105	208	15
Geothermal electricity	0	0	
Hydro large-scale	64,560	62,370	-1
Hydro small-scale	2,582	3,630	7
Photovoltaics	0	0	0
Wind onshore	205	600	24
Total	**70,183**	**71,804**	**0.1**
Share of total consumption [%]	49.10%	46%	
Non-large Hydro RES-E	5.623	8.230	

In the **heat sector** the use of biomass, in particular in new CHP and district heating installations, has grown substantially over the past decade (by nearly 40% compared with 1990). The current use has reached a level of about 5 Mtoe. Solar thermal collectors have been introduced in Sweden, but their contribution still remains small. The market for solar thermal applications grew by 7% in 2002 to nearly 0,2

31 Based on EUROSTAT data, which are up-to-date only until 2001. For many RES, e.g. wind-onshore and PV more recent data from sector organisations and national statistics have been used.

32 Based on data by Swedish Energy Agency

million m^2 installed capacity. For geothermal heat pumps very strong growth has been observed over recent years.

Table 2: RES-heat production up until 2002

	Penetration 1997 [ktoe]	Penetration 2002 [ktoe]	Growth rate since 1997 [%]
Biomass heat	5408	4995*	-2
Solar thermal heat	4.47	5.02	2
Geothermal heat incl. heat pumps	-	299	-

*Biomass heat only up until 2001

The biofuel sector has started to develop recently, but the absolute level still remains very small.

Table 3: RES-biofuel production up until 2002

	Penetration 1997 [ktoe]	Penetration 2002 [ktoe]	Growth rate since 1997 %
Liquid biofuels	-	41	-

2.1. Mid-term Potentials

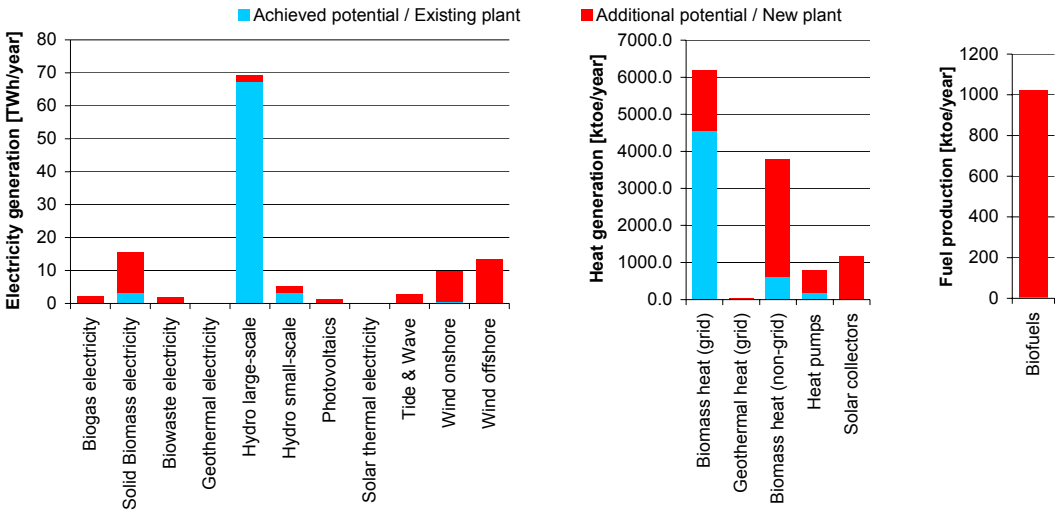

Figure 3: Mid-term potentials of RES electricity heat and transport in Sweden

Table 4: Policy assessment for RES - Sweden

RES-type	Wind onshore	Wind offshore	PV	Biomass electricity	Hydro - small	Hydro - large	Geoth. electr.	Biomass heat	Solar thermal	Geoth. heat	Biofuels
Dominant instrument	Electricity certificates Investment reduction subsidy	Electricity certificates Investment reduction subsidy	Electricity certificates Energy tax exemption	Electricity certificates Energy tax exemption	Electricity certificates Energy tax exemption	n.a.	Electricity certificates Energy tax exemption	Energy tax exemption	n.a.	Energy tax exemption	Energy tax exemption
Type of instrument	Tradable Green Certificates Investment compensation schemes	Tradable Green Certificates Investment compensation schemes	Tradable Green Certificates Energy or environmental tax incentives	Tradable Green Certificates Energy or environmental tax incentives	Tradable Green Certificates Energy or environmental tax incentives	n.a.	Tradable Green Certificates Energy or environmental tax incentives	Energy or environmental tax incentives	n.a.	Energy or environmental tax incentives	Energy or environmental tax incentives
When implemented	Since 2003	Since 2003	Since 2003	Since 2003		n.a.	Since 2003	Since 1990	n.a.	Since 2003	Unknown
Key factors	Market competition on price Market price maybe too low to be competitive	Market competition on price Market price maybe too low to be competitive	Support through certificates too low to be competitive	Market competition on price Resource availability	Planning and environmental restrictions Market competition on price		Price	Tax exemptions and landfill tax in selected cases sufficient to be competitive with fossil		Price	Gap with fossil price
Degree and duration of support	●●●	●●	●	●●●	●●●	n.a.	●	●●●	n.a.	●	●
Non-economic factors	●●●	●●	●	●●●●	●●●	n.a.	●	●●●	n.a.	●	●

Elaboration of support										
	●	Insufficient support or very strong barriers	●●	Little support or significant constraints	●●●	Moderate support or acceptable market conditions	●●●●	High support or good market conditions	●●●●●	Very high support or very good conditions

UNITED KINGDOM

1. Summary of RES markets and policy

Background

In the United Kingdom renewable energy is strongly supported by a system with mandatory demand and several grants programs. Renewables are an important part of the climate change strategy. Renewable energy is therefore exempted from the Climate Change Levy (CCL). After one year of the new established certificate market, the CCL and the grants programs in full operation, the development of RES seems to be increasing apace.

RES targets

The RES-E target to be achieved by the UK in 2010 is 10 % of gross electricity consumption. An indicative target for RES-E of 20% for 2020 has been set. No formal targets exist for RES-H and biofuels.

Status of the renewable energy market

The buy-out revenues for non-compliances are recycled to the suppliers in proportion to the certificates they have used for complying with the obligation. This mechanism increased the certificate price above the buy-out price because the market is short. High prices in the first year gave the ROC (Renewable Obligation scheme) market a kick-start. Targets specified for 2010 and scheme duration specified until 2027 provide long-term security for renewable energy investors.

Main supporting policies

- Obligatory targets with tradable green certificate system. The non-compliance 'buy-out' price for 2003-2004 is set at £30.51/MWh (approx4.5 €ct/kWh). This buy-out price will be annually adjusted in line with the retail price index.
- Climate Change Levy: renewable electricity is exempted from the climate change levy on electricity of 0.43 p/kWh (approx. 0.63 € ct/kWh)
- Grants schemes: funds are reserved from the New Opportunities Fund for new capital grants for investments in energy crops/biomass power generation (at least £33m (€53m) over three years), for small scale biomass/CHP heating (£3m or €5m), and· planting grants for energy crops (£29m or €46m for a period of seven years).

Major issues

- The targets for the obligatory demand are set up to 2027, ensuring long-term demand.
- High targets and the redistribution of buy-out revenues make RES-E investments economically viable.
- A great differentiation of grant programmes with large budgets aimed at technologies and/or municipalities give a wide range of support to initiatives.
- Grid connection issues and severe competition on the electricity market could disadvantage RES in of the support programs.

Other issues

Government has announced new plans on off-shore wind in 2003 and around 1.400 MW installed capacity has already been approved.

2. Current status and potentials of RES

2.1. Current penetration

The **renewable electricity production** in the period 1990-2002 in the UK is shown in Figure 1. It can be seen that in this period annual RES-E production increased from 5.8 TWh in 1990 to around 11 TWh in 2002. **Hydro** generated electricity is the most important RES-E source, although its relative share in the RES-E production is decreasing. In 1990 hydro power was responsible for more than 90% of the annual RES-E production, whereas in 2002 its contribution was 42%. At present the second most important RES-E source is generation with **biogas**. Over the last decade the contribution of biogas to the RES-E production has increased from 8% in 1990 to 28% in 2002. Responsible for this increase is the production of **landfill gas**, which accounted for 90% of total biogas electricity production in 2002. Other technologies with an increasing contribution to the overall RES-E production in the UK are **on-shore wind** (11% in 2002), **solid biomass** (8% in 2002) and **biowaste** (8% in 2002). Installed wind power in the UK increased by 19% in 2002 to a total installed capacity of 534 MW.

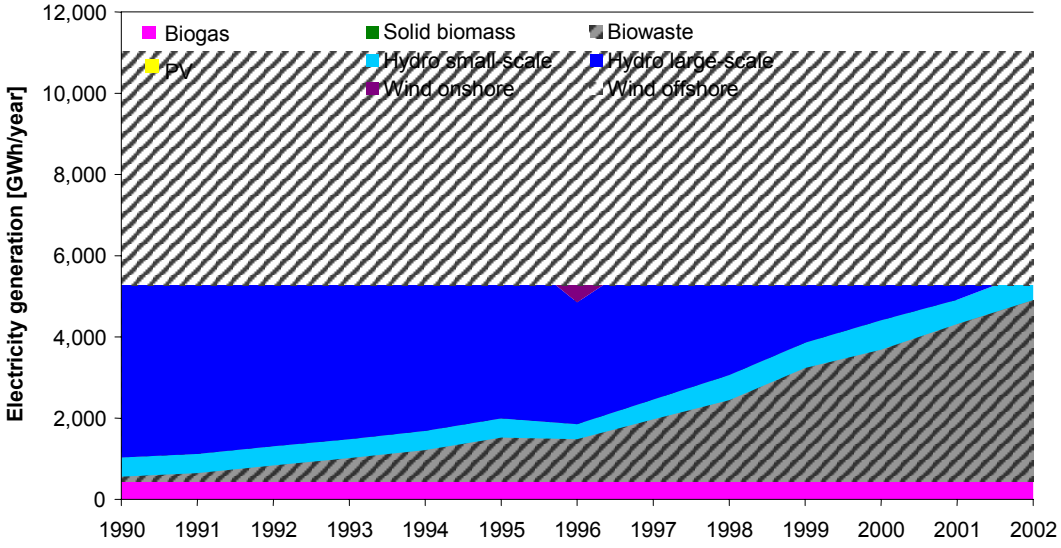

Figure 1: RES-electricity production up until 2002[33]

[33] Based on EUROSTAT data, which are up-to-date only until 2001. For many RES, e.g. wind-onshore and PV more recent data from sector organisations and national statistics have been used.

Table 1: RES electricity production in 1997 and 2002 in GWh

RES-E Technology	1997 [GWh]	2002 [GWh]	Av. Annual growth [%]
Biogas	1,326	3,076	18%
Solid Biomass	199	870	34%
Biowaste	483	958	15%
Geothermal electricity	0	0	-
Hydro large-scale	4,005	4,584	3%
Hydro small-scale	164	204	4%
Photovoltaics	0	3	
Wind onshore	665	1,251	13%
Wind off-shore	0	5	-
Total	6,842	10,951	12%
Share of total consumption [%]	1.70%	2.8%	

Table 2 shows data indicating the penetration of **RES-heat** in the UK. **Biomass heat** production in 2002 reached 700 ktoe, which is significantly lower than the 917 ktoe reached in 1997. **Solar thermal heat** and **geothermal heat** production is still relatively small compared with biomass heat, but solar thermal heat has increased by average annual growth rates of 13% in the period 1997-2002.

As can be seen in Table 3, the production of **biofuel** corresponded to 3 ktoe in the year 2002, while in 1997 still virtually no biofuels were being produced.

Table 2: RES-heat production in 1997 and 2002 in ktoe

	Penetration 1997 [ktoe]	Penetration 2002 [ktoe]	Average growth rate since 1997 [%/year]
Biomass heat	917	700*	-5
Solar thermal heat	9	16	13
Geothermal heat incl. heat pumps	0.8	0.8	0

*Biomass heat only up until 2001

Table 3: RES-biofuel production up until 2002

	Penetration 1997 [ktoe]	Penetration 2002 [ktoe]	Growth rate since 1997 %
Liquid biofuels	-	3	-

2.1. Mid-term Potentials

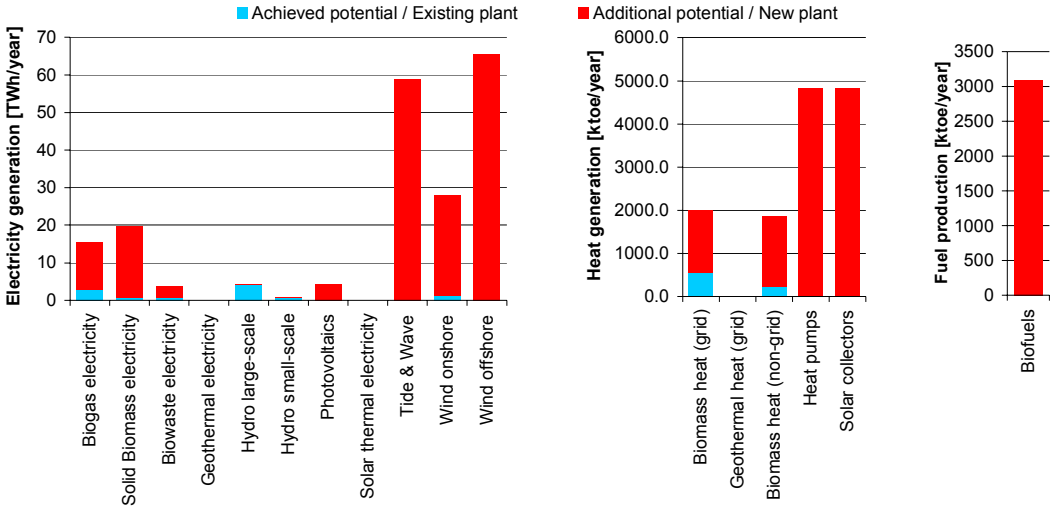

Figure 2: Mid-term potentials of RES electricity heat and transport in the UK

Table 4: Policy assessment for RES - United Kingdom

RES-type	Wind onshore	Wind offshore	PV	Biomass electricity	Hydro - large	Hydro - small	Geoth. electr.	Wave & Tidal	Biomass heat	Solar thermal	Geot h. heat	Biofuels
Dominant instrument	Climate change levy and renewables obligation	As wind onshore plus capital grants	Govt promotion funds (plus see wind onshore)	As wind onshore plus govt funds for energy crops		As wind onshore	As wind onshore	As wind onshore	Govt funds for energy crops	Clear Skies Scheme		Tax exemption
Type of instrument	Tax incentive and green certificates	Inv. compensation scheme plus see wind onshore	Rebates plus see wind onshore	Rebates plus see wind onshore		As wind onshore	As wind onshore	As wind onshore		Investment compensation scheme		Tax incentive
When implemented	2002	2002	2002	2002		2002	2002	2002		2002		2004
Key factors	Only the currently cost-efficient technologies are stimulated; fluctuating prices Long-term certainty, high targets and prices For off-shore: possible locations already identified and secured; extra grants available		Programmes too small to result in lowering of production costs for PV. Political willingness assumed to be stable factor to stimulate success of programmes.	See hydro-small		Only the currently cost-efficient technologies are stimulated. Long term certainty, high targets and prices		See hydro-small	High investment grants	Grants are less than 50% of installation costs for communities. Direct financial support for households and small-scale levels		
Degree and duration of support	●●●●●	●●●●●	●	●●		●●●●	●●●	●●●	●●●	●●●●		
Non-economic factors	●●●●	●●●●	●●●	●●●●		●●●●	●●●	●●●●	●●●●	●●●		

Elaboration of support									
●	Insufficient support or very	●●	Little support or significant	●●●	Moderate support or acceptable market	●●●●	High support or good market	●●●●●	Very high support or very good

	strong barriers		constraints		conditions		conditions		conditions