

### 3. Identifying successful Member State/technology combinations

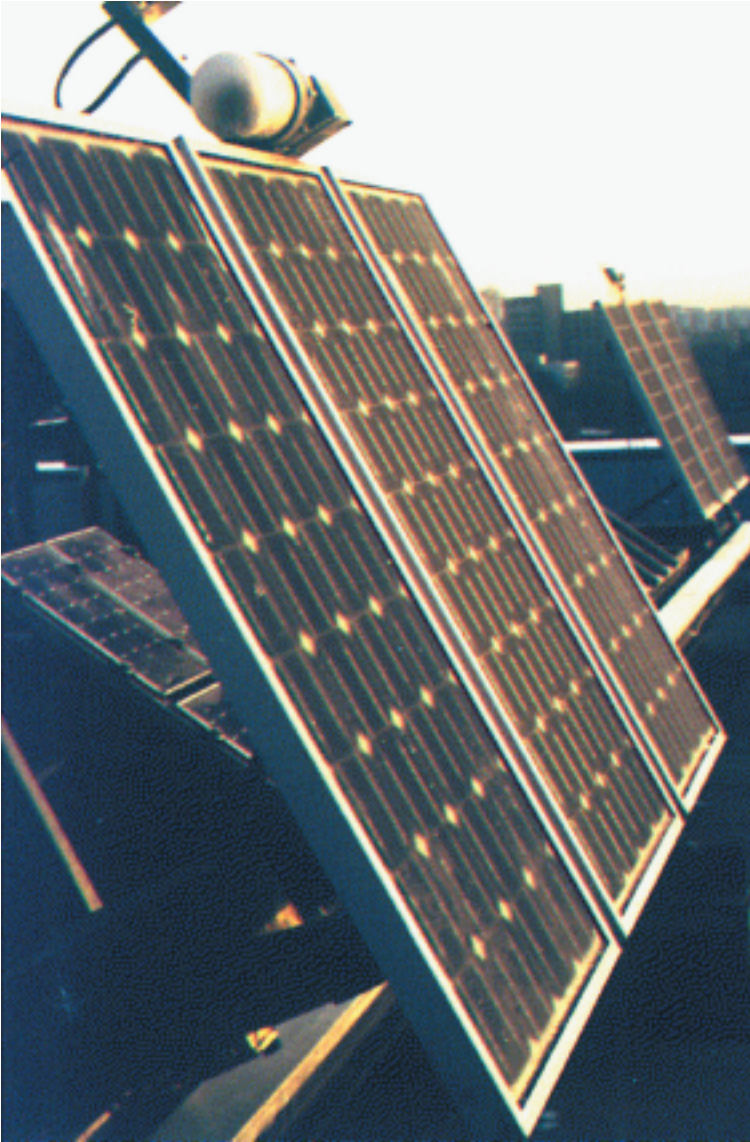


Photo: Volker Quaschnig

#### 3.1. Selection criteria for identifying successful Member State/technology combinations

In order to identify those Member State/technology combinations where there has been most success in achieving renewable energy penetration, the following two selection criteria have been applied. This approach was carried out in each Member State and for each technology covered in this study, over the six-year period 1993–99.

- An absolute increase equivalent to at least 10 % of the total EU-wide increase in renewable energy output for that particular technology over the period 1993–99. The 10 % threshold was selected to identify those Member States which made the greatest contribution to the increase in renewable energy output of each technology in the EU.
- A percentage increase of renewable energy output of the examined technology greater than the EU-wide percentage increase for that technology between 1993 and 1999. This compares the percentage increase of each renewable energy source with the EU-wide percentage increase, and identifies those Member State/technology combinations which exceed the EU-wide figure.

This two-stage approach gives an opportunity to identify those Member State/technology combinations where exploitation of the technology is already well established, and continues to expand. It also highlights those Member States where a technology may be in its initial stages of take-up, with a rapid rate of increase in penetration but still with only limited quantities of energy output.

For the six-year period 1993–99, Eurostat data provides comprehensive statistics for all Member States and all energy sources. Although data for many Member States and energy sources are available for 1990–93, some of the annual data in this earlier dataset are not comprehensive. This period also pre-dates the time of greatest activity for renewable energy exploitation for most of the energy sources and Member States. This study therefore uses the 1993–99 dataset to identify the levels of penetration of each renewable energy source in each Member State.

### 3.2. Successful Member State/technology combinations and country-specific trends

The results of applying these two criteria are summarised in Table 2. This shows which Member State/technology combinations meet either of these two criteria. Background data relating to Table 2 are shown in Table 3. Figures 3–8 illustrate graphically the data presented in Table 3, by technology.

Table 2

Application of selection criteria to identify successful Member State/technology combinations for the period 1993–99

Source: Eurostat.

Technology: Selection criteria (see note 1):	Photo- voltaics	Solar thermal	Wind	Biomass: power	Biomass: district heating (1993–98)	Biomass: biofuels (see note 2)
Austria		✓ ✓		✓	✓ ✓	✓
Belgium				✓		
Denmark		✓	✓	✓		
Finland		✓	✓	✓		
France			✓		✓	✓
Germany	✓ ✓	✓ ✓	✓ ✓	✓		✓
Greece		✓				
Ireland		✓	✓			
Italy		✓	✓	✓	✓	✓
Luxembourg						
Netherlands	✓	✓				
Portugal			✓			
Spain	✓ ✓		✓ ✓	✓		
Sweden			✓	✓	✓ ✓	
UK		✓				

A tick (✓) indicates that the selection criterion was met, except in the case of biofuels (note 2 below).

Biomass power includes combined heat and power and refers to electricity output only; biomass district heating refers to heat output from heat plants only.

Note 1: Two criteria for selection are used:

✓ (left) represents a contribution of at least 10 % of the total EU increase in absolute terms, 1993–99;

✓ (right) represents a percentage increase greater than the EU percentage increase, 1993–99.

Note 2: Biofuels only:

✓ represents those Member States which indicate that they use biofuels (most do not).

Application of selection criteria to identify successful Member State/technology combinations, 1993–99  
Background data relating to Table 2

Table 3

	Photovoltaics		Solar thermal		Wind		Biomass power		Biomass district heating	
	1993–99		1993–99		1993–99		1993–99		1993–98	
	Absolute increase (GWh)	% increase	Absolute increase (ktoe)	% increase	Absolute increase (GWh)	% increase	Absolute increase (GWh)	% increase	Absolute increase (ktoe)	% increase
Austria	1.4	233	37.1	150	42.0		574.9	59	47.5	62
Belgium	0		0		4.9	60	140.3	238	0	
Denmark	0		3.7	100	1 994.8	193	316.0	189	-15.3	-8
Finland	0		0.2	8 270	45.0	1 125	2 697.0	47	20.2	33
France	0		4.2	30	32.5	928	223.0	18	9.0	113
Germany	32.0	1 070	54.4	260	4 854.0	720	258.0	61	0	
Greece	0		31.9	34	114.5	241	0		0	
Ireland	0		0.1	90	171.9	1 138	0		0	
Italy	5.3	50	3.7	70	398.6	9 059	241.3	812	3.2	58
Luxembourg	0		0		18.0		0		0	
Netherlands	5.3	757	4.0	140	471.0	270	0		0	
Portugal	0.5	100	2.9	20	112.0	1 018	179.0	20	0	
Spain	15.8	1 330	6.5	30	2 628.0	2 266	432.0	89	0.5	
Sweden	0		0.6	10	319.3	618	898.0	42	205.4	56
United Kingdom	1.0		4.8	90	678.0	310	0		0	
EU increase 1993–99:	61.3	358	154.1	65	11 884.5	502	5 959.5	50	270.5	39
10 % of EU increase 1993–99:	6.1		15.4		1 188.5		596.0		27.1	
Criteria thresholds used:	Higher than 6.1 GWh	Higher than 358 %	Higher than 15.4 ktoe	Higher than 65 %	Higher than 1 189 GWh	Higher than 502 %	Higher than 596 GWh	Higher than 50 %	Higher than 27 ktoe	Higher than 39 %

Data in shaded cells meet the selection criteria, that is:

- at least 10 % of the total EU increase;
- a percentage increase greater than that for the EU.

Blank cells indicate that the value for 1993 is equal to zero.

Biomass in power includes combined heat and power and refers to electricity output only; biomass district heating refers to heat output from heat plants only, and data refer to the period 1993–98.

Source: Eurostat.

Figure 3 Photovoltaics: absolute and % increase in generation, 1993–99

Source: Eurostat.

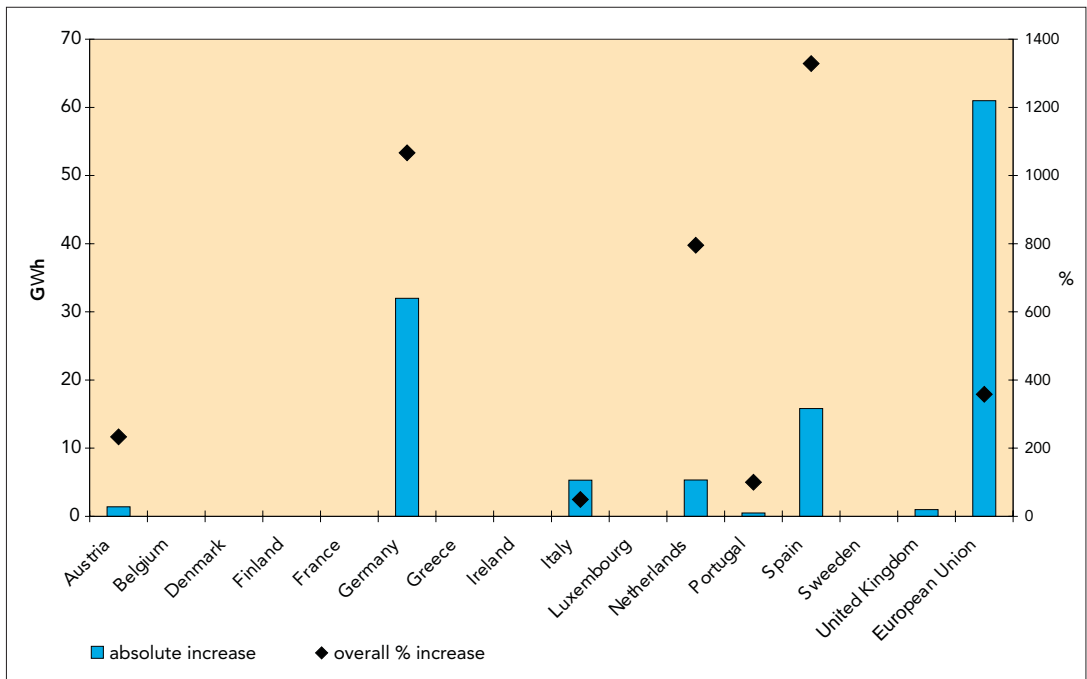
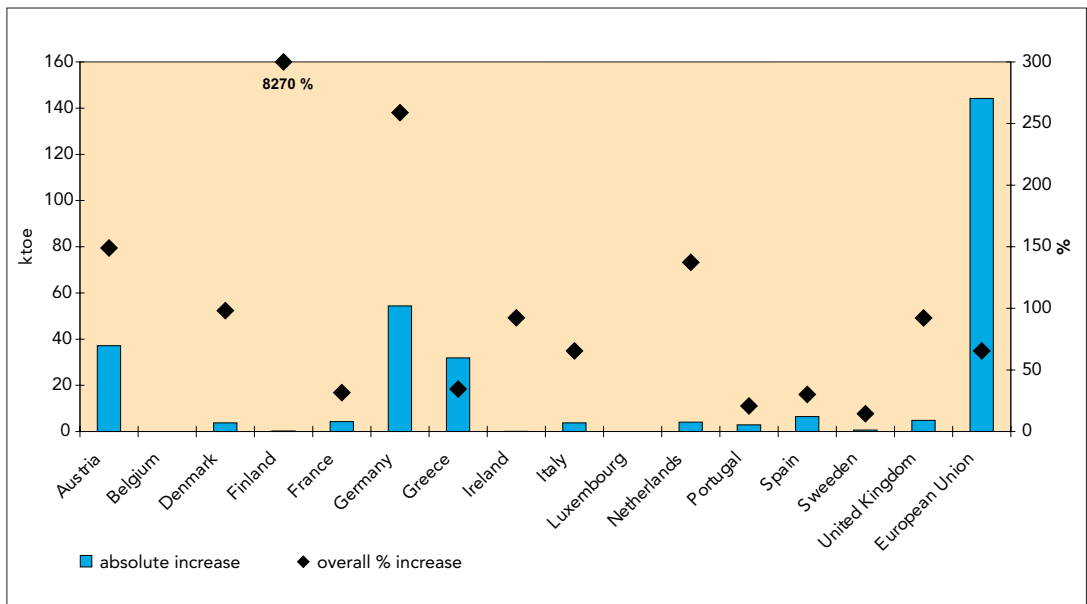


Figure 4 Solar thermal: absolute and % increase in generation, 1993–99

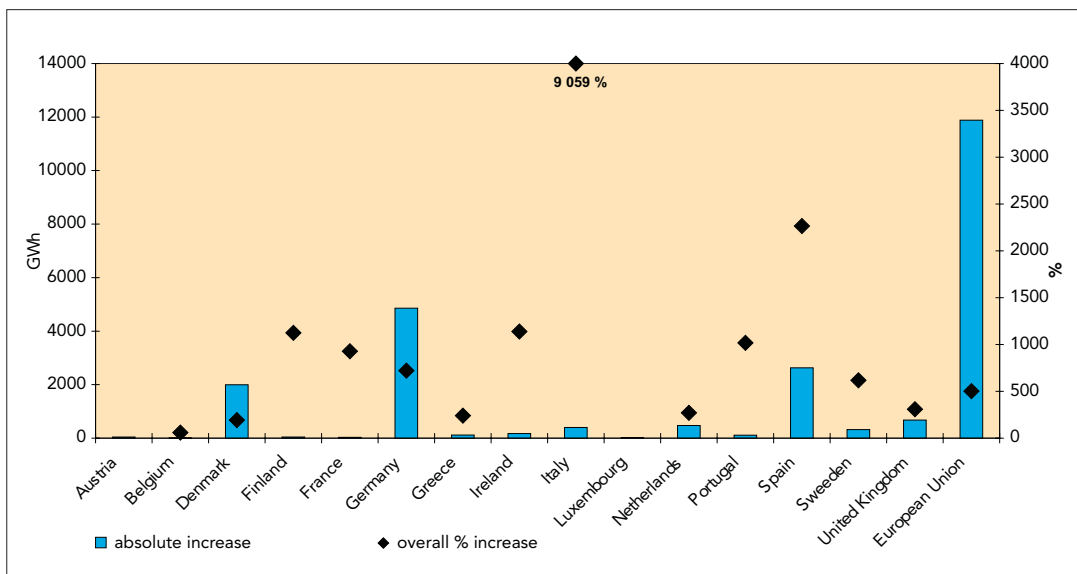
Source: Eurostat.



Wind: absolute and % increase in generation, 1993–99

Figure 5

Source: Eurostat.



Biomass power generation and combined heat and power: absolute and percentage increase in generation, 1993–99

Figure 6

Source: Eurostat.

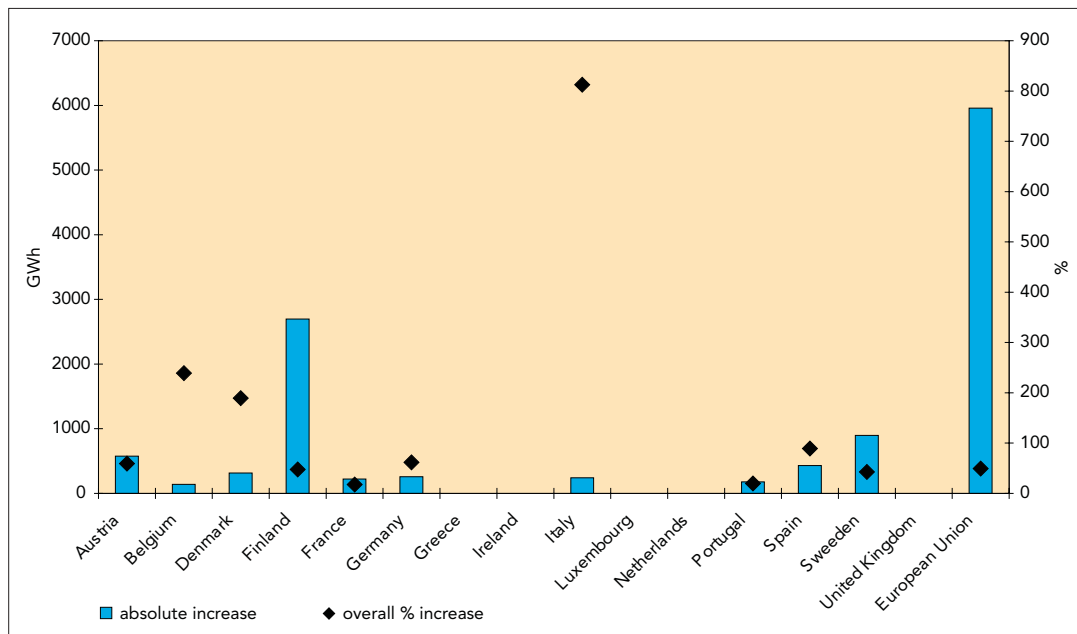


Figure 7 Biomass district heating: absolute and % increase in generation, 1993–98

Source: Eurostat.

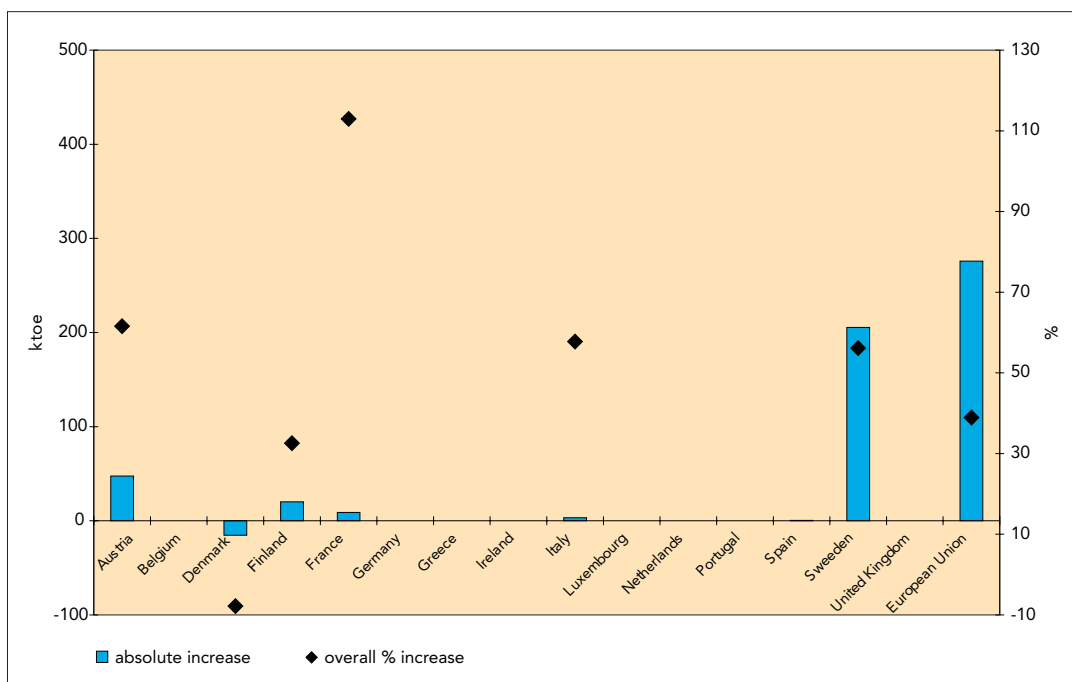


Figure 8 Liquid biofuels production in the EU, 1993–99

Source: Eurostat.

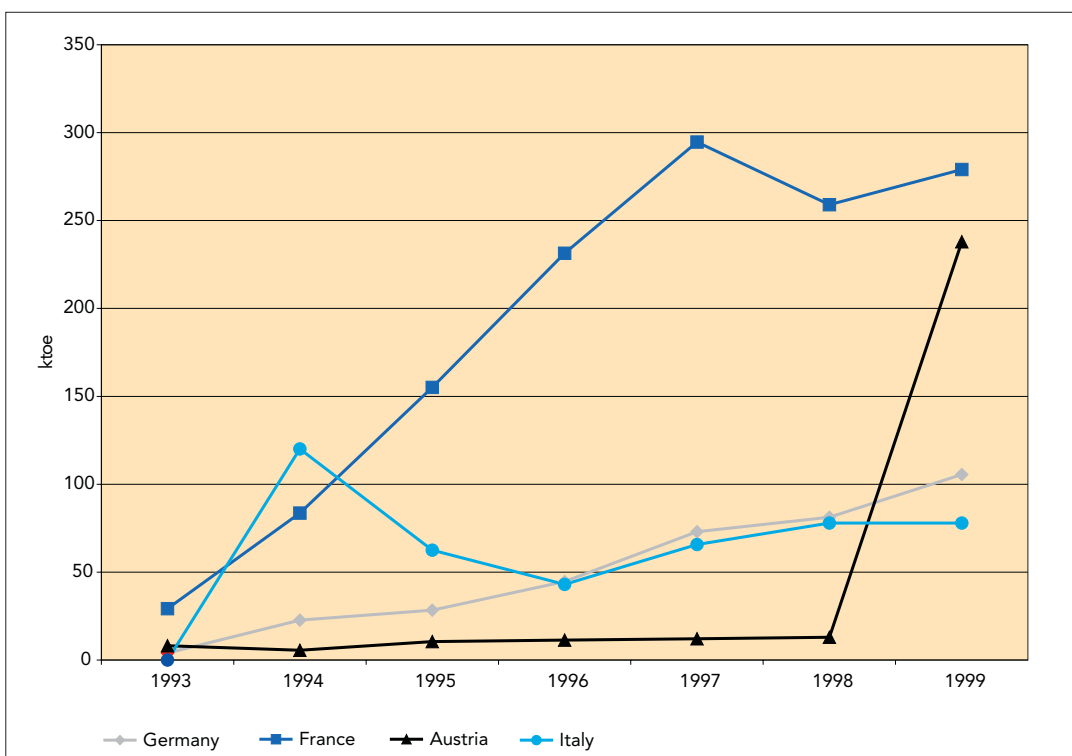


Table 2, Table 3 and Figures 3–8 show that the overall increase in renewable energy penetration achieved in the EU is not shared equally among the 15 Member States.

In terms of the absolute increase in renewable energy penetration, for most of the technologies only a few Member States contributed more than 10 % (each) of the total new resource output for the EU over the six-year period 1993–99<sup>(12)</sup>:

- two Member States (Germany and Spain) contributed 78 % of the new total EU output from photovoltaics;
- three Member States (Austria, Germany and Greece) contributed 80 % of new solar thermal installations;
- three Member States (Denmark, Germany and Spain) contributed 80 % of new wind output;
- two Member States (Finland and Sweden) contributed 60 % of new generation from biomass fuelled power stations (including biomass combined heat and power stations);
- two Member States (Austria and Sweden) dominated the increase in output from biomass district heating installations. Denmark's policy of replacing heat-only biomass district heating plants with biomass combined heat and power generation was evident from its reduced output over the period 1993–98;
- only four Member States use biofuels to any significant extent. France is the market leader, producing about 40 % of the total.

When the second selection criterion is applied, a greater number of Member States achieved a percentage increase in output higher than the percentage figure for the EU as a whole over the period 1993–99<sup>(13)</sup>. Three Member States surpassed the EU percentage figure for photovoltaics. For solar thermal and wind, eight Member States exceeded the EU figure and for biomass in power stations (including combined heat and power stations) six Member States exceeded the EU figure over this period. The data for biomass district heating show that over the period 1993–98, only four Member States achieved percentage increases higher than that for the total EU.

Only a few Member State/technology combinations recorded positives for both criteria, i.e. a rapid **and** a significant increase in renewable energy output over the period (see Tables 2 and 3). Germany achieved the greatest levels of new renewable penetration over the period and met both of the criteria for all the technologies except biomass. Positive combinations are also highlighted in some other Member States — in Spain (photovoltaics and wind), Sweden (biomass district heating) and Austria (solar thermal and biomass district heating).

Many Member States show either a large absolute increase in renewable energy output for individual technologies, **or** a large percentage increase. The fact that only a small number of Member State/technology combinations meet both of the criteria usually relates to their starting level of renewable energy output for the technology in 1993. Thus Member States with only very low initial levels of renewable energy use may demonstrate rapid growth rates even though the actual quantity of output is still only small. Examples here include Finland, which increased its solar thermal output over the period by 8 270 %, but in absolute terms output rose by a very small quantity (0.2 ktoe).

Conversely, Member States with levels of renewable energy use that were already relatively high in 1993 show a less rapid percentage growth rate, but these Member States may still have added significant quantities to the overall output. For example, Denmark's wind industry was already well established by 1993, but it added a further 1 995 GWh by 1999, an increase of 193 %. In Finland, power from biomass was already high in 1993, but continued to expand steadily, adding 2 697 GWh over the period, a 47 % increase over the 1993 level.

One Member State (Luxembourg) did not meet either of the two criteria for any of the technologies, while Belgium, Greece, Portugal and the UK met one of the criteria only once.

(12) For biomass district heating, the period examined was 1993–98.

(13) *Idem*.