POCKETBOOK

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sources statistics in the EU, Iceland and Norway

Data 1989-2000

Part 1

8

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Contents

Introduction

In the late 80's very few statistics existed on renewable energy either at the EU level or in the Member States. At the time only data on electricity generation from large hydro plants were collected regularly. The Council Recommendation of 9 June, 1988 (88/349/EEC) stipulates that the Member States, in collaboration with Eurostat, should establish a statistical system for data collection on Renewable Energy Sources.

Main actions

- 1990: The first data collection was launched, with 1989 as the reference year. Creation of a network of national centres of expertise (Ministries, Energy Agencies, Statistical offices) at national level.
- 1991-99: Revision and finalisation for the data collection methodology, in collaboration with the Member States. Collection of statistics continued on an annual basis and was financed partially by the Commission (DG Energy - Altener Programme), Eurostat and DG R&D). Member States presented their national results in various national publications. The repetition of data collection allowed Member States to improve the quality of statistics for certain applications as well as to bring the project to a level of routine activity. Specific surveys were also performed for difficult applications, either as a result of this project or as a result of other surveys initiated by Eurostat (e.g. households, services, combined heat and power plants).
- 2000: Member States agreed to undertake the entire cost of this data collection and reporting to Eurostat in the future. For this purpose Eurostat created a new questionnaire to be used in conjunction with the existing four questionnaires covering conventional fuels. This questionnaire fully meets the requirements of DG TREN, and will also be used for data collection in all OECD countries (Joint Eurostat/IEA/UNECE questionnaire).

Project Results

This project, a joint effort of Eurostat, DG TREN and DG R&D has provided the following concrete results:

- Reference statistics for setting and monitoring Community quantitative targets on the contribution of renewable energy sources,
- Four specific publications with statistics and the methodology used,
- A database with detailed information on RES from 1989 to 2000,
- Expertise developed by the national statistical systems in providing harmonised statistics.

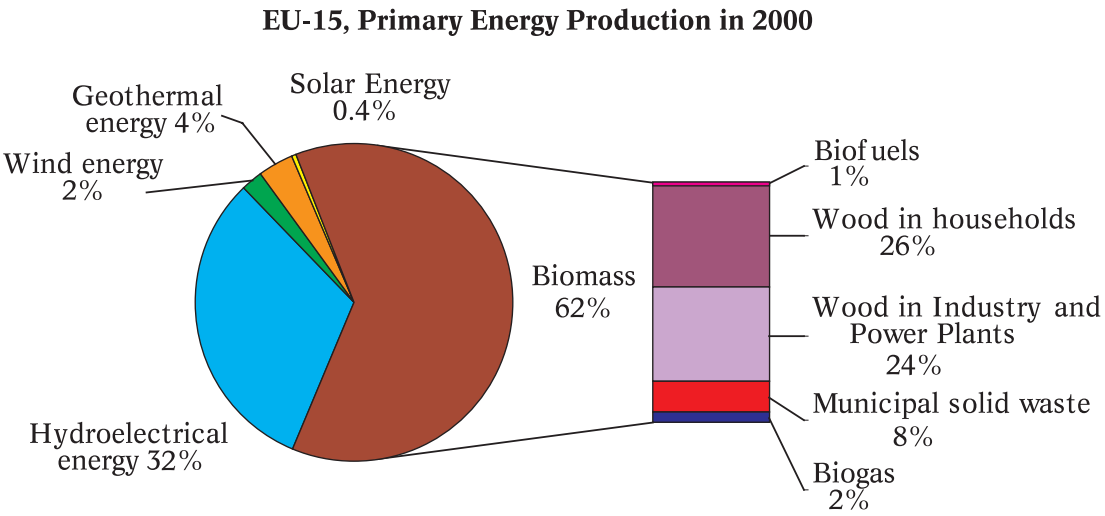
This publication contains the main renewable energy data and indicators for the period 1989 to 2000 for the European Union, Norway and Iceland based on statistics collected by Eurostat and financed in the framework of the Altener programme, Directorate General for Energy and Transport. The information was compiled by the Centre for Renewable Energy Sources, CRES, Greece and the Institute for the Diversification and Energy Saving, IDAE, Spain.

Renewable Energy Sources Statistics
EU - 15 Data

Glossary

CAP	Common Agricultural Policy
CHP	Combined Heat and Power
EU	European Union
GIC	Gross Inland Consumption
MSW	Municipal Solid Waste
NCV	Net Calorific Value
PV	Photovoltaic
RES	Renewable Energy Sources
WECs	Wind Energy Converters
kJ	Kilojoule
MJ	Megajoule
TJ	Terajoule
ktoe	Thousand tonnes of oil equivalent
Mtoe	Million tonnes of oil equivalent
kWp	Kilowatt peak
MW	Megawatt
MW_{th}	Megawatt thermal
MW_e	Megawatt electric
MWh	Megawatthour
GW	Gigawatt
GWh	Gigawatthour
TWh	Terawatthour
na	Not Available

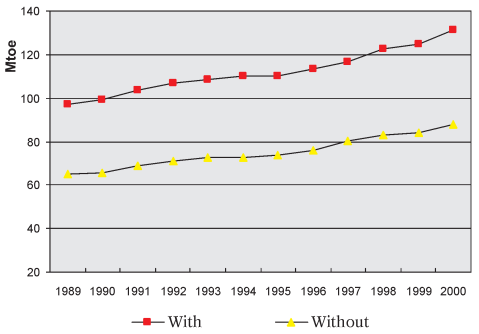
ktoe	1989	1995	2000	Average Annual Increase per period 89-95	95-00	89-00
All Fuels	**719 962**	**736 563**	**758 694**	**0.4%**	**0.6%**	**0.5%**
Renewables	**65 010**	**73 505**	**87 645**	**2%**	**4%**	**3%**
WIND	45	350	1931	41%	41%	41%
SOLAR	127	242	364	11%	9%	10%
HYDRO	21 619	24 948	27 663	2%	2%	2%
GEOTHERMAL	2 216	2 517	3 335	2%	6%	4%
BIOMASS incl. BIOFUELS	41 002	45 450	54 352	2%	4%	3%
Total RES Electricity Generation (TWh)	**271**	**321**	**388**	**3%**	**4%**	**3%**


EU-15, Primary Energy Production in 2000
Geothermal energy 4%
Solar Energy 0.4%
Wind energy 2%
Hydroelectrical energy 32%
Biomass 62%
Biofuels 1%
Wood in households 26%
Wood in Industry and Power Plants 24%
Municipal solid waste 8%
Biogas 2%

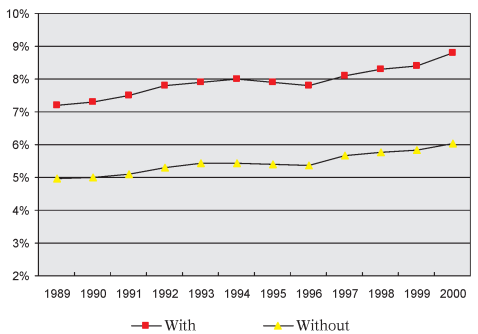
Primary energy production from RES in EU-15					
Year	**Primary energy production from RES (ktoe)**	**Total primary production (ktoe)**	**Total inland consumption (ktoe)**	**Contribution of RES to total primary production**	**Contribution of RES to total inland consumption**
1989	65 010	719 962	1 310 261	9.0%	5.0%
1990	65 760	705 705	1 319 239	9.3%	5.0%
1991	68 830	707 474	1 346 604	9.7%	5.1%
1992	70 810	701 893	1 336 150	10.1%	5.3%
1993	72 440	709 102	1 336 212	10.2%	5.4%
1994	72 772	722 754	1 336 436	10.1%	5.4%
1995	73 506	736 511	1 363 797	10.0%	5.4%
1996	76 079	762 107	1 413 344	10.0%	5.4%
1997	80 064	755 897	1 410 318	10.6%	5.7%
1998	82 996	750 562	1 436 907	11.1%	5.8%
1999	84 245	764 518	1 444 142	11.0%	5.8%
2000	87 635	758 681	1 455 105	11.6%	6.0%

The application of the **substitution principle** shows that if the electricity generated from hydropower, wind, geothermal, biomass and photovoltaic systems had been produced from a conventional power station (where 220 toe of primary energy are required to produce 1 GWh), renewable energy in the year 2000 in the European Union (EU 15) would have contributed 16.4% to total primary energy production.

Primary Energy Production from RES
with or without the substitution principle

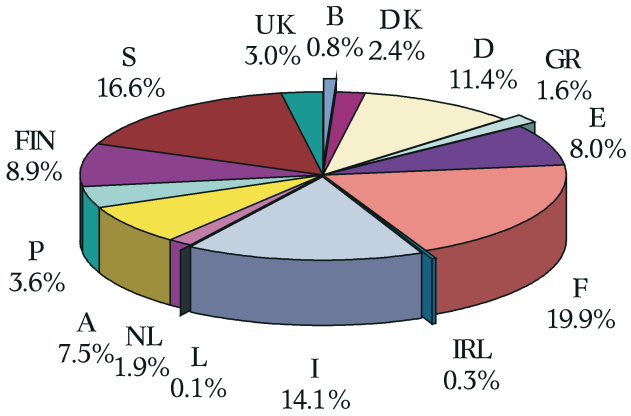


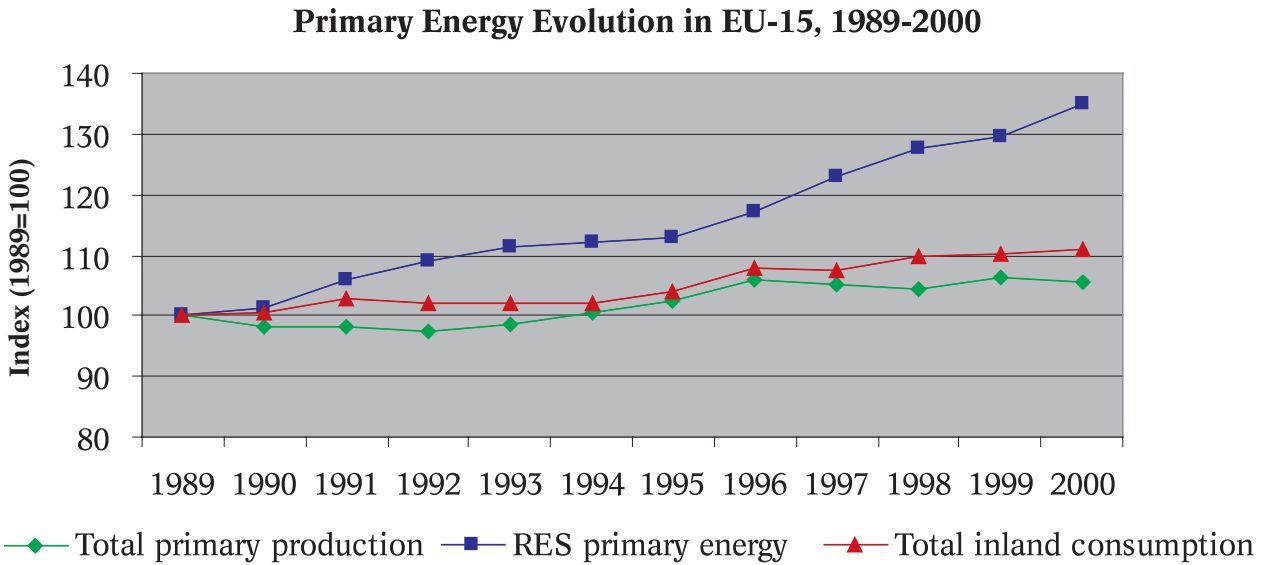
Contribution of RES to Total Inland Consumption
with or without the substitution principle



Primary energy production of renewable energy sources in the European Union (EU-15) in 1989 was 65 Mtoe, representing 9.0% of overall primary energy production. The increase to 88 Mtoe over the period 1989-2000, resulted in a higher contribution to primary production (11.6% in 2000).

Member States Contribution to EU-15 RES Primary Energy Production in 2000




Primary Energy Evolution in EU-15, 1989-2000
Index (1989=100)
140
130
120
110
100
90
80
1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000
Total primary production
RES primary energy
Total inland consumption

Inland Consumption

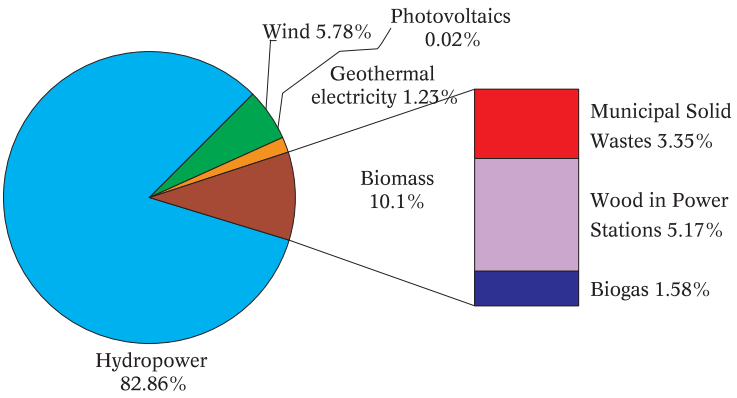
Renewable energy sources accounted for 5.0% of the total inland consumption in the European Union (EU-15) in 1989. This percentage was increased to 6.0% in 2000. In the European Union, hydro and biomass/wastes are the major renewable energy sources while geothermal, solar and wind energy, make a smaller contribution. The use of biomass/wastes is predominantly in the form of firewood consumption in households, although wood waste burned in industry and municipal solid waste incineration, contribute significantly.

* Gross Electricity Consumption of a country or a region is the sum of the Gross Electricity Production plus the net imports of electricity in the country or the region.

RES Contribution in 2000			
Country	To Total Primary Production	To Total Inland Consumption	To Gross Electricity Consumption*
B	5.6%	1.3%	1.5%
DK	7.7%	10.8%	17.1%
D	7.6%	2.9%	6.8%
GR	14.1%	5.0%	7.7%
E	22.5%	5.7%	15.7%
F	13.4%	6.8%	15.0%
IRL	11.3%	1.8%	4.9%
I	40.5%	7.0%	16.1%
L	100.0%	1.6%	2.9%
NL	2.9%	2.1%	3.9%
A	69.9%	23.2%	71.5%
P	100.0%	13.0%	29.4%
FIN	52.7%	23.9%	28.5%
S	49.3%	30.7%	55.3%
UK	1.0%	1.1%	2.7%
EU-15	**11.6%**	**6.0%**	**14.7%**

Electricity Generation

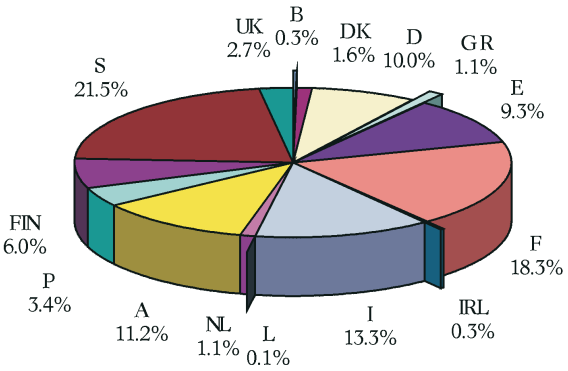
In 2000, electricity generation in the European Union (EU-15) from renewable energy sources was 388 TWh, representing 14.7% of the Gross Electricity Consumption and coming essentially from hydropower plants (321 TWh in 2000). Looking at electricity generation from biomass/wastes (39.2 TWh in 2000), municipal solid wastes (13.0 TWh) account for 33.2% of the total electricity from biomass, while wood/wood waste and agricultural solid wastes burned in power stations (20 TWh) for 51.1%, with the remainder being generated from biogas. In 1989, 528 GWh were generated from wind turbines whose total installed capacity was 354 MW at that time, while in 2000, 22 434 GWh were generated from an installed capacity of 12 792 MW.



Electricity Generation from RES in EU-15

Year	Electricity Generation from RES (TWh)	Gross Electricity Consumption (TWh)	Contribution of RES to Gross Electricity Consumption
1989	271	2 044	13.3%
1990	279	2 086	13.4%
1991	289	2 238	12.9%
1992	309	2 251	13.7%
1993	315	2 254	14.0%
1994	325	2 287	14.2%
1995	321	2 345	13.7%
1996	324	2 410	13.5%
1997	335	2 434	13.8%
1998	353	2 506	14.1%
1999	360	2 555	14.1%
2000	388	2 641	14.7%

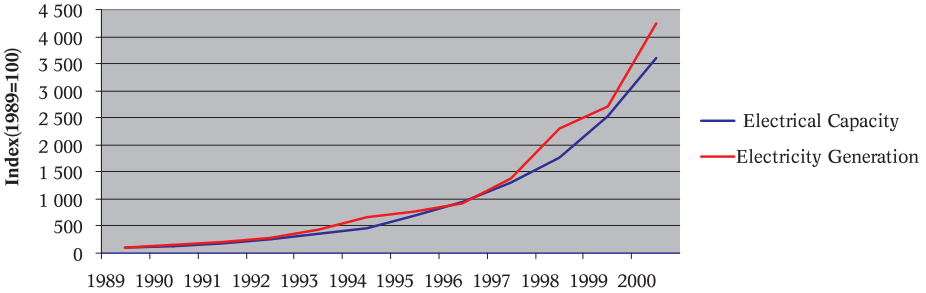
Member States Contribution to EU-15 RES Electricity Generation in 2000



Wind

In 2000, the installed capacity of wind energy converters in EU-15 was 12 792 MW, generating 22 434 GWh of electricity (1931 ktoe). Since 1989, installed capacity has increased by a factor of 36 while electricity generation has risen by a factor of almost forty-two. The average annual increase of the electricity generated by wind energy converters in the period 1995-2000 is 41%.

Wind Energy Trend in EU-15, 1989-2000



Hydropower

Hydropower is the second largest renewable energy source in EU-15 in terms of primary energy production, accounting for 31.6% (27 663 ktoe) of total RES primary energy production in 2000. By the end of 2000, installed capacity was 94 620 MW, showing an increase of 11.2% over the period 1989-2000. It must be stressed that the potential of large-scale plants in the European Union has almost already been exploited.

Hydropower in EU-15

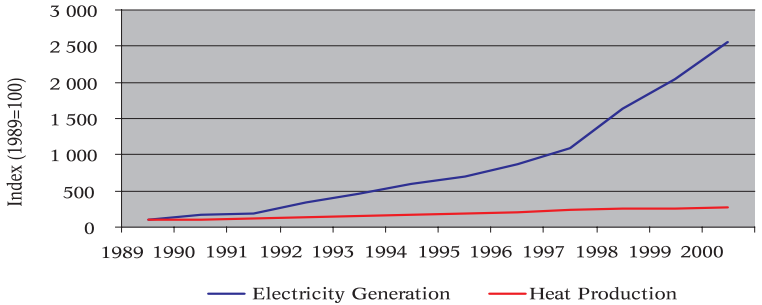
Year	Installed Capacity (MW)	of which < 10 MW	Primary energy production (ktoe)	Electricity generation (TWh)	Contribution of Hydro Electricity in Total RES Electricity
1989	85 055	8 495	21 619	251	93%
1990	85 659	8 604	22 275	259	93%
1991	86 320	8 702	23 085	268	93%
1992	86 739	8 812	24 587	286	93%
1993	87 430	9 084	24 883	289	92%
1994	91 019	9 268	25 536	297	91%
1995	91 380	9 417	24 948	290	90%
1996	91 756	9 653	24 816	288	89%
1997	92 972	9 755	25 454	296	88%
1998	93 614	9 845	26 265	305	86%
1999	93 440	9 870	26 319	306	85%
2000	94 620	9 708	27 663	321	83%

Solar energy

In 2000, the total installed surface of solar collectors in EU-15 was 10.4 million square metres. Primary energy production was 356 ktoe, i.e. 0.4% of total EU-15 RES primary energy. Production has almost tripled over the reference period. About 29% of the total surface area of installed solar collectors in EU-15 was located in Germany, 29% in Greece and 18% in Austria while the shares to the total heat production are 26%, 28% and 13% for Germany, Greece and Austria respectively.

Installed capacity of photovoltaic (PV) panels in EU-15 by the end of 2000 was 88 MWp, which means an increase of twenty times the 1989 capacity of 4.4 MWp. Electricity generation has risen by a factor of twenty six from 1989 (4 GWh) to 2000 (96 GWh). Significant reductions in cost due to the use of cheaper materials, together with promotion policies in some Member States, have resulted in significant development of PV panels mainly in small-scale stand-alone applications. Germany had the largest PV capacity in EU-15 in 2000 with more than 40 MW.

Solar Energy Evolution in EU-15, 1989-2000



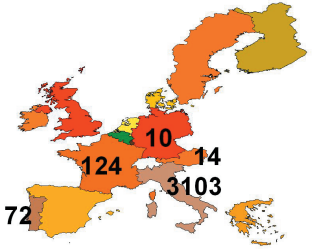
Geothermal Energy

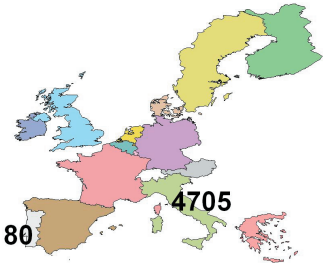
Primary production of geothermal energy was 3 335 ktoe in 2000, which represented 3.8% of total RES primary energy in EU-15. The main contributing Member State is Italy with 3 103 ktoe in 2000 with a share of 93%.

In EU-15, electricity production and installed capacity of geothermal power plants in 2000 were 4 785 GWh and 644 MWe respectively, i.e. an increase of 51.4% in generation and 21.6% in capacity since 1989. Electricity generation is almost exclusively confined to Italy (4 705 GWh) due to the high enthalpy geothermal resources while minor contributions were made by Portugal (80 GWh).

In contrast to the use of geothermal heat for electricity generation, the direct end-use of low enthalpy geothermal heat is more widely spread across the European Union and serves mainly in district heating and agriculture.

Countries with more than 10 ktoe Primary Production

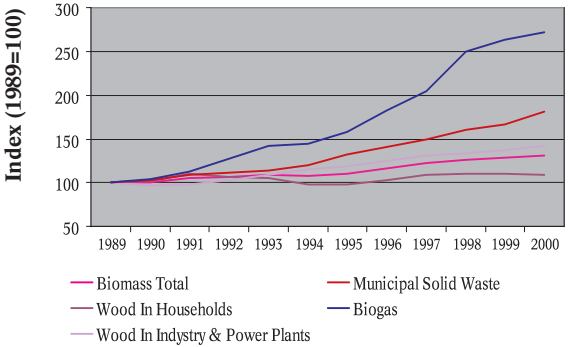




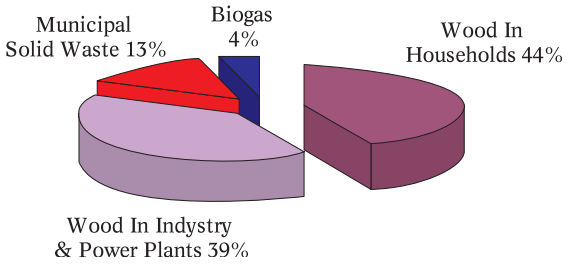
Electricity Producing Countries (GWh)

Biomass/Wastes

Biomass/Wastes are the most important renewable energy sources in EU-15.
Biomass/wastes contributed 53 690 ktoe of primary energy production in EU-15 in 2000, representing 61.3% (62.0% including Biofuels) of total RES energy production. They are mainly used to produce heat, the electricity generation being 39.2 TWh in 2000.



The Breakdown of Biomass in 2000



Municipal Solid Waste incineration

Incineration is the method used most frequently to recover energy from wastes disposed of by households, industry and the tertiary sector. In 2000, primary energy production of Municipal Solid Wastes, was 7 243 ktoe, i.e. an increase of 81% since 1989, representing about 13.5% of the total primary energy production from biomass/wastes. In Europe, electricity generation from MSW was 13.0 TWh in 2000, showing an increase of 169% since 1989. It represented 33.2% of total electricity generation from biomass/wastes. It must be noticed that, in the above figures, no distinction between biodegradable and non-biodegradable Waste is made.

It must be noticed that although the above data include both biodegradable and non-biodegradable MSW, the statistical system is now adapted to the requirements of the new Directive on electricity from renewables and future statistics will exclude the non-biodegradable part from the production and consumption of Municipal Solid Wastes.

Year	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Primary Production (ktoe)	4 006	4 103	4 376	4 440	4 548	4 811	5 283	5 648	5 968	6 406	6 685	7 243
Primary Production (index 1989=100)	100	102	109	111	114	120	132	141	149	160	167	181

Wood/Wood Wastes/Other Solid Wastes

The combustion of firewood and forestry/agricultural solid wastes is the major RES technology in EU-15, accounting for 82.5% of total primary energy production from biomass/wastes and 50.5% of the total RES energy production. The principal fuels used are firewood and wood waste (wood chips, bark etc.), while there are minor contributions from black liquor, straw and other agricultural wastes.

Firewood consumption in households was 23 182 ktoe in 2000. France (7 407 ktoe), Germany (3 727 ktoe), Italy (3 614 ktoe) and Spain (2 049 ktoe) show significant levels of firewood consumption for domestic heating. It should be noted here that accurate statistics on firewood consumption can only be obtained with surveys.

The quantity of wood and wood waste used in power stations and industry for electricity and/or heat production was 21 100 ktoe in 2000, while electricity generation was 20.0 TWh, as mentioned above.

Primary Production of Wood, Wood Waste and Other Solid Waste (index 1989=100)

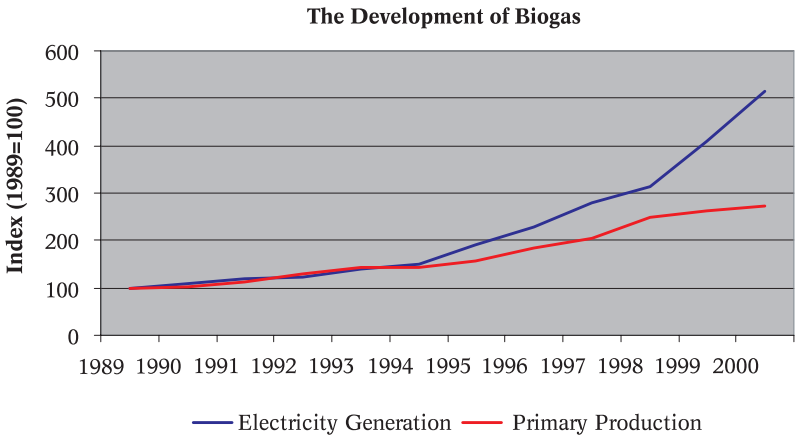
Year	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
In Households	100	102	110	107	106	98	98	102	109	111	111	109
In Power Stations and Industry	100	97	98	102	110	115	119	125	131	134	137	142

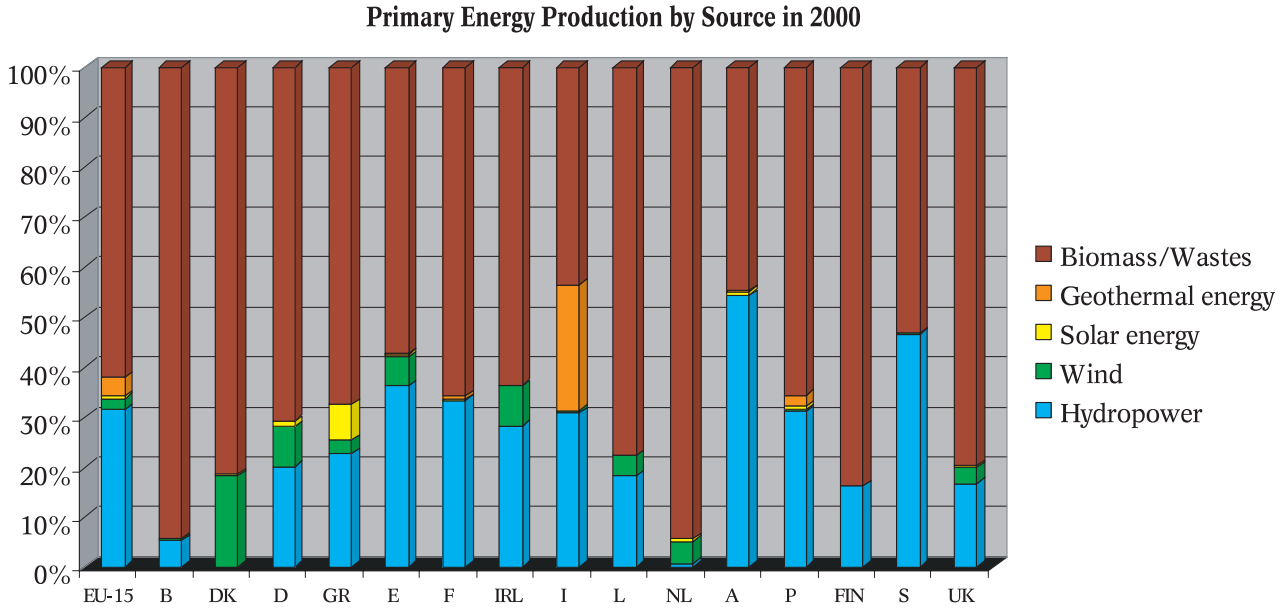
Biogas

The anaerobic fermentation of organic wastes is a practice that has been rapidly expanding in EU-15. Whereas it is an activity that takes place mainly for environmental reasons, energy recovery is a welcomed by-product. In EU-15, biogas energy production was 2 164 ktoe in 2000, mainly from landfill gas and sewage sludge gas. Electricity generation from biogas in EU-15 was 6.1 TWh in 2000, mainly from landfill gas.

Biofuels

Primary energy production of liquid biofuels in EU-15 has increased significantly since 1989 and attained 663 ktoe in 2000.




Primary Energy Production by Source in 2000
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
EU-15
B
DK
D
GR
E
F
IRL
I
L
NL
A
P
FIN
S
UK
Biomass/Wastes
Geothermal energy
Solar energy
Wind
Hydropower

Electricity Generation by Source in 2000