

## EN30 Renewable Electricity

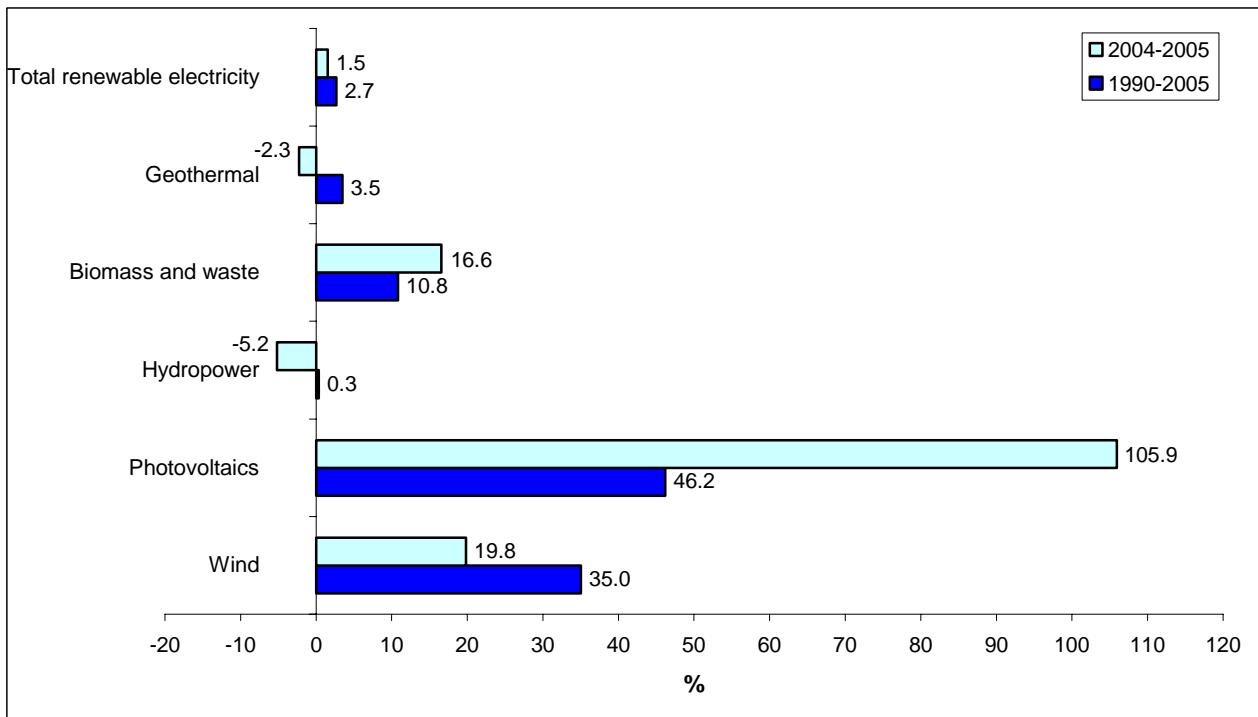
### Key message

The share of renewable energy in EU-27 electricity consumption grew only slightly over the period 1990-2005 to reach 14 %, despite a substantial increase in the total amount of renewable electricity generation (up by 48 % since 1990). Hydro production fell in 2005 as a result of lower rainfall. Production from wind increased by 20 % in the last year (similar to biomass), and that from photovoltaics more than doubled. However, significant further growth will be needed to meet the EU indicative target of a 21 % share of renewables in electricity by 2010 and beyond this the new target of 20 % renewables (in final energy consumption) agreed by the Council in March 2007.

### Rationale

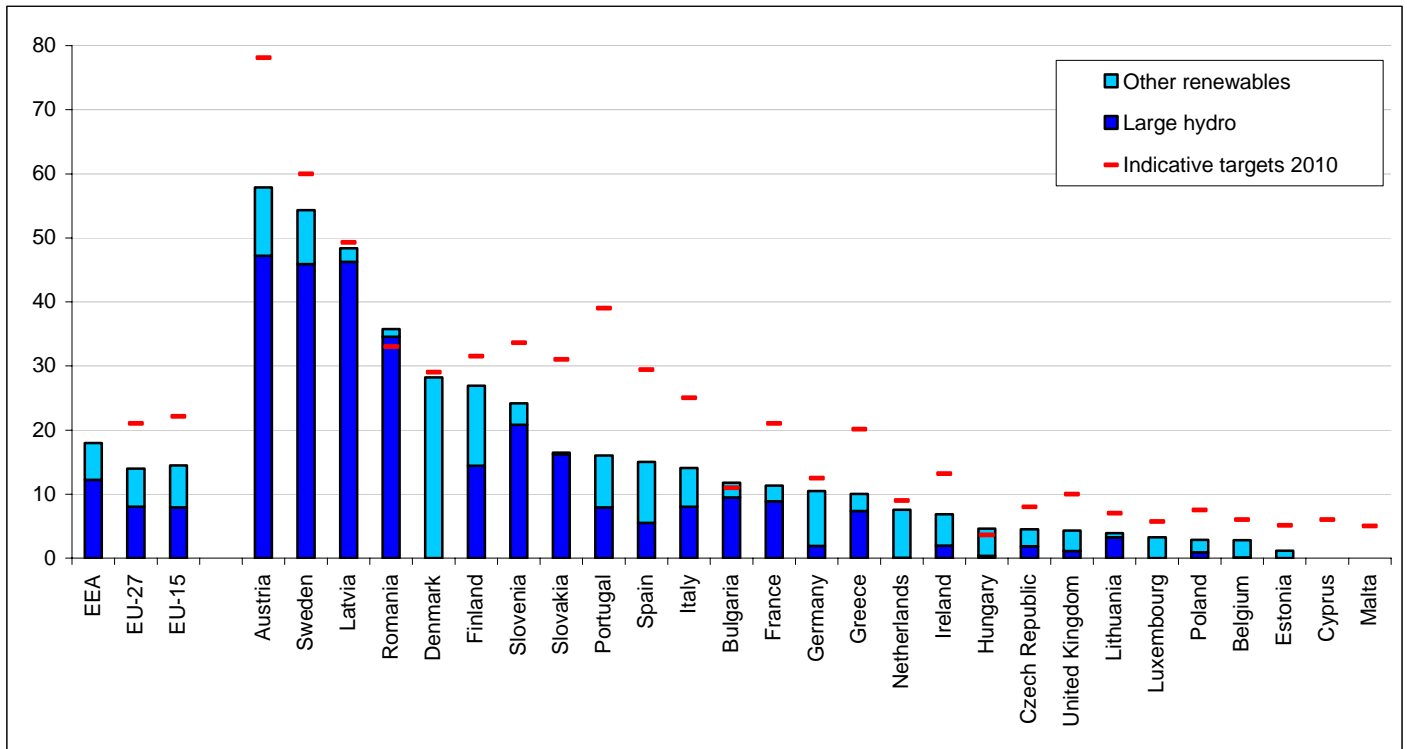
Electricity produced from renewable energy sources is generally considered more environmentally benign with almost no CO<sub>2</sub> emissions. An increased share of renewable electricity will thus help the EU to meet its Kyoto target and various renewable energy targets mentioned above.

Fig. 1: Average annual growth rates 1990-2005 and 2003-2005



Data source: Eurostat

**Fig. 2: Renewable electricity as a percentage of gross electricity consumption, 2005**



Data source: Eurostat

**Note:** The renewable electricity directive (2001/77/EC) defines renewable electricity as the share of electricity produced from renewable energy sources in total electricity consumption. The latter includes imports and exports of electricity. The electricity generated from pumping in hydropower plants is included in total electricity consumption but it is not included as a renewable source of energy. Large hydropower plants have a capacity of more than 10 MW.

## 1. Indicator assessment

Renewable energy makes an important contribution to meeting electricity consumption, with a share of 14 % in 2005. However, this share has only grown slightly since 1990, where it was about 12 %, despite increasing substantially in absolute terms. Renewable electricity production grew by 48 % over the period 1990 to 2005 - faster than the growth in overall electricity consumption (a 24 % increase over the same period). On average, the share of large hydro in gross electricity consumption has declined since 2001 as a result of lower rainfall. This reduction has been more than offset by the increase in other renewable sources. Very strong growth in electricity production can be observed for wind, photovoltaics and biomass-fired power stations. Hydropower still dominates renewable electricity production in most Member States with approximately a share of 2/3 across the EU-27 in 2005. This compares with just above 17 % coming from biomass and waste, 15 % from wind and the rest from geothermal (1.2 %), and solar (0.3 %).

There are significant differences in the share of renewables between the EU-27 Member States. These reflect differences in the availability of natural resources in each country and the policies chosen to support the development of renewable energy. Amongst the EU-27 in 2005, Austria, Sweden and Latvia had the greatest shares of renewable electricity, including large hydropower, in gross electricity consumption. Denmark shows the largest share of renewable electricity when large hydropower is excluded.

Despite the introduction of policies promoting the development of renewable energy in EU Member States, substantial additional production will be required to meet the EU renewable electricity indicative target of 21 % by 2010 set in Directive 2001/77/EC; particularly given the expected increase in gross electricity consumption over this period. While large hydropower accounts for almost two-thirds of renewable electricity production, it is unlikely to increase substantially in the future due to environmental concerns and a lack of suitable sites, particularly within EU-15. Other renewable energy sources, such as wind, biomass, solar and small-scale hydropower will therefore have to grow substantially if the 2010 target is to be met.

The 2004 communication from the European Commission expects the share of renewable electricity for the EU-15 at between 18 and 19 % in 2010 on the basis of currently implemented policies (EC, 2004), still short of the 21 % indicative target. More recently (10/01/2007) the Commission issued a report on the progress made towards the 2010 renewable electricity target, showing that the overall share of renewable electricity will fall just short of the target, reaching 19 % by 2010.

More recently, the European Council of 8-9 March 2007 endorsed a binding target of a 20 % share of renewable energies in overall EU energy consumption by 2020. Therefore, even larger contributions from renewable electricity can be expected in order to meet the overall renewables target. According to the Council, differentiated national overall targets should be derived from the overall renewables target, leaving it to Member States to decide on national targets for each specific sector of renewable energies (electricity, heating and cooling, biofuels).

Projections:

The projections from POLES and WEO 2007 show an increase in the share of renewable electricity. The share shown by the Baseline Scenario in 2020 of POLES does not meet the set target for the EU in 2010. The GHG Reduction Scenario only exceeds it marginally by 2.3%. In the WEO 2007 scenarios the share of wind energy grows rapidly, between 2005 and 2020 the production from wind energy increases almost five times. The steep increase of PV will also continue. Between 2005 and 2020 the absolute amount of electricity generated by PV increases more than tenfold. However, its relative share remains quite low.

**Fig. 3: Share of renewable electricity in gross electricity consumption in EU-27, 2020**

	(IPTS) POLES		(IEA) WEO 2007	
	Baseline	GHG Reduction	Reference	Alternative Policy
<b>Total renewable electricity</b>	18.8%	23.1%	25.0%	30.1%
<b>Hydro</b>	9.1%	10.4%	10.4%	11.7%
<b>Biomass and waste</b>	9.7%	12.6%	4.4%	5.7%
<b>Wind</b>			9.1%	11.6%
<b>Geothermal</b>			0.2%	0.3%
<b>Solar</b>			0.7%	0.8%
<b>Tide and wave</b>			0.1%	0.1%

Data source: IPTS, IEA

## 2. Indicator rationale

### 2.1 Environmental context

The share of electricity consumption from renewable energy sources provides a broad indication of progress towards reducing the environmental impact of electricity consumption as renewable electricity is generally considered environmentally benign, with very low net emissions of CO<sub>2</sub> per unit of electricity produced, even allowing for emissions associated with the construction of the electricity production facilities. Increasing the share of renewables in electricity consumption will thus help the EU reduce the CO<sub>2</sub> emissions from power generation, although its overall impact has to be seen within the context of the total fuel mix, the extent to which pollution abatement equipment is fitted, and potential impacts on biodiversity.

Emissions of other pollutants are also generally lower for renewable electricity production than for electricity produced from fossil fuels. The exception to this is the incineration of Municipal and Solid Waste (MSW), which due to high costs of separation, usually involves the combustion of some mixed wastes including materials contaminated with heavy metals. Emissions to the atmosphere from MSW incineration are subject to stringent regulations including tight controls on emissions of cadmium, mercury, and other such substances.

The exploitation of renewable energy sources usually has some negative impact on landscapes, habitats and ecosystems, although many impacts can be minimised through careful site selection. Large hydropower schemes in particular can have adverse impacts including flooding, disruption of ecosystems and hydrology, and socio-economic impacts if resettlement is required. Some solar photovoltaic schemes require relatively large quantities of heavy metals in their construction and geothermal energy can release pollutant gases carried by hot fluids if not properly controlled. Wind turbines can have visual impacts on the areas in which they are sited. Some types of biomass and biofuel crops have considerable land, water and agricultural input requirements such as fertilisers and pesticides.

### 2.2 Policy context

The original EU Directive on the promotion of electricity from renewable energy sources in the internal electricity market (2001/77/EC) sets an indicative target of 22.1 % of gross EU-15 electricity consumption from renewable sources by 2010. It requires Member States to set and meet annual national indicative targets consistent with the Directive and national Kyoto Protocol commitments. For the new Member States, national indicative targets are included in the Accession Treaty (the EU-10 calculated theoretical aggregate target would be 11.1 %): the 22.1 % target set initially for EU-15 for 2010 became 21.0 % for the EU-25.

**Fig. 4 Share of renewable electricity in gross electricity consumption ( %) 1990-2005 in EEA member countries and 2010 indicative targets**

	1990	1995	2000	2001	2002	2003	2004	2005	2010 targets
EEA	16.6	17.6	18.1	17.8	17.0	16.2	17.5	18.0	-
EU-27	11.9	13.0	13.8	14.4	12.9	12.9	13.9	14.0	21.0
EU-15	12.9	13.8	14.6	15.2	13.5	13.7	14.7	14.5	22.1
World	20.1	20.8	19.8	18.9	18.7	18.4	18.6	18.8	-
MENA	6.7	5.4	4.0	4.2	4.3	4.5	4.3	4.5	-
United States	11.6	10.8	8.3	6.9	8.7	9.0	8.7	8.7	-
China	21.2	19.6	18.7	18.5	17.5	15.5	15.9	16.8	-
Russia	-	21.7	20.0	21.0	19.5	18.2	20.1	19.4	-
Belgium	1.1	1.2	1.5	1.6	1.8	1.8	2.1	2.8	6.0
Bulgaria	4.1	4.2	7.4	4.7	6.0	7.8	8.9	11.8	11.0
Czech Republic	1.9	3.9	3.6	4.0	4.6	2.8	4.0	4.5	8.0
Denmark	2.4	5.8	16.4	17.3	19.9	23.2	27.1	28.2	29.0
Germany	3.8	5.0	6.5	6.5	8.1	8.2	9.5	10.5	12.5
Estonia	0.0	0.1	0.3	0.2	0.5	0.6	0.7	1.1	5.1
Ireland	4.8	4.1	4.9	4.2	5.4	4.3	5.1	6.8	13.2
Greece	5.0	8.4	7.7	5.2	6.2	9.7	9.5	10.0	20.1
Spain	17.2	14.3	15.7	20.7	13.8	21.7	18.5	15.0	29.4
France	14.8	17.8	15.2	16.5	13.7	13.0	12.9	11.3	21.0
Italy	13.9	14.9	16.0	16.8	14.3	13.7	15.9	14.1	25.0
Cyprus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0
Latvia	43.9	47.1	47.7	46.1	39.3	35.4	47.1	48.4	49.3
Lithuania	2.5	3.3	3.4	3.0	3.2	2.8	3.5	3.9	7.0
Luxembourg	2.1	2.2	2.9	1.6	2.8	2.3	3.2	3.2	5.7
Hungary	0.4	0.4	0.5	0.8	0.7	0.9	2.3	4.6	3.6
Malta	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0
Netherlands	1.4	2.1	3.9	4.0	3.6	4.7	5.7	7.5	9.0
Austria	65.4	70.6	72.0	67.4	66.0	53.4	58.7	57.9	78.1
Poland	1.4	1.6	1.7	2.0	2.0	1.6	2.1	2.9	7.5
Portugal	34.5	27.5	29.4	34.2	20.8	36.4	24.4	16.0	39.0
Romania	23.0	28.0	28.8	28.4	30.8	24.3	29.9	35.8	33.0
Slovenia	25.8	29.5	31.7	30.5	25.4	22.0	29.1	24.2	33.6
Slovakia	6.4	17.9	16.9	17.4	18.6	12.0	14.3	16.5	31.0
Finland	24.4	27.0	28.5	25.7	23.7	21.8	28.3	26.9	31.5
Sweden	51.4	48.2	55.4	54.1	46.9	39.9	46.1	54.3	60.0
United Kingdom	1.7	2.0	2.7	2.5	2.9	2.8	3.7	4.3	10.0
Turkey	40.9	41.9	24.3	19.1	25.6	25.2	30.9	24.7	-
Iceland	99.9	99.8	99.9	100.0	99.9	99.9	100.0	99.9	-
Norway	114.6	104.6	112.2	96.2	107.3	92.1	89.7	108.4	-

Data source: Eurostat, IEA, EIA

Note: Almost all electricity generated in Iceland and Norway come from renewable energy sources. The renewable electricity share in Norway is above 100% in some years because a part of the (renewable) electricity generated domestically is exported to other countries. The share of renewable electricity in Germany in 1990 refers to West Germany only. National indicative targets for the share of renewables electricity in 2010 are taken from Directive 2001/77/EC. Notes to their 2010 indicative targets are made by Italy, Luxemburg, Austria, Portugal, Finland and Sweden in the directive; Austria and Sweden note that reaching the target is dependent upon climatic factors affecting hydropower production, with Sweden considering 52% a more realistic figure if long-range models on hydrologic and climatic conditions were applied. No energy data for Liechtenstein available from Eurostat.

Note: The data for World, MENA (Middle East and North Africa, excl. Djibouti and Palestinian territories), Russia and China are extracted from the EIA-database from the US DOE. These figures slightly differ from the Eurostat data.

In terms of future targets, the realisation of a share of renewables in energy-production of 20% by 2020, as defined in the "Energy Policy for Europe" (COM(2007)2 has been adopted by the Council on 8/9 march (7224/1/07). However, this does not specify a target for the production of renewable electricity.

The power and heat generation sector is responsible for a significant share (24 % in 2005 (EEA, 2007)) of European greenhouse gas emissions and therefore increased market penetration of renewable electricity would help to reach the EU commitment under the Kyoto Protocol of the United Nations Framework Convention on Climate Change. The overall Kyoto target for the pre-2004 EU-15 Member States requires an 8 % reduction in emissions of greenhouse gases by 2008-2012 from 1990 levels, while all except two of the new Member States have individual targets under the Kyoto Protocol. For 2020 the Commission and the Council have set a target of 20 - 30% reduction (COM(2007)2 final).

On January 23rd 2008 the European Commission presented a new comprehensive package on climate change and energy (COM(2008)16, 17 and 19). This package is a bundle of legislative proposals aiming at realising at least 20% emission reduction of greenhouse gases in 2020. It includes an improvement of the EU Emissions Trading Scheme (with a binding target of 21% emission reduction of greenhouse gases in 2020 vs. 2005 for large sources of CO<sub>2</sub>-emissions), targets for Member States for the emissions outside the EU-ETS and targets for the use of renewable energy sources.

Within the package, the proposal for a Directive on the use of renewable energy sources (COM(2008)19) sets a target of 20% for the EU-27, and (binding) targets for the individual Member States. These targets account for the total use of renewables, and are not specifically related to the production of electricity.

On November 22, 2007, The European Commission launched the Strategic Energy Technology Plan (SET-Plan, IP/07/1750), which aims at accelerating the development and implementation of "low-carbon technologies". Key-elements of this SET-Plan are #1. a joint strategic planning of research and #2. the launch of six new European Industrial Initiatives (Wind, Solar, Bio-energy, CO<sub>2</sub>-capture, Electricity grid and sustainable nuclear fission). For these initiatives the plan indicates the potential impact on energy-production and CO<sub>2</sub>-reductions. Most of the "technology avenues" defined are directly related to electricity production.

## References

- COM(2006)105 final – Green Paper on A European Strategy for Sustainable, Competitive and Secure Energy  
[http://ec.europa.eu/energy/green-paper-energy/doc/2006\\_03\\_08\\_gp\\_document\\_en.pdf](http://ec.europa.eu/energy/green-paper-energy/doc/2006_03_08_gp_document_en.pdf)
- COM (2007)2 final – Limiting Global Climate Change to 2 degrees Celsius. The way ahead for 2020 and beyond.
- COM(2008) 16 Proposal for a Directive amending Directive 2003/87/EC (EU ETS)
- COM(2008) 17 Proposal for a Decision on the effort of Member States to reduce their greenhouse gas emissions
- COM(2008) 19 Proposal for a Directive on the use of renewable energy sources
- Directive 2001/77/EC of the European Parliament and of the Council of 27 September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market.
- EC (2004) COM(2004) 366 final – The share of renewable energy in the EU, European Commission.
- EEA, Greenhouse Gas Emission Trends and Projections in Europe 2007
- European Commission (2004) European energy and transport – scenarios on key drivers, Directorate General for Transport and Energy
- European Council (2006). Presidency Conclusions European Council 23/24 March 2006. Council Document 7775/06
- European Strategic Energy Technology Plan "towards a low carbon future" (IP/07/1750)
- Treaty of Accession to the European Union, Annex II, Part 12, page 588, which amends Directive 2001/77/EC in order to set targets for new Member States on the contribution of renewable energy to electricity generation.
- Presidency conclusions European Council (7224/1/07), 8/9 march, Brussels

## Meta data

### Technical information

1. Data source:  
 Eurostat (historical data), <http://europa.eu.int/comm/eurostat/>  
 Renewable electricity consumption is one of the European Environment Agency's core-set indicators. More information can be found at <http://themes.eea.eu.int/IMS/CSI>  
 IEA Data Services, <http://data.iea.org/IEASTORE/DEFAULT.ASP>  
 EIA (Energy Information Administration of the U.S. Department of Energy), <http://www.eia.doe.gov/>
2. Description of data / Indicator definition:  
 The share of renewable electricity is the ratio between the electricity produced from renewable energy sources and gross national electricity consumption calculated for a calendar year, expressed as a percentage. It measures the contribution of electricity produced from renewable energy sources to the national gross electricity consumption. As well as being one of the EEA's core set indicators, it is also one of the structural indicators used to underpin the European Commission's analysis in its annual Spring report to the European

Council. The methodologies are identical for both indicators.

Renewable energy sources are defined as renewable non-fossil energy sources: wind, solar, geothermal, wave, tidal, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases. Electricity produced from renewable energy sources comprises the electricity generation from hydro plants (excluding that produced as a result of pumping storage systems), wind, solar, geothermal and electricity from biomass/wastes. Electricity from biomass/wastes comprises electricity generated from wood/wood wastes and the burning of other solid wastes of a renewable nature (straw, black liquor), municipal solid waste incineration, biogas (incl. landfill, sewage, farm gas) and liquid biofuels. Gross national electricity consumption comprises total gross national electricity generation from all fuels (including autoproduction), plus electricity imports, minus exports.

The data sets of Eurostat, IEA and EIA differ <1%.

Projections are for 2020 from the POLES (IPTS) Baseline and GHG Reduction Scenario and from the WEO 2007 (IEA) Reference and Alternative Policy Scenario.

3. Geographical coverage:

The Agency had 32 member countries at the time of writing of this fact sheet. These are the 27 European Union Member States and Turkey, plus Iceland, Norway, Liechtenstein and Switzerland.

No energy data available for Switzerland.

Data for World, United States, China, Russia and the Middle East and North Africa (MENA).

4. Temporal coverage: 1990-2005, projections 2020.

5. Methodology and frequency of data collection: Data collected annually.

Eurostat definitions for energy statistics <http://forum.europa.eu.int/irc/dsis/coded/info/data/coded/en/Theme9.htm>

Eurostat metadata for energy statistics [http://europa.eu.int/estatref/info/sdds/en/sirene/energy\\_base.htm](http://europa.eu.int/estatref/info/sdds/en/sirene/energy_base.htm)

6. Methodology of data manipulation:

Share of electricity produced from renewable energy sources as a percentage of total national electricity consumption. The coding (used in the Eurostat New Cronos database) and specific components of the indicator are:

Numerator: hydro 5510 primary production 100100 + wind 5520 primary production 100100 + photovoltaic (PV) 5534 primary production 100100 + 6000 electrical energy 107002 gross electricity generation - geothermal power plants + 6000 electrical energy 107011 gross electricity generation -biomass-fired powerstations.

Denominator: 6000 electrical energy 107000 total gross electricity generation + 6000 electrical energy 100900 gross inland consumption (i.e. net balance of imports minus exports).

Average annual rate of growth calculated using:  $[(\text{last year}/\text{base year})^{(1/\text{number of years})} - 1] * 100$

IEA data set:

Report 'Electricity Information', table 'OECD, Electricity and Heat Generation', balance 'Gross Electricity Production (GWh)', plant 'Total plants', products 'Hydro', 'Pumped Hydro Production', 'Geothermal', 'Solar', 'Tide, Wave and Ocean', 'Wind', 'Municipal Waste (renew)', 'Municipal Waste (non-renew)', 'Wood/Woodwaste/Other solid waste', 'Landfill Gas', 'Sewage Sludge Gas', 'Other Biogas', 'Liquid Biofuels', 'Non-specified comb. renew and waste', 'Non-specified comb. fuels for Heat' and 'Other Sources'.

Eurostat 100100 Primary production (5510 Hydro power) equals IEA Hydro -/ Pumped Hydro Production (<1% difference)

EIA data set:

International Electricity Generation, 6.3 World Total Net Electricity Generation, 2.6 World Net Hydroelectric Power Generation, 2.8 World Net Geothermal, Solar, Wind, and Wood and Waste Electric Power Generation.

Eurostat 100100 Primary production (5510 Hydro power) equals EIA 2.6 Net Hydroelectric Power Generation (<1% difference)

Projections:

POLES: Net electricity generation Hydro (TWh)/Net electricity generation Total (TWh)

Net electricity generation Renewables (TWh)/Net electricity generation Total (TWh)

WEO 2007: Electricity generation Hydro (TWh)/Electricity generation Total (TWh)

Electricity generation Biomass and waste (TWh)/Electricity generation Total (TWh)

Electricity generation Wind (TWh)/Electricity generation Total (TWh)

Electricity generation Geothermal (TWh)/Electricity generation Total (TWh)

Electricity generation Solar (TWh)/Electricity generation Total (TWh)

Electricity generation Tide and wave (TWh)/Electricity generation Total (TWh)

Qualitative information

7. Strengths and weaknesses (at data level)

Data gaps for breakdown of large hydropower. No projection data for Croatia, Iceland and Liechtenstein.

Data have traditionally been compiled by Eurostat through the annual Joint Questionnaires, shared by Eurostat and the International Energy Agency, following a well established and harmonised methodology. Methodological information on the annual Joint Questionnaires and data compilation can be found on Eurostat's website in the section on metadata on energy statistics:

[http://europa.eu.int/estatref/info/sdds/en/sirene/energy\\_sm1.htm](http://europa.eu.int/estatref/info/sdds/en/sirene/energy_sm1.htm)



8. Reliability, accuracy, robustness, uncertainty (at data level):

Indicator uncertainty (historic data)

The renewables electricity directive (2001/77/EC) defines the share of renewable electricity as the percentage of electricity produced from renewable energy sources in gross electricity consumption. The numerator includes all electricity generated from renewable sources, most of which is for domestic use. The denominator contains all electricity consumed in a country, thus including imports and excluding exports of electricity. Therefore, the share of renewable electricity can be higher than 100 % in a country if all electricity is produced from renewable sources and some of the over-generated renewable electricity is exported to a neighbouring country. Biomass and wastes, as defined by Eurostat, cover organic, non-fossil material of biological origin, which may be used for heat production or electricity generation. They comprise wood and wood waste, biogas, municipal solid waste (MSW) and biofuels. MSW comprises biodegradable and non-biodegradable wastes produced by different sectors. Non-biodegradable municipal and solid wastes are not considered to be renewable, but current data availability does not allow the non-biodegradable content of wastes to be identified separately, except for industry.

The electricity produced as a result from hydropower storage systems is not classified as a renewable source of energy in terms of electricity production, but is part of the gross electricity consumption in a country.

The share of renewable electricity could increase even if the actual electricity produced from renewable sources falls. Similarly, the share could fall despite an increase in electricity generation from renewable sources. Therefore, from an environmental point of view, attaining the 2010 target for the share of renewable electricity does not necessarily imply that carbon dioxide emissions from electricity generation will fall.

Electricity consumption within the national territory includes imports of electricity from neighbouring countries. It also excludes the electricity produced nationally but exported abroad. In some countries the contribution of electricity trade to total electricity consumption and the changes observed from year to year need to be looked at carefully when analysing trends in renewable electricity. Impacts on the (national) environment are also affected since emissions are accounted where the electricity is produced whereas consumption is accounted where the electricity is consumed.

It should also be noted that electricity consumption in 1990 for Germany refers only to the western part.

9. Overall scoring – historic data (1 = no major problems, 3 = major reservations):

Relevance: 1

Accuracy: 1

Comparability over time: 1

Comparability over space: 1