

## EN29 Primary Renewable Energy

### Key message

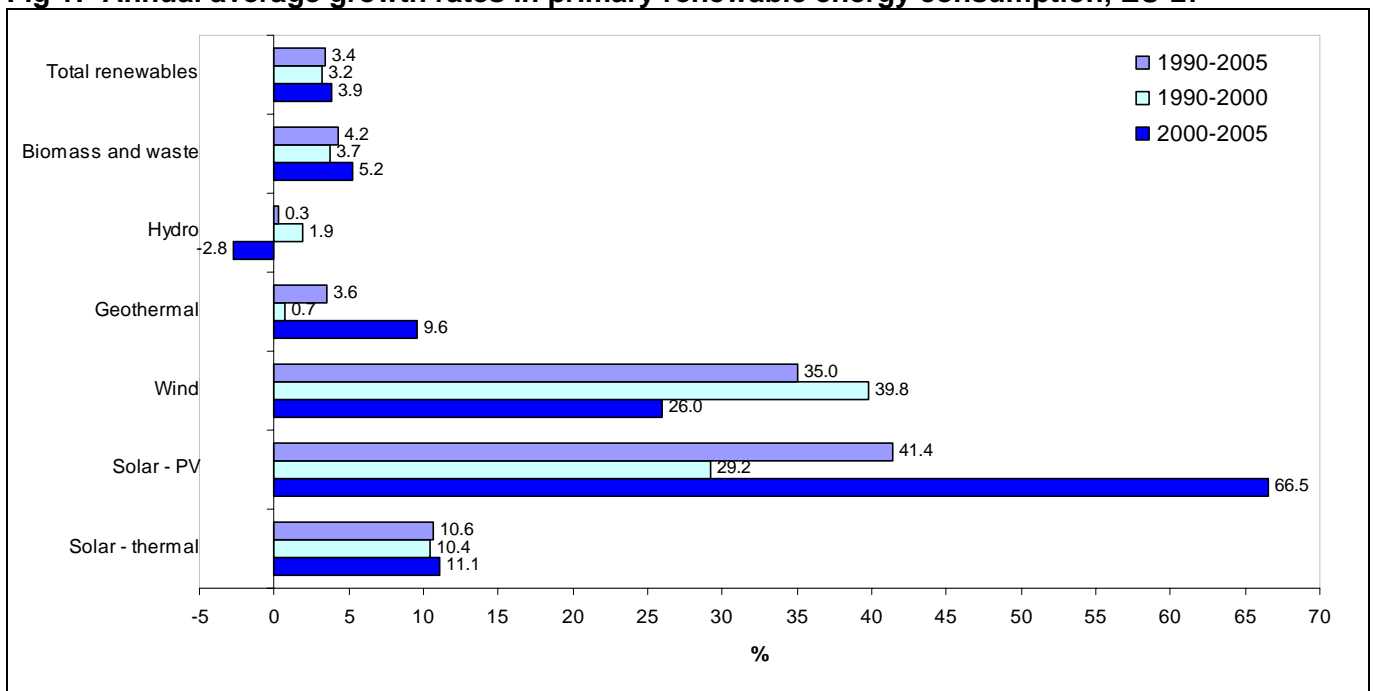
The share of renewable energy sources in primary energy consumption increased slowly in the EU-27 from 4.4 % in 1990 to 6.7 % in 2005. This has helped reduce greenhouse gas emissions. However, rising overall energy consumption in absolute terms has counteracted some of the environmental benefits from the increased use of renewables. The strongest increase came from wind and solar energy. In absolute terms, about 80 % of the increase was accounted for by biomass. Significant growth will be needed to meet the indicative target of a 12 % share of renewables for the EU by 2010.

*The European Council of 8-9 March 2007 has recently endorsed a binding target of a 20 % share of renewable energies in 'final' energy consumption by 2020. The renewables share in final energy consumption was about 8.5 % in 2005. A new indicator on 'renewable final energy consumption' will be developed during 2008 to address this new target.*

### Rationale

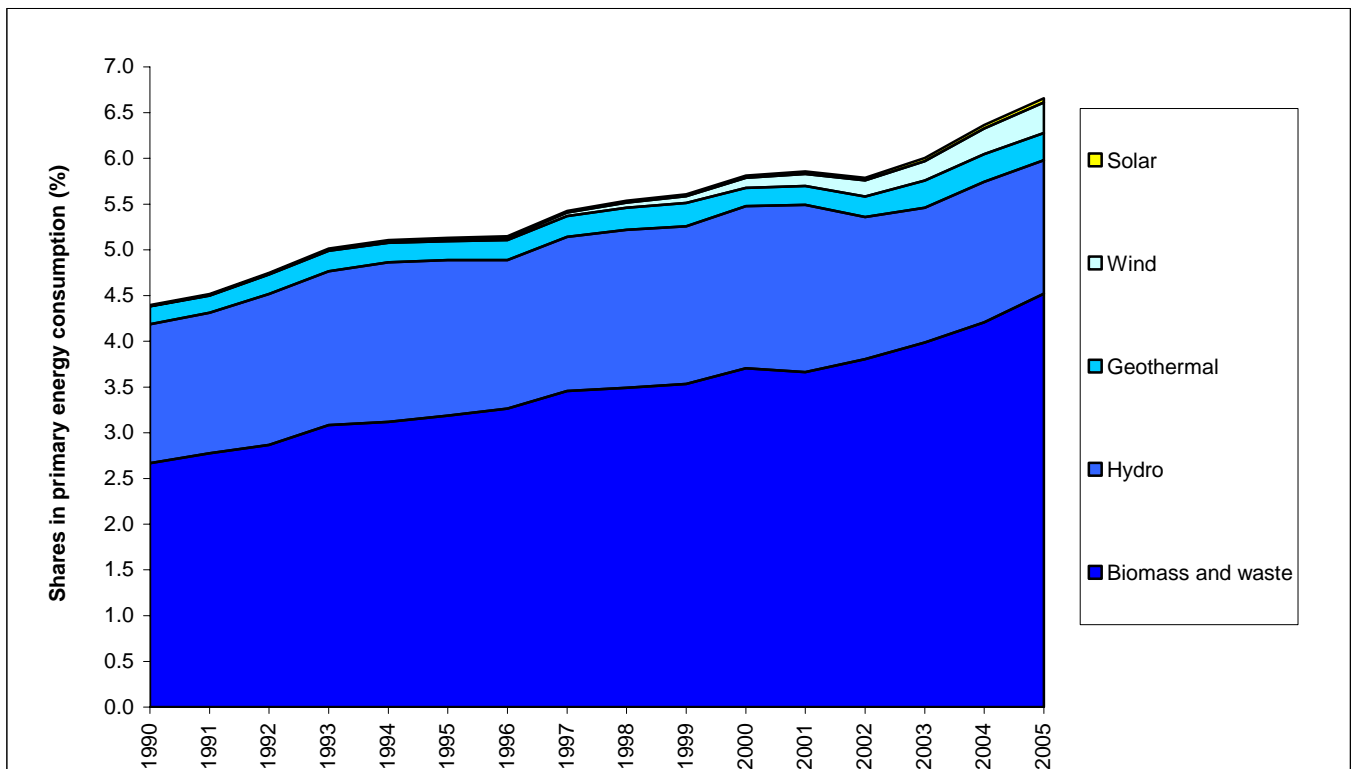
Renewable energies are generally considered more environmentally benign than fossil fuels with regard to emissions of greenhouse gases as well as other air pollutants such as SO<sub>2</sub> and NO<sub>x</sub>. The share of energy consumption from renewable energy thus provides a broad indication of progress towards reducing the environmental impact of energy consumption, although its overall impact has to be seen within the context of growth in energy use, the total fuel mix, potential impacts on biodiversity and the extent to which pollution abatement equipment is fitted.

**Fig 1: Annual average growth rates in primary renewable energy consumption, EU-27**



Data source: Eurostat

**Fig. 2: Contribution of renewable energy sources to primary energy consumption in the EU-27**



Data source: Eurostat

## 1. Indicator assessment

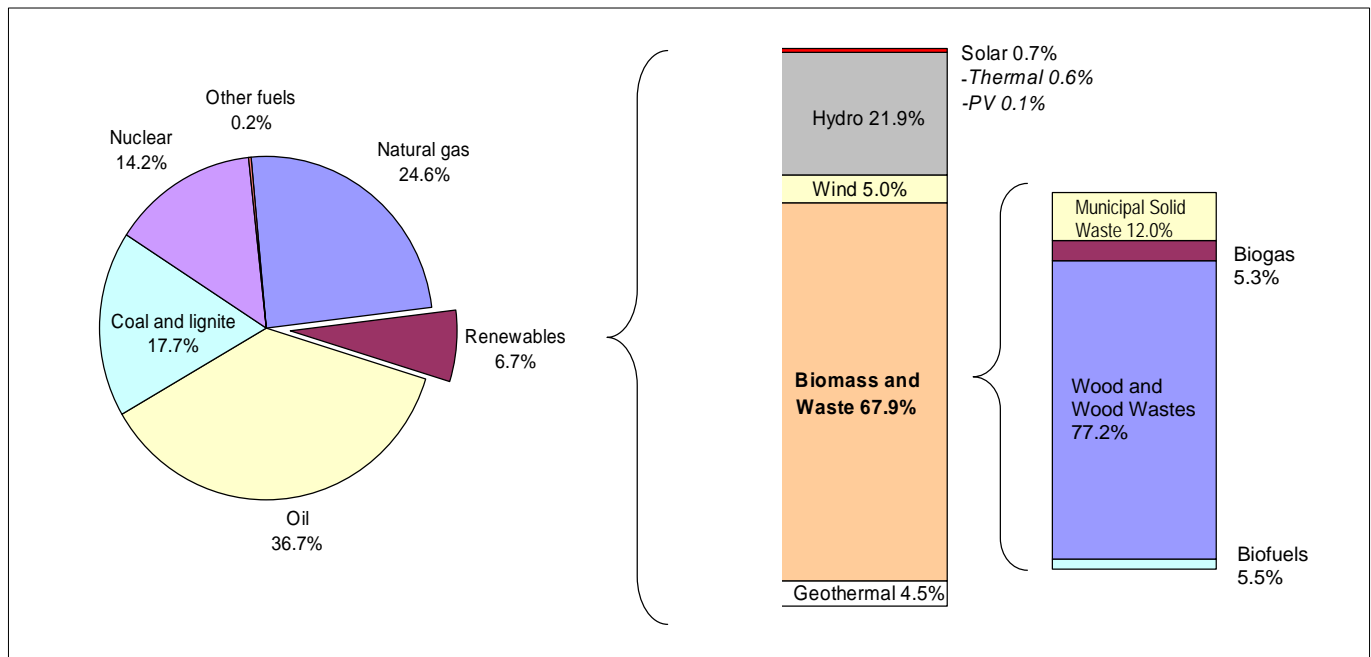
The contribution of renewable energy sources to primary energy consumption increased in the EU-27 from 4.4 % in 1990 to 6.7 % in 2005, up by 0.3 percentage points from the share in 2004. This is still substantially short of the indicative target set in the White Paper on renewable energy (COM(97) 599 final) to derive 12 % of total primary energy consumption in the EU from renewable sources by 2010. More recently, the European Commission launched a comprehensive 'energy package' (10/01/2007). As a result, 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 [http://europa.eu/european\\_council/conclusions/index\\_en.htm](http://europa.eu/european_council/conclusions/index_en.htm) The new renewable energy target refers to final energy consumption and not to primary energy consumption. The renewables share in final energy consumption was about 8.5 % in 2005. This new target will be dealt with separately in a new indicator to be developed during 2008.

Biomass and waste is the largest renewable energy source (2/3 of the total) and was responsible for the majority of the absolute growth in renewables during the period 1990-2005, with an increase of about 69 % in the EU-27. Only the biodegradable part of municipal solid waste should be seen as renewable. Biomass and waste can be used to produce electricity and heat and biofuels for transport. It is also seen as one of the main areas for future growth in renewable energy. However, increased use must be balanced against potentially increased environmental pressures on biodiversity, soil and water resources. Latvia, Finland, and Sweden have particularly high shares of biomass and waste in total primary energy consumption.

Consumption of hydropower has increased by about 5 % over the period 1990-2005. However, hydropower production has been falling in the past years as a result of lower rainfall to reach a share of 22 % of renewable energy consumption and of 1.5 % of total primary energy consumption in the EU-27 in 2005. Energy consumption from hydropower is not expected to increase significantly due to environmental concerns and a lack of suitable sites, particularly within the EU-15. For example, the Water Framework Directive (2000/60/EC) places a greater emphasis on the protection of the environment, and due to the obligation to prevent any further deterioration it is likely that the construction of new hydro-power plants will become more difficult.

Between 1990 and 2005, wind energy in the EU-27 grew by a factor of 90; and only in the last year increased by 20 %. This was largely due to strong growth in Spain and Germany, which together account for more than 2/3 of all the EU's wind production. Wind power is a fast-growing energy source worldwide, and this trend is expected to be reflected throughout the EU-27, as technological development both on- and offshore, combined with national renewable energy promotion policies lead to the introduction of wind power in all Member States. At present however, output still accounts for a small (around 0.3 %) proportion of total primary energy consumption and 5 % of renewable energy consumption.

**Fig. 3: Total primary energy consumption by energy source in 2005, EU-27**



Data source: Eurostat

Geothermal power-production increased by 69 % in the EU between 1990 and 2005. The use of geothermal schemes depends on the quality (temperature and density) of the heat available. Relatively low quality heat is used as an input to district heating schemes and some industrial processes, and higher quality heat can be used to produce steam for electricity production in turbines. Geothermal energy contributed only 4 % to renewable energy consumption (and 0.3 % of primary total energy consumption) in the EU-27 in 2005, with Italy accounting for around 90 % of this. There is still significant potential to exploit geothermal heat, particularly in the form of heat pump technology (IEA, 2004).

Between 1990 and 2005 in the EU-27, solar energy grew by around a factor of five. In the last year alone, it grew by almost 20 %. Solar thermal energy developments in Austria, Germany and Greece benefited greatly from proactive government policy coupled with subsidy schemes and communication strategies that emphasised the benefits of solar thermal. In 2006, Spain passed a law making solar panels compulsory in new and renovated buildings. In most Member States solar energy comes from solar thermal energy, rather than electricity generated using photovoltaic (PV) cells. At present use of PV cells is limited due to relatively high production and installation costs, but represent a medium- to long-term opportunity as costs are beginning to fall (JRC, 2004). The proportion of solar energy in renewable energy amounted to 0.7 % (only half a percentage of primary total energy consumption) in 2005.

**Fig. 4: Share of renewable energy sources in total gross inland energy consumption in EU-27, 2020**

	(IPTS) POLES		(IEA) WEO 2007	
	Baseline	GHG Reduction	Reference	Alternative Policy
<b>Total renewables</b>	15.5%	18.1%	11.7%	13.9%
<b>Biomass and waste</b>	x	x	7.5%	8.9%
<b>Hydro</b>	x	x	1.8%	2.0%
<b>Wind</b>	x	x	2.3%	3.0%
<b>Solar - thermal</b>	x	x		
<b>Solar - PV</b>	x	x		
<b>Geothermal</b>	x	x		

Data source: IPTS, IEA

Note: The POLES scenarios show an inconsistency in 2005 concerning the data used for the scenario and the actual data from Eurostat. The POLES data is significantly higher.

Projections:

Despite growing subsidies and programmes, and support for renewables in individual Member States, the observed growth rates in renewable energy consumption are not sufficient if the indicative target of a 12 % share in 2010 is to be met.

The projections from POLES and WEO 2007 both show an increase in the share of renewable energy sources in total gross inland energy consumption. Biomass remains the dominant source of renewable energy, but the share of wind, solar and geothermal energy increases rapidly. According to the Reference Scenario of WEO 2007 the indicative target set for 2010 (share of 12% renewables in the EU) will not be met even in 2020.

**Fig. 5: Share of primary renewable energy in total energy consumption (in %)**

	1990	1995	2000	2001	2002	2003	2004	2005
EEA	5.5	6.2	6.9	6.8	6.8	6.9	7.2	7.6
EU-27	4.4	5.1	5.8	5.9	5.8	6.0	6.4	6.7
EU-15	4.9	5.3	5.9	6.0	5.8	6.0	6.4	6.7
World	12.8	13.2	13.2	13.1	13.1	13.0	12.8	12.7
MENA	1.9	1.5	1.3	1.4	1.3	1.3	1.3	1.3
United States	5.2	5.3	4.8	4.3	4.3	4.6	4.6	4.7
China	24.2	20.9	20.8	21.4	20.0	17.7	15.8	14.9
Russia	3.0	3.8	3.4	3.5	3.4	3.1	3.5	3.4
Belgium	1.4	1.4	1.3	1.5	1.5	1.9	2.1	3.5
Bulgaria	0.6	1.6	4.2	3.6	4.4	4.9	5.2	5.6
Czech Republic	0.2	1.5	1.5	1.7	2.1	3.4	4.0	4.1
Denmark	6.7	7.6	10.8	11.4	12.4	13.5	15.1	16.2
Germany	1.6	1.9	2.8	3.0	3.4	3.6	4.0	4.8
Estonia	4.5	8.8	10.8	10.4	10.3	9.5	10.6	11.2
Ireland	1.6	1.5	1.8	1.7	1.9	1.8	2.1	2.6
Greece	5.0	5.3	5.0	4.5	4.7	5.1	5.1	5.2
Spain	7.0	5.5	5.7	6.6	5.5	7.0	6.5	6.1
France	7.0	7.5	7.0	7.1	6.4	6.4	6.3	6.0
Italy	4.2	4.8	5.2	5.5	5.3	5.9	6.8	6.5
Cyprus	0.4	2.1	1.8	1.8	1.7	1.7	1.9	2.0
Latvia	13.1	27.5	34.3	34.1	34.5	33.1	36.0	36.3
Lithuania	2.0	5.7	9.2	8.4	8.1	7.9	8.0	8.8
Luxembourg	1.3	1.4	1.5	1.3	1.4	1.4	1.6	1.6
Hungary	1.8	2.4	2.1	1.9	3.4	3.4	3.7	4.2
Malta	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Netherlands	1.4	1.6	2.4	2.4	2.6	2.6	2.9	3.5
Austria	20.2	22.0	23.2	22.2	22.2	19.3	20.8	20.5
Poland	1.6	3.9	4.2	4.5	4.6	4.5	4.7	4.8
Portugal	18.8	16.3	15.4	15.7	14.0	17.1	14.9	13.4
Romania	4.2	5.9	10.9	9.3	9.8	10.0	11.7	12.8
Slovenia	4.6	9.4	12.3	11.5	10.9	10.3	11.6	10.6
Slovakia	1.6	2.9	2.8	3.9	3.7	3.3	3.9	4.3
Finland	19.0	21.2	23.9	22.4	21.9	20.9	23.0	23.2
Sweden	24.9	26.0	31.4	28.3	26.3	25.3	25.8	29.8
United Kingdom	0.5	0.9	1.1	1.1	1.2	1.3	1.5	1.7
Turkey	18.5	17.4	13.1	13.2	13.4	12.7	13.2	11.9
Iceland	64.9	67.6	71.4	73.2	72.8	72.8	72.3	73.0
Norway	53.2	48.9	51.0	44.0	51.7	38.3	37.7	40.4

**Data source:** Eurostat, IEA

**Note:** No data for Liechtenstein or Switzerland is available from Eurostat. Data for World, MENA (Middle East and North Africa, no data is available for Djibouti and Palestinian territories), United States, China and Russia are extracted from IEA database.

## 2. Indicator rationale

### 2.1 Environmental context

The share of energy consumption from renewable energy provides a broad indication of progress towards reducing the environmental impact of energy consumption, although its overall impact has to be seen within the context of the total fuel mix, potential impacts on biodiversity and the extent to which pollution abatement equipment is fitted.

Renewable energy sources are generally considered more environmentally benign, with very low net emissions of CO<sub>2</sub> per unit of energy produced, even allowing for emissions associated with the construction of the plant. Emissions of other pollutants are also often lower for renewable energy production than for fossil fuel energy production. The exception to this is municipal and solid waste (MSW) incineration which, due to the cost associated with separation, usually involves the combustion of some mixed wastes including materials contaminated with heavy metals. However, emissions from MSW incineration are subject to stringent regulations including tight controls on quantities of cadmium, mercury, and other such substances.

Most renewable (and non-renewable) energy sources have some impact on landscape, noise and ecosystems, although many of these 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 its hot fluid if not properly controlled. Some types of biomass and biofuel crops also have considerable land, water and agricultural input requirements such as fertilisers and pesticides.

### 2.2 Policy context

Energy use (both energy production and final consumption) is the biggest contributor to greenhouse gas emissions in the EU-27 (see EN01). Increased market penetration of renewable energy can 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 most 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 aimed at realising at least a 20% reduction in emissions of greenhouse gases in 2020. It includes an improvement of the EU Emissions Trading Scheme (with a binding target of a 21% emission reduction of greenhouse gases in 2020 vs. 2005 for large sources of CO<sub>2</sub>-emissions), targets for Member States for emissions outside the EU-ETS and targets for the use of renewable energy sources.

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.

Previous relevant legislation includes the EU Directive on the promotion of electricity from renewable energy sources in the internal electricity market (2001/77/EC), which sets an indicative target of 22.1 % of gross electricity consumption from renewable sources in EU-15 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.

Specific for the transport-sector, the EU Energy Policy set the target of a level of 10% biofuels by 2020. This follows the Directive (2003/30/EC) on the promotion of the use of biofuels or other renewable fuels for transport. In this Directive national indicative targets of 2 % are set for transport consumption to come from biofuels by 2005 and 5.75 % by 2010.

On November 22, 2007, The European Commission also launched the Strategic Energy Technology Plan (COM(2007)072), 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.

#### References

COM(97) 599 final - Energy for the future: Renewable sources of energy. White Paper for a Community strategy and action plan.

COM(2007)072 Towards a Low Carbon Future – A European Strategic Energy Technology Plan

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.

Directive (2003/30/EC) on the promotion of the use of biofuels or other renewable fuels for transport.

European Council (2006). Presidency Conclusions European Council 23/24 March 2006. Council Document 7775/06. [http://europa.eu/european\\_council/conclusions/index\\_en.htm](http://europa.eu/european_council/conclusions/index_en.htm)

European Strategic Energy Technology Plan "towards a low carbon future" (IP/07/1750)

IEA (2004) International Energy Agency Geothermal Energy Annual Report 2004.

JRC (2004) PV Status Report 2004: Research, Solar Cell Production and Market Implementation of Photovoltaics, European Commission Joint Research Centre. <http://streference.jrc.cec.eu.int/pdf/PV%20Status%20Report%202004.pdf>.

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 Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy.

## Meta data

### Technical information

#### 1. Data source:

Eurostat (historic data), <http://europa.eu.int/comm/eurostat/>

Renewable energy 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>

#### 2. Description of data / Indicator definition:

The share of renewable energy consumption is the ratio between gross inland consumption of energy from renewable sources (TOE) and total gross inland energy consumption (TOE) calculated for a calendar year, expressed as a percentage. Both renewable energy and total energy consumption are measured in thousand tonnes of oil equivalent (ktoe).

Renewable energy sources are defined as renewable non-fossil sources: wind, solar, geothermal, wave, tidal, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases.

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 and Liechtenstein. No projection data are available for Iceland, Liechtenstein.

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:

Renewable energy consumption is the ratio between the gross inland consumption of energy from renewable sources and the total gross inland energy consumption calculated for a calendar year.

The coding (used in the Eurostat New Cronos database) and specific components of the indicator are:

Numerator: solar energy 5530 gross inland consumption 100900 + biomass and waste 5540 gross inland consumption 100900 + geothermal energy 5550 gross inland consumption 100900 + hydropower 5510 gross inland consumption 100900 + wind energy 5520 gross inland consumption 100900.

Denominator: (total) gross inland consumption (of energy) 100900

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

Solar-thermal: 100900 Gross inland consumption (5530 solar energy) - 100100 Primary production (5534 Photovoltaic power)

IEA data:

Report 'Energy balances Non-OECD countries' and 'Energy balances OECD countries', table 'Energy balances (ktoe)', products 'Hydro', 'Geothermal', 'Solar/Wind/Other', 'Combustible renewables and waste' and 'Total', flow 'Total Primary Energy Supply'.

Eurostat data set and IEA data set show small inconsistencies of < 1%.

Projections:

POLES: Gross inland consumption Other (EJ)/Gross inland consumption Total (EJ)

WEO 2007: Primary energy demand Biomass and waste (Mtoe)/Total primary energy demand (Mtoe)

Primary energy demand Hydro (Mtoe)/Total primary energy demand (Mtoe)

Primary energy demand Other renewables (Mtoe)/Total primary energy demand (Mtoe)

#### Qualitative information

##### 7. Strengths and weaknesses (at data level)

Data have been traditionally 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 in Eurostat's web page for 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):

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 indicator measures the relative consumption of energy from renewable sources in total energy consumption for a particular country. The share of renewable energy could increase even if the actual energy consumption from renewable sources falls. Similarly, the share could fall despite an increase in energy consumption from renewable sources. CO<sub>2</sub> emissions depend not on the share of renewables but on the total amount of energy consumed from fossil sources. Therefore, from an environmental point of view, attaining the 2010 target for the share of renewable energy does not necessarily imply that CO<sub>2</sub> emissions from energy consumption will fall.

##### 9. Overall scoring (historical data)

Relevance: 1

Accuracy: 2

Comparability over time: 1

Comparability over space: 1