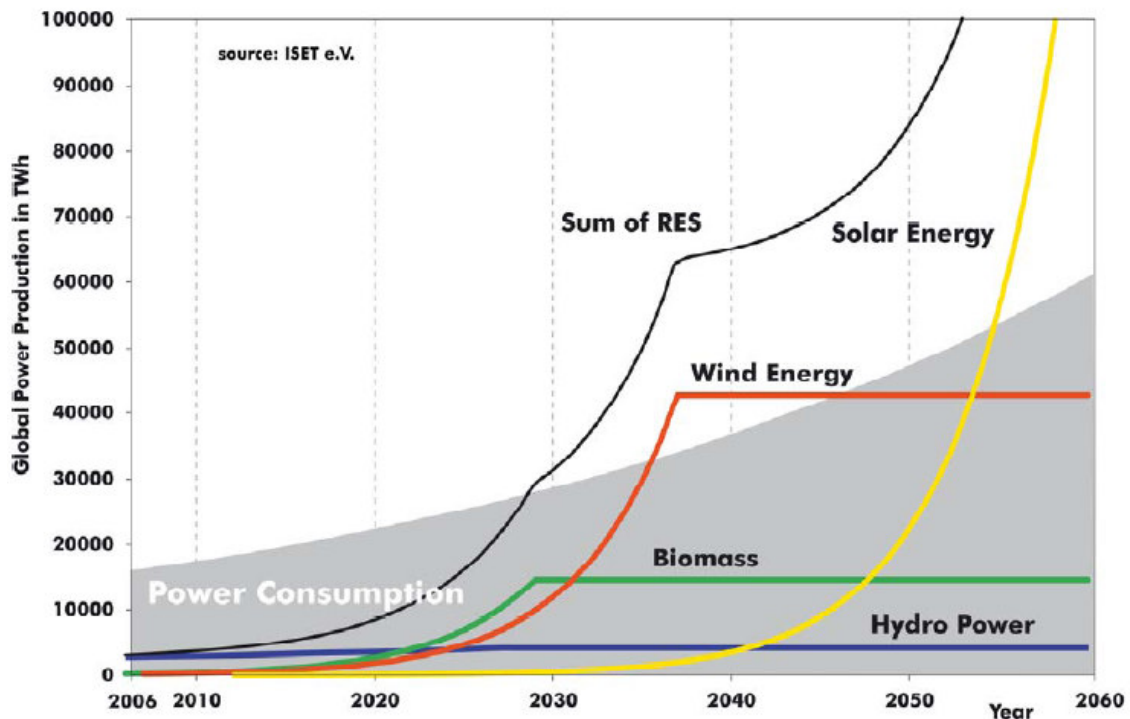


Contributions of Solar and Wind Energy to the World Electrical Energy Demand

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A bibliographical review shows that in 30 years, the contributions of solar and wind energy to the total electrical energy demand will be as follows: **Photovoltaic System 16.2 %**, **Solar Thermal Electric Power 9.2%**, and **Wind Energy between 3.5 – 4.7%** .

A hypothetical evolution of the contributions of solar power (Photovoltaic and Solar Thermal Power Plants), wind power, hydropower and biomass to the global power consumption is shown in figure below [ISET Institut für Solare Energieversorgungstechnik e.V. (EAW)]. The electricity demand increases 2,5% per year, the production from Renewable Energies grows 20 % each year, starting from today's installed capacities.



SOLAR ENERGY

As Solar Energy technology becomes increasingly affordable and available, its potential as a major source of low-carbon energy grows. In a 2004 report entitled, "Solar Generation" [Greenpeace and the European Photovoltaic Industry Association (EPIA)], estimated that, by 2020, Photovoltaic systems could provide **276.10⁶** MWh of energy-equivalent to 1% of the global demand projected by the International Energy Agency (IEA). The study assumed that the Photovoltaic systems market would grow at a compound annual growth rate of 30% until 2020, well below the 45% growth that the industry averaged from 2002 to 2007. This would prevent the emission of 664 million tons of CO₂ annually. Moreover, the report found that with a 15% growth rate from 2020 to 2040, the solar energy output could be more than **9000.10⁶** MWh, which would be 26% of the projected global demand.

The solar energy is subdivided in tree different types:

Solar Thermal Heating and Cooling

Solar thermal technologies, which provide heating and hot water for residential, commercial and industrial end uses, have a long history of commercial application. They have been used widely in building design and hot water heating, which are considered the easiest and most direct applications of solar energy. Solar space heating systems can be either water systems or air heating systems. The technologies are well developed for many of the applications, although more cost reductions to improve competitiveness are still being achieved. They are considered cost effective in countries with favorable climates, for example those below 40 degrees latitude, and increasingly there are new applications that are also cost effective above 40 degrees latitude.

Solar thermal systems have proven popular for a variety of special-purpose markets, e.g. for heating swimming pools, where there are between 1 and 2 million m² of collectors installed worldwide. Solar thermal systems supply hot water or cooling in hotels and other service areas such as hospitals where hot water consumption is high. Solar desalination is important in many parts of the world where fresh water for irrigation is at a premium. Solar cooking has also proven popular.

One of the main benefits of solar thermal systems is that there are no emissions. This is particularly beneficial for solar cooking as it avoids indoor air pollution, a major health concern in developing countries. An advantage is that they can be combined with other sources of energy

Solar heating can be constrained because of the mismatch between demand and supply (which is available when there is sun), thus requiring some form of storage. There are a variety of storage systems available, and a new generation of storage technologies is at the demonstration stage.

Photovoltaics

Photovoltaic (PV) systems use semiconductor materials to convert sunlight directly into electricity. They can be used separately or in hybrid form,

in combination with another generating option such as other renewables or fossil fuels. Costs have dropped to between one-third and one-fifth of 1980 levels.

Photovoltaic is now cost effective in many specific-purpose applications, such as telecommunications, lighting, water pumping, leisure and signaling. Applications in hospitals can be valuable in regions where conventional energy supply is unreliable. A recent application, which shows good promise worldwide, is a Photovoltaic system that floats and purifies water in landlocked areas.

They are highly reliable, with few breakdowns and are easy to use. They have few detrimental effects on the environment, with minimal visual impact. Their modularity makes them flexible and easy to increase capacity depending on demand requirements. Installation is quick and easy and they can be arranged to meet a wide range of power requirements. Operating and maintenance costs are generally quite low, as Photovoltaic systems are highly reliable. Photovoltaic can be important in developing countries where the electricity infrastructure is poor or non-existent.

Some consider that by 2010 the total installed capacity for grid purposes worldwide might be 4001,000 MW. The global potential is high, considering that Photovoltaic systems could be used in most of the 400 million households currently without electricity. By 2040 the photovoltaic system could provide 16,8% of the global demand projected by the International Energy Agency (IEA).

Solar Thermal Electric Power

High-temperature solar thermal power systems – also known as concentrating solar power – to produce electricity, and to some extent hot water, are showing good promise. These large scale systems are on a path to becoming cost effective. Plants in operation are achieving costs of approximately US\$ 0.12/kWh, which are the lowest of any solar technology. The technology can also be combined in hybrid form (solar thermal plants coupled with diesel generators), achieving costs of around US\$ 0.08/kWh.

The main benefit of solar thermal power technologies is that they can provide dispatchable power for peak or intermediate loads. These technologies can also be used in distributed, stand-alone applications and are suitable for fossil-hybrid operation or can include cost effective storage to meet dispatchability requirements. The systems have low environmental impact and could be beneficial in remote areas as a source of electricity to small communities.

Siting is restricted to regions with the best solar resources but globally there is significant potential, especially in latitudes +/- 40 degrees latitude. This is not limited to the IEA region, which includes Australia, the Mediterranean region and southwest United States, as there are many appropriate locations in developing countries around the world on all continents. According to the International Energy Agency (IEA) the estimate electrical energy production by 2040 is 9,2% of the global demand.

[<http://www.un.org/>]

[www.iea.org]

WIND ENERGY

Wind energy is considered one of the most promising technologies for electricity generation. Its recent deployment has been one of the fastest growing renewable technologies worldwide.

Wind turbines are seen to be increasingly competitive with conventional generating sources. Costs have come down appreciably over the past decade and are now considered commercially viable in many situations besides that have proven successful in locations such as islands, northern areas and other remote regions not adequately serviced by grids. They have also proven valuable in providing power for irrigation, watering cattle, cooling and desalination. They come in a variety of sizes that can be as small as a few kilowatts, although the average new turbine is over 500 kW with a growing number exceeding 1 MW. However, small turbines for individuals are becoming more popular.

The total installed capacity worldwide at the end of 2004 was 47.6 GW, and 8.3 GW were added in 2004. The average annual growth rate of wind power between 1990 and 2002 was about 23%. Still, the contribution of wind power was just 0,006% of electricity production in the OECD in 2003. In Denmark, wind contributed 12% to electricity production in 2003, un Spain 4,6% in Germany 3,1%. The International Energy Agency (IEA) World Energy Outlook 2004 projects that wind could provide just over 7% of electricity production in the OECD in 2030, which is equivalent to about half of all renewable electricity production in 2030 under this scenario.

Global wind resources are ample and are theoretically capable of supplying a large percentage of energy needs. However, the practical potential is limited by a number of factors, including cost, variability and intermittency, and siting. Wind turbines are proving very popular in developing countries such as India, China and Latin America, which is aided through increasing support from IFIs (international financial institutions). While the World Energy Outlook expects for wind energy to account between 3.5 – 4.7% of the global electricity production by 2030, the industry in its moderate scenario projects that this share will reach between 10.8- 15.6%, depending on energy efficiency measures that are taken at the same time.

[\[http://www.iea.org\]](http://www.iea.org)

[\[www.gwec.net\]](http://www.gwec.net)