Primary renewable energy

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World total primary energy consumption by type in 2020[1]

World total primary energy supply of 162,494 TWh (or 13,792 Mtoe) by region in 2017 (IEA, 2019)[2]

Primary energy (PE) is the energy found in nature that has not been subjected to any human engineered conversion process. It encompasses energy contained in raw fuels and other forms of energy, including waste, received as input to a system. Primary energy can be non-renewable or renewable.

Total primary energy supply (TPES) is the sum of production and imports, plus or minus stock changes, minus exports and international bunker storage.[3]The International Recommendations for Energy Statistics (IRES) prefers total energy supply (TES) to refer to this indicator.[4] These expressions are often used to describe the total energy supply of a national territory.

Secondary energy is a carrier of energy, such as electricity. These are produced by conversion from a primary energy source.

Primary energy is used as a measure in energy statistics in the compilation of energy balances,[5] as well as in the field of energetics. In energetics, a primary energy source (PES) refers to the energy forms required by the energy sector to generate the supply of energy carriers used by human society.[6] Primary energy only counts raw energy and not usable energy and fails to account well for energy losses, particularly the large losses in thermal sources. It therefore generally grossly undercounts non thermal renewable energy sources .

Primary energy sources should not be confused with the energy system components (or conversion processes) through which they are converted into energy carriers.

Primary energy sources are transformed in energy conversion processes to more convenient forms of energy that can directly be used by society, such as electrical energy, refined fuels, or synthetic fuels such as hydrogen fuel. In the field of energetics, these forms are called energy carriers and correspond to the concept of "secondary energy" in energy statistics.

Energy carriers are energy forms which have been transformed from primary energy sources. Electricity is one of the most common energy carriers, being transformed from various primary energy sources such as coal, oil, natural gas, and wind. Electricity is particularly useful since it has low entropy (is highly ordered) and so can be converted into other forms of energy very efficiently. District heating is another example of secondary energy.[8]

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According to the laws of thermodynamics, primary energy sources cannot be produced. They must be available to society to enable the production of energy carriers.[6]

Conversion efficiency varies. For thermal energy, electricity and mechanical energy production is limited by Carnot"s theorem, and generates a lot of waste heat. Other non-thermal conversions can be more efficient. For example, while wind turbines do not capture all of the wind"s energy, they have a high conversion efficiency and generate very little waste heat since wind energy is low entropy. In principle solar photovoltaic conversions could be very efficient, but current conversion can only be done well for narrow ranges of wavelength, whereas solar thermal is also subject to Carnot efficiency limits. Hydroelectric power is also very ordered, and converted very efficiently. The amount of usable energy is the exergy of a system.

Site energy is the term used in North America for the amount of end-use energy of all forms consumed at a specified location. This can be a mix of primary energy (such as natural gas burned at the site) and secondary energy (such as electricity). Site energy is measured at the campus, building, or sub-building level and is the basis for energy charges on utility bills.[9]