

30% Efficient



You or Nuclear

Is electrical power generation more efficient using nuclear energy, the energy from coal, or the energy from the wind?

Are you more efficient at converting food into useful energy compared to the efficiency of a nuclear power plant converting nuclear fuel into useful energy?

Often the conversion of energy from one form to another form is reported as efficiency, i.e. the total energy input compared to the total energy output. Have you ever been curious about the actual numbers for total system efficiency? Then read on.

Electrical power generation: Perhaps surprising to some, electrical power generation using nuclear fuel or fossil fuel, or wind energy all report in at about 30% efficient. On the other hand, hydroelectric generation measures about 90% efficiency. The sun has already done most of the work by lifting the water.

The human being is not more than 20% efficient at converting food into thermal energy.

Speaking of thermal energy, does body fat or coal produce more heat? Body fat (or triglycerides) has virtually the same energy content (per pound) as coal or petroleum, around 3,500 to 4,000 Calories per pound. Your body gives off enough heat in 30 minutes to bring half a gallon of water to a boil. The brain operates on the same amount of power as 10-watt light bulb, even while you are sleeping.

The energy in a 2,000-Calorie daily dietary intake can be described equally as an input of 3.12 horsepower-hours or 7,900 Btu or 2.325 Kilowatt-hour of energy.

Forget not the motive power: i.e. the conversion of energy into motion. While the two-stroke diesel engine reports in at about 50% efficiency and the gas turbine at about 45%, the external combustion engine is not far behind at 40%. On the other hand, the piston steam engine is 1 to 10% efficient for a non-condensing engine and up to 25% for a multi-expansion condensing engine. The internal combustion engine using gasoline can achieve nearly 30% efficiency.

Free sun energy: Electrical power generation using the photovoltaic cell is at best about 13% efficient while heat using the solar thermal conversion process can be as high as 80% efficient but more typically around 40%.

Electric–Motion–Electric: Converting electricity into rotary motion (the electric motor) is about 90% efficient while converting rotary motion into electricity (the generator) is about 86% efficient.

Lighting Efficiency: From a low of about 10% for the incandescent electric bulb, the CFL achieves about 25% and the LED about 40%. Metal halide and high-pressure sodium lighting achieve well over 50% efficiency.

Saving the best for last: Heat Pumps out perform many other processes. For example, according to the U.S. Department of Energy, the Geothermal Heat Pump can run between 300% and 600% efficient. The air-source Heat Pump is between 175% to 250% efficient on a cool day and the Gas Absorption Heat Pump can achieve 150% efficiency.

Disclaimer: At best, efficiency is difficult to measure for many energy conversion processes. The numbers used here are for general comparison purposes only and can vary for individual processes.