Energy Efficiency Encyclopedia Article

Energy Efficiency

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Energy Efficiency

Energy efficiency is a measure of how much of the input energy is useful as output energy. An automobile, for example, typically has a low efficiency, around 30%, as much of the consumed fuel is converted to heat instead of power in the driveshaft. A conventional electric generator converts about 95-99% of the mechanical energy input to the rotor shaft into electrical energy at the generator's terminals.

The first law of thermodynamics is the statement of conservation of energy: an isolated system has the same amount of energy at all times. Energy is neither created or destroyed. (A nonisolated system has external forces acting on it, or energy added to or deleted from it, which disrupts the energy balance. But almost any system is isolated if viewed from a considerable distance.) However, energy can be converted from one form into another--for example, in the case of a coin sliding across a tabletop, some of its kinetic energy is invariably lost and converted to heat energy (and perhaps a small amount to sound energy).

Energy efficiency, then, is a measure of how much energy is lost as a system changes. In the case above where some kinetic energy is lost to heat, the system (consisting of the coin) loses energy to friction and sound. But the coin plus the tabletop plus the atoms underneath the tabletop plus the air around it is isolated, and so energy is conserved in that system. Energy efficiency will be 100% only in extreme examples like collisions between a small number of elementary particles like electrons and photons. In more everyday systems, energy efficiency will never be 100%, because in all real systems some energy is lost to the production of heat, light, sound, chemical reactions, potential energy, atomic reactions, etc.

Engineers of all types often spend great effort in the design of an instrument or machine to increase its efficiency. Doing so not only can save money, it often leads to reduced weight and size of the instrument (important for aircraft and space vehicles), makes it more reliable or provides a longer lifetime.