

Electric Power Generation: Energy Efficiency and Energy Loss Points

Energy efficiency can be described as the amount of useful energy produced by a system compared to the amount of energy input into the system. A perfectly 100% energy-efficient machine would convert all of the input energy into useful power. However, 100% efficiency is not technologically available at this time. Converting one form of energy to another involves the loss of usable energy. This loss is usually in the form of heat through friction and other mechanical processes.

Energy losses occur throughout the power generation process. But the fundamental law of energy conservation insists that energy is neither destroyed nor created. The sum of all energy (potential energy, kinetic energy, thermal energy, chemical energy and electrical energy) entering a power plant must be exactly the same as the sum of all energy leaving (or lost in) a plant. For example, if one pound of coal, containing 13,500 British Thermal unit (Btu), is stoked into the furnace, the electrical equivalent of 13,500 Btu should be distributed from the plant. But, in fact, only about the equivalent of 4,000 Btu exit the plant as distributable electricity. The other Btu's are "lost" within the plant in a variety of ways.

Furnace Losses

Hydrocarbon fuels burn with various efficiencies. Different types of coal burn with varying percentages of efficiency—the balance is ash and pollutants, which must be properly disposed of.

Steam-Cycle Losses

The steam cycle, which includes the boiler and all its associated piping, condensers, and various heat exchangers, and the cooling-water system, suffers thermal losses through radiation and absorption, and is especially susceptible to friction losses—fluid flow through miles of conduits is slowed by both turbulence and drag.

Turbine Rotation Losses

Major losses associated with this system, once it has obtained operational rotation speed, have to do with acceleration and deceleration and with auxiliary equipment operation.

Generator Losses

Generator losses consist of mechanical "drag" (friction) losses, and electrical drag losses in any generator or motor.