

Efficiency

Machines convert energy from one form into another. Unfortunately, in almost any transformation, the supplied energy is only partly converted into a «useful» form, while some of the energy is transformed into internal energy (due to friction), which warms the machine and its surroundings.

The efficiency η of a machine is the percentage of energy (or power supplied) that is transferred into useful energy (or power extracted).

Definition:

$$\eta = \frac{E_{\text{useful}}}{E} = \frac{P_{\text{extracted}}}{P_{\text{supplied}}}$$

η («Eta») is a number between 0 and 1 (or a percentage between 0 and 100 %).

Experiment: Determine the efficiency of an electric motor

An electric motor is lifting objects of different masses:

Energy input: The energy consumed by the motor (E) is the electric power supplied multiplied by the time it takes to lift the object.

Energy output: The useful energy (E_{useful}) is the gravitational potential energy (E_p) of the lifted object: its mass m multiplied by the acceleration of free fall g and by the height h .

P_{el} [W]	t [s]	E_{el} [J] = $P \cdot t$	m [kg]	h [m]	E_p [J] = $m \cdot g \cdot h$	$\eta = \frac{E_{\text{useful}}}{E} = \frac{E_p}{E_{\text{el}}}$

Typical values of efficiencies: