

# Energy

## Meaning

Energy is the property of matter that characterizes the amount of work that this matter can do on its environment. In simple terms, if we can use a collection of matter (i.e. a system) to lift a weight, then that matter has energy.

## Examples



Water behind a dam (matter) has energy because we can run the water through a turbine, generate electricity to run a motor and lift a weight



A spinning flywheel (matter) has energy because we could hook a rope/pulley to the flywheel and lift a weight



Gasoline (matter) has energy because we can put the gasoline into a piston/cylinder, burn the gasoline and use the expanding gas to lift a weight that is situated on top of the piston.

## Attributes (facts)

- \* common units: J, N-m, Whr, Btu, cal,
- \* primary dimensions are  $M \cdot L^2 / T^2$
- \* energy is a scalar quantity
- \* energy characterizes an amount (not a rate)
- \* a joule is a very small quantity of energy; a 60 W light bulb emits 60 joules of energy every second

## Connections (to other concepts)

- \* energy/time = power
- \* energy and work are balanced via the 1st law of thermo  $Q - W = \Delta U$
- \* energy can be classified into categories: mechanical energy, thermal energy, nuclear energy, electrical energy, chemical energy