

# Units of Energy and Power

The **joule (J)** is a measure of energy, or the ability or capacity to do work.

The **watt (W)** is a measure of *electric* power. (Power is the rate of doing work or producing or expending energy.)

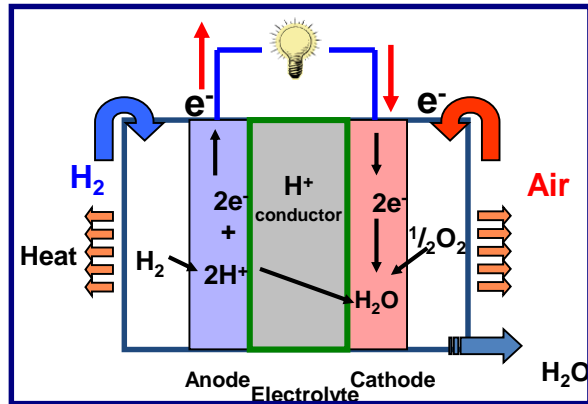
One watt is equal to 1 joule (J) per second. A **megawatt (MW)** is one million watts.

Other measures of energy are **kilowatt-hour (kWh)**, a thousand watts of power produced or used for one hour, equivalent to 3.6 million joules (MJ).

**British thermal unit (Btu)**, equivalent to 1,055 J or 0.293 Wh.

# ELECTROCHEMICAL ENERGY STORAGE AND CONVERSION TECHNOLOGIES

## Fuel Cell

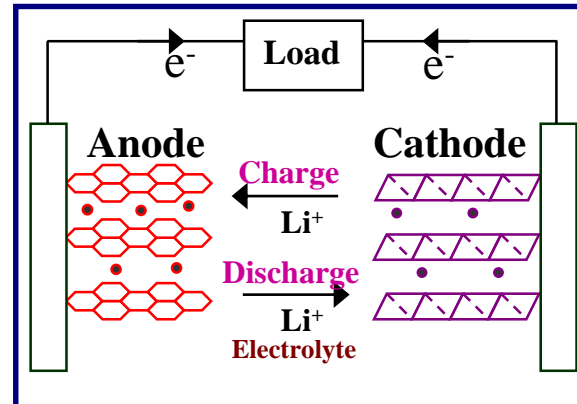


### Conversion Device

Portable, transportation, & stationary



## Battery

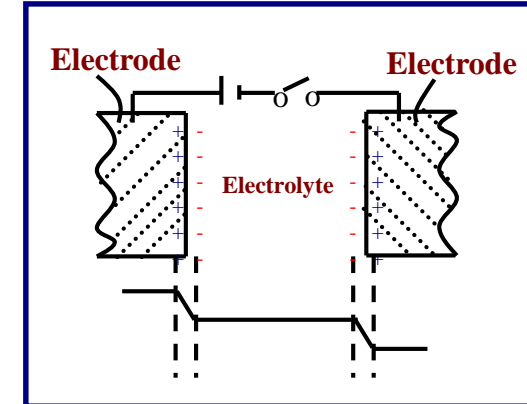


### Storage Device

Portable, transportation, & stationary



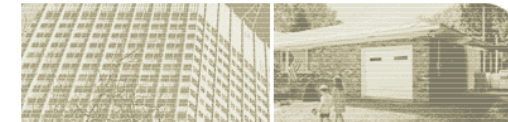
## Supercapacitor



### Storage Device

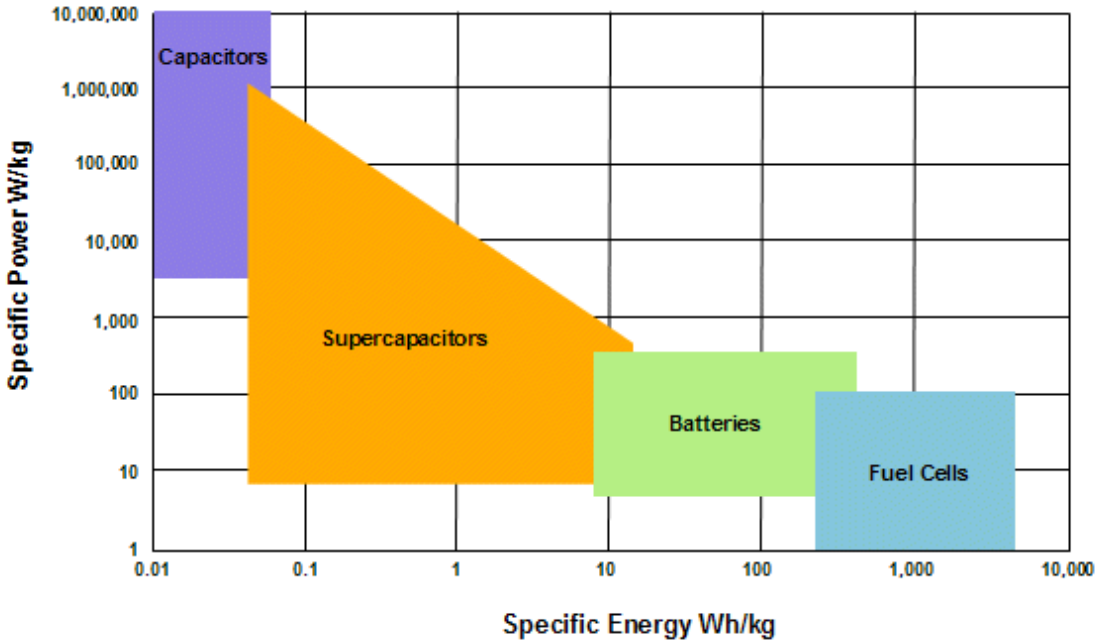
Portable & transportation

### On-Site Power Generation

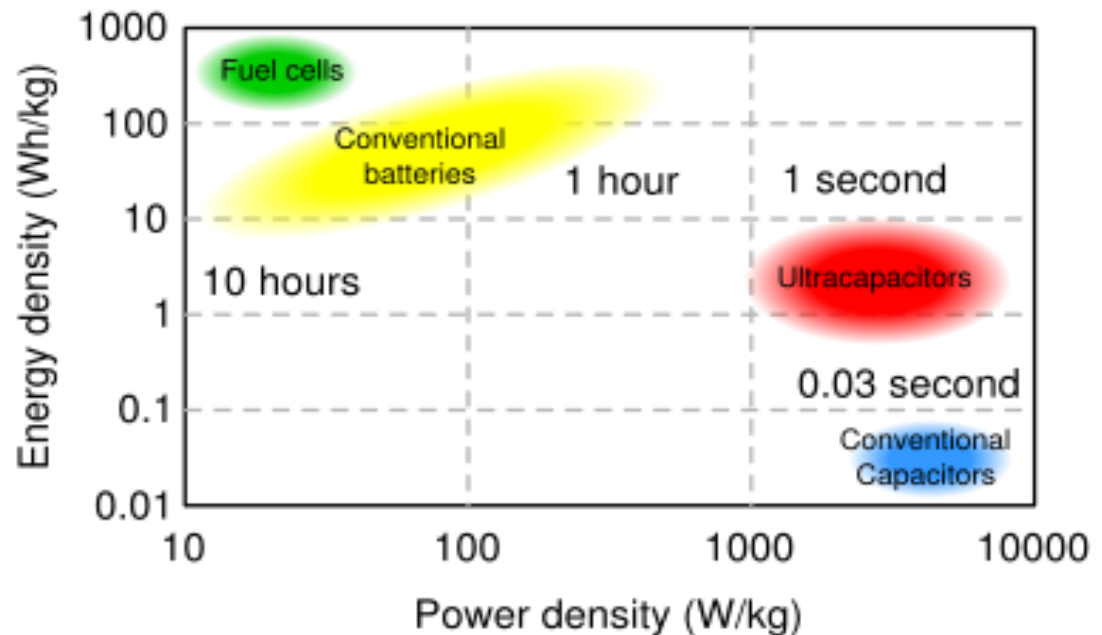


- Chemical energy directly into electrical energy – clean energy technologies
- **Challenges:** high cost, safety, durability, & operability problems

# Energy Storage Devices



Specific power against specific energy



## Supercapacitor



More power required for small  
time interval in 200 m race

## Batteries and Fuel cells



Constant but less power  
required for large time in 20 km  
race

# Energy Conversion

- Hydroelectric power plants take advantage of the gravitational potential energy of water as it falls from the top of a dam to the bottom.
- A car transforms the potential energy trapped in gasoline into Energy
- Coal and natural gas use the chemical potential energy trapped in fossil fuels.
- Nuclear power plants change the nuclear potential energy of uranium or plutonium into electricity too.
- Wind turbines change the kinetic energy of air molecules in wind into electricity.