

ENERGY, POWER, ELECTRICITY

Main themes

- Power and energy
- Energy consumption quantification
- Electricity

Energy and electricity

- **Non-electrical energy**

- Road transport
- Rail transport
- Heating
- Hot water
- Cooking
- Sea transport
- Aviation

- **Electrical energy**

- Grid
- Rail transport



Power (W)

The rate at which work is done

Rate at which energy is consumed by an appliance

Rate at which energy is produced by generator

The unit of power is the watt (W)

Usually written on the labels of appliances

1000 watts is a kilowatt (kW)

kW_e

kW_t

Energy (Wh)

Energy is amount of work (over time) done
Amount of energy consumed by an appliance
Amount of energy produced by generator
The unit of energy is the watt-hour (Wh)
1000 watt-hours is a kilowatt-hour (kWh)

kWh_e

kWh_t

Basic energy calculation

1 x 80 W light bulb x 2 hours = 160 Wh

2 x 80 W light bulb x 1 hours = 160 Wh

3 x 80 W light bulb x 6 hours = 1,440 Wh

3 x 80 W light bulb x 6 hours = 1.44 kWh

Energy consumption - lights

Low energy light bulb

$$18 \text{ W} \times 4 \text{ h} = 72 \text{ Wh}$$



Incandescent

$$80 \text{ W} \times 4 \text{ h} = 320 \text{ Wh}$$



LED (less light)

$$4 \text{ W} \times 4 \text{ h} = 16 \text{ Wh}$$



Energy consumption - computers

Laptop computer

$$30 \text{ W} \times 4 \text{ h} = 120 \text{ Wh}$$



Flat screen computer (small)

$$100 \text{ W} \times 4 \text{ h} = 400 \text{ Wh}$$



Desktop computer (cathode)

$$200 \text{ W} \times 4 \text{ h} = 800 \text{ Wh}$$

(90 W to 300 W)



Use of **large** plasma screens consumes a lot of energy

Energy consumption - fridges

Fridge

$80 \text{ W} \times 8 \text{ h} = 640 \text{ Wh} / \text{day}$

or

LABEL:

$234 \text{ kWh} / \text{year}$

divided by 365

$= 640 \text{ Wh} / \text{day}$

Large low energy fridge (A)
can consume more energy
than small less efficient (B)

Energy	
Manufacturer Model	Logo ABC 123
More efficient	
A	
B	
C	
D	
E	
F	
G	
Less efficient	
Energy Consumption kWh/cycle (based on standard test results for 60 degree cotton cycle)	XYZ
Washing performance A: higher G: lower	ABCDEF
Spin drying performance A: higher G: lower	ABCDEF
Spin speed (rpm)	1100
Capacity (cotton) kg	7-8
Water consumption l	10
Noise (dB(A) re 1pW) Spinning	XX xyz



Energy consumption – shower, heater

Shower

$$8000 \text{ W} \times 0.08 \text{ h} = 640 \text{ Wh}$$

(5 minutes)

Immersion heater

$$2000 \text{ W} \times 0.5 \text{ h} = 1,000 \text{ Wh}$$

(30 minutes)

Electric bar heater

$$2,000 \text{ W} \times 4 \text{ h} = 8,000 \text{ Wh}$$

Cooling

Fan

$$30 \text{ W} \times 6 \text{ h} = 180 \text{ Wh}$$

Air conditioning unit

(wall mounted)

$$2,000 \text{ W} \times 6 \text{ h} = 12,000 \text{ Wh}$$

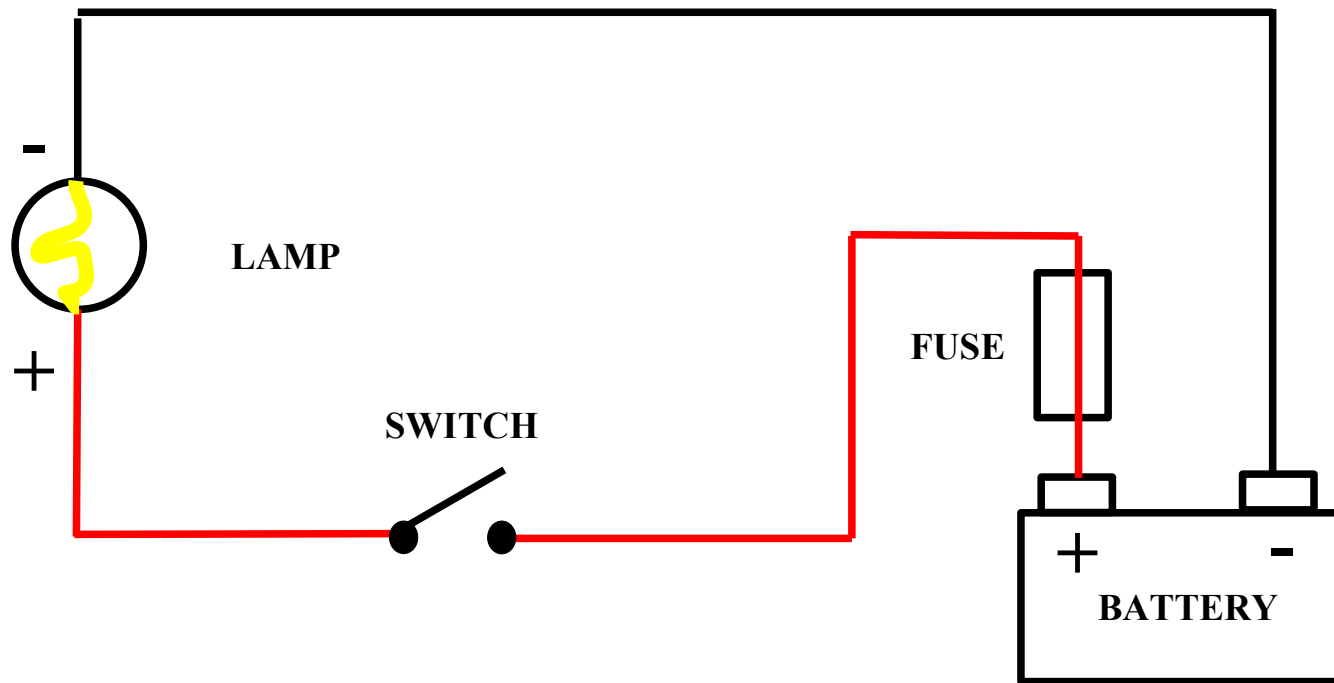


30 W

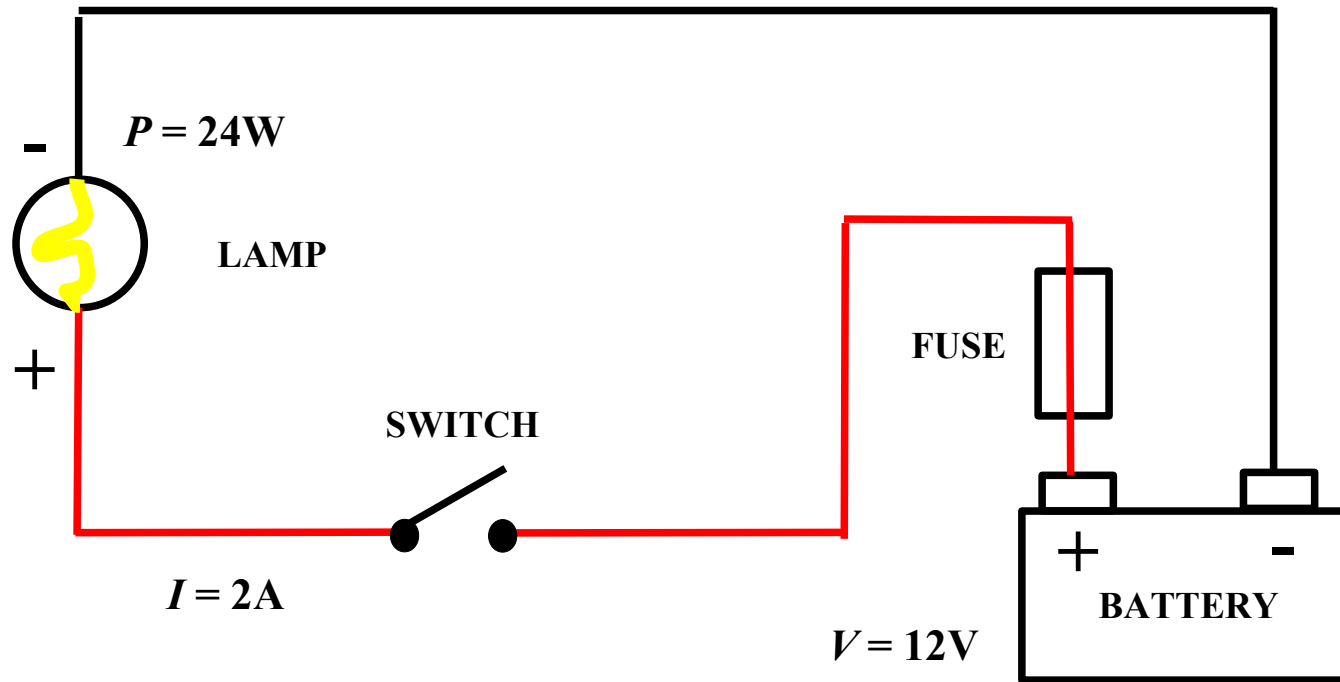
Daily electrical energy use calculation

Appliance	Quantity	Wattage	Hours on	Wh/day
Low energy lights	2	13	4	104
Low energy lights	2	18	4	144
Laptop	1	30	7	210
Music system	1	30	3	90
Fridge		400 kWh /365 days		1095
TOTAL (Wh/day)				1643

Electricity – basic circuit



$$P = V I \quad V = \frac{P}{I} \quad I = \frac{P}{V}$$



Voltage [V] is measured in units of volts [V]
Current [I] is measured in units of amps [A]
Power [P] is measured in units of watts [W]

Electricity – DC & AC

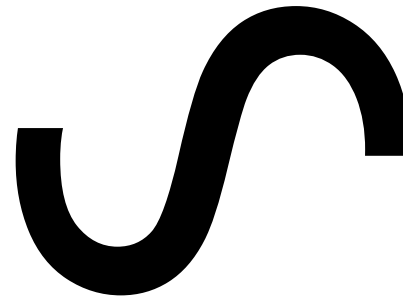


Direct Current

Batteries

Solar modules

Small wind generators



Alternating current

The grid

Generators

Inverters

Inverter

