

Calculating Efficiency

Efficiency is the term used to describe how well something does its job and how little energy it requires to do that job. *For example:* the old style light bulb was not very efficient because most of the electrical energy (input) is wasted by the bulb (transducer) as heat (output).



1) Calculate the energy used in Joules (J) for each of these bulbs. Each bulb is used for **2 hours**: what is the ***difference*** in energy usage?

A newer 'energy saving' bulb uses 18W of power to create the equivalent light of a 100W bulb.

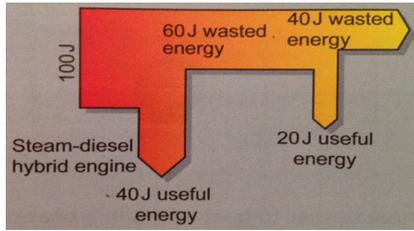
Remember:

Energy (J) = power (W) x time (in seconds).

Knowing how efficient something is helps people to decide which device will cost less to use. If you were going shopping for some consumer electrical goods which one would you buy? Calculate their efficiency using the following formula.

$$\text{Efficiency} = \frac{\text{Useful energy out (J)}}{\text{Total energy in (J)}}$$

Device	Energy transfer	Efficiency (%)
	Input: 400J <i>Output</i> Sound: 225J Heat: 75J Light: 100J	Useful energy = Sound (225J) + Light (100J) 225+100=325J. Total output = 400 Efficiency = 325/400 = 0.8125 (x100) = 81%
	Input: 275J <i>Output</i> Light: 75J Sound: 90J Heat: 110J	
	Input: 1KJ <i>Output</i> Heat: 325J Sound: 300J Light: 375J	
	Input: 0.75KJ <i>Output</i> Heat: 400J Sound: 350J	
	Input: 2000J <i>Output</i> Heat: 1.5KJ Sound: 100J Light: 400J	



In a steam-diesel hybrid car, wasted energy is used to heat water and then produce steam; which is used as an input energy. The steam is used to power the car at slow speeds and conserves the diesel fuel.

- 1) Calculate the efficiency of this hybrid car using the data above.

- 2) Write an energy chain for the hybrid car (*input energy(s) – transducer – output energy(s)*).

- 3) Explain why this hybrid car is more efficient than a petrol only engine.

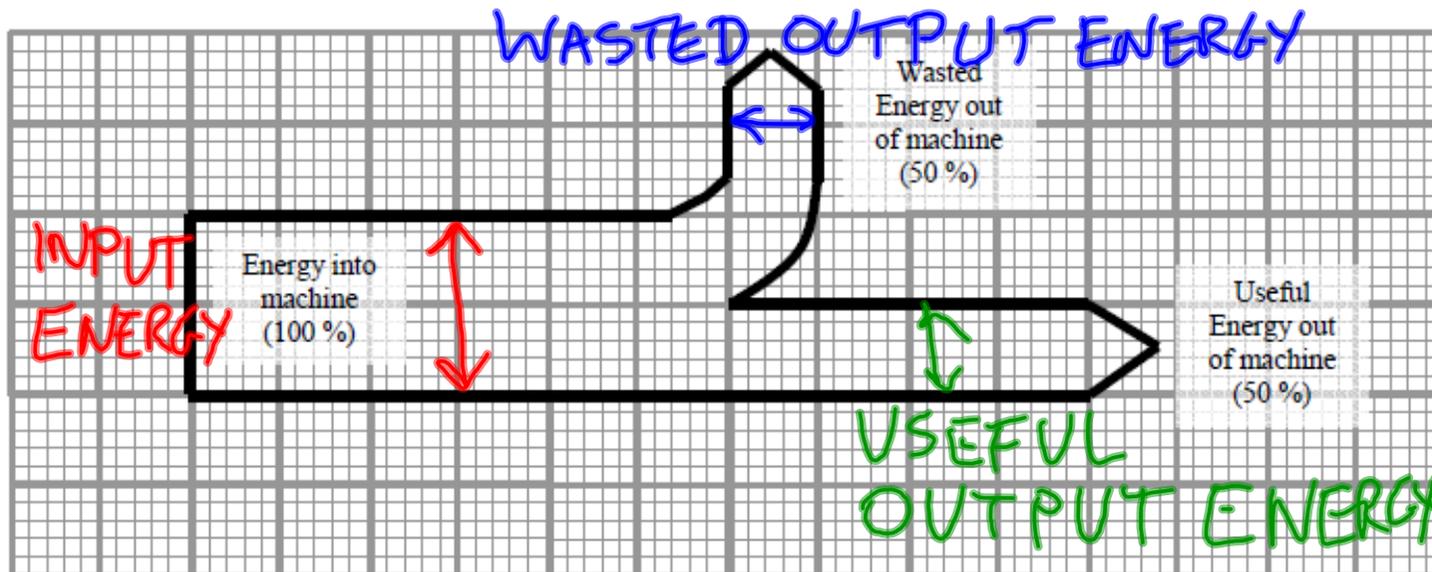
- 4) What could be done to a car to make it more efficient?

Keyword	Meaning	Example
Efficiency		
Energy		
	Something that changes an input energy into useful and not useful energies.	
		Petrol, coal and gas are examples of this type of energy.
Power		

Sankey Diagrams

A Sankey diagram shows you how well a machine uses energy. In other words, it tells you if it uses it **efficiently** (without much waste) or **inefficiently** (with a lot of waste).

The thickness of the arrows shows how much energy is involved. (The length of the arrows does not matter in a Sankey Diagram.) Useful energy transfers are shown going left to right. Wasteful energy transfers are shown going upwards.



1. Write in these labels on the diagram above:
 - a. INPUT ENERGY
 - b. USEFUL OUTPUT ENERGY
 - c. WASTED OUTPUT ENERGY





2. A normal filament bulb transfers 10% of energy as light (useful) but 90% as heat energy (wasted). Draw a Sankey diagram in the space below.



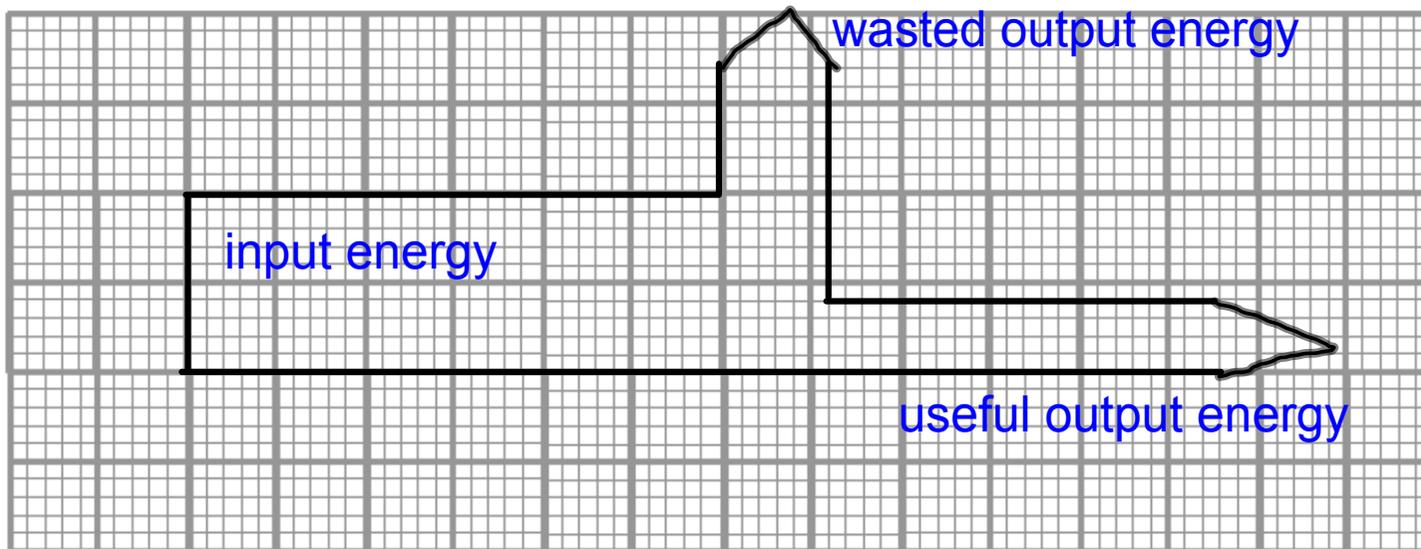
Remember to label it with: INPUT ENERGY, USEFUL OUTPUT ENERGY, WASTED OUTPUT ENERGY

3. An energy efficient bulb transfers 40% of the energy as useful light energy.

a. How much energy is transferred as heat?

60%

b. Draw a Sankey Diagram in the space below



Remember to label it with: INPUT ENERGY, USEFUL OUTPUT ENERGY, WASTED OUTPUT ENERGY

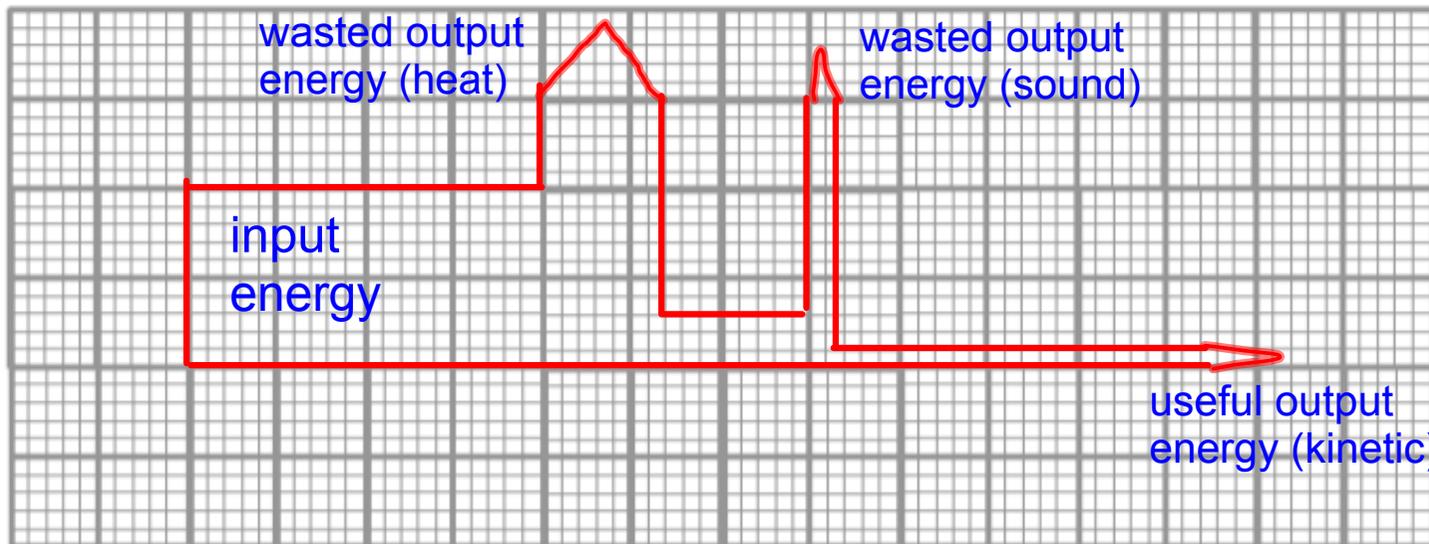
4. A team of scientists test an “old banger” car. They find out that only 10% of the energy is transferred as kinetic energy (useful) and 20% is transferred as heat energy (wasted).



a. How much energy is wasted as sound?

20%

b. Draw a Sankey Diagram in the space below

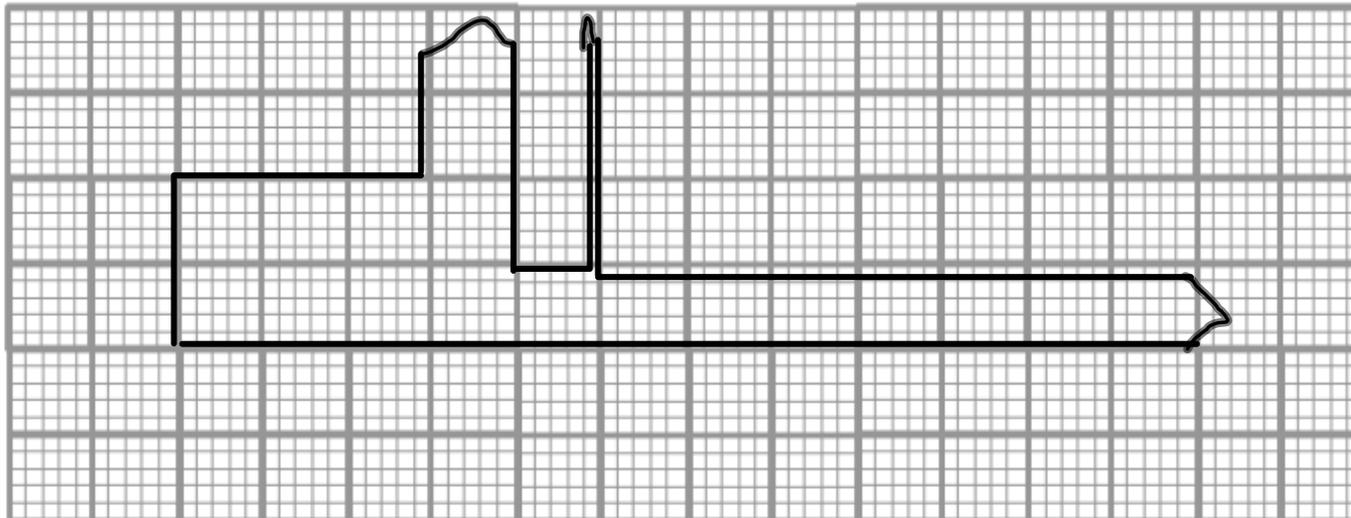


Label the arrows with input energy, useful output energy (kinetic), wasted output energy (heat), wasted output energy (sound)

5. A team of scientists test a brand new hybrid car. They find out that 40% of the energy is transferred as kinetic energy (useful) and 55% is transferred as heat energy (wasted).



- a. How much energy is wasted as sound? _____ 5% _____
- b. Draw a Sankey Diagram in the space below



Remember to label each of the arrows!!!

6. Explain why driving a newer car is 'greener' than driving a very old car.

An old car is inefficient i.e. it wastes a lot of energy.

A newer car is more efficient i.e. it wastes less energy.

A newer car will burn less fuel travelling from A to B since less energy is wasted.

Less burned fuel means less CO₂ given off and less global warming.

Less burned fuel means less smoke and fewer pollutants released to the atmosphere...
