32 Payback Times ♡

Domestic photovoltaic solar panels or small scale wind turbines are popular additions to many people's homes. Given the ever rising cost of fossil fuels and their environmental impact, individuals are investing significant sums of money in the hope of saving money in the long run.

Payback time: the time to save as much money as the initial investment.

Example 1 – A wind turbine costs £1 000 including installation. Since its installation, it has saved the owner £50 per year on their electricity bill. How long will it take for the owner to be in profit?
£1 000 / £50 per year $=$ 20 years.

32.1 Two of the domestic upgrades with highest installation costs are solar panels and double glazed windows, whereas cavity wall insulation is more midrange.

(a) A photovoltaic solar panel costs £5 000 to install and saves £100 per year in electricity costs. What is the payback time?

(b) Fitting an entire house with double glazed windows costs £9 000. Once fitted, the windows provide a saving of £800 each year in the heating bill. What is the payback time?

(c) Fitting cavity wall insulation to a flat costs £400. The annual saving in heating bills is £90. What is the payback time?

32.2 A jacket for a hot water tank costs £30 and the payback time is 8.0 months. How much money does the jacket save each year?

32.3 Photovoltaic solar panels cost £500 per square metre to install on a 6.0 m $\times$ 6.0 m roof. They save the owner £75 per month. What is the payback time?

32.4 A builder quotes that they can fit loft insulation to your house for £300 and it will pay for itself in two years.

(a) How much money will you save in heating bills over ten years if their quote is accurate?

(b) What is the profit after ten years (money saved in heating minus the installation cost) if you follow their advice?

32.5 Another photovoltaic cell costs just £3 000 to install but saves only £50 per year in electricity costs. What is the payback time?

	Installation Cost	Annual Saving on Bill
A.	£10 000	£500
B.	£4 000	£250
C.	£500	£10

32.6 Three solar panels A, B, C have the above costs and savings. Calculate the payback time for each, and identify the best investment.

(a) Which is the best investment if you wish to pay for the solar panels as quickly as possible?

(b) Faced with this choice, which option would save you the most money over 30 years?

Example 2 – A wind turbine can generate an average of 100 W throughout the year [1 W = 1 J/s; see section 33]. Electricity suppliers charge for each kilowatt-hour (kW h):
1 kW h = 1 kW x 1 hour = 1000 W x 3600 s = 3.6 $\times 10^6$ J
The owner usually pays 20p per kW h. If she wants to be "in profit" within 5.0 years, what is the maximum cost of the turbine?

$(100\text{ W}/1\,000) \times 365$ days $\times$ 24 hours per day $=$ 876 kW h per year.
876 kW h $\times$ £0.20 $=$ £175.20 saved per year.
£175.20/year $\times$ 5.0 years $=$ £876 maximum cost.

Assume one year $=$ 365 days in the following questions.

32.7 A wind turbine can generate 150 W on average and costs £3 000.

(a) What is the cost per kW h from the turbine by the end of the first year?

(b) What does the cost per kW h fall to by the end of the fifth year?

(c) If the lowest price for electricity from the utilities supplier is 15p per kW h, what is the payback time?

32.8 A photovoltaic phone charger, of voltage 5.00 V and current 2.00 A, can only operate between the hours of 8am and 7pm. It costs £40.15 and saves 10.0p per kW h. What is the payback time?

32.9 A wind turbine on a caravan can keep a 35 W fridge running. The payback time is 7.0 years and saves the owner 15p per kW h. How much did the turbine cost?

32.10 A nightlight has a power of 2.0 W. It only needs to be on from 7pm to 7am, but the parent does not want to switch it manually. A timer 'uses' electricity all the time. What is the maximum power of a timer which will still save the family money on their electricity bill?