



Name Class Date

You are a Renewable Energy Consultant working with INEOS TEAM UK to measure the output of their solar array. Complete the tasks to help them make the most of their renewable energy and increase their sustainability.



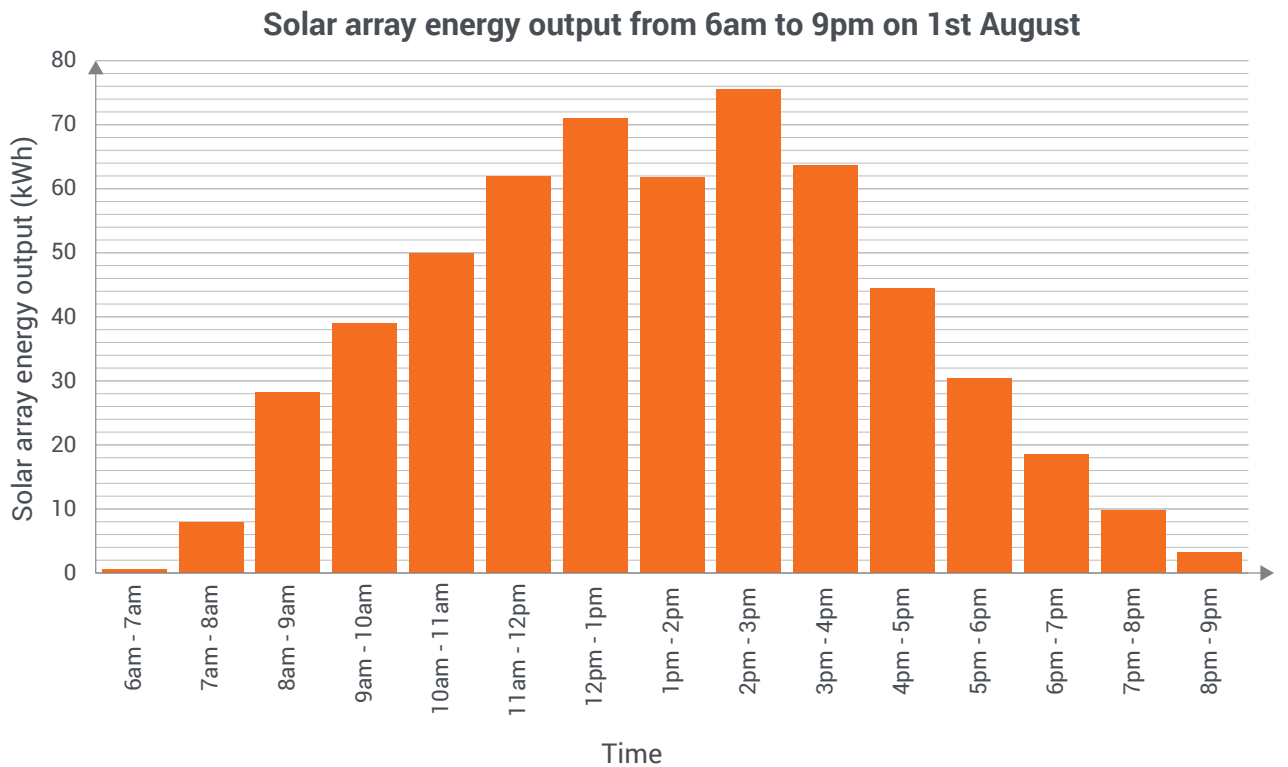
Mark Rogers: Facilities Manager at INEOS TEAM UK

Mark helps to ensure the INEOS TEAM UK base is as energy efficient as possible.

The INEOS TEAM UK base has a fantastic solar array on the roof. To ensure they are reaching their sustainability goals, Mark and the team need to ensure it's working at its best, and understand the impact that it has.

Task 1: Changes With Time

1 The chart below shows the hourly energy output of the base's solar array, in kWh.





a Describe and explain what happens to the power output throughout the day. Make sure you include the overall pattern, any changes to the pattern, quantitative examples and the range of output.

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b What could have caused the dip between 1pm and 2pm?

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c What was the total energy output between 11am and 4pm?

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d What is the average hourly output between 11am and 4pm?

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e How many hours, starting from 6am, does it take to produce the same amount of energy as that produced between 2pm and 3pm?

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f During which hours could we run all the following equipment using only solar energy? Work out the total energy required to run them all for one hour, and draw a line on the chart to help you.

Equipment	Quantity	Energy used in 1 hour (Wh)	Quantity x energy (Wh)
Desktop computer	80	110Wh	
TV screen	12	75Wh	
Lights	22	25Wh	
Air conditioner	8	1000Wh	
		Total energy over 1h	

Extension

g The base’s working hours are 9am to 5pm. Could the team run all the equipment on solar power during working hours on 1st August?



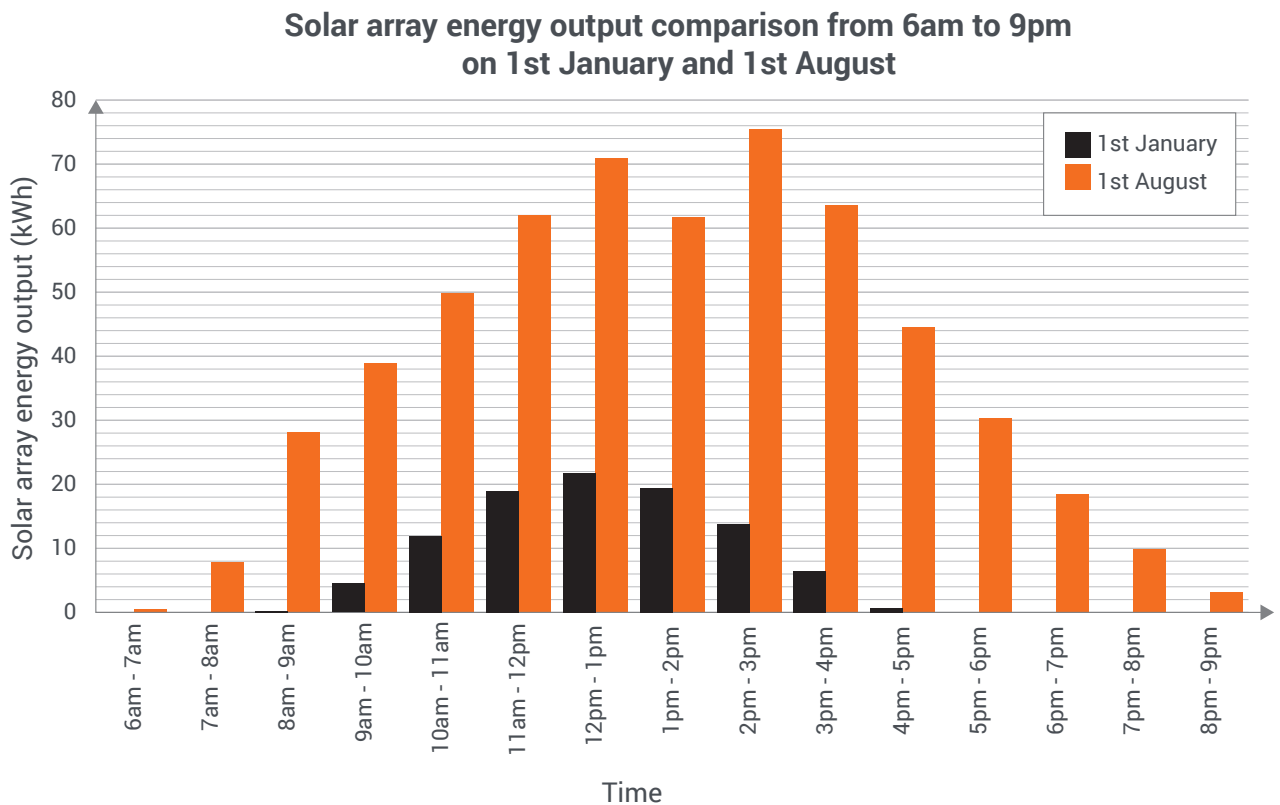
h Would there be other times when they couldn’t run the equipment? Consider weather, seasons, and other factors!





Task 2: Changes With Season

2 The chart below compares the solar array's output on a single day in summer (1st August) and winter (1st January)



a What was the total energy output between 11 am and 4pm on 1st January?

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b What is the average hourly output between 11 am and 4pm on 1st January?

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c How much more energy was produced between 12pm and 1pm on 1st August than 1st January?

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d Describe and explain the difference between summer and winter outputs using both quantitative and qualitative descriptions. You should:

- compare differences in maximum outputs
- think about what time the maximum output occurs
- calculate how many hours power is produced for
- compare your averages calculated in **questions 1d and 2b**

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e At what times could the equipment in **question 1f** be run using only solar power on 1st January?

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f When the solar panels do not produce enough power to run the base then it is 'topped up' by buying extra electricity from the National Grid. Purchasing electricity from the National Grid costs 25p per kWh.

INEOS TEAM UK need to keep their base open from 9am to 5pm on 1st January.

- Calculate how much additional energy needs to be purchased from the National Grid.
- How much would this cost?

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Task 3 (Extension): Electricity At Home

The INEOS TEAM UK base uses a large solar panel array, but lots of people also choose to have smaller arrays on their homes. These may consist of just a few panels.

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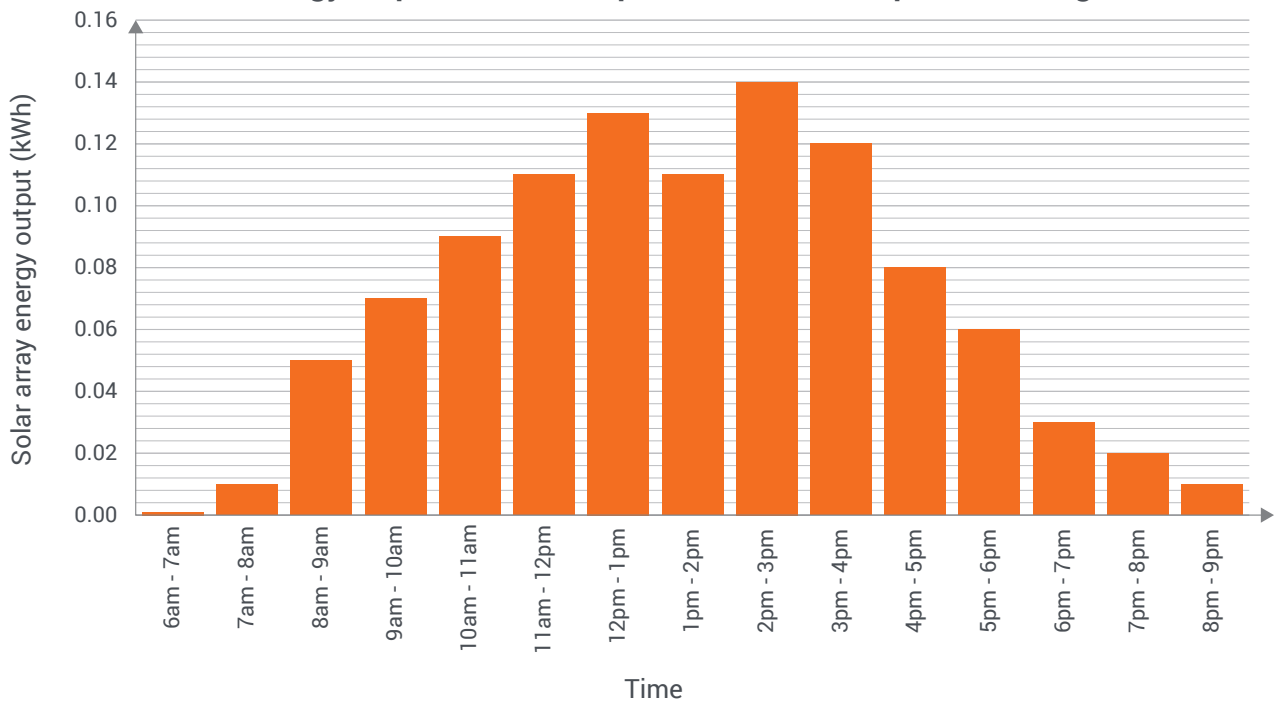
Here are some power requirements for common household devices:

Device	Power requirement	Number of panels needed on 1st August	Number of panels needed on 1st January
42" TV	75W		
Xbox One	110W		
PlayStation 4	137W		
Laptop	70W		
Washing machine	500W		
Kettle	2200W		

- a** The output of one panel at 11:30am is 30W on 1st January and 110W on 1st August. Complete the table above to find out how many solar panels you would need on your roof to run each device completely on solar energy at 11:30am on 1st January and 1st August.
- b** The chart below shows the output of one solar panel on 1st August. Suppose a home has 5 panels. Using only solar power, at what times of day could they:
- » Run their washing machine?
 - » Play on the Xbox One? (Note: they will need to run the TV too.)
 - » Boil the kettle?



Energy output of one solar panel from 6am to 9pm on 1st August



c An average electricity bill for a family home is £540 per year. A house with solar panels can save 20% on their electricity bill. How much will their bill now cost?

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d The National Grid buys back electricity generated from solar panels at 3.6p per kWh. 5 solar panels could generate 1400kWh per year. How much money could 5 solar panels earn in a year?

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e Extension: what could you do to reduce your electricity bill?

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