

# DESCRIBING DATA: NEGATIVE EMISSIONS AMBITION

The Describing Data series of resources allows students to practise graph or data interpretation. The topics are predominantly related to electricity or climate, and each resource includes short answer and challenge questions.

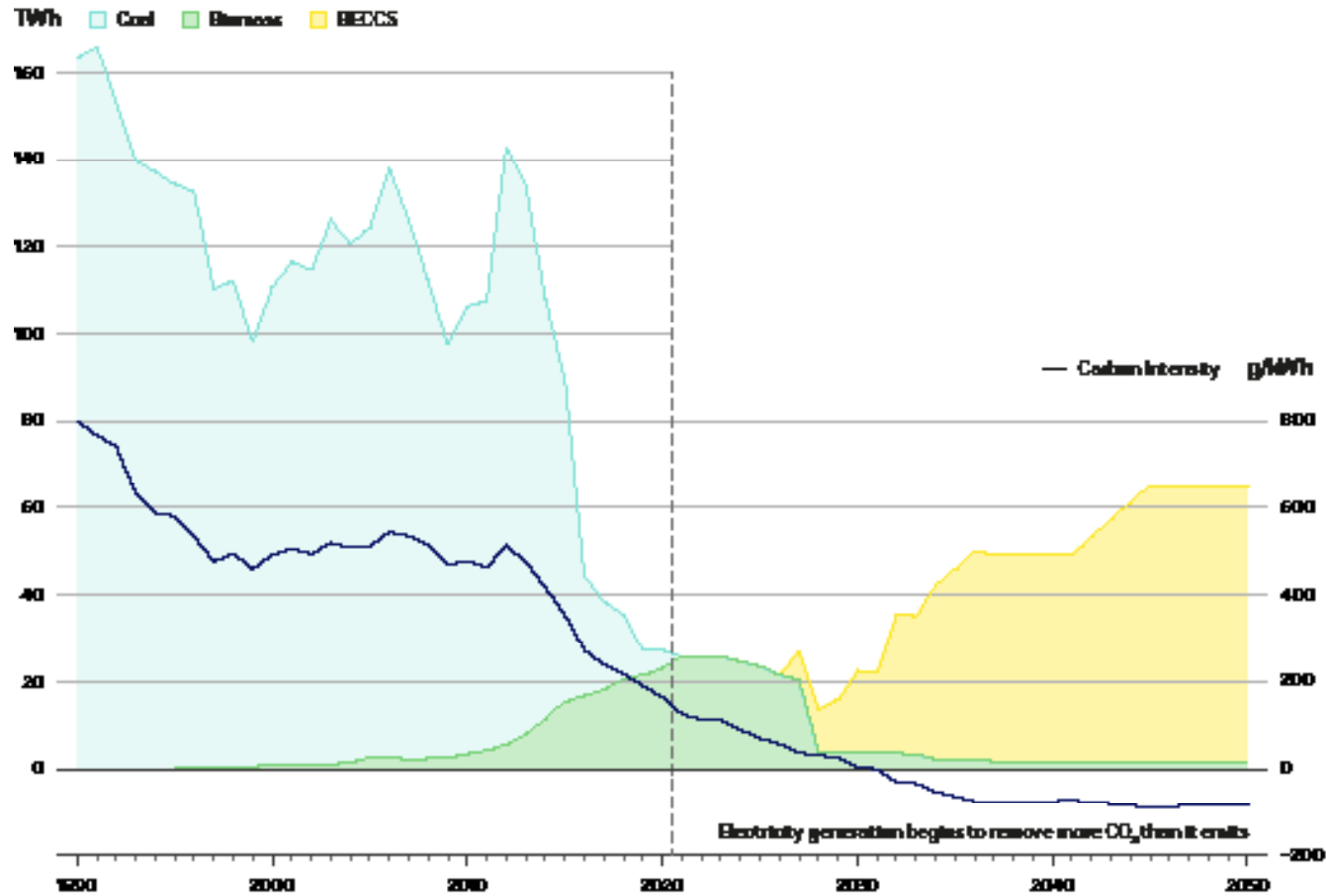
## TEACHER NOTES

<b>Most suited to</b>	KS4
<b>May be suitable for</b>	KS3, KS5
<b>Skills</b>	Using a graph, data interpretation, data visualisation, scientific literacy
<b>Subject</b>	Science/physics/chemistry/maths/geography/ environmental issues
<b>Topic</b>	Electricity generation, sources of energy, climate change, resource use
<b>Suggested use</b>	Lesson activity, homework, remote provision, home learning
<b>Resources needed</b>	Optional internet access, paper or electronic copies of data sheet and questions
<b>Mark schemes guidance</b>	Suggested or model answers are given. Numerical values are approximate. Suggested number of marks are given in brackets at the end of each answer

Feedback: <https://forms.office.com/r/VkQ6FF4xxJ>

Contact us: [educational.resources@drax.com](mailto:educational.resources@drax.com)

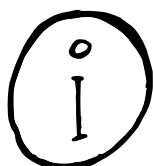
# DESCRIBING DATA: NEGATIVE EMISSIONS AMBITION



Annual electricity generation from solid fuels in Britain and the average carbon intensity of electricity, shown over the past three and next three decades according to National Grid's "Leading the Way" future energy scenario.

## BACKGROUND INFORMATION:

- BECCS stands for 'Bioenergy with carbon capture and storage'.
- Bioenergy (the 'BE' in 'BECCS') involves continuously regrowing trees or plants that are then used for energy. The carbon emitted during energy generation is absorbed by the plants in photosynthesis, meaning net-zero emissions.
- If emissions from the power station are captured and locked away underground (the 'CCS' in 'BECCS'), the plants being grown and regrown remove net carbon from the atmosphere. This is more than offsetting the bioenergy emissions.
- The 'carbon intensity' of electricity is a measure of how much carbon dioxide is emitted per kilowatt hour of electricity consumed.
- TWh is a measure of electrical energy. 1TWh or 1 terra watt hour, is 1,000,000,000,000 Wh or  $10^{12}$  watt-hours. 1 watt-hour is a unit of energy equal to one watt of output for an hour, which is the same as 3,600 joules. A terawatt-hour is one trillion watts for one hour. It's used to describe electrical generation within a country or from a large power station. It's too large a unit to describe household electricity use.
- g/kWh means grams of carbon dioxide per kilowatt hour of electricity generated.



If you'd like to read more on this topic:

- <https://reports.electricinsights.co.uk/wp-content/uploads/2021/05/Drax-Electric-Insights-Q1-2021-Report.pdf>
- <https://www.drax.com/about-us/our-projects/bioenergy-carbon-capture-use-and-storage-beccs/>

# DESCRIBING DATA: NEGATIVE EMISSIONS AMBITION QUESTIONS



Answer the following questions on paper or in your book, as requested.

1. What's shown on the x axis of this graph?
2. The grey line and grey shaded area show how much electricity is generated from coal. What do the orange line and shaded area show?
3. There are two y axes on this graph. The left-hand axis shows the amount of electricity generated each year, measured in TWh. What does the right-hand axis show? What are the units?
4. Why does this graph need to have two y axes?
5. What does the black trend line describe?
6. What was the carbon intensity in the year 2000?
7. In which year does the graph predict that carbon intensity may become negative?
8. What was the approximate maximum electricity generated from coal (in TWh)? In which year did this happen?
9. Describe the trend in carbon intensity between the years 2000 and 2040.
10. Does this graph show when no electricity will be generated from coal?
11. Describe what happens to electricity generation from coal from the year 1990 to the year 2020. Include data points from the graph in your description.
12. Does generation from BECCS replace generation from coal? Include data from the graph and explain your answer.

## CHALLENGE QUESTIONS

These questions need more information than you'll find on the graph. To help, read the background information and follow the suggested links.

1. Why does electricity generated using BECCS have the potential for negative carbon intensity, and remove more carbon dioxide than emitted?
2. Look at the graph. Do you think we used less electricity in 2020 than 1990? If not, why not, and what other types of electricity generation could be added to the graph?

## DESCRIBING DATA: NEGATIVE EMISSIONS AMBITION ANSWERS

1. The year (the graph ranges from 1990 to 2050, so starts with known information and then changes to predicted information). (1)
2. Annual (so the total per year) electricity generated (made) from biomass. (1)
3. The right-hand axis shows the carbon intensity of electricity generated each year. The units are g/kWh (grams of carbon dioxide released to the atmosphere for every kilowatt hour of electricity made). (2)
4. The graph uses two axes to allow the display of two different data sets on the same x axis (years). The data sets have different units and ranges, so they cannot be shown using a single axis. (1)
5. The black trend line is the average carbon intensity of electricity generated each year. (1)
6. The carbon intensity in the year 2000 was approximately 500 g/kWh (make sure you read across to the right-hand axis!). (1)
7. In the year 2030, carbon intensity may become negative (hint: this is the point carbon intensity crosses the x-axis). (1)
8. In 1991, the maximum electricity generated from coal was approximately 165 TWh. (2)
9. Carbon intensity between 2000 and 2012 stayed constant (at around 500 g/kWh). It then started to decrease. It decreased rapidly to around 275 g/kWh in the year 2016. It then decreased more slowly to around -75 g/kWh predicted in 2040. (suggest any 3 points)
10. No, it's not clear from this graph when there'll be no electricity generated from coal. (1)
11. Electricity generation from coal was around 162 TWh in the year 1990. The general trend was a rapid decrease in generation to the year 2000, when it was around 110 TWh. However, there were some fluctuations in this trend, with small increases in electricity generation from coal occurring in 1991, 2018 and 2020. (suggest any 3 points)
12. Generation from BECCS doesn't replace all the electricity generation from coal. The maximum electricity generated from BECCS on the graph is about 65 TWh. This doesn't replace the maximum coal generation of between 100 and 140 TWh achieved between 1990 and 2012. (suggest any 3 points).

## CHALLENGE QUESTIONS – SUGGESTED CONTENT

1. BECCS uses bioenergy. This means that biomass (such as wood pellets) is burned to create steam that drives turbines to generate electricity. The biomass material (such as trees) absorbs carbon dioxide from the atmosphere during photosynthesis and is constantly replanted. BECCS generation also includes carbon dioxide capture, so the carbon dioxide is locked away after combustion and not returned to the atmosphere. This means that more carbon is removed than is released.
2. People and businesses did not significantly reduce electricity consumption. Some types of electricity generation are not included in the graph. Other types of generation that could be added are gas, and renewables such as wind energy.

Feedback:

