

COMPREHENDING SCIENCE: BIOMASS PELLETS

The Comprehending Science series of resources uses extracts of Drax website articles, alongside comprehension questions, in topics relevant to the national curriculum. A shorter version of this resource is also available, with less text and six comprehension questions.

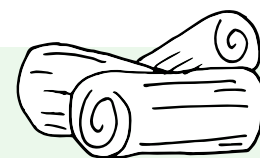
TEACHER NOTES

Most suited to	KS3, KS4
May be suitable for	KS2
Skills	Comprehension, scientific literacy
Subject	Science, English language
Topic	Electricity generation, sources of energy, electricity
Suggested use	Lesson activity, homework, remote provision, home learning
Resources needed	Optional internet access, paper or electronic copies of worksheet and questions
Mark schemes guidance	Suggested or model answers are provided

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

Contact us: educational.resources@drax.com

- Read the text about how to make biomass pellets, edited from:
www.drax.com/sustainable-bioenergy/this-is-how-you-make-a-biomass-wood-pellet
- Write the answers to the questions in your books/on paper, as instructed. Use full sentences. The numbers in brackets help you find the line numbers you need in the text. You may need some additional science knowledge or resources for some of the short answer and challenge questions.



THIS IS HOW YOU MAKE A BIOMASS WOOD PELLET

2 Wood has been used as fuel for tens of thousands of years, but this wood – a
 4 compressed wood pellet – is different. It's the size of a child's crayon and weighs
 6 next to nothing. Yet, when combined with many similar pellets, it's a smart solution to
 8 generating electricity that's cleaner than using coal. Drax Power Station uses wood
 pellets like these to generate electricity and power businesses and homes across
 Britain. Not only are these pellets renewable and sustainable, they're also a very
 efficient fuel for power stations (because they're compressed, dried and made from
 incredibly fine wood fibres).

10 Wood arrives at the plant via truck and is sent to one of four places: the wood storage
 12 yard; the wood circle (where wood is primed for processing); the sawdust and woodchip
 14 piles; or straight into processing. Logs are fed into a debarker machine that beats the
 logs together inside a large drum to remove the bark. The bark is put aside and used
 to fuel the woodchip dryer, used later in the process. The logs – low-value fibre from
 sustainably managed working forests – need to be cut down into even smaller pieces.
 Only then can they be shredded into the fine material needed for creating pellets. Inside
 the wood chipper, multiple blades spin and cut the logs into chips roughly 10mm long and
 3mm thick. The resulting chips are fed into the woodchip pile, ready for screening.

18 Chipped down wood can include waste elements like sand, remaining bark or stones
 20 that can all affect pellet production. The chips are passed through a screener that
 removes the waste, leaving only ideal-sized wood chips. The wood chips need to have
 a moisture level of between 11.5% and 12% before they go into the pelleting process.
 22 Any other level of moisture could compromise the quality of the resulting pellets. The
 chips enter a large drum that's blasted with hot air generated in a heater powered by
 24 bark collected from the debarker. The chips are moved through the drum by a large fan,
 ready for the hammer mill.

26 Inside the hammer mill, there's a spinning shaft mounted with a series of hammers. The
 wood chips are fed into the top of the drum and the spinning hammers chip and
 28 shred them down into a fine powdery substance that's used to create the pellets. The
 shredded woodchip powder is fed into the pellet mill. Inside, a rotating arm presses
 30 the powdered wood fibre through a grate featuring several small holes. The intense
 pressure heats up the wood fibre and helps it bind together as it passes through the
 32 holes in a metal ring die, forming the compressed wood pellets.

34 Fresh pellets from the mill are damp and hot; they need to rest and cool before they're
 transported off site. The pellets are moved to large storage silos that are kept at
 low temperatures, so they can cool and harden and be ready for shipping. Specially
 36 designed and constructed storage domes are used to store the wood pellets after they're
 transported to the Mississippi River, Louisiana and before they cross the Atlantic to the UK.

IF YOU WANT TO UNDERSTAND MORE ON THIS TOPIC

- Read the full article by using the hyperlink above, or www.drax.com/sustainable-bioenergy/this-is-how-you-make-a-biomass-wood-pellet/
- Explore related articles at www.drax.com

Feedback:



COMPREHENDING SCIENCE: BIOMASS PELLETS QUESTIONS



COMPREHENSION QUESTIONS

1. What fossil fuel is being replaced with biomass wood pellets? (4)
2. Where are the biomass pellets used? (4-5)
3. The wood comes from what type of forests? (14)
4. What's a 'debarker'? (11-12)
5. How is the woodchip dryer heated? (22-24)
6. What percentage of moisture do the chips need to have before the pelleting process can begin? (20-21)
7. What three contaminants need to be removed from the woodchip? (18)
8. Are any other additions made to the shredded woodchip powder before making the pellets? (26-32)
9. Are fresh pellets transported straight away? (33-35)
10. How are the biomass pellets transported to the UK? (35-37)
11. Why is biomass imported into the UK instead of being produced locally?

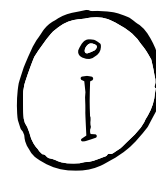
SHORT ANSWER QUESTIONS

1. What does 'renewable' mean, in the context of this article? (6)
2. What is a 'working forest'? (14)
3. If 100g of wood chips have a moisture content of 12%, how many grams of water do they contain? (maths)
4. What's the scientific name for the process of burning woodchips? (science)
5. What does the word 'biomass' refer to? (article title)
6. What country are the wood pellets in the article made in? (35-37)

CHALLENGE TASKS

1. Turn the text of the article into a series of annotated diagrams.
2. Biomass pellets must be stored and transported in controlled conditions. One requirement is that they're stored in a low oxygen (hypoxic) atmosphere. Explain why this is important and how this could be achieved.
3. Why is biomass imported into the UK instead of being produced locally?

COMPREHENDING SCIENCE: BIOMASS PELLETS ANSWERS



COMPREHENSION QUESTIONS

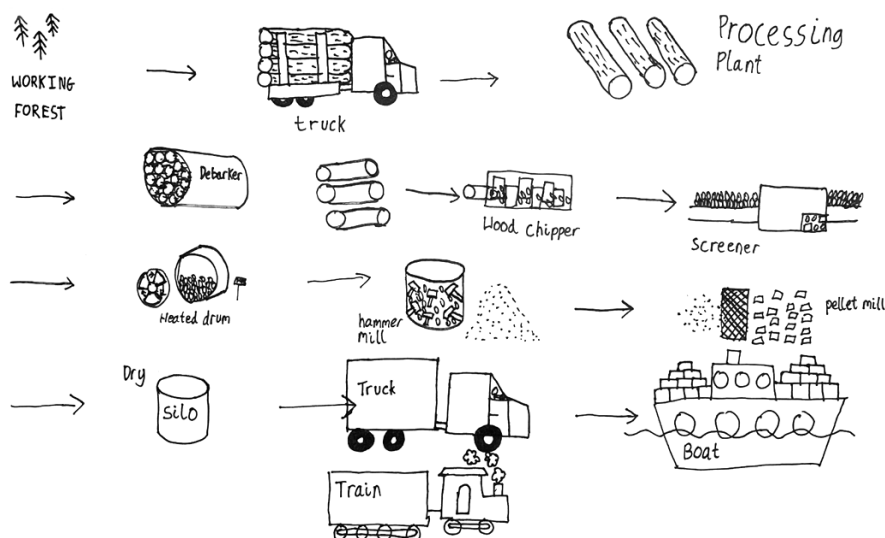
1. Coal is being replaced with biomass wood pellets.
2. The biomass pellets are used at Drax Power Station.
3. The wood comes from working forests that are sustainably managed.
4. A 'debarker' is a machine that breaks the bark off the outside of wooden logs.
5. The woodchip dryer is heated with hot air. This air is heated by burning bark.
6. The moisture content of the chips needs to be between 11.5% and 12% before they go into the hammer mill.
7. Sand, any bark still on the wood, and stones need to be removed from the woodchip.
8. There are no additions made to the shredded woodchip powder. The pellets are just made from compressed woodchip.
9. Fresh pellets are not transported straight away; they have to be stored while they cool and harden.
10. The biomass pellets are transported to the UK by ship, across the Atlantic.

SHORT ANSWER QUESTIONS

1. 'Renewable' means that the biomass for the pellets can be replaced (by replanting) at least as quickly as it's used.
2. A 'working forest' is one that's managed for producing sustainable timber, by replanting harvested areas with more trees, removing overcrowded or damaged trees, and monitoring for insect damage.
3. 100g of woodchip would contain 12 grams of water.
4. The scientific name for the process of burning is 'combustion'.
5. The word 'biomass' means any fuel that has been grown. Biomass includes wood and wood processing residues/waste, crops (plants) and agricultural wastes, and sewage.
6. The wood pellets in the article are made in the USA.

CHALLENGE TASKS

1. You should aim to include at least seven simple, labelled diagrams to show each stage of the processes involved in making biomass wood pellets. Here's an example:



2. Biomass pellets are a fuel. They burn in air, in a combustion reaction with the oxygen in the air (air contains around 21% oxygen). If the oxygen is removed, or reduced a lot, the pellets cannot combust. Combustion during transport or storage is not wanted as it's potentially dangerous, would damage infrastructure (e.g. storage areas, ships). It would also cost money and disrupt the fuel supply to the power station where it's needed. Pellets could start to combust in uncontrolled storage or transport conditions because of an accidental spark, heat from equipment, or from self-heating (biomass can warm itself up!). Oxygen can be removed from storage or transport by replacing the air around the biomass pellets with nitrogen gas (carbon dioxide gas would work too).
3. Biomass is imported because the managed forests in the UK are much smaller than the managed forests in Canada and the USA. These countries are much larger and use a lot more timber; many homes and buildings there are built using timber rather than bricks and blocks. The USA and Canada have huge areas just for working forests to produce this timber. It would not be possible to supply all of the biomass from UK forests sustainably. UK trees could not be replanted quickly enough, as Drax Power Station alone can use up to 32,000 tonnes of biomass pellets every day if producing power at full capacity. However, some of the biomass used is sourced more locally (from the UK and Europe) and the power station trials new biomass sources from time to time.