Subject: **Chemistry / Physics**

Topic: **The atmosphere / Energy resources**

Application: **Climate change and renewable energy**

Using the worksheet and podcast resources

This worksheet is based on the Inventive podcast.

It supports Gatsby Benchmark 4: Careers in the curriculum by introducing a career and role model. The worksheets are based on topics in the KS3 curriculum.

The short audio clips can be used to provide context to the worksheet and could be played during a lesson.

A QR code on the student sheet links directly to the podcast.

KS3 National Curriculum statements

Chemistry

- The composition of the atmosphere.
- The production of carbon dioxide and the impact on climate

Physics

- Fuels and energy resources

Audio clips from Inventive podcast

Available from: *nustem.uk/inventive/#enas_manjot (scan QR code)*

- **Enass&Manjot Clip 1:** Impact of not having easily accessible electricity
- **Enass&Manjot Clip 2:** What is hydrogen, why it does not emit pollutants, why it isn't used widely at the moment
- **Enass&Manjot Clip 3:** What H2GO does.
- **Enass&Manjot Clip 4:** What an integration engineer does

Other resources

Enass' career poster
Manjot's career poster
More information about Enass
More information about Manjot

Watch Enass' RI Christmas Lecture on H2GO tecnology

Meet the engineers

Enass Abo-Hamed & Manjot Chana

Enass Abo-Hamed is an activist and chemical engineer. She set up a company called H2GO. The company uses surplus renewable energy to store hydrogen to be used in fuel cells.

Manjot Chana is Head of Systems and Integration at H2GO. A systems and integration engineer links different systems together to make one system that works.

Scan the QR code

to access all the resources and the full podcast from: *nustem.uk/inventive/#enas_manjot*

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Know

1a. Fossil fuels - coal, oil, gas; Renewable energy resources - wind solar (biomass, geothermal)
1b. Greenhouse gases - found in atmosphere; reduce energy radiated form earth so average temperature rise.

2.

	Wind and solar	**Fossile fuels**
Advantages	Free; renewable; no pollution	Available when needed, enegy-dense
Disadvantages	Not always available; can't be stored	Polluting, will run out, cause global warming

Apply

3a. Water → hydrogen + oxygen; $2\ H_2O \rightarrow O_2 + 2\ H_2$
3b. Hydrogen + oxygen → water; $O_2 + 2\ H_2 \rightarrow 2\ H_2O$
3c. Only uses water, hydrogen, oxygen - none of these contain carbon.

4. The hydrogen can be produced using renewable energy sources (wind, solar); it does not produce greenhouse gases; it is a way to store surplus renewable energy; water is easily available - does not need to be mined, etc.

5. Answer (allow anything correct)
Petrol fuelled - greenhouse gases released when car is driven; environmental impact when oil is produced and refined
Electric cars - no exhaust emissions at point of use; environmental impact depends on energy mix of UK electricity generation
Hydrogen fuel cells - no pollution at point of use; environmental impact depends if surplus renewables can be used to store hydrogen, or if hydrogen is produced using general UK electricity supply

Extend

6. e.g. Pledges from COP26: meet next year to pledge further cuts to carbon dioxide emissions; reduce use of coal; significant contributions to help poorer countries cope with climate change and increase clean energy; phase out fossil fuel subsidies; stop deforestation; reduce methane emissions; https://www.bbc.co.uk/news/science-environment-56901261

Specific actions from COP - process started after the Paris agreement at COP21 in 2015; COP26 was checking up on these pledges. https://www.energynetworks.org/campaigns/net-zero has specific points; also look at Environment Bill; Net Zero strategy; Heat and Buildings Strategy; Transport Decarbonisation Plan; hydrogen power

Community actions/Personal: e.g. use electric vehicles for public and private vehicles; encourage commuting (to school or work) by walking and cycling; reduce use of electricity within schools, offices and companies as well as homes; install insulation; Councils can install solar panels on council houses; develop ways to 'lock away' carbon in natural resources such as trees and forests.
Students might want to look at what their local council strategy for achieving net zero is.

Worksheet version: 2.0, 2022-06

Climate change and renewable energy

Fossil fuels (coal, oil and gas) are used to generate electricity and for transportation. When fossil fuels burn, methane and carbon dioxide are released into the atmosphere.

These gases are called greenhouse gases because they reduce the total amount of energy radiated from Earth. This has made the average temperature around the world rise by over 1°C in the last 40 years (global warming).

Renewable energy resources include wind turbines and solar power.

Wind and solar power do not cause pollution while generating electricity. However, wind speeds can be unpredictable and solar panels do not work at night.

Hydrogen is a pollution-free energy source that can be stored as a solid and used instead of fossil fuels. Hydrogen production could use surplus energy from renewable energy resources.

Meet the engineers

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Link to their story

Know

1a. Name three fossil fuels and two renewable energy resources

Fossil fuels:

Renewable energy resources:

1b. Explain where greenhouse gases are found, and what they do

2. Complete this table:

	Wind and solar	**Fossile fuels**
Advantages		
Disadvantages		

Apply

3. H2GO uses electrolysis of water to produce hydrogen. The hydrogen is stored until needed. Then, a fuel cell uses the hydrogen to release energy.

3a. Write down the equation for the production of hydrogen from water.

3b. Write down the equation for the production of water from hydrogen and oxygen

3c. Explain why this process does not release greenhouse gases

4. Green energy is generated from non-polluting resources and has little impact on the environment. Green energy resources are usually renewable. Explain why H2GO calls the hydrogen it produces a green energy resource.

5. Electric cars do not produce carbon dioxide at the point of use. They use batteries which are charged from mains electricity. Charging points may be at home, work, or public charging points.

In the future, some cars could use hydrogen fuels cells that store energy from surplus renewable energy production.

Discuss the impact on the environment of petrol-fuelled cars, electric cars that use batteries and hydrogen cars that use fuel cells.

Petrol fuelled car:

Electric car:

Hydrogen car:

Extend

6. COP26 was the 26th conference for leaders of nations across the world to meet and discuss how to reduce the impact of climate change. It took place in Glasgow in November 2021.

The general aims were to agree how to:

- Reduce greenhouse gas emissions
- Invest in renewable energy resources
- Keep global warming as low as possible
- Help less-developed countries reduce greenhouse gas emissions

In groups, find out:

- What pledges were agreed by the end of COP26
- What the UK plans (or suggest what it should do) to meet COP pledges.
- What your community can do to support the COP26 pledges

Prepare a letter to your MP to suggest actions the UK Government can take to ensure the UK meets the COP26 pledges.