

Green hydrogen: Ras Duqm

Aim and introduction

Hydrogen holds a huge potential as a future clean energy source. When hydrogen is used in fuel cells the only byproduct is water, it is a zero-emission technology. There are several ways to obtain hydrogen. Currently, the leading two ways are via water electrolysis (green hydrogen) and natural gas reforming (blue hydrogen).

••• This lesson looks at the Special Economic Zone at Duqm (SEZAD) in Oman, called Ras Duqm. It consists of 2,000km² of land, an airport, industrial zones, housing, a major oil refinery and petrochemicals complex, port and dry dock. One of the main exports from Duqm is green hydrogen, with a current annual output of 100,000 tonnes of green ammonia in the first phase of the project.

This lesson will take between 45 and 60 minutes.

Curriculum links

AQA

3.2.5.4 Energy security. Strategies to increase energy supply (oil and gas exploration, nuclear power and development of renewable sources).

Edexcel

Topic 6: The Carbon Cycle and Energy Security.

6.5 Reliance on fossil fuels to drive economic development is still the global norm.

OCR

3.1 Climate change.

4. In what ways can humans respond to climate change?

4.c. Mitigation and adaptation are complementary strategies for reducing and managing the risks of climate change.

WJEC

4.4: Energy Challenges and Dilemmas.

4.4.7 The need for sustainable solutions to meet the demand for energy.

Learning goals

1. Know what hydrogen is.
2. Understand the different types of hydrogen and extraction feasibility.
3. To be able to describe the social costs and benefits, and implications for the carbon cycle.

Learning outcomes

Greater depth: Students will be able to describe in detail what hydrogen is and how it is produced by different means. They will be knowledgeable on green hydrogen and will appreciate why it is a sustainable form of energy. They will be able to quote the HYPOR example of an SEZ in detail. They will produce an excellent infographic, full of data and detail on both green hydrogen and Duqm.

Expected level: Students will be able to describe what hydrogen is and how it is produced by different means. They will be knowledgeable on green hydrogen. Some will appreciate why it is a sustainable form of energy. They will be able to quote the HYPOR example of an SEZ. They will produce a good infographic and will be able to locate Duqm on a map of Oman.

Working towards: Students will be able to describe what hydrogen is. They will be knowledgeable on green hydrogen. They will know some information for the HYPOR example of a SEZ. They will produce a basic poster on green hydrogen and will be able to locate Oman on a world map.

Key terms

Green hydrogen: produced from water electrolysis. Electricity is used to split water (H_2O) into hydrogen (H_2) and oxygen (O_2). If the electricity used is generated from renewable energy the hydrogen can be called 'green' hydrogen.

Special Economic Zone: an area within a country where business and trade laws differ from the rest of the country. They are designed to encourage economic activity through incentives like tax breaks and relaxed regulations.

HYPOR: means hydrogen (HY) production and its strategic location near the Duqm port (PORT) in SE Oman.

Challenge and support

To challenge students read this document and follow the *Ask students* subheadings. Set students the task of producing a detailed infographic, to present at the end of the lesson.

To support students consider reducing the timeline for hydrogen use and annotate key information onto the diagram of grey / blue / green hydrogen.

Starter

1. Using the information on the PowerPoint, students create a timeline summarising the evolution of hydrogen use.
2. Ask students to watch the [BBC video](#) to answer the question: how is hydrogen used?

Main 1 – types of hydrogen

1. Talk through the different sources of producing hydrogen then, using the information on the PowerPoint, students define the three main types of hydrogen: grey, blue and green.

As a challenge task, students could justify which they feel is the most effective.

2. Use a platform such as Canva to create an infographic on green hydrogen. Identify what it is, how it is created, how it is used, pros and cons.

Main 2 – Ras Duqm

1. Using the PowerPoint, students describe the location of Ras Duqm on their sheets (example answer in italics below).

Duqm has a strategic location. It is located on the southeastern coast of Oman, offering access to major global shipping routes, making it ideal for trade and logistics.

2. Ask students to look at the images in the PowerPoint to identify the industries present in the SEZAD (example answer in italics below).

The SEZAD zone includes industries such as petrochemicals, manufacturing, logistics, fisheries, and tourism. It has a focus on renewable energy projects. The images show the petrochemical industry, operational since 2023, fish processing warehouses in Duqm harbour, increased in depth by 10m, the 'Little India' tourism complex, designed to be a 'home from home' for Indian expatriates in Oman, and a new manufacturing hub.

3. Ask students to read the article [HYPORT Duqm set to be among world's first green hydrogen projects](#) to answer the following questions on their sheets (example answer in italics below).

1. Where will the project rank among the world's large-scale ventures in green hydrogen?
It will be the first such large-scale venture of its kind internationally.
2. What will HYPORT Duqm be the first in the world to do?
HYPORT will be the first to produce green hydrogen and green ammonia.
3. What will the production of green hydrogen and green ammonia be powered by?
It will be powered by solar and wind energy.
4. How many green hydrogen projects have been signed by the Sultan of Oman?
Six.
5. What is the goal of these projects?
To produce ~1 million tonnes of renewable hydrogen by 2030.

Produced for, and in association with

Plenary – costs and benefits

1. Students should identify the **socioeconomic** and **environmental** costs(+) and benefits(-) in the speech bubbles on their sheet.

2. Ask students which comments they agree with and justify their ideas.

As a challenge task, students could add any other ideas to their own sheet.

