

Overall learning objectives

- Investigate how maths can support the modelling of a system using data and logic.
- Apply ideas about energy transfer and sustainability to a novel context to produce a practical overall system.
- Devise technical solutions, appreciate their impact on ecosystems and communities and explore how they can be modified.

Overall learning outcomes

- To identify various characteristics to be allowed for ineffective energy provision.
- To evaluate different methods of supplying energy for domestic consumption.
- To present and evaluate plans effectively and persuasively

Curriculum learning objectives

Students should be able to:

Maths

- Use existing mathematical knowledge to create solutions to unfamiliar problems.
- Understand that mathematics is used as a tool in a wide range of contexts.
- Identify the mathematical aspects of the situation or problem.
- Engage in mathematical discussion of results.

Science

- Recall, analyse, interpret, apply and question scientific information or ideas.
- Present information, develop an argument and draw a conclusion, using scientific, technical and mathematical language, conventions and symbols and ICT tools.
- Describe the use of contemporary scientific and technological developments and their benefits, drawbacks and risks.
- Consider how and why decisions about science and technology are made, including those that raise ethical issues, and about the social, economic and environmental effects of such decisions.
- Explain how energy transfers can be measured and their efficiency calculated, which is important in considering the economic costs and environmental effects of energy use.
- Describe how electrical power is readily transferred and controlled, and can be used in a range of different situations.

Extended learning – Siemens Digital Badges

Help your students showcase their achievements further and reward them with a Siemens Digital Badge.

Get your pupils to earn their Energy badge by registering at www.openbadgeacademy.com/siemens

Find out more at www.siemens.co.uk/digitalbadges



Energy
Challenger

Use video "Island in the Wind"

Introduction

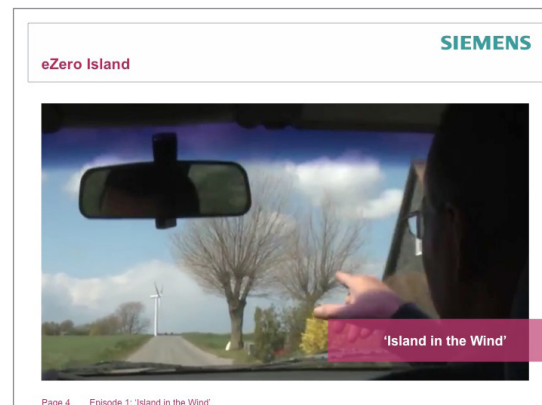
This episode is designed to set the scene for the challenge of an island becoming self-sufficient and to stimulate some ideas about not only how but also why they might want to do that.

Learning objectives

- To consider how a group of islanders made their island self-sufficient.
- To consider how easily these ideas could be transferred to other locations, such as students' home area.

Learning activities

1. Show students the video "Island in the Wind".
2. Ask students for their responses as to why the islanders moved towards being self-sufficient in energy.
3. Ask students to work in groups to consider these questions and formulate responses:
 - a) How have the islanders made their island self-sufficient?
 - b) Why do you think they wanted to?
 - c) Do you think it's easier or more difficult to do that with an island than with, for example, a large town on the mainland?
 - d) Which of the techniques they used might work where you live?
4. Take feedback and draw out key points including that the island uses several different sorts of energy provision and that the islanders wanted to reduce their dependency on oil. Explore how transferable the ideas are. Emphasise that although this development might be easier to implement on an island, especially one where the energy requirements may be lower and where there is plenty of sun and wind, the ideas can be used in a variety of settings.



Outcomes

- To have presented ideas about how and why an island became self-sufficient in energy.
- To have suggested how those ideas could be used elsewhere.

Present the challenge of designing an energy supply system for an island that doesn't rely on fossil fuel

Introduction

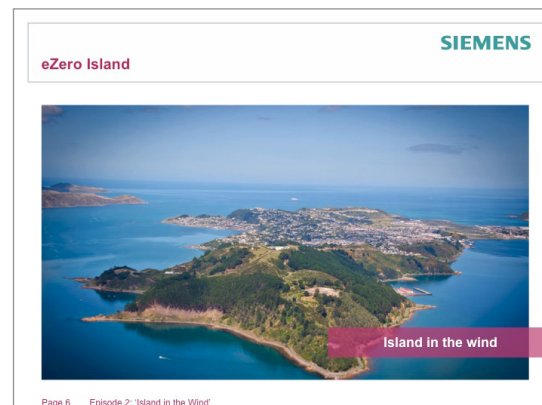
This episode presents the challenge of providing an island with energy. Students will be working in groups to design and test their ideas against a number of criteria. This episode is designed to 'set the scene'.

Learning objectives

- To consider the challenges represented by varied energy requirements.
- To suggest various ways of meeting these challenges.

Learning activities

1. Show the students a picture of an island and explain that their challenge is to provide the islanders with a power generation system. Say that there will be various alternatives as to how electricity can be generated. Ask them to work in groups to identify a range of typical uses to which electricity is put in the home (they should not include battery powered devices but they should include mains-chargers for battery powered devices).
2. Explain that electricity is very useful as it can easily be used to produce a range of effects such as heat, light, sound and movement, but that this may not necessarily be the most efficient method. Then ask them to go through their list and to divide it into two – those devices which have to run on electricity, such as TVs, and functions which could be powered by electricity but don't have to be, such as water heating.
3. Ask students to think about how the total energy demand in a home varies over a 24-hour cycle. Working in groups, they should sketch the shape of the graph and label it to explain the main features. Ask students to identify the assumptions made in drawing the graph and draw out points such as whether the home is empty during the day, whether the temperature outside is much lower than inside, whether it is insulated and how many people live there.
4. Then ask for suggestions about what would make a good energy source. As well as price, encourage them to think about pollution, reliability, storage and ease of starting up.
5. Gather ideas together and capture key points for future reference.



Outcomes

- To have identified how energy is used in the home and how this demand varies.
- To explain how these demands represent a challenge for the supply of energy.

Provide information on various alternatives

Introduction

In this episode students select from a number of alternatives an energy plan for the island. As well as making decisions about how to provide energy they have to consider the pollution caused, the reliability of the supply, how easy it is to store and how easily it can be regulated to allow for fluctuating demand.

Learning objectives

- To weigh up a number of factors and decide on the best way of providing energy for the island.
- To justify the decisions made.

Learning activities

1. Explain that the task they are to undertake is to provide for the energy needs of the islanders. They will have to make decisions about the fuels to use, whether to generate electricity or to use directly. The plan will have to allow for fluctuating demand, ease of storage and use, and pollution. Say that because this is an island, options that only work on a large scale, such as fossil or nuclear power stations, aren't available.



2. Provide each group with a map of the island and a set of energy cards. Each energy card represents the same number of units of energy; it shows the cost, advantages and disadvantages of that energy source. Groups are given a weather forecast and a prediction of the energy requirements. They decide what combination of energy resources to use.
3. To support this activity, or as an alternative, students can play the on-line Siemens Island energy game. This also uses the context of an island that needs decisions making about the supply of energy and presents students with information, constraints and challenges. It uses students' inputs to run a simulated 24-hour cycle and then provides feedback in terms of marks and comments. To use the game, go to [insert URL].
4. Each group then prepares a labelled poster based on their plan. It should show:
- The types of energy being used.
 - The cost of the plan.
 - The pollution caused.
 - How responsive the system would be if the demands upon it changed.
 - The good features of the plan.
 - The weaker features.

Outcomes

- To have developed a plan for energy provision allowing for a number of factors.
- To have presented ideas in a clear and coherent way.

Teams of students to present energy provision proposals and to peer assess presentations and solutions

Introduction

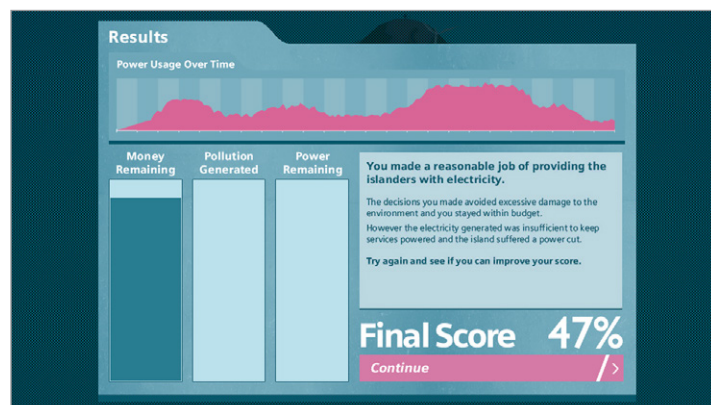
In this episode students are presenting their ideas. The plan indicates that three or four teams will present (this will work well if the plans are significantly different) and other students are involved in assessing and providing feedback. If desired, and time allowing, teams in one half of the group can present to the other and then vice versa.

Learning objectives

- To consider how particular features of different ways of providing energy have certain advantages and will appeal to certain interests.
- To present ideas convincingly and effectively.

Learning activities

- Three or four teams are selected to 'make a pitch' for the contract of supplying the island with its energy. The teams should have their poster presentations on display.
- Each team gets, say, three minutes to present the key features of the energy provision plan to the governor of the island (possibly played by the teacher) and to groups of islanders (students who are not making presentations; this is best done in groups of 2/3). The audience should think through what they would be looking for e.g.
 - Islanders - happier if costs lower, less mess, energy needs met.
 - Governor - happier if less pollution, island looking attractive to tourists, islanders happy.
- Say that the last contractor didn't make a good job of it and there were some instances where the power went off. Both the governor and the islanders can ask questions.
- At the end, get the groups of islanders to explain which plan they prefer and why. The governor then provides a summing-up, offering a broader perspective and ensuring that strengths from all bids are recognised. It may be considered appropriate for the governor to award the contract to a particular team.



Outcomes

- Either to effectively communicate key features of an energy provision plan and answer questions effectively or to scrutinise plans effectively and make considered decisions.