1. Lesson 1: The Production and Use of Energy

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| **Knowledge Objective** | **Key Questions and Ideas** | **Teaching and Learning Activities** | **Key Facts** | **Key Resources** | **Assessment Opportunities** |
| Humans consume energy through use of electricity, heating and transport. | * What activities do humans carry out that require energy? | **Starter:**  Introduce the energy value chain: supply, transformation and consumption / demand. Talk through a number of examples of how this framework applies to day-to-day uses of energy, such as gas heating or air travel.  **Main Activity:**  Ask each student to map their energy use through the day - across heat, electricity and transport.  Discuss the primary sources of energy – coal, gas, oil, nuclear, wind, solar, biomass.  Talk through the UK’s energy mix and how this has changed over the last 20 years.  Identify the main sources of coal, gas, oil and renewables.  **Plenary:**  Going back to each student’s energy ‘map’, identify the main sources of this energy and determine how sustainable it is.  Discuss how can we reduce the demand for use of energy? Distinguish between changing activities vs. continuing activities but more efficiently. | The principal activities responsible for consuming energy can be grouped into use of electricity, heat and transport | **Slides:**   * Energy Flows (1-3) * UK Energy Flows * Types of electricity generation * Finite vs. renewable energy * UK electricity supply (2016) * Change in UK energy mix; * Energy diary * Reducing energy demand   **Links:**  Digest of UK Energy Statistics (DUKES)  **Case Studies** | * Ask each student to prepare an energy diary for a typical day; * Identify the energy supply, transformation and demand for a number of energy uses; * Ask students to produce 5 actions to reduce their energy consumption. |
| The energy we use comes from capturing and transforming sources of energy elsewhere | * Where does the energy we use come from? | Energy is not created – it must be captured and transformed from another source.  Energy is lost in this transformation |
| Conventional, fossil fuelled energy, uses resources faster than they are produced | * Coal, oil and gas require thousands of years to be formed through earth processes * We are extracting and using these resources faster than they are being produced. | There is a finite supply of certain energy types. Finite energy generation relies on energy that has been captured and converted over millions of years and exists in stores. |
| Renewable energy uses resources as they are produced | * Renewable energy relies on the transformation of energy from sources that will not expire as they are used. | Renewable energy sources generate electricity by transforming energy real-time. They do not require the build-up of reserves over many years. |

1. Lesson 2: Types of Renewable Energy

| **Knowledge Objective** | **Key Questions and Ideas** | **Teaching and Learning Activities** | **Key Facts** | **Key Resources** | **Assessment opportunities** |
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| There are a number of different types of renewable energy | * How is renewable energy produced? * What are the key inputs and outputs? | **Starter:**  Identify the proportion of electricity generated from renewable sources in the UK. Identify the main renewables in use (wind and solar).  **Main Activity:**  Talk through each of the renewable technologies, with a focus on identifying the renewable source of energy, how technology is used in its transformation and what the energy outputs are (electricity, heat, transport).  Ask students to identify resources in their local area that could be used to generate renewable energy.  Focus on offshore wind as a case study.  **Plenary:**  Summarise the types of renewables and highlight the potential issues with intermittency (solar, wind) and environmental (tidal, hydro). | * Renewable energy involves the transformation of light and heat energy (solar, wind), chemical energy (biofuels / biomass), gravitational potential energy (tidal) and heat energy (geothermal) to energy used in electricity, heat use and transport. * Renewable energy comes in multiple forms based on the energy being converted | **Slides:**   * UK generation mix (2016) * Renewable technologies   **Links:**  The Crown Estate Offshore Wind pages  **Case Studies:**   * UK Offshore Wind * Krafla Geothermal | * Ask students to identify renewable energy sources near them * Research one type of renewable energy and summarise the environmental conditions that support that technology. |
| Renewable energy relies on different technologies for converting naturally occurring sources of energy to energy for electricity, heat or transport. | * What are the energy inputs and what technologies are used to convert these inputs into energy for use in electricity, heat or transport. | * Some technologies are more established than others * Technologies have different costs associated with building and operating them. |
| Renewable energy transforms energy real-time | * What is the difference between finite and renewable energy? * What makes renewable energy sustainable? | * Renewable energy comes from the light, kinetic, potential and chemical energy occurring naturally. * Use of renewable energy must not deplete stores that have built up over many years |
| Renewables have certain challenges related to intermittency and environmental concerns | * What is making up the supply gap when wind and solar are not producing? * What are the possible environmental issues with biomass, hydro and tidal projects? | * Biomass is only renewable where the plant inputs are sustainably produced. * Tidal and hydro schemes can impact the environments in which they are built. |

1. Lesson 3: Energy Challenges

| **Knowledge Objective** | **Key Questions and Ideas** | **Teaching and Learning Activities** | **Key Facts** | **Key Resources** | **Assessment opportunities** |
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| Because of its importance, energy is a political concern | * How do politicians decide on energy policy? | **Starter:**  Discuss the importance of energy with students. Summarise where energy (across transport, heating and electricity) is used in homes and businesses.  What would happen if we did not have access to energy reliably?  **Main Activity:**  Show students the energy trilemma triangle.  Discuss each aspect of the triangle, setting out the objectives of each.  Describe policies that can be used to promote each of the different aspects of the trilema  Identify that these objectives are not always aligned. For example, a move to renewable electricity generation meets the objectives of the green agenda but involves additional costs for consumers.  **Plenary:**  Ask students to map four policies against each aspect of the ‘trilema’. Ask students for their views on which of the three priorities the government should focus and why. | * Access to energy is critical for the operations of society and economic development. * Politicians have an interest in ensuring energy is available to everyone at an affordable cost. | **Slides:**   * The Energy Trilema * What drives energy cost (1-3) * Security of supply * Green Agenda * Energy policy exercise (1-2)   **Links:**  **Case Studies:**   * Hinkley Point as a means of achieving security of supply at additional cost. * Japan’s reliance on nuclear, and need to import expensive gas following Fukishima | * Energy policy exercise: Ask students to rate a number of energy policies against each part of the ‘Energy Trilema’. * Ask students to describe their views on which of the three aspects of the energy trilema the government should focus and why. |
| Energy policy needs to balance: (i) security of supply; (ii) the green agenda; and (iii) cost. | * What is security of supply and what is it important? * Why is the green agenda important? * What drives energy costs and why does cost matter? | * Security of supply ensures the ‘lights remain on’. i.e. there is enough supply to meet demand. This means there is sufficient infrastructure to produce, transport and refine energy and limited reliance of foreign countries who may have their own interests; * The green agenda seeks to reduce greenhouse gas emissions from energy generation, which is one of the largest contributors to GHG emissions; * Energy cost is a function of the cost of production and the cost of transport, each of which have different elements |
| The objectives of each aspect of the trilema are not always aligned and therefore difficult decisions must be made. | * Where do these objectives conflict with one-another? * Which objectives are most important? | * Objectives can often conflict, for example pursuing the green agenda often involves additional cost associated with new technologies; security of supply involves the development of new infrastructure (e.g. Hinkley Point) which is expensive relative to securing energy from abroad |