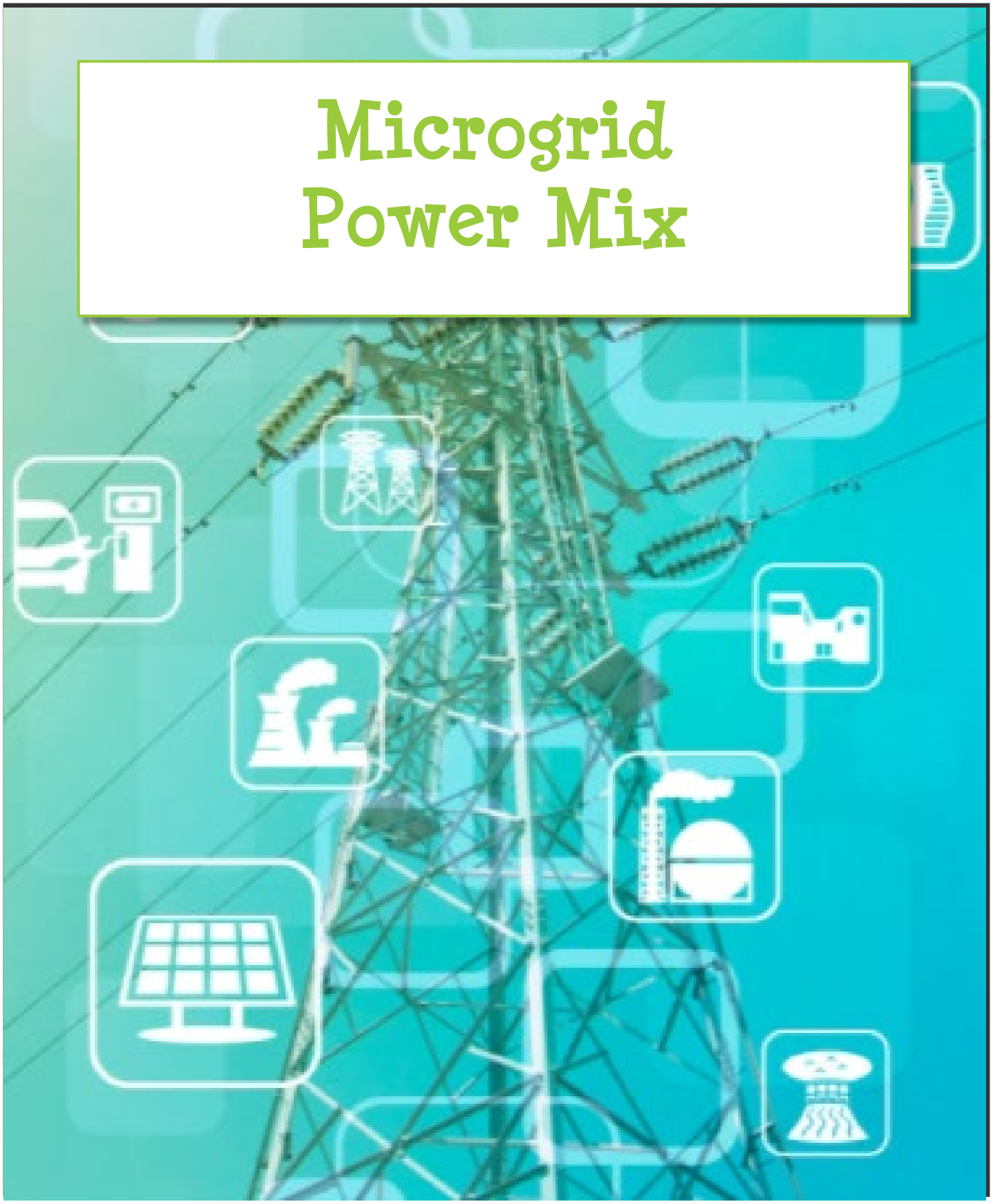
Microgrid Power Mix



the human energy company™ Chevron

AUSTRALIAN EARTH SCIENCE EDUCATION

Microgrid Power Mix – Teacher Resource

Powering Careers in Energy Links:

Unit 1: Identify and explain the role of energy in our community

Unit 2: Outline the forms and sources of energy

Background Information:

Onslow's Microgrid provides an example of the future of hybrid electricity systems. The microgrid combines solar panels, battery storage and natural gas, to supply the community with reliable and environmentally friendly energy.

Aim

To explore the roles of different energy sources and energy storage in supplying a community

Materials

Per student or small group

- Table 1: Energy Generation Options
- Table 2: Energy Storage Options
- Access to a computer with internet or basic facts about the local area (sunny days, rainfall, wind, water reserves, natural gas pipelines, available power plants, population)

Method

1. Watch the video Onslow Microgrid (2:04) and see Chevron Australia's website for more information.
2. Discuss the reasons for installation of a microgrid at Onslow (isolated, self-sufficient community) and the power choices (near Wheatstone facility, lots of sunlight).
3. Students work in groups to design a microgrid to power their local area, using information from the tables provided and for their local area.

Results

Students present their microgrid power mix as a poster or a presentation, justifying their choice of energy sources.

Discussion

1. How does Onslow's location affect the choice of energy in the microgrid?

   Onslow is not connected to the main WA grid, so needs to be self-sufficient. The nearby Wheatstone natural gas facility makes natural gas a reliable and cheap source of energy. The large amount of solar energy also makes sunlight a good choice. When it is very sunny, not all solar energy collected is needed. Batteries in the microgrid store excess solar energy so that it can be used at another time (like at night).

2. Why are renewable energy sources often paired with energy storage?

   Renewable energy sources, such as solar and wind, are intermittent. Energy storage allows people to use the energy when they need it. For example, to use energy from the Sun at night.

3. What factors did you think were most important in choosing the features of your community microgrid?

   Students may identify factors such as amount of sunlight, need for energy storage, population size, cost of implementing different solutions, etc.

Evaluation:

1. Why is it important to consider local conditions when designing a microgrid?

   Options must be suitable for the local environment, such as wind turbines for a windy area. Because a microgrid supplies a small area, some options are not cost effective (e.g., coal-fired power plant). The local landscape also affects the implementation of hydro and pumped hydro.

2. State electricity grids supply power to millions of households and businesses. How does this affect the energy mix choices?

   State electricity grids cover a larger area and can use a wider variety of energy generation and storage options. Large projects, such as hydro, are cost-effective for state grids and the wide geographic spread means you have more options for locating appropriate energy sources (e.g., windy areas for wind turbines, rivers for hydro power, etc.)

Extension:

- Students could design a microgrid for an isolated agricultural property or mine site.

Worksheet: Microgrid Power Mix

Aim

To explore the roles of different energy sources and types of energy storage in supplying a community.

Materials

Per student or small group

- Table 1: Energy Generation Options
- Table 2: Energy Storage Options
- Access to a computer with internet or basic facts about the local area (sunny days, rainfall, wind, water reserves, natural gas pipelines, available power plants, population)

Method

1. Watch the video Onslow Microgrid (2:04) and see Chevron Australia's website for more information.
2. Discuss the reason that a microgrid was installed in Onslow and why the particular power sources were chosen.
3. Work in groups to design a microgrid to power your local area, using information from the tables provided and for your local area.

Results

Present your microgrid power mix as a poster, infographic or presentation, justifying your choice of energy sources.

Discussion

1. How does Onslow's location affect the choice of energy in the microgrid?

2. Why are renewable energy sources often paired with energy storage?

4. What factors did you think were most important in choosing the features of your community microgrid?

Evaluation

1. Why is it important to consider local conditions when designing a microgrid?

2. State electricity grids supply power to millions of households and businesses. How does this affect the energy mix choices?

Table 1: Energy Generation Options

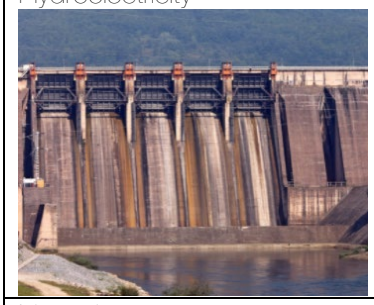
Energy source	Advantages	Disadvantages
Solar panels 	• Abundant supply • Non-polluting • Silent • Low maintenance • Can easily add more panels	• Only collects energy when the Sun is shining • Takes up a large amount of space • High upfront costs
Wind turbines 	• Renewable • Space efficient • Non-polluting • Low operating cost	• Only collects energy when it is windy • High upfront costs • Linked to deaths of birds and bats
Hydroelectricity 	• Renewable • Non-polluting • Quick response to demand	• Disturbs river habitats • Affected by drought • Expensive
Natural gas 	• Burns cleaner than other fossil fuels • Quick response to demand • Can use gas directly for heating and cooking • Inexpensive	• Combustion releases carbon dioxide • Non-renewable
Diesel generator 	• Well-established technology • Reliable • Quick response to demand • Variety of sizes available	• Air pollution • Spilled fuel causes soil and water pollution • Non-renewable
Coal-fired power plant 	• Inexpensive fuel • Reliable	• Slow response to changing demand • Must be run at large scale • Non-renewable • Highly polluting (carbon dioxide and impurities, such as nitrogen and sulfur)

Table 2: Energy Storage Options

Option	How it works	Advantages	Disadvantages
Battery 	• Excess energy is used to charge the battery • Electricity is released when needed	• Super fast response • Available in a wide range of sizes • Easy to add more storage as needed	• Expensive • Loses efficiency over time • Materials are currently not recycled well
Pumped hydro  Pumped hydro storage in Michigan USA, 2011, public domain	• Excess energy is used to pump water to a high reservoir • Water is released to provide hydro electricity when needed	• Cheaper than batteries at large scale • Does not lose efficiency over time • Long life of project	• Very expensive • Must be large scale • Evaporation of water may be a problem • Must have high and low reservoirs close to each other