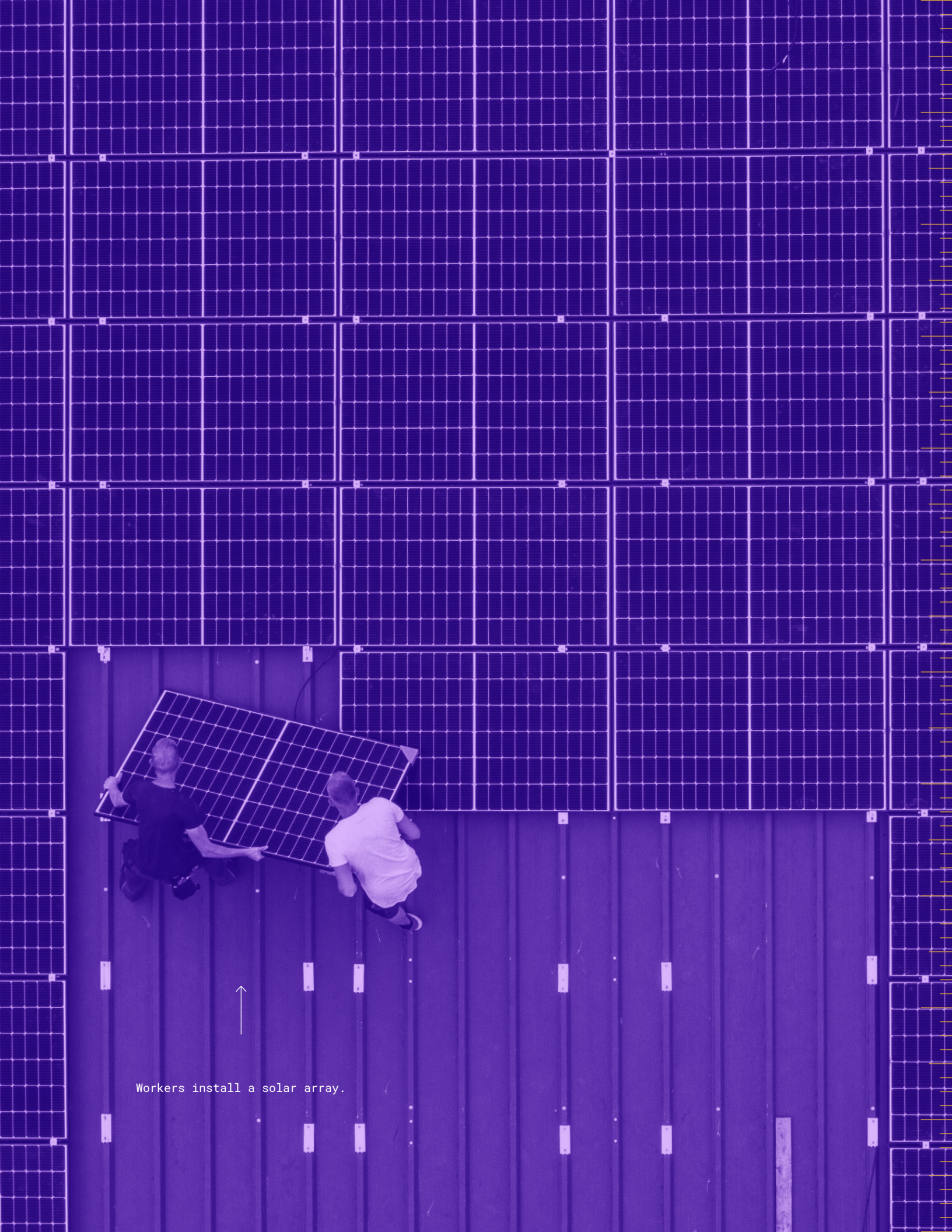




ACTIVITY 1

Vanwick's Energy Project

CARD-BASED INVESTIGATION



Workers install a solar array.



1 : VANWICK'S ENERGY PROJECT

GUIDING QUESTION

How are facts and values connected to decision-making?

INTRODUCTION

From humans' first use of fire to the present day, people have harnessed energy to improve their lives. As human populations continue to grow and dependence on electronic devices increases, so do human energy needs. Around the world, people are making decisions about the ways they get and use energy. Some thinking tools about making energy decisions—such as considering the facts of a situation and values of a community—can inform decision-making.

In this unit, you will learn about a fictional city that is making decisions about their local energy system. Throughout the unit, you will play various roles that will allow you to participate and advise the City Council as they decide on the specifics of an energy plan for the future. The scenario throughout the unit will introduce you to important tools used in decision analysis. **Decision analysis** is any process of systematically considering the information that might affect a decision. Decision analysis is not a single method to analyze a problem, and all decision-analysis processes include an approach to decision-making that is intentional. As you go through the unit, you may find ways in which the scenario is similar to or different from how group decisions are made in your own community.

CONCEPTUAL
TOOLS



PROCEDURE

PART A: VANWICK ENERGY FACTS AND VALUES

- 1 With your group, read the following scenario.

Vanwick is a small city with a population of 100,000. Recently, Vanwick citizens learned that the local coal power plant that powers the city is scheduled to shut down. The Vanwick City Council recognized this as both a problem and an opportunity. The city began exploring a transition to an energy system that includes renewable energy. The city hopes to achieve its goal of reducing greenhouse gas emissions, while powering the city into the future.

After considering options, energy experts in the town identified solar and/or wind energy as possible replacements for the coal power plant. They want to take advantage of Vanwick's climate, which has sunny and windy weather conditions throughout the year. The city does not want to spend a lot of money on this, but it can get funding to build the new energy infrastructure by creating a detailed plan. They have named the plan Project Re-Energize Vanwick (REV). Project REV needs local approval, so the City Council wants to increase support by involving citizens in the decision-making process. They decided to start the process by figuring out what facts Vanwick citizens know about renewable energy and by investigating Vanwick citizens' values related to the issue.



Transmission towers help distribute electrical power from generation sites to communities.

If you need to review the concept of electrical power generation and greenhouse gas emissions, you will find a Science Review at the end of this activity.

MATERIALS LIST

FOR EACH GROUP
OF FOUR STUDENTS
— SET OF 13 ENERGY
STATEMENT CARDS

PART A: VANWICK ENERGY FACTS AND VALUES (CONTINUED)

- 2 In your group of four, find the FACT and VALUE cards in the set of Energy Statement cards and place them face up on the table. Stack the remaining cards face down on the table where you can all reach them.
- 3
 - a Take turns drawing a card from the deck. Share the card with the group.
 - b Discuss whether the card states a fact or a value. Remember to listen to and consider the ideas of other members of your group. If you disagree with others in your group, explain why you disagree.
 - If you agree, place the card next to the FACT or VALUE card.
 - If you disagree, place the card face up between the two categories to show your disagreement or uncertainty.
 - c Continue with the remaining cards in the deck, spreading them out so all group members can see all the cards.
- 4 Compare your results to other students' results by repeating Step 3 as a class.
 - If as a class you agree, record on the board whether it is a fact or value.
 - If as a class you disagree, write the statement on the board. Then, work together to underline any part of the statement that is factual and circle any part that is a value. Use the statement on the board to help explain your position to one another.
- 5 Your teacher will read aloud several statements that are about facts and values. Follow your teachers' instructions to indicate if you agree, disagree, or think it depends for each statement.
- 6 As a class, construct definitions for *fact* and *value*.

PART B: VANWICK DECISION

- 7 Reread the scenario from Step 1. Make a list of the City Council's values and the facts related to Project REV. Use these facts and values to decide if you think the City Council should move ahead with Project REV.
- 8 With your class, use a Walking Debate to show if you agree or disagree with moving ahead with Project REV.
- 9 Look at the following additional facts and conduct the Walking Debate again.
 - Some Vanwick residents think it is more important for the City Council to improve the school system instead of applying for renewable energy funding.
 - The amount of money the City Council would be required to contribute to Project REV is equal to the amount of money it would take to build a new school.
- 10 After the second debate, discuss how these additional facts and values informed your decision with your small group. Then, share your ideas with the class.

BUILD UNDERSTANDING

- ① Provide an example from this activity where there are conflicting values about Project REV.
- ② Which of the following statements about deciding to use renewable energy sources are facts and which are values?
 - a Building a nuclear power plant is more expensive than other kinds of power plants.
 - b The ecosystem damage caused by hydroelectric power is unacceptable.
 - c Burning biomass gives off a strong smell.
 - d Geothermal energy can only be used in certain locations.
 - e It is important to keep our hills clear of the ugliness of wind turbines.
 - f Renewable energy is the most important part of our future.
- ③ If you were on a committee deciding which renewable energy source to use in your own community, which statement(s) in Question 2 would most influence your decision? Explain by using the words *fact* and *value*.
- ④ Explain how using facts and values can be part of a decision analysis.

The Build Understanding and Connections to Everyday Life questions are intended to guide your understanding. Some of these questions may be discussed with a partner, be part of a class discussion, or require an individual written response. Your teacher will guide you as to how these questions will be used in your class.



FIGURE 1.1
Project REV

CONNECTIONS TO EVERYDAY LIFE

- ⑤ You are at the cafeteria deciding between a salad and a burger for lunch.
- a What are two values you might consider in making this decision?
 - b Provide a fact for each value that relates to the decision and explain how it influenced your choice.
 - c How would the decision change if you had to make the choice for a group and you could only choose one kind of meal? Explain in terms of facts and values.
- ⑥ Your friend Ota says she is looking for a job that is interesting work and provides a good paycheck. She looked into becoming an electrician and learned that it pays over \$30 per hour. She thinks electricity is an important part of everyday life, and that appeals to her.
- a What are the values and related facts to her decision?
 - b How do these facts and values inform her decision?

KEY SCIENTIFIC TERMS

decision analysis

fact

value

SCIENCE REVIEW: ELECTRICAL POWER GENERATION AND CLIMATE CHANGE

Where Does Electricity Come From?

Electrical power generation is the process of transforming a natural resource such as coal, natural gas, wind, or sunlight into electrical power. Often, the transformation happens at a centralized power plant. Then the electrical power (often called electricity) needs to be transmitted, often over large distances, through a web of transmission lines called the electrical grid. Then it is distributed to homes and businesses.



FIGURE 1.2
Traditional electricity generation, transmission, and distribution

There are many types of power plants that run on various resources, including natural gas, petroleum, wind, water, sunlight, and biomass. Most often, a generator converts mechanical energy into electrical energy. For natural gas, coal, biomass, and petroleum, the heat from burning these resources creates steam. The pressure from the steam pushes the blades of a turbine. The spinning turbine turns the shaft of a generator, producing electricity. A traditional power plant burns fuel to heat up water, which creates steam. The pressure from the steam pushes the blades of a turbine. The spinning turbine turns the shaft of a generator.

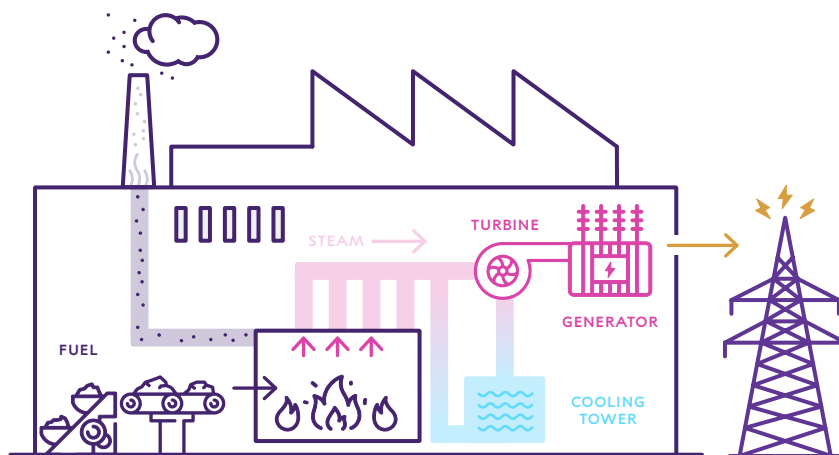


FIGURE 1.3
Coal power plant

Nuclear fission also produces heat and can generate electricity this way. Wind power and hydropower move the turbine blades directly. Solar power is generated through a different process that converts sunlight directly to electricity.

Renewable vs Nonrenewable Resources

Some of the resources used to generate electricity are renewable, and some are nonrenewable. A renewable resource is one that has a continuous supply, such as sunlight, water, wind, and biomass. To be considered renewable, a resource must be supplied faster than it is used up. A nonrenewable resource, such as coal, natural gas, and petroleum, is one that has a limited supply; once it is used up, the resource is gone.

Fossil fuels—coal, natural gas, and petroleum—are convenient in our current society because much of the world already has the infrastructure to access, process, and transport these fuels (such as railroads near coal mines, pipelines, power plants, and transmission lines). Fossil fuels have the advantage of being energy dense, meaning the amount of energy released per kilogram of fuel burned is greater than that of other kinds of energy transformation, such as burning biomass. However, burning fossil fuel produces greenhouse gases, which are driving global climate change. While there are some technological advances that can help reduce the number of pollutants released during burning, particularly at coal plants, they still produce significant amounts of greenhouse gases. As the world's energy demand increases and the effects of climate change become more significant, the need for energy sources that do not produce greenhouse gases is on the rise.

Solar, wind, tidal, hydro, and geothermal are all methods of electrical power generation that come from renewable resources that do not emit greenhouse gases during the generation process. As suggested by the name, these resources don't run out, while the world's fossil fuel supply will eventually be completely used up. The cost for some of these methods has also decreased over time as technology improves and more infrastructure has been built. Additionally, some renewable power generation can be installed on a small scale—for instance, for a single home or building—such as solar panels and wind turbines. Several renewable generation methods, including solar and wind energy, are now less expensive than fossil fuel methods. However, many of these resources depend on weather conditions and take up more space than nonrenewable generation. They are not transportable in the way that fossil fuels are, which means that more infrastructure must be built and that changes to the electric grid are often needed to utilize these methods. These needs can be expensive and, in some communities, can mean that switching from nonrenewable to renewable electricity generation is difficult or impossible.

Greenhouse Gases and Climate Change

Greenhouse gases are a gas that traps thermal energy in the atmosphere, such as carbon dioxide, water vapor, and methane. They act like a blanket wrapped around our planet. As greenhouse gases increase, more heat is trapped, leading to warmer average global temperatures. This causes changes in weather patterns, including increased frequency and intensity of droughts, severity of wildfires, rising sea levels, more powerful storms, and stronger flooding. Since the 1800s, human activity has been the main driver of climate change. Many human activities produce greenhouse gases, including generating power, manufacturing and consuming goods, cutting down forests, using transportation, constructing buildings, and producing food.

An abundance of scientific evidence shows that fossil fuel use is the largest contributor to global climate change, generating over 75% of greenhouse gas emissions (including 90% of carbon dioxide emissions). The last decade (2011–2020) was the warmest decade ever recorded and, in recent years, many other records have been broken repeatedly, such as highest temperature and worst flooding. Climate change has already affected people's health, ability to grow food, the biodiversity of our planet, and many other aspects of our lives; scientific models indicate that this will intensify without significant, rapid intervention. Reducing, or eliminating, the production of greenhouse gases in electricity generation is one important way to help mitigate the effects of climate change.