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SCIENCE
for Global Goals

ENERGY!

Part 4:

Energy in the Community

SUSTAINABLE DEVELOPMENT GOALS

developed by

Smithsonian
Science Education Center

in collaboration with

iap SCIENCE HEALTH POLICY
the interacademy partnership

Smithsonian Science Education Center greatly appreciates the efforts of all the individuals listed below in the development of *Energy! How can we ensure sustainable energy for all?* Part 4. Each contributed his or her expertise to ensure this project is of the highest quality. For a full list of acknowledgments please refer to the acknowledgments section at the beginning of this guide.

Smithsonian Science Education Center Module Development Staff

Executive Director - Dr. Carol O'Donnell

Division Director for Curriculum, Digital Media, and Communications - Dr. Brian Mandell

Science Curriculum Developer - Logan Schmidt

Research Mentor
Dr. Kiron Neale

Technical Reviewers
Dr. Lim Boon Han
Michelle Fouard
Nida Mizani

The contributions of the Smithsonian Science Education Center staff, project advisors, research mentors, and technical reviewers are found in the acknowledgments section.

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PART 4: ENERGY IN THE COMMUNITY

Find out More!

For additional resources and activities, please visit the *Energy!* StoryMap at http://bit.ly/3Kx41Jy.

Planner

Activity	Description	Materials and Technology	Additional Materials	Approximate Timing	Page Number
Task 1: How is energy used in the spaces in our community?					
Discover	Identify the spaces in the community that are important to you and explore how they use energy to help you meet your needs.	• Paper • Pens or pencils		10 minutes + extended observation time	102
Understand	As a team, select from three energy investigations that will help you learn about energy use in your community.	• Paper • Pens or pencils		10 minutes + community investigation time	105
Act	Use your *How I Meet My Needs* document and the results of your investigations to create a community energy use map.	• Paper • Pens or pencils • Art or craft materials (optional)	*How I Meet My Needs*	25 minutes	111

Activity	Description	Materials and Technology	Additional Materials	Approximate Timing	Page Number
Task 2: How can we use sustainable energy in our community?					
Discover	Examine data about energy use around the world and relate it to your local community.	• Paper • Pens or pencils	*Futures Mood Board*	15 minutes	115
Understand	Carry out investigations into how you can incorporate sustainable energy (such as micro-hydropower, micro-solar, and micro-wind power) into your community.	• Paper • Pens or pencils • Flexible hose • Funnel (or 2-liter bottle) • Measuring tape • Rocks, sticks, boards • 20-liter (5-gallon) bucket • Watch or timer	*Community Energy Use Map*	15 minutes + investigation time	117
Act	Use the *Community Energy Use Map* and your investigations from Understand to come up with sustainable energy solutions for your community, and brainstorm small actions you can take to reduce energy use.	• Paper • Pens or pencils	*Community Energy Use Map* *Futures Mood Board*	30 minutes	126

Meet Your Research Mentor

Meet Dr. Kiron Neale. Kiron (pronounced *KY-ron*) will be your research mentor to help you understand how **sustainable energy** can be used to meet energy needs in a **community** and how communities make decisions.

Kiron is a solutions engineer for a company that specializes in sustainable energy solutions. He has a master's degree in **environmental** change and management and a PhD in geography and the environment. He has special expertise on how small island nations can use **solar energy** to meet their energy needs and has done research in Trinidad and Tobago, Barbados, and O'ahu, Hawai'i. However, he also has knowledge and **perspectives** that come from other parts of his **identity**. Since Kiron is now working with you, it is important to understand who he is.

Kiron's Identity Map

- Male
- Indo and Afro-Caribbean
- Grew up in a rural village-town in Southern Trinidad
- Has brown eyes
- Has brown skin and black curly hair
- Likes hiking, painting, and beach walks
- Interested in energy efficiency
- Interested in solar energy and climate change
- Princes Town and San Fernando (Trinidad & Tobago) are important
- Madrid, Granada, Tenerife, and Murcia, Spain are important to him
- 33 years old
- Interested in behavioral and cultural change
- Interested in energy on small islands
- Average height
- Likes to listen to others
- Reserved, patient, dedicated, and optimistic
- Likes breakdancing, playing football, sprinting, and fitness
- St. Annes on the Sea, and Oxford (UK) are important to him

Task 1: How is energy used in the spaces in our community?

People use energy to meet needs such as lighting, heating or cooling air, keeping food cold, and heating water. A community can create a more sustainable energy future either by switching to **low-carbon** sources of energy or trying to find ways to use *less* energy to meet their needs by changing their habits or the items they use.

In this task, you will ***discover*** how the places in your community use energy to help people meet their needs. You will collect **data** to ***understand*** what energy in your community is used for, how much is used, and if there are areas of **inequity** in your community. Finally, you will ***act*** by creating a map of your community's energy use and deciding which spaces are most important to change.

Before you begin the rest of Part 4, think quietly to yourself about Kiron's identity map.

- Are there things you have in common with Kiron?
- Are there ways in which you are different from Kiron?
- Can you see anything about Kiron's identity that makes it easier for him to find sustainable energy solutions for buildings in a community?

During Part 4 you will notice Kiron sharing ideas and experiences with you. He may help you understand better ways to conduct investigations, or he may share some of the work he has done.

Discover: *What spaces do I use in my community?*

What are your favorite places in your community? Maybe it's a community center where you play games with friends, your home or a relative's home, a library, or a restaurant or food kiosk where you and your friends like to eat. There are places in every community that help people meet their needs. Those places use energy. In this activity, you will explore which places are most important to you, what kind of energy those places use, and what the energy is used for.

1. Get out a blank document. Title it "How I Meet My Needs"
2. Divide the document into four columns. Title the first column "Location," the second column "Why is this place important to me?," the third column "How does this place use energy?," and the fourth column "How could this place use energy to meet my needs better?" Figure 4.1 shows an example of this document.

How I Meet My Needs

Location	Why is this place important to me?	How does this place use energy?	How could this place use energy to meet my needs better?

Figure 4.1: Example of a blank How I Meet My Needs document.

a. Use the *Location* column to list any places in your community that help you meet your needs, such as a school, a restaurant, a health care center, or a gym or recreation center.

b. Use the *Why is this place important to me?* column to describe how you meet your needs at this place. What do you use it for? Why is it important to you?

c. Use the *How does this place use energy?* column to list the ways this place uses energy to meet people's needs. Read *How Energy Helps People Meet Their Needs* for more information.

How Energy Helps People Meet Their Needs

Energy is used in so many different ways in a community, but in this part, you can just focus on the following uses:

- Heating and cooling air indoors
- Heating water
- Keeping food cold with refrigerators or freezers
- Using lights or computers
- Washing or drying clothing and dishes

d. Use the *How could this place use energy to meet my needs better?* column to describe any need you wish could be met at this place but isn't being met right now. For example, you might wish that your school was better able to heat and cool the air so you could concentrate and be comfortable at school.

3. You can find out the information you need to fill in this document in several ways:
   a. You can use your memory to think about the places in your community that you use to meet your needs. You might remember places you use every day, or places you have only used once but were very important, such as a hospital.
   b. You can write down or record the places as you use them over a specific period of time, like a day or a week. Each time you use a place to meet your needs, you can record information about it.
   c. Move around your community and observe the places in your community. This can help you identify the places you use to meet your needs.
   d. Use a community map to help you identify the places you use to meet your needs.
   e. Ask a friend, a teacher, or a person in your home to help you think of the places you use to meet your needs. Or compare with a member of your class.
4. Record your answers in the *How I Meet My Needs* document. Figure 4.2 shows an example of how to do this. Try to record at least three places in your community on your document. You can also record more than three places, if you would like.
5. Find a safe place to keep this document. You will share it with your classmates later in this task.

How I Meet My Needs

Location	Why is this place important to me?	How does this place use energy?	How could this place use energy to meet my needs better?
My grandmother's house	I go once a week to eat at her house	Lights, a small refrigerator, and a hot water heater. My grandmother also has one tiny air conditioner in her window.	I wish my grandmother was better able to cool her home. I worry about her being too hot in the summer. But I know it's expensive to run the air conditioner.

Figure 4.2: Example of one entry in the How I Meet My Needs document.

⚠ Emotional Safety Tip

There might be some places that help you meet your needs that you would rather keep private. That's okay. You don't have to record or share any place in your community that you don't want to.

You may also feel uncomfortable when thinking about how places could better meet your needs. It might make you feel frustrated or like things are unfair. It's normal to experience those feelings. This guide can help you think of ways to make your community's energy use more fair.

Understand: *How does our community use energy to meet its needs?*

You and your team are using this guide to help your community make more sustainable energy choices in the future. One way to reach that goal is to investigate what sources of energy your community uses. If your community is using unsustainable sources of energy, you can try to help switch to more sustainable sources.

Another way to reach the goal of a sustainable energy future is to investigate *how* your community uses sources of energy. What does your community use energy for? How much energy does your community use? Can people change their behavior to reduce the amount of energy they use? Does everyone have the same **access** to energy? You will investigate some of these questions with your team.

1. Read Kiron's perspective about why it is important to use sustainable energy sources. Keep this perspective in mind as you plan your investigations.

Kiron Says . . .

Using sustainable energy sources can help reduce the **emissions** that cause climate change. But it's not only about emissions. You have some things that are basic needs, like food, clothing, and shelter. Energy is another one of those basic needs.

In thinking about a transition to sustainable energy, it's not just about switching to renewables. It's really thinking about, "What are the energy sources that we use? What does that mean for our community? How can we take steps at a local level to make sure we use energy responsibly, efficiently, and sustainably in the long term?"

2. Gather as a team.
3. Read about *Investigations 1, 2,* and *3*. These investigations can help you figure out how your community uses energy to meet people's needs. Decide which investigation each team member would like to do. Then carry out the investigation. You can work by yourself or with others. You can do one of the investigations, some of them, or all of them.

Investigation 1: Lighting Observation

a. Get out a piece of paper or choose another way to record information.
b. Pick one building or a group of buildings in your community that you can easily observe. You can pick buildings where people live, such as houses or apartment buildings. You can also pick buildings where people work, visit, or get goods and services, such as an office, a community center, or a food market.
c. Make the following observations about each building:
   - Time
     - What time does the building open and close to the people who use it?
     - Is the building open 24 hours a day?
   - Lights
     - Where does this building have lights? Inside, outside, in a sign, near a security camera, in a parking area?
     - Observe whether the lights in the building are still on after the building is closed and people are no longer using it. It may be easiest to do this by observing the part of the building that faces the street. Do not enter a building after it has closed. List any lights that stay on after the building has closed. For example, you might record, "The sign in the front is still lit up."

d. Work by yourself or with your team to identify why those lights may stay on. For example, a business may leave its lights on even when the building is closed to discourage anyone from breaking in. Or a parking area or bus stop may have lights on at night to help people see, move around safely, and feel safe when it is dark.

Figure 4.3: This office building has lights on at night even after most employees have left the building.

e. Work by yourself or with your team to identify any lights that you think could be turned off after the building is closed. Explain your reasoning.

⚠ Physical Safety Tip

Only make these observations if it is safe and comfortable to do so. Make sure you stay on public property. Feel free to ask a trusted adult for help or to go with you during this investigation. Some of the observations listed here might need to happen at night. If this is not safe in your community, you can choose another investigation.

Investigation 2: Energy in the Community Interview

a. Get out a piece of paper or choose another way to record information.
b. Pick one building or a group of buildings in your community that you can easily observe. You can pick buildings where people live, such as houses or apartment buildings. You can also pick buildings where people work, visit, or get goods and services, such as an office, a community center, or a food market.
c. Contact the people who own, manage, or use the building and ask if you can interview them about energy use in that building.
d. Work by yourself or with your team to write interview questions about what energy is used for, how much is used, and what could be better about energy use in the building.
e. Take your *Energy Source Cards* with you. If the person you are interviewing does not know about an energy source, you can use these cards to share information.

Suggested Interview Questions

Here are some interview question suggestions:

a. What kinds of energy does this building use? (There might be more than one kind of energy used. For example, perhaps the water is heated using natural gas, but the electricity comes from a coal **power plant**). If the person you are interviewing doesn't know, you could share your *Energy Source Cards* with them to help them think through the most likely options.
b. What does your building use energy for?
    - Do you use lights?
    - Do you heat or cool the air?
    - Do you heat the water?
    - Do you use refrigerators or freezers?
    - Do you have electronics such as dishwashers, clothes dryers, computers, or televisions?
c. What use of energy do you think you spend the most money on?

d. Do you ever feel like you aren't able to get or afford the energy you need to keep this building useful, comfortable, or safe for people?
e. Have you thought about asking people to change their behavior or habits to reduce the amount of energy this building uses? What ideas do you have?
f. Do you wish you could use a different source of energy for this building?

⚠ Emotional Safety Tip

People may be uncomfortable discussing money. Do not ask someone directly how much they spend on energy. If they choose to tell you that information, that's okay.

Investigation 3: Energy Equity Survey

Carry out a **survey** of the people who live in your community. Remember that Part 1, Task 1, Understand includes instructions on how to carry out a survey.

a. Decide whether you want to carry out the survey in person, over the phone, on the Internet, or another way. You can also use more than one way to get the most responses from your community.
b. Work by yourself or with your team to write survey questions. Choose questions that will help you figure whether people have access to energy, if that access is **reliable**, or if they are at greater **risk** than others. Some suggestions are listed here.

- Do you have access to energy where you live?
- Have you ever experienced a loss of power or a blackout where you live or work? How often does it happen?
- What do you use in your home to keep it comfortable? For example, do you heat the air or water in your home?
- Are you able to afford all the energy you need to keep your home safe and comfortable?

- Do you know of any parts of the community that experience greater heat or cold than other parts?
- Have you ever felt unsafe or unhealthy because you didn't have access to energy?

c. Choose five to ten questions for your survey.
d. Decide where, who, and how you will conduct your survey.
e. Conduct your survey by yourself or with your team and record the results.

⚠ Emotional Safety Tip

It can be upsetting for people to share that they cannot afford to pay for energy, to discuss blackouts, or to share information about their health and safety. If you are conducting this survey in person, be sensitive to the people you are surveying and allow them to skip any questions that make them uncomfortable.

4. Find a safe place to keep any data you recorded. You will share it with your teammates in the next activity.
5. Read Kiron's thoughts on how best to gather information from a community. Why do you think the investigation or investigations you just did are important?

Kiron Says . . .

Oftentimes, one does not necessarily connect with or relate to a culture unless you are in it or a part of it. For example, I'm Caribbean, and so, I can connect with the broader Caribbean culture and shared regional experiences. However, I'm not Barbadian, so I won't understand or connect with all the nuances of that specific culture fully. I'm also not Hawaiian or from the United States, so I won't fully connect with those cultures completely either. So, I approach it as, "You tell me and I'll listen." I am Trinidadian, so I do

know and connect with that culture quite well. But what I'm interested in at the end of the day is people's individual perspective. If someone is sharing their lived experience within a culture with me, I like to listen and empathize with their experience because it's not necessarily my cultural life or outlook.

Act: *What spaces in the community are the most important to make changes to?*

You have collected data about how the places in your community use energy to help you and other people meet their needs. You have investigated what sources of energy your community uses, what it uses energy for, how much energy it uses, and whether everyone in the community has access to energy. In this activity, you will continue to think about perspectives on energy use. You will also make a map of your community's energy use. All this information can help you figure out the best places and ways to take action on energy use in your community.

1. Read the following statement by yourself:
    a. "I own a business in my community. I keep the lights and air conditioning on 24 hours a day inside my business, even though it's only open from 10 a.m. to 4 p.m. I know this wastes energy, but I worry about people stealing from my store at night so I keep the lights on. And my community is so hot that if I turn the air conditioning off overnight, it's too hot to work inside the next day. My electricity comes from the nearby coal power plant. I want to switch to solar power, but it's too expensive to install."
2. Do you agree or disagree with how this business owner uses energy? Why or why not?
3. What perspectives do you notice in that statement? Remember that you learned about **social**, **economic**, environmental, and **ethical** perspectives in Part 2. The statement in step 1 includes multiple perspectives.
4. Find a partner and discuss the following:
    a. What perspectives did you notice?
    b. Which perspective do you think is the most important to consider?

c. What changes would you want this business owner to make? Why?

d. Is there any reason some of those changes might be difficult for the business owner?

5. Read Kiron's explanation of the kinds of perspectives that are most important to people when they make decisions about sustainable energy.

Kiron Says . . .

When people think about switching to sustainable energy, most people are concerned about economics. They might ask, "What is this transition going to look like for my wallet?"

But people also want more information to understand what this new technology actually does. For instance, the understanding of solar power in Barbados is very different from Trinidad. People in Barbados have used solar technology for much longer than people in Trinidad, so they understand the technology better.

It's important to give people the information they need about sustainable energy like solar. You want to move people from just being aware of sustainable energy to being comfortable enough to invest in it.

6. Take out your *How I Meet My Needs* document from the Discover activity.
7. Take out the data you recorded from the investigations in the Understand activity.
8. Read *Making a Community Energy Use Map* and follow the directions.

Making a Community Energy Use Map

You and your team are going to use the information you gathered in the Discover and Understand activities to make a map of your community. This map will help you represent the places in your community that are important to you, what you know about those places and how they use energy, and what you are concerned about. This map will help your team decide where to take action in your community. It can also help educate other members of the community about the work your team is doing.

a. Gather as a team.
b. Decide what kind of map you want to create. You can draw a map on paper, use a digital mapping tool, create a map using images, draw a concept map, or create a table that lists the places in your community. The map does not have to be perfect or show accurate distances. You are just using it to gather and display information.
c. Share your *How I Meet My Needs* document with your team.
d. Choose one or two places from your document that are important to each of you, and add those locations to the map. Figure 4.4 shows an example.

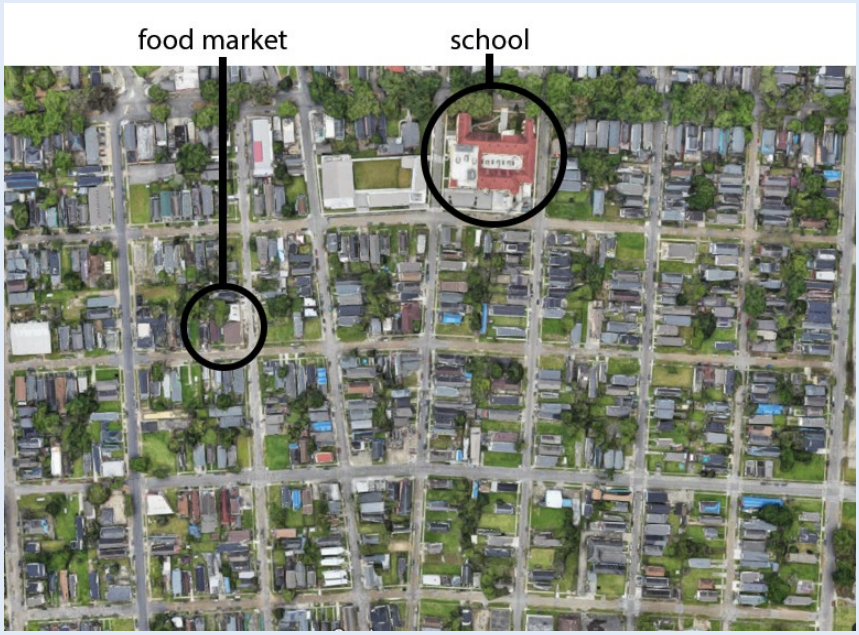

Figure 4.4: Example of a map with two places labeled that help you meet your needs.

e. Add information from your document to the map. If you can, try to record the information near the location on the map. For example, if you are using a paper map you could place a sticky note with information next to the location. Consider adding:
    a. Why this place is important to you
    b. What you are worried or concerned about
f. After each team member has added their information, notice if anyone else named the same places you did or had similar answers.
g. As a team, take out the data you recorded in the Understand investigations.

h. Choose a few places from your investigations that you are most worried or concerned about and add those locations to the map.

i. Add information from your investigations to your map. Some suggestions are listed here:

- Places that are important to you
- What energy sources are used, and what they are used for? Use your *Energy Source Cards* to help you remember the different sources of energy.
- Places where people sometimes feel uncomfortable, unsafe, or unhealthy because they do not have enough energy to meet their needs
- Areas where people have difficulty paying for energy

9. Consider your *Community Energy Use Map* as a team.
10. Discuss which places, buildings, or areas in your community **concern** you the most. You might be concerned about the source of energy, the way energy is used, how much energy is used, or an issue of energy **equity**.
11. Use a mark, circle, another symbol, or some other way to identify the places that concern you the most.
12. Keep this map in a safe place. You will use it in the next task.

Task 2: How can we use sustainable energy in our community?

In this task you will ***discover*** how you think and feel about global data and relate it back to your own community. Then you will ***understand*** more about the choices your community can make about sources of energy and behavior to help create a more sustainable energy future. Finally, you will ***act*** by thinking of behavior changes and adding solutions to your *Community Energy Use Map*.

Discover: *How do I think and feel about energy around the world?*

In Task 1 you and your team collected information about how your community uses energy to make spaces safe, comfortable, and usable. You investigated what sources of energy people use, how they use that energy, how much they use, and any issues related to energy equity.

Your local community is part of a larger, global community. The issues you have in your community may also be found in many other communities around the world. Thinking about connections between your community and the rest of the world will help you contribute to sustainable solutions that impact more than just your local area.

In this activity you will examine data about energy access and energy use around the world and think about how it relates to your community's sustainable energy future.

1. Examine the map in Figure 4.5 by yourself. This map contains data about how many people in the world had **access to electricity** in 2020. Each color on the scale represents a percentage of the population that has access to electricity in that country. This map defines "access to electricity" as having a source of electricity that can provide basic lighting, charge a phone, or power a radio for four hours a day.

Electricity Access, 2020

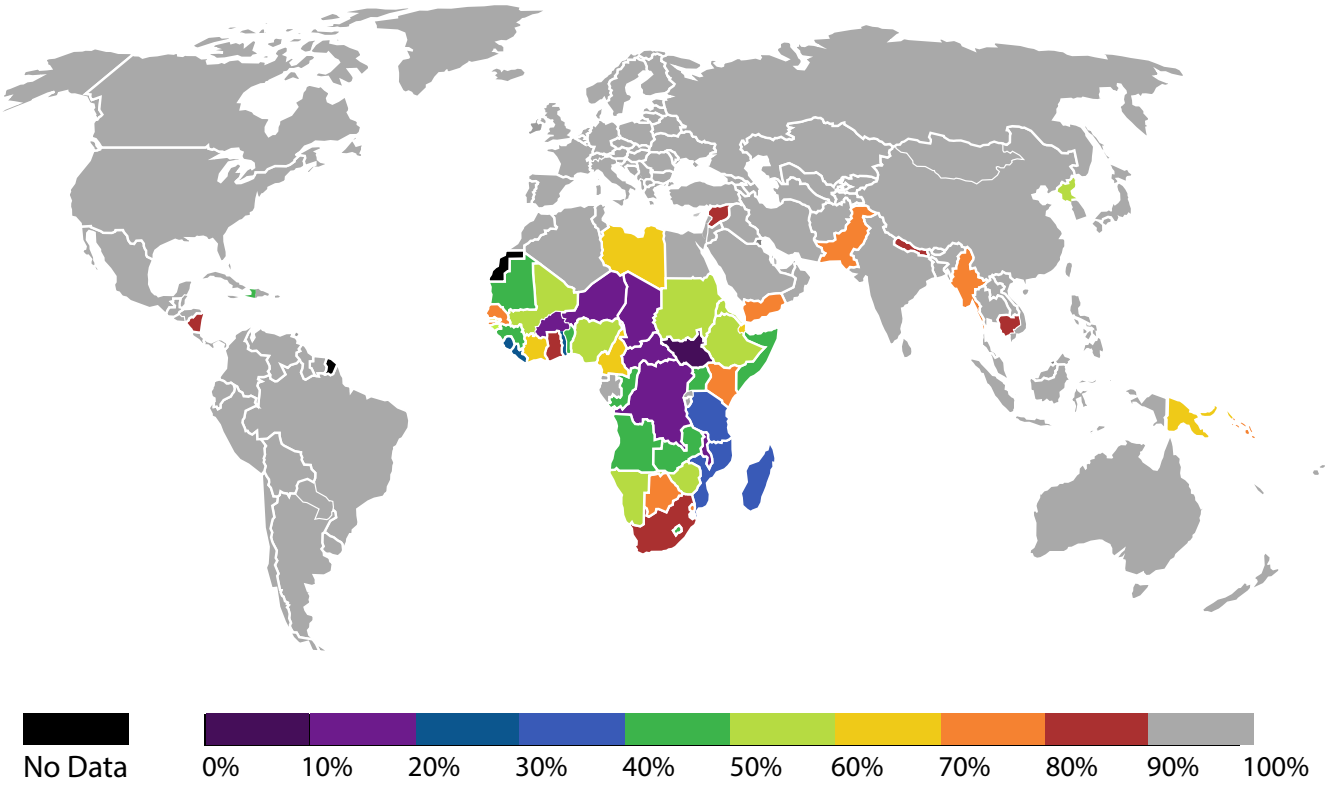

Figure 4.5: A map showing the percentage of people with access to electricity in each country.[1]

2. Think quietly to yourself about the following questions:
   a. What do you notice about this map?
   b. How does this map make you feel?
   c. Does this global map remind you of any parts of your local community? Are there areas where people lack access to electricity?
   d. What would you like to see change about this map in the future?
3. Gather as a team.
4. Share your answers from step 2. What answers surprise you?
5. Take out your *Futures Mood Board*. Think about the answers you just shared with your team. Is there anything you would like to add to your vision of a sustainable energy future, based on this data? Are there new **hopes** you want to add? Are there new concerns you want to add?

Understand: *How can we make changes to energy use in our community?*

You have collected data about energy use in your local community and the world. You've identified what you are most concerned about. Now it's time to start developing potential solutions. In this activity you and your team will have the option of conducting several investigations about the kinds of sustainable energy that are a good fit for your community.

1. Gather as a team.
2. Take out your *Community Energy Use Map*.
3. Take out your *Energy Source Cards*.
4. Find the marks you used to identify the places you are most concerned about. Review those places as a team. You may start to notice patterns in the concerns you have.
5. Review your *Energy Source Cards*. Discuss the following questions:
   a. What do we want to change about the sources of energy our community uses?
   b. What do we want to change about the way our community uses energy?
6. Read *At the Smithsonian* to find out more about how generating renewable energy locally might be helpful.

At the Smithsonian

Dr. Hal Wallace is the curator of the electricity collections at the National Museum of American History in the Smithsonian Institution. Hal's job is to do research that helps educate people about the past and future of energy and electricity. Right now, many people get their power from an **electric grid**. An electric grid is a network that connects producers of energy, such as power plants, with consumers of energy, such as homes and businesses.

However, this isn't the only option. Hal says, "You don't have to have huge electrical grids. You can have micro-grids. If you have renewable energy produced at the local level, it can help you avoid a blackout in your community. The large electrical grid might fail because of a storm or a tree falling, but anyone connected to the micro-grid can stay up and operational."

7. Read *Renewable Energy Investigations 1*, *2*, and *3* to learn about ways you could generate electricity in your community. Some types of renewable energy are best for certain types of places. Which type would you guess might work best in your community?
8. Decide which investigation would be right for you and carry out that investigation. You can work by yourself or with others. You can do one of the investigations, some of them, or all of them. Try to investigate types of renewable energy that you think might work well in your community.

Renewable Energy Investigation 1: Micro-Hydropower

Hydropower involves using the force of flowing water to turn a **turbine**. The turbine connects to a generator, which can generate electrical energy. You may know about hydropower because you have noticed hydroelectric dams or tidal hydroelectric systems on the coast. Those systems can supply energy to an entire community.

A **micro-hydropower** system can supply energy to a much smaller area, such as a single house. In this investigation you will build a simple version of a water turbine called a water wheel that can help you investigate whether the flowing water in your community is a good match for micro-hydropower.

Gather information on water wheels

Have you ever noticed water, wind, or sand turning something? You may have noticed something big like a water wheel, or something small like a toy. Think carefully: What are the different parts that allow something to spin as water, wind, or sand flows over it?

Examine Figure 4.6. What parts do you notice in this water wheel?

Figure 4.6: A water wheel.

You will now design your own water wheel. Before you start, try to gather information about how others have designed a wheel that turns as water flows past it. You could:

a. Go online or to a local library and search for images or diagrams of water wheels.
b. Search for videos of water turbines and water wheels in use. The *Energy!* StoryMap has some examples.
c. Think about examples of water turbines you have noticed in your area. Ask others in your community about whether they have ever noticed water wheels or water turbines.

Turn to a partner and talk about the important parts of water wheels. Not all water wheels will look the same, but you and your partner should discuss what water wheels usually have in common. For example:

a. What shape are most water wheels?
b. What makes a water wheel turn?
c. What provides structure to a water wheel?

Think about how water wheels might generate electricity, and discuss your ideas with your partner.

a. Would it be better for the wheel to spin quickly or slowly?
b. How does the amount or speed of the water affect how a water wheel spins?

Plan and create a water wheel with your partner

Gather your materials to build your water wheel. You can use any materials that you can find easily, but you might want to consider these types of items:

a. Something circular, such as a paper plate
b. Things to temporarily catch water, such as paper or plastic cups or parts of plastic water bottles
c. Something to attach items together, such as glue, tape, string, or rubber bands
d. Something to twirl at the center of your wheel, such as a wooden stick or a straw
e. Pencils, pens, color pencils, or markers

Work with a partner, a small group, or your whole team to design your water wheel.

a. Plan your water wheel. You may want to draw it and include which materials you plan to use.
b. Create your water wheel according to your plan. If you need to, you can make changes to your plan along the way. You are **engineering** and often that means you need to adjust your plan if something is not yet working.

Test your water wheel and make observations

Find an area nearby that has running water, like a bathroom, kitchen, or classroom sink. If you do not have access to running water indoors you can also use natural areas such as a stream, creek, or small river.

a. Take out something to help you record your observations.
b. Place your water wheel in the running water to find out if it will spin. You can hold your water wheel as it spins, but you cannot help the wheel spin.
c. Take notes on how your water wheel moves. Does your water wheel spin when water flows through it or is poured on it? If not, what might be preventing your water wheel from spinning?
d. Discuss with your group:
    - What worked well and what did not work well in your first trial?
    - Are there changes that you want to make to your water wheel? For example, maybe you want to replace, strengthen, or add a part.
e. Make any changes you want and test again.
f. Continue until you are happy with your water wheel.

Find places in your community that might create micro-hydropower

a. Use a map of your local community and identify all the places in your community where water flows naturally. These are places like streams, creeks, or small rivers. Maps can be found online, at your school, or at your local library. If you cannot find a map, just think about places where you know water flows in your community.
b. With your team, discuss:
    - Which spaces in your community have naturally flowing water?
    - Does everyone in your community have access to natural sources of flowing water?

c. If you can, bring your water wheel to one or more of the locations you identified on your map and test it. If the water wheel spins, it may mean this location could be a good place for micro-hydropower.
d. If you can, find a way to compare how fast your water wheel spins at different locations. Which place might generate the most electricity?
e. If you cannot go to a water source, think about your past experiences. Is there a place in your local area where water flows quickly all the time? If you could choose, where would you put a water wheel to generate electricity?

⚠ Physical Safety Tip

Always ask permission from an adult to do investigations in water. Do not go into fast-flowing water that is deeper than your ankles or mid-calf. Always have another person present when working near or in water. Make sure you have a change of clothes available in case you get wet. Wash your hands thoroughly after touching the water.

If you are interested in finding out how much electricity flowing water can generate, the *Energy!* StoryMap has details about an investigation you can do.

Renewable Energy Investigation 2: Micro-Solar

Solar power captures energy from sunlight to generate electricity or to heat water.

You may have noticed large solar farms with many solar panels. But individuals, small groups of people, and communities can also use smaller, local micro-solar power that use fewer solar panels. This investigation will help you investigate whether there are any sites in your community, such as your school or home, that are a good match for micro-solar power.

Figure 4.7: Several buildings are using this micro-solar grid on Selakan Island in Malaysia.

a. Use paper or another way to record your observations and information.
b. Observe the site you want to investigate to make sure it gets at least four hours of direct sunlight per day. Direct sunlight means light from the sun lands directly on a site without being blocked by an object or material.
c. Check the site to see if there are nearby objects that might create shade, such as tall buildings, tall trees, or hills and mountains.
d. If you live in the northern hemisphere, figure out if you can place your solar panel on a high surface facing south, such as a roof. If you live in the southern hemisphere, figure out if you can place your solar panel facing north.
e. Move around your neighborhood to see if any nearby homes or buildings use solar power. If you are able, contact the owners of those homes or buildings and ask them about the sun conditions in the area and how much hot water or power they are able to generate.

Renewable Energy Investigation 3: Micro-Wind

Wind energy captures energy from moving air, or wind, to turn a turbine, which connects to a generator.

You may have noticed wind farms with many wind turbines. But individuals or small communities can also use fewer or smaller turbines to create micro-wind power. This investigation will help you investigate whether there are any sites in your community, such as your school or home, that are a good match for micro-wind power.

a. Use paper or another way to record your observations and information.
b. A good site for wind power usually has an average wind speed of at least 14 kilometers (9 miles) per hour. Measure the average wind speed at a site in one of the following ways:

- Use the average wind speed data from a nearby airport. Keep in mind that wind speed can vary based on the height at which it is measured and surrounding objects. But the airport data is a good start.
- Check to see if your community, state, or country has wind maps. These maps display the average wind speed.
- Observe tall trees near the site for signs of **flagging.** Flagging is when a tree changes shape because of long periods of wind. Figure 4.8 shows an example. Higher average wind speeds cause more flagging in local trees. If you notice flagging in the trees near your site, it might be a good site for wind power. You can also use the Griggs-Putnam Index of Deformity in Figure 4.9 to help you.

Figure 4.8: A tree that is flagging because of strong winds in the area.

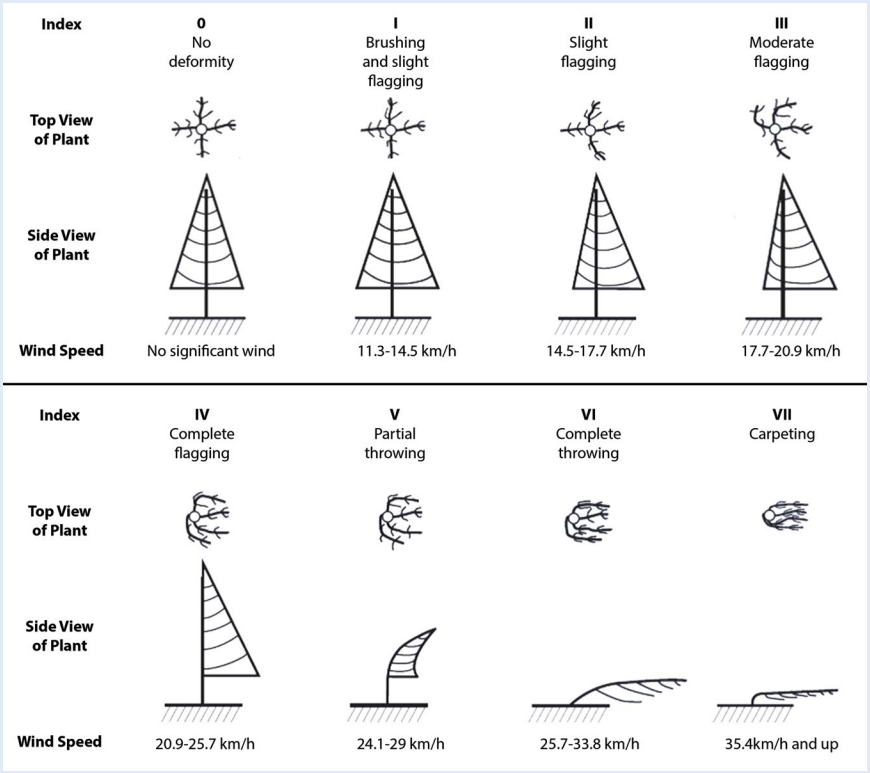

Figure 4.9: The Griggs-Putnam Index of Deformity.[2]

c. Observe the site for any tall objects that might get in the way of wind flow. These objects might be tall buildings, hills, tall trees, or young trees that will grow larger over time. If your site is surrounded by a large area of flat, smooth land, it might be a good fit for wind power.
d. Move around your neighborhood to see if any nearby homes or buildings use wind power. If you are able, contact the owners of those homes or buildings and ask them about the wind conditions in the area and how much power they are able to generate.

9. After your investigations, discuss with your team:
   a. Remembering the results of your investigations, which type of micro-renewable energy do you think might be the best for your community?
   b. Are there other things you need to consider besides the environment around you?
10. Read Kiron's thoughts about other things you might need to consider if you are thinking about solar power. What might be some similar considerations for hydro or wind power?

Kiron Says . . .

If students are wondering, "Would solar be a good option for a home?" they may want to think about, "Is it sunny enough?" and not just on that one day, but across the entire year. They should also think about if the home is strong enough to support solar panels on the roof. Solar panels last for up to 25 years or more, so the house should be strong enough to hold them for a long time.

They should think about if the resident owns the home or rents. If you are renting, you probably can't put the panels on the roof. Even if you are allowed to put panels on the roof, you have to work with your landlord or landlady to decide who actually owns the panels and the energy they produce. You also have to think about the number of people in the home and how much energy you will need.

An example of a cultural consideration is, "Will people be able to see the panels when they walk by?" This is an issue that comes up a lot in the United Kingdom, where you have **listed buildings** with strict rules. These rules guide any changes that can be made to the building. In general, it is more complicated to put solar panels on these buildings because they are protected by law.

11. Keep your observations and information about renewable energy in a safe place. You will use them in the Act activity.

Act: *How can I help my community make sustainable energy choices?*

In this part, you and your team investigated energy use in the places in your community that are important to you. You have explored energy use and energy equity locally and globally. In Task 2, you began to investigate solutions for a more sustainable energy future.

In this activity, you will use your *Community Energy Use Map* and the information you gathered in this part to help you add to your *Futures Mood Board* and come up with sustainable energy solutions for your community.

1. Gather as a team.
2. Get out your *Community Energy Use Map*. Review the concerns you discussed in Task 2, Understand, step 5.
3. Add any information from your Task 2, Understand investigations that will help you create sustainable energy solutions to address those concerns. Record those solutions directly on the *Community Energy Use Map*.
    a. For example, if there is an area of your community that does not have access to electricity, it might be a good idea to add some micro-sources of energy to that area.
4. Work with your team to think of how changes in behavior could help provide sustainable solutions. Remember that changing to low-carbon sources of energy is just one way to create a more sustainable energy future. When your team examines the *Community Energy Use Map*, how could changes in behavior create solutions to your concerns? Here are some suggestions:
    a. Set the thermostat several degrees higher in high temperatures or lower in low temperatures. This means you use less energy for cooling and heating. You could use fans or warm clothing to stay comfortable.
    b. Use motion-sensing lights that turn off when no one is using a space.
    c. Make different choices about items in your home that use energy. For example, you could switch to LED light bulbs, which use much less energy than incandescent or halogen bulbs.
    d. Take shorter showers or smaller baths.
    e. Wash clothes with cold water.
    f. Use a smaller refrigerator.
5. Read Kiron's thoughts on how to make sustainable energy a part of a community's culture and behavior. How could you use his suggestions in your sustainable energy solutions? Add any ideas to your *Community Energy Use Map*.

Kiron Says . . .

I think about sustainable energy technology as part of community's culture. Imagine that you have a large solar farm in one part of a community, but you don't see it or interact with it on a daily basis. You may not really know where you are getting your power from. Now imagine you have solar panels on your rooftop. You actually interact with the thing that is helping you generate electricity. The solar panel technology becomes part of your culture.

In Barbados, people use solar energy to heat water. The people in Barbados realize that solar is one of their sources of energy because they can see it on top of their roofs. They can actually describe how the system works. Because they've had that contact time with solar power, they understand it. Solar power has become a part of their energy culture.

6. Stop and examine the suggestions your team came up with in step 4. What are some social, ethical, environmental, or economic perspectives you should consider when suggesting that people change their behavior? For example:
   a. A hospital may not be able to safely change its indoor temperature without causing health or comfort problems for patients.
   b. A restaurant may not be able to serve all its customers if it switches to a smaller refrigerator.
7. Add any information from steps 4 and 6 that will help you create sustainable energy solutions to the concerns on your *Community Energy Use Map*. Record those solutions directly on the map.
8. Keep your *Community Energy Use Map* in a safe place. You can use it to help develop your action plan in Part 7.
9. Get out your *Futures Mood Board* and add any helpful information from this task. You may want to add some of your solutions in the *Hopes* section.

Congratulations!

You have finished Part 4.

Find out More!

For additional resources and activities, please visit the *Energy!* StoryMap at http://bit.ly/3Kx41Jy.

Glossary

This glossary can help you understand words you may not know. You can add drawings, your own definitions, or anything else that will help. Add other words to the glossary if you would like.

Access: Able to reach a place, thing, or idea

Access to electricity: Having a source of electricity that can provide basic lighting, charge a phone, or power a radio for four hours a day

Community: A group of people who share something in common, such as a space or an identity

Concern: Something that causes anxiousness, worry, or fear

Data: Facts and statistics that have been collected about a topic

Economic: About money, income, and the use of wealth

Electric grid: A network that connects producers of energy, such as power plants, with consumers of energy, such as homes and businesses

Emission: Material that is sent into the air, such as exhaust from a car

Energy: Anything that gives the ability to do work

Engineering: Designing, building, and maintaining machines, structures, and technology that solve problems

Environmental: About the natural world

Ethical: Something that is fair

Equity: Fair treatment of all people

Flagging: A process by which tree branches bend or break in the direction of the prevailing (or most common or constant) wind

Hope: Something that is desired, wished for, or wanted

Identity: The characteristics that make you you

Inequity: Unfairness

Listed building: A building with special historical or architectural significance that is protected by law

Low-carbon: An energy source that releases very little carbon dioxide gas into the atmosphere

Micro-hydropower: A small hydroelectric plant that can generate up to 100 kilowatts of electricity

Perspectives: The different ways we think about the world around us

Power plant: A place where electricity is generated for many people

Reliable: Dependable or gives the expected result over and over

Risk: The possibility to lose something, be harmed, or injured

Social: Relating to the interaction of people in a community

Solar power: A renewable and low-carbon resource that converts light energy from the sun into electricity using solar panels or uses the heat of the sun to heat water or other substances

Survey: A list of simple questions you can ask a group of people

Sustainable: An approach that balances different perspectives and can keep working for a long time

Turbine: A device spun by wind, water, steam, or gas that generates electricity

Wind energy: A renewable and low-carbon resource that converts wind, or the movement of air, into electricity using a wind turbine

End Notes

1. Ritchie, Hannah, and Max Roser. 2022. Energy Access. *OurWorldInData.org.* Retrieved from https://ourworldindata.org/energy-access
2. Office of Energy Efficiency and Renewable Energy. Small Wind Guidebook. *Energy.gov.* Accessed September 8, 2023. Retrieved from https://windexchange.energy.gov/small-wind-guidebook