Smithsonian | SCIENCE *for Global Goals*

STARTING WITH SUSTAINABILITY

LESSON SET

Energy and Renewables

ACTIVITIES + INVESTIGATIONS
COMMUNITY RESEARCH TOOLS
MULTIMEDIA EXTENSIONS
SCIENCE READINGS
FOR YOUTH AGES 11-18

ssec.si.edu/global-goals

Smithsonian | SCIENCE *for Global Goals*

welcome

Welcome to this Starting with Sustainability Lesson Set. This lesson set includes educator and youth-facing lessons and supplemental materials that are inspired by the United Nations Sustainable Development Goals and draw on content from the Smithsonian Science for Global Goals guide series found at **https://ssec.si.edu/global-goals**.

Smithsonian Science for Global Goals uses a *Discover*, *Understand*, *Act* framework to guide youth from ideas about real-world problems to actions. The Discover section contextualizes global issues within local communities by encouraging young people to recognize their existing knowledge. In the Understand section, youth gather data on real-world problems through natural and social science research. Finally, youth apply their learning through self-determined actions to help solve problems for their local and global communities.

DISCOVER
How are we using energy in our community?

UNDERSTAND
What are the best renewable options for my place?

ACT
How will we act to improve our community's use of renewables?

Essential Understanding: Renewable energy sources are low-carbon alternatives to fossil fuels. Choosing renewable options that are appropriate for my place can help my community and the planet.

Topics: Energy, Renewable energy, Hydropower, Wind power, Solar power, Research, Community

Target Population: Youth, ages 11 to 18

Estimated Time: At least 90 minutes to complete the lesson set

Lesson Set Resource Page:
ssec.si.edu/sustainability-lesson-set-energy-renewable

- Full Lesson Slides
- Connections with Standards
- Activity + Investigations instructions
- Worksheets
- Printables

Discover: Educator Overview

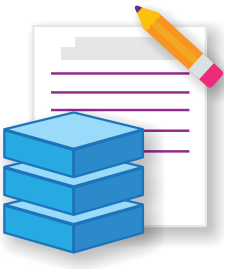
Learning Objective:

Students will be able to identify different energy sources and analyze the energy situation of their local community.

Activity Overview:

- **Discover Reading (optional):** A 1-page reading on sources of energy, including an overview of fossil fuels and renewable energy sources.
  Estimated Time: 15 minutes
- **Discover Investigation:** Students explore more about the strengths and weaknesses of their personal and community energy use. Optional social science investigations support deeper analysis.
  Estimated Time: 10 minutes + optional community investigation time
- **Discover Investigation Extension (optional):** Students can extend their learning by considering energy opportunities and threats for their community and designing a communication to creatively share their learning.
  Estimated Time: 10 minutes + communication design time

Materials List



- Paper
- Pen or pencil
- Art materials (optional, for the extension)

Discover Resources:

ssec.si.edu/sustainability-lesson-set-energy-renewable

1. Discover activity slides
2. SWOT Analysis Worksheet
3. Community Interview Instructions slides
4. Community Energy Observation slides

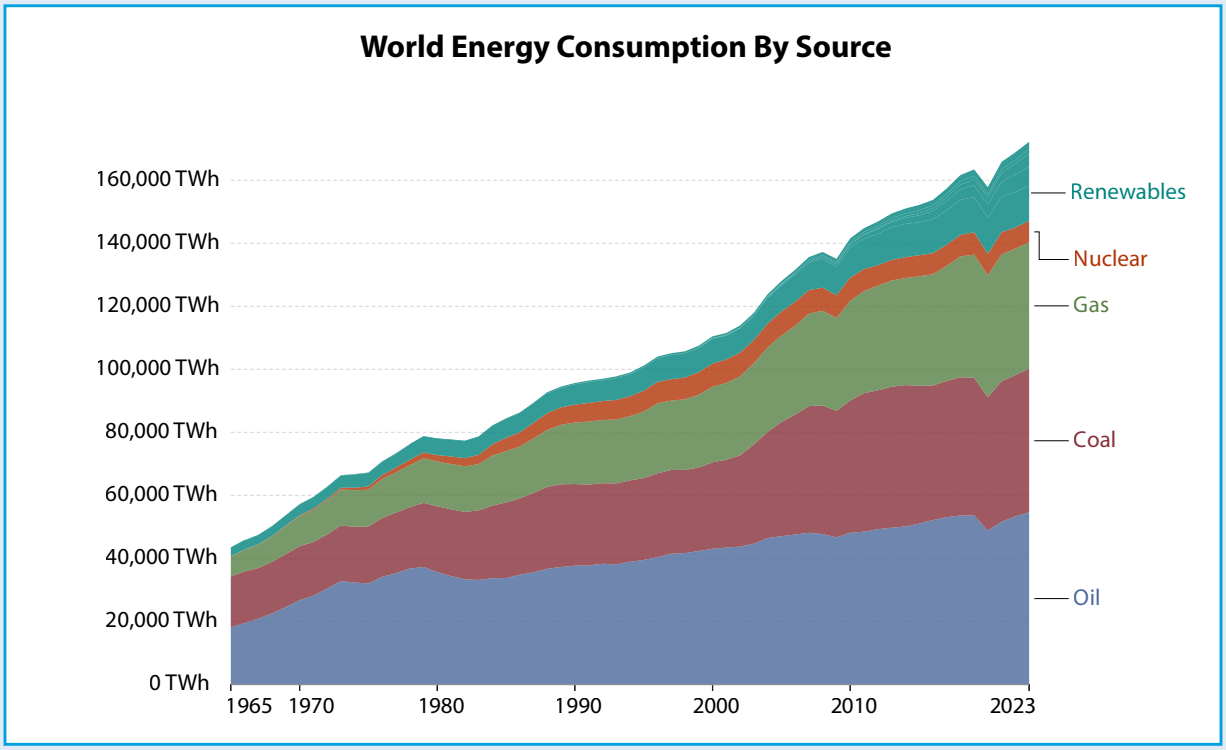
Discover Reading (optional):
Sources of Energy

Energy powers our lives. We use it to run machines, give off light, cook, and travel. Some energy sources are fossil fuels, such as coal, oil, and gas. Though fossil fuels can be a dependable and often affordable source of energy, using them also creates problems. One problem is that burning fossil fuels for energy puts carbon into the air. Increasing carbon in the air traps heat and causes warming of the global climate. Another problem with fossil fuels is only a limited amount exist on Earth. Some other energy sources, such as wind and solar, are renewable. Renewable energy sources are unlikely to run out for a very long time or are replaced faster than they are used.

Examine this graph about the sources of energy people use around the world. Compare the fossil fuels oil, coal, and gas with other energy sources and answer the questions.

- **Notice:** What do you notice about the different amounts of energy sources used and how they have changed over time?
- **Think:** What do you think are some problems with our current energy consumption?
- **Wonder:** What do you wonder about how we could change our use of fossil fuels?

Discover Reading (Continued)



Sometimes people may know where the energy they use comes from. For example, if they are driving in a car that uses petrol or gasoline, they may know that energy comes from oil. Other times, people may not know. For example, many people use electricity but may not know how a power company generated that electricity.

Community Connection

List the activities you do every day that require energy. Share your list with a partner and together mark which energy sources you know and which you don't.

Discover Investigation:

How are we using energy in our community?

People use energy to meet needs such as lighting, heating or cooling air, keeping food cold, and heating water. Each place has its own strengths and weaknesses when it comes to energy. Some places struggle with availability when there is no electrical grid. Other places struggle with affordability when electricity is too expensive. Other places may have access to affordable energy, but the energy sources commonly used cause a lot of pollution and warm the climate.

1. As a team, take a piece of paper or open a digital document and divide it into four boxes. Label the boxes as shown below. This is called a SWOT Analysis.

   Resource: SWOT Analysis Worksheet

Strengths	**Weaknesses**
Opportunities	**Threats**

2. Start by filling in what you know about the *Strengths* and *Weaknesses* of your personal energy use and the energy use in your community. For example, maybe you have 24-hour access to electricity. List that as a strength. However, maybe electricity is too expensive for some to afford. List that as a weakness. You may not have all the information you want, and that is okay. Just start with what you already know.
3. If you have time, choose one or more ways to investigate more about energy in your community. Pick from:
   a. Community interview: Choose someone in your community who knows a lot about the way people use energy and interview them.
      Resource: Community Interview Instructions slides
   b. Community energy observation: Observe your community's energy use and record your observations.
      Resource: Community Energy Observation slides
4. Add the information you gather to your *Strengths* and *Weaknesses*.

Discover Extension (optional):

Apply your learning to your community!

Understanding the current strengths and weaknesses of your community is important. However, the world around us is always changing. Renewable energy technology, climate change, artificial intelligence, and self-driving vehicles are just a few examples of current changes. It is important to think about what you want for the future and how to plan for it.

1. Take out your SWOT Analysis Worksheet and remind yourself of the strengths and weaknesses of energy use in your community.
2. With your team, list out loud some changes you can think of that are happening in your community or globally.
3. For each change you list, try to think how this might affect energy use.
   a. What are the potential good things that might come from this change? List those in your *Opportunities* section.
   b. What are the potential bad things that might come from this change? List those in your *Threats* section.
4. Examine your SWOT Analysis Worksheet and think about what your community really needs to know about their energy situation now and in the future. Design a way to communicate that information to them. For example, you might create a poster, an infographic, a short essay, a public service announcement, or something else.
5. If you can, share your communication with your community.
6. Examine the mood board below.
   a. When you think about the energy situation in your community right now, which of the mood board symbols best shows how you feel?
   b. When you think about the opportunities and threats for the energy situation in the future, which of the mood board symbols best shows how you feel?

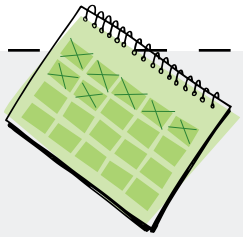
MOODBOARD

Notes:

Understand: Educator Overview

Learning Objective:

Students will be able to identify, investigate, and analyze a renewable source of energy that would be a good fit for their community.



Activity Overview:

- **Understand Reading (optional):** A 1-page reading on different renewable sources of energy.
  Estimated Time: 10 minutes
- **Understand Investigation:** Students decide on a possible renewable source of energy for their community and then choose between solar, wind, and hydropower investigations to understand the energy source further.
  Estimated Time: 30–45 minutes
- **Understand Investigation Extension (optional):** Students can extend their learning through perspective-taking on the social, environmental, economic, and ethical perspectives related to their chosen renewable energy source.
  Estimated Time: 15 minutes

Materials List

- Paper
- Pen or pencil
- Hydropower investigation materials (optional)

Understand Resources:

ssec.si.edu/sustainability-lesson-set-renewables

1. Understand activity slides
2. Solar Energy Investigation slides
3. Wind Energy Investigation slides
4. Hydropower Energy Investigation slides
5. Perspective Research slides

Understand Reading (optional):
Choosing a More Sustainable Energy Source

Choosing an energy source can depend on a lot of things. It is often a combination of your priorities (that is, what is important to you) and where you are.

Priorities are often different among people. Priorities related to energy often include some of the following characteristics of energy sources: dependable (able to be used at all times), affordable, accessible (able to be used by everyone), low carbon (doesn't add a lot of carbon dioxide to the air), clean (doesn't create pollution when it is accessed or used), renewable (cannot be used up), and safe.

Location also affects people's energy choices. If a place is near many coal reserves, people might think about the opportunity to use those resources. If a place is near a powerful water source, people might think about the opportunity for hydropower. The best renewable energy sources often depend on the characteristics of a place and what is available there.

Here are brief descriptions of some possible renewable energy sources.

- **Solar energy:** converts light energy from the sun into electricity using solar panels

Understand Reading (Continued)

- **Wind energy:** converts wind, or the movement of air, into electricity using a windmill or turbine

- **Hydropower and ocean energy:** converts energy from moving water, such as a river or the tides of the ocean, into electricity

- **Geothermal energy:** uses heat from underground to produce electricity or heat

- **Biofuel energy:** uses the energy found in living things, such as wood, algae, or animal fat or poop, to generate electricity or produce heat

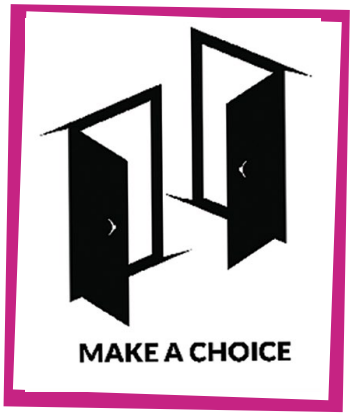
Community Connection

Think about energy priorities. What are your top three priorities? Think about the renewable energy sources that might work best in your place. Which ones do you think might be possible?

Understand Investigation:
What are the best renewable options for my place?

Not all renewable energy sources work well in all places. If your place is sunny most days, then solar energy might work well. If your place is often very windy, then wind energy might work well. If your place has moving water, then hydropower or ocean energy might work well. If you live near a geothermal hot spot, such as places near hot springs or volcanoes, then geothermal energy might work well. If you have many biofuel resources, such as wood waste, algae, or animal poop, then biofuel energy might work well.

1. As a group, think about the place you live. What are the characteristics of the environment around you? For example, does it have a lot of sun, wind, running water, an ocean, volcanoes, or other features?
2. Discuss each type of renewable energy: solar, wind, hydropower or ocean, geothermal, and biofuel.
   a. How do you think each renewable would fit or not fit with the characteristics and resources of your place?
3. Make a choice. Pick one or more of these investigations to explore different renewable energy options.
   a. Solar power investigation
      Resource: Solar Energy Investigation slides
   b. Wind power investigation
      Resource: Wind Energy Investigation slides
   c. Hydropower investigation
      Resource: Hydropower Energy Investigation slides



4. After your investigation, discuss as a group:
   a. Based on what you learned, which renewables might work in your area?
   b. Are there other things you think people should think about when deciding on a renewable energy source?
5. If you have your SWOT Analysis Worksheet from the Discover activity, take it out and examine it. How do you think the renewables you identified might help your community take advantage of some opportunities or minimize some threats?

Understand Extension (optional):
Research more!

When a community or group decides to start using a different energy source, there are many points of view, or perspectives, to balance. The perspectives you will explore now are social, environmental, economic, and ethical. People using different perspectives believe different parts of the community system are most important to consider. The four perspectives you will be thinking about are social, environmental, economic, and ethical. Balancing these perspectives is important if you want something to be sustainable, or able to work for a long time.

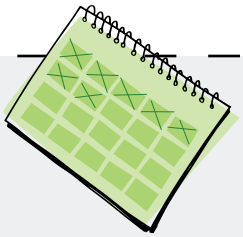
1. As a group, pick the renewable energy source you think might be the best option for your community.
2. Divide your group into four smaller groups and assign each small group a perspective: social, environmental, economic, or ethical.
3. As a small group, take out a piece of paper or use a part of a class board to record your ideas.
4. As a small group, use your own knowledge to answer the questions from your perspective. If you have time, you can also do additional research.
   Resource: Perspective Research slides
   a. Social: How does this renewable energy source help or harm the health, well-being, education, or social interactions among people? For example, does it make people healthier by decreasing air pollution or take away community spaces?
   b. Environmental: How does this renewable energy source help or harm the natural world? For example, does it protect habitats or hurt living things?
   c. Economic: How does this renewable energy source help or harm the economic situation? For example, does it create jobs or cost a lot of money?
   d. Ethical: How does this renewable energy source make your community fairer or less fair? For example, does it help provide energy access to more people or does it increase inequality between people?
5. Post your papers around your learning space and examine them.
6. Discuss as a team. Sustainable means an approach that balances the different perspectives and can keep working for a long time. Do you think this renewable energy source could be sustainable for your community?

Notes:

Act: Educator Overview

Learning Objective:

Students will apply what they have learned by choosing and implementing actions to move towards more renewable energy sources.



Activity Overview:

- **Act Reading (optional):** A 1-page reading from field expert Dr. Kiron Neale sharing information about communities and the shift to sustainable energy sources. *Estimated Time: 10 minutes*
- **Act Investigation:** An activity where students build consensus around a group action and complete a detailed Action Plan. *Estimated Time: 20 minutes*
- **Act Investigation Extension (optional):** Students implement their Action Plan and evaluate which Smithsonian Science for Global Goals guide might best support their additional areas of interest. *Estimated Time: 10 minutes + action implementation time*

Materials List

- Paper
- Pen or pencil

Act Resources:

ssec.si.edu/sustainability-lesson-set-energy-renewables

1. Act activity slides
2. Action Planner Worksheet
3. *Energy!* guide
4. *Sustainable Communities!* guide
5. *Climate Action!* guide

Act Reading (optional):
Transition to Sustainable Energy

Meet Dr. Kiron Neale. Kiron (pronounced *KY-ron*) is a solutions engineer for a company that specializes in sustainable energy. He is one of many experts around the world working with communities to make decisions about their energy futures. Here are his thoughts.

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

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 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?

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.

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. 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."

Community Connection

- What kind of information do you think your community would need before they would be comfortable enough to invest in renewable energy?

Act Investigation:

How will we act to improve our community's use of renewables?

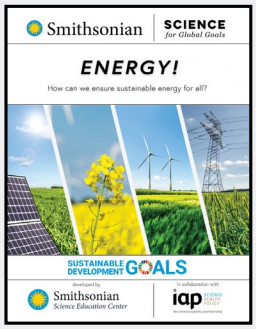
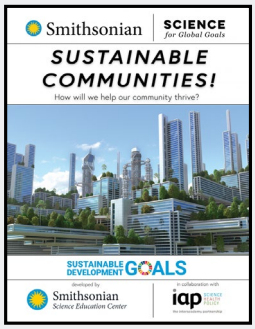
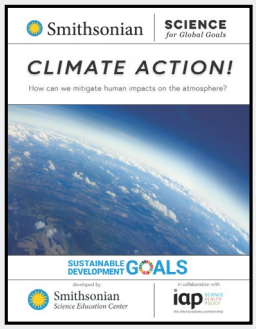
Now you will get ready to act. The first step toward action is deciding what problem you want to solve and the action you want to use to solve it. Then you can plan when and how you will act.

1. With your group, decide on the problem you want to help solve. This might be a problem such as lack of knowledge about the renewable energy options that might be a good fit for your community. Or it might be a problem about how to shift to more renewable energy sources. Or it could be another problem you noticed. Write down the problem either on the Action Planner Worksheet or a separate piece of paper.
   Resource: Action Planner Worksheet
2. Using the worksheet or paper, list any actions you can think of that might help solve the problem. For example, maybe you want to start a renewable energy education campaign in your community. Maybe you want to meet with a decision-maker to discuss shifting to renewable energy sources.
3. Write down the strengths your group has and how they could be used to improve the energy situation of your community. For example,
   a. Are members of your group part of any groups that you could communicate with?
   b. Do members of your group have any special talents, such as art or music, that might be useful to capture people's attention?
   c. Are members of your group interested in science and engineering or other ways to try to find innovative solutions?
   d. Do group members have good planning or organization skills?
4. Pick an action based on the strengths of your group.
5. Write down your ideas to plan for your action. Be sure to think about:
   a. What would you need to do?
   b. How can you make sure everyone in your group is included?
   c. Are there other people you need to help or give you permission?
   d. Where will your action take place?
   e. What materials would you need?
   f. What challenges should you be prepared for?
6. List each step you need to do in order to complete this action.
7. Assign each person in your group to one or more steps.
8. Congratulations, you have planned your action!

Act Research Extension (optional):
Choose your path!

The time has come to act! You can use everything you have learned to take the first step toward making your community's energy use more sustainable.

1. With your teammates, implement your Action Plan. This may take some time. When you are finished, come back and complete this activity.
2. Think quietly about the action you took.
   - What went well?
   - What do you think could have gone better?
   - How would you change your action if you had to do it again?
3. Decide on how you want to learn more! The Community Research Guides listed here can help you explore different topics. Which topics interest you most?

		
Energy! Explore more about different energy sources and uses.	*Sustainable Communities!* Explore more about the ways energy is used in a sustainable community.	*Climate Action!* Explore how renewable energy can play a role in climate action.

4. As a group, pick a guide that you would like to use and start to explore together.

— — — — — — — — — — — — — — — — — — — —

MOODBOARD

How do you feel about a sustainable energy future for your community?

Starting with Sustainability Lesson Set
Energy and the Renewables

Smithsonian Science for Global Goals Development Team

Lesson Set Developers/Writers
Heidi Gibson

Douglas M. Lapp and Anne B. Keiser Director
Dr. Carol O'Donnell

Division Director
Dr. Brian Mandell

Global Goals Series Developers
Heidi Gibson
Andre Radloff
Logan Schmidt
Khadijah Thibodeaux

Project Manager
Hannah Osborn

Marketing & Communications Team
Carolina Gonzalez

Digital Media Team
Sofia Elian
Joao Victor Lucena

Publishing Assistant
Raymond Williams, III

Smithsonian Science Education Center Staff

Executive Office
Kate Echevarria
Johnny McInerney

Advancement & Partnerships
Denise Anderson
Inola Walston

Finance & Administration
Lisa Rogers, Division Director
Allison Gamble
Jasmine Rogers

Professional Services
Dr. Amy D'Amico, Division Director
Addy Allred
Alexia Antunez-Hernandez
Katherine Blanchard
Katherine Fancher
Katie Gainsback
Grace Harnett
Dr. Hyunju Lee
Shellie Pick
Layla Sastry
Elle Satterthwaite
Amanda Tao
Sherrell Williams

Contributing Interns
Hailey Bowers
Aanila Kishwar Tarannum

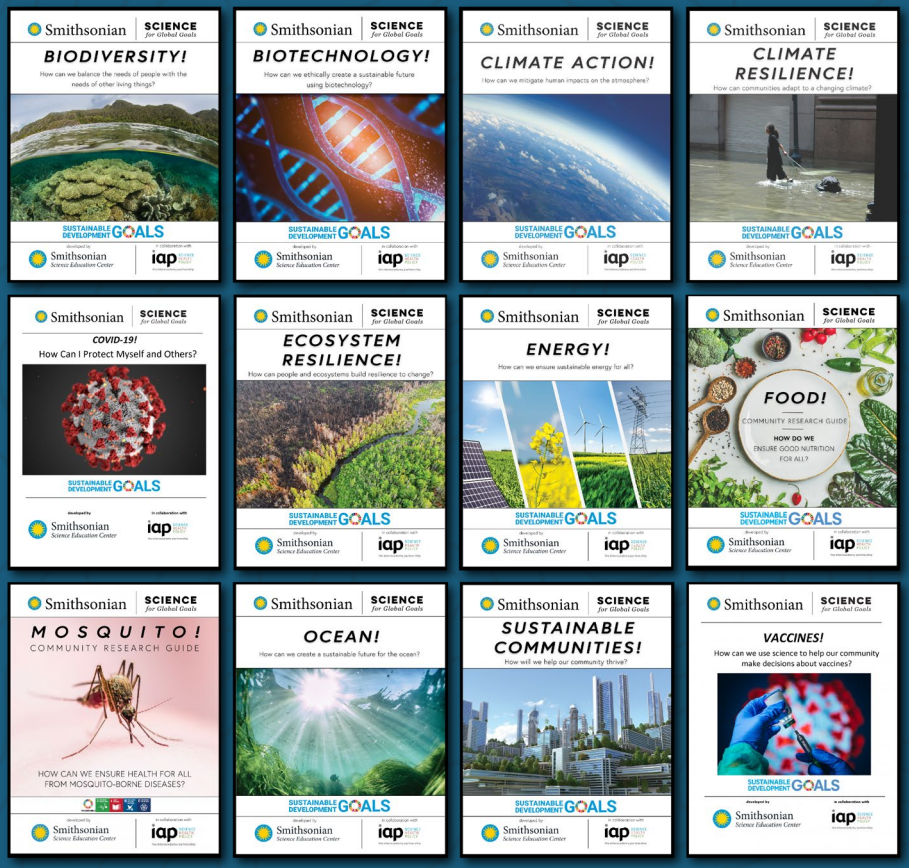
Research Mentor

Dr. Kiron Neal

Image Credits:
All designs, icons, guide covers, and tables – Smithsonian Science Education Center
World energy consumption graph – Our World in Data
Four types of energy – GetYourPic/iStock/Getty Images Plus
Solar panels – Vladimir Kazakov/iStock/Getty Images Plus

MAKE A CHOICE FOR THE FUTURE

Ready to learn more? Access the Smithsonian Science for Global Goals guides to discover, understand, and take action on sustainability issues in your community.



Smithsonian | SCIENCE *for Global Goals*

ssec.si.edu/global-goals