



FPL Solar Energy & Battery Storage Patch Program

Purpose of the FPL Solar Energy & Battery Storage Patch:

Note: The activities and information contained in this patch program are targeted toward Girl Scout Brownies through Ambassadors (grades 2-12).

- Allow girls to **DISCOVER** how solar and battery storage technology works.
 - How do solar-powered batteries allow you to enjoy the benefits of solar energy even when the sun is not shining?
- **CONNECT** solar energy with their lives, community and the planet.
- **TAKE ACTION** on what they've learned to use solar energy as a renewable and emissions-free resource.

How you or your troop can earn the patch:

1. Complete the activities and discussions listed below in the **DISCOVER**, **CONNECT**, and **TAKE ACTION** sections.
2. Girls and volunteers can use the information and resources contained here to facilitate conversations, answer questions and lead activities.
3. Complete the **REPORTING** section at the end of this patch program document to get your FPL Solar Energy and Battery Girl Scouts of Gulfcoast Florida patch.

DISCOVER

Part 1: What is solar energy, and what are the benefits of solar energy?

The Basics:

*The sun is a large ball of burning gas in the center of our solar system. It's made of mostly hydrogen that burns hotter than you could ever imagine. It is the largest source of energy in our solar system. In fact, more energy from the sun hits the earth in one hour than the ENTIRE world uses in a year. That's a LOT of energy!

*The energy that the sun produces is called solar energy. Solar means "from the sun".

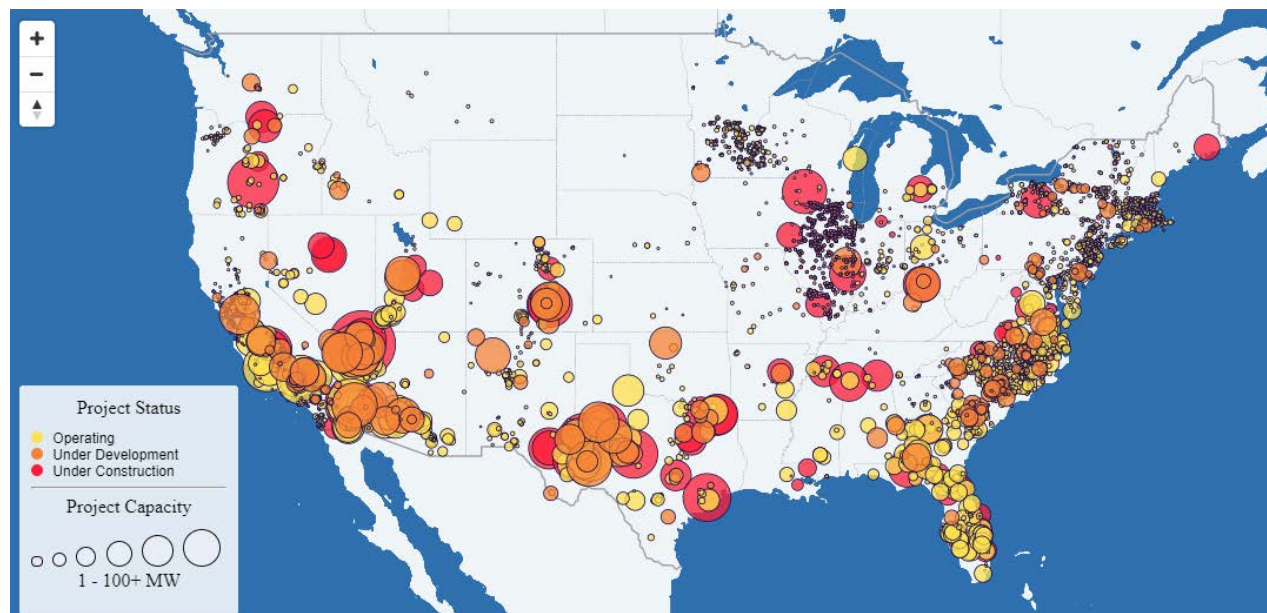
*Solar panels can convert solar energy into clean, emissions free electricity that can be used to power homes and businesses.



DISCOVER Activity 1:

The map below ([linked here](#)) shows major solar projects in operation, in development and under construction across the United States. Identify a large-scale solar farm in your community, state or region, and answer the following questions:

- How much electricity can it generate?
- How many large-scale solar projects are being built or developed in your community, state or region?
- Identify three potential benefits of having a large-scale (or utility-scale) solar farm in your community, state or region.



PART 2: How do solar energy and battery storage work together?

The Basics: Solar Energy

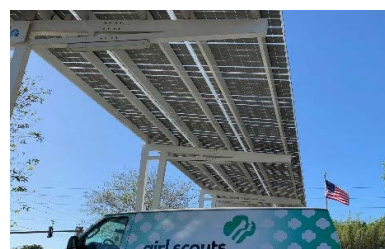
*A photovoltaic (PV) solar cell is used to convert sunlight into clean, emissions-free electricity.

*Most solar PV cells are made from silicon. Silicon is used to make many other products, including concrete, glass, ceramics, cosmetics, and computers. Silicon also makes sandy beaches!

*A solar panel (also called a “module”) is made of photovoltaic (PV) solar cells.

*Solar panels are then wired together to form a “solar array”. Solar arrays can be found at solar farms, like the more than 40 solar farms Florida Power & Light Company has installed across Florida. They can also be on solar trees, like the one at Honi Hanta Girl Scout Camp, or on solar canopies, like the one at the Girl Scouts of Gulfcoast Florida headquarters.

***Solar energy** is considered a “**variable energy source**.” That means it’s a renewable energy source that produces energy only when the sun is shining. However, battery storage technology is changing the solar industry by allowing us to enjoy solar energy even when it’s dark outside.



The Basics: Batteries

*A battery is a container consisting of one or more cells, in which chemical energy is converted into electricity and used as a source of power.

*Batteries are used to power everything from your phone and car to your TV remote or favorite toy. Some batteries are single use or primary batteries. Others are rechargeable.



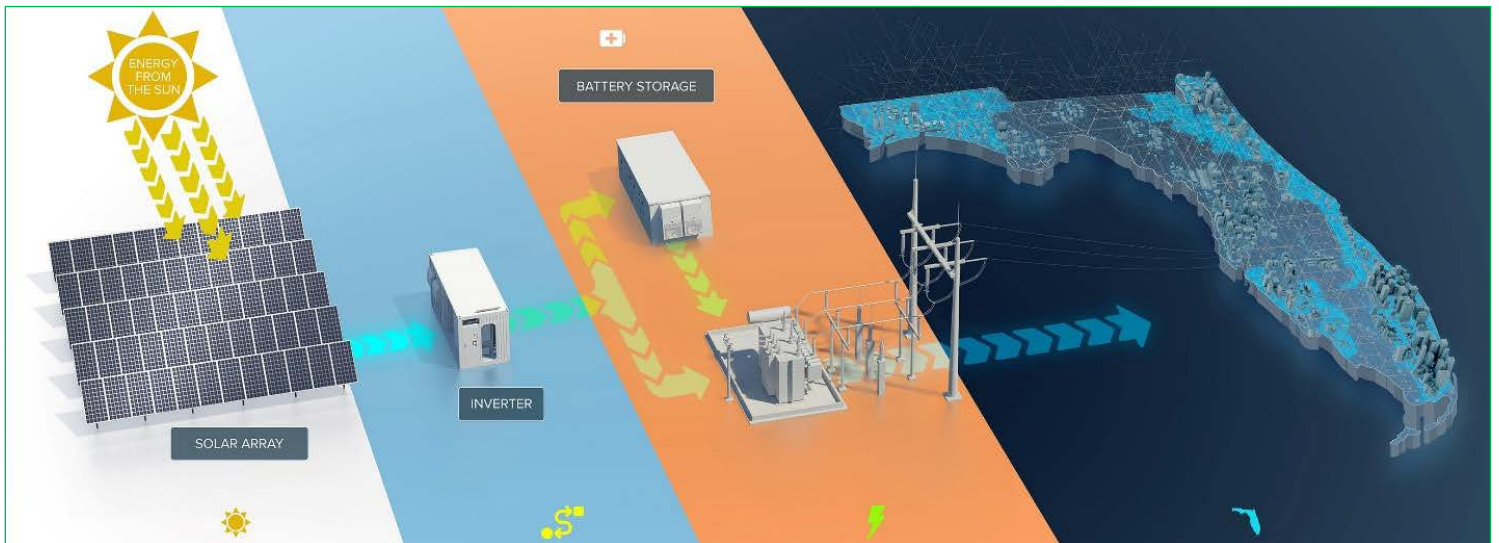
*You're probably used to batteries that look like this.

However, batteries come in many of shapes and sizes especially when they're being used to increase the reliability of renewable energy sources like solar energy. Just take a look at the batteries being loaded into one of the 132 containers at the FPL Manatee Energy Storage Center – the world's largest solar-powered battery. Just one battery weighs more than 200 lbs! Each container houses about 400 of those batteries.



Together these batteries are capable of powering 329,000 homes for two hours using energy generated by a nearby solar farm. That's a lot of clean, emissions-free power!

The Basics: Solar energy and battery storage



1. Solar panels convert the sun's rays into zero-emissions, direct current (DC) electricity. Those solar panels may be located at a large-scale solar farm, a house, business or on another fun solar installation like a solar tree or canopy.
2. The DC electricity flows into a power inverter where it is converted into alternating current (AC) electricity, which is the type of electricity that powers homes and businesses.
3. That energy can either be fed directly into the grid to power homes and businesses or it can be stored in a battery for when it's needed later, which means you can enjoy the benefits of solar energy even when the sun isn't shining like at night or on a cloudy day.

DISCOVER Activity 2:

Look around your house. Make a list of things that run on batteries and separate them based on whether those things run on regular batteries or rechargeable batteries. Make a chart, like the one on the right, then answer the following questions.

Item	Primary Battery (Non-rechargeable)	Rechargeable Battery
Laptop		✓
TV Remote	✓	
Cell Phone		✓

- What type of battery do you think would help increase the reliability of renewable energy sources like solar – primary or rechargeable?
- Why?
- What type of batteries do you think are used at FPL Manatee Energy Storage Center – the world's largest solar-powered battery?
- Based on what you've learned so far, what are the benefits of pairing batteries with solar energy?

PART 3: Solar and solar-powered batteries growing role in our electric system

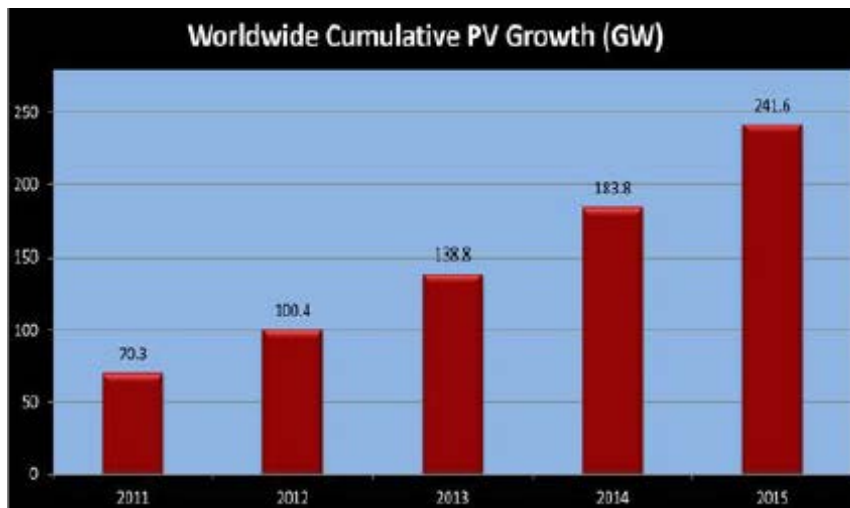
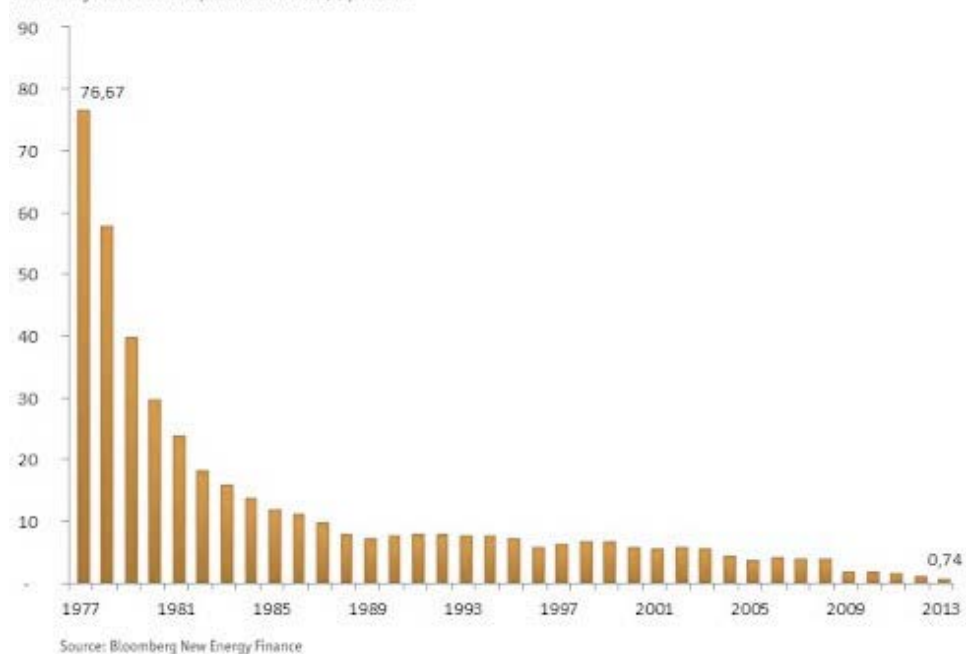
The Basics: Solar energy is more accessible than ever.

*Solar provides clean, renewable, locally produced energy. Unlike other sources of energy, such as coal, it produces zero carbon emissions which means it is good for our environment.

*Solar panels are more affordable than ever! In fact, the cost of solar has dropped 90% since the 1970s. The drop in cost has made solar energy an increasingly popular energy option in the United States and around the world.

The Swanson effect

Price of crystalline silicon photovoltaic cells, \$ per watt

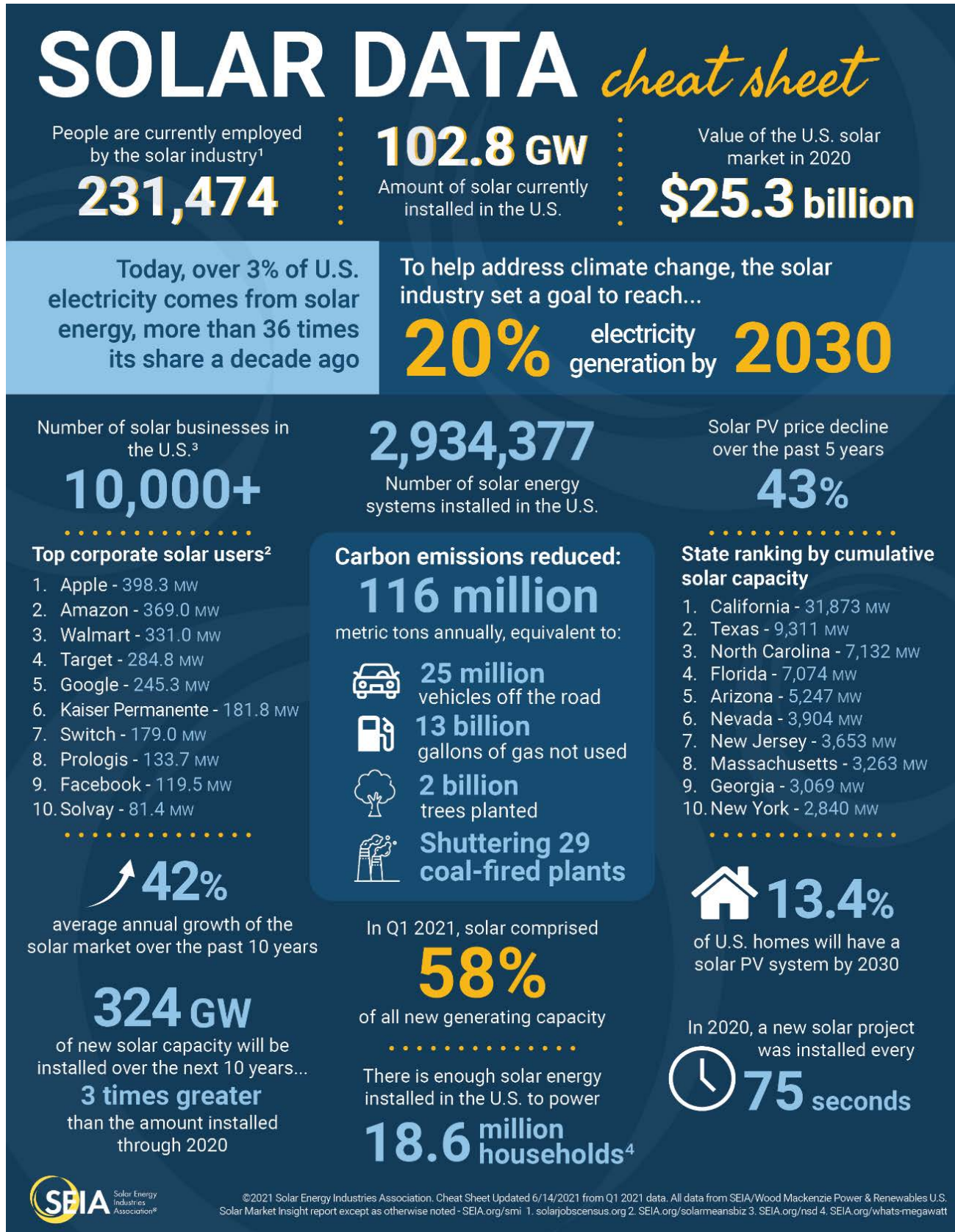


*In fact, around the nation and the world, solar energy is becoming a common renewable energy source.

*The increase in solar panel availability has led to significant growth in the solar industry which means there are more solar jobs available than ever before.

DISCOVER Activity 3:

Look at the following infographic depicting different statistics about solar energy in the United States.



Is your home state listed on the infographic? Use the internet to learn more about solar energy usage in your state. How many solar panels are being installed in your state? Who is installing the solar panels (your electric utility, a private company, local homeowners, etc.)? How many solar jobs are in your state?

The Basics: Battery storage is increasing the reliability of solar energy.

*Batteries can extend the benefits of solar energy, so that you can get access to clean, emissions free energy even when the sun isn't shining.

*Solar-powered batteries, like the batteries at the FPL Manatee Energy Storage Center, can store excess solar energy and dispatch it to homes and businesses when people need it most or during times when the sun isn't shining.

*Solar-powered batteries can also be useful during a disaster. If a disaster causes damage to the system that delivers power to your home, a solar-powered battery can be used to deploy power locally.

DISCOVER Activity 4:

Research the last natural disaster in your community, state or region. How many people were left without power? How might renewable energy and battery storage used together help people maintain power? Create a one pager that shows how solar energy and battery storage could have been useful during the natural disaster you researched.

CONNECT and TAKE ACTION

CONNECT Activity 1: Solar Scavenger Hunt – Identifying solar energy in your community

Description: You've learned about solar energy. Now, it's time to see it in your community. Get with your family to take a walk (or drive) around your neighborhood and take pictures of solar energy at work in your community. Try to find five examples of solar energy at work (don't forget to check stop lights, streetlamps, construction signs and parking lots!) and answer the following questions:

- How many solar panels did you find in your community?
- What are the solar panels powering?
- What are the benefits of using solar energy to power these items?



CONNECT Activity for Girl Scout Brownies (Grades 2-3), Girl Scout Juniors (Grades 4-5) and Girl Scout Cadettes (Grades 6-8 grades)

Solar S'mores

1. Watch the videos on this page to learn more about solar energy.
2. Ask 5 friends, teachers, or family members what they know about solar energy and if they think it is important - why or why not?
3. Create a collage about why you think solar energy is important. Include things you've learned from these activities and heard from your friends, family, and teachers.
4. Make s'mores with the sun! Follow the instructions in this video to make a solar oven [HERE](#).



Solar S'mores Oven Instructions

Materials: Cardboard pizza box (the kind delivered pizza comes in), pencil, ruler, scissors, aluminum foil, aluminum pie plate, clear tape, black construction paper, plastic wrap, an oven mitt, graham crackers, chocolate bars, marshmallows and sunshine!

Instructions:

1. Line your pizza box with black construction paper.
2. Using your ruler, draw three lines about an inch away from the edges of the box lid. Do not draw a line on the connected side. The final product should look like a square with a missing side.
3. Ask an adult to help you safely cut the lines, leaving the connected side hinged. This will create a flap in your pizza box.
4. Cover the entire lid and sides of the pizza box with aluminum foil. That helps reflect the sun's rays and warm up the food!
5. Use clean plastic wrap to wrap the bottom of your box and secure with tape. The plastic wrap will create a greenhouse roof that allows the sun to reflect while keeping the heat inside the box. Once your box is wrapped, you should have an easy opening to slide your aluminum pie plate in and out of (see the photo below).
6. Now, it's time to construct your s'mores! Place the graham crackers on the aluminum pie plate. Put your chocolate and marshmallows on top of the graham crackers.
7. Slide your pie plate, with the graham cracker, marshmallows and chocolate on top into your oven.
8. Make sure you pick a sunny spot for your solar oven! Position the lid of the pizza box in a way that reflects the most sun onto the food. You can use a pencil or a chopstick to prop the lid open so that it stays in place.
9. Wait and watch as the chocolate and marshmallows melt. Depending on how sunny it is, this could take just a few minutes. Don't be afraid to reposition your solar oven when needed so that it faces direct sunlight.
10. Use an oven mitt to carefully take the pie plate out of your solar oven.



11. Enjoy your solar s'mores!

CONNECT Activity for Girl Scout Brownies (Grades 2-3), Girl Scout Juniors (Grades 4-5) and Girl Scout Cadettes (Grades 6-8 grades)

WHAT HAPPENED? The heat from the sun was trapped inside your solar oven, and it got very hot in there. Ovens like this one are called collector boxes, because they collect sunlight. As it sat out in the sun, your oven eventually heated up enough to melt the chocolate and marshmallow!



What made the s'mores cook?

Rays of light are coming to the earth at an angle. The foil reflects the light ray and bounces it directly into the opening of the box. Once it has gone through the plastic wrap, it heats up the air that is trapped inside. The black paper absorbs the heat at the bottom of the oven, and the plastic wrap keeps it from escaping from the sides of the oven. Your solar oven will reach about 200° F on a sunny day. Although this method will take longer than a conventional oven, it is very easy to use, and it is safe to leave alone while the energy from the sun cooks your food.

CONNECT Activity for Girl Scout Seniors (Grades 9-10) and Ambassadors (Grades 11-12)

Help make your community's energy cleaner:

1. Put together a presentation on solar energy and battery storage. You're encouraged to reach out to your local utility, sustainability department or solar installer to get more information about solar energy in your specific community. Your final presentation should include the following information:
 - a. An explanation of what solar energy is and how it works.
 - b. The benefits of solar energy.
 - c. Solar energy options in your community, state or region (utility-scale solar energy centers, rooftop solar, etc.) – Consider contacting a company that installs solar to get more information about the options available around you.
 - d. An explanation of battery storage and how it works and how it can improve the reliability of solar energy.
 - e. How everyday people can incorporate solar energy and battery storage into their lives.
2. Gather a group of people you know (it could be your class, your Girl Scout troop or even a group of your neighbors) and teach them what you've learned.
3. At the end of your presentation, hold an open discussion about solar energy. Ask the group how they can incorporate solar energy in their own lives. Write them down. Ask the group about ways your community could incorporate solar energy. Write those down too. Make sure you have a few ideas in mind ahead of time! If you're stumped, check out "Babcock Ranch" online to get inspiration.
4. Give everyone paper and a pen. Ask them to write a letter to a local government agency (perhaps an office of sustainability) or a local official you've identified ahead of time, asking them to incorporate some of the ideas your group brainstormed as opportunities for your local community.
5. Collect the letters and send them to the government agency or local official you've identified.