



## Renewable Energy Classroom Activity

### Activity Overview

Renewable energy is energy generated from sources that are replenished easily, such as wind, sun and water. Renewable energy typically has a lower impact on the environment and is an alternative to fossil fuels in some situations. In this activity, students will be presented with three unique small business requests to utilize renewable energy to power the following: a lodge on the water, a charging accessory for people on the go, and a food truck. Students will evaluate two green sources of electricity, solar and wind, and create a unique design to incorporate them as a green energy solution. As an extension, students will discover how Renewable Energy Certificates (RECs) can help businesses still use green energy even when they cannot invest in their own solar panels or wind turbines.

**Target Audience:** Middle School Students

**Activity Duration:** 45 to 60-minute class session

### Essential Questions

- What are the advantages and disadvantages of using solar power as a renewable energy solution?
- What are the advantages and disadvantages of using wind power as a renewable energy solution?
- What are Renewable Energy Certificates (RECs)?
- How do RECs help businesses utilize green energy?

### Objectives

Students will:

- Evaluate the advantages and disadvantages of two renewable energy sources, solar and wind.
- Create a unique design that incorporates solar power and/or wind power as a renewable energy source.

- Describe how Renewable Energy Certificates (RECs) can help small businesses use green energy.

## National Standards

### **ESS3.A: Natural Resources**

Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. (MS-ESS3-1)

### **ETS1.A: Defining and Delimiting an Engineering Problem**

The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions. (Secondary to MS-PS3-3)

### **ETS1.B: Developing Possible Solutions**

There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3)

### **Constructing Explanations and Designing Solutions**

Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific knowledge, principles, and theories.

Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. (MS-PS1-6)

## Materials

- Computers or other devices with Internet access
- Copies of all Green Energy T-charts
- NGSS Engineering Design Process (From NGSS April 2013 Appendix I)
- NGSS Green Energy Design Plan Handout
- Copies of Green Energy Exit Slip

## Procedure

1. Show the beginning of the Renewable Energy video to students.
2. Lead students in a class discussion to review some of the benefits and challenges of using wind and solar renewable energy. Explain to students that later in the activity they will be invited to select a renewable energy solution for a unique business plan.

3. Review the three core ideas of the NGSS Engineering Design Process with students:  
[http://www.nextgenscience.org/sites/default/files/Appendix%20I%20-%20Engineering%20Design%20in%20NGSS%20-%20FINAL\\_V2.pdf](http://www.nextgenscience.org/sites/default/files/Appendix%20I%20-%20Engineering%20Design%20in%20NGSS%20-%20FINAL_V2.pdf)

The three components are listed below: Emphasize to students that these components do not always follow in order. Design solutions can be reevaluated and ideas replaced with new ones at any stage.

- A. Defining and delimiting engineering problems
  - B. Designing solutions to engineering problems
  - C. Optimizing the design solution
4. In order to define the engineering problem and to ask meaningful questions, students will briefly review two green sources of electricity - wind and solar. (Students can work individually, in pairs, or in small groups depending upon the number of devices with internet connections available.)
    - <http://energy.gov/science-innovation/energy-sources/renewable-energy>
      - The U.S Department of Energy has links to many resources, but students should focus primarily on the topics of solar energy and wind power:
        - Top 6 Things You Didn't Know About Solar Energy*
        - Unlocking Our Nation's Wind Potential*

**Key points include the following:**

- WIND ENERGY:
    - Wind turbines spin a generator to create electricity in the form of alternating current without releasing pollutants into the air.
    - Wind turbines do not emit greenhouse gases and they are inexpensive to operate; however, they are expensive to build.
    - The best sites for wind turbines are open, windy places.
  - SOLAR ENERGY:
    - Solar energy is the most abundant energy resource on Earth.
    - Photovoltaic (PV) cells convert sunlight directly into electricity for the grid.
    - Solar energy does not produce greenhouse gases, nor does it produce any air or water pollution.
    - The biggest hurdles to making solar energy affordable are the costs of equipment.
5. Invite small groups of students to randomly select a business request: 1) charging accessory for people on the go, 2) lodge on the water, or 3) a food truck. All three-business requests should be included. Depending on class size, more than one group

may end up selecting the same business request. Each group will be assigned two T-charts to complete in which they evaluate the advantages and disadvantages of using solar power and wind power for their specific business request.

6. Each group should compare the two T-charts so they can come to a consensus as to which renewable energy source makes the most sense for their business request. They may choose wind, solar, or a combination of the two for their green energy design.

Optional additional factors to consider when selecting a green energy source include:

- What are the costs associated with using this energy source for their particular business request?
  - Are there any barriers based on utility rules in that region?
7. Each group should elect a reporter to explain to the rest of the class the choice their group made for their design and rationale. Engage students in a whole group discussion about the choices made. Highlight similarities and differences between different groups' designs for the same business request.
  8. Instruct the groups to complete the Renewable Energy Design handout where they will describe their solution to the problem, as well as provide a prototype drawing, ways to test their prototype and evaluate the results, and ideas for redesigning the prototype if they have alternatives in mind. Factors to consider when planning the design include:
    - What will the physical structures look like?
    - What types of materials will be used?
    - Where will the physical structures go?
  9. Show the last segment of the Renewable Energy video.
  10. Lead a short class discussion to clarify RECs. Instruct individual students to complete the Renewable Energy Design Exit Slip before leaving class.

To locate green power suppliers or REC products by state or region click on the following links:

<https://www.epa.gov/greenpower/locate-green-power-suppliers>

<http://apps3.eere.energy.gov/greenpower/markets/certificates.shtml?page=0>

**Key Points about RECs include:**

- A green energy provider is credited with 1 REC for 1 megawatt-hour of electricity that it produces.
- Purchasing RECs provides support for clean energy initiatives
- RECs track the environmental benefits associated with generating electricity without burning fossil fuels.

## Optional Extension

Students will write a letter to the principal of their school advocating for renewable energy. They should suggest ways the school district could research programs based on the following resources:

Wind for Schools Project - U.S Department of Energy:

[http://apps2.eere.energy.gov/wind/windexchange/schools\\_wfs\\_project.asp](http://apps2.eere.energy.gov/wind/windexchange/schools_wfs_project.asp)

New Study Reveals the Power of Solar Schools:

<http://www.energy.gov/eere/articles/new-study-reveals-power-solar-schools>

## Additional Resources

Middle School Renewable Energy Activities:

<http://www.nrel.gov/docs/gen/fy01/30927.pdf>

Office of Energy Efficiency and Renewable Energy:

<http://energy.gov/eere/office-energy-efficiency-renewable-energy>

NAMES: \_\_\_\_\_

PD. \_\_\_\_\_

DATE: \_\_\_\_\_

**ADVANTAGES VERSUS DISADVANTAGES T-CHART: RENEWABLE ENERGY**

<b>SMALL BUSINESS REQUEST: <i>LODGE ON THE WATER</i></b>	
<b>ADVANTAGES OF USING SOLAR POWER</b>	<b>DISADVANTAGES OF USING SOLAR POWER</b>

NAMES: \_\_\_\_\_

PD. \_\_\_\_\_

DATE: \_\_\_\_\_

**ADVANTAGES VERSUS DISADVANTAGES T-CHART: RENEWABLE ENERGY**

<b>SMALL BUSINESS REQUEST: CHARGING ACCESSORY FOR PEOPLE ON THE GO</b>	
<b>ADVANTAGES OF USING SOLAR POWER</b>	<b>DISADVANTAGES OF USING SOLAR POWER</b>

NAMES: \_\_\_\_\_

PD. \_\_\_\_\_

DATE: \_\_\_\_\_

**ADVANTAGES VERSUS DISADVANTAGES T-CHART: RENEWABLE ENERGY**

<b>SMALL BUSINESS REQUEST: FOOD TRUCK</b>	
<b>ADVANTAGES OF USING SOLAR POWER</b>	<b>DISADVANTAGES OF USING SOLAR POWER</b>



NAMES: \_\_\_\_\_

PD. \_\_\_\_\_

DATE: \_\_\_\_\_

**ADVANTAGES VERSUS DISADVANTAGES T-CHART: RENEWABLE ENERGY**

<b>SMALL BUSINESS REQUEST: LODGE ON THE WATER</b>	
<b>ADVANTAGES OF USING WIND POWER</b>	<b>DISADVANTAGES OF USING WIND POWER</b>

NAMES: \_\_\_\_\_

PD. \_\_\_\_\_

DATE: \_\_\_\_\_

**ADVANTAGES VERSUS DISADVANTAGES T-CHART: RENEWABLE ENERGY**

<b>SMALL BUSINESS REQUEST: CHARGING ACCESSORY FOR PEOPLE ON THE GO</b>	
<b>ADVANTAGES OF USING WIND POWER</b>	<b>DISADVANTAGES OF USING WIND POWER</b>

NAMES: \_\_\_\_\_

PD. \_\_\_\_\_

DATE: \_\_\_\_\_

**ADVANTAGES VERSUS DISADVANTAGES T-CHART: RENEWABLE ENERGY**

<b>SMALL BUSINESS REQUEST: <i>FOOD TRUCK</i></b>	
<b>ADVANTAGES OF USING WIND POWER</b>	<b>DISADVANTAGES OF USING WIND POWER</b>

NAMES: \_\_\_\_\_

PD. \_\_\_\_\_

DATE: \_\_\_\_\_

***NGSS RENEWABLE ENERGY DESIGN PLAN***

- I. WHICH SOLUTION DID YOU CHOOSE FOR THE BUSINESS REQUEST? MAKE SURE TO STATE THE SPECIFIC BUSINESS REQUEST YOU WORKED ON.**

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- II. DRAW THE PROTOTYPE TO BE BUILT (INCLUDE TYPES OF MATERIALS)**

- III. HOW WILL YOU TEST THE PROTOTYPE?**

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- IV. HOW WILL YOU EVALUATE THE RESULTS & REDESIGN?**

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### RENEWABLE ENERGY DESIGN EXIT SLIP

Answer the following question in the space below and hand your response to the teacher on your way out of class today:

Name: \_\_\_\_\_

Your Group's Business Request: \_\_\_\_\_

**Your client informs you that they cannot afford your proposed green energy design plan for their small business. Taking into account what you have learned about RECs, explain the advantages of buying RECs to help out the business.**

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