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CLEAN GREEN POWER

TEACHING GUIDE



Hull Wind II, Hull, MA: Photo by S. Reyes

DISCOVER CLEAN ENERGY !

An innovative and fun way for educators and their students to learn about alternative, renewable energy through activities, interviews, projects and field trips in their local community.

LOADED WITH IDEAS AND RESOURCES

This educational program was developed by the Northeast Sustainable Energy Association in collaboration with the Girl Scouts of Western Massachusetts, and funded by the Massachusetts Technology Collaborative Renewable Energy Trust.



www.nesea.org
nesea@nesea.org



www.masstech.org

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NORTHEAST SUSTAINABLE ENERGY ASSOCIATION:

The Northeast Sustainable Energy Association (NESEA) is the nation's leading regional membership organization focused on promoting the understanding, development, and adoption of energy conservation and non-polluting, renewable energy technologies. NESEA has worked successfully for more than a quarter century in the fields of transportation, building construction, and renewable energy.

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Unit Lesson Plan Outline

This outline offers an overview of the Clean Green Power unit and how it might accommodate a wide range of educational levels.

Grade level: The program is adaptable to students of all levels, K to 12, and is also a great way for adults to gain an introduction to clean, renewable energy technologies, environmental issues and the related scientific principles.

Rationale & Objectives: The Clean Green Power program offers an introduction to the technology involved in clean, renewable energy and makes a great starting point for in-depth studies in several related areas. It provides a great context for teaching scientific principles related to energy transformations, chemical transformations, electricity, and light, which are central to many clean energy technologies. The Clean Green Power program also provides a natural segway to environmental, ecological, social and human health studies in a variety of topics such as: climate change/global warming; acid rain; ground level ozone; air pollution; surface mining; oil spills and mercury poisoning.

Massachusetts State Curriculum Standards:

Many Massachusetts Department of Education Curriculum frameworks can be met and exceeded, and a list of some of the potentially relevant Massachusetts Science, Technology and Engineering curriculum frameworks can be found in the appendix. [Click here.](#)

Activities & Time Recommended:

The basic structure of the Clean Green Power program is simple. There are three basic steps:

1. **Learn:** Short introductory activities are offered to become familiar with clean energy and develop some background knowledge. Educators can use the simple activities provided or develop their own to suit the learning needs of their students, and the direction they wish to take the unit. Allot one or two 40 – 60 minute class periods or more depending on activities.
2. **Explore:** A local site where clean energy is currently in use is selected for a field trip, students prepare to interview their hosts, and then visit the chosen site with their teachers or mentors. It is often a surprise for educators and students alike to learn that

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people from all walks of life, living in most neighborhoods around us, are already using clean and green energy for their electricity, heating, transportation and other needs, and also learning to use energy more efficiently. Their efforts are helping to make a cleaner, healthier environment for all of us, and they are often eager to talk about the science and technology they have put to use and/or the environmental issues that led them to choose alternatives. Allot a class period prior to the trip to develop questions and review visit logistics. The time at the destination site will vary based on site, ages, specific interests, etc., but negotiate this with the host ahead of time; 1 to 1½ hours is a generally useful time frame.

3. **Act:** Students complete an art, science, or communications project and present the project to a wider audience, contacting the media with their new knowledge. The presentation and media contact raise the bar on the quality of the work completed. Also, students are empowered by the opportunity to participate in helping more people learn about energy conservation, practical energy alternatives, and the relevant health, environmental and political issues. Students should receive enough time and instructional support during the project phase to create a polished project that they can present with clarity. Three or more weeks are recommended for both in and out of classroom time.

Upon completion of these three steps, you can download certificates of completion for your students or create your own awards if you wish. Girl Scouts of all levels are eligible to receive a patch upon completion. [Click here](#) to see the Girl Scout section in the appendix.

Resources & Materials:

This Clean Green Power Teacher Guide together with its glossaries and web site resources should enable successful completion of the program. This information can also be accessed on-line at: www.nesea.org/education/ycleanenergy

Assessment:

The final project and its presentation provide a means to assess specific learning objectives developed by the educator.

For the best student progress and outcome, continual assessment and adjustment of instruction throughout the unit is also recommended.

CLEAN GREEN POWER***Learn: An Introduction
(All Grades)*****What Do We Mean, Clean Green Power?**

Lighting homes, heating water, warming spaces, running machines, operating factories, driving cars and flying planes all require energy. The power to do such things is called **Clean Green Power** if the energy comes from clean and green sources.

But what is a clean green energy?

Clean energy and green energy mean that the energy comes from sources that produce little or no air, water or land pollution. As a result, using clean energy is friendlier and less damaging for the natural environment and for our health than the usual sources. Getting energy directly from the sun, wind, moving water, and plants are some examples of energy sources that are generally considered clean and green.

The not so good news is that the way we are getting most of our energy at present is not clean. Today, we are still adding pollution to our environment. Even electricity, which seems clean, needs energy to be generated, and right now one of the most common ways is by burning fossil fuels such as coal and oil. We also heat most of our buildings and water with energy that comes from burning fossil fuels and their by-products that include fuel oil, propane, or natural gas. We drive most of our cars by burning gasoline, and we also burn fuels to keep machines in our factories running. Furthermore, we often use far more energy than we need, which adds more unnecessary pollution to our air, water, and land.

When we burn fuel for energy the pollution that goes into our air changes the environment in many ways and harms humans, plants, animals, and other living things. Acid rain, ozone pollution, mercury contamination, and global warming are some that have been in the news a lot recently. Also, fossil fuels aren't renewable, which means you cannot replace what you burned since it took millions of years to form them in nature.

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Luckily, some people are beginning to use energy sources that are clean and green and to use energy more slowly. But most people don't realize how possible this is. We need more people to learn about clean, green power, and you can help! More kids and adults need to know that the clean, renewable energy is out there working well, right now! In this program, you visit a local clean energy site, meet and interview a person who has made smart energy choices, make a project, spread the good news, and have some fun!

Completing the Clean Green Power program makes a difference!

B. A Little More ...for your level

Kindergarten to Grade 2:

Read & discuss "A Breath of Fresh Air."

[\(Click here to fly to the story\)](#)

First Grade and Up:

Complete A Web Warm Up.

[\(Click here to whip to it\)](#)

Third Grade and Up:

Complete A Web Warm Up([Click here to whip to it](#)), the True and False Quiz ([Click here to zip to it](#)), and the Easy Energy Survey([Click here to go quickly](#)).

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CLEAN GREEN POWER**Learn*****Learn: A Breath of Fresh Air Short Story
(Grades K – 2)***

This short story is meant to help children begin to understand some of the issues around energy alternatives and to get them in the frame of mind of the clean green power unit, thinking about what the kinds of places they might visit, the interview questions they might ask, and even the project they might carry out.

After reading, discuss the story. Where can they find evidence of pollution? Where was it coming from? What are some ways people are saving energy and using cleaner alternatives?

A Breath of Fresh Air

By Susan Reyes

A hazy sun rose as warm as summer on a late winter day. A week of rain and warmth had melted away the deep snow that covered the area only last week. Jasmine was eager to get together with her best friends Samantha and Benito to find something to do, so she called over Sam, and they both headed to Benito's farm.

The threesome seemed to figure how to make the best out of every season, and winter had been an easy favorite. If there was snow, they could sled down the huge hill behind Sam's house; in the early darkness, they could gaze at the constellation Orion and his sparkling dog Sirius from Jasmine's deck, or any day, they could embark on untold adventures, exploring the frozen mysterious maze of swampland or just visiting animals around Benito's farm.

This particular morning, Jasmine noticed that the air felt a bit heavy to breathe, and she felt inside her pocket to be sure her inhaler was there since her asthma had been worse than usual this winter.

Soon the excitement of seeing Benito's older sister Rosa busy at work training a young pony in her indoor rink took the center of her attention. Though it seemed almost unimaginable, soon she and her friends would each get a pony to care for and ride. This all came about because of Rosa who was almost magic in her ability to make

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everything grow strong and healthy whether it was kids or vegetables or horses. Last summer, Rosa had started a small vegetable stand selling rare, tasty vegetables you couldn't find in the supermarket. She learned how to grow them without chemical fertilizers or pesticides.

Jasmine, Benito and Samantha were eager helpers with growing and selling the organic vegetables, and learned a lot in return. They never even thought of asking for anything more in return for their help, and never imagined Rosa would arrange for each child to care for and ride one of the farm's young ponies as if it were their own, and that over the years, Rosa planned to work her wonders creating companions of ponies and children. Tonight there would be a neighborhood ceremony where everyone would gather and Rosa would present each child the pony she thought matched their personality the best, and then the pony naming ceremony would follow. Jasmine couldn't wait !

For today, the friends decided they'd mount their bikes, head along the back roads for a five mile ride to the local store, and reward themselves with a treat when they got there. Benito's mom would ride along and carry back a few groceries in her pack as she often did.

As they started off, they felt exuberant as they smelled sun-warmed pine needles and saw the earth born again from winters' grasp. Soon they noticed that their neighbor Jim was tapping some maples and he invited them in to show them his new energy saving machine that required less fuel to be burned. It looked impressive, and the syrup tasted fine, and Jasmine was glad to take the break since her breathing was feeling a little tight, though she didn't say anything. All thanked Jim, thrilled to get an extra treat as they headed along.

Soon, they stopped at a small old graveyard and read some of the interesting epithets on the stones. Benito observed, "The white ones are like, all fuzzy, and you can't read 'em and the thin dark ones, even though they're really old, don't seem as corroded or something." Anita noted that the fuzziness happened because the white marble stones were affected more by the acid in the rain than the dark slate stones.

Coasting down a hill where one could usually catch a view of a distant blue mountain, the haze was so thick they could not see its snow covered ski slopes. Then a panicked hare leaped across their path with the gold flash of a wild cat in hot pursuit. The bikers had come to a stop. An excited Samantha was sure she'd seen a mountain lion, but

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Benito's mom, a wildlife biologist, settled the matter with a clear identification of the animal as a bobcat.

As they stood still, they could hear the rushing of the river that told them they were not far from their destination. Jasmine noted that they must live in the best place in the world—beautiful and wild and at the same time, not too far away from all the great things that you could do downtown. All nodded and headed onward toward the river's bridge, where they'd make one last stop before a short, hard uphill climb to earn their treat.

"Hey, look at those yellow signs!" shouted Sam, and sure enough, in place of the signs that were up last Fall showing how to tell Atlantic salmon apart from Brook trout, there were warnings not to eat any fish in the river because tests showed they were high in mercury, a poisonous metal. Jasmine said, "That can't be true! The river looks too clean, and we can't possibly have any pollution here."

Stopped at the bridge, they looked down the river, which looked crystal clear. Benito noticed that here and there lay a dead fish. "The mercury is killing the fish!"

"No, its not likely the mercury," said his mom, "it's something called acid rain, and it can come down as snow or just fall out of the sky, and when all the snow melted last week, there was just too much coming into the river all at once for the fish to handle."

"Who's doing this to our river?" they asked in anger and in unison.

"I suppose you could say we all are, though we don't intend to," his mom gently replied, "We all seem stuck in an old way of doing things that is harming the environment and us, too. "

"We'll change that!" said Jasmine, and her friends agreed as they pumped up the hill with renewed energy. Halfway up, Jasmine, the athlete of the threesome, began to slip behind. She got off her bike and it was clear she was having difficulty breathing. Her friends were worried, but she explained that she had her inhaler and would soon be ok, but she had to walk the rest of the way up to the store. Her friends stood at her side and at the first sight of the sun's reflection off the shiny metal panels on the roof, Sam shouted, "We're here!"

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Inside, Jasmine was breathing a lot better. While Anita was shopping, the kids enjoyed their treats and began to talk about the pollution. Jasmine wondered if her asthma might have been made worse by air pollution and Benito figured you couldn't see as far with polluted air. Everyone was angry about the fish and wondered what other harm the pollution might be doing. They all wanted to know how air pollution could even exist in a beautiful place like theirs. Ms. Henson, who worked at the store, was impressed with their conversation and invited Anita and the kids to see the solar panels on the roof.

She explained that burning gasoline, coal and other fuels to make electricity, run factories, heat places, and run cars, planes, and so on was what was polluting the air. She explained how the solar panels work and proudly announced that all their electricity came from the sun and was clean, renewable energy. Then she started to list many other people in town who were saving energy and starting to switch over and go clean and green! "The library uses energy from deep inside the warm earth! The Rogers have a wind turbine on their farm. My friend Eva started recording her driving miles 2 months ago and figured out how to cut them in half by sharing rides and walking. We're using photovoltaic cells to get electricity from the sun. Right now, we just need to do two things: get people to think about conserving energy more and get more people learning about clean energy alternatives. It looks like you are just the kids for the job!"

The children were so full of ideas they ended up walking their bikes much of the way home so they could talk. They had seen and felt some of the damage done by burning fossil fuels for themselves, and now they knew that with a little care and a different approach, the earth and air could be clean and healthy as it was meant to be.

At the ceremony, the ponies' names came to mind as if each animal had whispered it to each child: Benito called his Earthfire, and the pony's powerful gold-tipped legs looked as if they brought the earth's energy into his strong black body; Jasmine's spirited golden pony practically spoke the name Sunlight, and the wind rustled the extra long mane of Samantha's dappled mare as she named her Windstreak.

That night, Jasmine fell asleep quickly, dreaming of herself riding on Sunlight holding a lantern at night; she was a messenger with a mission. Suddenly she came to a rich green pasture with her friends and felt at home. The ponies grazed and the air felt light and sweet.

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Learn

***Learn: A Web Warm Up
(Grades 1 and Up)***

The Internet can be a really helpful place to learn more about clean energy, energy conservation, and pollution from burning fossil fuels. You can get great ideas for your project from the web, too.

First through Fourth grade:

Learn About Energy Waste at Home and/or Energy Efficiency
Spend at least 20 minutes at one of the following sites:

1.) www.energyhog.org. There are five games to play, and if you want, there is a home energy survey you can take, or 2.) Go to <http://nstar.sawmac.com/> and there are games here, too. Older Girl Scouts and leaders might be interested in the teacher's guides as they have some games and activities that could lead to project ideas.

First Grade and Up:

In Depth On Solar

Go to the Solar Energy International web site together with a partner:
www.solarenergy.org/resources/kids.html

Read through the website's frequently asked questions on solar energy section for younger kids (ages 6-106) and/or older kids (ages 12-112) as you see fit.

Share something about the reading with your partner and have them share with you: explain something you learned; something that surprised you; a new question you have; an idea you have, etc.

Sixth grade and up:

Some Basics

Go to www.nesea.org to scavenge for answers to #1-6 below.

1. What is the name of the school of the most recent Junior Solar Sprint Grand Champion in the (Hint: Pull down Education and go to Junior Solar Sprint):

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2. What industry is currently the largest polluter in our country (Hint: Look for Information about Clean Energy)? _____

3. Name 5 sources of clean energy:

4. Replacing one ordinary light bulb with a compact fluorescent can save _____ pounds of coal from being burned to make the electricity (Hint: Look at "Eleven easy things you can do..." under "Information on Green Buildings") .

5. Find the author and title of this book (Hint: Look for recommended books under Clean Energy):

a. Explains the basics of solar power and especially useful if you feel you know nothing about how solar energy can become electricity: _____

6. Find a glossary of solar terms (hint: Rhode Island Schools) and find what is meant by Building Integrated Photovoltaics: _____

Sixth grade and Up:

Mini Web Search

Pick a topic of interest which is about either clean energy or about the problems of burning fossil fuels. Google It! ...or try another search engine to find more information for a brief look. For most people, including adults, the words education or kids help bring them to sites which use clear language on unfamiliar topics. You might also find activities on such sites which could be a part of your Clean Green Power program.

Note the title and web address of at least one good site you might return to for your project or more information: _____

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CLEAN GREEN POWER***Learn: Clean Green Power True and False Quiz
(Grades 3 and Up)***

Take this Quick True and False Quiz and check out the correct answers to start learning about clean (and dirty) energy sources:

1. We need an energy source to make anything work. This means without energy we would not have lights or machines work. Without energy, we could not make a car, plane, train or anything else move. Without energy we couldn't keep a building warm. Without energy, we would not be able to make anything. TRUE or FALSE? True. Read on!

2. The only source of energy to do everything is gasoline.
TRUE or FALSE?

False. Energy might come from many sources. Some other examples include: moving water, wind, burning coal, burning wood, splitting atoms, the earth's heat, the sun, and your own muscles.

3. Most of the energy we use in our country today comes from burning fossil fuels—ancient remains of sea and plant life buried underground for millions of years.

TRUE or FALSE ?

True. Coal comes from ancient plants that were around at the time of the dinosaurs, and petroleum which contains natural gas, propane, gasoline, jet fuel, oil and other fuels we use comes from the remains of ancient sea life.

4. There's so much oil under the ground, we can keep increasing our use of it over time just as we've been doing for at least the next 100 years. TRUE or FALSE?

False. While we do have a lot of coal in the US, and there are other fossil fuels available, easily accessible oil could run out if our demand continues to grow and we do not seek alternatives. Fossil fuels are non-renewable energy sources.

5. Massachusetts has to import all of its fossil fuels used to generate electricity. TRUE or FALSE?

True. The good news is that Massachusetts can get its own clean energy from a variety of sources, such as solar, biomass and

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geothermal. We also have wind, and the proposed wind farm off of Cape Cod would be the first offshore up the whole US.

6. Coal mining is an almost invisible operation since the mining is usually deep underground. TRUE or FALSE?

False. It is often surface mined, which may mean mountain top removal and extensive disruption to the local environment. Check out the web site under strip mining in the glossary to learn more.

7. It is possible for an individual or family to make choices that can prevent tons of carbon dioxide (a major contributor to global warming) from going into the air each year. TRUE or FALSE ?

True. Today, U.S. individuals put an average of about 22 tons of carbon dioxide into the air per year, while the worldwide average is 6 tons per person per year. A ton is 2000 pounds, about the weight of a car. The good news is that we can help save a lot of carbon dioxide from getting into the air. A car that gets better gas mileage could save tons compared to a gas guzzler. Just carpooling for 2 regular trips a week can save about 1500 lbs per year; recycling can save 850 lbs per year. Planting trees saves 50 lbs per tree since they use carbon dioxide for photosynthesis. Buying things in bulk and reusable containers and save 230 lbs per year. That's just a start! There's a lot more that can be done, and a great project to learn about it. This information is from the U.S. Environmental Protection Agency.

[http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/SU5BPKVH/\\$File/climatesmarttips.pdf](http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/SU5BPKVH/$File/climatesmarttips.pdf)

8. The biggest source of ozone pollution in our country is from the smokestacks of factories. TRUE or FALSE?

False. Its from the tailpipes of cars, trucks and SUVs

<http://www.nasa.gov/missions/earth/f-ozone.html>

9. Water vapor in the air can trap heat. TRUE or FALSE?

True. Water vapor is a greenhouse gas as is carbon dioxide. Some scientists have suggested that when we put extra carbon dioxide into the air from burning fuels, not only does it cause warming, but so does the increased water in the air from evaporation. Interactions in nature can be complex!

<http://www.climateark.org/articles/reader.asp?linkid=48121>

QUIZ SCORE: Stellar!

Have fun as you explore the web, interview, make your project and spread the word.

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***Learn: Easy Energy Survey
(Grades 3 and Up)***

This quick survey is meant to get you thinking a bit about your own energy use. Be honest; its good to know where you are at right now. As you work through the Clean Green Power Program, see how many no's can become yes's:

Do you almost always turn off lights when you leave a room?
YES NO

Do you ride or drive only when necessary, choosing buses, trains, carpooling, biking, walking etc when you can?
YES NO

Do you know about how many miles you rode in a car last week?
YES NO

Do you usually consider fixing broken items or buy used one before buying new?
YES NO

Do you grow some of your own food or buy it through a local farmer?
YES NO

Do you separate recyclables?
YES NO

Do you know the average kilowatt hours (kWh--a measure of electrical power usage) used over the last year in your home or apartment?
YES NO

If your family has cars, trucks, or other vehicles, do you know how many miles each one can travel per gallon of gasoline in the tank?
YES NO

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Do you know what heating system(s) your house or apartment uses?

YES NO

Do you know the energy source(s) for the heating system(s)?

YES NO

Have you ever tested TVs, DVDS, etc for energy leakage with a device such as a Kill-a-Watt? YES NO

Do you use compact fluorescent light bulbs wherever lights are on the most? YES NO

Do you know the expected yearly kWh usage of any of your home's major appliances, such as water heater, refrigerator, wash machine, drier, freezer, or air conditioner (in the last several years they have come with yellow stickers that tell)?

YES NO

Do you know what an Energy Star rating on an appliance means?

YES NO

Do you know how much insulation is in your attic and walls?

YES NO

Did you ever make the connection between energy use and pollution?

YES NO

Have you ever changed a habit to save energy?

YES NO

Clean Energy Tidbit

Each year, Americans spend more money to power home audio and DVD products when turned off than when actually in use.

Alliance to Save Energy,

http://www.ase.org/uploaded_files/powersmart/

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CLEAN GREEN POWER***Explore:*****Visit Clean Energy Sites and Interview Hosts and Hostesses**

All grades can carry out the site visit and interview, varying detail of information as appropriate to age level.

Step #1: Find a site to visit. Go to our web site, “Clean Energy for a Clean Environment” www.nesea.org/education/ycleanenergy/
There are several Massachusetts sites to try. You might also plan your field trip on Northeast Sustainable Energy Association’s Green Building Open House Day which occurs annually around October 1. Look for details on the NESEA home page.

Click on the “Site Destinations” picture. You should see a map of Massachusetts. Click on your area to get a list of people in your county with clean energy sites who have volunteered to be interviewed and visited by youth with their parent or adult mentors. Teachers and mentors make arrangements directly with site hosts and hostesses.

Site Finding & Arrangement Tips:

- ✚ Check sites in the nearby counties in addition to your own.
- ✚ If you are willing to travel, choose a site anywhere in the state.
- ✚ Do browse around all over the state to get a sense of the diversity of clean energy alternatives in use
- ✚ Maybe you know someone who has a clean energy site you’d like to visit that is not on our list. Feel free to go and interview that person and let us know if they are open to others interviewing them as well.
- ✚ Consider planning a fun side visit while you are on the road. Pair up the clean energy site visit with an ice cream stand stop, some other refreshments and some other local fun opportunity.
- ✚ Arrange a schedule for the visit, or at least a time estimate—it helps to be clear about time expectations.
- ✚ Contact your local news media and you might fulfill the publicity requirement by having them join you or write about your visit.

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Step #2: Prepare for Your Interview:

Before you go to the site, you should work with students to prepare some interview questions and write them down. Here are some tips:

1. One very helpful first question is to ask why the host/ess decided to use alternative sources of energy and how they learned to use clean power. Here's how the question might be framed: Could you tell me the story of how you got involved in using clean power?

2. Equip students with personal energy information. Before you go, figure out how families heat their homes, heat water, light the house, and try to identify everywhere energy is needed, and where it is coming from with as much detail as possible. If you have an electric bill, it will show you how much electricity was consumed over the last year. You could have students compare how their uses and needs are similar and different to the hosts. Energy conservation measures can be shared both ways.

3. Here are a few more general sample questions; be sure to check out the site you are going to and create questions that fit:
What makes your power source "clean?"
Why is it renewable?
How does it work?
How long have you been using this system?
Were there any people, books, organizations, websites, people, stores, etc. that influenced your decisions, or that you recommend?

Interview Question & Site Visit Tips:

- ✚ Especially for older students, to get the most out of the interview and site visit, explore the web sites in this Clean Green Power Program. You can also click on "Glossaries" on the Clean Energy for a Clean Environment website www.nesea.org/education/ycleanenergy and research clean energy topic(s) you will encounter at your site visit. This will help your group come up with smart questions ahead of time.
- ✚ Use pre-visit research to get a head start on projects--the interview & site visit can be part of the project as well.
- ✚ If you want to bring a tape recorder, camera, or video camera to the interview, that would be a really great record of the visit—just be sure to ask the host/ess ahead of time if its ok to

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record images or voice –and let them know how the information will be used.

- ✚ The interview is a good opportunity to ask what some unfamiliar terms mean. Encourage students to ask and ask again if needed.
- ✚ Plan to bring paper to the interview and be prepared to jot down new questions to ask, or possibly to follow-up on later. Bring a notebook or clipboard.

Step #3 See Clean Power at Work and Carry Out the Interview

Meet a clean energy pioneer! See clean power technology up close. Enjoy the interview, learn a lot and help get students inspired to carry out their projects.

On Site and After Site Tips for Adult Mentors:

- ✚ Many sites are homes and host/esses may be unfamiliar with the age and academic levels of children so adult mentors may need to help the site host/ess in this regard—ask for simpler words, etc.
- ✚ Its helpful to remind kids to be respectful of someone else’s home and the different cultures we have—taking off shoes or not, etc.
- ✚ Parents and adult mentors must accompany youngsters during all parts of site visits and take responsibility for all safety considerations.
- ✚ Write individual or group thank you notes. Site hosts would be thrilled with specific notes about what was meaningful as well as drawings or photocopies of artwork.

Clean Energy Tidbit

If every household in the U.S. replaced **just one** bulb or fixture with an Energy Star qualified model, we could save more than 8 billion kWh--equivalent to removing 1 million cars from the road per year!

Alliance to save Energy

http://www.ase.org/uploaded_files/powersmart/

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CLEAN GREEN POWER**Create a Project**

All ages and grades carry out a science, language art or art project in the spirit of clean, green energy. Some examples of project ideas are provided to get your creative ideas flowing. The opportunities are open to imagination! The final draft or finished product should be of a quality high enough that you would be proud to display it in your local library, environmental center, kids museum, youth hall, school, etc.

Be sure to check the Clean Energy Glossary ([Click here](#)) as well, since it has more web sites as well as the definitions. Some web sites would be very useful in the project aspect of the program.

This ideas section is written mostly in a format directed to the students themselves. Use it as it best fits your class or group.

A. Examples of project ideas adaptable to a variety of levels:

Cozy Nature Saving Quilt The squares could each be made by a different child and symbolize the things we love and are protecting as we conserve energy and protect our environment from acid rain and ozone pollution: a brook trout, a white pine, clear blue sky, a mountain view, etc. An information sheet or booklet could explain the squares.

A Breath of Fresh Air

Illustrate the story—it could be broken up into parts with each child getting a frame to illustrate and then mount on a story mural. The next chapter or a sequel could be written to this story and also illustrated. How do the children accomplish their mission? What adventures do they embark on? What surprises do they encounter?

Tell Your Site Visit Story

Tell the story of the place you visited and the person you interviewed in some form of media. Be sure it is ok with hosts before you proceed with this project! As you do this, make sure that the story comes out so that you would be proud about the way someone else told your story; double check for accurate details. Most hosts will be happy to answer questions. Be sure to send them a copy of your final product or photos if applicable!

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Expect to make a few drafts before your presentation draft!

Include credits and thank you's as appropriate.

Some ways to tell the story:

Comic Strips: Start with a page of mini-sketches (thumbnails) telling the whole story before starting in one section. Make several copies of blank comic strips to work in with neat boundaries –use rulers & shapes.

Books: Use interesting borders; make borders around photos and drawings; laminate the front and back; bind for presentation

Power Point and Video: Think about the most interesting pictures and messages; the order and plan your frames. Be sure to open and close well.

Clean Energy is Here Now! One way to spread the message is through a set of dioramas, tiles or a mural showing many examples of uses of clean and renewable energy technology: wind turbines, hydrogen fuel cells, solar panels, solar hot water on a roof, earth sheltered homes, straw bale buildings, solar ovens, etc. Each child in a class can find out why an energy source or use is clean and green, find or imagine a picture to represent it, and then construct a 3D model in a diorama. With the help of a carpenter, older students could design a mural they paint on a board and hang it on a wall. Box dioramas can also be stacked to create a wall art piece. Short descriptions of each should be available to interested viewers.

Re Use It Gifts

Re-using saves energy because it takes energy to make anything, not to mention the land space used up by trash, pollution from the materials, etc. With this in mind, girls identify commonly discarded items that they could make as reusable gifts with pictures/slogans that remind to save. Paper towels, napkins, plastic dishware, and lunch containers are common, and cloth alternatives with stenciled suns, trees, etc. Some craft places offer time and space to paint ones own tiles and dishes at a cost.

Grow Organic or

Compare Locally Organic Grown vs. Supermarket Food

Students who have visited an organic farm can make a set of posters showing clean green benefits of buying local organic food: energy saved in transportation and the health of the soil and water as well. You could also research how to grow organic and plan an organic vegetable garden or even organic family lawn this summer.

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Compost or Vermicompost

Get some red wigglers and have fun as you learn to transform nutrients from your food scraps into great fertilizer for your plants, and help keep your food local. Make a booklet describing how someone else can do the same thing.

Composting Toilets

Sewer treatment requires energy, even septic systems in rural backyards as sewage may need to be pumped up hill or taken away in trucks. Composting toilets are an interesting topic to explore and they keep lots of good nutrients local. Visit a composting toilet; learn how it works; make a model or diagram; research a good site for a composting toilet and campaign for the toilets.

Recyclables Art & Programs

Start or rejuvenate a recycling program in your community, school, town or even in your homes. Collect interesting recyclables, visit a re-use or recyclables store and construct sculptures with your finds. Beautiful new designs can be created in mosaic tiles from broken pottery pieces set in mortar.

Meaningful Message Postcards

Gather some helpful reminders and tips on pollution prevention and send them out printed on postcard size copies of your artwork—pen line with color; water color; pastel. Illustrate the beauty of the nature we are protecting. Save digital photos as proof of your work.

Green Buildings

Make a model of a green building technology such as you may have seen at your site visit or one you are interested in:

- a straw bale house—straw bales make the sides of these homes
- an earth sheltered house-partly underground homes

Write up the benefits and display a photo of your creation.

Make the NO a YES

Take fresh look at the Easy Energy Survey. Turn some of those no's on the quick energy survey into yeses and make a system of rewards for doing so. Expand on this survey and create an energy survey for your community. Provide rewards for people who record a change. You might do this through a school, class, library, troop or club. You could even calculate the pollution saved.

Minimize the Miles

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Figure out how many miles families in your class are currently driving and then brainstorm ways to trim the weekly average. Be supportive of one another and agree on no criticism, only praise. Invite parents' ideas and graph your progress.

Conduct a Poetry Slam, Contest or a Tea

Write poetry about environmental conservation, environmental stewardship, damage of mining, air pollution, clean energy or related topics. Plan the set up with food, mike, and guidelines for poet etiquette. Send invitations to a wider audience and advertise.

Weigh the Waste

A fun activity where kids get to choose what they eat and how much is to weigh the food waste at the end of the meal—not counting inedible, fatty parts, etc. and to graph it. Food takes a lot of energy to produce and transport (and don't forget the energy in getting the fuel itself) and mapping out all the sources of energy that go into getting a meal on the table makes a great project.

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B. Examples of projects suitable for middle school and older:

Build a model solar electric car, or for the oldest students, mentor a model a team of builders. There's a whole program called Junior Solar Sprint for kids up through 8th grade—teams can enter their car in race and design events. Mentors attend a workshop on how to do it—see www.nesea.org/education/jss for workshop dates and locations.

OZONE: Good Up High, Bad Near By

Learn about ozone pollution at ground level and how it harms plants, and animals including people. A totally different problem is that some of our human made pollutants are thinning our ozone layer high in the atmosphere, where we need it to protect us from dangerous radiation. Create a public project to help people get clear about this common confusion. Try

<http://www.nationalgeographic.com/eye/ozone/science.html> for a quick picture.

http://www.epa.gov/sunwise/kids/kids_ozone.html for learning about the importance of the good ozone layer, and

<http://science.howstuffworks.com/ozone-pollution.htm> for everything you wanted to know about it.

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You can do science experiments testing for ozone pollution in areas around where you live by using ozone sensitive papers you could buy through <http://www.o3zone.com/ozoneser/>

Or check out some amazing work that New Hampshire scientists are doing with students, where they study the pine needles of white pines all over (including Massachusetts) for evidence of ozone damage that you can see using sophisticated equipment.

www.forestwatch.sr.unh.edu

Test for Carbon Dioxide

With plastic bags, big syringes, and a liquid acid indicator (red cabbage juice works fine), you can go around collecting samples from different locations such as car exhaust, breath, air near a bus terminal, or even straight carbon dioxide made by mixing vinegar and baking soda in a bag or an Alka Seltzer in water, and bubble it with the syringe through the acid indicator. Carbon dioxide shows a slightly acidic reading.

Build and Cook Meals on a Solar Oven

Here's a great site to learn about cooking with solar ovens, and a lot of global culture around the topic.

The Solar Cooking Archive, Solar Cookers International

www.solarcooking.org

Solar and Wind Kinetic Sculpture

Once you know how electric circuits, solar panels and motors work, you can play around and create some sculptures with parts that move from the power of the sun. Solar fountains are fun and you can start with a kit and work from there.

Audit the energy use in your own home .

Home Energy Saver

Learn about energy conservation and save your family money while you are at it. <http://hes.lbl.gov/>

To get answers to FAQs (Frequently Asked Questions), check out: <http://hes.lbl.gov/hes/answerdesk.html>

Create a Web Site on an Energy Issue

Your class can become experts on a specific topic such as Global Warming and help make all the important connections for other kids: The carbon cycle; how burning fossil fuels creates carbon

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dioxide; how that traps the sun's energy in the atmosphere; how the warmth affects the surface of the ocean & land; how interactions among living things could change, etc. You could review other web sites, make links and recommend the best.

Start, Moderate or Join an Energy Issues Discussion Forum

Organize an energy issues forum in your town or participate and support an existing one by taking an active role—in discussions, raising questions, agenda items as well as logistics.

Energy Information Exhibits

You've been to fairs and you know what attracts people to a booth. Can you make one fun, interactive and informative? Develop interactive demonstrations and models, and make handouts for visitors. Join an earth day event, or have your own expo. Travel to classrooms, school assemblies, etc.

Make Model Wind Turbines

Build a working model wind turbine and demonstrate it with the help of fans. You could have replaceable blades to experiment with different blade shapes and sizes.

Model Fuel Cell Car

Learn about the exciting technology of hydrogen fuel cells. Kits are available to make and conduct experiments and races with model cars. www.h2help.org

Public Access TV

Get show time! Many adults would be eager to help you get an energy panel discussing important issues on air.

A Cause and Effect Map or "1 + 1 = 2"

The idea here is that lots, perhaps most, voting adults don't understand the connections between current energy use, health and environmental problems and alternative choices. Try to list each problem and each effect on a piece of paper. Write "causes" or "may cause" or "can lead to" on several little strips of paper and attach them to several separate strings. Use the strings to connect the problems and effects in every way that makes sense based on your research. A large wall poster can be created when you have identified several sound cause and effect relationships.

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Act: Spread the Word !

Publicizing the experience with clean energy is an important aspect of the project. It can be done in many ways, and here are some examples, but feel free to think up your own ideas, too:

1. Create press releases for your site visit and interview, or for the project(s) if it is an event or if it will be displayed at an event. Do be sure it is ok with the site owner to have the press involved prior to inviting them. For press release tips, see, "Make Yourself a Star" at the last part of this section, or [click here](#).
2. Make the focus of your project spreading the word about clean energy. Teach other people about what you have learned by displaying your project at your local school, library, city or town hall, or other commonly visited places. Have an opening reception just prior to a meeting such as PTO and advertise with good looking photocopied fliers in advance.

If your project is geared toward teaching kids of a certain age group, you might get permission from the teacher to make a special class visit or from the principal to offer a special assembly. The school library is also a great place to spread the word.

3. Prepare a 10 to 15 minute presentation with your project and get yourself on the agenda at a local adult meeting of the Rotary Club, or another group. Here's a simple outline. Tell:
 - a. About the program and what clean green power means.
 - b. Where you went, why, & what you learned there.
 - c. What project you created and explain it.
 - d. About the most important things you learned, changes you hope for and what you think are most important things adults can do.
4. Write a letter to the editor of your newspaper describing a position on clean energy, energy alternatives, energy conservation, or problems associated with energy use. You may also respond to an energy related article you find in the newspaper. Tips:

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Look at the length of the letters they publish. Usually it is about two or three paragraphs. That's the space you have to get across your point. Respectfully share your point of view and give reasons for it.

5. Look for a small newspaper, zine, newsletter where you can write about your project and include some photos. You could even create your own publication and have each troop member's project set up in article form.

Check out The Green Schools Gazette

At this site you can look through previous editions of this newsletter for students and by students. You could get ideas for a project and maybe publicity. Articles wanted!

<http://www.ase.org/section/program/greenschl/gazette/>

ADDITIONAL IDEAS FOR PLACES TO SHARE PROJECTS & EXPERIENCES

Earth Day Events

Environmental Centers

Energy Committees in Towns

Energy Study Groups

Green Car Clubs

County or Agricultural (you can win awards, too !)

Conferences

National Honor Society

Nature & Hiking Clubs

After School Clubs

After School Care for Younger Kids

Historical Societies

Science Fairs & Expos

Open Mikes

Key Club

Public Access Television

Interfaith Councils

Other Girl Scout Troops

Rotary Club

Asking around among parents, checking with your Chamber of Commerce, can lead to some good ideas for places where you can share your project and spread the word.

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MAKE YOURSELF A STAR !

Alerting the local press about your activities and achievements associated with the Clean Green Power program is an important way to spread the word about clean renewable energy! In the process, you get a sparkling image of yourself out in your community as well. Follow these steps and make the news!

Step #1: Find media outlets to cover your event or project. Besides the well read area newspapers, try getting an article in the elementary, middle, high school and college papers. Also consider publicity on the local television and radio stations.

Step#2: Call your local media or check websites to find a contact person in education or local interest reporting. Be sure to get a full name, phone, and fax.

Step #3: Prepare yourself to speak directly to your contact person and tell them briefly about the Clean Green Power program, what you've done that is newsworthy, and what you want them to do (article, interview, visit event etc.). In addition, be prepared to send (usually by fax with a call to check that they got it) them a press release if they request it.

How to Write a Press Release:

a.Type it, and if possible, have your school or organization logo at the top with its name and address. This part is called the letterhead and it helps makes it look sharp and important.

b.Underneath, a heading in this format works well:

FOR IMMEDIATE RELEASE
April 5, 2006

CONTACT: Ms. Super Trooper
Work: (508)000-0000
Cell: (508)000-0000

c.Then put a title which describes your achievement or event:

LOCAL YOUTH BRING ENERGY EXPO
TO TOWN COMMON ON EARTH DAY

d. Then start with town and state in parentheses:

(Shutesbury, MA) –

e.Tell about your event as if you are the newspaper writer, saving the reporter all the work—answer Who? What? When? Where? Why?

Include a few quotes from yourself and others.

Name sponsors and volunteers.

Step #4 Follow Up !

Call the reporters who received your press release. Ask:

Do they have any questions?

Would they like a digital photo (if you can offer)?

Are they planning to come or write an article? When?

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CLEAN GREEN POWER**Appendix****Massachusetts Science, Technology and Engineering Curriculum Frameworks****Applicable Massachusetts Science, Technology and Engineering Frameworks:**

Many Massachusetts Science, Technology and Engineering Frameworks can be fulfilled by teaching the Clean Green Power unit. Furthermore, Skills of Inquiry for all grade levels under Inquiry and Experimentation are readily incorporated in the Clean Green Power program. Massachusetts curriculum frameworks from other areas of study can also be fulfilled due to the interdisciplinary nature of the program. Meeting a particular set of standards depends on choices and adaptations to the Clean Green Power program made by the individual educator.

Strand 1 Earth and Space Science**Grades PreK-2****The Sun as a Source of Light and Heat**

2. Recognize that the sun supplies heat and light to the earth and is necessary for life.

Grades 3-5**Weather**

2. Describe how global patterns such as the jet stream and water currents influence local weather in measurable terms such as temperature, wind direction and speed, and precipitation.

Grades 6-8**Heat Transfer in the Earth System**

1. Differentiate among radiation, conduction, and convection, the three mechanisms by which heat is transferred through the earth's system.

2. Explain the relationship among the energy provided by the sun, the global patterns of atmospheric movement, and the temperature difference among water, land and atmosphere.

Grades 9-10**2. The Earth's Sources of Energy**

Broad Concept: Numerous earth resources are used to sustain human affairs. The abundance and accessibility of these resources can influence their use.

2.1 Recognize, describe, and differentiate between renewable (e.g. solar, wind, water, biomass) and nonrenewable (e.g. fossil fuels, nuclear [Ura-235] sources of energy.

2.2 Explain the advantage and limitations of renewable sources of energy.

2.3 Explain the advantage and limitations of nonrenewable sources of energy.

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- 2.4 Describe the effects on the environment of using both renewable and nonrenewable sources of energy.
- 2.5 Describe the effect on the environment of using both renewable and nonrenewable sources of energy.
- 2.6 Describe ways in which scientists are addressing effects on the environment of using both renewable and nonrenewable sources of energy, e.g., creation of new technologies.

Strand 3 Physical Sciences (Chemistry and Physics)**Grades 3-5****Forms of Energy**

1. Identify the basic forms of energy (light, sound, heat, electrical, and magnetic). Recognize that energy is the ability to cause motion or create change.
2. Give examples of how energy can be transferred from one form to another.

Electrical Energy

3. Recognize that electricity in circuits requires a complete loop through which an electrical current can pass, and that electricity can produce light, heat, and sound.
4. Identify and classify objects that conduct electricity and objects and materials that are insulators of electricity.
5. Explain how electromagnets can be made, and give examples of how they can be used.

Magnetic Energy

6. Recognize that magnets have poles that repel and attract each other.
7. Identify and classify objects and materials that a magnet will not attract.

Light Energy

8. Recognize that light travels in a straight line until it strikes an object or travels from one medium to another, and that light can be reflected, refracted, and absorbed.

Grades 6-8**Forms of Energy**

1. Differentiate between potential and kinetic energy. Identify situations where kinetic energy is transformed into potential energy and vice versa.

Heat Energy

2. Recognize that heat is a form of energy and that temperature change results from adding or taking away heat from a system.
3. Explain the effect of heat on particle motion through a description of what happens to particles during a change in phase.
4. Give examples of how heat moves in predictable ways, moving from warmer objects to cooler ones until they reach equilibrium.

Grades 9-10**3. Heat and Heat Transfer**

Broad Concept: Heat is energy that is transferred between bodies that are at different temperatures by the processes of convection, conduction, and or radiation.

- 3.1 Relate thermal energy to molecular motion.
- 3.2 Differentiate between specific heat and heat capacity.

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3.3 Explain the relationship among temperature change in a substance for a given amount of heat transferred, the amount (mass) of the substance, and the specific heat of the substance.

3.4 Recognize that matter exists in four phases, and explain what happens during a phase change.

5. Electromagnetism

Broad Concept: Stationary and moving charge particles result in the phenomenon known as electricity and magnetism.

5.1 Recognize the characteristics of static charge, and explain how a static charge is generated.

5.2 Interpret and apply Coulomb's Law

5.3 Explain the difference in concept between electric forces and electric fields.

5.4 Develop a qualitative and quantitative understanding of current, voltage, resistance, and the connection between them.

5.5 Identify appropriate units of measurement for current, voltage, resistance, and explain how they are measured.

5.6 Analyze circuits (find the current at any point and the potential difference between any two points in the circuit) using Kirchoff's and Ohm's Laws.

6. Electromagnetic Radiation

Broad Concept: Oscillating electric or magnetic fields can generate electromagnetic waves over a wide spectrum of energies.

6.1 Describe the electromagnetic spectrum in terms of wavelength and energy, and be able to identify specific regions such as visible light.

6.2 Explain how various wavelengths in the electromagnetic spectrum have many useful applications such as radio, television, microwave appliances and cellular telephones.

6.3 Calculate the frequency and energy of an electromagnetic wave from the wavelength.

6.4 Recognize and explain the ways in which the direction of visible light can be changed.

Strand 4 Technology/Engineering

Grades preK-2

2. Engineering Design

Broad Concept: Engineering design requires creative thinking and consideration of a variety of ideas to solve practical problems.

2.1 Identify tools and simple machines used for a specific purpose, e.g., ramp, wheel, pulley, lever.

2.2 Describe how human beings use parts of the body as tools (e.g. teeth for cutting, hands for grasping and catching), and compare their use with the ways in which animals use those parts of their bodies.

Grades 3-5

2. Engineering Design

Broad Concept: Engineering design requires creative thinking and strategies to solve practical problems generated by needs and wants.

2.1 Identify a problem that reflects the need for shelter, storage, or convenience.

2.2 Describe different ways in which a problem can be represented, e.g. sketches, diagrams, graphic organizers, and lists.

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2.3 Identify relevant design features (e.g., size, shape, weight) for building a prototype of a solution to a given problem.

2.4 Compare natural systems with mechanical systems that are designed to serve similar purposes, e.g., a bird's wings as compared to an airplane's wings.

Grades 6-8

2. Engineering Design

Broad Concept: Engineering Design is an iterative process involving modeling and optimizing for developing technological solutions to problems within given constraints.

2.1 Identify and explain the steps of the engineering design process, i.e., identify the need or problem, research the problem, develop possible solutions, select the best possible solution(s), construct a prototype, test and evaluate, communicate the solution(s), and redesign

2.2 Demonstrate methods of representing solutions to a design problem, e.g. sketches, orthographic projections, multiview drawings.

2.3 Describe and explain the purpose of a given prototype.

2.4 Identify appropriate materials, tools, and machines needed to construct a prototype of a given engineering design.

2.5 Explain how such design features as size, shape, weight, function, and cost limitations would affect the construction of a given prototype.

2.6 Identify the five elements of a universal systems model: goal, inputs, processes, outputs, and feedback.

7. Bioengineering Technologies

Broad Concept: Bioengineering technologies explore the production of mechanical devices, products, biological substances, and organisms to improve health and/or contribute improvement to our daily lives.

7.1 Explain examples of adaptive or assistive devices, e.g. prosthetic devices, wheelchairs, eyeglasses, grab bars, hearing aids, lifts, braces.

7.2 Describe and explain adaptive and assistive bioengineered products, e.g. food, bio-fuels, irradiation, integrated pest management.

Grades 9-10

1. Engineering Design

Broad Concept: Engineering design involves practical problem solving, research, development, and invention and requires designing, drawing, building, testing and redesigning.

1.1 Identify and explain the steps of the engineering design process, i.e., identify the problem, research the problem, develop possible solutions, select the best possible solutions, select the best possible solution(s), and redesign.

1.2 Demonstrate knowledge of pictorial and multi-view drawings (e.g., orthographic projection, isometric, oblique, perspective using proper techniques.

1.3 Demonstrate the use of drafting techniques with paper and pencil or computer aided design (CAD) systems when available.

1.4 Apply scale and proportion to drawings, e.g., $\frac{1}{4}'' = 1'0''$

1.5 Interpret plans, diagrams, and working drawings in the construction of a prototype.

2. Construction Technologies

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Broad Concept: Various materials, processes, and systems are used to build structures.

2.1 Distinguish among tension, compression, shear, and torsion, and explain how they relate to the selection of materials in structures.

2.2 Identify and explain the purposes of common tools and measurement devices used in construction, e.g., spirit level, transit, framing square, plumb bob, spring scale, tape measure, strain gauge, venturi meter, pitot tube.

2.3 Describe how structures are constructed using a variety of processes and procedures, e.g., welds, bolts, and rivets are used to assemble metal framing materials.

2.4 Identify and explain the engineering properties of materials used in structures, e.g., elasticity, plasticity, thermal conductivity, and density.

2.5 Differentiate the factors that affect the design and building of structures, such as zoning laws, building codes, and professional standards.

2.6 Calculate quantitatively the resultant forces for live loads and dead loads.

3. Energy and Power Technologies-Fluid Systems

Broad Concept: Fluid systems are made up of liquids or gases and allow force to be transferred from one location to another. They also provide water, gas, and oil, and remove waste. They can be moving or stationary and have associated pressures and velocities.

3.1 Differentiate between open (e.g. irrigation, forced hot air system) and closed (e.g. forced hot water system, hydroponics) fluid systems and their components such as valves, controlling devices and metering devices.

3.2 Identify and explain sources of resistance (e.g., 45° elbow, 90° elbow, type of pipes, change in diameter) for water moving through a pipe.

3.3 Explain Bernoulli's Principle and its effect on practical applications, i.e., airfoil design, spoiler design, carburetor.

3.4 Differentiate between hydraulic and pneumatic systems and provide examples of appropriate applications of each as they relate to manufacturing and transportation systems.

3.5 Explain the relationship between velocity and cross-sectional areas in the movement of a fluid.

3.6 Solve problems related to hydrostatic pressure and depth in fluid systems.

4. Energy and Power Technologies- Thermal Systems

Broad Concept: Thermal systems involve transfer of energy through conduction, convection, and radiation, and are used to control the environment.

4.1 Differentiate among conduction, convection, and radiation in a thermal system, e.g., heating and cooling a house, cooking.

4.2 Give examples of how conduction, convection, and radiation are used in the selection of materials, e.g., home and thermostat designs, circuit breakers.

4.3 Identify the differences between open and closed thermal systems, e.g., humidity control systems, heating systems, cooling systems.

4.4 Explain how environmental conditions influence heating and cooling of buildings and automobiles.

4.5 Identify and explain the tools, controls, and properties of materials used in a thermal system, e.g., thermostats, R Values, thermal conductivity, temperature sensors.

LEARN EXPLORE ACT
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5. Energy and Power Technologies-Electrical Systems

Broad Concept: Electrical systems generate, transfer, and distribute electricity.

5.1 Describe the different instruments that can be used to measure voltage, e.g., voltmeter, multimeter.

5.2 Identify and explain the components of a circuit including a source, conductor, load and controllers (controllers are switches, relays, diodes, transistors, integrated circuits).

5.3 Explain the relationship between resistance, voltage and current (Ohm's Law).

5.4 Determine the voltages and currents in a series and a parallel circuit.

5.5 Explain how to measure voltage, resistance, and current in electrical systems.

5.6 Describe the differences between Alternating Current (AC) and Direct Current (DC).

Clean Energy Tidbit

Natural gas school buses emit 90% less toxic soot and 30% less smog forming pollution than new diesel school buses. At least 130 U.S. school districts in 19 states transport students in nearly 4000 alternative fuel buses. http://go.ucsusa.org/just_the_facts/112.html

Over a 70 year life-time of exposure, it is estimated that 125,000 people get cancer caused by our burning of diesel fuel. http://go.ucsusa.org/just_the_facts/106.html

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**Special Section for Girl Scouts
FREE CLEAN GREEN POWER PATCH**

Requirements Worksheet & Patch Order Form

Send or email this completed form & the evaluation form to Elizabeth Brooke-Willbanks at ebwillbanks@gswma.org or mail to Girl Scouts of Western Massachusetts, P.O. Box 558, 241 Haydenville Rd., Leeds, MA 01053

Pictures are welcome !

Name(s) of girls earning the patch : _____
Troop & Level: _____ Council: _____
Completion Date: _____

Please send _____ patch(es) to:

Name: _____
Full street address: _____
City or Town: _____ State: _____ Zip Code: _____
Phone(s): _____
Email: _____

How to Earn Your Patch:

In the Clean Green Power Patch, all Girl Scouts fully complete the requirements in each of the sections: Learn, Explore and Act. On these two sheets you record what you did, and have your troop leader or adult mentor initial each requirement to indicate that you have completed each requirement with excellent effort & high quality work.

Learn: What is clean green power ? Why change?

Find out why people are choosing clean energy.

- A.** All Girl Scouts read, "What Do We Mean, Clean Green Power?" for an introduction.
- B.** Complete the additional activity or activities required for your Girl Scout level. Circle which one(s) you did:
 - 1. "A Breath of Fresh Air" (Daisy & Brownie Girl Scouts)
 - 2. True and False Quiz (Brownie, Junior, & Teen GS)
 - 3. A Web Warm Up (Junior and Teen Girl Scouts)
- C.** Easy Energy Survey (Junior and Teen Girl Scouts)

Explore: Visit clean energy sites and conduct an interview

Learn how people living near you are taking action to keep our air, water and land clean. Choose a "clean energy site" and arrange a visit and develop an interview to carry out with someone who can tell you

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their story and show you how they conserve our valuable energy resources. Find people and places to visit in Massachusetts at our web site www.nesea.org/education/gscleanenergy/ or you can also locate your own. Your adult mentor, troop leader or parent must accompany you throughout the visit.

Name of Person Interviewed: _____

Type of Clean Energy Alternative: _____

Address of Site Visited: _____

____ **Act: Create a project** inspired by what you've learned, or based on a special area of interest. Many project ideas for each level can be found in the Clean Green Power Teacher's Guide.

Description of project: _____

Was it an individual or group project? What did you do?

____ **Act: Spread the good news about clean energy!** Share your project with others, get publicity, and get the word out about how we can all live in a cleaner, healthier environment. Check out the ideas for getting publicity in the patch program guide. Explain how you shared your project and got publicity:

Safety: Troop leaders, educators, parents and adult mentors must assume responsibility for children and youth in their care and use their own best judgment in each situation. Follow all Girl Scout guidelines for safety. No responsibility for safety is assumed by the Northeast Sustainable Energy Association.

Patches are **free** due to grant funding through the Massachusetts Technology Collaborative Renewable Energy Trust.

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CLEAN GREEN POWER PROGRAM EVALUATION

Please let us know how this program and resources worked for you and your group.

1. In what context did you use this teacher guide ?
Formal (classroom) or informal education
Grade or age of students: _____
2. What was your overall experience of the unit?
3. What was best about the web site, teacher's guide and program?
4. What suggestions would you have to improve the guide, web site, or program?
5. Other comments:

Thank you for taking the time to tell us about this program!

Optional:

Your Name:

Address:

City/Town:

Zip:

Email:

Send responses to:

Susan Reyes

Northeast Sustainable Energy Association

50 Miles St.

Greenfield, MA 01301

Or email to: sreyes@nesea.org

CLEAN GREEN POWER**Clean Energy Glossary**

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Clean Energy Glossary

There may be many new terms that both adults and students might encounter in their journey through this unit. Below you will find a short energy glossary in simple language. For more terms and additional definitions, you are encouraged to browse some of the glossaries on the internet that follows this section [\(Click here to jump to it\)](#). Sometimes you might have to explore a topic a bit deeper to get an understanding you are satisfied with. Keep asking questions, looking up information and helping each other learn!

A Short Energy Glossary:

Alternative Fuel: Alternative means not what is usually used, so for driving a vehicle like a car or truck, the usual (conventional) fuel is gasoline or diesel; examples of alternative fuels would be natural gas, biodiesel, propane, or many other possibilities.

You can get more information than imaginable at this adult-oriented site, the Alternative Fuels Data Center:

<http://www.eere.energy.gov/afdc/index.html>

Atmosphere: Layers of gases around the earth including the air we breath which is mostly nitrogen (78%), about 21 % oxygen, with the rest being small but very important amounts of other gases including water vapor, argon, carbon dioxide, neon, helium, methane, hydrogen, nitrous oxide and ozone.

Biodiesel: An alternative fuel from fat or vegetable oil that can be used directly or mixed with a conventional fuel like diesel in a diesel engine.

Climate: Moisture, temperature and weather averaged over a long time period in a particular region. Usually it is measured over a 30 year time period. Check out Columbia University's Climate Kids Corner for more information: <http://ocp.ldeo.columbia.edu/climatekidscorner/>

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Climate Change: Patterns of change observed in climate—may be used to describe natural changes over time or human caused changes such as global warming. The National Atmospheric and Oceanic Association has an educational site which provides an extensive resource on climate change and many other topics for students of all levels: <http://www.education.noaa.gov/students.html>

Electrical Circuit: An unbroken loop of material that electricity can flow through—like copper metal wires. If there is a break in the circuit, the electricity does not flow and cannot do work.

Electricity: A form of energy. We can use it for power when we get the electricity to flow (in the form of tiny parts of atoms called electrons) through wires in large numbers. Try this site for deeper exploration:

<http://science.howstuffworks.com/electricity.htm>

Electricity Generation: Electrical energy is produced in some different ways. Usually we need to get a machine spinning, because a spinning a magnetic field inside coils of copper wire creates current electricity. Moving water or steam is usually used to get the machine to spin, and to make that happen we usually burn fossil fuels, mostly coal, although sometimes the water is heated from splitting atoms (nuclear energy) and sometimes the moving water doesn't need to be heated because it has the power of falling from a height (hydropower).

Emissions: Gases, particles, and materials released or emitted into the environment.

Generate your own electricity by following activities at the Matsushita Electric Industrial Company's educational site for young people: <http://www.discovery.panasonic.co.jp/en/library/lib01elc/I01017.html>

A very different way of generating electricity is through solar power which involved photovoltaic cells which turn the energy of sunlight directly into electrical energy.

Energy: This can be a tough term to define—it is the ability to do work. It is not the same as power which is the rate or how fast work is done.

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Energy Conservation Strategies: Techniques for saving and avoiding wasteful and unnecessary use of energy. Saving energy prevents pollution, and keeps animals, people and plants healthier. Many people are surprised about how much money they can save, too!

Energy Star: If an appliance, like a refrigerator, says “Energy Star Appliance” it means it uses significantly less energy compared to other similar appliances. <http://www.energystar.gov/>

Fuel: Anything we burn or can burn to get energy, such as wood, gasoline, coal, heating oil, propane, natural gas, etc. Note that some fuels are cleaner when they burn than others.

Fossil Fuels: Natural fuels that took millions of years to form in the earth. They are rich in the elements carbon and hydrogen and come from the remains of ancient living things. Coal is a fossil fuel from the remains of plant life. Gasoline, natural gas, propane and others are fossil fuels from sea life of long ago. A friendly way to learn about fossil fuels with games, history, activities and more is found at U.S. Energy Information Administration, Energy Kids Page: <http://www.eia.doe.gov/kids/energyfacts/index.html>

Geothermal Energy: Heat energy from inside the earth. Alliant Energy has a clear explanation and pictures and is friendly for a wide range of ages. http://www.powerhousekids.com/stellent2/groups/public/documents/pub/phk_ee_re_001506.hcsp

Global Warming: There is strong evidence that by burning a lot of fossil fuels and letting the carbon dioxide get into the atmosphere, people are causing the atmosphere to warm up, mostly because of more carbon dioxide. Many problems could result: more, longer lasting and stronger hurricanes; melting ice caps and flooding coastlines and cities; changes in how wet or dry certain regions become; new movement of animals, plants and diseases around the world, and other concerns. The Environmental Protection Agency Global Warming Kids Page. Informative for all ages, with games, animations, and links. <http://www.epa.gov/globalwarming/kids/index.html>
U.S. Environmental Protection Agency--This is a central, though more advanced site to launch a global warming investigation from: <http://yosemite.epa.gov/oar/globalwarming.nsf/content/index.html>

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Greenhouse Gases: Any gas that traps a certain kind of radiation from the sun called infrared radiation that transforms to heat energy. Carbon dioxide, water vapor, methane, nitrous oxide and a number of other gases can do this. Humans have made great changes in how much carbon dioxide is in the atmosphere due to burning fossil fuels and cutting down lots of trees.

High Efficiency: Think about being efficient with your time. Are you highly efficient? In the energy context, the term means that something uses energy without wasting or losing much.

Hydrogen Fuel Cell: In a hydrogen fuel cell, hydrogen and oxygen get converted into water and electricity is produced which can then be used for power. More information can be found at and through the Hydrogen Energy Learning Program: <http://www.h2help.org/>

kWh: kilowatt hours

Check out your electric bill and it will show how many kWh you used each month for the last year, and you can even learn to read the figure off your own meter. The kilowatts tell the power or rate of the energy used and the hours tell how much time it was used. As a result, the kWh figure tells the electric energy you bought from the electric company.

Mercury: A poisonous metal that is released into the air when coal is burned among other things. It can build up in the bodies of living things over time. Too much mercury in the body causes brain and nerve damage, and developing babies and young children are most vulnerable, so that is why there are warnings for women who could have children not to eat or to limit eating of fish from Massachusetts waters. Good basic information for different ages:

<http://faculty.washington.edu/chudler/merc.html>

An adult site, but readable:

<http://www.epa.gov/waterscience/fishadvice/advice.html>

A Sierra Club activist's flier with information and references:

www.sierraclub.org/community/philadelphia/MercuryFactSheet.pdf

Nonrenewable: Once its used up, its gone. For example, coal, oil and gas are non-renewable energy sources. It may have taken nature 100 million years to make them and we cannot replace them once used.

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Nuclear Power: Splitting atoms heats water to move turbines and generate electricity. Teacher created web site with interesting interviews, activities and information:

<http://www.naschools.net/teachers/nuclear/nuclear.htm>

Ozone: An important gas which is GOOD for us up high in the atmosphere and BAD for us and the environment down low where we breathe and where it damages plants, especially food crops..

Up high, ozone shields us from harmful radiation. We have to be careful that we do not send up the kinds of pollution that break down the layer of ozone up high. Ozone is the major pollutant in smog, and it comes mostly from burning gasoline and other fossil fuels.

PV Cells-Stands for *photovoltaic* cells: A sandwich of special materials, mostly silicon, enables light energy from the sun to be transformed into electrical energy and transported with wired to do work in an electrical circuit.

Photovoltaic (PV) System:

A system designed with special materials which can produce electricity directly from light. A basic part of a PV system is a photovoltaic cell or solar panel. Get many of your questions about PV systems answered at <http://www.solarenergy.org/resources/olderkids.html#1>

Power: The rate at which work is accomplished-we measure it in watts or thousands of watts (kilowatts).

Renewable: Means it does not run out or be replenished in a short time. Examples include solar, wind, geothermal, hydropower, and biomass. Here are a few sites:

For kids, Alliance Energy a company that serves utility customers with natural gas and electricity, has basic simple information.

http://www.alliantenergykids.com/stellent2/groups/public/documents/pub/phk_ee_re_index.hcsp

The Energy Efficiency and Renewable Energy government site offers the exciting Dr. E's Energy Lab, with video clips, fact sheets, activities and more: <http://www.eere.energy.gov/kids/general.html>

For older elementary through adult, The Union of Concerned Scientists has very readable information in "Energy 101" as well as sound information on how biomass, solar, hydroelectric wind and geothermal work.

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http://www.ucsusa.org/clean_energy/renewable_energy_basics/energy-101-take-a-tour.html

Smog: A mixture of air pollutants, mostly ozone. You cannot see as far when there is smog, and even at low levels, it can harm some people, inflaming their lungs, and making breathing difficult. Try out this interactive site: <http://www.smogcity.com/welcome.htm>

Solar panels: Another term for photovoltaic (PV) cells. Can be thought of as a sandwich of special materials. When struck by sunlight, electrons in the substance in the middle get energized start to flow, making electricity.

To learn more technical details about how photovoltaic cells work, see <http://www.howstuffworks.com/solar-cell1.htm>

For inspiring profiles of interesting people involved in solar energy and a kid-friendly Q and A format, try Solar Energy International <http://www.solarenergy.org/resources/kids.html>

Strip Mining: Coal is often easily but dramatically mined from the surface by mountain top removal.

This site explains forms of surface mining and offers diagrams: <http://www.digistar.mb.ca/minsci/surf/strip.htm>

This Public Broadcasting Station site offers a short description of a film "Razing Appalachia" some pictures and an insight on the controversies around the method:

<http://www.pbs.org/independentlens/razingappalachia/mtop.html>

Sustainable: Usually when we say something is sustainable, like sustainable energy, we mean that it can be used for a long time, won't run out and won't cause major harm to the environment, animals and plants. Many people discuss the meaning of the term:

<http://www.davidsuzuki.org/WOL/Introduction.asp>

Technology: Anything people have made could be called technology, but usually people think of more advanced technology--taking scientific knowledge and applying it to a practical use, like creating photovoltaic cells or wind turbines.

Turbine: A machine that spins to generate power. Electricity can be generated if you spin magnets inside coils of wire. Michael Faraday was a scientist from the 1800s who figured out this important scientific idea which has been put to practical use ever since!

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Watt: A watt is a measure of power. In other words, the rate, or how fast how fast energy gets used. A 100 watt bulb can receive more energy per second than a 60 watt bulb and so it is brighter and hotter. A kilowatt (kW) means 1000 watts and a megawatt (MW) means a million (1,000,000) watts, and a gigawatt (GW) is a billion (1,000,000,000) watts.

Wind Energy: Moving air is wind and that can push blades that turn a turbine and generate electricity. Wind keeps coming back, so its renewable, you don't burn fossil fuels to generate the electricity, so its clean energy. The American Wind Energy Association offers a thorough tutorial for more in depth and advanced exploration
http://www.awea.org/faq/tutorial/wwt_basics.html

The Renewable Energy Research Laboratory Center for Energy Efficiency and Renewable Energy
http://www.ceere.org/rerl/about_wind/
offers a series of reliable fact sheets on wind energy –perfect for an depth study on wind. http://www.ceere.org/rerl/about_wind/

Clean Energy Tidbit

To generate the same amount of electricity as a single 1-MW wind turbine for 20 years would require burning 26,000 tons of coal (a line of 10-ton trucks 10 miles long) or 87,000 barrels of oil. To generate the same amount of electricity as today's U.S. wind turbine fleet (6,374 MW) would require burning 8.6 million tons of coal (a line of 10-ton trucks 4,321 miles long) or 28 million barrels of oil *each year*.
http://www.masstech.org/renewableenergy/Community_Wind/FAQ.htm

Bird deaths from wind turbines are small compared with other human structures. http://go.ucsusa.org/just_the_facts/42.html

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Energy Glossaries on the Internet:

Massachusetts Technology Collaborative's Energy Glossary
Each term is accompanied by an explanation.

<http://www.mtpc.org/cleanenergy/energy/glossary.htm>

U.S. Environmental Protection Agency's Clean Energy Glossary
Aimed at adults; more details; fewer entries than DOE Glossary

<http://www.epa.gov/cleanenergy/glossary.htm>

U.S. Department of Energy, Energy Information Administration,
Though found on the Energy Kids Page, this glossary uses many terms
that could be challenging for kids to understand.

<http://www.eia.doe.gov/kids/glossary/index.html>

U.S. Environmental Protection Agency's Clean Energy Glossary
Aimed at adults; more details; fewer entries than DOE Glossary

<http://www.epa.gov/cleanenergy/glossary.htm>

Additional Helpful Websites:

Here are a handful of sites especially selected for adult mentors. They
offer various offer resources and curriculum materials to select from.

1. Alliance to Save Energy

Students Leading the Way 2004-2005

Energy Saving Success Stories From California

This guide offers dozens of clean energy action projects classes have
carried out and provides a gold mine of ideas for projects.

<http://www.ase.org/images/lib/educators/Success%20Book%2005.pdf>

2. DSIRE

This is a database of state incentives for renewable energy (rebates for
solar energy, etc)—included here since adults you meet everywhere
are sure to get excited about clean green power when you tell them
what a difference it makes.

<http://www.dsireusa.org/>

2. The Massachusetts Technology Collaborative

The Guide to Teaching Renewable Energy

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Here is an educator's perfect one-stop guide to activities and resources related to renewable energy and global warming. Over 120 materials are described and assessed by educators.

<http://masstech.org/cleanenergy/curriculum/about.htm>

3. Northeast Sustainable Energy Association

www.nesea.org/education/

Browse around our site for activities to download for your projects and activities, and this is where you will find the Clean Energy for a Clean Environment web page, sites to visit in Massachusetts, and more.

4. U.S. Department of Energy

Energy Efficiency and Renewable Energy

An important gateway web site for many clean energy sites! On the home page you can go straight to links for Kids, Consumers, Education, specific areas of renewable energy and more.

<http://www.eere.energy.gov/>

5. Here's an organized selection of energy links for educational purposes: <http://www.kathimitchell.com/energy.htm>

6. An interesting discussion on the meaning of "green" at this commercial site:

http://www.ecodepotinc.com/?What_Does_Green_Mean%3F

Clean Energy Tidbit

"Coal generates 54% of our electricity, and is the single biggest air polluter in the U.S." The Union of Concerned Scientists offers you a comparison of coal vs wind as energy sources.

http://www.ucsusa.org/clean_energy/coalvswind/c01.html

For more interesting tidbits of clean energy information, you can choose the topic areas such as Clean Energy, Air Pollution, Renewable Energy, etc. at the Union for Concerned Scientists' web site:

http://go.ucsusa.org/just_the_facts/index.html

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Contacts

Clean Green Power Program Contacts:

For questions and feedback about the teacher’s guide, Girl Scout patch programs, web sites, site destinations, and clean, renewable energy:

Susan Reyes 413-774-6051 x27 sreyes@nesea.org or
Arianna Alexandra Collins 413-774-6051 x21 acollins@nesea.org

www.nesea.org/education/
Northeast Sustainable Energy Association
50 Miles St. Greenfield, MA 01301

For questions about Girl Scouting, and to receive patches earned:

Elizabeth Brooke-Willbanks 413-584-2602 x11
ebwillbanks@gswma.org
Girl Scouts of Central & Western Massachusetts
P.O. Box 558, 241 Haydenville Rd. Leeds, MA 01053

The Girl Scout patch program can be found at the Girl Scouts Clean Energy for a Clean Environment Web Site:
www.nesea.org/education/gscleanenergy/

Clean Energy Tidbit

One of the unique features of Massachusetts is its diversity of clean energy resources. The state boasts an abundant bio-energy stock, excellent wind potential in a number of areas, existing hydropower facilities and infrastructure, and sufficient solar energy for widespread solar photovoltaic installations. The actual amount of clean energy that could be developed in the state is far greater than what is currently being utilized. For more information, check out:

<http://www.masstech.org/cleanenergy/massenvironment/potential.htm>

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