2010 Teacher's Guide: Energy

Written for the National Student/Parent Mock Election

www.nationalmockelection.org

2010 Elections -- Teacher's Guide to Energy Issues

Introduction:

A simple definition of energy is "the power to do work." Whether that work is done by muscle power or machinery, it requires either some form of fuel, or a direct energy source such as sunlight. As human civilization has developed, so have our uses and sources of energy. Today, most of us today are not hunter-gatherers, and most horses in the U.S. are no longer used to provide horsepower. We are dependent on fossil fuels, with hotly contested consequences. We hope to change that in the future; but there is no consensus on how.

This guide does not attempt to duplicate lesson plans about energy found elsewhere; see the section on sources of further information for examples of those. Instead, it is a guide to the political side of energy-related issues, and the choices to be made. Energy *per se* is apolitical, and every living thing must use it. The choices noted in this guide are therefore about how we should acquire and use energy; not the scientific or technical aspects of particular forms of energy.

The first section of this guide is an outline of some choices and consequences related to energy conservation and other energy issues; each subcategory can bring up new questions not listed. None of these have "right answers" or simple solutions, but are topics for further student research, discussion, etc.

Section 2 of this guide uses one form of energy generation, concentrated solar thermal power, in a hypothetical example of a power plant proposal. Students can develop greater understanding of the political consequences of energy-related choices through a variety of suggested classroom activities.

Section 1 -- Election issues:

Recent events like the Gulf Oil Spill, and 2010 as the hottest year on record so far, have made our energy choices important election fodder. There are two basic approaches to energy issues: produce more, and/or use less. There is little agreement on how to do this. Use the following activities and issues to understand our choices.

This guide was made possible by Tucson Electric Power/UniSource Energy Services

Assume the role of a newly appointed energy advisor to the President*. You believe that everyone has heard about conserving energy – turn off the lights, use less gasoline, etc. However, much of what you have heard you believe is not accurate, or doesn't work as well as alternatives.

In addition, simply telling people to conserve energy, in your view, can be counterproductive; many people don't like to be told what to do, and will do the opposite. Others think that conserving energy means having to live a more primitive lifestyle. You are very concerned that energy policy changes are being dictated by politics, not science. You believe the nation needs an energy education campaign so that people – including legislators – will not simply vote for what they currently believe, or what is familiar and popular, but for what represents the best available technology to save not only energy but money.

You are wondering whether, in addition to an education campaign, energy conservation ought to be mandatory. Appoint a task force to help you decide who should do what. Break the task force up into sub-committees to investigate each possibility.

*To the Teacher: The advisor can be an appointed or elected student or the teacher.

Alternatively, the teacher can role-play the President asking questions of his advisor and energy team.

Some of the easy methods of conserving energy have been done in the U.S. – switching to LED traffic lights, for example. And while people may think they are saving energy by turning off lights when they are not using them, the effect may perhaps be minimal compared to other actions. In order to decide how best to conserve energy, your task force needs to explore what methods work and don't work, and then design a plan for how to get people to use them.

Read the following article titled "Survey Shows Many are Clueless on How to Save Energy" at: http://www.earth.columbia.edu/articles/view/2717

Can you write a piece that disagrees with the author?

How do we get people to change their behavior? The article cites ineffective beliefs in "curtailment" of existing behaviors rather than changing to new ones. But is promoting behavior change good politics? Will people vote for candidates who tell them they are doing it all wrong?

Ask your task force to survey a variety of classes, schools, parents, teachers, etc. What have they done to conserve energy? What do they believe are the best methods? Do they support or oppose government-mandated conservation programs such as requiring the manufacturing of efficient automobiles or appliances? Do they support or oppose tax incentives for energy conservation? If they support tax breaks, how should they benefit both businesses and individuals? For example, if a utility gets its customers to save energy, should the utility as well as the customers benefit?

Ask members of your task force to research what other countries have done to promote or require energy conservation. For example, the European Union has banned general-purpose incandescent light bulbs. How does this compare with the U.S.? See http://en.wikipedia.org/wiki/Energy_Independence_and_Security_Act_of_2007_-Provision_of_final_version

Mexico City bans cars from driving on certain days according to their license plate numbers, but people who can afford two or more cards can drive any day. Is there a better system? Central London has a "congestion charge" for vehicles. How does reducing congestion save energy? Would it work in U.S. cities? Would voters support candidates who favor it?

Taxes in much of Europe make gasoline more than twice as expensive as in the U.S. What do different countries do with that tax money? Does it encourage fuel-efficiency, use of public transit or carpooling, bicycling, less travel, etc.? Would it work in areas of the U.S. with limited public transportation and long-distance commutes?

Do electric or hybrid vehicles save enough energy to justify their additional cost? What are the consequences of generating the electricity to charge them? Should they get special privileges like the use of carpool lanes? Should we judge how much energy vehicles conserve based only on their fuel economy, or do we need toe examine the entire production and disposal process? How do we measure the energy cost of each of thousands of parts from all over the world?

Electricity that is not generated on site needs to be transported over power lines, which lose energy to factors like friction and coronal discharge. See: http://en.wikipedia.org/wiki/Electric_power_transmission

High-voltage power lines are more efficient than lower voltage lines, but also require higher pylons or poles, bigger rights-of-way, etc. What are the tradeoffs involved --esthetic, economic, environmental, etc.?

There are many ways to generate electricity for on-site use, including using solar, wind, or water power, cogeneration, etc. Most of these are not yet cost-efficient for small consumers like single-family homes. In addition, there are both economic and energy costs to produce, install, and maintain the equipment. Should the government subsidize such systems or provide tax incentives? As with any other energy conservation measures, there are tradeoffs: Who pays? Who wins? Who loses? Who decides?

Public transportation can save considerable energy, but outside of U.S. cities it can be very limited, and Americans are much less likely to use it than Europeans. Public transportation anywhere in the world is often not profitable and requires large government subsidies. Who pays? Who wins? Who loses? Who decides?

How willing are those your task force interviews to change their transportation habits by walking, bicycling, carpooling, using public transportation, or traveling less? Would students be willing to walk or bicycle a mile to school? Is this practical in hot or cold weather? What other factors affect your decisions?

Ask your task force to research the comparative economic and environmental costs of producing energy from various fuels – oil, coal, natural gas, liquefied natural gas, uranium, sunlight, etc. Is there any method of producing energy that does not have negative impacts? How do we choose which costs we will pay for which benefits? What are the positions of the various parties and candidates on each of these fuels? Can you find out on the internet? If not, ask them.

Find out what we are doing now to conserve energy that is not working well. Here are two reports to start off with:

http://www.voxeu.org/index.php?q=node/5064
Energy conservation "nudges"….

http://www.aceee.org/press/2010/06/aceee-study-finds-smart-meters-not-smart-enough-slash-re
ACEEE Study Finds 'Smart Meters' Not Smart Enough to Slash Residential Power Use and Significantly Reduce Consumer Electric Bills

Are there better ideas for conserving energy your task force can suggest? Would it be proactive for the government to distribute refrigerator magnets to every household in the country with energy saving tips? (See the examples below from Tucson Electric Power)

Energy Conservation Tips:

- Set your thermostat no lower than 78º (for cooling) and no higher than 68º (for heating). About half of household energy goes to heating and cooling. Varying your thermostat by as little as 1º can reduce your energy bill by 1-3%.

- For fast energy savings consider more efficient lighting alternatives. Compact fluorescent lights (CFLs) with an Energy Star label use about 75% less energy than standard incandescent bulbs, last up to 10 times longer, and generate much less heat.

- Turn off lights. A typical incandescent light bulb left on for 24 hours per day will cost you about $75.00 each year.

- Turn off and/or unplug electrical appliances when not in use. Hold the plug, not the cord, when unplugging.

- Apply weather stripping and caulking around doors and windows to maintain comfortable indoor temperatures in both summer and winter.

- If your house seems too cool in the winter, consider putting on a sweater instead of turning up the thermostat.

- Invest in a timer. Timers that automatically turn lights on and off can reduce your energy use and at the same time increase safety by making your house seem occupied even when people are away.

- Plant deciduous trees on the south and west sides of your house to provide shade in the summer and let in light in the winter.

- For forced-air heating and cooling systems, change your air filter regularly. This provides greater efficiency and delivers cleaner air.

- Reduce the cost of heating water by insulating your water heater. See: http://www.energysavers.gov/your_home/water_heating/index.cfm/mytopic=13070

- Go to http://www.tep.com/Green/EnergyTips/HomeEnergyTips.asp for more home energy conservation tips

Is global climate change the elephant in the room? If so, how soon do we have to act to minimize it through energy conservation and how? What should the government role be in energy conservation? What is Congress doing now? Again, what are the positions of the various parties and candidates? See:

http://www.aceee.org/blog/2010/09/legislative-clock-running-out-federal-energy-policy
The Legislative Clock is Running out on Federal Energy Policy

More Issues:

Consider the following issues in terms of how they will affect families, communities, the country and the planet. Which ones are being addressed by the candidates? Which are not getting the attention you believe they must receive?

I) What should be the government role in energy policy?

a) Let the market decide; or regulate sources, uses, and consequences like pollution?

1) Should any regulation be via controls, taxes, incentives, etc?
2) What government agencies are or should be in charge of regulation? What responsibilities should be federal, state, or local?
3) In the future, what should be the percentages of renewable vs. nonrenewable sources? How do we achieve our goals?
4) How should government policy support various power supply options: fossil fuels, clean coal, fuel cells, solar, wind, hydropower, geothermal, nuclear, fusion, tidal, biofuels, artificial photosynthesis, hydrogen, etc.?
5) When, where, and how should increased energy production and/or conservation be a government responsibility or mandate?

II) When determining the costs and benefits of particular forms of energy, what should be included?

a) In addition to the costs of materials, labor, etc. should we include environmental or social costs?

1) How broadly do you try to measure such costs? For example, do you try to include the consequences of producing every piece of equipment in a power plant or oil rig, including factors like the energy use of workers commuting to the manufacturers, or the resulting traffic congestion and aggravation?

b) When calculating benefits, do you include secondary or more distant benefits, such as government educational aid paid by taxes on energy production or facilities?

III) What are the consequences of using various energy sources: pollution, effects on development and business growth, etc.?

a) What are the effects of mitigating those consequences? Who pays? What new consequences are created?

1) What are the costs of upgrading oil refineries, power plants, etc. to the "best available technology" for less pollution and more efficiency?
2) Which costs should be borne by taxpayers vs. ratepayers vs. stockholders?
3) Should resource cost allocations be local, regional, national, etc? For example, should areas like the Midwest that rely on cheap coal for electricity pay for the damage it does downwind? Should areas with access to cheap hydropower be forced to subsidize other areas that must rely on more expensive power sources?
4) When should consumers be required to cut energy use to control costs, environmental effects, etc.?

IV) How should we overcome energy shortages or inadequate infrastructure such as insufficient power lines, pipelines, or radioactive waste containment?

a) How should we determine the routes of new rights-of-way for new infrastructure?

1) If a power line or pipeline has to be routed through either a park or housing, how should the choice be made?
2) Rights-of-way can be taken by eminent domain. How is the value of the property determined? What is the economic value of a rare species or habitat or a scenic vista?

b) If we build more nuclear power plants, what do we do with the radioactive waste?
c) If we import energy, how do we avoid creating problems at the source?

V) How do we plan for the future?

a) What are the options for going "off the grid" such as solar, cogeneration, fuel cells, small hydropower, etc.?

b) What alternative sources of fossil fuels are becoming economically viable, such as shale oil and gas, and what are the consequences?

c) Can we count on energy conservation if we to change current practice? If so, what steps must we follow?

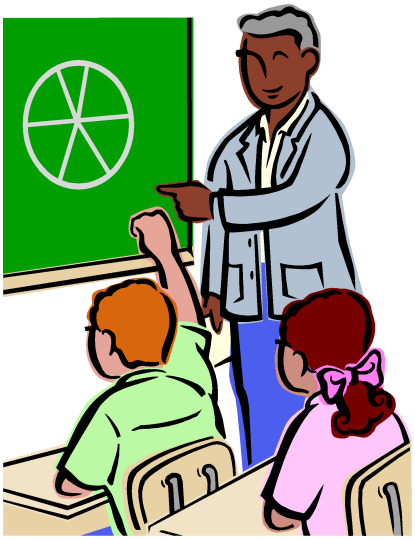
d) What are the security and foreign relations issues related to our dependency on energy sources in other countries, even friendly ones like Canada and Mexico? How will our foreign policy change as our energy usage changes?

e) What are the consequences to us of other countries like China increasing their energy usage and resulting pollution?

Put together a report for the President listing all of your task force's recommendations and the research that backs them.

Do you believe your work is good enough to share with President Obama?

Send it to the White House!



Section 2

The following is a hypothetical scenario of a proposal for a new power plant, which can be used as a basis for a variety of classroom activities such as debates, essays, further research, etc. -- see the suggestions after the proposal description. The overriding questions to consider is will the benefits outweigh the increase in cost? Might learning how to conserve the forms of energy available to us now be more cost effective than trying to develop new sources of energy? Why? Why not?

Project Synopsis:

Monolithic Energy Inc. is proposing to build a 300 megawatt solar power plant on federally owned land in the Narnian Desert in the state of New Calizona. This would provide enough electricity for over 100.000 homes, and would be wholesaled to power companies throughout the region.

The proposed plant would use a technology called concentrated solar thermal power, which uses tens

of thousands of mirrors to concentrate sunlight on large towers in order to produce steam to run generators. The plant would require over 3000 acres (about 5 square miles) plus access roads and power lines to the facility.

The land would be leased from the U.S. Government, which along with the states would collect taxes on the profits and infrastructure. Most of the financing would be from commercial banks, but government grants, loan guarantees, and tax breaks would also be part of a complex arrangement.

The desert is home to a wide variety of fauna and fauna, some of which is endangered and threatened. In addition, there are known archaeological sites in the area, and the desert soils are subject to wind and water erosion if disturbed. The power towers will be over 400 feet (40 stories) high, visible for many miles in a flat landscape, and will have to have flashing warning lights to alert aircraft. The high-voltage power lines will also alter the landscape.

While the plant itself would avoid producing hundreds of thousands of tons of annual carbon dioxide emissions from comparable fossil fuel power generation, the materials used in its construction require significant fossil fuel power to produce.

In order for this project to be approved, a series of government agencies must examine the proposal, hold public hearings, issue reports, consider comments on those reports, and issue rulings that may be challenged in court. It is neither a simple nor a quick process. Factors to be considered include the economic and social justification of the project, alternatives, environmental impacts and mitigation, land use conflicts, water supplies and quality, competing interests, and compliance with various laws and regulations.

For information on actual concentrated solar thermal power projects, see:

http://en.wikipedia.org/wiki/Solar_power_plants_in_the_Mojave_Desert
http://www.mercurynews.com/bay-area-news/ci_15675800?source=rss&nclick_check=1
http://www.energy.ca.gov/sitingcases/ivanpah/documents/

Suggested Classroom Activities:

These activities are geared toward Problem Based Learning, which uses practical open-ended problems without "right" answers. For more information and links, see:

http://en.wikipedia.org/wiki/Problem-based_learning
http://www.educationatlas.com/problem-based-learning.html

1) Hold a mock congressional debate about whether or not the federal government should subsidize

solar energy development as opposed to wind power, oil exploration, etc. Ask members of the class to take positions representing various stakeholders, and then give opposing sides an opportunity to try to persuade their opponents or those who take a middle position to join them in a compromise position.

2) Organize a mock town meeting or panel discussion among the citizens of Midlanoware, a town about to be impacted by the construction of a large power plant. What will it mean in terms of jobs, business, noise, traffic, rents, lifestyles, local services and taxes, etc.?

3) Organize a mock court hearing on taking a dozen homes by eminent domain to make way for a new power line. Have students represent homeowners, lawyers, company executives, state officials, expert witnesses, etc. Invite local lawyers to explain the process and typical conflicts in such cases.

4) Research different technological implementations of concentrated solar thermal power on the internet or in your local library. Divide the class into committees that share their reports on various designs.

5) Research what is/is not being done in your state or area to encourage the use of solar energy. Where and how is it most effectively used -- in large power plants or individual buildings; for electricity or heat; in urban or rural areas, etc?

6) Write to your state's elected officials asking about their positions on large solar power plants. Do the answers address specific effects and consequences, or are they just political posturing? Don't expect many politicians to oppose solar power, but pay attention to how they qualify their answers, and why.

7) Examine the economics of solar power generation now and in the future. What is the difference between base and peak power generation, and how can solar power best be used? How is it best stored for use when needed or at night? How much does it cost to build new transmission lines to bring power from where it is generated to where it is used? What are the secondary economic effects of power lines such as impacts on property values or development?

8) Discuss the roles you believe the federal, state, and local governments should play in regulating the production, distribution, and sale of electricity. Should everyone pay the same rates, or should large users get quantity discounts? Should homes with energy conserving features get lower rates, or is that unfair to those who cannot afford new appliances, lighting, etc.?

9) Have students write an essay or editorial concerning the tradeoffs required to use more solar power.

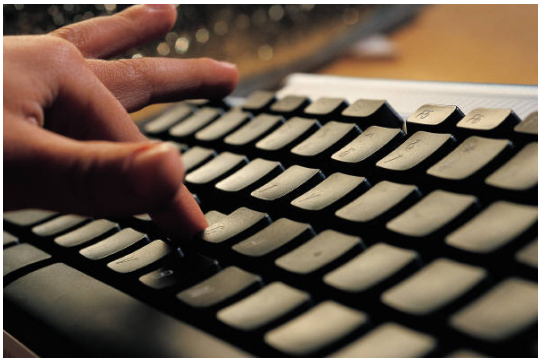
10) Collect news articles/video clips concerning solar energy and determine if they are biased toward particular viewpoints.

11) Map the source of the energy resources you use now. What percentage is from solar power?

12) Build a model solar power concentrator that can cook a hot dog. Google "solar hot dog cooker" for more information.

13) Measure the output of a small solar voltaic or water heating panel under various weather conditions and orientations. Calculate whether a larger system would be cost-effective in your area, and how many years it would take to pay back the initial investment. Are you better off economically generating your own solar power and/or heat, or buying it from a large producer?

14) Ask your local power company to send a representative to explain their solar energy programs. Ask representatives of local environmental organizations to explain their support or opposition to these programs and proposals. Ask representatives of local businesses what the impacts would be if they had to pay more for solar power than that generated from fossil fuels. What would be the benefits that might offset the increased costs?



Section 3 -- Sources of further information

Republican energy policy: http://www.gop.gov/energy

Democratic energy policy: http://www.democrats.org/a/national/clean_environment/energy/

Green Party energy policy: http://www.gp.org/press/pr-national.php?ID=86 and http://www.gp.org/

Energy Kids -- U.S. Energy Information Administration: http://tonto.eia.doe.gov/kids/index.cfm

Energy and science resource links from the California Energy Commission:
http://www.energyquest.ca.gov/teachers_resources/lesson_plans.html

Renewable energy information from the Texas State Energy Conservation Office:
http://www.infinitepower.org/lessonplans.htm

American Council for an Energy-Efficient Economy
http://www.aceee.org/

Plan B 4.0: Mobilizing to Save Civilization -- Lester R. Brown
http://www.earth-policy.org/index.php?/books/pb4

Al Gore's Energy Use
http://www.snopes.com/politics/business/gorehome.asp

Energy Efficient World
http://www.midamericanenergy.com/eew/index.html

Energy efficiency information
http://www.midamericanenergy.com/eew/efficiently/index.html

LESSON PLANS:

Do Something about... the Environment 10-Day Unit
http://www.lessonplanspage.com/ScienceSSLAODoSomethingAboutTheEnvironmentUnitDay1Introductions712.htm

Teacher's Guide From Energy Efficient World
http://www.midamericanenergy.com/eew/teachers/index.html

U.S. Dept. of Energy Energy Efficiency & Renewable Energy lesson plans:
http://www1.eere.energy.gov/education/lessonplans/

Solar power lesson plans:
http://www.powernaturally.org/Programs/SchoolPowerNaturally/InTheClassroom/default.asp?i=9

Free renewable energy lesson plans: http://www.lessonplansdirectory.com/renewable_energy/

The Alliance to Save Energy lesson plans: http://ase.org/section/_audience/educators/lessons

National Geographic Xpeditions lesson plans:
http://www.nationalgeographic.com/xpeditions/lessons/16/g912/energydebate.html

Society of Petroleum Engineers "Essential Energy Education": http://www.energy4me.org/

Tucson Electric Power Company classroom materials:
http://www.tep.com/Community/EducationalServices/ClassroomMaterials.asp

Tucson Electric Power Company Green Energy:
http://www.tep.com/Green/