Questions & Resources for Teams
2007 Massachusetts Envirothon Current Issue

Energy Conservation and Renewable Energy for Massachusetts Communities

In our lifetime, energy will become an increasingly critical issue. Worldwide oil production is peaking, but demand for oil is still growing. Carbon emissions from burning fossil fuels, a major contributor to climate change, are still increasing. Renewable energy sources are being developed, but to wean ourselves from fossil fuels we will have to make do with much less energy than we use today.

For this year's Envirothon Current Issue, your team will develop an energy plan for your community that proposes large reductions in fossil fuel use, made possible through new renewable energy generation and changes in the ways we use energy.

Big changes will be required. In your presentation next May, your team will be expected to demonstrate that you understand the extent of the changes that will be needed. So, as part of your preparation you will need to *find and crunch some real numbers* related to the amount of energy used in your community. And in your presentation you will need to *describe what life will be like in your community* if your plan is implemented.

If your team does a thorough job in your research on the Current Issue, you can qualify for the Mass Envirothon Community Research Award. If you take what you learn from this research and apply it in service to your community, you can qualify for the Mass Envirothon Community Service Award.

There are three parts to this guide:

This document is an outline of topics and issues and questions to pursue. In some cases, we recommend specific web sites. In other cases, we use <brackets> to suggest useful search terms. In all cases, we recommend careful use of the Internet. See Tips for Using the Web as an Information Source at http://www.maenvirothon.org/currentissuetips06.htm

This guide was prepared by Will Snyder, UMass Extension, with help from Marybeth Campbell, Massachusetts Technology Collaborative, and others. Your questions are welcome, as are your suggestions for other resources that will be helpful to Mass Envirothon teams. Contact Will Snyder at 413/545-3876 or wsnyder@umext.umass.edu.

I. BACKGROUND ON THE ENERGY ISSUE

A. Why is energy a critical issue?

Cheap and plentiful energy has shaped American society for more than a century. The global economy that has developed in recent decades is also dependent on cheap energy.

Most of this energy has come from fossil fuels -- energy from the sun that was stored in the form of oil, coal, and natural gas millions of years ago. Oil has been the most easily accessed and most useable form of fossil fuel.

This era of cheap energy will draw to a close within our lifetimes. In the 21st century, two emerging issues will compel us to change the amounts and kinds of energy we use: *scarcity* and *climate change*.

1. Scarcity

Long before oil resources "run out" they will become more scarce and more expensive. For over a century, supply and demand have been kept in rough balance by the continuing discovery of new oil fields. The premise of <peak oil> theory is that this balance will change in coming decades: fewer new oil fields will be coming on line at the same time that demand keeps rising. The result will be scarcity and a dramatic price rise, even though we have essentially only consumed half of the world's oil resources.

See links from the web page of Princeton University geology professor Ken Deffeyes, including the Association for the Study of Peak Oil at http://www.princeton.edu/hubbert/links.html. See also the Post Carbon Institute at: http://www.postcarbon.org/ .

What will life be like after cheap oil? Many people do not realize how much of modern life depends on abundant fossil fuels. Authors such as <James Howard Kunstler> (*The Long Emergency*, 2005) and <Richard Heinberg> (*Powerdown*, 2005) paint a sobering picture and urge action now to ease the transition to a <postcarbon> society:

Heinberg: *For many years I've been interested in trying to understand what makes humans societies change over time. . . . From hunting and gathering to agriculture, to industrialism, the main factor that has changed, really, is the amount of energy harvested from the environment per capita. . . . In the U.S., for example, in 1850 something like 65% of all the work that got done in the economy was done by animal and muscle-power. Something like 15% of the work done in the economy was through human muscle-power. By 1970 the amount of work done in the U.S. economy by animal and muscle-power had reduced to virtually zero and everything was being done by fuels. Meanwhile, the total amount of work done in society per capita had increased dramatically. We're at the point now where if all of the work done for us as average Americans each day by fuel-fed machines had to be done by humans, using the equivalent human muscle power, each of us would have something like 150 energy slaves taking care of our every need, getting us to where we want to go, cleaning our clothes, and doing all the other things that machines do for us. . . . I think we're just about to wake up to the awful truth that in fact fossil energy resources are limited and that's going to have a terrible impact on our economies.*
(http://www.mnforsustain.org/oil_heinberg_puplava_interview_032203.htm)

Kunstler: *Most of all, the Long Emergency will require us to make other arrangements for the way we live in the United States. America is in a special predicament due to a set of unfortunate choices we made as a society in the twentieth century. . . . Suburbia will come to be regarded as the greatest misallocation of resources in the history of the world. . . . The circumstances of the Long Emergency will require us to*

downscale and re-scale virtually everything we do and how we do it, from the kind of communities we physically inhabit to the way we grow our food to the way we work and trade the products of our work. Our lives will become profoundly and intensely local. Daily life will be far less about mobility and much more about staying where you are. Anything organized on the large scale, whether it is government or a corporate business enterprise such as Wal-Mart, will wither as the cheap energy props that support bigness fall away. . . . Food production is going to be an enormous problem in the Long Emergency. . . . The American economy of the mid-twenty-first century may actually center on agriculture, not information, not high tech, not "services" like real estate sales or hawking cheeseburgers to tourists. Farming. (http://www.rollingstone.com/politics/story/7203633/the_long_emergency)

2. Climate Change

The scientific community tells us that carbon emissions from human activity are a key factor in climate change. Recent science suggests that climate changes are happening more rapidly than expected. The United States, with 6% of the world's population, is responsible for more than 25% of the carbon emissions each year. The world community, including national and local governments, civil society, and business, is beginning to respond.

For background and links on the climate issue, see the Pew Center on Global Climate Change at http://www.pewclimate.org/ . To see the work of the climate scientists directly, see the Intergovernmental Panel on Climate Change at http://www.ipcc.ch. For a review of the climate issue in Massachusetts communities, see last year's Mass Envirothon Current Issue guide at http://www.maenvirothon.org/currentissue06.htm.

How much must we reduce carbon emissions to stem climate change? Estimates vary, but all estimates involve dramatic reductions. The U.S. Public Interest Research Group (USPIRG) reported in August 2006 that to avoid the worst consequences of global warming, the United States and other industrialized countries will have to stabilize emissions within the next decade and reduce them by about 80% by midcentury (http://uspirg.org/uspirg.asp?id2=26147).

Is this possible? Many plans have been put forward to make these changes. Two examples:

USPIRG has released *Rising to the Challenge: Six Steps to Cut Global Warming Pollution in the United States* (2006). See http://uspirg.org/uspirgnewsroom.asp?id2=26147#1.

The Pew Center on Global Climate Change has released *Agenda for Climate Action* (2006). See http://www.pewclimate.org/global-warming-in-depth/all_reports/agenda_for_climate_action/index.cfm

For years, political leaders have voiced concern that actions to reduce carbon emissions would hurt the economy. Now there are indications that a new consensus is emerging. From the British government's (2006) <Stern Review on the Economics of Climate Change>: "*The world does not have to choose between averting climate change and promoting growth and development. . . . Indeed, ignoring climate change will eventually damage economic growth. Emissions can be cut through increased energy efficiency, changes in demand, and through adoption of clean power, heat, and transport technologies. . . . With strong, deliberate policy choices, it is possible to reduce emissions in both developed and developing economies on the scale necessary for stabilisation in the required range while continuing to grow*." See http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm

3. Solutions: Technology and Willpower

Solutions proposed for the problems of oil scarcity and climate change are remarkably similar. Both focus primarily on reducing our use of fossil fuels.

There is no single new energy source that can replace our dependence on fossil fuels. Addressing the problem will require many small, diverse, local solutions. They will involve both high and low technology, both reduction in demand and energy from new sources. Solutions call for action -- change, and some pain -- by all of us.

Is it possible for us to make the necessary changes? Some examples -- from far and near -- that communities and nations can achieve the political will to take action:

> In February 2006, the northern European nation of Sweden, at the same latitude as Alaska, announced that it will attempt to wean itself off oil completely by 2020, without building a new generation of nuclear power stations. The intention, according to *The Guardian* newspaper (2/8/2006) "is to replace all fossil fuels with renewables before climate change destroys economies and growing oil scarcity leads to huge new price rises. 'Our dependency on oil should be broken by 2020,' said Mona Sahlin, minister of sustainable development" http://www.sweden.gov.se/sb/d/2031/a/67096
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> In March 2005, Worcester became the first city in Massachusetts to set a goal of using renewable energy sources to meet 20% of its municipal electricity needs by 2010. The "'20 Percent by 2010 Clean Energy Resolution'calls for greater use of electricity generated from clean sources of power, such as wind, water and the sun, instead of electricity generated from coal, oil, natural gas and nuclear power." (http://www.mipandl.org/pdfs/T&G.Article.March30.2005.MIPL.REC.pdf)
>
> Legislation introduced in the U.S. House of Representatives by California Democrat Henry Waxman in June 2006 aims for an ambitious timetable: The Safe Climate Act ". . . freezes U.S. greenhouse gas emissions in 2010, at the 2009 levels. Beginning in 2011, it cuts emissions by roughly 2% per year, reaching 1990 emissions levels by 2020. After 2020, it cuts emissions by roughly 5% per year. By 2050, emissions will be 80% lower than in 1990. This goal is similar to goals that have been announced by United Kingdom Prime Minister Tony Blair and California Governor Arnold Schwarzenegger." (http://www.house.gov/waxman/safeclimate/index.htm)
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> Across Massachusetts, conversations are beginning and citizen groups are forming to respond to the twin energy issues. In some cases the groups are being established as official town committees. See http://forums.e-democracy.org/pioneer-valley and http://www.city.northampton.ma.us/nhamptonenergy/policy.htm

B. Our Current Energy Use

What is the source of our energy? Energy is so available to us that we hardly give it a thought. But the first step in addressing energy issues is to understand where we stand and how the system works today.

Most of our energy comes from <nonrenewable energy sources>, particularly fossil fuels and nuclear power. These sources have supplied us with abundant, inexpensive energy for the past century. Some recommended web sites providing information and perspectives on current energy use and also on renewable energy include:

U.S. Department of Energy http://www.energy.gov/energysources/index.htm

The National Energy Education Development Project: http://www.need.org/EnergyInfobooks.php
The Union of Concerned Scientists http://www.ucsusa.org/clean_energy/fossil_fuels/

How do we supply the energy where we need it? In the case of electricity, it is available via <the electrical grid>, an interconnected distribution system of electric wires that requires constant power generation. It's the job of the New England Independent Systems Operator (ISO) to operate the regional electricity market and monitor all the power plants to make sure the electricity supply stays at a constant level. Sometimes ISO might ask power generators to make more or less electricity depending on the needs of the grid.

Imagine a bathtub filling with water, with the water representing electricity. Then imagine a number of spouts pouring water into the tub, each spout representing a power generator -- perhaps a coal, oil, nuclear, or natural gas power plant, or a solar panel that is grid-connected and in the sun today. Each time we use electricity the water/energy level drops just a little. If all of us use our microwave, toaster oven, electric hot water heater, and lots of lights at the same time, there will be many drains in the tub and it would soon be empty. However, the ISO works to maintain a constant level, deciding which power plants should keep providing electricity and when. The more energy we use, the more ISO has to maintain the grid by requesting that the power generators operate more.

In the case of gasoline, the energy supply trail is even more complex. In the series "A Tank of Gas, A World of Trouble" Chicago Tribune reporter Paul Salopek traced a tank of gas back to its sources, considering the social and environmental consequences, and the effects on international relations. See http://energybulletin.net/18702.html

Negative Side Effects. Our energy use has also had negative effects on society and on the environment. Fossil fuel extraction, processing, and consumption, including electricity generation, all produce toxic pollution, causing <acid rain>, <smog>, lung damage (from <fine particulate soot>), and water contamination (mercury). The term <clean coal> refers to the processing of coal, not the way it is mined, which can involve <mountaintop removal> and watershed destruction. Nuclear power produces <nuclear waste> that is essentially permanent. The environmental consequences of our energy habits fall disproportionately on poorer communities, and are at the root of many <environmental justice> issues. See http://www.epa.gov/sustainability/energy.htm

C. Energy Choices - "There is no silver bullet, only silver buckshot"

There is no one, big energy solution. Instead, there are many energy options:

1. Sources - What energy sources are available to replace energy from fossil fuels?

<Renewable energy> sources are sustainable in that they are replenished at essentially the same rate that they are used. The term <clean energy> has come to represent sources that are less polluting, environmentally friendly, climate friendly, and renewable.

Renewable sources include <solar energy> (including <passive solar>, <active solar>, <photovoltaic>), <hydropower>, <wind power>, <biomass>, <tidal energy>, and <geothermal energy> (including <ground source heat pump> systems).

Wikipedia offers a good hub site on renewables: http://en.wikipedia.org/wiki/Renewable_energy

The Massachusetts Technology Collaborative website offers information about renewable energy and energy efficiency in Massachusetts, including background information, state policies, teaching and how-to guides at http://www.masstech.org/cleanenergy/index.htm

The U.S. Department of Energy's Energy Efficiency and Renewable Energy web site offers links to a number of government sites at http://www.eere.energy.gov/

The Union of Concerned Scientists has information at http://www.ucsusa.org/clean_energy/

2. Energy Carriers - How can we store and transmit energy efficiently?

<Energy carriers> provide ways to store energy and deliver it to the places we need it, when we need it. Some examples of current energy carriers include: gasoline and diesel fuel, steam, and electricity. Though energy carriers sometimes seem like energy sources, they are not the original source of the energy. (See http://www.cecarf.org/Programs/Fuels/SourcesCarriers.html)

Electricity is the prime example of a versatile energy carrier. Unfortunately, electricity is hard to store, so we generate a constant supply and make it available through the grid. Small amounts of electrical energy can be stored in batteries.

Hydrogen is another energy carrier that seems to hold much promise, especially for transportation. In combination with <fuel cell> technology, hydrogen can be an extremely clean, versatile, and efficient way to store and use intermittent, small scale energy sources like sun and wind. The Rocky Mountain Institute is a leader in promoting the idea of a <hydrogen economy>. See links at http://www.rmi.org/sitepages/pid304.php

There are other potential energy carriers. If you are not concerned about travelling more than 60 miles per hour or more than 100 miles a day, why not consider a vehicle that runs on compressed air? See http://news.bbc.co.uk/1/hi/world/africa/988265.stm

3. Conservation - How can we get by with less energy, particularly fossil fuels?

Advocates for conservation note that the cheapest source of energy is energy that we have saved.

Neither renewables nor nuclear power can be expected to completely replace fossil fuels. This means that, somehow we must reduce our energy use. There are three major ways this can be done:

a. **Efficiency** means meeting the same needs with less energy, usually through technological innovation. Examples of efficiency include:
- <fluorescent> and <light emitting diode> (LED) <lighting>
- <green building> practices
- <fuel efficiency> (e.g. higher <CAFE standards> and <hybrid vehicles>)
- <energy smart technologies>
- <"energy star"> appliances (a U.S. Environmental Protection Agency rating system)

b. **Simple changes in habits** can result in significant energy savings. These are things everyone can do in daily life. Examples include (try combining <energy use> or <save energy> with any of the terms below):
- turning down the thermostat and putting on a sweater
- drinking tap water rather than <bottled water>

- <reusing> and <recycling>
- combining car errands and <carpooling>
- eating <locally grown foods>
- using <public transit> and/or <bicycling> where possible
- unplugging appliances that draw power even when turned off (<phantom loads>).

c. System changes can reduce energy waste over the long term. However, long range planning is required; these changes can't happen overnight. Examples include (try combining <energy use> or <save energy> with any of the terms below):

- <smart growth> land use planning
- supporting <local agriculture>
- cultivating the <urban forest> to provide shade and windbreaks
- <waste reduction>, reduced <packaging>, and <recycling>
- providing <public transportation>

4. What is the role of communities in addressing energy issues?

Energy action can be taken at the household level (e.g. switching to flourescent light bulbs, adding insulation, buying a hybrid vehicle, using public transit). Energy policy at the state, national, and international level (e.g. <CAFE standards> for vehicle miles per gallon, support for renewable energy research, caps for greenhouse gas emissions) is also an important arena for action. Between the household level and the state and national level is the community level. Local government and community organizations also have a role to play. This middle level is the focus of this year's Envirothon current issue.

Here are two national organizations offering resources for community energy initiatives:

The Smart Communities Network (http://www.smartcommunities.ncat.org) offers a variety of information and services for communities interested in sustainable development. In particular, see the collection of links to "Other Community Energy Resources" at http://www.smartcommunities.ncat.org/municipal/othtoc.shtml

The Rocky Mountain Institute, a leader in energy ideas since the 1970s, also has a links to resources for community initiatives (see http://www.rmi.org/sitepages/pid14.php). In particular, RMI has launched an interactive website, the Community Energy Opportunity Finder (www.energyfinder.org), that calculates potential energy and dollar savings, air pollution emissions reductions, and potential jobs a community could create by implementing an energy efficiency program.

5. Some Other Important Considerations for Energy Choices

a. Is this an <appropriate technology>? This term, coined by E.F. Schumacher in his 1973 book *Small is Beautiful: Economics as if People Mattered*, refers to the idea that "higher" technology is not always better. Technologies should be selected and introduced based on what will promote human values and minimize environmental impact. A technology may be appropriate in one setting and not another. See http://practicalaction.org/?id=about_us

b. Does this choice represent a <soft energy path>? In his 1976 book *Soft Energy Paths*, Amory Lovins coined this term to describe energy choices that are cheaper, simpler, and more flexible, emphasizing conservation and diverse renewable sources. In contrast, hard energy paths involve high

technology, are more expensive, tend to rely on single sources to the exclusion of others, and are less flexible and reversible. See http://www.rmi.org/sitepages/pid292.php

c. What about <nuclear power>? Nuclear power is not a renewable energy source. In fact, it is considered to be the classic example of a hard (sometimes even called "brittle") energy path. However, some policymakers, and even some environmentalists, say that new nuclear power plants should part of the answer to oil scarcity and climate change. There are strong scientific, economic, security, environmental, and social arguments in this debate. If you choose to consider nuclear power as part of your plan for your community's energy future, you should research and weigh all these factors, and include details of how you would site a nuclear plant in your community.

D. Some current hot energy topics in Massachusetts

Wind power projects. Some love them, some hate them. Some are concerned about bird and bat mortality. Sometimes it matters what the scale of the project is, and who owns it. By now everyone in Massachusetts is aware of the large scale project proposed by Cape Wind for Nantucket Sound. There are also successful, noncontroversial projects.
http://www.capewind.org/
http://www.saveoursound.org/
http://www.reliance.org/WindPower.htm
http://www.hullwind.org/

Green Building. A host of energy efficiency innovations have been developed since the energy crisis of the 1970s. These approaches have been successful in reducing energy consumption at a relatively low cost. Recently, a more comprehensive view of the environmental effects of buildings has focused on minimizing the impact of building elements on human health and the environment.
http://www.masstech.org/cleanenergy/greenbuilding.htm
http://www.thetrustees.org/pages/42_doyle_conservation_center.cfm
http://www.genzyme.com/genzctr/genzctr_home.asp

Clean energy choice. It is now possible for electric power customers to choose the kinds of energy producers they want to have contributing power to the grid. Choices differ depending on the power company supplying a community. See http://www.cleanenergychoice.org/index.htm

Biomass. Biomass fuels are considered a carbon neutral energy source, but sometimes these plants raise objections because of what they burn (Sometimes they are allowed to burn waste from construction and demolition or municipal solid waste, which can include toxic materials) or because the size of the plant means that many trucks will be passing through surrounding neighborhoods to bring fuel to the plant. For an example of a citizen group opposing a plant, see http://www.concernedcitizensofrussell.org/

Smart Growth. Land use planning has not usually been considered an energy issue, but this is changing. Smart growth is an antidote to suburban sprawl, acknowledged to be a huge energy waster for American society. For information on smart growth initiatives in Massachusetts, see http://www.mass.gov/?pageID=ocdhomepage&L=1&sid=Eocd&L0=Home . For some excellent papers on this topic nationally, see
http://www.eesi.org/programs/Smartgrowth/smartgrowth.htm

Waste and recycling. When you consider the embodied energy in everything we throw away, solid waste management is very clearly an important energy issue. Massachusetts communities have much room for improvement. Here's an issue where simple changes in individual buying and disposal practices

could make a dramatic difference in costs to the environment, will also be felt immediately in a town's waste management budget. See http://www.mass.gov/dep/recycle/

Local Agriculture. What does <local agriculture> have to do with energy? By some estimates, the <food system> is the biggest piece of our overall energy budget. Transportation is a major part of that budget, especially for the urbanized northeast, with most food items travelling 1300 miles before they reach our dining tables. For many reasons, not just energy, support for local agriculture is growing in Massachusetts. For examples, see http://www.umassvegetable.org/food_farming_systems/csa/
http://www.ucsusa.org/food_and_environment/sustainable_food/
http://www.umassd.edu/semap/buy_local/welcome.cfm

E. Resources on Massachusetts Energy Issues

<Massachusetts town energy committees> are springing up in response to energy prices, peak oil, and <economic localization> concerns. The Massachusetts Climate action network (http://www.massclimateaction.org) provides links to municipal efforts and plans.

-- Regional Planning Agencies in Massachusetts help towns and cities work together on issues like transportation, land use, housing, and environmenbt that are associated with energy. They are a major resource for local planning. The Citizen Planner Training Collaborative website at http://www.umass.edu/masscptc/resources.html includes links to all Massachusetts regional planning agencies, councils, and commissions.

State Agencies
Massachusetts Department of Energy Resources http://www.mass.gov/doer/
Massachusetts Department of Environmental Protection www.mass.gov/dep
Massachusetts Department of Telecommunications and Energy www.mass.gov/DTE

Utilities
National Grid http://www.nationalgridus.com/
Western Mass Electric Company http://www.wmeco.com/
NSTAR http://www.nstaronline.com/

Local NGOs
Healthlink www.healthlink.org
Clean Air Cool Planet www.cleanair-coolplanet.org/
MassPIRG www.masspirg.org
Cape and Islands Self reliance www.reliance.org
Regional Environmental Council www.recworcester.org/
Clean Water Action www.cleanwateraction.org/
The Green Roundtable www.greenroundtable.org/
Mass Climate Action Network www.massclimateaction.org/
Northeast Sustainable Energy Association www.nesea.org-
Center for Ecological Technology http://www.cetonline.org/

Green Businesses
Environmental Business Council - New England http://ebc.terranovum.com/

II. STRATEGIES & QUESTIONS FOR COMMUNITY INVESTIGATION

1. Plan Your Research!

Get started early. Most successful Envirothon teams start early and pace themselves in their preparations for Current Issue presentations. Plan you work with a calendar. Here are some suggestions:

- Warm up first. Read through the strategies suggested in this section. Which activities appeal to you? Don't wait. Set meeting dates to try them out together.
- Make a list of research tasks. The criteria for the Community Research Award can be used as a guide.
- Leave more time than you think you will need to arrange visits and interviews. Arrangements with town boards and busy resource people can take time.
- Use teamwork: Split up the tasks and share what you find.
- Begin planning service projects by early winter.

2. Warm up with some tests of your energy literacy

What questions could you ask yourselves and your classmates that would test math skills AND Internet research skills, AND ALSO raise your energy awareness? For example, try answering these questions using the power of the Internet and your own measurements:

- How long would you need to run on a treadmill to power your computer use today?
- Compare the energy (in granola bar calorie equivalents) that it would take for you to walk, bike, drive, carpool, or ride the school bus to school.
- What is the <embodied energy> of your school lunch, compared to the actual caloric value?

Keep track of the sources you used for your calculations. Make your assumptions explicit.

Calculate your *ecological footprint* http://www.myfootprint.org or *happy planet index* http://www.happyplanetindex.org (life satisfaction x life expectancy divided by ecological footprint). How much of the footprint is related to energy use?

To solve and create more problems use your imagination and mix and match some key words: <Earth's energy budget> <energy conversion> <conversion factors> <energy efficiency> <fuel value> <calories burned during exercise> <how things work> <tracing energy> <energy audits> <energy measurement> You get the idea!

Also Try these sites:
http://www.eia.doe.gov/basics/energybasics101.html
http://www.ucsusa.org/clean_energy/renewable_energy_basics/energy-101-take-a-tour.html

3. Discover your community's energy story.

Where you live 500 years ago, 200 years ago, and 100 years ago:

What were the main ways people were using energy? How much energy were they using? What energy sources were they drawing upon? Which were renewable? Which were nonrenewable? Where did the

energy come from? Were people wasteful with energy? What actions did they take to conserve energy? (How did they think about energy waste and efficiency? What did they call it?)

How was the landscape different because of energy use? Consider accessible woodlands, water bodies for water power and transportation, roads and trails, settlement patterns, prime agricultural land. What remnants of this past can you still find on maps and on the landscape itself? . A visit to the local historical society and the library for historic maps and other background information such as local and county histories will help enrich this experience for you. The Library of Congress has an amazing collection of maps and "bird's eye views" of Massachusetts landscapes online at the American Memory website, http://memory.loc.gov/ammem/

What can you learn about your community's energy story from the living memory of your parents, grandparents, neighbors? How would they answer these questions? In particular, what are their memories of the "energy crisis" of the 1970s?

Now, answer these questions for yourself: What kinds of energy do you use now? How much do you use? Where does it come from? What people and what landscapes are affected by your energy use today?

BONUS: How would you compare the quality of life of people in these different time periods with today? (Come to think of it, what factors make up "quality of life" for people in all periods of history?)

4. Perform a quick, informal energy audit of your school.

How much and what kind of energy are involved in your school's operations? What are the energy sources that your school depends on? Who pays the costs of energy use?

Who are the people who have this information? Who are the people who can help you understand the school's energy systems?

Remember to look at:

- heating and cooling
- power
- light
- transportation
- breakfast and lunch
- materials purchases
- solid waste management and recycling
- water heating and sewage treatement

See if you can find some real numbers related to actual energy use. Does the school or town government keep records of these energy numbers?

Can you use the numbers you find to calculate the "ecological footprint" of your school. How much of the size of the footprint is related to energy use?

What are the "low hanging fruit" (the changes that would save a lot of energy and be easy to make)?

Remember to check the web for ideas and examples. For example, the Union of Concerned Scientists has conducted a study of school bus energy and pollution, and has made some surprising suggestions. See http://www.ucsusa.org/clean_vehicles/big_rig_cleanup/clean-school-bus-pollution.html

For some inspiration, see the Mass Technology Council's Green School Intitiative web site at: http://www.mtpc.org/renewableenergy/green_schools.htm or search the web for <high school energy audit>

5. Inventory your community's energy issues, resources, and opportunities.

Before you start your community inventory, try out the Rocky Mountain Institute's interactive website, the Community Energy Opportunity Finder (www.energyfinder.org).

In your inventory, look for:

Hot topics:

- What local stories about energy have been reported in recent months in your community's newspaper?

People resources:

- Who are the key people on energy issues and action in your community?
- Who is concerned about energy, climate, and/or other related issues? Who is trying to do something about it right now?
- Who has expertise (e.g. technical know-how) that will be useful in addressing energy issues? Who can answer questions about energy efficiency and energy use in your community (You may already have found some of them in your audit of the school)?
- What organizations - businesses, nongovernmental organizations, citizen groups, local government departments and committees - are concerned or potentially concerned because of their missions/responsibilities?
- What regional, state, or other agencies beyond the community will have an interest, and something to offer?

Renewable energy resources:

- Does your town's landscape have features that lend themselves to renewable energy generation? Is anyone making plans to tap these resources?
- Are there renewable sources already in use?
- Are there examples of "green buildings"? New or retrofitted solar homes? Try http://www.nesea.org/buildings/openhouse/listings.php

Waste reduction/efficiency opportunities:

- How is garbage collection handled in your community? Where does the garbage go? How about large quantities, like junked cars or construction debris? Is compostable material separated? How about hazardous items, like old paint and computers? Is there a system for promoting reuse as well as recycling? See http://www.mass.gov/dep/recycle/reducere.htm
- What is your municipality's official recycling rate? How does it compare with other towns? http://www.mass.gov/dep/recycle/reduce/munirate.pdf

Smart growth opportunities

- How does the physical layout of your town encourage residents to save energy? How does it promote wasting energy?
- Do you have public transportation system(s)? Are roadways pedestrian friendly? bicycle friendly?
- What is the history of railroads in your community? Is there a working railroad line in town now?

III. PUTTING YOUR RESEARCH TO WORK

A. Developing Your Recommendations

Through your Current Issue research you have accumulated information and resources in your own community and beyond. You have made connections with people and organizations. You have begun to generate your own informed opinions about the scope of the problem and the actions that will be required.

The Envirothon Current Issue Problem will ask you to propose a plan for significant reductions in fossil fuel consumption in your community.

Your plan should be tailored to the specific current conditions of the community, based on your inventory of the issues, resources, and opportunities in your community.

If designed well, your plan may solve other problems and/or provide other opportunities for people in the future.

1. Delineate a clear focus area of your community for your plan. Defining your focus will be easier if you have spent time on your community-wide inventory.

Your defined focus should be a representative sample of your community. For example, it should

- be recognized as an entity in the community (but be more than a single building or institution)
- as much as possible be a microcosm of the diversity of energy sources/uses community-wide
- represent the concerns, interests, and opinions about energy found in your community.
- have many connections to other parts of the community (it should not be self-contained)

You should be able to develop a picture of the amounts and kinds of energy that are used in your focus area, and what they are used for. You may be able to find this in the budget.

Possibilities for focus areas include:

- the whole school system - including after school programs, parent and community involvement, and transportation issues
- main street businesses - including the town services that support them
- town government - including all the departments, committees, and buildings

2. Develop a plan for your community to cut its use of nonrenewable energy significantly, in two stages.

This plan will involve estimates. For your Envirothon presentation, the judges will be looking for real numbers. You must be able to explain how you arrived at your estimate, and convince the judges that you did what was reasonably possible to gather accurate figures.

Start with your best number estimate of the kinds and amounts of energy in the current energy "budget". How much of this energy is from nonrenewable sources? This is the number that you need to reduce.

Your plan should include reductions in two stages.

> **First**, your plan should reduce the use of fossil fuels by at least 25% in the next five years (by 2012).
>
> **Second**, your plan should reduce your use of fossil fuels by another 50% from the original number over the next 40 years (by 2037)

This reduction, while drastic, is a reasonable request, given the urgency of the crisis. It is what climate scientists recommend and what current legislation (the Safe Climate Act of 2006) deems possible, although it has a somewhat faster start.

Your plan should include a mix of strategies. It should involve a combination of approaches for reaching the targets. You will show how well you know your community by what you recommend. Plans should:

- Develop renewable energy sources using the natural features and resources of your landscape. You should be able to explain the technologies you are recommending. How will your community take responsibility for any negative enviromental or health effects that these sources may involve?
- Find specific opportunities for using energy more efficiently. Again, you should be able to explain the technologies you are recommending.
- Explain how much you will rely on people to change the habits and attitudes that waste energy. How will you encourage these changes? Will you enforce these changes?
- Propose system changes that can reduce energy use over the long term. Where should people live? What should their houses be like? How should they get around? Where should their food and fuel come from?

Your plan should include real numbers. It should provide your best estimates of the real amounts of energy involved, and detail on how you arrived at this estimate.

Your plan should include next steps. It should detail specific steps for implementation of these changes in the five year and forty year timeframes. What new laws will be needed? What funds will be needed? What public education will be needed? Who will be involved? Will there be a role for high school students? Is the plan fair? How will you convince town leaders, businesses, town residents to undertake this plan?

Your presentation should include vivid description. What will the change feel like? What will the landscape look like? Describe daily life in your town in ten years, and in 50 years, assuming these changes. Will there by hardships? Will there be benefits? What will be the impact on the quality of life for you and your children?

B. Preparing a Winning Presentation

Your Current Issue presentation is an important part of your Envirothon participation. The Current Issue represents 100 points, or one quarter of the team's total Envirothon score.

Approximately four weeks before the day of the Envirothon, your team will receive a copy of the Current Issue Problem, including specific guidance on what you should include in your presentation. When this information arrives

- make an outline of your presentation, based on the plan you have developed
- identify any information you need to fill in the gaps

- consider what visual aids will best make your points
- practice your presentation as a dress rehearsal three or four times - enough so you can be relaxed and conversational with the judges.

At the Envirothon, your team will be assigned a time and place for your Current Issue presentation. Teams have 15 minutes to present to a panel of judges. The presentation is followed by a 10 minute period for formal questions from the panel. Altogether, the session is approximately 30 minutes.

With the Current Issue Problem you will also receive a copy of the scoring sheet that the judges will use to evaluate your presentation. Judging criteria will include:

- evidence of first hand knowledge of energy issues in your community, from contacts and interviews with people and organizations in your community and from visits to places.
- background knowledge of energy science and particularly renewable energy technology that you are recommending
- knowledge of a variety of strategies that have might be used to address energy issues, including renewable energy sources, energy efficiency, conservation, and long term changes.
- the quality of your plan, including realistic estimates with real numbers, backed up by your research
- an appropriate mix of energy strategies
- clear next steps in the next five years
- a vivid description of what life will be like
- the quality of your presentation, including organization, speaking skills, teamwork, effective use of visual aids, time management, and response to questions
- overall quality, including evidence of curiosity, critical thinking, effort, depth, honesty, and creativity

C. Qualifying for the Massachusetts Envirothon Community Awards

If your team does a thorough job in your Current Issue investigations, you will not only score well but you can qualify for Mass Envirothon's Community Research Award. And if you use what you learn in a service project in your community, you can qualify for Mass Envirothon's Community Service Award.

These awards are optional and noncompetitive, and can be earned by any team that meets the high standards established for the awards. Teams and their coaches are responsible for certifying the quality and completeness of their work. Both awards are presented on the day of the Envirothon.

The Massachusetts Envirothon Community Research Award recognizes teams who have done thorough and wide-ranging community investigations in preparation for their Current Issue presentations. To meet the standard for the award, a team must show that they have been resourceful in using a variety of research strategies, including field study, interviews, map use, web research, library research, and queries to state agencies, local boards, and/or nongovernmental organizations. Teams who prepare diligently for the Current Issue portion of the Envirothon competition are likely to find that their work fulfills the requirements for the Community Research Award.

The Massachusetts Envirothon Community Service Award recognizes teams who take what they learn in preparation for their Current Issue presentations and apply that knowledge in service to their community. To be eligible for this award, a team must first meet all the requirements for the Community Research Award. Teams who have done thorough research on the issue are more likely to identify an important need and to develop a service project that is meaningful to them and useful to the community. Service projects do not have to be completed by the day of the Envirothon, but teams should be able to show substantial progress toward their service goals.

More information is at the Massachusetts Envirothon website at http://www.maenvirothon.org .

D. Planning a Roundtable

At lunchtime on the day of the Envirothon, after the testing is over but before the awards ceremony begins, all Envirothon teams are invited to offer a roundtable. Teams who have qualified for the Community Research Award or the Community Service Award are especially encouraged to plan a roundtable.

Roundtables are freewheeling small group discussions around a place, a question, or an idea of your choice. This is a great time to display and discuss interesting things you learned in your current issue research and/or any service projects you have undertaken. Elaborate displays are discouraged! If you want, you can simply bring your Current Issue presentation materials. When you think of items to display, ask yourself: What will help start a good conversation about the work we have done?

All Envirothon participants will be invited to visit informally at these tables. Team members at roundtables take turns sitting at the home table and visiting other tables.

More information on planning your roundtable will be sent a month before the Envirothon with the Current Issue Problem.