

Possible Lesson Plans for Energy Topics

Lesson Plans

The science classes might include information about Natural Resources including

- Soil Resources
- Water Resources
- Fuel Resources
- Renewable Resources

To supplement this information, with a focus on energy, here are some suggested projects that students could do for homework, lab work, or as in-class individual supervised study. This might be covered by existing lesson plans. Teachers can use these suggestions any way they see fit. The idea is simply to bring attention to energy topics so students can think about them, perhaps investigate them, and, in any case, learn something about them.

Projects

For each of these projects, the depth of the investigation depends on the grade level. First grade might be just getting familiar with the terms – energy, efficiency, climate, weather, fossil fuel energy, solar energy, wind energy, hydroelectric energy. These projects could be repeated at each grade level with each advancing grade doing more investigation.

After each project, the student should write up what they learned. And there should be some classroom discussion to share what was learned.

The students should be encouraged to come up with their own questions to answer – they do not have to stick to the project list. They should be encouraged to explore according to their interests.

For grades 9-12, more in-depth investigation should be expected. And the students should be encouraged to contact other people in the community for information and advice. And they should be able to share ideas with members of the MEC for feedback. The MEC members would be thrilled to hear what students think about these subjects. Perhaps the school could arrange a feedback session – MEC members present to hear what students found in their investigations, and to suggest any other areas of investigation.

The projects are listed under each major category.

Climate Change

These projects look at the effects of climate change. One person changing their energy consumption may not have much effect on greenhouse gases, but 300 million people changing in the US can make a difference.

Note that internet search engines will locate a lot of data. You have to look at any data carefully, to be able to weed out misinformation – you can compare sources and also use your own judgment – if some data seems odd, be sure to apply your own common sense.

Subprojects:

- What is climate change? What is global warming? What is the difference?

Answer: Google both. One result of the search is this:

https://www.usgs.gov/faqs/what-difference-between-global-warming-and-climate-change-1?qt-news_science_products=0#qt-news_science_products

- How will climate change affect you?

Answer: Google “effects of climate change”. Note that there are economic impacts, changes to farming, changes to animal habitat. You can look at what might affect you – changes over time to what trees can survive as wood pests migrate here from warmer parts of the country. How about changes to dirt roads in Mason – as winters get warmer, we have longer or multiple mud seasons. Does climate change likely result in a wetter or drier New Hampshire.

- Have your parents noticed any changes in climate since childhood?

Answer: Interview your parents and grandparents.

- Describe climate change in terms of changes in storms, drought, cold snaps, heat waves.

Answer: Google climate change for this data. One example is this web site:

<https://climate.nasa.gov/news/2881/earths-freshwater-future-extremes-of-flood-and-drought/>

You can also look at how climate change affects the jet stream and what that means for climate in New England.

- How is climate change affecting the arctic regions? Look at permafrost, sea ice, land ice.

Answer: Google climate change and arctic. There is a lot of data about permafrost and ice in the Arctic and Antarctic regions. Here is an example web site:

https://en.wikipedia.org/wiki/Climate_change_in_the_Arctic

- How is climate change affecting the US in terms of sea level rise?

Answer: Google sea level rise. A web site that appears is:

<https://oceanservice.noaa.gov/facts/sealevel.html>

- How is climate change affecting the rest of the world in terms of sea level rise (Pacific islands, Europe)?

Answer: Continue googling as the previous question but look more specifically at areas in other parts of the world.

- How are rising global temperatures affecting the Middle East, Asia, Central America, South America, Europe?

Answer: Google global temperature, and find sites like this:

<https://climate.nasa.gov/vital-signs/global-temperature/>

- How are rising global temperatures affecting North America, include the effect on farming?

Answer: Google global temperature and find information like this:

<https://www.epa.gov/arc-x/implications-climate-change>
<https://19january2017snapshot.epa.gov/climate-impacts/climate-impacts-agriculture-and-food-supply.html>

- How does global warming affect energy consumption? Less need for heat in the winter, more need for A/C in the summer – for Mason? What about other parts of the country?

Answer: Google search this topic. Also, what does your house use for heating in the winter and cooling in the summer. Interview your parents about energy consumption over the years – what changes have been happening with heating and cooling bills?

Energy Efficiency and Conservation

We can build more power plants and increase the production of greenhouse gases, or we can reduce our energy costs by improving efficiency and doing conservation, with the added benefit of reducing the environmental impact of power generation.

Conversion from fossil fuels to renewable energy is important as well, especially as the cost of renewables and improving technology also makes this conversion more cost effective.

Subprojects:

- Where does energy come from, list the sources and percent, and CO2 contribution?

Answer: Google search energy sources, for sites like this:

<https://www.eia.gov/energyexplained/what-is-energy/sources-of-energy.php>

- Where is energy used (home heating, home cooling, lighting, transportation, industry)?

Answer: Google search home energy usage, for sites like this:

<https://www.eia.gov/energyexplained/use-of-energy/homes.php>

- How does better insulation affect energy usage?

Answer: Google search for home insulation. You can explore many aspects of home construction as well. Here is an example web site:

<https://www.energy.gov/energysaver/weatherize/insulation/where-insulate-home>

- How does teleworking affect energy usage?

Answer: Google search for telework and work-from-home. You can find sites like this:

<https://therevelator.org/telework-environmental-benefits/>

But also, how would working from home affect your household – this includes doing remote classes if schools schedules are limited by the pandemic. What about your parents, neighbors – do they or can they work from home. Are their working schedules impacted by the pandemic, so they commute less?

- What things can you do to affect energy usage at home?

Answer: Look at heating, cooling, lights. What kind of lights do you have – incandescent, compact fluorescent, LED? Any outside lights that perhaps should be on a motion detector rather than being on all the time?

What about insulation of heating ducts, hot water pipes?

- If you change one light bulb that is on for 4 hours a day from incandescent to LED, how much energy is saved per year?

Answer: For a 100w bulb, incandescent is $100 * 4 * 365 * 0.19 \text{ \$/kwh} = \$27.74 / \text{year}$, LED is $16 * 4 * 365 * 0.19 \text{ \$/kwh} = \$4.44 / \text{year}$. Then factor in the lifespan of each – incandescent bulbs average 1000 hours, LED 25000 hours. The cost of the bulbs varies a lot, but the current cost appears to be similar.

- If you spend \$x on improvements, what is the payback time, i.e., is it worth making the improvements?

Answer: This is a math question. You just need to know how much is the initial cost, how much you would save per year, and you can calculate the payback time. After the payback time, your energy cost goes down. You can complicate the answer by factoring in interest rates and energy rebates.

- Investigate light bulb choices and energy cost.

Answer: Here is a website that compares light bulbs, assuming 15 cents/kwh. Note that electricity in Mason may be slightly more expensive.

<https://blog.arcadia.com/led-vs-regular-lightbulbs-do-they-really-make-a-difference/>

- Investigate air conditioning choices and energy cost. Look at choices around the world .

Answer: Google search for air conditioning.

Here is a web site:

https://en.wikipedia.org/wiki/Air_conditioning

Dry climates can use evaporative coolers. Humid climates need dehumidification and more expensive types of air conditioning.

Look at the increasing demand for air-conditioning across the world, especially as the climate warms.

- Investigate home heating choices and energy cost.

Answer: Google search for home heating. Look at choices in New Hampshire – oil, natural gas, propane, solar, geothermal, wood pellets, firewood, electricity – look at the cost of each, both for installation of the heating systems and for long term use, fuel cost and maintenance.

- Investigate transportation choices and energy cost.

Answer: Google search transportation and look at transportation by automobile, bus, truck, train, ship, airplane – look at it in terms of personal transportation and commercial transportation. Look at the fuels used for each – gasoline, diesel, electricity, aviation fuel.

- Most motor vehicle runs on gasoline or diesel. What will you be using in 10 years?

Answer: There are statistics that show increasing adoption of electric vehicles. Can you make any sense of the many different opinions? Can you project what it will look like in 10 years, 20 years?

- How does wind energy work, how do you make it work when the wind isn't blowing?

Answer: Google search wind energy. You will find a lot of data including pros and cons. One of the cons is that when the wind stops blowing, you get no energy – or do you – if you pair wind turbines with battery storage, do you get a more viable source of energy?

- How does solar energy work, how do you make it work when the sun is not shining?

Answer: Google search solar energy. Look for forthcoming solar cell improvements that increase efficiency especially in low light conditions. Look at how solar can be combined with battery storage to provide reliable power.

Look for electric grid improvements that come from using batteries to even out energy usage to avoid ramping up and down power plants to adjust to demand.

- Where does electricity come from now? Where will it come from in 10 years, 20 years?

Answer: Google search for electricity source. You can find sites like this:

<https://www.eia.gov/tools/faqs/faq.php?id=427&t=3>

which gives utility-scale electricity generation statistics.

And this:

https://afdc.energy.gov/fuels/electricity_production.html

Look at projections for coal, gas, nuclear, solar, wind, hydroelectric.

- Which is easier, do home energy improvements, or build a new power plant to generate the power needed? List the pros and cons of each.

Answer: Look at the cost of building a new power plant. Look at the cost of doing home improvements to reduce energy usage. Note that utilities offer energy rebates for more energy efficient appliances and lighting – is it worth it for utilities to pay customers to reduce energy usage rather than just build another power plant?

- Cost is one thing, convenience is another, why conserve energy at all? How fast is energy consumption worldwide increasing and is it possible to keep up by just building new power plants?

Answer: What do you think, based on what you have learned about energy?

- Would you want to live next to a power plant? How about a pipeline? How about next to high voltage power lines?

Answer: Google search power plants and environmental impact. Find out about the 'stop the pipeline' effort in New Hampshire a few years ago.

Energy Sources

For each of these projects, students should look at the impact of each energy source across the natural resources. For example, how does coal mining or natural gas extraction affect water quality in the local areas, including rivers and lakes. And how much CO₂ is emitted as a result. Or, for example, what is the impact on water of oil and gas fracking?

Subprojects:

- When you turn on a light, where is the electricity coming from – diagram it out – at each step, show the environmental impact.

For example, a coal-fired power plant is converting buried coal into electricity. The coal is mined which takes energy, the mining has environmental impact, then gets transported to the power plant, using energy to do so. Then the coal is burned to generate steam to run steam turbines which rotate a generator which produces the electricity, producing air pollution, CO₂ emissions. Then the electricity flows along power lines to local power stations and transformers and finally into your house to the light bulb. There are power losses along the way due to resistance in power lines and the losses as power goes through a transformer.

Answer: Google what you need to research this in detail. Compare results with others to refine and expand your ideas and knowledge. Consider that you use energy, everyone uses energy, there is an impact on you and your environment in the future for the energy choices you make every day.

- Repeat this analysis for each type of energy source – coal, natural gas, nuclear, hydroelectric, solar, wind. Detail the steps along the process and get an idea of the true cost.

For example, solar should include the cost and manufacture of solar panels. Nuclear should include the cost of fuel, the impact of mining for uranium, and the cost of dealing with nuclear waste, but recognizing the lack of CO₂ and smokestack pollutants. Hydroelectric should show the impact to the environment of building dams needed. Wind should show the impact of windmills on the environment. Natural gas should include the burn off of waste gases from wells and methane emissions and impact of pipeline leaks.

Answer: Continue the investigations and research.

- How 'green' is coal as an energy source? How much coal is used worldwide? How much coal is left? Repeat for natural gas, nuclear, hydroelectric, solar, wind.

Answer: Google green energy and learn about each source of energy. Look at projections to get an idea how much of each type of fuel remains and how long will it last. Factor in the environmental effects of current energy usage.

- Currently, transportation uses primarily fossil fuels. Show what transportation uses, for automobiles, trucks, buses, trains, ships, airplanes. What changes do you expect for transportation over the next 10 years, 20 years?

Answer: Google search transportation trends. What changes could be expected for airplane transportation?

- What would the impact on energy usage if automobiles, trucks, buses converted from internal combustion engines to electric motors?

Answer: Google search impact of converting to electric vehicles. How much more demand on the electricity grid is there? How will that demand be satisfied?

- What is the impact on energy usage in pandemic times, i.e., more working from home, so more home energy consumption, less commercial energy consumption, and less fuel used for transportation.

Answer: Look at the changes within your household and your neighbors.

- What is the future of each type of transportation?

Answer: Google transportation futures for each type.

- What is the electric grid? How does it work? How robust is it?

Answer: Google electricity grid, and look at web sites such as:

https://en.wikipedia.org/wiki/Electrical_grid

- What evidence do you see in Mason of renewable energy (wood heat, solar panels, geothermal installations)?

Answer: In your travels through Mason and vicinity, how many solar panel installations do you see? Do you know of any geothermal? Are there any windmills visible? How many houses have stacks of firewood ready for next winter? Or stacks of pellets?