

Expeditionary Learning Schools
Learning Expedition Documentation Project

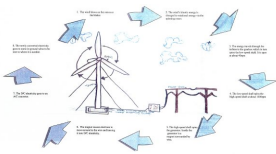
Reducing the Carbon Footprint of Vergennes Union Middle and High School Grades 7 and 8

Expedition Authors

Jennifer Lawson and Christine Napolitano

Vergennes Union Middle School

Vergennes, VT



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Summary

In an attempt to help VUMS/VUHS reduce its carbon footprint, approximately 40 seventh and eighth graders from “Team Farside” set out to determine the amount of energy used on a yearly basis by the students and faculty of the school. The VUMS/VUHS building manager, Mike O’Malley, met with the team to employ their services in investigating an alternative energy source for VUMS/VUHS. Mr. O’ Malley informed students of the annual cost for heating the building and what other some schools in the state were currently doing to cut back on their use of fossil fuels, including the use of: wind turbines, solar panels, methane digesters, and/or biomass furnaces. Thus began Team Farside’s expedition, *Reducing the Carbon Footprint of VUMS/VUHS*.

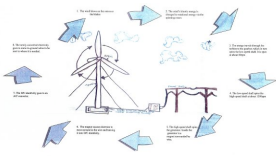
Following the meeting with Mr. O’Malley, students were engaged in a critical examination of the issue. The first investigation involved measuring the volume of the school and completing an inventory of all the items in the school that required electricity. This information, along with the students’ estimation of the amount of heating fuel consumed, was used to calculate the actual carbon footprint of the building. The second



investigation focused on the changing climate of the earth as emission levels in the atmosphere continue to increase. The final investigation of the expedition required students to travel to various sites in Vermont to examine systems employed to reduce the use of fossil fuels. During these visits, students met with building managers and principals to interview them about the process of implementing their alternative energy source and the impact it had on their school or business.

The expedition included support from a wide range of professional experts, from public and private institutions, with consultations at the school and out in the field. Fieldwork research was conducted within the school and around the state. In addition to the broad goal of possible substantive changes to the school’s energy sources, small teams of students also pursued smaller projects to increase energy efficiencies within the school’s current physical plant systems. These “Go Green” service projects generated recommendations to improve energy conservation in the school; some were adopted immediately.

The students of Team Farside compiled their findings into a report titled *The Alternative Energy Report*. Students presented their findings and made a recommendation to the VUMS/VUHS



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School Board as to which alternative energy source would best suit our site. The presentation was open to the public and included student findings regarding the science behind the technology, a cost benefit analysis, the steps necessary to implement the source, and the advantages or disadvantages of each of the sources: wind turbine, solar panels, biomass furnace, or a methane digester. In addition to the presentation on the alternative energy sources, two eighth-grade students presented their proposal requesting the replacement of the current gymnasium lights with energy efficient lights and occupancy sensors.

Guiding Questions

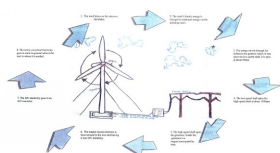
- Do individuals have the power to change the course of political, environmental, and/or economic issues?
- Do humans have the power to change the current trend of global warming?
- Would the earth be better off without the impact of human beings?

Investigation Topic 1

Determining the Energy Usage at VUMS/VUHS

In this investigation students determined the total amount of energy used by VUMS/VUHS. They accomplished this enormous task in a series of small steps which helped them recognize that many large problems may be solved using deductive reasoning and that they can develop aids to help them. First, they worked in small groups to measure the volume of the school and conduct an energy audit of all of the electrical appliances used in the building. Students presented their learning with scale drawings showing the mathematical approach they used to determine the volume of their assigned space. Based on this information, students then completed an energy audit in which they presented the total KWH of electricity used per product in the school, and the total amount of heating fuel used to heat the school.





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Longterm Learning Targets

- I can determine the cost of energy use at VUMS/VUHS.

Supporting Learning Targets

- I can describe how using a model helps to understand a larger problem.
- I can describe what volume is and how to calculate it.
- I can read a building plan.
- I can measure the volume of different geometric shapes.
- I can identify the proper formulas to use for calculations.
- I can decide when to make precise measurements and when to estimate.
- I can calculate the volume of a rectangle, pyramid and cylinder.
- I can collect and organize data.
- I can determine watts when given volts and amps.
- I can graphically represent the energy usage at VUHS.
- I can determine KWH for different appliances in the school.
- I can categorize the energy usage at VUHS.



Investigation Topic 2

Global Warming and Climate Change in Vermont

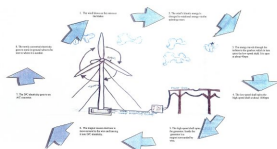
In this investigation, students explored the causes of global warming and investigated changes in Vermont's climate over the past decade. Students studied the impact of increased carbon emissions and other greenhouse gases on the temperature of the earth's atmosphere and oceans and then wrote an informative postcard to educate their selected audience about the changes in Vermont's climate. Students identified a cause and an effect associated with global warming in Vermont. This investigation helped students to draw conclusions about how choices within an economic system can affect the environment in the world.

Long Term Learning Targets

- I can write a persuasive paragraph to an authentic audience on signs of climate change in Vermont.

Supporting Learning Targets

- I can clearly define a significant problem, issue, topic, or concern about climate change in Vermont.
- I can make a judgment or assertion about the impact climate change is having on Vermont.

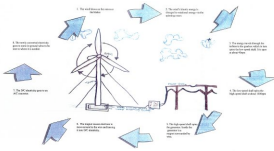


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Supporting Learning Targets

- I can explain why there is a need to use alternative energy sources.
- I can explain the pros and cons of renewable and non-renewable resources.
- I can analyze the pros and cons of alternative energy sources at VUHS.
- I can determine if my assigned alternative energy source will be viable at VUHS.
- I can explain how wind, sun, manure, or wood can be converted into energy.
- I can understand the role geography plays in how well my alternative energy source will function on this site.
- I can analyze the landscape of VUHS and its climate to determine whether or not my alternative energy source is fitting for this site.
- I can explain the process an institution must go through in order to implement my alternative energy source.
- I can interview, read, write, and organize the steps needed for VUHS to make the shift from its current fuel source to an alternative energy source.





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Connections to State and District Standards

Language Arts

- Students read for meaning, demonstrating both initial understanding and personal response to what is read.
- Students draft, revise, edit, and critique written products so that final drafts are appropriate in terms of the following dimensions:
 - Purpose: Intent is established and maintained within a given piece of writing.
 - Organization: The writing demonstrates order and coherence.
 - Details: The details contribute to development of ideas and information, evoke images, or otherwise elaborate on or clarify the content of the writing.
 - Voice or Tone: An appropriate voice or tone is established and maintained.
- In written reports, students organize and convey information and ideas accurately and effectively.
- In persuasive writing, students judge, propose, and persuade.

Personal Development

- Students make informed decisions.
- Students make decisions that demonstrate understanding of natural and human communities, the ecological, economic, political, or social systems within them, and awareness of how their personal and collective actions affect the sustainability of these interrelated systems.
- Students perform effectively on teams that set and achieve goals, conduct investigations, solve problems, and create solutions (e.g., by using consensus-building and cooperation to work toward group decisions).

Technology

- Students interpret and communicate using mathematical, scientific, and technological notation and representation.
- Students use computers, telecommunications, and other tools of technology to research, to gather information and ideas, and to represent information and ideas accurately and appropriately.
- Students use organizational systems to obtain information from various sources (including libraries and the Internet).

Reasoning and Problem Solving

- Students use reasoning strategies, knowledge, and common sense to solve complex problems related to all fields of knowledge.
- Students solve problems of increasing complexity.
- Students devise and test ways of improving the effectiveness of a system.
- Students produce solutions to mathematical problems requiring decisions about approach and presentation, so that final drafts are appropriate in terms of these dimensions:
 - Approach & Reasoning: The reasoning, strategies, and skills used to solve the problem;
 - Connections: Demonstration of observations, applications, extensions, and generalizations;
 - Solution: All of the work that was done to solve the problem, including the answer;
 - Mathematical Language: The use of mathematical language in communicating the solution;
 - Mathematical Representation: The use of mathematical representation to communicate the solution; and
 - Documentation: Presentation of the solution.
- Students represent their ideas and/or the ideas of others in detailed form.
- Students modify or change their original ideas and/or the ideas of others to generate innovative solutions.
- Students design a product, project, or service to meet an identified need.



Science

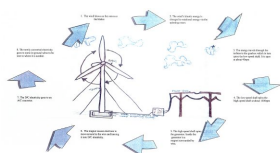
- ## Math

- ## History and Social Sciences

- ## Civic & Social Responsibility

- ## Arts

- Students design and create media products that successfully communicate.



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Major Projects

This expedition included two related projects, each with substantial discrete components, and each resulting in student products for audiences beyond the school.

Project One: Assessing and Improving the Carbon Footprint of the School

Components

1. Determining the volume of the school
2. Conducting an energy audit of the school
3. “Go Green” proposals for energy conservation in school
4. Alternative energy report with recommendations for new school energy sources

1. Determining the Volume of the School

Description

As a kick-off for this learning expedition, students built models of buildings using toothpicks and marshmallows, in order to learn skills of estimating and measuring volume. After logically estimating volume, students measured the volume of their models, which included irregular shapes, using rulers. Employing these skills, the students determined the volume of the classroom, without measuring tools, and then defended their logic to their peers and teachers. The entire class then used building plans to divvy up sections of the school and they embarked on measuring the volume of the entire building.

Key Skills Addressed (Aligned with Standards)

- Volume
- Dimensions
- Geometric shapes
- Geometric models
- Scale drawings
- Problem-solving applications
- Conversion of units
- Measurement

First Glance

Name:

Date:

Lens: CO2 Levels

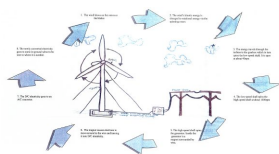
Gather and record all the information you can about CO2 levels, nothing else.
Record what you found about CO2 levels on a timeline below:

Inferences you can make about CO2 levels over the course of time:

Questions you have about CO2 levels:

Key Vocabulary for Anchor Chart:

—



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2. Conducting an Energy Audit of the School

Description

Students gained familiarity with the energy systems in the school by reading about forced hot air heating and reading an actual energy audit completed by an engineer. They examined the heating and electricity bills from the school and graphed the monthly usage of each. Students then synthesized this information with their previous knowledge of the volume of the school and their inventory of each piece of electronic equipment in the building, and created an energy audit of the school.

Key Skills Addressed (Aligned with Standards)

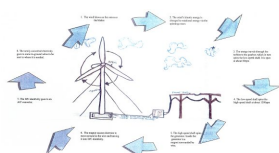
- Graphing
- Analyzing Data
- Organizing and Displaying Data

Energy Audit at VUHS					
ROOM/SPACE	Big Lights	Small Lights	Other lights	Computers/ Printers	Others (be specific)
C1					
C2					
C3					
C4					
C5					
C6					
C7					
C8					
C9					
C10					
C11 (Computer Lab)					
C12 (Learning Center)					
C14 (Faculty Room)					
C15 (Learning Center)					
ROOM/SPACE	Big Lights	Small Lights	Other lights	Computers/ Printers	Others (be specific)
MS Boys Bathroom					
D1					
D2					
D3					
D4					
D5					

3. “Go Green” Energy Conservation Proposals

Description

Students worked with their mentor or mentee to design a “Go Green” project for Vergennes Union. Students devised solutions for smaller environmental issues existing at the school and presented their results to teachers and administration. Some of the projects included determining whether or not it was more energy efficient to turn computers off at night vs. putting them in sleep mode. The students found that it was better to turn off the computers at night and communicated their findings by making laminated footprints that reminded people to turn off their computers before leaving for the day. These footprints were affixed to all the computers in the school building. Other projects included composting in the cafeteria, using hand towels versus paper towels, greening up rooms with plants, and using hand held pencil sharpeners instead of electric pencil sharpeners. This service project took place during Crew time and was based on a visit to an alternative energy business that was employing a variety of methods to reduce the carbon footprint.



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4. Alternative Energy Report

Description

For this culminating project, students were broken up into groups, based upon their interests, in order to begin in-depth research into one of four alternative energy sources: wind power, solar power, biomass power, or methane power. Each group was required to answer a set of specific questions about their alternative energy source, including:

- How does your alternative energy source work? What is the science behind the technology?
- Profile of resource for this area: site specifics
- Which source would work best for the geography of this area?
- Solar: What is the average amount of sunlight for this area?
- Wind: What are the average wind speeds for this area? What is the highest wind speed recorded for this area?
- Biomass: Why are trees a viable resource? How many trees does it take to create energy?
- Advantages/Disadvantages of each alternative energy source
- Incentives for each alternative energy source provided to schools
- Cost effectiveness
- Storage
- Accessibility/Availability
- Benefit of/consequences to the environment
- Benefit of/consequences to people in the community

Each group then completed a report that included the science behind the technology, the advantages

Science behind the Technology

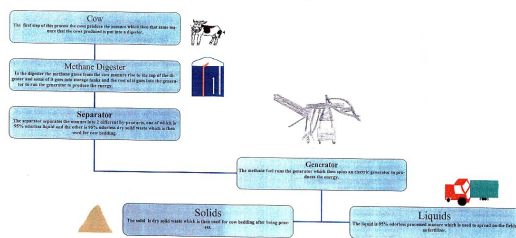
Methane Digester Steps

By: Andrew Lucia and Joey LaPerle

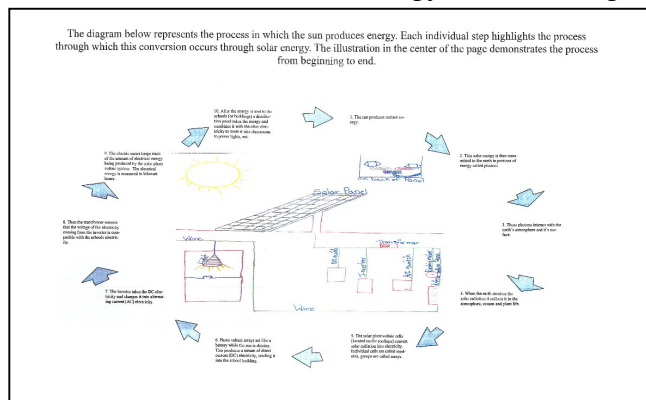
My team, Farside, has been studying alternative energy sources after reading and viewing "An Inconvenient Truth". We realize we have to start the process of using alternative energy sources to help the planet with the rising CO2 levels. My group studied Cow power. We were able to go to a farm in Bridport where they have a methane digester. When the manure is placed in the methane digester it begins a process which separates the gases from the solids. The gasses go into the generator which runs the generator to produce electricity. The methane is a renewable resource which produces clean power.



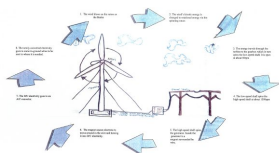
The diagram below represents the process in which the methane digester produces energy. Each individual step highlights the process through which this conversion occurs through methane.



The diagram below represents the process in which the sun produces energy. Each individual step highlights the process through which this conversion occurs through solar energy. The illustration in the center of the page demonstrates the process from beginning to end.



and disadvantages of the energy source, the monthly and installation costs, the benefit for the environment, a cost benefit-analysis, including the return on the investment over time, and the financial support available from the state and federal government. This report was compiled into a report, *Alternative Energy Report*, and presented to the school board along with Team Farside's recommendation for the best alternative energy source to reduce the carbon footprint at VUMS/VUHS.



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Project Two: Understanding Effects of Climate Change in Vermont

Components

1. Research and lab experiments related to global warming
2. Research, writing and graphics in service of educating others about climate change in Vermont

1. The Science of Global Warming

Description



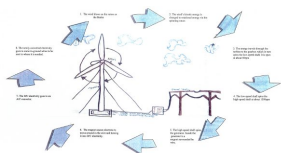
Students developed their background knowledge of global warming by identifying what they already knew about the subject and then using expert texts and videos to further develop their knowledge. Students both watched and read Al Gore's *An Inconvenient Truth*, as well as Elizabeth Colbert's *Field Notes of a Catastrophe*. They identified the relative importance of new information, created vocabulary charts,

and developed questions for further study. Each student wrote a letter to Al Gore that included his or her thoughts, reactions, and questions about the global warming crisis.

With this background knowledge as a base, students conducted laboratory experiments to simulate global warming and to explain the science behind the phenomenon. Follow-up labs included: Conduction, Convection, and Radiation Popcorn Lab; Layers of the Atmosphere; Greenhouse Gases; and Renewable and Non-Renewable Resources.

Extension Activity for Crew

Students counted out a million white navy beans to represent parts per million and black beans to represent CO₂ particulates per million. While counting out the beans with their mentors or mentees, students estimated and calculated the ratios, percentages, and weight counted on any given day. Students then displayed the collection of beans in the library to help people visualize what the increase of CO₂ levels looks like in the atmosphere. The display included labels of the years, CO₂ levels, and significant events that have impacted the CO₂ levels such as the industrial revolution, the invention of the automobile, the first Earth Day, and so on.



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Key Skills Addressed (Aligned with Standards)

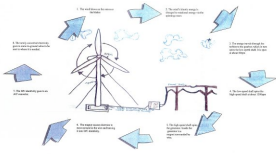
- Note taking
- Drawing and labeling diagrams
- Citing sources
- Revising research based on personal reflection, peer critique, expert opinion, etc.
- Reading and interpreting a variety of effective representations of the earth such as maps, globes, and photographs, and project future change
- Plot location and data

3. Climate Change in Vermont

Description

In this final portion of the investigation on global warming and climate change, students composed persuasive RAFTS to a native Vermonter. This project centered around the students' scientific observations and conclusions about spring in Vermont. Employing phenological methods, they went weekly to the Nature's Classroom to measure the temperature of the mud, water, and air. They conducted close observations to determine if the flora and fauna associated with this time of year was present. Within the classroom, students used the Farmer's Almanac to organize the average temperature, mean wind speed, and types of precipitation for a decade of one given date in each of the four seasons. With this information, students determined relative changes in the precipitation, wind and/or temperature over the last decade in Vermont.

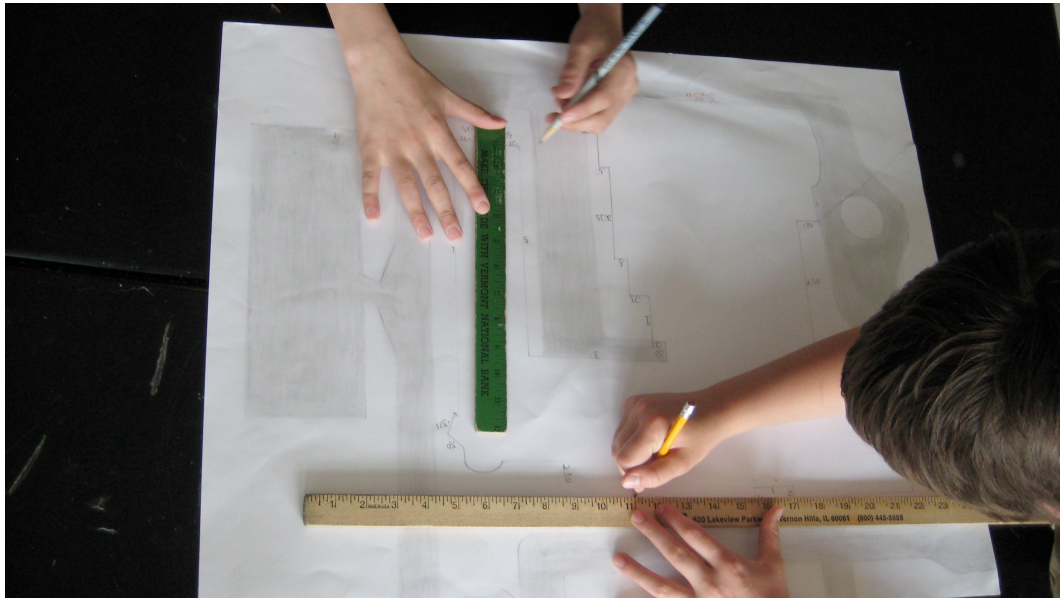
The class then participated in a gallery walk of the *nine identified indicators* that scientists use to determine if climate change is occurring over time. Students were assigned one of these indicators and wrote a persuasive postcard that informed a Vermonter about the significance of this indicator of climate change. To complete this assignment, students participated in a mini-lesson during Writing Workshop on how to write the "picture perfect" paragraph. Once students felt confident that they could write a topic sentence that is supported by one of the "five fingers" and followed up with a concluding sentence, they composed their postcard, which also included an illustrated front. The postcards were mailed to their selected Vermonter in the hopes of educating him or her about how to identify climate change.

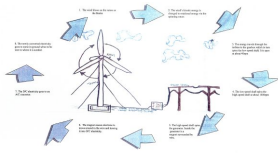


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Final Product

Selected students and student volunteers worked with their teacher to create a poster called *Clues to Climate Change in Vermont*. The purpose of this poster was for elementary schools to begin educating students about scientific observation and global warming. This poster, which includes a handful of the completed RAFTS postcards, is an interactive map that can be used with children to link common Vermont experiences with possible indications of climate change. The students presented the posters to their elementary school principals and made a donation of the poster to *ECHO Museum*, *Vermont Public Research Interest Group (VPIRG)*, and the *Natural Resource Department* at the *University of Vermont*, all of which contributed to educating the students about this topic.





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Connections to the Community and Larger World

Fieldwork

The fieldwork for this learning expedition included site visits to schools and institutions employing one of the alternative energy sources studied in class, including:

- Field Trip to Searsburg Wind Farm
- Field Trip to NRG (Wind and Solar Production Plant)
- Site visits to various parts of VUMS/VUHS (including boiler room, roof, and grounds) to determine placement and potential for alternative energy source

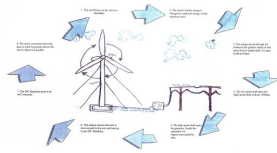
Service

Most of the work of this expedition was centered in service to the school and broader community. The expedition was grounded in a mission of global environmental stewardship, with the particular focus of improving the carbon footprint of the school and the state. All of the student products from the expedition were service projects:

- The Alternative Energy Report
- Go Green Conservation Proposals
- Educational Posters on Climate Change in Vermont for Elementary Students
- Illustrated Cards to Legislators.

Experts

- Various public and private sector energy consultants
- Building Managers of schools and institutes employing alternative energy sources
- School Principals of schools and institutes employing alternative energy sources
- Vergennes Union Middle/High School Building Manager
- Vermont State Department Energy Auditor/Engineer
- Speech Pathologist, Curriculum Coordinator, and College Professor to work with students on the final report to the school board
- Documentary Film Maker
- *VEEP*: Vermont Energy Education Program
- Green Mountain Electric Power Company
- *ECHO* Museum
- University of Vermont Natural Resource Department
- *VPIRG* (Vermont Public Interest Research Group)



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Calendar

February	March	April	May	June
• Kick-Off visit from Building Manager • Measuring the Volume of the School • Building background knowledge on global warming • Visit to Searsburg Wind Farm	• Finalize the scale drawings of the volume of all the room in the school • Site visit to NRG Systems • Understanding and reading the school's energy bills • Write up of school's heating use • Determining the heat used by the school on a given school year • Viewing and Reading <u>An Inconvenient Truth</u> • Phenology studies of Vermont climate	• Continue phenology observations • Science of global warming • Energy audit of school • Film production training • Community service project in Crew • Site visits- interview, filming, and science behind the technology	• RAFT postcard to local community member regarding climate change in VT • Site analysis visits with energy consultants for potential implementation at VUMS/VUHS • Working with VEEP to determine cost benefit analysis to VUMS/VUHS for each alternative energy source • Drafting report	• Revising and editing findings and writing • Run through presentations • Team vote on most viable energy source for VUMS/VUHS • Presentation to the school board