Meeting Energy Needs

Begin with the End in Mind – Energy Project

- People have many reasons for disagreeing about how to resolve local energy resource challenges.
- Electricity needs of a community can be met by advocating sweeping conservation efforts or by generating more electricity with non-renewable nuclear or fossil fuel power plants or renewable, alternative energy sources.
- Impacts of each energy transformation alternative need to be carefully evaluated and presented to all affected stakeholders before a proposal is decided upon.

Identify the content standards that students will learn in this project

Physical Science Content Standards – High School: Apply that energy exists in various forms, and its transformation and conservation occur in processes that are predictable and measurable.

1. Society and energy providers must conduct a cost-benefit analysis of different ways to provide electricity to our society.
2. An understanding of energy transformations is necessary when designing clean energy systems that convert any type of energy into electricity such as wind generators and solar cells.
3. Politics plays a role in shaping energy policy such as balancing conflicting stakeholder needs.

Earth Science Content Standards – High School: There are costs, benefits, and consequences of exploration, development, and consumption of renewable and nonrenewable resources.

Evidence Outcomes – Students can:

a. Develop, communicate, and justify an evidence-based scientific explanation regarding the costs and benefits of exploration, development, and consumption of renewable and nonrenewable resources
b. Evaluate positive and negative impacts on the geosphere, atmosphere, hydrosphere, and biosphere in regards to resource use

National Science Education Standards – Physical Science-Conservation of Energy and the Increase in Disorder

a. The total energy of the universe is constant. Energy can be transferred by collisions in chemical and nuclear reactions, by light waves and other radiations, and in many other ways. However, it can never be destroyed. As these transfers occur, the matter involved becomes steadily disordered.

National Science Education Standards – Science in Personal and Social Perspectives: Content Standard F, grades 9-12, Specifically:

a. The earth does not have infinite resources; increasing human consumption places severe stress on the natural processes that renew some resources, and it depletes those resources that cannot be renewed.
b. Natural ecosystems provide an array of basic processes that affect humans. Those processes include maintenance of the quality of the atmosphere, generation of soils, control of the hydrologic cycle, disposal of wastes, and recycling of nutrients. Humans are changing many of these basic processes, and the changes may be detrimental to humans.
c. Individuals and society must decide on proposals involving new research and the introduction of new technologies into society. Decisions involve assessment of alternatives, risks, costs, and benefits and consideration of who benefits, who suffers, who pays and gains, and what the risks are and who bears them. Students should understand the appropriateness and value of basic questions – "What can happen?" – "What are the odds?" – and "How do scientists and engineers know what will happen?"

The ORIGINAL Driving Question

How should your local government handle the exponentially increasing electrical demand of the rapidly exploding population in our area? Should a new power plant be built? If you conclude that it should not, what solutions do you propose for resolving the brownout and blackout problems that are occurring more frequently? If you assert that a new plant should be built, do you recommend a fossil fuel or alternative energy generating plant and where should it be sited? What constraints and considerations guide your choice of type of electrical generating plant and the location where it should be built?

Performance Objectives/Targets-

Early:

Students dramatize a community forum in which community members express radically different and passionate concerns/complaints about electrical brownouts and blackouts that have occurred as a result of dramatically increased demand due to rapidly increased population and increased individual use. Through this dramatization, students are made aware of different stakeholder needs and convictions with respect to meeting the increased demand for energy.

By examining the issues of fossil fuel and alternative energy sources for generating electrical energy as well as the option of conservation, students consider various options for meeting need in an underserved area.

Students calculate the efficiency of multi-step transformation processes and conclude that efficiency is an important factor in electricity generation that must be taken into account in seeking alternate sources of electricity.

By researching electrical power generation simulations, students evaluate the various techniques for generating electricity, comparing and contrasting costs and benefits to fossil fuel generation (Summary Tables).

Through in-class activities, students explore environmental impacts of fossil fuel power generation, from mining to transportation of fuel to producing electricity, and compare these impacts to those of alternative generation methods.

During:
Using GIS, students learn to use multiple criteria to evaluate optimal location sites for a wind farm in our area.

End:
Summative Project: using GIS and criteria specified for locating a fossil fuel power plant in southeastern Wisconsin, propose two prospective sites meeting the five stated mandatory

requirements as well as other factors that indicate preference of one site over another. Argue for the preferred location. Present findings in a word document supported with layouts of proposed sites.

Plan the Assessment

Step 1: Define the products and artifacts for the project:

Early in the Project:

Stakeholders' analyses.

Efficiency calculations for multi-step processes. Various approaches to improving efficiency. Summary statements.

Fossil Fuel and Alternative Energy Summary Tables.

During the Project:
GIS products – siting a wind farm in our area

End of Project:

Word document responding to charge: present two prospective sites on which to locate a new fossil fuel power plant in southeastern Wisconsin. Argue persuasively for the site you prefer. Present layouts of proposed sites, referenced in word document.

Map the Project

Product: PowerPoint or Poster, including GIS layouts, summary compilations, recommendations for preferred solution

Knowledge and Skills Needed	Already	Before	During
Understand the problem		X	
Know about Different Types of Energy, Transformations, and Efficiency		X	
Know Environmental Impacts of Alternatives		X	X
Have Internet Research Skills	X		
Have ArcGIS Skills	X	X	
Environmental Decision-Making Process			X
Presentation Skills	X		

Map the Project:

Week 1	Mock community forum presenting stakeholder viewpoints. Introduce stakeholder charts	Film: Kilowatt Ours- presenting issues and alternatives to meeting electrical energy needs	Internet research: Compare fossil fuel, hydroelectric, nuclear, and alternative methods of generating electricity	Film-20-mile Mine (issues of mining coal needed for modern coal-fired power plants)
Week 2	Class Activity- Calculating Efficiency in Multi-Step Processes	Explore GIS Applications- Wind Farm Siting Project	Continue Wind Farm Siting Activity	Complete Wind Farm Siting Activity
Week 3	Introduce Assessment: Siting a Fossil Fuel Power Plant in SE Wisconsin	Individual work on Power Plant Siting Project	Individual work on Power Plant Siting Project	Complete work on Power Plant Siting Project

Dear Environmental Scientist task force:

The Board of Directors of Midwest Power, Inc., has completed its review of local supply and demand of electricity. At last week's meeting, the Board decided to increase our operations in the southeastern Wisconsin market. We intend to proceed with initial locating plans for a coal-burning power plant to be built somewhere in the Lake Geneva, WI area. This is a temperate area of rolling farmland, with many lakes and streams, and many hardworking and honest people who will soon join the Midwest Power family.

I would like your task force to prepare a location report for Midwest Power, Inc. that describes two preferred locations and argues persuasively for the best location within this area to locate a coal-burning power plant. The chosen location should facilitate the movement of resources to and from the power plant and be welcomed by the local population. It needs to be both economically and environmentally sound.

Our engineers have decided that a 350-megawatt plant is needed to meet the electricity needs of the region. A plant of this size requires at least 5 acres of land just for buildings and storage for the plant. It also requires the plant to be located near the shores of a lake with at least 13,000,000 cubic meters of water for cooling. A zone of 5 km around the chosen lake is expected to feel most of the effects of the power plant. Additionally, the plant needs to be within 2.5 miles of railroads, as rail is by far the most economical method for shipping coal. Highway access within 1.0 mile is also important and, of course, the plant must be located on land that is both affordable and that minimizes any potential for negative environmental and community impact.

Please prepare a report that presents two prospective sites and argues persuasively for the most preferred site. Include a detailed rationale for each of your sites and an explanation of the techniques that you used to reach your decision. I will review the list and then forward it to the Board of Directors for the final decision.

I appreciate your willingness to tackle this challenging and important task.

Rubric Template:

Deliverables:	**0**	**1**	**3**	**5**
Map (NO Red Exclamation Points)				
• 10 layers provided (not all must be used) • 3 buffered layers • 1 intersect layer • 1 final layer after erase • 2 final sites selected as polygons and included as layers • CREATIVE BONUS	Not submitted	• 2 layers • 1 buffered layer	• 6 layers • 2 buffered layers	• All ten layer • 3 buffered layers • 1 intersect layer • I final layer • 2 final sites
Map layout(s) • Study Area and Site locations clearly visible and labeled • Map components complete (N-S arrow, Map Scale, Labels (cities, lakes, etc.) clearly visible, Site Choices labeled	Not included Not included	1 component present	3 components present	• 2 sites clearly visible and labeled • ALL Map components present
Writing Mechanics	Errors repeatedly distract the audience and major editing and revision is required.	Spelling, punctuation, and grammar errors distract from or impair readability.	The text is clearly written with little or no editing required for grammar, punctuation, and spelling. (3 or more errors)	The text is written with no errors in grammar, capitalization, punctuation and spelling.

Content:	**0**	**1**	**3**	**5**
MS Word Document Arguing for Sites 1 and 2 and distinguishing a preference	Content lacks any connection with assignment.	Content lacks a clear point of view and logical sequence of information. Includes little persuasive information and includes only one or two facts about the topic. Information is incomplete, out of date, and/or incorrect. Sequence of ideas is unclear.	The content is vague in conveying a point of view and does not create a strong sense of purpose. Includes some persuasive information with some facts. Information may not seem to fit. Sources appear unreliable.	The content is written clearly and concisely with a logical progression of ideas and supporting information. Audience immediately has a clear sense of the main idea or claim. Information is accurate, current and from reliable sources.
Data and Analysis Supporting Sites 1 and Site 2 Claim: An assertion or conclusion that answers the original question Evidence: Scientific data that support the claim. The data need to be appropriate and sufficient to support the claim. Analysis: A justification links the claim and evidence and shows why the data count as evidence to support the claim by using appropriate and sufficient scientific principles	No claims, evidence or analysis offered	1 argument supports each claim Data support 1 argument Analysis follows from 1 argument	3 arguments support each claim Data support 3 arguments Analysis follows from 3 arguments	5 arguments support each claim Data support 5 arguments Analysis follows from 5 arguments
Final Site choice	Not addressed	No reasonable justification for preference	Justification shows one site over the other an one or two factors	Justification accounts for all factors, may include qualifications for uncertainties

Process:	**0**	**1**	**3**	**5**
(Timely contributions/ Collaboration with partners)	Did not Contribute/ collaborate	Rarely focuses on the task and what needs to be done. Lets others do the work. Chooses not to participate and does not complete assigned tasks.	Focuses on the task and what needs to be done only with reminders from teacher or partner(s) to stay on task. Makes occasional satisfactory contributions to what is required.	Is consistently focused on the task and what needs to be done. Very self-directed. A true team member and leader who contributes a lot of individual effort and encourages and supports the efforts of partner(s)
Deliverables:	**0**	**1**	**3**	**5**
(Final Product Components)				
PowerPoint or Poster Presentation	Not submitted	Presentation style shows little structure, is cluttered, confusing, distracting, with no spacing, headings, sub-headings or white space	Presentation style uses horizontal and vertical white space appropriately with a sensible structure	Presentation style is visually pleasing and contributes to the overall message with effective use of headings, sub-headings and white space.
2 Map layouts per partner	Not included	Layouts are not relevant to claims, lacking title, scale, legend and/or other information needed to understand a connection with claims.	Layouts are either relevant to claims but lacking in necessary map details or vice versa.	Layouts clearly support claims and have all the required map components.
Text Discussion	Not included	Text is extremely difficult to read, with long blocks of text in small font size, distracting background and/or effects.	Text is too long or too short, sometimes effective, sometimes busy or detracts from readability.	Text is appropriate in length and to the point. Choice of background and font enhances readability of the text.
Citations	None included	No way to check the validity of information. Sometimes incomplete reference information is provided for data, photos and graphics.	Most sources are properly credited so that it is possible to check on the accuracy of information.	All sources of information are properly cited and the audience can readily determine the credibility and authority of the information presented.
Writing Mechanics	Errors repeatedly distract the audience and major editing and revision is required.	Spelling, punctuation, and grammar errors distract from or impair readability. (3 or more errors)	The text is clearly written with little or no editing required for grammar, punctuation, and spelling.	The text is written with no errors in grammar, capitalization, punctuation and spelling.

Content:	**0**	**1**	**3**	**5**
Components: Global Water considerations CO surface water per capita Local water uses, potential disruptions Proposal for sustainable community action	Content lacks any connection with assignment.	Content lacks a clear point of view and logical sequence of information. Includes little persuasive information and includes only one or two facts about the topic. Information is incomplete, out of date, and/or incorrect. Sequence of ideas is unclear.	The content is vague in conveying a point of view and does not create a strong sense of purpose. Includes some persuasive information with some facts. Information may not seem to fit. Sources appear unreliable.	The content is written clearly and concisely with a logical progression of ideas and supporting information. Audience immediately has a clear sense of the main idea or claim. Information is accurate, current and from reliable sources.
Data and Analysis Supporting Claim Claim: An assertion or conclusion that answers the original question Evidence: Scientific data that support the claim. The data need to be appropriate and sufficient to support the claim. Analysis: A justification links the claim and evidence and shows why the data count as evidence to support the claim by using appropriate and sufficient scientific principles	No claims, evidence or analysis offered	Claim is inaccurate based on other information provided. Does not provide evidence, or only provides inappropriate evidence (not supporting the claim). Does not provide analysis, or only provides reasoning that does not link evidence to the claim.	Makes an accurate but incomplete claim. Provides appropriate, but insufficient evidence to support the claim. May include some inappropriate evidence. Provides analysis that links the claim and evidence. Repeats the evidence and/or includes some scientific principles, but not sufficient to convince.	Makes an accurate and complete claim. Provides appropriate and sufficient evidence to support the claim. Provides analysis and reasoning that links evidence to the claim. Includes appropriate and sufficient scientific principles.
GIS utilized	No GIS included	Map layouts bear little relationship to claims	GIS supports claims	GIS visualizations clearly enhance arguments and support claims. Suggestions for future analysis are proposed.