The Isle of Navitas: Towards a Better Understanding of Energy and Decision Making Using GIS

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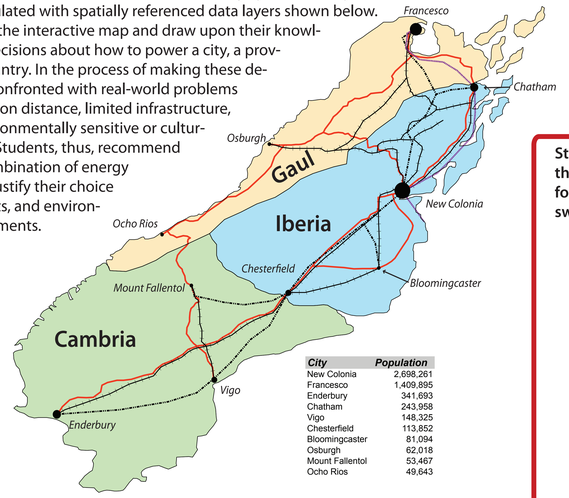
Welcome to Navitas

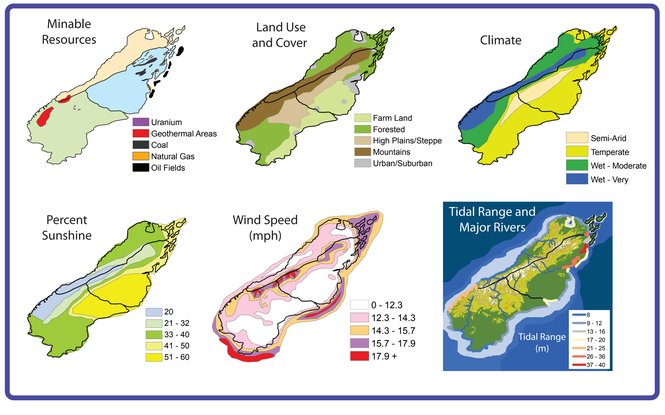
What is Navitas?

The Isle of Navitas (latin for energy) is a fictional island nation that is the core of the capstone activity for an 8 week interdisciplinary technology-supported middle school science inquiry unit about energy. This curricular unit focuses on the world's energy resources. Students use geospatial information technology (GIT) tools including My World GIS and Google Earth, and inquiry-based lab activities to investigate energy sources, production, and consumption. The population, land area, and energy needs of Navitas are patterned roughly after Pennsylvania and the island is populated with spatially referenced data layers shown below. Students manipulate the interactive map and draw upon their knowledge base to make decisions about how to power a city, a province, or the whole country. In the process of making these decisions students are confronted with real-world problems including transportation distance, limited infrastructure, and resources in environmentally sensitive or culturally significant areas. Students, thus, recommend the most efficient combination of energy sources and have to justify their choice with the benefits, costs, and environmental impact assessments.



City	Population
New Colonia	2,698,261
Francesco	1,409,895
Enderbury	341,693
Chatham	243,958
Vigo	148,325
Chesterfield	113,852
Bloomingcaster	81,094
Osburgh	62,018
Mount Fallentol	53,467
Ocho Rios	49,643

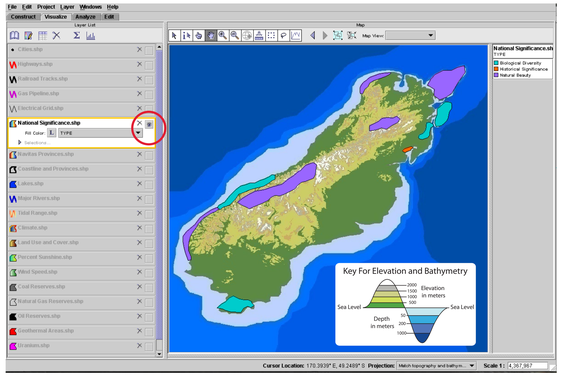
Data Layers for the Isle of Navitas Include



Part 1: Exploring Resources

The first part of this activity is dedicated to taking stock of the resources available to power the society that lives on the island. Students are presented with a base map of the Isle of Nativats showing topography and bathymetry to which they can start adding any number of spatially referenced data layers using the My World GIS interface. (http://www.myworldgis.org)

Students can manipulate the data that they see in order to make descsions about the viability of different energy resources for their province as they consider how to power a city, a province, or the country as a whole. Here the "National Significance" layer is turned on and shows the location of different types of protected areas in Navitas.



Student Activity

Students are responsible for evaluating the resources available in their province for each potential energy resource by answering a series of questions.

1) Where in this province is the most suitable location for the appropriate power generation plant?

2) Does the transportation infrastructure and/or electrical grid exist near your proposed power generation location?

3) What infrastructure is needed to develop the resource? For example, what facilities or infrastructure will be needed to produce and then use this resource?

4) What are the benefits of using this resource? What are the environmental or other impacts of using this resource?

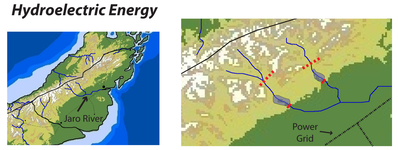
Interpretation and Analysis

Assessment

Students draw upon their knowledge base from the rest of the instructional module to answer these questions for the various power generation options available to them and then they are asked to assess the use of individual resources from 1 - 5 (1 = poor option, 5 = best option) including justification for their assessment drawn from their answers to the above questions.

Activity Example Using the Province of Iberia

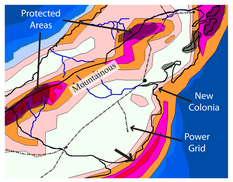
Hydroelectric Energy



Maps showing the locations of dams along the Jaro River that are most feasible given the wide valleys that drain the mountains in the this area (red dashed lines = 10 km). These dams would not create huge reservoirs, but rather smaller ones like those shown. These locations benefit from being close to the existing power grid.

Wind Energy

Red and purple areas indicate sufficient average wind speeds for energy production, however here students must decide how the potential benefits of clean energy are offset by the costs of developing costs of developing wind power in a protected mountainous area or off shore.



Tidal Energy

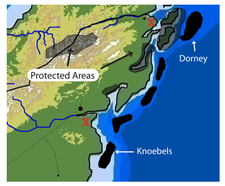
The most ideal location for tidal power generation is indicated by the black arrow, where the funnel shape of the coastline causes a large tidal range. The inlet to the north (indicated by the navy blue arrow) also has a large tidal range, however it is not as close to a large city or the power grid, and lies within an area that is protected for it's biological diversity.

Fossil Fuels

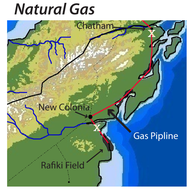
Iberia contains ample reserves of coal, petroleum, and natural gas and therefore all are viable options for energy generation. However, as students have already learned, these resources have the potential for detrimental environmental impacts both during extraction, transport, and energy generation. In addition several of the largest fossil fuel deposits are located next to or within protected areas of national significance.

Coal

Petroleum



Natural Gas



Students are responsible for deciding where power generation plants would be located for each potential power source. Possible sites that minimize transport distance and maximize use of existing infrastructure are indicated using X's.

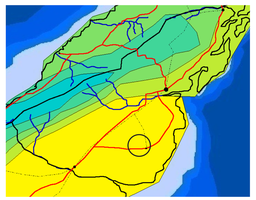
Because not all fossil fuel deposits are created equal, students can use the attribute tables to find out how productive a particular coal, crude oil, or natural gas field may be.

10 Records (of 10) Find... Make Selection from Rovie Exchange Rovie & Columns Export...

	NAME	Area (computed) m^2	Perimeter (computed) m	ID	AMOUNT (billions of Tonnes)
1	Steel Force	989,992,192	176,701.2188	0	88
2	Hydra	1,400,943,872	266,911.9375	0	75
3	Great Bear	129,590,968	56,585.2031	0	11
4	Crazy Mouse	123,555,672	75,820.8594	0	9
5	Talon	135,699,456	55,962.1211	0	8
6	Cornet	63,925,192	50,186.5352	0	5
7	Wildcat	128,070,960	98,607.6641	0	4
8	Ravine Flyer	61,023,036	64,624.2109	0	3
9	Laser	63,356,416	41,745.1406	0	2
10	Little Laser	24,546,176	25,919.2676	0	1

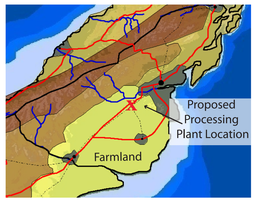
It is important to note that the global and regional distributions of energy resources and demand are very non-uniform and Navitas was designed to reflect this. As such, not every method of producing energy will be cost effective or feasible in any single province. It is up to the students to make honest assessments of the resources they are presented.

Solar Energy



Map showing the percent sunshine for Iberia, the yellow area in the southeast receives enough sun to make it suitable for solar power generation and the proximity of transmission lines and cities make it a good option. An ideal location for a solar plant is indicated by the circle.

Biofuels/Biomass



Map showing the distribution of farmland and transportation infrastructure necessary for biofuel/biomass production. The red "X" denotes an ideal location for a proposed processing plant since it is located along the transmission line and a highway. It is also close to a city.

Part 2: Students as Energy Planners

Students are given the position of chief energy officer (CEO) of one of three provinces on the Isle of Navitas. Their task is to develop an energy policy for their province that provides sufficient energy to meet the demand of the population, while minimizing the environmental impact. The energy demands and resources to meet that demand are indicated in the table below.

Province			*Cambria*	*Gaul*	*Iberia*
Population (thousands)			734	1,902	4,392
Energy Need (MW)			7,340	19,200	43,900
Energy Sources	Impact Assessment Domestic	Impact Assessment Imported	*Province Energy Resources*		
Tidal	2	3	200	1,000	10,000
Hydro	1	2	5,000	12,000	2,000
Solar	8	9	100	1,000	2,000
Wind	4	5	5,000	100	500
Biofuels	50	60	200	10	100
Geothermal	2	3	400	100	0
Oil	100	110	0	0	20,000 (50 years)
Gas	60	65	0	0	20,000 (30 years)
Coal	200	250	0	0	50,000 (100 years)
Nuclear	10	11	9,000 (40 years)	0	0

In defending their decisions for implementing various energy sources students are encouraged to consider the following questions:

1. What efficient combination of energy sources do you recommend for your province?
2. Is it better to import cleaner energy (either raw material or power through the grid) from other provinces or use locally generated power from your province?
3. Describe the locations in your province that you recommend to locate new energy-generating plants. Clearly explain why you would you build the energy-generating plants in those locations?
4. What major infrastructure (such as building facilities) is required to develop your recommended energy sources?
5. What major transportation infrastructure (such as existing highways, railroad tracks, pipelines, and grid) are required for your recommended energy sources?
6. What are the major benefits (such as free and unlimited supply, no/little pollution) of your recommended energy sources?
7. What are the environmental impacts of your recommended energy?
8. Provide recommendations for energy conservation for the Isle of Navitas. What can citizens do to conserve energy?