

Investigating Energy Resources for the Isle of Navitas with Web GIS Teacher Guide

IMPORTANT NOTE: Prior to implementing this activity with your students, please refer to **Investigating Energy Resources for the Isle of Navitas with GIS Assessments** for each province and its accompanied **Visual Guide to Assess the Isle of Navitas Activity** to assist you with additional content knowledge about this activity.

Describe the following scenario to your students:

You are the chief energy officer (CEO) of one of three provinces on the Isle of Navitas, an island about the size of Pennsylvania. It has a population of about 7,000,000 people. Your task is to explore the energy resources for your province using Web GIS to recommend an efficient combination of energy sources that will minimize the impact on the environment. You will

1. Explore energy resources for the Isle of Navitas.
2. Analyze the benefits and costs of each energy source.
3. Analyze the environmental impacts of each energy source.
4. Recommend an efficient combination of energy sources for your province.



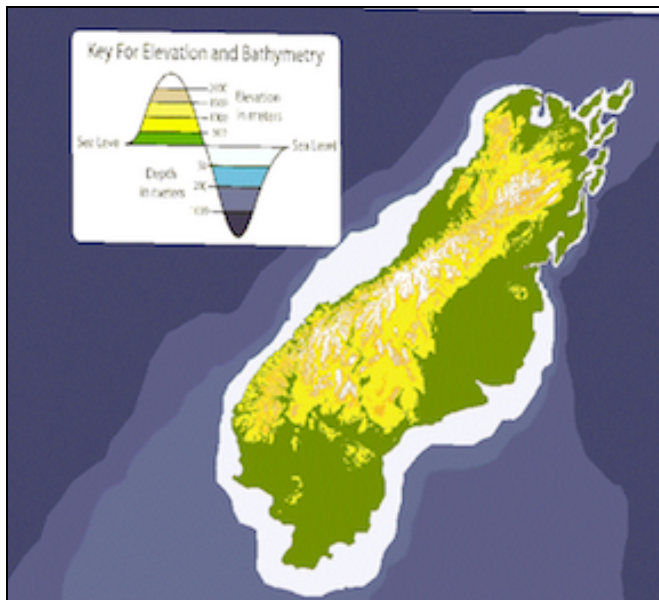
Step 1: Download data.

1. Open your Web browser. Go to www.ei.lehigh.edu/learners/energy/
2. Click on **Investigating Energy Resources for the Isle of Navitas with My World GIS.**




Step 2: Basic Features of Web GIS

- a. Your screen should open to a view of the Isle of Navitas as shown in the picture below.




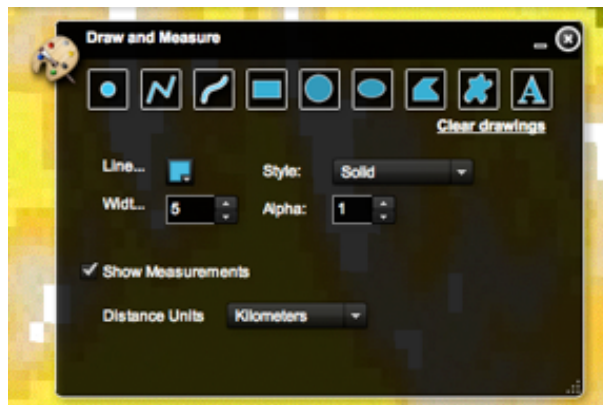
- b. To navigate in Web GIS students can use the navigational tools (# 1) or the hand (# 2). They can move around the map by selecting different areas or scrolling to them.
- c. Students can zoom in on an area by using the zoom in tool options (# 3).
- d. A map scale is located in the bottom left corner of the map.






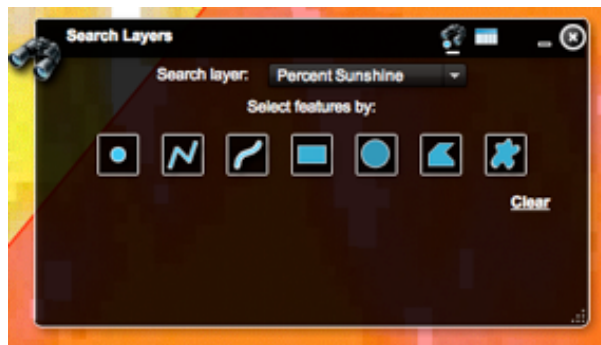
- e. Students can get back to the main view by using the **Bookmark** icon in the toolbar at the top of the screen (# 2 below). In the window that appears, select **Navitas, Complete View or Alternate View**. These views will vary based on the computer platform you are using or the size of your computer screen.
- f. The data for each layer can be activated using the **Map Legend Tool** (# 1 below). Place the mouse over this box and click on it. The Map Legend window will appear. In the Map Legend box, activate the data layer you wish to display by clicking in the checkbox. You can expand or shrink a legend item by clicking on the globe icon next to each data layer label.
- g. To observe the legend for a specific data layer, select the globe icon  next to that item in the list (# 3). The legend can be closed by clicking the globe icon a second time.



- h. A **Draw and Measure tool**  is located on the top toolbar. This is a useful feature that can be used for measuring distances between locations on the Web GIS.



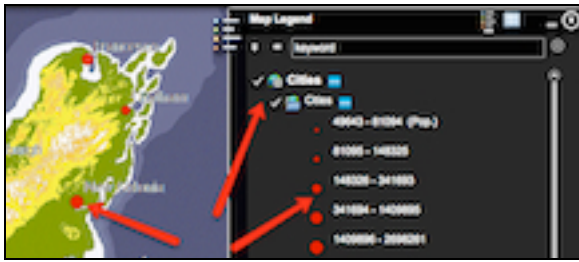
- i. You can use the **Search tool**  located on the top toolbar to obtain data in the GIS layers. Select the data layer you wish to gather information from by using the **Search layer** dropdown menu. Next, **select features by** clicking on a drawing shape. Then, click on the area on the Web GIS map that you wish to obtain data from. The **Draw Point** tool  is used to obtain a single location. The shape and polygon draw tools  can be used to obtain data from larger areas in the GIS.



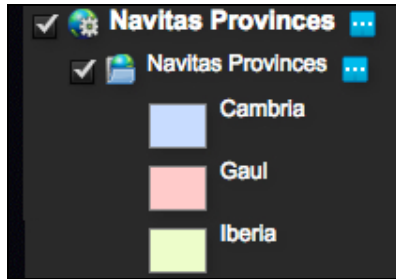
Step 3: Explore energy resources.

The Web GIS shows the elevation and bathymetry of the Isle of Navitas. Elevation is how high the ground is above sea level. Bathymetry is how deep the ocean is in a particular area. Topography is a map of elevations and bathymetry. Model the following procedural steps with your students to become familiar with displaying the Web GIS legend and key.

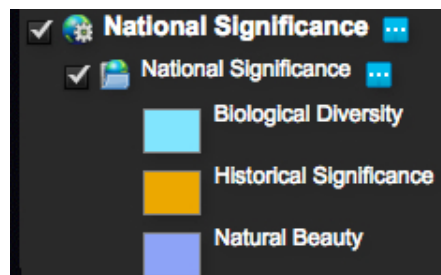
1. Click on the **Cities** layer to make it active. The population bar and legend can be displayed in the Map Legend box as described above. Expand the legend as shown to the right to display the population key and legend. The big red circles on the map represent cities with larger populations and the small red circles represent cities with smaller populations.




2. Locate the **Navitas Provinces** layer. Click the square to display this layer. This layer displays the three provinces of the Isle of Navitas: Cambria, Gaul, and Iberia. Expand the layer to view the legend key.



3. Turn the **Navitas Provinces** layer off.
4. Turn the **Coastline and Provinces** layer on. This layer outlines the coastline and the province boundaries.
5. Turn the **National Significance** layer on. This layer displays locations of biological diversity, historical significance, and natural beauty. These are protected areas.



6. Have students **zoom in**  to their assigned province to explore the different energy resources.

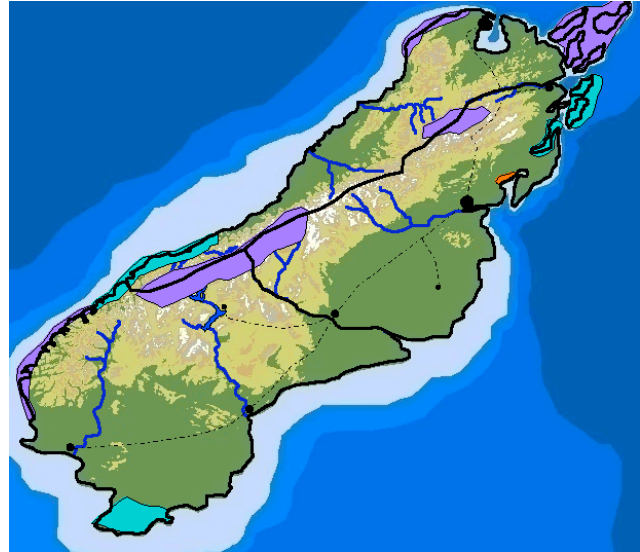
Hydroelectric Power: Steps 7 – 9

Thought process: The factors needed to determine the ideal location of a hydroelectric dam include the topography, a canyon that can be dammed, and an area to make a reservoir upstream of the dam. Zoom in to where the streams start in the mountainous areas (light green or white). Hydroelectric power requires a power plant at the dam site and access to the grid for power distribution.

7. Click the square to turn the **Lakes** layer on. This layer displays locations of lakes.
8. Click the square to turn the **Major Rivers** layer on. This layer displays locations of major rivers.
9. Click the square to turn the **Electrical Grid** layer on. This layer displays the grid that transmits and distributes electricity to the cities.

The following layers should now be turned on for hydroelectric energy:

- i. Coastline and Provinces
- ii. National Significance
- iii. Lakes
- iv. Major Rivers
- v. Electrical Grid



Prompt students to use the GIS map and their Impacts of Energy Sources Investigation sheet to complete the **Hydroelectric Power** table and the rating on their investigation sheet.

10. Click the square next to the **Lakes** and **Major Rivers** layers to turn them off.

Tidal Energy: Step 11

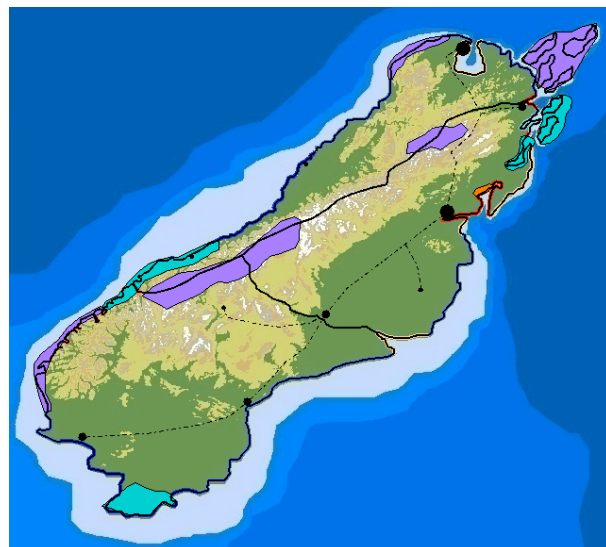
Thought process: The factors needed to determine the ideal shore location of a tidal power plant include a large tidal range and a funnel shaped shoreline pointing inland. Tidal power requires a power plant at the coast and access to the grid for power distribution.

11. Click the square to turn the **Tidal Range** layer on. This layer displays the tidal range. The tidal range **bar and legend** are displayed by selecting the globe icon next to the data layer.

The following layers should now be turned on for tidal energy:

- i. Tidal Range.shp
- ii. Coastline and Provinces.shp
- iii. National Significance.shp
- iv. Electrical Grid.shp

If needed, turn the **Coastline and Provinces** and **National Significance** layers off to see the tidal range on the map.





Prompt students to use the GIS map and their Impacts of Energy Sources Investigation sheet to complete the **Tidal Energy** table and the rating on their investigation sheet.

12. Click the square next to the **Tidal Range** layer to turn it off.

Biofuels/Biomass: Steps 13 – 17

Thought process: The factors needed to determine the ideal location for biomass production include lots of level farm land (may need to fertilize and water) and transportation infrastructure to get the fuel to a processing plant. Biofuels/Biomass production requires a biofuel processing plant. Although biofuels are most commonly used for transportation, they can be used to create electricity. To do this, an energy generating plant with access to the grid is also needed for power distribution.

13. Click the square at the right end of the **Climate** layer to turn it on. This layer displays the different types of climate.

The keys in the panel on the right display the type of climate and corresponding precipitation. Precipitation is the annual (yearly) amount of rain.

14. Click the square next to the **Climate** layer to turn it off.

15. Click the square to turn the **Land Use and Cover** layer on. This layer displays the different types of land use and ground cover.

The land use and cover **key** is displayed in the Map Legend box.

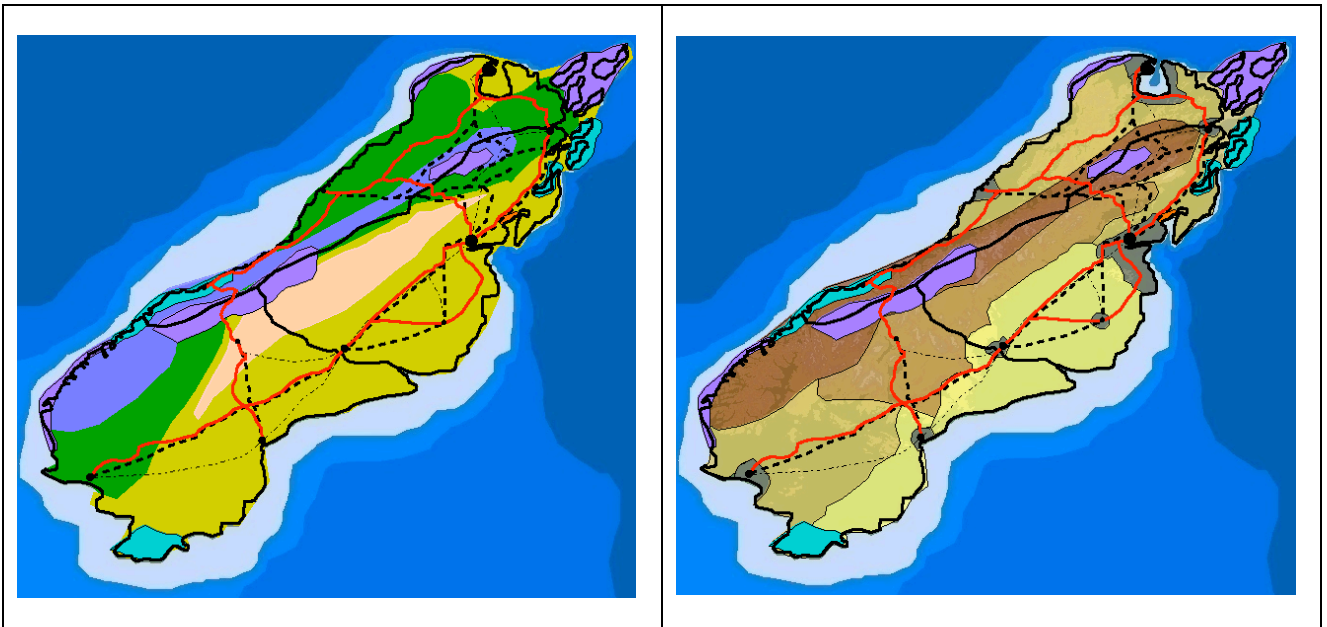
16. Click the square to turn the **Highways** layer on. This layer displays the major highways that are used for transportation.

17. Click the square to turn the **Railroad Tracks** layer. This layer displays the railroads used for transportation.

The following layers should now be turned on for biomass:

- i. Coastline and Provinces
- ii. National Significance
- iii. Climate
- iv. Land Use and Cover
- v. Highways
- vi. Railroad Tracks
- vii. Electrical Grid

Go back and forth between the **Climate** and **Land Use and Cover** layers to determine a good location for producing biomass.



Prompt students to use the GIS map and their Impacts of Energy Sources Investigation sheet to complete the **Biofuels/Biomass** table and the rating on their investigation sheet.

18. Click the square next to the **Climate, Land Use and Cover, Highways, and Railroad Tracks** layers to turn them off.

Solar Energy: Step 19

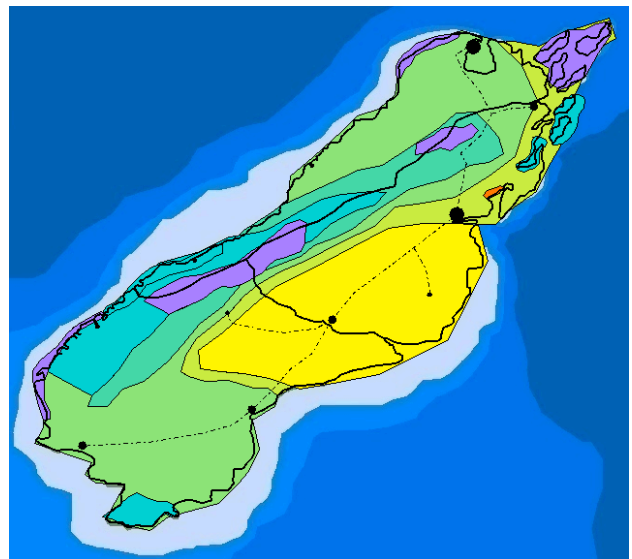
Thought process: The factors needed to determine the ideal location of a solar power plant include lots of open flat areas, lots of sunshine, and no shadowing trees or buildings. Solar energy requires infrastructure to make power and distribute electricity to the grid.

19. Click the square to turn the **Percent Sunshine** layer on. This layer displays the percent annual average sunshine.

The percent sunshine **bar and legend** can be displayed in the Map Legend box.

The following layers should now be turned on for solar energy:

- i. Coastline and Provinces
- ii. National Significance
- iii. Percent Sunshine
- iv. Electrical Grid





Prompt students to use the GIS map and their Impacts of Energy Sources Investigation sheet to complete the **Solar Energy** table on and the rating their investigation sheet.

20. Click the square next to the **Percent Sunshine.shp** layer to turn it off.

Wind Energy: Step 21

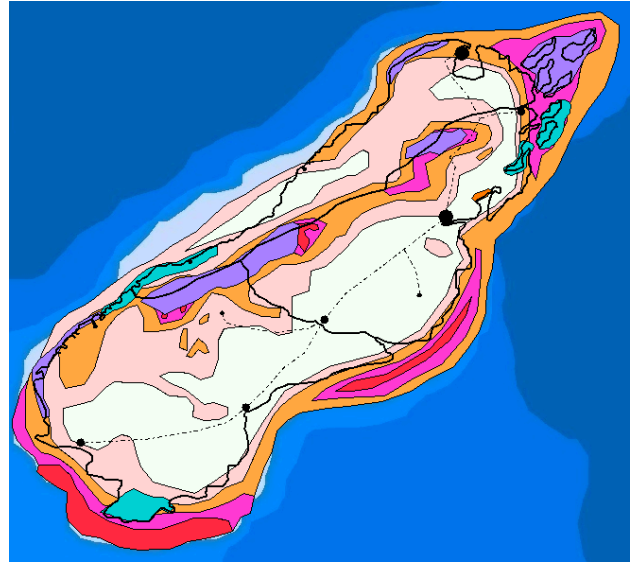
Thought process: The factors needed to determine the ideal location of a wind farm include enough sustained winds and grid access for power distribution.

21. Click the square to turn the **Wind Speed** layer. This layer displays the wind speeds.

The wind speed **legend** can be viewed in the Map Legend box.

The following layers should now be turned on for wind energy:

- i. Coastline and Provinces
- ii. National Significance
- iii. Wind Speed
- iv. Electrical Grid



Prompt students to use the GIS map and their Impacts of Energy Sources Investigation sheet to complete the **Wind Energy** table and the rating on their investigation sheet.

22. Click the square next to the **Wind Speed** layer to turn it off.

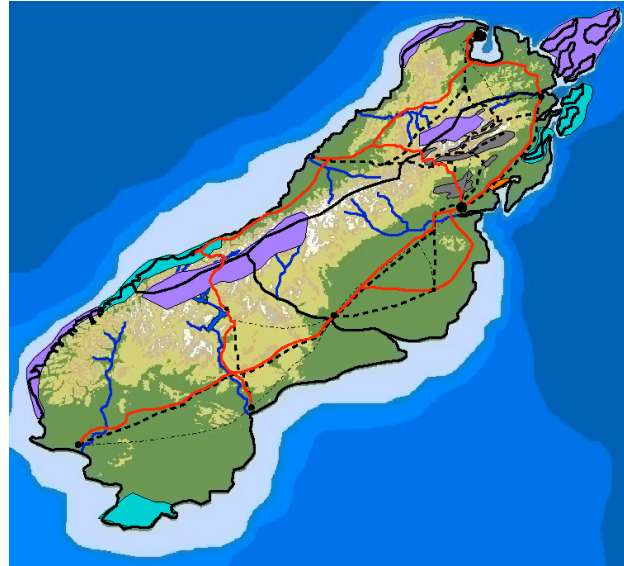
Coal: Steps 23 – 24

Thought process: The factors needed to determine the ideal location of a coal-fired power plant include transportation infrastructure for fuel delivery, water for the electrical generation plant, storage of solid waste produced by the plant, and access to the grid for power distribution.

23. Click the square to turn the **Coal Reserves** layer on. This layer displays locations of coal reserves.
24. Click the square at the right end of the **Highways, Railroad Tracks, Lakes, and Major Rivers** layers to turn them on.

The following layers should now be turned on for coal:

- i. Coastline and Provinces
- ii. National Significance
- iii. Coal Reserves
- iv. Highways.shp
- v. Railroad Tracks
- vi. Lakes
- vii. Major Rivers
- viii. Electrical Grid



Prompt students to use the GIS map and their Impacts of Energy Sources Investigation sheet to complete the **Coal** table and the rating on their investigation sheet.

25. Click the square next to the **Coal Reserves, Highways, Railroad Tracks, and Electrical Grid** layers to turn them off.

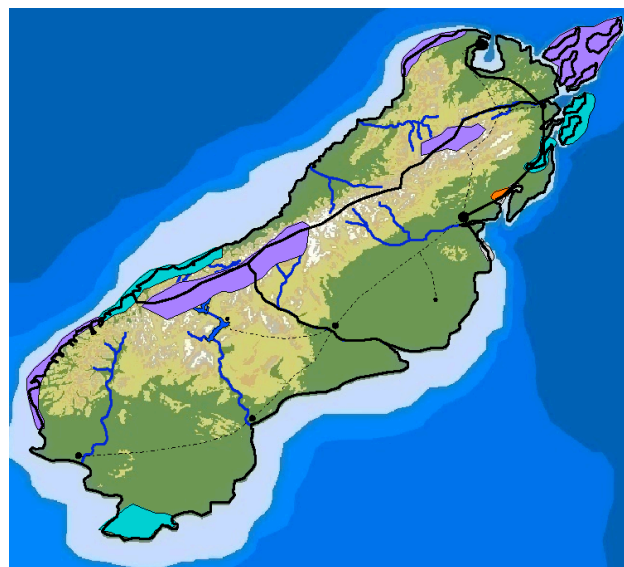
Natural Gas: Steps 26 – 27

Thought process: The factors needed to determine the ideal location a natural gas power plant include pipelines for fuel delivery, water for the electrical generation plant, and access to the grid for power distribution.

26. Click the square to turn the **Natural Gas Reserves** layer. This layer displays locations of natural gas reserves.
27. Click the square to turn the **Gas Pipeline** layer on. This layer displays pipelines used for transportation.

The following layers should now be turned on for natural gas:

- i. Coastline and Provinces
- ii. National Significance
- iii. Natural Gas Reserves
- iv. Gas Pipeline
- v. Lakes
- vi. Major Rivers
- vii. Electrical Grid





Prompt students to use the GIS map and their Impacts of Energy Sources Investigation sheet to complete the **Natural Gas** table and the rating on their investigation sheet.

28. Click the square next to the **Natural Gas Reserves** and **Gas Pipeline** layers to turn them off.

Petroleum (Crude oil): Steps 29 – 30

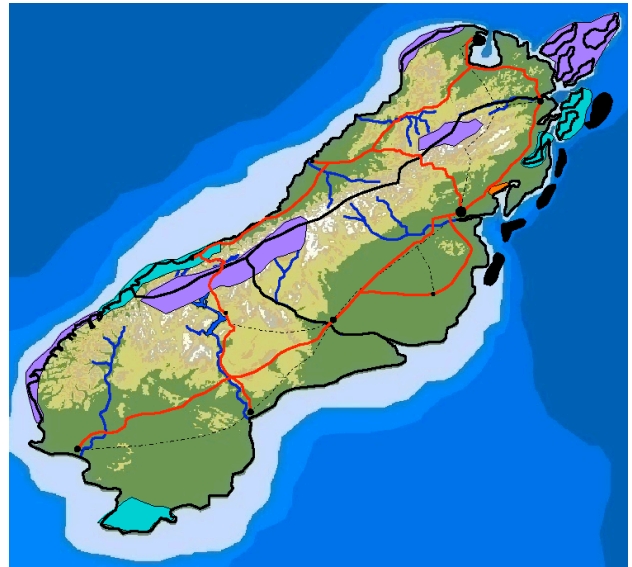
Thought process: The factors needed to determine the ideal location a petroleum (crude oil) power plant include a refinery to process the crude oil into fuel, a plant for electrical generation, water for the electrical generation plant, and access to the grid for power distribution.

29. Click the square to turn the **Oil Reserves** layer on. This layer displays locations of oil reserves.

30. Click the square to turn the **Highways** layer on.

The following layers should now be turned on for oil:

- i. Coastline and Provinces
- ii. National Significance
- iii. Oil Reserves
- iv. Highways
- v. Lakes
- vi. Major Rivers
- vii. Electrical Grid



Prompt students to use the GIS map and their Impacts of Energy Sources Investigation sheet to complete the **Petroleum (Crude oil)** table and the rating on their investigation sheet.

31. Click the square next to the **Oil Reserves** and **Highways** layers to turn them off.

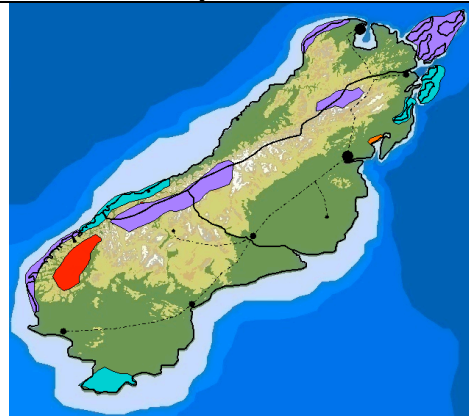
Geothermal Energy: Step 32

Thought process: The factors needed to determine the ideal location of a geothermal power plant include a hot Earth location and access to the grid to distribute electricity.

32. Click the square to turn the **Geothermal Areas** layer. This layer displays areas where the Earth is hot.

The following layers should now be turned on for geothermal energy:

- i. Coastline and Provinces
- ii. National Significance
- iii. Geothermal Areas
- iv. Electrical Grid





Prompt students to use the GIS map and their Impacts of Energy Sources Investigation sheet to complete the **Geothermal Energy** table and the rating on their investigation sheet.

33. Click the square next to the **Geothermal Areas** layer to turn it off.

Nuclear Energy: Step 34 - 35

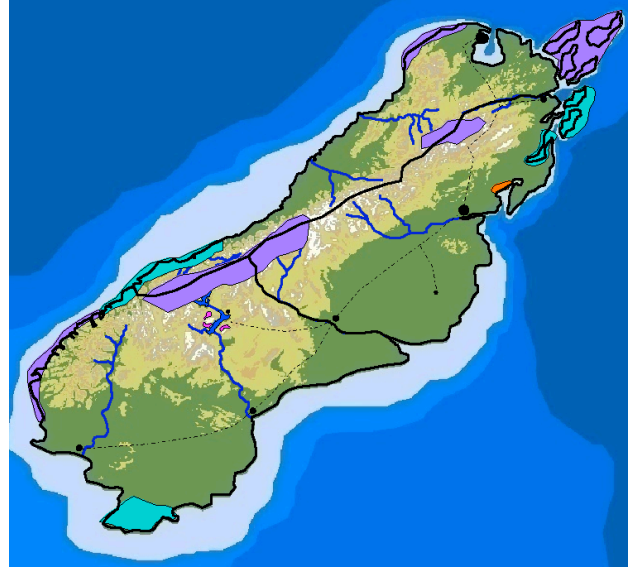
Thought process: The factors needed to determine the ideal location of a nuclear power plant include uranium mines, a plant to process the ore into fuel rods, an electrical generation plant, cooling water for power plant, grid to distribute electricity, and a place to store radioactive waste.

34. Click the square to turn the **Uranium** layer on. This layer displays locations of uranium reserves.

35. Click the square at the right end of the **Lakes** and **Major Rivers** layers to turn them on.

The following layers should now be turned on for nuclear energy:

- i. Coastline and Provinces
- ii. National Significance
- iii. Uranium
- iv. Lakes
- v. Major Rivers
- vi. Electrical Grid



Prompt students to use the GIS map and their Impacts of Energy Sources Investigation sheet to complete the **Nuclear Energy** table and the rating on their investigation sheet.

36. Click the square next to the **Uranium**, **Lakes**, and **Major Rivers** layers to turn them off.



Instruct students to analyze the completed tables on their investigation sheet to answer **questions 2 - 7**.