

Activity	Investigating Missouri's SO ₂ and NO emissions from energy plants.
Missouri Learning Standards	<p>9-12.PS3.A.3 – Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.</p> <p>9-12.ETS1.B.1 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts</p> <p>9-12.ETS1.B.2 Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem</p>
Learning Outcomes	<ul style="list-style-type: none">• I can identify and describe how energy/temperature flows within a system and transfers between systems• I can create a model that demonstrates how energy is conserved within a system and calculate the change in energy of that system

Map URL: <http://arcg.is/15bnfq>

Ask

What is being consumed and emitted in Missouri's energy plants?

- Students click on the URL above to access the map
- ? What do you think the larger circle mean on the map? (*The larger the circle, the larger the water consumption is. Students will not come to this conclusion on their own, unless they are shown the map key.*)
- ? What regions do you think will have the highest SO₂ and NO_x emissions? (*Answers will vary. At this point no correct answer is necessary; just get a feel for what the students are thinking*)

Acquire

What types of energy are being used in your region of Missouri?

- Student groups will be assigned one of the following regions of Missouri (*Northwest, Northeast, St. Louis, Central, Kansas City, Southwest, and Ozark*).
- ? What type of energy plants reside in your region? (*NW: wind-7, natural-5, petroleum-6, solar-2, bio-mass-1 NE: natural-3, petroleum-12, coal-1, other-1 STL: coal-4, petroleum-2, natural-2, solar-1 CENTRAL: solar-1, natural-6, petroleum-5, coal-1, nuclear-1, hydro-2 KC: coal-3, natural-10, petroleum-5, other-2, solar-2, bio-mass-1 SW: hydro-3, solar-2, natural-4, coal-2, bio-mass-1 OZARK: solar-2, coal-1, bio-mass-1, natural-1 SE: coal-3, petroleum-6, natural-5, other-1*)

Explore

Which types of energy plants are emitting the most SO₂ and NO_x?

- On the content tab, find the US POWER PLANTS WITH EMISSIONS. Underneath click on the 3-shape icon (circle, square, and triangle). Change the second drop down menu and select EIA Model Estimates of NO_x emission.
- ? What type of energy plant emits the most NO_x? (*Coal*)
- ? Where are those plants located and how many are within that region? (*STL-3, SE-3, NE-1, KC-1*)
- ? What type of energy plant emits the most SO₂? (*Coal*)
- ? Where are those plants located and how many are within that region? (*NE/NW-1, STL-2, SE-2*)



Analyze

Is there a correlation between types of energy and population density?

- ? Does it make sense for wind turbines to be located in less densely populated areas? (*Answers may vary; however, hopefully they realize that wind turbines take up some amount of ground space. This would be a good time to pull up pictures of some wind turbines to show the students who may have never seen them before.*)
- ? Are the hydro plants located in the areas found? (*Answers may vary, however they should make the connection that there is a vast lake and many rivers located in that region of Missouri. If not, perhaps zoom in on the map and show them the water features found in those areas.*)
- ? Are the plants that emitted more SO₂ and NO_x located in highly populated areas? (*NO_x: Just in the STL and KC regions; SO₂: just the STL region*)



Act

How can Missouri be greener?

- ? What can Missouri do to have fewer emissions? (*Answers may vary*)

Change the Data Style

- Using the Details pane, click the button, Show Contents Of Map.
- Hover over the layer name.
- Under the layer name, select the button, Change Style.
- For Choose an Attribute to Show, select an attribute to map.
- For Select A Drawing Style, select the best symbology for the data.

Identify a Map Feature

- Click any feature on the map, and a pop-up window will open with information.
- Links and images in the window are often clickable.
- An arrow icon in the upper-right of the window indicates that multiple features have been selected. Click the arrow button to scroll through the features

Next Steps

DID YOU KNOW? ArcGIS Online is a mapping platform freely available to U.S. public, private, and home schools as a part of the White House ConnectED Initiative. A school subscription provides additional security, privacy, and content features. Learn more about

WWW.ESRI.COM/GEOINQUIRIES

Version Q4 2016. Send feedback: <http://mga.missouri.edu>

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