ADVANCED ENVIRONMENTAL SCIENCE

Spinning up wind power

from the Esri GeoInquiries™ collection for Environmental Science

Audience – Advanced environmental science **Time required – 15 minutes**

Activity	This activity explores potential and developed wind capacity by state as well as challenges that Texas has faced to develop wind power.
Science Standards	**APES:** V. Energy Resources and Consumption **NGSS: HS-ESS3.** Earth and Human Activity (Natural Resources & Energy)
Learning Outcomes	• Explore current wind patterns across the U.S. and potential areas for wind power. • Investigate potential issues related to development of wind power.

Map URL: http://esriurl.com/enviroGeoinquiry11

Engage

What are the typical wind conditions in the U.S.?

→ Click the map URL link above to open the map.
→ In the Details pane, click the button, Show Map Legend.
– The map shows typical winds across the U.S.
? Where is the wind speed the highest? What direction is it blowing? *[Click the legend to see wind-speed scale. The direction is indicated by the arrow.]*
? What is your local wind speed and wind direction? [*Answers will vary.]*

Explore

Where is the highest potential capacity for wind power?

→ Click the checkbox to the left of the layer, Wind Capacity.
? What states have the highest potential for wind power based on average wind speeds and suitable land available? *[Texas, Kansas, Nebraska, Montana, North Dakota, and South Dakota]*
→ Click the markers on the map to view details of various states.
→ Hover the mouse over the layer name, Wind Capacity. Click the button, Show Table.
→ In the table, click the column header for Installed Wind Power in 1999. Sort descending.
→ In the table, click the column header for Installed Wind Power in 2015. Also sort descending
? Which state has shown the greatest increase? *[Texas]*

Explain

Why does Texas have the greatest wind-power capacity?

? What factors determine wind-power capacity? *[Average wind speed, number of windy days, land use, and topography]*
→ Turn on the Texas Wind Farm layer.
? Based on the placement of the wind turbines, where is the average wind speed the highest? *[West Texas]*
– Wind power measures the energy available in wind. Cube the wind speed to determine wind power.
? What is the power from an average wind speed of 8 mph and 10 mph? *[512 and 1,000]*

more ▶

Elaborate

How has Texas developed its wind power?

? Where are the highest power demands? *[Urban areas like Dallas.]*

→ Click the button, Measure. Choose the Distance button and set units to miles. Hint: See tool tip below for additional help.

? How far is it from a wind farm (group of linked turbines) to a large city (Dallas or Austin)? *[≈ 250 miles]*

→ Turn on the CREZ layer.

– In 2005, Texas created renewable-energy zones and installed large transmission lines to carry future wind and solar power to urban areas.

? What patterns do you notice? *[Wind farms built near lines]*

→ Zoom in on wind turbines for site details.

Evaluate

How can renewable power supply a city's electricity demands?

→ Turn on the layer, Map Notes.

→ Zoom in to Georgetown, TX. Click the pop-up to read about the city's power plans for 2017.

? How many wind turbines will Georgetown need to supply 50 percent of their power needs? (Zoom in and click individual wind turbines for detailed energy generation information.) *[50-150 wind turbines]*

? City planners cite cost savings for their choice, but what are other ways that the city could benefit? *[Better air quality, and less groundwater contamination and noise from drilling.]*

USE THE MEASURE TOOL

- Click Measure, select the Distance button, and from the drop-down list, choose a unit of measurement.
- On the map, click once to start the measurement, click again to change direction, and double-click to stop measuring.
- Hint: Position the area of interest on the map so that it is not obscured by the Measure window.

SORT IN TABLES

- Tables are only available for certain map layers.
- In the Details pane, point to the desired layer name and click the Show Table button.
- Click the Name column header and choose Sort Ascending or Sort Descending.

Next Steps

DID YOU KNOW? ArcGIS Online is a mapping platform freely available to public, private, and home schools. A school subscription provides additional security, privacy, and content features. Learn more about ArcGIS Online and how to get a school subscription at http://www.esri.com/schools.

THEN TRY THIS...

- Explore the story map by NOAA, *Understanding Ocean Wind Energy*, at http://esriurl.com/Geo4282.
- With an ArcGIS Online organizational subscription for schools, use the analysis tools to Summarize Within or Find Hot Spots to better understand how close or efficient wind turbines are nearby.

TEXT REFERENCES

This GIS map has been cross-referenced to material in sections of chapters from these texts.

- *Environmental Science for AP (2nd Edition) by W.H. Freeman and Company/BFW — Chapter 13, page 460*
- *Environmental Science: A Global Concern (AP Edition) by McGraw-Hill — Chapter 20, page 466*

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