

# Spinning up wind power

Audience – High school environmental science

Time required – 15 minutes

<b>Activity</b>	This activity explores potential and developed wind capacity by state as well as challenges that Texas has faced to develop wind power.
<b>Science Standards</b>	APES: V. Energy Resources and Consumption NGSS: HS-ESS3. Earth and Human Activity (Natural Resources & Energy)
<b>Learning Outcomes</b>	<ul style="list-style-type: none"> <li>• Explore current wind patterns across the U.S. and potential areas for wind power.</li> <li>• Investigate potential issues related to development of wind power.</li> </ul>

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



## Engage

### What are the current 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 current winds across the U.S.
- ? Where is the wind speed the highest? What direction is it blowing? *[Click the legend to see current or live wind-speed scale. The direction is indicated by the arrow.]*
- Zoom in and click individual arrows to see your local wind speed and wind direction.



## 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]*

## 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 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 ArcGIS Online and how to get a school subscription at <http://connected.esri.com>.

### 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 (2<sup>nd</sup> 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