Wind Energy's Effect on School Finances and Student Outcomes

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Outline

- Background
- Analysis data
- Results
- Take-aways!
Wind Development Over Time

Year: 1996

Cumulative MW

- 15
- 30
- 60
- 125
- 300
- 600
- 1000
- 1400

US Counties

- USWTDB
Wind Development Over Time
Wind Development Over Time

Year: 2008

Cumulative MW
- 15
- 30
- 60
- 125
- 300
- 600
- 1,000
- 1,400

USWTDB
US Counties
Wind Development Over Time

Year: 2016

Cumulative MW

- 15
- 30
- 60
- 125
- 300
- 600
- 1000
- 1400

USWTDB
US Counties
Background (i.e. Why Study This?)

Wind Money Fuels Spending and Benefits in Small Schools
The New York Times
Nov. 10, 2011
TX

Wind farm’s a cash cow for communities, but not everyone’s sold
THE BLADE
APR 7, 2019
OH

Schools reap wind benefit
The Register-Mail
Jul 12, 2018
IL

Washington’s wind power windfall
The Columbian
October 10, 2010
WA
A Dizzying Array of Tax Policies Where Wind Development Has Occurred

- Local vs. county vs. state tax policy differences
- Tax abatements and exemptions might exist
- State aid to schools might change as local revenue increases
- Tax rate and individual spending type (e.g., O&M) caps might exist
- Valuation might occur at the property vs. energy production vs. project revenue level
- Some jurisdictions have payments in lieu of taxes (PILOT)
- Rural economic zones and enterprise zones could be present
Background (i.e. Why Study This?)

**Impacts of wind power development on Oklahoma’s public schools**

Becca Castleberry and J. Scott Greene*  

Abstract  

**Background:** The development of wind energy in western Oklahoma has expanded dramatically in recent years, as the amount of installed capacity has gone from 0 in 2002 to enough turbines to generate approximately 20% of Oklahoma’s electrical needs in 2016. Associated with that development has been an increase in tax revenue and support for local schools, including many in struggling areas. This paper examines and quantifies the overall impact that increased wind-industry related tax revenue in western Oklahoma.  

**Methods:** Variables collected and analyzed for this study include: percentage of revenue from local and county sources, student-teacher ratios, and per-student expenditures. This information was obtained for each school district in the state.

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**What blows in with the wind?**

De Silva, Dakshina G. and McComb, Robert P. and Schiller, Anita R.  

Texas Tech University  

3 November 2014  

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**Wind Farm Implications for School District Revenue**

Center for Renewable Energy  
Illinois State University  
July 2011
Gaps in Wind & School Economics Literature

- Impacts across all of the U.S
- Types of expenditures, such as capital and current
- Student achievement and teacher-student ratios
- “Flypaper” vs. Tax Relief effects
Project Overview

- **Project Scope:** Is there empirical evidence that wind development has an effect on school revenue, expenditures and student outcomes?

- **Project Team:**
  - Eric Brunner, Professor of Economics & Policy, University of Connecticut
  - Josh Hyman, Assistant Professor of Economics, Amherst College
  - Ben Hoen, Research Scientist, Berkeley Lab

- **Funder:** Department of Energy Wind Energy Technologies Office
Research Questions

1. Is there empirical evidence that wind development improves school revenue nationally and at state levels?

If so:

2. How are expenditures divided among capital and current expenses?

3. Is there evidence that student outcomes (e.g., teacher-student ratios, test scores) have improved?

4. Is there evidence of a flypaper (vs. tax-relief) effect?
Analysis Data

- **Wind energy installations**: U.S. Wind Turbine Database 1995-2016
- **District Areas (i.e., map polygons)**: National Center for Education Statistics
- **School Finances**: Local Education Agency Finance Survey from the National Center for Education Statistics (NCES) 1994-2016
- **Staff & Student Counts**: Annual Common Core of data (CCD) from NCES 1994-2016
- **Student Achievement**: National Assessment of Educational Progress (NAEP) 2000-2016
- **Census Data**: Special School District Tabulations of the 1990 Census
Study Sample Statistics

- States: 34
- Number of districts:
  - with wind projects: 638
  - without wind projects: >10,000
- Study Period: 1995-2016
- Median wind district: 243kW/pupil

Analysis Data Example

Screenshot of Texas, Oklahoma & Kansas Counties with Wind Projects and School Districts
Outline

■ Background
■ Analysis data
■ **Results**
  – Event Studies
  – Difference-in-Difference Results
■ Take-aways!
EVENT STUDIES
Event Study: Effects Before & After Wind Development

Local Revenue

Total Expenditures

Average Expenditure %s
Across Full Sample (i.e., ~10K districts)

Current 85%
Capital 8%
Other 7%

Current Expenditures

Capital Expenditures

Other Expenditures

16%

41%

43%
Despite significant increases in current spending we find only small changes in pupil-teacher ratios and no apparent change in teacher salaries.
With no apparent change in either pupil/teacher ratios no teacher salaries, it is not surprising that we also do not find changes in test scores.
DIFFERENCE-IN-DIFFERENCE RESULTS
Effects Estimated Based on Wind Turbine(s) Installed Capacity – KW/pupil

<table>
<thead>
<tr>
<th>School District Revenues</th>
<th>Treatment: Installed Turbine Capacity Per-Pupil (KW)</th>
<th>Effect at Mean Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local</td>
<td>3.92*** (0.71)</td>
<td>918.33*** (171.21)</td>
</tr>
<tr>
<td>Total</td>
<td>3.66*** (0.82)</td>
<td>872.32*** (200.22)</td>
</tr>
<tr>
<td>State</td>
<td>-0.31 (0.26)</td>
<td>-61.29 (64.02)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>School District Expenditures</th>
<th>Treatment: Installed Turbine Capacity Per-Pupil (KW)</th>
<th>Effect at Mean Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>4.86*** (0.97)</td>
<td>1167.96*** (236.87)</td>
</tr>
<tr>
<td>Current</td>
<td>0.95*** (0.20)</td>
<td>214.09*** (48.97)</td>
</tr>
<tr>
<td>Capital</td>
<td>2.11*** (0.44)</td>
<td>514.79*** (106.15)</td>
</tr>
<tr>
<td>Other</td>
<td>1.80*** (0.59)</td>
<td>439.08*** (143.08)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Education Production Inputs</th>
<th>Treatment: Installed Turbine Capacity Per-Pupil (KW)</th>
<th>Effect at Mean Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pupil-Teacher Ratio</td>
<td>-0.20** (0.09)</td>
<td>-0.04* (0.02)</td>
</tr>
<tr>
<td>Teacher Salary</td>
<td>0.23 (0.29)</td>
<td>58.80 (72.90)</td>
</tr>
</tbody>
</table>

**Mean Wind/Student Capacity:** 0.243 MW/pupil

Expanded Controls | No | Yes | Yes
Local Revenue Effects Estimated by Pupil by MW

Local Revenue Per MW Per Pupil

- **All Districts**
  - Local: $3,780
  - State: $(250)
  - Other: $60

- **All Districts Except Texas**
  - Local: $2,330
  - State: $(480)
  - Other: $140

- **Texas**
  - Local: $7,780
  - State: $390
  - Other: $(130)

Mean wind/student capacity: 0.243 MW/pupil
Expenditure Effects Estimated by Pupil by MW

Expenditures Per MW Per Pupil

- All Districts
  - Current: $880
  - Capital: $2,120
  - Other: $1,810

- All Districts Except Texas
  - Current: $900
  - Capital: $1,320
  - Other: $700

- Texas
  - Current: $880
  - Capital: $4,330
  - Other: $4,820

Note: "Other" expenditures are predominantly debt service and payments to state.

Mean wind/student capacity: 0.243 MW/pupil

Pre-wind (1994) Current to Capital spending ratios were 10:1.
Here we see it at roughly 1:2.
Tests for Capacity Additions on Test Scores

No statistically significant relationships are found between test scores and increasing wind capacity.

<table>
<thead>
<tr>
<th></th>
<th>NAEP Data</th>
<th></th>
<th>NAEP Data and SEDA Data</th>
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<tr>
<td></td>
<td>Baseline</td>
<td>No Texas</td>
<td>Baseline</td>
<td>No Texas</td>
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<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
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<tr>
<td>Post</td>
<td>-0.011</td>
<td>-0.010</td>
<td>0.002</td>
<td>0.003</td>
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<tr>
<td></td>
<td>(0.020)</td>
<td>(0.020)</td>
<td>(0.020)</td>
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<tr>
<td>Post*Trend</td>
<td>-0.000</td>
<td>-0.000</td>
<td>-0.000</td>
<td>-0.000</td>
</tr>
<tr>
<td></td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.003)</td>
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<tr>
<td>Trend</td>
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<td>0.001</td>
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<tr>
<td></td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>Effect 5 Years Post</td>
<td>-0.006</td>
<td>0.005</td>
<td>-0.037</td>
<td>-0.026</td>
</tr>
<tr>
<td></td>
<td>(0.020)</td>
<td>(0.019)</td>
<td>(0.026)</td>
<td>(0.027)</td>
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<tr>
<td>Observations</td>
<td>84,079</td>
<td>81,000</td>
<td>246,361</td>
<td>225,303</td>
</tr>
<tr>
<td>Expanded Controls</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

energylearn.lbl.gov
"Flypaper" vs. Tax Relief Effects

Tax Rates Relative to the First Wind Installation
In Each School District

Illinois

Equates to a 13% average decrease in tax rates

Texas
Appendix A: State Wind Energy Taxation Laws and School Finance Formulas

What follows is a description of how states tax wind installations and how wind installation tax revenue affects local school districts. We present this information for the top 21 wind production states in the nation based on installed megawatts as of 2018. These 21 states account for approximately 95% of the total installed wind energy capacity in the nation.

California: Due to Proposition 13, property tax rates are capped at 1% of assessed value. As a result, wind projects are also taxed at 1% of assessed value. Due to school finance reform in California, school districts are subject to a revenue limit which limits the total amount of revenue a district can collect from local property taxes and state aid. Each district’s revenue limit is set by the state. When local property tax revenue increases, state aid is decreased proportionally so that a district remains within its revenue limit. As a result, increases in a school district’s tax base that results from a wind energy installation have little effect on school district operating revenues. If a school district’s tax base is large enough that even without state aid it would exceed its revenue limit, then the state allows the district to keep the revenue. Such districts are known as basic aid districts.

Colorado: As of 2006, Colorado assesses the value of wind projects based on the income generated by the project. The state sets a tax factor that is applied to the sale price of wind energy to determine the projects assessed value. Funding to school districts is based on a per-pupil formula that calculates the district’s spending limit known as the Total Program. A district can exceed its spending limit if it gets approval from local voters during an override election which allows for additional property tax revenues. Starting in 2009-10, a district’s override revenues were limited to 25% (30% for small rural districts) of its Total Program. When a district passes an override, its state share of funding is not reduced.

Idaho: In 2007, Idaho authorized a property tax exemption for wind energy producers. In lieu of paying property taxes, producers pay a tax of 3% of annual energy earnings to the county. Wind developers that

*Some have changed since then.*
Conclusions

- This study represents the first national effort to quantify wind deployment effects on school district finances and student outcomes.
- An average sized district with average wind buildout sees annual increases in revenue of ~$900 per pupil.
- Similar increases in capacity are estimated to increase per pupil current and capital expenditures by ~$215 and ~$515/pupil, respectively, opposite of normal spending patterns.
- Fleet wide, U.S. wind energy projects installed through 2016 are estimated to contribute between approximately $1.1 and $1.4 billion to local school district revenue annually.
- A small, though statistically significant effect on pupil-teacher ratios is evident of -0.15 (or ~ -1%).
- No effect is discovered for student achievement nor teacher salaries (not shown).
- Wind effects on school finances differ significantly by state, largely driven by differences in tax policy.
- In Illinois, some evidence of tax relief. None is found in TX.
- Wind energy tax laws and school finance formulas for the top 21 wind states are also presented.
Eric Brunner & David Schwegman have completed an analysis of how wind development affects county-level finances (similar to the school-district analysis contained here)

They find:

- Wind energy installations led to large increases in county own-source (i.e., property tax) revenue and expenditures (26% increase in revenue, 23% increase in expenditures).
- County governments use this windfall revenue to prioritize spending on highways and hospitals (76% increase in hospital spending and a 55% increase in highway spending).
- The additional spending is capitalized into housing values, providing evidence that residents value the enhancements to local public services and spending that accompany wind energy installations.
Thank You

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https://emp.lbl.gov/publications/school-district-revenue-shocks