Wind Energy's Effect on School Finances and Student Outcomes

LBNL Working Paper Release
March 26th, 2021

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Please Note:

- All participants will be muted during the webinar
- Please submit questions via the "Questions and Answers" chat window
- This webinar will be recorded

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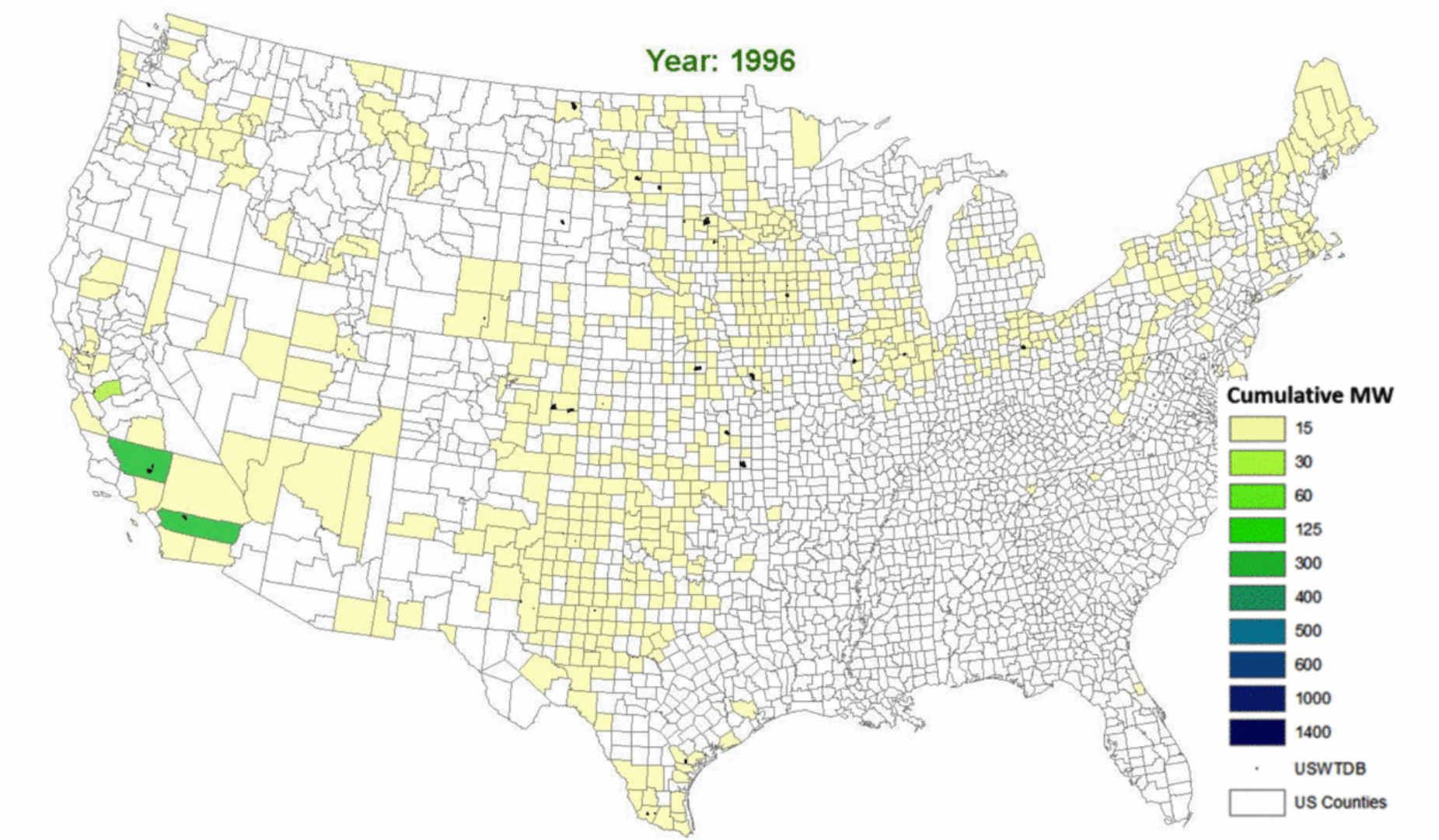
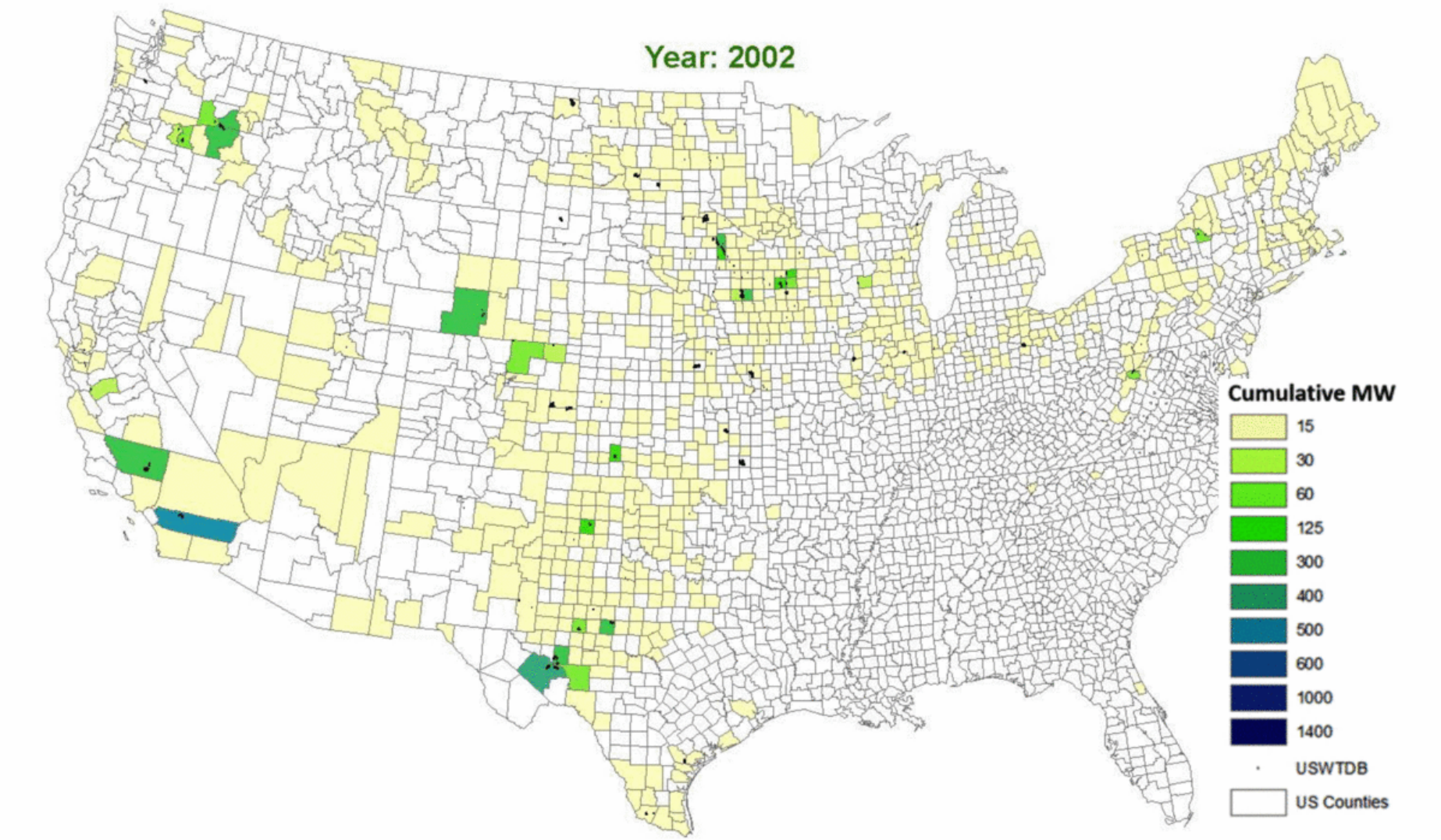
Outline

- **Background**
- Analysis data
- Results
- Take-aways!

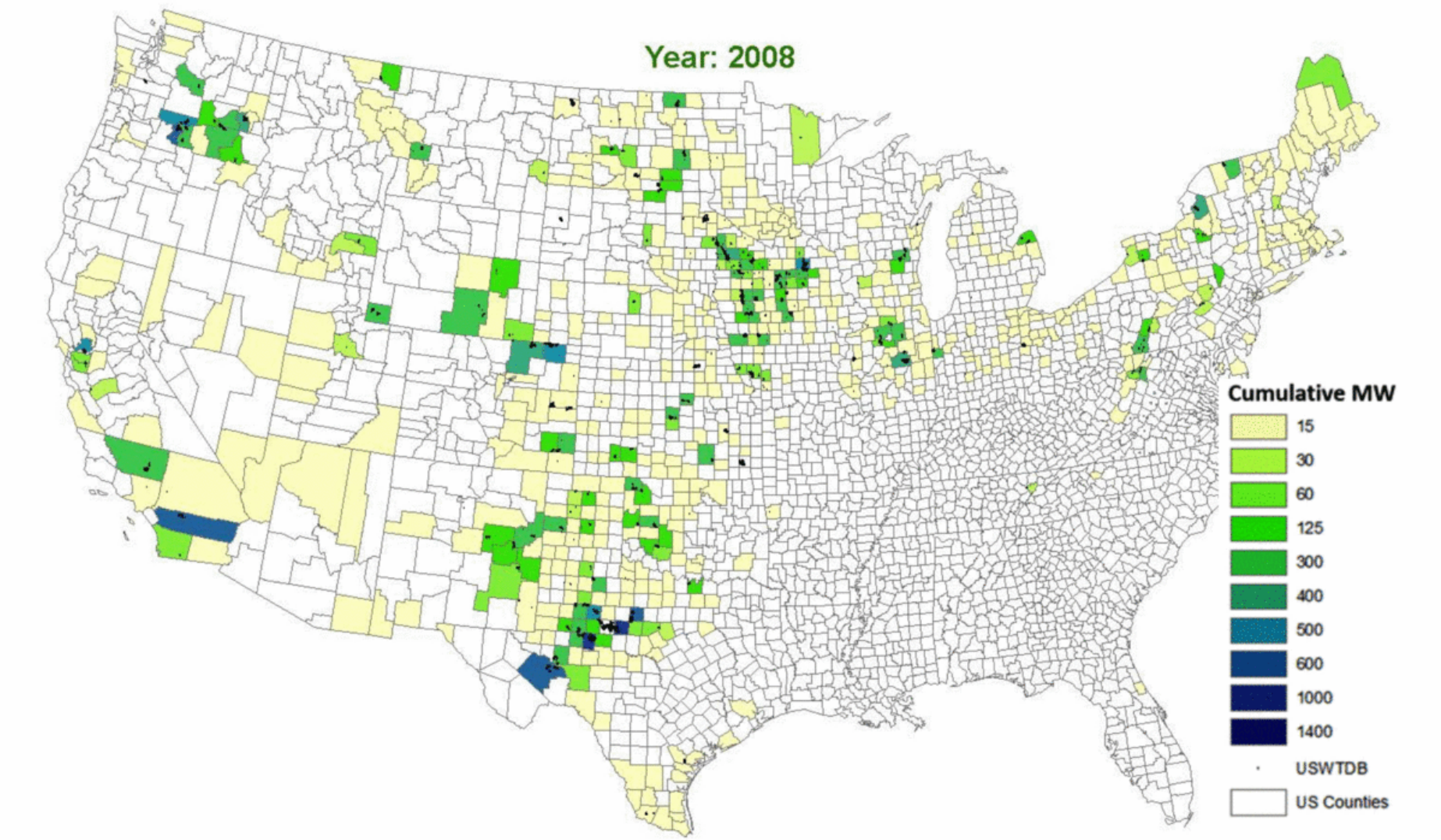
Wind Development Over Time



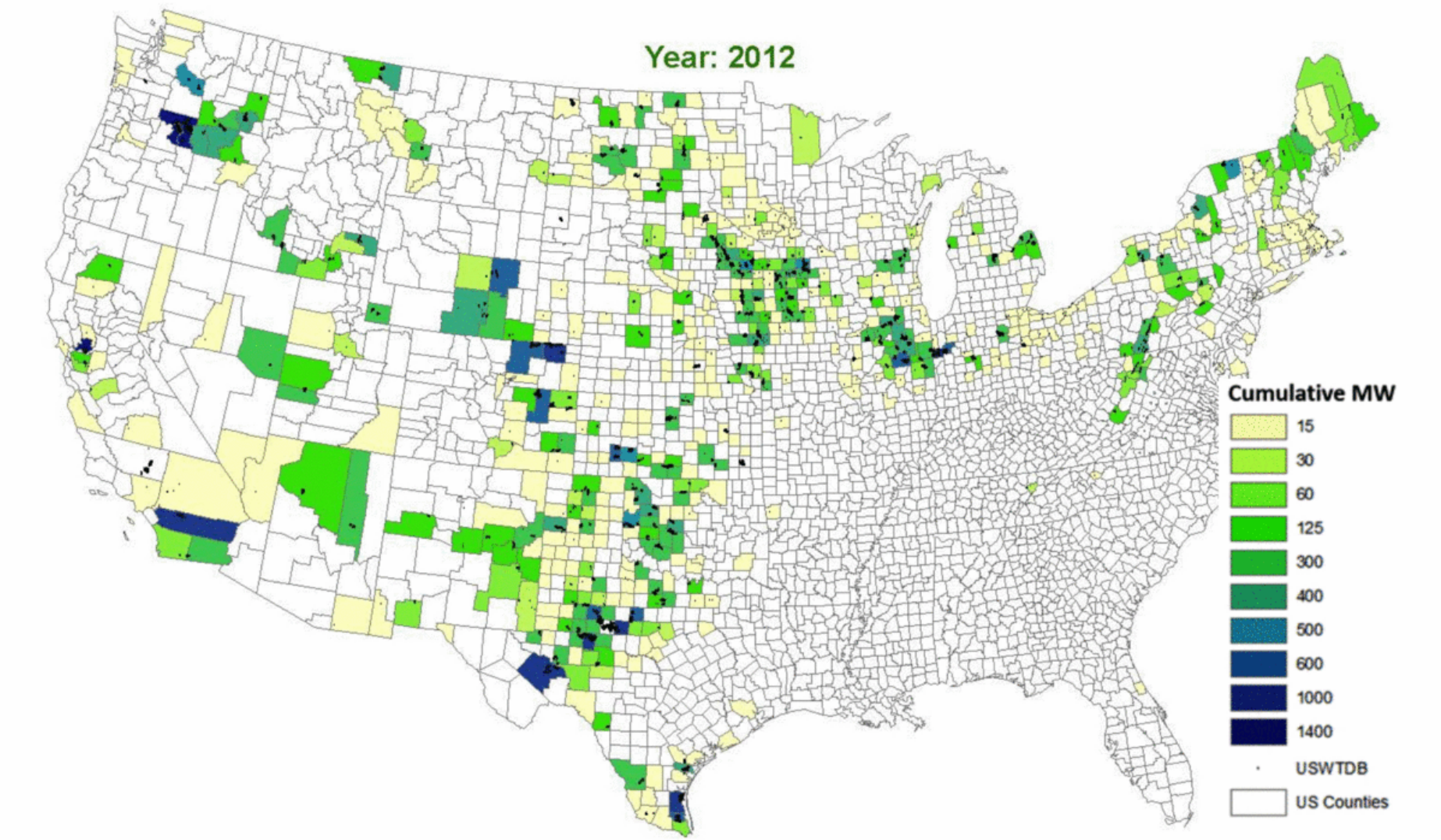
Wind Development Over Time



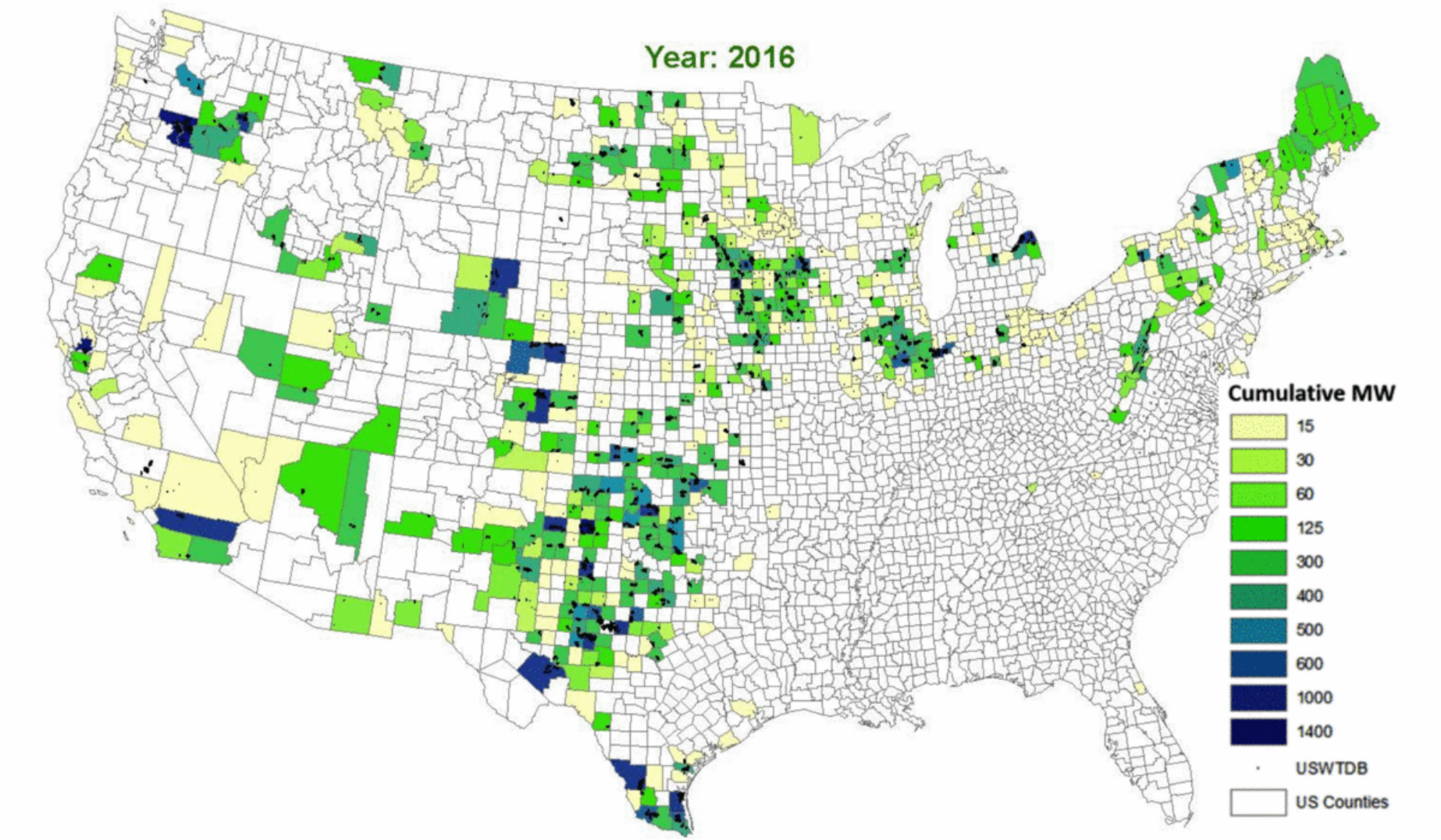
Wind Development Over Time



Wind Development Over Time



Wind Development Over Time



Background (i.e. Why Study This?)

Wind Money Fuels Spending and Benefits in Small Schools

The New York Times Nov. 10, 2011 TX

Schools reap wind benefit

The Register-Mail Jul 12, 2018 IL

Wind farm's a cash cow for communities, but not everyone's sold

THE BLADE APR 7, 2019 OH

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?)

Castleberry and Scott Greene *Energy, Sustainability and Society* (2017) 7:34
DOI 10.1186/s13705-017-0138-8

Energy, Sustainability and Society

ORIGINAL ARTICLE Open Access

Impacts of wind power development on Oklahoma's public schools

Becca Castleberry[1] and J. Scott Greene[2*]

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 of the 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 distri

OK

Energy Policy 59 (2013) 800–807

Contents lists available at SciVerse ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Local non-market quality of life dynamics in new wind farms communities

Matthew E. Kahn*

Department of Economics, UCLA's Institute of the Environment, USA

HIGHLIGHTS

- Rural counties with wind farms have lower property tax rates than neighbor counties.
- Wind farm counties have lower student–teacher ratios.
- Ambient air pollution levels are higher near fossil fuel fired power plants.

TX

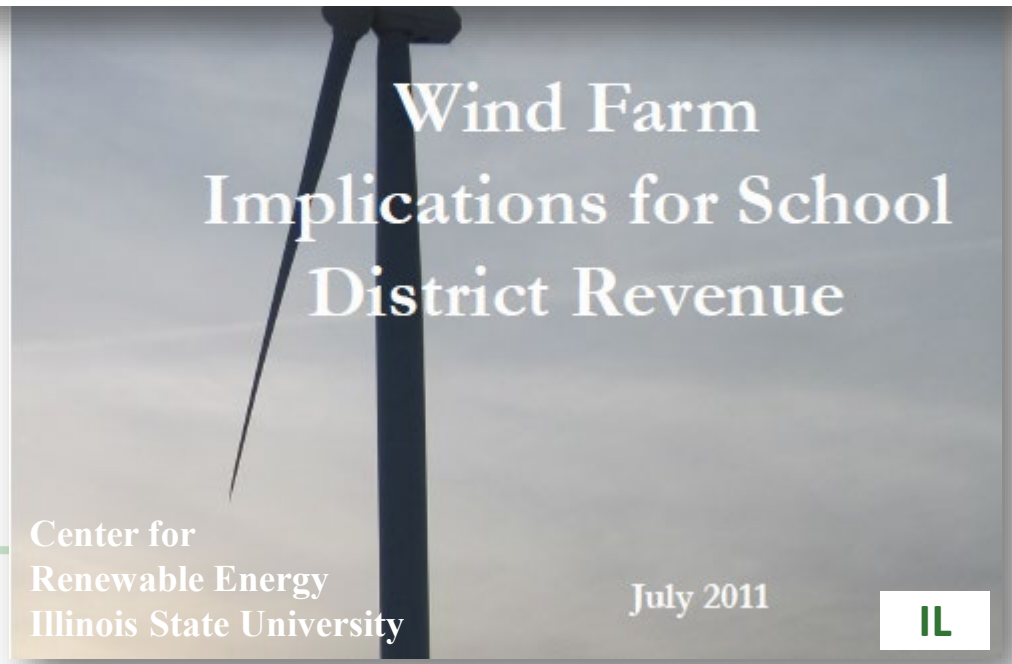
What blows in with the wind?

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

Texas Tech University

3 November 2014

TX



IL

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?

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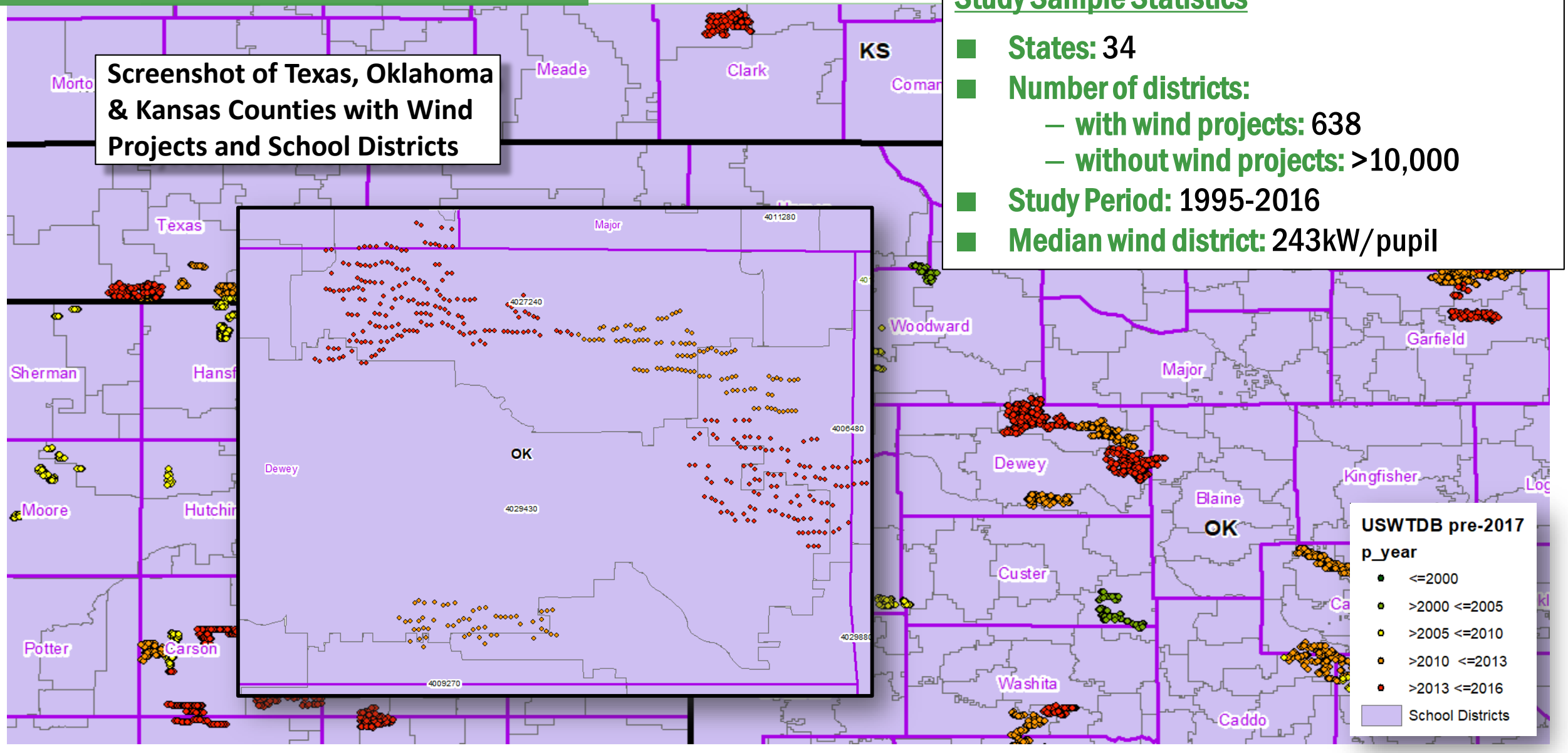
Analysis Data

- **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

Analysis Data Example

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



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

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  - Event Studies
  - Difference-in-Difference Results
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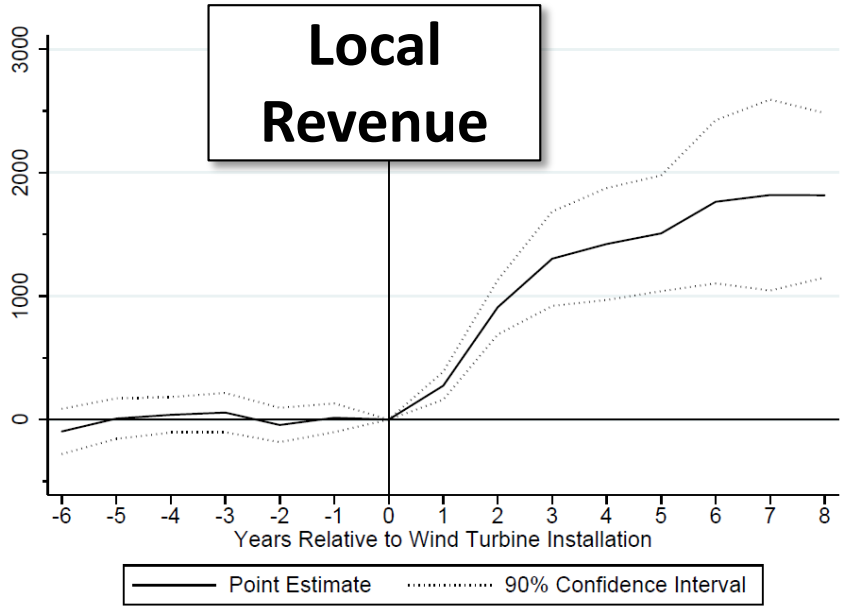
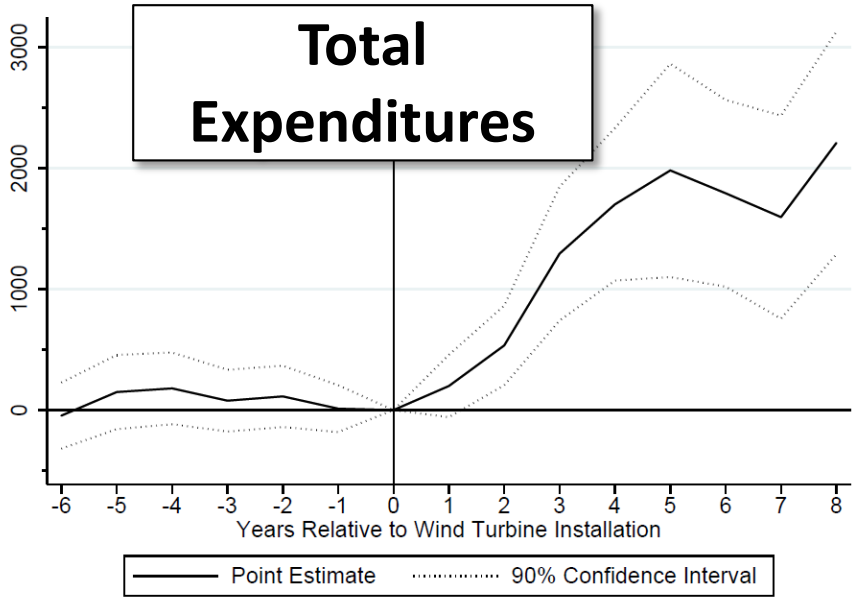
EVENT STUDIES

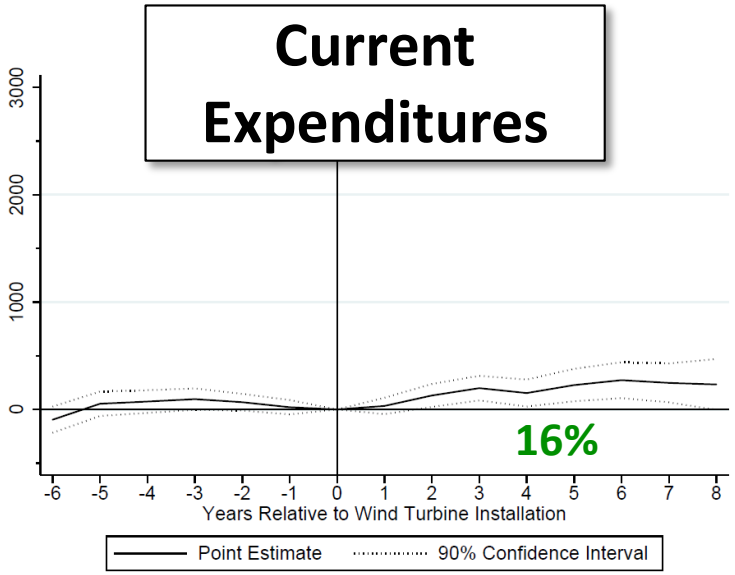
Event Study: Effects Before & After Wind Development

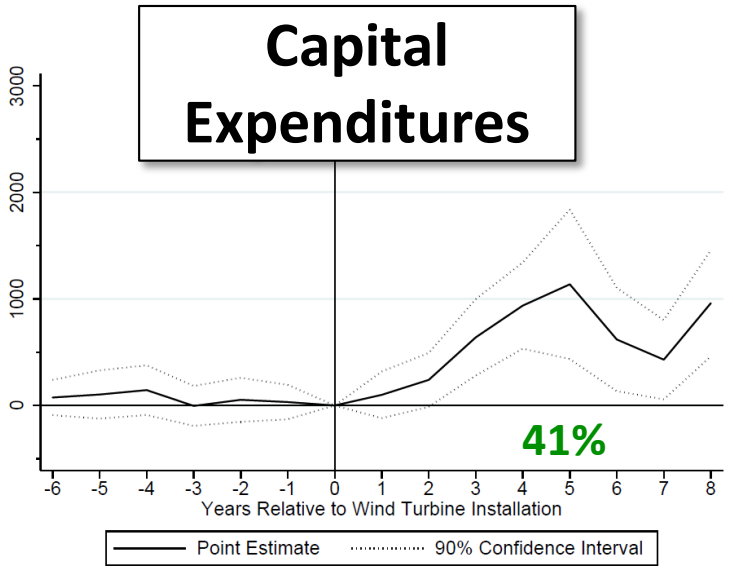


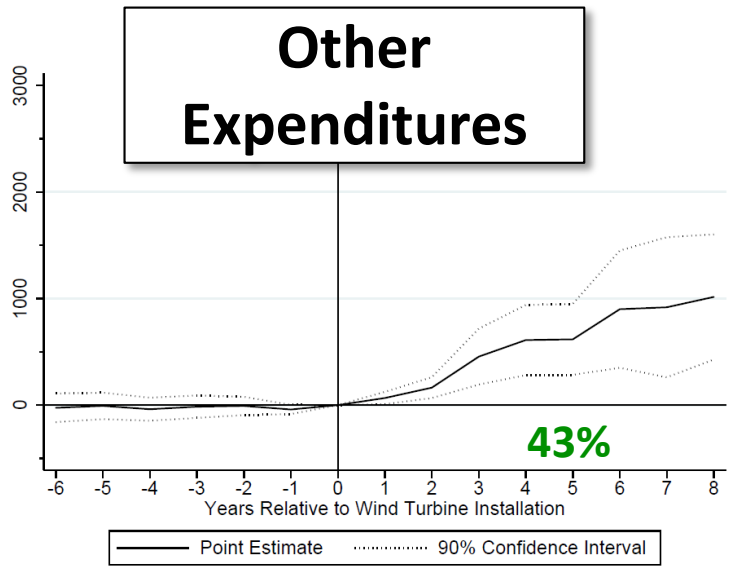


Average Expenditure %s Across Full Sample (i.e., ~10K districts)

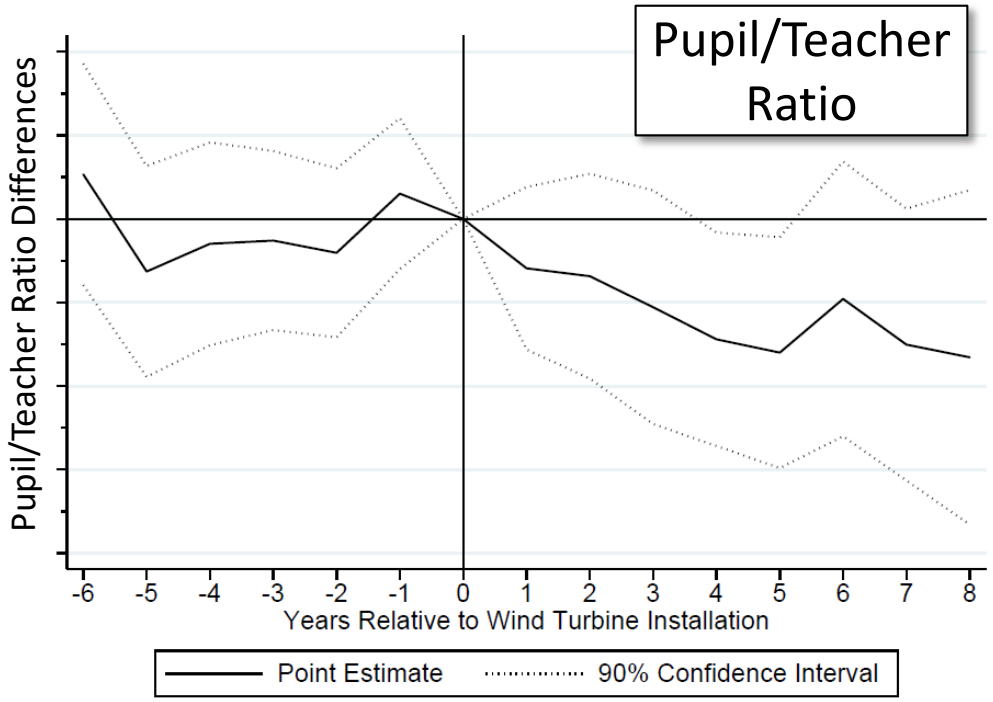
Current	85%
Capital	8%
Other	7%

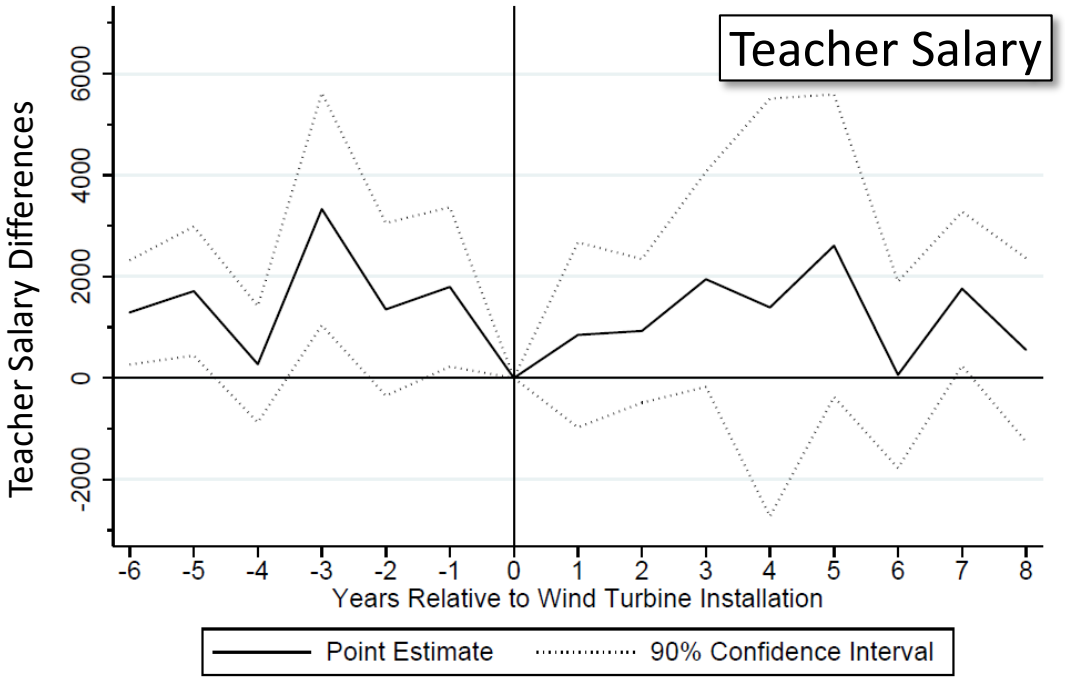






Pupil/Teacher Ratio and Teacher Salary Differences Relative to First Wind Installation In Each School District



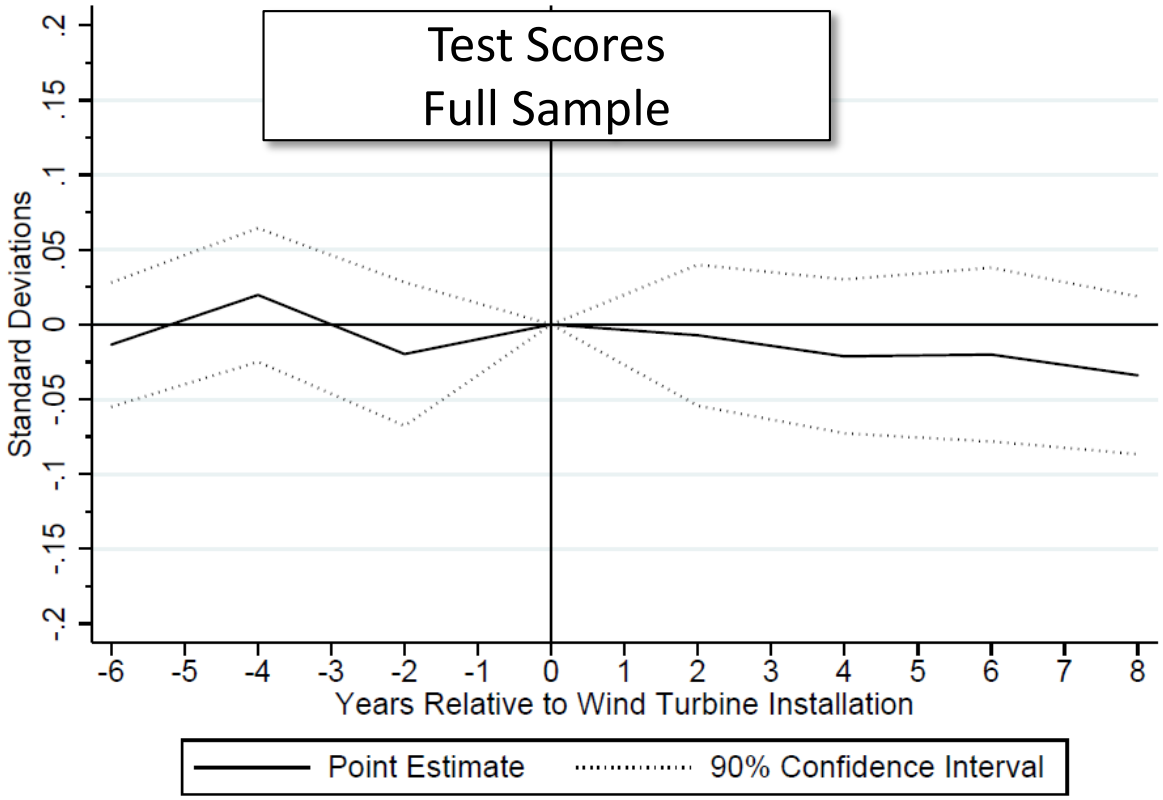


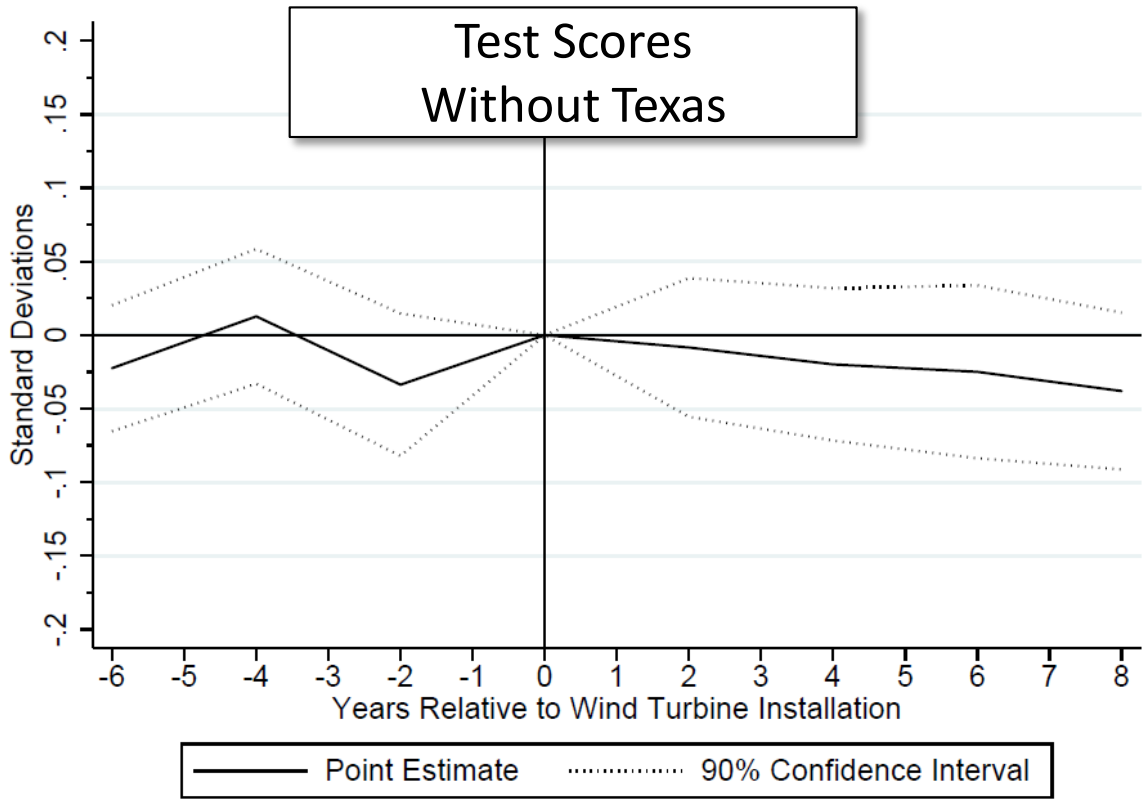
Effect = -0.15 (p <0.90) per KW/pupil, which equates to < 1/10th of a student per teacher

Effect = 0.23 (p >0.90) per KW/pupil, which is not statistically significant

Despite significant increases in current spending we find only small changes in pupil-teacher ratios and no apparent change in teacher salaries

Test Score Differences Relative to First Wind Installation In Each School District





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.

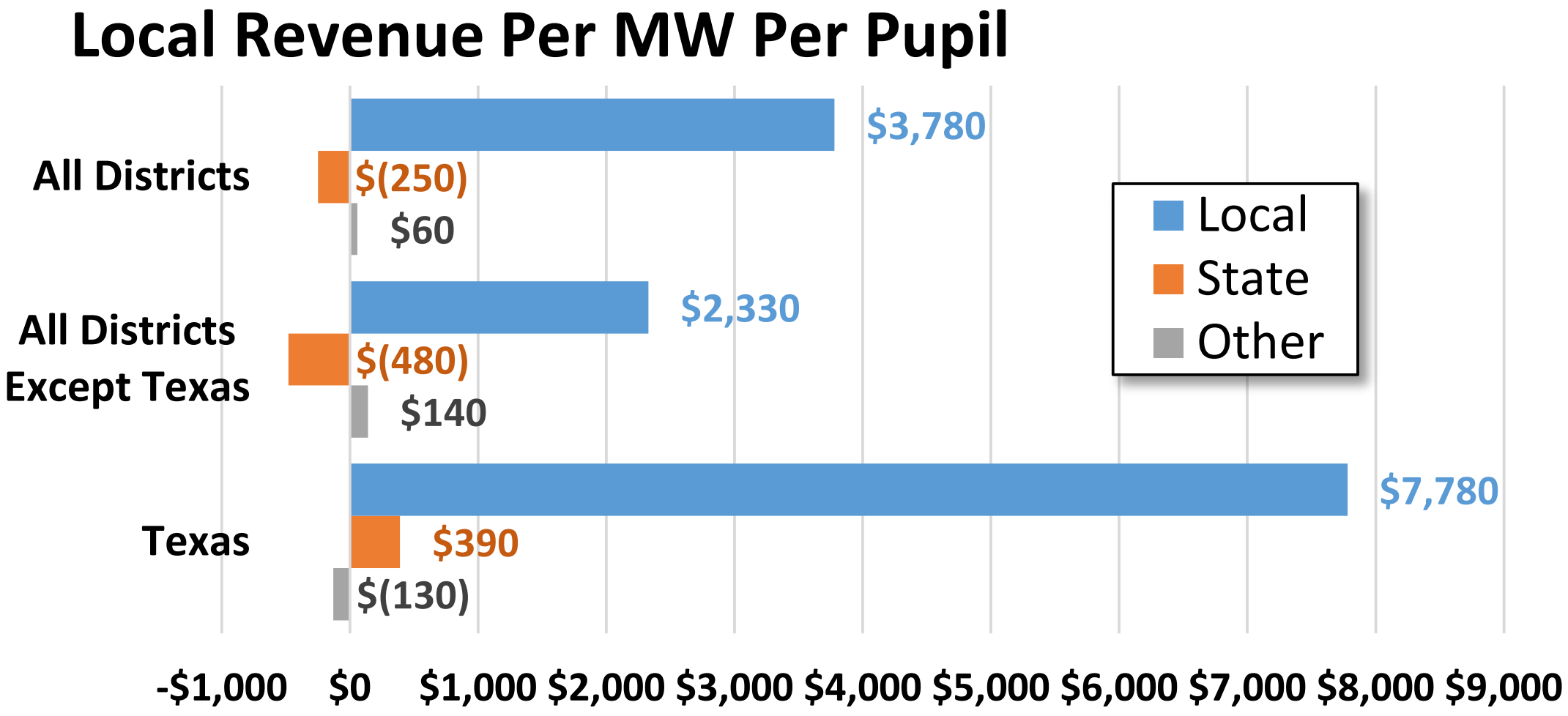
DIFFERENCE-IN-DIFFERENCE RESULTS

Effects Estimated Based on Wind Turbine(s) Installed Capacity – KW/pupil

	Treatment: Installed Turbine Capacity Per-Pupil (KW)		Effect at Mean Capacity
Dependent Variable	(3)	(4)	(5)
School District Revenues			
Local	3.92***	3.78***	918.33***
	(0.71)	(0.70)	(171.21)
Total	3.66***	3.59***	872.32***
	(0.82)	(0.82)	(200.22)
State	-0.31	-0.25	-61.29
	(0.26)	(0.26)	(64.02)
School District Expenditures			
Total	4.86***	4.81***	1167.96***
	(0.97)	(0.97)	(236.87)
Current	0.95***	0.88***	214.09***
	(0.20)	(0.20)	(48.97)
Capital	2.11***	2.12***	514.79***
	(0.44)	(0.44)	(106.15)
Other	1.80***	1.81***	439.08***
	(0.59)	(0.59)	(143.08)
Education Production Inputs			
Pupil-Teacher Ratio	-0.20**	-0.15*	-0.04*
	(0.09)	(0.09)	(0.02)
Teacher Salary	0.23	0.23	58.80
	(0.29)	(0.29)	(72.90)
Expanded Controls	No	Yes	Yes

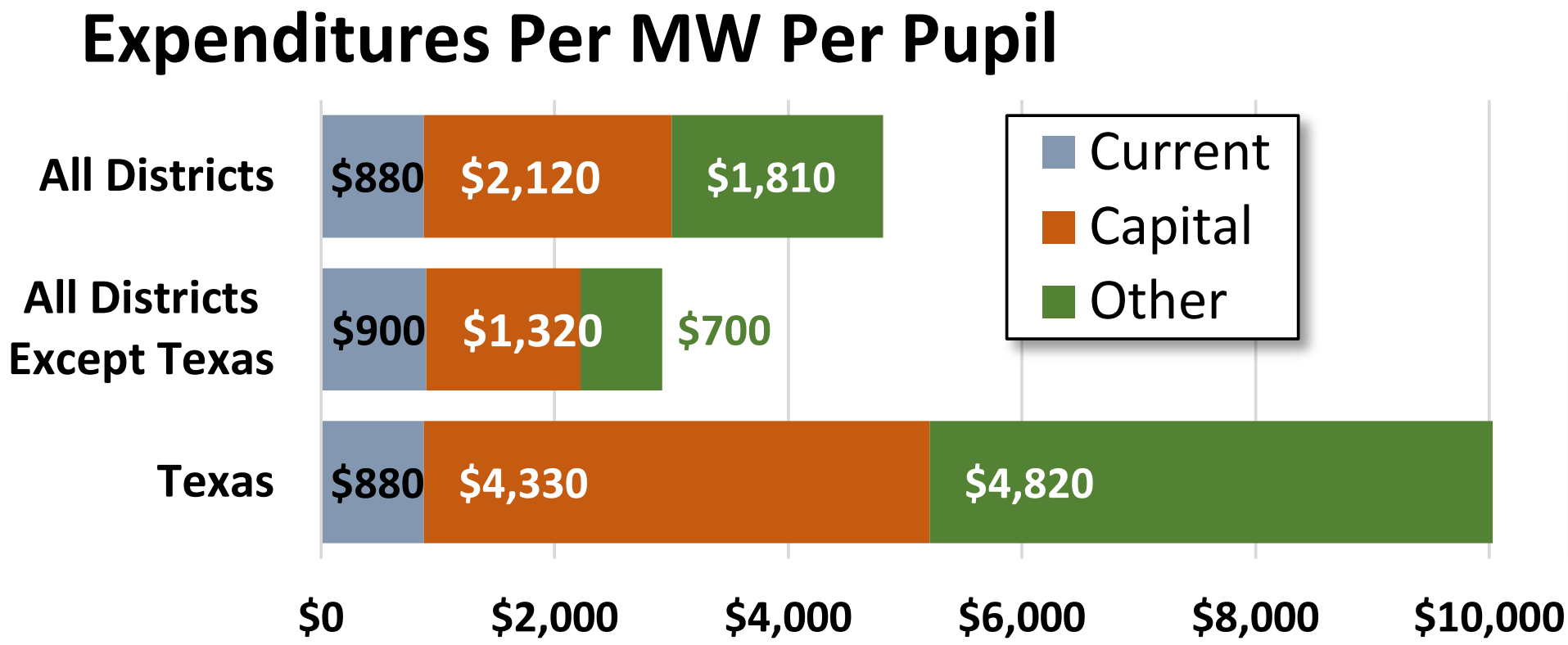
Mean Wind/Student Capacity: 0.243 MW/pupil

Local Revenue Effects Estimated by Pupil by MW



Mean wind/student capacity: 0.243 MW/pupil

Expenditure Effects Estimated by Pupil by MW



Pre-wind (1994) Current to Capital spending ratios were 10:1.

Here we see it at roughly 1:2

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

Mean wind/student capacity: 0.243 MW/pupil

Tests for Capacity Additions on Test Scores

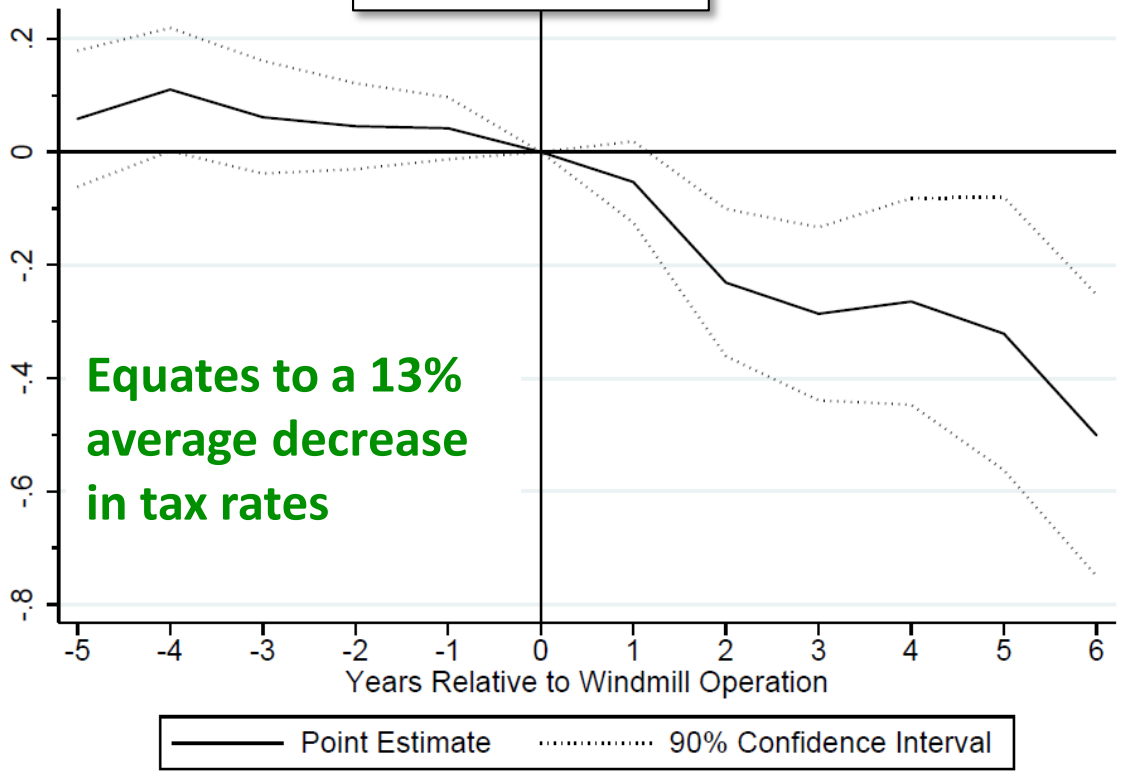
	NAEP Data				NAEP Data and SEDA Data			
	Baseline		No Texas		Baseline		No Texas	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post	-0.011	-0.010	0.002	0.003	-0.032	-0.030	-0.013	-0.013
	(0.020)	(0.020)	(0.020)	(0.020)	(0.023)	(0.023)	(0.024)	(0.024)
Post*Trend	-0.000	-0.000	-0.000	-0.000	-0.001	0.000	0.000	0.000
	(0.003)	(0.003)	(0.003)	(0.003)	(0.005)	(0.005)	(0.006)	(0.006)
Trend	0.001	0.001	0.000	0.001	-0.001	-0.001	-0.003	-0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Effect 5 Years Post		-0.006		0.005		-0.037		-0.026
		(0.020)		(.019)		(0.026)		(0.027)
Observations	84,079		81,000		246,361		225,303	
Expanded Controls	No	Yes	No	Yes	No	Yes	No	Yes

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

“Flypaper “ vs. Tax Relief Effects

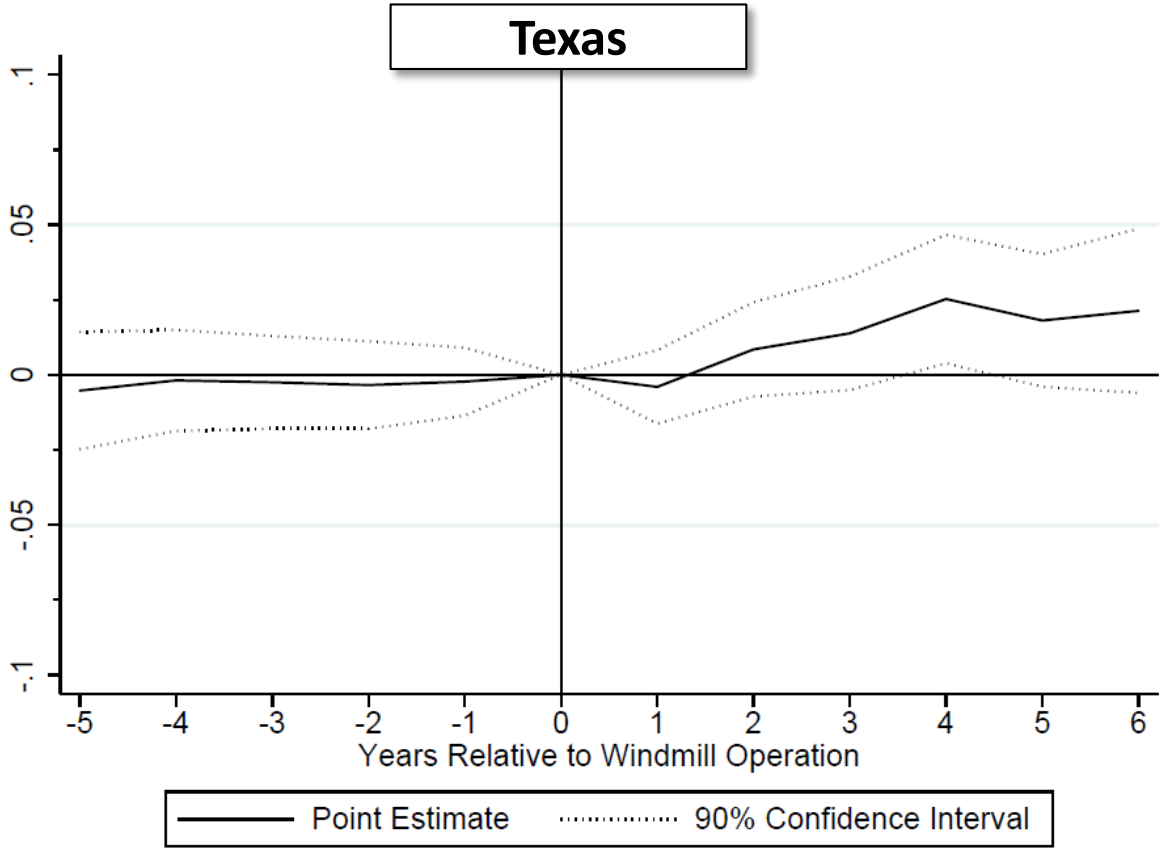
Tax Rates Relative to the First Wind Installation In Each School District

Illinois

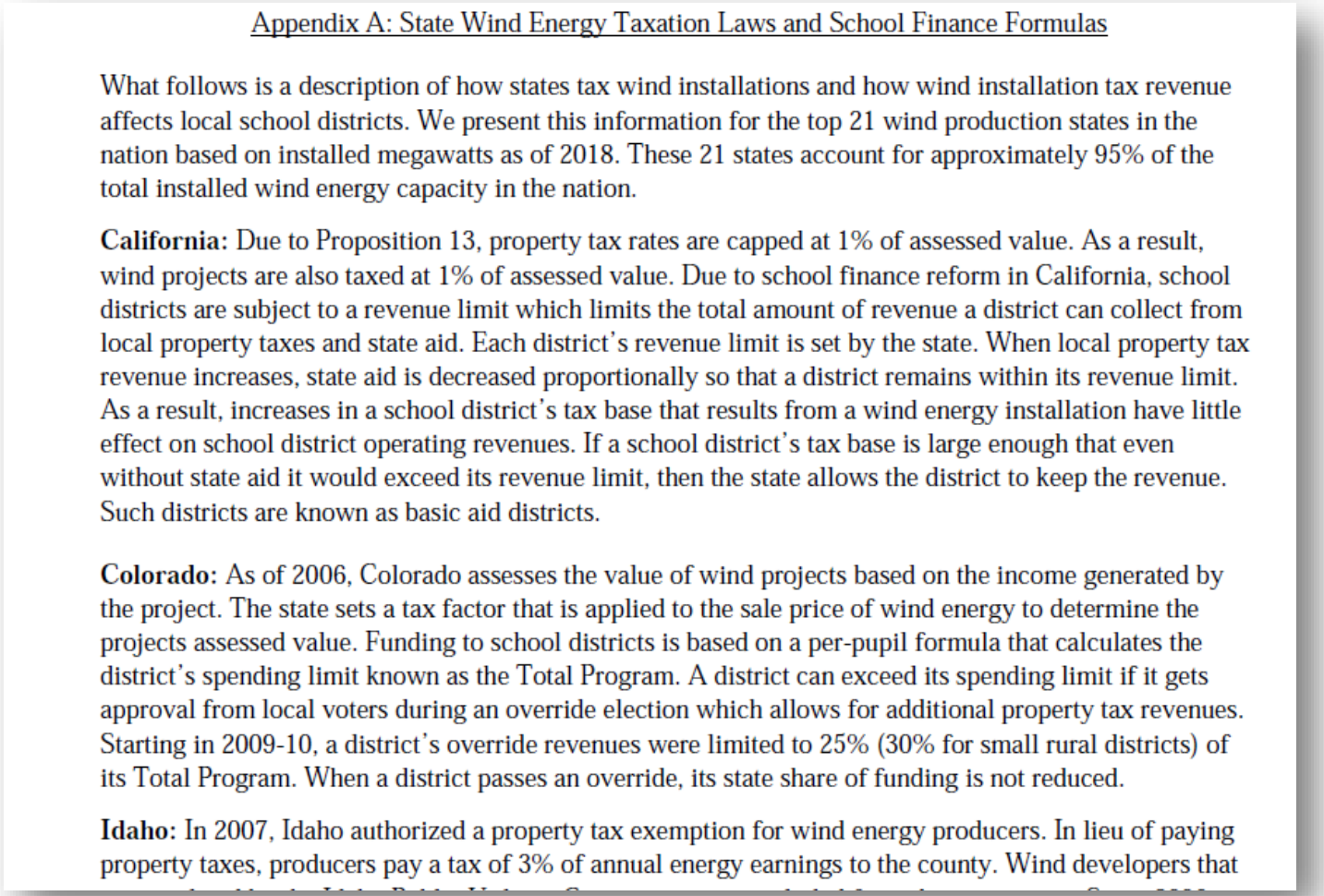


Equates to a 13% average decrease in tax rates

Texas



Wind Energy Taxation Laws and School Finance Formulas



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

The paper also contains a summary of wind energy taxation laws and school finance formulas for the top 21 wind production states as of early 2020*

** 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

Bonus: Snapshot of Upcoming Report

- 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

- Contact Information:
  - Ben Hoen, LBNL, bhoen@lbl.gov, 845-758-1896
  - Eric Brunner, University of Connecticut, eric.brunner@uconn.edu
  - Josh Hyman, Amherst College, jhyman@amherst.edu
- Thanks to the DOE
  - This work was made possible via funding from the Wind Energy Technologies Office of the U.S. Department of Energy under Contract No. DE-AC02-05CH11231

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School District Revenue Shocks, Resource Allocations, and Student Achievement: Evidence from the Universe of U.S. Wind Energy Installations

Date Published
03/2021

Authors
Eric Brunner, Ben Hoen, Joshua Hyman

Related Files
Working Paper PDF (1.44 MB)
Project Summary PDF (200.46 KB)

Abstract
We examine the impact of wind energy installation on school district finances and student achievement using data on the timing, location, and capacity of the universe of U.S. installations from 1995 through 2017. Wind energy installation substantially increased district revenues, causing large increases in capital outlays, but only modest increases in current spending, and little to no change in class sizes or teacher salaries. We find zero impact on student test scores. Using administrative data from Texas, the country's top wind energy producer, we find zero impact of wind energy installation on high school completion and other longer-run student outcomes.

Year of Publication 2021

Notes
A webinar covering the results of the study is scheduled for 1 PM ET / 10 AM PT on Friday, March 26, 2021. Registration Link: https://lbnl.zoom.us/webinar/register/WN_7nJtHk_iQx6Pu_7TzAB3kQ

This is a working paper. A final journal paper will be posted when it is published.

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