Rural Futures Lab™

Wind Energy and Rural Development

A Case Study of West Texas

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Rural Futures Lab™

The Rural Futures Lab is a new venture affiliated with the Rural Policy Research Institute dedicated to creating a future-oriented narrative for rural America. The Lab is focused on the productive capacity of rural America to respond to growing economic, social, and environmental challenges as food, energy, natural resources, and ecosystem services become globally scarcer. This requires paying attention to both hard infrastructure, such as transportation, health care, and telecommunications, and soft infrastructure, such as innovation and entrepreneurship, regional governance, and youth engagement. The Lab's approach assumes a set of core principles around equity, diversity, collaboration, and sustainability that will ensure rural people and places can be full partners in the stewardship and development of rural-based resources. The Lab is located within the Harry S. Truman School of Public Affairs at the University of Missouri. Read more at www.ruralfutureslab.org

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Case Studies of Wealth Creation and Rural-Urban Linkages

This case study is from a collection of four case studies of wealth creation and rural-urban linkages (Dabson, Jensen et al, 2012). These are part of a broader effort supported by the Ford Foundation, known as the *Wealth Creation in Rural Communities* initiative. The primary purpose of these case studies is to stimulate learning, discussion, and further inquiry about the application of the rural wealth creation framework. The cases were selected to illustrate different facets of this framework in action, and to further clarify the ways in which the framework could prove to be instrumental in achieving sustainable economic prosperity for rural people and places. The subjects of each of these cases represent decades of dedication and hard work by many people and organizations often in extremely challenging economic, social, and political contexts. These case studies are not evaluations or judgments of these efforts; on the contrary they are intended to provide foundations for rich debate on the future of rural regions and communities across the United States.

The other cases are:

- *Transitioning to a Restoration Economy: A Case Study of Oregon's Forestry Sector*, which focuses on the forestry sector in Eastern Oregon and on the value chain intermediary, Sustainable Northwest, based in Portland, Oregon.
- *Plastics from Plants: A Case Study of NatureWorks, LLC, Blair, Nebraska* describes a subsidiary of Cargill that converts corn into a value-added plastic resin as a replacement for petroleum-based plastics.
- *Building a Regional Food System: A Case Study of Market Umbrella in the New Orleans Region*, which looks at the value chain intermediary, Market Umbrella, in New Orleans and on the particular challenges of promoting rural food systems in that region.

The four case studies illustrate different dimensions of wealth creation, value chains, and rural-urban linkages. Table A provides a preview of these dimensions.

Table A: Case Study Dimensions

Sector	Forestry Products	Alternative Energy	Bio-Manufacturing	Food Systems
State	Oregon	Texas	Nebraska	Louisiana
Wealth Creation	Shift from exploitative to restoration rural economy	Market driven with multi-level wealth implications	Market driven with multi-level wealth implications	Focus on social capital
Value Chains	Market development intermediary	Demand driven entrepreneurship	Corporate driven market development	Market development intermediary
Rural-Urban Linkages	Rural production, niche urban markets	Rural production, state/national urban markets	Rural/regional production, global markets	Rural production, urban public markets
Scale	State/multi-state	National	Global	Local/regional

For readers not familiar with the language of wealth creation, some of the terms used in these case studies may be unfamiliar or at least used in unfamiliar ways. Table B offers some definitions as an initial guide.

Table B: Definitions of Key Terms

Assets or Capitals	Forms of wealth that encompass the financial, natural, social, individual, built, intellectual, and political dimensions of a community or region
Asset Accumulation	Savings by individuals and households for key assets such as housing, education, and business start-up
Clusters	Geographic concentrations of interconnected companies and institutions that derive tangible benefits from proximity, common technologies, skills, etc., to enhance their competitiveness
Resilience	Ability of households, companies, communities and regions to anticipate problems, opportunities, and potentials, reduce vulnerabilities, respond to major disasters, and recover rapidly, better, safer, and fairer
Rural-Urban Linkages	Mutually beneficial relationships between rural and urban places and economies
Rural Wealth	The stock of enduring assets over which rural places have stewardship, control, or ownership
Rural Wealth Creation Value Chains	Value chains that intentionally protect and increase the stock of assets in rural areas, and which embody a set of values about which the consumer cares (such as renewable energy or locally-grown and/or organic food)
Sustainable Livelihoods	Capabilities, assets, and activities needed to make a living, ensure resilience, and build wealth
Value Chains	Sequence of activities and processes required to bring a product or service from conception to final use, where at each stage value is added as tools, labor, knowledge, skills are applied
Wealth Creation	Policies and practices that lead to the retention and creation of wealth

1. Introduction

With a quarter of total installed capacity in the U.S.,[1] the State of Texas is currently leading the nation in the development of wind energy. Wind energy is promoted as a reliable, domestic energy source free of adverse environmental impacts at the national level. In rural regions like West Texas, wind has been celebrated for its ability to provide a supplemental income to struggling farmers, create jobs, and increase local tax revenues (DOE 2004; Myers 2009).

And although wind energy only accounted for 1.9 percent of total U.S. electricity generation in 2009, Texas—with plans to construct thousands of miles of transmission lines to accommodate future development—is a driving force behind the U.S. Department of Energy's goal of providing 20 percent of national electricity needs with wind energy by 2030 (DOE, 2008). For wind to provide one-fifth of the nation's electricity, however, there are a number of challenges to consider, including:

- Energy economics and the production process (i.e., technology, manufacturing, transmission) (Lu et al. 2011),
- Potential impacts to wildlife and the environment (Kunz et al., 2007; Arnett et al., 2008),
- Visual and noise impacts on communities (Devine-Wright 2005a, 2005b; Johansson & Laike, 2007; Pedersen & Wye, 2007; Pedersen et al., 2009; Swofford & Slattery, 2010), and
- The distribution of wealth generated by the industry (HRO, 2008).

And while conflicts surrounding the development of renewable resources may never cease, Pasqualetti reminds us that "considering more deeply the relationship between landscapes and the people who occupy and value them, in advance, will help smooth the otherwise bumpy road toward a more sustainable future" (2011, p.915).

The Texas case is particularly thought-provoking because of the important rural-urban linkages that comprise the wind industry value and supply chains. A transition to more renewable forms of energy requires increasing amounts of land used in energy production, while the demand for electricity is concentrated in urbanized areas.

Based on the interviews conducted for this study, the West Texas story is in many ways a positive one. Given the scale of investment and rapid growth of the wind industry in the state, the Texas experience can provide important lessons for other communities and regions across the country as wind energy becomes more ubiquitous. More specifically, a better understanding of the extent to which wealth created by wind energy development remains in the communities that it is generated in can better inform state- and local-level economic and community development policies and programs.

Furthermore, a nascent literature on wind energy and community impacts has so far failed to distinguish between various types of wealth when considering the costs and benefits associated with the industry (Patullo, 2010; Brannstrom et al., 2011; Slattery et al., 2011). As a consequence, community leaders may benefit from a better understanding of the cumulative impacts of this fast-growing industry and the relationship between different forms of wealth.

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[1] Currently there is 40,181 MW of installed capacity in the U.S., enough to supply electricity for over 10 million American homes (see http://www.awea.org/newsroom/pressreleases/release_07APR11_.cfm).

2. The National Picture

> *"At this point, 2012 is poised to be one of the largest years, if not the largest year in the U.S. wind market, in terms of installation."*[1]
>
> Alex Klein, IHS Energy Research

The history of wind power—a centuries-old but largely marginal technology—has bemused proponents and historians for decades. In fact, until the 1970s, when the Arab Oil Embargo increased the price of electricity generated from oil, wind energy was largely obsolete. As recently as 1980, global generating capacity totaled a mere 10 megawatts (MW), or enough electricity to power approximately 3,000 U.S. homes (Vasi, 2011). Today, just over 30 years later, this figure exceeds 74,000 MW (74 gigawatts).[2]

After a decade of trailing countries like Germany and Spain, the U.S. retained its leadership in 2006 as Iowa and Texas became the first states to institute renewable energy requirements, and the use of a federal production tax credit became more prolific (DOE, 2008). By the end of 2009, the U.S. had close to 35,000 MW of installed capacity and an average annual growth rate of 39 percent from 2005 to 2009 (AWEA, 2010). Even so, wind energy still supplied less than one percent of the electricity generated in the U.S. in 2010, a figure that pales in comparison to coal, nuclear, and natural gas.[3]

Wind is also far from reaching its full potential; in fact, a number of studies have concluded that wind resources in the U.S. are more than sufficient to supply present-day and projected national electricity demands (Elliott et al., 1991; Hoogwijk et al., 2004; Lu et al., 2009). Still, many experts believe that a

[2] DOE (2008, 6)
[3] See http://www.eia.gov/totalenergy/data/annual/pdf/sec8_16.pdf.

confluence of supportive state and federal policies, growing interest in renewable energy, and advancements in wind technology and performance will fuel a continuing resurgence in wind, allowing the U.S. to remain a global competitor. The U.S. Department of Energy has propagated these forecasts, releasing a landmark study in 2008 that explores the steps needed to meet 20 percent of national electricity demand with wind energy by 2030.

Policy Drivers

In recent years, many governments around the world have set ambitious targets and goals to promote electricity generation from renewable energy sources. These efforts are often accompanied by various subsidies and incentives designed to overcome an almost ubiquitous cost disadvantage faced by renewables in comparison to electricity generated from fossil or nuclear fuels (Haas et al. 2008). While debate surrounds the efficacy of or justification for specific programs, policy and planning measures have had an undeniable effect on the development of renewables and wind energy in particular in many countries (Bird et al. 2005; Alagappan et al. 2011).

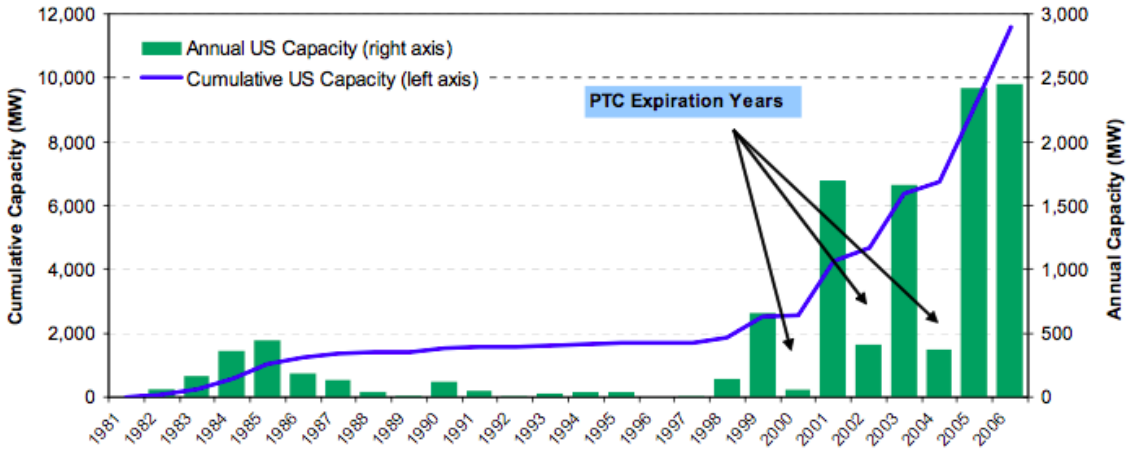
In terms of the motives behind national energy policy, Bird et al. (2005) observe that the promotion of renewables has been driven in large part by carbon abatement goals and adoption of the Kyoto protocol in Europe, whereas the U.S. has not explicitly linked energy policy with carbon policy. There is evidence, however, that some state governments are beginning to craft energy policies with carbon emissions in mind and many consumers who voluntarily purchase renewable energy often do so out of concern for climate change.

The Production Tax Credit

The federal renewable energy production tax credit, first established under the Energy Policy Act of 1992, has played a critical role in the development of U.S. wind energy capacity (Bird et al., 2005; Lu, 2011) (see Figure 1). The credit was first set to expire in 1999, but has since been renewed seven times, most recently until 2012 under the American Recovery and Reinvestment Act of 2009 (Lu, 2011). Under the production tax credit, qualified wind developers are eligible for an income tax credit of 2.1 ¢/kilowatt-hour (adjusted upward, in future years, for inflation) of electricity produced for the first ten years of operation. The production tax credit reduces the cost of wind power by roughly one-third, making wind more attractive to electric utilities and other investors, and even more competitive than conventional electrical generation sources in some regions. Given this, experts expect the growth of wind energy to slow significantly in the absence of the production tax credit or some alternative policy (Wiser,2007; Lu et al., 2011).

Barradale (2010), Wiser (2007), and others point out that the production tax credit's repeated expiration and extension over the years has created a boom-bust pattern of development and investment. Indeed, Figure 1 shows that development has peaked in years when the credit was scheduled to expire (i.e., 1999, 2001, and 2003). The effectiveness of the production tax credit is thus limited because eligible utilities cannot rely on a consistent revenue stream, instead relying on Congressional appropriations to continue the program.

Figure 1. U.S. wind power capacity (annual and cumulative)
Source: Wiser (2007, p.6)



On November 2, 2011, Representatives Dave Reichert and Earl Blumenauer introduced a bill to extend the renewable energy production tax credit through 2016.[4] Advocates for the credit argue that if passed, the *American Renewable Energy Production Tax Credit Extension Act* (H.R. 3307) will prevent future boom-bust cycles caused by hesitation on the part of financiers and developers due to uncertainty created by pending expirations of the credit in the past (U.S. House, 2011; Witkin, 2011). As of this writing, H.R. 3307 has been referred to the House Committee on Ways and Means.

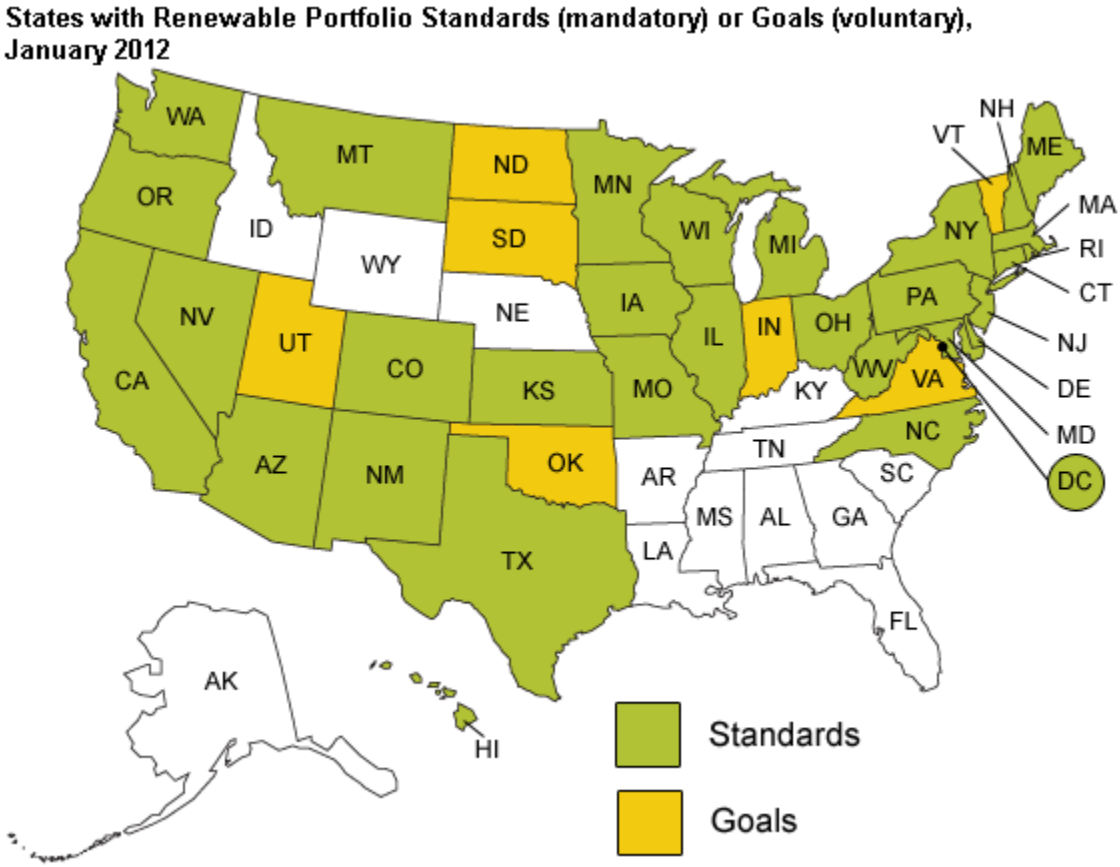
Renewable Portfolio Standards

In addition to national renewable energy mandates and financial incentives, state-level policies have also spurred a large amount of activity, especially in the U.S. States have the authority to impact the use of different energy sources through statutes, and state-run public utility commissions oversee the development of power plants and transmission lines (Sautter & Twaite, 2009).

In the absence of federally mandated development of renewables, 29 states including Puerto Rico and the District of Columbia have initiated renewable portfolio standards, key state-level drivers of wind development (Lyon & Yin, 2010; Alagappan et al., 2011) (see Map 1). A renewable portfolio standard requires load serving entities (i.e., electricity providers) to include in their resource portfolios a specified amount of electricity generated from renewable resources. Mandates vary widely from state to state, ranging from relatively short-term goals such as 29 percent by 2015 goal in New York—meaning 29 perecent of electricity generated in the state should come from renewable resources by 2015—to longer-term but more aggressive goals such as Hawaii's 40 percent by 2030 mandate.

[4] The American Renewable Energy Production Tax Credit Extension of 2011, if passed, would amend Paragraph (1) of section 45(d) of the Internal Revenue Code of 1986 by striking "January 1, 2013" and inserting "January 1, 2017".

Map 1: States with Renewable Portfolio Standards (mandatory) or Goals (voluntary), January 2012)
Source: Database of State Incentives for Renewables and Efficiency (DSIRE)



Market Drivers

Important market forces have also increased the competitiveness of wind as an energy source. Chief among these has been significant volatility in the price of natural gas over the last decade, which has raised the cost of electricity from gas-fired generation, narrowing the gap between the cost of power from wind and conventional sources. In 2000, U.S. prices for natural gas averaged $3.68 per thousand cubic feet (Mcf) at the wellhead before peaking in 2005 and 2008 at over $7 Mcf. Prices have since fallen slightly again to an average of $4.16 Mcf.[5] According to Lehr et al. (2011), wind energy generation is generally cost-effective with natural gas prices at $3.50 Mcf.

The cost of generating electricity from wind has also dropped with numerous technological improvements and a movement toward larger and more efficient turbines. The average turbine installed in the U.S. in 2006 had a nameplate capacity of 1.6 MW of electrical power. While engineers have found ways to increase the height and size of turbines while minimizing costs, experts "do not expect the rotors of land-based turbines to become much larger than about 100 meters in diameter, with corresponding power outputs of about 3-5 MW," primarily because of logistical constraints related to transporting large components on U.S. highways (DOE 2008). In fact, since 1995 generating efficiencies have improved by more than 15% (Bird et al., 2005).

[5] See http://www.eia.gov/dnav/ng/hist/n9190us3A.htm.

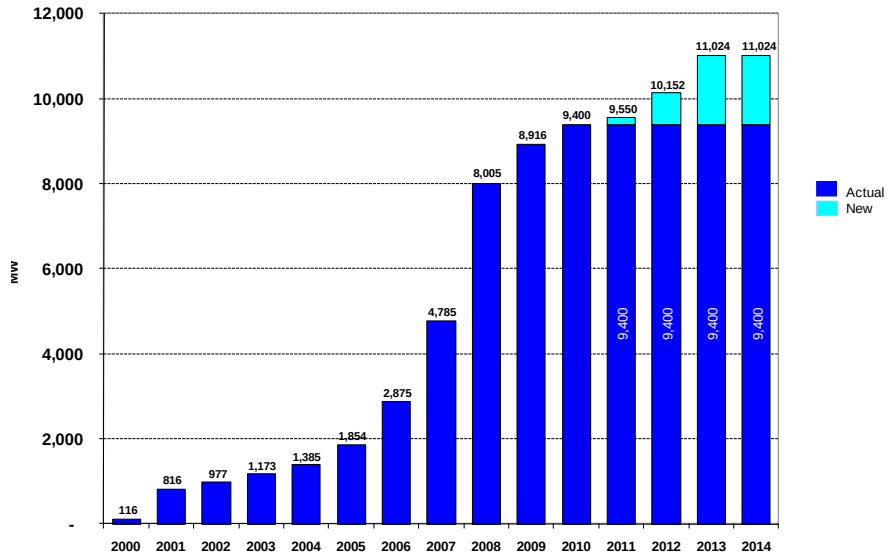
3. Wind Energy in Texas

Over the last decade, Texas has emerged as the leading state in the development of U.S. wind energy capacity, expanding at a greater rate than any other state (Wiser and Bollinger 2008). Texas is home to seven of the nation's top ten largest wind farms, and has a total installed capacity of 10,135 MW—nearly a quarter of national capacity[6] (AWEA, 2011; Brannstrom et al., 2011) (see Figure 2).

According to the American Wind Energy Association (AWEA), the wind industry supported 8,000-9,000 direct and indirect jobs in Texas in 2010 and supports approximately 75,000 direct and indirect jobs nationwide.[7] Using 2010 state and national employment data provided by the Bureau of Labor Statistics,[8] it is estimated that Texas has a wind industry location quotient ranging between 1.328 and 1.494.[9] This indicates that Texas is particularly strong in terms of its share of employment in the wind industry relative to the nation.

The rapid development of wind power in Texas is primarily due to favorable state and federal-level policies as well as market factors that have driven growth in the industry (Langniss & Wiser, 2003; Bird et al., 2005; Fischlein et al. 2010).

Figure 2. Texas installed wind-generating capacity, 2000-2014 (projected)
Source: Emerging Technologies Integration Plan, Electric Reliability Council of Texas



[6] According to the American Wind Energy Association (AWEA), the U.S. wind industry totals 42,432 MW of cumulative capacity as of June 2011 and represents more than 20 percent of the world's installed wind power (See http://www.awea.org/learnabout/industry_stats/index.cfm).

[7] See http://awea.org/learnabout/publications/upload/Texas.pdf and http://www.awea.org/newsroom/pressreleases/Save_USA_wind_jobs.cfm.

[8] The State of Texas employed 11,198,645 workers at the end of 2010; the U.S. employed approximately 139,415,000 workers during this time.

[9] $LQ = \frac{e_i/e}{E_i/E} = \frac{8{,}000\ /11{,}198{,}645}{75{,}000/139{,}415{,}000} = 1.328\ or\ \frac{9{,}000/11{,}198{,}645}{75{,}000/139{,}415{,}000} = 1.494$

Interestingly, state-level wind-enabling policies in Texas were not enacted out of any explicit concern over climate change, but were largely motivated by declining oil production, an excellent wind resource (Zarnikau, 2011, p.3906), and the promise of rural economic development within the state (Langniss and Wiser, 2003, 528; Fischlein et al., 2010). Through a series of interviews with state-level policymakers, Fischlein et al., (2010) found that Texans were actually careful *not* to frame the development of renewable energy as an environmental or climate change mitigation effort out of repelling the large conservative voter base in the state.

One of the key renewable energy policies, the renewable portfolio standard, was established in 1999 under then governor George W. Bush. Texas was one of the first states to establish a renewable portfolio standard during a restructuring of the state's electricity market (Fischlein, 2010), and represents one of the most ambitious state-level policies in terms of added capacity (Langniss & Wiser, 2003, p.528). When first established, the renewable portfolio standard required the installation of 2,000 MW of new renewable capacity by 2009—a goal that was met by 2005 (Langniss & Wiser, 2003, p.528; Public Utility Commission, 2011). Even the updated requirements of 5,880 MW by 2015 and 10,000 MW by 2025 have already been met as of 2011, indicating the significant contribution of wind energy to meeting the state's goals (AWEA, 2011; Public Utility Commission, 2011).

Competitive Renewable Energy Zones

To meet the requirements of the state's renewable portfolio standard, the Public Utility Commission of Texas has initiated the nearly $6.8 billion Competitive Renewable Energy Zones (CREZ) program. A CREZ is a geographic area where wind generation facilities will be constructed over the next several years.

In 2008, the Public Utility Commission designated five CREZ Zones for the generation of wind power and required transmission expansions that will allow for the movement of electricity from remote parts of West Texas and the Texas Panhandle to more urbanized and heavily populated areas of the state (i.e., Austin, Dallas-Fort Worth, and San Antonio).[10] The CREZ program is expected to increase Texas's current level of wind generation capacity by over 80 percent, from 10,135 MW to a level of 18,456 MW.[11] This planned development of approximately 8,321 MW of new generation capacity will cost an estimated at $6.79 billion, and is being justified on the basis of the project's ability to improve air quality, wean the state off fossil fuels, and, perhaps most importantly, stimulate the state's economy.

Context: West Texas

While the wind energy industry has impacted communities and regions across the entire state of Texas through complex rural-urban linkages, the production of electricity itself is concentrated in the western portion of the state. While West Texas is a vernacular term used by many to describe certain areas west of Austin, Dallas-Fort Worth, and Houston, there is in general a lack of consensus regarding the boundaries that separate East Texas from West Texas.

For the purposes of the following demographic and economic analyses, a functional region including only counties with installed wind capacity will be used. The majority of counties with wind development

[10] CREZ Transmission Program Information Center, 2010, "Program Overview," Public Utility Commission of Texas, http://www.texascrezprojects.com/overview.aspx.

[11] See http://www.texascrezprojects.com/overview.aspx for information on the CREZ build-out and http://awea.org/learnabout/publications/upload/Texas.pdf for more information on Texas's current capacity level.

are located in the West Texas and Northwest Texas regions in Figure 4; of the 32 counties included in this analysis, two counties—Cooke and Kenedy—are geographic outliers in the sense that they are located in the eastern portion of the state. This region of analysis will hereafter be referred to as *West Texas*.

Map 2: Texas Comptroller's 13 Regions of Texas
Source: http://www.window.state.tx.us/ecodata/regional/index.html

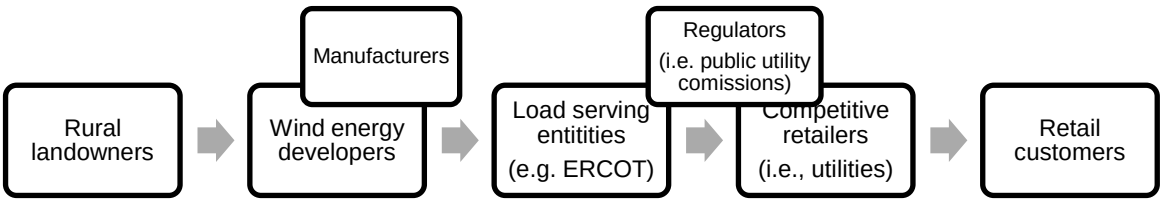
The West Texas region is considered to be rural. The 32 counties with installed wind capacity in Texas cover a total of 43,555 square miles and were collectively home to 1,087,224 people in 2010. Counties with installed wind capacity are generally very low density. Across the selected counties, population density is only 25 persons per square mile, compared to 96.3 persons per square mile in Texas and 87.4 persons per square mile in the U.S.[12] Land across the West Texas countryside is devoted primarily to agriculture uses, and is expansive and flat in most places, save for the occasional bluff.

[12] 2010 Census, U.S. Census Bureau

4. Rural-Urban Linkages and the Wind Industry Value Chain

Because of its low population density and abundant land, rural America will play an important role in the transition to more renewable forms of energy, which tend to be less energy dense[13] (Smil, 2010; Blair, Kay & Howe, 2011). The development of wind energy in West Texas is no exception. But while virtually all of Texas's wind production takes place on large wind farms situated across miles of farmland, much of the electricity demanded derives from large metropolitan regions in the eastern portion of the state. Moreover, like many other capital-intensive industries, the value chain connecting a single wind turbine to a consumer of wind-generated electricity is complex and dispersed geographically, consisting of myriad manufactures, utilities, landowners, and consumers (see Figure 3).

Figure 3: Wind energy development value chain



Those close to the industry in West Texas are well aware of the complex value chains on which wind development relies:

> There's a [manufacturer] in Brownwood, right close [to] Coleman, that builds the internal steel works—ladders and platforms. And the areas that hold the monitoring and the login equipment and the electrical. They told me—the man who owned it—they put 14 tons of steel inside one of those General Electric towers. And then there's a place in Coleman that finishes the blades. The closest rolling mills for the towers are I think in Fort Worth. [And Zoltec in Abilene] does the carbon fiber stuff. That's quite an impressive facility there in Abilene (Interviewee 3, 2011).

Overall, the wind industry has had strong effects on the West Texas region. Many studies of the economic impacts resulting from renewable energy development rely on the Jobs and Economic Development Impact (JEDI) Models, created by the National Renewable Energy Laboratory (NREL) and based upon a set of unique industry production inputs and economic multipliers provided by the Minnesota IMPLAN Group. The JEDI model runs in Microsoft Excel using specific production inputs such as construction costs, equipment costs, annual operating and maintenance costs, and financing parameters, among others. The model then estimates project development and onsite labor impacts (direct), local revenue and supply chain impacts (indirect), as well as induced impacts.

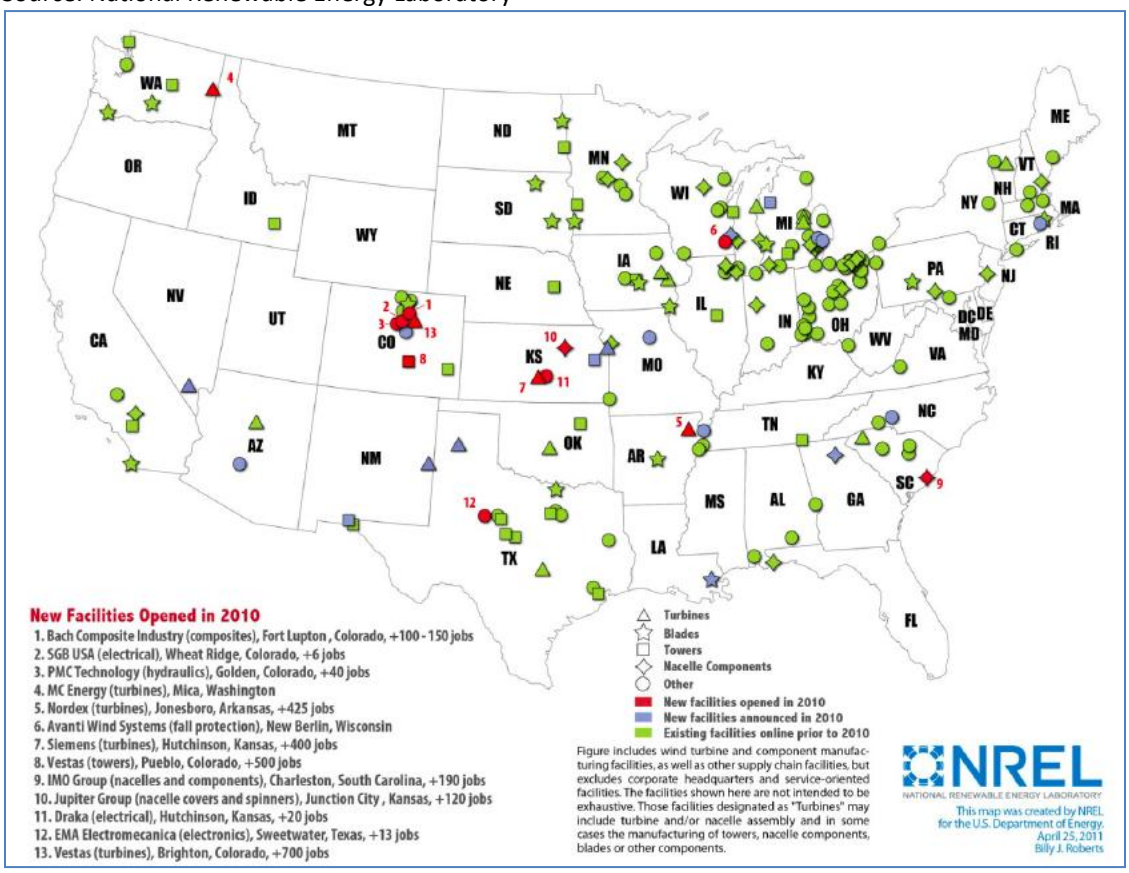
A JEDI wind model was used to estimate the purchases of goods and services associated with an 8,321 MW expansion of installed wind energy capacity in the State of Texas. The NREL estimates that an 8,321 MW wind farm built in 2012 cost a total of $16.6 billion and result in nearly $2.9 billion in regional

[13] Energy density describes how much land the development of a specific energy resource requires per unit of energy produced. Renewable energy sources as a rule yield less energy per unit of land by an order of magnitude or more in comparison to fossil fuels.

spending. Total annual operating expenses are estimated at $2.8 billion.[14] Because local policymakers are typically concerned with the economic impacts occurring *within* their state or particular region, regional rather than total purchases are used in the following estimates.[15] Using RIMS II multipliers, it is estimated that nearly $2.2 billion in regional purchases during the construction period of an additional 8,321 MW of wind energy development will result in approximately $3.5 billion in total output, $1.1 billion in earnings, and 24,917 jobs across the Texas economy.

While manufacturers of wind turbines installed in the U.S. hail from Europe, Japan, India, China, and South Korea, among others, General Electric was the number one manufacturer of wind turbines supplying the nation in 2010. In 2010, GE General Electric supplied the U.S. market with 50 percent of turbine installations and had a 9.6 percent market share globally (DOE, 2011, p.18-19). The U.S. Department of Energy and American Wind Energy Association both report a continuing trend of increased domestic turbine and component manufacturing, as well as a proliferation of assembly facilities. A map produced by the National Renewable Energy Laboratory (Map 3) shows locations of 13 manufacturing facilities that opened in 2010, 18 new announced facilities, and over 150 facilities open prior to 2010.

Map 3: Wind manufacturing facilities in the United States
Source: National Renewable Energy Laboratory



[14] Estimates assume a total of 4,161 installed turbines, each with a size of 2,000 KW.

[15] The entire State of Texas is used as the region of analysis for the purposes of this study. In addition, local share percentages are estimated at the national level by the NREL and thus do not reflect spending patterns specific to Texas.

Accompanying the growth in U.S. wind capacity has been an increase in the share of turbines and turbine components that are domestically manufactured. Analysis of trade data conducted by the U.S. Department of Commerce highlight a trend in which "wind power capacity additions have outpaced equipment imports, yielding a growing share of domestic manufacturing content" (DOE, 2011, p.25).

And as the industry has expanded its footprint across West Texas, the region has developed important comparative advantages for wind-related manufacturing. Economic geography has played a critical role in firm location decisions and the development of supply chains. One Texas interviewee identified specific examples of firms that re-located to the area to take advantage of market proximity. Large firms like General Electric have begun to realize that attractiveness of locating its facilities in West Texas as many of the turbines they produce end up there. As one economic development practitioner recalls, "[General Electric] started looking and [they said], 'Almost all our turbines are coming here.' So we have the only GE wind center in the United States because at any what time [they] monitor as much as 800 MW of power."[16] The same interviewee noted that adequate infrastructure and cooperative landowners are also factors in some manufacturer's decisions:

> …we actually brought a company from Argentina that is manufacturing some components that go into the wind business, here in Sweetwater now because it was the right place to be in the United States market… The companies were looking and said, 'You know, Sweetwater is a good place, Nolan County, West Texas, they're a good group of people. They have the services we need, willing landowners, and…why not?' (Interviewee 2, 2011).

Rural West Texas not only depends on the products and markets from urban areas in Texas and around the United States, but these areas also depend on the same rural communities for the energy produced. Dabson (2007) has framed this interdependence as a series of contributions that rural and metropolitan regions make toward each other's overall prosperity.

5. Building Rural Wealth

The Wealth Creation in Rural Communities (WCRC) initiative[17] has adopted a "community capital" framework for targeting and measuring the impacts of economic development policies and programs. An approach that transcends the traditional focus on economic and financial wealth, as WCRC suggests, "is more likely to create rural livelihoods that are sustainable over the long term, and more likely to benefit the many rather than the few."

The WCRC initiative broadens the traditional focus on financial capital to include six additional forms:[18]

- Natural capital includes non-renewable resources as well as renewable resources. Deforestation is considered to be a depletion of natural capital.
- Social capital represents the stock of trust, relationships, and networks that support a healthy community by reducing the cost of doing business and building relationships.
- Individual capital is the stock of skills and the physical and mental health of people in a region, including the entrepreneurial ability to start new businesses.

[16] Interviewee 2
[17] See http://www.creatingruralwealth.org/.
[18] The list of the WCRC seven forms of capital is adapted from http://www.creatingruralwealth.org/wealth-creation-approach/multiple-forms-of-wealth/.

- Built capital is most often thought of as a community's physical infrastructure, such as water and sewer lines, fiber optic cables, and housing stock.
- Intellectual capital is the stock of knowledge and innovation in a region, embodied not in individual minds—as individual capital is—but instead in the enduring intellectual products those minds have created. Intellectual capital is about institutionalizing new shared knowledge and new ways of seeing.
- Political capital describes the stock of power and goodwill held by individuals, groups, and organizations that can be wielded to achieve desired ends in a region. Political capital can be used to increase access to and control over other forms of capital.

Financial Capital

Financial capital is made up of the monetary assets belonging to an individual, household, or community. Interviews with landowners, industry representatives, and municipal officials illuminate the accumulation of several forms of financial capital generated by wind development, some more elusive than others. In addition to jobs created directly and indirectly through wind energy development, the industry also provides new tax revenue for states and municipalities, as well as income to landowners hosting a wind turbine or transmission tower (Slattery et al. 2011).

Property Tax

Required to pay property taxes on leased land, wind developers are providing new revenue to counties, municipalities, and school districts across West Texas. While some early developments paid property taxes in full, many developers now receive abatements. In Nolan County, for instance, the market value of wind farms grew from a total value of almost nothing in 2001 to $1.9 billion in 2009, while tax abatement agreements put the taxable value at about $831 million (Adame 2011). A county judge recalls the exponential growth in the county's tax base over the last decade,

> When I first took office, which was January 1, 1999, our entire tax base for the county was just slightly over $500 million. And for 2011, before abatements, it's $3,051,106,130—that's the total market value. The total assessed value is $2,630,868,000. And after abatement our total taxable property is $1,599,118,880. So you can see that that's quite an increase.

While the property tax is no longer a significant source of revenue for most states, its contribution to local revenues can be significant (Bowman & Kearney, 2006). In West Texas, landowners are benefiting from the wind industry's impact on property taxes:

> That [increased tax revenue] directly impacts everybody that is a landowner or owns any kind of property in Nolan County because all of a sudden your tax burden's been decreased because the valuations are so much higher. The tax that they need to put on that to collect a certain amount of money to run the county was lowered (Interviewee 2, 2011).

On the other hand, one interviewee reported a tighter rental market as a result of the influx of construction workers in counties experiencing wind development. Compared to state and national levels, however, ownership is a more common form of tenure than renting in many West Texas counties. In Nolan County, for instance, 68.4 percent of households were owner occupied in 2010, compared to 63.7 percent in Texas and 65.1 percent nationally.[19]

[19] 2010 Census, U.S. Census Bureau

Sales Tax

Wind development not only results in increased property tax revenues, but indirectly affects the amount of sales tax collected as well. A study by New Amsterdam Wind Source, LLC, a consulting firm in Nolan County,[20] reports that sales tax revenue in the City of Sweetwater increased 40% from 2000-2007, a period of significant wind development in the area (WTWEC, 2008). According to the report, this additional revenue is partially owed to "substantial new retail operations and dining options [that] have opened in Sweetwater…since 2004," ostensibly a result of the influx of wind industry employees during this time. The authors go on to predict that "intensified industrial service operations will add additional momentum to local sales tax revenues in the near future" (WTWEC, 2008, p.15). Local municipal officials confirm the rise in sales tax revenue and attribute it to new retail and hotel development stemming from an influx of wind industry employees:

> …our sales tax has increased greatly…we've already collected $725,000 this year and we still have three months to go so we're only 75% of the way. So we'll more than double what it was less than 20 years ago. And a lot of that is not just wind based but it's just a progression of retail on Interstate 20, the Wal-Mart coming in. Now with the wind we have three brand new hotels we didn't have before wind.

In several West Texas cities, interviewees commented on the positive impact tax revenues have had on local schools. In fact, one landowner feels the local school systems are "one of the biggest beneficiaries"[21] of increased revenues. He says, in "the Roscoe school district, until the Roscoe wind farm arrived, the tax base was like $65 million. And Roscoe was a poor school district…very small tax base. The peak of the valuation from the wind farm and the land peaked at $365 million."

Increased funding for schools has been manifested in real improvements to school facilities and curriculums, which has in turn improved the quality of education provided to many local students. For example,

> Roscoe built over half of a new school in their first year…they went online with this early college program [and] they had a senior girl graduate with an associate's degree one week before she got her high school diploma. So that was the step and they're doing a great job. Highland School District is rebuilding about 50% of their school. Blackwell School District built a $12 million school for about 100 kids. Trent School District has done the same thing; built a brand new school (Interviewee 2, 2011).

[20] Disclosure: Gregory L. Wortham, current mayor of Sweetwater, is the president of New Amsterdam Wind Source, LLC.

[21] Interviewee 3

Other school districts, like the one is Blackwell, TX, have brokered lucrative deals with wind energy developers in order to secure financing for a new football stadium, scholarship money, and iPads for students, among other things.[22]

> In the past, local school districts in Texas were able to keep whatever revenue they earned, meaning wealthy suburban and rural districts would spend much more per pupil than inner-city districts around the state. Today, local tax revenue is collected and then redistributed by the state according to a specific apportionment formula.[23] While this has leveled the playing field in terms of educational spending across Texas, local school systems are still permitted to use tax revenue for important capital improvements and debt servicing. As a county tax assessor remarks, "What it's done is it's allowed schools to build new because they can take on a debt knowing that they get full value at the debt rate…it's allowed them to keep quite a bit of it and build new schools and do things like that."

Landowner Income

In addition to creating jobs and increasing local tax revenues, the development of new wind generation provides lease income to landowners hosting electrical transmission towers, and both lease and royalty income to those with actual turbines on their property. This type of compensation is common with many forms of energy production, and lease terms are increasingly negotiated by landowner coalitions, especially in the case of natural gas production (Jacquet, 2011). Generally, a wind developer will approach landowners living in an area under consideration and draw up lease terms. The developer will typically offer a one-time signing payment, in addition to guaranteed production royalties that are based on the amount of electricity generated by any turbines on the property during the term of the lease, and "…then [compensation for] damages for the roads and pads and anything else that's used," according to one landowner.

There is also anecdotal evidence that landowner payments have become more consistent as development has become prolific across parts of West Texas:

> [Landowners] receive a signing bonus, and all of these situations are negotiable so it's different all the way across the wind belt. But the industry is beginning to settle down and arrive at a standard, more or less. And it varies across the nation. (Interviewee 3, 2011).

Lease arrangements vary, with some landowners agreeing to individual leases while others opt into shared arrangements. Shared (or co-opted) arrangements, whereby compensation is distributed equally among participants, are often designed to prevent competition between neighboring landowners. One interviewee recounted his experience:

> …the royalties is based on a percent of the gross sales of electricity off of either your property if it's a co-opted deal. So you've got one windmill and there's a hundred windmills out there—or 1 MW and there's 100 MW—you get one percent of the total. If your one windmill breaks down you're not sitting there watching everybody else make money. Now there are some wind farms that are set up like that. You only receive a percent of the electricity generated on your farm. [There are] many different arrangements here.

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[22] See Smith (2011).

[23] In 1992 the State of Texas, then under Governor Ann Richards, launched the "Robin Hood Plan," which requires wealthier school districts to remit property taxes to the state, which are then redistributed to poorer districts (Texas State Historical Association, http://www.tshaonline.org/handbook/online/articles/fri62).

> We had voted ourselves a dollar an acre assessment because we wanted to negotiate as one entity. We didn't want our neighbors competing against each other [for] contracts. We didn't want different deals with different individuals because boy, you talk about causing conflict in the community. When one guy's got more, a better deal than anybody else, you just do not want that. (Interviewee 3, 2011)

Estimates of annual royalty payments from wind development range from nearly $12.3 million in 2008 (Adame, 2011) to over $17 million by late 2009 (WTWEC 2008). Payments to individual landowners are difficult to pinpoint, but one industry advocate from Nolan County feels payments are not excessive, "…probably the average income is $15-20,000, [maybe] $25,000 a year per landowner that has a windmill on 'em." He feels that there's "no concentration of income" because so many tracts of land are leased and the benefits are thus distributed among many landowners. Of course, those who do not own farmland in West Texas do not benefit directly from lease and royalty payments.

Employment and Wages

Wind development, while capital-intensive relative to other forms of energy production, has job creation potential, especially during the construction phase of a project. After a wind farm is constructed, however, relatively few positions are required in operation and maintenance. While new jobs are highly desired in struggling regions like West Texas, wind development clearly results in a boom phenomenon and resulting economic fluctuations, as illustrated by the following account:

> …in a very short amount of time, by the middle of 2008, we had over 1,000 people in Nolan County working on building wind … We were down in the low 4% [unemployment range]. [Experts] said just with the turnover in jobs and those that choose not to work, if you're down to 4 you can't find anybody to work. And we got to that point where it was hard to find someone to go to work, some of the jobs that used to start out at $7 or $8 an hour all the sudden had to pay $9, $10, $11 an hour because it was costing you more to get the bodies that you needed (Interviewee 2, 2011).

Positions that do remain after a wind farm has been constructed, while fewer than those supported during the construction phase, are often "direct jobs tied just to the industry itself" (Interviewee 2, 2011) and, unlike construction jobs, are permanent. The types of jobs vary, but most are related to maintaining and servicing the wind turbines themselves. As mentioned previously, General Electric located a large maintenance facility in Nolan County to take advantage of the rapid development, and has hired technicians from the local labor market. (Interviewee 4, 2011)

While the economic boom experienced with wind development is similar to that in the case of natural gas or oil extraction, some farmers have noticed that wind production is less volatile than conventional forms of energy production over the long-run. This is likely a result of a relatively stable wholesale electricity market in Texas, but the stability of wind development could be undermined by changes in policy direction.

Spillover Financial Effects

Even businesses that are unrelated to wind experience increased business, especially during booming construction periods. Interestingly, the influx of employees has also led to rising wages across the local economy in some places. One economic development practitioner explains the phenomenon as follows:

> We're only a county that had 6,200-6,300 people, and 1,000 of 'em are working in one industry that's brand new… You had people that would go out there and do nothing but pick up trash as they were constructing these [wind farms] and start out at $15 an hour.

> So your hotel industry, your janitorial industry, was struggling because that is an area that normally pays lower in a community and it's probably a $7, $8, $9 job; all of a sudden they had to increase it because of that.
>
> Some of our manufacturing—I've got a friend that worked at United States Gypsum for 20 years and that was probably the best paying blue-collar job in our community that left that to go work for the wind industry because they could make more money and travel all over the United States and do a lot of things like that.

Indeed, in tight markets it is not uncommon for businesses to respond to a labor shortage by raising wages across the board. This shift can be troublesome, however, if it is based on an artificial shortage caused by temporary employment, as is the case in counties dependent on new wind development.

Built Capital

Schools and municipal building improvements, like the remodeled courthouse in Sweetwater[24], were the most frequently cited examples of growing physical wealth in interviews and news reports. Many of the interviewees described the new construction in their community with pride and delight. They have witnessed how built capital fosters investment in other forms of capital, such as intellectual capital in the schools:

> And you can also see what the wind industry's done for all the other schools in the county…other rural schools in the county. Highland down here about five miles…they're getting a new facility. Blackwell is at the southeast corner of the county and they're getting a brand new school facility. North of us is Hermleigh, right up 84…they're getting a new school facility. So that gives you an idea of the educational benefits. (Interviewee 3, 2011)

While some benefits are difficult to notice, new building and infrastructure construction can provide one of the most visible signs of wind development's impact on the West Texas region, as one resident attests to: "I've seen the change, and I get to see the new hotels being built and the businesses coming in and I actually get to see the amount of value change…I think it's been very beneficial to the entire community."

Natural Capital

Examples indicating both the accrual and depletion of natural and physical wealth were alluded to in many interviews. A community's landscape, natural resources, and plants and animals constitute its stock of natural capital, while built capital describes the schools, roads, and buildings that contribute to building other forms of capital.

The most fervent debate in Texas has stemmed from planned transmission lines that would cross a region colloquially known as Hill Country, a Central Texas region described fondly by one interviewee as "a recreational area, it's a sporting area. It's been settled since the 1840s. It's rugged hills, lots of valleys, lots of streams of creeks. It's a very special place." While the boundaries of Hill Country are indefinite, the area is easily distinguishable from West Texas by most Texans, particularly by its higher land values and natural features.

[24] See Kraus (2011).

At issue is the fact that electricity generated in the rural communities of West Texas must be transmitted east to urban areas like Austin, San Antonio, and Dallas-Fort Worth. Wind generation is concentrated in West Texas with load growth is concentrated to the east and southeast, and Hill Country as the open expanse in the middle. In Hill Country, residents often see the turbines as a source of "eye pollution"(Interviewee 2 ,2011).

While coalitions from Hill Country have already had success in forcing the Texas Public Utility Commission to reroute a controversial transmission line that was planned to bisect sacred lands,[25] future skirmishes are inevitable as Texas continues its massive transmission build out, and a better understanding of a community's stock of natural capital will help to weigh the costs and benefits of such development.

Individual and Intellectual Capital

Forms of human and intellectual capital—or the capital invested in people—are also critical to the sustenance of healthy communities. Intellectual capital is generally distinguished from individual or human capital using measures of innovation and knowledge creation. Within the management literature, where the term is perhaps most frequently used, the intellectual capital belonging to a person or organization is regarded as that person or organization's ability to innovate, or, more specifically, "its ability to utilize knowledge resources" (Subramaniam & Youndt, 2005). The wealth creation approach defines intellectual capital in a similar way: Intellectual capital is the stock of knowledge and innovation in a region, embodied not in individual minds—as individual capital is—but instead in the enduring intellectual products those minds have created (WCRC, n.d.).

Of course, as indicated previously, local schools were repeatedly cherished as the key to reviving West Texas communities and maintaining the intellectual and human capital that seems to be missing. Schools, as an interviewee commented, "[are] the heart of the community. Once the school's gone the community just dies."

One of the most visible signs of knowledge building can be found at area technical colleges and workforce training programs. In a region dominated by a very limited number of industries, colleges are working to meet the wind industry's workforce needs and close the knowledge gap:

> The Texas State Technical College saw a need and in a very short amount of time put together a state-of-the-art program. In fact they're one of only three approved training facilities for AWEA (American Wind Energy Association). So they got out in front of it; they actually help other colleges. (Interviewee 2, 2011)

[25] See http://www.texastribune.org/texas-energy/energy/controversial-hill-country-power-lines-canned/.

By building the skillsets in a region, firms can capitalize on local talent and promote the kind of long-term employment than contributes to a more stable economy. Intellectual capital building also takes place within organizations, as stories from the wind industry indicate. In such a nascent industry, wind technicians and mechanics are developing the types of skills and knowledge sets that allow them to provide their expertise in other parts of the country:

> The infancy of the wind business is so new, you have guys that have been in it for five, six, seven years are experts because they've been in it for longer than anybody else. Well, some of [the] guys are working all over the country from this office because they have more experience than anybody else in their system does (Interviewee 2, 2011).

Importantly, the wind industry is providing some permanent jobs and is, in turn, keeping young people in the area or attracting them back. One rancher bemoans the continuing population loss of "our best and brightest" in and around Roscoe, TX, and remarks that the wind industry has been "kind of a double blessing" that is creating jobs and bringing young people back to rural Texas.

Depopulation was indeed a serious concern among many interviewees. One interviewee suggested that West Texans weren't concerned enough, asking things like "why aren't they alarmed that we're 500 people down since the census from ten years ago?" His frustration seemed to be targeted toward public officials in some cases, suggesting that efforts to preserve the wealth in their community were not strong enough:

> …to me I think it would make sense if we spent some money to improve the quality of life here which would make it easier to attract businesses and industry here. And then we have an improved quality of life. [Downtown revitalization], that's the kind of stuff…that we're hurtin' for. Programs for the kids, summer activities…there's nothin' here, except what I do.

Another source of intellectual capital in the region is the entrepreneurial spirit sparked by the burgeoning wind industry, as Texans recognize important business opportunities:

> I used to work for the electric utility here, Texas Utilities, and two people that I hired when I was manager for them, left TU and started a business of their own. They have a couple more partners but they're the main ones. And they have a very, very active repair business for wind generation. And that's just one small example but we have a lot of inhabitants of the county that were provided jobs due to the wind generators. (Interviewee 4, 2011)

> [Aside from operation and maintenance (O&M) work], there is quality control; we're still in warranty work…most of these windmills are still in warranty. There's of course electrician, computer, [and] office work. They have to monitor each one of these projects. Even pilot car companies, local people, that have set up pilot car companies that for these big components of the wind industry that have to go up and down the roads. They have to have a pilot car in front of them…with the flashing lights and the warnings because they're over-wide, overloaded. Those kind of things. And a lot of those are local companies that just sprang up as the demand [went up]. (Interviewee 3, 2011)

> We had companies that got in on the ground floor with some of these wind companies. Good friend of ours that owns CGS Graphics, he started making signs and decals and things like that for the companies. Well, as these men would move to another location they said, 'I'm just going to order all my stuff from Russ because I'm used to having him do it.' So even though the volume decreased in our Nolan County area, his volume didn't decrease because of the relationships that he had built with some of these other individuals. (Interviewee 2, 2011)

Dabson (2001, p.35) has argued that this same spirit, when harnessed, can actually tackle deep-rooted economic problems in rural communities and should be given "greater recognition as a means to revitalize rural America." There is a certain ethos in West Texas that is difficult to deny, as onlookers watch how the industry "just grows and grows." What is less clear, however, is how this momentum will be maintained.

Community and Regional Inequities

Wind development has led to a multitude of benefits in rural, West Texas communities, but it is important to ask: Who is losing out in this process? A deeper analysis reveals that this rapid influx of investment, or capital, has in many ways reinforced existing social and economic structures, systematically promoting the interests of those who control society's productive capital.

It is clear that individual landowners are most likely to benefit in rural communities where the production of electricity is taking place. Farmers and ranchers hosting wind turbines own a critical element of productive capital—land—that contributes to a cycle of wealth accumulation and inequality within society. As long as the production of wind energy takes place on their property, their interests are effectively promoted over the interests of the non-landowning.

Interestingly, evidence to support this notion is most observable in local debates over economic development policy. The most commonly practiced economic development policies in rural West Texas communities generally include the use of business incentives to attract and retain firms. The prevailing belief among "wind welcomers" (Brannstrom, Jepson & Persons, 2011) is that wind development has had an extremely positive impact on the West Texas economy and that tax abatements are "important to foment wind-energy development."

This strategy has garnered support among many, but others say generous tax abatements represent, at best, a form of "corporate welfare" (Interviewee 9). One point of contention stems from the types of projects that economic development monies may be used for in Texas. One local business owner expresses the difficulty he faces in securing financial assistance under a structure that favors more conventional, industrial economic development:

> The real rub on the economic development thing is that we have two structures: 4A and 4B in economic development. Well 4A is what we have here; it allows you to do industrial development, it's essentially created jobs…building jobs. Which is great, everybody loves jobs. But the 4B projects allow you to reinvest in infrastructure. It would help me. Then I could get some money and fix my roof, which leaks. I struggle, struggle, struggle, and they go give a bunch of money to some out-of-town guy… I didn't [receive] nothin' to open this [café]…yet I grew up here.

Brannstrom, Jepson &Peters (2011) also document growing disenchantment with tax abatements among some community members. While some are concerned that local governments will eventually lack the funds necessary to make critical infrastructure improvements if tax abatements continue in earnest, others argue that the benefits of wind development would be more widely distributed if incentives were discontinued: "If they didn't have the tax abatements, then [wind energy firms] wouldn't be paying those landowners so much… Now if the companies had to pay taxes, the whole community would benefit, not just the people out there that are getting wealthy" (Brannstrom, Jepson & Peters, 2011, p.847).

Local officials and wind boosters acknowledge that "There always is [criticism] with any kind of abatement," and "There's probably not gonna be 100 percent of people in the county that agree with [the tax abatements]," but there is a belief that economic development policy has, "for the common good, it has helped them."

6. Conclusions

West Texas, a struggling and depopulating region, may be gaining a second wind, quite literally. The rapid development of wind energy across the region has contributed to economic growth, but has also had a pervasive impact on local communities. The extent to which wealth being generated by rapid wind energy development in West Texas has remained in and benefited rural communities ultimately depends on who you ask.

The wind industry has the potential to reinvigorate a depopulating region by offering employment opportunities for "young people to come back to." Indeed, proponents feel that the wind is "…bringing new blood [into the area] and this is [the] best thing that can happen to a rural community [when] nearly all of these young people that are coming back [and] staying here" (Interviewee 3, 2011).

Moreover, as many Texans observed severe economic decline in many parts of the country following the 2008 financial crisis, some felt that West Texas was able to persevere because of wind development: "We never had a decline in the market as far as our market values, our property. The rest of the country had an economic decline and we might have sort of hung in there but we didn't really decline" (Interviewee 5).

As Brannstrom, Jepson & Persons (2011, p.849) remind us, however, "the absence of resistance to wind-energy development does not signify complete acceptance," and underrepresented population groups to exist that may be excluded from the benefits derived from this industry. A successful and sustainable regional economy will only be realized through policies that foster economic competitiveness while concurrently providing social equity.

As development continues, important questions over the redistribution of wealth are bound to emerge. A rising tide will only lift all boats if the needs of those likely to lose out—be it the uneducated, landless, or small business-owning—are not addressed. Given the influx of new employees and their families, state and local policies that help small businesses and improve the quality of life in rural West Texas communities will improve the region's ability to attract firms and their investment, while also helping to shelter the region from economic volatility.

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Interviews

Unstructured, face-to-face interviews were conducted with 12 stakeholders in the West Texas wind energy value chain from October 10-14, 2011, in the following West Texas cities: Coleman, Fort Stockton, Mason, McCamey, Roscoe, San Angelo, and Sweetwater. One interview was conducted over the phone and several follow up calls were made in October and November 2011. All interviews were recorded and transcribed for more accurate analysis and verification.

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