center for
ENERGY STUDIES
Rice University's Baker Institute for Public Policy

TEXAS CREZ LINES: HOW STAKEHOLDERS SHAPE MAJOR ENERGY INFRASTRUCTURE PROJECTS

Julie Cohn, Ph.D.
Nonresident Scholar, Center for Energy Studies

Olivera Jankovska, M.Sc.
Nonresident Fellow, Center for Energy Studies

November 2020

Julie Cohn, Ph.D.
Olivera Jankovska, M.Sc.
"Texas CREZ Lines: How Stakeholders Shape Major Energy Infrastructure Projects"

https://doi.org/10.25613/261m-4215

Introduction

In the 21st century, increasing legal and regulatory uncertainty hangs over development of new large-scale electric power infrastructure in the United States. Over the past 12 years, transmission service providers (TSPs) have put thousands of circuit miles of high-voltage transmission lines into operation in North America, yet numerous projects remain on the drawing board.[1] Many proposed extra-high-voltage AC and DC transmission projects, especially to link utility-scale renewables to major power markets, have met with a variety of hurdles, from state level opposition to regulatory blockades to landowner activism, causing lengthy delays and cancellations.[2] Completion of low-voltage transmission lines far outpaces the high capacity projects needed to support new windfarm and solar farm initiatives.[3]

According to the U.S. Department of Energy, greater investment in transmission infrastructure remains a challenge, primarily due to three complex requirements for initiation of a project: establishing a need for the project and decision-making (transmission planning), providing the funding source (cost allocation to various classes of electricity suppliers/users), and obtaining the appropriate state and federal permissions.[4] FERC issued order No. 1,000 in 2011 to alleviate the first two of the above requirements.[5] Besides these fundamental challenges, transmission investment also depends upon regulatory certainty, given that this type of infrastructure is very capital intensive and has a long life span—usually half a century or more.[6]

The Texas Competitive Renewable Energy Zone (CREZ) initiative offers a compelling case study of both 21st-century challenges to new transmission line projects and the legal and regulatory approaches that can facilitate successful infrastructure development. First anticipated by state legislation passed in 2005, all CREZ transmission lines were in

[1] Between 2008 and 2019, TSPs completed more than 15,575 circuit miles of transmission lines rated at 345 kV and above at an average cost of $1.1 million/mile. Jean Reaves Rollins, The C-Three Group, LLC, personal communication with the authors, September 22-23, 2020. The authors note that locating reliable comprehensive data for high-voltage transmission line additions to the U.S. transmission networks is difficult. Data available from government sources including the Department of Energy, the Federal Energy Regulatory Commission, and the Department of Homeland Security are either outdated, incomplete, aggregated in a way that makes it difficult to identify only lines in voltage classes higher than 345 kV, or inclusive of existing lines.

[2] Examples include the Tres Amigas Superstation in Clovis, New Mexico (http://www.tresamigasllc.com/); three Clean Line Energy power lines designed to link mid-western wind to eastern markets (https://www.cleanlineenergy.com/); and the TransWest Express Transmission project west of the Rocky Mountains (http://www.transwestexpress.net/).

[3] In 2019 TSPs added nearly 8,000 circuit miles of lower voltage lines (230 kV and below), but fewer than 2,000 circuit miles of high voltage lines (345 kV and above). Rollins, personal communication with the authors.

[4] "Staff Report to the Secretary on Electricity Markets and Reliability," U.S. Department of Energy, Washington, D.C., 2017.

[5] Ibid.; 18 CFR Part 35: Transmission Planning and Cost Allocation by Transmission Owning and Operating Public Utilities, Federal Energy Regulatory Commission, Washington, D.C., July 21, 2011.

[6] "Transmission Infrastructure Investment," Edison Electric Institute, Washington, D.C., December 2017.

operation within nine years. Notably, the 3,600 circuit miles of CREZ lines represent 23% of all new high-voltage lines added to U.S. transmission networks in the past 12 years. When enacting CREZ, the Texas Legislature effectively addressed all three of the requirements for initiating a major transmission project: (1) the law established the necessity for new service and the adequacy of existing service, thus allowing the regulatory commission to focus on planning;[7] (2) earlier state law established postage-stamp reimbursement of transmission costs, shared by all ratepayers, thus offering a clear method for repayment to transmission investors without burdening renewable generators that would be the predominant users of the lines;[8] and 3) with all CREZ lines internal to the state, only one agency—the Public Utility Commission of Texas (PUCT)—had regulatory oversight for permission and siting. In part due to state law and policy, landowners, local governments, and regional organizations also played an unexpectedly important role in shaping this significant energy infrastructure. Projected in 2008 to cover 2,300 circuit miles at a cost of $4.93 billion, the completed transmission lines stretched more than 1.5 times that distance at a cost of $6.9 billion.[9] The differences between the projected and final size and cost of the project, and the nine-year time frame from legislation to completion, suggest that patience and flexibility will be key policy tools for future projects.

Using the single metric of quantity of installed wind power capacity, Texas has achieved unqualified success. In 1999, when the legislature instituted a Renewable Portfolio Standard, the state counted 116 MW of installed wind capacity.[10] In 2005, when the legislature authorized CREZ, the total had increased to nearly 2,000 MW. Today, Texas leads the country with 24,000 MW of installed capacity, providing upwards of 23% of the total average power generated in the state.[11] Other metrics can be just as important: cost to customers, return to investors, government incentives for and profitability of wind generating companies, environmental impacts, ecosystem preservation, aesthetic changes, economic development, local government tax base, and system reliability and stability, to name several. To different Texans, and different policymakers, success might be measured as reduced air pollution resulting from increased reliance on wind, and failure might be measured as formerly idyllic landscapes marred by giant transmission lines and wind turbines.

---

[7] Barry Smitherman, chair of the Public Utility Commission of Texas through most of the CREZ process, underscored the importance of this provision of the law. Barry Smitherman, communication with Julie Cohn, July 27, 2020.

[8] See Texas Utilities Code § 35.004, Provision of Transmission Service, 2019. In Texas, the cost of power transmission is shared equally by rate-payers, regardless of where they are located and where the power sources are located, much like the cost of a postage stamp to mail a letter in the United States, which is the same from anywhere to anywhere.

[9] Warren Lasher, "The Competitive Renewable Energy Zones Process," Electric Reliability Council of Texas, Austin, TX, August 11, 2014, https://www.energy.gov/sites/prod/files/2014/08/f18/c_lasher_qer_santafe_presentation.pdf; Docket 33672, PUC CADM: Order, Public Utility Commission of Texas, August 15, 2008.

[10] Electric Reliability Council of Texas, "2008 Annual Report," ERCOT, Austin, TX, May 2009, http://www.ercot.com/content/news/presentations/2010/ERCOT%202008%20Annual%20Report.pdf.

[11] Fact Sheet, Electric Reliability Council of Texas, Austin, TX, March 2020, http://www.ercot.com/content/wcm/lists/197391/ERCOT_Fact_Sheet_3.25.20.pdf .

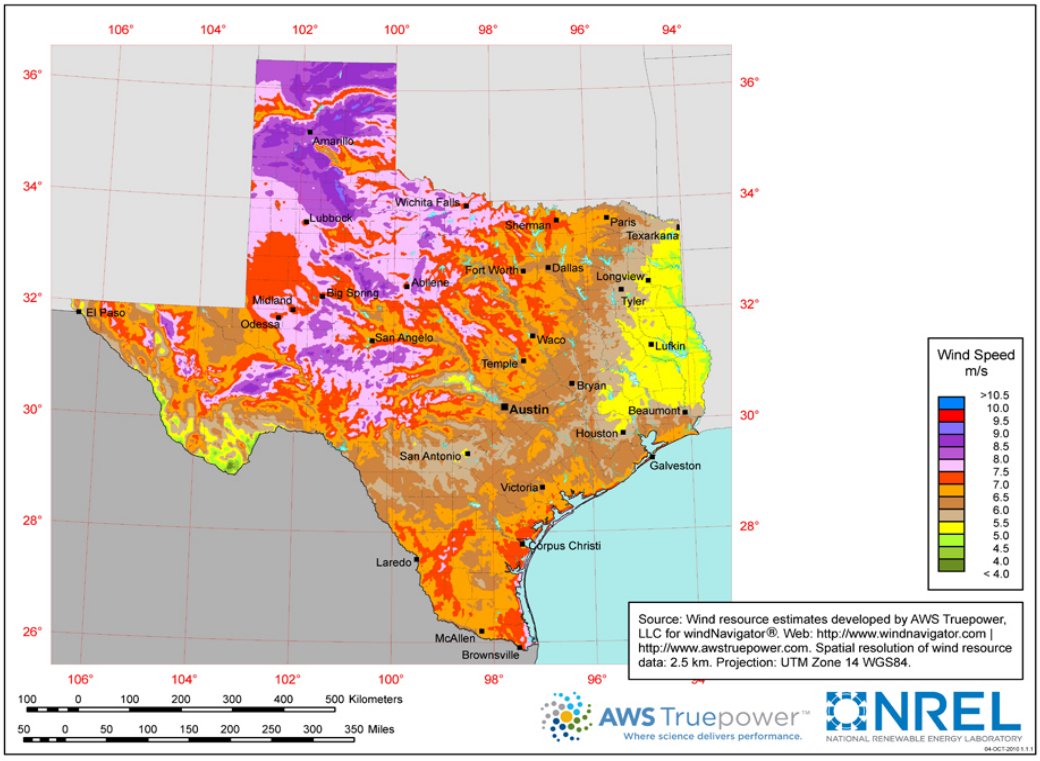
In 2020, Texas leads the country in total wind power generation, total installed wind power capacity, and total installed renewables capacity.[12] In conjunction with geography conducive to wind and solar development, state and federal tax incentives, public support, improved technologies, and dropping capital costs, the CREZ initiative stands out as a major renewables achievement in the United States. This paper explores the factors that facilitated the establishment of CREZ and the completion of CREZ transmission lines; the chief goal of wind-power expansion as well as other considerations important to stakeholders; and the implications for future energy infrastructure projects across the country.

[12] "Electric Power Monthly Data for January 2020," EIA.gov, U.S. Department of Energy, accessed April, 6, 2020, https://www.eia.gov/electricity/monthly/.

Legislating the CREZ

Successful wind development in Texas resulted from a congenial mix of appropriate geography, functional technology, and favorable policies. Large parts of the state are blessed with relatively high winds in areas with generally flat topography—ideal for utility-scale wind farms, as illustrated in the map in Figure 1.

Figure 1. Texas Annual Average Wind Speed at 80 m.



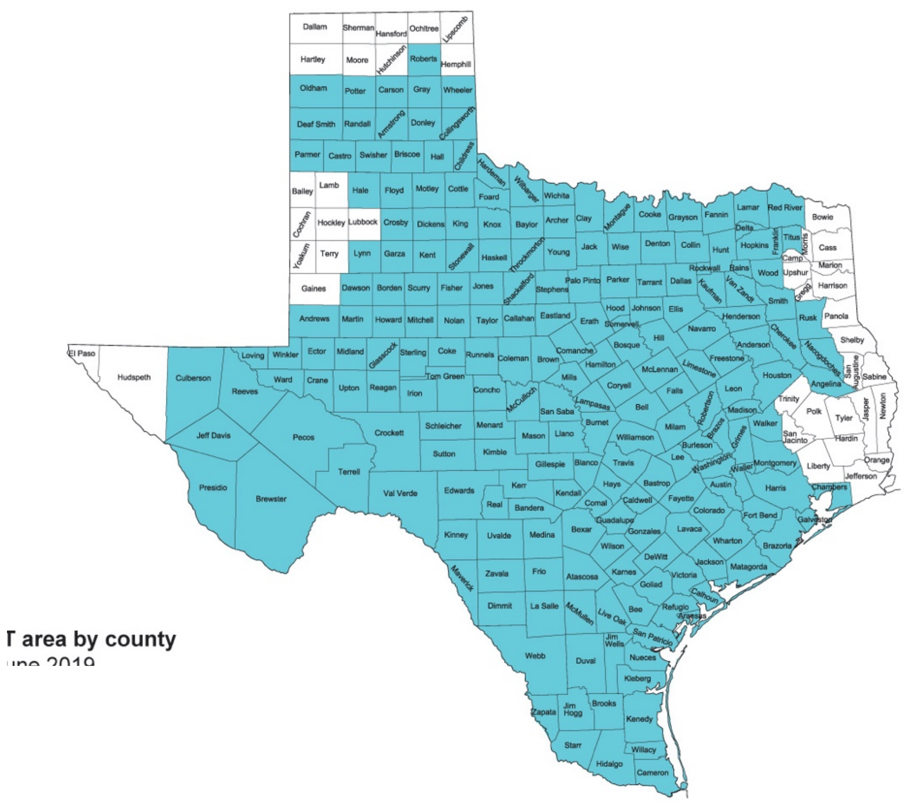
Map created by Billy Roberts, National Renewable Energy Laboratory. Additional sources: U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, WindExchange website, Texas 80-Meter Wind Resource Map, https://windexchange.energy.gov/maps-data/122.

By the early 2000s, turbine design had improved sufficiently to make wind-generated electric power commercially feasible.[13] But perhaps most importantly, through a combination of state and federal policy choices, Texas offered an excellent venue for wind developers.

[13] Kate Galbraith and Asher Price, *The Great Texas Wind Rush: How George Bush, Ann Richards, and a Bunch of Tinkerers Helped the Oil and Gas State Win the Race to Wind Power*, The Peter T. Flawn Series in Natural Resource Management and Conservation (Austin, TX: University of Texas Press, 2013).

While Texas exceptionalism may be a myth in most respects, it is a reality with respect to electric power. Over the past century, Texas utilities worked to avoid federal regulation by keeping wholesale power transactions within the state.[14] Ninety percent of Texas electricity customers acquire power from a grid that is internal to the state and does not regularly exchange power with its neighbors. There are links between the Texas grid (also known as ERCOT[15]) and surrounding states and Mexico, but they are not considered interconnections and are operated under strict circumstances that keep the power transactions out of federal oversight. It is important to note, however, that some parts of Texas are served by power companies that are linked into the enormous Eastern and Western Interconnections, and not the Texas grid. The map below delineates the region served by the Texas grid:

Figure 2. ERCOT Area by County as of June 2019



Source: Electric Reliability Council of Texas website, http://www.ercot.com/content/wcm/landing_pages/89373/sized-county-map-6.27.19.jpg.
Note: Areas shown in white are served by power companies that are not connected to the Texas grid.

---

[14] For exceptions during World War II, see Julie Cohn, *The Grid: Biography of an American Technology* (Cambridge, MA: MIT Press, 2017), 109.

[15] The Electric Reliability Council of Texas (ERCOT) operates the Texas Interconnect, one of the three major grids that provide power in the continental United States. The other two are the Eastern Interconnect (east of the Rocky Mountains)—which also serves customers in Canada, and the Western Interconnect (west of the Rocky Mountains)—which also serves customers in Canada and parts of Mexico.

The move to increase renewables in Texas took place within legislative efforts to restructure the state's electricity markets.[16] State Senate Bill 7, signed by then-Gov. George W. Bush on June 18, 1999, established competitive wholesale and retail power markets in Texas, required the unbundling of regulated monopoly utilities, and provided exceptions for municipal power companies and rural cooperatives. Within this bill, Texas adopted a Renewable Portfolio Standard (RPS), among the first states to do so.[17] The RPS set hard goals for installed capacity:

1999 installed capacity:	116 MW
2003 goal:	1280 MW
2009 goal:	2880 MW

Various authors[18] attribute this action by the Texas Legislature to several influences:

1. The influence of wind power inventors and developers on specific legislators and the governor.
2. Texas' entrepreneurial spirit and long history as an energy producing state.
3. Legally mandated citizen input into the state's power planning process that revealed strong support for renewables and a willingness to pay for them.
4. Active and well-organized lobbying by environmental groups.

As one analyst offers, "all participants in these negotiations [for the 1999 law establishing the RPS] ultimately endorsed the bill as a win-win strategy that could foster new competition in electricity, protect existing utilities through financial coverage of their stranded costs, and also make new commitments on improved air quality."[19]

With the RPS in place, and both state and federal tax incentives and credits available, wind power developers jumped on board and the state met its first goal well before the deadline. By 2001, Texas had exceeded the 2003 goal, and by early 2005, it was clear that the state would meet the 2009 goal within months.[20] In addition, the state's grid operator,

---

[16] L. Lynne Kiesling and Andrew N. Kleit, eds., *Electricity Restructuring: The Texas Story* (Washington, D.C.: AEI Press, 2009).

[17] States with RPS by 1999: Nevada, Iowa, Wisconsin, Maine, Massachusetts, Connecticut, New Jersey, and Texas. See https://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx.

[18] R. Ryan Staine, "CREZ II, Coming Soon to a Windy Texas Plain Near You: Encouraging the Texas Renewable Energy Industry through Transmission Investment," *Texas Law Review* 93, no. 2 (December 2014); Becky H. Diffen, "Competitive Renewable Energy Zones: How the Texas Wind Industry is Cracking the Chicken & Egg Problem," *Rocky Mountain Mineral Law Foundation Journal* 46, no. 1 (2009); Galbraith and Price, *The Great Texas Wind Rush*, 2013; Barry G. Rabe, "Statehouse and Greenhouse: The Emerging Politics of American Climate Change Policy" (Washington, D.C.: Brookings Institution Press, 2004); Kiesling and Kleit, *Electricity Restructuring*, 2009; Leah Cardamore Stokes, *Short Circuiting Policy: Interest Groups and the Battle over Clean Energy and Climate Policy in the American States*, Studies in Postwar American Political Development (Oxford: Oxford University Press, 2020).

[19] Rabe, "Statehouse and Greenhouse," 59.

[20] David Hurlbut, "A Look Behind the Texas Renewable Portfolio Standard: A Case Study," *Natural Resources Journal* 48, no. 1 (2008).

ERCOT, discovered that concentrated wind development in certain areas resulted in bottlenecks on the transmission infrastructure. The transmission lines reaching from wind farms to the state's grid were simply too small. ERCOT forced certain wind power operators to curtail their generation from time to time, and investors were leery of adding new wind power to the system.

With these issues in mind, Texas legislators enacted Senate Bill 20 (SB 20) in 2005 to increase the RPS goals, to extend them out to 2015 (with a further target for 2025), and to add a specific target for solar power:[21]

2005 installed capacity	1,992 MW
2015 goal	5,880 MW
2025 target	10,000 MW
Non-wind target	500 MW

The legislators also ordered the PUCT to establish the CREZ and to plan for related improvements in transmission infrastructure. This was intended to direct investment in wind power to areas of the state with both good wind potential and plenty of land, and at the same time to assure that new power generation could be added to the state's grid without causing bottlenecks.

[21] SB 20, "An Act Relating to this State's Goal for Renewable Energy," 79th Legislature, Special Session, Texas Utilities Code §36.053 (passed July 20, 2005).

The CREZ Development Process

"I think this process really worked because all of the decision-makers and all of the stakeholders and interested market participants were aligned."

— Jeff Billo, ERCOT Manager of Transmission Planning[22]

Following enactment of SB 20, the PUCT initiated a multi-year process of identifying CREZ, determining needed infrastructure additions and upgrades, designating transmission corridors, selecting TSPs, and determining actual line routes. The commission opened 72 contested cases, beginning in October 2005. In the first case, "Rulemaking relating to renewable energy amendments," the PUCT asked participants to answer questions about how to implement SB 20 and stakeholders responded through the bulk of 219 filings.[23] Thereafter, the commission opened separate dockets to consider which proposed high-wind areas should become CREZ, how to select TSPs, how to resolve certain regulatory and technical issues, where transmission corridors would occur, and what precise route each transmission line would follow. Stakeholders filed more than 24,000 items across all dockets. In tandem, ERCOT initiated several studies—first to identify areas of the state with high wind, adequate land, and feasible transmission routes to qualify as CREZ; then to address technical challenges of bringing more wind into the state grid; and finally to assess specific routing issues raised through the hearing process.

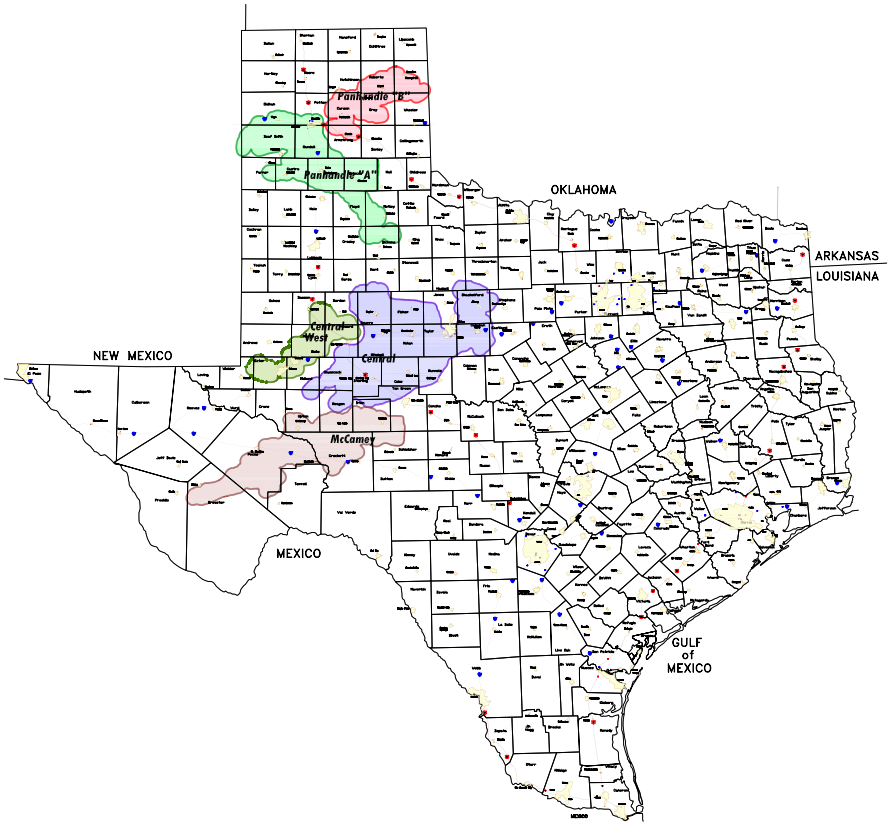
Over the course of three and a half years, the PUCT and ERCOT together hit numerous milestones in the CREZ process. In December 2006, ERCOT released an "Analysis of Transmission Alternatives for Competitive Renewable Energy Zones," detailing the characteristics of 25 CREZ candidate zones. Within this report, ERCOT studied a subset of 10 zones to determine potential transmission feasibility and costs.[24] Nine months later, the PUCT issued its interim order designating five large CREZ, two in the Panhandle and three in the central-west portion of Texas. Key criteria for the CREZ included adequate wind potential, sufficient land for wind development, feasible transmission routes, and expressed interest from wind developers. This latter criterion explains why, despite great wind potential as shown in Figure 1, the Gulf Coast region was not included—no developers expressed interest in that area. The five CREZ appear in Figure 3 below.

[22] "Webinar: Transmission Planning, Renewable Energy Futures, and Competitive Renewable Energy Zones," Clean Energy Solutions Center, September 12, 2017, https://www.youtube.com/watch?v=I7Jwd0G_ruY.

[23] Docket 31852, "PUC ADM: Request for Comments," Public Utility Commission of Texas, January 10, 2005.

[24] "Analysis of Transmission Alternatives for Competitive Renewable Energy Zones in Texas," Electric Reliability Council of Texas, Austin, TX, December 2006.

Figure 3. Competitive Renewable Energy Zones, 2007



Source: ERCOT Website, 2007 Reports and Publications, Map of CREZ Zones November 2007, http://ercot.com/content/news/presentations/2007/CREZ-11-02-07_public.pdf.

In April 2008, ERCOT submitted to the PUCT a transmission optimization study for the five CREZ, with four scenarios for moving electric power to markets.[25] The least costly scenario (Scenario 1), proposed new and upgraded transmission infrastructure to support 5,150 MW of new wind capacity. The most ambitious scenario (Scenario 3) would support 17,956 MW of new wind capacity. By late summer of that year, the PUCT selected its preferred transmission scenario—Scenario 2, to support 11,553 MW of new wind power—and the following spring the commission designated the TSPs to build the lines.[26] Over the next three years, in multiple dockets, the PUCT considered routing for each segment of each transmission line, and processed thousands of filings in dozens of case dockets. The commission issued final orders for each route at different times, some of which triggered lawsuits from unhappy landowners, local governments, and others. By January 2014, all the CREZ lines were in service.

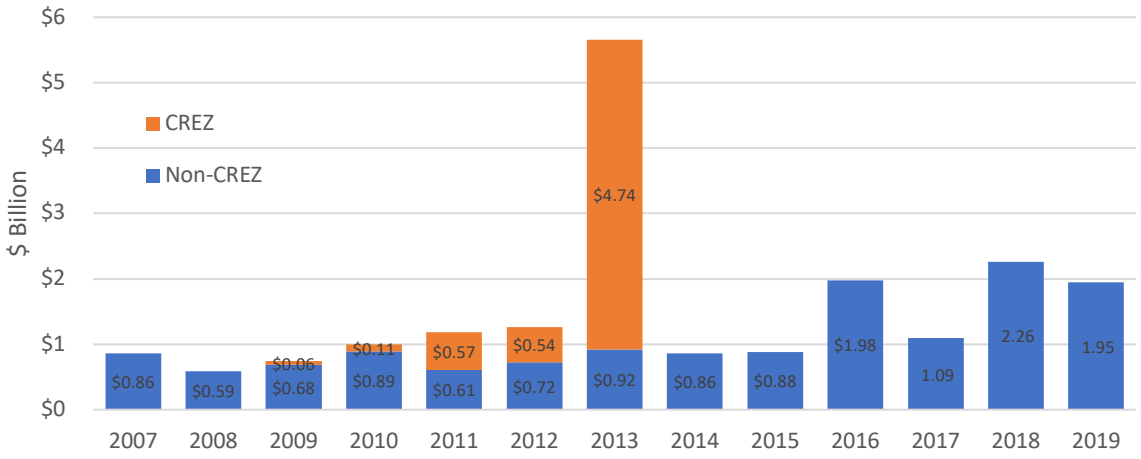
[25] Docket 33672, "ERCOT's CREZ Transmission Optimization Study," Public Utility Commission of Texas, April 2, 2008.

[26] "PUC CADM: Order," August 15, 2008; Docket 35665, "PUC CADM: Final Order," Public Utility Commission of Texas, March 30, 2009.

CREZ Results

The 3,600 circuit miles of new CREZ lines represent a significant contribution to North America's power networks in the 21st century. CREZ lines comprise one-third of high-voltage transmission lines placed into service across the country during the project lifetime, and 23% of lines placed into service in the past 12 years.[27] Nationally, annual transmission investment has more than doubled from $10.2 billion in 2010 to $21.9 billion in 2017, with an average annual growth rate of 12%.[28] Over that same period, ERCOT transmission spending totaled nearly $14 billion (or an average of almost $2 billion per year).[29] The CREZ transmission project represents by far the largest share of this cost in Texas, as illustrated in Figure 4 below, amounting to more than $6 billion over a five-year period (2009-2013).[30]

Figure 4. ERCOT Transmission Project Cost by Service Year



Source: Data for 2007-2016 come from the "2017 Report on Existing and Potential Electric System Constraints and Needs" and data for 2017/2018/2019 come from the "2018/2019/2020 Transmission Project Information Tracking (TPIT) report," respectively.

[27] Rollins, personal communication with the authors.

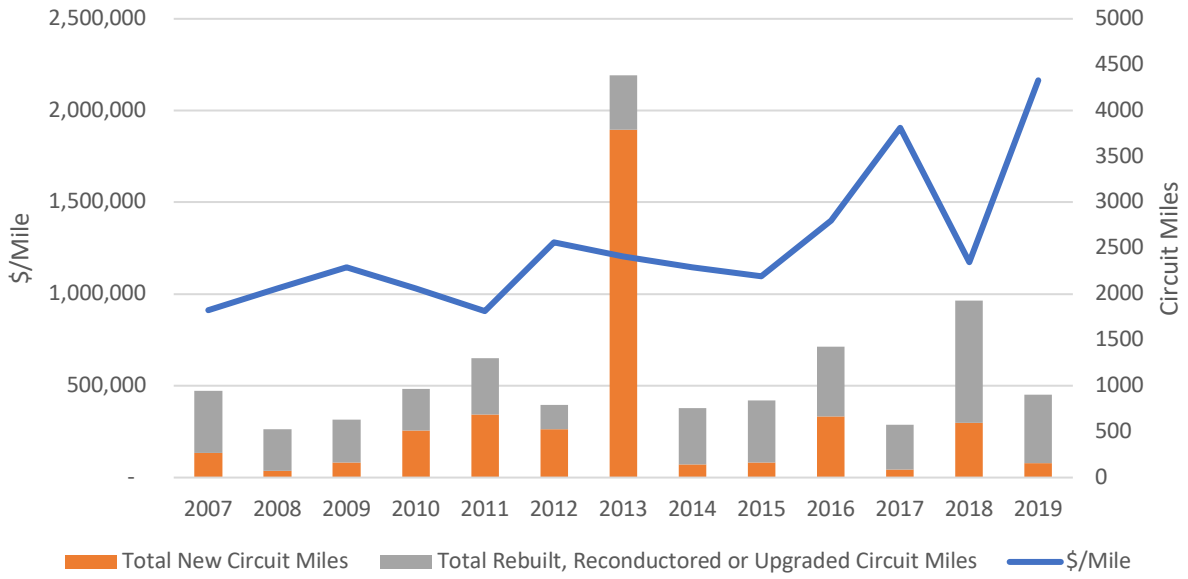
[28] "Transmission Projects: At a Glance," Edison Electric Institute,Washington, D.C., October 2018; Statistics and Industry Research Group Edison Electric Institute Economics, "Historical and Projected Transmission Investment," Edison Electric Institute, Washington, D.C., October 2018, https://www.eei.org/issuesandpolicy/transmission/Documents/bar_Transmission_Investment.pdf.

[29] "Report on Existing and Potential Electric System Constraints and Needs," Electric Reliability Council of Texas, Austin, TX, December 2019), iii, http://www.ercot.com/content/wcm/lists/172485/2019_Constraints_and_Needs.pdf; Lori Aniti, "Utilities Continue to Increase Spending on Transmission Infrastructure," *Today in Energy*, February 9, 2018, https://www.eia.gov/todayinenergy/detail.php?id=34892.

[30] "Report on Existing and Potential Electric System Constraints," 2019.

As shown in Figure 5 below, TSPs within ERCOT added or upgraded more than 15,000 circuit miles of transmission in the past 12 years (2007-2019). New transmission miles accounted for approximately 54% of the share, of which 80% were 345 kV lines, and about half of those were CREZ lines. During the same period, transmission project cost per circuit mile in ERCOT was variable, ranging from approximately $0.9 million to $2.2 million.[31] Notably, while CREZ infrastructure stands out as the single largest one-year addition in ERCOT, at $1.2 million per circuit mile, the cost matched the average over the past 12 years. In terms of transmission investment for the load it served, the ERCOT load-weighted transmission investment of $4.48/MWh was the highest of all NERC regions in the U.S. The rest had load-weighted averages ranging from $0.55/MWh to $3.98/MWh.[32] In other words, while CREZ was expensive, it was not more expensive for ratepayers than other transmission infrastructure on a per mile basis and it provided higher than average load capacity per dollar invested.

Figure 5. Transmission Project Cost per Circuit Mile and Total Circuit Miles (new and upgrades, all voltage types)



Source: Data come from the "Transmission Project Information Tracking (TPIT) Report" and was extracted and analyzed by the authors.

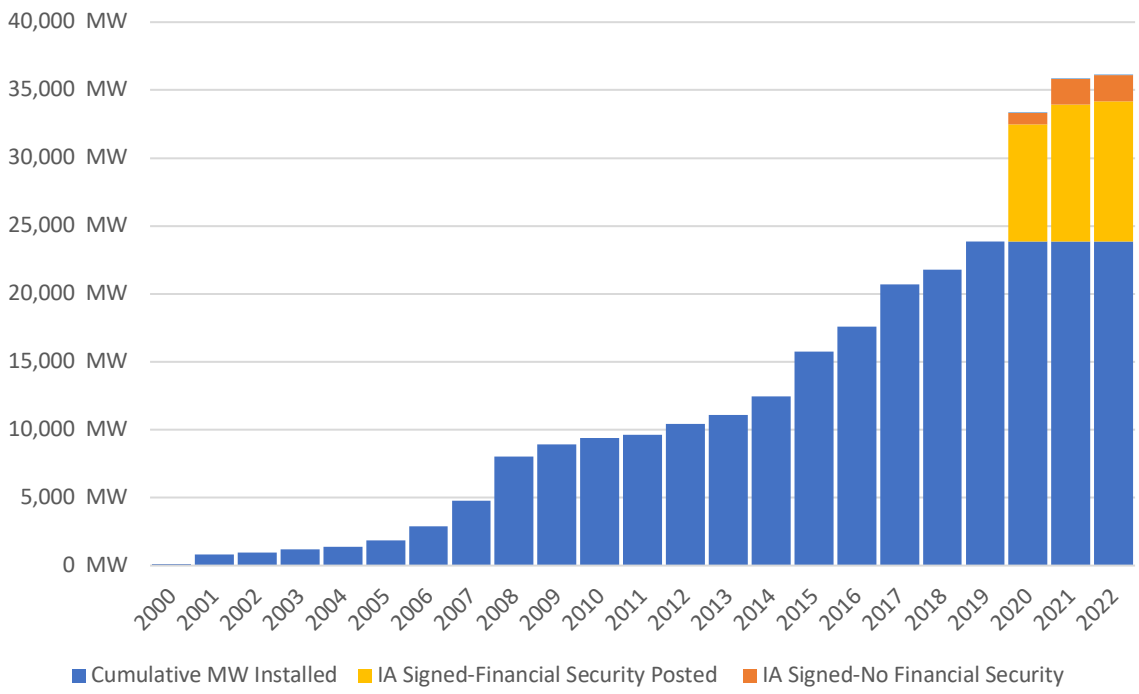
[31] "Transmission Project and Information Tracking," Electric Reliability Council of Texas, Austin, TX, February 1, 2020, http://www.ercot.com/gridinfo/planning.

[32] "Transmission Metrics," Federal Energy Regulatory Commission, Washington, D.C., 2017, https://www.ferc.gov/sites/default/files/2020-04/transmission-investment-metrics_0.pdf.

Growth in Wind Generation

The growth of wind generation, including a significant portion in the CREZ, drove investment in new transmission infrastructure.[33] Figure 4 below shows ERCOT wind additions by year as well as projected growth in capacity through 2022.

Figure 6. ERCOT Cumulative Wind Capacity (as of Jan 31, 2020)



Source: Projected values come from the Capacity Changes by Fuel Type, January 2020 report and are based on the current IA (Interconnection Agreements).

Wind developers added nearly half the 23,860 MW of installed wind capacity within ERCOT after the completion of the CREZ lines.[34] For the McCamey, Central West, and Central CREZ (which is now part of the region ERCOT calls West Texas) wind developers added 11 GW of new capacity, of which 4 GW went into service after the CREZ transmission lines were completed.[35] For the Panhandle A & B CREZ (now known as the Panhandle), developers added 4.4 GW of wind capacity, of which almost all went into service after the completion of CREZ lines. Demand continues for additional transmission

[33] "Impact of Increased Wind Resources in the ERCOT Region," Electric Reliability Council of Texas, Austin, TX, 2018, http://www.ercot.com/content/wcm/lists/144927/Wind_One_Pager_FINAL.pdf.

[34] "Report on Existing and Potential Electric System Constraints," 2019.

[35] "ERCOT Capacity, Demand, and Reserve Report," May 2020, http://www.ercot.com/content/wcm/lists/197379/CapacityDemandandReserveReport_May2020.xlsx) .

investment linking the Panhandle, the state's prime wind generation area, to the rest of ERCOT.[36] As recently as 2019, oil and gas production in West Texas, with its attendant increased electricity load, has led to additional calls for transmission investment.[37] Congestion rent in these areas reached over $53 million from October 2018 to September 2019.[38] It is worth noting that the Panhandle export yielded over $164 million in congestion rents the prior fiscal year.

Other CREZ Results

For some, cleaner air was the intended outcome of the state's RPS and the CREZ initiative. According to the Texas Commission on Environmental Quality, "Texas air quality has made major strides in the past few decades."[39] Air quality measurements in virtually every category of criteria pollutants have improved over the past 15 years. In addition, power plant emissions as a subset of all statewide emissions are informative. EPA data indicate that power plant contributions have fallen as a share of total greenhouse gas emissions in Texas, as illustrated in Figure 7.[40] It is noteworthy that Texas population grew by 15% and GDP grew 46% while total greenhouse gas emissions were basically unchanged over these same years.[41]

[36] Juan Andrade and Ross Baldick, "Estimation of Transmission Costs for New Generation" (white paper UTEI/2016-09-2, 2017), https://energy.utexas.edu/sites/default/files/UTAustin_FCe_TransmissionCosts_2017.pdf.

[37] "Report on Existing and Potential Electric System Constraints and Needs," Electric Reliability Council of Texas, Austin, TX, December 2017, http://www.ercot.com/content/wcm/lists/114740/2017_Constraints_and_Needs_Report.pdf.

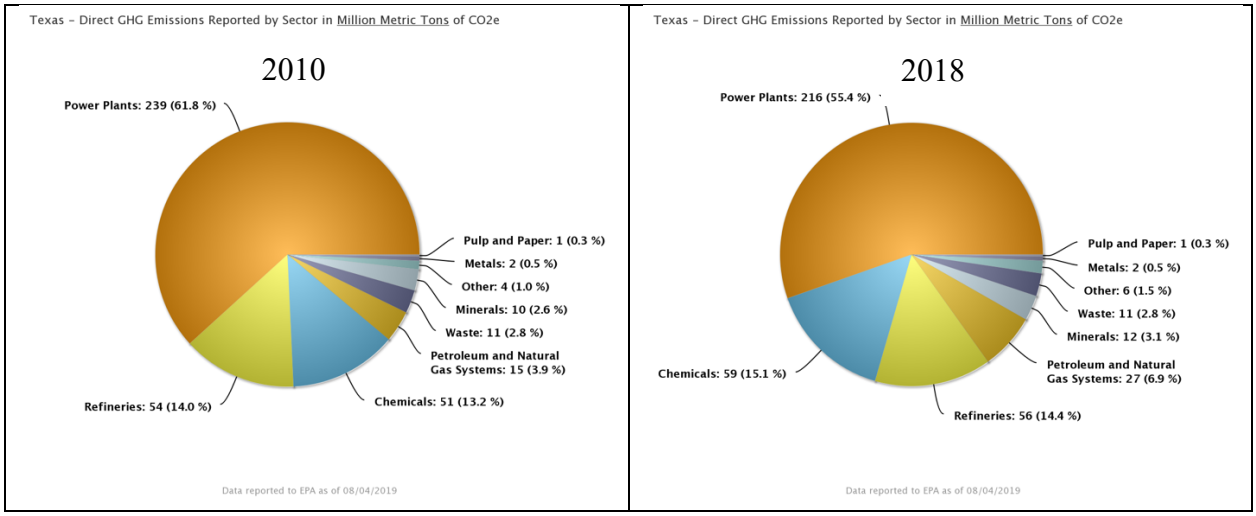
[38] Congestion on the transmission network occurs when generation exceeds the capacity of a given power line for safe transmission. ERCOT imposes a congestion charge when scheduled power flow across a particular transmission segment will exceed the safe limit for that area and will result in a constraint. A transmission congestion right, also called a congestion rent, is a financial instrument that allows an entity to hedge against congestion charges when scheduling power transactions. See ERCOT Glossary, accessed August 19, 2020, http://www.ercot.com/glossary.

[39] "Air Quality Successes—Criteria Pollutants," Texas Commission on Environmental Quality, accessed July 22, 2020, https://www.tceq.texas.gov/airquality/airsuccess/airsuccesscriteria.

[40] Environmental Protection Agency, EPA Facility Level GreenHouse Gases Tool (FLIGHT), accessed July 22, 2020, http://www.ghgdata.epa.gov/ghgp/main.do#. Greenhouse gas emissions measured by EPA include CO2, CH4, N2O, and several fluorinated GHGs.

[41] "2018 Estimated Population of Texas, Its Counties, and Places," Texas Demographic Center, San Antonio, TX, December 2019, https://demographics.texas.gov/Resources/publications/2019/20191205_PopEstimatesBrief.pdf; U.S. Bureau of Economic Analysis, "Total Gross Domestic Product for Texas (TXNGSP)," Federal Reserve Bank of St. Louis, accessed August 25, 2020, https://fred.stlouisfed.org/series/TXNGSP.

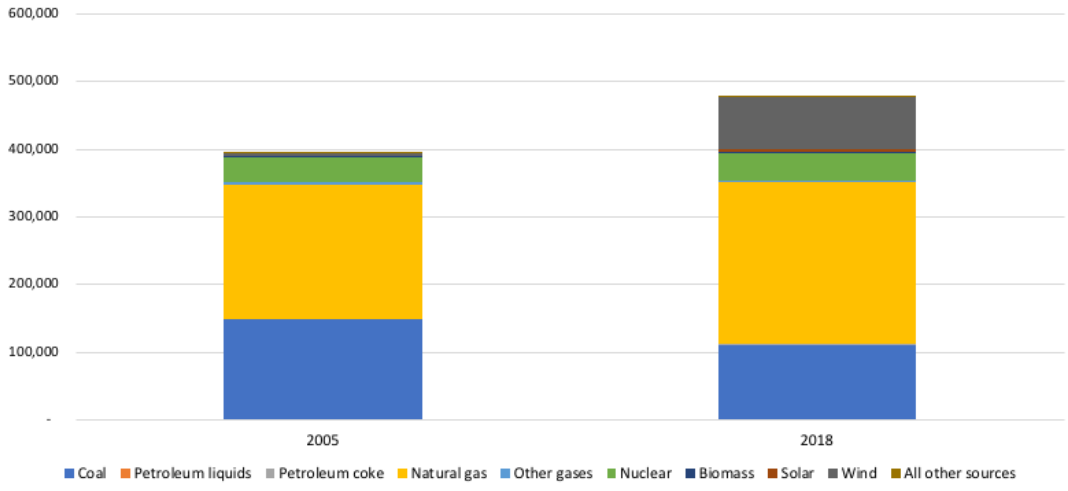
Figure 7. Power Plant GHG Emissions as a Fraction of All Emissions



Source: EPA FLIGHT website, https://ghgdata.epa.gov/ghgp/main.do. Filtered by: 2010 and 2018, All emitters, Texas, All Fuel Types, All Greenhouse Gases, All Emission Ranges, All Facilities.

These changes may be attributable in part to the increased portion of power generated by wind in Texas; but they must also be attributed to the significant shift from coal-fired power generation to natural gas-fired power generation. Total power generation between 2005 and 2018 increased by 20%, and generation by natural gas increased by 21%. Generation by wind also increased, by 1,787%. Generation by coal, by contrast, decreased by 25%. Figure 8 indicates the change in energy sources for power generation between 2005 and 2018.

Figure 8. Net Generation in Texas by Source, 2005 and 2018 (in thousands of megawatthours)



Source: EIA.gov Electricity Data Browser, Net generation for all sectors, selected fuel sources, https://www.eia.gov/electricity/data/browser/.

Emissions data are also informative. Between the enactment of CREZ in 2005 and 2018, the most recent year for which data are available, power plant emission of three pollutants—carbon dioxide (CO2), sulphur dioxide (SO2), and nitrogen oxide (NOX)—fell by 13%, 63%, and 31%, respectively. The data are provided in Figure 9 below.

Figure 9. Power Plant Emissions of Three Key Pollutants, 2005 and 2018

Power Plant Emissions	2005	2018	Difference	% Change
Total Number of Plants	208	209	1	
CO2 (metric tons, in thousands)	261,332	227,146	(34,186)	-13%
SO2 (metric tons)	548,937	203,329	(345,608)	-63%
NOX (metric tons)	246,974	170,065	(76,909)	-31%

Source: EIA.gov Electricity Data Browser (Beta), Number of plants for multiple sectors, Texas, multiple fuel types: Plant Level Data, Annual Emissions, 2005 and 2018, https://bit.ly/32a4D1f

As these charts and figures suggest, changes in air emissions in Texas are undoubtedly due to multiple factors: overall economic activity; improvements in plant operations of all types; changes in primary energy resource, design, and operation of fossil-fuel-fired power plants; and the addition of wind power. But they do suggest that CREZ made at least a small contribution to improved air quality in the state.

Other factors that stakeholders discussed through the CREZ process included changes in property tax bases in the counties through which transmission lines passed, improved funding for schools as a result, visual effects on the landscape, and increases or decreases in electricity rates paid by customers.

Challenges to Transmission Investment and the Importance of Stakeholders

Challenges inherent in transmission investment in the 21st century framed the CREZ process. First, multiple types of entities—including regulated utilities and merchant entities—may invest in, construct, and own transmission lines.[42] But there are many examples of private companies building private transmission lines outside the regulatory process, including in Texas.[43] Each type of investment revolves around the ownership, cost allocation, benefits distribution, and operation of the transmission infrastructure.[44] Second, transmission investments are complicated because multiple stakeholders are involved and are subject to varying economic benefits and costs of the investment.[45] Third, cost allocation is one of the most contentious issues for transmission investment decisions.[46] In some instances, cost is borne by the generators who use the transmission lines; in others, cost is distributed among ratepayers. Additionally, new transmission project costs are often unpredictable and difficult to estimate due to a variety of direct, indirect, and hidden costs.[47] Government institutions such as utility commissions often mandate transmission upgrades in the interest of pursuing a socially positive solution when the preceding challenges may be limiting project development.[48]

The chicken-and-egg problem further complicates renewables-linked transmission investment.[49] Areas with high potential for utility scale wind and solar development are often physically far from centers of power use. Much like the major dam projects of the 20th century, wind and solar developments will succeed only if someone builds new high voltage transmission lines to bring power to customers. There are two major differences,

---

[42] "Utilities Continue to Increase Spending on Transmission Infrastructure," Energy Information Agency, Washington, D.C., 2018, https://www.eia.gov/todayinenergy/detail.php?id=34892#:~:text=The%20Edison%20Electric%20Institute%20(EEI,continued%20to%20increase%20in%202017.&text=In%202016%2C%20total%20transmission%20expenditures,up%2061%25%20of%20that%20total.

[43] Eileen O'Grady, "FPL Builds Private Transmission Line in Texas," *Reuters*, October 26, 2009, https://www.reuters.com/article/utilities-wind-texas/fpl-builds-private-transmission-line-in-texas-idUSN2620354820091026. Florida Power and Light built a private line through the scenic Texas Hill Country during the very time the PUCT considered routes for a CREZ line in the same region.

[44] William W. Hogan, "A Primer on Transmission Benefits and Cost Allocation," *Economics of Energy & Environmental Policy, International Association for Energy Economics* 0, no. 1 (2018): Section 3, https://ideas.repec.org/a/aen/eeepjl/eeep7-1-hogan.html.

[45] L. Olmos, M. Rivier, and Ignacio J. Pérez-Arriaga, "Transmission Expansion Benefits: The Key to Redesigning the Regulation of Electricity Transmission in a Regional Context," *Economics of Energy and Environmental Policy* 7, no. 1 (2018): 47-62; Ingo Vogelsang, "Can Simple Regulatory Mechanisms Realistically Be Used for Electricity Transmission Investment? The Case of H-R-G-V," *Economics of Energy and Environmental Policy* 7, no. 1 (2018): 63-88.

[46] Judy Chang, Johannes Pfeifenberger, and Michael Hagerty, "The Benefits of Electric Transmission: Identifying and Analyzing the Value of Investments," The Brattle Group, July 31, 2013.

[47] Andrade and Baldick, "Estimation of Transmission Costs for New Generation," 2017.

[48] M. Rivier, "Electricity Transmission," in *Regulation of the Power Sector*, I.J. Perez-Arriaga, ed., Power Systems (London: Springer-Verlag London, 2013), 251-340.

[49] Diffen, "Competitive Renewable Energy Zones," 2009.

however. First, the federal government financed the vast majority of hydroelectric dams built in the United States, and second, transmission projects were less costly to permit and build and much quicker to complete than major dams. Today, private developers build wind and solar installations, and the projects are less expensive and quicker to complete than high voltage transmission lines. This latter situation creates the chicken-and-egg problem. Wind and solar developers are reluctant to invest in renewables projects if there is uncertainty about how they will reach power markets. Transmission developers are reluctant to go through the lengthy and expensive process of locating and building new power lines to the middle of nowhere in the absence of firm generation project plans. The Texas CREZ initiative specifically addressed this conundrum, as well as many of the other challenges to transmission development.

In the CREZ case, the state legislature mandated the construction of new transmission infrastructure, state policy required allocation of investment costs to all ratepayers within ERCOT, and agency practices ensured that a broad range of stakeholders participated in the siting and permitting process. For wind developers, the state promised designated transmission corridors. For transmission providers, the state promised speedy determination of convenience and necessity and the power of eminent domain. For citizens, the state served the common good by bringing wind power into the shared ERCOT network and spreading costs among power customers. In this sense, all ratepayers within ERCOT had a stake in selection of CREZ and routing of transmission lines.

Citizens as Stakeholders

Both the network characteristics resulting from electricity's physical properties and the policy characteristics resulting from historical choices made by utilities and legislators in Texas have significance. As a matter of physics, every power customer within ERCOT accesses electricity generated from CREZ renewable resources (i.e., the power customer cannot distinguish electrons from one power source or another). Once the wind-generated electrons in, say, the Panhandle enter the network, they may power light switches anywhere from Amarillo to Galveston. Similarly, a Gulf Coast gas-fired power plant on the ERCOT system may serve users from Galveston to Amarillo. Technically, because there are energy losses along the transmission lines, it may be less likely that a distant customer benefits from a faraway wind farm, but nonetheless, the renewable energy is, in fact, serving the entire system. The Texas Interconnect is, indeed, a pool of power from which all customers draw their electricity. At the same time, through the postage stamp transmission rates, every power customer within ERCOT shares the cost of new CREZ lines. Historically, transmission costs for all generators on ERCOT have been allocated equally to all customers, regardless of the distance from generation to load. Texas could have charged new wind generators in, say, the Panhandle, for the cost of the new transmission lines, thereby raising the delivered cost of wind power relative to the cost of incumbent sources of power. Texas decided that transmission cost allocation for CREZ should be consistent with the historical treatment of other transmission lines in the state.

These two points frame the role of private citizens, landowners, local governments, and regional organizations as stakeholders in the CREZ process. Every ratepayer *explicitly* shares the cost of the CREZ lines. For this reason, every ratepayer had a vested interest in encouraging cost-effective CREZ transmission routes. Every ratepayer *implicitly* has access to electricity generated with renewable energy. As a result, every ratepayer who favored renewables for environmental, economic, or political reasons stood to benefit from CREZ infrastructure. Within the CREZ development process, however, the non-industry commenters and intervenors raised issues other than these explicit costs and implicit benefits. Policymakers might note that potentially unifying concerns held less importance than locally distinct issues.

Citizen Input

Citizen participation in power planning actually dates back to 1995, before CREZ, when Texas first ventured into the restructuring of the wholesale power market. The resulting legislation included a requirement that utilities engage in triennial integrated resource planning, and within this requirement, the legislation provided for customer input.[50] The PUCT elected to use a process described as "deliberative polling" to assess customer interests and needs around the state.[51] Through this process, the PUCT learned that customers not only wanted access to power generated using renewable energy resources, but also were willing to pay more for it. This, some assert, provided the impetus for the legislature to address renewables within the next round of legislation in 1999.[52]

Following passage of Senate Bill 20 in 2005, the PUCT and ERCOT both operated in transparent and public-facing fora. The PUCT held contested cases (a term referring to an open, adjudicated hearing process) that resulted in an extensive, publicly available written record. Within the PUCT's dockets, a wide array of stakeholders participated as both formal intervenors—who could question all other witnesses and intervenors—and as commenters who simply submitted their comments and questions. The array of stakeholders included incumbent power generators, potential wind developers, both existing and aspiring TSPs, municipal power companies, rural cooperatives, cities, counties, regional and sub-regional coordinating agencies, chambers of commerce and economic development organizations, real estate groups, ranchers and farmers, residential landowners, environmental advocates, and state and federal agencies.

[50] R.L. Lehr, et al., "Listening to Customers: How Deliberative Polling Helped Build 1,000 MW of New Renewable Energy Projects in Texas," National Renewable Energy Lab, June 2003.

[51] Ibid.

[52] Pat Wood, III and Gürcan Gülen, "Laying the Groundwork for Power Competition in Texas," in Kiesling and Kleit, *Electricity Restructuring*, 25-36.

In a similar vein, ERCOT conducted its planning through the Regional Planning Committee (RPC), which met in public sessions, open to anyone interested in participating.[53] In a major report to the PUCT, ERCOT credited stakeholders with participating in the project and providing key input.[54] The report noted that ERCOT sought input from existing and potential transmission owners, market participants, and vendors, and that 276 individuals joined a mailing list for information about this project. At least 50 stakeholders, including private citizens, attended each of 12 meetings held by the task force.[55]

Locals influenced the decisions of the PUCT, which had extensive authority to reshape the landscape as illustrated in the three examples below. The first example focuses on the Texas Panhandle, where the PUCT delineated two expansive CREZ, despite the technical reports of ERCOT that focused on smaller eligible areas.[56] In the second example, within the Texas Hill Country, citizen input led the PUCT to abandon a planned CREZ line. The third example, also in the Texas Hill Country, illustrates that citizen concerns outweighed cost, in the midst of a contest between two towns to keep the CREZ line out.

Example 1. The Texas Panhandle

To identify the best wind potential in Texas, ERCOT contracted with AWS Truewind, a renewable energy consultant, to map areas with great wind speeds, open land, and expressions of interest from wind power developers. In December 2006, ERCOT presented the PUCT with a report that identified the 25 spots with the highest annual wind potential.[57] The four top-ranked zones all fell within the Texas Panhandle, with some of the very best wind located in Deaf Smith County (ranked No. 1).[58] For its next level of analysis, ERCOT selected 10 of the 25 zones, including two of the four in the Panhandle, but not Deaf Smith County. Potential wind generators had demonstrated a high level of interest in the 10 selected zones, but few had shown interest in Deaf Smith. As former PUCT Chairman Barry Smitherman explained, historically, without existing transmission infrastructure, wind developers had been reluctant to invest in the Panhandle.[59] And, at the furthest reach of the region, and thus least likely to be served by new transmission infrastructure, Deaf Smith County had been least attractive to wind developers before CREZ.

During the first contested case, which was held to establish rules for the CREZ process, Panhandle residents already exhibited great enthusiasm both for CREZ designation and for transmission corridors. A typical local government resolution included this type of statement:

---

[53] "Regional Planning Group," ERCOT website, http://www.ercot.com/committee/rpg. Accessed October 16, 2020.

[54] "ERCOT's CREZ Transmission Optimization Study," April 2, 2008.

[55] Warren Lasher, Senior Director of Systems Planning at ERCOT, communication with Julie Cohn, April 23, 2020.

[56] Thank you to Warren Lasher for bringing this example to the authors' attention. Lasher, communication with Cohn.

[57] "Analysis of Transmission Alternatives," 2006.

[58] Ibid., 16-17.

[59] Smitherman, communication with Cohn, July 2020.

"citizens of the Texas Panhandle generally welcome large energy and infrastructure projects and the increased property tax base and economic development benefits such projects produce, and have limited alternative opportunities for economic development."[60] Many of the Panhandle counties had experienced population loss and economic decline in the years immediately preceding the CREZ cases.

During the follow-on contested case regarding the actual location and delineation of the zones, administrators from numerous Panhandle counties sought CREZ projects, stating, "The flat, open terrain of the Texas Panhandle allows for relatively low cost construction of transmission lines, and local community support for these efforts should also help facilitate their successful completion which will be the most expedient area to build transmission of all the potential CREZs."[61] As one enthused, "The citizens of the Texas Panhandle wholeheartedly welcome these clean energy and infrastructure projects and the increased property tax base and economic development benefits such projects produce." Indeed, State Representative David Swinford assured the PUCT that every single one of the more than 100 county commissions and city councils in his Panhandle district had approved a resolution stating support for designation of a CREZ in the region.[62]

As the PUCT prepared for a key public hearing on July 20, 2007, Commissioner Julie Parsley proposed that the PUCT limit its focus, and all further research, to just four CREZ out of the 10 studied by ERCOT.[63] Parsley made the case that the legislature had anticipated new transmission infrastructure to support CREZ that might cost as much as $1.3 billion, but probably not much more. PUC Chairman Paul Hudson offered a different recommendation.[64] Based on the wind studies, and expressions of financial commitment, he was ready to designate seven zones as CREZ, including Parsley's four. He was ready to eliminate all the others, including Zone 1, largely encompassing Deaf Smith County.[65] At the hearing itself, however, Commissioner Smitherman made the case for expanding the Panhandle CREZ to include Zone 1. He argued, "the evidence demonstrates that [Zone] 1 has the best wind capacity factor by a margin of almost 20% over any other zone."[66] To persuade his colleagues he asked, "Tell me how you're going to explain when you go down to the Legislature or you get a call from a rancher in Zone 1 why you didn't designate Zone 1."[67] Smitherman later explained that

---

[60] Docket 31852, "Swisher County: Resolution in Support, Public Utility Commission of Texas," Public Utility Commission of Texas, April 27, 2006.

[61] Docket 33672, "Comments of County Judges of Dallam, Sherman, Oldham, Swisher, Lipscomb, and Parmer Counties," Public Utility Commission of Texas, April 25, 2007; Docket 33672, "Comments of County Judges of Lamar and Hall Counties," Public Utility Commission of Texas, April 26, 2007.

[62] Docket 33672, "Representative Swinforf [sic] Comments on Designation," Public Utility Commission of Texas, June 12, 2007.

[63] Docket 33672, "Open Meeting, July 20, 2007—Agenda Item No. 22—Memo from Commissioner Parley [sic]," Public Utility Commission of Texas, July 20, 2007.

[64] Docket 33672, "Open Meeting, July 20, 2007—Agenda Item No. 22—Chairman Hudson Memo," Public Utility Commission of Texas, July 20, 2007.

[65] Docket 33672, "Interim Order on Reconsideration," Public Utility Commission of Texas, November 6, 2007.

[66] Public Utility Commission of Texas, "Open Meeting," 100, July 20, 2007.

[67] Ibid., 124.

the Panhandle represented the chicken-and-egg problem.[68] Further, he wanted to bolster the commission's decisions against potential lawsuits claiming the commissioners had failed to adhere to legislative priorities.[69] The commission voted to combine Zone 1 into Zone 2, also in the Panhandle, with Parsley dissenting.[70]

Within the interim order designating the CREZ, the commissioners explained that the ERCOT study of statewide wind power potential and transmission constraints, the consultant's wind study, and the developers' evidence of financial commitment led to CREZ designations. While commissioners may have considered the several hundred comments, letters, and other forms of input from private citizens, local governments, and alliances of interested environmental groups, these were not mentioned in the order. Yet Smitherman's reference to ranchers and legislators during the hearing suggests that the commissioners were attuned to the citizen stakeholders. In fact, the order specifically stated "stakeholder input" would be considered in ERCOT's CREZ Transmission Optimization Study.

Example 2. Eliminating a CREZ Line

While Panhandle residents eagerly endorsed wind farms and CREZ transmission lines, residents of Texas' scenic Hill Country expressed strong opposition to new infrastructure. In May 2009, the PUCT issued the order designating TSPs for each new CREZ transmission line.[71] The commission selected the Lower Colorado River Authority Transmission Services Corporate (LCRA TSC), an incumbent provider, to build new lines across the Hill Country and opened a case to collect comments on possible corridors. LCRA TSC's portfolio included three new lines of interest in this paper: one from a station near McCamey, Texas, called "McCamey D" to Kendall; one from Kendall to Gillespie; and one from Gillespie to Newton. The arrows in Figure 10 below point to these three lines.

LCRA TSC had been holding meetings in potentially affected communities throughout the spring of 2009.[72] On the first day of filings, Smitherman introduced correspondence he had already received from landowners shaken by the possibility of new power lines crossing their property. He assured the correspondents that political clout would not affect the commission's decisions, stating "The siting of high capacity transmission lines, while of critical importance to our state, can be a difficult and emotional process for landowners; therefore, it very important that we adhere to the criteria outlined in both statute and Commission rule."[73]

---

[68] Smitherman, communication with Cohn, July 2020.

[69] Ibid.

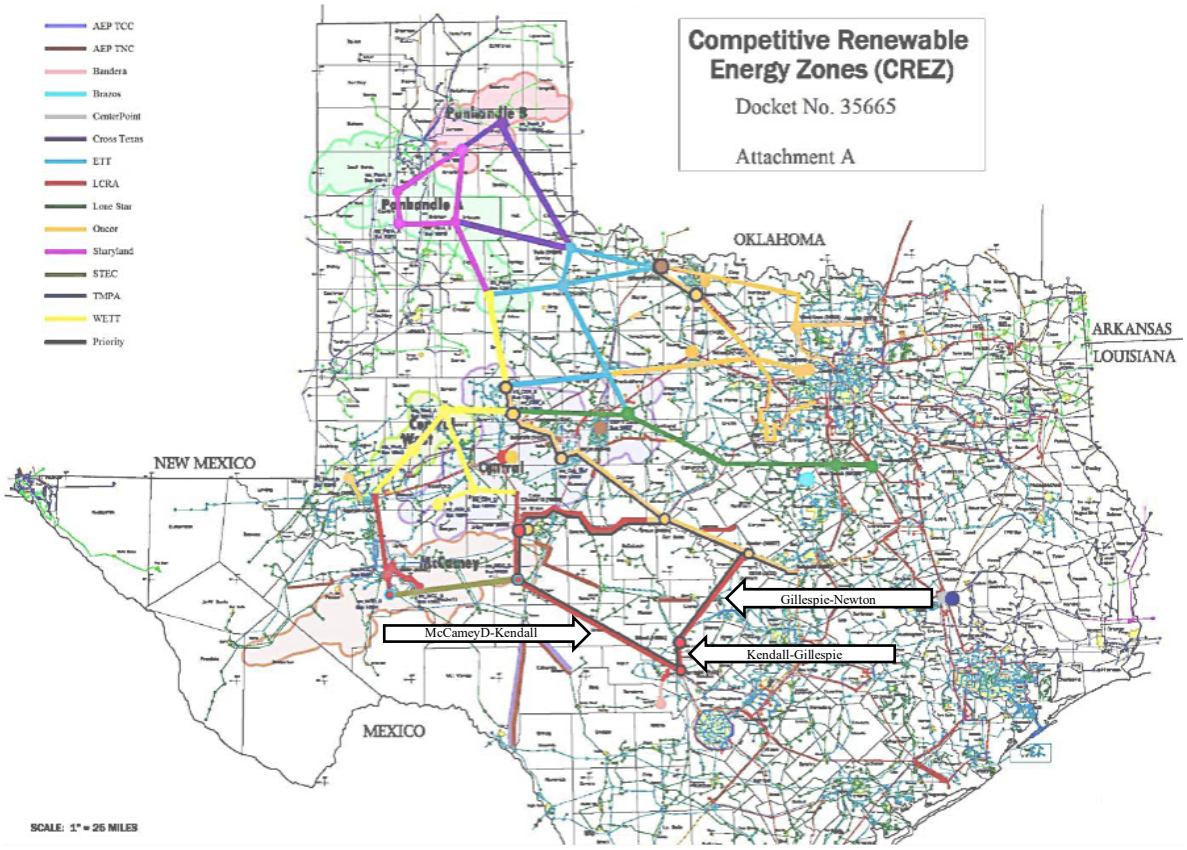
[70] Public Utility Commission of Texas, "Open Meeting," 132, July 20, 2007. Part of Parsley's dissent also addressed the question of whether new wind power in the Panhandle would connect to the Southwest Power Pool rather than ERCOT. As shown in Figure 2, the northernmost part of the Panhandle is not part of ERCOT.

[71] Docket 35665, "PUC ADM: Order on Rehearing," Public Utility Commission of Texas, May 15, 2009.

[72] Docket 35665, "Letter to Gov Rick Perry Regarding Signatures Petition Opposing Transmission Line in Gillespie County," Public Utility Commission of Texas, January 14, 2009.

[73] Docket 37409, "Chairman Barry Smitherman: Various Comments and Responses," Public Utility Commission of Texas, May 28, 2009.

Figure 10. Map of TSPs and Assigned CREZ Lines



Source: PUC ADM: Order on Rehearing, Docket 35665, May 15, 2009, Attachment A. Map

A few months later, the PUCT opened the first of two cases to consider specific route options. By early 2010, a heated controversy arose over the two lines connecting Kendall to Gillespie and Gillespie to Newton (see the right-hand arrows in Figure 10), marked by more than 1,000 filings by mid-February. LCRA TSC preferred one route from Gillespie to Newton, the PUCT's legal staff recommended a second route, and the administrative law judge hearing the case recommended a third.[74] The commission then rejected all the proposed routes and asked ERCOT to reconsider the need for both the Kendall to Gillespie and the Gillespie to Newton lines. Smitherman, who by this date was chairman of the PUCT, recalled that both legislators and local citizens objected to the lines and it appeared that existing infrastructure might support the increased wind power transmission.[75] By August 2010, ERCOT reported that these two new lines were not needed and the PUCT

[74] Docket 37448, "SOAH: PFD", Public Utility Commission of Texas, March 18, 2010; Docket 37448, "PUC Legal: Commission Staff's Reply Brief," Public Utility Commission of Texas, March 2, 2010; Docket 37448, "LCRA-TSC's Initial Post-Hearing Brief," Public Utility Commission of Texas, February 26, 2010.

[75] Smitherman, communication with Cohn, July 2020.

removed them from the infrastructure plan. Importantly, by eliminating the lines, the PUCT saved well over $100 million, and "took opponents off the table."[76]

Example 3. The Contest Between Mason and Kerrville

In a parallel case, the PUCT considered proposed routes from McCamey D to Kendall—a power line earlier described by both ERCOT and LCRA TSC as much needed to serve growing demand in the Hill Country as well as further east.[77] The potential routes proposed by LCRA TSC fell within Schleicher, Kimball, Kerr, Kendall, and Gillespie counties—falling south of the city and county of Mason, and skirting Kerrville within Kerr County. These routes were clearly the most direct, but the routes crossed many properties with no previous utility infrastructure. With objections pouring in from cities, counties, landowners, and newly formed civic groups, the PUCT ordered LCRA TSC to expand its study area north to include an existing right-of-way for an old 138 KV line and south to include right-of-way along I-10. This brought Mason and Kerrville directly into the process.

Objections covered the gamut. Commenters and intervenors expressed concern about scenic views, tourism, property values, health and safety, protection of endangered species, and so forth. While Kerr County and Kerrville urged the commission to place the line north in Mason County, Mason residents urged the commission to place the line south, running along I-10 through the entrance to Kerrville. Residents between those counties generally promoted the I-10 route. The LCRA TSC preferred the shorter and less expensive original routes. Following the PUCT's decision to remove the Kendall to Gillespie and Gillespie to Newton lines, filers also recommended that the PUCT eliminate the McCamey D to Kendall line altogether.

Those potentially affected by the proposed new energy infrastructure undertook a formidable effort to stop, reroute, or at the very least change the appearance of CREZ lines. Local communities and landowners formed numerous alliances and organizations to consolidate opposition.[78] Kerr County, Kerrville, and the Kerrville Public Utility Board together hired attorneys to formally intervene in the case.[79] The city of Mason and Mason County established the state's first sub-regional planning commission, a type of entity authorized during the 1960s to increase the influence of local communities on large

[76] Ibid.

[77] "Analysis of Transmission Alternatives, 2006"; Docket 33672, "Direct Testimony and Exhibits of Sergio Garza, P.E. On Behalf of Applicant LCRA Transmission Services Corporation," Public Utility Commission of Texas, April 24, 2007.

[78] Docket 38354, "P-Line Intervention Association: Direct Testimony of Scott Zesch," Public Utility Commission of Texas, September 28, 2010; Docket 38354, "Clear View Alliance, Inc.: Direct Testimony of Bill Neiman," Public Utility Commission of Texas, September 28, 2010; Docket 35665, "Save Our Scenic Hill Country Environment, Inc.: Comments," Public Utility Commission of Texas, December 4, 2008.

[79] Kerr County Commissioners Court Special Session, "Minutes," June 21, 2010, http://www.co.kerr.tx.us/commcrt/minutes/2010/052410cc.txt

development projects.[80] In the end, the commission chose a route that hewed closely to existing utility rights-of-way along state highways and I-10. The Mason group celebrated. The Kerr County group responded by suing the PUCT, but was ultimately unsuccessful. LCRA carried on with plans to build the more expensive and longer power line along I-10 as finally approved.

Reflecting on this docket, former commission chair Smitherman noted that local residents were well organized and well represented in their filings.[81] He did not recall one county's case as being stronger than another's. For him, the deciding factors were three-fold: 1) during the LCRA open houses held in spring 2009, residents' number one concern was preserving the integrity of the Hill Country; 2) only one route (the one selected) followed existing right-of-way and also offered sufficient space for a 345 KV line; and 3) both the administrative law judges overseeing the docket and the PUCT staff argued that the selected route minimized environmental impacts.

Taken together, these three examples reflect the power of the PUCT to determine how new energy infrastructure would reshape the landscape, and the ability of the PUCT to consider and respond to citizen and environmental input (even if it resulted in a higher-cost route). Legislation required both CREZ and supporting infrastructure; policy distributed the cost across all ratepayers; and historical choices limited the dimensions of the project to the Texas borders. The remaining issues addressed the size, shape, and final location of the power lines. These were not trivial matters. Citizens, local governments, business and environmental groups, and a variety of other entities filed literally tens of thousands of documents weighing in on CREZ.

In the planning and development of transmission lines, the question has become: who is a stakeholder? As a matter of policy, federal, regional, and state entities that regulate and operate energy infrastructure include "stakeholders" in their planning processes. Yet the definition of stakeholders is often limited to the companies with a financial and operational interest in the outcome. The CREZ case illustrates that a much broader definition of "stakeholder" should include individuals and entities concerned with the physical presence of power lines in their vicinity. Local stakeholders may desire or abhor the new infrastructure. They will inevitably influence the pace of project development, and the final, physical scope of the outcome.

[80] Dan Byfield, "The Politics of Transmission Lines," *Scripps Interactive Newspapers Group*, updated June 29, 2010, http://www.greentechmedia.com/articles/read/in-texas-big-wind-jumps-on-new-transmission.

[81] Smitherman, communication with Cohn, July 2020.

Policy Implications

Based on the foregoing, the Texas CREZ project succeeded in adding new wind power to the state's energy portfolio, contributed to improved air quality, increased the school-tax base in certain affected counties, and provided extra revenue to landowners (e.g., in the Texas Panhandle) who could now exploit their wind resources. Additionally, increased wind generation resulted in lower spot prices on the wholesale market.[82] This may be linked to changes in retail customer electricity rates. The power lines also no doubt reduced enjoyment of the landscape for residents and visitors to the Hill Country and other scenic and idyllic regions. How the lines affected individual property values and tourism is beyond the scope of this study.

Several policy choices framed the successes of this project (as considered in this report)[83]:

1. Legislated goals for renewable energy and related new transmission infrastructure.
2. Federal and state tax incentives for renewables that attracted investors to this market.
3. Expert input on geographically desirable locations for renewables and transmission development.
4. Elimination of the need for designated transmission service providers to prove the necessity of new power lines.
5. Delineation of priority considerations for infrastructure in both the law and agency policies.
6. Postage stamp transmission rates that spread the cost of new transmission infrastructure across all ratepayers, as has been the case for new transmission infrastructure since 1999. (In this case, the postage stamp policy understated the real delivered cost of wind power from remote renewable locations, especially when compared with the cost of delivered power from gas- and coal-fired plants located closer to loads.)
7. Final decision-making about the location of CREZ and CREZ transmission lines vested in a single entity (the PUCT).

---

[82] Chen-Hao Tsai, "Effect of Wind Generation on ERCOT Nodal Prices," *Energy Economics* 76 (October 2018), https://www-sciencedirect-com.ezproxy.lib.uh.edu/science/article/pii/S0140988318303931; C.K. Woo, et al., "The Impact of Wind Generation on the Electricity Spot-Market Price Level and Variance: The Texas Experience," *Energy Policy* 39, no. 7 (July 2011), https://www-sciencedirect-com.ezproxy.lib.uh.edu/science/article/pii/S0301421511002813.

[83] Other analyses have provided deeper consideration of the legislative and policy decisions that affected customers, power producers, and transmission companies, including provision for stranded costs of incumbents in the wholesale market and protection of corporate financial confidentiality throughout the CREZ process. See, for example, Peter Hartley, Kenneth Medlock, and Olivera Jankovska, "Electricity Reform and Retail Pricing in Texas," Center for Energy Studies, Rice University's Baker Institute for Public Policy, June 2017; Staine, "CREZ II, Coming Soon to a Windy Texas Plain Near You," 2014; Diffen, "Competitive Renewable Energy Zones," 2009; Madeline Claire Gould, "Everything's Bigger in Texas: Evaluating the Success and Outlook of the Competitive Renewable Energy Zone (CREZ) Legislation in Texas" (Master of Arts thesis, University of Texas, 2018); Kiesling and Kleit, *Electricity Restructuring,* 2009 ; Galbraith and Price, *The Great Texas Wind Rush,*2013; Stokes, *Short Circuiting Policy,* 2020.

8. Explicit solicitation of citizen input at every stage of the transmission approval process, which allowed regulators to acknowledge some landowner objection to any transmission path and build a record that was thorough and defensible.
9. Transparency on the part of the implementing agencies.

Additional considerations for policymakers:

1. Identify the particular chicken-and-egg nature of each renewable and transmission development project.
2. Acknowledge implicit benefits/explicit costs of renewables projects to all connected to the power pool.
3. Build time for patience and flexibility into the implementation process. This may result in reconsideration of RPS timetable goals, although in the Texas case, developers exceeded those goals despite delays in some transmission line development.
4. Anticipate locally determined benefits and costs that will influence final total size, cost, and location of energy infrastructure.

Acknowledgements

The authors would like to thank Barry Smitherman, former Chair of the Public Utility Commission of Texas, and Warren Lasher, Senior Director of Systems Planning at ERCOT, for sharing their reflections on the CREZ process. Jean Reaves Rollins of The CThree Group, LLC, provided invaluable assistance in providing and parsing U.S. transmission line data. In addition, we thank Elaine Gie and Guarav Tripathi with GSI Environmental, Inc.; Jody Grinstead with Kerr County; and Pattie Allen with the city of Mason for providing invaluable assistance with research and data acquisition. We greatly appreciate Michael Maher at the Baker Institute for his close reading of this research paper.