ESL-TR-21-07-01

STATEWIDE AIR EMISSIONS CALCULATIONS FROM WIND AND OTHER RENEWABLES

VOLUME I

A Report to the
Texas Commission on Environmental Quality
For the Period January 2020 – December 2020

Juan-Carlos Baltazar, Ph.D., P.E.; Jeff Haberl, Ph.D.;
Bahman Yazdani, P.E.; Qinbo Li, Ph.D.; David Claridge, Ph.D., P.E.;
Mitra Azimi; Jounghwan Ahn; Yu Sun

July 2021

ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

TEXAS A&M ENGINEERING EXPERIMENT STATION

ENERGY SYSTEMS LABORATORY

July 15, 2021

Mr. Robert Gifford
Air Quality Division
Texas Commission on Environmental Quality
Austin, TX 78711-3087

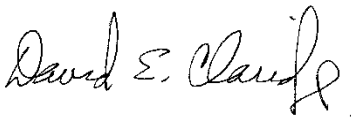
Dear Mr. Gifford,

The Energy Systems Laboratory (ESL) at the Texas Engineering Experiment Station of The Texas A&M University System is pleased to provide its annual report, "Statewide Emissions Calculations From Wind and Other Renewables," as required by the 79th Legislature. This work has been performed through a contract with the Texas Commission on Environmental Quality (TCEQ).

In this work, the ESL is required to obtain input from public/private stakeholders, and develop and use a methodology to annually report the energy savings from wind and other renewables. This report summarizes the work performed by the ESL on this project from January 2020 to December 2020.

Please contact me at (979) 845-9213 should you have questions concerning this report or the work presently being done to quantify emissions reductions from renewable energy measures as a result of the TERP implementation.

Sincerely,



David E. Claridge, Ph.D., P.E.
Director

Enclosure

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ACKNOWLEDGMENT

This report cannot be accomplished without the help of many people. Special thanks to Connor Anderson, Planning Engineer, Resource Adequacy Department at Electric Reliability Council of Texas (ERCOT), for providing the wind farm power generation data.

SUMMARY REPORT

Statewide Air Emissions Calculations from Wind and Other Renewables

1 EXECUTIVE SUMMARY

The 79th Legislature, through Senate Bill 20, House Bill 2481 and House Bill 2129, amended Senate Bill 5 to enhance its effectiveness by adding 5,880 MW of generating capacity from renewable energy technologies by 2015 and 500 MW from non-wind renewables.

This legislation also requires the Public Utilities Commission of Texas (PUCT) to establish a target of 10,000 megawatts of installed renewable capacity by 2025 and requires the Texas Commission on Environmental Quality (TCEQ) to develop a methodology for computing emissions reductions from renewable energy initiatives and the associated credits. Table 1-1 lists the statutory mandates and total wind power generation capacity (including installed and announced) in Texas from 2001 to 2025. It shows that Texas has achieved its milestone of 10,000 MW by the end of 2010 and could reach total 42,284 MW by 2023 according to the information from PUCT[1]. By the end of 2020, the total installed capacity in Texas is 32,413 MW.

Table 1-1: Installed/Announced Wind Power Capacity and the Statutory Mandates

Texas Wind Summary			**SB20 Plan**	
Month-Yr	Installed MW	Announced[2] MW	Month-Year	MW
Dec-2001	1,012	-		
Dec-2002	1,091	-		
Dec-2003	1,292	-		
Dec-2005	1,965	-		
Dec-2006	2,786	-	Jan-2007	2,280
Dec-2007	4,438	-		
Dec-2008	8,215	-	Jan-2009	3,272
Dec-2009	9,652	-		
Dec-2010	10,222	-	Jan-2011	4,264
Dec-2011	10,468	-		
Dec-2012	11,737	-	Jan-2013	5,256
Dec-2013	12,302	-		
Dec-2014	14,035	-	Jan-2015	5,880
Dec-2015	17,377	-		
Dec-2016	19,632	-		
Dec-2017	22,937	-		
Dec-2018	24,154	-		
Dec-2019	28,188	-		
Dec-2020	32,413	-		
Dec-2021	-	6,778		
Dec-2022	-	1,539		
Dec-2023		900	Jan-2025	10,000

[1] The service date for announced wind farms is searched from PUCT (http://www.puc.texas.gov/industry/electric/reports/Default.aspx).

[2] TBD projects in the announced project list were not included in installed/announced capacity calculations in Table 1-1. Total announced wind power capacity including TBD projects is 9,217 MW by 2023.

In this Legislation, the function of the Energy Systems Laboratory (ESL) is to assist the TCEQ in quantifying emissions reductions credits from energy efficiency and renewable energy programs, through a contract with the TCEQ to develop and annually calculate creditable emissions reductions from wind and other renewable energy resources for the State Implementation Plan (SIP).

The ESL, in fulfillment of its responsibilities under this Legislation, submits its annual report, "Statewide Air Emissions Calculations from Wind and Other Renewables," to the TCEQ.

The report is organized in several deliverables:

1. A summary report, which details the key areas of work,
2. Volume I report, which includes main document of renewable energy projects and
3. Volume II technical Appendix that includes all information and details about renewables (i.e., wind power, non-utility scale and utility-scale solar PV, solar thermal, biomass, hydroelectric, geothermal, and landfill gas-fired)
4. Supporting data files, including weather data, and wind energy production data.

This executive summary provides key areas of accomplishment this year, including:

- Analysis of power generation from wind farms using improved method and 2018 data,
- Analysis of emissions reductions from wind farms,
- Analysis of other renewables, including solar PV, solar thermal, biomass, hydroelectric, geothermal, and landfill gas, and
- Review of electricity generation by renewable sources and transmission planning study reported by ERCOT

1.1 Texas wind power generation (ERCOT and PUCT)

For several years now, Texas has been the largest producer of wind energy in the United States. As of January 2021, the capacity of installed wind turbine totals was 32,413 MW with another 9,217 MW announced for new projects to be completed by 2023. Figure 1-1 shows the growth pattern of the installed wind power capacity in Texas and their power generation in the ERCOT region from September 2005 to December 2020.

In the last few years, the electricity generated by wind has continually shown progressive and substantial increases. However, the wind electricity generation contains a significant seasonal response, which can be observed during the Ozone Season Period[3] when a dramatic reduction in the power generation can be observed. This reduction is mainly due to the fact that the wind speed in those periods is lower than other times during the year. On the other hand, it is also observed that the peaks of wind electricity generation occur more often during the winter periods when the wind speed also has a higher overall average value.

[3] Since 2018 the Ozone Season Period (OSP) was changed from the period of July 15 to Sep 15 to the period of May 1 to September 30.

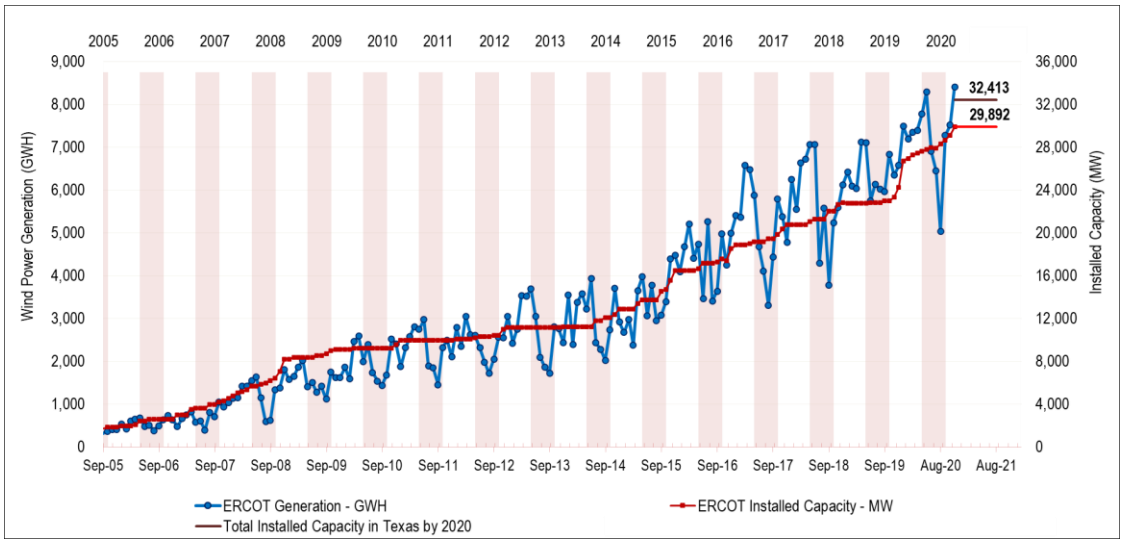


Figure 1-1: Installed Wind Power Capacity and Power Generation in the ERCOT Region from September 2005 to December 2020

1.2 Analysis of wind farms using an improved method and 2020 electricity generation data.

In this report, the weather normalization procedures, developed together with the Stakeholders, were presented and applied to all the wind farms that reported their data to ERCOT during the 2020 measurement period.

In the previous Wind and Renewables reports to the TCEQ, weather normalization analysis methods were reviewed and determined to be appropriate for this report. Therefore, this report used the same analysis method as the previous reports to present the same weather normalization procedure, including:

- the processing of weather and power generation data, modeling of daily power generation versus daily wind speed using the ASHRAE Inverse Model Toolkit (IMT) for two separate periods, i.e., Ozone Season Period (OSP), from May 1 to September 30, and Non-Ozone Season Period (Non-OSP);
- predicting wind power generation based on 2018 baseline wind speed data, using developed coefficients from 2020 daily OSP and Non-OSP models for all the wind farms; and
- the analysis of monthly capacity factors generated using the models.

This report also includes an uncertainty analysis that was performed on all the daily regression models for the entire year and OSP. The detailed analysis for each wind farm is provided in Volume II, Appendix A to this report. The original data used in the analysis is included in Volume II and the accompanying CD-ROM with this report.

1.3 Analysis of emissions reduction from wind farms

In this report, the procedure for calculating annual and peak-day, county-wide NOx reductions from electricity savings from wind projects implemented in the Competitive Load (CL) zones in ERCOT was presented. The calculation of the NOx emission reductions is based on the 2018 eGRID as modified according to ESL-TR-08-12-04 report (US EPA and ESL, 2008). As shown in Table 1-2 based on the 2020 measured ERCOT data, the total MWh savings for all the wind farms within the ERCOT region are 87,079,414 MWh/yr and 225,118 MWh/day for an average day in the OSP. The total NOx emissions reductions in 2020 across all the counties amounts are 53,492.4 tons/yr and 130.5 tons/day for the OSP. A comparison of the measured 2020 data and the modeled 2008 data is presented in Section 3.2 of this report.

Table 1-2: Electricity Generation and NOx Emission Reductions for All the Wind Farms in ERCOT Region in 2020

	Annual	**OSP**
Measured Electricity Generation in 2020	87,079,414 [MWh/yr]	225,118 [MWh/day]
NOx Emission Reduction in 2020	53,492.4 [Tons/yr]	130.5 [Tons/day]

Figure 1-2 and Figure 1-3 show the measured annual and OSP NOx emissions reductions from wind power in each county of Texas in 2020.

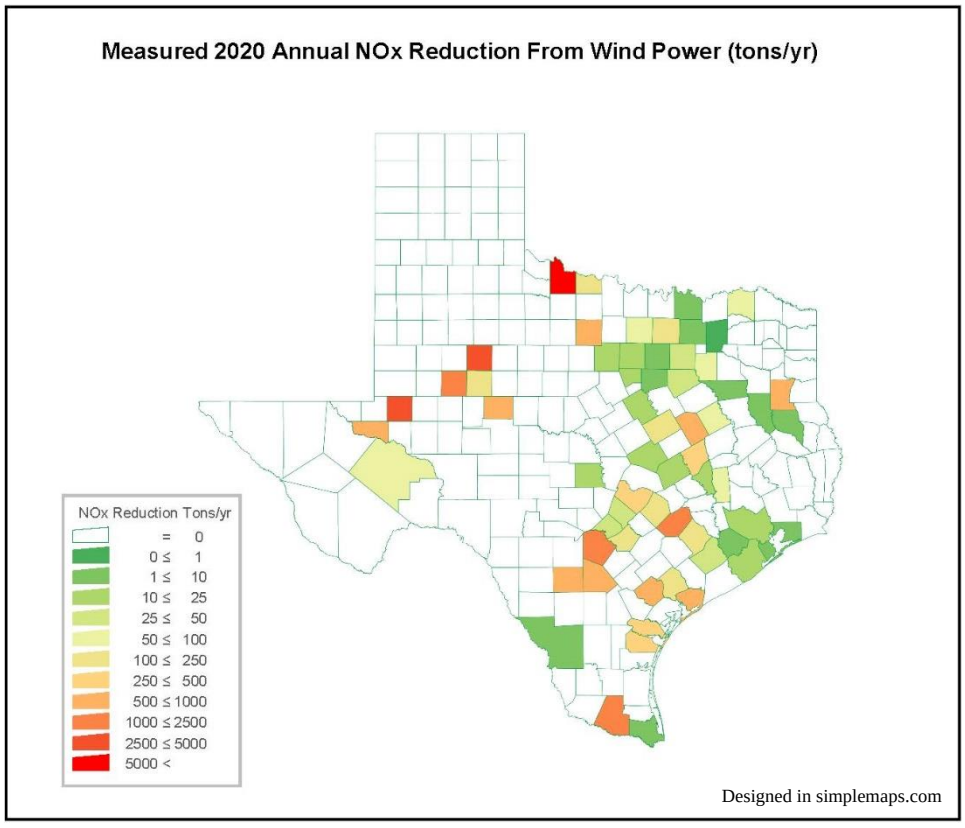


Figure 1-2: Measured 2020 Annual NOx Reductions from Wind Power in Texas

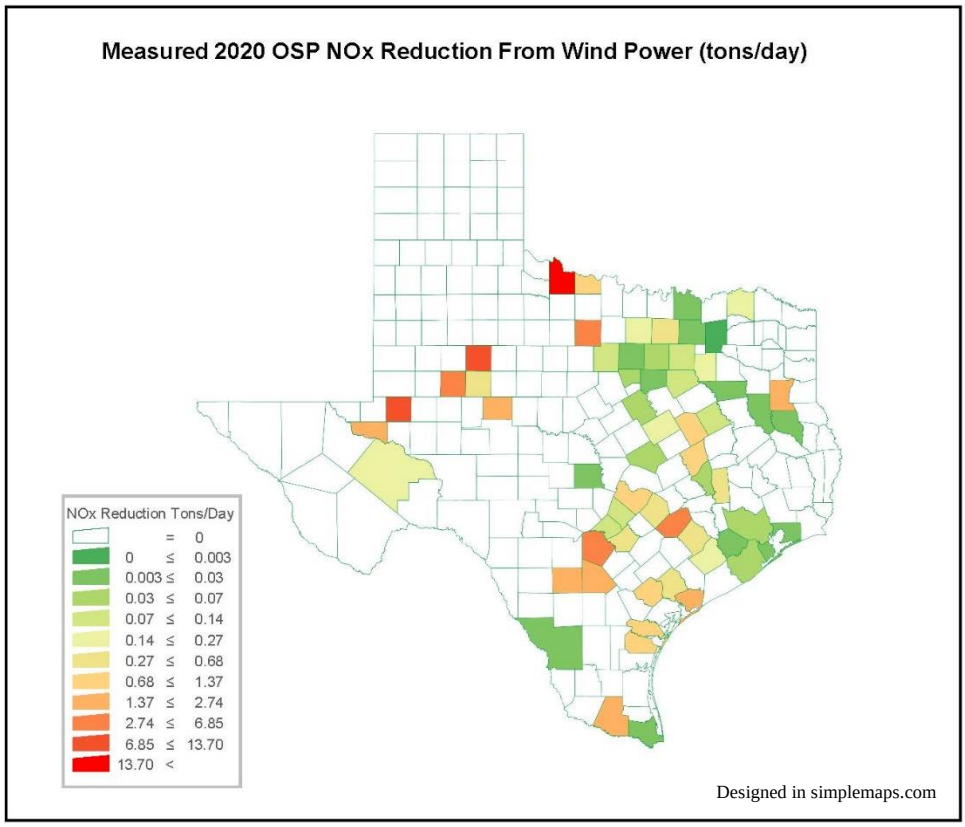


Figure 1-3: Measured 2020 OSP NOx Reductions from Wind Power in Texas

1.4 Analysis of other renewable sources

Five specific renewable sources were determined: solar, biomass, hydroelectric, geothermal, and landfill gas-fired. To generate/save energy throughout the State of Texas, six types of renewable energy projects were identified: solar photovoltaic (PV) including solar power, solar thermal, biomass power, hydroelectric power, geothermal HVAC, and landfill gas-fired power projects. The solar photovoltaic project accounts for non-utility scale PV installations in Texas whereas the solar power project accounts for utility-scale (solar power plant) constructions. Table 1-3 presents the number of newly located renewable energy projects and total renewable energy projects included in this report.

This report also presents county-wide annual/OSP energy savings for solar photovoltaic including solar power, solar thermal, biomass, and hydroelectric projects. The annual/OSP energy savings calculation for solar photovoltaic was conducted based on the LBNL public dataset. In addition, the annual/OSP energy savings calculation for solar thermal was conducted based on the project data from various web sources. Finally, the power generation data for the other renewable energy projects (solar power, biomass, and hydroelectric), which were obtained from the ERCOT, were used to evaluate the annual/OSP energy generation. Then, the annual NOx emission reductions calculation was conducted with the special version of Texas 2018 eGRID.

In 2020, the total annual/OSP energy savings from each renewable projects across all the counties were:

- solar photovoltaic projects (non-utility scale): 451,803 MWh/yr and 1,400 MWh/day; in addition, solar power projects (utility-scale): 8,450,944 MWh/yr and 31,762 MWh/day,
- solar thermal projects: 255 MWh/yr and 0.7 MWh/day,
- biomass projects: 352,924 MWh/yr and 1,069 MWh/day, and
- hydroelectric projects: 632,438 MWh/yr and 1,845 MWh/day.

In 2020, the annual NOx emission reductions from renewable projects across all the counties were:

- solar photovoltaic projects (non-utility scale): 222.7 tons/yr; in addition, solar power projects (utility-scale): 5,458.6 tons/yr,
- solar thermal projects: 0.1 tons/yr and,
- hydroelectric projects: 188 tons/yr.

Table 1-3: Number of Projects Identified for Other Renewable Sources

Renewable Energy Projects	Number of New Projects in 2020	Total Number of Projects in 2020	Annual Measured/ Estimated Electricity Generation in 2020 [MWh/yr]	OSP Measured/ Estimated Electricity Generation in 2020 [MWh/day]	NOx Emission Reductions in 2020 [tons/yr]
Solar Photovoltaic[4]	5,375	34,781	451,803	1,400.0	222.7
Solar Power[5]	7	82	8,450,944	31,762.0	5,458.6
Solar Thermal	1	41	255	0.7	0.1
Biomass[6]	0	12	352,924	1,069.0	-
Hydroelectric	0	30	632,438	1,845.0	188.0
Geothermal[7]	12	306	-	-	-
Landfill Gas-Fired[8]	1	34	-	-	-

[4] This TERP report used the "Tracking the Sun" project dataset of Lawrence Berkeley National Laboratory (LBNL) (https://emp.lbl.gov/tracking-the-sun/). The Tracking the Sun project public database included 34,781 projects from 2004 to 2020.
[5] Two solar power projects that were retrieved from the Open PV Project Database of the National Renewable Energy Laboratory (NREL) in 2019 are excluded because the information not available anymore.
[6] Two biomass projects had no generation compared to 2019 list. Therefore, they are excluded from the list for this year. Also, NOx emission reductions for biomass are not reported since biomass itself has high NOx emissions.
[7] Annual or OSP electricity savings and NOx emission reductions from the geothermal and landfill gas-fired could not be estimated due to limited information.
[8] Landfill gas-fired project information from EPA have seven sub-categories for their status: operational, candidates, potential, construction, shutdown, planned, and others. EPA rearranged/added/removed some projects information within the seven sub-categories. Operational projects were considered for the number of projects.

1.5 Review of electricity savings and transmission planning study reported by ERCOT

In this report, the information posted on ERCOT's Renewable Energy Credit (REC) Program site www.texasrenewables.com was reviewed. In particular, information posted under the "Public Reports" tab was downloaded and assembled into an appropriate format for review. This includes ERCOT's 2001 through 2020 reports to the Legislature and information from ERCOT's listing of REC generators.

Each year ERCOT is required to compile a list of grid-connected sources that generate electricity from renewable energy and report them to the Legislature. Table 1-4 contains the data reported by ERCOT from 2001 to 2020. Figure 1-4 is included to better illustrate the annual data collected by ERCOT. Other sources present different renewable electricity generation values compared to the ERCOT source, but those are explained in general because the numbers reported in this report are focused on the ERCOT region.

Table 1-4: Annual Electricity Generation by Renewable Resources (MWh, ERCOT: 2001 - 2020)[9]

Year	Biomass (MWh)	Hydro (MWh)	Landfill gas (MWh)	Solar* (MWh)	Wind (MWh)	Total (MWh)
2001	0	30,639	0	0	565,597	596,236
2002	0	312,093	29,412	87	2,451,484	2,793,076
2003	39,496	239,684	154,206	220	2,515,482	2,949,087
2004	36,940	234,791	203,443	211	3,209,630	3,685,014
2005	58,637	310,302	213,777	227	4,221,568	4,804,512
2006	60,569	210,077	306,087	470	6,530,928	7,108,131
2007	54,101	382,882	356,339	1,844	9,351,168	10,146,333
2008	70,833	445,428	387,110	3,338	16,286,440	17,193,150
2009	73,364	507,507	412,923	4,492	20,596,105	21,594,390
2010	97,535	609,257	464,904	14,449	26,828,660	28,014,805
2011	137,004	267,113	497,645	36,580	30,769,674	31,708,016
2012	288,988	389,197	549,037	139,439	32,746,534	34,113,195
2013	200,564	294,238	550,845	178,326	36,909,385	38,133,358
2014	343,469	240,792	518,580	312,757	40,644,362	42,059,961
2015	349,600	414,289	561,915	410,318	45,165,341	46,901,462
2016	247,643	393,740	518,403	848,410	57,796,161	59,804,357
2017	216,431	444,453	446,119	2,289,394	66,076,742	69,473,139
2018	287,014	334,460	395,428	3,183,238	73,960,577	78,160,716
2019**	153,531	266,718	335,361	4,466,873	81,770,300	86,992,784
2020	140,878	207,373	270,377	8,746,022	93,387,597	102,752,245

* Solar includes the utility scale solar power only
** 2019 hydro, solar and wind REC data is updated due to ERCOT's data modification this year

NOTE: The REC Program tracks renewable generation in Texas, including non-ERCOT regions of Texas. Not all renewable is eligible for REC credit.

[9] https://www.texasrenewables.com/reports.asp

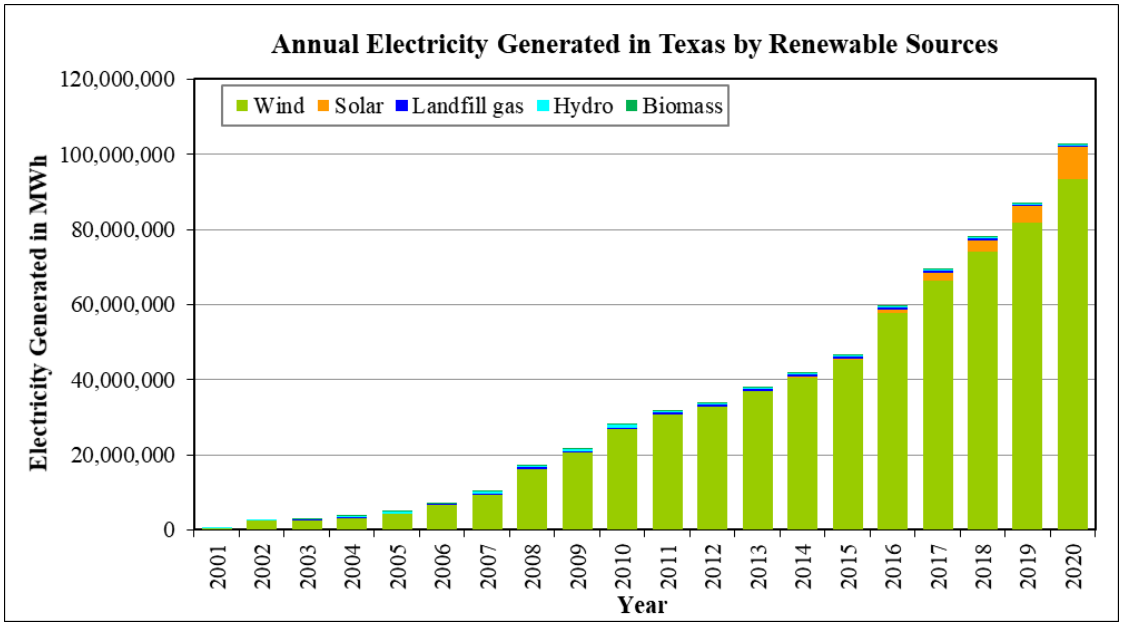


Figure 1-4: Electricity Generation by Renewable Resources (ERCOT: 2001–2020 Annual)

TABLE OF CONTENTS

1 EXECUTIVE SUMMARY 4
1.1 Texas wind power generation (ERCOT and PUCT) 5
1.2 Analysis of wind farms using an improved method and 2020 electricity generation data. 6
1.3 Analysis of emissions reduction from wind farms 7
1.4 Analysis of other renewable sources 9
1.5 Review of electricity savings and transmission planning study reported by ERCOT 10
TABLE OF CONTENTS 12
LIST OF FIGURES 13
LIST OF TABLES 15
2 INTRODUCTION 16
2.1 Statement of Work for Calculations of Emissions from Wind and Other Renewables 16
2.2 Summary of Progress 16
3 ANALYSIS ON POWER PRODUCTION FROM WIND FARMS USING 2020 DATA 18
3.1 Introduction 18
3.2 Summary of Wind Power Production for All Wind Farms in the Texas ERCOT Region 24
3.3 Comparison of Measured Wind Power in Previous Reports and Present Report 33
3.4 Uncertainty Analysis on the 2020 Daily Regression Models 40
4 DEGRADATION ANALYSIS FOR WIND FARMS 49
5 CALCULATING NO_x EMISSIONS REDUCTION FROM WIND POWER 56
5.1 Calculation of NOx Emissions from Wind Power Using 2018 eGRID 56
6 OTHER RENEWABLE SOURCES 68
6.1 Implementation 68
6.2 Renewable Energy Projects 69
6.2.1 Solar Photovoltaic 69
6.2.2 Solar Thermal 91
6.2.3 Biomass 94
6.2.4 Hydroelectric 99
6.2.5 Geothermal 104
6.2.6 Landfill Gas-Fired 104
6.3 Results 107
7 REVIEW OF ERCOT'S RENEWABLE ENERGY CREDIT PROGRAM INFORMATION 108
7.1 Introduction 108
7.2 Summary of Renewable Projects in Texas 108
8 REFERENCES 115

LIST OF FIGURES

Figure 1-1: Installed Wind Power Capacity and Power Generation in the ERCOT Region from September 2005 to December 2020 6
Figure 1-2: Measured 2020 Annual NOx Reductions from Wind Power in Texas 7
Figure 1-3: Measured 2020 OSP NOx Reductions from Wind Power in Texas 8
Figure 1-4: Electricity Generation by Renewable Resources (ERCOT: 2001–2020 Annual) 11
Figure 3-1: Installed Wind Power Capacity and Power Generation in the ERCOT Region from September 2005 to December 2020 18
Figure 3-2: Procedure for the 2018 Annual and OSP Weather Normalized Wind Power Generation for Each Wind Farm in Operation in 2020 in Texas ERCOT Region 19
Figure 3-3: Completed Wind Projects in Texas 20
Figure 3-4: Announced and Retired Wind Projects in Texas 21
Figure 3-5: A List of Completed, Announced and Retired Wind Projects in Texas 22
Figure 3-6: Comparison of Total 2020 Measured and 2018 Modeled Power Production 29
Figure 3-7: Comparison of Total 2020 OSP Measured and 2018 OSP Modeled Power Production 29
Figure 3-8: Comparison of 2020 Measured and 2018 Modeled Wind Power Production for Each Wind Farm 30
Figure 3-9: Comparison of 2020 OSP Measured and 2018 OSP Modeled Wind Power Production for Each Wind Farm 31
Figure 3-10: Measured Annual Wind Power Comparison between 2018 and 2020 34
Figure 3-11:Measured OSP Wind Power Comparison between 2018 and 2020 35
Figure 3-12: Difference Comparison between 2018 and 2020 - Measured Annual Wind Power 37
Figure 3-13:Difference Comparison between 2018 and 2020 - Measured OSP Wind Power 38
Figure 3-14: Linear Model Presentation of the Daily Wind Power Generation on the Year 2020 for Callahan_Wind_1 Farm 40
Figure 3-15: Uncertainty of the Wind Power Generation Prediction Using the Linear Daily Models for Base 2018 48
Figure 4-1: Example Sliding 12-month Hourly Wind Power Generation for Anacacho Wind 50
Figure 4-2: Design and Hourly Measured Maximum Capacity for 157 Wind Farms 55
Figure 5-1: 2018 Annual eGRID NOx Emissions for the CL zones: (a) Houston, (b) North, (c) West and (d) South. 57
Figure 5-2: 2018 OSP eGRID NOx Emissions for the CL zones: (a) Houston, (b) North, (c) West and (d) South. 58
Figure 5-3: Modeled 2018 and Measured 2020 Annual NOx Reductions from Wind Power in Texas Map 62
Figure 5-4: Modeled 2018 OSP and Measured 2020 OSP NOx Reductions from Wind Power in Texas Map 62
Figure 5-5: Comparisons of Modeled 2018 and Measured 2020 Annual NOx Emissions Reductions from Wind Power 63
Figure 5-6: Comparisons of Modeled 2018 and Measured 2020 OSP NOx Emissions Reductions from Wind Power 63
Figure 6-1: Chart of Workflow for Other Renewable Energy Projects 69
Figure 6-2: Map of Non-Utility Solar PV Projects Installed in Each County of Texas 72
Figure 6-3: Annual Electricity Generation per County from Solar Photovoltaic Projects up to 2020 75
Figure 6-4: OSP Electricity Generation per County from Solar Photovoltaic Projects up to 2020 77
Figure 6-5: NOx Emissions Reductions per County from Solar Photovoltaic Projects up to 2020 80
Figure 6-6: Annual Electricity Generation by Solar Power Plants in the State of Texas through 2020 86
Figure 6-7: Map of Solar Power Plants Projects Installed in Each County of Texas 87
Figure 6-8: Annual Electricity Generation per County from Solar Power Plant Projects through 2020 88
Figure 6-9: Ozone Season Period Electricity Generation per County from Solar Power Plant Projects through 2020 89

Figure 6-10: NOx Emissions Reductions per County from Solar Power Plant Projects through 2020 90
Figure 6-11: Hourly Electricity Generation Profile for Solar Photovoltaic Project ACACIA_UNIT_1 91
Figure 6-12: Daily Total Electricity Generation Profile for Solar Photovoltaic Project ACACIA_UNIT_1 91
Figure 6-13: Map of Solar Thermal Projects Installed in Each County of Texas 92
Figure 6-14: Annual Electricity Savings per County from Solar Thermal Projects through 2020 93
Figure 6-15: Ozone Season Period Electricity Savings per County from Solar Thermal Projects through 2020 93
Figure 6-16: NOx Emissions Reductions per County from Solar Thermal Projects through 2020 94
Figure 6-17: Annual Electricity Generation by Biomass Projects in the State of Texas through 2020 95
Figure 6-18: Map of Biomass Projects Installed in Each County of Texas 96
Figure 6-19: Annual Electricity Savings per County from Biomass Projects through 2020 97
Figure 6-20: Ozone Season Period Electricity Savings per County from Biomass Projects through 2020 97
Figure 6-21: Hourly Electricity Generation Profile for Biomass DG-78252-4UNITS 98
Figure 6-22: Daily Total Electricity Generation Profile for Biomass Project DG-78252-4UNITS 98
Figure 6-23: Annual Electricity Generation by Hydroelectric Projects in the State of Texas through 2020 100
Figure 6-24: Map of Hydroelectric Projects Installed in Each County of Texas 101
Figure 6-25: Annual Electricity Savings per County from Hydroelectric Projects through 2020 102
Figure 6-26: Ozone Season Period Electricity Savings per County from Hydroelectric Projects through 2020 102
Figure 6-27: NOx Emissions Reductions per County from Hydroelectric Projects through 2020 103
Figure 6-28: Hourly Electricity Generation Profile for Hydroelectric Project AMISTAD_AMISTAG1 103
Figure 6-29: Daily Total Electricity Generation Profile for Hydroelectric Project AMISTAD_AMISTAG1 103
Figure 6-30: Map of Geothermal Projects Installed in Each County of Texas 105
Figure 6-31: Map of Landfill Gas-Fired Projects Installed in Each County of Texas 106
Figure 7-1: Electricity Generation by Renewable Sources (ERCOT: 2001–2020 Annually) 113
Figure 7-2: Electricity Generation by Renewable Sources Other than Wind (ERCOT: 2001–2020 Annually) 113
Figure 7-3: Electricity Generation by Renewable Sources from Solar, Landfill Gas, and Biomass (ERCOT: 2001–2020 Annually) 114
Figure 7-4: Electricity Generation by Renewable Sources from Solar and Biomass (ERCOT: 2001–2020 Annually) 114

LIST OF TABLES

Table 1-1: Installed/Announced Wind Power Capacity and the Statutory Mandates 4
Table 1-2: Electricity Generation and NOx Emission Reductions for All the Wind Farms in ERCOT Region in 2019 7
Table 1-3: Number of Projects Identified for Other Renewable Sources 9
Table 1-4: Annual Electricity Generation by Renewable Resources (MWh, ERCOT: 2001 - 2020) 10
Table 3-1: Summary of Annual Power Production for All Wind Farms Operated for more than 6 months in 2020 25
Table 3-2: Summary of 2018 and 2020 Monthly Average Wind Speed for Five ERCOT Weather Zones 29
Table 3-3: Statistical Parameters of the Determined Daily Power Production Linear Models 42
Table 3-4: 2018 Uncertainty of the Power Generation Prediction using the Linear Daily Models 45
Table 4-1: Summary of 90th Percentile Hourly Wind Power Degradation Analysis for 157 Wind Farms in Texas 51
Table 4-2: Summary of Maximum Hourly Wind Power Analysis for 157 Wind Farm in Texas 53
Table 5-1: Wind Farm Information from the PUCT — Updated Jan 15th, 2021 59
Table 5-2: Modeled 2018 and Measured 2020 Wind Power Production Assigned to Each CL Zone in the ERCOT Region 62
Table 5-3: Distribution of the Annual Emission Reductions per CL Zone for each County (Base Year 2018) 64
Table 5-4: Distribution of the Annual Emission Reductions per CL Zone for each County (Year 2020) 65
Table 5-5: Distribution of the OSP Emission Reductions per CL Zone for each County (Base Year 2018) 66
Table 5-6: Distribution of the OSP Emission Reductions per CL Zone for each County (Year 2020) 67
Table 6-1: Solar Photovoltaic Projects: Annual Energy and OSP Energy up to 2020 70
Table 6-2: Texas Non-Utility Solar Photovoltaic Projects up to 2020 72
Table 6-3: Solar Power Plant Projects in the State of Texas through 2020 84
Table 6-4: Solar Power Plant Projects throughout Texas through 2020 87
Table 6-5: Solar Thermal Projects: Energy Reductions up to 2020 91
Table 6-6: Solar Thermal Projects throughout Texas through 2020 92
Table 6-7: Biomass Projects in the State of Texas through 2020 95
Table 6-8: Biomass Projects throughout Texas through 2020 96
Table 6-9: Hydroelectricity Power Projects in the State of Texas through 2020 100
Table 6-10: Hydroelectric Projects throughout Texas through 2020 101
Table 6-11: Geothermal Projects Installed throughout Texas through 2020 105
Table 6-12: Landfill Gas-Fired Projects Installed throughout Texas through 2020 106
Table 6-13: Comparison of the Projects Identified from Previous and Present Reports 107
Table 7-1: Quarterly Electricity Generation by Renewable Sources, in MWh, for 2001–2020 109
Table 7-2: Annual Electricity Generation by Renewable Sources (MWh, ERCOT: 2001–2020) 112

2 INTRODUCTION

2.1 Statement of Work for Calculations of Emissions from Wind and Other Renewables

This summary report covers the Energy Systems Laboratory's work from January 2020 through December 2020. This work is intended to cover the basic work outline included below:

Task 1: Obtain input from public/private stakeholders

Task 2: Develop and maintain a methodology in cooperation with the Texas Commission on Environmental Quality (TCEQ) and the U.S. Environmental Protection Agency (US EPA) for calculating emissions reductions obtained through wind and other renewable energy resources in Texas

Task 3: Calculate annual, creditable emissions reductions for wind and other renewable energy resources for inclusion in the State SIP

Task 4: Include emissions reductions by county from wind and renewable energy resources in the ESL's annual report to the TCEQ

Task 5: Incorporate wind and renewable energy emissions reductions as a component of the ESL's *Texas Energy Summit* to facilitate the technical transfer

2.2 Summary of Progress

The progress toward completing each task is provided in the following section and throughout this report.

Task 1: Obtain input from public/private stakeholders.

Legislation passed during the regular session of the 79th Legislature directed the Energy Systems Laboratory to work with the TCEQ to develop a methodology for computing emissions reductions attributable to renewable energy and for the ESL to quantify the emissions reductions attributable to renewables for inclusion in the State Implementation Plan (SIP) annually. HB 2921 directed the Texas Environmental Research Consortium (TERC) to engage the Texas Engineering Experiment Station for the development of this methodology.

During the period from January 2020 to December 2020, several presentations were done to report the analysis methodology and the results to interested parties.

- November 2020 – Presentation at the Texas Energy Summit about Emissions Reduction Impact of Renewables, Austin, Texas.

Task 2: Develop a methodology in cooperation with the Texas Commission on Environmental Quality and the U.S. Environmental Protection Agency for calculating emissions reductions obtained through wind and other renewable energy resources in Texas.

This task is composed of the following subtasks:

- Review existing methodologies for calculating emissions reductions from wind energy and other renewable energy systems with US EPA, TCEQ, and stakeholders.
- Develop acceptable methodologies for wind and renewables.
- Determine how to implement methodologies for Texas, including the accounting of current installations, future sites, degradation, discounting/uncertainty, grid constraints, etc.
- Review methodologies for verifying wind energy production and renewable energy installations with TCEQ, US EPA, and stakeholderss.

- Develop acceptable methodologies for verifying installations, including documentation, EPA Quality Assurance Project Plan (QAPP), etc.
- Develop draft State Guidelines for the TCEQ for EE/RE SIP credits

Task 3: Calculate annual, creditable emissions reductions for wind and other renewable energy resources for inclusion in the State SIP.

This task is composed of the following subtasks:

- Calculate annual emissions from wind and other renewable energy projects; verify annual installations of wind and renewable energy systems in Texas;
- Verify ERCOT historical data for wind production and other renewables

Task 4: Include emissions reductions by county from wind and renewable energy resources in the ESL's annual report to the TCEQ.

This task is composed of the following subtasks:

- Report annual emissions from wind and other renewable energy projects;
- Report on verification of installations of wind and renewable energy systems in Texas;
- Develop documentation for all methods developed

Task 5: Incorporate wind and renewable energy emissions reductions as a component of the ESL's Texas Energy Summit to facilitate the technical transfer.

Additional information regarding the ESL's efforts on Tasks 2, 3, 4 and 5 are listed below and presented in detail in the following sections. This work was performed during the period of January 2020 through December 2020.

- Analysis of wind farms using 2020 data
- Analysis of emissions reduction from wind farms
- Updates of the degradation analysis to include more wind farms
- Analysis of other renewables
- Review of electricity savings and transmission planning study reported by ERCOT

3 ANALYSIS ON POWER PRODUCTION FROM WIND FARMS USING 2020 DATA

3.1 Introduction

Texas is the largest producer of wind energy in the United States. As of December 2020,[10], the installed wind turbine capacity totals 32,413 MW in Texas, and it has been announced new projects that will add another 9,217 MW of capacity by the end of 2023. The ERCOT region represents 29,892 MW, which accounts for 92.2% of the 2020 total capacity installed in Texas. Figure 3-1 shows the monthly electricity generation and capacity installed in the ERCOT region from September 2005 to December 2020. Figure 3-3 to Figure 3-5 shows the location and lists of the completed, announced, and retired wind farms based on the information from the PUCT.

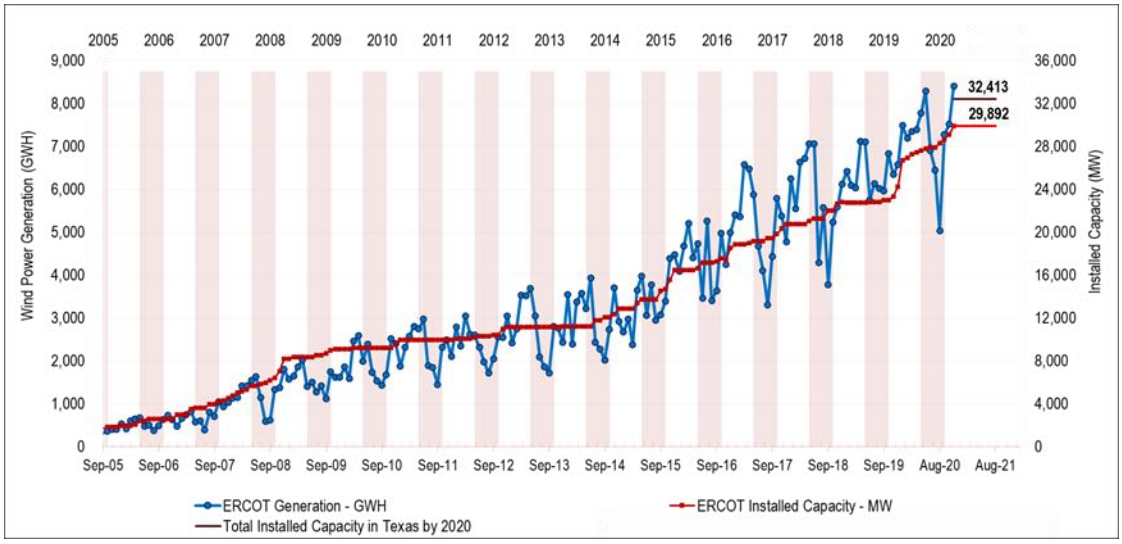


Figure 3-1: Installed Wind Power Capacity and Power Generation in the ERCOT Region from September 2005 to December 2020

In Section 3.2, a summary of wind power production for all wind farms in the Texas ERCOT region is presented. In order to weather normalize the wind power generation of the wind farms, linear regression models are developed for each wind farm that has been in operation in 2020. As shown in Figure 3-2, the model coefficients for each wind farm are obtained from these regression models using the 2020 daily power generation data of the corresponding wind farm and the 2020 daily wind speed data of the most representative ERCOT weather zone among the five ERCOT zones. The model is then used to estimate the wind power generation using the 2018 wind speed data. The weather normalized modeled power generation allows the comparison of the wind power generation of each wind farm in different years. In addition, a comparison between the annual and OSP wind power generation from the previous report and this report is presented.

An uncertainty analysis was also performed on all the daily regression models and included in this report to show the accuracy of applying the OSP and Non-OSP linear regression models to predict the wind power generation that the wind farms would have had in the base year of 2018. The detailed analysis for each wind farm is provided in Volume II, Appendix A. The original data used in the analysis is presented in Volume II and the accompanying CD-ROM with this report.

[10] Wind project information obtained from the Public Utility Commission of Texas (www.puc.texas.gov) as of 1/15/2021 and the Electric Reliability Council of Texas (ERCOT) as of June 2020.

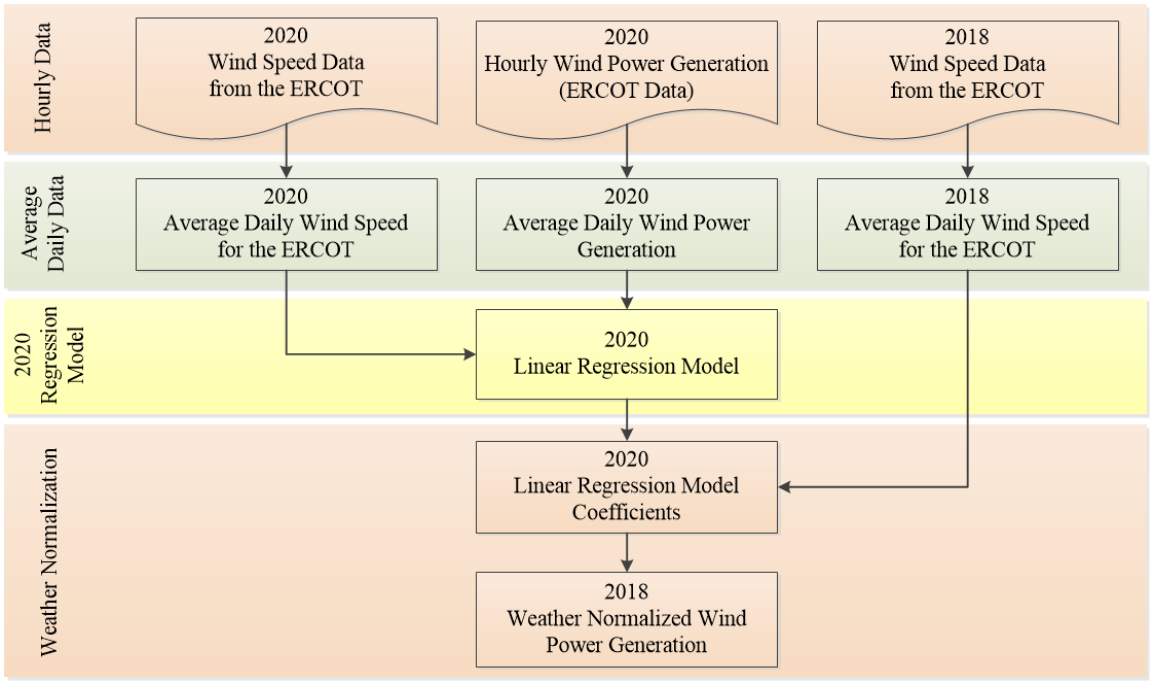


Figure 3-2: Procedure for the 2018 Annual and OSP Weather Normalized Wind Power Generation for Each Wind Farm in Operation in 2020 in Texas ERCOT Region

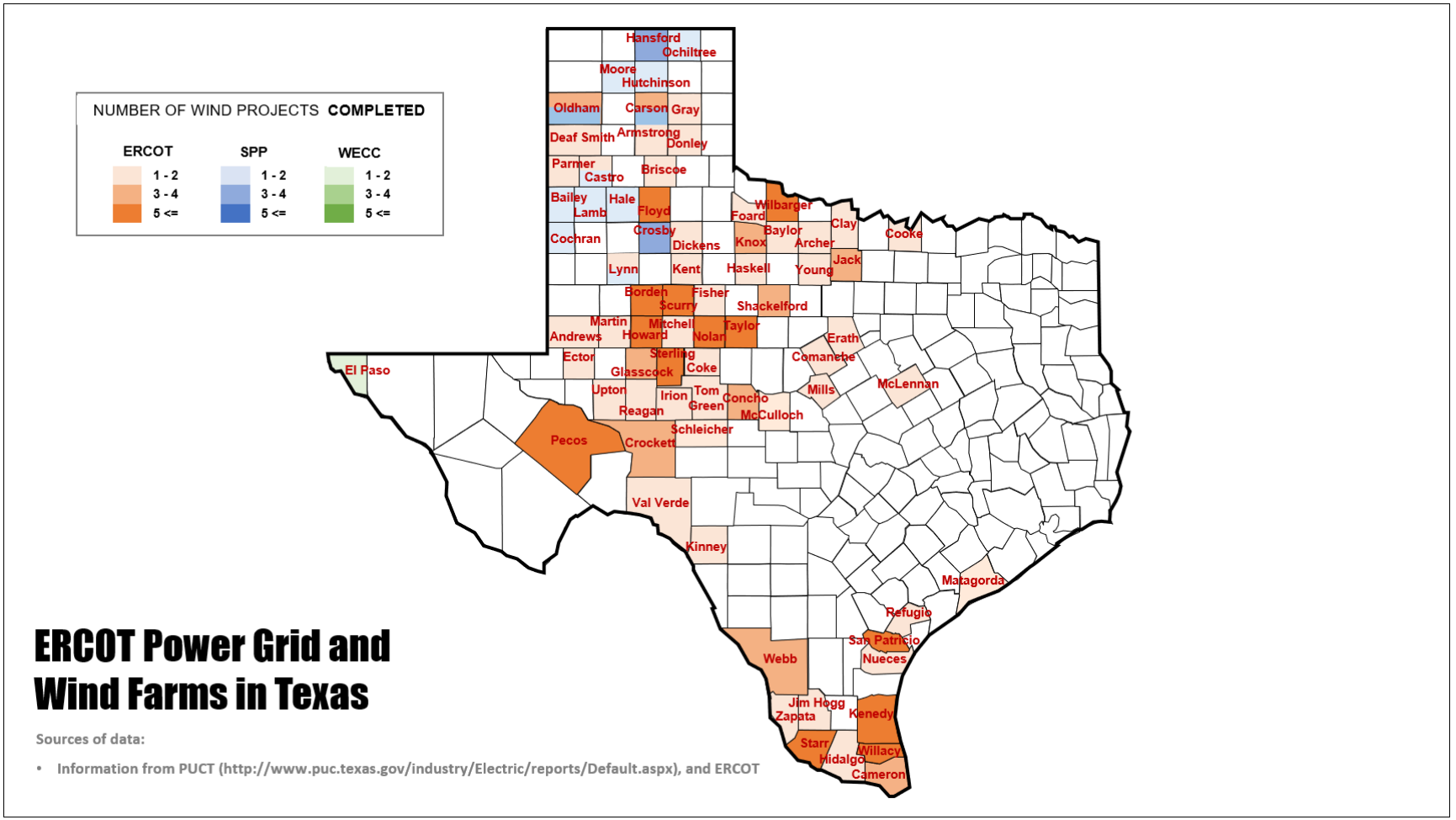


Figure 3-3: Completed Wind Projects in Texas

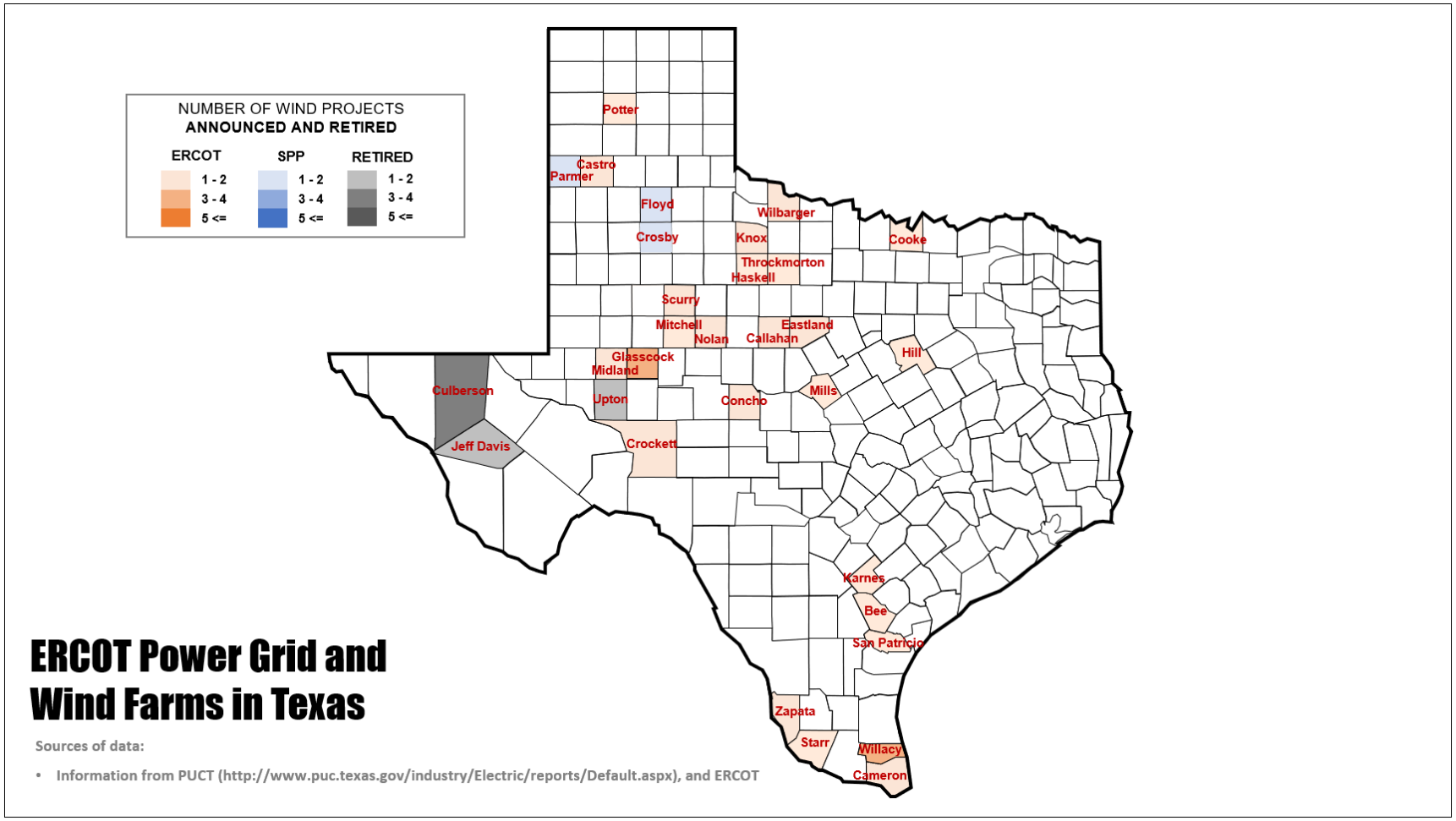


Figure 3-4: Announced and Retired Wind Projects in Texas

WIND PROJECTS COMPLETED :

ERCOT Region - 30,164 MW

1. Andrews, Barrow Ranch Wind, 160 MW, March-20
2. Archer, Windthorst 2, 65 MW, Dec-14
3. Armstrong, Route66 Wind, 150 MW, Aug-15
4. Baylor, S_Hills Wind, 30.24 MW, Aug-19
5. Borden, Bull Creek Wind Plant, 180 MW, Nov-08
6. Borden, Gopher Creek Wind, 158 MW, Mar-20
7. Borden, Mesquite Creek W, 211 MW, Apr-15
8. Borden, Red Canyon 1, 84 MW, May-06
9. Borden, Stephens Ranch Wind Phase 1, 211 MW, Dec-14
10. Borden, Stephens Ranch Wind Phase b, 165 MW, May-15
11. Briscoe, Briscoe Wind, 150 MW, Nov-15
12. Briscoe, Longhorn Energy Center North, 200 MW, Sep-15
13. Cameron, Cameron County Wind, 165 MW, Jan-16
14. Cameron, San Roman Wind 1, 94 MW, Feb-17
15. Cameron, Palmas Altas Wind, 144.9 MW, Nov-20
16. Carson, Colbeck's Corner, 200 MW, May-16
17. Carson, Grandview Phase 1 (Conway Windfarm), 211 MW, Dec-14
18. Carson, Panhandle Wind 1, 218 MW, Jul-14
19. Carson, Panhandle Wind 2, 198 MW, Nov-14
20. Castro, Jumbo Road Wind (Hereford 2), 300 MW, Apr-15
21. Clay, Bobcat Bluff, 163 MW, Mar-13
22. Clay, Shannon Wind, 200 MW, Dec-15
23. Coke, Aviator Wind, 525 MW, Jul-20
24. Comanche, Flat Top Wind I, 200 MW, Sep-18
25. Comanche, Logan's Gap Wind I, 211 MW, Sep-15
26. Concho, Cactus Flats Wind, 148.4 MW, Jan-20
27. Concho, Maverick Creek I W, 373.2 MW, Oct-20
28. Concho, Panther Creek 3, 200 MW, Aug-09
29. Cooke, Tyler Bluff Wind (Muenster Wind), 118 MW, Dec-16
30. Cooke, Wolf Ridge Windfarm, 113 MW, Oct-08
31. Crockett, High Lonesome W, 449.5 MW, Jan-20
32. Crockett, High Lonesome Wind Phase II, 50.6 MW, Jan-20
33. Crockett, Ranchero Wind, 300 MW, May-20
34. Deaf Smith, Falvez Astra Wind, 163 MW, May-17
35. Deaf Smith, Hereford Wind Project (Hereford 1), 200 MW, May-15
36. Dickens, McAdoo Wind Energy, 150 MW, May-08
37. Dickens, Wake Wind, 300 MW, Oct-16
38. Donley and Gray, Salt Fork Wind, 200 MW, Dec-16
39. Ector, Notrees Windpower, 153 MW, Jan-09
40. Erath, Buckthorn Wind, 100 MW, Dec-17
41. Erath, Silver Star Phase I, 60 MW, Mar-08
42. Fisher, Whitehorse Wind, 418.9 MW, Mar-20
43. Fisher, WKN Amadeus Wind, 250.1 MW, Nov-20
44. Floyd, Cotton Plains Wind, 50 MW, Mar-17
45. Floyd, Old Settler Wind, 150 MW, Apr-17
46. Floyd, South Plains Wind I, 200 MW, Nov-15
47. Floyd, South Plains Wind II Phase a, 152 MW, Jun-16
48. Floyd, South Plains Wind II Phase b, 148 MW, Jun-16
49. Floyd, Whirlwind, 60 MW, Dec-07
50. Foard, Foard City Wind, 350 MW, Nov-19
51. Glasscock, Bearkat Wind A, 197 MW, Feb-18
52. Glasscock, Bearkat Wind B, 162.1 MW, Jun-20
53. Glasscock, RattleSnake Wind Ph 1, 211 MW, Sep-15
54. Gray, Miami Wind 1 Project, 289 MW, Dec-14
55. Haskell, Horse Creek Wind, 230 MW, Jan-17
56. Haskell, Willow SpriGass Wind (Salvtion), 250 MW, Dec-17
57. Hidalgo, Hidalgo & Starr Wind, 250 MW, Dec-16
58. Hidalgo, Hidalgo II Wind, 51 MW, Feb-20
59. Howard, Big Spring Wind Power, 34 MW, Feb-99
60. Howard, Big Spring Wind Power, 7 MW, Jun-99
61. Howard, Elbow Creek Wind, 117.3 MW, Nov-08
62. Howard, Gunsight Mountain, 120 MW, Sep-16
63. Howard, Ocotillo Windpower 1, 59 MW, Aug-08
64. Howard, Panther Creek, 143 MW, Jul-08
65. Howard, Panther Creek 2, 115 MW, Nov-08
66. Irion, Oveja Wind, 300 MW, Jan-20
67. Jack, Barton Chapel Wind 1, 120 MW, Dec-07
68. Jack, Keechi Wind, 102 MW, Jan-15
69. Jack, Senate Wind Project, 150 MW, Dec-12
70. Jim Hogg, Sendero Wind Energy Project, 78 MW, Dec-15
71. Kenedy, Gulf Wind 1, 283 MW, Nov-08
72. Kenedy, Baffin Wind Farm (Penascal 3), 202 MW, Jun-16
73. Kenedy, Penascal Wind Farm, 202 MW, Nov-08
74. Kenedy, Penascal Wind Farm 2, 202 MW, Mar-10
75. Kenedy, Penascal Wind Farm 3, 100.8 MW, Oct-10
76. Kenedy, Stella 1 Wind, 201 MW, Dec-18
77. Kent, Mozart, 30 MW, Dec-12
78. Kinney, Anacacho Windfarm, 100 MW, Dec-12
79. Knox, Green Pastures W, 300 MW, Nov-15
80. Knox, Vera Wind, 208.8 MW, Aug-20
81. Knox, Vera Wind V110, 34 MW, Nov-20
82. Lynn, Sage Draw Wind, 338 MW, Jan-20
83. Lynn, Tahoka Wind, 300 MW, Mar-19
84. Martin, Stanton Wind Energy, 120 MW, Jan-08
85. Matagorda, Peyton Creek Wind, 151.2 MW, Jun-20
86. McCulloch, Prairie Hill Wind, 300 MW, Dec-20
87. McCulloch, RTS Wind, 160 MW, Sep-18
88. McCulloch, RTS 2 Wind, 179.9 MW, May-20
89. Mills, Goldthwaite Wind Energy, 149 MW, Jun-14
90. Mitchell, Loraine Windpark, 150 MW, Oct-09
91. Nolan, Inadale, 197 MW, Nov-08
92. Nolan, Sweetwater Wind 1, 37.5 MW, Dec-03
93. Nolan, Sweetwater Wind 2, 91.5 MW, Feb-05
94. Nolan, Sweetwater Wind 3 (Cottonwood Creek), 135 MW, Dec-05
95. Nolan, Sweetwater Wind 4 (Cottonwood Creek), 241 MW, May-07
96. Nolan, Sweetwater Wind 5, 80 MW, Dec-07
97. Nolan, Trent Mesa, 150 MW, Nov-01
98. Nolan, Turkey Track Energy Center, 169.5 MW, Nov-08
99. Nueces, Chapman Ranch Wind 1, 250 MW, Oct-17
100. Nueces, Shaffer Wind, 226 MW, Jan-20
101. Oldham, Canadian Breaks Wind, 210 MW, Dec-19
102. Oldham, Spinning Spur Wind II, 161 MW, Jun-14
103. Oldham, Spinning Spur Wind III, 194 MW, Oct-15
104. Parmer, Mariah Del Notre, 230 MW, Mar-17
105. Pecos, Desert Sky (Indian Mesa II), 160 MW, Dec-01
106. Pecos, Indian Mesa, 82.5 MW, Jun-01
107. Pecos, Sherbino Mesa Wind Farm, 150 MW, Sep-08
108. Pecos, Sherbino Mesa Wind Farm 2, 158 MW, Nov-11
109. Pecos, Woodward Mountain Ranch, 160 MW, Jul-01
110. Reagan, Santa Rita Wind (Hickman), 300 MW, May-18
111. Refugio, Cranel Wind, 220 MW, Jun-20
112. San Patricio, Karankawa Wind, 206.6 MW, Dec-19
113. San Patricio, Karankawa 2 Wind, 101 MW, Dec-19
114. San Patricio, Midway Wind, 162.9 MW, Jun-19
115. San Patricio, Papalote Creek Wind Farm, 180 MW, Sep-09
116. San Patricio, Papalote Creek Phase II, 198 MW, Jun-10
117. Schleicher, Wilson Ranch, 199.5 MW, Apr-20
118. Scurry, Brazos Wind Ranch, 160 MW, Dec-03
119. Scurry, Camp Springs I, 130 MW, Jul-07
120. Scurry, Camp Springs II, 120 MW, Jun-08
121. Scurry, Champion Wind Farm, 126 MW, Jan-08
122. Scurry, Dermott Wind 1 , 250 MW, Aug-17
123. Scurry, Fluvanna Renewable 1, 155 MW, Nov-17
124. Scurry, Pyron, 249 MW, Nov-08
125. Scurry, Roscoe Wind Farm 1, 209 MW, Jan-08
126. Scurry, Snyder Wind Project, 63 MW, Dec-07
127. Shackelford, Hackberry Wind Farm, 165 MW, Nov-08
128. Shackelford, Lone Star - Mesquite Wind, 200 MW, Dec-07
129. Shackelford, Lone Star - Post Oak Wind, 200 MW, May-08
130. Starr, Cabezon Wind, 237.6 MW, Dec-19
131. Starr, Los Vientos III, 200 MW, Dec-15
132. Starr, Los Vientos IV, 200 MW, Jun-16
133. Starr, Los Vientos V, 200 MW, Sep-16
134. Starr, Mesteno Wind, 201.6 MW, Jan-20
135. Sterling, Capricorn Ridge Wind, 364 MW, Sep-07
136. Sterling, Capricorn Ridge Wind (exp), 298 MW, May-08
137. Sterling, Forest Creek Wind Farm, 124.2 MW, Dec-06
138. Sterling, Goat Wind, 80 MW, Apr-08
139. Sterling, Goat Wind Phase 2, 70 MW, Apr-09
140. Sterling, Sand Bluff Wind Farm, 90 MW, Dec-06
141. Taylor, Buffalo Gap 1, 120 MW, Sep-05
142. Taylor, Buffalo Gap 2 (Cirello 1), 233 MW, Aug-07
143. Taylor, Buffalo Gap 3, 170 MW, Apr-08
144. Taylor, Callahan Divide Wind Energy Center, 114 MW, Feb-05
145. Taylor, Horse Hollow Phase 1, 213 MW, Oct-05
146. Taylor, Horse Hollow Phase 2, 223.5 MW, May-06
147. Taylor, Horse Hollow Phase 3, 299 MW, Sep-06
148. Taylor, Horse Hollow Phase 4, 115 MW, May-06
149. Taylor, South Trent Wind Farm, 101.2 MW, Oct-08
150. Tom Green, Langford Wind Power, 150 MW, Oct-09

Figure 3-5: A List of Completed, Announced and Retired Wind Projects in Texas

151. Upton, King Mountain Wind Ranch, 278 MW, Dec-01
152. Val Verde, Val Verde Wind, 149 MW, Oct-17
153. Webb, Cedro Hill Wind, 150 MW, Oct-10
154. Webb, Torrecillas Wind, 300.5 MW, Nov-19
155. Webb, Whitetail Wind Project, 92 MW, Dec-12
156. Wilbarger, Blue Summit Wind, 135 MW, Dec-12
157. Wilbarger, Blue Summit II, 102 MW, Apr-20
158. Wilbarger, Blue Summit III, 200 MW, May-20
159. Wilbarger, Electra Wind, 230 MW, Jan-17
160. Wilbarger, Lockett Wind, 184 MW, Sep-19
161. Willacy, Bruenning's Breeze Wind Farm, 228 MW, Dec-17
162. Willacy, East Raymond Wind, 201.6 MW, Nov-20
163. Willacy, Los Vientos I, 200 MW, Jan-13
164. Willacy, Los Vientos II, 202 MW, Jan-13
165. Willacy, Magic Valley Wind, 206 MW, Apr-12
166. Young, Trinity Hills Wind Farm, 225 MW, Jan-12
167. Zapata, Javelina Wind, 250 MW, Dec-15
168. Zapata, Javelina 2 Wind, 200 MW, Feb-17

WIND PROJECTS COMPLETED :

SPP Region - 2,519 MW

169. Bailey and Lamb, Blue Cloud Renewable Energy, 148.4 MW, Dec-18
170. Carson, Llano Estacado Wind Ranch, 79 MW, Jan-02
171. Carson, Majestic Wind, 79.5 MW, Dec-09
172. Carson, Majestic Wind II, 79.6 MW, Dec-12
173. Carson, Pantex Wind Farm, 11.5 MW, Jun-14
174. Castro, Bethel Wind Energy Facility, 276 MW, Jan-17
175. Cochran, Wildcat Ranch Wind Project, 150.5 MW, Dec-18
176. Crosby, Ralls Wind Farm, 10 MW, Jul-11
177. Crosby, Pleasant Hill Wind Energy, 20 MW, Oct-15
178. Crosby, Fiber Winds Energy Project, 78.8 MW, Dec-18
179. Hale, Hale Community Energy, 478 MW, Jun-19
180. Hansford, , 3 MW, Dec-03
181. Hansford, Noble Great Plains Windpark, 114 MW, Feb-09
182. Hansford, JD Wind 1-7, 9-11, Wege, 189.8 MW, Dec-09
183. Hansford, Frisco Wind Farm, 20 MW, Feb-12
184. Hutchinson, Little Pringle 1,2, 20 MW, Sep-10
185. Lynn, Cirrus Wind Energy, 61.2 MW, Dec-12
186. Moore, Sunray Wind I, II, III, 49.5 MW, Aug-09
187. Ochiltree, Palo Duro Wind, 250 MW, Dec-14
188. Oldham, Wildorado Wind Ranch, 161 MW, Apr-07
189. Oldham, GS Panhandle Wind Ranch, 78 MW, Sep-11
190. Oldham, Spinning Spur Wind Ranch, 161 MW, Dec-12

WECC Region - 1 MW

191. El Paso, Hueco Mountain Wind Ranch, 1.3 MW, Apr-01

WIND PROJECTS ANNOUNCED :

ERCOT Region – 8,682 MW

1. Bee, Blackjack Creek Wind, 241 MW, Sep-21
2. Callahan, Baird North Wind, 331 MW, Jul-21
3. Callahan, Baird North II Wind, 20 MW, Jul-21
4. Cameron, Chalupa Wind, 174 MW, Mar-21
5. Cameron, Espiritu Wind, 25.2 MW, Mar-21
6. Castro, Hart Wind, 151.5 MW, Dec-22
7. Concho, Maverick Creek II W, 118.8 MW, Mar-21
8. Cooke, WILDWIND, 180.08 MW, Jun-21
9. Crockett, White Mesa Wind, 152.3 MW, Jul-21
10. Crockett, Big Sampson Wind , 400 MW, Sep-23
11. Eastland, Roadrunner Crossing Wind, 200.2 MW, Dec-21
12. Eastland, Anchor Wind, 300 MW, Dec-21
13. Glasscock, Edmondson Ranch Wind, 293.28 MW, Dec-21
14. Glasscock, Kontiki 1 Wind (ERIK), 250.1 MW, Mar-23
15. Glasscock, Kontiki 2 Wind (ERNEST), 250.1 MW, Mar-23
16. Haskell, Apogee Wind, 393.24 MW, Dec-21
17. Hill, Aquilla Lake Wind, 202 MW, Aug-21
18. Hill, Aquilla Lake 2 Wind, 100 MW, Oct-21
19. Karnes, Foxtrot Wind, 504 MW, Feb-22
20. Knox, Griffin Trail Wind, 225.6 MW, Jul-21
21. Knox, TG East Wind, 336 MW, Dec-21
22. Midland, Hutt Wind, 336 MW, Oct-21
23. Mills, Priddy Wind , 300 MW, Nov-21
24. Mitchell, Loraine Windpark Phase III, 100 MW, May-22
25. Nolan, Maryneal Wind, 182.4 MW, Jul-21
26. Potter, CAROL wind, 169.2 MW, Dec-21
27. San Patricio, El Algodon Alto W, 201 MW, Dec-21
*28. Scurry, Coyote Wind, 242.6 MW, Dec-20**
29. Scurry, Canyon Wind, 259.44 MW, May-22
30. Starr, Venado Wind , 201.6 MW, Jan-21
31. Throckmorton, Monarch Creek Wind, 209 MW, Dec-21
32. Throckmorton, Vortex Wind, 350.15 MW, Dec-21
33. Wilbarger, Ajax Wind, 336.6 MW, Dec-21
*34. Willacy, Las Majadas Wind, 272.6 MW, Dec-20**
35. Willacy, Monte Alto I, 223.8 MW, Dec-22
36. Willacy, West Raymond (El Trueno) Wind, 239.8 MW, May-21
37. Zapata, Reloj Del Sol Wind, 209.4 MW, Mar-21

SPP Region – 535 MW

38. Parmer, Lazbuddie Wind Energy Project, 235 MW, Oct-21
39. Crosby and Floyd, Cone Renewable Energy Project, 300 MW, Jun-22

WIND PROJECTS RETIRED :

ERCOT Region - 266 MW

1. Culberson, Delaware Mountain Wind Farm, 30 MW, 1999
2. Culberson, Texas Wind Power Project, 35 MW, 1995
3. Culberson, Windpower Partners 1994 - Kunitz, 39 MW, 1995
4. Jeff Davis, Fort Davis Wind Farm, 6.6 MW, 1996
5. Upton, Southwest Mesa Wind Project, 75 MW, 1999
6. Upton, West Texas Wind Farm, 80 MW, 1999

Note:

- The wind projects written in *italics* in the Figure 3-5 are updated projects for the current year.
- One wind project (i.e., Harbor Wind project in Nueces county) was removed from the ERCOT completed projects list because this wind project had no electricity generation data.
- Two wind projects (i.e., Las Majadas Wind project in Willacy county and Coyote Wind project in Scurry county) were expected to start the operation by Dec-2020. However, these projects had no electricity generation data this year. Therefore, these two projects were included in the announced projects list.

Figure 3-5: A List of Completed, Announced and Retired Wind Projects in Texas (Cont.)

3.2 Summary of Wind Power Production for All Wind Farms in the Texas ERCOT Region

Table 3-1 shows the summary of the 2020 measured power production for the wind farms that were operating in the year of 2020 in the Texas ERCOT region and the modeled wind power production using daily regression models and wind speed data from 2018 (Volume II, Appendix A). This table includes annual generations, OSP generations, wind power capacity, wind zone, and CL zone for all wind farms operated for more than six months in Texas. The power generation in 2020 of Goat Wind, Inadale, Sherbino Mesa Wind Farm, Sherbino Mesa Wind Farm 2, Ocotillo Windpower 1, and Gulf Wind 1 have been reduced over 50% compared to last year.

Table 3-2 shows the monthly average wind speed across five ERCOT weather zones in 2018 (new base year) and 2020, which are mainly used for the wind modeling analysis. For this year, the average wind speed of ERCOT weather zones was used for data processing.

As shown in Figure 3-6 and Figure 3-7, the modeled annual wind power production using 2018 wind speed data (90,732,487 MWh/yr) is higher by about 5.69% when compared to what was measured in 2020 (85,565,799 MWh/yr)[11]. For the OSP, the modeled average daily power production using 2018 wind speed data is 243,411 MWh/day, which is 8.25 % higher than that measured in 2020 (223,327MWh/day)[10]. This is because, for the modeling analysis of this year, the average wind speed of ERCOT for the year 2020 is used for the analysis of most wind farms and more wind power was produced in the OSP. The OSP in this year's report includes the period from May 1st to September 30th.

Figure 3-8 presents the comparison of the 2020 measured annual wind power production against the modeled annual wind power production using 2018 wind speed data for each wind farm. Figure 3-9 shows the difference between the 2020 measured average daily power production and the modeled average daily wind power production using 2018 wind speed data during the OSP for each wind farm.

[11] This value reflects the total power generation for all windfarms operated for more than six months in 2020.

Table 3-1: Summary of Annual Power Production for All Wind Farms Operated for more than 6 months in 2020

Wind Unit Code	Facility Name	County	Capacity (MW)	ERCOT Wind Zone	CL Zone	Wind Power for 2018 Predicted		Wind Power for 2020 Measured	
						Annual (MWh/yr)	OSP (MWh/day)	Annual (MWh/yr)	OSP (MWh/day)
ANACACHO_ANA	ANACACHO WIND	KINNEY	99.8	SOUTH	S	324,103	886	319,831	865
ASTRA_UNIT1	FALVEZ ASTRA WIND	DEAF SMITH	163.2	PANHANDLE	W	487,977	1,265	439,607	1,209
BAFFIN_UNIT1	BAFFIN WIND	KENEDY	100.0	COASTAL	S	397,337	1,151	285,395	779
BAFFIN_UNIT2	BAFFIN WIND	KENEDY	102.0	COASTAL	S	373,400	1,078	265,096	721
BARROW_UNIT1	JUMBO HILL WIND	ANDREWS	90.0	WEST	W	327,759	946	282,632	924
BARROW_UNIT2	JUMBO HILL WIND	ANDREWS	70.0	WEST	W	256,352	733	219,455	716
BBREEZE_UNIT1	BRUENNING'S BREEZE A	WILLACY	120.0	COASTAL	S	451,987	1,091	285,476	701
BBREEZE_UNIT2	BRUENNING'S BREEZE B	WILLACY	108.0	COASTAL	S	395,747	958	250,231	608
BCATWIND_WIND_1	BOBCAT BLUFF WIND	CLAY	162.0	WEST	W	526,629	1,365	552,051	1,299
BLSUMMIT_BLSMT1_5	BLUE SUMMIT WIND 1 A	WILBARGER	8.8	WEST	W	27,140	75	28,351	72
BLSUMMIT_BLSMT1_6	BLUE SUMMIT WIND 1 B	WILBARGER	124.3	WEST	W	399,853	1,076	417,900	1,043
BLSUMMIT_UNIT2_17	BLUE SUMMIT WIND 2 B	WILBARGER	6.7	WEST	W	21,990	62	23,875	60
BLSUMMIT_UNIT2_25	BLUE SUMMIT WIND 2 A	WILBARGER	89.7	WEST	W	338,443	948	365,915	925
BLSUMIT3_UNIT_17	BLUE SUMMIT WIND 3 A	WILBARGER	13.4	WEST	W	46,532	130	50,837	126
BLSUMIT3_UNIT_25	BLUE SUMMIT WIND 3 B	WILBARGER	182.4	WEST	W	723,789	1,955	764,865	1,877
BORDAS_JAVEL18	JAVELINA I WIND 18	ZAPATA	19.7	SOUTH	S	62,980	174	61,501	168
BORDAS_JAVEL20	JAVELINA I WIND 20	ZAPATA	230.0	SOUTH	S	904,222	2,490	885,894	2,405
BORDAS2_JAVEL2_A	JAVELINA II WIND 1	ZAPATA	96.0	SOUTH	S	377,559	1,036	369,263	1,001
BORDAS2_JAVEL2_B	JAVELINA II WIND 2	ZAPATA	74.0	SOUTH	S	289,636	802	283,464	775
BORDAS2_JAVEL2_C	JAVELINA II WIND 3	ZAPATA	30.0	SOUTH	S	124,087	338	121,500	327
BRAZ_WND_WND1	GREEN MOUNTAIN WIND U1	SCURRY	99.0	WEST	W	185,208	540	187,523	493
BRAZ_WND_WND2	GREEN MOUNTAIN WIND U2	SCURRY	61.0	WEST	W	136,172	416	142,854	418
BRISCOE_WIND	BRISCOE WIND	BRISCOE	149.8	PANHANDLE	W	366,160	852	312,269	807
BRTSW_BCW1	BARTON CHAPEL WIND	JACK	120.0	NORTH	N	301,300	898	250,062	658
BUCKTHRN_UNIT1	BUCKTHORN WIND 1 A	ERATH	44.9	NORTH	N	194,715	515	159,776	375
BUCKTHRN_UNIT2	BUCKTHORN WIND 1 B	ERATH	55.7	NORTH	N	263,131	696	216,483	507
BUFF_GAP_UNIT1	BUFFALO GAP WIND 1	TAYLOR	120.6	WEST	W	302,693	779	320,054	734
BUFF_GAP_UNIT2_1	BUFFALO GAP WIND 2_1	TAYLOR	115.5	WEST	W	268,652	774	258,848	728
BUFF_GAP_UNIT2_2	BUFFALO GAP WIND 2_2	TAYLOR	117.0	WEST	W	253,134	704	244,009	662
BUFF_GAP_UNIT3	BUFFALO GAP WIND 3	TAYLOR	170.2	WEST	W	377,400	1,055	394,239	992
BULLCRK_WND1	BULL CREEK WIND U1	BORDEN	88.0	WEST	W	142,563	410	144,788	385
BULLCRK_WND2	BULL CREEK WIND U2	BORDEN	90.0	WEST	W	160,289	461	162,732	434
CABEZON_WIND1	RIO BRAVO I WIND 1 A	STARR	115.2	SOUTH	S	274,284	812	264,934	785
CABEZON_WIND2	RIO BRAVO I WIND 1 B	STARR	122.4	SOUTH	S	314,701	928	308,839	897
CALLAHAN_WND1	CALLAHAN WIND	TAYLOR	114.0	WEST	W	412,270	1,122	431,565	1,076
CAMWIND_UNIT1	CAMERON COUNTY WIND	CAMERON	165.0	COASTAL	S	648,456	1,628	476,488	1,155
CAPRIDG4_CR4	CAPRICORN RIDGE WIND 4	STERLING	121.5	WEST	W	377,013	1,052	395,079	1,001
CAPRIDGE_CR1	CAPRICORN RIDGE WIND 1	STERLING	231.7	WEST	W	739,660	2,033	777,706	1,938
CAPRIDGE_CR2	CAPRICORN RIDGE WIND 2	STERLING	149.5	WEST	W	443,594	1,229	464,943	1,176
CAPRIDGE_CR3	CAPRICORN RIDGE WIND 3	STERLING	200.9	WEST	W	596,084	1,619	626,308	1,547
CEDROHIL_CHW1	CEDRO HILL WIND 1	WEBB	75.0	SOUTH	S	249,403	694	242,763	667
CEDROHIL_CHW2	CEDRO HILL WIND 2	WEBB	75.0	SOUTH	S	226,470	631	220,137	606
CFLATS_U1	CACTUS FLATS WIND	CONCHO	148.4	WEST	W	479,688	1,285	492,072	1,237
CHAMPION_UNIT1	CHAMPION WIND	SCURRY	126.5	WEST	W	328,614	908	338,803	862
CN_BRKS_UNIT_1	CANADIAN BREAKS WIND	OLDHAM	210.1	PANHANDLE	W	1,024,781	2,434	830,327	2,222
COTPLNS_COTTONPL	COTTON PLAINS WIND	FLOYD	50.4	PANHANDLE	W	241,105	531	199,330	485
COTPLNS_OLDSETLR	OLD SETTLER WIND	FLOYD	151.2	PANHANDLE	W	627,994	1,515	511,525	1,384
COTTON_PAP2	PAPALOTE CREEK WIND II	SAN PATRICIO	200.1	COASTAL	S	731,020	2,117	520,370	1,391
CRANELL_UNIT1	CRANEL WIND	REFUGIO	220.0	COASTAL	S	616,333	1,031	230,643	587
CSEC_CSECG1	CAMP SPRINGS WIND 1	SCURRY	130.5	WEST	W	309,096	967	312,121	925
CSEC_CSECG2	CAMP SPRINGS WIND 2	SCURRY	120.0	WEST	W	277,157	824	279,565	790
DERMOTT_UNIT1	DERMOTT WIND 1_1	SCURRY	126.5	WEST	W	470,050	1,282	490,035	1,224
DERMOTT_UNIT2	DERMOTT WIND 1_2	SCURRY	126.5	WEST	W	466,910	1,293	487,611	1,235
DIGBY_UNIT1	ELECTRA WIND 1	WILBARGER	98.9	WEST	W	397,786	1,095	413,801	1,052
DIGBY_UNIT2	ELECTRA WIND 2	WILBARGER	131.1	WEST	W	508,221	1,400	529,090	1,344
ELB_ELBCREEK	ELBOW CREEK WIND	HOWARD	118.7	WEST	W	423,073	1,136	439,161	1,089
ENAS_ENA1	SNYDER WIND	SCURRY	63.0	WEST	W	61,191	166	63,268	160
EXGNSND_WIND_1	SENDERO WIND ENERGY	JIM HOGG	76.0	SOUTH	S	320,603	882	308,920	806
EXGNWTL_WIND_1	WHITETAIL WIND	WEBB	92.3	SOUTH	S	248,090	704	240,042	677

Table 3-1: Summary of Annual Power Production for All Wind Farms Operated for more than 6 months in 2020 (Cont.)

Wind Unit Code	Facility Name	County	Capacity (MW)	ERCOT Wind Zone	CL Zone	Wind Power for 2018 Predicted		Wind Power for 2020 Measured	
						Annual (MWh/yr)	OSP (MWh/day)	Annual (MWh/yr)	OSP (MWh/day)
FERMI_WIND1	ROCK SPRINGS VAL VERDE WIND 1	VAL VERDE	121.9	WEST	S	385,177	1,143	395,417	1,107
FERMI_WIND2	ROCK SPRINGS VAL VERDE WIND 2	VAL VERDE	27.4	WEST	S	103,632	303	106,243	295
FLTCK_SSI	SILVER STAR WIND	ERATH	52.8	NORTH	N	13,807	90	64,802	32
FLUVANNA_UNIT1	FLUVANNA RENEWABLE 1 A	SCURRY	79.8	WEST	W	303,361	842	316,351	806
FLUVANNA_UNIT2	FLUVANNA RENEWABLE 1 B	SCURRY	75.6	WEST	W	289,601	786	302,253	755
FOARDCTY_UNIT1	FOARD CITY WIND 1 A	FOARD	186.5	WEST	W	657,337	1,766	685,047	1,691
FOARDCTY_UNIT2	FOARD CITY WIND 1 B	FOARD	163.8	WEST	W	574,868	1,547	599,227	1,480
FTWIND_UNIT_1	FLAT TOP WIND I	MILLS	200.0	NORTH	N	1,035,245	2,798	880,452	2,148
GOAT_GOATWIND	GOAT WIND	STERLING	80.0	WEST	W	160,643	498	159,593	469
GOAT_GOATWIN2	GOAT WIND 2	STERLING	69.6	WEST	W	146,907	449	145,216	427
GOPHER_UNIT1	GOPHER CREEK WIND 1	BORDEN	82.0	WEST	W	319,739	883	331,505	852
GOPHER_UNIT2	GOPHER CREEK WIND 2	BORDEN	76.0	WEST	W	304,731	846	315,612	818
GPASTURE_WIND_I	GREEN PASTURES WIND I	KNOX	150.0	WEST	W	477,194	1,259	500,873	1,204
GRANDVW1_COLA	DOUG COLBECK'S CORNER A	CARSON	100.2	PANHANDLE	W	530,137	1,272	440,716	1,162
GRANDVW1_COLB	DOUG COLBECK'S CORNERB	CARSON	100.2	PANHANDLE	W	530,888	1,284	440,536	1,174
GRANDVW1_GV1A	GRANDVIEW WIND 1GV1A	CARSON	107.4	PANHANDLE	W	534,452	1,245	446,991	1,146
GRANDVW1_GV1B	GRANDVIEW WIND GV1B	CARSON	103.8	PANHANDLE	W	525,112	1,261	440,335	1,161
GUNMTN_G1	GUNSIGHT MOUNTAIN WIND	HOWARD	119.9	WEST	W	486,077	1,327	507,602	1,280
GWEC_GWEC_G1	GOLDTHWAITE WIND 1	MILLS	148.6	NORTH	N	653,956	1,743	550,318	1,305
HARALD_UNIT1	HARALD (BEARKAT WIND B)	GLASSCOCK	162.1	WEST	W	427,890	920	278,807	794
H_HOLLOW_WND1	HORSE HOLLOW WIND 1	TAYLOR	230.0	WEST	W	717,402	1,872	749,165	1,784
HHOLLOW2_WIND1	HORSE HOLLOW WIND 2	TAYLOR	184.0	WEST	W	585,650	1,587	612,409	1,502
HHOLLOW3_WND_1	HORSE HOLLOW WIND 3	TAYLOR	241.4	WEST	W	698,904	1,854	732,059	1,764
HHOLLOW4_WND1	HORSE HOLLOW WIND 4	TAYLOR	115.0	WEST	W	403,292	1,048	419,991	1,001
HICKMAN_G1	HICKMAN	REAGAN	152.5	WEST	W	658,455	1,839	652,790	1,776
HICKMAN_G2	HICKMAN	REAGAN	147.5	WEST	W	316,030	895	625,551	1,725
HI_LONE_WGR1	HIGH LONESOME WIND POWER	CROCKETT	219.5	WEST	W	145,911	393	293,466	556
HI_LONE_WGR2	HIGH LONESOME WIND PHASE II	CROCKETT	51.0	WEST	W	89,358	302	286,321	687
HI_LONE_WGR3	HIGH LONESOME W	CROCKETT	128.0	WEST	W	398,243	1,246	411,824	1,202
HI_LONE_WGR4	HIGH LONESOME W	CROCKETT	102.0	WEST	W	347,434	1,088	358,687	1,054
HORSECRK_UNIT1	HORSE CREEK WIND 1	HASKELL	131.1	WEST	W	478,007	1,325	498,119	1,265
HORSECRK_UNIT2	HORSE CREEK WIND 2	HASKELL	98.9	WEST	W	362,682	998	377,668	954
HRFDWIND_JRDWIND1	JUMBO ROAD WIND 1	CASTRO	146.2	PANHANDLE	W	618,731	1,396	498,192	1,261
HRFDWIND_JRDWIND2	JUMBO ROAD WIND 2	CASTRO	153.6	PANHANDLE	W	637,777	1,451	514,703	1,311
HRFDWIND_WIND_G	HEREFORD WIND G	DEAF SMITH	99.9	PANHANDLE	W	417,319	956	338,480	864
HRFDWIND_WIND_V	HEREFORD WIND V	DEAF SMITH	100.0	PANHANDLE	W	510,244	1,219	417,308	1,107
HWF_HWFG1	HACKBERRY WIND	SHACKELFORD	163.5	WEST	W	412,346	1,201	418,647	1,144
INDL_INADALE1	INADALE WIND 1	NOLAN	95.0	WEST	W	236,460	687	246,931	652
INDL_INADALE2	INADALE WIND 2	NOLAN	102.0	WEST	W	250,600	727	260,065	683
INDNENR_INDNENR	DESERT SKY WIND 1	PECOS	66.0	WEST	W	195,696	583	202,256	567
INDNENR_INDNENR_2	DESERT SKY WIND 2	PECOS	66.0	WEST	W	211,683	664	222,119	642
INDNENR_UNIT_1B	DESERT SKY WIND 1	PECOS	24.0	WEST	W	65,379	183	69,009	178
INDNENR_UNIT_2B	DESERT SKY WIND 2	PECOS	15.0	WEST	W	43,749	137	45,992	133
INDNNWP_INDNNWP2	INDIAN MESA WIND	PECOS	91.8	WEST	W	230,646	741	240,271	713
KARAKAW1_UNIT1	KARANKAWA WIND 1A	Bee	103.3	COASTAL	S	464,168	1,217	338,482	826
KARAKAW1_UNIT2	KARANKAWA WIND 1B	Bee	103.3	COASTAL	S	459,955	1,218	334,719	829
KARAKAW2_UNIT3	KARANKAWA WIND 2	Bee	100.4	COASTAL	S	441,058	1,175	322,165	800
KEECHI_U1	KEECHI WIND 138 KV JOPLIN	JACK	110.0	NORTH	N	524,623	1,400	431,523	1,022
KEO_KEO_SM1	SHERBINO 1 WIND	PECOS	150.0	WEST	W	65,309	426	123,797	419
KING_NE_KINGNE	KING MOUNTAIN WIND (NE)	UPTON	79.7	WEST	W	156,367	469	161,354	451
KING_NW_KINGNW	KING MOUNTAIN WIND (NW)	UPTON	79.7	WEST	W	177,207	543	183,228	527
KING_SE_KINGSE	KING MOUNTAIN WIND (SE)	UPTON	40.5	WEST	W	74,442	233	76,768	223
KING_SW_KINGSW	KING MOUNTAIN WIND (SW)	UPTON	79.7	WEST	W	175,481	539	180,612	524
LGD_LANGFORD	LANGFORD WIND POWER	TOM GREEN	160.0	WEST	W	402,671	1,041	406,932	999
LGW_UNIT1	LOGANS GAP WIND I U1	COMANCHE	106.3	NORTH	N	429,497	1,140	348,972	811
LGW_UNIT2	LOGANS GAP WIND I U2	COMANCHE	103.8	NORTH	N	402,237	1,067	328,900	778
LHORN_N_UNIT1	LONGHORN WIND NORTH U1	BRISCOE	100.0	PANHANDLE	W	463,566	1,007	349,786	903
LHORN_N_UNIT2	LONGHORN WIND NORTH U2	BRISCOE	100.0	PANHANDLE	W	476,646	1,057	359,212	947

Table 3-1: Summary of Annual Power Production for All Wind Farms Operated for more than 6 months in 2020 (Cont.)

Wind Unit Code	Facility Name	County	Capacity (MW)	ERCOT Wind Zone	CL Zone	Wind Power for 2018 Predicted		Wind Power for 2020 Measured	
						Annual (MWh/yr)	OSP (MWh/day)	Annual (MWh/yr)	OSP (MWh/day)
LNCRK_G83	LONE STAR WIND 1 (MESQUITE)	SHACKELFORD	194.0	WEST	W	460,218	1,182	484,792	1,126
LOCKETT_UNIT1	LOCKETT WIND FARM	WILBARGER	183.7	WEST	W	730,573	1,980	741,984	1,905
LNCRK2_G871	LONE STAR WIND 2 U1	SHACKELFORD	98.0	WEST	W	250,965	663	263,094	631
LNCRK2_G872	LONE STAR WIND 2 U2	SHACKELFORD	100.0	WEST	W	254,211	664	265,914	633
LONEWOLF_G1	LORAINE WINDPARK I	MITCHELL	49.5	WEST	W	121,647	357	125,446	342
LONEWOLF_G2	LORAINE WINDPARK II	MITCHELL	51.0	WEST	W	120,657	353	124,647	336
LONEWOLF_G3	LORAINE WINDPARK III	MITCHELL	25.5	WEST	W	67,799	198	70,065	189
LONEWOLF_G4	LORAINE WINDPARK IV	MITCHELL	24.0	WEST	W	59,793	172	61,848	164
LV1_LV1A	LOS VIENTOS WIND I	WILLACY	200.1	COASTAL	S	784,692	2,063	569,739	1,429
LV2_LV2	LOS VIENTOS WIND II	WILLACY	201.6	COASTAL	S	696,532	1,721	496,939	1,193
LV3_UNIT_1	LOS VIENTOS III WIND	STARR	200.0	SOUTH	S	625,473	1,861	601,745	1,752
LV4_UNIT_1	LOS VIENTOS IV WIND	STARR	200.0	SOUTH	S	649,813	1,964	631,815	1,890
LV5_UNIT_1	LOS VIENTOS V WIND	STARR	110.0	SOUTH	S	365,801	1,020	355,608	980
MARIAH_NORTE1	MARIAH DEL NORTE 1	PARMER	115.2	PANHANDLE	W	436,279	1,089	362,807	1,001
MARIAH_NORTE2	MARIAH DEL NORTE 2	PARMER	115.2	PANHANDLE	W	433,749	1,093	361,552	1,005
MCDLD_FCW1	FOREST CREEK WIND	STERLING	124.2	WEST	W	302,483	899	313,079	855
MCDLD_SBW1	SAND BLUFF WIND	STERLING	90.0	WEST	W	140,955	425	143,523	406
MESQCRK_WND1	MESQUITE CREEK WIND 1	BORDEN	105.6	WEST	W	357,295	921	372,262	880
MESQCRK_WND2	MESQUITE CREEK WIND 2	BORDEN	105.6	WEST	W	347,038	905	361,775	864
MESTENO_UNIT_1	MESTENO WIND	STARR	201.6	SOUTH	S	480,016	1,566	462,851	1,509
MIAM1_G1	MIAMI WIND G1	GRAY	144.3	PANHANDLE	W	691,953	1,612	568,776	1,478
MIAM1_G2	MIAMI WIND G2	GRAY	144.3	PANHANDLE	W	672,372	1,618	544,044	1,480
MIDWIND_UNIT1	MIDWAY WIND	SAN PATRICIO	162.8	COASTAL	S	687,451	2,029	476,355	1,336
MIRASOLE_MIR11	HIDALGO & STARR WIND 11	HIDALGO	52.0	SOUTH	S	146,498	471	142,430	452
MIRASOLE_MIR12	HIDALGO & STARR WIND 12	HIDALGO	98.0	SOUTH	S	285,452	905	277,752	869
MIRASOLE_MIR13	Hidalgo II Wind	HIDALGO	50.0	SOUTH	S	121,746	407	108,479	391
MIRASOLE_MIR21	HIDALGO & STARR WIND 21	HIDALGO	100.0	SOUTH	S	278,663	874	271,083	839
MOZART_WIND_1	WKN MOZART WIND	KENT	30.0	WEST	W	70,291	188	65,221	181
MWEC_G1	MCADOO WIND	DICKENS	150.0	PANHANDLE	W	499,947	1,369	446,678	1,249
NBOHR_UNIT1	NIELS BOHR (BEARKAT WIND A)	GLASSCOCK	196.6	WEST	W	669,141	1,926	693,491	1,853
NWF_NWF1	NOTREES WIND 1	ECTOR	92.6	WEST	W	231,220	676	231,924	663
NWF_NWF2	NOTREES WIND 2	ECTOR	60.0	WEST	W	164,138	471	164,149	462
OVEJA_G1	OVEJA WIND (SANTA RITA EAST)	IRION	150.0	WEST	W	637,381	1,793	632,248	1,730
OVEJA_G2	OVEJA WIND (SANTA RITA EAST)	IRION	150.0	WEST	W	636,850	1,794	630,480	1,731
OWF_OWF	OCOTILLO WIND	HOWARD	58.8	WEST	W	54,679	123	49,824	111
PALMWIND_UNIT1	PALMAS ALTAS WIND	CAMERON	144.9	COASTAL	S	358,006	1,018	287,994	790
PAP1_PAP1	Papalote Creek Wind Farm	SAN PATRICIO	179.9	COASTAL	S	0	0	502,840	1,296
PC_NORTH_PANTHER1	PANTHER CREEK WIND 1	HOWARD	142.5	WEST	W	538,768	1,435	557,503	1,332
PC_SOUTH_PANTHER2	PANTHER CREEK WIND 2	HOWARD	115.5	WEST	W	420,491	1,123	436,686	1,040
PC_SOUTH_PANTHER3	PANTHER CREEK WIND 3	HOWARD	199.5	WEST	W	539,258	1,512	560,426	1,438
PENA_UNIT1	PENASCAL WIND 1	KENEDY	160.8	COASTAL	S	415,583	1,216	298,276	857
PENA_UNIT2	Penascal Wind Farm 2	KENEDY	141.6	COASTAL	S	0	0	262,480	746
PENA3_UNIT3	PENASCAL WIND 3	KENEDY	100.8	COASTAL	S	268,439	817	182,272	522
PEY_UNIT1	PEYTON CREEK WIND	MATAGORDA	151.2	COASTAL	S	462,327	1,359	336,774	918
PH1_UNIT1	PANHANDLE WIND 1 U1	CARSON	109.2	PANHANDLE	W	374,373	993	314,207	923
PH1_UNIT2	PANHANDLE WIND 1 U2	CARSON	109.2	PANHANDLE	W	373,973	951	309,919	886
PH2_UNIT1	PANHANDLE WIND 2 U1	CARSON	94.2	PANHANDLE	W	391,806	1,023	327,642	962
PH2_UNIT2	PANHANDLE WIND 2 U2	CARSON	96.6	PANHANDLE	W	403,722	1,065	336,336	998
PYR_PYRON1	PYRON WIND 1	SCURRY	121.5	WEST	W	333,539	944	343,470	890
PYR_PYRON2	PYRON WIND 2	SCURRY	127.5	WEST	W	346,323	964	359,290	909
RANCHERO_UNIT1	RANCHERO WIND	CROCKETT	150.0	WEST	W	620,856	1,832	643,287	1,770
RANCHERO_UNIT2	RANCHERO WIND	CROCKETT	150.0	WEST	W	620,784	1,786	641,751	1,729
RDCANYON_RDCNY1	RED CANYON WIND	BORDEN	89.6	WEST	W	318,024	888	333,054	853
REDFISH_MV1A	MAGIC VALLEY WIND (REDFISH) 1A	WILLACY	99.8	COASTAL	S	364,351	989	264,285	640
REDFISH_MV1B	MAGIC VALLEY WIND (REDFISH) 1B	WILLACY	103.5	COASTAL	S	383,071	1,019	275,136	652
ROUTE_66_WIND1	ROUTE 66 WIND	ARMSTRONG	150.0	PANHANDLE	W	571,895	1,519	504,863	1,463
RSNAKE_G1	RATTLESNAKE I WIND G1	GLASSCOCK	104.3	WEST	W	341,039	1,006	347,593	971
RSNAKE_G2	RATTLESNAKE I WIND G2	GLASSCOCK	103.0	WEST	W	335,456	1,011	341,703	978

Table 3-1: Summary of Annual Power Production for All Wind Farms Operated for more than 6 months in 2020 (Cont.)

Wind Unit Code	Facility Name	County	Capacity (MW)	ERCOT Wind Zone	CL Zone	Wind Power for 2018 Predicted		Wind Power for 2020 Measured	
						Annual (MWh/yr)	OSP (MWh/day)	Annual (MWh/yr)	OSP (MWh/day)
RTS_U1	RTS WIND	MCCULLOCH	160.0	SOUTH	S	602,107	1,468	587,344	1,419
RTS2	HEART OF TEXAS WIND	MCCULLOCH	180.0	SOUTH	S	714,906	1,468	399,546	1,420
SAGEDRAW_UNIT1	SAGE DRAW WIND	LYNN	169.0	WEST	W	537,020	1,709	544,022	1,646
SAGEDRAW_UNIT2	SAGE DRAW WIND	LYNN	169.0	WEST	W	549,465	1,628	566,202	1,565
SALTFORK_UNIT1	SALT FORK 1 WIND U1	DONLEY	64.0	PANHANDLE	W	319,505	741	267,240	676
SALTFORK_UNIT2	SALT FORK 1 WIND U2	DONLEY	110.0	PANHANDLE	W	559,069	1,304	461,599	1,186
SALVTION_UNIT1	WILLOW SPRINGS WIND A	HASKELL	125.0	WEST	W	458,979	1,258	478,399	1,201
SALVTION_UNIT2	WILLOW SPRINGS WIND B	HASKELL	125.0	WEST	W	455,082	1,244	475,088	1,186
SANROMAN_WIND_1	SAN ROMAN WIND	CAMERON	95.2	COASTAL	S	375,664	1,007	268,680	688
SANTACRU_UNIT1	CHAPMAN RANCH WIND IA	NUECES	150.6	COASTAL	S	567,895	1,505	402,818	996
SANTACRU_UNIT2	CHAPMAN RANCH WIND IB	NUECES	98.4	COASTAL	S	391,536	1,006	281,907	681
SENATEWD_UNIT1	SENATE WIND	JACK	150.0	NORTH	N	610,071	1,603	501,690	1,161
SGMTN_SIGNALM	TEXAS BIG SPRING WIND A	HOWARD	27.7	WEST	W	55,618	139	58,909	131
SGMTN_SIGNALM2	TEXAS BIG SPRING WIND B	HOWARD	6.6	WEST	W	13,350	33	14,526	31
SHAFFER_UNIT1	SHAFFER (PATRIOT WIND)	NUECES	226.0	COASTAL	S	747,893	1,960	533,568	1,283
SHANNONW_UNIT_1	SHANNON WIND	CLAY	204.1	WEST	W	656,795	1,657	687,536	1,580
SPLAIN1_WIND1	SOUTH PLAINS WIND 1 U1	FLOYD	102.0	PANHANDLE	W	491,347	1,096	401,259	990
SPLAIN1_WIND2	SOUTH PLAINS WIND 1 U2	FLOYD	98.0	PANHANDLE	W	486,519	1,098	399,430	996
SPLAIN2_WIND21	SOUTH PLAINS WIND 2 U1	FLOYD	148.5	PANHANDLE	W	658,812	1,448	525,987	1,302
SPLAIN2_WIND22	SOUTH PLAINS WIND 2 U2	FLOYD	151.8	PANHANDLE	W	666,774	1,448	535,370	1,300
SRWE1_SRWE2	STEPHENS RANCH WIND 2	BORDEN	164.7	WEST	W	556,573	1,431	583,104	1,368
SRWE1_UNIT1	STEPHENS RANCH WIND 1	BORDEN	211.2	WEST	W	747,176	1,940	780,272	1,865
SSPURTWO_SS3WIND1	SPINNING SPUR WIND TWO C	OLDHAM	96.0	PANHANDLE	W	481,279	1,155	393,367	1,059
SSPURTWO_SS3WIND2	SPINNING SPUR WIND TWO B	OLDHAM	98.0	PANHANDLE	W	505,654	1,213	413,357	1,104
SSPURTWO_WIND_1	SPINNING SPUR WIND TWO A	OLDHAM	161.0	PANHANDLE	W	721,533	1,735	583,653	1,585
STELLA_UNIT1	STELLA WIND	KENEDY	201.0	COASTAL	S	860,652	2,364	617,944	1,651
STWF_T1	SOUTH TRENT WIND	TAYLOR	98.2	WEST	W	257,369	751	266,269	710
S_HILLS_UNIT1	SEYMOUR HILLS WIND	BAYLOR	30.2	WEST	W	143,458	386	148,366	374
SWEC_G1	STANTON WIND ENERGY	MARTIN	120.0	WEST	W	271,818	802	274,479	772
SWEETWN2_WND2	SWEETWATER WIND 2B	NOLAN	110.8	WEST	W	379,367	1,050	396,783	1,004
SWEETWN2_WND24	SWEETWATER WIND 2A	NOLAN	16.8	WEST	W	46,347	125	48,898	117
SWEETWN3_WND3A	SWEETWATER WIND 3A	NOLAN	33.6	WEST	W	94,268	288	97,538	276
SWEETWN3_WND3B	SWEETWATER WIND 3B	NOLAN	118.6	WEST	W	326,724	954	341,696	916
SWEETWN4_WND4A	SWEETWATER WIND 4-4A	NOLAN	125.0	WEST	W	319,825	832	336,816	783
SWEETWN4_WND4B	SWEETWATER WIND 4-4B	NOLAN	112.0	WEST	W	295,292	771	310,653	728
SWEETWN4_WND5	SWEETWATER WIND 4-5	NOLAN	85.0	WEST	W	191,788	552	194,895	514
SWEETWND_WND1	SWEETWATER WIND 1	NOLAN	42.5	WEST	W	139,181	388	145,410	370
TAHOKA_UNIT_1	TAHOKA WIND 1	LYNN	150.0	WEST	W	597,574	1,557	621,361	1,500
TAHOKA_UNIT_2	TAHOKA WIND 2	LYNN	150.0	WEST	W	609,625	1,601	632,592	1,543
TKWSW1_ROSCOE	ROSCOE WIND	SCURRY	114.0	WEST	W	274,301	798	283,486	750
TKWSW1_ROSCOE2A	ROSCOE WIND 2A	SCURRY	95.0	WEST	W	220,166	620	227,104	583
TORR_UNIT1_25	TORRECILLAS WIND 1	WEBB	150.0	SOUTH	S	578,923	1,610	565,814	1,553
TORR_UNIT2_23	TORRECILLAS WIND 2	WEBB	23.0	SOUTH	S	82,857	233	81,022	225
TORR_UNIT2_25	TORRECILLAS WIND 3	WEBB	127.5	SOUTH	S	505,640	1,417	494,334	1,368
TRENT_TRENT	TRENT WIND	NOLAN	150.0	WEST	W	532,936	1,447	555,774	1,378
TRINITY_TH1_BUS2	TRINITY HILLS WIND 2	YOUNG	94.6	WEST	W	148,346	176	147,002	80
TTWEC_G1	TURKEY TRACK WIND	NOLAN	169.5	WEST	W	382,203	1,115	386,557	1,074
TYLRWIND_UNIT1	TYLER BLUFF WIND	COOKE	125.6	NORTH	N	488,899	1,319	395,220	912
VERTIGO_WIND_I	GREEN PASTURES WIND 2	KNOX	150.0	WEST	W	458,770	1,210	480,657	1,154
WAKEWE_G1	WAKE WIND	DICKENS	114.9	PANHANDLE	W	315,933	715	518,139	1,272
WAKEWE_G2	WAKE WIND	DICKENS	142.3	PANHANDLE	W	387,052	877	633,515	1,557
WEC_WECG1	WHIRLWIND ENERGY	FLOYD	57.0	PANHANDLE	W	202,369	511	179,868	488
WHTTAIL_WR1	WOLF RIDGE WIND	COOKE	112.5	NORTH	N	343,875	1,056	272,176	725
WH_WIND_UNIT1	WHITEHORSE WIND	FISHER	209.0	WEST	W	429,498	1,360	398,477	1,217
WH_WIND_UNIT2	WHITEHORSE WIND	FISHER	210.0	WEST	W	434,536	1,543	433,639	1,494
WL_RANCH_UNIT1	WILSON RANCH	SCHLEICHER	199.5	WEST	W	790,163	2,129	817,229	2,044
WNDTHST2_UNIT1	WINDTHORST 2 WIND	ARCHER	67.6	WEST	W	220,209	565	230,377	541
WOODWRD1_WOODWRD1	PECOS WIND 1 (WOODWARD)	PECOS	90.0	WEST	W	173,811	545	177,842	505
WOODWRD1_WOODWRD2	PECOS WIND 2 (WOODWARD)	PECOS	86.0	WEST	W	153,669	462	158,198	446

Table 3-2: Summary of 2018 and 2020 Monthly Average Wind Speed for Five ERCOT Weather Zones

Month		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average	OSP Average
Wind Speed COASTAL (mph)	2018	11.8	12.3	11.8	12.5	12.5	13.0	10.8	11.8	9.0	11.7	10.9	11.7	11.7	11.4
	2020	10.0	10.0	11.6	9.5	9.0	8.3	10.2	8.1	9.7	9.3	9.8	10.8	9.7	9.1
Wind Speed NORTH (mph)	2018	13.2	12.0	11.3	14.0	16.5	17.6	12.6	11.0	8.5	11.1	12.9	12.9	12.8	13.2
	2020	13.2	12.9	12.6	13.3	13.4	11.9	10.7	10.9	9.7	9.6	9.2	8.8	11.4	11.3
Wind Speed PANHANDLE (mph)	2018	17.4	17.4	18.2	19.7	18.3	19.1	13.7	15.3	14.8	14.5	16.1	15.4	16.7	10.2
	2020	14.2	13.8	15.3	16.6	15.8	18.8	14.6	14.8	12.8	12.3	13.1	12.2	14.5	10.4
Wind Speed SOUTH (mph)	2018	11.6	11.9	13.6	13.8	14.8	13.5	11.8	13.7	10.4	12.4	10.9	11.6	12.5	10.2
	2020	12.6	11.6	14.1	14.5	14.0	12.6	13.9	11.6	10.6	10.6	9.9	12.0	12.3	10.1
Wind Speed WEST (mph)	2008	11.6	11.9	13.6	13.8	14.8	13.5	11.8	13.7	10.4	12.4	10.9	11.6	12.5	12.8
	2020	13.0	12.9	12.1	12.6	12.9	13.8	12.9	12.6	10.6	13.4	13.6	13.4	12.8	12.6

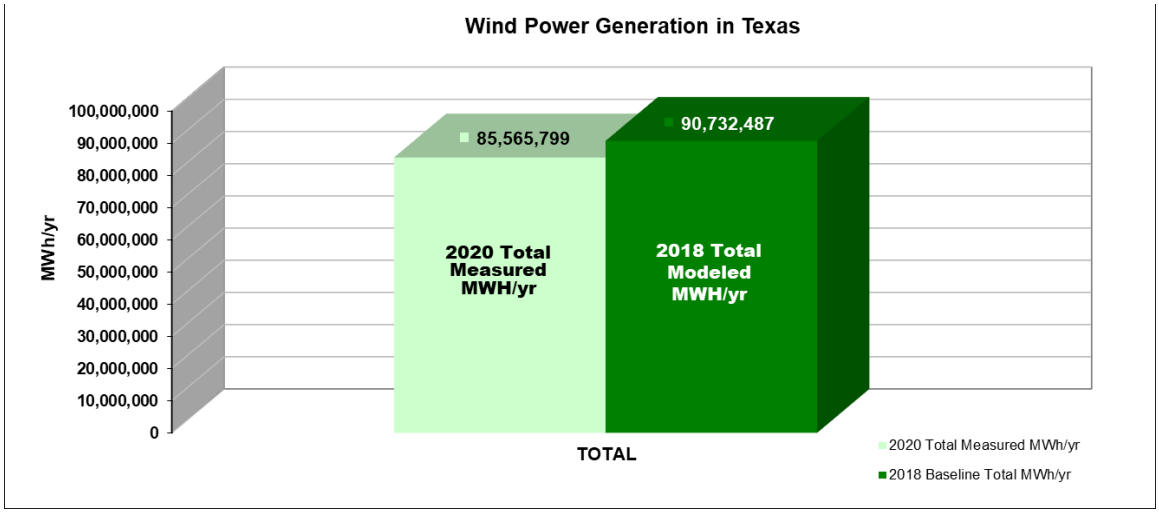


Figure 3-6: Comparison of Total 2020 Measured and 2018 Modeled Power Production

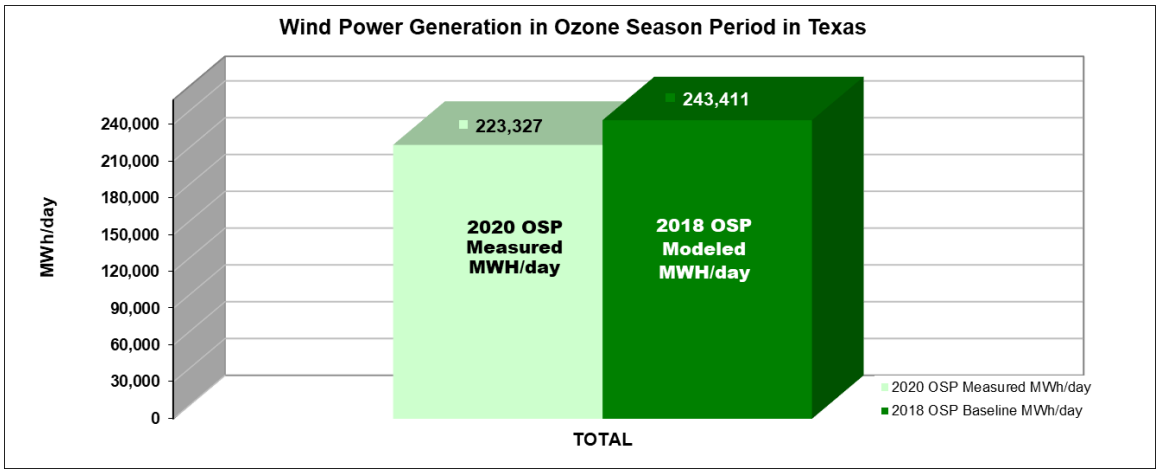


Figure 3-7: Comparison of Total 2020 OSP Measured and 2018 OSP Modeled Power Production

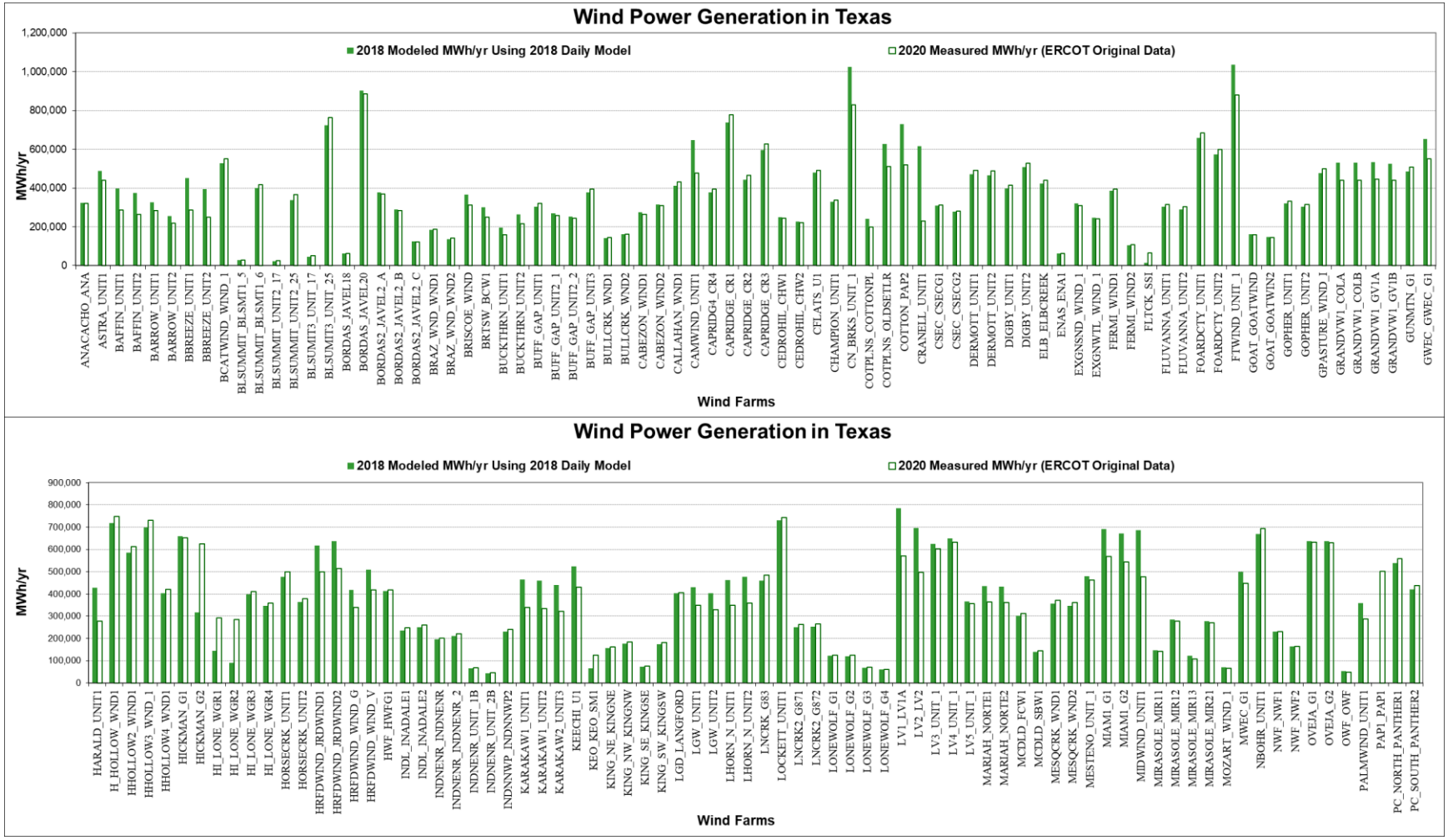


Figure 3-8: Comparison of 2020 Measured and 2018 Modeled Wind Power Production for Each Wind Farm

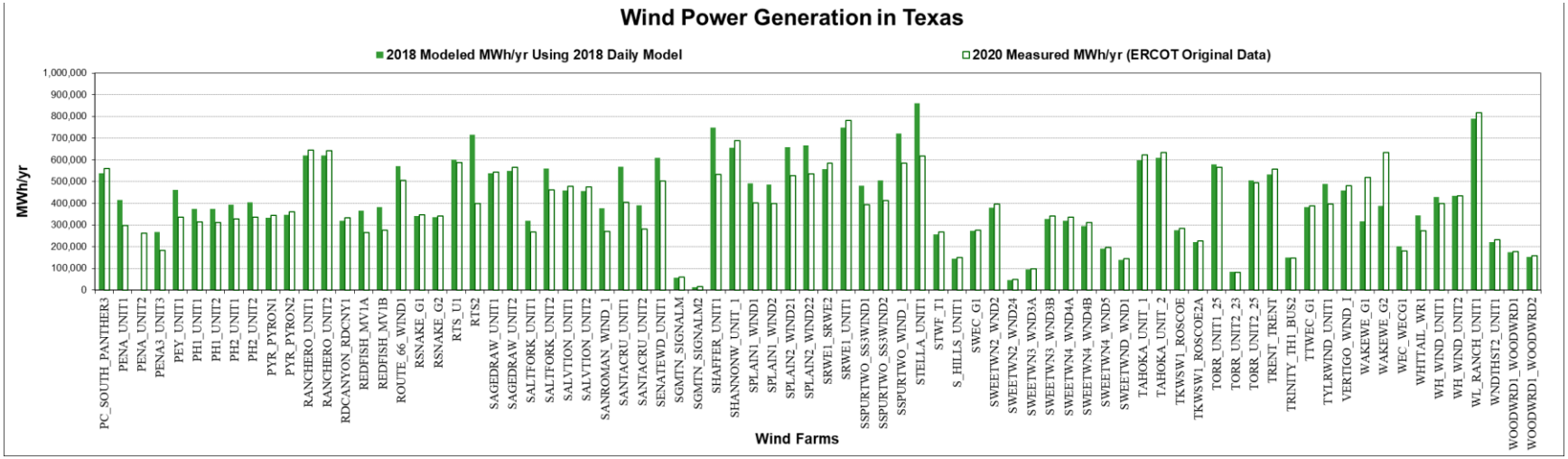


Figure 3-8: Comparison of 2020 Measured and 2018 Modeled Wind Power Production for Each Wind Farm (Cont.)

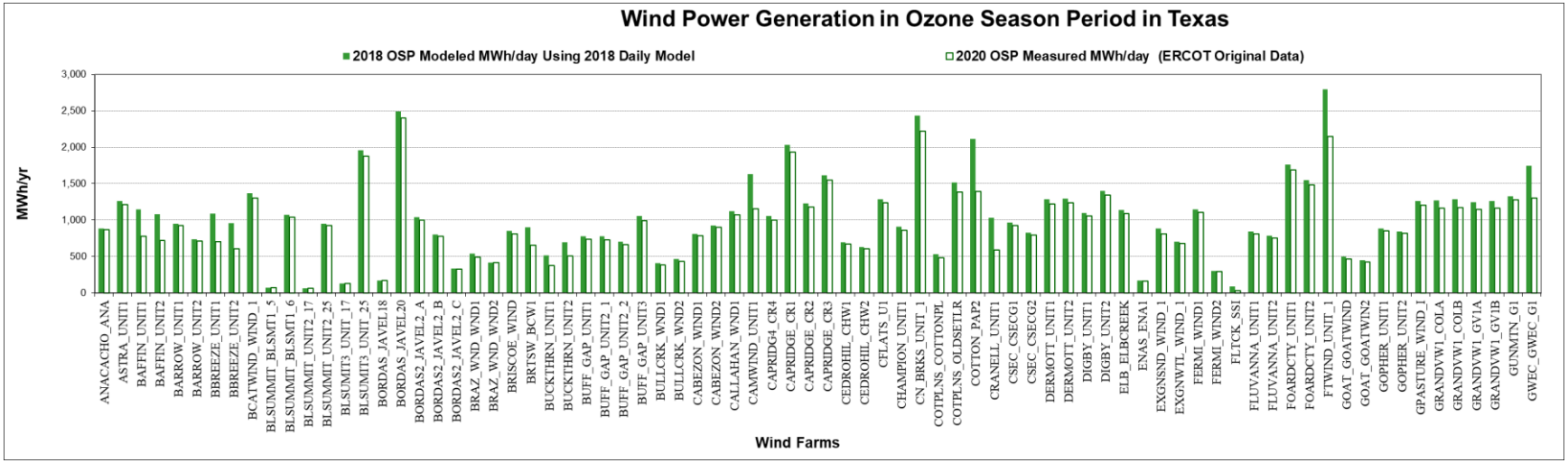


Figure 3-9: Comparison of 2020 OSP Measured and 2018 OSP Modeled Wind Power Production for Each Wind Farm

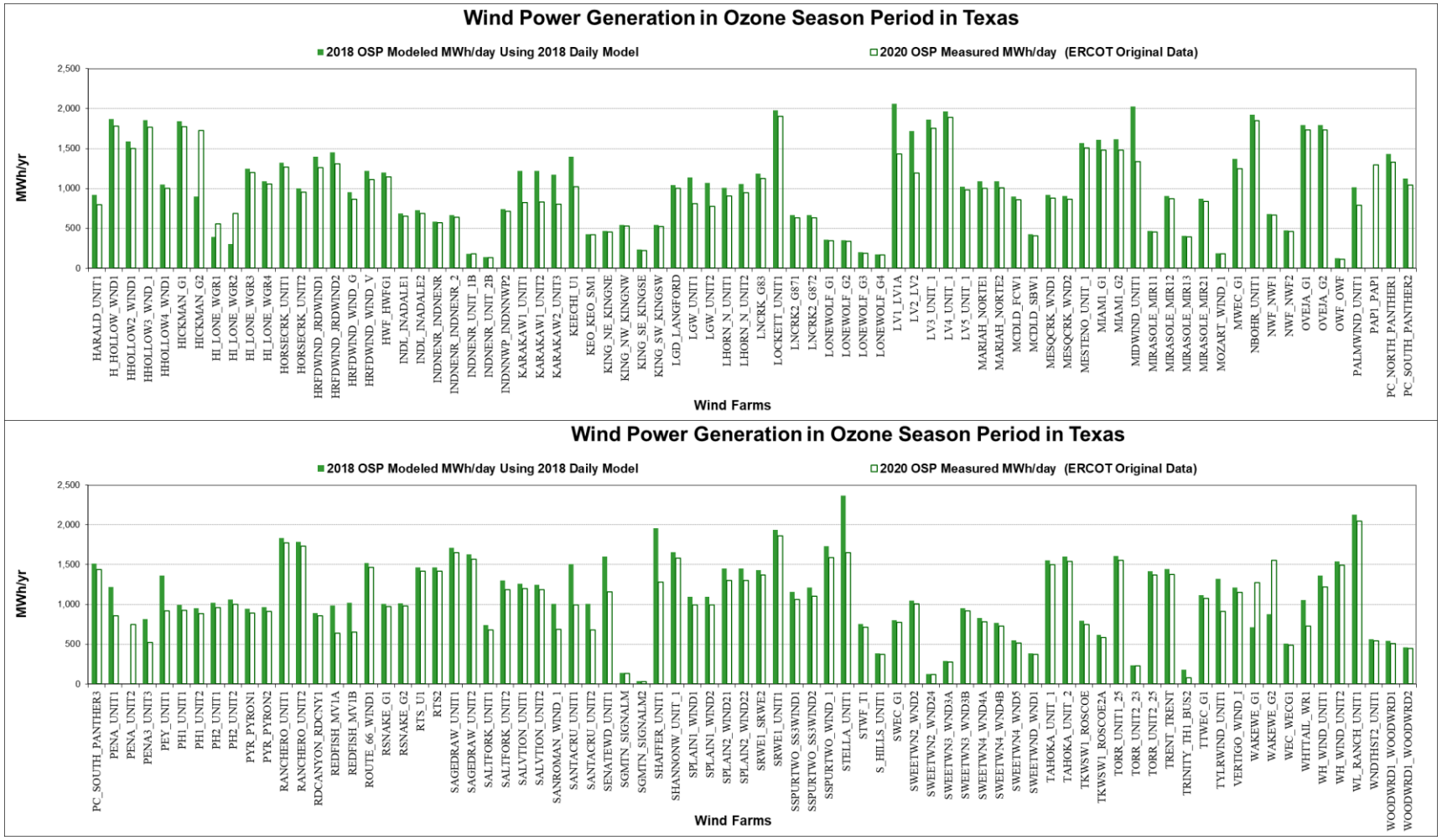


Figure 3-9: Comparison of 2020 OSP Measured and 2018 OSP Modeled Wind Power Production for Each Wind Farm (Cont.)

3.3 Comparison of Measured Wind Power in Previous Reports and Present Report

Unlike the previous annual reports, the 2020 reports have used a 2018 base year instead of the 2008 base year. The daily model is used for predicting the annual and OSP wind power productions. Due to the different base year analysis, this section only compares the ERCOT measured annual and OSP wind power productions. Compared to what was reported in the previous year's annual report, an increase of 16.25% on measured annual wind production was observed, from 74,903,938 MWh/yr in 2019 to 87,079,414 MWh/yr in 2020[12].

The average daily wind power production during the OSP showed an increase of 13.14%, from 198,978 MWh/day to 225,118 MWh/day.

Twenty-seven new wind farm units with over 6,043 MW capacity have been operating since the beginning of 2020. Figure 3-10 shows the measured annual wind power comparison of 2008 through 2020 for all the wind farms. Figure 3-11 shows the wind power comparison of 2008 through 2020 during the ozone season. The annual wind power difference percentages are compared for 2008 through 2020, shown in Figure 3-12. It has been observed that most of the analyzed wind farms show differences in percentage between 2018 and 2020. According to 2020 ERCOT data, Canadian Breaks Wind, Lockett Wind, Oveja Wind, Chapman Ranch Wind 1, and Seymour Hills Wind had over 50% power generation increase compared to last year. This is due to the differences in wind speed values resulted in different power generation values. In addition, Figure 3-13 shows the difference comparison of 2008 through 2020 measured data during the ozone season.

[12] This value reflects the total power generation for all windfarms operated in 2020.

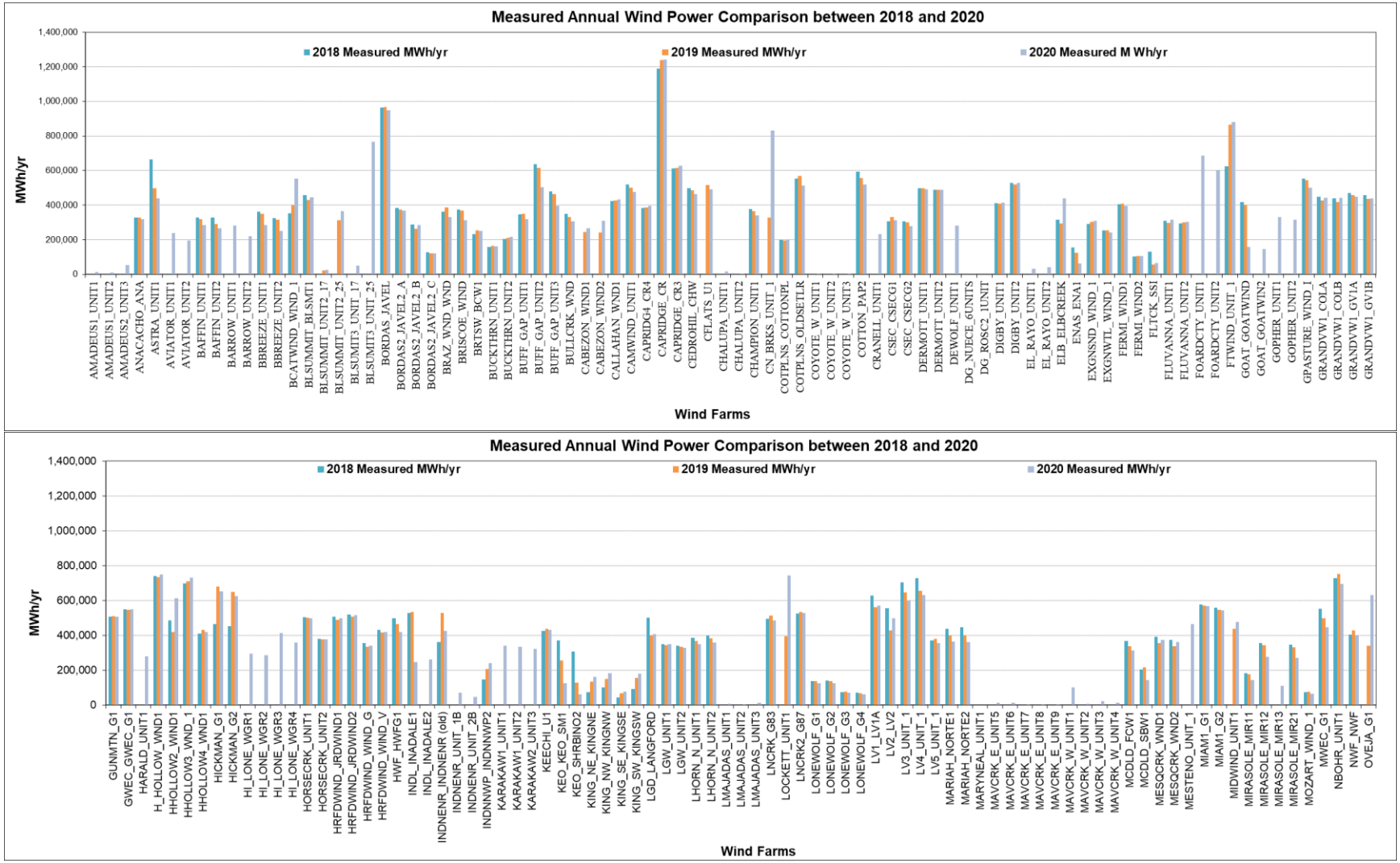


Figure 3-10: Measured Annual Wind Power Comparison between 2018 and 2020

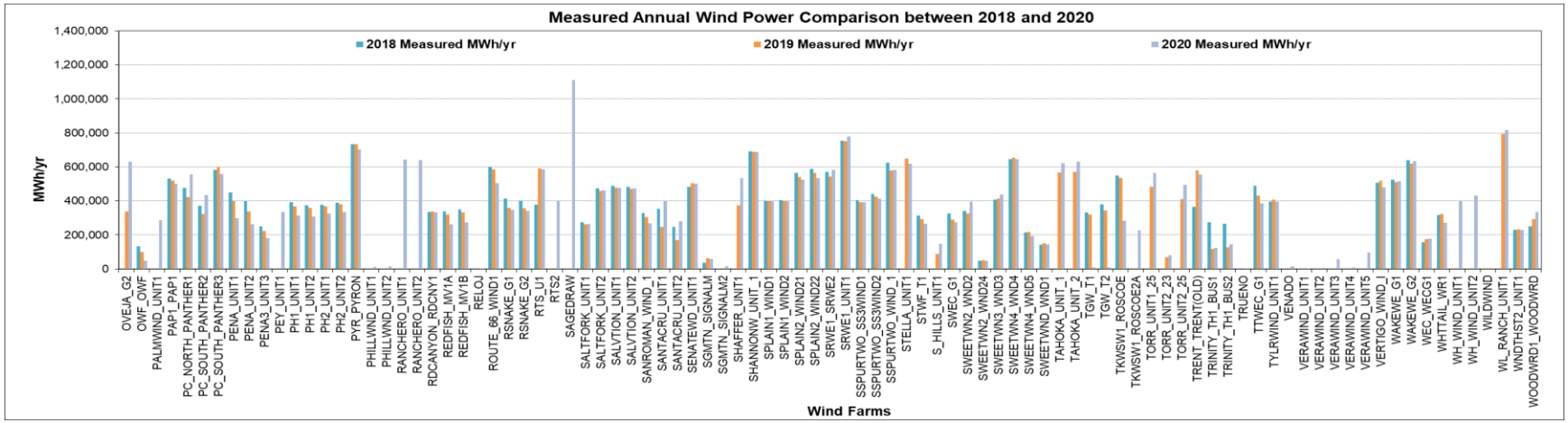


Figure 3-10: Measured Annual Wind Power Comparison between 2018 and 2020(Cont.)

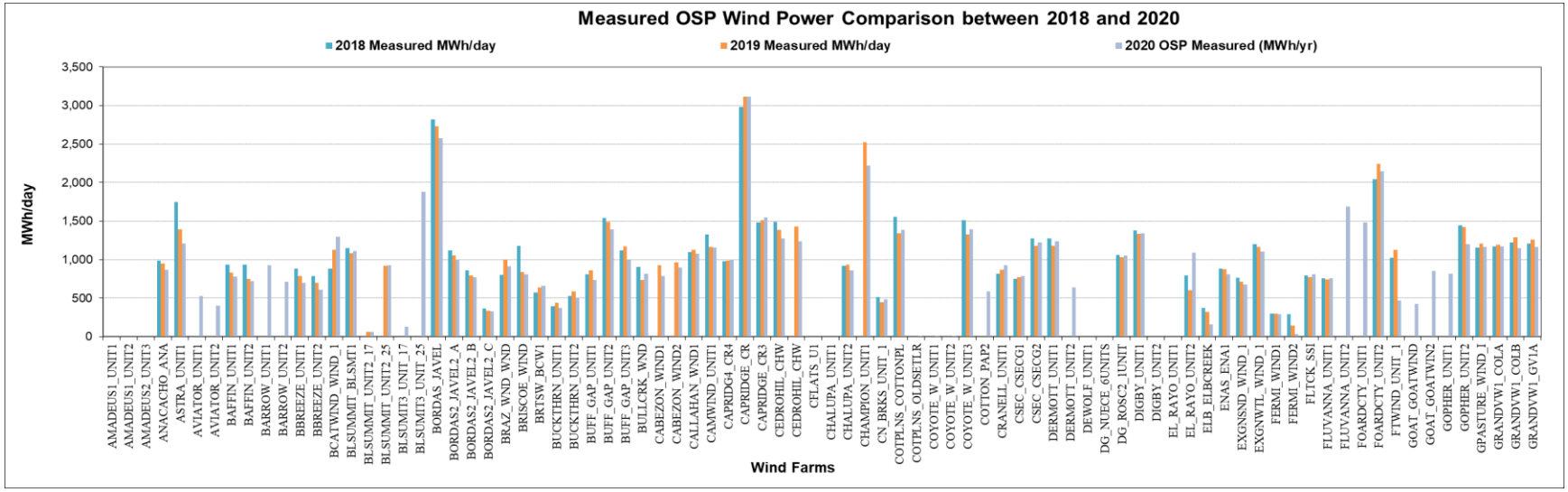


Figure 3-11:Measured OSP Wind Power Comparison between 2018 and 2020

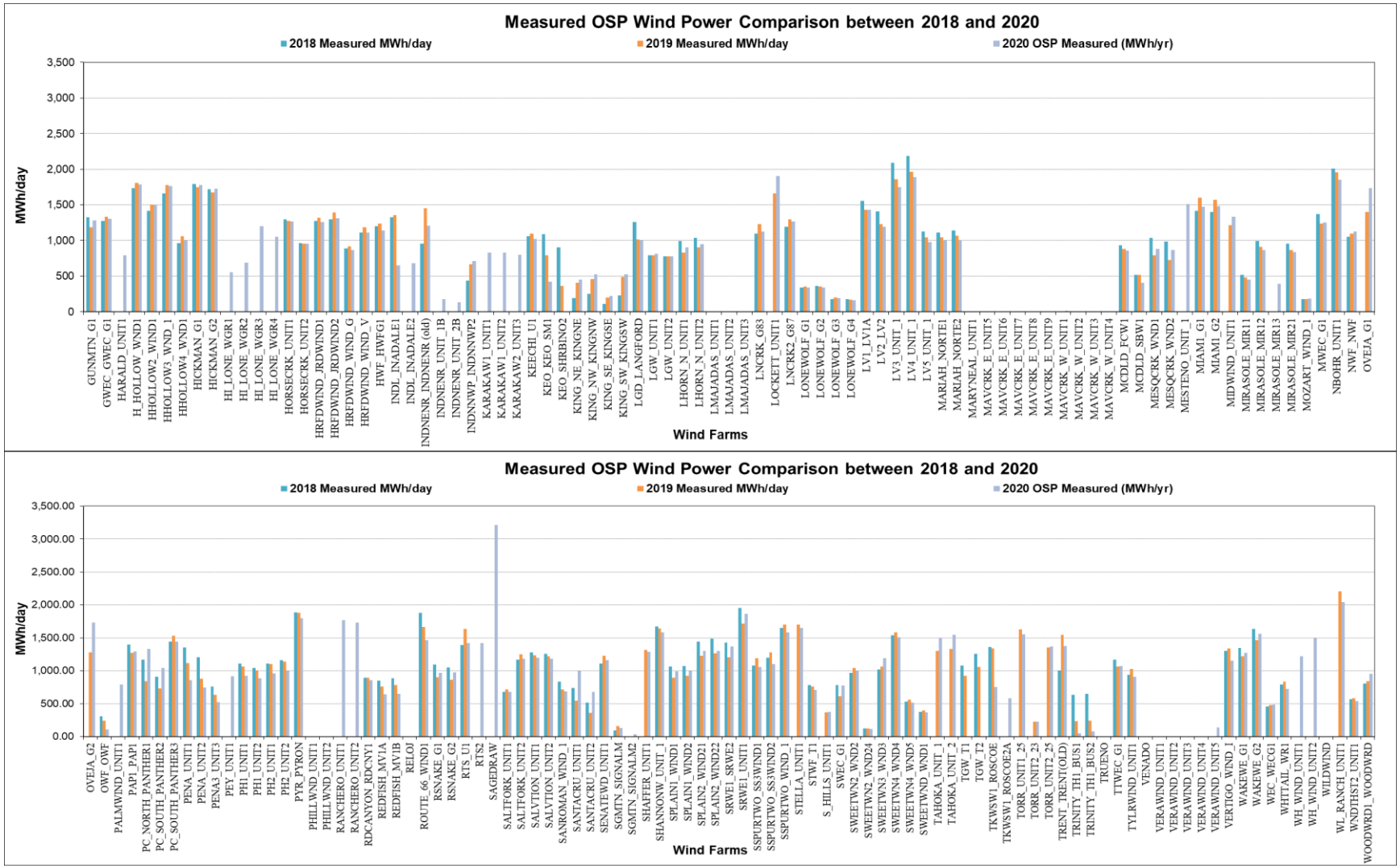


Figure 3-11:Measured OSP Wind Power Comparison between 2018 and 2020 (Cont.)

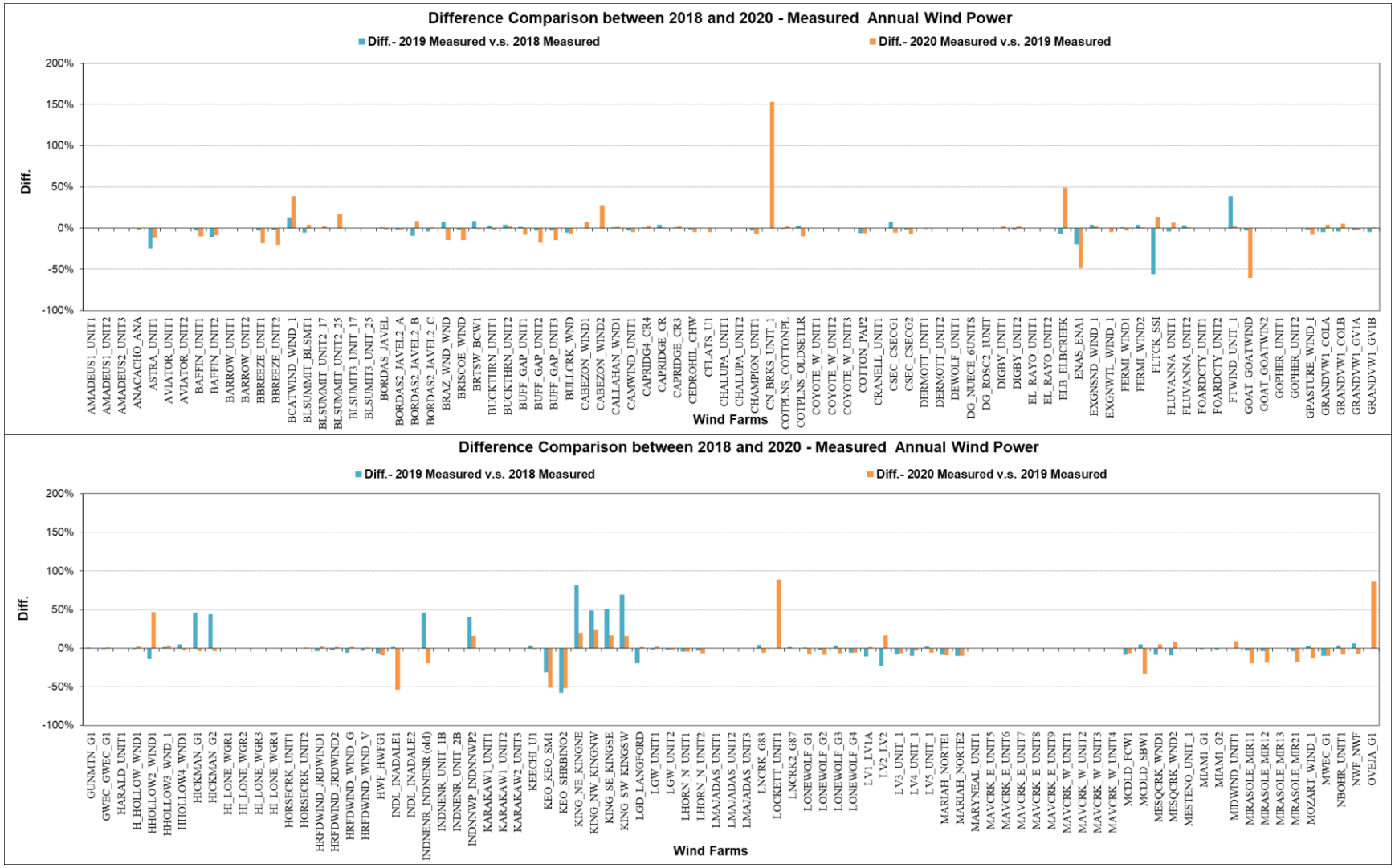


Figure 3-12: Difference Comparison between 2018 and 2020 - Measured Annual Wind Power

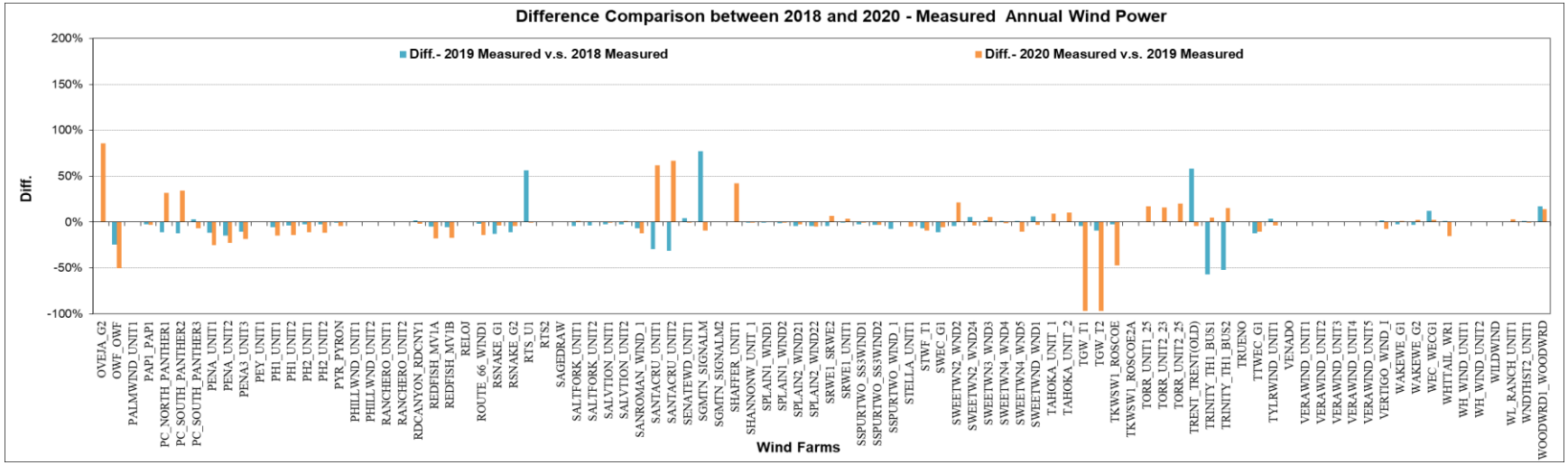


Figure 3-12: Difference Comparison between 2018 and 2020 - Measured Annual Wind Power (Cont.)

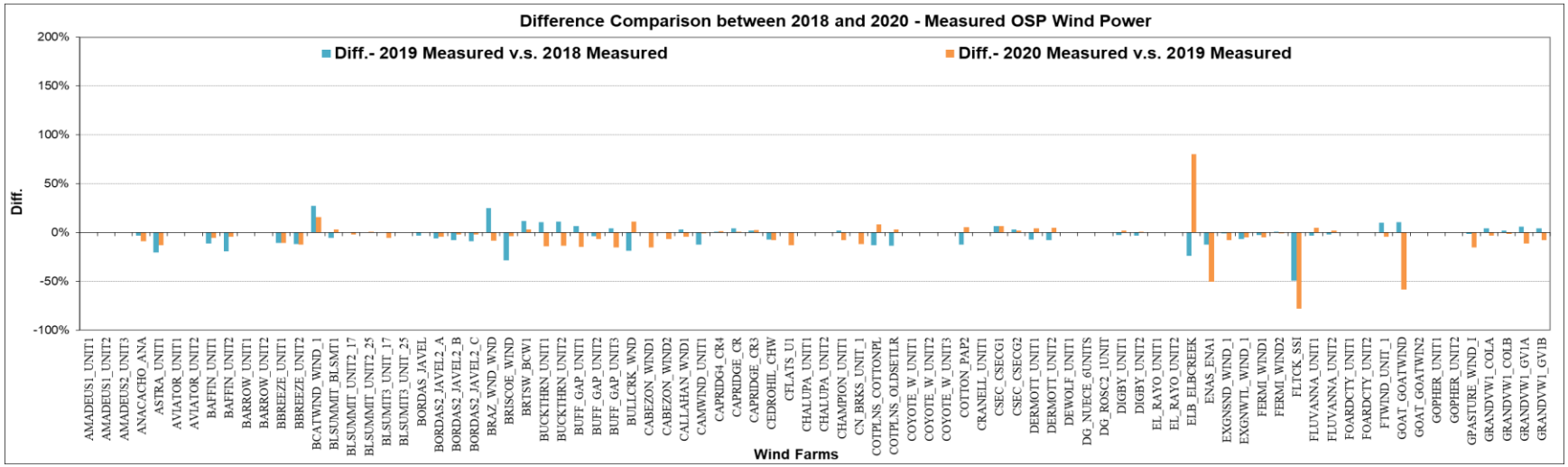


Figure 3-13:Difference Comparison between 2018 and 2020 - Measured OSP Wind Power

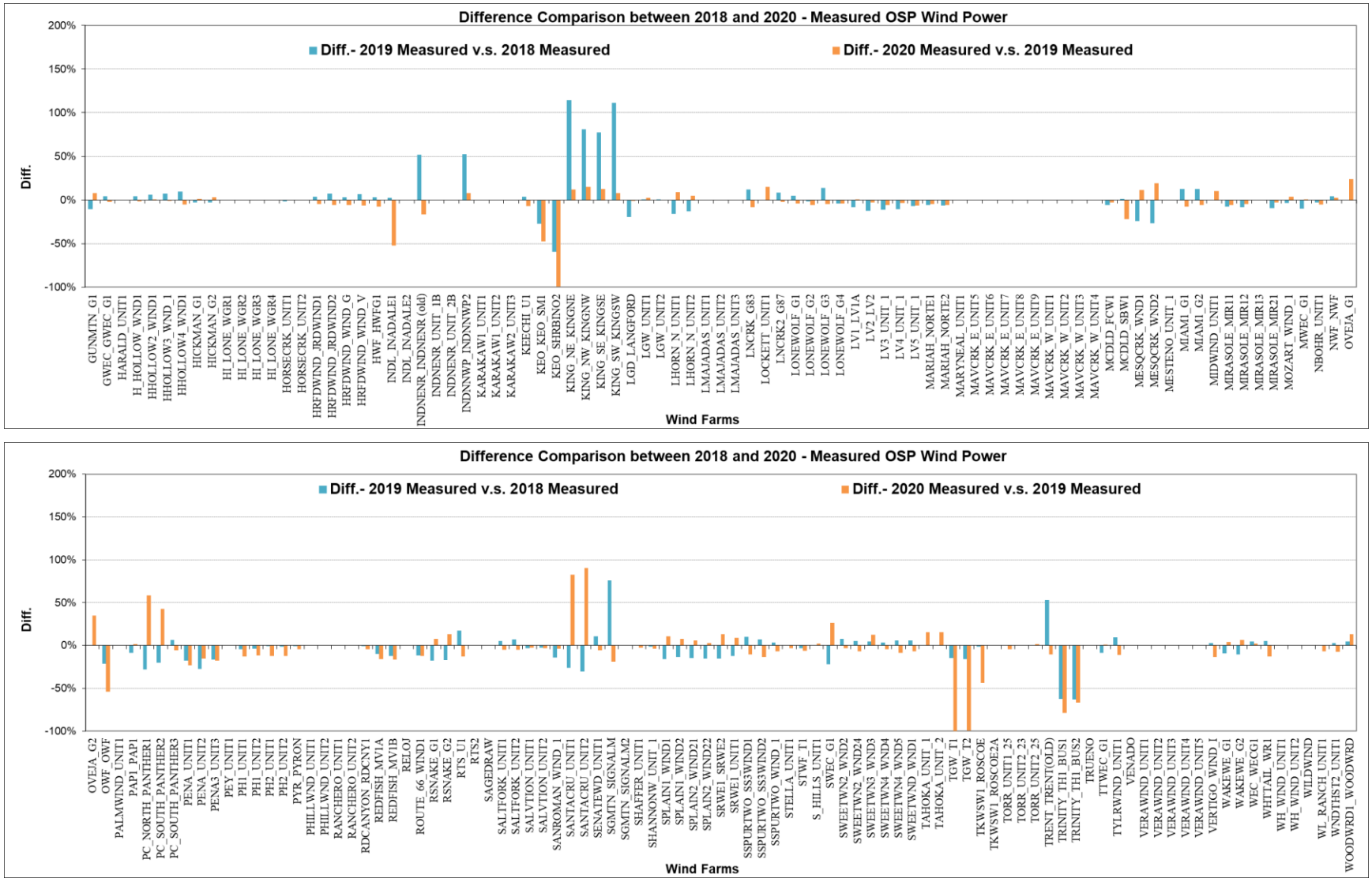


Figure 3-13:Difference Comparison between 2018 and 2020 - Measured OSP Wind Power (Cont.)

3.4 Uncertainty Analysis on the 2020 Daily Regression Models

One of the advantages of using regression models is that it allows for an uncertainty analysis to be calculated, which can be used to assess the accuracy of the model. This section of the report presents an updated uncertainty analysis for the daily regressions that were applied to the 2020 data.

Assuming that the daily energy production of wind farm data can be related linearly with the daily average wind speed (see Figure 3-14) and expressed as

$$\hat{E}_i = c_o + c_1 V_i \qquad \text{Equation 1}$$

where V is the daily average wind speed, $\hat{E}$ is the daily total energy production, and c_o and c_1 are the resultant coefficients of linear regression. The subscript i represents any day over the modeling period.

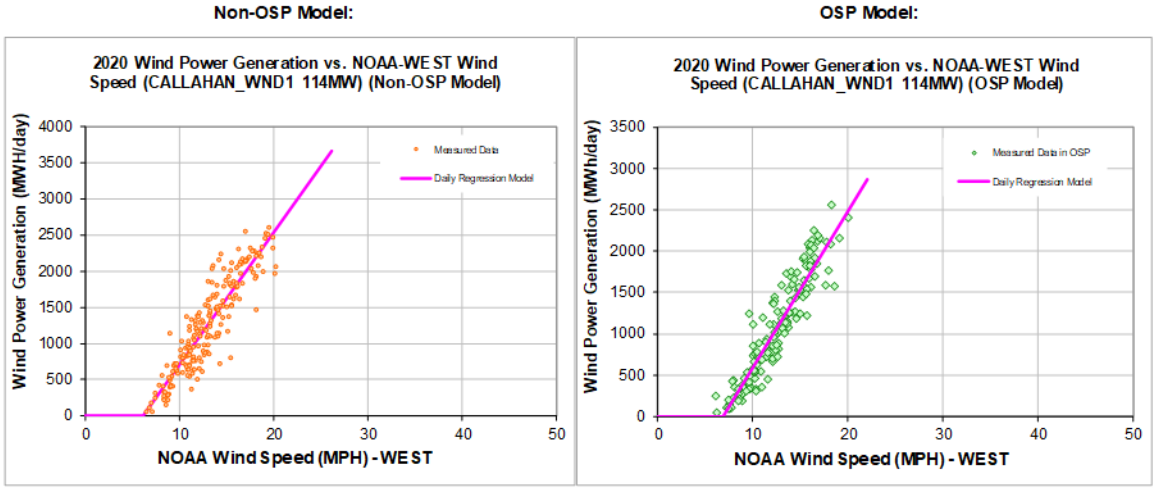


Figure 3-14: Linear Model Presentation of the Daily Wind Power Generation on the Year 2020 for Callahan_Wind_1 Farm

The primary purpose of modeling in this analysis is to back-cast the wind power production or predict the power production in another year that would have occurred if the turbines had been installed and operating. This allows for the evaluation of the NOx reductions during the base-year weather conditions. Unfortunately, any prediction intrinsically contains uncertainty, which is related to the prediction variance. Thus, the prediction uncertainty, $\sigma^2(\hat{E}_{pred,j})$, assuming no autocorrelation effects in the data used to generate the linear model, can be presented for a particular observation, j, during any time a particular condition is presented as follows:

$$\sigma^2(\hat{E}_{pred,j}) = MSE(\hat{E}_i) \cdot \left[1 + \frac{1}{n} + \frac{(V_j - \bar{V}_n)^2}{\sum_{i=1}^{n}(V_i - \bar{V}_n)^2}\right]$$

Equation 2

The mean square error, $MSE(\hat{E}_i)$, during the period of the development of the linear model can be computed by:

$$MSE(\hat{E}_i) = \left[\frac{1}{n-(k+1)}\right]\sum_{i=1}^{n}(E_i - \hat{E}_i)^2$$

Equation 3

Where *n* is the number of days in the period used for the developed model, *k* is the number of regressor variables in the linear model and $\bar{V}_n$ is the mean value of the velocity on the modeling period.

The last term in the brackets of equation 2 accounts for the increase in the variance of the energy prediction for any particular observation, *j*, which is different from the centroid of the modeling data. On the other hand, the second term accounts for the variance in predicting the mean energy predicted for the observation, j.

The total uncertainty for a period of interest, of *m* days, is then the sum of all the wind energy predicted $\hat{E}_{pred,j}$ in each individual observation.

Assuming that

$$\sum_{j=1}^{m} \sigma^2\left(\hat{E}_{pred,j}\right) = \sigma^2\left(\sum_{j=1}^{m}\left(\hat{E}_{pred,j}\right)\right) = \sigma^2\left(\hat{E}_{pred,total}\right)$$

Equation 4

And the total prediction variance or uncertainty is obtained through

$$\sigma^2\left(\hat{E}_{pred,total}\right) = MSE\left(\hat{E}_i\right) \cdot m \cdot \left[1 + \frac{1}{n} + \frac{\sum_{j=1}^{m}\left(V_j - \bar{V}_n\right)^2}{m\sum_{i=1}^{n}(V_i - \bar{V}_n)^2}\right]$$

Equation 5

Thus, it is observable that the last equation is affected by the number of days that the wind energy will be predicted, the number of days used for the modeling development and the uncertainty due to the distances between the data predicted and the centroid of the modeling data. Therefore, increasing *n* and *m* yields an effective relative decrease in the uncertainty, which is expected.

Table 3-3 presents all the statistical parameters for the daily linear models of all the wind farms in the ERCOT region.

Table 3-4 and Figure 3-15 show the uncertainty of applying the linear models to predict the energy generation that they would have had in the 2018 Non-OSP using the N-OSP model, which considers the period of Jan 1 through April 30 and October 1 through December 31. The uncertainty of using Non-OSP models for predicting wind power in the 2018 N-OSP varies from 2.38% to 12.82%. The maximum uncertainty comes from a wind farm named WH_WIND_UNIT2. One reason for this may be the meter problems suspected when measuring the ERCOT data since the data include "0" generation values regardless of the wind speed. Also, wind speed can change significantly due to elevation, windmills distances, etc. In the current modeling, the average wind speed of ERCOT is used for all the wind farms. Therefore, the average wind speed may not represent the real wind speed where the wind farms are located. The model uncertainty can come from incorrect wind speed information.

In addition, the same table and figure include the uncertainty related to the predicted wind generated for the same wind farms in the 2018 OSP using the OSP model, which considers the period of May 1 through September 31 – about 153 days. The uncertainty of using OSP models for predicting wind power in the 2018 OSP varies from 2.37 % to 20.71% for all the wind farms. The maximum uncertainty of OSP models comes from a wind farm named HI_LONE_WGR2.

Table 3-3: Statistical Parameters of the Determined Daily Power Production Linear Models

Wind Farm	Statistical Parameters of Non-OSP Daily Models						Statistical Parameters of OSP Daily Models					
	c_0	c_1	AdjR^2	RMSE	CV-RMSE	# Days	c_0	c_1	AdjR^2	RMSE	CV-RMSE	# Days
ANACACHO_ANA	(28.96)	74.34	0.30	366.26	41.9%	211	-199.20	84.84	0.60	227.93	26.4%	153
ASTRA_UNIT1	376.33	59.28	0.13	606.61	50.2%	208	165.18	67.99	0.18	558.92	46.2%	153
BAFFIN_UNIT1	(560.63)	135.11	0.55	315.41	39.2%	204	-564.68	150.77	0.57	317.58	40.2%	151
BAFFIN_UNIT2	(591.08)	132.59	0.58	287.97	38.5%	204	-575.53	145.35	0.62	279.62	38.3%	151
BARROW_UNIT1	(314.27)	95.44	0.41	373.12	40.0%	150	-255.55	93.91	0.53	266.53	28.8%	153
BARROW_UNIT2	(280.08)	77.86	0.45	279.71	38.0%	148	-206.34	73.40	0.53	206.56	28.9%	153
BBREEZE_UNIT1	(1,045.39)	201.42	0.74	313.83	31.6%	177	-603.88	148.97	0.59	308.40	42.0%	146
BBREEZE_UNIT2	(866.74)	172.10	0.77	246.63	28.2%	177	-525.80	130.40	0.61	260.05	40.2%	144
BCATWIND_WIND_1	(1,612.00)	252.27	0.75	467.35	28.1%	211	-1828.15	248.96	0.77	413.15	31.8%	153
BLSUMMIT_BLSMT1_5	(43.26)	9.48	0.50	30.97	38.7%	210	-82.44	12.32	0.72	22.96	31.8%	153
BLSUMMIT_BLSMT1_6	(837.37)	157.94	0.62	391.88	32.1%	209	-1161.36	174.71	0.73	319.12	30.9%	153
BLSUMMIT_UNIT2_17	(28.77)	7.13	0.48	23.29	37.5%	196	-65.72	9.96	0.68	20.64	34.8%	153
BLSUMMIT_UNIT2_25	(608.86)	123.38	0.62	296.72	31.1%	192	-928.30	146.58	0.72	266.66	29.6%	151
BLSUMIT3_UNIT_17	(67.66)	15.71	0.54	45.64	34.7%	191	-139.19	20.98	0.70	40.32	33.0%	147
BLSUMIT3_UNIT_25	(1,230.20)	262.26	0.65	602.45	28.4%	200	-1857.67	297.88	0.74	533.82	28.6%	148
BORDAS_JAVEL18	(96.45)	21.74	0.66	50.92	30.4%	211	-136.92	24.29	0.82	37.03	22.1%	153
BORDAS_JAVEL20	(937.68)	276.14	0.66	647.88	26.9%	210	-1727.69	329.56	0.88	406.34	16.9%	153
BORDAS2_JAVEL2_A	(399.12)	116.11	0.65	281.44	27.8%	211	-754.86	139.97	0.88	167.68	16.8%	153
BORDAS2_JAVEL2_B	(320.34)	89.84	0.65	213.60	27.7%	211	-565.01	106.79	0.88	131.09	16.9%	153
BORDAS2_JAVEL2_C	(90.54)	35.02	0.61	90.91	27.1%	211	-191.81	41.39	0.85	57.64	17.6%	153
BRAZ_WND_WND1	(482.80)	78.37	0.56	218.80	40.8%	206	-749.03	100.49	0.67	215.90	41.5%	145
BRAZ_WND_WND2	(338.89)	55.19	0.57	152.03	40.3%	206	-509.34	72.24	0.71	137.74	35.0%	148
BRISCOE_WIND	25.46	63.79	0.15	577.57	62.6%	202	-20.61	53.90	0.18	434.27	53.8%	153
BRTSW_BCW1	20.40	59.81	0.31	294.84	42.0%	211	-782.49	127.32	0.82	169.36	25.7%	153
BUCKTHRN_UNIT1	(136.62)	54.35	0.52	174.41	36.1%	211	-463.72	74.16	0.81	102.99	27.4%	153
BUCKTHRN_UNIT2	(159.80)	71.51	0.50	239.00	36.5%	211	-623.07	99.90	0.80	140.75	27.8%	153
BUFF_GAP_UNIT1	(1,284.48)	173.76	0.83	249.12	25.5%	210	-1247.13	157.70	0.75	274.43	37.4%	153
BUFF_GAP_UNIT2_1	(1,140.99)	149.28	0.73	296.18	36.3%	179	-1263.55	158.53	0.82	221.81	30.5%	153
BUFF_GAP_UNIT2_2	(1,097.02)	143.92	0.72	295.93	37.5%	179	-1155.26	144.65	0.84	193.76	29.3%	153
BUFF_GAP_UNIT3	(1,326.07)	189.81	0.70	397.58	34.7%	210	-1720.80	215.98	0.83	300.05	30.2%	153
BULLCRK_WND1	(222.17)	48.58	0.33	217.19	53.3%	208	-683.92	85.07	0.74	151.45	39.4%	153
BULLCRK_WND2	(252.67)	54.82	0.32	247.96	54.0%	207	-753.58	94.53	0.74	166.79	38.5%	153
CABEZON_WIND1	(160.08)	70.30	0.21	446.44	64.4%	205	-421.90	96.44	0.61	251.01	31.8%	152
CABEZON_WIND2	(162.99)	79.19	0.22	480.69	60.1%	211	-519.17	113.11	0.71	236.21	26.2%	152
CALLAHAN_WND1	(1,130.95)	183.72	0.82	269.68	21.5%	209	-1317.91	190.48	0.87	226.26	21.1%	153
CAMWIND_UNIT1	(1,378.85)	274.97	0.76	401.69	28.6%	211	-689.04	203.61	0.50	521.18	45.1%	153
CAPRIDG4_CR4	(1,152.47)	175.99	0.86	231.22	20.3%	210	-1405.47	191.65	0.89	203.58	20.1%	151
CAPRIDGE_CR1	(2,404.25)	358.63	0.89	404.98	17.9%	210	-2642.20	364.63	0.91	345.85	17.8%	153
CAPRIDGE_CR2	(1,400.09)	211.16	0.81	324.89	24.0%	209	-1471.50	210.75	0.85	270.44	23.0%	153
CAPRIDGE_CR3	(1,771.09)	276.85	0.86	358.40	19.6%	210	-1977.82	280.65	0.88	315.46	20.4%	153
CEDROHIL_CHW1	(388.64)	86.30	0.65	206.40	31.3%	211	-625.51	103.10	0.88	124.38	18.6%	153
CEDROHIL_CHW2	(426.44)	84.29	0.67	191.88	32.1%	211	-611.62	97.08	0.89	110.57	18.2%	153
CFLATS_U1	(475.48)	146.82	0.50	469.18	32.7%	210	-1245.03	197.62	0.77	328.06	26.5%	153
CHAMPION_UNIT1	(514.74)	114.33	0.50	366.25	37.6%	210	-1275.43	170.16	0.85	217.70	25.3%	153
CN_BRKS_UNIT_1	(1,162.06)	249.06	0.69	649.25	27.6%	207	-1682.32	254.38	0.73	600.24	27.0%	153
COTPLNS_COTTONPL	(185.90)	55.19	0.63	165.96	28.0%	207	-390.65	56.99	0.75	127.72	26.4%	153
COTPLNS_OLDSETLR	(618.30)	146.10	0.50	569.67	39.7%	206	-1056.33	158.91	0.67	431.35	31.2%	153
COTTON_PAP2	(1,348.65)	275.41	0.65	520.02	36.1%	211	-1437.71	312.40	0.65	582.73	41.9%	153
CRANELL_UNIT1	(1,821.06)	335.89	0.79	429.65	28.6%	91	-643.41	147.16	0.40	473.46	70.1%	133
CSEC_CSECG1	6.21	60.99	0.17	424.50	53.0%	210	-1182.67	167.77	0.79	258.94	28.0%	153
CSEC_CSECG2	105.95	49.05	0.13	400.49	53.8%	210	-960.99	139.37	0.77	228.26	28.9%	153
DERMOTT_UNIT1	(1,240.97)	205.39	0.87	258.75	18.1%	209	-1617.50	226.23	0.91	219.18	17.9%	153
DERMOTT_UNIT2	(1,282.86)	206.94	0.87	253.96	18.1%	208	-1625.26	227.69	0.90	224.13	18.2%	153
DIGBY_UNIT1	(775.01)	150.99	0.71	315.23	26.6%	211	-1133.63	174.02	0.79	269.08	25.6%	153
DIGBY_UNIT2	(1,071.73)	199.41	0.70	422.42	27.9%	211	-1540.01	229.60	0.77	375.62	27.9%	153
ELB_ELBCREEK	(1,003.59)	176.77	0.80	285.89	22.1%	208	-1308.56	190.83	0.88	207.63	19.1%	153
ENAS_ENA1	(132.23)	24.39	0.35	105.60	56.9%	208	-187.90	27.67	0.70	54.45	34.1%	153
EXGNSND_WIND_1	(255.32)	91.66	0.60	233.14	27.5%	208	-434.98	102.93	0.82	160.51	18.9%	144
EXGNWTL_WIND_1	(264.42)	75.14	0.54	228.54	35.2%	209	-634.62	104.56	0.86	138.19	20.4%	153
FERMI_WIND1	(252.04)	100.81	0.37	426.10	40.3%	211	-816.32	153.10	0.68	314.84	28.4%	153
FERMI_WIND2	(30.66)	24.38	0.35	107.18	37.5%	211	-164.51	36.52	0.62	85.85	29.2%	153
FLUVANNA_UNIT1	(669.46)	121.10	0.79	200.87	22.1%	210	-972.85	141.65	0.89	148.40	18.4%	153
FLUVANNA_UNIT2	(607.29)	114.09	0.80	183.85	20.9%	210	-810.94	124.68	0.89	134.77	17.8%	153
FOARDCTY_UNIT1	(1,387.81)	260.75	0.68	580.13	29.1%	211	-2055.45	298.27	0.77	487.01	28.8%	153
FOARDCTY_UNIT2	(1,252.32)	230.99	0.70	490.33	28.1%	211	-1847.33	264.91	0.80	404.96	27.4%	153
FTWIND_UNIT_1	95.38	220.03	0.50	734.17	28.2%	211	-1809.98	349.87	0.85	415.97	19.4%	153
GOAT_GOATWIND	(440.90)	68.02	0.57	193.32	43.4%	194	-745.67	96.87	0.83	134.85	28.6%	152
GOAT_GOATWIN2	(306.21)	54.77	0.48	185.07	45.4%	194	-549.91	77.91	0.80	119.12	27.7%	152
GOPHER_UNIT1	(483.40)	109.85	0.64	262.90	27.8%	210	-832.83	134.04	0.84	174.85	20.6%	153
GOPHER_UNIT2	(413.14)	100.57	0.64	239.14	26.7%	210	-709.46	121.52	0.85	154.47	18.9%	153
GPASTURE_WIND_I	(1,445.48)	226.01	0.75	416.74	27.8%	209	-1552.02	219.38	0.82	308.66	25.6%	153
GRANDVW1_COLA	(275.49)	109.10	0.68	296.49	23.5%	207	-862.81	131.94	0.79	260.86	22.4%	153
GRANDVW1_COLB	(304.72)	110.53	0.69	292.84	23.4%	207	-857.05	132.31	0.78	270.71	23.1%	153
GRANDVW1_GV1A	(219.95)	108.16	0.67	302.77	23.3%	207	-682.07	119.11	0.72	284.28	24.8%	153
GRANDVW1_GV1B	(201.08)	103.79	0.69	274.03	21.8%	207	-683.69	120.18	0.76	259.61	22.4%	153
GUNMTN_G1	(995.54)	189.05	0.81	292.16	19.9%	210	-1185.86	196.35	0.85	247.51	19.3%	153
GWEC_GWEC_G1	(60.22)	150.02	0.50	497.98	30.2%	211	-1345.41	234.24	0.84	288.45	22.1%	153
HARALD_UNIT1	(1,288.96)	214.47	0.56	642.89	40.7%	95	-998.75	149.79	0.43	499.91	58.4%	142
H_HOLLOW_WND1	(1,794.06)	310.38	0.71	640.37	28.5%	210	-2465.30	338.29	0.83	465.52	26.1%	153
HHOLLOW2_WIND1	(1,899.53)	284.97	0.81	438.56	24.1%	209	-2354.77	307.05	0.84	400.22	26.6%	153
HHOLLOW3_WND_1	(2,215.11)	338.30	0.83	497.40	22.7%	209	-2510.32	340.29	0.85	432.04	24.5%	153

Table 3-3: Statistical Parameters of the Determined Daily Power Production Linear Models (Cont.)

Wind Farm	Statistical Parameters of Non-OSP Daily Models						Statistical Parameters of OSP Daily Models					
	c_0	c_1	AdjR^2	RMSE	CV-RMSE	# Days	c_0	c_1	AdjR^2	RMSE	CV-RMSE	# Days
HHOLLOW4_WND1	(942.88)	169.42	0.75	310.43	24.6%	210	-1319.94	184.77	0.81	273.19	27.3%	153
HICKMAN_G1_J01	(495.34)	112.34	0.75	206.82	21.7%	198	-791.27	133.75	0.88	151.74	17.1%	153
HICKMAN_G1_J02	(488.61)	111.71	0.75	207.61	21.8%	198	-790.28	133.52	0.88	150.74	17.0%	153
HICKMAN_G2_J01	(479.34)	107.37	0.75	199.37	22.0%	198	-807.49	133.04	0.88	146.72	17.0%	153
HICKMAN_G2_J02	(473.19)	106.79	0.74	200.08	22.1%	198	-806.48	132.81	0.88	145.91	16.9%	153
HI_LONE_WGR1A	(212.61)	50.08	0.52	156.22	35.2%	195	-277.03	52.33	0.65	115.49	31.5%	96
HI_LONE_WGR1B	(229.35)	50.67	0.39	205.72	47.4%	196	-166.85	39.14	0.40	144.54	46.0%	96
HI_LONE_WGR1C	(197.69)	33.94	0.48	117.93	47.6%	141	-83.95	23.67	0.52	69.27	33.5%	95
HI_LONE_WGR3	(658.43)	132.84	0.51	425.28	39.9%	211	-1115.11	184.43	0.81	268.94	22.4%	153
HI_LONE_WGR4	(462.33)	106.69	0.50	346.40	37.6%	211	-749.34	143.59	0.76	244.74	23.2%	153
HI_LONE_WGR2	(32.88)	19.13	0.35	66.13	37.3%	56	-155.91	35.80	0.41	76.89	43.3%	31
HI_LONE_WGR2A	(210.16)	35.89	0.55	107.64	42.1%	155	-178.67	37.78	0.76	64.60	21.8%	153
HORSECRK_UNIT1	(1,171.46)	200.30	0.79	331.64	23.2%	211	-1677.07	234.22	0.86	285.35	22.6%	153
HORSECRK_UNIT2	(844.68)	148.84	0.77	267.10	24.6%	211	-1241.08	174.71	0.85	219.02	23.0%	153
HRFDWIND_JRDWIND1	(696.50)	153.22	0.74	359.04	24.5%	207	-1223.49	161.85	0.80	313.09	24.8%	153
HRFDWIND_JRDWIND2	(689.85)	155.74	0.73	372.31	24.7%	207	-1265.97	167.91	0.80	322.72	24.6%	153
HRFDWIND_WIND_G	(376.88)	97.25	0.67	268.51	27.0%	206	-823.75	109.97	0.79	215.26	24.9%	153
HRFDWIND_WIND_V	(419.49)	114.33	0.69	301.76	25.4%	207	-952.86	134.21	0.79	265.06	23.9%	153
HWF_HWFG1	(308.46)	112.38	0.31	532.22	46.1%	209	-1581.65	217.01	0.83	297.46	26.0%	153
INDL_INADALE1	(513.64)	91.88	0.53	279.70	41.0%	209	-1176.06	144.93	0.87	165.85	26.0%	152
INDL_INADALE2	(544.71)	97.50	0.51	305.24	42.2%	209	-1315.04	158.70	0.87	182.55	26.9%	153
INDNENR_INDNENR	(262.38)	62.10	0.41	243.54	44.8%	211	-265.11	66.24	0.38	256.42	45.2%	153
INDNENR_INDNENR_2	(376.11)	73.19	0.47	252.51	44.1%	210	-542.08	94.25	0.67	201.22	31.4%	153
INDNENR_UNIT_1B	(102.59)	22.62	0.44	83.72	44.0%	208	-73.54	20.05	0.30	91.49	51.3%	153
INDNENR_UNIT_2B	(62.30)	13.76	0.45	49.10	42.4%	208	-94.09	18.06	0.58	46.65	35.1%	153
INDNNWP_INDNNWP2	(688.15)	100.49	0.50	325.06	52.8%	211	-735.93	115.37	0.72	218.60	30.6%	153
KARAKAW1_UNIT1	(854.15)	182.41	0.74	279.17	28.1%	211	-701.45	168.64	0.73	260.02	31.5%	153
KARAKAW1_UNIT2	(873.69)	182.36	0.73	286.60	29.5%	211	-688.28	167.52	0.72	265.15	32.0%	153
KARAKAW2_UNIT3	(787.23)	170.13	0.71	281.91	30.1%	211	-663.95	161.65	0.74	246.26	30.8%	153
KEECHI_U1	(336.11)	143.23	0.54	439.30	33.9%	211	-1246.28	200.45	0.83	258.38	25.3%	153
KING_NE_KINGNE	(368.04)	62.21	0.48	205.82	46.7%	208	-457.78	72.39	0.71	138.98	30.8%	153
KING_NW_KINGNW	(304.29)	60.68	0.37	249.53	51.2%	209	-320.47	67.48	0.61	162.75	30.9%	153
KING_SE_KINGSE	(162.79)	28.04	0.43	102.83	50.7%	209	-276.22	39.74	0.69	79.45	35.6%	153
KING_SW_KINGSW	(236.44)	54.72	0.31	257.17	53.9%	209	-303.67	65.88	0.53	185.95	35.5%	153
LGD_LANGFORD	(141.87)	104.52	0.22	616.55	50.7%	208	-1161.93	172.00	0.67	360.80	36.1%	153
LGW_UNIT1	(240.70)	114.90	0.51	374.45	35.1%	210	-1027.59	164.12	0.82	215.01	26.2%	151
LGW_UNIT2	(252.71)	109.80	0.52	355.98	35.7%	210	-950.76	152.83	0.79	223.04	28.7%	153
LHORN_N_UNIT1	(505.19)	115.44	0.68	306.59	27.2%	186	-1010.94	124.70	0.76	270.27	29.9%	153
LHORN_N_UNIT2	(551.45)	119.69	0.72	294.08	25.8%	186	-1064.66	131.06	0.78	268.57	28.4%	153
LNCRK_G83	(1,681.78)	242.86	0.86	319.16	21.7%	211	-1570.25	214.65	0.84	277.69	24.7%	153
LOCKETT_UNIT1	(1,507.37)	285.88	0.68	623.78	28.6%	204	-2019.59	312.41	0.80	472.86	24.8%	153
LNCRK2_G871	(785.70)	120.89	0.81	188.66	24.1%	211	-870.85	119.60	0.87	139.89	22.2%	153
LNCRK2_G872	(714.40)	116.32	0.80	189.07	23.8%	211	-860.87	118.94	0.86	144.94	22.9%	153
LONEWOLF_G1	(210.10)	42.66	0.51	134.65	39.0%	209	-453.25	63.24	0.90	64.94	19.0%	153
LONEWOLF_G2	(216.53)	43.05	0.51	136.56	39.7%	209	-481.96	65.10	0.89	70.41	21.0%	153
LONEWOLF_G3	(127.19)	24.66	0.55	72.21	37.2%	209	-256.90	35.49	0.90	36.68	19.4%	153
LONEWOLF_G4	(110.30)	21.75	0.50	70.11	40.6%	209	-237.65	31.94	0.90	32.78	20.0%	153
LV1_LV1A	(1,553.27)	317.29	0.72	508.92	30.4%	207	-1043.18	273.01	0.62	548.58	38.4%	153
LV2_LV2	(1,802.20)	324.04	0.78	441.30	29.7%	209	-866.33	227.44	0.55	528.44	44.3%	153
LV3_UNIT_1	(779.24)	193.48	0.46	691.93	44.0%	209	-1934.94	296.47	0.77	511.67	29.0%	152
LV4_UNIT_1	(868.05)	204.01	0.49	687.65	42.6%	209	-1663.97	283.44	0.75	540.02	28.6%	153
LV5_UNIT_1	(628.16)	131.23	0.64	324.28	33.5%	210	-934.85	152.69	0.77	272.88	27.8%	153
MARIAH_NORTE1	(217.36)	87.43	0.37	451.25	44.9%	206	-620.46	105.65	0.56	361.32	36.1%	153
MARIAH_NORTE2	(200.32)	85.55	0.37	442.02	44.4%	206	-619.80	105.86	0.55	366.57	36.5%	153
MCDLD_FCW1	(611.97)	112.74	0.60	296.66	34.7%	210	-1217.33	164.99	0.88	186.07	21.8%	153
MCDLD_SBW1	(80.15)	35.53	0.17	250.36	65.5%	210	-509.33	72.89	0.83	98.97	24.4%	153
MESQCRK_WND1	(729.33)	141.99	0.74	266.98	23.9%	210	-871.49	140.01	0.80	208.31	23.4%	151
MESQCRK_WND2	(756.90)	141.22	0.73	273.48	25.3%	210	-919.26	142.47	0.79	220.79	25.2%	151
MESTENO_UNIT_1	(296.29)	115.87	0.28	608.80	54.8%	207	-1269.25	221.53	0.68	494.13	32.8%	153
MIAM1_G1	(505.54)	153.05	0.67	425.43	25.8%	206	-1001.19	161.50	0.72	385.18	26.1%	153
MIAM1_G2	(742.19)	161.32	0.72	394.44	25.8%	206	-1072.54	166.28	0.73	391.68	26.5%	153
MIDWIND_UNIT1	(1,223.30)	252.82	0.63	509.60	38.4%	202	-1369.42	298.72	0.74	456.24	34.2%	153
MIRASOLE_MIR11	(85.92)	35.42	0.25	197.91	57.4%	211	-457.46	72.50	0.74	139.95	31.0%	153
MIRASOLE_MIR12	(107.08)	64.81	0.22	395.83	58.2%	211	-879.63	139.42	0.75	266.78	30.7%	153
MIRASOLE_MIR13	(16.11)	24.02	0.18	161.48	59.2%	176	-361.20	60.00	0.73	120.09	30.7%	153
MIRASOLE_MIR21	(163.52)	68.61	0.25	384.21	57.3%	211	-853.62	134.97	0.74	264.78	31.6%	153
MOZART_WIND_1	(12.31)	16.84	0.19	106.06	52.3%	182	-210.80	31.17	0.69	63.20	35.0%	153
MWEC_G1	420.60	55.60	0.11	597.38	49.7%	208	-1030.11	148.25	0.64	430.40	34.6%	153
NBOHR_UNIT1	(1,389.24)	255.94	0.62	641.53	32.8%	207	-1952.82	302.95	0.86	375.03	20.2%	153
NWF_NWF1	205.37	32.06	0.11	290.46	46.6%	208	-30.51	55.25	0.34	231.34	34.9%	153
NWF_NWF2	188.63	19.80	0.09	200.19	44.8%	208	-44.03	40.27	0.39	150.84	32.7%	153
OVEJA_G1	(1,095.22)	227.75	0.76	406.35	22.1%	198	-1572.49	262.95	0.85	333.47	19.3%	153
OVEJA_G2	(987.78)	218.75	0.74	416.90	22.7%	198	-1573.91	263.14	0.86	314.81	18.2%	153
OWF_OWF	(80.32)	20.25	0.30	99.77	55.0%	178	-162.30	22.23	0.40	79.52	67.2%	144
PALMWIND_UNIT1	(101.43)	88.78	0.27	379.53	47.6%	208	-100.10	98.27	0.40	306.85	38.8%	153
PAP1_PAP1_J01	(374.97)	73.58	0.72	117.05	31.6%	211	-332.52	73.80	0.65	137.76	41.0%	153
PAP1_PAP1_J02	(1,232.45)	225.89	0.78	305.77	29.0%	211	-888.58	204.12	0.64	391.43	40.8%	153
PC_NORTH_PANTHER1	(1,227.08)	221.70	0.87	276.93	16.7%	210	-1491.18	228.50	0.85	284.93	20.9%	149
PC_SOUTH_PANTHER2	(1,113.30)	185.42	0.87	226.56	17.4%	210	-1307.43	189.73	0.89	199.78	18.6%	148

Table 3-3: Statistical Parameters of the Determined Daily Power Production Linear Models (Cont.)

Wind Farm	Statistical Parameters of Non-OSP Daily Models						Statistical Parameters of OSP Daily Models					
	c_0	c_1	AdjR^2	RMSE	CV-RMSE	# Days	c_0	c_1	AdjR^2	RMSE	CV-RMSE	# Days
PC_SOUTH_PANTHER3	(1,084.43)	205.80	0.60	533.96	33.5%	210	-2040.02	276.92	0.90	283.29	19.7%	153
PENA_UNIT1	(616.04)	143.08	0.44	395.08	48.2%	202	-544.76	154.73	0.43	454.09	53.0%	153
PENA_UNIT2_J01	(263.73)	59.31	0.44	171.30	51.2%	203	-221.15	62.14	0.43	183.07	53.6%	153
PENA_UNIT2_J02	(207.39)	57.11	0.38	184.90	50.8%	198	-243.16	70.85	0.42	211.55	53.3%	152
PENA3_UNIT3	(416.32)	92.02	0.44	249.62	49.5%	201	-525.96	118.06	0.56	259.34	48.4%	149
PEY_UNIT1	(671.37)	157.57	0.36	538.77	58.3%	210	-803.81	190.13	0.60	392.73	42.8%	153
PH1_UNIT1	(183.12)	72.34	0.33	401.58	48.1%	205	-371.20	84.32	0.48	333.75	36.2%	153
PH1_UNIT2	(232.26)	76.92	0.37	389.08	46.0%	204	-310.87	77.97	0.49	307.91	34.8%	153
PH2_UNIT1	(259.44)	80.39	0.37	405.43	46.4%	204	-162.79	73.29	0.41	339.10	35.2%	153
PH2_UNIT2	(299.19)	84.28	0.37	419.07	47.1%	204	-219.95	79.38	0.40	370.48	37.1%	153
PYR_PYRON1	(598.88)	120.92	0.53	363.42	37.3%	210	-1496.36	189.97	0.88	211.95	23.8%	153
PYR_PYRON2	(579.26)	123.06	0.51	387.15	38.0%	208	-1508.23	192.47	0.87	220.68	24.3%	153
RANCHERO_UNIT1	(942.00)	206.68	0.66	486.32	27.9%	211	-1523.59	262.18	0.82	366.93	20.7%	153
RANCHERO_UNIT2	(771.23)	195.43	0.63	481.84	27.3%	211	-1302.80	241.40	0.84	320.37	18.5%	153
RDCANYON_RDCNY1	(825.20)	136.60	0.80	219.51	23.0%	210	-931.06	142.06	0.88	159.50	18.7%	153
REDFISH_MV1A	(521.93)	128.61	0.61	263.96	33.8%	211	-457.65	127.13	0.47	331.52	47.4%	140
REDFISH_MV1B	(626.32)	143.01	0.63	281.02	34.2%	211	-509.22	134.33	0.42	390.55	54.8%	140
ROUTE_66_WIND1	321.10	75.04	0.15	688.49	50.4%	203	445.54	66.31	0.14	614.76	42.0%	153
RSNAKE_G1	(549.95)	116.21	0.55	334.12	35.0%	206	-869.48	146.51	0.86	180.32	18.6%	153
RSNAKE_G2	(534.49)	112.50	0.45	397.26	43.1%	206	-793.69	141.02	0.83	192.49	19.7%	153
RTS_U1	250.54	123.83	0.20	811.83	46.2%	210	-988.95	192.01	0.55	565.17	39.8%	153
RTS2	(464.42)	225.20	0.35	867.63	44.3%	92	-370.54	143.65	0.28	744.83	52.3%	152
SAGEDRAW_UNIT1	(963.13)	183.48	0.26	986.43	69.3%	202	-1654.03	262.72	0.77	429.87	26.1%	153
SAGEDRAW_UNIT2	(900.34)	187.96	0.37	782.84	50.8%	209	-1678.67	258.21	0.76	433.50	27.7%	153
SALTFORK_UNIT1	(78.23)	61.68	0.55	220.29	27.8%	205	-510.02	77.29	0.73	182.37	27.0%	153
SALTFORK_UNIT2	(291.60)	116.72	0.62	360.45	26.6%	205	-986.34	141.53	0.79	284.42	24.0%	153
SALVTION_UNIT1	(1,116.84)	192.51	0.77	338.37	24.4%	210	-1610.12	223.76	0.85	279.36	23.3%	153
SALVTION_UNIT2	(1,182.84)	197.23	0.79	325.05	23.5%	210	-1612.67	222.77	0.86	273.06	23.0%	153
SANROMAN_WIND_1	(845.26)	159.31	0.72	257.00	33.5%	211	-538.51	135.83	0.59	290.09	41.9%	152
SANTACRU_UNIT1	(1,262.08)	240.55	0.81	300.49	25.6%	211	-991.35	219.41	0.71	356.88	35.8%	153
SANTACRU_UNIT2	(844.20)	165.57	0.79	219.47	26.4%	211	-587.80	140.10	0.65	265.38	39.0%	153
SENATEWD_UNIT1	(369.11)	166.26	0.49	565.75	37.1%	211	-1483.20	233.67	0.84	283.76	24.5%	153
SGMTN_SIGNALM	(247.16)	33.04	0.87	40.83	22.2%	209	-225.67	28.40	0.80	42.73	32.6%	153
SGMTN_SIGNALM2	(58.56)	7.89	0.87	9.70	21.9%	208	-53.15	6.71	0.80	9.98	32.3%	152
SHAFFER_UNIT1	(1,558.38)	309.40	0.78	422.92	26.9%	211	-1354.20	291.26	0.78	390.09	30.4%	153
SHANNONW_UNIT_1	(1,771.22)	297.94	0.70	637.37	30.4%	211	-2162.98	297.94	0.75	518.87	32.9%	153
SPLAIN1_WIND1	(409.82)	113.74	0.68	304.32	25.6%	208	-967.64	127.54	0.81	240.42	24.3%	153
SPLAIN1_WIND2	(373.75)	110.21	0.70	283.52	24.1%	208	-890.22	122.86	0.79	242.47	24.4%	153
SPLAIN2_WIND21	(850.84)	171.18	0.72	424.79	27.3%	208	-1385.78	175.12	0.75	390.42	30.0%	153
SPLAIN2_WIND22	(767.34)	168.49	0.71	424.91	26.5%	208	-1418.21	177.08	0.73	419.29	32.3%	153
SRWE1_SRWE2	(1,309.90)	235.44	0.70	493.72	28.2%	208	-1763.96	249.32	0.78	400.72	29.3%	153
SRWE1_UNIT1	(1,538.00)	297.12	0.71	602.58	25.9%	210	-2020.90	309.32	0.77	502.98	27.0%	153
SSPURTWO_SS3WIND1	(473.94)	112.24	0.70	294.58	26.9%	209	-709.71	115.22	0.68	306.01	28.9%	153
SSPURTWO_SS3WIND2	(463.96)	115.93	0.69	311.84	26.9%	209	-655.17	115.45	0.61	353.43	31.6%	151
SSPURTWO_WIND_1	(863.46)	177.14	0.68	493.75	30.6%	209	-1177.31	179.96	0.69	465.92	29.4%	153
STELLA_UNIT1	(1,572.47)	330.73	0.79	443.02	25.0%	204	-989.24	294.75	0.57	631.06	38.0%	152
STWF_T1	(549.51)	99.08	0.38	403.88	54.3%	209	-1118.66	145.61	0.75	253.02	35.6%	153
S_HILLS_UNIT1	(178.84)	46.77	0.73	91.99	21.5%	211	-300.48	53.66	0.82	74.81	20.0%	153
SWEC_G1	135.88	45.88	0.14	356.69	48.7%	210	-800.25	125.15	0.72	232.80	30.2%	153
SWEETWN2_WND2	(1,073.81)	170.72	0.88	206.65	18.0%	210	-1276.86	181.59	0.87	215.08	21.4%	153
SWEETWN2_WND24	(208.41)	27.20	0.85	36.20	24.9%	210	-211.62	26.16	0.83	35.61	30.3%	152
SWEETWN3_WND3A	(195.76)	35.08	0.60	92.03	35.3%	210	-314.63	47.06	0.85	60.67	21.9%	153
SWEETWN3_WND3B	(960.22)	146.91	0.80	234.33	24.6%	210	-1046.82	156.26	0.87	181.89	19.9%	153
SWEETWN4_WND4A	(1,221.07)	172.30	0.85	229.68	22.5%	210	-1214.80	159.46	0.82	223.27	28.3%	152
SWEETWN4_WND4B	(1,138.11)	159.77	0.88	191.28	20.2%	209	-1046.39	141.67	0.83	196.02	26.7%	152
SWEETWN4_WND5	(278.29)	63.61	0.45	222.41	40.3%	209	-670.74	95.43	0.78	151.36	28.7%	149
SWEETWND_WND1	(396.66)	62.70	0.86	83.11	19.9%	211	-485.56	68.14	0.87	80.60	21.8%	153
TAHOKA_UNIT_1	(984.49)	217.39	0.72	439.08	23.8%	210	-1574.69	244.56	0.79	375.90	25.1%	153
TAHOKA_UNIT_2	(941.54)	215.87	0.72	435.29	23.3%	210	-1537.07	245.17	0.76	414.99	26.9%	153
TKWSW1_ROSCOE	(588.78)	106.01	0.52	323.50	40.9%	210	-1306.49	163.71	0.88	185.62	24.8%	153
TKWSW1_ROSCOE2A	(408.66)	81.10	0.46	283.44	43.8%	210	-1012.74	127.04	0.86	151.54	26.0%	153
TORR_UNIT1_25	(685.42)	182.79	0.63	460.33	30.0%	211	-1231.44	222.03	0.87	277.81	17.9%	153
TORR_UNIT2_23	(102.06)	26.35	0.61	69.06	31.7%	211	-195.27	33.44	0.86	43.85	19.6%	153
TORR_UNIT2_25	(549.95)	155.06	0.63	384.94	28.8%	211	-996.64	188.60	0.85	256.89	18.8%	153
TRENT_TRENT	(268.34)	47.96	0.60	115.34	34.7%	186	-444.58	61.44	0.86	70.00	22.4%	146
TRENT_UNIT_1B	(97.39)	21.93	0.69	47.40	25.1%	209	-183.26	28.32	0.86	34.17	19.9%	152
TRENT_UNIT_2	(496.97)	77.09	0.79	128.17	25.2%	207	-662.58	86.18	0.83	120.03	28.6%	152
TRENT_UNIT_3A	(415.70)	62.89	0.86	79.88	19.8%	210	-443.87	61.37	0.85	78.99	24.2%	153
TRENT_UNIT_3B	(11.21)	9.16	0.44	32.05	32.6%	129	-62.36	13.02	0.51	36.83	39.9%	116
TTWEC_G1	35.00	77.95	0.23	457.91	43.8%	210	-1116.02	174.27	0.70	346.95	32.3%	153
TYLRWIND_UNIT1	(289.85)	130.78	0.45	484.58	40.4%	211	-1465.73	210.17	0.79	306.83	33.6%	153
VERTIGO_WIND_I	(1,346.27)	213.83	0.74	407.59	28.3%	209	-1572.48	217.03	0.79	337.60	29.3%	153
WAKEWE_G1_J01	(82.17)	60.96	0.53	213.65	28.5%	194	-474.71	73.32	0.79	145.89	22.4%	153
WAKEWE_G1_J02	(66.96)	58.01	0.59	194.43	26.0%	208	-450.38	69.60	0.79	139.34	22.5%	153
WAKEWE_G2_J01	(53.27)	62.02	0.38	254.54	35.8%	134	-521.53	81.54	0.71	175.23	26.6%	129
WAKEWE_G2_J02	(89.14)	71.43	0.57	249.51	27.3%	208	-586.42	87.50	0.75	193.62	25.6%	153
WEC_WECG1	(44.13)	36.96	0.29	229.59	48.4%	203	-456.88	59.82	0.67	161.02	35.6%	147
WHTTAIL_WR1	(174.43)	82.28	0.32	398.39	52.4%	210	-1213.54	171.13	0.73	287.95	39.5%	152
WH_WIND_UNIT1	(1,893.44)	236.46	0.47	792.17	66.3%	175	-1721.78	240.44	0.73	441.37	34.1%	144
WH_WIND_UNIT2	(1,689.71)	211.34	0.36	882.83	81.9%	187	-1470.74	235.42	0.68	482.28	32.4%	153
WL_RANCH_UNIT1	(1,620.52)	309.19	0.72	619.67	25.8%	209	-2294.29	345.38	0.83	465.16	22.8%	153
WNDTHST2_UNIT1	(576.10)	97.90	0.74	187.90	27.1%	211	-663.58	95.91	0.75	165.60	30.6%	153
WOODWRD1_WOODWRD1	(445.90)	70.73	0.42	266.79	56.5%	211	-554.76	85.89	0.61	208.69	38.9%	144
WOODWRD2_WOODWRD2	(456.99)	68.72	0.48	229.60	53.0%	206	-414.61	68.51	0.61	164.01	36.8%	153

Table 3-4: 2018 Uncertainty of the Power Generation Prediction using the Linear Daily Models

Wind Farm	2018 Non Ozone Season Period				2018 Ozone Season Period (OSP)			
	Predicted days	Total Variance	Total Estimated	Relative Uncertainty	Predicted Days	Total Variance	Total Estimated	Relative uncertainty
ANACACHO_ANA	212	10,483.29	187,589.99	5.59%	153	5,540.31	135,627.37	4.08%
ASTRA_UNIT1	212	17,392.27	293,040.57	5.94%	153	13,605.57	193,603.00	7.03%
BAFFIN_UNIT1	212	9,036.63	220,186.69	4.10%	153	7,732.93	173,762.85	4.45%
BAFFIN_UNIT2	212	8,250.54	207,411.23	3.98%	153	6,808.68	162,811.76	4.18%
BARROW_UNIT1	212	10,694.12	182,091.87	5.87%	153	6,481.48	144,771.47	4.48%
BARROW_UNIT2	212	8,017.33	143,518.14	5.59%	153	5,023.05	112,133.24	4.48%
BBREEZE_UNIT1	212	8,994.04	283,820.30	3.17%	153	7,510.21	159,294.32	4.71%
BBREEZE_UNIT2	212	7,068.38	248,114.16	2.85%	153	6,332.95	137,930.82	4.59%
BCATWIND_WIND_1	212	13,377.88	316,388.26	4.23%	153	10,047.06	208,801.44	4.81%
BLSUMMIT_BLSMT1_5	212	886.54	15,542.20	5.70%	153	558.39	11,523.47	4.85%
BLSUMMIT_BLSMT1_6	212	11,219.06	234,127.71	4.79%	153	7,760.29	164,633.21	4.71%
BLSUMMIT_UNIT2_17	212	666.87	12,476.98	5.34%	153	501.97	9,453.06	5.31%
BLSUMMIT_UNIT2_25	212	8,498.95	192,450.61	4.42%	153	6,486.14	143,171.44	4.53%
BLSUMIT3_UNIT_17	212	1,307.14	26,585.36	4.92%	153	980.65	19,042.62	5.15%
BLSUMIT3_UNIT_25	212	17,252.98	422,630.18	4.08%	153	12,982.92	289,403.92	4.49%
BORDAS_JAVEL18	212	1,457.36	36,208.26	4.02%	153	900.08	26,599.64	3.38%
BORDAS_JAVEL20	212	18,544.38	520,827.20	3.56%	153	9,876.94	380,924.25	2.59%
BORDAS2_JAVEL2_A	212	8,055.46	217,970.48	3.70%	153	4,075.75	158,557.07	2.57%
BORDAS2_JAVEL2_B	212	6,113.79	166,201.59	3.68%	153	3,186.46	122,643.38	2.60%
BORDAS2_JAVEL2_C	212	2,602.10	72,060.73	3.61%	153	1,401.15	51,687.46	2.71%
BRAZ_WND_WND1	212	6,265.11	102,058.92	6.14%	153	5,250.84	78,321.70	6.70%
BRAZ_WND_WND2	212	4,352.92	72,089.56	6.04%	153	3,349.85	61,627.99	5.44%
BRISCOE_WIND	212	16,565.48	234,873.63	7.05%	153	10,571.39	130,286.35	8.11%
BRTSW_BCW1	212	8,442.15	163,088.69	5.18%	153	4,137.44	137,388.50	3.01%
BUCKTHRN_UNIT1	212	4,993.81	115,313.95	4.33%	153	2,515.99	78,869.33	3.19%
BUCKTHRN_UNIT2	212	6,843.41	155,945.22	4.39%	153	3,438.46	106,467.12	3.23%
BUFF_GAP_UNIT1	212	7,131.77	182,655.05	3.90%	153	6,673.70	119,211.24	5.60%
BUFF_GAP_UNIT2_1	212	8,482.18	149,529.66	5.67%	153	5,394.02	118,388.49	4.56%
BUFF_GAP_UNIT2_2	212	8,474.92	144,752.98	5.85%	153	4,711.93	107,689.52	4.38%
BUFF_GAP_UNIT3	212	11,381.85	214,967.72	5.29%	153	7,296.52	161,400.77	4.52%
BULLCRK_WND1	212	6,218.39	79,505.70	7.82%	153	3,682.93	62,667.57	5.88%
BULLCRK_WND2	212	7,099.86	89,282.18	7.95%	153	4,056.07	70,569.31	5.75%
CABEZON_WIND1	212	12,778.71	149,265.44	8.56%	153	6,101.35	123,457.38	4.94%
CABEZON_WIND2	212	13,758.51	171,814.41	8.01%	153	5,741.78	141,098.42	4.07%
CALLAHAN_WND1	212	7,721.38	239,417.16	3.23%	153	5,502.13	171,726.85	3.20%
CAMWIND_UNIT1	212	11,506.60	397,671.17	2.89%	153	12,685.42	249,012.85	5.09%
CAPRIDG4_CR4	212	6,619.26	214,962.93	3.08%	153	4,951.02	158,914.86	3.12%
CAPRIDGE_CR1	212	11,593.64	426,621.12	2.72%	153	8,410.44	311,017.66	2.70%
CAPRIDGE_CR2	212	9,301.36	254,372.58	3.66%	153	6,576.52	188,009.22	3.50%
CAPRIDGE_CR3	212	10,260.27	346,804.23	2.96%	153	7,671.42	247,651.50	3.10%
CEDROHIL_CHW1	212	5,907.55	142,510.21	4.15%	153	3,023.17	106,211.18	2.85%
CEDROHIL_CHW2	212	5,492.00	129,275.73	4.25%	153	2,687.58	96,575.28	2.78%
CFLATS_U1	212	13,431.60	281,793.98	4.77%	153	7,977.77	196,583.76	4.06%
CHAMPION_UNIT1	212	10,484.89	188,801.00	5.55%	153	5,294.11	138,915.21	3.81%
CN_BRKS_UNIT_1	212	18,617.57	649,594.73	2.87%	153	14,611.41	372,386.54	3.92%
COTPLNS_COTTONPL	212	4,758.95	159,131.70	2.99%	153	3,109.08	81,314.18	3.82%
COTPLNS_OLDSETLR	212	16,336.67	394,484.39	4.14%	153	10,500.13	231,793.98	4.53%
COTTON_PAP2	212	14,896.12	405,176.00	3.68%	153	14,183.63	323,846.89	4.38%
CRANELL_UNIT1	212	12,375.08	456,923.57	2.71%	153	11,528.08	137,107.51	8.41%
CSEC_CSECG1	212	12,152.42	160,256.87	7.58%	153	6,297.01	147,994.89	4.25%
CSEC_CSECG2	212	11,465.13	150,271.39	7.63%	153	5,550.90	126,128.24	4.40%
DERMOTT_UNIT1	212	7,407.57	272,562.80	2.72%	153	5,330.14	196,202.86	2.72%
DERMOTT_UNIT2	212	7,271.35	267,778.39	2.72%	153	5,450.41	197,855.63	2.75%
DIGBY_UNIT1	212	9,023.52	229,223.12	3.94%	153	6,543.51	167,476.48	3.91%
DIGBY_UNIT2	212	12,091.76	292,571.71	4.13%	153	9,134.30	214,261.00	4.26%
ELB_ELBCREEK	212	8,184.46	248,121.45	3.30%	153	5,049.23	173,796.02	2.91%
ENAS_ENA1	212	3,023.30	35,555.07	8.50%	153	1,324.08	25,469.18	5.20%
EXGNSND_WIND_1	212	6,675.20	184,742.80	3.61%	153	3,901.80	127,044.20	3.07%
EXGNWTL_WIND_1	212	6,541.22	139,742.14	4.68%	153	3,359.01	107,669.85	3.12%
FERMI_WIND1	212	12,197.28	209,260.44	5.83%	153	7,656.37	174,863.67	4.38%
FERMI_WIND2	212	3,067.93	57,024.67	5.38%	153	2,087.81	46,323.68	4.51%
FLUVANNA_UNIT1	212	5,750.60	173,763.24	3.31%	153	3,608.87	128,768.88	2.80%
FLUVANNA_UNIT2	212	5,263.34	168,620.95	3.12%	153	3,277.41	120,189.14	2.73%
FOARDCTY_UNIT1	212	16,606.35	385,416.38	4.31%	153	11,843.08	270,124.34	4.38%
FOARDCTY_UNIT2	212	14,035.66	336,623.77	4.17%	153	9,847.87	236,673.62	4.16%
FTWIND_UNIT_1	212	21,021.50	604,323.86	3.48%	153	10,161.77	428,092.13	2.37%
GOAT_GOATWIND	212	5,535.25	84,005.52	6.59%	153	3,279.43	75,700.82	4.33%
GOAT_GOATWIN2	212	5,298.91	77,875.41	6.80%	153	2,896.75	68,181.53	4.25%
GOPHER_UNIT1	212	7,526.32	183,770.48	4.10%	153	4,252.12	135,095.25	3.15%
GOPHER_UNIT2	212	6,846.01	174,503.54	3.92%	153	3,756.37	129,394.98	2.90%
GPASTURE_WIND_I	212	11,930.57	283,196.24	4.21%	153	7,506.09	192,694.37	3.90%
GRANDVW1_COLA	212	8,500.86	334,058.26	2.54%	153	6,349.97	194,630.41	3.26%
GRANDVW1_COLB	212	8,396.31	332,993.77	2.52%	153	6,589.86	196,443.65	3.35%
GRANDVW1_GV1A	212	8,681.01	342,455.25	2.53%	153	6,920.11	190,536.91	3.63%
GRANDVW1_GV1B	212	7,856.96	330,750.61	2.38%	153	6,319.68	192,926.28	3.28%
GUNMTN_G1	212	8,363.83	281,671.74	2.97%	153	6,018.89	203,077.65	2.96%
GWEC_GWEC_G1	212	14,258.84	385,478.96	3.70%	153	7,046.70	266,690.23	2.64%
HARALD_UNIT1	212	18,461.75	286,031.81	6.45%	153	12,162.05	130,573.94	9.31%
H_HOLLOW_WND1	212	18,332.57	428,951.59	4.27%	153	11,320.44	286,490.23	3.95%
HHOLLOW2_WIND1	212	12,555.61	341,231.10	3.68%	153	9,732.58	242,819.06	4.01%
HHOLLOW3_WND_1	212	14,239.74	413,277.79	3.45%	153	10,506.30	283,716.96	3.70%

Table 3-4: 2018 Uncertainty of the Power Generation Prediction using the Linear Daily Models (Cont.)

Wind Farm	2018 Non Ozone Season Period				2018 Ozone Season Period (OSP)			
	Predicted days	Total Variance	Total Estimated	Relative Uncertainty	Predicted Days	Total Variance	Total Estimated	Relative uncertainty
HHOLLOW4_WND1	212	8,887.01	241,775.39	3.68%	153	6,643.56	160,414.99	4.14%
HICKMAN_G1_J01	212	5,922.12	187,742.59	3.15%	153	3,690.05	140,847.16	2.62%
HICKMAN_G1_J02	212	5,944.81	187,515.71	3.17%	153	3,665.66	140,550.39	2.61%
HICKMAN_G2_J01	212	5,708.78	178,175.13	3.20%	153	3,567.99	136,991.20	2.60%
HICKMAN_G2_J02	212	5,729.21	177,971.56	3.22%	153	3,548.30	136,706.50	2.60%
HI_LONE_WGR1A	212	4,472.77	85,440.88	5.23%	153	2,813.34	37,691.65	7.46%
HI_LONE_WGR1B	212	5,889.69	83,426.03	7.06%	153	3,520.99	32,070.17	10.98%
HI_LONE_WGR1C	212	3,379.97	46,596.37	7.25%	153	1,687.50	20,801.58	8.11%
HI_LONE_WGR3	212	12,173.59	206,592.77	5.89%	153	6,540.02	190,561.89	3.43%
HI_LONE_WGR4	212	9,915.90	180,002.83	5.51%	153	5,951.64	166,481.70	3.57%
HI_LONE_WGR2	212	1,921.18	42,877.02	4.48%	153	1,940.16	9,368.27	20.71%
HI_LONE_WGR2A	212	3,084.11	49,042.33	6.29%	153	1,570.97	46,627.81	3.37%
HORSECRK_UNIT1	212	9,493.21	273,928.13	3.47%	153	6,939.27	202,773.21	3.42%
HORSECRK_UNIT2	212	7,645.66	208,970.00	3.66%	153	5,326.05	152,721.34	3.49%
HRFDWIND_JRDWIND1	212	10,295.67	403,506.44	2.55%	153	7,621.48	213,534.18	3.57%
HRFDWIND_JRDWIND2	212	10,676.10	413,995.62	2.58%	153	7,855.97	222,038.39	3.54%
HRFDWIND_WIND_G	212	7,699.67	269,935.59	2.85%	153	5,240.02	146,243.54	3.58%
HRFDWIND_WIND_V	212	8,652.46	322,358.10	2.68%	153	6,452.26	186,491.85	3.46%
HWF_HWFG1	212	15,236.43	227,463.07	6.70%	153	7,233.63	183,756.60	3.94%
INDL_INADALE1	212	8,007.40	130,637.33	6.13%	153	4,033.71	104,489.17	3.86%
INDL_INADALE2	212	8,738.36	138,694.69	6.30%	153	4,439.20	111,220.65	3.99%
INDNENR_INDNENR	212	6,971.36	106,202.48	6.56%	153	6,235.65	89,140.30	7.00%
INDNENR_INDNENR_2	212	7,228.17	111,016.50	6.51%	153	4,893.24	101,600.10	4.82%
INDNENR_UNIT_1B	212	2,396.43	37,190.03	6.44%	153	2,224.87	28,010.43	7.94%
INDNENR_UNIT_2B	212	1,405.44	22,656.90	6.20%	153	1,134.37	20,972.27	5.41%
INDNNWP_INDNNWP2	212	9,305.01	116,619.90	7.98%	153	5,315.95	113,396.03	4.69%
KARAKAW1_UNIT1	212	7,996.96	276,651.48	2.89%	153	6,328.84	186,248.53	3.40%
KARAKAW1_UNIT2	212	8,209.75	272,388.28	3.01%	153	6,453.73	186,310.45	3.46%
KARAKAW2_UNIT3	212	8,075.48	260,032.25	3.11%	153	5,993.99	179,820.83	3.33%
KEECHI_U1	212	12,578.48	308,973.94	4.07%	153	6,311.97	214,216.11	2.95%
KING_NE_KINGNE	212	5,892.39	84,199.23	7.00%	153	3,379.76	71,740.92	4.71%
KING_NW_KINGNW	212	7,143.90	93,627.36	7.63%	153	3,957.80	83,095.63	4.76%
KING_SE_KINGSE	212	2,943.96	38,603.04	7.63%	153	1,932.02	35,635.14	5.42%
KING_SW_KINGSW	212	7,362.67	92,476.09	7.96%	153	4,521.99	82,525.15	5.48%
LGD_LANGFORD	212	17,651.23	242,300.65	7.28%	153	8,773.87	159,269.67	5.51%
LGW_UNIT1	212	10,721.68	253,973.73	4.22%	153	5,253.33	172,070.26	3.05%
LGW_UNIT2	212	10,192.86	237,896.15	4.28%	153	5,448.57	163,242.25	3.34%
LHORN_N_UNIT1	212	8,796.92	308,164.21	2.85%	153	6,579.03	154,135.33	4.27%
LHORN_N_UNIT2	212	8,438.11	313,670.18	2.69%	153	6,537.83	161,673.20	4.04%
LNCRK_G83	212	9,135.97	278,052.63	3.29%	153	6,752.80	180,908.20	3.73%
LOCKETT_UNIT1	212	17,858.98	425,563.33	4.20%	153	11,499.12	303,013.38	3.79%
LNCRK2_G871	212	5,400.54	148,889.66	3.63%	153	3,401.80	101,389.57	3.36%
LNCRK2_G872	212	5,412.29	151,911.20	3.56%	153	3,524.69	101,604.87	3.47%
LONEWOLF_G1	212	3,854.64	66,629.26	5.79%	153	1,579.32	54,685.32	2.89%
LONEWOLF_G2	212	3,909.48	66,293.96	5.90%	153	1,712.19	54,032.96	3.17%
LONEWOLF_G3	212	2,067.12	37,309.54	5.54%	153	891.89	30,304.62	2.94%
LONEWOLF_G4	212	2,006.96	33,295.85	6.03%	153	797.13	26,333.40	3.03%
LV1_LV1A	212	14,580.00	466,908.99	3.12%	153	13,352.46	315,639.31	4.23%
LV2_LV2	212	12,641.58	431,259.89	2.93%	153	12,862.27	263,369.32	4.88%
LV3_UNIT_1	212	19,804.55	339,002.68	5.84%	153	12,439.15	282,900.61	4.40%
LV4_UNIT_1	212	19,682.28	347,609.49	5.66%	153	13,126.26	300,427.91	4.37%
LV5_UNIT_1	212	9,281.52	208,803.43	4.45%	153	6,632.80	155,998.04	4.25%
MARIAH_NORTE1	212	12,939.19	268,445.38	4.82%	153	8,795.57	166,641.92	5.28%
MARIAH_NORTE2	212	12,674.72	265,297.01	4.78%	153	8,923.20	167,266.82	5.33%
MCDLD_FCW1	212	8,492.64	164,131.47	5.17%	153	4,524.98	137,525.15	3.29%
MCDLD_SBW1	212	7,167.42	75,599.39	9.48%	153	2,406.69	64,970.94	3.70%
MESQCRK_WND1	212	7,643.09	215,439.53	3.55%	153	5,065.85	139,037.48	3.64%
MESQCRK_WND2	212	7,829.05	207,639.50	3.77%	153	5,369.46	136,640.25	3.93%
MESTENO_UNIT_1	212	17,426.41	239,145.18	7.29%	153	12,010.80	239,559.26	5.01%
MIAM1_G1	212	12,199.22	443,409.53	2.75%	153	9,376.27	246,652.62	3.80%
MIAM1_G2	212	11,310.44	422,957.63	2.67%	153	9,534.53	247,576.80	3.85%
MIDWIND_UNIT1	212	14,599.00	375,088.32	3.89%	153	11,104.82	310,484.84	3.58%
MIRASOLE_MIR11	212	5,664.52	74,083.05	7.65%	153	3,401.80	72,014.24	4.72%
MIRASOLE_MIR12	212	11,329.54	146,185.46	7.75%	153	6,484.56	138,486.86	4.68%
MIRASOLE_MIR13	212	4,624.98	59,176.11	7.82%	153	2,919.11	62,237.25	4.69%
MIRASOLE_MIR21	212	10,996.86	144,139.61	7.63%	153	6,435.87	133,762.35	4.81%
MOZART_WIND_1	212	3,038.75	41,276.11	7.36%	153	1,536.82	28,822.43	5.33%
MWEC_G1	212	17,129.05	289,162.01	5.92%	153	10,477.10	209,419.23	5.00%
NBOHR_UNIT1	212	18,366.65	372,633.60	4.93%	153	9,119.93	294,679.10	3.09%
NWF_NWF1	212	8,315.24	127,085.66	6.54%	153	5,625.69	103,502.15	5.44%
NWF_NWF2	212	5,730.92	91,576.04	6.26%	153	3,668.05	72,113.76	5.09%
OVEJA_G1	212	11,635.47	361,303.12	3.22%	153	8,109.44	274,336.34	2.96%
OVEJA_G2	212	11,937.81	360,627.80	3.31%	153	7,655.46	274,481.74	2.79%
OWF_OWF	212	2,857.33	35,750.53	7.99%	153	1,934.47	17,674.06	10.95%
PALMWIND_UNIT1	212	10,871.91	201,268.73	5.40%	153	7,468.73	155,759.43	4.80%
PAP1_PAP1_J01	212	3,352.81	105,140.67	3.19%	153	3,353.02	77,594.08	4.32%
PAP1_PAP1_J02	212	8,758.90	305,652.25	2.87%	153	9,527.48	219,373.54	4.34%
PC_NORTH_PANTHER1	212	7,927.90	317,795.57	2.49%	153	6,930.76	213,761.75	3.24%
PC_SOUTH_PANTHER2	212	6,485.87	247,515.85	2.62%	153	4,858.72	166,210.62	2.92%

Table 3-4: 2018 Uncertainty of the Power Generation Prediction using the Linear Daily Models (Cont.)

Wind Farm	2018 Non Ozone Season Period				2018 Ozone Season Period (OSP)			
	Predicted days	Total Variance	Total Estimated	Relative Uncertainty	Predicted Days	Total Variance	Total Estimated	Relative uncertainty
PC_SOUTH_PANTHER3	212	15,286.27	306,492.43	4.99%	153	6,889.19	231,292.08	2.98%
PENA_UNIT1	212	11,323.85	228,435.33	4.96%	153	11,052.60	186,011.79	5.94%
PENA_UNIT2_J01	212	4,907.87	92,919.22	5.28%	153	4,455.87	74,345.02	5.99%
PENA_UNIT2_J02	212	5,298.51	99,338.28	5.33%	153	5,149.39	85,575.48	6.02%
PENA3_UNIT3	212	7,155.58	142,659.78	5.02%	153	6,315.00	121,776.56	5.19%
PEY_UNIT1	212	15,433.29	253,076.21	6.10%	153	9,559.13	207,987.60	4.60%
PH1_UNIT1	212	11,515.42	221,397.89	5.20%	153	8,124.41	151,952.15	5.35%
PH1_UNIT2	212	11,158.59	227,482.66	4.91%	153	7,495.43	145,468.20	5.15%
PH2_UNIT1	212	11,628.61	234,192.26	4.97%	153	8,254.64	156,543.32	5.27%
PH2_UNIT2	212	12,019.75	239,749.42	5.01%	153	9,018.42	162,869.71	5.54%
PYR_PYRON1	212	10,403.97	188,152.92	5.53%	153	5,154.30	144,475.05	3.57%
PYR_PYRON2	212	11,084.10	197,873.05	5.60%	153	5,366.40	147,503.82	3.64%
RANCHERO_UNIT1	212	13,921.08	338,903.93	4.11%	153	8,923.00	280,255.30	3.18%
RANCHERO_UNIT2	212	13,792.83	345,767.71	3.99%	153	7,790.86	273,320.11	2.85%
RDCANYON_RDCNY1	212	6,284.14	181,286.02	3.47%	153	3,878.78	135,869.20	2.85%
REDFISH_MV1A	212	7,561.14	212,070.69	3.57%	153	8,074.49	138,430.68	5.83%
REDFISH_MV1B	212	8,049.89	226,088.74	3.56%	153	9,512.31	142,686.21	6.67%
ROUTE_66_WIND1	212	19,745.45	337,996.89	5.84%	153	14,964.98	232,336.04	6.44%
RSNAKE_G1	212	9,566.25	186,244.31	5.14%	153	4,385.13	153,862.44	2.85%
RSNAKE_G2	212	11,373.98	179,858.97	6.32%	153	4,680.94	154,680.15	3.03%
RTS_U1	212	23,236.41	375,820.65	6.18%	153	13,737.51	224,641.06	6.12%
RTS2	212	24,968.26	488,389.04	5.11%	153	18,105.88	223,096.28	8.12%
SAGEDRAW_UNIT1	212	28,242.22	274,038.56	10.31%	153	10,453.67	261,513.71	4.00%
SAGEDRAW_UNIT2	212	22,411.79	298,947.56	7.50%	153	10,541.90	249,016.31	4.23%
SALTFORK_UNIT1	212	6,316.56	205,309.81	3.08%	153	4,439.33	113,322.28	3.92%
SALTFORK_UNIT2	212	10,335.33	358,049.46	2.89%	153	6,923.50	199,492.29	3.47%
SALVTION_UNIT1	212	9,686.91	265,192.55	3.65%	153	6,793.48	192,532.56	3.53%
SALVTION_UNIT2	212	9,305.57	263,581.95	3.53%	153	6,640.41	190,256.87	3.49%
SANROMAN_WIND_1	212	7,361.88	220,581.29	3.34%	153	7,060.88	153,049.44	4.61%
SANTACRU_UNIT1	212	8,607.64	336,082.36	2.56%	153	8,686.39	230,260.56	3.77%
SANTACRU_UNIT2	212	6,286.87	236,511.45	2.66%	153	6,459.43	153,954.49	4.20%
SENATEWD_UNIT1	212	16,199.16	363,101.84	4.46%	153	6,932.03	245,302.79	2.83%
SGMTN_SIGNALM	212	1,168.85	34,152.94	3.42%	153	1,039.00	21,312.97	4.87%
SGMTN_SIGNALM2	212	277.82	8,247.08	3.37%	153	242.62	5,032.93	4.82%
SHAFFER_UNIT1	212	12,114.70	446,026.46	2.72%	153	9,494.79	299,823.37	3.17%
SHANNONW_UNIT_1	212	18,244.82	401,448.62	4.54%	153	12,618.00	253,552.08	4.98%
SPLAIN1_WIND1	212	8,725.79	322,270.25	2.71%	153	5,852.55	167,734.69	3.49%
SPLAIN1_WIND2	212	8,129.41	317,219.37	2.56%	153	5,902.41	167,970.55	3.51%
SPLAIN2_WIND21	212	12,180.27	435,394.89	2.80%	153	9,503.97	221,617.00	4.29%
SPLAIN2_WIND22	212	12,183.61	443,421.34	2.75%	153	10,206.69	221,530.68	4.61%
SRWE1_SRWE2	212	14,134.42	336,077.80	4.21%	153	9,744.81	218,974.91	4.45%
SRWE1_UNIT1	212	17,250.53	448,335.65	3.85%	153	12,231.58	296,798.80	4.12%
SSPURTWO_SS3WIND1	212	8,444.20	303,282.21	2.78%	153	7,449.16	176,681.93	4.22%
SSPURTWO_SS3WIND2	212	8,939.03	318,686.65	2.80%	153	8,603.72	183,160.11	4.70%
SSPURTWO_WIND_1	212	14,153.73	454,157.74	3.12%	153	11,341.66	265,403.42	4.27%
STELLA_UNIT1	212	12,692.76	496,563.19	2.56%	153	15,366.01	359,373.47	4.28%
STWF_T1	212	11,562.70	141,810.11	8.15%	153	6,152.85	114,855.31	5.36%
S_HILLS_UNIT1	212	2,633.30	83,970.06	3.14%	153	1,819.20	59,095.74	3.08%
SWEC_G1	212	10,211.31	148,365.75	6.88%	153	5,661.30	122,709.94	4.61%
SWEETWN2_WND2	212	5,915.86	217,666.49	2.72%	153	5,230.35	160,664.46	3.26%
SWEETWN2_WND24	212	1,036.36	27,137.86	3.82%	153	866.04	18,957.54	4.57%
SWEETWN3_WND3A	212	2,634.50	49,941.12	5.28%	153	1,475.42	44,069.20	3.35%
SWEETWN3_WND3B	212	6,708.33	179,809.29	3.73%	153	4,423.30	146,021.54	3.03%
SWEETWN4_WND4A	212	6,575.13	191,656.36	3.43%	153	5,429.49	126,462.89	4.29%
SWEETWN4_WND4B	212	5,476.31	176,549.64	3.10%	153	4,766.74	117,165.03	4.07%
SWEETWN4_WND5	212	6,367.30	106,780.24	5.96%	153	3,681.04	82,275.02	4.47%
SWEETWND_WND1	212	2,379.07	79,473.08	2.99%	153	1,959.92	59,327.28	3.30%
TAHOKA_UNIT_1	212	12,569.95	357,792.67	3.51%	153	9,141.20	238,148.70	3.84%
TAHOKA_UNIT_2	212	12,461.51	362,948.04	3.43%	153	10,091.79	245,011.32	4.12%
TKWSW1_ROSCOE	212	9,261.09	151,533.44	6.11%	153	4,514.04	122,018.51	3.70%
TKWSW1_ROSCOE2A	212	8,114.43	124,715.54	6.51%	153	3,685.18	94,849.15	3.89%
TORR_UNIT1_25	212	13,175.79	331,031.70	3.98%	153	6,752.66	246,309.22	2.74%
TORR_UNIT2_23	212	1,976.60	47,019.23	4.20%	153	1,065.84	35,611.20	2.99%
TORR_UNIT2_25	212	11,017.88	287,482.41	3.83%	153	6,244.29	216,775.69	2.88%
TRENT_TRENT	212	3,305.45	68,148.17	4.85%	153	1,703.19	50,106.06	3.40%
TRENT_UNIT_1B	212	1,357.02	36,514.34	3.72%	153	831.00	27,261.19	3.05%
TRENT_UNIT_2	212	3,669.37	95,788.77	3.83%	153	2,918.87	67,470.37	4.33%
TRENT_UNIT_3A	212	2,286.75	76,026.04	3.01%	153	1,920.95	52,462.31	3.66%
TRENT_UNIT_3B	212	919.64	21,502.54	4.28%	153	896.72	12,090.08	7.42%
TTWEC_G1	212	13,108.01	210,543.40	6.23%	153	8,437.16	170,615.26	4.95%
TYLRWIND_UNIT1	212	13,875.09	285,722.25	4.86%	153	7,495.56	201,840.79	3.71%
VERTIGO_WIND_I	212	11,668.68	272,360.55	4.28%	153	8,209.69	185,156.12	4.43%
WAKEWE_G1_J01	212	6,132.38	201,873.43	3.04%	153	3,551.24	108,897.85	3.26%
WAKEWE_G1_J02	212	5,574.29	194,467.81	2.87%	153	3,392.00	103,414.20	3.28%
WAKEWE_G2_J01	212	7,344.28	211,822.61	3.47%	153	4,275.39	102,924.62	4.15%
WAKEWE_G2_J02	212	7,153.32	238,058.71	3.00%	153	4,713.32	126,913.32	3.71%
WEC_WECG1	212	6,583.42	123,611.47	5.33%	153	3,920.59	75,138.11	5.22%
WHTTAIL_WR1	212	11,408.05	181,441.19	6.29%	153	7,036.23	160,438.34	4.39%
WH_WIND_UNIT1	212	22,695.47	220,198.58	10.31%	153	10,735.25	195,883.08	5.48%
WH_WIND_UNIT2	212	25,285.59	197,299.66	12.82%	153	11,728.01	236,049.25	4.97%
WL_RANCH_UNIT1	212	17,739.05	462,319.47	3.84%	153	11,311.79	325,684.63	3.47%
WNDTHST2_UNIT1	212	5,378.56	133,145.54	4.04%	153	4,027.12	86,461.62	4.66%
WOODWRD1_WOODWRD1	212	7,636.81	89,958.25	8.49%	153	5,075.66	78,472.99	6.47%
WOODWRD2_WOODWRD2	212	6,573.68	82,516.99	7.97%	153	3,988.34	70,732.59	5.64%

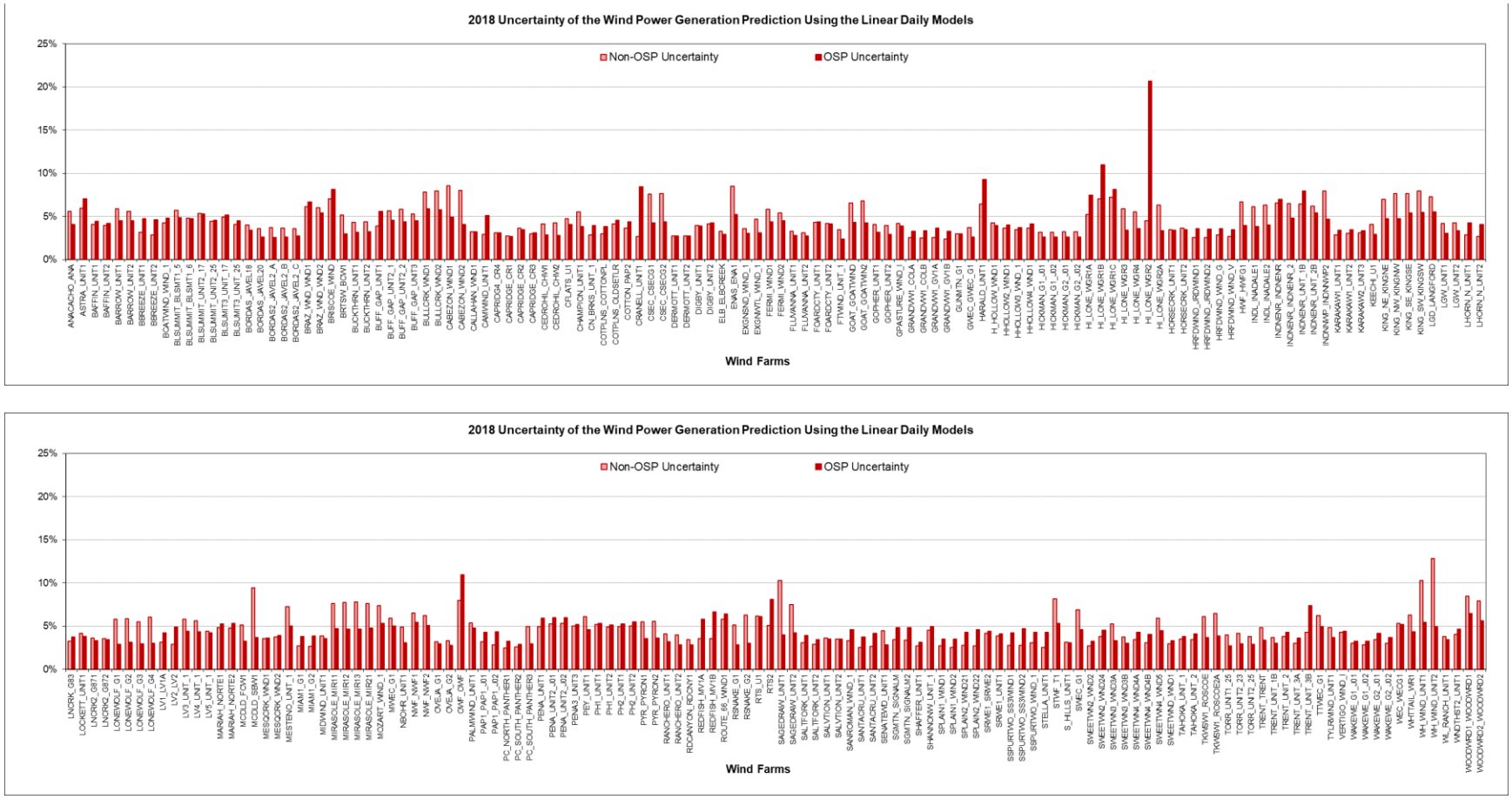


Figure 3-15: Uncertainty of the Wind Power Generation Prediction Using the Linear Daily Models for Base 2018

4 DEGRADATION ANALYSIS FOR WIND FARMS

This report contains an updated analysis to determine any degradation that could be observed in the measured power generation from Texas wind farms. By request of the TCEQ, the ESL has been evaluating any observed degradation from the measured data for Texas wind farms. To accomplish this, in this report one hundred and fifty-seven sites[13] built from 2002 to 2017, which have been in operation for more than three years, were evaluated with a total capacity of 19,786 MW (see Table 4-1).

In this analysis, a sliding statistical index was established for each site that used the 10th, 25th, 50th, 75th, 90th, and 99th percentiles of the hourly power generation over a 12-month sliding period, as well as mean, minimum and maximum hourly power generation of the same 12-month period. These indices were then displayed using one data symbol for each 12-month slide, beginning from the first 12-month period until the last 12-month period for each of the wind farms.

Table 4-1 presents a summary of the degradation analysis for the one hundred and fifty-seven sites. For each of the wind farms that are included in the degradation analysis, Table 4-1 includes the first year, average, maximum, and minimum 12-month sliding 90th percentile as well as the number of months of data and the capacity. The first year 12-month sliding 90th percentile reports the 90th percentile for the generation in MW for the first 12-months that the wind farm has been in operation. Similarly, the 90th percentile for the generation in each 12-month is calculated by sliding one month at-a-time toward the current date. Then the maximum and minimum of the calculated 12-month 90th percentiles are reported for each wind farm. Furthermore, the difference between the first 12-month 90th percentile and each of the average, maximum, and minimum 12-month 90th percentiles are reported.
Of the one hundred and fifty-seven sites analyzed, ninety-four sites showed an increase when one compares the 90th percentile of the whole period to the 90th percentile of the first 12-month period, ranging from 0.2% to 59.9%, the remaining sixty-one sites showed a decrease from -0.2% to -33.5%, and two sites did not show any change. The weighted average of this increase across all wind farms studied is 3.3% (positive), which indicates that no degradation was observed from the aggregated energy production from these wind farms over the studied operation period. Based on the observations, special attention needs to be paid to sites Roscoe Wind Farm (-10.0%), Papalote Creek Wind Farm (-10.8%), Chapman Ranch Wind IA (Santa Cruz) (-12.9%), Chapman Ranch Wind IB (Santa Cruz) (-13.9%), Penascal Wind 3 (-14.8%), Big Spring Wind Farm (-21.5%), Harbor Wind (-31.5%), and Sherbino 2 Wind (-33.5%). Those wind farms have comparison percentages larger than 10%, which may be caused by wind farm operation issues, meter problems or other similar issues.

Table 4-2 and Figure 4-2 show the design capacity, the maximum and minimum of the observed maximum hourly wind power over the sliding 12-month period, and the observed maximum hourly wind power for the last 12-month period for the studied wind farms. It is interesting to note that in most cases the observed maximum hourly wind power generation is equal to, or slightly lower than the design/announced capacity for all the sites. Figure B-1 to Figure B-157 (in Volume II, Appendix B) also present sliding 12-months wind power generations for degradation analysis. An example of the degradation analysis figures shown in Appendix B is illustrated in Figure 4-1.

[13] The one hundred and fifty-seven sites presented in the degradation analysis section include one hundred and eighty-six individual wind farms.

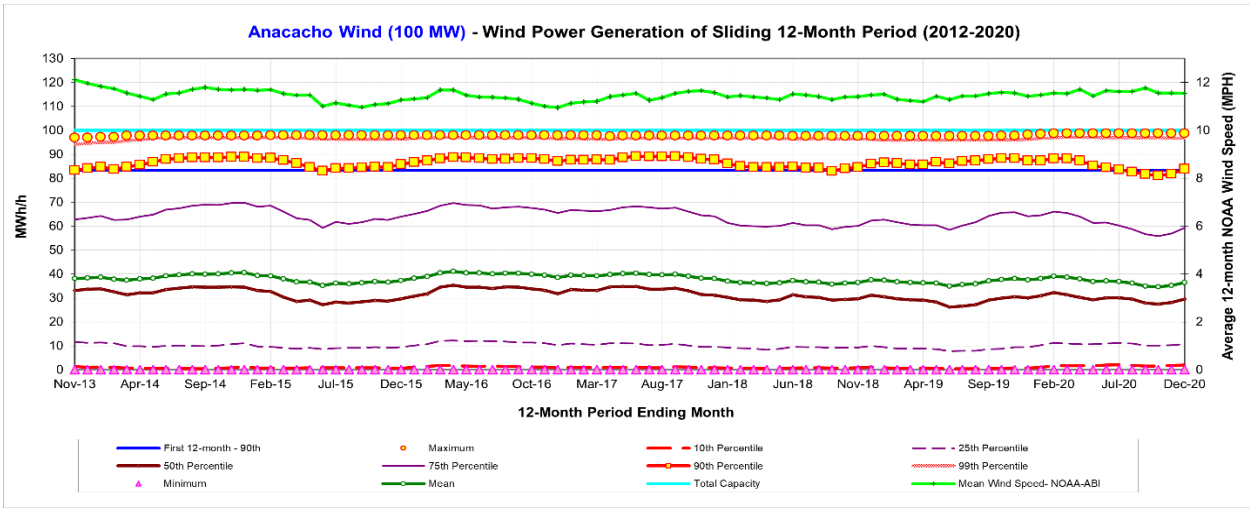


Figure 4-1: Example Sliding 12-month Hourly Wind Power Generation for Anacacho Wind

Table 4-1: Summary of 90th Percentile Hourly Wind Power Degradation Analysis for 157 Wind Farms in Texas

Wind Farm	12-Month Sliding 90th Percentile Hourly Wind Report								No. of Months of Data	Capacity (MW)
	First Year		Average		Minimum		Maximum			
	First 12-mo Ending Mo.	MW	MW	% Diff. vs. First 12-mo	MW	% Diff. vs. First 12-mo	MW	% Diff. vs. First 12-mo		
Anacacho Wind	Nov-13	83.4	86.4	3.6%	81.2	-2.7%	89.2	6.9%	86	100
Baffin Wind 1	Dec-16	80.5	83.6	3.8%	76.5	-5.0%	86.3	7.2%	49	100
Baffin Wind 2	Dec-16	73.3	79.8	8.9%	71.8	-2.0%	83.3	13.6%	49	102
Barton Chapel Wind 1	Dec-09	74.9	74.6	-0.4%	61.2	-18.2%	89.1	19.0%	133	120
Big Spring Wind Farm	Dec-02	27.2	21.4	-21.5%	11.1	-59.2%	27.2	0.0%	217	41
Blue Summit Wind	Oct-13	121.9	119.0	-2.4%	112.3	-7.9%	128.5	5.4%	87	135
Bobcat Bluff Wind	Nov-13	115.0	110.4	-4.0%	92.8	-19.4%	129.8	12.9%	86	150
Brazos Wind Ranch	Dec-04	127.5	122.0	-4.3%	93.5	-26.7%	139.4	9.3%	193	160
Briscoe Wind_19	Jun-16	123.4	113.5	-8.0%	96.8	-21.5%	128.3	4.0%	55	149.8
Buckthorn Wind 1 A	May-18	36.9	39.7	7.4%	36.9	0.0%	41.1	11.2%	32	44.9
Buckthorn Wind 1 B	May-18	47.7	49.7	4.3%	47.6	-0.1%	52.5	10.1%	32	55.7
Buffalo Gap 1	Nov-06	100.9	97.3	-3.5%	75.4	-25.2%	105.7	4.8%	170	120
Buffalo Gap 2	Apr-08	183.4	177.4	-3.3%	104.9	-42.8%	207.6	13.2%	153	233
Buffalo Gap 3	Apr-10	122.4	138.1	12.8%	109.5	-10.5%	152.1	24.2%	129	170
Bull Creek Wind Plant	Dec-09	93.9	95.3	1.5%	41.5	-55.8%	130.4	38.9%	133	180
Callahan Divide Wind	Feb-06	93.3	94.7	1.5%	83.9	-10.0%	101.5	8.8%	179	114
Cameron County Wind (Camwind_Unit1)	Dec-16	128.0	130.0	1.6%	119.8	-6.4%	142.5	11.4%	49	165
Camp Springs Wind 2	Jan-09	94.0	95.9	2.1%	78.8	-16.1%	107.9	14.8%	144	120
Camp Springs Wind Energy Center	Apr-08	111.3	105.0	-5.7%	87.0	-21.8%	120.9	8.6%	153	130
Capricorn Ridge Wind 1&2	Aug-08	258.0	260.4	0.9%	174.5	-32.4%	309.3	19.9%	149	364
Capricorn Ridge Wind 3	Jan-09	120.3	139.0	15.5%	97.9	-18.6%	157.2	30.7%	144	186
Capricorn Ridge Wind 4	May-09	83.5	87.7	5.1%	67.6	-19.0%	100.2	20.0%	140	112.5
Cedro Hill Wind	Dec-11	136.3	123.1	-9.7%	101.9	-25.2%	136.9	0.4%	109	150
Champion Wind Farm	Jan-09	89.4	101.5	13.5%	87.7	-1.9%	113.2	26.6%	144	126.5
Chapman Ranch Wind IA (Santa Cruz)	Mar-18	104.4	91.0	-12.9%	54.6	-47.7%	122.0	16.8%	34	150.6
Chapman Ranch Wind IB (Santa Cruz)	Mar-18	71.1	61.2	-13.9%	41.5	-41.7%	78.9	11.0%	34	98.4
Desert Sky Wind Farm	Dec-02	89.0	115.8	30.1%	83.1	-6.7%	134.4	50.9%	217	160.5
Doug Colbeck's Corner (Conway) A	Jan-17	92.6	93.0	0.4%	91.2	-1.5%	95.2	2.8%	48	100.2
Doug Colbeck's Corner (Conway) B	Jan-17	90.1	92.2	2.4%	85.7	-4.8%	94.7	5.2%	48	100.2
Elbow Creek Wind	Dec-09	94.5	93.8	-0.8%	70.2	-25.7%	105.7	11.8%	133	121.9
Falvez Astra Wind	Jan-18	149.3	141.3	-5.3%	121.0	-18.9%	155.6	4.2%	36	163.2
Forest Creek Wind	Dec-07	105.2	103.1	-2.0%	85.6	-18.6%	111.2	5.7%	157	124.2
Goat Wind	Apr-09	67.0	103.5	54.6%	61.8	-7.8%	122.6	83.0%	141	150
Goldthwaite Wind 1	Dec-14	122.8	127.6	3.9%	115.8	-5.7%	134.4	9.4%	73	149
Grandview Wind 1 (Conway) GV1A	Nov-15	99.3	97.9	-1.3%	91.0	-8.3%	101.4	2.2%	62	107
Grandview Wind 1 (Conway) GV1B	Nov-15	94.0	93.8	-0.3%	89.5	-4.8%	98.0	4.2%	62	104
Green Mountain Wind 1 (Brazos)	Aug-18	92.7	97.7	5.4%	87.7	-5.4%	103.3	11.4%	29	120
Green Mountain Wind 2 (Brazos)	Aug-18	82.8	86.2	4.2%	76.9	-7.1%	90.0	8.8%	29	108
Green Pastures Wind I_19	Feb-16	125.2	133.9	7.0%	125.2	0.0%	139.2	11.2%	59	150
Gulf Wind 1	Jun-10	108.6	99.7	-8.2%	1.9	-98.2%	119.4	9.9%	127	141.6
Gulf Wind 2	Jun-10	116.5	108.9	-6.5%	3.1	-97.3%	126.3	8.4%	127	141.6
Gunsight Mountain Wind	Jan-17	109.5	113.4	3.5%	109.5	0.0%	115.2	5.2%	48	119.9
Hackberry Wind	Dec-09	138.0	126.5	-8.3%	105.8	-23.3%	140.6	1.9%	133	165.5
Harbor Wind	Jan-13	6.1	4.2	-31.5%	0.0	-100.0%	7.1	15.9%	96	9
Hereford Wind G_19	Dec-15	80.9	83.3	3.0%	79.9	-1.2%	86.9	7.5%	61	99.9
Hereford Wind V_19	Dec-15	90.4	94.0	4.0%	90.4	0.0%	95.7	5.8%	61	100
Hidalgo & Starr Wind 11	Jul-17	45.1	45.8	1.6%	39.8	-11.6%	47.3	5.1%	42	52
Hidalgo & Starr Wind 12	Jul-17	85.8	87.7	2.2%	76.5	-10.9%	91.2	6.3%	42	98
Hidalgo & Starr Wind 21	Jul-17	85.0	86.4	1.6%	76.5	-10.1%	89.2	4.9%	42	100
Horse Creek Wind 1	Dec-17	121.6	122.6	0.9%	121.3	-0.2%	123.6	1.7%	37	131.1
Horse Creek Wind 2	Dec-17	92.3	92.4	0.2%	90.8	-1.6%	93.8	1.6%	37	98.9
Horse Hollow Phase 1	Jun-06	157.0	167.4	6.7%	141.3	-10.0%	185.1	17.9%	175	213
Horse Hollow Phase 2	Aug-07	145.7	141.2	-3.1%	99.0	-32.1%	164.9	13.2%	161	184
Horse Hollow Phase 3	May-07	169.2	168.8	-0.3%	123.9	-26.8%	187.7	11.0%	164	223.5
Horse Hollow Phase 4	Jun-07	88.6	90.9	2.5%	80.9	-8.7%	103.1	16.3%	163	115
Inadale Wind	Sep-10	117.9	139.9	18.7%	99.0	-16.0%	166.3	41.1%	124	197
Indian Mesa Wind Farm	Dec-02	48.0	54.7	14.0%	36.0	-24.9%	72.2	50.5%	217	82.5
Javelina II Wind 1	Dec-17	86.2	87.4	1.3%	83.4	-3.3%	89.1	3.3%	37	96
Javelina II Wind 2	Dec-17	64.9	66.4	2.2%	63.4	-2.3%	68.0	4.7%	37	74
Javelina II Wind 3	Dec-17	27.5	27.7	0.8%	26.4	-3.9%	28.5	3.8%	37	30
Javelina Wind 18&20_19	Sep-16	211.0	221.6	5.0%	211.0	0.0%	229.3	8.7%	52	249.7
Jumbo Road Wind 1_19	Mar-16	117.3	123.9	5.6%	117.3	0.0%	129.1	10.1%	58	146.2
Jumbo Road Wind 2_19	Mar-16	119.7	127.6	6.6%	119.7	0.0%	133.0	11.1%	58	153.6
Keechi Wind 138 Kv Joplin_19	Dec-15	99.7	102.5	2.8%	99.5	-0.2%	103.8	4.1%	61	110
King Mountain-NE Wind Farm	Dec-02	41.8	43.4	3.8%	20.8	-50.3%	56.4	34.8%	217	79.3
King Mountain-NW Wind Farm	Dec-02	44.7	51.6	15.4%	27.7	-37.9%	65.3	46.1%	217	79.3
King Mountain-SE Wind Farm	Dec-02	21.6	21.9	1.3%	11.8	-45.7%	28.1	29.8%	217	40.3
King Mountain-SW Wind Farm	Dec-02	41.6	44.3	6.5%	22.9	-44.9%	53.7	29.1%	217	79.3
Langford Wind	Dec-10	115.7	124.5	7.6%	107.8	-6.9%	134.3	16.0%	121	150
Logans Gap Wind I U1_19	Apr-16	88.5	85.9	-2.9%	80.6	-9.0%	90.6	2.3%	57	103.8
Logans Gap Wind I U2_19	Apr-16	83.8	83.4	-0.5%	77.5	-7.6%	86.6	3.3%	57	106.3
Lone Star-Mesquite Wind	Sep-08	140.4	145.8	3.8%	121.0	-13.9%	168.1	19.7%	148	200
Lone Star-Post Oak Wind	Mar-09	149.1	150.9	1.2%	128.1	-14.1%	170.5	14.4%	142	200
Longhorn Wind North U1_19	Mar-16	91.0	92.7	1.8%	91.0	0.0%	94.0	3.3%	58	100
Longhorn Wind North U2_19	Dec-15	88.9	93.1	4.8%	88.9	0.0%	95.0	6.9%	61	100
Loraine Windpark I	Dec-10	30.4	35.9	18.0%	25.9	-14.8%	42.3	39.2%	121	126
Loraine Windpark II	Dec-10	27.8	36.5	31.2%	25.7	-7.6%	43.3	55.7%	121	124.5
Loraine Windpark III	Jan-12	16.2	20.4	25.7%	16.2	0.0%	22.6	39.4%	108	26
Loraine Windpark IV	Dec-12	17.4	17.3	-0.6%	5.0	-71.5%	20.8	19.1%	97	24

Table 4-1: Summary of 90th Percentile Hourly Wind Power Degradation Analysis for 157 Wind Farms in Texas (Cont.)

Wind Farm	12-Month Sliding 90th Percentile Hourly Wind Report								No. of Months of Data	Capacity (MW)
	First Year		Average		Minimum		Maximum			
	First 12-mo Ending Mo.	MW	MW	% Diff. vs. First 12-mo	MW	% Diff. vs. First 12-mo	MW	% Diff. vs. First 12-mo		
Los Vientos I Wind	Oct-13	148.5	164.6	10.8%	148.5	0.0%	175.1	17.9%	87	200.1
Los Vientos II Wind	Nov-13	153.3	149.3	-2.6%	124.6	-18.7%	164.3	7.2%	86	201.6
Los Vientos Iii Wind_19	Feb-16	154.0	167.3	8.7%	154.0	0.0%	175.9	14.3%	59	200
Los Vientos IV Wind	Apr-17	167.7	173.3	3.4%	160.1	-4.5%	180.0	7.3%	45	200
Los Vientos V Wind	Dec-16	92.1	93.6	1.6%	89.4	-3.0%	96.9	5.2%	49	110
Magic Valley Wind (Redfish) 1A	Apr-13	88.6	85.1	-3.9%	70.8	-20.0%	90.7	2.4%	93	99.8
Magic Valley Wind (Redfish) 1B	Jul-13	94.2	88.9	-5.7%	76.5	-18.8%	94.6	0.4%	90	103.5
Mariah Del Norte 1	Dec-17	103.7	103.5	-0.3%	98.6	-5.0%	106.7	2.8%	37	115.2
Mariah Del Norte 2	Dec-17	105.6	104.0	-1.5%	97.6	-7.6%	107.9	2.2%	37	115.2
McAdoo Wind	Dec-09	111.7	135.5	21.3%	111.7	0.0%	143.6	28.5%	133	150
Mesquite Creek Wind 1_19	Dec-15	93.3	91.7	-1.7%	83.6	-10.3%	97.7	4.7%	61	105.6
Mesquite Creek Wind 2_19	Dec-15	90.5	90.2	-0.3%	83.6	-7.6%	96.2	6.2%	61	105.6
Miami Wind G1	Aug-15	125.8	129.4	2.8%	124.9	-0.8%	132.6	5.4%	65	144
Miami Wind G2	Aug-15	126.0	129.8	3.1%	125.4	-0.5%	133.4	5.9%	65	144
Notrees Windpower	Feb-10	103.7	112.3	8.3%	103.7	0.0%	122.9	18.6%	131	153
Ocotillo Windpower	Dec-09	39.1	38.3	-2.1%	16.4	-58.0%	47.2	20.7%	133	58.8
Panhandle Wind 1 U1	May-15	94.5	95.5	1.0%	82.7	-12.5%	101.3	7.2%	68	109
Panhandle Wind 1 U2	May-15	90.6	91.7	1.2%	80.4	-11.2%	98.0	8.2%	68	109
Panhandle Wind 2 U1	Oct-15	88.2	87.1	-1.3%	82.3	-6.6%	90.0	2.0%	63	94
Panhandle Wind 2 U2	Sep-15	90.2	90.0	-0.2%	85.8	-4.8%	93.4	3.6%	64	97
Panther Creek 2	Dec-09	91.8	96.7	5.4%	83.5	-9.0%	107.7	17.3%	133	115.5
Panther Creek 3	Aug-10	128.5	154.8	20.5%	120.0	-6.6%	177.1	37.8%	125	199.5
Panther Creek	Dec-09	114.4	121.7	6.4%	107.8	-5.8%	130.4	14.0%	133	142.5
Papalote Creek Phase II	Dec-11	174.2	163.5	-6.1%	148.5	-14.8%	176.3	1.2%	109	200.1
Papalote Creek Wind Farm	Dec-10	150.1	133.9	-10.8%	39.6	-73.6%	157.9	5.2%	121	180
Penascal Wind 1	Feb-11	133.2	121.9	-8.5%	85.2	-36.0%	141.5	6.2%	119	161
Penascal Wind 2	Dec-09	83.3	106.4	27.8%	74.9	-10.0%	125.4	50.5%	133	142
Penascal Wind 3	May-11	87.1	74.2	-14.8%	53.0	-39.2%	88.8	2.0%	116	101
Pyron	Dec-09	157.2	192.5	22.5%	151.4	-3.7%	220.1	40.0%	133	249
Rattlesnake Den Wind Phase 1 G1_19	Mar-16	97.0	92.4	-4.8%	78.6	-18.9%	99.7	2.8%	58	104.3
Rattlesnake Den Wind Phase 1 G2_19	Mar-16	93.5	89.6	-4.2%	76.2	-18.5%	97.3	4.0%	58	103
Red Canyon1	Aug-07	76.4	75.8	-0.8%	71.0	-7.0%	79.5	4.1%	161	84
Roscoe Wind Farm	Dec-08	169.4	152.4	-10.0%	108.1	-36.2%	179.8	6.2%	145	209
Route 66 Wind_19	Mar-16	139.0	139.3	0.2%	132.9	-4.4%	142.6	2.5%	58	150
Saltfork_Unit1	Aug-17	58.1	60.7	4.5%	58.1	0.0%	61.7	6.2%	41	64
Saltfork_Unit2	Aug-17	100.9	104.3	3.3%	100.9	0.0%	105.4	4.4%	41	110
San Roman Wind	Dec-17	82.1	79.6	-3.1%	72.5	-11.7%	82.9	1.0%	37	95.2
Sand Bluff Wind	Nov-08	69.4	62.9	-9.3%	39.8	-42.6%	75.4	8.6%	146	90
Senate Wind	Sep-13	127.1	125.3	-1.4%	119.0	-6.4%	132.2	4.0%	88	150
Sendero Wind Energy_19	Aug-16	67.2	70.5	5.0%	67.2	0.0%	72.6	8.1%	53	76
Shannon Wind_19	Oct-16	175.3	178.8	2.0%	174.6	-0.4%	183.9	4.9%	51	204.1
Sherbino 1 Wind	Dec-09	104.7	102.9	-1.7%	42.1	-59.8%	128.1	22.4%	133	150
Sherbino 2 Wind	Dec-12	125.7	83.6	-33.5%	13.3	-89.5%	125.7	0.0%	97	150
Silver Star Wind	Apr-09	40.6	40.1	-1.2%	6.1	-85.0%	50.5	24.4%	141	60
Snyder Wind Project	Dec-08	46.5	42.4	-8.7%	17.4	-62.6%	50.9	9.6%	145	63
South Plains Wind 2_19	Jul-16	89.2	90.4	1.4%	88.1	-1.2%	92.5	3.7%	54	98
South Plains Wind I_19	Jul-16	94.8	93.4	-1.5%	90.7	-4.4%	95.5	0.8%	54	102
South Plains Wind II A	Dec-16	120.2	135.6	12.8%	120.2	0.0%	141.3	17.5%	49	148.5
South Plains Wind II B	Dec-16	128.1	140.9	10.0%	128.1	0.0%	145.1	13.2%	49	151.8
South Trent Wind Farm	Dec-09	67.7	82.7	22.2%	65.4	-3.5%	91.0	34.4%	133	101.2
Spinning Spur 3 (Wind 1)_19	Apr-16	87.5	90.6	3.5%	87.5	0.0%	91.6	4.7%	57	96
Spinning Spur 3 (Wind 2)_19	Apr-16	88.4	92.9	5.1%	88.4	0.0%	93.9	6.2%	57	98
Spinning Spur Wind Two	May-15	140.9	145.7	3.4%	140.9	0.0%	149.4	6.1%	68	161
Stanton Wind Energy	Dec-08	79.4	94.9	19.6%	75.3	-5.2%	107.1	34.8%	145	120
Stephens Ranch Wind 2_19	Mar-16	144.3	148.7	3.1%	144.3	0.0%	151.9	5.3%	58	164.7
Stephens Ranch Wind Phase 1	Nov-15	182.9	189.0	3.3%	182.9	0.0%	193.1	5.6%	62	211
Sweetwater Wind 1	Dec-04	34.1	33.1	-2.9%	28.8	-15.4%	36.2	6.2%	193	37.5
Sweetwater Wind 2	Jan-06	71.4	82.6	15.8%	71.4	0.0%	89.6	25.6%	180	97.5
Sweetwater Wind 3	Dec-06	99.6	101.1	1.5%	67.1	-32.7%	111.2	11.6%	169	135
Sweetwater Wind 4	Mar-08	161.0	171.2	6.3%	153.2	-4.9%	182.2	13.2%	154	240.8
Sweetwater Wind 5	Dec-08	66.5	61.7	-7.2%	45.6	-31.4%	69.3	4.3%	145	80.5
Sweetwater Wind24	Mar-08	13.1	13.7	4.3%	12.0	-8.7%	14.8	13.3%	154	16
Trent Mesa Wind Farm	Dec-02	108.8	108.8	0.0%	33.4	-69.3%	132.8	22.0%	217	150
Trinity Hills Wind Farm 1	Dec-12	78.8	71.2	-9.7%	12.5	-84.2%	89.3	13.3%	97	118
Trinity Hills Wind Farm 2	Dec-12	74.8	70.4	-5.9%	23.9	-68.0%	88.0	17.7%	97	108
Turkey Track Wind Energy Center	Dec-09	77.4	123.7	59.9%	76.5	-1.1%	143.1	85.0%	133	169.5
Tyler Bluff Wind	Aug-17	104.0	108.2	4.0%	104.0	0.0%	110.7	6.5%	41	125.6
Vertigo Wind (Formerly Green Pastures Wind 2)_19	Nov-16	123.5	129.1	4.6%	121.3	-1.8%	133.4	8.0%	50	150
Wake Wind 1	Apr-17	109.3	109.0	-0.3%	107.4	-1.8%	110.2	0.8%	45	114.9
Wake Wind 2	Apr-17	136.0	135.3	-0.5%	133.3	-2.0%	137.0	0.7%	45	142.3
Whirlwind	Dec-08	54.0	52.0	-3.7%	39.8	-26.3%	56.9	5.4%	145	60
Whitetail Wind	Oct-13	72.9	67.7	-7.0%	60.2	-17.4%	73.1	0.3%	87	92
Willow Springs Wind A	Jul-18	118.1	118.4	0.2%	116.8	-1.2%	119.6	1.2%	30	125
Willow Springs Wind B	Jul-18	117.7	118.3	0.5%	117.4	-0.2%	119.3	1.4%	30	125
Windthorst 2	Oct-15	50.3	56.3	11.9%	50.3	0.0%	59.4	18.1%	63	68
WKN Mozart Wind	Oct-13	22.4	22.0	-1.9%	19.4	-13.4%	25.8	15.0%	87	30
Wolf Ridge Wind	Dec-09	105.9	99.9	-5.7%	81.2	-23.4%	108.8	2.7%	133	112.5
Woodward Wind Farm	Dec-02	85.3	94.1	10.4%	65.2	-23.5%	112.4	31.8%	217	159.7
Weighted Average:				**0.0%**		**0.0%**		**0.0%**	**Total:**	**19,786**

Table 4-2: Summary of Maximum Hourly Wind Power Analysis for 157 Wind Farm in Texas

Wind Farm	Design Capacity (A)	12-Month Slididng Maximum MW-Measured		Maximum MW in Last 12-mo - Measured (D)	Difference (A-B)	Difference (B-D)
		Maximum (B)	Minimum (C)			
Anacacho Wind	100	98.7	97.0	98.7	1.3	0.0
Baffin Wind 1	100	98.6	96.0	96.0	1.4	2.6
Baffin Wind 2	102	99.9	98.9	99.9	2.1	0.0
Barton Chapel Wind 1	120	114.1	101.1	106.9	5.9	7.2
Big Spring Wind Farm	41	37.0	17.1	29.0	4.0	8.0
Blue Summit Wind	135	135.0	132.7	134.7	0.0	0.3
Bobcat Bluff Wind	150	150.0	145.2	150.0	0.0	0.0
Brazos Wind Ranch	160	160.0	118.9	135.3	0.0	24.6
Briscoe Wind_19	150	147.9	146.0	147.2	1.9	0.6
Buckthorn Wind 1 A	45	43.9	43.9	43.9	1.0	0.0
Buckthorn Wind 1 B	56	54.4	54.3	54.4	1.3	0.0
Buffalo Gap 1	120	120.0	111.5	117.3	0.0	2.7
Buffalo Gap 2	233	232.7	223.3	223.3	0.3	9.4
Buffalo Gap 3	170	167.9	162.1	162.1	2.1	5.9
Bull Creek Wind Plant	180	177.6	73.6	170.1	2.4	7.5
Callahan Divide Wind	114	114.0	103.7	114.0	0.0	0.0
Cameron County Wind (Camwind_Unit1)	165	163.6	156.4	163.6	1.4	0.0
Camp Springs Wind 2	120	120.0	118.3	119.6	0.0	0.4
Camp Springs Wind Energy Center	130	130.0	125.7	129.5	0.0	0.5
Capricorn Ridge Wind 1&2	364	358.3	335.8	350.5	5.7	7.8
Capricorn Ridge Wind 3	186	186.0	180.1	182.8	0.0	3.2
Capricorn Ridge Wind 4	113	112.5	110.1	112.5	0.0	0.0
Cedro Hill Wind	150	149.9	144.5	144.5	0.1	5.4
Champion Wind Farm	127	124.5	122.3	122.3	2.0	2.2
Chapman Ranch Wind IA (Santa Cruz)	151	148.3	76.1	138.3	2.3	10.0
Chapman Ranch Wind IB (Santa Cruz)	98	96.8	51.3	96.8	1.6	0.0
Desert Sky Wind Farm	161	160.3	105.8	139.5	0.3	20.8
Doug Colbeck's Corner (Conway) A	100	100.1	98.2	98.3	0.1	1.9
Doug Colbeck's Corner (Conway) B	100	99.5	97.6	98.5	0.7	1.0
Elbow Creek Wind	122	118.7	88.9	118.2	3.2	0.4
Falvez Astra Wind	163	162.8	162.0	162.2	0.4	0.6
Forest Creek Wind	124	123.9	112.0	112.0	0.3	11.9
Goat Wind	150	149.9	80.9	139.7	0.1	10.2
Goldthwaite Wind 1	149	148.7	143.9	148.6	0.3	0.1
Grandview Wind 1 (Conway) GV1A	107	106.9	103.5	105.3	0.1	1.6
Grandview Wind 1 (Conway) GV1B	104	103.8	99.3	99.7	0.2	4.1
Green Mountain Wind 1 (Brazos)	120	119.9	119.6	119.6	0.1	0.3
Green Mountain Wind 2 (Brazos)	108	108.0	107.8	107.8	0.0	0.2
Green Pastures Wind I_19	150	149.9	148.5	149.7	0.1	0.2
Gulf Wind 1	142	140.7	106.6	106.6	0.9	34.0
Gulf Wind 2	142	140.9	72.7	72.7	0.7	68.2
Gunsight Mountain Wind	120	118.6	118.4	118.4	1.3	0.2
Hackberry Wind	166	162.8	162.0	162.3	2.7	0.5
Harbor Wind	9	9.0	0.0	0.0	0.0	9.0
Hereford Wind G_19	100	98.4	96.6	98.1	1.5	0.3
Hereford Wind V_19	100	99.2	98.0	98.8	0.8	0.4
Hidalgo & Starr Wind 11	52	51.7	51.1	51.7	0.3	0.0
Hidalgo & Starr Wind 12	98	97.8	96.3	97.5	0.2	0.3
Hidalgo & Starr Wind 21	100	98.3	97.4	97.5	1.7	0.8
Horse Creek Wind 1	131	130.9	130.4	130.4	0.2	0.5
Horse Creek Wind 2	99	98.3	98.2	98.3	0.6	0.1
Horse Hollow Phase 1	213	212.2	196.7	212.2	0.8	0.0
Horse Hollow Phase 2	184	183.4	156.7	179.3	0.6	4.1
Horse Hollow Phase 3	224	223.0	178.7	219.6	0.5	3.4
Horse Hollow Phase 4	115	114.0	105.3	112.2	1.0	1.8
Inadale Wind	197	197.0	188.5	196.9	0.0	0.1
Indian Mesa Wind Farm	83	82.5	49.4	82.5	0.0	0.0
Javelina II Wind 1	96	95.8	95.6	95.7	0.2	0.1
Javelina II Wind 2	74	73.7	73.5	73.5	0.3	0.2
Javelina II Wind 3	30	30.0	30.0	30.0	0.0	0.0
Javelina Wind 18&20_19	250	247.9	245.3	245.3	1.8	2.6
Jumbo Road Wind 1_19	146	144.9	143.3	144.9	1.3	0.0
Jumbo Road Wind 2_19	154	153.2	151.0	153.2	0.4	0.0
Keechi Wind 138 Kv Joplin_19	110	107.5	106.7	107.5	2.5	0.0
King Mountain-NE Wind Farm	79	77.0	47.2	67.0	2.3	10.0
King Mountain-NW Wind Farm	79	77.6	52.1	65.5	1.7	12.2
King Mountain-SE Wind Farm	40	40.0	27.8	33.9	0.3	6.2
King Mountain-SW Wind Farm	79	75.9	45.6	68.1	3.4	7.8
Langford Wind	150	150.0	147.2	150.0	0.0	0.0
Logans Gap Wind I U1_19	104	103.3	95.6	103.2	0.5	0.0
Logans Gap Wind I U2_19	106	102.1	99.4	101.3	4.2	0.8
Lone Star-Mesquite Wind	200	195.0	172.5	172.5	5.0	22.4
Lone Star-Post Oak Wind	200	192.1	178.8	181.2	7.9	10.9
Longhorn Wind North U1_19	100	99.3	97.6	97.7	0.7	1.6
Longhorn Wind North U2_19	100	99.0	97.7	98.1	1.0	0.9
Loraine Windpark I	126	95.2	48.0	57.8	30.8	37.4
Loraine Windpark II	125	85.0	49.2	85.0	39.5	0.0
Loraine Windpark III	26	26.0	23.6	25.7	0.0	0.3
Loraine Windpark IV	24	24.0	17.5	23.9	0.0	0.1

Table 4-2: Summary of Maximum Hourly Wind Power Analysis for 157 Wind Farm in Texas (Cont.)

Wind Farm	Design Capacity (A)	12-Month Slididng Maximum MW-Measured		Maximum MW in Last 12-mo - Measured (D)	Difference (A-B)	Difference (B-D)
		Maximum (B)	Minimum (C)			
Los Vientos I Wind	200	199.2	195.9	195.9	0.9	3.4
Los Vientos II Wind	202	201.4	195.8	198.1	0.2	3.2
Los Vientos Iii Wind_19	200	195.5	188.0	190.5	4.5	5.0
Los Vientos IV Wind	200	195.6	192.0	193.2	4.4	2.5
Los Vientos V Wind	110	107.8	105.6	107.5	2.2	0.3
Magic Valley Wind (Redfish) 1A	100	98.7	95.9	98.2	1.1	0.4
Magic Valley Wind (Redfish) 1B	104	103.4	99.3	103.4	0.1	0.1
Mariah Del Norte 1	115	113.7	112.9	112.9	1.5	0.9
Mariah Del Norte 2	115	114.3	113.7	113.7	0.9	0.6
McAdoo Wind	150	150.0	149.6	150.0	0.0	0.0
Mesquite Creek Wind 1_19	106	104.1	100.1	100.1	1.5	4.0
Mesquite Creek Wind 2_19	106	103.6	100.2	101.5	2.0	2.1
Miami Wind G1	144	141.3	139.1	139.1	2.7	2.2
Miami Wind G2	144	141.5	139.3	139.3	2.5	2.1
Notrees Windpower	153	151.7	137.3	138.5	1.3	13.2
Ocotillo Windpower	59	57.5	38.1	38.1	1.3	19.4
Panhandle Wind 1 U1	109	109.0	106.1	108.8	0.0	0.2
Panhandle Wind 1 U2	109	108.3	103.7	103.8	0.7	4.5
Panhandle Wind 2 U1	94	93.8	91.3	92.3	0.2	1.5
Panhandle Wind 2 U2	97	96.9	94.7	94.9	0.1	2.0
Panther Creek 2	116	115.5	112.2	115.5	0.0	0.0
Panther Creek 3	200	199.5	193.6	199.3	0.0	0.2
Panther Creek	143	142.5	139.0	142.5	0.0	0.0
Papalote Creek Phase II	200	195.6	191.6	193.9	4.5	1.7
Papalote Creek Wind Farm	180	180.0	49.2	177.0	0.0	3.0
Penascal Wind 1	161	161.0	137.0	137.0	0.0	24.0
Penascal Wind 2	142	142.0	120.9	120.9	0.0	21.1
Penascal Wind 3	101	100.9	92.6	92.6	0.1	8.3
Pyron	249	249.0	244.3	248.8	0.0	0.2
Rattlesnake Den Wind Phase 1 G1_19	104	103.6	95.3	98.8	0.7	4.8
Rattlesnake Den Wind Phase 1 G2_19	103	101.7	97.0	98.9	1.3	2.7
Red Canyon1	84	84.0	82.1	82.8	0.0	1.2
Roscoe Wind Farm	209	209.0	199.5	208.7	0.0	0.3
Route 66 Wind_19	150	147.1	146.3	146.8	2.9	0.3
Saltfork_Unit1	64	64.0	62.8	63.0	0.0	0.9
Saltfork_Unit2	110	108.7	108.3	108.6	1.3	0.1
San Roman Wind	95	94.4	93.4	94.2	0.8	0.3
Sand Bluff Wind	90	89.3	67.3	67.3	0.7	22.0
Senate Wind	150	146.1	141.8	142.8	3.9	3.3
Sendero Wind Energy_19	76	76.0	75.9	76.0	0.0	0.0
Shannon Wind_19	204	202.1	201.3	201.5	2.0	0.6
Sherbino 1 Wind	150	149.9	96.1	96.1	0.1	53.8
Sherbino 2 Wind	150	146.8	44.4	115.6	3.2	31.2
Silver Star Wind	60	60.0	14.1	49.0	0.0	11.0
Snyder Wind Project	63	63.0	36.6	36.6	0.0	26.4
South Plains Wind 2_19	98	97.3	95.5	95.8	0.7	1.4
South Plains Wind I_19	102	100.7	99.1	99.4	1.3	1.3
South Plains Wind II A	149	146.4	145.5	146.4	2.1	0.0
South Plains Wind II B	152	149.8	148.3	149.8	2.0	0.0
South Trent Wind Farm	101	99.0	89.8	97.0	2.2	2.0
Spinning Spur 3 (Wind 1)_19	96	95.4	93.6	95.4	0.6	0.0
Spinning Spur 3 (Wind 2)_19	98	98.0	95.4	96.9	0.0	1.1
Spinning Spur Wind Two	161	157.9	156.3	157.7	3.1	0.2
Stanton Wind Energy	120	120.0	118.7	119.4	0.0	0.6
Stephens Ranch Wind 2_19	165	164.1	160.5	164.1	0.6	0.0
Stephens Ranch Wind Phase 1	211	207.6	204.8	207.2	3.4	0.4
Sweetwater Wind 1	38	37.5	36.0	37.4	0.0	0.1
Sweetwater Wind 2	98	97.5	91.8	97.5	0.0	0.0
Sweetwater Wind 3	135	132.5	121.5	132.5	2.5	0.0
Sweetwater Wind 4	241	240.6	216.7	238.0	0.2	2.6
Sweetwater Wind 5	81	80.5	76.9	77.4	0.0	3.1
Sweetwater Wind24	16	16.0	15.9	16.0	0.0	0.0
Trent Mesa Wind Farm	150	147.6	37.4	37.8	2.4	109.7
Trinity Hills Wind Farm 1	118	117.7	29.4	100.8	0.3	16.9
Trinity Hills Wind Farm 2	108	107.6	45.5	95.6	0.4	11.9
Turkey Track Wind Energy Center	170	169.5	164.8	168.7	0.0	0.8
Tyler Bluff Wind	126	123.2	117.5	123.2	2.4	0.0
Vertigo Wind (Formerly Green Pastures Wind 2)_19	150	148.6	146.9	146.9	1.4	1.7
Wake Wind 1	115	114.5	113.1	114.5	0.4	0.0
Wake Wind 2	142	140.4	138.7	140.2	1.9	0.2
Whirlwind	60	59.3	57.0	58.4	0.7	0.9
Whitetail Wind	92	90.7	88.5	88.5	1.3	2.1
Willow Springs Wind A	125	125.0	124.5	124.5	0.0	0.5
Willow Springs Wind B	125	124.4	124.0	124.4	0.6	0.0
Windthorst 2	68	66.7	64.5	66.3	1.3	0.4
WKN Mozart Wind	30	30.0	29.9	29.9	0.0	0.1
Wolf Ridge Wind	113	112.5	109.2	109.9	0.0	2.6
Woodward Wind Farm	160	148.7	104.1	142.2	11.0	6.5
Total:	**19,786.0**	**19,533.1**	**17,464.3**	**18,692.1**	**252.9**	**841.0**

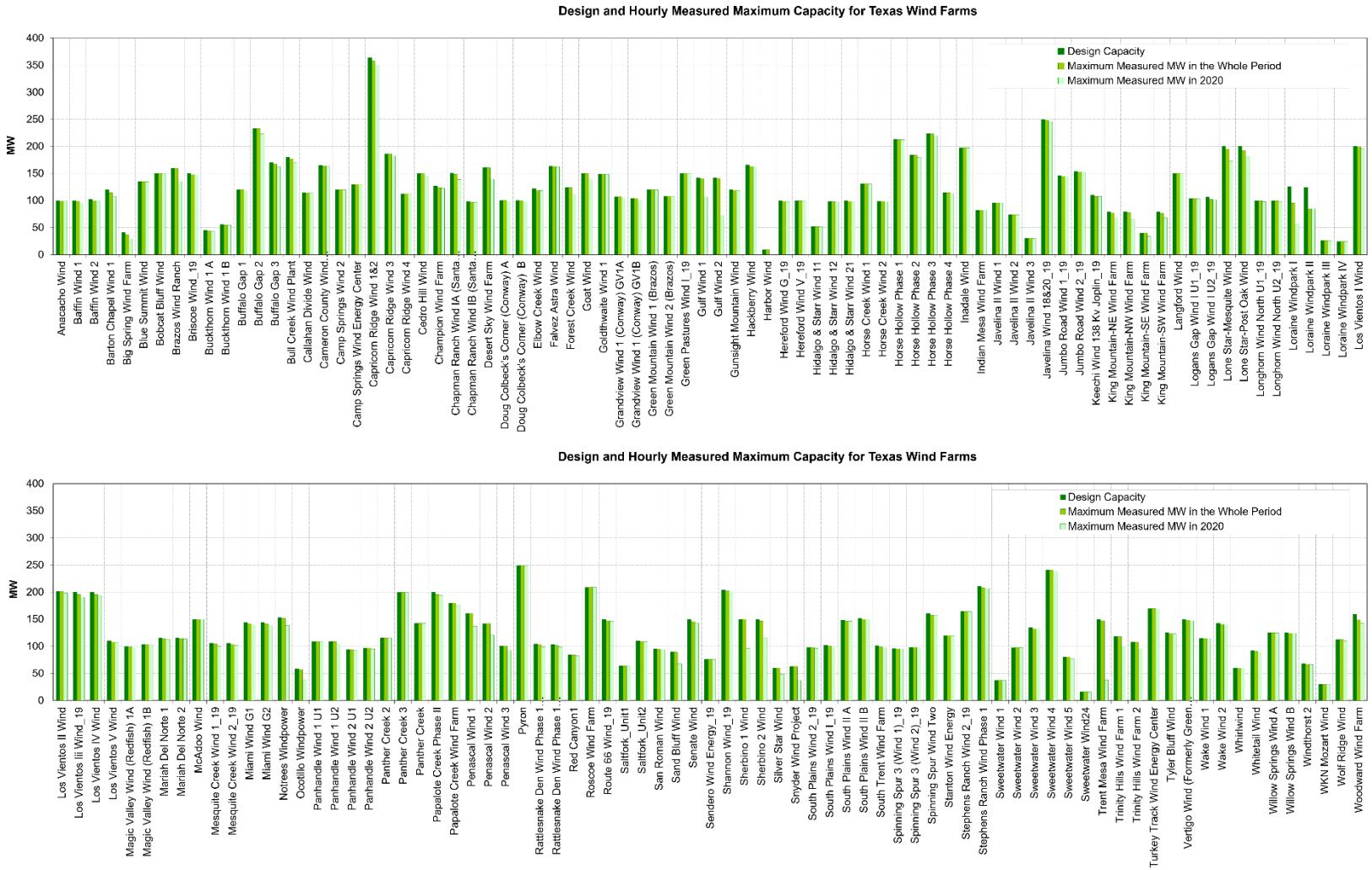


Figure 4-2: Design and Hourly Measured Maximum Capacity for 157 Wind Farms

5 CALCULATING NO_x EMISSIONS REDUCTION FROM WIND POWER

5.1 Calculation of NOx Emissions from Wind Power Using 2018 eGRID

The Energy Systems Laboratory has worked closely with the TCEQ and EPA to develop credible procedures for calculating NOx reductions from electricity savings using the 2018 EPA's Emissions and Generation Resource Integrated Database (eGRID[14]). The calculation uses a simplified dispatch approach of the ERCOT grid to estimate NOx emission reductions across the ERCOT region in Texas. ERCOT is currently divided into four CL zones: Houston (H), North (N), South (S), and West (W). The 2018 eGrid table, which describes the distribution of the NOx emission reductions per Competitive Load (CL) zone for each county in Texas, has four developed steps (EPA and ESL: 2008):

1. assign energy savings to CL Zones
2. assign generation reductions within each CL Zone to individual plants
3. determine plant-specific NOx emission rates
4. assemble all CL Zones for total savings

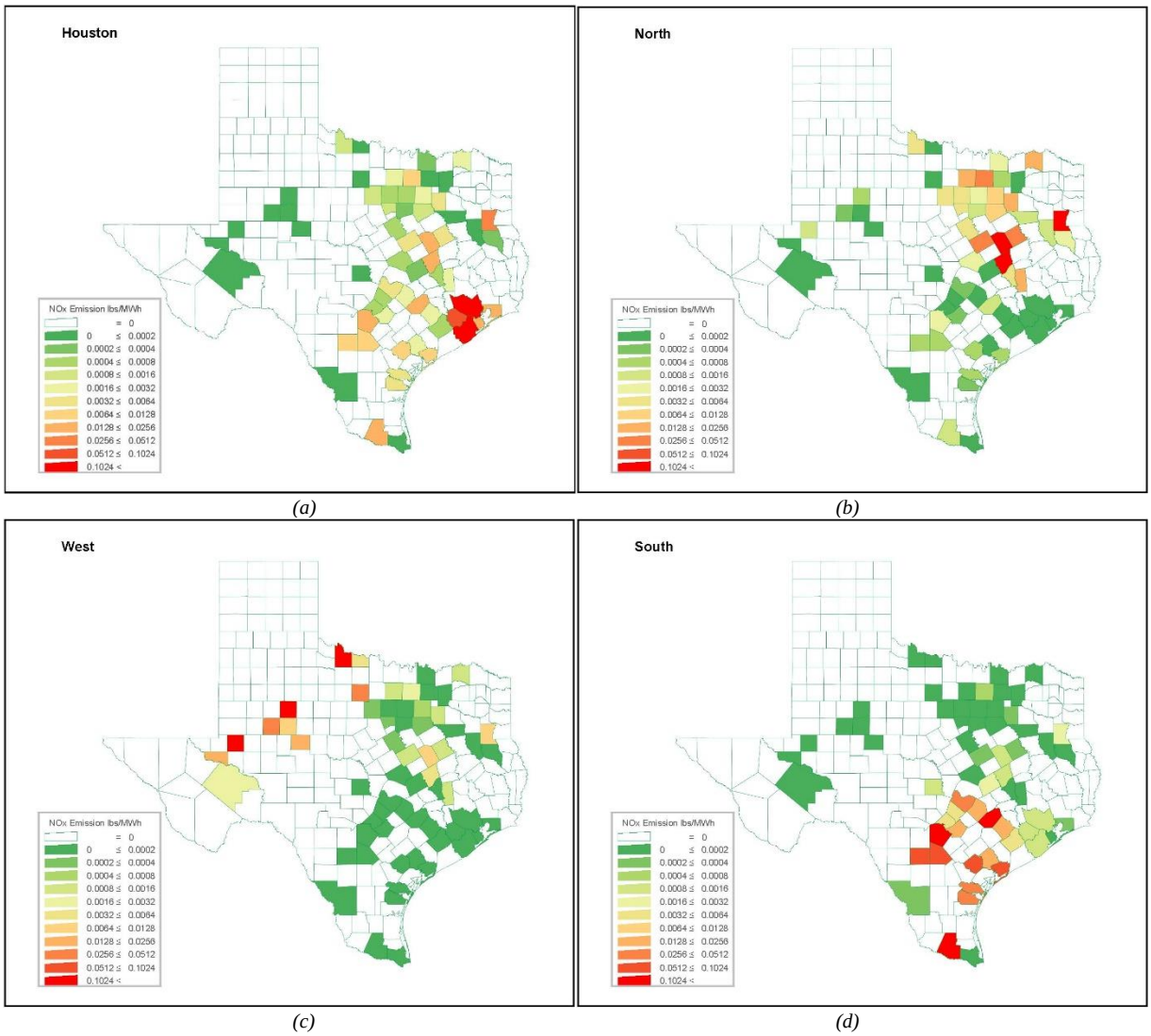
The procedure presented in this section calculates annual and peak-day, county-wide NOx reductions from electricity generations from wind projects implemented in the ERCOT CL Zones listed in the EPA's eGRID. For this purpose, a special version of eGRID[15] was developed that reflects the 2018 electricity and pollution from electric utilities in ERCOT. The NOx production for each power plant is provided from the 2018 eGRID database for four CL zones: Houston, North, West, and South. This eGRID matrix was utilized to assign the power plant used by CL zones, once a CL zone had been chosen for a given county. Figure 5-1 shows a snapshot of the NOx emission distribution among Texas counties from generating one mega-watt-hour of electricity in the CL zones, which was derived from the 2018 Annual eGRID table. For example, the counties marked in red show higher NOx emissions of above 0.1 lbs/MWh. The counties marked in dark green were least impacted by the NOx emissions (less than 0.0005 lbs/MWh), Figure 5-1 and Figure 5-2 shows county-wide NOx emissions distribution for all the CL zones: Houston, North, West, and South.

Table 5-1 shows the latest wind farm information from PUCT, updated in Jan 2021. To calculate the NOx emissions reduction from the wind projects within the ERCOT region, the total MWh wind power for each CL zone is summarized in Table 5-2 for modeled 2018 baseline and 2020 measured data. Both annual wind power and OSP wind power are presented. Only the completed projects are shown in the ERCOT, WSCC and SPP regions, with a total generation capacity of 33,186 MW by wind resource. The total MWh production in each CL zone was input in the corresponding cells in the eGRID table to calculate the total annual and OSP emissions reductions for the entire ERCOT region in 2018 model (using 2018 wind speed data) and 2020 (using measured data), as shown from Table 5-3 to Table 5-6.

According to the developed models, the total MWh savings in the base year 2018 for the wind farms within the ERCOT region are 90,732,487 MWh/yr and 243,411 MWh/day in the OSP, compared with total 87,079,414 MWh/yr savings and 225,118 MWh/day in the OSP in 2020 within ERCOT. The total NOx emissions reductions for modeled 2018 across all the counties amount to 55082.9 tons/yr and 139.2 tons/day for the OSP. Compared to the modeled 2018, the total NOx emissions reductions in 2020 is lower by 2.9 %, from 55082.9 tons/yr to 53492.4 tons/yr. For the OSP, the total NOx emissions reductions in 2020 is lower by 8.9 %, from 139.2 tons/day to 130.5 tons/day. The distribution of the NOx emissions reduction in the counties within the ERCOT region is shown in Figure 5-3 through Figure 5-6. The 2018 eGRID shows that the counties Scurry, Potter and Wilbarger got the most emissions benefit from the wind farms.

[14] This report used the non-attainment areas established by TCEQ information at https://www.tceq.texas.gov/assets/public/comm_exec/pubs/rg/rg388/rg-388.pdf

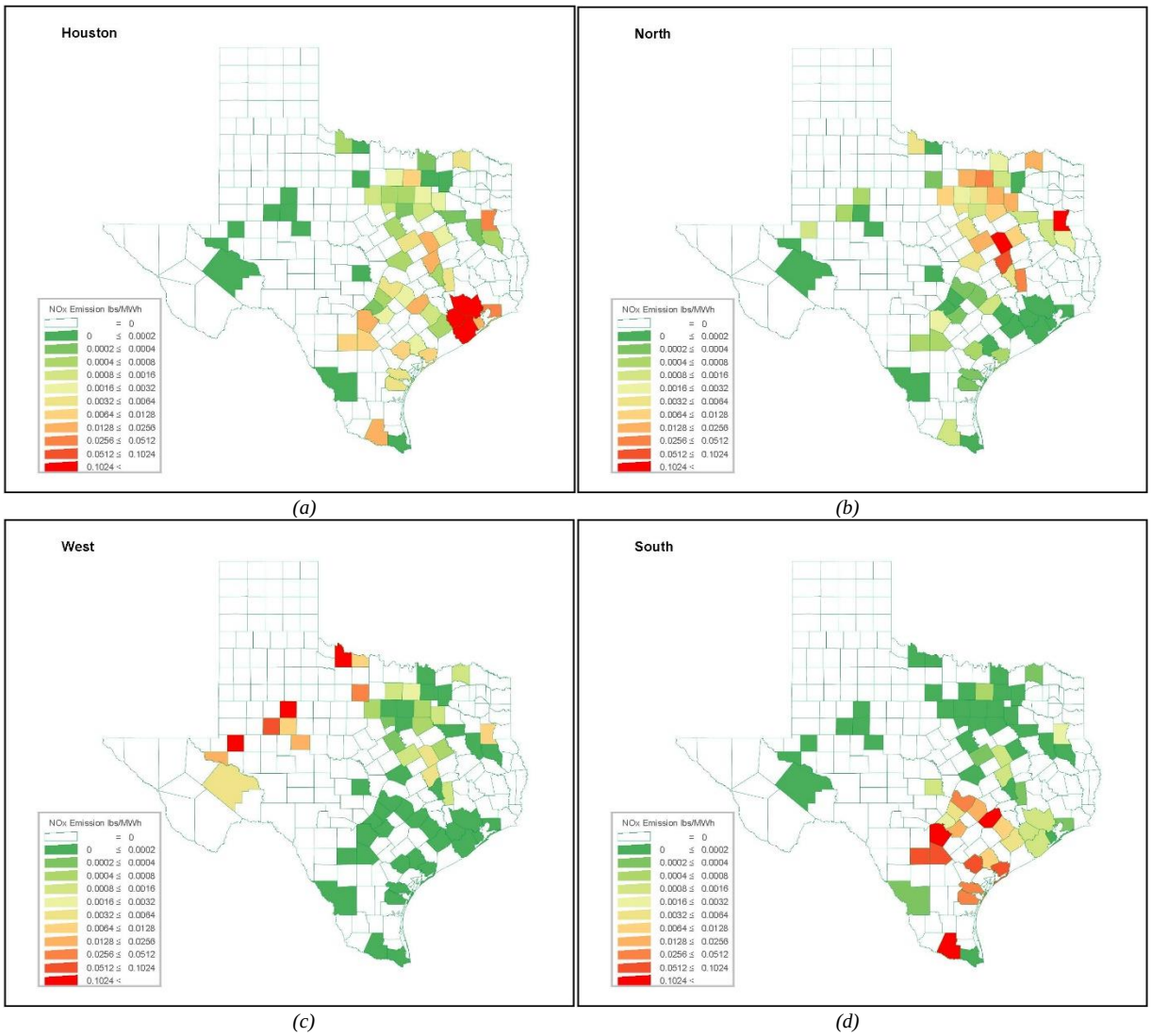
[15] 2018 eGRID table for Texas was retrieved by the US EPA at https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid



(a) *(b)*

(c) *(d)*

Figure 5-1: 2018 Annual eGRID NOx Emissions for the CL zones: (a) Houston, (b) North, (c) West and (d) South.



(a) *(b)*

(c) *(d)*

Figure 5-2: 2018 OSP eGRID NOx Emissions for the CL zones: (a) Houston, (b) North, (c) West and (d) South.

Table 5-1: Wind Farm Information from the PUCT — Updated Jan 15th, 2021

Facility	County	Resource	Capacity (MW)	In Service	Region	Notes
Big SpriGas Wind Power	Howard	Wind	27.7	Feb-99	ERCOT	
Big SpriGas Wind Power	Howard	Wind	6.6	Jun-99	ERCOT	
Hueco Mountain Wind Ranch	El Paso	Wind	1.3	Apr-01	WSCC	
Indian Mesa	Pecos	Wind	91.8	Jun-01	ERCOT	
Woodward Mountain Ranch	Pecos	Wind	176.0	Jul-01	ERCOT	
Trent Mesa	Nolan	Wind	150.0	Nov-01	ERCOT	
Desert Sky (Indian Mesa II)	Pecos	Wind	170.2	Dec-01	ERCOT	
KiGas Mountain Wind Ranch	Upton	Wind	279.6	Dec-01	ERCOT	
Llano Estacado Wind Ranch	Carson	Wind	79.0	Jan-02	SPP	
Brazos Wind Ranch	Scurry	Wind	160.0	Dec-03	ERCOT	
Sweetwater Wind 1	Nolan	Wind	42.5	Dec-03	ERCOT	
Hansford	Hansford	Wind	3.0	Dec-03	SPP	
Callahan Divide Wind Energy Center	Taylor	Wind	114.0	Feb-05	ERCOT	
Sweetwater Wind 2	Nolan	Wind	127.6	Feb-05	ERCOT	
Buffalo Gap 1	Taylor	Wind	120.6	Sep-05	ERCOT	
Horse Hollow Phase 1	Taylor	Wind	230.0	Oct-05	ERCOT	
Sweetwater Wind 3 (Cottonwood Creek)	Nolan	Wind	152.2	Dec-05	ERCOT	
Horse Hollow Phase 2	Taylor	Wind	184.0	May-06	ERCOT	
Red Canyon 1	Borden	Wind	89.6	May-06	ERCOT	
Horse Hollow Phase 3	Taylor	Wind	241.4	Sep-06	ERCOT	
Forest Creek Wind Farm	SterliGas	Wind	124.2	Dec-06	ERCOT	
Sand Bluff Wind Farm	SterliGas	Wind	90.0	Dec-06	ERCOT	
Wildorado Wind Ranch	Oldham	Wind	161.0	Apr-07	SPP	
Sweetwater Wind 4 (Cottonwood Creek)	Nolan	Wind	237.0	May-07	ERCOT	
Camp SpriGass I	Scurry	Wind	130.5	Jul-07	ERCOT	
Buffalo Gap 2 (Cirello 1)	Taylor	Wind	232.5	Aug-07	ERCOT	
Capricorn Ridge Wind	SterliGas	Wind	381.2	Sep-07	ERCOT	previously Goat Mtn.
Capricorn Ridge Wind (exp)	SterliGas	Wind	322.4	May-08	ERCOT	previously Goat Mtn.
Barton Chapel Wind 1	Jack	Wind	120.0	Dec-07	ERCOT	
Lone Star - Mesquite Wind	Shackleford	Wind	194.0	Dec-07	ERCOT	
Snyder Wind Project	Scurry	Wind	63.0	Dec-07	ERCOT	
Sweetwater Wind 5	Nolan	Wind	85.0	Dec-07	ERCOT	
Whirlwind	Floyd	Wind	57.0	Dec-07	ERCOT	
Champion Wind Farm	Scurry	Wind	126.5	Jan-08	ERCOT	
Roscoe Wind Farm 1	Scurry	Wind	209.0	Jan-08	ERCOT	
Stanton Wind Energy	Martin	Wind	120.0	Jan-08	ERCOT	
Silver Star Phase I	Erath	Wind	52.8	Mar-08	ERCOT	
Buffalo Gap 3	Taylor	Wind	170.2	Apr-08	ERCOT	
Goat Wind	SterliGas	Wind	80.0	Apr-08	ERCOT	
Lone Star - Post Oak Wind	Shackleford	Wind	198.0	May-08	ERCOT	
McAdoo Wind Energy	Dickens	Wind	150.0	May-08	ERCOT	
Camp SpriGass II	Scurry	Wind	120.0	Jun-08	ERCOT	
Panther Creek	Howard	Wind	142.5	Jul-08	ERCOT	
Ocotillo Windpower 1	Howard	Wind	58.8	Aug-08	ERCOT	
Sherbino Mesa Wind Farm	Pecos	Wind	150.0	Sep-08	ERCOT	
South Trent Wind Farm	Taylor	Wind	98.2	Oct-08	ERCOT	
Wolf Ridge Windfarm	Cooke	Wind	112.5	Oct-08	ERCOT	
Bull Creek Wind Plant	Borden	Wind	178.0	Nov-08	ERCOT	
Elbow Creek Wind	Howard	Wind	118.7	Nov-08	ERCOT	
Gulf Wind 1	Kenedy	Wind	283.2	Nov-08	ERCOT	
Hackberry Wind Farm	Shackleford	Wind	163.5	Nov-08	ERCOT	
Inadale	Nolan	Wind	197.0	Nov-08	ERCOT	
Panther Creek 2	Howard	Wind	115.5	Nov-08	ERCOT	
Penascal Wind Farm	Kenedy	Wind	160.8	Nov-08	ERCOT	
Pyron	Scurry	Wind	249.0	Nov-08	ERCOT	
Turkey Track Energy Center	Nolan	Wind	169.5	Nov-08	ERCOT	
Notrees Windpower	Ector	Wind	152.6	Jan-09	ERCOT	
Noble Great Plains Windpark	Hansford	Wind	114.0	Feb-09	SPP	
Goat Wind Phase 2	SterliGas	Wind	69.6	Apr-09	ERCOT	
Panther Creek 3	Concho	Wind	199.5	Aug-09	ERCOT	
Sunray Wind I, II, III	Moore	Wind	49.5	Aug-09	SPP	
Papalote Creek Wind Farm	San Patricio	Wind	179.9	Sep-09	ERCOT	
LaGasford Wind Power	Tom Green	Wind	160.0	Oct-09	ERCOT	
Loraine Windpark	Mitchell	Wind	150.0	Oct-09	ERCOT	
JD Wind 1-7, 9-11, Wege	Hansford	Wind	189.8	Dec-09	SPP	completed 2006-2009
Majestic Wind	Carson	Wind	79.5	Dec-09	SPP	
Penascal Wind Farm 2	Kenedy	Wind	141.6	Mar-10	ERCOT	
Papalote Creek Phase II	San Patricio	Wind	200.1	Jun-10	ERCOT	
Little PriGasle 1,2	Hutchinson	Wind	20.0	Sep-10	SPP	
Cedro Hill Wind	Webb	Wind	150.0	Oct-10	ERCOT	

Table 5-1: Wind Farm Information from the PUCT — Updated Jan 15th, 2021 (Cont.)

Facility	County	Resource	Capacity (MW)	In Service	Region	Notes
Ralls Wind Farm	Crosby	Wind	10.0	Jul-11	SPP	
GS Panhandle Wind Ranch	Oldham	Wind	78.0	Sep-11	SPP	
Sherbino Mesa Wind Farm 2	Pecos	Wind	132.0	Nov-11	ERCOT	
Trinity Hills Wind Farm	YouGas	Wind	198.0	Jan-12	ERCOT	
Frisco Wind Farm	Hansford	Wind	20.0	Feb-12	SPP	
Harbor Wind Project	Nueces	Wind		Mar-12	ERCOT	
Magic Valley Wind	Willacy	Wind	203.3	Apr-12	ERCOT	also called Redfish
Anacacho Windfarm	Kinney	Wind	99.8	Dec-12	ERCOT	
Blue Summit Wind	Wilbarger	Wind	133.1	Dec-12	ERCOT	
Cirrus Wind Energy	Lynn	Wind	61.2	Dec-12	SPP	
Majestic Wind II	Carson	Wind	79.6	Dec-12	SPP	
Mozart	Kent	Wind	30.0	Dec-12	ERCOT	15-yr PPA JP Morgan EV
Senate Wind Project	Jack	Wind	150.0	Dec-12	ERCOT	
SpinniGas Spur Wind Ranch	Oldham	Wind	161.0	Dec-12	SPP	15-yr PPA SPS
Whitetail Wind Project	Webb	Wind	92.3	Dec-12	ERCOT	25-yr PPA Austin Energy
Los Vientos I	Willacy	Wind	200.1	Jan-13	ERCOT	25-yr PPA CPS Energy
Los Vientos II	Willacy	Wind	201.6	Jan-13	ERCOT	PPA Austin Energy
Bobcat Bluff	Clay	Wind	162.0	Mar-13	ERCOT	
Goldthwaite Wind Energy	Mills	Wind	148.6	Jun-14	ERCOT	
Pantex Wind Farm	Carson	Wind	11.5	Jun-14	SPP	
SpinniGas Spur Wind II	Oldham	Wind	161.0	Jun-14	ERCOT	
Panhandle Wind 1	Carson	Wind	218.4	Jul-14	ERCOT	
Panhandle Wind 2	Carson	Wind	190.8	Nov-14	ERCOT	
Grandview Phase 1 (Conway Windfarm)	Carson	Wind	211.2	Dec-14	ERCOT	
Miami Wind 1 Project	Gray	Wind	288.6	Dec-14	ERCOT	
Palo Duro Wind	Ochltree	Wind	250.0	Dec-14	SPP	
Stephens Ranch Wind Phase 1	Borden	Wind	211.2	Dec-14	ERCOT	
Windthorst 2	Archer	Wind	67.6	Dec-14	ERCOT	
Keechi Wind	Jack	Wind	110.0	Jan-15	ERCOT	
Jumbo Road Wind (Hereford 2)	Castro	Wind	299.8	Apr-15	ERCOT	PPA AE
Mesquite Creek W	Borden	Wind	211.2	Apr-15	ERCOT	
Hereford Wind Project (Hereford 1)	Deaf Smith	Wind	199.9	May-15	ERCOT	
Stephens Ranch Wind Phase b	Borden	Wind	164.7	May-15	ERCOT	
Route66 Wind	ArmstroGas	Wind	150.0	Aug-15	ERCOT	
Logan's Gap Wind I	Comanche	Wind	210.1	Sep-15	ERCOT	
LoGashorn Energy Center North	Briscoe	Wind	200.0	Sep-15	ERCOT	
RattleSnake Wind Ph 1	Glasscock	Wind	207.3	Sep-15	ERCOT	prev. Rattlesnake Den
Pleasant Hill Wind Energy	Crosby	Wind	20.0	Oct-15	SPP	
SpinniGas Spur Wind III	Oldham	Wind	194.0	Oct-15	ERCOT	PPAs GUS, GPL
Briscoe Wind	Briscoe	Wind	149.8	Nov-15	ERCOT	
Green Pastures W	Knox	Wind	300.0	Nov-15	ERCOT	
South Plains Wind I	Floyd	Wind	200.0	Nov-15	ERCOT	
Shannon Wind	Clay	Wind	204.1	Dec-15	ERCOT	prev. South Clay Wind
Los Vientos III	Starr	Wind	200.0	Dec-15	ERCOT	25-yr PPA Austin Energy
Sendero Wind Energy Project	Jim Hogg	Wind	76.0	Dec-15	ERCOT	
Javelina Wind	Zapata	Wind	249.7	Dec-15	ERCOT	
Cameron County Wind	Cameron	Wind	165.0	Jan-16	ERCOT	
Colbeck's Corner	Carson	Wind	200.4	May-16	ERCOT	
South Plains Wind II Phase a	Floyd	Wind	148.5	Jun-16	ERCOT	
South Plains Wind II Phase b	Floyd	Wind	151.8	Jun-16	ERCOT	
Baffin Wind Farm (Penascal 3)	Kenedy	Wind	202.0	Jun-16	ERCOT	
Los Vientos IV	Starr	Wind	200.0	Jun-16	ERCOT	25-yr PPA Austin Energy
Gunsight Mountain	Howard	Wind	119.9	Sep-16	ERCOT	
Los Vientos V	Starr	Wind	110.0	Sep-16	ERCOT	
Wake Wind	Dickens	Wind	257.2	Oct-16	ERCOT	
Salt Fork Wind	Donley and Gray	Wind	174.0	Dec-16	ERCOT	
Tyler Bluff Wind (Muenster Wind)	Cooke	Wind	125.6	Dec-16	ERCOT	
Hidalgo & Starr Wind	Hidalgo	Wind	250.0	Dec-16	ERCOT	
Electra Wind	Wilbarger	Wind	230.0	Jan-17	ERCOT	
Horse Creek Wind	Haskell	Wind	230.0	Jan-17	ERCOT	
Bethel Wind Energy Facility	Castro	Wind	276.0	Jan-17	SPP	
Javelina 2 Wind	Zapata	Wind	200.0	Feb-17	ERCOT	
San Roman Wind 1	Cameron	Wind	95.2	Feb-17	ERCOT	
Mariah Del Notre	Parmer	Wind	230.4	Mar-17	ERCOT	Mariah Wind B
Cotton Plains Wind	Floyd	Wind	50.4	Mar-17	ERCOT	Blanco Canyon Wind 1
Old Settler Wind	Floyd	Wind	151.2	Apr-17	ERCOT	Blanco Canyon Wind 2
Cotton Plains Wind	Floyd	Wind		Apr-17	ERCOT	Blanco Canyon Wind 1
Falvez Astra Wind	Deaf Smith	Wind	163.2	May-17	ERCOT	prev. Happy Whiteface
Dermott Wind 1	Scurry	Wind	253.0	Aug-17	ERCOT	Amazon Wind Farm
Chapman Ranch Wind 1	Nueces	Wind	249.0	Oct-17	ERCOT	

Table 5-1: Wind Farm Information from the PUCT — Updated Jan 15th, 2021 (Cont.)

Facility	County	Resource	Capacity (MW)	In Service	Region	Notes
Val Verde Wind	Val Verde	Wind	149.3	Oct-17	ERCOT	Rock SpriGass
Fluvanna Renewable 1	Scurry	Wind	155.4	Nov-17	ERCOT	
Willow SpriGass Wind (SALVTION)	Haskell	Wind	250.0	Dec-17	ERCOT	
SALVTION (Willow SpriGass Wind)	Haskell	Wind		Dec-17	ERCOT	
BUCKTHORN WIND	Erath	Wind	100.6	Dec-17	ERCOT	
BBREEZE (BruenniGas's Breeze)	Willacy	Wind	228.0	Dec-17	ERCOT	Magic Valley II and Redfish
Niels Bohr (BearKat Wind A)	Glasscock	Wind	196.6	Feb-18	ERCOT	
HICKMAN	Reagan	Wind	300.0	May-18	ERCOT	Santa Rita Wind Energy Center
Flat Top Wind I	Comanche	Wind	200.0	Sep-18	ERCOT	Logan's Gap Wind II
RTS Wind Project	McCulloch	Wind	160.0	Sep-18	ERCOT	Rattlesnake Wind Project
Stella 1 Wind	Kenedy	Wind	201.0	Dec-18	ERCOT	
Wildcat Ranch Wind Project	Cochran	Wind	150.5	Dec-18	SPP	
Fiber Winds Energy Project	Crosby	Wind	78.8	Dec-18	SPP	
Blue Cloud Renewable Energy	Bailey and Lamb	Wind	148.4	Dec-18	SPP	
Tahoka Wind	Lynn	Wind	300.0	Mar-19	ERCOT	
Hale Community Energy	Hale	Wind	478.0	Jun-19	SPP	
Midway Wind	San Patricio	Wind	162.8	Jun-19	ERCOT	
S_Hills Wind	Baylor	Wind	30.2	Aug-19	ERCOT	
Lockett Wind	Wilbarger	Wind	183.7	Sep-19	ERCOT	
Torrecillas Wind	Webb	Wind	300.5	Nov-19	ERCOT	Javelina III
Foard City Wind	Foard	Wind	350.3	Nov-19	ERCOT	
Cabezon Wind	Starr	Wind	237.6	Dec-19	ERCOT	Rio Bravo
Canadian Breaks Wind	Oldham	Wind	210.1	Dec-19	ERCOT	
Karankawa Wind	San Patricio	Wind	206.6	Dec-19	ERCOT	
Karankawa 2 Wind	San Patricio	Wind	100.4	Dec-19	ERCOT	
Gopher Creek Wind	Borden	Wind	158.0	Mar-20	ERCOT	
Wilson Ranch	Schleicher	Wind	199.5	Apr-20	ERCOT	
Blue Summit II	Wilbarger	Wind	96.4	Apr-20	ERCOT	
Blue Summit III	Wilbarger	Wind	195.8	May-20	ERCOT	
Ranchero Wind	Crockett	Wind	300.0	May-20	ERCOT	
Peyton Creek Wind	Matagorda	Wind	151.2	Jun-20	ERCOT	
Palmas Altas Wind	Cameron	Wind	144.9	Nov-20	ERCOT	
Whitehorse Wind	Fisher	Wind	419.0	Mar-20	ERCOT	
Aviator Wind	Coke	Wind	525.0	Jul-20	ERCOT	
Mesteno Wind	Starr	Wind	201.6	Jan-20	ERCOT	
RTS 2 Wind	McCulloch	Wind	180.0	May-20	ERCOT	
Hidalgo II Wind	Hidalgo	Wind	50.0	Feb-20	ERCOT	
Harald (BearKat Wind B)	Glasscock	Wind	162.1	Jun-20	ERCOT	
Cranel Wind	Refugio	Wind	220.0	Jun-20	ERCOT	
Vera Wind	Knox	Wind	209.0	Aug-20	ERCOT	
Vera Wind V110	Knox	Wind	34.0	Nov-20	ERCOT	
Shaffer Wind	Nueces	Wind	226.0	Jan-20	ERCOT	
Oveja Wind	Irion	Wind	300.0	Jan-20	ERCOT	
Sage Draw Wind	Lynn	Wind	338.0	Jan-20	ERCOT	
WKN Amadeus Wind	Fisher	Wind	251.0	Nov-20	ERCOT	
Barrow Ranch Wind	Andrews	Wind	160.0	Mar-20	ERCOT	
East Raymond Wind	Willacy	Wind	200.0	Nov-20	ERCOT	
High Lonesome W	Crockett	Wind	449.5	Jan-20	ERCOT	
High Lonesome Wind Phase II	Crockett	Wind	50.6	Jan-20	ERCOT	
Cactus Flats Wind	Concho	Wind	148.4	Jan-20	ERCOT	
Maverick Creek I W	Concho	Wind	373.0	Oct-20	ERCOT	
Prairie Hill Wind	McLennan	Wind	300.0	Dec-20	ERCOT	
Horse Hollow Phase 4	Taylor	Wind	115.0	May-06	ERCOT	
Penascal Wind Farm 3	Kenedy	Wind	100.8	Oct-10	ERCOT	
Total			32412.6			

Table 5-2: Modeled 2018 and Measured 2020 Wind Power Production Assigned to Each CL Zone in the ERCOT Region

	Modeled 2018		Measured 2020	
CL Zones	**Annual Wind Power (MWh/yr)**	**OSP Wind Power (MWh/day)**	**Annual Wind Power (MWh/yr)**	**OSP Wind Power (MWh/day)**
Houston	0	0	0	0
North	5,261,357	14,325	4,428,708	10,434
West	63,484,735	169,262	64,024,898	164,554
South	21,986,395	59,823	18,625,808	50,129
Total	90,732,487	243,411	87,079,414	225,118

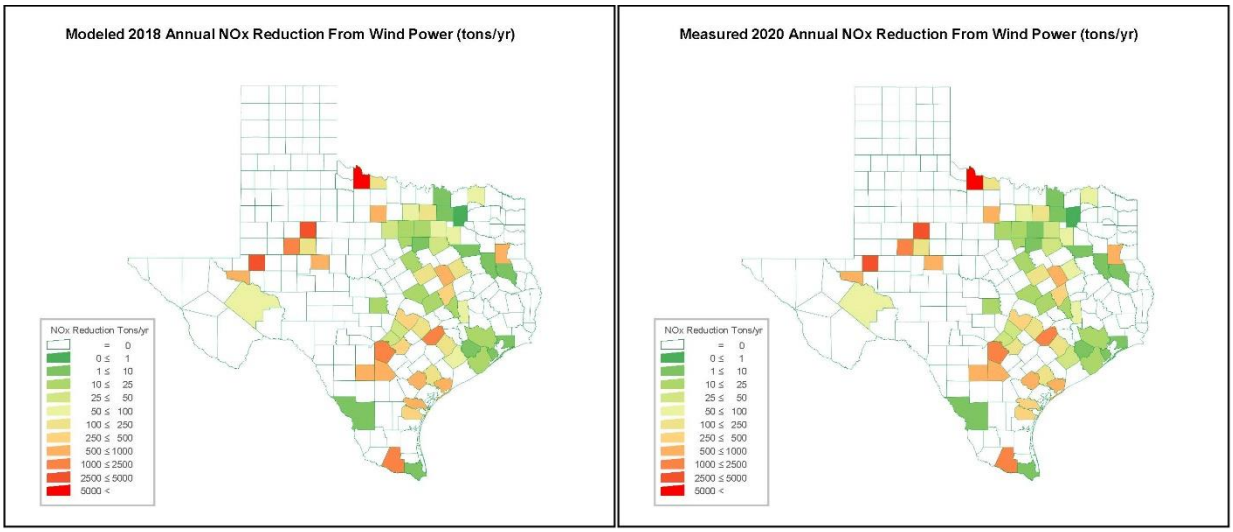


Figure 5-3: Modeled 2018 and Measured 2020 Annual NOx Reductions from Wind Power in Texas Map

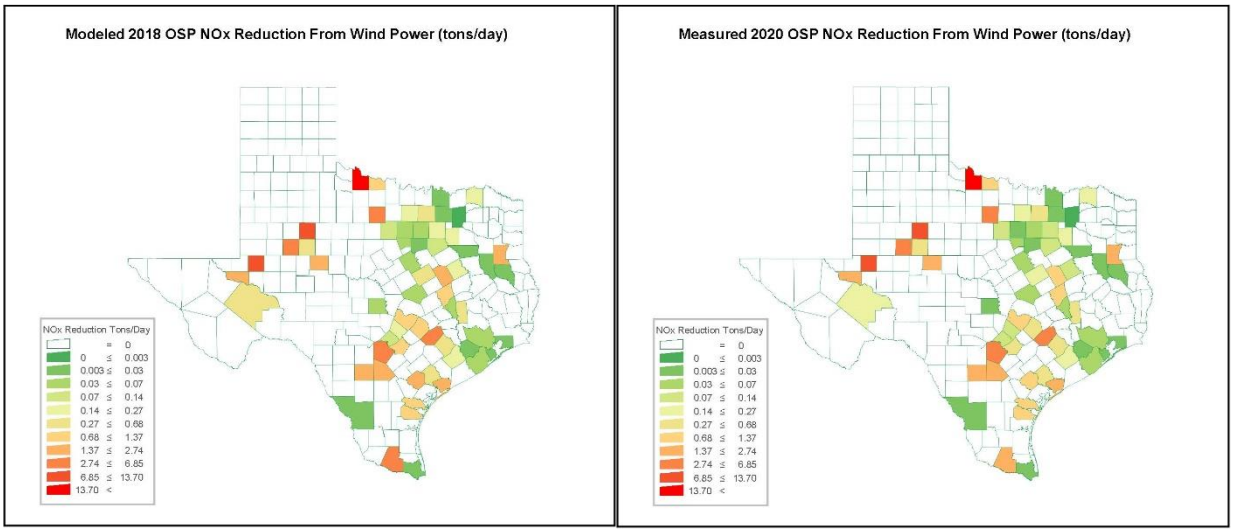


Figure 5-4: Modeled 2018 OSP and Measured 2020 OSP NOx Reductions from Wind Power in Texas Map

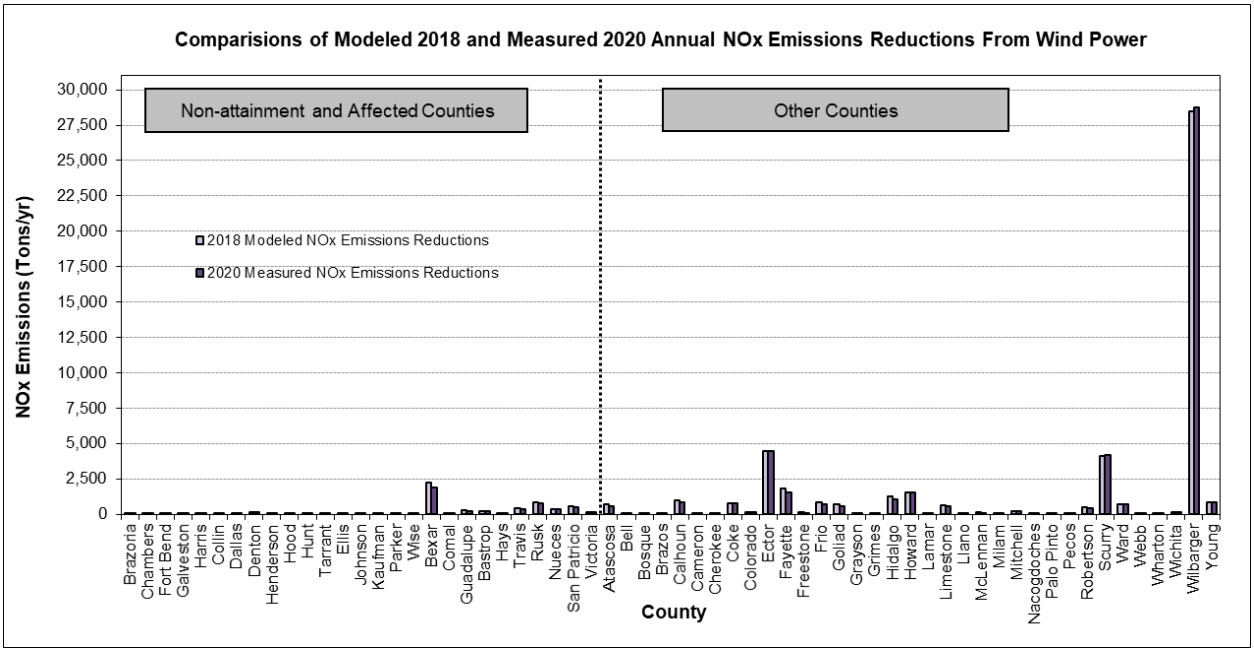


Figure 5-5: Comparisons of Modeled 2018 and Measured 2020 Annual NOx Emissions Reductions from Wind Power

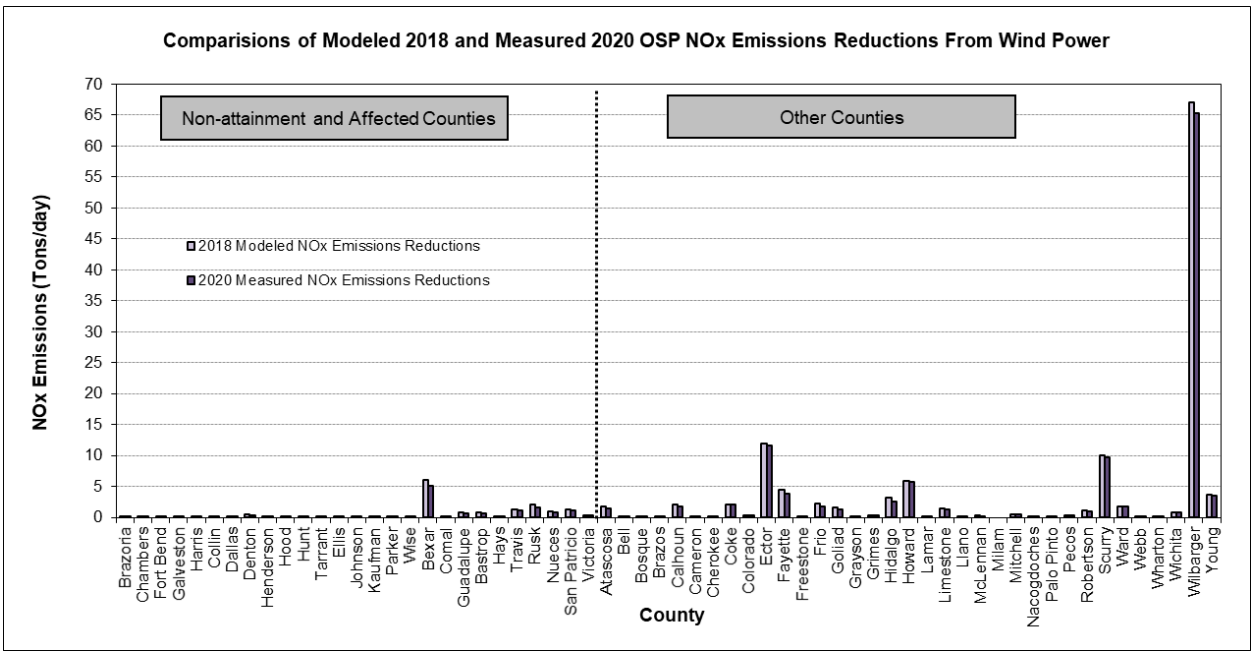


Figure 5-6: Comparisons of Modeled 2018 and Measured 2020 OSP NOx Emissions Reductions from Wind Power

Table 5-3: Distribution of the Annual Emission Reductions per CL Zone for each County (Base Year 2018)

Area	County	CL Zones								Total Nox Reductions (lbs)	Total Nox Reductions (Tons)
		H		N		W		S			
Houston-Galveston Area	Brazoria	0.1445243	0	0.0000183	96	0.0000009	56	0.0013540	29,769	29,922	14.9609
	Chambers	0.0232302	0	0.0000029	16	0.0000001	9	0.0002176	4,785	4,810	2.40
	Fort Bend	0.0925360	0	0.0000117	62	0.0000006	36	0.0008669	19,061	19,158	9.58
	Galveston	0.0189140	0	0.0000024	13	0.0000001	7	0.0001772	3,896	3,916	1.96
	Harris	0.1374166	0	0.0000174	92	0.0000008	53	0.0012874	28,305	28,450	14.23
	Liberty*	-	-	-	-	-	-	-	-	-	-
	Montgomery	-	-	-	-	-	-	-	-	-	-
	Waller*	-	-	-	-	-	-	-	-	-	-
Beaumont/ Port Arthur Area	Hardin*	-	-	-	-	-	-	-	-	-	-
	Jefferson*	-	-	-	-	-	-	-	-	-	-
	Orange*	-	-	-	-	-	-	-	-	-	-
Dallas/ Fort Worth Area	Collin	0.0000743	0	0.0004556	2,397	0.0000220	1,397	0.0000046	102	3,896	1.95
	Dallas	0.0019090	0	0.0117105	61,613	0.0005656	35,909	0.0001195	2,627	100,149	50.07
	Denton	0.0066429	0	0.0407509	214,405	0.0019683	124,959	0.0004158	9,141	348,505	174.25
	Henderson	0.0001509	0	0.0009255	4,870	0.0000447	2,838	0.0000094	208	7,915	3.96
	Hood	0.0008451	0	0.0051842	27,276	0.0002504	15,897	0.0000529	1,163	44,336	22.17
	Hunt	0.0000043	0	0.0000263	138	0.0000013	81	0.0000003	6	225	0.11
	Tarrant	0.0004188	0	0.0025693	13,518	0.0001241	7,879	0.0000262	576	21,973	10.99
	Ellis	0.0013349	0	0.0081890	43,085	0.0003955	25,111	0.0000835	1,837	70,033	35.02
	Johnson	0.0002010	0	0.0012332	6,489	0.0000596	3,782	0.0000126	277	10,547	5.27
	Kaufman	0.0034596	0	0.0212228	111,661	0.0010251	65,078	0.0002165	4,761	181,499	90.75
	Parker	0.0005940	0	0.0036438	19,171	0.0001760	11,173	0.0000372	817	31,162	15.58
	Rockwall*	-	-	-	-	-	-	-	-	-	-
	Wise	0.0031300	0	0.0192012	101,025	0.0009275	58,879	0.0001959	4,307	164,211	82.11
El Paso Area	El Paso*	-	-	-	-	-	-	-	-	-	-
San Antonio Area	Bexar	0.0253670	0	0.0017108	9,001	0.0000826	5,246	0.2025905	4,454,234	4,468,482	2234.24
	Comal	0.0005285	0	0.0000356	188	0.0000017	109	0.0042210	92,804	93,101	46.55
	Guadalupe	0.0030546	0	0.0002060	1,084	0.0000100	632	0.0243949	536,355	538,071	269.04
	Wilson	-	-	-	-	-	-	-	-	-	-
Austin Area	Austin	-	-	-	-	-	-	-	-	-	-
	Bastrop	0.0024800	0	0.0001673	880	0.0000081	513	0.0198060	435,463	436,856	218.43
	Caldwell*	-	-	-	-	-	-	-	-	-	-
	Hays	0.0004731	0	0.0000319	168	0.0000015	98	0.0037782	83,069	83,335	41.67
	Travis	0.0046184	0	0.0003115	1,639	0.0000150	955	0.0368846	810,960	813,554	406.78
	Williamson	-	-	-	-	-	-	-	-	-	-
North East Texas Area	Gregg*	-	-	-	-	-	-	-	-	-	-
	Harrison*	-	-	-	-	-	-	-	-	-	-
	Rusk	0.0322708	0	0.1979648	1,041,563	0.0095620	607,043	0.0020197	44,406	1,693,013	846.51
	Smith*	-	-	-	-	-	-	-	-	-	-
	Upshur*	-	-	-	-	-	-	-	-	-	-
Corpus Christi Area	Nueces	0.0042426	0	0.0002861	1,505	0.0000138	877	0.0338828	744,960	747,343	373.67
	San Patricio	0.0063692	0	0.0004296	2,260	0.0000207	1,317	0.0508668	1,118,377	1,121,954	560.98
Victoria Area	Victoria	0.0016730	0	0.0001128	594	0.0000054	346	0.0133614	293,769	294,708	147.35
Other ERCOT counties	Anderson	-	-	-	-	-	-	-	-	-	-
	Andrews*	-	-	-	-	-	-	-	-	-	-
	Angelina	-	-	-	-	-	-	-	-	-	-
	Atascosa	0.0077084	0	0.0005199	2,735	0.0000251	1,594	0.0615620	1,353,527	1,357,857	678.93
	Bell	0.0004444	0	0.0027262	14,344	0.0001317	8,360	0.0000278	612	23,315	11.66
	Bosque	0.0007214	0	0.0044257	23,285	0.0002138	13,571	0.0000452	993	37,849	18.92
	Brazos	0.0005654	0	0.0034687	18,250	0.0001675	10,637	0.0000354	778	29,665	14.83
	Calhoun	0.0111852	0	0.0007544	3,969	0.0000364	2,313	0.0893292	1,964,026	1,970,309	985.15
	Cameron	0.0000231	0	0.0000016	8	0.0000001	5	0.0001843	4,053	4,066	2.03
	Cherokee	0.0001844	0	0.0011310	5,951	0.0000546	3,468	0.0000115	254	9,673	4.84
	Coke	0.0000223	0	0.0001365	718	0.0231815	1,471,674	0.0000014	31	1,472,423	736.21
	Coleman*	-	-	-	-	-	-	-	-	-	-
	Colorado	0.0016158	0	0.0001090	573	0.0000053	334	0.0129041	283,714	284,621	142.31
	Crockett*	-	-	-	-	-	-	-	-	-	-
	Ector	0.0001338	0	0.0008206	4,318	0.1393442	8,846,230	0.0000084	184	8,850,731	4425.37
	Fannin*	-	-	-	-	-	-	-	-	-	-
	Fayette	0.0204274	0	0.0013777	7,248	0.0000665	4,225	0.1631405	3,586,872	3,598,345	1799.17
	Freestone	0.0042261	0	0.0259247	136,399	0.0012522	79,496	0.0002645	5,815	221,711	110.86
	Frio	0.0097614	0	0.0006583	3,464	0.0000318	2,019	0.0779581	1,714,018	1,719,501	859.75
	Goliad	0.0077047	0	0.0005196	2,734	0.0000251	1,593	0.0615328	1,352,885	1,357,212	678.61
	Grayson	0.0002857	0	0.0017525	9,220	0.0000846	5,374	0.0000179	393	14,987	7.49
	Grimes	0.0029942	0	0.0183678	96,640	0.0008872	56,323	0.0001874	4,120	157,083	78.54
	Hardeman*	-	-	-	-	-	-	-	-	-	-
	Haskell*	-	-	-	-	-	-	-	-	-	-
	Hidalgo	0.0140830	0	0.0009498	4,997	0.0000459	2,912	0.1124720	2,472,854	2,480,764	1240.38
	Hill	-	-	-	-	-	-	-	-	-	-
	Howard	0.0000467	0	0.0002865	1,508	0.0486558	3,088,903	0.0000029	64	3,090,475	1545.24
	Jack*	-	-	-	-	-	-	-	-	-	-
	Jones*	-	-	-	-	-	-	-	-	-	-
	Lamar	0.0031379	0	0.0192492	101,277	0.0009298	59,026	0.0001964	4,318	164,621	82.31
	Limestone	0.0231674	0	0.1421203	747,745	0.0068646	435,800	0.0014500	31,879	1,215,425	607.71
	Llano	0.0001855	0	0.0000125	66	0.0000006	38	0.0014818	32,578	32,683	16.34
	McLennan	0.0043688	0	0.0268006	141,007	0.0012945	82,182	0.0002734	6,012	229,201	114.60
	Milam	0.0002486	0	0.0000168	88	0.0000008	51	0.0019850	43,644	43,783	21.89
	Mitchell	0.0000072	0	0.0000443	233	0.0075244	477,682	0.0000005	10	477,925	238.96
	Nacogdoches	0.0002714	0	0.0016647	8,759	0.0000804	5,105	0.0000170	373	14,237	7.12
	Nolan	-	-	-	-	-	-	-	-	-	-
	Palo Pinto	0.0010391	0	0.0063745	33,538	0.0003079	19,547	0.0000650	1,430	54,515	27.26
	Pecos	0.0000029	0	0.0000180	95	0.0030637	194,501	0.0000002	4	194,600	97.30
	Potter	-	-	-	-	-	-	-	-	-	-
	Presidio*	-	-	-	-	-	-	-	-	-	-
	Reagan	-	-	-	-	-	-	-	-	-	-
	Red River	-	-	-	-	-	-	-	-	-	-
	Robertson	0.0184177	0	0.1129830	594,444	0.0054573	346,453	0.0011527	25,344	966,240	483.12
	Scurry	0.0001246	0	0.0007646	4,023	0.1298311	8,242,293	0.0000078	172	8,246,487	4123.24
	Taylor*	-	-	-	-	-	-	-	-	-	-
	Titus	-	-	-	-	-	-	-	-	-	-
	Tom Green*	-	-	-	-	-	-	-	-	-	-
	Upton	-	-	-	-	-	-	-	-	-	-
	Ward	0.0000206	0	0.0001265	666	0.0214790	1,363,587	0.0000013	28	1,364,281	682.14
	Webb	0.0000253	0	0.0000017	9	0.0000001	5	0.0002020	4,441	4,455	2.23
	Wharton	0.0006585	0	0.0000444	234	0.0000021	136	0.0052594	115,635	116,005	58.00
	Wichita	0.0000051	0	0.0000315	166	0.0053432	339,214	0.0000003	7	339,387	169.69
	Wilbarger	0.0008609	0	0.0052810	27,785	0.8967472	56,929,760	0.0000539	1,185	56,958,730	28479.36
	Wood	-	-	-	-	-	-	-	-	-	-
	Young	0.0000257	0	0.0001578	830	0.0267892	1,700,706	0.0000016	35	1,701,571	850.79
	Total	**0.6511636**	**0**	**0.6960434**	**3,662,132**	**1.3352091**	**84,765,398**	**0.9887171**	**21,738,325**	**110,165,855**	**55082.93**
Energy Savings (MWh)		**0**		**5,261,357**		**63,484,735**		**21,986,395**			

Note *: These counties are not quantified because they are not in the ERCOT region.

Table 5-4: Distribution of the Annual Emission Reductions per CL Zone for each County (Year 2020)

Area	County	CL Zones								Total Nox Reductions (lbs)	Total Nox Reductions (Tons)
		H		N		W		S			
Houston-Galveston Area	Brazoria	0.1445243	0	0.0000183	81	0.0000009	57	0.0013540	25,219	25,357	12.6785
	Chambers	0.0232302	0	0.0000029	13	0.0000001	9	0.0002176	4,054	4,076	2.04
	Fort Bend	0.0925360	0	0.0000117	52	0.0000006	36	0.0008669	16,147	16,236	8.12
	Galveston	0.0189140	0	0.0000024	11	0.0000001	7	0.0001772	3,300	3,318	1.66
	Harris	0.1374166	0	0.0000174	77	0.0000008	54	0.0012874	23,979	24,110	12.05
	Liberty*	-	-	-	-	-	-	-	-	-	-
	Montgomery	-	-	-	-	-	-	-	-	-	-
	Waller*	-	-	-	-	-	-	-	-	-	-
Beaumont/ Port Arthur Area	Hardin*	-	-	-	-	-	-	-	-	-	-
	Jefferson*	-	-	-	-	-	-	-	-	-	-
	Orange*	-	-	-	-	-	-	-	-	-	-
Dallas/ Fort Worth Area	Collin	0.0000743	0	0.0004556	2,018	0.0000220	1,409	0.0000046	87	3,513	1.76
	Dallas	0.0019090	0	0.0117105	51,862	0.0005656	36,215	0.0001195	2,225	90,302	45.15
	Denton	0.0066429	0	0.0407509	180,474	0.0019683	126,023	0.0004158	7,744	314,240	157.12
	Henderson	0.0001509	0	0.0009255	4,099	0.0000447	2,862	0.0000094	176	7,137	3.57
	Hood	0.0008451	0	0.0051842	22,959	0.0002504	16,032	0.0000529	985	39,977	19.99
	Hunt	0.0000043	0	0.0000263	116	0.0000013	81	0.0000003	5	203	0.10
	Tarrant	0.0004188	0	0.0025693	11,379	0.0001241	7,946	0.0000262	488	19,813	9.91
	Ellis	0.0013349	0	0.0081890	36,267	0.0003955	25,325	0.0000835	1,556	63,147	31.57
	Johnson	0.0002010	0	0.0012332	5,462	0.0000596	3,814	0.0000126	234	9,510	4.75
	Kaufman	0.0034596	0	0.0212228	93,990	0.0010251	65,632	0.0002165	4,033	163,654	81.83
	Parker	0.0005940	0	0.0036438	16,137	0.0001760	11,268	0.0000372	692	28,098	14.05
	Rockwall*	-	-	-	-	-	-	-	-	-	-
	Wise	0.0031300	0	0.0192012	85,037	0.0009275	59,380	0.0001959	3,649	148,065	74.03
El Paso Area	El Paso*	-	-	-	-	-	-	-	-	-	-
San Antonio Area	Bexar	0.0253670	0	0.0017108	7,577	0.0000826	5,291	0.2025905	3,773,411	3,786,279	1893.14
	Comal	0.0005285	0	0.0000356	158	0.0000017	110	0.0042210	78,619	78,887	39.44
	Guadalupe	0.0030546	0	0.0002060	912	0.0000100	637	0.0243949	454,374	455,924	227.96
	Wilson	-	-	-	-	-	-	-	-	-	-
Austin Area	Austin	-	-	-	-	-	-	-	-	-	-
	Bastrop	0.0024800	0	0.0001673	741	0.0000081	517	0.0198060	368,903	370,161	185.08
	Caldwell*	-	-	-	-	-	-	-	-	-	-
	Hays	0.0004731	0	0.0000319	141	0.0000015	99	0.0037782	70,372	70,612	35.31
	Travis	0.0046184	0	0.0003115	1,379	0.0000150	963	0.0368846	687,006	689,349	344.67
	Williamson	-	-	-	-	-	-	-	-	-	-
North East Texas Area	Gregg*	-	-	-	-	-	-	-	-	-	-
	Harrison*	-	-	-	-	-	-	-	-	-	-
	Rusk	0.0322708	0	0.1979648	876,728	0.0095620	612,208	0.0020197	37,619	1,526,555	763.28
	Smith*	-	-	-	-	-	-	-	-	-	-
	Upshur*	-	-	-	-	-	-	-	-	-	-
Corpus Christi Area	Nueces	0.0042426	0	0.0002861	1,267	0.0000138	885	0.0338828	631,094	633,246	316.62
	San Patricio	0.0063692	0	0.0004296	1,902	0.0000207	1,328	0.0508668	947,435	950,666	475.33
Victoria Area	Victoria	0.0016730	0	0.0001128	500	0.0000054	349	0.0133614	248,866	249,715	124.86
Other ERCOT counties	Anderson	-	-	-	-	-	-	-	-	-	-
	Andrews*	-	-	-	-	-	-	-	-	-	-
	Angelina	-	-	-	-	-	-	-	-	-	-
	Atascosa	0.0077084	0	0.0005199	2,302	0.0000251	1,608	0.0615620	1,146,643	1,150,553	575.28
	Bell	0.0004444	0	0.0027262	12,074	0.0001317	8,431	0.0000278	518	21,022	10.51
	Bosque	0.0007214	0	0.0044257	19,600	0.0002138	13,686	0.0000452	841	34,127	17.06
	Brazos	0.0005654	0	0.0034687	15,362	0.0001675	10,727	0.0000354	659	26,748	13.37
	Calhoun	0.0111852	0	0.0007544	3,341	0.0000364	2,333	0.0893292	1,663,828	1,669,502	834.75
	Cameron	0.0000231	0	0.0000016	7	0.0000001	5	0.0001843	3,434	3,445	1.72
	Cherokee	0.0001844	0	0.0011310	5,009	0.0000546	3,498	0.0000115	215	8,722	4.36
	Coke	0.0000223	0	0.0001365	605	0.0231815	1,484,196	0.0000014	26	1,484,826	742.41
	Coleman*	-	-	-	-	-	-	-	-	-	-
	Colorado	0.0016158	0	0.0001090	483	0.0000053	337	0.0129041	240,349	241,168	120.58
	Crockett*	-	-	-	-	-	-	-	-	-	-
	Ector	0.0001338	0	0.0008206	3,634	0.1393442	8,921,498	0.0000084	156	8,925,288	4462.64
	Fannin*	-	-	-	-	-	-	-	-	-	-
	Fayette	0.0204274	0	0.0013777	6,101	0.0000665	4,260	0.1631405	3,038,624	3,048,986	1524.49
	Freestone	0.0042261	0	0.0259247	114,813	0.0012522	80,173	0.0002645	4,926	199,912	99.96
	Frio	0.0097614	0	0.0006583	2,916	0.0000318	2,036	0.0779581	1,452,033	1,456,985	728.49
	Goliad	0.0077047	0	0.0005196	2,301	0.0000251	1,607	0.0615328	1,146,099	1,150,007	575.00
	Grayson	0.0002857	0	0.0017525	7,761	0.0000846	5,420	0.0000179	333	13,514	6.76
	Grimes	0.0029942	0	0.0183678	81,346	0.0008872	56,803	0.0001874	3,490	141,639	70.82
	Hardeman*	-	-	-	-	-	-	-	-	-	-
	Haskell*	-	-	-	-	-	-	-	-	-	-
	Hidalgo	0.0140830	0	0.0009498	4,206	0.0000459	2,937	0.1124720	2,094,882	2,102,026	1051.01
	Hill	-	-	-	-	-	-	-	-	-	-
	Howard	0.0000467	0	0.0002865	1,269	0.0486558	3,115,185	0.0000029	54	3,116,508	1558.25
	Jack*	-	-	-	-	-	-	-	-	-	-
	Jones*	-	-	-	-	-	-	-	-	-	-
	Lamar	0.0031379	0	0.0192492	85,249	0.0009298	59,528	0.0001964	3,658	148,436	74.22
	Limestone	0.0231674	0	0.1421203	629,409	0.0068646	439,508	0.0014500	27,007	1,095,924	547.96
	Llano	0.0001855	0	0.0000125	55	0.0000006	39	0.0014818	27,599	27,693	13.85
	McLennan	0.0043688	0	0.0268006	118,692	0.0012945	82,881	0.0002734	5,093	206,666	103.33
	Milam	0.0002486	0	0.0000168	74	0.0000008	52	0.0019850	36,973	37,099	18.55
	Mitchell	0.0000072	0	0.0000443	196	0.0075244	481,746	0.0000005	8	481,951	240.98
	Nacogdoches	0.0002714	0	0.0016647	7,372	0.0000804	5,148	0.0000170	316	12,837	6.42
	Nolan	-	-	-	-	-	-	-	-	-	-
	Palo Pinto	0.0010391	0	0.0063745	28,231	0.0003079	19,713	0.0000650	1,211	49,155	24.58
	Pecos	0.0000029	0	0.0000180	80	0.0030637	196,156	0.0000002	3	196,239	98.12
	Potter	-	-	-	-	-	-	-	-	-	-
	Presidio*	-	-	-	-	-	-	-	-	-	-
	Reagan	-	-	-	-	-	-	-	-	-	-
	Red River	-	-	-	-	-	-	-	-	-	-
	Robertson	0.0184177	0	0.1129830	500,369	0.0054573	349,401	0.0011527	21,470	871,239	435.62
	Scurry	0.0001246	0	0.0007646	3,386	0.1298311	8,312,423	0.0000078	145	8,315,954	4157.98
	Taylor*	-	-	-	-	-	-	-	-	-	-
	Titus	-	-	-	-	-	-	-	-	-	-
	Tom Green*	-	-	-	-	-	-	-	-	-	-
	Upton	-	-	-	-	-	-	-	-	-	-
	Ward	0.0000206	0	0.0001265	560	0.0214790	1,375,189	0.0000013	24	1,375,773	687.89
	Webb	0.0000253	0	0.0000017	8	0.0000001	5	0.0002020	3,762	3,775	1.89
	Wharton	0.0006585	0	0.0000444	197	0.0000021	137	0.0052594	97,961	98,295	49.15
	Wichita	0.0000051	0	0.0000315	139	0.0053432	342,101	0.0000003	6	342,246	171.12
	Wilbarger	0.0008609	0	0.0052810	23,388	0.8967472	57,414,149	0.0000539	1,004	57,438,540	28719.27
	Wood	-	-	-	-	-	-	-	-	-	-
	Young	0.0000257	0	0.0001578	699	0.0267892	1,715,177	0.0000016	30	1,715,905	857.95
	Total	**0.6511636**	**0**	**0.6960434**	**3,082,573**	**1.3352091**	**85,486,628**	**0.9887171**	**18,415,655**	**106,984,856**	**53492.43**
Energy Savings (MWh)		**0**		**4,428,708**		**64,024,898**		**18,625,808**			

Note *: These counties are not quantified because they are not in the ERCOT region.

Table 5-5: Distribution of the OSP Emission Reductions per CL Zone for each County (Base Year 2018)

Area	County	CL Zones								Total Nox Reductions (lbs)	Total Nox Reductions (Tons)
		H		N		W		S			
Houston-Galveston Area	Brazoria	0.1338985	0	0.0000170	0	0.0000008	0	0.0012544	75	75	0.0377
	Chambers	0.0326319	0	0.0000041	0	0.0000002	0	0.0003057	18	18	0.01
	Fort Bend	0.1028262	0	0.0000130	0	0.0000006	0	0.0009633	58	58	0.03
	Galveston	0.0163861	0	0.0000021	0	0.0000001	0	0.0001535	9	9	0.00
	Harris	0.1329895	0	0.0000169	0	0.0000008	0	0.0012459	75	75	0.04
	Liberty*	-	-	-	-	-	-	-	-	-	-
	Montgomery	-	-	-	-	-	-	-	-	-	-
	Waller*	-	-	-	-	-	-	-	-	-	-
Beaumont/ Port Arthur Area	Hardin*	-	-	-	-	-	-	-	-	-	-
	Jefferson*	-	-	-	-	-	-	-	-	-	-
	Orange*	-	-	-	-	-	-	-	-	-	-
Dallas/ Fort Worth Area	Collin	0.0001333	0	0.0008179	12	0.0000395	7	0.0000083	0	19	0.01
	Dallas	0.0020916	0	0.0128308	184	0.0006198	105	0.0001309	8	297	0.15
	Denton	0.0066363	0	0.0407106	583	0.0019664	333	0.0004153	25	941	0.47
	Henderson	0.0002303	0	0.0014128	20	0.0000682	12	0.0000144	1	33	0.02
	Hood	0.0009171	0	0.0056259	81	0.0002717	46	0.0000574	3	130	0.07
	Hunt	0.0000072	0	0.0000443	1	0.0000021	0	0.0000005	0	1	0.00
	Tarrant	0.0006459	0	0.0039625	57	0.0001914	32	0.0000404	2	92	0.05
	Ellis	0.0015545	0	0.0095358	137	0.0004606	78	0.0000973	6	220	0.11
	Johnson	0.0002466	0	0.0015125	22	0.0000731	12	0.0000154	1	35	0.02
	Kaufman	0.0029234	0	0.0179336	257	0.0008662	147	0.0001830	11	414	0.21
	Parker	0.0004755	0	0.0029172	42	0.0001409	24	0.0000298	2	67	0.03
	Rockwall*	-	-	-	-	-	-	-	-	-	-
	Wise	0.0031354	0	0.0192341	276	0.0009290	157	0.0001962	12	445	0.22
El Paso Area	El Paso*	-	-	-	-	-	-	-	-	-	-
San Antonio Area	Bexar	0.0251261	0	0.0016946	24	0.0000819	14	0.2006666	12,005	12,043	6.02
	Comal	0.0003940	0	0.0000266	0	0.0000013	0	0.0031468	188	189	0.09
	Guadalupe	0.0031600	0	0.0002131	3	0.0000103	2	0.0252373	1,510	1,515	0.76
	Wilson	-	-	-	-	-	-	-	-	-	-
Austin Area	Austin	-	-	-	-	-	-	-	-	-	-
	Bastrop	0.0030802	0	0.0002077	3	0.0000100	2	0.0245997	1,472	1,476	0.74
	Caldwell*	-	-	-	-	-	-	-	-	-	-
	Hays	0.0005948	0	0.0000401	1	0.0000019	0	0.0047504	284	285	0.14
	Travis	0.0055911	0	0.0003771	5	0.0000182	3	0.0446524	2,671	2,680	1.34
	Williamson	-	-	-	-	-	-	-	-	-	-
North East Texas Area	Gregg*	-	-	-	-	-	-	-	-	-	-
	Harrison*	-	-	-	-	-	-	-	-	-	-
	Rusk	0.0284443	0	0.1744911	2,500	0.0084282	1,427	0.0017802	106	4,033	2.02
	Smith*	-	-	-	-	-	-	-	-	-	-
	Upshur*	-	-	-	-	-	-	-	-	-	-
Corpus Christi Area	Nueces	0.0041146	0	0.0002775	4	0.0000134	2	0.0328606	1,966	1,972	0.99
	San Patricio	0.0052899	0	0.0003568	5	0.0000172	3	0.0422468	2,527	2,535	1.27
Victoria Area	Victoria	0.0016002	0	0.0001079	2	0.0000052	1	0.0127795	765	767	0.38
Other ERCOT counties	Anderson	-	-	-	-	-	-	-	-	-	-
	Andrews*	-	-	-	-	-	-	-	-	-	-
	Angelina	-	-	-	-	-	-	-	-	-	-
	Atascosa	0.0075430	0	0.0005087	7	0.0000246	4	0.0602409	3,604	3,615	1.81
	Bell	0.0005412	0	0.0033200	48	0.0001604	27	0.0000339	2	77	0.04
	Bosque	0.0007335	0	0.0044996	64	0.0002173	37	0.0000459	3	104	0.05
	Brazos	0.0005896	0	0.0036168	52	0.0001747	30	0.0000369	2	84	0.04
	Calhoun	0.0087907	0	0.0005929	8	0.0000286	5	0.0702058	4,200	4,213	2.11
	Cameron	0.0000245	0	0.0000016	0	0.0000001	0	0.0001954	12	12	0.01
	Cherokee	0.0002513	0	0.0015416	22	0.0000745	13	0.0000157	1	36	0.02
	Coke	0.0000237	0	0.0001452	2	0.0246578	4,174	0.0000015	0	4,176	2.09
	Coleman*	-	-	-	-	-	-	-	-	-	-
	Colorado	0.0015097	0	0.0001018	1	0.0000049	1	0.0120568	721	724	0.36
	Crockett*	-	-	-	-	-	-	-	-	-	-
	Ector	0.0001352	0	0.0008292	12	0.1408089	23,834	0.0000085	1	23,846	11.92
	Fannin*	-	-	-	-	-	-	-	-	-	-
	Fayette	0.0187428	0	0.0012641	18	0.0000611	10	0.1496873	8,955	8,983	4.49
	Freestone	0.0019968	0	0.0122492	175	0.0005917	100	0.0001250	7	283	0.14
	Frio	0.0091204	0	0.0006151	9	0.0000297	5	0.0728387	4,357	4,371	2.19
	Goliad	0.0067193	0	0.0004532	6	0.0000219	4	0.0536627	3,210	3,220	1.61
	Grayson	0.0003257	0	0.0019979	29	0.0000965	16	0.0000204	1	46	0.02
	Grimes	0.0046998	0	0.0288309	413	0.0013926	236	0.0002941	18	666	0.33
	Hardeman*	-	-	-	-	-	-	-	-	-	-
	Haskell*	-	-	-	-	-	-	-	-	-	-
	Hidalgo	0.0130513	0	0.0008802	13	0.0000425	7	0.1042321	6,235	6,255	3.13
	Hill	-	-	-	-	-	-	-	-	-	-
	Howard	0.0000670	0	0.0004110	6	0.0697893	11,813	0.0000042	0	11,819	5.91
	Jack*	-	-	-	-	-	-	-	-	-	-
	Jones*	-	-	-	-	-	-	-	-	-	-
	Lamar	0.0032049	0	0.0196606	282	0.0009496	161	0.0002006	12	454	0.23
	Limestone	0.0211793	0	0.1299244	1,861	0.0062756	1,062	0.0013255	79	3,003	1.50
	Llano	0.0001481	0	0.0000100	0	0.0000005	0	0.0011830	71	71	0.04
	McLennan	0.0040079	0	0.0245863	352	0.0011876	201	0.0002508	15	568	0.28
	Milam	0.0000000	0	0.0000000	0	0.0000000	0	0.0000000	0	0	0.00
	Mitchell	0.0000065	0	0.0000398	1	0.0067613	1,144	0.0000004	0	1,145	0.57
	Nacogdoches	0.0004206	0	0.0025801	37	0.0001246	21	0.0000263	2	60	0.03
	Nolan	-	-	-	-	-	-	-	-	-	-
	Palo Pinto	0.0015001	0	0.0092024	132	0.0004445	75	0.0000939	6	213	0.11
	Pecos	0.0000031	0	0.0000192	0	0.0032590	552	0.0000002	0	552	0.28
	Potter	-	-	-	-	-	-	-	-	-	-
	Presidio*	-	-	-	-	-	-	-	-	-	-
	Reagan	-	-	-	-	-	-	-	-	-	-
	Red River	-	-	-	-	-	-	-	-	-	-
	Robertson	0.0156406	0	0.0959474	1,374	0.0046344	784	0.0009789	59	2,217	1.11
	Scurry	0.0001133	0	0.0006948	10	0.1179741	19,969	0.0000071	0	19,979	9.99
	Taylor*	-	-	-	-	-	-	-	-	-	-
	Titus	-	-	-	-	-	-	-	-	-	-
	Tom Green*	-	-	-	-	-	-	-	-	-	-
	Upton	-	-	-	-	-	-	-	-	-	-
	Ward	0.0000207	0	0.0001271	2	0.0215799	3,653	0.0000013	0	3,655	1.83
	Webb	0.0000313	0	0.0000021	0	0.0000001	0	0.0002498	15	15	0.01
	Wharton	0.0007265	0	0.0000490	1	0.0000024	0	0.0058023	347	348	0.17
	Wichita	0.0000093	0	0.0000571	1	0.0096992	1,642	0.0000006	0	1,643	0.82
	Wilbarger	0.0007609	0	0.0046675	67	0.7925755	134,153	0.0000476	3	134,223	67.11
	Wood	-	-	-	-	-	-	-	-	-	-
	Young	0.0000415	0	0.0002543	4	0.0431818	7,309	0.0000026	0	7,313	3.66
	Total	**0.6378044**	**0**	**0.6440648**	**9,226**	**1.2610464**	**213,448**	**0.9317090**	**55,738**	**278,412**	**139.21**
Energy Savings (MWh)		**0**		**14,325**		**169,262**		**59,823**			

Note *: These counties are not quantified because they are not in the ERCOT region.

Table 5-6: Distribution of the OSP Emission Reductions per CL Zone for each County (Year 2020)

Area	County	CL Zones								Total Nox Reductions (lbs)	Total Nox Reductions (Tons)
		H		N		W		S			
Houston-Galveston Area	Brazoria	0.1338985	0	0.0000170	0	0.0000008	0	0.0012544	63	63	0.0316
	Chambers	0.0326319	0	0.0000041	0	0.0000002	0	0.0003057	15	15	0.01
	Fort Bend	0.1028262	0	0.0000130	0	0.0000006	0	0.0009633	48	49	0.02
	Galveston	0.0163861	0	0.0000021	0	0.0000001	0	0.0001535	8	8	0.00
	Harris	0.1329895	0	0.0000169	0	0.0000008	0	0.0012459	62	63	0.03
	Liberty*	-	-	-	-	-	-	-	-	-	-
	Montgomery	-	-	-	-	-	-	-	-	-	-
	Waller*	-	-	-	-	-	-	-	-	-	-
Beaumont/ Port Arthur Area	Hardin*	-	-	-	-	-	-	-	-	-	-
	Jefferson*	-	-	-	-	-	-	-	-	-	-
	Orange*	-	-	-	-	-	-	-	-	-	-
Dallas/ Fort Worth Area	Collin	0.0001333	0	0.0008179	9	0.0000395	7	0.0000083	0	15	0.01
	Dallas	0.0020916	0	0.0128308	134	0.0006198	102	0.0001309	7	242	0.12
	Denton	0.0066363	0	0.0407106	425	0.0019664	324	0.0004153	21	769	0.38
	Henderson	0.0002303	0	0.0014128	15	0.0000682	11	0.0000144	1	27	0.01
	Hood	0.0009171	0	0.0056259	59	0.0002717	45	0.0000574	3	106	0.05
	Hunt	0.0000072	0	0.0000443	0	0.0000021	0	0.0000005	0	1	0.00
	Tarrant	0.0006459	0	0.0039625	41	0.0001914	31	0.0000404	2	75	0.04
	Ellis	0.0015545	0	0.0095358	99	0.0004606	76	0.0000973	5	180	0.09
	Johnson	0.0002466	0	0.0015125	16	0.0000731	12	0.0000154	1	29	0.01
	Kaufman	0.0029234	0	0.0179336	187	0.0008662	143	0.0001830	9	339	0.17
	Parker	0.0004755	0	0.0029172	30	0.0001409	23	0.0000298	1	55	0.03
	Rockwall*	-	-	-	-	-	-	-	-	-	-
	Wise	0.0031354	0	0.0192341	201	0.0009290	153	0.0001962	10	363	0.18
El Paso Area	El Paso*	-	-	-	-	-	-	-	-	-	-
San Antonio Area	Bexar	0.0251261	0	0.0016946	18	0.0000819	13	0.2006666	10,059	10,090	5.05
	Comal	0.0003940	0	0.0000266	0	0.0000013	0	0.0031468	158	158	0.08
	Guadalupe	0.0031600	0	0.0002131	2	0.0000103	2	0.0252373	1,265	1,269	0.63
	Wilson	-	-	-	-	-	-	-	-	-	-
Austin Area	Austin	-	-	-	-	-	-	-	-	-	-
	Bastrop	0.0030802	0	0.0002077	2	0.0000100	2	0.0245997	1,233	1,237	0.62
	Caldwell*	-	-	-	-	-	-	-	-	-	-
	Hays	0.0005948	0	0.0000401	0	0.0000019	0	0.0047504	238	239	0.12
	Travis	0.0055911	0	0.0003771	4	0.0000182	3	0.0446524	2,238	2,245	1.12
	Williamson	-	-	-	-	-	-	-	-	-	-
North East Texas Area	Gregg*	-	-	-	-	-	-	-	-	-	-
	Harrison*	-	-	-	-	-	-	-	-	-	-
	Rusk	0.0284443	0	0.1744911	1,821	0.0084282	1,387	0.0017802	89	3,297	1.65
	Smith*	-	-	-	-	-	-	-	-	-	-
	Upshur*	-	-	-	-	-	-	-	-	-	-
Corpus Christi Area	Nueces	0.0041146	0	0.0002775	3	0.0000134	2	0.0328606	1,647	1,652	0.83
	San Patricio	0.0052899	0	0.0003568	4	0.0000172	3	0.0422468	2,118	2,124	1.06
Victoria Area	Victoria	0.0016002	0	0.0001079	1	0.0000052	1	0.0127795	641	643	0.32
Other ERCOT counties	Anderson	-	-	-	-	-	-	-	-	-	-
	Andrews*	-	-	-	-	-	-	-	-	-	-
	Angelina	-	-	-	-	-	-	-	-	-	-
	Atascosa	0.0075430	0	0.0005087	5	0.0000246	4	0.0602409	3,020	3,029	1.51
	Bell	0.0005412	0	0.0033200	35	0.0001604	26	0.0000339	2	63	0.03
	Bosque	0.0007335	0	0.0044996	47	0.0002173	36	0.0000459	2	85	0.04
	Brazos	0.0005896	0	0.0036168	38	0.0001747	29	0.0000369	2	68	0.03
	Calhoun	0.0087907	0	0.0005929	6	0.0000286	5	0.0702058	3,519	3,530	1.77
	Cameron	0.0000245	0	0.0000016	0	0.0000001	0	0.0001954	10	10	0.00
	Cherokee	0.0002513	0	0.0015416	16	0.0000745	12	0.0000157	1	29	0.01
	Coke	0.0000237	0	0.0001452	2	0.0246578	4,058	0.0000015	0	4,059	2.03
	Coleman*	-	-	-	-	-	-	-	-	-	-
	Colorado	0.0015097	0	0.0001018	1	0.0000049	1	0.0120568	604	606	0.30
	Crockett*	-	-	-	-	-	-	-	-	-	-
	Ector	0.0001352	0	0.0008292	9	0.1408089	23,171	0.0000085	0	23,180	11.59
	Fannin*	-	-	-	-	-	-	-	-	-	-
	Fayette	0.0187428	0	0.0012641	13	0.0000611	10	0.1496873	7,504	7,527	3.76
	Freestone	0.0019968	0	0.0122492	128	0.0005917	97	0.0001250	6	231	0.12
	Frio	0.0091204	0	0.0006151	6	0.0000297	5	0.0728387	3,651	3,663	1.83
	Goliad	0.0067193	0	0.0004532	5	0.0000219	4	0.0536627	2,690	2,698	1.35
	Grayson	0.0003257	0	0.0019979	21	0.0000965	16	0.0000204	1	38	0.02
	Grimes	0.0046998	0	0.0288309	301	0.0013926	229	0.0002941	15	545	0.27
	Hardeman*	-	-	-	-	-	-	-	-	-	-
	Haskell*	-	-	-	-	-	-	-	-	-	-
	Hidalgo	0.0130513	0	0.0008802	9	0.0000425	7	0.1042321	5,225	5,241	2.62
	Hill	-	-	-	-	-	-	-	-	-	-
	Howard	0.0000670	0	0.0004110	4	0.0697893	11,484	0.0000042	0	11,489	5.74
	Jack*	-	-	-	-	-	-	-	-	-	-
	Jones*	-	-	-	-	-	-	-	-	-	-
	Lamar	0.0032049	0	0.0196606	205	0.0009496	156	0.0002006	10	371	0.19
	Limestone	0.0211793	0	0.1299244	1,356	0.0062756	1,033	0.0013255	66	2,455	1.23
	Llano	0.0001481	0	0.0000100	0	0.0000005	0	0.0011830	59	59	0.03
	McLennan	0.0040079	0	0.0245863	257	0.0011876	195	0.0002508	13	465	0.23
	Milam	0.0000000	0	0.0000000	0	0.0000000	0	0.0000000	0	0	0.00
	Mitchell	0.0000065	0	0.0000398	0	0.0067613	1,113	0.0000004	0	1,113	0.56
	Nacogdoches	0.0004206	0	0.0025801	27	0.0001246	21	0.0000263	1	49	0.02
	Nolan	-	-	-	-	-	-	-	-	-	-
	Palo Pinto	0.0015001	0	0.0092024	96	0.0004445	73	0.0000939	5	174	0.09
	Pecos	0.0000031	0	0.0000192	0	0.0032590	536	0.0000002	0	536	0.27
	Potter	-	-	-	-	-	-	-	-	-	-
	Presidio*	-	-	-	-	-	-	-	-	-	-
	Reagan	-	-	-	-	-	-	-	-	-	-
	Red River	-	-	-	-	-	-	-	-	-	-
	Robertson	0.0156406	0	0.0959474	1,001	0.0046344	763	0.0009789	49	1,813	0.91
	Scurry	0.0001133	0	0.0006948	7	0.1179741	19,413	0.0000071	0	19,421	9.71
	Taylor*	-	-	-	-	-	-	-	-	-	-
	Titus	-	-	-	-	-	-	-	-	-	-
	Tom Green*	-	-	-	-	-	-	-	-	-	-
	Upton	-	-	-	-	-	-	-	-	-	-
	Ward	0.0000207	0	0.0001271	1	0.0215799	3,551	0.0000013	0	3,552	1.78
	Webb	0.0000313	0	0.0000021	0	0.0000001	0	0.0002498	13	13	0.01
	Wharton	0.0007265	0	0.0000490	1	0.0000024	0	0.0058023	291	292	0.15
	Wichita	0.0000093	0	0.0000571	1	0.0096992	1,596	0.0000006	0	1,597	0.80
	Wilbarger	0.0007609	0	0.0046675	49	0.7925755	130,422	0.0000476	2	130,473	65.24
	Wood	-	-	-	-	-	-	-	-	-	-
	Young	0.0000415	0	0.0002543	3	0.0431818	7,106	0.0000026	0	7,109	3.55
	Total	**0.6378044**	**0**	**0.6440648**	**6,720**	**1.2610464**	**207,510**	**0.9317090**	**46,706**	**260,937**	**130.47**
Energy Savings (MWh)		**0**		**10,434**		**164,554**		**50,129**			

Note *: These counties are not quantified because they are not in the ERCOT region.

6 OTHER RENEWABLE SOURCES

Five specific renewable sources were determined: solar, biomass, hydroelectric, geothermal, and landfill gas-fired, to generate energy throughout the State of Texas, six types of renewable energy projects were identified: solar photovoltaic (PV), including solar power, solar thermal, biomass power, hydroelectric power, geothermal HVAC, and landfill gas-fired power projects. The generated, avoided, and used energy from renewable energy projects impacts emissions reductions throughout the State of Texas. To determine the amount of NOx emission reductions using 2018 eGRID, this report collected installation and/or generation data of renewable energy projects. The majority of the collected data were after the year 2000. However, projects before the year 2000 were also included in order to provide a complete record.

6.1 Implementation

This report included a lot of newly located renewable energy projects in the six renewable energy projects categories, as already discussed. The information was collected using the following modes:

- information from the internet websites of manufacturers, distributors, and consultants related to renewable energy products;
- some information was collected by personally emailing individuals, who were either manufacturers, distributors or consultants; and
- information published from environmental agencies like the Electric Reliability Council of Texas (ERCOT), the Environmental Protection Agency (EPA), and Lawrence Berkeley National Laboratory (LBNL) which are available to the general public.

It was mainly the same methodology/protocol followed for data collection used in the previous report. Most of the information collected from websites was very limited since the information did not include detailed project information such as system specifications data. To obtain more information, we emailed manufacturers, consultants, distributors, or officers in environmental agencies. Unfortunately, we were not able to take many responses back from the people whom we contacted. Therefore, most of the updated information in the present report was obtained from environmental agencies like ERCOT, EPA, and LBNL.

In the last year's TERP reports, the ESL integrated small-scale solar photovoltaic projects from various websites (e.g., NREL Open PV database and others, described in the previous ESL TERP reports) and the *Tracking the Sun* public database of the LBNL for the non-utility scale solar PV calculations. However, the NREL Open PV database is no longer available since June 2019. In addition, other projects information from other sources used in the 2019 report were not available. Therefore, to acquire verified information each year about the non-utility scale solar PV projects, the ESL determined to use only the database from the LBNL, "*Tracking the Sun"* report (https://emp.lbl.gov/tracking-the-sun/). Compared to the previous integrated projects, which included 29,406 projects from 2004 to 2019, the *Tracking the Sun* public database included 34,781 projects from 2004 to 2020. *Tracking the Sun* public database contains data about solar projects across the United States from 2004 to 2020, including geographical information (e.g., zip code, state), project features (e.g., capacity, cost, date), and utility company. In this report, these data were used to compute annual energy generations and NOx savings from non-utility solar PV projects in Texas up to 2020.

The solar thermal projects and geothermal projects throughout the State of Texas were identified from various web sources. The present report data for three other utility-scale renewable resources (i.e., solar power, biomass, and hydroelectricity) were obtained from the Electric Reliability Council of Texas (ERCOT). The information for the landfill gas-fired power plant section was provided by the Environmental Protection Agency's (EPA's) project database for Landfill Methane Outreach Program (LMOP).

To determine energy savings from solar photovoltaic and solar thermal, the generated energy was calculated in electricity and electricity equivalent. Then, NOx emission reductions throughout the State of Texas were evaluated based on the generated energy. To determine NOx emission reductions, the 2018

eGRID version was used. Figure 6-1 presents the work process to implement the analysis of other renewable resources, including steps: project classification, data collection, data preparation, NOx emission reductions calculation, and result production.

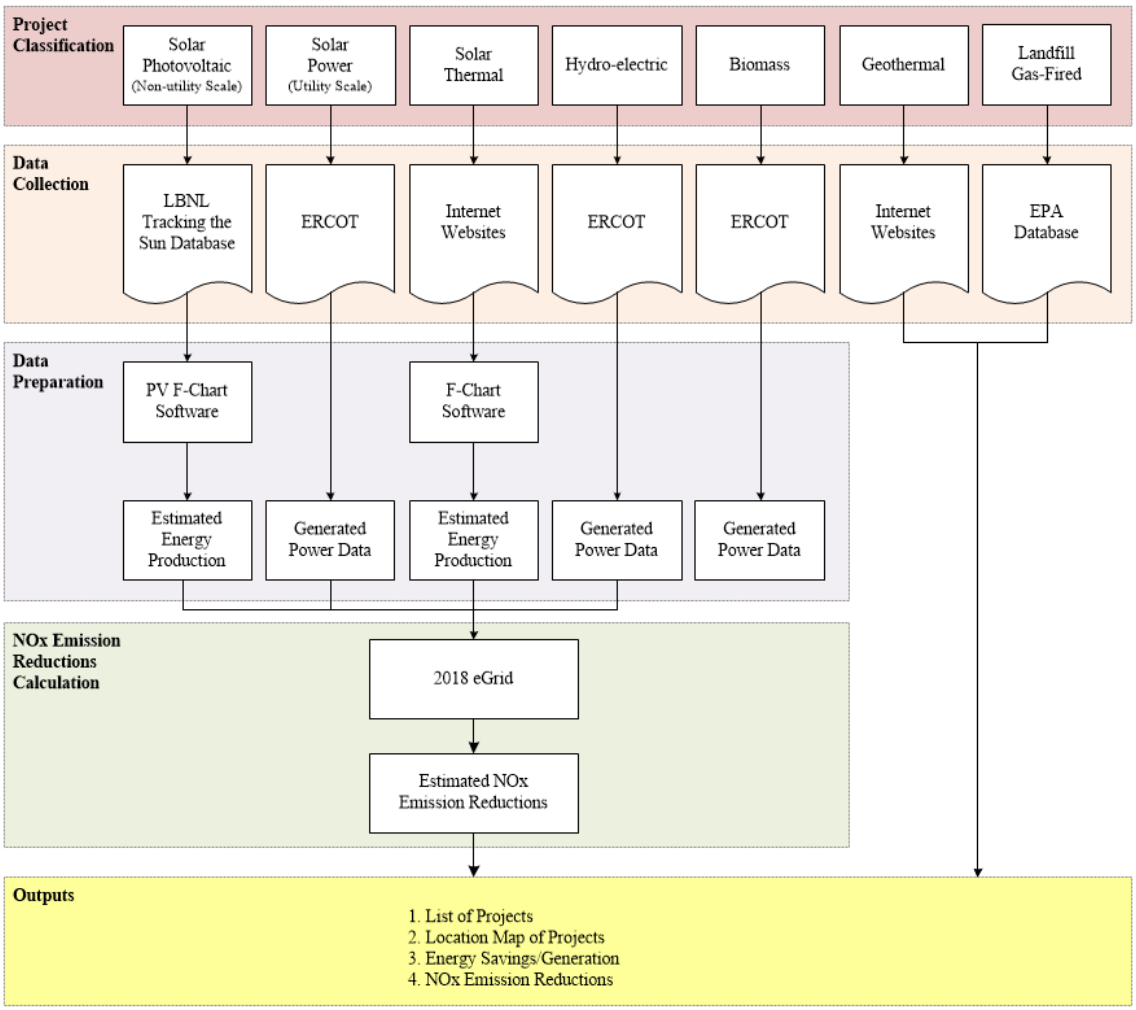


Figure 6-1: Chart of Workflow for Other Renewable Energy Projects

6.2 Renewable Energy Projects

6.2.1 Solar Photovoltaic

As of the end of 2020, a total of 34,781 projects (non-utility scale) were found. These data were collected from the *Tracking the Sun* public database of the Lawrence Berkeley National Laboratory (LBNL). The new database from Tracking the Sun provides information about solar PV projects that have been implemented since 2004. The database includes individual solar PV projects (non-utility scale) of residential and non-residential in Texas. Also, it provides detailed information, such as zip code, system size (kW DC), cost, date installed, and location. All of the identified solar PV projects can be found in Table G-1 (Vol II, Appendix G). In addition, Figure 6-2 shows the map of the solar PV projects installed in each county of Texas.

The generated energy from all the solar PV projects is presented in Table 6-1. The annual electric generations per county and the OSP electric generations per county, which were estimated from these projects, are presented in Figure 6-3 and in Figure 6-4. Please note that Figure 6-3 is presented using a logarithmic scale for the electricity generation because of the large variation in the amounts shown. In addition, the corresponding annual NOx emission reductions are shown in Figure 6-5.

To improve the accuracy of the current calculation methods, this report recalculated the weighted solar PV efficiencies based on *2020 Tracking the Sun* data. Using the PV F-Chart software, the annual solar generation coefficients and OSP solar generation coefficients were recomputed using forty TMY3 weather stations to estimate annual and OSP solar PV generations by county. Also, the target counties were expanded from the previous 41 counties to 254 counties to treat entire regions across Texas. Additional details of this year's update (e.g., solar PV efficiency, data source transition, etc.) are described in Vol II Appendix F.

Table 6-1: Solar Photovoltaic Projects: Annual Energy and OSP Energy up to 2020

County	Annual Elec. Generation (MWh/year)	OSP Elec. Generation (MWh/Day)	County	Annual Elec. Generation (MWh/year)	OSP Elec. Generation (MWh/Day)
Anderson	29.7	0.09	Crockett	-	-
Andrews	-	-	Crosby	-	-
Angelina	86.1	0.27	Culberson	-	-
Aransas	87.5	0.30	Dallam	-	-
Archer	228.3	0.68	Dallas	4,685.4	14.02
Armstrong	-	-	Dawson	-	-
Atascosa	1,433.2	4.37	Deaf Smith	-	-
Austin	-	-	Delta	-	-
Bailey	-	-	Denton	885.8	2.65
Bandera	-	-	De Witt	10.0	0.03
Bastrop	-	-	Dickens	-	-
Baylor	-	-	Dimmit	-	-
Bee	4.2	0.01	Donley	-	-
Bell	439.9	1.37	Duval	24.0	0.08
Bexar	297,581.0	906.54	Eastland	31.4	0.09
Blanco	-	-	Ector	85.8	0.24
Borden	-	-	Edwards	-	-
Bosque	38.6	0.12	Ellis	429.9	1.29
Bowie	182.6	0.59	El Paso	5,676.8	15.94
Brazoria	15.9	0.05	Erath	15.9	0.05
Brazos	-	-	Falls	9.6	0.03
Brewster	405.9	1.17	Fannin	23.7	0.08
Briscoe	-	-	Fayette	-	-
Brooks	-	-	Fisher	-	-
Brown	94.2	0.27	Floyd	-	-
Burleson	-	-	Foard	-	-
Burnet	16.1	0.05	Fort Bend	-	-
Caldwell	12.7	0.04	Franklin	5.8	0.02
Calhoun	-	-	Freestone	-	-
Callahan	221.9	0.64	Frio	7.0	0.02
Cameron	1,684.5	5.33	Gaines	-	-
Camp	-	-	Galveston	100.8	0.33
Carson	-	-	Garza	-	-
Cass	45.2	0.15	Gillespie	-	-
Castro	-	-	Glasscock	-	-
Chambers	-	-	Goliad	39.6	0.12
Cherokee	97.5	0.29	Gonzales	-	-
Childress	-	-	Gray	-	-
Clay	49.9	0.15	Grayson	121.9	0.39
Cochran	-	-	Gregg	308.3	0.99
Coke	-	-	Grimes	18.5	0.06
Coleman	17.6	0.05	Guadalupe	7,797.8	23.76
Collin	1,057.3	3.39	Hale	22.3	0.06
Collingsworth	-	-	Hall	-	-
Colorado	35.4	0.11	Hamilton	18.8	0.06
Comal	7,826.6	23.84	Hansford	-	-
Comanche	-	-	Hardeman	-	-
Concho	-	-	Hardin	28.1	0.09
Cooke	127.8	0.38	Harris	-	-
Coryell	14.6	0.05	Harrison	21.9	0.07
Cottle	-	-	Hartley	-	-
Crane	-	-	Haskell	17.4	0.05

Table 6-1: Solar Photovoltaic Projects: Annual Energy and OSP Energy up to 2020 (Cont.)

County	Annual Elec. Generation (MWh/year)	OSP Elec. Generation (MWh/Day)
Hays	-	-
Hemphill	-	-
Henderson	63.2	0.19
Hidalgo	4,339.6	13.92
Hill	3.7	0.01
Hockley	-	-
Hood	19.2	0.05
Hopkins	380.6	1.22
Houston	-	-
Howard	340.7	0.97
Hudspeth	-	-
Hunt	60.4	0.19
Hutchinson	-	-
Irion	-	-
Jack	-	-
Jackson	13.8	0.04
Jasper	-	-
Jeff Davis	123.8	0.36
Jefferson	39.9	0.12
Jim Hogg	5.6	0.02
Jim Wells	549.5	1.87
Johnson	134.7	0.40
Jones	69.7	0.20
Karnes	12.8	0.04
Kaufman	39.1	0.13
Kendall	5,340.2	16.27
Kenedy	-	-
Kent	-	-
Kerr	-	-
Kimble	78.5	0.23
King	-	-
Kinney	-	-
Kleberg	41.4	0.14
Knox	73.0	0.22
Lamar	194.7	0.65
Lamb	-	-
Lampasas	-	-
La Salle	9.5	0.03
Lavaca	-	-
Lee	-	-
Leon	25.7	0.08
Liberty	-	-
Limestone	15.3	0.05
Lipscomb	-	-
Live Oak	-	-
Llano	-	-
Loving	-	-
Lubbock	-	-
Lynn	-	-
McCulloch	-	-
McLennan	944.4	2.88
McMullen	-	-
Madison	-	-
Marion	-	-
Martin	-	-
Mason	-	-
Matagorda	58.1	0.17
Maverick	102.0	0.31
Medina	1,500.3	5.02
Menard	-	-
Midland	163.9	0.46
Milam	-	-
Mills	-	-
Mitchell	-	-
Montague	6.2	0.02
Montgomery	289.8	0.87
Moore	-	-
Morris	21.8	0.07
Motley	-	-
Nacogdoches	-	-
Navarro	29.0	0.09
Newton	-	-
Nolan	16.9	0.05
Nueces	886.0	2.80
Ochiltree	-	-

County	Annual Elec. Generation (MWh/year)	OSP Elec. Generation (MWh/Day)
Oldham	-	-
Orange	116.7	0.36
Palo Pinto	8.0	0.02
Panola	29.9	0.10
Parker	75.5	0.21
Parmer	-	-
Pecos	40.8	0.12
Polk	-	-
Potter	-	-
Presidio	548.9	1.58
Rains	-	-
Randall	-	-
Reagan	-	-
Real	32.2	0.11
Red River	57.3	0.16
Reeves	95.0	0.27
Refugio	-	-
Roberts	-	-
Robertson	6.3	0.02
Rockwall	85.7	0.27
Runnels	15.9	0.05
Rusk	38.0	0.12
Sabine	-	-
San Augustine	-	-
San Jacinto	-	-
San Patricio	34.2	0.11
San Saba	-	-
Schleicher	32.7	0.09
Scurry	-	-
Shackelford	119.8	0.35
Shelby	-	-
Sherman	-	-
Smith	263.2	0.79
Somervell	-	-
Starr	107.5	0.34
Stephens	-	-
Sterling	-	-
Stonewall	-	-
Sutton	-	-
Swisher	-	-
Tarrant	3,320.1	9.94
Taylor	404.9	1.18
Terrell	-	-
Terry	-	-
Throckmorton	-	-
Titus	-	-
Tom Green	914.4	2.64
Travis	91,787.6	302.70
Trinity	14.1	0.04
Tyler	23.0	0.07
Upshur	8.4	0.03
Upton	-	-
Uvalde	10.9	0.04
Val Verde	20.5	0.06
Van Zandt	37.0	0.12
Victoria	8.2	0.03
Walker	29.9	0.09
Waller	12.9	0.04
Ward	-	-
Washington	-	-
Webb	1,969.2	6.05
Wharton	9.8	0.03
Wheeler	-	-
Wichita	384.5	1.14
Wilbarger	125.7	0.37
Willacy	-	-
Williamson	2,720.2	9.01
Wilson	48.4	0.15
Winkler	2.1	0.01
Wise	-	-
Wood	14.4	0.04
Yoakum	-	-
Young	15.0	0.04
Zapata	-	-
Zavala	-	-

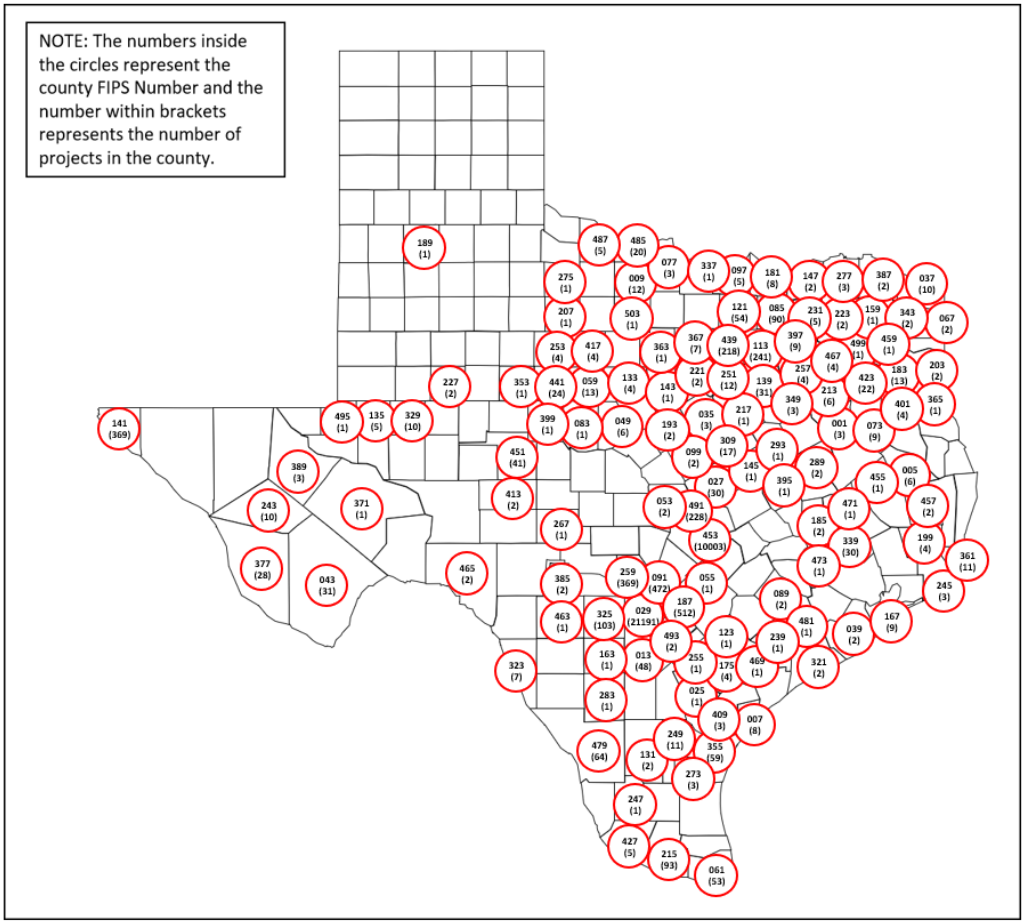


Figure 6-2: Map of Non-Utility Solar PV Projects Installed in Each County of Texas

Table 6-2: Texas Non-Utility Solar Photovoltaic Projects up to 2020

County	FIPS Code	No. of Projects
Anderson	001	3
Andrews	003	0
Angelina	005	6
Aransas	007	8
Archer	009	12
Armstrong	011	0
Atascosa	013	48
Austin	015	0
Bailey	017	0
Bandera	019	0
Bastrop	021	0
Baylor	023	0
Bee	025	1
Bell	027	30
Bexar	029	21,191
Blanco	031	0
Borden	033	0
Bosque	035	3
Bowie	037	10
Brazoria	039	2
Brazos	041	0
Brewster	043	31

County	FIPS Code	No. of Projects
Briscoe	045	0
Brooks	047	0
Brown	049	6
Burleson	051	0
Burnet	053	2
Caldwell	055	1
Calhoun	057	0
Callahan	059	13
Cameron	061	53
Camp	063	0
Carson	065	0
Cass	067	2
Castro	069	0
Chambers	071	0
Cherokee	073	9
Childress	075	0
Clay	077	3
Cochran	079	0
Coke	081	0
Coleman	083	1
Collin	085	90
Collingsworth	087	0

County	FIPS Code	No. of Projects
Colorado	089	2
Comal	091	472
Comanche	093	0
Concho	095	0
Cooke	097	5
Coryell	099	2
Cottle	101	0
Crane	103	0
Crockett	105	0
Crosby	107	0
Culberson	109	0
Dallam	111	0
Dallas	113	241
Dawson	115	0
Deaf Smith	117	0
Delta	119	0
Denton	121	54
De Witt	123	1
Dickens	125	0
Dimmit	127	0
Donley	129	0
Duval	131	2

Table 6-2: Texas Non-Utility Solar Photovoltaic Projects up to 2020 (Cont.)

County	FIPS Code	No. of Projects
Eastland	133	4
Ector	135	5
Edwards	137	0
Ellis	139	31
El Paso	141	369
Erath	143	1
Falls	145	1
Fannin	147	2
Fayette	149	0
Fisher	151	0
Floyd	153	0
Foard	155	0
Fort Bend	157	0
Franklin	159	1
Freestone	161	0
Frio	163	1
Gaines	165	0
Galveston	167	9
Garza	169	0
Gillespie	171	0
Glasscock	173	0
Goliad	175	4
Gonzales	177	0
Gray	179	0
Grayson	181	8
Gregg	183	13
Grimes	185	2
Guadalupe	187	512
Hale	189	1
Hall	191	0
Hamilton	193	2
Hansford	195	0
Hardeman	197	0
Hardin	199	4
Harris	201	0
Harrison	203	2
Hartley	205	0
Haskell	207	1
Hays	209	0
Hemphill	211	0
Henderson	213	6
Hidalgo	215	93
Hill	217	1
Hockley	219	0
Hood	221	2
Hopkins	223	2
Houston	225	0
Howard	227	2
Hudspeth	229	0
Hunt	231	5
Hutchinson	233	0
Irion	235	0
Jack	237	0
Jackson	239	1
Jasper	241	0
Jeff Davis	243	10
Jefferson	245	3
Jim Hogg	247	1
Jim Wells	249	11
Johnson	251	12
Jones	253	4
Karnes	255	1
Kaufman	257	4
Kendall	259	369
Kenedy	261	0
Kent	263	0
Kerr	265	0
Kimble	267	1
King	269	0
Kinney	271	0
Kleberg	273	3
Knox	275	1
Lamar	277	3
Lamb	279	0
Lampasas	281	0
La Salle	283	1
Lavaca	285	0
Lee	287	0
Leon	289	2
Liberty	291	0
Limestone	293	1
Lipscomb	295	0
Live Oak	297	0
Llano	299	0
Loving	301	0
Lubbock	303	0
Lynn	305	0
McCulloch	307	0
McLennan	309	17
McMullen	311	0
Madison	313	0
Marion	315	0
Martin	317	0
Mason	319	0
Matagorda	321	2
Maverick	323	7
Medina	325	103
Menard	327	0
Midland	329	10
Milam	331	0
Mills	333	0
Mitchell	335	0
Montague	337	1
Montgomery	339	30
Moore	341	0
Morris	343	2
Motley	345	0
Nacogdoches	347	0
Navarro	349	3
Newton	351	0
Nolan	353	1
Nueces	355	59
Ochiltree	357	0
Oldham	359	0
Orange	361	11
Palo Pinto	363	1
Panola	365	1
Parker	367	7
Parmer	369	0
Pecos	371	1
Polk	373	0
Potter	375	0
Presidio	377	28
Rains	379	0
Randall	381	0
Reagan	383	0
Real	385	2
Red River	387	2
Reeves	389	3
Refugio	391	0
Roberts	393	0
Robertson	395	1
Rockwall	397	9
Runnels	399	1
Rusk	401	4
Sabine	403	0
San Augustine	405	0
San Jacinto	407	0
San Patricio	409	3
San Saba	411	0
Schleicher	413	2
Scurry	415	0
Shackelford	417	4
Shelby	419	0
Sherman	421	0
Smith	423	22
Somervell	425	0
Starr	427	5
Stephens	429	0
Sterling	431	0

Table 6-2: Texas Non-Utility Solar Photovoltaic Projects up to 2020 (Cont.)

County	FIPS Code	No. of Projects
Stonewall	433	0
Sutton	435	0
Swisher	437	0
Tarrant	439	218
Taylor	441	24
Terrell	443	0
Terry	445	0
Throckmorton	447	0
Titus	449	0
Tom Green	451	41
Travis	453	10,003
Trinity	455	1
Tyler	457	2
Upshur	459	1
Upton	461	0
Uvalde	463	1
Val Verde	465	2
Van Zandt	467	4
Victoria	469	1
Walker	471	1
Waller	473	1
Ward	475	0
Washington	477	0
Webb	479	64
Wharton	481	1
Wheeler	483	0
Wichita	485	20
Wilbarger	487	5
Willacy	489	0
Williamson	491	228
Wilson	493	2
Winkler	495	1
Wise	497	0
Wood	499	1
Yoakum	501	0
Young	503	1
Zapata	505	0
Zavala	507	0

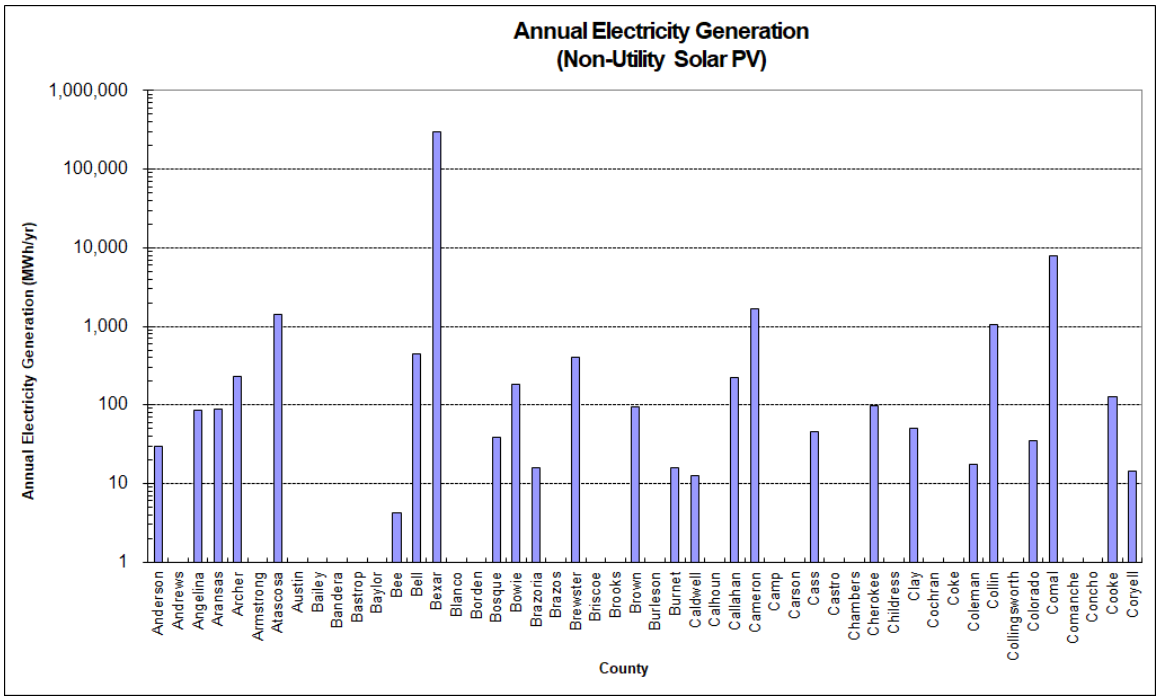


Figure 6-3: Annual Electricity Generation per County from Solar Photovoltaic Projects up to 2020

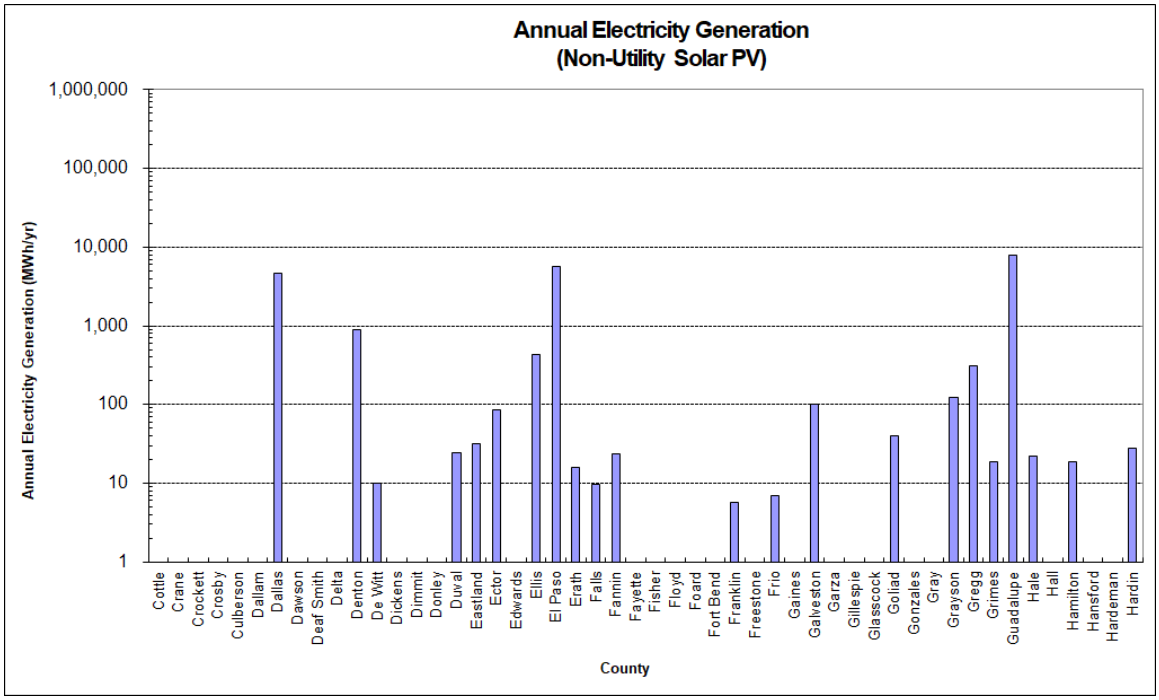


Figure 6-3: Annual Electricity Generation per County from Solar Photovoltaic Projects up to 2020 (Continued)

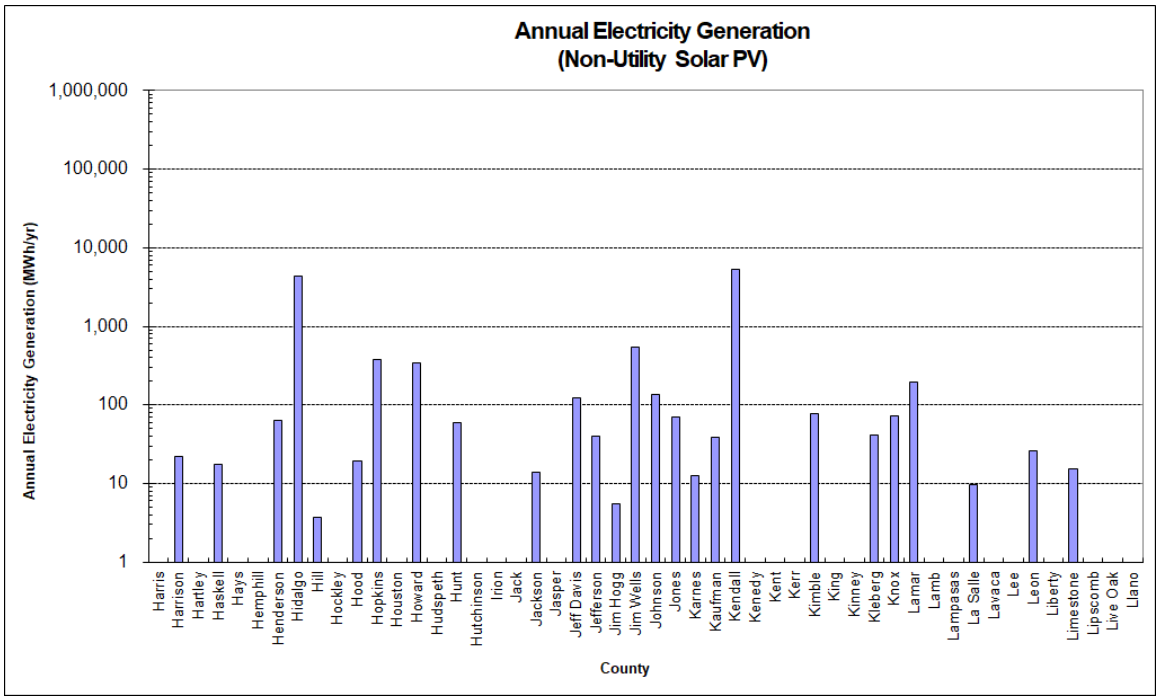


Figure 6-3: Annual Electricity Generation per County from Solar Photovoltaic Projects up to 2020 (Continued)

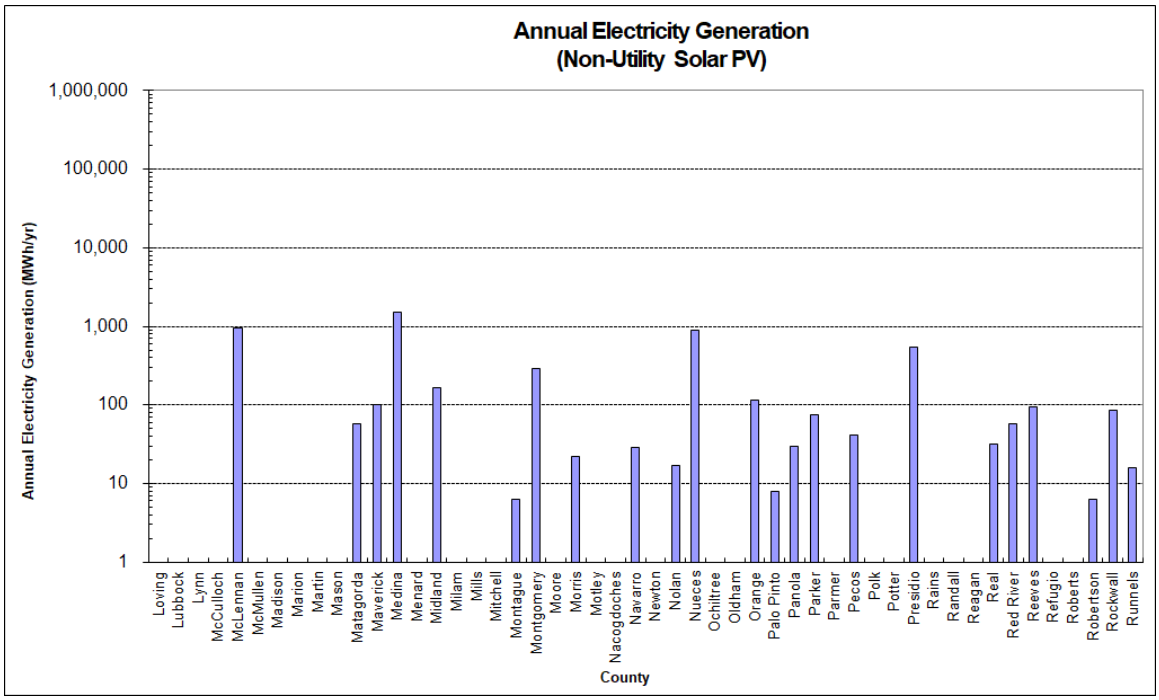


Figure 6-3: Annual Electricity Generation per County from Solar Photovoltaic Projects up to 2020 (Continued)

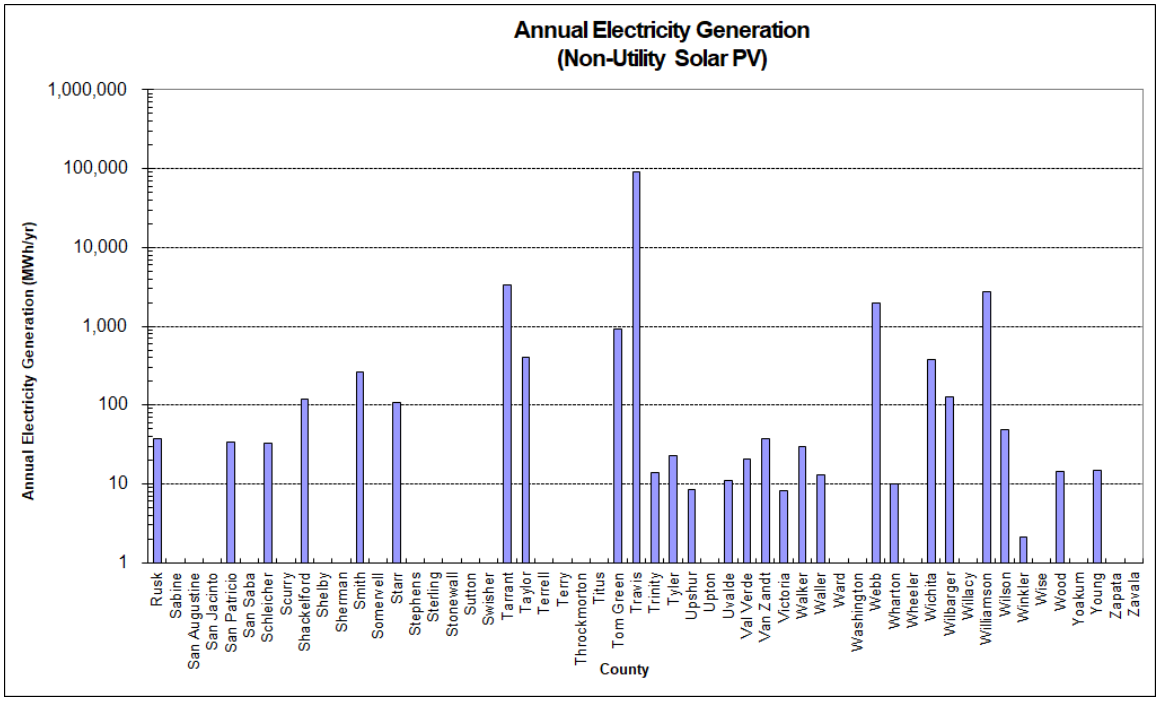


Figure 6-3: Annual Electricity Generation per County from Solar Photovoltaic Projects up to 2020 (Continued)

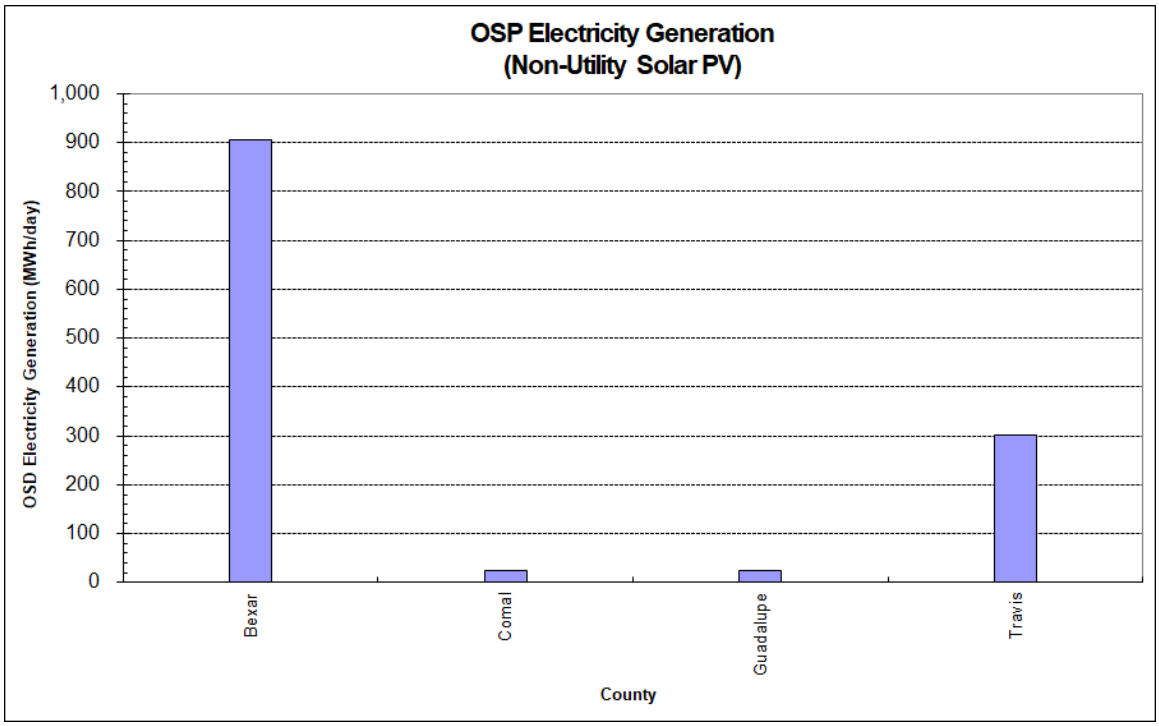


Figure 6-4: OSP Electricity Generation per County from Solar Photovoltaic Projects up to 2020

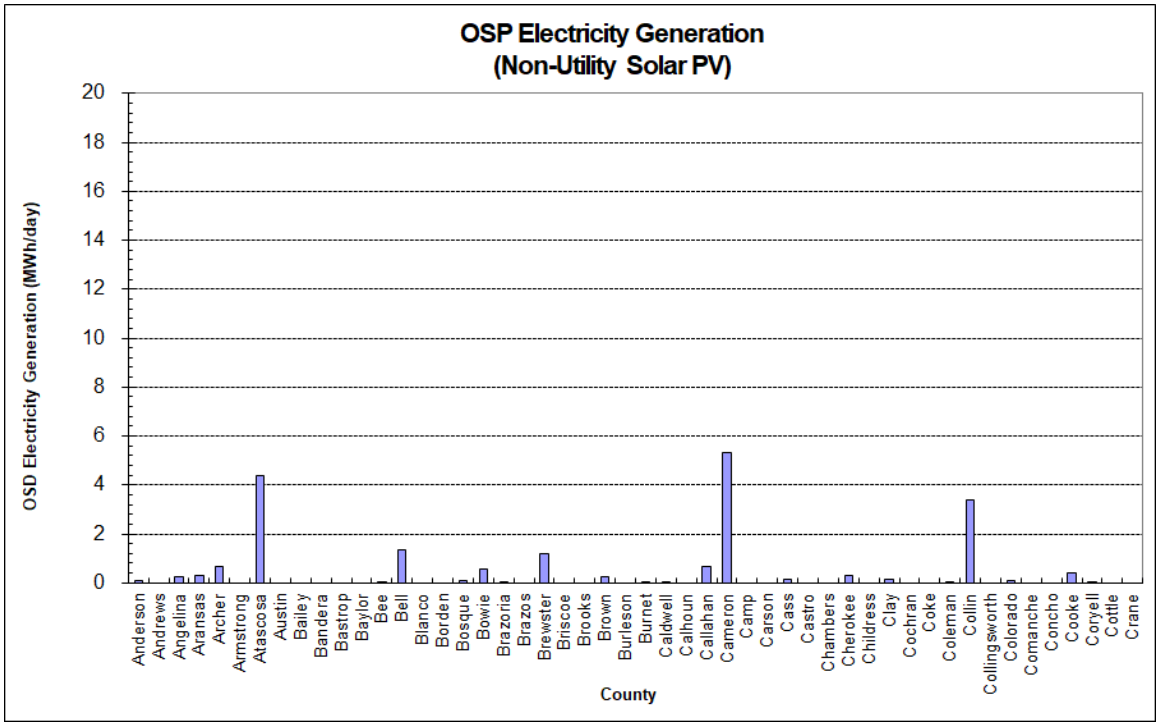


Figure 6-4: OSP Electricity Generation per County from Solar Photovoltaic Projects up to 2020 (Continued)

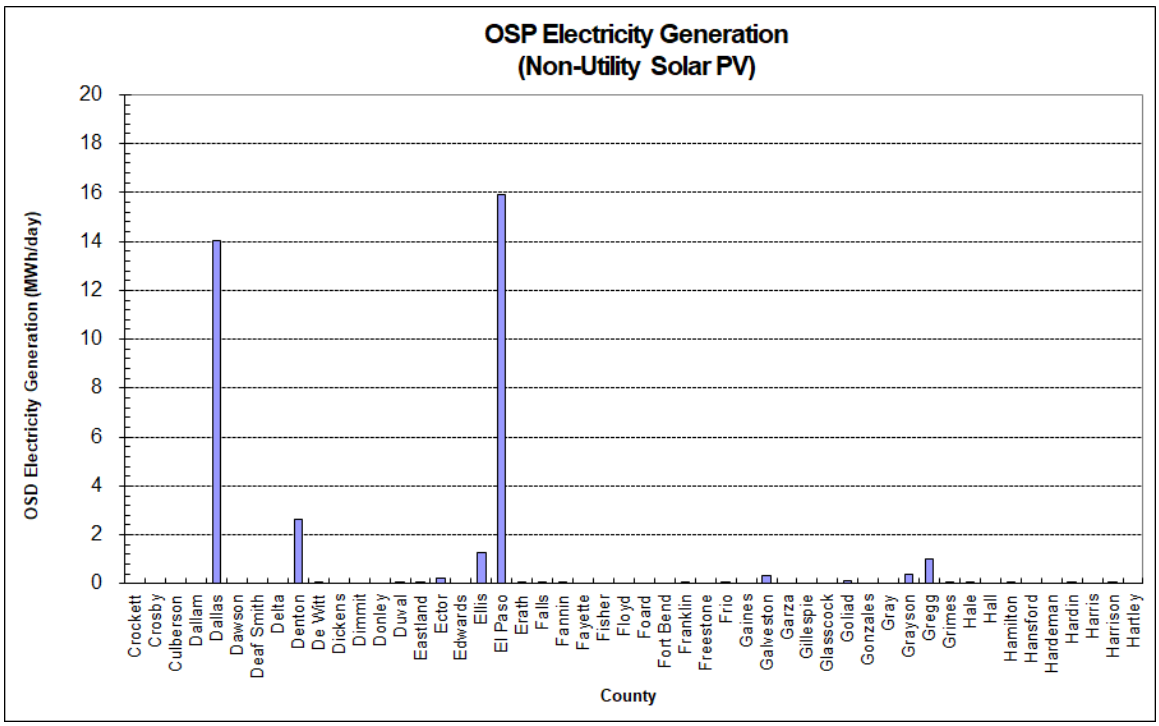


Figure 6-4: OSP Electricity Generation per County from Solar Photovoltaic Projects up to 2020 (Continued)

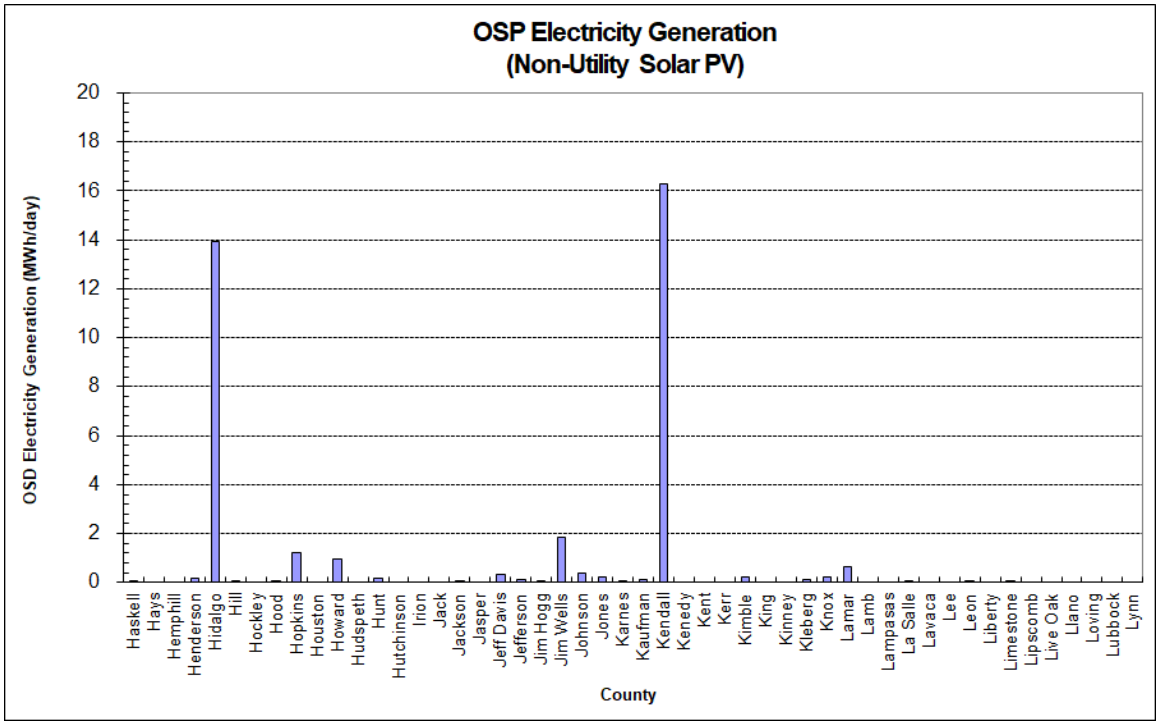


Figure 6-4: OSP Electricity Generation per County from Solar Photovoltaic Projects up to 2020 (Continued)

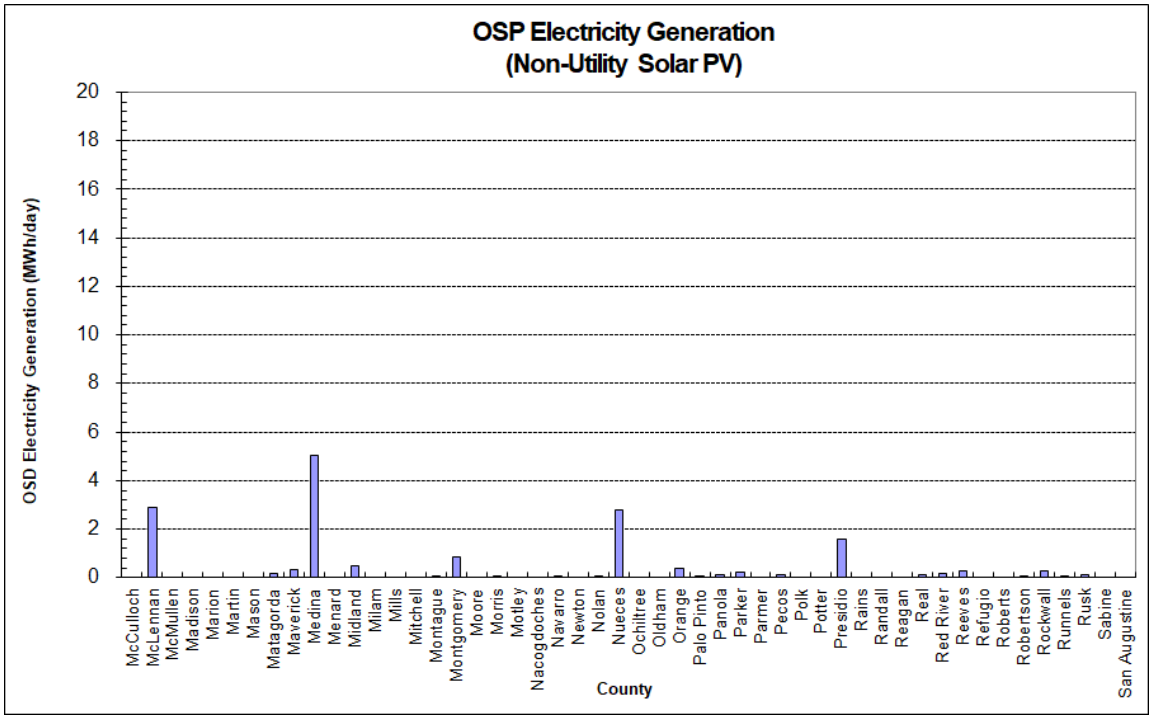


Figure 6-4: OSP Electricity Generation per County from Solar Photovoltaic Projects up to 2020 (Continued)

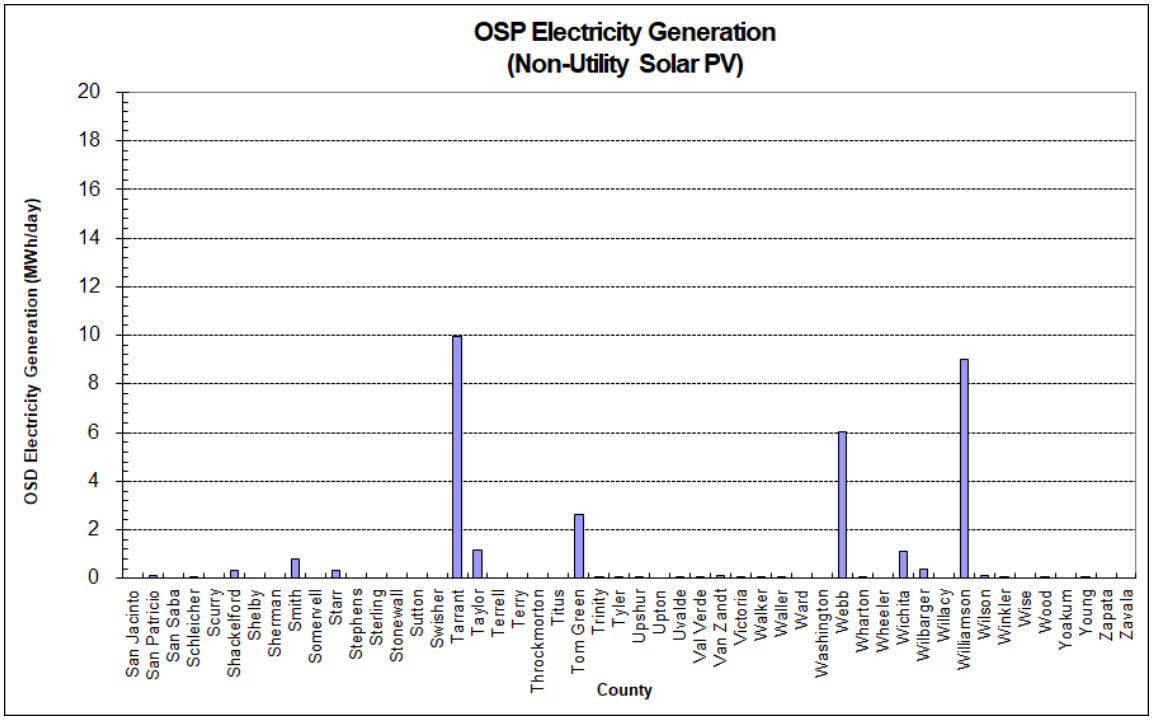


Figure 6-4: OSP Electricity Generation per County from Solar Photovoltaic Projects up to 2020 (Continued)

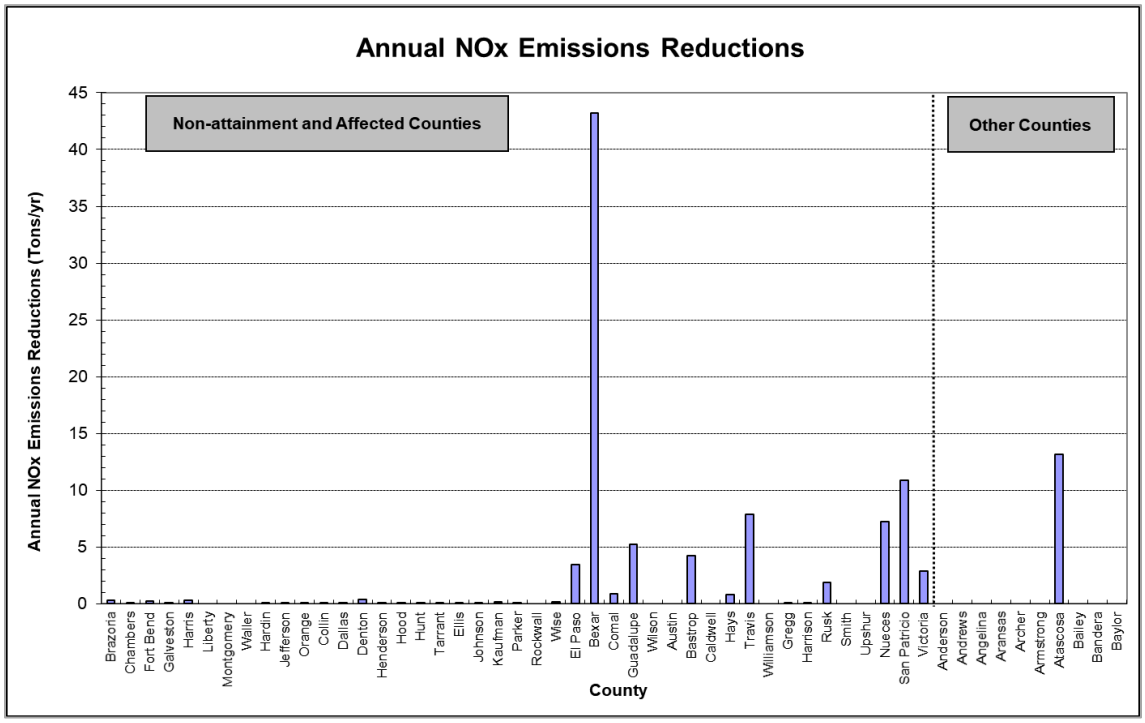


Figure 6-5: NOx Emissions Reductions per County from Solar Photovoltaic Projects up to 2020

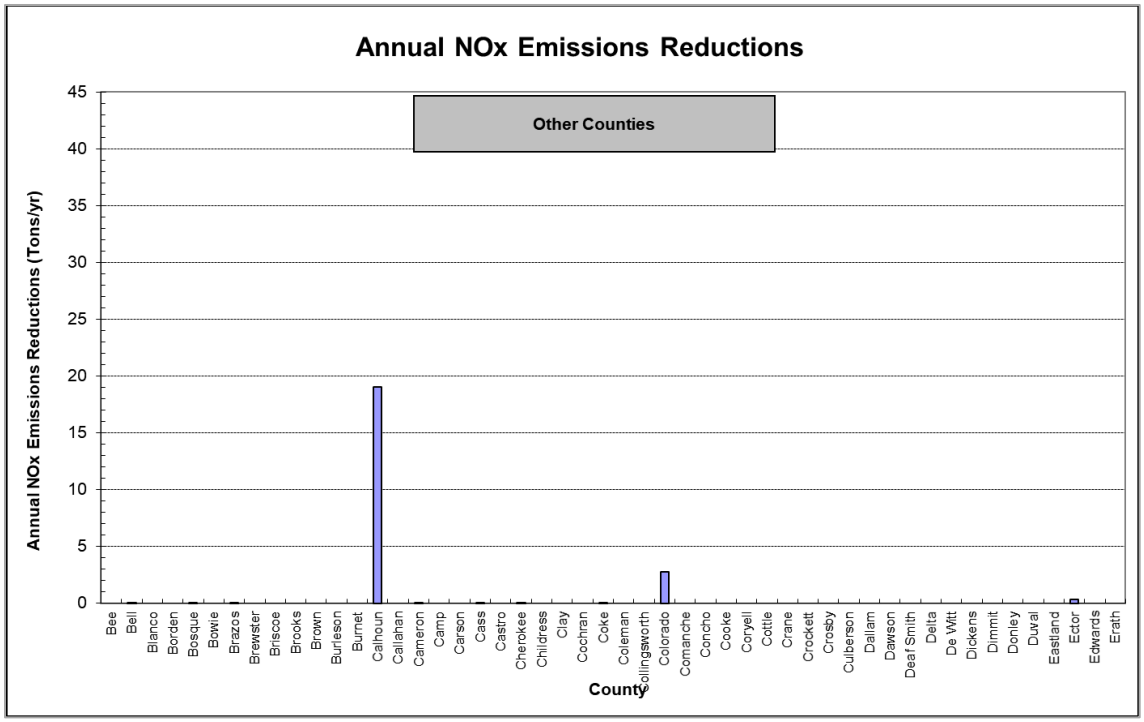


Figure 6-5: NOx Emissions Reductions per County from Solar Photovoltaic Projects up to 2020 (Continued)

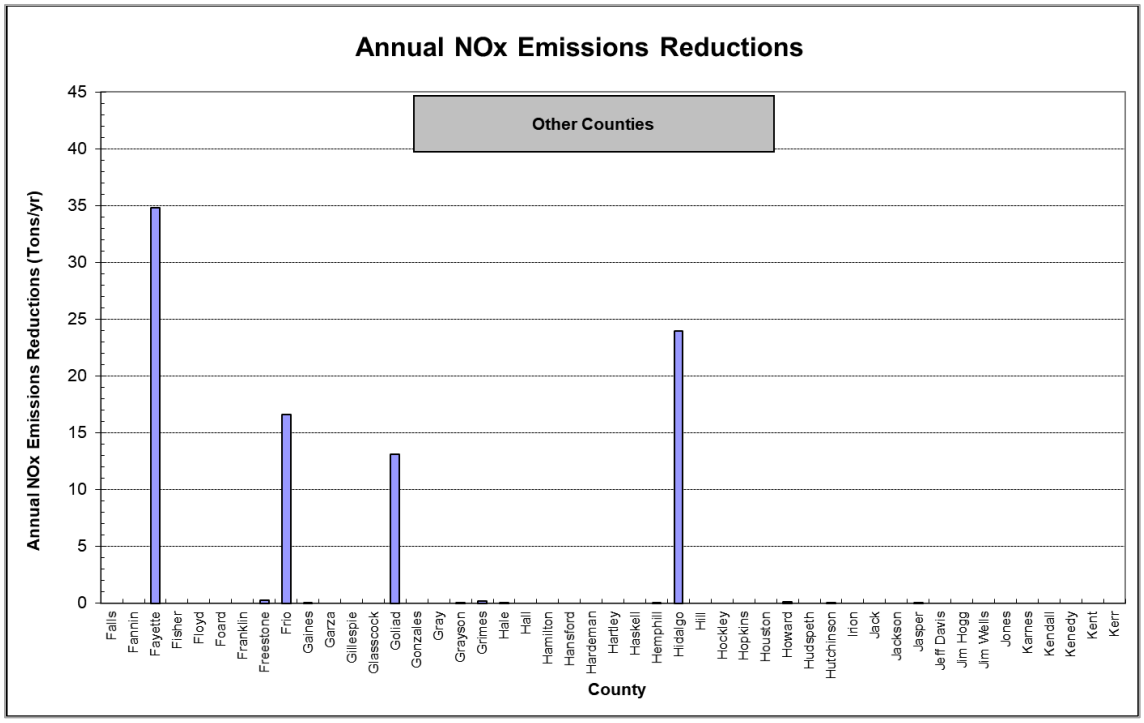


Figure 6-5: NOx Emissions Reductions per County from Solar Photovoltaic Projects up to 2020 (Continued)

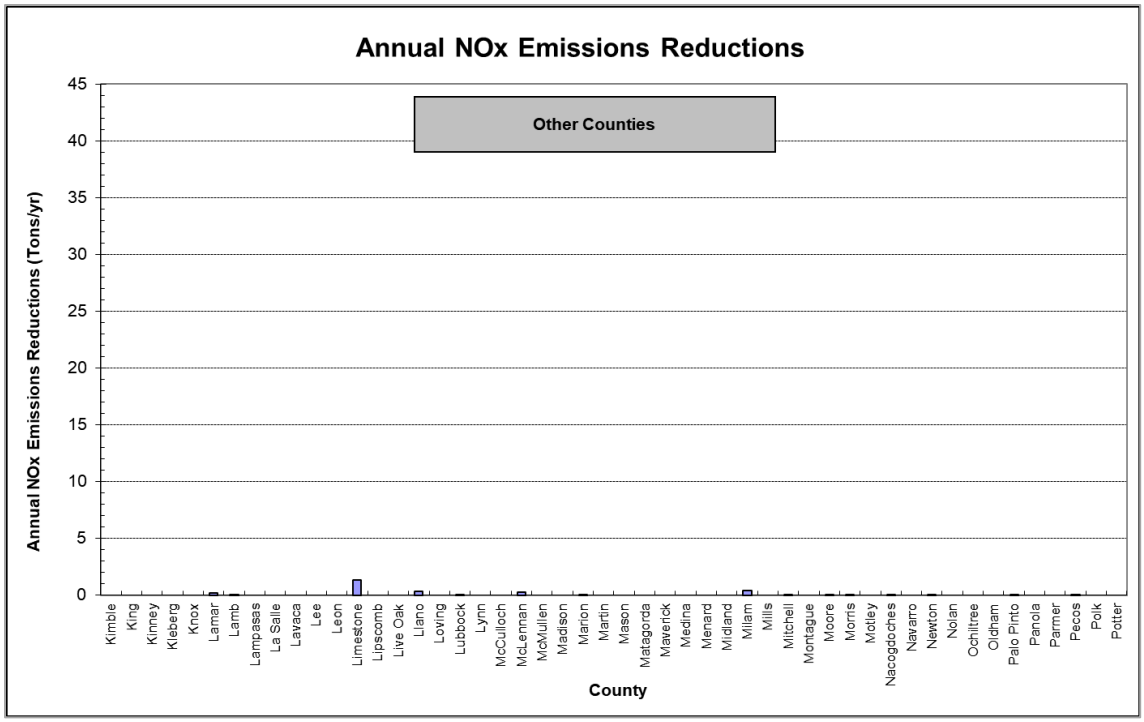


Figure 6-5: NOx Emissions Reductions per County from Solar Photovoltaic Projects up to 2020 (Continued)

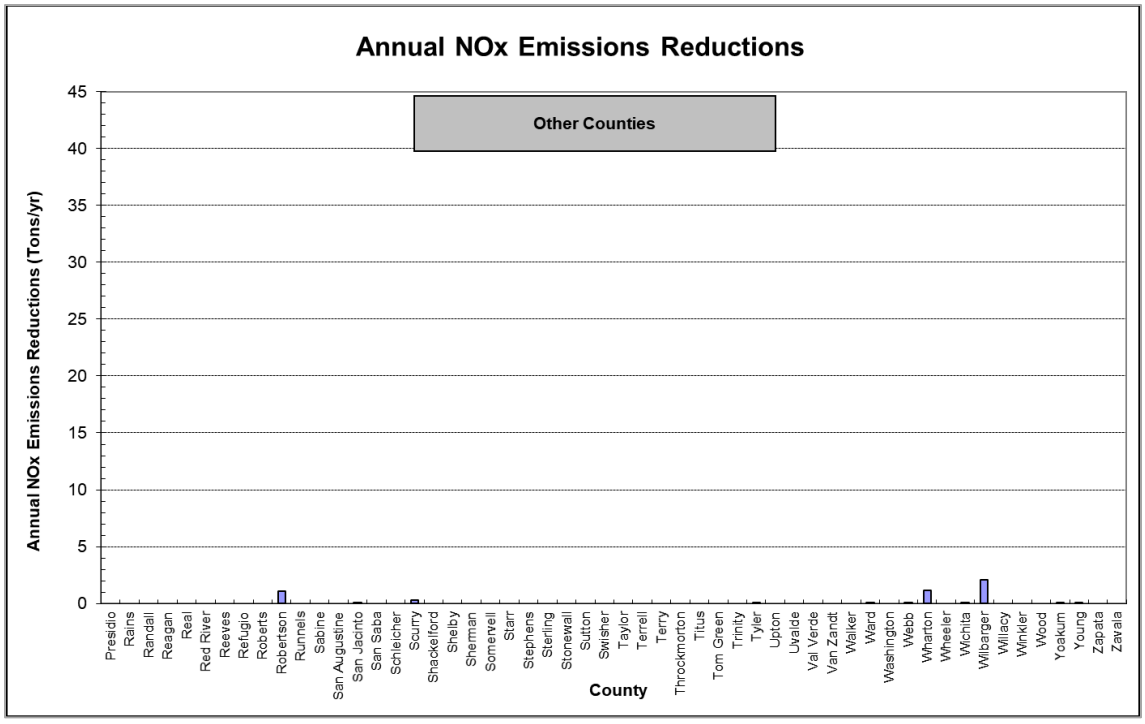


Figure 6-5: NOx Emissions Reductions per County from Solar Photovoltaic Projects up to 2020 (Continued)

6.2.1.1 Solar Power

This section includes only solar power plant projects (utility-scale) in Texas. The data from eighty-two solar power plants identified in the State of Texas were obtained. Table 6-3 shows the list of solar power plant projects with their names, respective county, year commissioned, the forecast zone they serve, installed capacity and total electricity produced for the year 2020. Figure 6-6 shows the annual electricity generation of solar power plant projects. In addition, Figure 6-7 shows the map of the number of solar power plants for each county. The total electricity generated for the year 2020 from all of the projects was 8,450,944 MWh/year.

The annual electric savings per county and the OSP electric savings per county, which were estimated from these projects, are presented in Figure 6-8 and in Figure 6-9, respectively. In addition, the corresponding annual NOx emission reductions are shown in Figure 6-10.

The hourly and daily total electricity generation profile of different solar power projects is shown in Volume II, Appendix C. Figure 6-11 shows an example of the hourly electricity generation profile and Figure 6-12 shows an example of the daily total generation profile.

Table 6-3: Solar Power Plant Projects in the State of Texas through 2020

No	Name of the Project	County	Year Commissioned	ERCOT Forecast Zone	Installed Capacity* (MW_{AC})	Power Generated in 2020** (MWh/year)
1	ACACIA_UNIT_1	Presidio	2012	West	10.0	23,948
2	ALEXIS_ALEXIS	Brooks	2019	South	10.0	11,175
3	BOOTLEG_UNIT1	Pecos	2017	West	121.1	297,200
4	BOVINE_BOVINE	Austin	2018	South	5.0	9,182
5	BOVINE2_BOVINE2	Austin	2018	South	5.0	9,867
6	BRNSN_BRNSN	Fort Bend	2018	Houston	5.0	9,070
7	BRNSN2_BRNSN2	Fort Bend	2018	Houston	5.0	9,900
8	CAPRIDG4_BB_PV	Sterling	2019	West	30.0	75,020
9	CASCADE_CASCADE	Wharton	2018	South	5.0	8,757
10	CASCADE2_CASCADE2	Wharton	2018	South	5.0	9,557
11	CASL_GAP_UNIT1	Upton	2018	West	180.0	426,289
12	CECSOLAR_DG_BECK1	Bexar	2016	South	1.0	1,645
13	CHISUM_CHISUM	Lamar	2018	North	10.0	15,390
14	COSERVSS_CSS1	Denton	2015	North	2.0	3,302
15	CS10_CATAN	Karnes	2020	South	10.0	2,103
16	DG_BROOK_1UNIT	Bexar	2010	South	7.6	10,244
17	DG_ELMEN_1UNIT	Bexar	2010	South	7.3	11,528
18	DG_SOME1_1UNIT	Bexar	2012	South	5.6	9,239
19	DG_SOME2_1UNIT	Bexar	2012	South	5.0	8,233
20	DG_STHWG_UNIT1	Bexar	2014	South	4.4	8,297
21	DG_VALL1_1UNIT	Bexar	2012	South	9.9	16,669
22	DG_VALL2_1UNIT	Bexar	2012	South	9.9	16,558
23	DG_WALZM_UNIT1	Bexar	2014	South	5.5	10,790
24	DG_WHITNEY_SOLAR1	Bosque	2017	North	10.0	21,316
25	ECLIPSE_UNIT1	Kinney	2014	South	37.6	65,930
26	EDDYII_EDDYII	McLennan	2018	North	10.0	20,300
27	FIFTHGS1_FGSOLAR1	Travis	2016	South	1.6	3,716
28	FWLR_SLR_UNIT1	Crane	2020	West	150.0	179,183
29	GRIFFIN_GRIFFIN	McLennan	2019	North	5.0	11,092
30	HELIOS_UNIT1	Uvalde	2015	South	100.0	201,624
31	HOLSTEIN_SOLAR1	Nolan	2020	West	102.2	191,673
32	HOLSTEIN_SOLAR2	Nolan	2020	West	102.3	183,607
33	HOVEY_UNIT1	Pecos	2015	West	22.0	44,352
34	HOVEY_UNIT2	Pecos	2020	West	7.4	15,227
35	HWY56_HWY56	Grayson	2017	North	5.3	8,820
36	KELAM_SL_UNIT1	Van Zandt	2020	North	59.8	7,594
37	LAMPWICK_LAMPWICK	Menard	2019	South	7.5	18,295
38	LAPETUS_UNIT_1	Andrews	2020	West	100.7	238,849
39	LASSO_UNIT1	Brewster	2018	West	50.0	123,853
40	LEON_LEON	Hunt	2017	North	10.0	14,008
41	LMESASLR_IVORY	Dawson	2018	West	50.0	130,202
42	LMESASLR_UNIT1	Dawson	2018	West	101.6	241,917
43	MARLIN_MARLIN	Falls	2017	North	5.3	9,512
44	MARS_MARS	Webb	2019	South	10.0	21,940
45	MISAE_UNIT1	Childress	N/A	West	240.0	240,428

* Capacity, Demand and Reserve Report-May2021.xls from the webpage of the ERCOT (http://www.ercot.com/gridinfo/resource/index.html)
** 2020 ERCOT solar power 15-min generation data

Table 6-3: Solar Power Plant Projects in the State of Texas through 2020 (Cont.)

No	Name of the Project	County	Year Commissioned	ERCOT Forecast Zone	Installed Capacity* (MW_{AC})	Power Generated in 2020** (MWh/year)
46	MISAE_UNIT2	Childress	N/A	West	517.3	235,641
47	NGNSVL_NGAINESV	Cooke	2017	North	5.2	7,450
48	OBERON_UNIT_1_J01	Ector	2020	West	180.0	236,277
49	OBERON_UNIT_1_J02	Ector	N/A	West	N/A	40,106
50	OCI_ALM1_UNIT1	Bexar	2013	South	39.2	90,400
51	OXYSOLAR_SOLAR_1	N/A	N/A	N/A	N/A	2,846
52	PCOMM_1UNIT	N/A	N/A	N/A	N/A	2,535
53	PFK_PFKPV	Travis	2017	South	2.6	3,887
54	PHOEBE_UNIT1	Winkler	2019	West	125.1	302,939
55	PHOEBE_UNIT2	Winkler	2019	West	128.1	313,363
56	PROSPERO_UNIT1	Andrews	2020	West	153.6	280,548
57	PROSPERO_UNIT2	Andrews	2020	West	150.0	267,051
58	QUEEN_SL_SOLAR1	Upton	2020	West	102.5	250,717
59	QUEEN_SL_SOLAR2	Upton	2020	West	102.5	256,397
60	QUEEN_SL_SOLAR3	Upton	2020	West	97.5	153,515
61	QUEEN_SL_SOLAR4	Upton	2020	West	107.5	193,529
62	RAMBLER_UNIT1	Tom Green	2020	West	200.0	322,158
63	REROCK_UNIT1	Pecos	2016	West	78.8	208,367
64	REROCK_UNIT2	Pecos	2016	West	78.8	205,157
65	RIGGINS_UNIT1	Pecos	2018	West	150.0	336,584
66	RIPPEY_UNIT1	Cooke	2020	North	59.8	11
67	SEALY_1UNIT	Austin	2015	South	1.6	757
68	SIRIUS_UNIT1	Pecos	2017	West	110.2	246,761
69	SIRIUS_UNIT2	Pecos	2017	West	49.1	100,388
70	SOLARA_UNIT1	Haskell	2016	West	112.0	256,610
71	SPTX12B_UNIT1	Upton	2017	West	157.5	352,233
72	STRLING_STRLING	Hunt	2018	North	10.0	17,670
73	WAYMARK_UNIT1	Upton	2018	West	182.0	384,442
74	WBORO_WHTSBORO	Grayson	2017	North	5.0	10,384
75	WBOROII_WHBOROII	Grayson	2017	North	5.0	9,350
76	WEBBER_S_WSP1	Travis	2011	South	26.7	57,916
77	WHTRT_WHTRGHT	Fannin	2017	North	10.0	19,189
78	WLNTSPRG_1UNIT	Bosque	2016	North	10.0	11,390
79	WMOOREII_WMOOREII	Grayson	2018	North	5.0	9,717
80	W_PECOS_UNIT1	Reeves	2019	West	100.0	247,278
81	X443PV1_SWRI_PV1	Bexar	2019	South	5.0	9,537
82	YLWJACKET_YLWJACKET	Bosque	2018	North	5.0	10,442
Total					**4,720**	**8,450,944**

* Capacity, Demand and Reserve Report-May2021.xls from the webpage of the ERCOT (http://www.ercot.com/gridinfo/resource/index.html)
** 2020 ERCOT solar power 15-min generation data

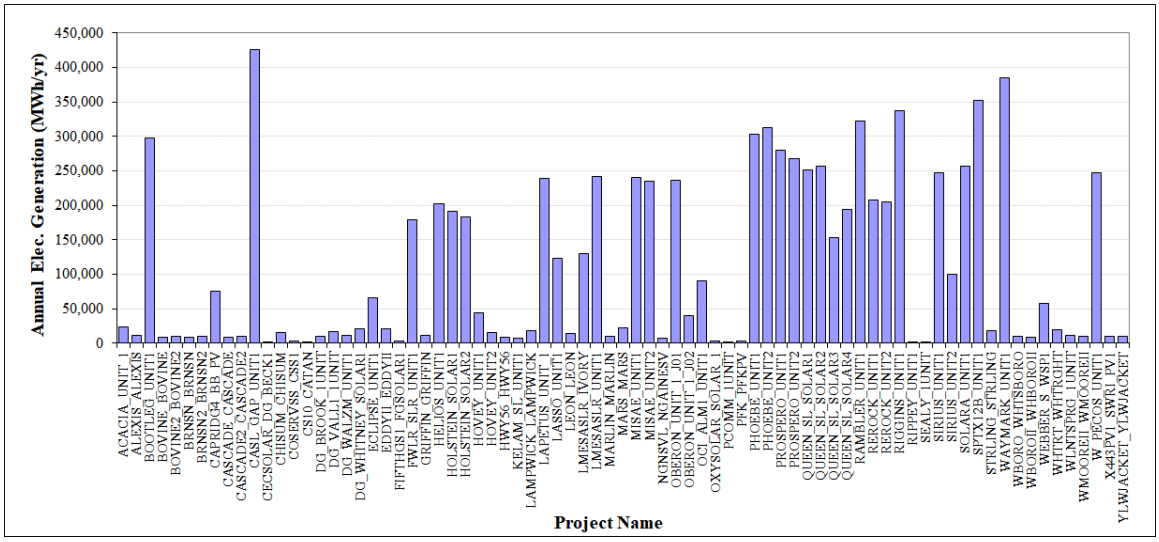


Figure 6-6: Annual Electricity Generation by Solar Power Plants in the State of Texas through 2020

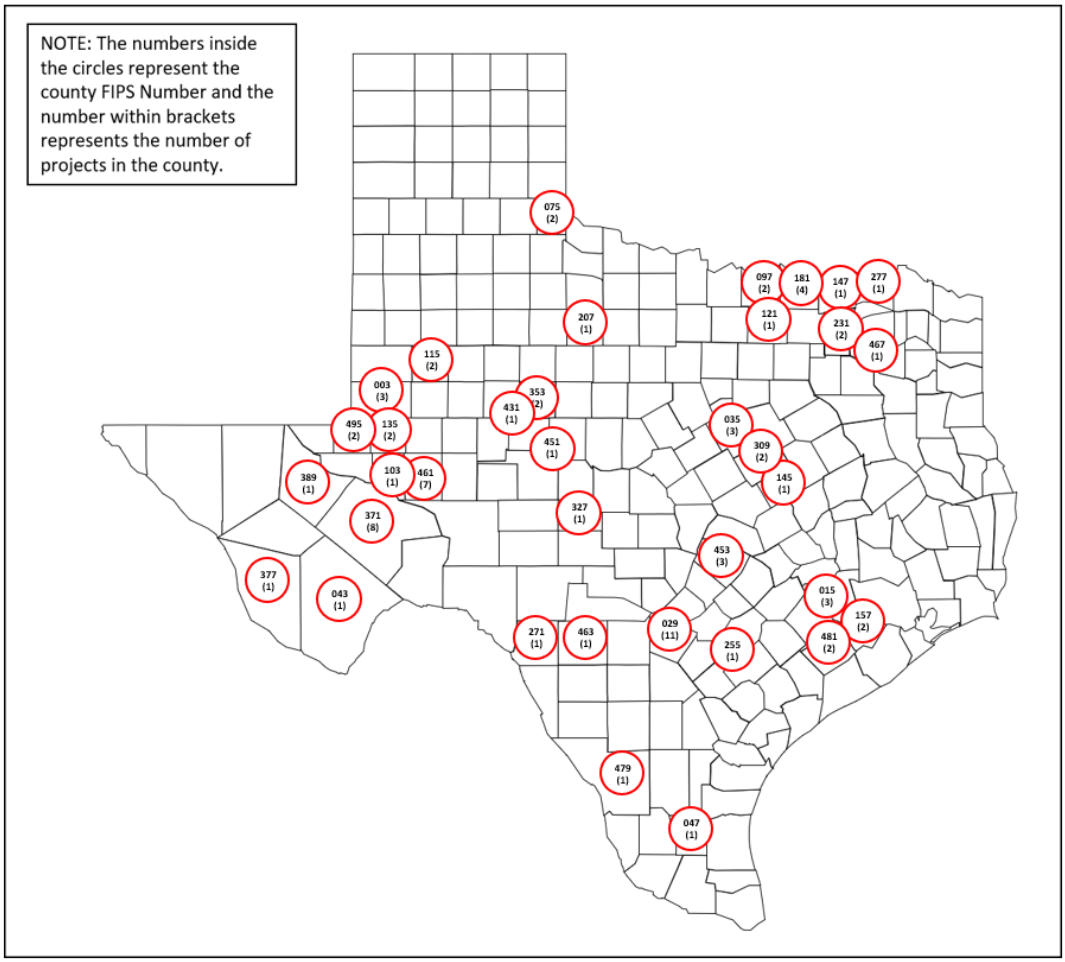


Figure 6-7: Map of Solar Power Plants Projects Installed in Each County of Texas

Table 6-4: Solar Power Plant Projects throughout Texas through 2020

County	FIPS Code	No. of Projects	County	FIPS Code	No. of Projects
Andrews	003	3	Karnes	255	1
Austin	015	3	Kinney	271	1
Bexar	029	11	Lamar	277	1
Bosque	035	3	McLennan	309	2
Brewster	043	1	Menard	327	1
Brooks	047	1	Nolan	353	2
Childress	075	2	Pecos	371	8
Cooke	097	2	Presidio	377	1
Crane	103	1	Reeves	389	1
Dawson	115	2	Sterling	431	1
Denton	121	1	Tom Green	451	1
Ector	135	2	Travis	453	3
Falls	145	1	Upton	461	7
Fannin	147	1	Uvalde	463	1
Fort Bend	157	2	Van Zandt	467	1
Grayson	181	4	Webb	479	1
Haskell	207	1	Wharton	481	2
Hunt	231	2	Winkler	495	2

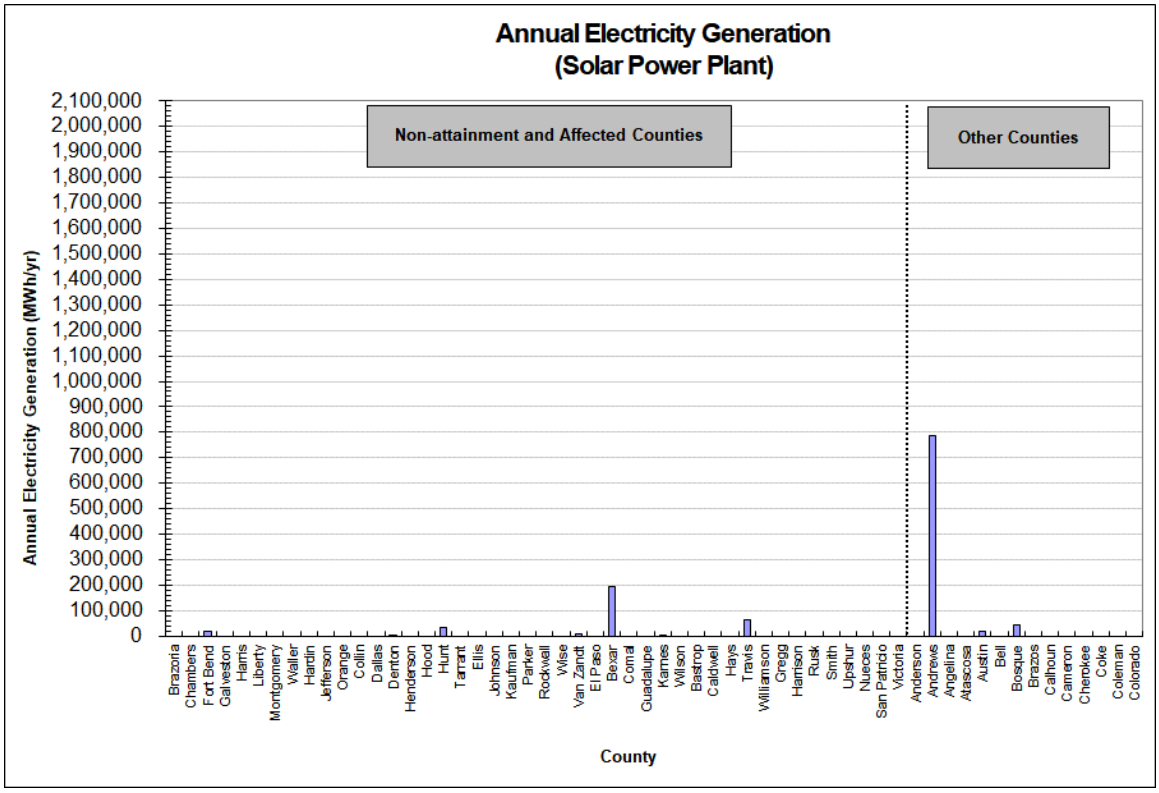


Figure 6-8: Annual Electricity Generation per County from Solar Power Plant Projects through 2020

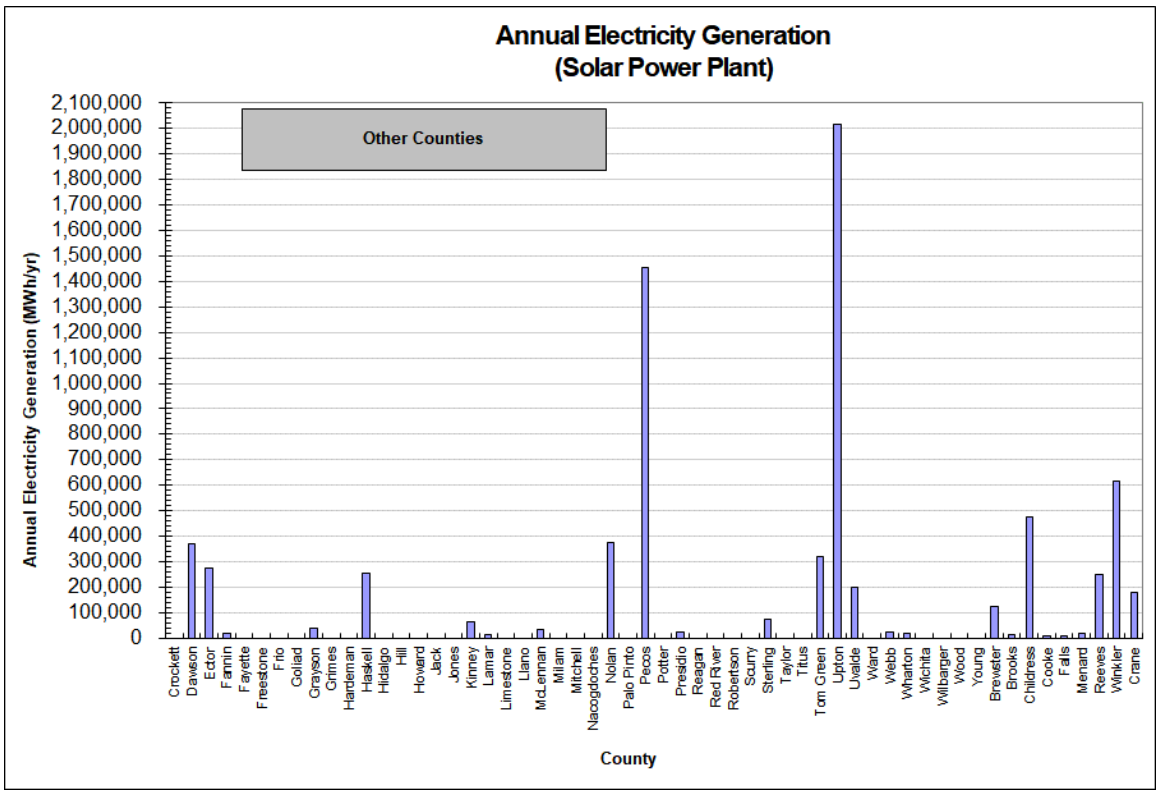


Figure 6-8: Annual Electricity Generation per County from Solar Power Plant Projects through 2020 (Continued)

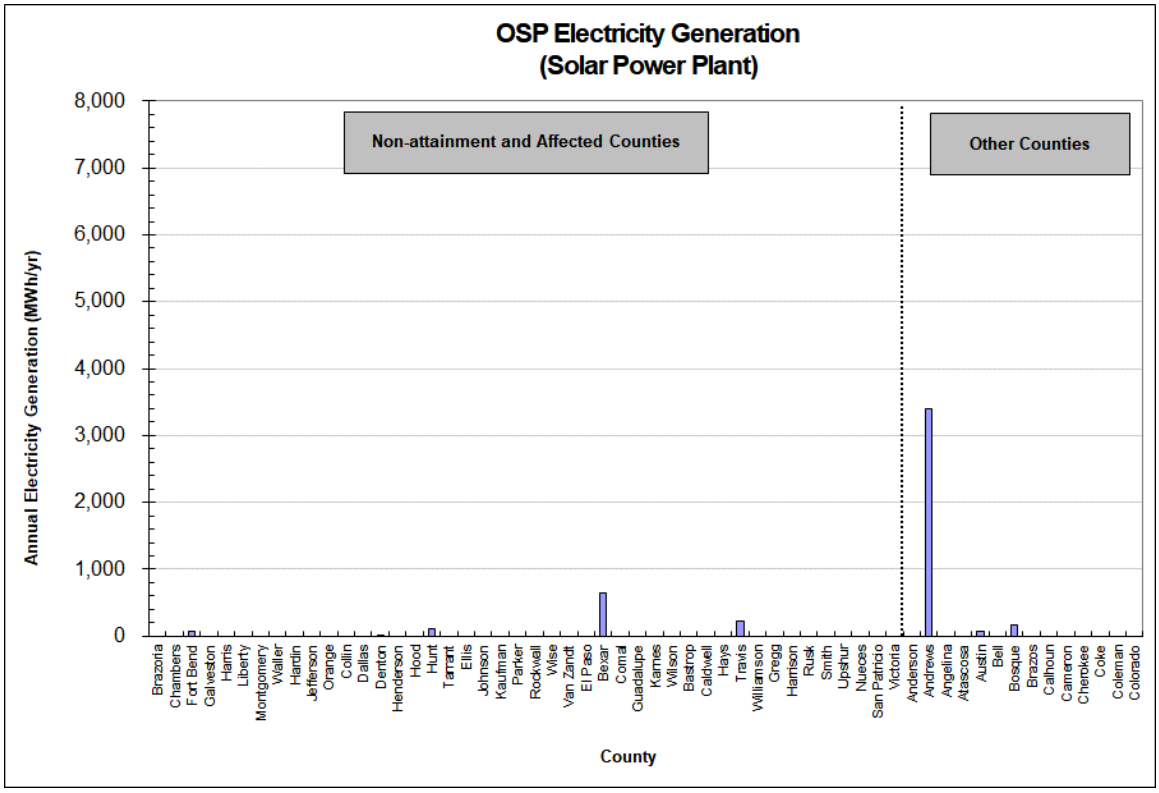


Figure 6-9: Ozone Season Period Electricity Generation per County from Solar Power Plant Projects through 2020

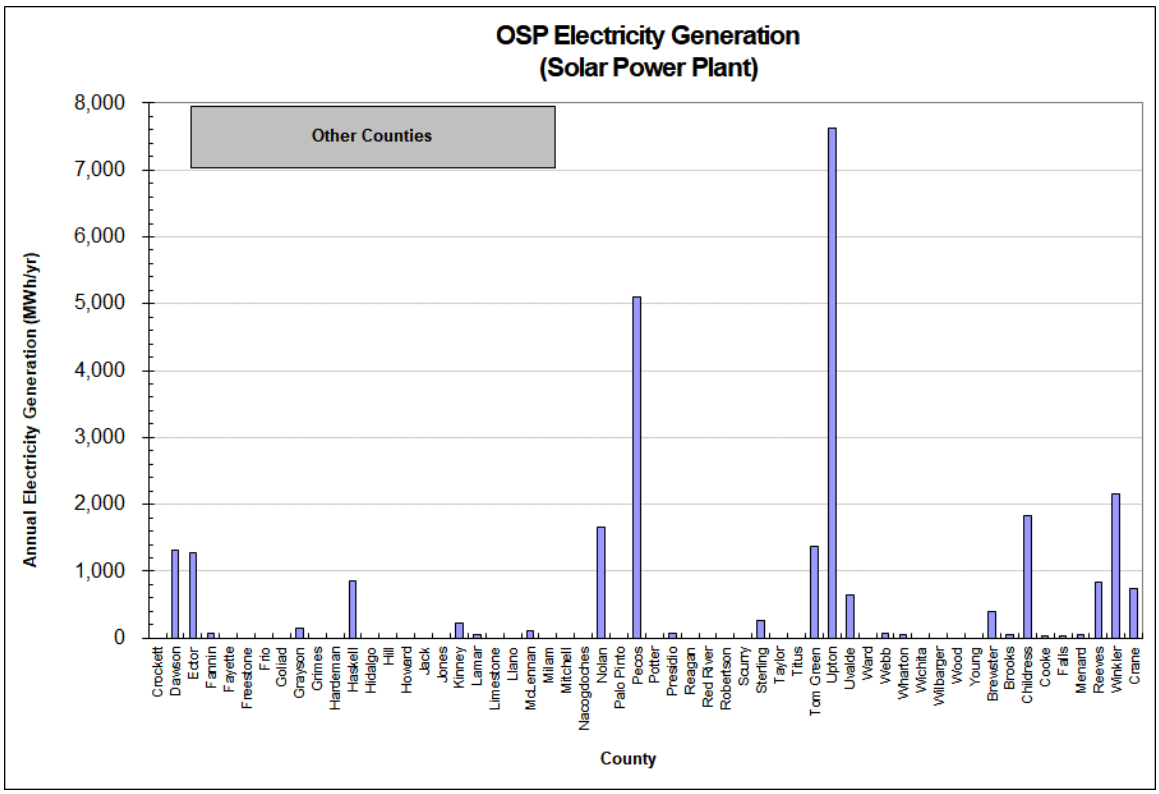


Figure 6-9: Ozone Season Period Electricity Generation per County from Solar Power Plant Projects through 2020 (Continued)

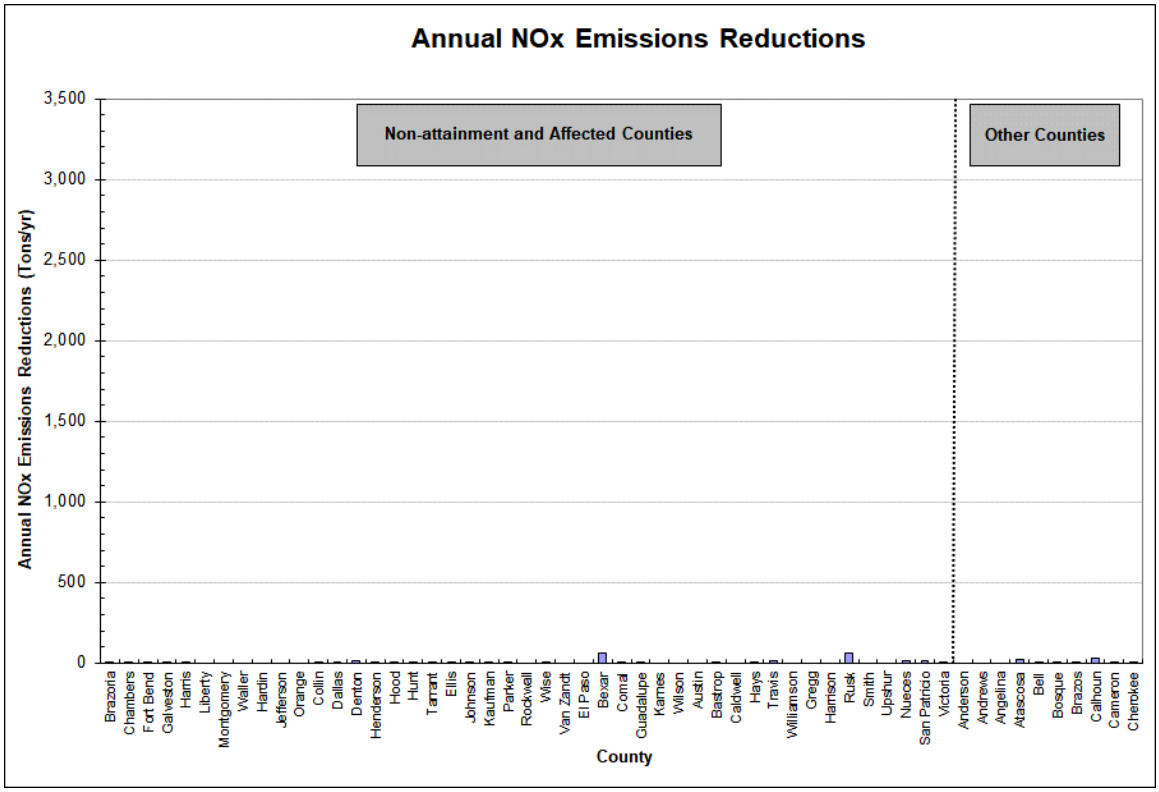


Figure 6-10: NOx Emissions Reductions per County from Solar Power Plant Projects through 2020

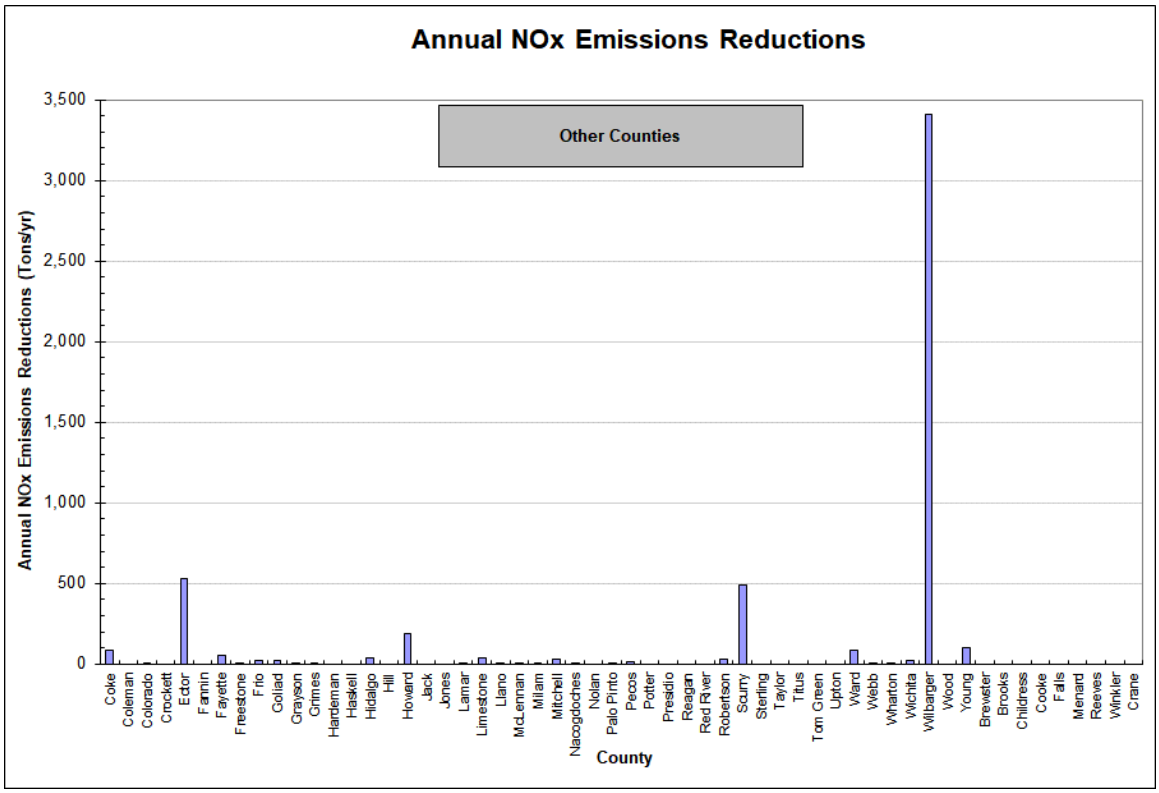


Figure 6-10: NOx Emissions Reductions per County from Solar Power Plant Projects through 2020 (Continued)

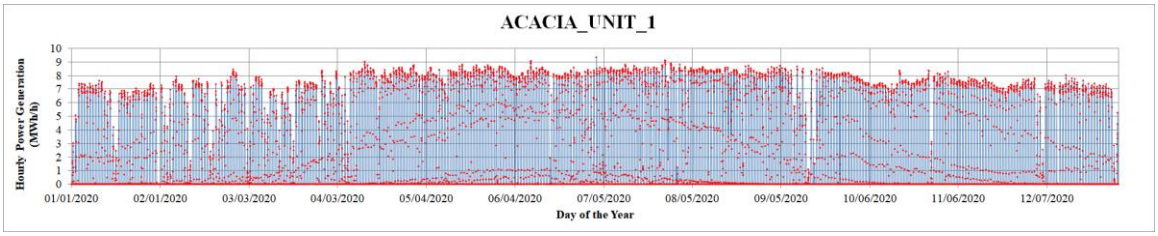


Figure 6-11: Hourly Electricity Generation Profile for Solar Photovoltaic Project ACACIA_UNIT_1

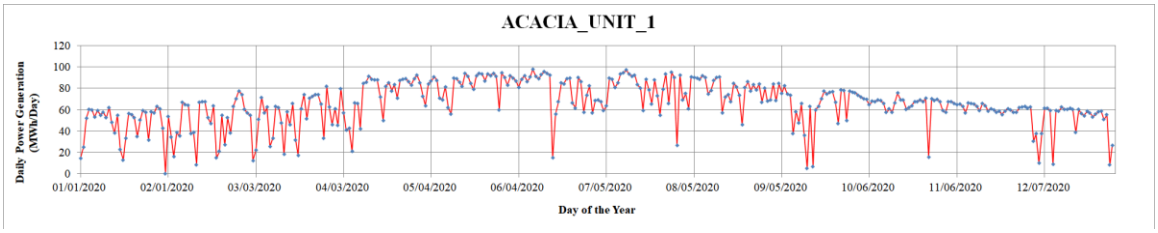


Figure 6-12: Daily Total Electricity Generation Profile for Solar Photovoltaic Project ACACIA_UNIT_1

6.2.2 Solar Thermal

Solar thermal projects are to generate thermal energy so that buildings utilize the thermal energy to heat water or air for their use. Many of the solar thermal projects throughout the State of Texas were identified from various web sources. In the present report for the year 2020, a new solar thermal project (i.e., Solar pre-heated water-Off-Grid Ranch) was found. As a result, the total number of solar thermal projects for the present report was 41. In 2020, it was estimated that solar thermal in Texas produced 254,511 kWh/yr through 2020 and 689 kWh/day in the OSP from nine counties.

The list of all the projects is shown in Table G-2 (Vol. II, Appendix G). Table 6-6 shows the map of the solar thermal projects identified in each county of Texas. The equivalent energy in electricity from all the solar thermal projects are presented in Table 6-5. The equivalent energy in electricity was estimated how much electricity can be saved by the amount of hot water produced by solar thermal water heater systems. eCalc (f-Chart method) was used in designing liquid solar heating system to calculate the hot water produced. Due to the limited availability of solar thermal project information, the estimation was based on the collector areas and project locations.

The annual electric savings per county and the OSP electric savings per county, which were estimated from these projects, are presented in Figure 6-14 and in Figure 6-15, respectively. In addition, the corresponding annual NOx emission reductions are shown in Figure 6-16.

Table 6-5: Solar Thermal Projects: Energy Reductions up to 2020

County	Annual Energy Savings (for Base Year Conditions)	OSP Energy Savings (for Base Year Conditions)
	Annual Elec. Equivalent (kWh/year)	OSP Elec. Equivalent (kWh/day)
Bexar	60,388	161
El Paso	141,850	390
Fort Bend	16,318	44
Hays	276	1
Nueces	12,250	34
Parker	9,806	27
Travis	1,768	1
Victoria	336	1
Williamson	11,519	31
Total	**254,511**	**689**

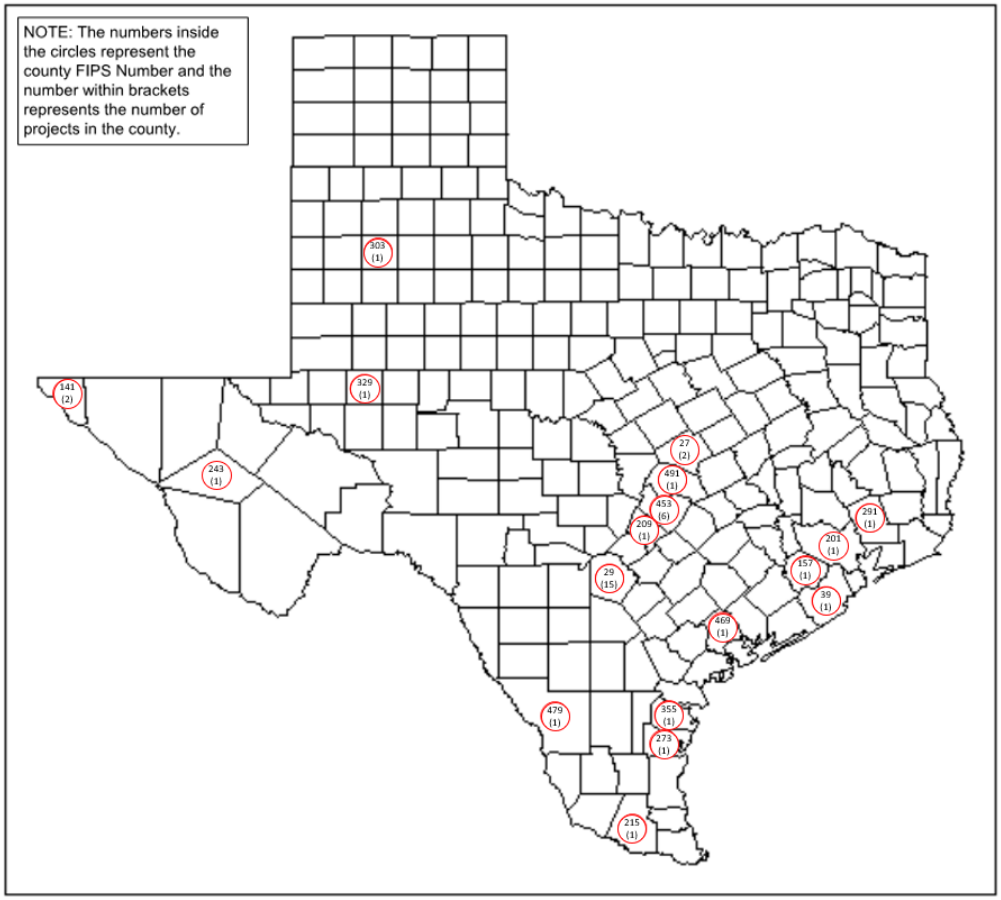


Figure 6-13: Map of Solar Thermal Projects Installed in Each County of Texas

Table 6-6: Solar Thermal Projects throughout Texas through 2020

County	FIPS Code	No. of Projects
Bell	27	2
Bexar	29	15
Brazoria	39	1
El Paso	141	2
Fort Bend	157	1
Harris	201	1
Hays	209	1
Hidalgo	215	1
Jeff Davis	243	1
Kleberg	273	1
Liberty	291	1
Lubbock	303	1
Midland	329	1
Nueces	355	1
Travis	453	6
Victoria	469	1
Webb	479	1
Williamson	491	1
N/A	-	2

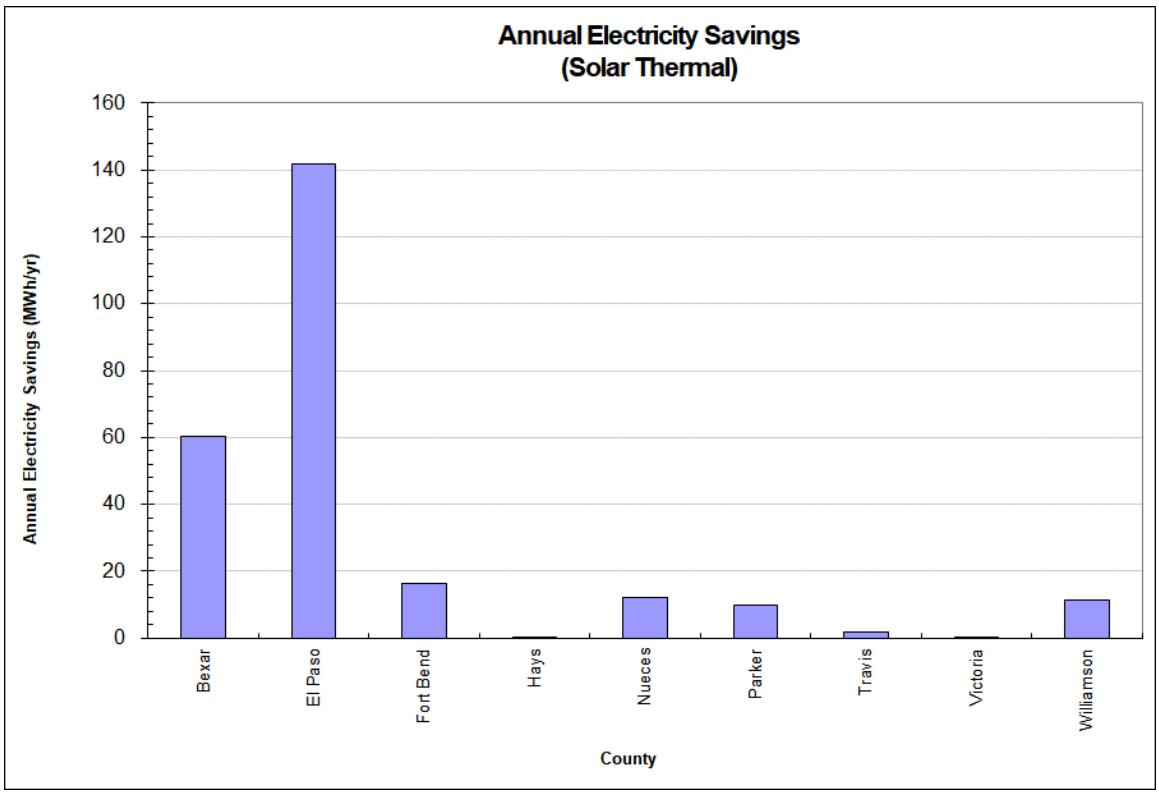


Figure 6-14: Annual Electricity Savings per County from Solar Thermal Projects through 2020

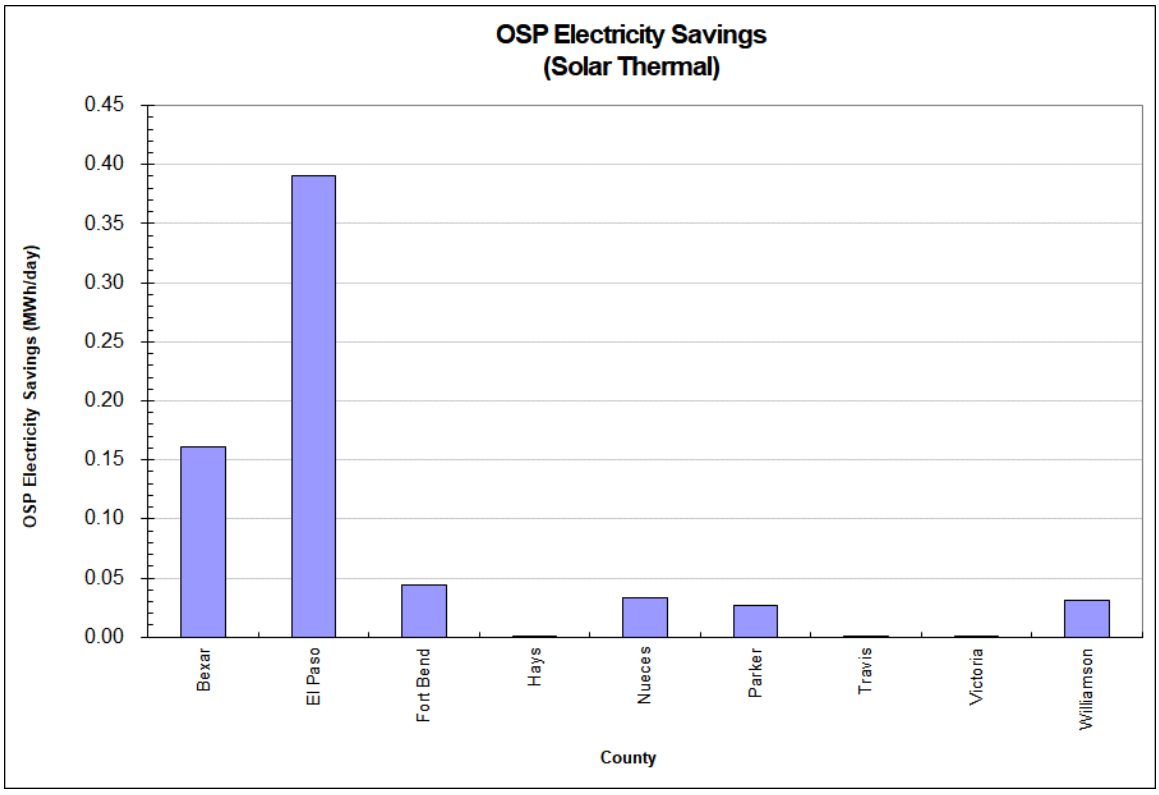


Figure 6-15: Ozone Season Period Electricity Savings per County from Solar Thermal Projects through 2020

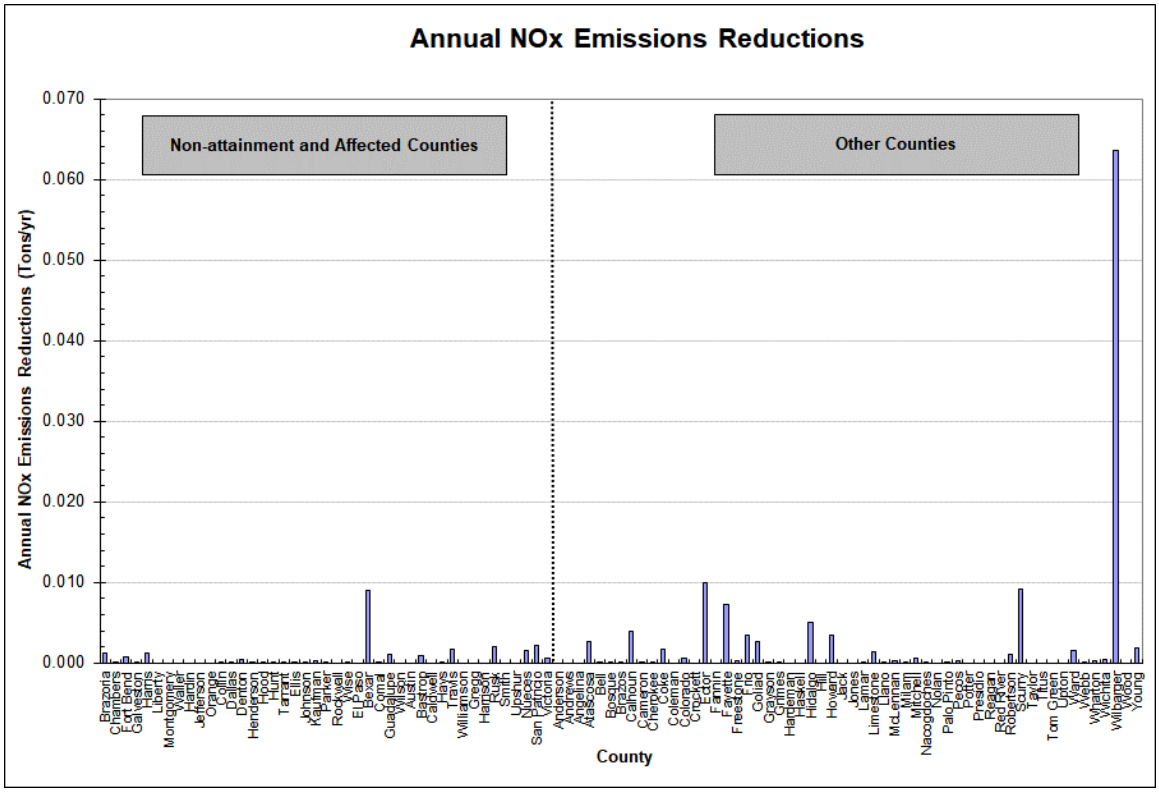


Figure 6-16*:* NOx Emissions Reductions per County from Solar Thermal Projects through 2020

6.2.3 Biomass

The data from 12 biomass power plants in the State of Texas were obtained from ERCOT. Table 6-7 shows the list of the biomass projects with their names, respective county, year commissioned, the forecast zone they serve, installed capacity and total electricity produced for the year 2020. Figure 6-17 shows the annual electricity generation of the identified biomass projects in the State of Texas. In addition, Figure 6-18 shows the map of the number of biomass projects for each county. The total power generation capacity from all biomass projects in 2020 is 167 MW. The capacity in 2020 is decreased compared to 2019 capacity because AV_DG1 biomass plant was not reported in ERCOT data and DG_FERIS_4_UNITS biomass project has zero generation in 2020 according to ERCOT data. The total annual electricity generation from all the biomass projects for the year 2020 was 352,924 MWh/year.

The annual electric savings per county and the OSP electric savings per county, which were estimated from these projects, are presented in Figure 6-19 and in Figure 6-20, respectively.

The hourly and total daily electricity generation profile of different Biomass projects is shown in Volume II, Appendix D. Figure 6-21 shows an example of the hourly electricity generation profile and Figure 6-22 shows an example of the daily total generation profile.

Table 6-7: Biomass Projects in the State of Texas through 2020

SNo	Name of the Project	County	Year Commissioned	ERCOT Forecast Zone	Installed Capacity* (MW_{AC})	Power Generated in 2020 ** (MWh/year)	Power Generated in OSP 2020 (MWh/year)
1	DG_78252_4UNITS	Bexar	2013	South	4.2	13,927	44
2	DG_BIO2_4UNITS	Denton	2009	North	6.4	42,020	105
3	DG_BIOE_2UNITS	Denton	1988	North	6.2	37,986	92
4	DG_FREIH_2UNITS	Comal	2011	South	3.2	24,924	65
5	DG_HBR_2UNITS	Denton	2011	North	3.2	26,743	73
6	DG_MEDIN_1UNIT	Bexar	2005	South	9.6	61,036	170
7	DG_S_SNR_UNIT1	Cameron	1973	South	4.5	1,413	0
8	DG_SPRIN_4UNITS	Travis	2007	South	6.4	31,956	85
9	DG_WALZE_4UNITS	Bexar	2002	South	9.8	33,693	78
10	DG_WSTHL_3UNITS	Parker	2010	North	4.8	24,078	62
11	NACPW_UNIT1	Nacogdoches	2012	North	105	55,143	295
12	TRIRA_1UNIT	Dallas	2015	North	4	5	0
Total					**167**	**352,924**	**1,069**

* 2020 ERCOT Renewable Generator Details.xlsx from ERCOT and PUCT
** 2020 ERCOT Renewable Generation (15min).xlsx from ERCOT

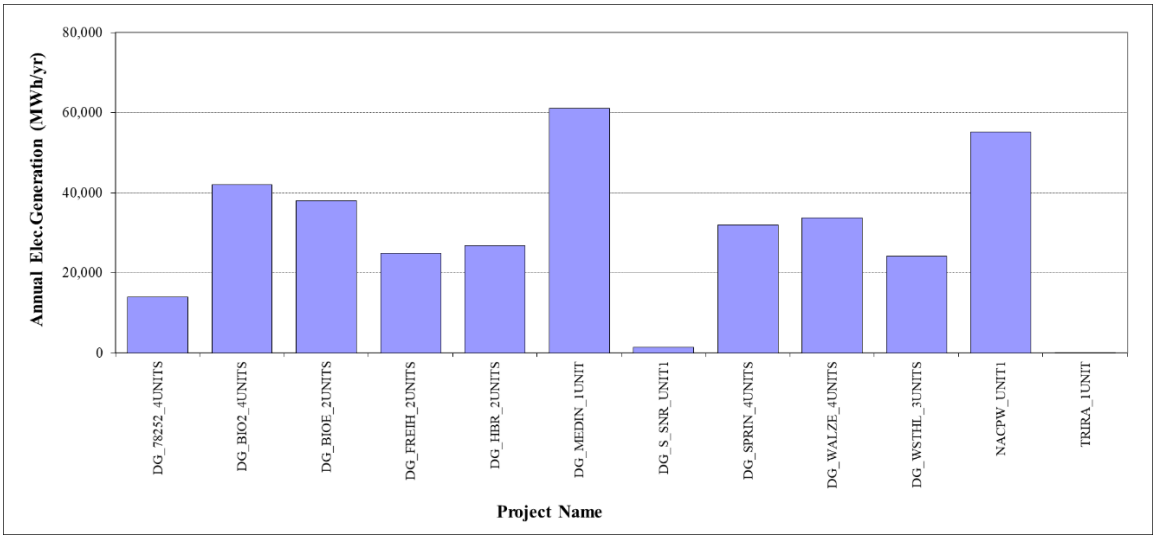


Figure 6-17: Annual Electricity Generation by Biomass Projects in the State of Texas through 2020

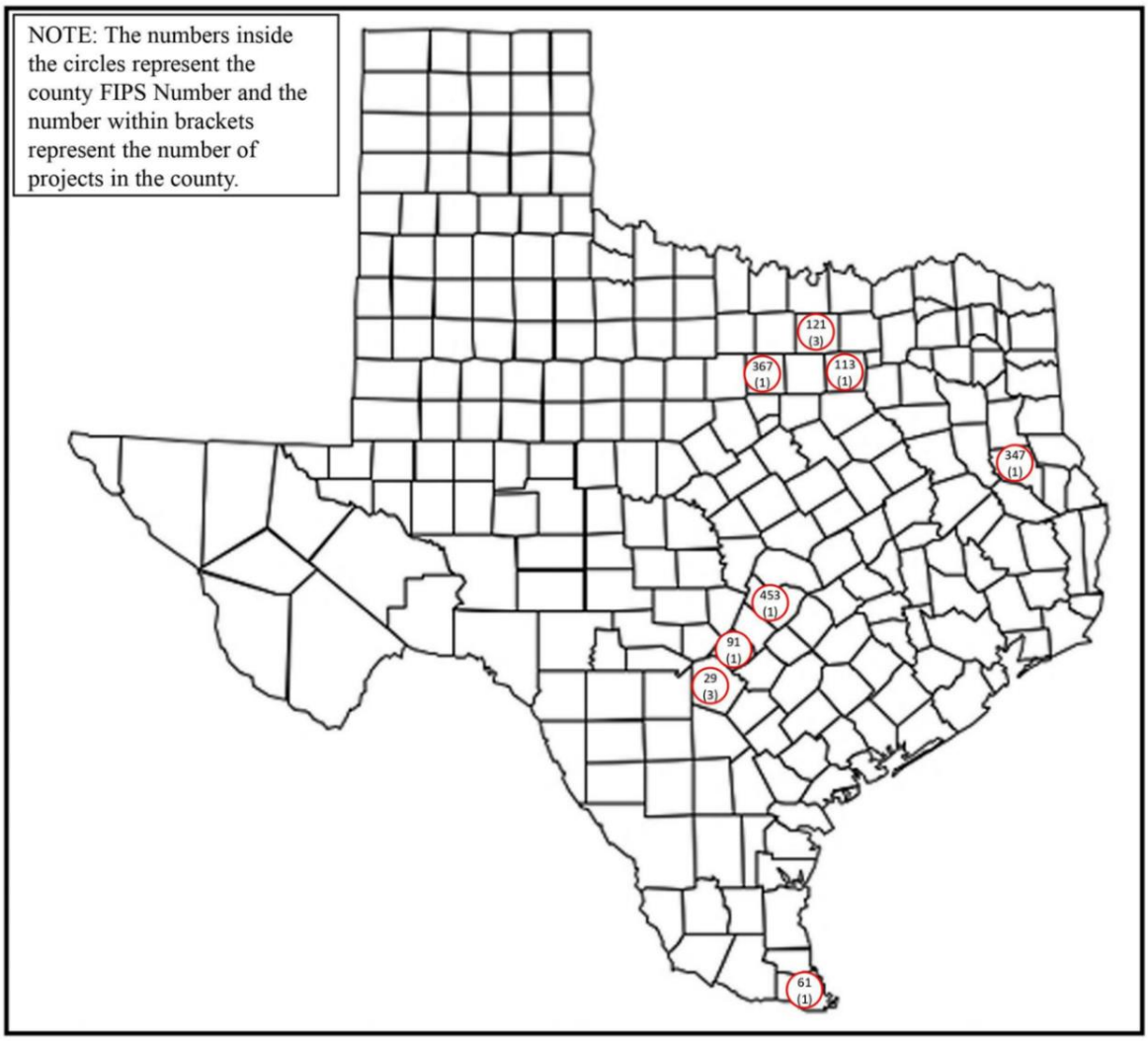


Figure 6-18: Map of Biomass Projects Installed in Each County of Texas

Table 6-8: Biomass Projects throughout Texas through 2020

County	FIPS Code	No. of Projects
Bexar	29	3
Cameron	61	1
Comal	91	1
Dallas	113	1
Denton	121	3
Nacogdoches	347	1
Parker	367	1
Travis	453	1

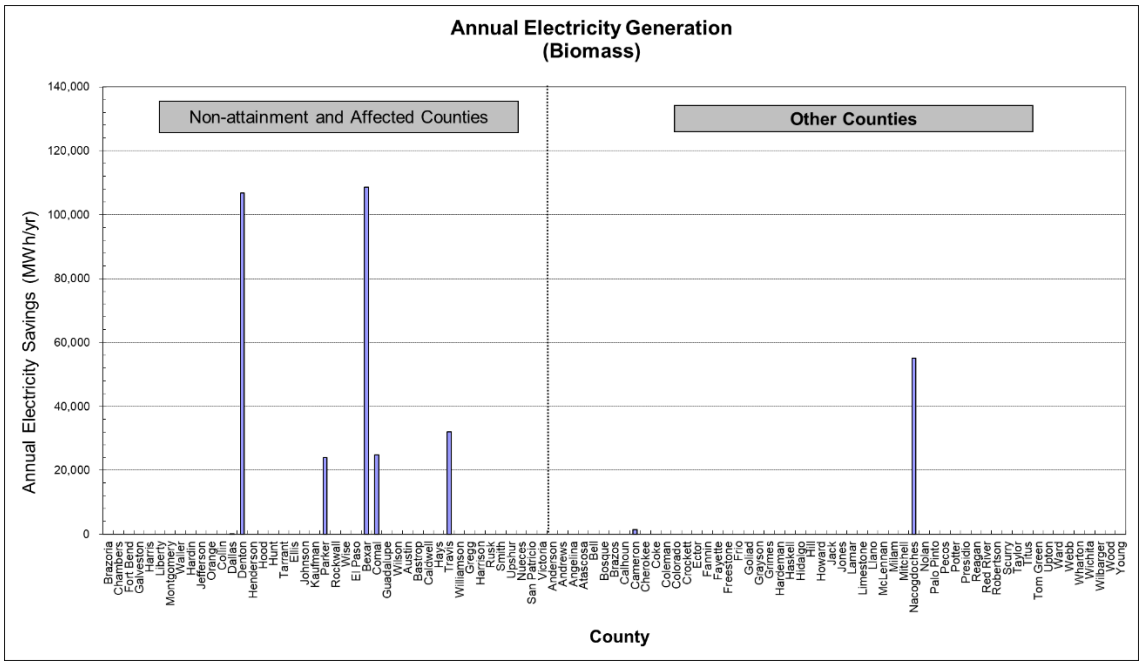


Figure 6-19: Annual Electricity Savings per County from Biomass Projects through 2020

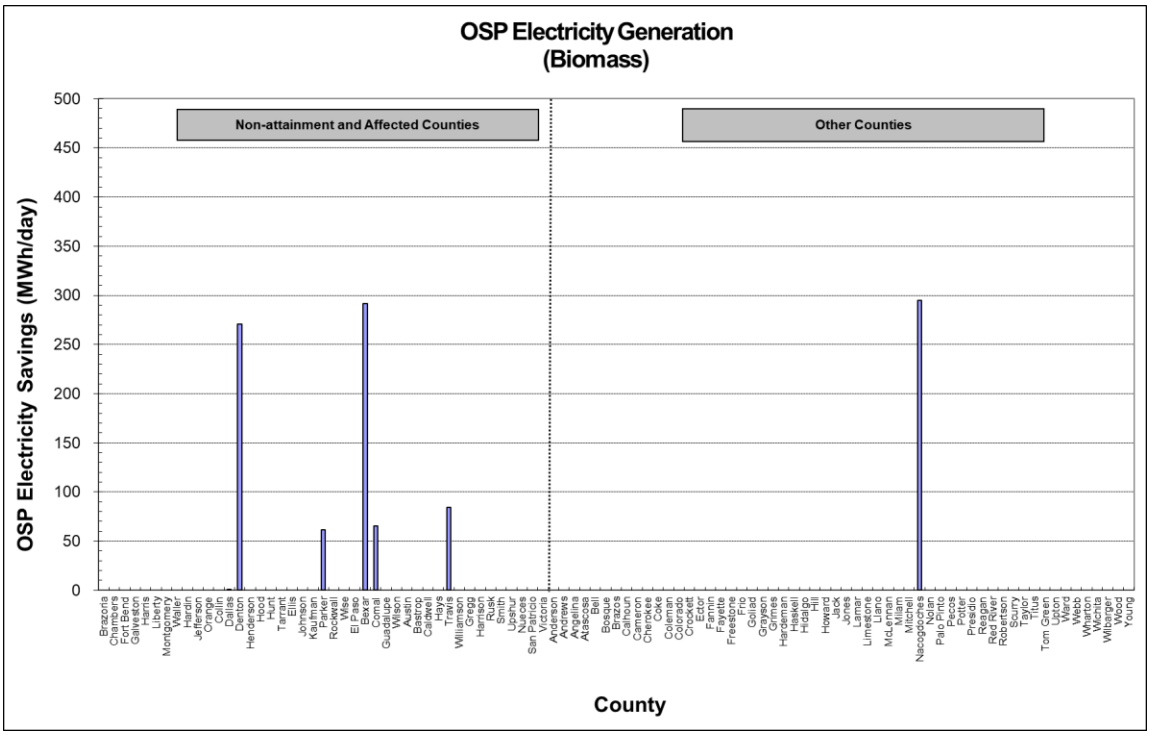


Figure 6-20: Ozone Season Period Electricity Savings per County from Biomass Projects through 2020

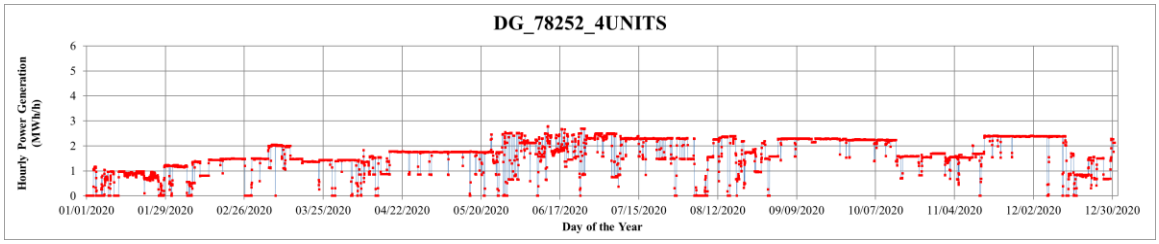


Figure 6-21: Hourly Electricity Generation Profile for Biomass DG-78252-4UNITS

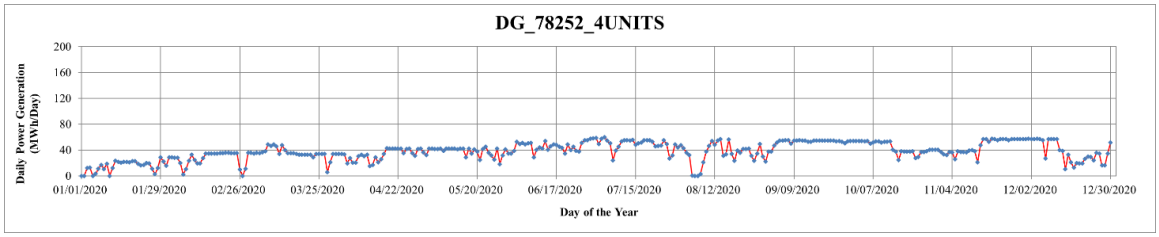


Figure 6-22: Daily Total Electricity Generation Profile for Biomass Project DG-78252-4UNITS

6.2.4 Hydroelectric

The data from 30 hydroelectric power plants in the State of Texas were obtained. Table 6-9 shows the list of hydroelectric projects with their names, respective county, year commissioned, the forecast zone they serve, installed capacity and total electricity produced for the year 2020. Figure 6-23 shows the annual electricity generation of the identified hydroelectric projects in the State of Texas. In addition, Figure 6-24 shows the map of the number of hydroelectric projects for each county. The total power generation capacity from all hydroelectric projects in 2020 is 557.6 MW. The total annual electricity generation from all the hydroelectric plants for the year 2020 was 632,438 MWh/year. Based on the power generation data from the hydroelectric power plants, one significant pattern was observed. Most of the hydroelectric plants were intermittently operated for a few hours of the day.

The annual electricity savings per county and the OSP electricity savings per county, which were estimated from these projects, are presented in Figure 6-25 and in Figure 6-26, respectively. In addition, the corresponding annual NOx emission reductions are shown in Figure 6-27.

The hourly and total daily electricity generation profile of different hydroelectric projects are shown in Volume II, Appendix E. Figure 6-28 shows an example of the hourly electricity generation profile and Figure 6-29 shows an example of the daily total generation profile.

Table 6-9: Hydroelectricity Power Projects in the State of Texas through 2020

SNo	Name of the Project	County	Year Commissioned	ERCOT Forecast Zone	Installed Capacity* (MW_{AC})	Power Generated in 2020** (MWh/year)	Power Generated in 2020 OSP (MWh/day)
1	AMISTAD_AMISTAG1	Val Verde	1983	South	37.9	50,593	103
2	AMISTAD_AMISTAG2	Val Verde	1983	South	37.9	54,627	109
3	AUSTPL_AUSTING1	Travis	1940	South	8.0	7,505	31
4	AUSTPL_AUSTING2	Travis	1940	South	9.0	7,732	34
5	BUCHAN_BUCHANG1	Llano	1938	South	16.0	6,281	19
6	BUCHAN_BUCHANG2	Llano	1938	South	16.0	6,330	17
7	BUCHAN_BUCHANG3	Llano	1950	South	17.0	4,608	19
8	CANYHY_CANYHYG1	Comal	1989	South	6.0	45	0
9	DG_LKWDT_2UNITS	Gonzales	1931	South	4.8	4,522	12
10	DG_LWSVL_1UNIT	Denton	1991	North	2.2	7,751	23
11	DG_MCQUE_5UNITS	Guadalupe	1928	South	7.7	14,816	40
12	DG_OAKHL_1UNIT	Tarrant	2014	North	1.4	1,294	4
13	DG_SCHUM_2UNITS	Guadalupe	1928	South	3.6	1	0
14	DNDAM_DENISOG1	Grayson	1944	North	40.0	64,007	392
15	DNDAM_DENISOG2	Grayson	1948	North	40.0	166,228	442
16	EAGLE_HY_EAGLE_HY1	Maverick	2005	South	9.6	36,942	88
17	FALCON_FALCONG1	Starr	1954	South	12.0	10,541	18
18	FALCON_FALCONG2	Starr	1954	South	12.0	10,635	21
19	FALCON_FALCONG3	Starr	1954	South	12.0	23,233	29
20	GONZ_HYDRO_GONZ_HYDRO	Gonzales	1986	South	1.5	437	0
21	INKSDA_INKS_G1	Llano	1938	South	14.0	8,429	26
22	MARBFA_MARBFAG1	Burnet	1951	South	21.0	6,886	16
23	MARBFA_MARBFAG2	Burnet	1951	South	20.0	6,777	14
24	MARSFO_MARSFOG1	Travis	1941	South	34.0	1,517	4
25	MARSFO_MARSFOG2	Travis	1941	South	36.0	29,155	116
26	MARSFO_MARSFOG3	Travis	1941	South	36.0	28,548	118
27	WIRTZ_WIRTZ_G1	Burnet	1951	South	29.0	10,327	24
28	WIRTZ_WIRTZ_G2	Burnet	1951	South	29.0	10,412	21
29	WND_WHITNEY1	Bosque	1953	North	22.0	26,840	52
30	WND_WHITNEY2	Bosque	1953	North	22.0	25,418	52
Total					**557.6**	**632,438**	**1,845**

* 2020 ERCOT Renewable Generator Details.xlsx from ERCOT and PUCT
** 2020 ERCOT Renewable Generation (15min).xlsx from ERCOT

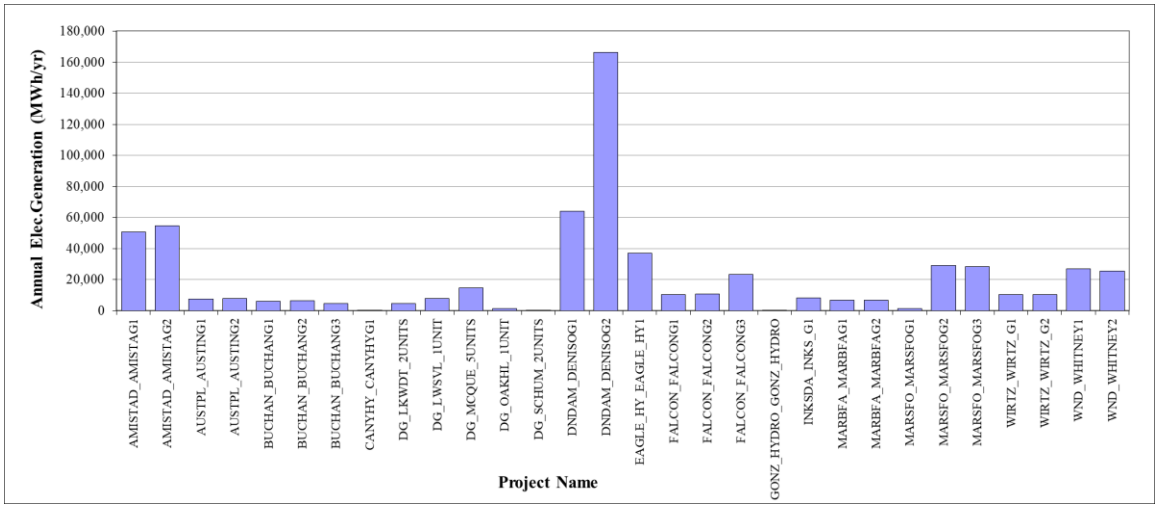


Figure 6-23: Annual Electricity Generation by Hydroelectric Projects in the State of Texas through 2020

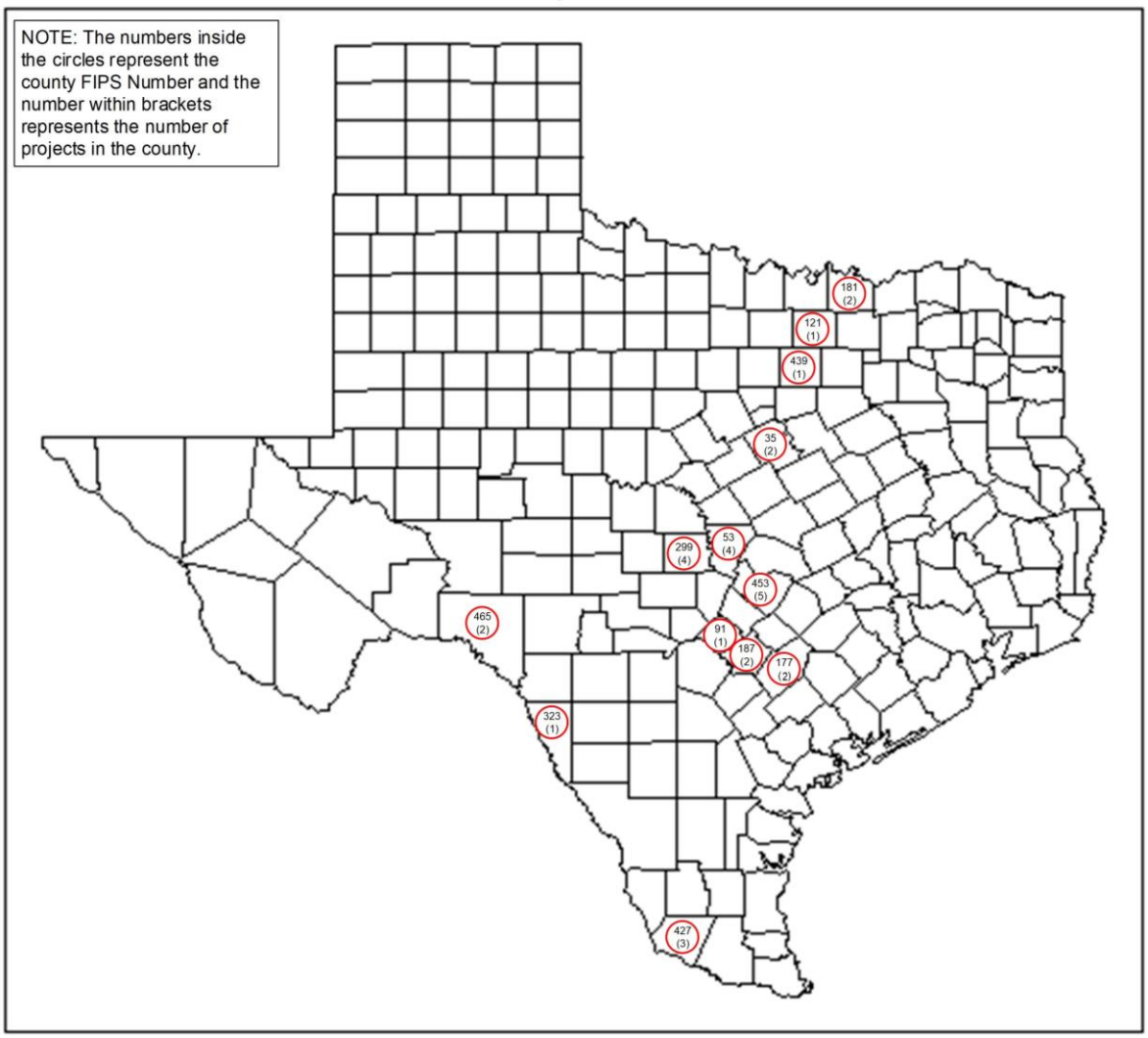


Figure 6-24: Map of Hydroelectric Projects Installed in Each County of Texas

Table 6-10: Hydroelectric Projects throughout Texas through 2020

County	FIPS Code	No. of Projects
Bosque	35	2
Burnet	53	4
Comal	91	1
Denton	121	1
Gonzales	177	2
Grayson	181	2
Guadalupe	187	2
Llano	299	4
Maverick	323	1
Starr	427	3
Tarrant	439	1
Travis	453	5
Val Verde	465	2

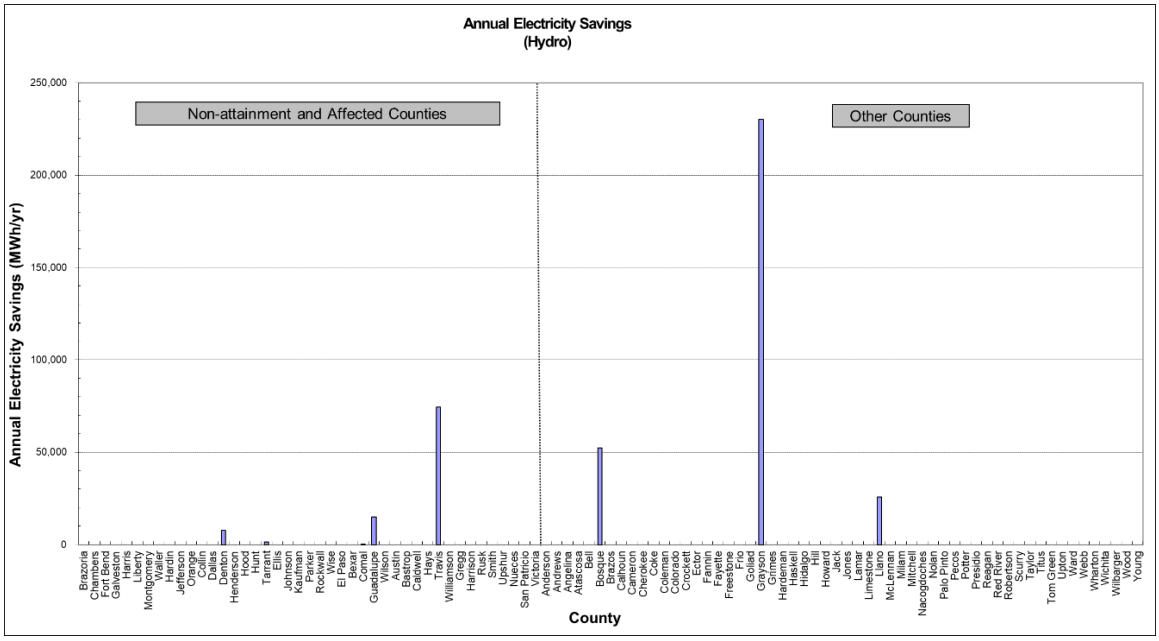


Figure 6-25: Annual Electricity Savings per County from Hydroelectric Projects through 2020

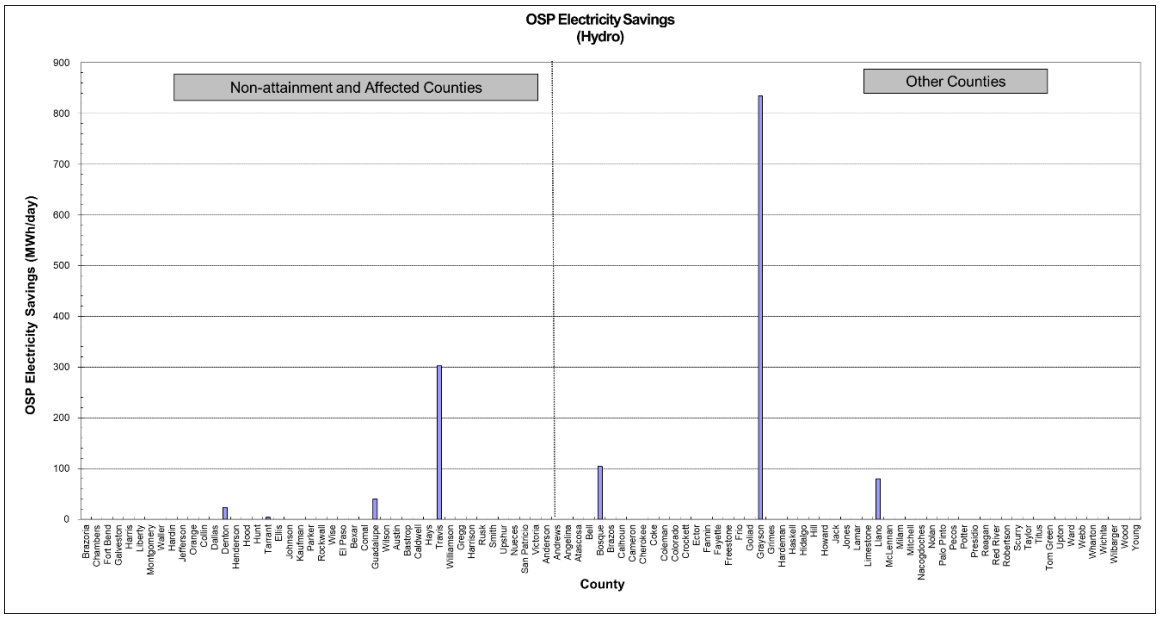


Figure 6-26: Ozone Season Period Electricity Savings per County from Hydroelectric Projects through 2020

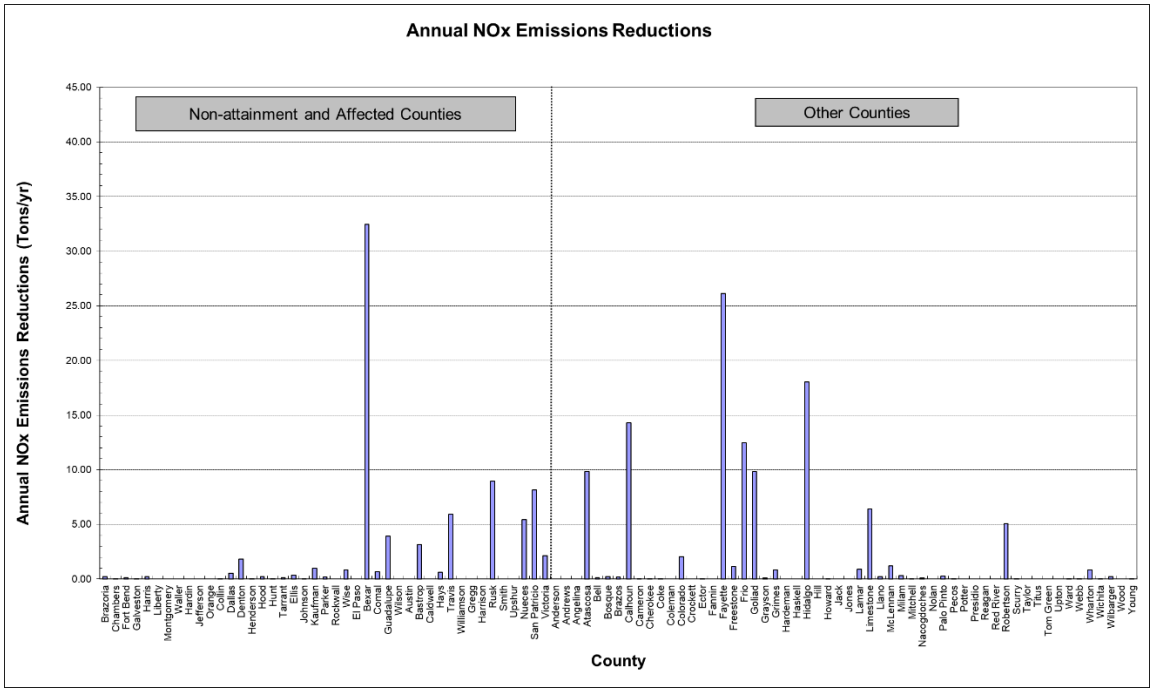


Figure 6-27: NOx Emissions Reductions per County from Hydroelectric Projects through 2020

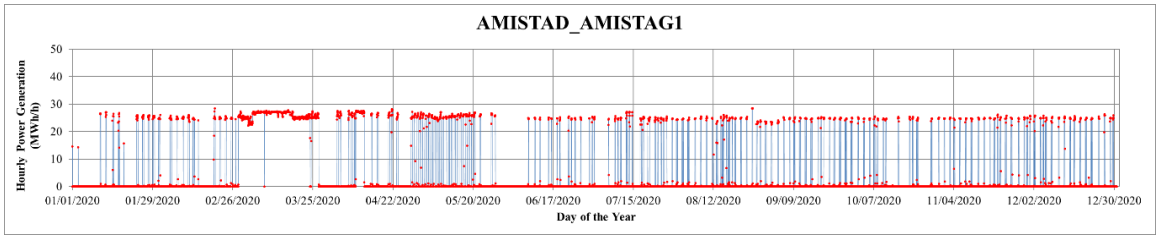


Figure 6-28: Hourly Electricity Generation Profile for Hydroelectric Project AMISTAD_AMISTAG1

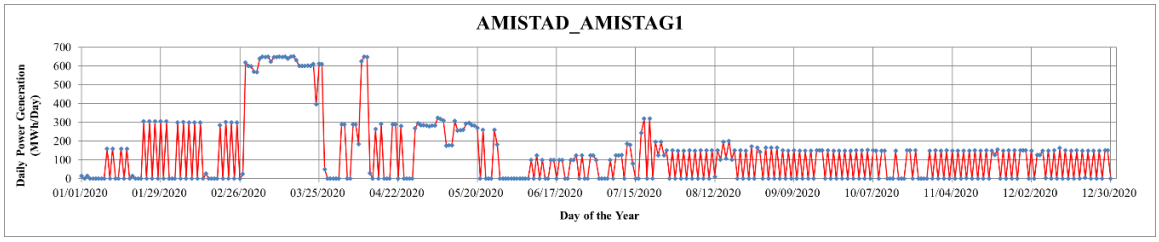


Figure 6-29: Daily Total Electricity Generation Profile for Hydroelectric Project AMISTAD_AMISTAG1

6.2.5 Geothermal

The total number of the identified geothermal projects for the present report was 306. Most of the geothermal projects throughout the State of Texas were identified from various web sources. For this report, twelve new geothermal projects were found.

Table G-4 (in Volume II, Appendix G) shows the list of the geothermal projects with their names, respective county, implementation year, installed capacity, and service area. In addition, Figure 6-30 shows the location of the geothermal projects for each county. We could not find either annual or OSP electricity savings and the NOx emission reductions per county from the geothermal projects, which were not possible to be estimated.

6.2.6 Landfill Gas-Fired

The information for the landfill gas-fired power plant section was found in the Environmental Protection Agency's (EPA's) project database for Landfill Methane Outreach Program (LMOP). The information includes all the landfill gas-fired power plants in operational, candidate, potential, construction, shutdown, and planned status. The EPA updated the project's information, and this report located the updated project information until March 2021.

Based on the EPA project database, 34 operational, 50 candidates, 35 potential, 4 construction, 29 shutdowns, 4 planned, and 3 other landfill gas-fired projects were identified. All of the landfill gas-fired power plants are listed in Table G-5 through Table G-11 (Volume II, Appendix G), respectively. Figure 6-31 shows in the Texas map the location and the number of landfilling projects in each county which are operational. This report did not include either annual or OSP electricity savings and NOx emission reductions per county from the landfill gas-fired projects, which could not be estimated.

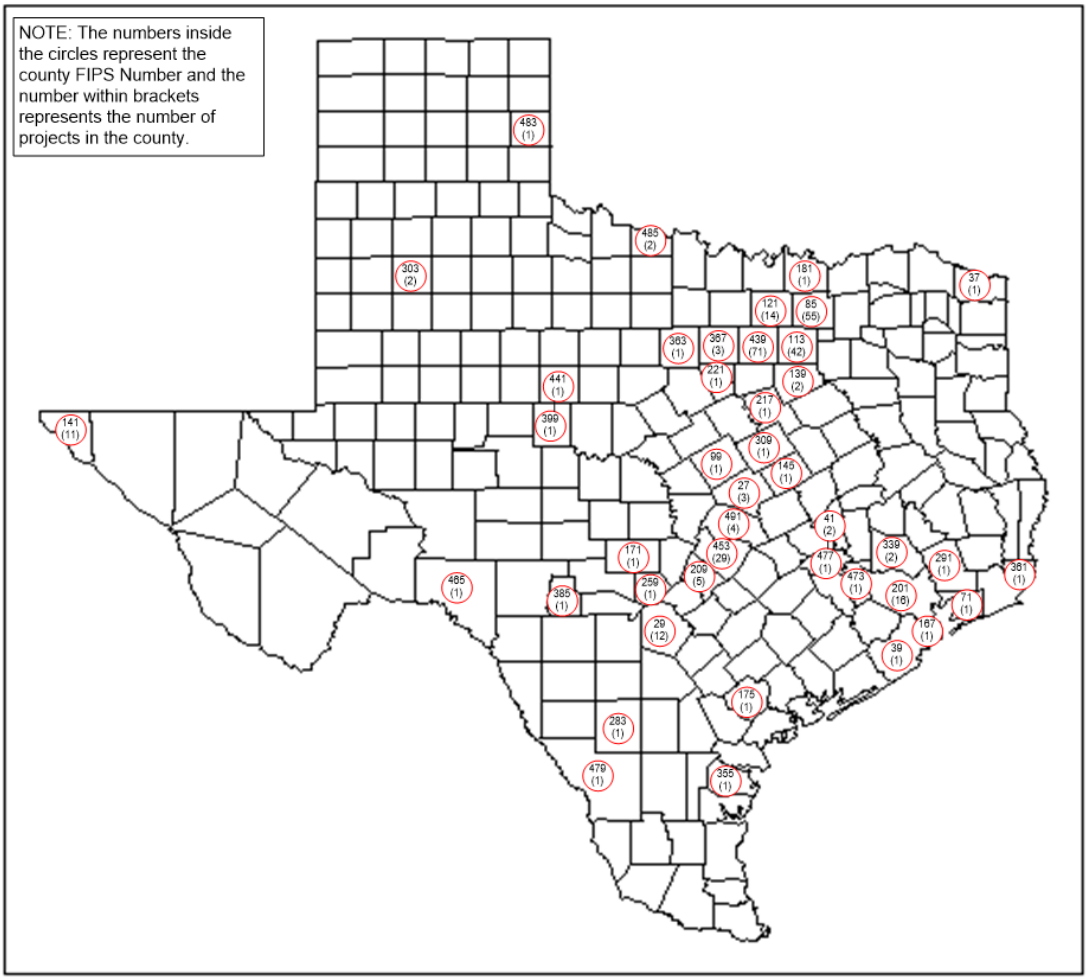


Figure 6-30: Map of Geothermal Projects Installed in Each County of Texas

Table 6-11: Geothermal Projects Installed throughout Texas through 2020

County	FIPS Code	No. of Projects	County	FIPS Code	No. of Projects
Bell	27	3	La Salle	283	1
Bexar	29	12	Liberty	291	1
Bowie	37	1	Lubbock	303	2
Brazoria	39	1	McLennan	309	1
Brazos	41	2	Montgomery	339	2
Chambers	71	1	Nueces	355	1
Collin	85	55	Orange	361	1
Coryell	99	1	Palo pinto	363	1
Dallas	113	42	Parker	367	3
Denton	121	14	Real	385	1
Ellis	139	2	Runnels	399	1
El Paso	141	11	Tarrant	439	71
Falls	145	1	Taylor	441	1
Galveston	167	1	Travis	453	29
Gillespie	171	1	Val Verde	465	1
Goliad	175	1	Waller	473	1
Grayson	181	1	Washington	477	1
Harris	201	16	Webb	479	1
Hays	209	5	Wheeler	483	1
Hill	217	1	Wichita	485	2
Hood	221	1	Williamson	491	4
Kendall	259	1	N/A	-	5

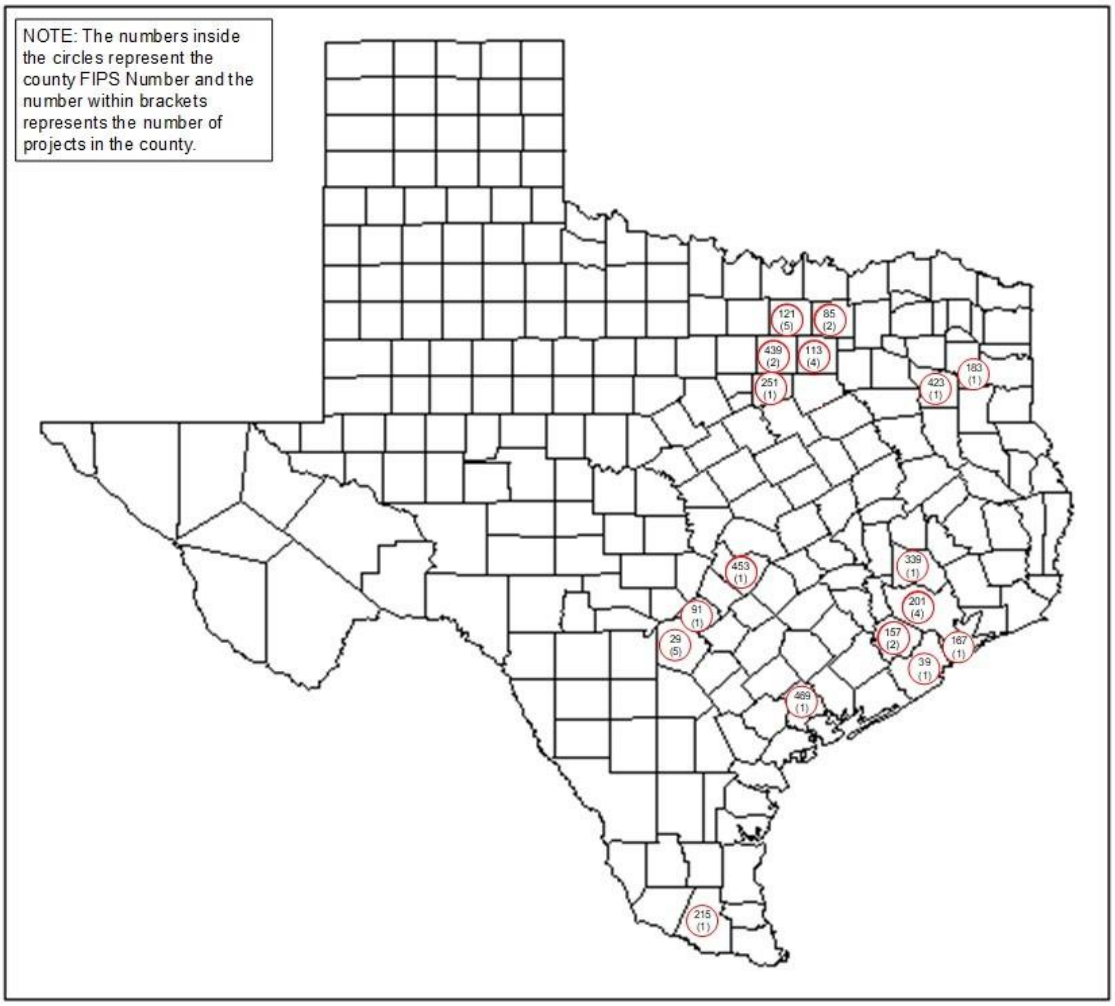


Figure 6-31: Map of Landfill Gas-Fired Projects Installed in Each County of Texas

Table 6-12: Landfill Gas-Fired Projects Installed throughout Texas through 2020

County	FIPS Code	No. of Projects(2020)
Bexar	29	5
Brazoria	39	1
Collin	85	2
Comal	91	1
Dallas	113	4
Denton	121	5
Fort Bend	157	2
Galveston	167	1
Gregg	183	1
Harris	201	4
Hidalgo	215	1
Johnson	251	1
Montgomery	339	1
Smith	423	1
Tarrant	439	2
Travis	453	1
Victoria	469	1

6.3 Results

The State of Texas leads the renewable energy development in the U.S. In July 2021, around 5,396 new renewable energy projects in Texas, which were not part of the previous report published, were identified, located and included in the present report. The details of the new project can be found in Table 6-13.

Table 6-13: Comparison of the Projects Identified from Previous and Present Reports

Renewable Energy Source	Number of Projects in 2019	Number of New Projects in 2020	Total Number of Projects in 2020
Solar Photovoltaic[1]	29,406	5,375	34,781
Solar Power[2]	77	7	82
Solar Thermal	40	1	41
Biomass[3]	14	0	12
Hydroelectric	30	0	30
Geothermal	294	12	306
Landfill Gas-Fired[4]	33	1	34

Note:

[1] This TERP report used the Tracking the Sun public dataset of Lawrence Berkeley National Laboratory (LBNL) (https://emp.lbl.gov/tracking-the-sun/). The *Tracking the Sun* project database included 34,781 projects from 2004 to 2020.

[2] Two solar power projects that were retrieved from the Open PV Project Database of the National Renewable Energy Laboratory (NREL) in 2019 list are excluded from the list for this year since the NREL Open PV database terminated its public data service in June 2019.

[3] Two biomass projects had no generation compared to 2019 list. Therefore, they are excluded from the list for this year. Also, NOx emission reductions for biomass is not reported since biomass itself has high NOx emissions.

[4] Landfill gas-fired project information from EPA have seven sub-categories for their status: operational, candidates, potential, construction, shutdown, planned, and others. EPA rearranged/added/removed some projects information within the seven sub-categories. Operational projects were considered for the number of projects.

This report also presents county-wide annual/OSP energy savings for solar photovoltaic including solar power, solar thermal, biomass, and hydroelectric projects. The annual/OSP energy savings calculation for solar photovoltaic was conducted based on the LBNL public dataset. In addition, the annual/OSP energy savings calculation for solar thermal was conducted based on the project data from various web sources. Finally, the power generation data for the other renewable energy projects (solar power, biomass, and hydroelectric), which were obtained from the ERCOT, were used to evaluate the annual/OSP energy generation. Then, the annual NOx emission reductions calculation was conducted with the special version of Texas 2018 eGRID, based on their energy savings/generation.

In 2020, the total annual/OSP energy savings from each renewable projects across all the counties were:

- solar photovoltaic projects (non-utility scale): 451,803 MWh/yr and 1,400 MWh/day;
  in addition, solar power projects (utility-scale): 8,450,944 MWh/yr and 31,762 MWh/day,
- solar thermal projects: 255 MWh/yr and 0.7 MWh/day,
- biomass projects: 352,924 MWh/yr and 1,069 MWh/day, and
- hydroelectric projects: 632,438 MWh/yr and 1,845 MWh/day.

In 2020, the annual NOx emission reductions from renewable projects across all the counties were:

- solar photovoltaic projects (non-utility scale): 222.7 tons/yr;
  in addition, solar power projects (utility-scale): 5,458.6 tons/yr,
- solar thermal projects: 0.1 tons/yr and,
- hydroelectric projects: 188 tons/yr.

These savings and reductions do not represent all of the solar thermal projects in the State of Texas. They only reflect the projects based on the investigated resources.

7 REVIEW OF ERCOT'S RENEWABLE ENERGY CREDIT PROGRAM INFORMATION

7.1 Introduction

In this section, the information posted on ERCOT's Renewable Energy Credit Program site (www.texasrenewables.com) was reviewed for use in the Laboratory's report to the TCEQ. In particular, information posted under the "Public Reports" tab was downloaded and assembled into an appropriate format for review. This includes ERCOT's 2001 through 2020 reports to the Legislature, which were converted into a tabular format for analysis and insertion into this report (in Volume II, Appendix H). Similarly, information from ERCOT's listing of REC generators was inspected to determine how it compared with other sources of information the Laboratory has assembled.

7.2 Summary of Renewable Projects in Texas

Each year ERCOT is required to compile a list of grid-connected sources that generate electricity from renewable energy and report it to the Legislature.

Table 7-1 shows quarterly electricity generation by renewable sources from 2001 to 2020.

Table 7-2 contains the data reported by ERCOT from 2001 through 2020. Figure 7-1, Figure 7-2, Figure 7-3 and Figure 7-4 have been included to better illustrate the annual data collected by ERCOT. In Figure 7-1 the annual total electricity generation of all the renewable sources is shown as well as 2019 wind, solar and hydro REC data is updated due to ERCOT's data modification this year. In Figure 7-2, the annual electricity generation of renewable sources excluding wind is shown. In Figure 7-3, the annual electricity generation of renewable sources excluding wind and hydro is shown. Similarly, in Figure 7-4, the annual electricity generation of renewable sources excluding wind, hydro and landfill gas is shown. This was done to understand the contribution of individual energy sources to the total electricity generated. In the figures and tables, it is clear to see that the electricity generated by wind each year is the largest single source of renewable energy in Texas. The renewable energy in Texas has grown from 596,236 MWh in 2001 to 102,752,245 MWh in 2020. This is followed by:

- Wind energy has grown from 565,597 MWh in 2001 to 93,387,597 MWh in 2020;
- Biomass energy has grown from 39,496 MWh in 2003 to 140,877 MWh in 2020;
- Hydroelectric energy has grown from 30,639 MWh in 2001 to 207,372 MWh in 2020;
- Landfill gas energy has grown from 29,412 MWh in 2002 to 270,377 MWh in 2020; and
- Solar energy has grown from 87 MWh in 2002 to 8,746,022 MWh in 2020.

Other sources of information present some differences in the values of the renewable electricity generated in Texas. It has been found some discrepancies between U.S. DOE Energy Information Administration (EIA) and ERCOT sources on electricity generation from wind, but it has been a small difference. In 2020, the wind electricity generation data from the ERCOT website is similar to the generation data from the EIA website. The EIA wind electricity generation for 2020 was 92,989 thousand MWh in a net generation, and EIA are 0.43% lower than ERCOT.

Table 7-1: Quarterly Electricity Generation by Renewable Sources, in MWh, for 2001–2020

Technology Type	Year	Quarter1	Quarter2	Quarter3	Quarter4	Total MWh
Biomass	2001	0	0	0	0	0
Hydro	2001	0	0	11,293	19,346	30,639
Landfill gas	2001	0	0	0	0	0
Solar	2001	0	0	0	0	0
Wind	2001	0	0	201,118	364,479	565,597
Totals		0	0	212,411	383,825	596,236

Technology Type	Year	Quarter1	Quarter2	Quarter3	Quarter4	Total MWh
Biomass	2002	0	0	0	0	0
Hydro	2002	105,817	69,165	80,154	56,956	312,093
Landfill gas	2002	8,216	7,073	6,986	7,137	29,412
Solar	2002	0	29	37	21	87
Wind	2002	611,708	716,896	622,262	500,618	2,451,484
Totals		725,741	793,163	709,440	564,732	2,793,076

Technology Type	Year	Quarter1	Quarter2	Quarter3	Quarter4	Total MWh
Biomass	2003	8,876	11,253	10,999	8,368	39,496
Hydro	2003	92,680	52,592	71,699	22,713	239,684
Landfill gas	2003	29,995	44,629	39,920	39,662	154,206
Solar	2003	32	70	69	49	220
Wind	2003	561,994	670,248	617,794	665,446	2,515,482
Totals		693,577	778,792	740,481	736,238	2,949,087

Technology Type	Year	Quarter1	Quarter2	Quarter3	Quarter4	Total MWh
Biomass	2004	6,274	11,459	11,482	7,725	36,940
Hydro	2004	55,638	52,735	52,350	74,067	234,791
Landfill gas	2004	52,801	47,964	53,659	49,018	203,443
Solar	2004	31	67	70	44	211
Wind	2004	815,010	1,014,396	610,157	770,066	3,209,630
Totals		929,755	1,126,621	727,718	900,920	3,685,014

Technology Type	Year	Quarter1	Quarter2	Quarter3	Quarter4	Total MWh
Biomass	2005	13,921	15,069	14,764	14,883	58,637
Hydro	2005	108,974	106,893	61,189	33,246	310,302
Landfill gas	2005	52,118	51,193	56,166	54,301	213,777
Solar	2005	46	69	67	46	227
Wind	2005	801,232	1,246,182	869,508	1,304,646	4,221,568
Totals		976,291	1,419,406	1,001,693	1,407,122	4,804,512

Technology Type	Year	Quarter1	Quarter2	Quarter3	Quarter4	Total MWh
Biomass	2006	16,327	10,479	17,152	16,610	60,569
Hydro	2006	55,000	83,064	44,870	27,143	210,077
Landfill gas	2006	69,191	78,650	75,665	82,580	306,087
Solar	2006	26	43	41	360	470
Wind	2006	1,478,927	1,584,166	1,376,540	2,091,295	6,530,928
Totals		1,619,471	1,756,403	1,514,268	2,217,988	7,108,131

Table 7-1: Quarterly Electricity Generation by Renewable Sources, in MWh, for 2001–2020 (Cont.)

Technology Type	Year	Quarter1	Quarter2	Quarter3	Quarter4	Total MWh
Biomass	2007	13,052	15,870	13,073	12,105	54,101
Hydro	2007	66,084	120,486	139,965	56,346	382,882
Landfill gas	2007	84,367	86,372	85,612	99,987	356,339
Solar	2007	339	503	541	461	1,844
Wind	2007	1,961,153	2,029,807	2,020,870	3,339,338	9,351,168
Totals		2,124,995	2,253,039	2260062	3508238	10,146,333

Technology Type	Year	Quarter1	Quarter2	Quarter3	Quarter4	Total MWh
Biomass	2008	21,154	14,019	12,564	23,095	70,833
Hydro	2008	98,510	177,051	78,751	91,116	445,428
Landfill gas	2008	105,217	97,361	88,470	96,062	387,110
Solar	2008	446	862	992	1,038	3,338
Wind	2008	4,030,973	4,737,188	2,639,509	4,878,770	16,286,440
Totals		4,256,300	5,026,481	2,820,287	5,090,081	17,193,150

Technology Type	Year	Quarter1	Quarter2	Quarter3	Quarter4	Total MWh
Biomass	2009	25,083	18,938	17,187	12,156	73,364
Hydro	2009	76,480	179,512	88,491	163,024	507,507
Landfill gas	2009	94,377	101,709	104,854	111,983	412,923
Solar	2009	101	1,409	1,761	1,222	4,492
Wind	2009	5,413,648	5,385,203	4,248,223	5,549,030	20,596,105
Totals		5,609,689	5,686,771	4,460,516	5,837,415	21,594,390

Technology Type	Year	Quarter1	Quarter2	Quarter3	Quarter4	Total MWh
Biomass	2010	20,974	27,769	17,407	31,385	97,535
Hydro	2010	196,238	133,408	192,252	87,358	609,257
Landfill gas	2010	110,511	114,893	116,789	122,711	464,904
Solar	2010	1,385	2,042	3,483	7,539	14,449
Wind	2010	6,459,442	7,806,011	5,307,840	7,255,367	26,828,660
Totals		6,788,550	8,084,123	5,637,771	7,504,361	28,014,805

Technology Type	Year	Quarter1	Quarter2	Quarter3	Quarter4	Total MWh
Biomass	2011	26,692	20,039	24,890	65,383	137,004
Hydro	2011	60,614	102,583	55,029	48,887	267,113
Landfill gas	2011	121,232	135,365	122,790	118,258	497,645
Solar	2011	7,390	10,160	11,202	7,827	36,580
Wind	2011	7,447,218	9,540,116	5,849,557	7,932,783	30,769,674
Totals		7,663,146	9,808,263	6,063,468	8,173,139	31,708,016

Technology Type	Year	Quarter1	Quarter2	Quarter3	Quarter4	Total MWh
Biomass	2012	41,567	95,834	100,633	50,954	288,988
Hydro	2012	122,942	125,992	68,908	71,355	389,197
Landfill gas	2012	129,505	132,653	144,644	142,235	549,037
Solar	2012	17,299	41,246	44,007	36,887	139,439
Wind	2012	8,938,807	8,399,672	6,376,312	9,031,743	32,746,534
Totals		9,250,120	8,795,396	6,734,504	9,333,174	34,113,195

Table 7-1: Quarterly Electricity Generation by Renewable Sources, in MWh, for 2001–2020 (Cont.)

Technology Type	Year	Quarter1	Quarter2	Quarter3	Quarter4	Total MWh
Biomass	2013	36,648	36,622	78,316	48,976	200,564
Hydro	2013	118,008	58,910	37,467	79,853	294,238
Landfill gas	2013	132,757	138,876	136,378	142,834	550,845
Solar	2013	36,112	44,268	57,165	40,781	178,326
Wind	2013	9,702,680	11,386,839	6,708,823	9,111,043	36,909,385
Totals		10,026,205	11,665,516	7,018,149	9,423,488	38,133,358

Technology Type	Year	Quarter1	Quarter2	Quarter3	Quarter4	Total MWh
Biomass	2014	67,700	88,454	111,573	75,743	343,469
Hydro	2014	39,915	106,890	47,850	46,138	240,792
Landfill gas	2014	130,630	130,738	126,337	130,876	518,580
Solar	2014	54,330	80,675	100,351	77,402	312,757
Wind	2014	10,474,109	11,930,083	7,735,157	10,505,013	40,644,362
Totals		10,766,684	12,336,839	8,121,267	10,835,171	42,059,961

Technology Type	Year	Quarter1	Quarter2	Quarter3	Quarter4	Total MWh
Biomass	2015	101,209	60,737	111,231	76,422	349,600
Hydro	2015	88,592	153,061	76,269	96,366	414,289
Landfill gas	2015	136,295	132,252	145,414	147,953	561,915
Solar	2015	79,124	109,563	137,757	83,875	410,318
Wind	2015	8,957,407	11,909,543	10,763,871	13,534,520	45,165,341
Totals		9,362,627	12,365,157	11,234,542	13,939,137	46,901,462

Technology Type	Year	Quarter1	Quarter2	Quarter3	Quarter4	Total MWh
Biomass	2016	57,139	50,673	87,606	52,224	247,643
Hydro	2016	117,562	137,075	86,712	52,392	393,740
Landfill gas	2016	145,658	132,271	121,302	119,174	518,403
Solar	2016	142,149	181,690	291,644	232,927	848,410
Wind	2016	15,226,603	13,799,634	13,335,532	15,434,392	57,796,161
Totals		15,689,111	14,301,343	13,922,795	15,891,109	59,804,357

Technology Type	Year	Quarter1	Quarter2	Quarter3	Quarter4	Total MWh
Biomass	2017	69,465	54,806	37,671	54,489	216,431
Hydro	2017	117,264	150,743	129,146	47,300	444,453
Landfill gas	2017	116,195	116,211	109,684	104,029	446,119
Solar	2017	388,388	640,167	713,644	547,195	2,289,394
Wind	2017	18,415,248	18,112,145	12,667,406	17,054,441	66,249,240
Totals		19,106,560	19,074,073	13,657,550	17,807,453	69,645,636

Technology Type	Year	Quarter1	Quarter2	Quarter3	Quarter4	Total MWh
Biomass	2018	69,323	95,818	83,508	38,364	287,014
Hydro	2018	103,841	125,344	58,133	47,142	334,460
Landfill gas	2018	101,233	96,217	97,221	100,756	395,428
Solar	2018	603,579	924,274	985,609	669,777	3,183,238
Wind	2018	19,518,189	22,106,314	14,445,761	17,890,313	73,960,577
Totals		20,396,165	23,347,967	15,670,232	18,746,352	78,160,716

Table 7-1: Quarterly Electricity Generation by Renewable Sources, in MWh, for 2001–2020 (Cont.)

Technology Type	Year	Quarter1	Quarter2	Quarter3	Quarter4	Total MWh
Biomass	2019	39,315	18,885	76,082	19,250	153,531
Hydro	2019	63,622	110,156	57,341	35,599	266,718
Landfill gas	2019	101,180	83,434	78,870	71,878	335,361
Solar	2019	771,136	1,275,379	1,444,295	976,062	4,466,873
Wind	2019	19,767,639	21,050,791	19,512,263	21,439,607	81,770,300
Totals		20,742,892	22,538,645	21,168,850	22,542,397	86,992,784

Technology Type	Year	Quarter1	Quarter2	Quarter3	Quarter4	Total MWh
Biomass	2020	38,198	14,600	63,198	24,881	140,877
Hydro	2020	82,394	58,587	33,147	33,244	207,372
Landfill gas	2020	70,709	70,958	66,135	62,575	270,377
Solar	2020	1,219,107	2,535,033	3,015,113	1,976,768	8,746,022
Wind	2020	23,626,732	25,304,220	19,768,237	24,688,408	93,387,597
Totals		25,037,139	27,983,398	22,945,830	26,785,877	102,752,245

Table 7-2: Annual Electricity Generation by Renewable Sources (MWh, ERCOT: 2001–2020)

Year	Biomass (MWh)	Hydro (MWh)	Landfill gas (MWh)	Solar (MWh)	Wind (MWh)	Total (MWh)
2001	0	30,639	0	0	565,597	596,236
2002	0	312,093	29,412	87	2,451,484	2,793,076
2003	39,496	239,684	154,206	220	2,515,482	2,949,087
2004	36,940	234,791	203,443	211	3,209,630	3,685,014
2005	58,637	310,302	213,777	227	4,221,568	4,804,512
2006	60,569	210,077	306,087	470	6,530,928	7,108,131
2007	54,101	382,882	356,339	1,844	9,351,168	10,146,333
2008	70,833	445,428	387,110	3,338	16,286,440	17,193,150
2009	73,364	507,507	412,923	4,492	20,596,105	21,594,390
2010	97,535	609,257	464,904	14,449	26,828,660	28,014,805
2011	137,004	267,113	497,645	36,580	30,769,674	31,708,016
2012	288,988	389,197	549,037	139,439	32,746,534	34,113,195
2013	200,564	294,238	550,845	178,326	36,909,385	38,133,358
2014	343,469	240,792	518,580	312,757	40,644,362	42,059,961
2015	349,600	414,289	561,915	410,318	45,165,341	46,901,462
2016	247,643	393,740	518,403	848,410	57,796,161	59,804,357
2017	216,431	444,453	446,119	2,289,394	66,076,742	69,473,139
2018	287,014	334,460	395,428	3,183,238	73,960,577	78,160,716
2019	153,531	266,718	335,361	4,466,873	81,770,300	86,992,784
2020	140,878	207,373	270,377	8,746,022	93,387,597	102,752,245

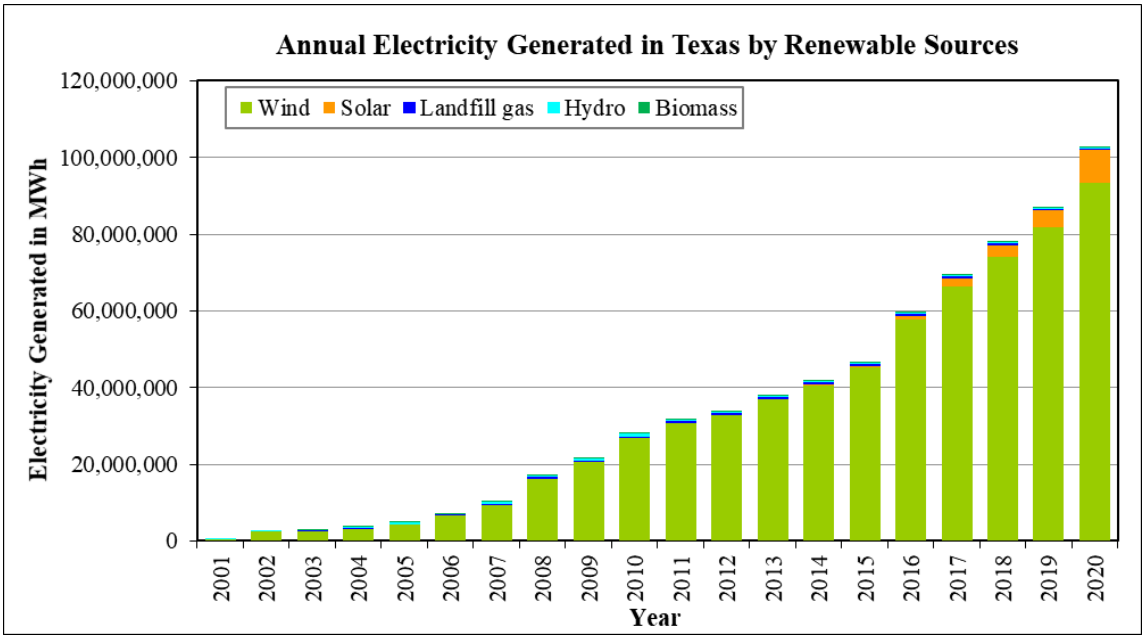


Figure 7-1: Electricity Generation by Renewable Sources (ERCOT: 2001–2020 Annually)

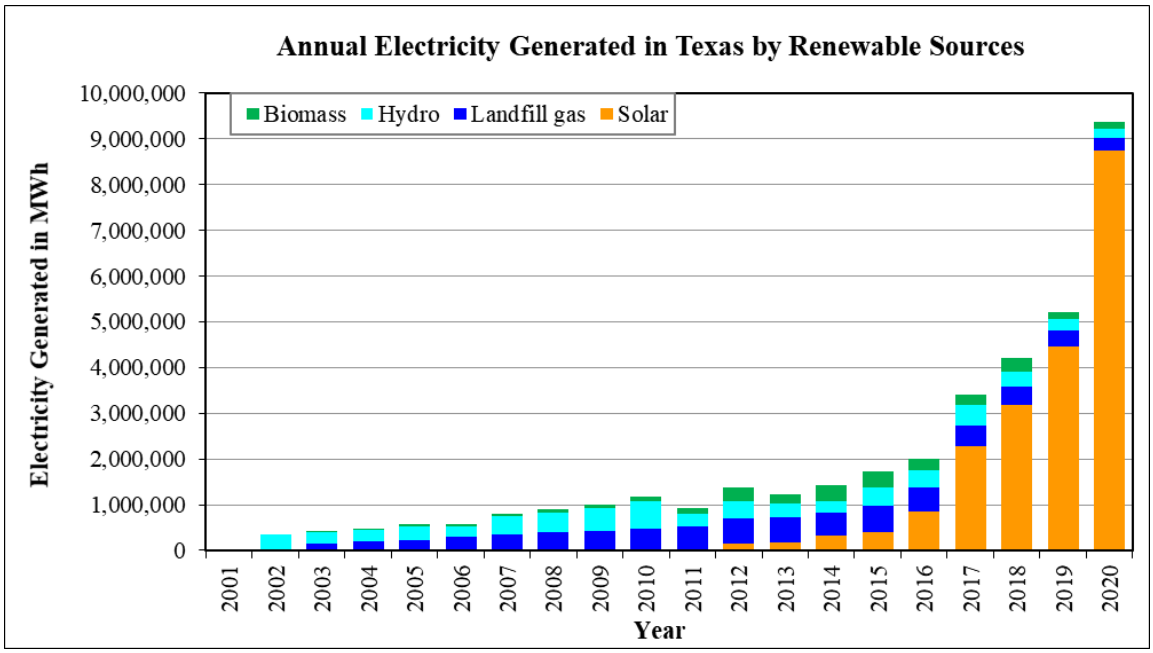


Figure 7-2: Electricity Generation by Renewable Sources Other than Wind (ERCOT: 2001–2020 Annually)

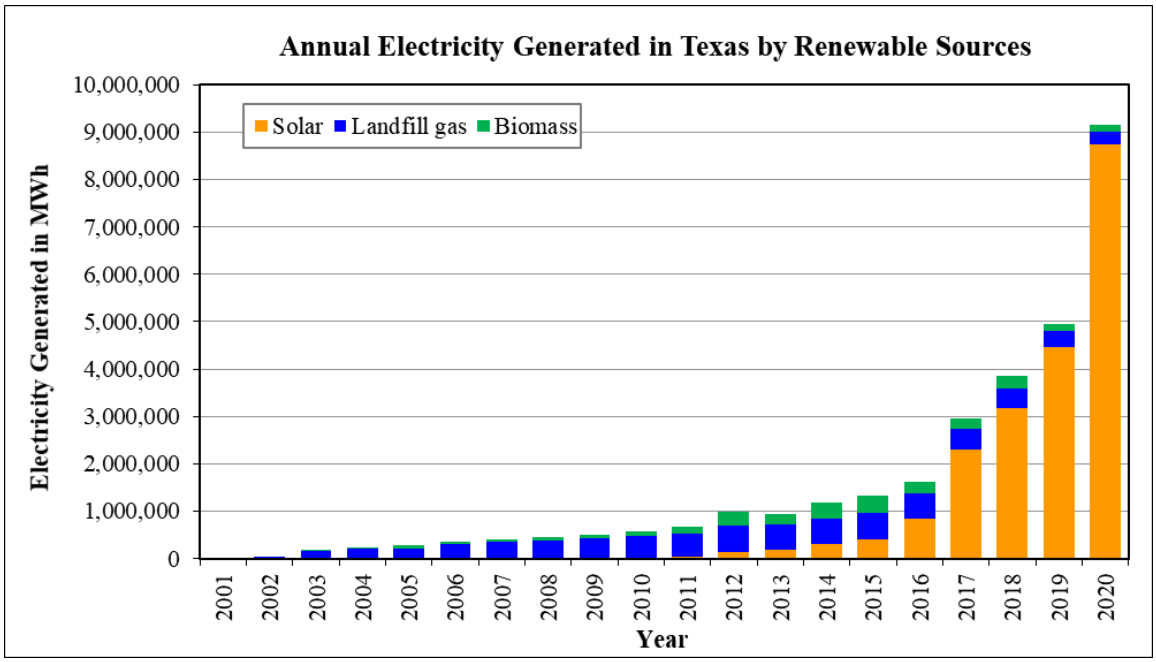


Figure 7-3: Electricity Generation by Renewable Sources from Solar, Landfill Gas, and Biomass (ERCOT: 2001–2020 Annually)

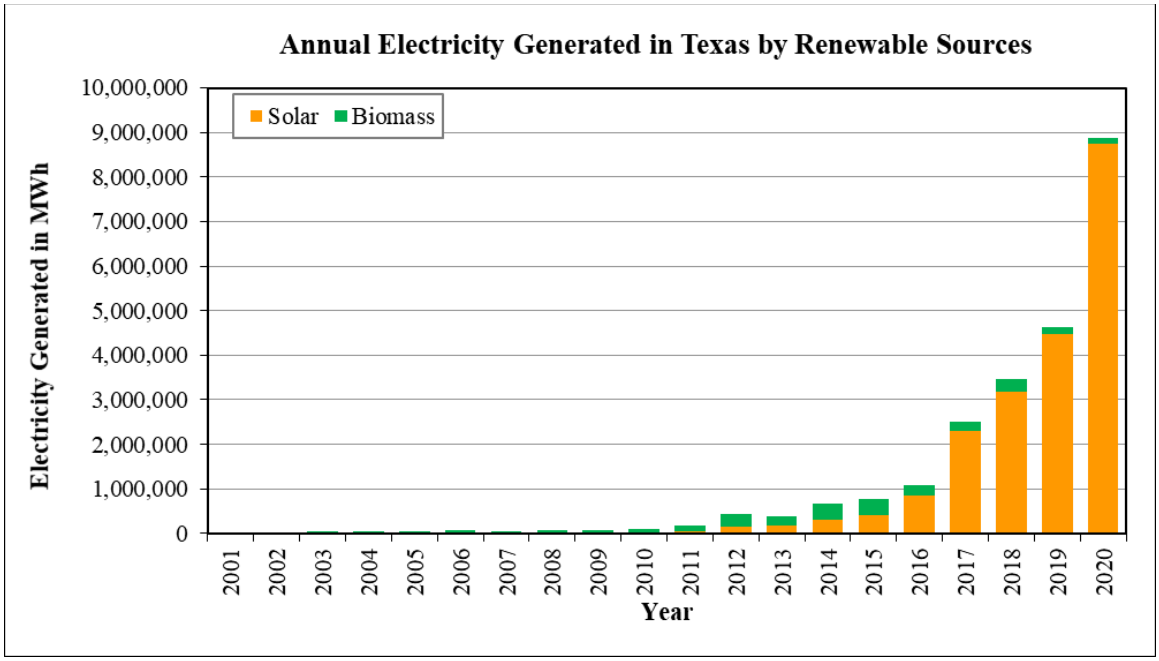


Figure 7-4: Electricity Generation by Renewable Sources from Solar and Biomass (ERCOT: 2001–2020 Annually)

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