

# **ENERGY EFFICIENCY/RENEWABLE ENERGY IMPACT IN THE TEXAS EMISSIONS REDUCTION PLAN (TERP)**

## **SUMMARY REPORT: INTEGRATED NOX EMISSIONS SAVINGS FROM EE/RE PROGRAMS STATEWIDE**

**Annual Report to the  
Texas Commission on Environmental Quality  
January 2021 – December 2021**



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**ENERGY SYSTEMS LABORATORY**  
TEXAS A&M ENGINEERING EXPERIMENT STATION



**TEXAS A&M ENGINEERING  
EXPERIMENT STATION**

**ENERGY SYSTEMS LABORATORY**

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September 29, 2022

Mr. David Serrins  
Mobile Source Programs Team Leader  
Air Quality Division  
Texas Commission on Environmental Quality  
Austin, TX 78711-3087

Dear Mr. Serrins:

The Energy Systems Laboratory (ESL) at the Texas A&M Engineering Experiment Station of the Texas A&M University System is pleased to provide this summary report, "Energy Efficiency/Renewable Energy Impact in the Texas Emissions Reduction Plan (TERP): Integrated NOx Emissions Savings from EE/RE Programs Statewide," as required under Texas Health and Safety Code Ann. § 388.003 (e) (Senate Bill 5, 77R as amended 78 R & 78S).

The ESL is required to annually report the energy savings from statewide adoption of the Texas Building Energy Performance Standards in Senate Bill 5 (SB 5), as amended, and the relative impact of proposed local energy code amendments in the Texas non-attainment and near-non-attainment counties as part of the Texas Emissions Reduction Plan (TERP).

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

Sincerely,

A handwritten signature in black ink that reads "David E. Claridge".

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

### **Disclaimer**

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### **Acknowledgments**

This work has been completed as a fulfillment of Sections 386.205, 386.252, 388.006, and 388.003 (e) of the Texas Health and Safety Code and Sections 39.9051 (g) (h), and 39.9052 (c) (d) of the Texas Utilities Code, which require the Laboratory to assist TCEQ in quantifying emissions reductions credits from energy efficiency and renewable energy programs.

The authors are also grateful for the timely input provided by the following individuals, and agencies: David Serrins, TCEQ, Dan Mantena, ERCOT, Therese Harris, PUCT, Eddy Trevino and Fred Yebra, SECO. Numerous additional individuals at the Energy Systems Laboratory contributed significantly to this report, including: Mitra Azimi, Yu Sun, and Jounghwan Ahn.

**SUMMARY REPORT:  
INTEGRATED NOX EMISSIONS SAVINGS FROM EE/RE STATEWIDE**

**Energy Efficiency/Renewable Energy Impact  
In The Texas Emissions Reduction Plan**

**Executive Summary**

The Energy Systems Laboratory (Laboratory), at the Texas A&M Engineering Experiment Station of the Texas A&M University System, in fulfillment of its responsibilities under Texas Health and Safety Code Ann. § 388.003 (e), submits this annual report, Energy Efficiency/Renewable Energy (EE/RE) Impact in the Texas Emissions Reduction Plan (Summary Report) to the Texas Commission on Environmental Quality.

This summary report shows the NOx emissions reductions from the energy-efficiency programs from multiple Texas State Agencies working under Senate Bill 5 and Senate Bill 7 in a uniform format to allow the TCEQ to consider the combined savings for Texas' State Implementation Plan (SIP) planning purposes. This required that the analysis should include the integrated savings estimation from all projects projected through 2026 for both the annual and Ozone Season Period (OSP)<sup>1</sup> NOx reductions. The year 2018 was used for the baseline year to estimate the emissions. The NOx emissions reductions from all these programs were calculated using estimated emissions factors for 2018 from the US Environmental Protection Agency (US EPA) eGRID database, which had been specially prepared for this purpose.

In 2021, the integrated total electricity savings from all programs are:

- Annual electricity savings is 39,483,996 MWh/year (23,275 tons-NOx/year) and
- OSP electricity savings are 187,558 MWh/day, which would be 7,815 MW average hourly load reduction during the OSP period (106.93 tons-NOx/day).

By 2026, the integrated total electricity savings from all programs are forecasted to be:

- Annual electricity savings 228,293,006 MWh/year (139,621 tons-NOx/year) and
- OSP electricity savings 887,442 MWh/day, which would be equivalent to 36,977 MW average hourly load reduction during the OSP period (515.87 tons-NOx/day).

A summary of the savings for 2021 and 2026 is presented in the table below using as baseline year 2018.

	2021	2026
Annual Electricity Savings (MWh/year)	39,483,996	228,293,006
Annual Emissions Reductions (tons NOx/year)	23,275	139,621
OSP Electricity Savings (MWh/day)	187,558	887,442
OSP Emissions Reductions (tons NOx/day)	106.93	515.87

<sup>1</sup> An Ozone Season Period (OSP) represents the daily average emissions during the period that runs from May 1 to September 30.

## Legislative Background

In 2001, the Texas Emissions Reduction Plan (TERP), established by the 77<sup>th</sup> Texas Legislature with the enactment of Senate Bill 5 (SB 5), identified that Energy Efficiency and Renewable Energy (EE/RE) measures make an important contribution to a comprehensive approach for meeting the minimum federal ambient air quality standards. In 2003 through 2007, the 78<sup>th</sup>, 79<sup>th</sup> and 80<sup>th</sup> Legislatures enhanced the use of EE/RE programs for meeting the TERP. The 78<sup>th</sup> Legislature enhanced the use of EE/RE programs for meeting TERP goals by requiring the Texas Commission on Environmental Quality (TCEQ) to promote EE/RE as a means to improve air quality standards and to develop a methodology for computing emissions reduction for use in the State Implementation Plan (SIP) from EE/RE programs.

The 79<sup>th</sup> Legislature expanded the scope of the SIP-eligible credits by adding savings from the State Renewable Portfolio Standards from the generation of electricity from renewable sources; specifically requiring the TCEQ to develop methods to quantify emissions reductions from renewable energy; and required the Laboratory to develop at least 3 alternative methods for achieving a 15 percent greater potential energy savings in residential, commercial and industrial construction.

In the 80<sup>th</sup> Legislature several new energy efficiency initiatives were introduced, including: requiring the Laboratory to provide written recommendations to the State Energy Conservation Office (SECO) about whether or not the energy efficiency provisions of latest published edition of the International Residential Code (IRC), or the International Energy Conservation Code (IECC), are equivalent to or better than the energy efficiency and air quality achievable under the editions adopted under the 2001 IRC/IECC; requiring the Laboratory to develop a standardized report format to be used by providers of home energy ratings; and encouraging the Laboratory to cooperate with an industry organization or trade association to develop guidelines for home energy ratings, including training.

The 81<sup>st</sup> Legislature (2009) extended the TERP to 2019 and required the TCEQ to contract with Laboratory to compute emissions reduction from wind and other renewable energy resources for the SIP.

The 82<sup>nd</sup> Legislature (2011), the Laboratory's responsibilities under TERP increased as new legislatively allocated energy efficiency initiatives were introduced.

The 83<sup>rd</sup> Legislature (2013), the Laboratory's responsibilities under TERP were kept the same as previous years.

The 84<sup>th</sup> Legislature (2015) changed to the Sec. 388.003. Adoption of Building Energy Efficiency Performance Standards, with the passage of HB 1736, affected the Laboratory's responsibilities under TERP.

The 85<sup>th</sup> and 86<sup>th</sup> Legislatures (2017, 2019 respectively) the Laboratory's responsibilities under TERP were kept the same as previous years.

The 87<sup>th</sup> Legislature (2021) amended Sec. 388.003 (i), (j) and (k) through H.B. 3215.

## Calculation of Integrated NO<sub>x</sub> Emissions Reductions from Multiple State Agencies Participating in the Texas Emissions Reduction Plan (TERP)

In January 2005, the Laboratory was asked by the Texas Commission on Environmental Quality (TCEQ) to develop a method by which the NO<sub>x</sub> emissions reductions from the energy-efficiency programs from multiple Texas State Agencies working under Senate Bill 5 and Senate Bill 7 could be reported in a uniform format to allow the TCEQ to consider the combined savings for Texas' State Implementation Plan (SIP) planning purposes. This required that the analysis should include the integrated savings estimation from all projects forecasted through 2026 for both the annual and Ozone Season Period (OSP) NO<sub>x</sub> reductions. In 2021, the NO<sub>x</sub> emissions reductions from all these programs were calculated using estimated emissions factors for 2018 from the US Environmental Protection Agency (US EPA) eGRID database, which had been specially prepared for this purpose. The different programs included in this 2021 integrated analysis are:

- ESL Single-family, Multi-family, and Commercial new construction,
- PUC Senate Bill 7 Program,
- SECO Senate Bill 5 Program,
- Electricity generated by renewables in Texas (ERCOT)<sup>2</sup>,
- SEER 14 upgrades to Single-family and Multi-family residences.

*The Laboratory's single-family and multi-family programs* include the energy savings attained by the construction of new residences in Texas. To estimate energy savings, the published data on residential construction characteristics provided by the Home Innovation Research Labs (HIRL) is used as a baseline as well as the adopted energy code in 2018 (i.e., the 2015 IECC). Annual electricity savings (MWh) are obtained from the Laboratory's Annual Reports to the TCEQ (Haberl et al., 2002 - 2018) (Baltazar et al., 2019 - 2021).

*The Laboratory's commercial program* includes the energy savings attained by constructing new commercial buildings in Texas, including office, apartment, healthcare, education, retail, food, and lodging as defined by Dodge building type (Dodge 2011). Energy savings were estimated from code-compliant buildings (ASHRAE Standard 90.1-2013) against pre-code buildings (ASHRAE Standard 90.1-2007) using the energy use intensity (EUI) in the USDOE report and constructed square footage in Dodge data (Dodge 2021).

*The Public Utility Commission of Texas (PUC) Senate Bill 7 program* includes the energy efficiency programs implemented by electric utilities under the Public Utility Regulatory Act §39.905. The PUC regulated energy efficiency program was adopted pursuant to 1999 legislation (SB 7) and subsequent legislation in 2001 (SB 5), 2007 (HB 3693), and 2011 (SB 1125). The energy efficiency measures include: high-efficiency HVAC equipment, variable speed drives, increased insulation levels, infiltration reduction, duct sealing, Energy Star Homes, etc. Annual electricity savings claimed by the utilities were reported for the different programs completed in the years 2021.

*The Texas State Energy Conservation Office (SECO) funds energy-efficiency programs* that are directed towards school districts, government agencies, city and county governments, private industries and residential energy consumers. For the 2021 reporting year SECO (SECO 2021) submitted annual energy savings values for projects funded by SECO and by Energy Service projects.

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<sup>2</sup> ERCOT is the Electric Reliability Council of Texas. ERCOT contains 215 Counties.

The *Electric Reliability Council of Texas (ERCOT) electricity production from currently installed green power generation* in Texas is reported. In this report, the measured electricity productions for 2001 through 2021 were included. For projections to 2026, an annual growth factor was estimated using the last six years of installed power capacity.

Finally, NO<sub>x</sub> emissions reductions from *the installation of SEER 14 air conditioners in existing residences* are also reported.

### **Description of the Analysis Method**

Annual and Ozone Season Period (OSP) NO<sub>x</sub> emissions reductions were calculated for 2021 and integrated through 2026 using several factors to discount the potential savings. These factors include an annual degradation factor, a transmission, and distribution factor, a discount factor, and growth factors as shown in Table 1 and are described as follows:

*Annual degradation factor:* This factor was used to account for an assumed decrease in the performance of the measures installed as the equipment wears down and degrades. With the exception of electricity generated from renewables, an annual degradation factor of 2% was used for ESL Single-family, Multi-family, and Commercial programs and an annual degradation factor of 5% was used for all other programs<sup>3</sup>. The value of the 5% degradation factor was taken from a study by Kats et al. (1996).

*Transmission and distribution loss:* This factor adjusts the reported savings to account for the loss in energy resulting from the transmission and distribution of the power from the electricity producers to the electricity consumers. For this calculation, the energy savings reported at the consumer level are increased by 7% to give credit for the actual power produced that is lost in the transmission and distribution system on its way to the customer. In the case of electricity generated by renewables, the T&D losses were assumed to cancel out since renewable energy is displacing power produced by conventional power plants; therefore, there is no net increase or decrease in T&D losses.

*Initial discount factor:* This factor was used to discount the reported savings for any inaccuracies in the assumptions and methods employed in the calculation procedures. For the Laboratory's Single, Multi-family and Commercial program, the discount factor was assumed to be 20%. For PUC's Senate Bill 7 program, the discount factor was taken as 10%. For the savings in the SECO program, the discount factor was 30% for the estimations. For the electricity from renewables, the discount factor was taken as 5%. In addition, the discount factor for SEER 14 single-family and multi-family program was 20%.

*Growth factor:* The growth factors shown in Table 1 were used to account for several different factors. Growth factors for single-family (4.1%), multi-family residential (6.1%), and commercial (5.3%) construction are projections based on the average growth rate for these housing types from recent U.S. Census data for Texas. The growth factor for renewable energy (8.5%) is a linear projection based on the installed renewable power generation capacity in 2021 from the Public Utility Commission of Texas. No growth was assumed for PUC programs, SECO, and SEER 14 entries.

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<sup>3</sup> A degradation of 5% per year would accumulate as a 5%, 10%, 15%...etc, degradation in performance. Although the assumption of this high level of degradation may not actually occur, it was chosen as a conservative estimate. For renewable energy, a degradation factor of 0% was used. The choice of a 0% degradation factor for renewables is based on the most recent four years of analysis of measured wind data from all Texas wind farms that shows no degradation.



Figure 1 shows the overall information flow that was used to calculate the NO<sub>x</sub> emissions savings from the annual and OSP electricity savings (MWh) from all programs. For the Laboratory's single-family and multi-family code-implementation programs, the annual and OSP were calculated from DOE-2 hourly simulation models<sup>4</sup>. The base case is taken as the average characteristics of single-family and multi-family residences for Texas published the Home Innovation Research Labs (HIRL) based on the performance path of the 2015 IECC. The annual electricity savings from PUC's energy efficiency programs were calculated using PUC approved demand savings calculations and verification methods (PUC 2022). The SECO electricity savings were submitted as annual savings by project<sup>5</sup>. The electricity production from renewables in Texas was from the on-site metered data recorded at 15-minute intervals except for non-utility scale solar photovoltaic (PV) projects. The OSP consumption is the average daily consumption for the period between May 1 and September 30.

Integration of the savings from the different programs into a uniform format allowed for creditable NO<sub>x</sub> emissions to be evaluated using different criteria as shown in Table 1. These include evaluation across programs, evaluation across individual counties by program, evaluation by SIP area, and evaluation for all ERCOT counties except Houston/Galveston.

### Calculation Procedure

The electricity savings in this report were estimated based on the baseline year of 2018. In addition, the emissions reduction estimation throughout this report was updated to include the 2018 eGrid database, which is applied to the four different Competitive Load (CL) zones: Houston, North, West, and South as well as other counties in Texas. For all the programs, except renewable projects, the corresponding OSP emissions reductions were calculated using an annual daily average. The OSP emissions reductions from the electricity generated by renewables except non-utility scale solar PV and biomass projects were estimated by actual measured data.

*ESL Single-family and Multi-family.* The calculation of the annual electricity savings has been reported since 2002, which included the savings from code-compliant new housing in all 42 non-attainment and affected counties as reported in the Laboratory's annual report submitted by the Laboratory to the Texas Commission of Environmental Quality (TCEQ). From 2018 to 2021, based on year 2018, the annual electricity savings were calculated for new residential construction in all the counties in ERCOT region as well as other counties in Texas, which includes the 42 non-attainment and affected counties. These savings were then tabulated by county and program. Using the calculated values through 2021, savings were then projected to 2026 by incorporating the different adjustment factors mentioned above. In these calculations, it was assumed that the same amount of electricity savings from the code-compliant construction would be achieved for each year after 2021 through 2026<sup>6</sup>. The projected energy savings through 2026, according to county, were then divided into the CL zones in ERCOT as well as other counties in Texas in the 2018 eGRID. To determine which CL zone was to be used, or in counties with multiple CL zone, the allocation to each CL zone by county was obtained from CL zone's listing published in the Laboratory's 2019 annual report<sup>7</sup>.

<sup>4</sup> These values are based on a performance analysis as defined by Chapter 4 of the 2006, 2009 and 2015 IECC, plus the corresponding NAHB and HIRL data.

<sup>5</sup> The reporting requirements to the SECO did not require energy savings by project type, although for selected sites, energy savings by project type was available.

<sup>6</sup> This includes the appropriate discount and degradation factors for each year.

<sup>7</sup> Haberl et al., 2020, Annual Report Volume I, pp. 60.

For this 2021 annual NO<sub>x</sub> emissions calculations, the US EPA's 2018 eGRID was used. An example of the eGRID spreadsheet<sup>8</sup> is given in the Table 2. The total electricity savings for each CL zone as well as other counties in Texas were used to calculate the NO<sub>x</sub> emissions reductions for each of the different counties using the emissions factors contained in eGRID. Similar calculations were performed for each year for which the analysis was required.

*ESL-Commercial Buildings.* From 2018 to 2021, based on the year 2018, the annual electricity savings were calculated for new commercial construction by county<sup>9</sup>. Using the calculated savings through 2021, savings were then projected to 2026 by incorporating the different adjustment factors mentioned above<sup>10</sup>. In the projected annual electricity savings, it was assumed that the same 2021 amount of electricity savings would be achieved for each year through 2026. Finally, the projected energy saving numbers through 2026, by county, were allocated into the appropriate CL zones.

*PUC-Senate Bill 7.* For the PUC Senate Bill 7 program savings, the annual electricity savings for 2021 were obtained from the Public Utility Commission of Texas. Using these savings were projected through 2026 by incorporating the different adjustment factors mentioned above. Similar savings were assumed for each year after 2021 until 2026. The 2018 annual eGRID was used to calculate the NO<sub>x</sub> emissions savings for the PUC-Senate Bill 7 program. The total electricity savings for each CL zone were used to calculate the NO<sub>x</sub> emissions reductions for each county using the emissions factors contained in the US EPA's eGRID spreadsheet, which then were used to estimate the integrated NO<sub>x</sub> emissions reductions for each county.

*SECO Savings.* The annual electricity consumption reported by political subdivisions for 2021 was obtained from the State Energy Conservation Office (SECO). Using the reported consumption, the annual and OSP electricity savings resulted from energy conservation projects were then calculated. To achieve this, the annual energy use intensity (EUI) for each county was estimated and the county's energy savings for each year against the baseline year of 2018 were then calculated<sup>11</sup>. In addition, the savings through 2026 were projected using the different adjustment factors mentioned above. In a similar fashion to the previous programs, it was assumed that the same amount of electricity savings will be achieved for each year through 2026. The 2018 annual eGRID was also used to calculate the NO<sub>x</sub> emissions savings for the SECO program.

*Electricity Generated by Renewables.* The measured and estimated electricity production from renewables in Texas for 2018 through 2021 was obtained from the reports *Statewide Air Emissions Calculations from Wind and Other Renewables (2018-2022)* (Baltazar et al., 2019 - 2022). Using the reported numbers for 2021, savings through 2026 were projected incorporating the different adjustment factors mentioned above. The 2016 eGRID was used for the 2019, and the 2018 eGRID was used for the period of 2020 through 2026 to calculate the NO<sub>x</sub> emissions reductions for the electricity generated by renewables in Texas. The total electricity savings for

<sup>8</sup> To use this spreadsheet electricity savings for each eGRID zone is entered in the bottom row of the spreadsheet (MWh). The spreadsheet then allocates the MWh of electricity savings according to the counties (blue columns) where the CL zone owned and operated a power plant. Totals for all CL zones are then listed on the far right columns (white columns). Similar spreadsheets for the 2018 eGRID exist for SO<sub>x</sub> and CO<sub>2</sub>.

<sup>9</sup> These savings include new construction in office, education, retail, food, lodging and warehouse construction as defined by Dodge building type (Dodge 2011), using energy savings from the US DOE's report (USDOE 2014), and data from CBECS (1995 - 2012) and Dodge (2021).

<sup>10</sup> This also includes the appropriate discount and degradation factors for each year.

<sup>11</sup> In this report, EUI values were used to calculate the electricity savings. This calculation method was also applied to savings estimation for the previous years from 2018 to 2021.

each CL zone were used to calculate the NO<sub>x</sub> emissions reductions for each of the different counties.

*SEER 14 Single-Family and Multi-Family.* In January of 2006, Federal regulations mandated that the minimum efficiency for residential air conditioners be increased to SEER 13 from the previous SEER 10. In this analysis, it was assumed that an equal number of existing houses had their air conditioners replaced, as reported for 2006, by the air conditioner manufacturers<sup>12</sup>. In this report, the annual and OSP electricity savings were calculated for all the counties in ERCOT region, which include the 42 non-attainment and affected counties, were calculated. Based on the energy use and electricity generated for 2018, the savings after 2019 until 2026 were projected by incorporating the appropriate adjustment factors<sup>13</sup>. Similarly, Federal regulations mandated that the minimum efficiency for residential air conditioners be increased to SEER 14. The savings estimation considers the replacement of air-conditioning units by units with an efficiency of SEER 14 in existing residences that were built seventeen years ago<sup>14</sup>. The total SEER 14 electricity savings for each CL zone were used to calculate the NO<sub>x</sub> emissions reductions for each of the different counties using the emissions factors contained in the 2018 eGRID. Integrated NO<sub>x</sub> emissions reductions for each county by non-attainment and affected counties were also calculated.

## Results

The total integrated annual and OSP electricity savings for all the different programs in the integrated format were calculated for 2019 through 2026 as shown in Table 3, using the adjustment factors shown in Table 1. Annual and OSP NO<sub>x</sub> emissions reductions from the electricity savings for all the programs in the integrated format are shown in Table 4.

In 2021, the total integrated annual savings from all programs are 39,483,996 MWh/year. The integrated annual electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction are 538,354 MWh/year (1.4% of the total electricity savings),
- Savings from the PUC's Senate Bill 7 program are 376,958 MWh/year (1.0%),
- Savings from SECO's Senate Bill 5 program are 828,391 MWh/year (2.1%),
- Electricity savings from renewable power generation are 37,278,263 MWh/year (94.4%), and
- Savings from residential air conditioner retrofits<sup>15</sup> are 462,030 MWh/year (1.2%).

In 2021, the total integrated OSP savings from all programs are 187,558 MWh/day, which would be 7,815 MW average hourly load reduction during the OSP period. The integrated OSP electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction are 1,475 MWh/day (0.8%),

<sup>12</sup> In 2011, the U.S.DOE revised the energy conservation standards for residential HVAC systems. Beginning in January 2015, split-system central air conditioners installed in Texas must be at least SEER 14. NO<sub>x</sub> emissions reductions from SEER 14 replacement air conditioners will be included in future TERP reports as statewide sales data can be evaluated.

<sup>13</sup> Additional details about this calculation are contained in the Laboratory's 2008 Annual Report to the TCEQ, available at the ESL web site "<http://esl.tamu.edu/>".

<sup>14</sup> The "lifespan" of a central air conditioner is about 15 to 20 years. Department Of Energy (USDOE, 2021):

<https://www.energy.gov/energysaver/central-air-conditioning#:~:text=The%2022lifespan%22%20of%20a%20central,new%20standard%20goes%20into%20effect.>

<sup>15</sup> This assumes air conditioners in existing homes are replaced with the more efficient 14 units, versus an average of SEER 11, which is slightly more efficient than the previous minimum standard of SEER 10.

- Savings from the PUC's Senate Bill 7 programs are 1,033 MWh/day (0.6%),
- Savings from SECO's Senate Bill 5 program are 2,268 MWh/day (1.2%),
- Electricity savings from renewable power generation are 181,516 MWh/day (96.8%), and
- Savings from residential air conditioner retrofits are 1,266 MWh/day (0.7%).

By 2026, the total integrated annual savings from all programs will be 228,293,006 MWh/year. The integrated annual electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction will be 2,151,776 MWh/year (0.9% of the total electricity savings),
- Savings from the PUC's Senate Bill 7 program will be 1,155,231 MWh/year (0.5%),
- Savings from SECO's Senate Bill 5 program will be 1,950,433 MWh/year (0.9%),
- Electricity savings from renewable power generation will be 221,888,583 MWh/year (97.2%), and
- Savings from residential air conditioner retrofits will be 1,146,983 MWh/year (0.5%).

By 2026, the total integrated OSP savings from all programs will be 887,442 MWh/day, which would be 36,977 MW average hourly load reduction during the OSP. The integrated OSP electricity savings from all the different programs are:

- Savings from code-compliant residential and commercial construction will be 5,895 MWh/day (0.7%),
- Savings from the PUC's Senate Bill 7 programs will be 3,165 MWh/day (0.4%),
- Savings from SECO's Senate Bill 5 program will be 5,342 MWh/day (0.6%),
- Electricity savings from renewable power generation will be 869,897 MWh/day (98.0%), and
- Savings from residential air conditioner retrofits will be 3,142 MWh/day (0.4%).

In 2021 (Table 4), the total integrated annual NO<sub>x</sub> emissions reductions from all programs are 23,275 tons-NO<sub>x</sub>/year. The integrated annual NO<sub>x</sub> emissions reductions from all the different programs are:

- NO<sub>x</sub> emissions reductions from code-compliant residential and commercial construction are 225 tons-NO<sub>x</sub>/year (1.0% of the total NO<sub>x</sub> savings),
- NO<sub>x</sub> emissions reductions from the PUC's Senate Bill 7 programs are 141 tons-NO<sub>x</sub>/year (0.6%),
- NO<sub>x</sub> emissions reductions from SECO's Senate Bill 5 program are 341 tons-NO<sub>x</sub>/year (1.5%),
- NO<sub>x</sub> emissions reductions from renewable power generation are 22,385 tons-NO<sub>x</sub>/year (96.2%), and
- NO<sub>x</sub> emissions reductions from residential air conditioner retrofits are 183 tons-NO<sub>x</sub>/year (0.8%).

In 2021, the total integrated OSP NO<sub>x</sub> emissions reductions from all programs are 106.93 tons-NO<sub>x</sub>/day. The integrated OSP NO<sub>x</sub> emissions reductions from all the different programs are:

- NO<sub>x</sub> emissions reductions from code-compliant residential and commercial construction are 0.57 tons-NO<sub>x</sub>/day (0.5%),
- NO<sub>x</sub> emissions reductions from the PUC's Senate Bill 7 programs are 0.37 tons-NO<sub>x</sub>/day (0.3%),
- NO<sub>x</sub> emissions reductions from SECO's Senate Bill 5 program are 0.87 tons-NO<sub>x</sub>/day (0.8%),

- NO<sub>x</sub> emissions reductions from renewable power generation are 104.65 tons-NO<sub>x</sub>/day (97.9%), and
- NO<sub>x</sub> emissions reductions from residential air conditioner retrofits are 0.47 tons-NO<sub>x</sub>/day (0.4%).

By 2026, the total integrated annual NO<sub>x</sub> emissions reductions from all programs will be 139,621 tons-NO<sub>x</sub>/year. The integrated annual NO<sub>x</sub> emissions reductions from all the different programs are:

- NO<sub>x</sub> emissions reductions from code-compliant residential and commercial construction will be 892 tons-NO<sub>x</sub>/year (0.6% of the total NO<sub>x</sub> savings),
- NO<sub>x</sub> emissions reductions from the PUC's Senate Bill 7 programs will be 430 tons-NO<sub>x</sub>/year (0.3%),
- NO<sub>x</sub> emissions reductions from SECO's Senate Bill 5 program will be 819 tons-NO<sub>x</sub>/year (0.6%),
- NO<sub>x</sub> emissions reductions from renewable power generation will be 137,026 tons-NO<sub>x</sub>/year (98.1%), and
- NO<sub>x</sub> emissions reductions from residential air conditioner retrofits will be 455 tons-NO<sub>x</sub>/year (0.3%).

By 2026, the total integrated OSP NO<sub>x</sub> emissions reductions from all programs will be 515.87 tons-NO<sub>x</sub>/day. The integrated OSP NO<sub>x</sub> emissions reductions from all the different programs are:

- NO<sub>x</sub> emissions reductions from code-compliant residential and commercial construction will be 2.27 tons-NO<sub>x</sub>/day (0.4%),
- NO<sub>x</sub> emissions reductions from the PUC's Senate Bill 7 programs will be 1.11 tons-NO<sub>x</sub>/day (0.2%),
- NO<sub>x</sub> emissions reductions from SECO's Senate Bill 5 program will be 2.1 tons-NO<sub>x</sub>/day (0.4%),
- NO<sub>x</sub> emissions reductions from renewable power generation will be 509.21 tons-NO<sub>x</sub>/day (98.7%), and
- NO<sub>x</sub> emissions reductions from residential air conditioner retrofits will be 1.17 tons-NO<sub>x</sub>/day (0.2%).

## Summary

This Summary report presents the NO<sub>x</sub> emissions reductions from the energy-efficiency programs from multiple Texas State Agencies working under Senate Bill 5 and Senate Bill 7 in a uniform format to allow the TCEQ to consider the combined savings for Texas' State Implementation Plan (SIP) planning purposes. This required that the analysis should include the integrated savings estimation from all projects projected through 2026 for both the annual and OSP NO<sub>x</sub> reductions. The NO<sub>x</sub> emissions reductions from all these programs were calculated using estimated emissions factors for 2018 from the US Environmental Protection Agency (US EPA) eGRID database, which had been specially prepared for this purpose.

In 2021, the integrated total electricity savings from all programs are:

- Annual electricity savings is 39,483,996 MWh/year (23,275 tons-NO<sub>x</sub>/year) and
- OSP electricity savings are 187,558 MWh/day, which would be 7,815 MW average hourly load reduction during the OSP period (106.93 tons-NO<sub>x</sub>/day).

By 2026, the integrated total electricity savings from all programs are forecasted to be:

- Annual electricity savings 228,293,006 MWh/year (139,621 tons-NO<sub>x</sub>/year) and
- OSP electricity savings 887,442 MWh/day, which would be equivalent to 36,977 MW average hourly load reduction during the OSP period (515.87 tons-NO<sub>x</sub>/day).

The Laboratory has and will continue to provide leading-edge technical assistance to counties and communities working toward obtaining full SIP credit for the energy efficiency and renewable energy projects that are lowering NO<sub>x</sub> emissions and improving the air quality for all Texans. The Laboratory will continue to provide superior technology to the State of Texas through efforts with the TCEQ and US EPA. The efforts taken by the Laboratory have produced significant success in bringing EE/RE closer to US EPA acceptance in the SIP for Texas.

If any questions arise, please contact us by phone at 979-845-9213.

Table 1: Final Adjustment Factors used for the Calculation of the Annual and OSP NOx Savings for the Different Programs

	ESL-Single Family	ESL-Multifamily	ESL-Commercial	PUC (SB7)	SECO	Renewables-ERCOT	SEER 14 Single Family	SEER 14 Multi Family
Annual Degradation Factor	2.0%	2.0%	2.0%	5.0%	5.0%	0.0%	5.0%	5.0%
T&D Loss	7.0%	7.0%	7.0%	7.0%	7.0%	0.0%	7.0%	7.0%
Initial Discount Factor	20.0%	20.0%	20.0%	10.0%	30.0%	5.0%	20.0%	20.0%
Growth Factor	4.1%	6.1%	5.3%	0.0%	0.0%	8.5%*	N.A.*	N.A.*
Weather Normalized	Yes	Yes	Yes	No	No	No	Yes	Yes

Notes: \* SEER 14 growth is based on the past permits of the recent seventeen years. Renewable projects have different growth factor for each type.

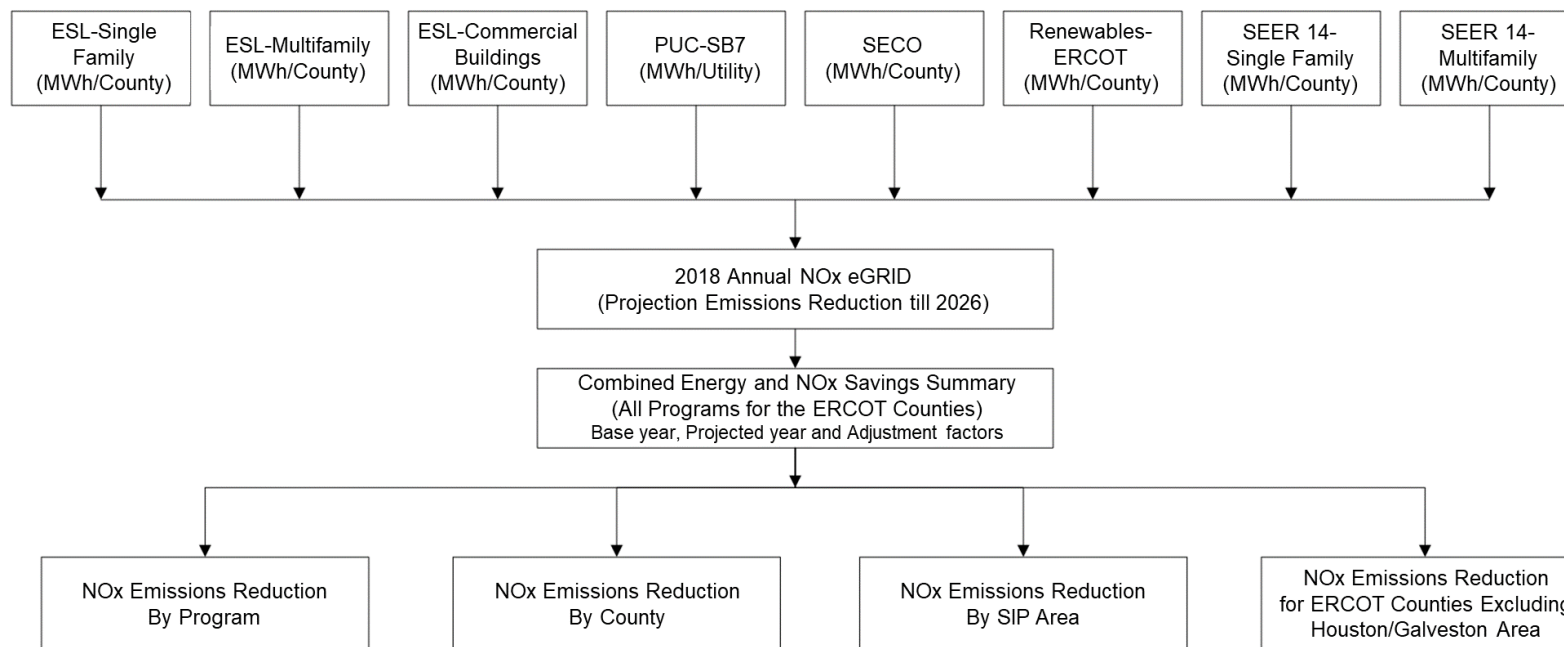


Figure 1: Process Flow Diagram of the NOx Emissions Reduction Calculations





*Table 3: Integrated Annual and OSP Electricity Savings for the Different Programs (Base Year 2018)*

PROGRAM	ANNUAL (MWh)								
	2018	2019	2020	2021	2022	2023	2024	2025	2026
ESL-Single Family	0	0	74,850	158,185	243,332	330,396	419,488	510,722	604,216
ESL-Multifamily	0	0	175,080	380,168	593,879	816,815	1,049,617	1,292,959	1,547,560
ESL-Commercial	0	0	0	0	0	0	0	0	0
PUC (SB7)	0	83,347	195,887	376,958	548,976	712,392	867,638	1,015,122	1,155,231
SECO	0	359,121	567,339	828,391	1,076,390	1,311,989	1,535,808	1,748,437	1,950,433
Renewables-ERCOT	0	4,091,723	22,537,959	37,278,263	48,106,652	65,434,397	93,882,613	141,434,510	221,888,583
SEER14-Single Family	0	60,071	181,188	356,259	599,673	820,221	883,003	875,735	863,529
SEER14-Multi Family	0	33,152	74,374	105,771	139,362	186,930	243,587	287,869	283,454
<b>Total Annual (MWh)</b>	<b>0</b>	<b>4,627,414</b>	<b>23,806,679</b>	<b>39,483,996</b>	<b>51,308,263</b>	<b>69,613,140</b>	<b>98,881,754</b>	<b>147,165,354</b>	<b>228,293,006</b>

PROGRAM	OZONE SEASON PERIOD - OSP (MWh/day)								
	2018	2019	2020	2021	2022	2023	2024	2025	2026
ESL-Single Family	0	0	205	433	667	905	1,149	1,399	1,655
ESL-Multifamily	0	0	480	1,042	1,627	2,238	2,876	3,542	4,240
ESL-Commercial	0	0	0	0	0	0	0	0	0
PUC (SB7)	0	228	537	1,033	1,504	1,952	2,377	2,781	3,165
SECO	0	984	1,553	2,268	2,947	3,593	4,206	4,789	5,342
Renewables-ERCOT	0	114,596	150,844	181,516	224,490	291,205	398,333	574,655	869,897
SEER14-Single Family	0	165	496	976	1,643	2,247	2,419	2,399	2,366
SEER14-Multi Family	0	91	204	290	382	512	667	789	777
<b>Total OSP (MWh)</b>	<b>0</b>	<b>116,063</b>	<b>154,318</b>	<b>187,558</b>	<b>233,260</b>	<b>302,653</b>	<b>412,028</b>	<b>590,354</b>	<b>887,442</b>

Note: 2022-2026 are projections.

*Table 4: Integrated Annual and OSP NO<sub>x</sub> Emissions Reduction Values for the Different Programs (Base Year 2018)*

PROGRAM	ANNUAL (in tons NO <sub>x</sub> )								
	2018	2019	2020	2021	2022	2023	2024	2025	2026
ESL-Single Family	0	0	31	66	101	137	174	212	249
ESL-Multifamily	0	0	73	159	248	341	438	540	643
ESL-Commercial	0	0	0	0	0	0	0	0	0
PUC (SB7)	0	25	74	141	205	265	323	378	430
SECO	0	121	230	341	447	547	642	733	819
Renewables-ERCOT	0	1,800	13,849	22,385	29,062	39,788	57,446	87,019	137,026
SEER14-Single Family	0	20	74	143	241	329	354	352	347
SEER14-Multi Family	0	10	27	40	55	72	93	109	108
<b>Total Annual (Tons NO<sub>x</sub>)</b>	<b>0</b>	<b>1,975</b>	<b>14,358</b>	<b>23,275</b>	<b>30,358</b>	<b>41,480</b>	<b>59,471</b>	<b>89,343</b>	<b>139,621</b>

PROGRAM	OZONE SEASON PERIOD - OSP (in tons NO <sub>x</sub> /day)								
	2018	2019	2020	2021	2022	2023	2024	2025	2026
ESL-Single Family	0.00	0.00	0.08	0.16	0.25	0.34	0.43	0.53	0.62
ESL-Multifamily	0.00	0.00	0.19	0.41	0.64	0.88	1.13	1.39	1.65
ESL-Commercial	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PUC (SB7)	0.00	0.07	0.19	0.37	0.53	0.69	0.84	0.98	1.11
SECO	0.00	0.35	0.59	0.87	1.14	1.40	1.65	1.88	2.10
Renewables-ERCOT	0.00	60.45	88.21	104.65	129.77	168.87	231.77	335.44	509.21
SEER14-Single Family	0.00	0.06	0.19	0.37	0.62	0.85	0.91	0.91	0.89
SEER14-Multi Family	0.00	0.03	0.07	0.10	0.14	0.19	0.24	0.29	0.28
<b>Total OSP (Tons NO<sub>x</sub>)</b>	<b>0.00</b>	<b>60.96</b>	<b>89.52</b>	<b>106.93</b>	<b>133.10</b>	<b>173.21</b>	<b>236.97</b>	<b>341.41</b>	<b>515.87</b>

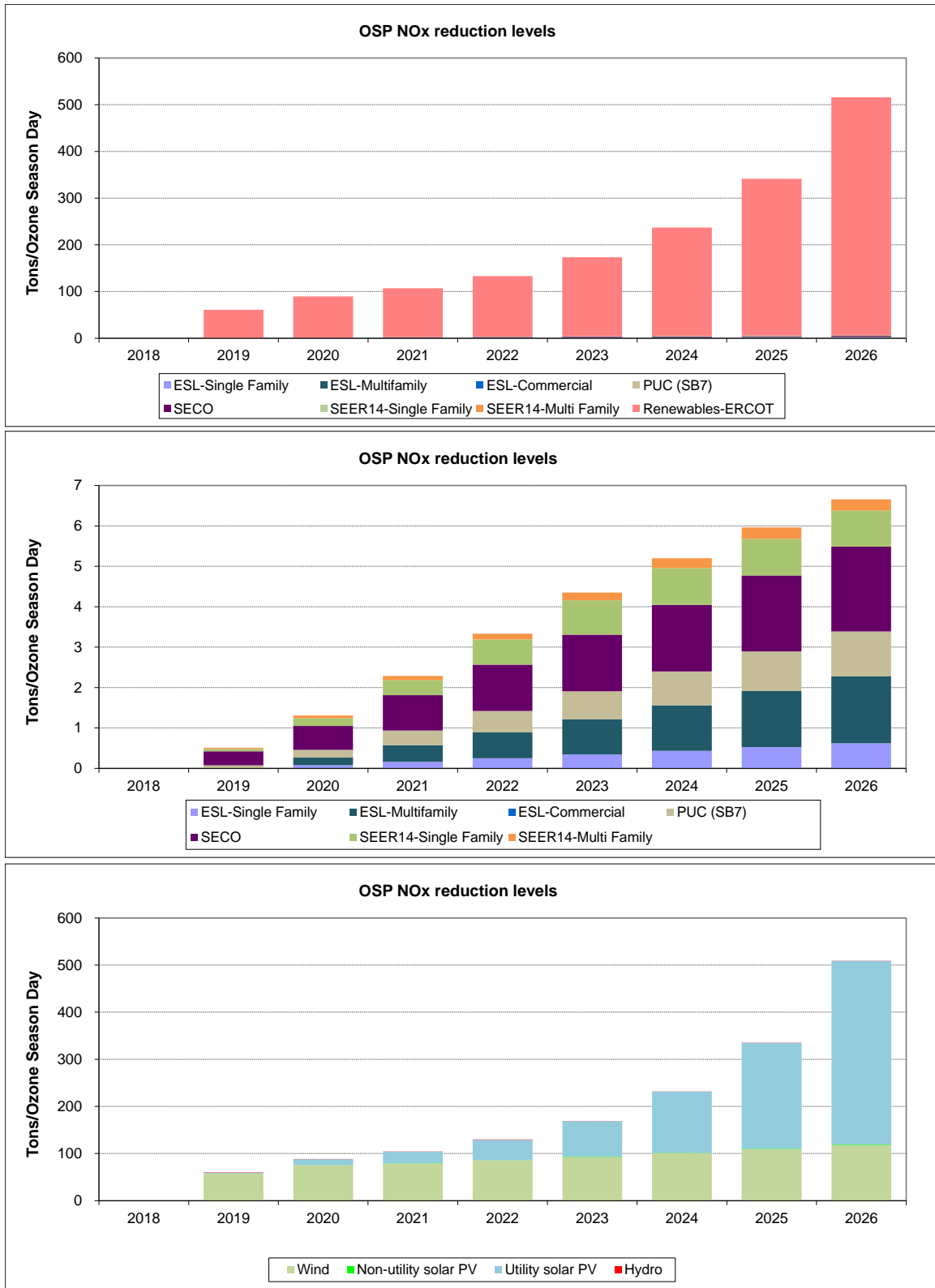


Figure 2: Integrated OSP NOx Emissions Reduction Projections through 2026. (Upper plot) all programs, (middle plot) all programs except Renewables, (lower plot) Renewables.

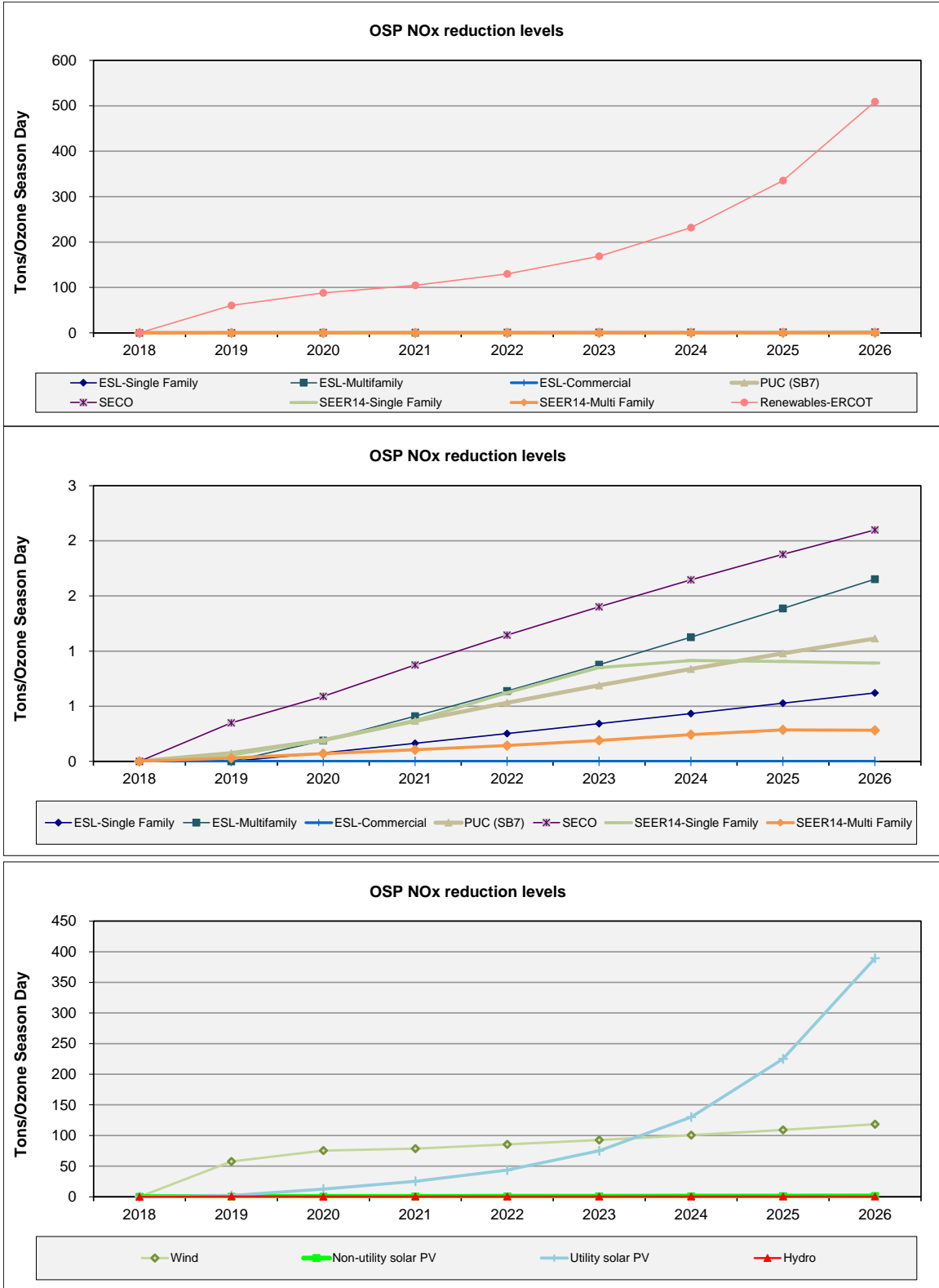


Figure 3: Integrated OSP Individual Programs NOx Emissions Reduction Projections through 2026. (Upper plot) all programs, (middle plot) all programs except Renewables, (lower plot) Renewables.

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