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

VOLUME II—TECHNICAL APPENDIX

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

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TEES | ENERGY SYSTEMS LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

TEXAS A&M ENGINEERING EXPERIMENT STATION
Energy Systems Laboratory

October 24, 2022

Mr. David Serrins
Mobile Source Programs Team Leader
Air Quality Division, Office of Air
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 its annual report, "Energy Efficiency/Renewable Energy Impact in the Texas Emissions Reduction Plan (TERP)," as required under Texas Health and Safety Code 386.205, 386.252, 388.006, 389.003 (e), and under Texas Utilities Code Sec. 39.9051 (g) (h), and Sec. 39.9052 (c) (d).

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 reduction from energy efficiency and renewable energy measures as a result of the TERP implementation.

Sincerely,

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

Enclosure

Disclaimer

This report is provided by the Energy Systems Laboratory of the Texas A&M Engineering Experiment Station (TEES) as required under 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. The information provided in this report is intended to be the best available information at the time of publication. TEES makes no claim or warranty, express or implied, that the report or data herein is necessarily error-free. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not constitute or imply its endorsement, recommendation, or favoring by the Energy Systems Laboratory or any of its employees. The views and opinions of authors expressed herein do not necessarily state or reflect those of the Texas A&M Engineering Experiment Station or the Energy Systems Laboratory.

VOLUME II – APPENDIX

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

1 EXECUTIVE SUMMARY

The Energy Systems Laboratory (Laboratory), a division of the Texas A&M Engineering Experiment Station and a member of The Texas A&M University System, in fulfillment of its responsibilities under 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, submits its annual report, Energy Efficiency/Renewable Energy (EE/RE) Impact in the Texas Emissions Reduction Plan (TERP) to the Texas Commission on Environmental Quality.

The report is organized in two volumes:

- Volume I – Technical Report – provides a detailed report of activities, methodologies and findings, including an executive summary and overview.
- Volume II – Technical Appendix – contains detailed data from simulations for each of the counties included in the analysis.

Accomplishments are as follow:

1.1 Energy Code Amendments

The Laboratory was requested by several Council of Governments (COGs) and municipalities to analyze the stringency of several proposed residential and commercial energy code amendments, including: the 2015 IECC and the ASHRAE Standards 90.1-2013. Results of the analysis are included in the Volume I – Technical Report.

1.2 Technical Assistance

The Laboratory provided technical assistance to the TCEQ, PUCT, SECO, ERCOT, and several political subdivisions, as well as Stakeholders participating in improving the compliance of the Texas Building Energy Performance Standards (TBEPS). The Laboratory also worked closely with the TCEQ to refine the integrated NOx emissions reduction calculation procedures that provide the TCEQ with a standardized, creditable NOx emissions reduction from energy efficiency and renewable energy (EE/RE) programs, which are acceptable to the US EPA. These activities have improved the accuracy of the creditable NOx emissions reduction from EE/RE initiatives contained in the TERP and have assisted the TCEQ, local governments, and the building industry with effective, standardized implementation and reporting.

1.3 NOx Emissions Reduction

Under the TERP legislation, the Laboratory must determine the energy savings from energy code adoption and, when applicable, from more stringent local codes or above-code performance ratings and must report these reductions annually to the TCEQ. Figure 1.1 shows the integrated NOx emissions reduction through 2026 for the electricity and natural gas savings from the various EE/RE programs.

In 2021, the annual NOx emissions reduction from code-compliant residential and commercial construction is calculated to be 225 tons-NOx/year (1.0% of the total NOx savings), savings from the PUC's Senate Bill 7 programs will be 141 tons-NOx/year (0.6%), savings from SECO's Senate Bill 5 program will be 341 tons-NOx/year (1.5%), electricity savings from green power purchases (wind) will be 22,385 tons-

NOx/year (96.2%), and savings from residential air conditioner retrofits will be 183 tons-NOx/year (0.8%). The total annual NOx emissions reduction from all programs will be 23,275 tons-NOx/year.

By 2026, the annual NOx emissions reduction from code-compliant residential and commercial construction is calculated to be 892 tons-NOx/year (0.6% of the total NOx savings), savings from the PUC's Senate Bill 7 programs is 430 tons-NOx/year (0.3%), savings from SECO's Senate Bill 5 program is 819 tons-NOx/year (0.6%), electricity savings from green power purchases (wind) are 137,026 tons-NOx/year (98.1%), and savings from residential air conditioner retrofits are 455 tons-NOx/year (0.3%). The total annual NOx emissions reduction from all programs is 139,621 tons-NOx/year.

In 2021, the Ozone Season Period (OSP) NOx emissions reduction from code-compliant residential and commercial construction is calculated to be 0.57 tons-NOx/day (0.5%), savings from the PUC's Senate Bill 7 programs will be 0.37 tons-NOx/day (0.3%), savings from SECO's Senate Bill 5 program will be 0.87 tons-NOx/day (0.8%), electricity savings from green power purchases (wind) will be 104.65 tons-NOx/day (97.9%), and savings from residential air conditioner retrofits will be 0.47 tons-NOx/day (0.4%). The total OSP NOx emissions reduction from all programs will be 106.93 tons-NOx/day.

By 2026, the OSP NOx emissions reduction from code-compliant residential and commercial construction is calculated to be 2.27 tons-NOx/day (0.4%), savings from the PUC's Senate Bill 7 programs will be 1.11 tons-NOx/day (0.2%), savings from SECO's Senate Bill 5 program will be 2.1 tons-NOx/day (0.4%), electricity savings from green power purchases (wind) will be 509.21 tons-NOx/day (98.7%), and savings from residential air conditioner retrofits will be 1.17 tons-NOx/day (0.2%). The total OSP NOx emissions reduction from all programs will be 515.87 tons-NOx/day.

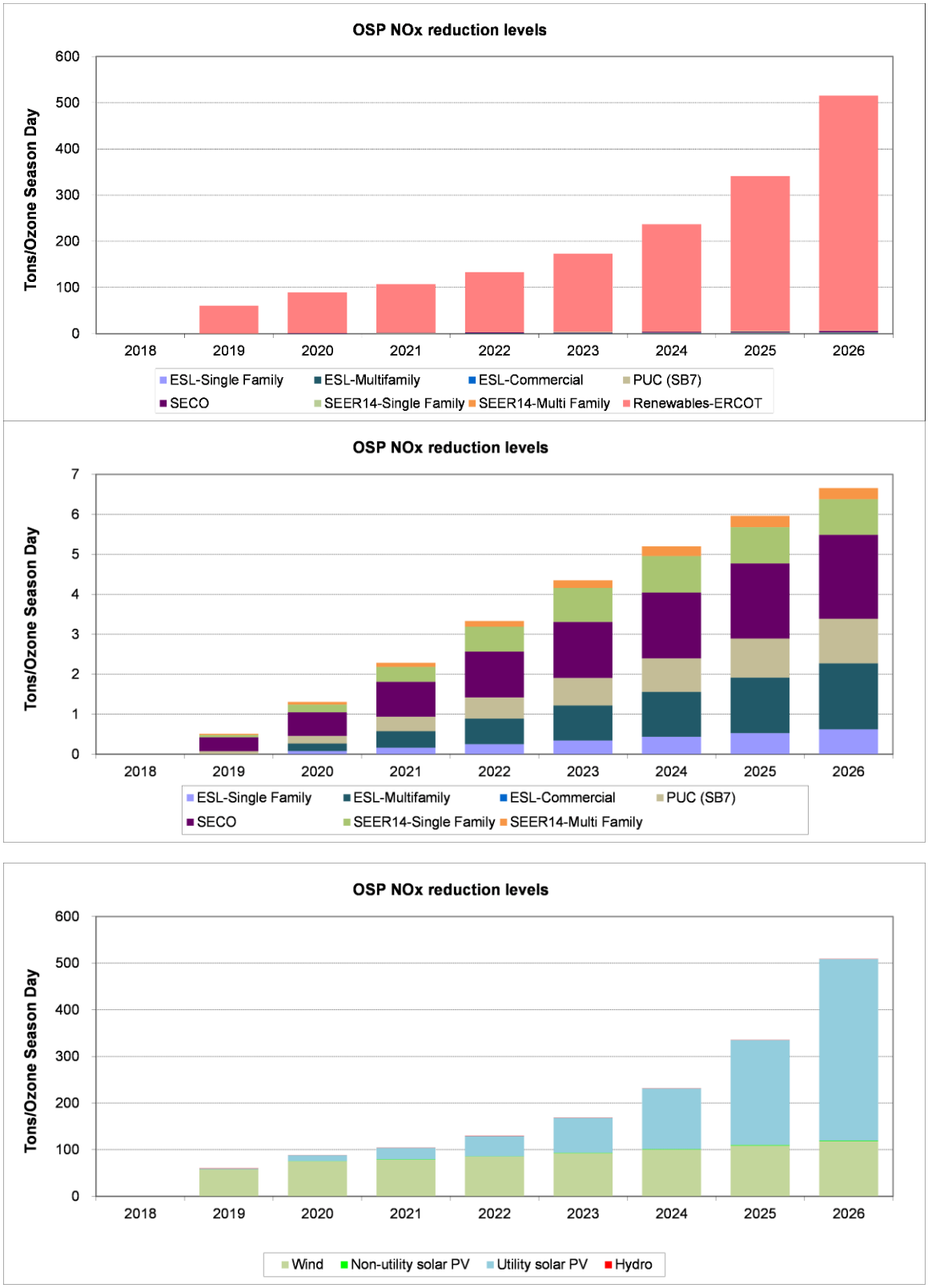

Figure 1.1: Integrated OSP NOx Emissions Reduction Projections through 2026. (Upper plot) all programs, (middle plot) all programs except Renewables, (lower plot) Renewables.

1.4 Technology Transfer

The Laboratory, along with the TCEQ, is host to the annual Clean Air Through Energy Efficiency (CATEE) – Texas Energy Summit conference, which is attended by top experts and policy makers in Texas and from around the country. At the conference the latest educational programs and technology are presented and discussed, including efforts by the Laboratory, and others, to reduce air pollution in Texas through energy efficiency and renewable energy. These efforts have produced significant success in bringing EE/RE closer to US EPA acceptance in the Texas SIP. The Laboratory will continue to provide superior technology to the State of Texas through such efforts with the TCEQ and the US EPA.

To accelerate the transfer of technology developed as part of the TERP, the Laboratory has also made presentations at national, state, and local meetings and conferences, which include the publications of peer-reviewed papers. The Laboratory will continue to provide technical assistance to the TCEQ, counties and communities working toward obtaining full SIP credit for the energy efficiency and renewable energy projects that are lowering emissions and improving the air quality for all Texans.

These efforts have been recognized nationally by the US EPA. In 2007, the Laboratory was awarded a National Center of Excellence on Displaced Emissions Reduction (CEDER) by the US EPA so that these accomplishments could be rapidly disseminated to other states for their use. The benefits of CEDER include reducing the financial, technical, and administrative costs of determining the emissions reduction from EE/RE measures; continuing to accelerate implementation of EE/RE strategies as a viable clean air effort in Texas and other states; helping other states better identify and prioritize cost-effective clean air strategies from EE/RE, and communicating the results of quantification efforts through case-studies and a clearinghouse of information.

The Laboratory will continue to provide technical assistance to the TCEQ, counties and communities working toward obtaining full SIP credit for the energy efficiency and renewable energy projects that are lowering emissions and improving the air quality for all Texans.

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

ACKNOWLEDGEMENTS

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.

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2 CODE AND PRE-CODE SIMULATION RESULTS BY COUNTY

This appendix to the Laboratory's 2021 annual report contains the simulation results for single-family and multi-family residences in the 254 counties. For each county, code and pre-code simulation, and annual results for individual residence are provided (Single-family and Multi-family).

For each county, pre-code and code simulation, and annual results, for 2018 base year, for individual Single-family and Multi-family residences can be viewed using the links provided in Table 1. Some simulations were performed with one representative county in the same climate zone. The annual savings for each county were calculated using the simulation results for the representative county for the same climate zone and number of houses.

The files included in Table 1 can be obtained upon request, please contact the Energy Systems Laboratory. An example of the files that can be provided are shown in Figure 2.1 that presents the simulation results of Annual and OSP energy usages of Bastrop County; Figure 2.2 shows annual and OSP energy savings of the single-family for Bastrop County in 2021. Figure 2.3 shows annual and OSP energy savings of the multi-family for Bastrop County in 2021.

Table 1: Simulation Results for Individual Single Family and Multi Family Residences for All Counties.[1]

	Non-attainment Counties (*Representative counties)	**2021**		
*	BEXAR	Summary	Single Family	Multifamily
**	FREESTONE	Summary	Single Family	Multifamily
	NAVARRO		Single Family	Multifamily
**	HUTCHINSON	Summary	Single Family	Multifamily
**	HOWARD	Summary	Single Family	Multifamily
	PANOLA	Summary	Single Family	Multifamily
*	RUSK		Single Family	Multifamily
	ANDERSON		Single Family	Multifamily
*	TITUS	Summary	Single Family	Multifamily
*	BRAZORIA	Summary	Single Family	Multifamily
*	CHAMBERS	Summary	Single Family	Multifamily
*	COLLIN	Summary	Single Family	Multifamily
	WISE		Single Family	Multifamily
*	DALLAS	Summary	Single Family	Multifamily
*	DENTON	Summary	Single Family	Multifamily
*	EL PASO	Summary	Single Family	Multifamily
*	ELLIS	Summary	Single Family	Multifamily
*	FORT BEND	Summary	Single Family	Multifamily
*	GALVESTON	Summary	Single Family	Multifamily
*	HARRIS	Summary	Single Family	Multifamily
*	JOHNSON	Summary	Single Family	Multifamily
*	KAUFMAN	Summary	Single Family	Multifamily
*	LIBERTY	Summary	Single Family	Multifamily
*	MONTGOMERY	Summary	Single Family	Multifamily
*	PARKER	Summary	Single Family	Multifamily
*	ROCKWALL	Summary	Single Family	Multifamily
*	TARRANT	Summary	Single Family	Multifamily
*	WALLER	Summary	Single Family	Multifamily
	Other Texas Counties (*Representative counties)			
*	HAYS	Summary	Single Family	Multifamily
*	NUECES	Summary	Single Family	Multifamily
*	SAN PATRICIO	Summary	Single Family	Multifamily
*	SMITH	Summary	Single Family	Multifamily
*	TRAVIS	Summary	Single Family	Multifamily
*	UPSHUR	Summary	Single Family	Multifamily
*	VICTORIA	Summary	Single Family	Multifamily
*	WILLIAMSON	Summary	Single Family	Multifamily
*	WILSON	Summary	Single Family	Multifamily

Note: **The representative county for Freestone and Navarro is Bell, for Hutchinson is Briscoe, and for Howard is Ector.

[1] Table 1 contains the list of simulation results that are compiled by the Laboratory each year for the TERP report. These include over 70 megabytes of files of results that contain the results of the simulations. These files are available upon request.

Table 1: Simulation Results for Individual Single Family and Multi Family Residences for All Counties (Continues)

	Other Texas Counties (*Representative counties)	**2021**		
*	COLEMAN	Summary	Single Family	Multifamily
	CALLAHAN		Single Family	Multifamily
	EASTLAND		Single Family	Multifamily
	ERATH		Single Family	Multifamily
	FISHER		Single Family	Multifamily
	HASKELL		Single Family	Multifamily
	JACK		Single Family	Multifamily
	JONES		Single Family	Multifamily
	MITCHELL	Summary	Single Family	Multifamily
	NOLAN		Single Family	Multifamily
	PALO PINTO		Single Family	Multifamily
	SHACKELFORD		Single Family	Multifamily
	STEPHENS		Single Family	Multifamily
*	TAYLOR		Single Family	Multifamily
	THROCKMORTON		Single Family	Multifamily
	YOUNG		Single Family	Multifamily
*	LEON	Summary	Single Family	Multifamily
	TRINITY		Single Family	Multifamily
*	CALDWELL	Summary	Single Family	Multifamily
*	BELL		Single Family	Multifamily
	BOSQUE		Single Family	Multifamily
	BROWN		Single Family	Multifamily
	COMANCHE		Single Family	Multifamily
	CORYELL		Single Family	Multifamily
	FALLS	Summary	Single Family	Multifamily
	HAMILTON		Single Family	Multifamily
	HILL		Single Family	Multifamily
	LAMPASAS		Single Family	Multifamily
	LIMESTONE		Single Family	Multifamily
	MCLENNAN		Single Family	Multifamily
	MILLS		Single Family	Multifamily
*	GUADALUPE	Summary	Single Family	Multifamily
	ARMSTRONG		Single Family	Multifamily
	BAILEY		Single Family	Multifamily
*	BRISCOE		Single Family	Multifamily
	CARSON		Single Family	Multifamily
	CASTRO		Single Family	Multifamily
	COCHRAN	Summary	Single Family	Multifamily
	DALLAM		Single Family	Multifamily
	DEAF SMITH		Single Family	Multifamily
	DONLEY		Single Family	Multifamily
	FLOYD		Single Family	Multifamily

Table 1: Simulation Results for Individual Single Family and Multi Family Residences for All Counties (Continues)

	Other Texas Counties (*Representative counties)	**2021**		
	GRAY		Single Family	Multifamily
	HALE		Single Family	Multifamily
	HANSFORD		Single Family	Multifamily
	HARTLEY		Single Family	Multifamily
	HOCKLEY		Single Family	Multifamily
	LAMB		Single Family	Multifamily
	LIPSCOMB		Single Family	Multifamily
	MOORE		Single Family	Multifamily
	OCHILTREE		Single Family	Multifamily
	OLDHAM		Single Family	Multifamily
	PARMER		Single Family	Multifamily
	RANDALL		Single Family	Multifamily
	ROBERTS		Single Family	Multifamily
	SHERMAN		Single Family	Multifamily
	SWISHER		Single Family	Multifamily
	YOAKUM		Single Family	Multifamily
*	GREGG	Summary	Single Family	Multifamily
	COLLINGSWORTH		Single Family	Multifamily
*	HALL	Summary	Single Family	Multifamily
	HEMPHILL		Single Family	Multifamily
	WHEELER		Single Family	Multifamily
*	BASTROP		Single Family	Multifamily
	CALDWELL	Summary	Single Family	Multifamily
	LEE		Single Family	Multifamily
	BLANCO		Single Family	Multifamily
	BURNET		Single Family	Multifamily
	GILLESPIE		Single Family	Multifamily
	KERR		Single Family	Multifamily
	REAL		Single Family	Multifamily
	HAYS	Summary	Single Family	Multifamily
	LLANO		Single Family	Multifamily
	MASON		Single Family	Multifamily
	SAN SABA		Single Family	Multifamily
*	TRAVIS		Single Family	Multifamily
	WILLIAMSON		Single Family	Multifamily
*	CHAMBERS	Summary	Single Family	Multifamily
	BROOKS		Single Family	Multifamily
	CAMERON		Single Family	Multifamily
*	HIDALGO	Summary	Single Family	Multifamily
	KENEDY		Single Family	Multifamily
	STARR		Single Family	Multifamily
	WILLACY		Single Family	Multifamily

Table 1: Simulation Results for Individual Single Family and Multi Family Residences for All Counties (Continues)

	Other Texas Counties (*Representative counties)	**2021**		
	JIM HOGG	Summary	Single Family	Multifamily
*	ZAPATA		Single Family	Multifamily
*	KLEBERG	Summary	Single Family	Multifamily
	ARANSAS	Summary	Single Family	Multifamily
*	NUECES		Single Family	Multifamily
	DUVAL		Single Family	Multifamily
	JIM WELLS		Single Family	Multifamily
	LIVE OAK		Single Family	Multifamily
	SAN PATRICIO		Single Family	Multifamily
	DIMMIT	Summary	Single Family	Multifamily
	LA SALLE		Single Family	Multifamily
	MAVERICK		Single Family	Multifamily
	MCMULLEN		Single Family	Multifamily
*	WEBB		Single Family	Multifamily
	ZAVALA		Single Family	Multifamily
	HENDERSON	Summary	Single Family	Multifamily
*	SMITH		Single Family	Multifamily
*	DALLAS	Summary	Single Family	Multifamily
	ELLIS		Single Family	Multifamily
	HOOD		Single Family	Multifamily
	JOHNSON		Single Family	Multifamily
	SOMERVELL		Single Family	Multifamily
	TARRANT		Single Family	Multifamily
	BOWIE	Summary	Single Family	Multifamily
	CAMP		Single Family	Multifamily
	CASS		Single Family	Multifamily
	LAMAR		Single Family	Multifamily
	MORRIS		Single Family	Multifamily
	RED RIVER		Single Family	Multifamily
	The simulation results of this group of counties are based on Titus County.			
*	COLLIN	Summary	Single Family	Multifamily
	DELTA		Single Family	Multifamily
	DENTON		Single Family	Multifamily
	FRANKLIN		Single Family	Multifamily
	HOPKINS		Single Family	Multifamily
	KAUFMAN		Single Family	Multifamily
	PARKER		Single Family	Multifamily
	RAINS		Single Family	Multifamily
	ROCKWALL		Single Family	Multifamily
	VAN ZANDT		Single Family	Multifamily
	WISE		Single Family	Multifamily
*	CULBERSON	Summary	Single Family	Multifamily

Table 1: Simulation Results for Individual Single Family and Multi Family Residences for All Counties (Continues)

	Other Texas Counties (*Representative counties)	**2021**		
*	HUDSPETH		Single Family	Multifamily
*	BASTROP	Summary	Single Family	Multifamily
	ANGELINA		Single Family	Multifamily
	CHEROKEE		Single Family	Multifamily
	HOUSTON		Single Family	Multifamily
	NACOGDOCHES	Summary	Single Family	Multifamily
	SABINE		Single Family	Multifamily
	SAN AUGUSTINE		Single Family	Multifamily
	SHELBY		Single Family	Multifamily
	The simulation results of this group of counties are based on Rusk County.			
*	HARRISON	Summary	Single Family	Multifamily
	BRAZORIA	Summary	Single Family	Multifamily
*	GALVESTON		Single Family	Multifamily
	AUSTIN		Single Family	Multifamily
	BRAZOS		Single Family	Multifamily
	BURLESON		Single Family	Multifamily
	COLORADO		Single Family	Multifamily
	FAYETTE		Single Family	Multifamily
	FORT BEND		Single Family	Multifamily
	GRIMES		Single Family	Multifamily
*	HARRIS	Summary	Single Family	Multifamily
	MADISON		Single Family	Multifamily
	MONTGOMERY		Single Family	Multifamily
	ROBERTSON		Single Family	Multifamily
	WALKER		Single Family	Multifamily
	WALLER		Single Family	Multifamily
	WASHINGTON		Single Family	Multifamily
*	MILAM	Summary	Single Family	Multifamily
	BORDEN		Single Family	Multifamily
	CHILDRESS		Single Family	Multifamily
	CROSBY		Single Family	Multifamily
	DAWSON		Single Family	Multifamily
	DICKENS		Single Family	Multifamily
	GARZA		Single Family	Multifamily
	KENT		Single Family	Multifamily
	KING	Summary	Single Family	Multifamily
	LUBBOCK		Single Family	Multifamily
	LYNN		Single Family	Multifamily
	MOTLEY		Single Family	Multifamily
*	SCURRY		Single Family	Multifamily
	STONEWALL		Single Family	Multifamily
	TERRY		Single Family	Multifamily

Table 1: Simulation Results for Individual Single Family and Multi Family Residences for All Counties (Continues)

	Other Texas Counties (*Representative counties)	**2021**		
*	CRANE		Single Family	Multifamily
	REAGAN	Summary	Single Family	Multifamily
	UPTON		Single Family	Multifamily
	COMAL	Summary	Single Family	Multifamily
	ANDREWS		Single Family	Multifamily
*	ECTOR		Single Family	Multifamily
	GAINES		Single Family	Multifamily
	GLASSCOCK		Single Family	Multifamily
	JEFF DAVIS		Single Family	Multifamily
	LOVING		Single Family	Multifamily
	MARTIN		Single Family	Multifamily
	MIDLAND		Single Family	Multifamily
	REEVES		Single Family	Multifamily
	WARD		Single Family	Multifamily
	WINKLER		Single Family	Multifamily
*	ATASCOSA	Summary	Single Family	Multifamily
	FRIO		Single Family	Multifamily
*	BEXAR		Single Family	Multifamily
	COMAL		Single Family	Multifamily
	GONZALES		Single Family	Multifamily
	GUADALUPE		Single Family	Multifamily
	KINNEY	Summary	Single Family	Multifamily
	MEDINA		Single Family	Multifamily
	UVALDE		Single Family	Multifamily
	VAL VERDE		Single Family	Multifamily
	WILSON		Single Family	Multifamily
	BANDERA	Summary	Single Family	Multifamily
*	KENDALL		Single Family	Multifamily
	BREWSTER		Single Family	Multifamily
	EDWARDS		Single Family	Multifamily
	KIMBLE		Single Family	Multifamily
	PECOS		Single Family	Multifamily
	PRESIDIO		Single Family	Multifamily
	SUTTON		Single Family	Multifamily
	TERRELL		Single Family	Multifamily
	CONCHO	Summary	Single Family	Multifamily
	CROCKETT		Single Family	Multifamily
	IRION		Single Family	Multifamily
	MCCULLOCH		Single Family	Multifamily
	MENARD		Single Family	Multifamily
	RUNNELS		Single Family	Multifamily
	SCHLEICHER		Single Family	Multifamily

Table 1: Simulation Results for Individual Single Family and Multi Family Residences for All Counties (Continues)

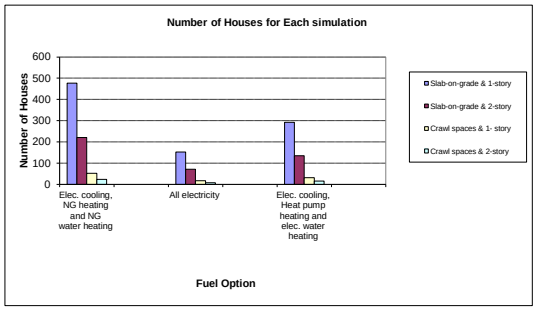
	Other Texas Counties (*Representative counties)	**2021**		
*	TOM GREEN		Single Family	Multifamily
*	COKE	Summary	Single Family	Multifamily
	STERLING		Single Family	Multifamily
	COOKE		Single Family	Multifamily
	FANNIN		Single Family	Multifamily
	GRAYSON	Summary	Single Family	Multifamily
*	HUNT		Single Family	Multifamily
	MONTAGUE		Single Family	Multifamily
	ARCHER		Single Family	Multifamily
	BAYLOR		Single Family	Multifamily
	CLAY		Single Family	Multifamily
	COTTLE		Single Family	Multifamily
	FOARD	Summary	Single Family	Multifamily
	HARDEMAN		Single Family	Multifamily
	KNOX		Single Family	Multifamily
*	WICHITA		Single Family	Multifamily
	WILBARGER		Single Family	Multifamily
	BEE		Single Family	Multifamily
	CALHOUN		Single Family	Multifamily
	GOLIAD		Single Family	Multifamily
	JACKSON		Single Family	Multifamily
	MATAGORDA	Summary	Single Family	Multifamily
	REFUGIO		Single Family	Multifamily
*	VICTORIA		Single Family	Multifamily
	WHARTON		Single Family	Multifamily
	DE WITT		Single Family	Multifamily
*	KARNES	Summary	Single Family	Multifamily
*	LAVACA	Summary	Single Family	Multifamily
*	HARRISON	Summary	Single Family	Multifamily
	MARION		Single Family	Multifamily
	JASPER		Single Family	Multifamily
*	ORANGE	Summary	Single Family	Multifamily
	NEWTON		Single Family	Multifamily
*	HARDIN		Single Family	Multifamily
	POLK	Summary	Single Family	Multifamily
	TYLER		Single Family	Multifamily
*	LIBERTY	Summary	Single Family	Multifamily
	SAN JACINTO		Single Family	Multifamily

County	SF or MF	Precode or Code-compliant	Options			Simulation #	Annual Elec. (kWh/yr)	Annual NG (Therms/yr)	Avg. OSP Daily Elec. (kWh/day)	Avg. OSP Daily NG (Therm/day)	Annual Elec.Savings (kWh/yr)	Annual NG Savings (Therms/yr)	Avg. OSP Daily Elec. Savings (kWh/day)	Avg. OSP Daily NG Savings (Therm/day)
Bastrop	SF	Precode	Slab-on-grade	Fuel Option 1	1-story	1	13888	393	38	1				
					2-story	2	13413	376	37	1				
				Fuel Option 2	1-story	3	21653	0	59	0				
					2-story	4	20787	0	57	0				
				Fuel Option 3	1-story	5	18369	0	50	0				
					2-story	6	17788	0	49	0				
			Crawl Space	Fuel Option 1	1-story	7	14780	407	40	1				
					2-story	8	13964	368	38	1				
				Fuel Option 2	1-story	9	22895	0	63	0				
					2-story	10	21152	0	58	0				
				Fuel Option 3	1-story	11	19362	0	53	0				
					2-story	12	18296	0	50	0				
		Code - Compliant	Slab-on-grade	Fuel Option 1	1-story	13	13441	382	37	1	447	11	1.22	0.03
					2-story	14	12958	367	36	1	455	9	1.25	0.02
				Fuel Option 2	1-story	15	21170	0	58	0	483	0	1.32	0.00
					2-story	16	20306	0	56	0	481	0	1.32	0.00
				Fuel Option 3	1-story	17	17822	0	49	0	547	0	1.50	0.00
					2-story	18	17242	0	47	0	546	0	1.50	0.00
			Crawl Space	Fuel Option 1	1-story	19	14210	395	39	1	570	12	1.56	0.03
					2-story	20	13436	357	37	1	528	11	1.45	0.03
				Fuel Option 2	1-story	21	22247	0	61	0	648	0	1.78	0.00
					2-story	22	20569	0	56	0	583	0	1.60	0.00
				Fuel Option 3	1-story	23	18675	0	51	0	687	0	1.88	0.00
					2-story	24	17673	0	48	0	623	0	1.71	0.00
	MF	Precode	Slab-on-grade	Fuel Option 1	1-story	1	49386	752	135	2				
					2-story	2	98037	1378	269	4				
					3-story	3	146585	2021	402	6				
				Fuel Option 2	1-story	4	63270	0	173	0				
					2-story	5	122835	0	337	0				
					3-story	6	182701	0	501	0				
				Fuel Option 3	1-story	7	60060	0	165	0				
					2-story	8	118592	0	325	0				
					3-story	9	177117	0	485	0				
		Code - Compliant	Slab-on-grade	Fuel Option 1	1-story	10	47763	736	131	2	1,623	16	4.45	0.04
					2-story	11	95262	1357	261	4	2,775	21	7.60	0.06
					3-story	12	142718	1990	391	5	3,867	31	10.59	0.08
				Fuel Option 2	1-story	13	61278	0	168	0	1,992	0	5.46	0.00
					2-story	14	119533	0	327	0	3,302	0	9.05	0.00
					3-story	15	178135	0	488	0	4,566	0	12.51	0.00
				Fuel Option 3	1-story	16	58250	0	160	0	1,810	0	4.96	0.00
					2-story	17	115533	0	317	0	3,059	0	8.38	0.00
					3-story	18	172863	0	474	0	4,254	0	11.65	0.00

Figure 2.1: The summary simulation results of Annual and OSP energy usages of Bastrop County

County Name	Bastrop
Division (East or West Texas)	East Texas
Number of new building permits for SFD	1,500

		Fuel Option 1: Elec. cooling, NG heating and NG water heating	Fuel Option 2: All electricity	Fuel Option 3: Elec. cooling, Heat pump heating and elec. water heating	Total
		51.5%	16.4%	31.5%	
90.30%	68.30%	31.76%	10.11%	19.43%	61.30%
	31.70%	14.74%	4.69%	9.02%	28.45%
9.70%	68.30%	3.41%	1.09%	2.09%	6.59%
	31.70%	1.58%	0.50%	0.97%	3.06%
Total		51.50%	16.40%	31.50%	99.40%



Number of Houses for each simulation

		Fuel Option 1: Elec. cooling, NG heating and NG water heating	Fuel Option 2: All electricity	Fuel Option 3: Elec. cooling, Heat pump heating and elec. water heating	Total
		51.5%	16.4%	31.5%	
90.30%	68.30%	476	152	291	920
	31.70%	221	70	135	427
9.70%	68.30%	51	16	31	99
	31.70%	24	8	15	46
Total		773	246	473	1,491

Precode Energy Use for each option (per house)

		Fuel Option 1: Elec. cooling, NG heating and NG water heating		Fuel Option 2: All electricity		Fuel Option 3: Elec. cooling, Heat pump heating and elec. water heating	
		Elec. Use (kWh)	NG Use (Therm)	Elec. Use (kWh)	NG Use (Therm)	Elec. Use (kWh)	NG Use (Therm)
Slab-on-grade	1-Story	13,886	393	21,653	0	18,369	0
	2-Story	13,413	376	20,787	0	17,788	0
Crawl spaces	1-Story	14,780	407	22,895	0	19,362	0
	2-Story	13,964	368	21,152	0	18,296	0
Total		56,045	1,544	86,487	0	73,815	0

Code compliant Energy Use for each option (per house)

		Fuel Option 1: Elec. cooling, NG heating and NG water heating		Fuel Option 2: All electricity		Fuel Option 3: Elec. cooling, Heat pump heating and elec. water heating	
		Elec. Use (kWh)	NG Use (Therm)	Elec. Use (kWh)	NG Use (Therm)	Elec. Use (kWh)	NG Use (Therm)
Slab-on-grade	1-Story	13,441	382	21,170	0	17,822	0
	2-Story	12,958	367	20,306	0	17,242	0
Crawl spaces	1-Story	14,210	395	22,247	0	18,675	0
	2-Story	13,436	357	20,569	0	17,673	0
Total		54,045	1,501	84,292	0	71,412	0

Precode Total Energy Use (For total houses in a County)

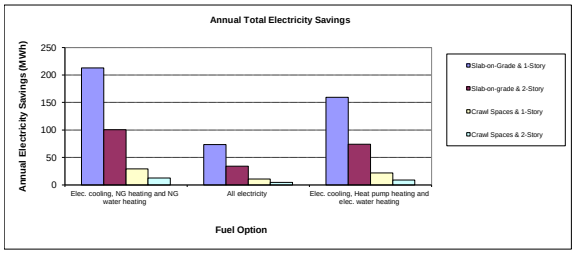
		Fuel Option 1: Elec. cooling, NG heating and NG water heating		Fuel Option 2: All electricity		Fuel Option 3: Elec. cooling, Heat pump heating and elec. water heating		Total	
		Elec. Use (MWh)	NG Use (Therm)	Elec. Use (MWh)	NG Use (Therm)	Elec. Use (MWh)	NG Use (Therm)	Elec. Use (MWh)	NG Use (Therm)
Slab-on-grade	1-Story	6,617	187,240	3,285	0	5,353	0	15,255	187,240
	2-Story	2,966	83,144	1,464	0	2,406	0	6,836	83,144
Crawl spaces	1-Story	756	20,830	373	0	606	0	1,736	20,830
	2-Story	332	8,741	160	0	266	0	758	8,741
Total		10,671	299,956	5,282	0	8,631	0	24,584	299,956

Code compliant Total Energy Use (For total houses in a County)

		Fuel Option 1: Elec. cooling, NG heating and NG water heating		Fuel Option 2: All electricity		Fuel Option 3: Elec. cooling, Heat pump heating and elec. water heating		Total	
		Elec. Use (MWh)	NG Use (Therm)	Elec. Use (MWh)	NG Use (Therm)	Elec. Use (MWh)	NG Use (Therm)	Elec. Use (MWh)	NG Use (Therm)
Slab-on-grade	1-Story	6,404	182,000	3,212	0	5,194	0	14,809	182,000
	2-Story	2,865	81,154	1,436	0	2,332	0	6,627	81,154
Crawl spaces	1-Story	727	20,216	363	0	585	0	1,674	20,216
	2-Story	319	8,480	156	0	257	0	732	8,480
Total		10,316	291,850	5,160	0	8,367	0	23,843	291,850

Total Energy Savings Due to the Code Adoption

		Fuel Option 1: Elec. cooling, NG heating and NG water heating		Fuel Option 2: All electricity		Fuel Option 3: Elec. cooling, Heat pump heating and elec. water heating		Total	
		Elec. Savings (MWh)	NG Savings (Therm)	Elec. Savings (MWh)	NG Savings (Therm)	Elec. Savings (MWh)	NG Savings (Therm)	Elec. Savings (MWh)	NG Savings (Therm)
Slab-on-grade	1-Story	213	5,241	73	0	159	0	446	5,241
	2-Story	101	1,990	34	0	74	0	208	1,990
Crawl spaces	1-Story	29	614	11	0	22	0	61	614
	2-Story	13	261	4	0	9	0	26	261
Total		355	8,106	122	0	264	0	741	8,106



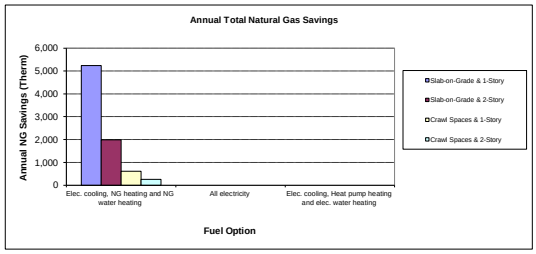


Figure 2.2: Annual and OSP energy savings of the single-family for Bastrop County in 2021

Precode Avg. OSP Daily Energy Use for each option (per house)

		Fuel Option 1: Elec. cooling, NG heating and NG water heating		Fuel Option 2: All electricity		Fuel Option 3: Elec. cooling, Heat pump heating and elec. water heating	
		Elec. Use (kWh)	NG Use (Therm)	Elec. Use (kWh)	NG Use (Therm)	Elec. Use (kWh)	NG Use (Therm)
Slab-on-grade	1-Story	38	1	59	0	50	0
	2-Story	37	1	57	0	49	0
Crawl spaces	1-Story	40	1	63	0	53	0
	2-Story	38	1	58	0	50	0
Total		154	4	237	0	202	0

Code compliant Avg. OSP Daily Energy Use for each option (per house)

		Fuel Option 1: Elec. cooling, NG heating and NG water heating		Fuel Option 2: All electricity		Fuel Option 3: Elec. cooling, Heat pump heating and elec. water heating	
		Elec. Use (kWh)	NG Use (Therm)	Elec. Use (kWh)	NG Use (Therm)	Elec. Use (kWh)	NG Use (Therm)
Slab-on-grade	1-Story	37	1	58	0	49	0
	2-Story	36	1	56	0	47	0
Crawl spaces	1-Story	39	1	61	0	51	0
	2-Story	37	1	56	0	48	0
Total		148	4	231	0	196	0

Precode Avg. OSP Daily Total Energy Use (For total houses in a County)

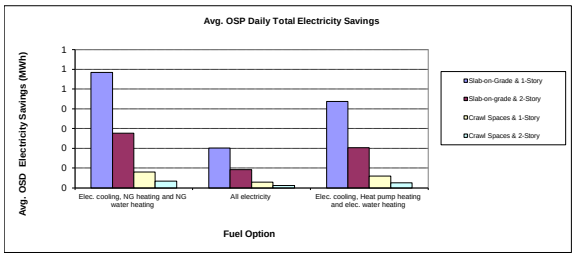
		Fuel Option 1: Elec. cooling, NG heating and NG water heating		Fuel Option 2: All electricity		Fuel Option 3: Elec. cooling, Heat pump heating and elec. water heating		Total	
		Elec. Use (MWh)	NG Use (Therm)	Elec. Use (MWh)	NG Use (Therm)	Elec. Use (MWh)	NG Use (Therm)	Elec. Use (MWh)	NG Use (Therm)
Slab-on-grade	1-Story	18	513	9	0	15	0	42	513
	2-Story	8	228	4	0	7	0	19	228
Crawl spaces	1-Story	2	57	1	0	2	0	5	57
	2-Story	1	24	0	0	1	0	2	24
Total		29	822	14	0	24	0	67	822

Code compliant Avg. OSP Daily Total Energy Use (For total houses in a County)

		Fuel Option 1: Elec. cooling, NG heating and NG water heating		Fuel Option 2: All electricity		Fuel Option 3: Elec. cooling, Heat pump heating and elec. water heating		Total	
		Elec. Use (MWh)	NG Use (Therm)	Elec. Use (MWh)	NG Use (Therm)	Elec. Use (MWh)	NG Use (Therm)	Elec. Use (MWh)	NG Use (Therm)
Slab-on-grade	1-Story	18	499	9	0	14	0	41	499
	2-Story	8	222	4	0	6	0	18	222
Crawl spaces	1-Story	2	55	1	0	2	0	5	55
	2-Story	1	23	0	0	1	0	2	23
Total		28	800	14	0	23	0	65	800

Avg. OSP Daily Total Energy Savings Due to the Code Adoption

		Fuel Option 1: Elec. cooling, NG heating and NG water heating		Fuel Option 2: All electricity		Fuel Option 3: Elec. cooling, Heat pump heating and elec. water heating		Total	
		Elec. Savings (MWh)	NG Savings (Therm)	Elec. Savings (MWh)	NG Savings (Therm)	Elec. Savings (MWh)	NG Savings (Therm)	Elec. Savings (MWh)	NG Savings (Therm)
Slab-on-grade	1-Story	1	14	0	0	0	0	1	14
	2-Story	0	5	0	0	0	0	1	5
Crawl spaces	1-Story	0	2	0	0	0	0	0	2
	2-Story	0	1	0	0	0	0	0	1
Total		1	22	0	0	1	0	2	22



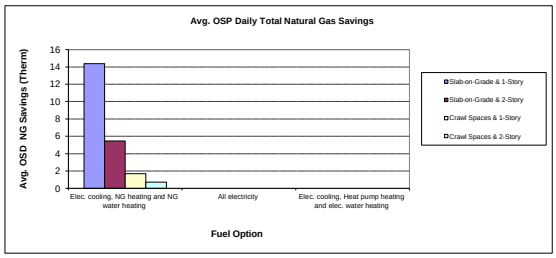


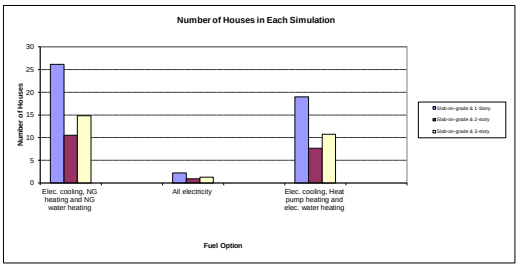
Figure 2.2: Annual and OSP energy savings of the single-family for Bastrop County in 2021 (Continued)

County Name	Bastrop
NAHB Division	West South Central
Number of new building permits for MF	94

		Fuel Option			Total
		1	2	3	
		Elec. cooling, NG heating and NG water heating	All electricity	Elec. cooling, Heat pump heating and elec. water heating	
		54.8%	4.7%	39.8%	
Slab-on-grade (100%)	50.80%	27.84%	2.39%	20.22%	50.44%
	20.40%	11.18%	0.96%	8.12%	20.26%
	28.80%	15.78%	1.35%	11.46%	28.60%
Total		54.80%	4.70%	39.80%	99.30%

Number of Houses for each simulation

		Fuel Option			Total
		1	2	3	
		Elec. cooling, NG heating and NG water heating	All electricity	Elec. cooling, Heat pump heating and elec. water heating	
		54.8%	4.7%	39.8%	
Slab-on-grade (100%)	50.80%	26	2	19	47
	20.40%	11	1	8	19
	28.80%	15	1	11	27
Total		52	4	37	93



Precode Energy Use for each option (per house)

		Fuel Option						Total	
		1		2		3			
		Elec. cooling, NG heating and NG water heating		All electricity		Elec. cooling, Heat pump heating and elec. water heating			
		Elec. Use (kWh)	NG Use (Therm)	Elec. Use (kWh)	NG Use (Therm)	Elec. Use (kWh)	NG Use (Therm)	Elec. Use (kWh)	NG Use (Therm)
Slab-on-grade	1-Story	49,386	752	63,270	0	60,060	0		
	2-Story	98,037	1,378	122,835	0	118,592	0		
	3-Story	146,585	2,021	182,701	0	177,117	0		
Total		294,008	4,151	368,806	0	355,769	0		

Code compliant Energy Use for each option (per house)

		Fuel Option					
		1		2		3	
		Elec. cooling, NG heating and NG water heating		All electricity		Elec. cooling, Heat pump heating and elec. water heating	
		Elec. Use (kWh)	NG Use (Therm)	Elec. Use (kWh)	NG Use (Therm)	Elec. Use (kWh)	NG Use (Therm)
Slab-on-grade	1-Story	47,763	736	61,278	0	58,250	0
	2-Story	95,262	1,357	119,533	0	115,533	0
	3-Story	142,718	1,990	178,135	0	172,863	0
Total		285,743	4,083	358,946	0	346,646	0

Precode Total Energy Use (For total houses in a County)

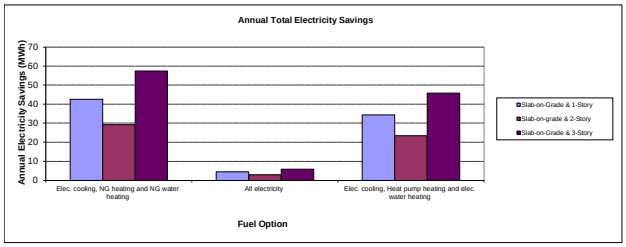
		Fuel Option						Total	
		1		2		3			
		Elec. cooling, NG heating and NG water heating		All electricity		Elec. cooling, Heat pump heating and elec. water heating			
		Elec. Use (MWh)	NG Use (Therm)	Elec. Use (MWh)	NG Use (Therm)	Elec. Use (MWh)	NG Use (Therm)	Elec. Use (MWh)	NG Use (Therm)
Slab-on-grade	1-Story	1,292	19,678	142	0	1,141	0	2,576	19,678
	2-Story	1,030	14,481	111	0	905	0	2,046	14,481
	3-Story	2,175	29,982	222	0	1,908	0	4,315	29,982
Total		4,497	64,142	485	0	3,955	0	8,937	64,142

Code compliant Total Energy Use (For total houses in a County)

		Fuel Option						Total	
		1		2		3			
		Elec. cooling, NG heating and NG water heating		All electricity		Elec. cooling, Heat pump heating and elec. water heating			
		Elec. Use (MWh)	NG Use (Therm)	Elec. Use (MWh)	NG Use (Therm)	Elec. Use (MWh)	NG Use (Therm)	Elec. Use (MWh)	NG Use (Therm)
Slab-on-grade	1-Story	1,250	19,260	138	0	1,107	0	2,494	19,260
	2-Story	1,001	14,260	108	0	882	0	1,991	14,260
	3-Story	2,117	29,523	227	0	1,863	0	4,206	29,523
Total		4,368	63,042	472	0	3,851	0	8,691	63,042

Total Energy Savings Due to the Code Adoption

		Fuel Option						Total	
		1		2		3			
		Elec. cooling, NG heating and NG water heating		All electricity		Elec. cooling, Heat pump heating and elec. water heating			
		Elec. Use (MWh)	NG Use (Therm)	Elec. Use (MWh)	NG Use (Therm)	Elec. Use (MWh)	NG Use (Therm)	Elec. Use (MWh)	NG Use (Therm)
Slab-on-grade	1-Story	42	419	4	0	34	0	81	419
	2-Story	29	221	3	0	23	0	55	221
	3-Story	57	460	6	0	46	0	109	460
Total		129	1,099	13	0	104	0	246	1,099



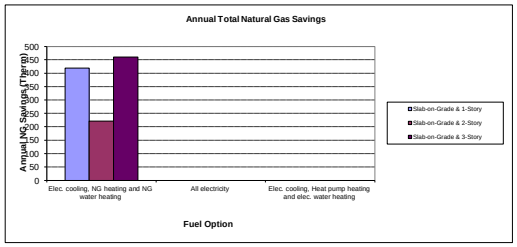


Figure 2.3: Annual and OSP energy savings of the multi-family for Bastrop County

Precode Avg. OSP Daily Energy Use for each option (per house)

		Fuel Option 1: Elec. cooling, NG heating and NG water heating		Fuel Option 2: All electricity		Fuel Option 3: Elec. cooling, Heat pump heating and elec. water heating	
		Elec. Use (kWh)	NG Use (Therm)	Elec. Use (kWh)	NG Use (Therm)	Elec. Use (kWh)	NG Use (Therm)
Slab-on-grade	1-Story	135.30	2.06	173.34	0.00	164.55	0.00
	2-Story	268.59	3.78	336.53	0.00	324.91	0.00
	3-Story	401.60	5.54	500.55	0.00	485.25	0.00
Total		805.50	11.37	1,010.43	0.00	974.71	0.00

Code compliant Avg. OSP Daily Energy Use for each option (per house)

		Fuel Option 1: Elec. cooling, NG heating and NG water heating		Fuel Option 2: All electricity		Fuel Option 3: Elec. cooling, Heat pump heating and elec. water heating	
		Elec. Use (kWh)	NG Use (Therm)	Elec. Use (kWh)	NG Use (Therm)	Elec. Use (kWh)	NG Use (Therm)
Slab-on-grade	1-Story	130.86	2.02	167.88	0.00	159.59	0.00
	2-Story	260.99	3.72	327.49	0.00	316.53	0.00
	3-Story	391.01	5.45	488.04	0.00	473.60	0.00
Total		782.86	11.19	983.41	0.00	949.72	0.00

Precode Avg. OSP Daily Total Energy Use (For total houses in a County)

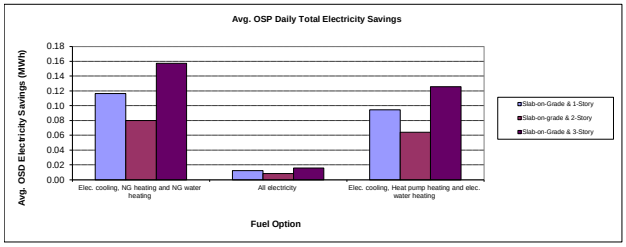
		Fuel Option 1: Elec. cooling, NG heating and NG water heating		Fuel Option 2: All electricity		Fuel Option 3: Elec. cooling, Heat pump heating and elec. water heating		Total	
		Elec. Use (MWh)	NG Use (Therm)	Elec. Use (MWh)	NG Use (Therm)	Elec. Use (MWh)	NG Use (Therm)	Elec. Use (MWh)	NG Use (Therm)
Slab-on-grade	1-Story	3.54	53.91	0.39	0.00	3.13	0.00	7.06	53.91
	2-Story	2.82	39.67	0.30	0.00	2.49	0.00	5.61	39.67
	3-Story	5.96	82.14	0.64	0.00	5.23	0.00	11.82	82.14
Total		12.32	175.73	1.33	0.00	10.84	0.00	24.49	175.73

Code compliant Avg. OSP Daily Total Energy Use (For total houses in a County)

		Fuel Option 1: Elec. cooling, NG heating and NG water heating		Fuel Option 2: All electricity		Fuel Option 3: Elec. cooling, Heat pump heating and elec. water heating		Total	
		Elec. Use (MWh)	NG Use (Therm)	Elec. Use (MWh)	NG Use (Therm)	Elec. Use (MWh)	NG Use (Therm)	Elec. Use (MWh)	NG Use (Therm)
Slab-on-grade	1-Story	3.42	52.77	0.38	0.00	3.03	0.00	6.83	52.77
	2-Story	2.74	39.07	0.30	0.00	2.42	0.00	5.45	39.07
	3-Story	5.80	80.88	0.62	0.00	5.10	0.00	11.52	80.88
Total		11.97	172.72	1.29	0.00	10.55	0.00	23.81	172.72

Total Energy Savings Due to the Code Adoption

		Fuel Option 1: Elec. cooling, NG heating and NG water heating		Fuel Option 2: All electricity		Fuel Option 3: Elec. cooling, Heat pump heating and elec. water heating		Total	
		Elec. Savings (kWh)	NG Savings (Therm)	Elec. Savings (kWh)	NG Savings (Therm)	Elec. Savings (kWh)	NG Savings (Therm)	Elec. Use (kWh)	NG Use (Therm)
Slab-on-grade	1-Story	0.12	1.15	0.01	0.00	0.09	0.00	0.22	1.15
	2-Story	0.08	0.60	0.01	0.00	0.06	0.00	0.15	0.60
	3-Story	0.16	1.26	0.02	0.00	0.13	0.00	0.30	1.26
Total		0.35	3.01	0.04	0.00	0.28	0.00	0.67	3.01



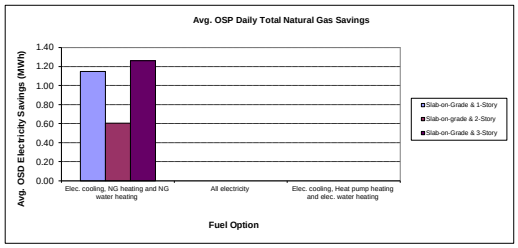


Figure 2.3: Annual and OSP energy savings of the multi-family for Bastrop County (Continued)