Texas Peaker Power Plants

Energy Storage Replacement Opportunities

Across Texas, 65 gas- and oil-fired peaker power plants and peaking units at larger plants help meet statewide peak electric demand. These facilities include gas turbines and internal combustion engines designed to ramp up quickly and meet peak demand, as well as older steam turbines now operated infrequently as peaker plants. Some of these units are stand-alone facilities, but a dozen power plants in Texas combine a mix of steam and gas turbines or internal combustion units all used to meet peak demand.

Texas peaker power plants reflect a wide spectrum of characteristics: very old and very young; inefficient and efficient; rural and urban; and some with high and some with low pollutant emission rates. Those units that are aging, inefficient, run infrequently, have high emission rates, have shorter runtimes when they start up, or are located in urban areas—particularly near vulnerable populations or in areas with poor air quality—may be good candidates for replacement with energy storage, solar, demand response, or a mix of clean energy resources that best match local grid needs. In addition, energy storage could be considered as an alternative to five proposed new peaker plants in the state.

Texas has significant wind and solar potential, and storage can help balances these variable resources to help meet the state's rapidly growing peak demand. Distributed solar+storage could also play a role in providing resilience in the face of outages following extreme weather events. However, Texas has a complicated regulatory environment, which currently limits the role of energy storage on the electric grid; revision of these regulations would enable energy storage to better meet peak demand across the state.

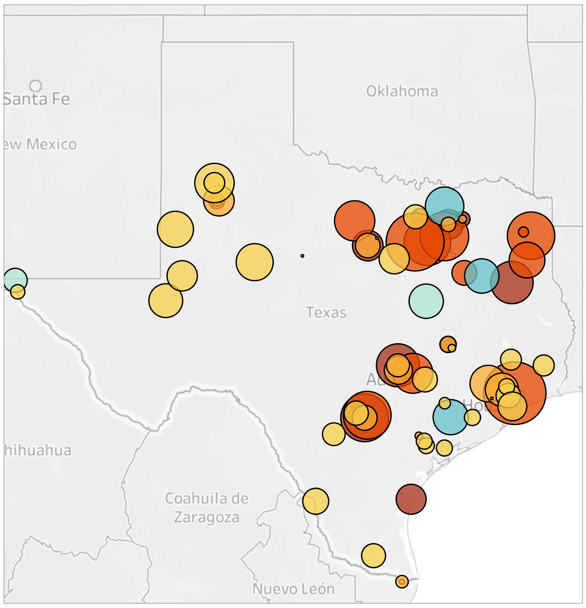

Figure 1: Peaker plants across Texas.

Texas State Policy and Regulatory Environment

The majority of the Texas grid is operated by the Electric Reliability Council of Texas (ERCOT), which operates independently from the rest of the United States electric grid. ERCOT does not have any explicit policies supporting energy storage. Texas also has more wind energy capacity than any other state, which helped it surpass its renewable energy targets years ago, and it has not set new targets. ERCOT has historically defined energy storage as an electricity generator (like a power plant), but prohibits utilities from owning generators, which limits the ability for energy storage to provide "stacked" energy services: that is, to meet peak electricity demand while also providing grid value such as reduced transmission and distribution infrastructure investments and frequency regulation. Texas has begun to revise these regulations by permitting municipal utilities and electric cooperatives to own energy storage systems. Investor-owned utilities, however, are still prohibited from do-

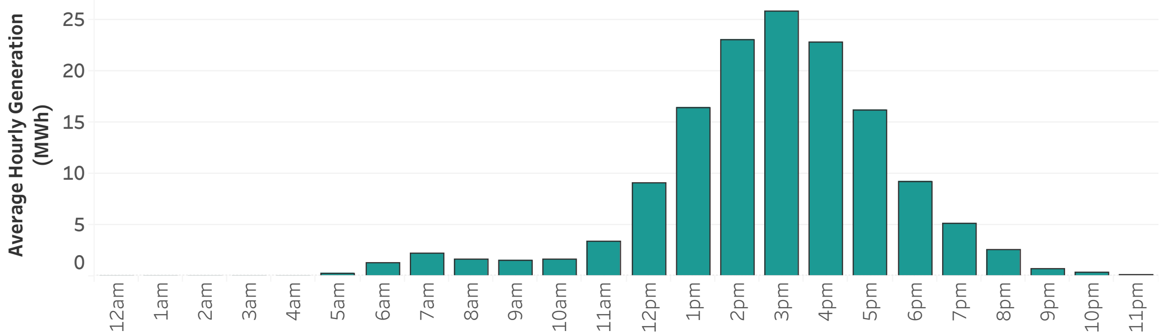

Figure 2: Average hourly generation from the Decker Creek gas turbine unit. This gas turbine unit, co-located with a steam turbine unit, typically meets peak afternoon loads. It also runs an average of 3.3 hours each start up and has a capacity factor of 0.1 percent. Batteries can serve a similar role on the grid.

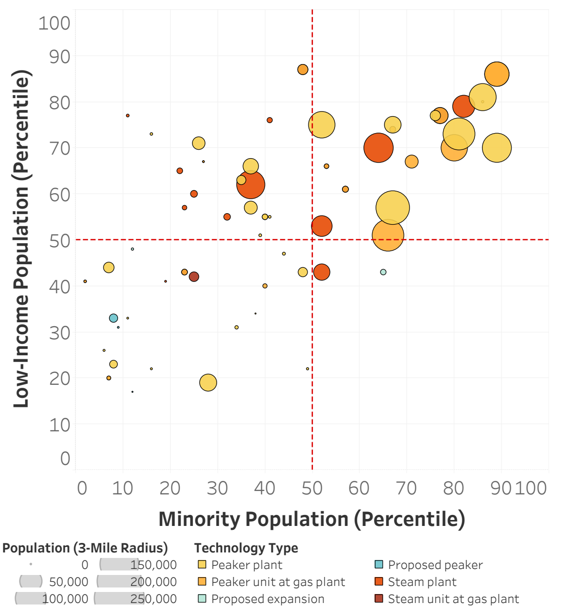

Figure 3: Demographics near Texas peaker plants. Bubbles reflect population size. Axes mark state percentiles for low-income (double federal poverty limit) and minority populations living within three miles of each facility.

ing so. ERCOT has also convened a Battery Energy Storage Task Force, whose recommendations may enable additional storage participation in the electric grid. Currently, many of the most promising projects combine energy storage with renewable energy generation, such as wind and solar. In particular, Texas frequently has a surplus of nighttime wind generation resulting in negative electricity prices, which could be alleviated by storing this energy to meet peak daytime demand.

Texas Peaker Plants

Peak electricity demand in Texas typically reaches its maximum on hot August days when air conditioning is in high demand statewide. This demand is partially met by 60 gas turbine, steam turbine, and internal combustion units, many of which are co-located at the same facilities. These plants include a wide spectrum of features: some are very young and some very old, some have short runtimes and some long, some are rarely used and some called upon frequently. A number of features may make certain plants good candidates for replacement with energy storage, demand response, and other clean energy alternatives. Factors to consider include:

- **Age:** 21 units are 50 years or older, while 11 were brought online in the last five years. The older facilities, which are mostly steam units, may be ready for retirement.
- **Efficiency:** More than two-thirds of the units are less efficient than the national average for similar facilities.
- **Capacity factor:** 30 units operate at a capacity factor of 5 percent or less—that is, they generate 5 percent of the electricity that they would if they were running constantly at full power all year—and 13 operate at a capacity factor of 1 percent or less.
- **Runtimes:** Ten units run 5 hours or less each time they start up, which may make them a good match for battery replacement (see **Figure 2**). Some aging steam plants are inflexible and may run for longer

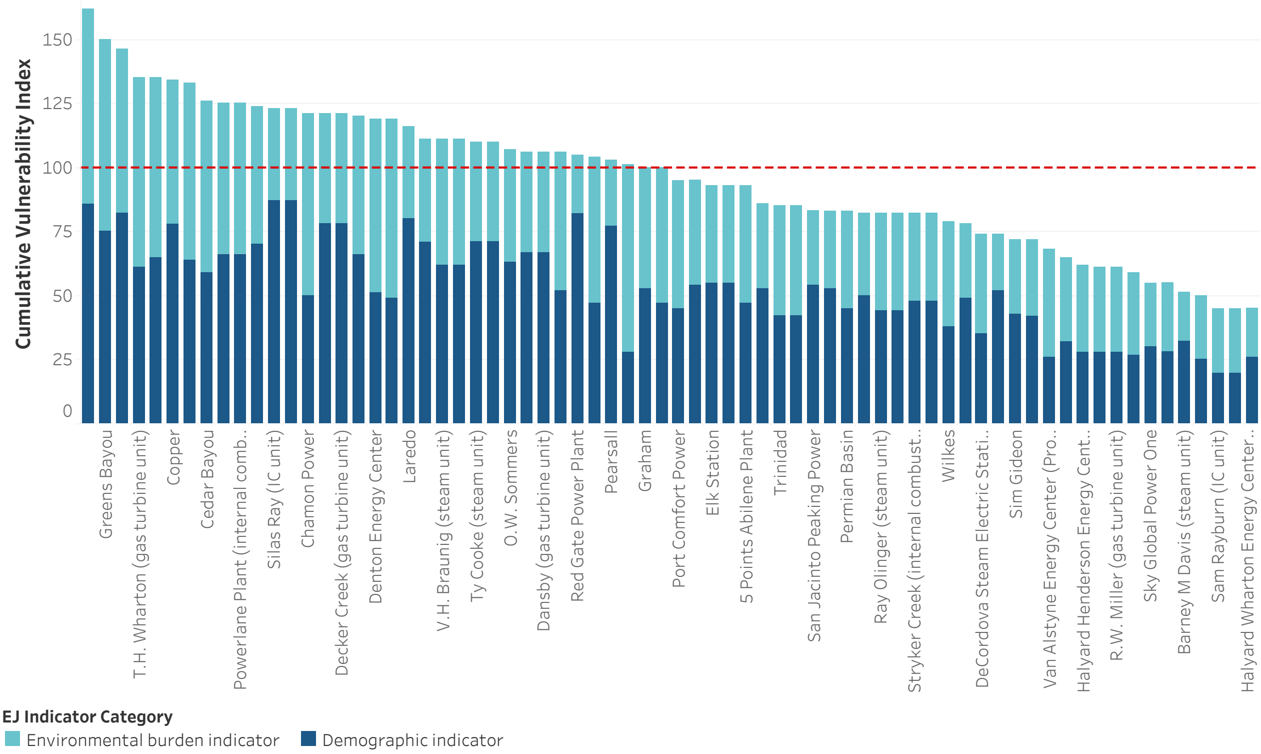

Figure 4: The cumulative vulnerability index reflects a set of environmental and demographic indicators for populations living within three miles of each plant. The score is based on a comparison of indicators to statewide values: if a plant ranked at the median percentile for all indicators, it would score 100, which is indicated by the red dashed line.

hours, but careful grid analysis can identify which are needed for this full period of time and which could be replaced with a shorter-duration battery or a mixed portfolio of resources.

In addition to replacing aging, inefficient or infrequently used facilities, energy storage can mitigate the need to build new peaking capacity. Four peaker plants and one plant expansion are currently proposed in Texas, providing an opportunity to instead build out a mix of storage, solar, and demand response to meet these peak grid needs.

Nearby Populations

Texas peaker plants are located in a mix of urban, semi-rural, and rural areas, with populations in a three-mile radius ranging from nearly no one to more than 110,000 near the Friendswood Energy facility. These nearby communities also reflect a mix of demographic characteristics: some have very high proportions of low-income population and minority populations, while others do not (see **Figure 3**). Many communities also experience high cumulative exposure to environmental health burdens from numerous sources. We developed a cumulative vulnerability index that integrates data on health burdens (asthma, heart attacks, premature birth rates); environmental burdens (ozone, particulate matter, toxics, traffic proximity, lead paint, and hazardous facilities); and demographic indicators (low-income, minority, linguistically isolated, and non-high school educated populations). The cumulative vulnerability index for populations living within three miles of each facility is shown in **Figure 4**. In Texas, urban plants tend to be located in areas where nearby populations experience higher cumulative burdens than elsewhere in the state. In addition to reducing emissions, distributed energy storage can play an important role in providing electricity to vulnerable populations during grid outages. Energy storage can be used to provide backup iduringn outages following hurricanes or to create resilient cooling centers for vulnerable populations during heat waves.

Emissions and the Environment

Texas's peaker power plants burn primarily natural gas, which produces greenhouse gases as well as criteria pollutants like nitrogen oxides (NO_x). In addition, a number of small internal combustion units across Texas burn primarily oil, which typically has higher rates of criteria pollutant emissions than natural gas facilities. NO_x is a precursor to ozone and particulate matter formation. Twenty-one of Texas peaker units, at nineteen separate facilities, are located in regions considered out-of-attainment for federal ozone standards; operation of these plants on hot summer days to meet air conditioning demands can exacerbate these poor air quality conditions. More than 20 percent of the electricity generation from both gas and steam turbine units at the Ray Olinger facility, for example, is produced on days when local ozone concentrations exceed federal standards. It is worth noting, however, that Texas has significant power generation from coal; regulatory efforts to manage when energy storage is charged can help limit the charging of batteries with coal generation and inadvertently increasing grid emissions.

Summary

Growing peak electricity demand in Texas is met by an aging fleet of steam turbine turbine units and younger gas and internal combustion units. The state's more urban plants tend to be located in communities with high levels of cumulative environmental and socioeconomic burdens. Energy storage, in combination with renewable energy generation, may provide a promising alternative to replace the state's more polluting, inefficient, and infrequently used facilities, particularly in urban areas or regions with poor air quality. Storage and other clean resources can also provide an alternative to building new natural gas peaking capacity. In the attached table, we provide operational, environmental and demographic data for Texas peakers and nearby populations. Indicators such as nearby population, emission rates, heat rate (fuel used per megawatt-hour), operation on poor air quality days, capacity factor, and typical run hours can also inform whether a given plant might be a good target for replacement with storage or solar+storage. These data should be accompanied by engagement with affected communities to determine replacement priorities and strategies.

Texas peaker plant operational and demographic data.
For methods see: www.psehealthyenergy.org.

	Plant description					Operation and emissions						Demographics (3-mile radius)			
Name (EIA ID)	**Status**	**County**	**Fuel**[1]	**MW**[2]	**Age**[3]	**Capacity factor**[4]	**Run hours/ start**[5]	**Heat rate**[6] MMBtu/ MWh	**CO_2 rate**[7] tons/ MWh	**NO_x rate**[8] lbs/MWh	**% MWh high ozone days**[9]	**Pop.**	**% non-white** (percentile)[10]	**% low-income** (percentile)[11]	**CVI**[12]
5 Points Abilene Plant	Unknown	Taylor	Oil	NA	NA	NA	NA	NA	NA	NA	NA	23,848	43% (37)	47% (66)	170
Antelope Station (57865)	Operating	Hale	Natural gas	167.4	9	10.2%	NA	9.2	0.5	0.4	NA	3,120	47% (40)	39% (55)	183
Bacliff (60264)	Operating	Galveston	Natural gas	324	2	0.9%	5.2	13.5	0.8	2.3	9.4%	16,799	43% (37)	40% (57)	163
Barney M Davis (steam unit)[13] (4939)	Operating	Nueces	Natural gas	352	46	1.5%	16.1	12.8	0.8	2.1	0.0%	9,302	32% (25)	30% (42)	103
Bryan (3561)	Operating	Brazos	Natural gas	22	45	0.2%	NA	17.4	1.0	5.1	NA	70,033	60% (52)	55% (75)	162
Cedar Bayou (3460)	Operating	Chambers	Natural gas	1,530	50	12.1%	242	9.8	0.6	0.7	2.3%	42,816	59% (52)	37% (53)	174

[1]Primary fuel; many plants burn both natural gas and oil.
[2]Installed nameplate capacity (plant size).
[3]Age of oldest unit in 2020.
[4]Percent of time running as compared to running all year at full capacity.
[5]Average number of hours plant runs each time it is turned on.
[6]Heat rates are energy burned per unit of electricity generated; high heat rates reflect low efficiency.
[7]Direct carbon dioxide emissions per unit of electricity generated; does not include upstream emissions.
[8]Nitrogen oxides (NO_x) emitted per unit of electricity generated; NO_x contributes to ozone and particulate matter formation.
[9]Percent of generation on days nearby monitors record exceedances of federal ozone standards.
[10]Percentile minority population indicates percent of census tracts across the state with lower fraction of non-white populations.
[11]Percentile low-income population indicates percent of census tracts across the state with lower fraction of households below double the federal poverty limit.
[12]Cumulative Vulnerability Index combines state percentiles for demographic and environmental exposure indicators. A median on all values would score 100.
[13]Steam turbine unit at 1082 MW gas combined cycle plant.

Chamon Power (60460)	Operating	Harris	Natural gas	100	3	2.7%	4.8	14.7	0.9	0.7	9.2%	8,725	55% (48)	30% (43)	180
Copper (9)	Operating	El Paso	Natural gas	80.5	40	4.7%	9.6	17.0	1.0	4.6	4.8%	101,342	90% (81)	53% (73)	183
Dansby (gas turbine unit)[14] (6243)	Operating	Brazos	Natural gas	98.2	16	3.4%	4.7	10.0	0.6	0.2	2.8%	2,167	61% (53)	47% (66)	149
Dansby (steam unit)[15] (6243)	Operating	Brazos	Natural gas	105	42	12.5%	1,668	13.2	0.8	1.2	1.7%	2,167	61% (53)	47% (66)	149
Decker Creek (gas turbine unit)[16] (3548)	Operating	Travis	Natural gas	206	32	2.5%	4.3	15.8	0.6	11.0	3.2%	25,522	87% (77)	57% (77)	176
Decker Creek (steam turbine unit)[17] (3548)	Operating	Travis	Natural gas	726	49	9.2%	28.3	10.9	0.6	1.3	2.9%	25,522	87% (77)	57% (77)	176
DeCordova Steam Electric Station (8063)	Operating	Hood	Natural gas	357.6	30	0.4%	2.6	14.2	0.8	8.6	4.4%	11,218	13%(7)	31% (44)	114
Denton Energy Center (61643)	Operating	Denton	Natural gas	225	2	7.5% [18]	NA	8.4	0.5	23.2	NA	8,452	42% (35)	45% (63)	174
DGS Palo Pinto	Unknown	Palo Pinto	Oil	NA	NA	NA	NA	NA	NA	NA	NA	16,015	32% (26)	52% (71)	160
Ector County Energy Center (58471)	Operating	Ector	Natural gas	358.8	5	10.2%	10.2	11.5	0.7	0.3	6.9	4	44% (38)	24% (34)	177
Elk Station (58835)	Operating	Hale	Natural gas	606	5	5.2%	NA	10.8	0.6	3.4	NA	3,120	47% (40)	39% (55)	183

[14] Gas turbine unit at 203 MW gas plant.
[15] Steam turbine unit at 203 MW gas plant.
[16] Gas turbine unit at 932 MW gas plant.
[17] Steam turbine unit at 932 MW gas plant.
[18] Denton came online in 2018 so data may not reflect ongoing operation.

Exelon LaPorte Generation Station (55365)	Operating	Harris	Natural gas	236	19	3.7%	5.8	13.0	0.8	2.5	3.5%	29,020	34% (28)	15% (19)	146
Friendswood Energy (60468)	Operating	Harris	Natural gas	117	2	2.4%	5.7	13.5	0.8	7.4	7.1%	112,565	77% (67)	40% (57)	172
Graham (3490)	Operating	Young	Natural gas	634.7	60	2.0%	9.6	11.2	0.7	2.8	6.1%	4,724	32% (25)	42% (60)	100
Greens Bayou (3464)	Operating	Harris	Natural gas	432	44	0.8%	5.6	15.3	0.9	3.2	2.7%	69,550	89% (80)	51% (70)	212
Halyard Henderson Energy Center (60268)	Proposed	Henderson	Natural gas	464	NA	NA	NA	NA	NA	NA	NA	356	15% (9)	23% (31)	62
Halyard Wharton Energy Center (60221)	Proposed	Wharton	Natural gas	484	NA	NA	NA	NA	NA	NA	NA	163	19% (12)	13% (17)	131
Handley (3491)	Operating	Tarrant	Natural gas	1,315	72	5.0%	25.6	11.6	0.7	0.3	6.4%	86,219	73% (64)	51% (70)	196
Hardin County Peaking Facility (56604)	Operating	Hardin	Natural gas	173	10	3.8%	8.5	12.8	0.8	0.4	0.0%	6,103	15% (8)	17% (23)	87
Jones (gas turbine unit) (3482)	Operating	Lubbock	Natural gas	365.4	9	14.7%	17.3	9.5	0.6	0.3	7.8%	1,897	46% (40)	28% (40)	153
Knox Lee (3476)	Operating	Gregg	Natural gas	501	70	2.6%	43.3	12.0	0.7	1.4	0.5%	3,313	29% (22)	46% (65)	185
Lake Hubbard (3452)	Operating	Dallas	Natural gas	927.5	50	2.9%	11.5	11.3	0.7	0.5	6.3%	26,680	59% (52)	30% (43)	138
Laredo (3439)	Operating	Webb	Natural gas	263.6	12	7.6%	7.1	9.7	0.6	0.1	0.0%	84,250	96% (89)	50% (70)	145
Leon Creek (3609)	Operating	Bexar	Natural gas	229.6	16	6.4%	7.3	10.7	0.6	0.2	2.5%	73,083	94% (86)	61% (81)	219
Lone Star (3477)	Operating	Morris	Natural gas	40	66	1.6%	36.3	13.1	0.8	1.2	0.0%	2,127	30% (23)	40% (57)	85

Morgan Creek (3492)	Operating	Mitchell	Natural gas	536.4	32	0.1%	2.4	15.9	0.9	10.7	6.5%	435	23% (16)	17% (22)	50
Mountain Creek (3453)	Operating	Dallas	Natural gas	852.2	75	5.1%	33.2	11.5	0.7	0.6	4.7%	49,011	91% (82)	58% (79)	204
Mustang Station Unit 4 (56326)	Operating	Yoakum	Natural gas	510	14	12.4%	23	11.5	0.7	0.3	5.6%	561	56% (49)	17% (22)	83
Newgulf (50137)	Operating	Wharton	Natural gas	101.9	36	1.4%	5.3	13.3	0.8	3.5	2.6%	919	51% (44)	33% (47)	159
Newman (gas turbine unit)[19] (3456)	Proposed expansion	El Paso	Natural gas	226	NA	NA	NA	NA	NA	NA	NA	3,152	75% (65)	30% (43)	137
O.W. Sommers (3611)	Operating	Bexar	Natural gas	892	48	8.0%	29.6	11.7	0.7	1.6	2.4%	2,817	47% (41)	56% (76)	175
Pearsall (3630)	Operating	Frio	Natural gas	201.6	11	13.0%	NA	9.5	0.6	24.9	NA	10,645	86% (76)	57% (77)	103
Permian Basin (3494)	Operating	Ward	Natural gas	447	32	1.0%	5.2	14.0	0.8	5.7	5.3%	1,205	40% (34)	22% (31)	83
Port Comfort Power (60459)	Operating	Calhoun	Natural gas	100	3	3.6%	4.5	13.6	0.8	1.5	1.8%	771	47% (41)	38% (55)	135
Powerlane Plant[20] (4195)	Operating	Hunt	Natural gas	87	54	0.8%	6.3	18.9	1.1	1.8	5.7%	10,381	55% (48)	68% (87)	125
Powerlane Plant (internal combustion unit)[21] (4195)	Operating	Hunt	Natural gas	25.2	10	7.2%	NA	10.4	0.6	0.7	NA	10,381	55% (48)	68% (87)	125
R.W. Miller (gas turbine unit)[22] (3628)	Operating	Palo Pinto	Natural gas	237.6	26	3.2%	7.9	13.7	0.8	1.1	5.4%	694	7% (2)	29% (41)	115

[19] Proposed expansion to existing natural gas plant.
[20] Steam turbine unit at 112 MW gas plant.
[21] Internal combustion unit at 112 MW gas plant.
[22] Gas turbine unit at 604 MW gas plant.

R.W. Miller (steam turbine unit)[23] (3628)	Operating	Palo Pinto	Natural gas	366	52	6.8%	14.3	11.2	0.7	1.7	4.5%	694	7% (2)	29% (41)	115
Ray Olinger (gas turbine unit)[24] (3576)	Operating	Collin	Natural gas	82.7	19	0.9%	5.1	12.1	0.7	0.4	22.6%	3,414	30% (23)	30% (43)	141
Ray Olinger (steam turbine unit)[25] (3576)	Operating	Collin	Natural gas	345	53	1.3%	12.7	11.6	0.7	0.6	18.7%	3,414	30% (23)	30% (43)	141
Red Gate Power Plant (59391)	Operating	Hidalgo	Natural gas	224.4	4	10.3%	NA	9.1	0.5	24.4	NA	585	93%(86)	59% (80)	177
Sam Rayburn (gas turbine unit)[26] (3631)	Operating	Victoria	Natural gas	22.4	57	0.2%	NA	79.7	4.7	0.5	NA	1,571	14% (7)	15% (20)	125
Sam Rayburn (internal combustion unit)[27] (3631)	Operating	Victoria	Oil	3.2	29	0.9%	NA	10.5	0.8	0.8	NA	1,571	14% (7)	15% (20)	125
San Jacinto Peaking Power (56603)	Operating	San Jacinto	Natural gas	170	11	11.9%	10.9	12.5	0.7	0.4	5.9%	706	23% (16)	53% (73)	168
Sand Hill (gas turbine unit)[28] (7900)	Operating	Travis	Natural gas	308.4	19	12.0%	7.1	9.5	0.6	0.2	2.2%	16,975	81% (71)	48% (67)	180
Silas Ray (gas turbine unit)[29] (3559)	Operating	Cameron	Natural gas	61	16	5.0%	7.8	10.6	0.6	0.1	0.0%	59,381	96% (89)	67% (86)	192

[23] Steam turbine unit at 604 MW gas plant.
[24] Gas turbine unit at 428 MW gas plant.
[25] Steam turbine unit at 428 MW gas plant.
[26] Gas turbine at 234 MW gas plant.
[27] Internal combustion unit at 234 MW gas plant.
[28] Gas turbine unit at 696 MW gas combined cycle plant.
[29] Gas turbine unit at 146 MW gas combined cycle plant.

Silas Ray (internal combustion unit)[30] (3559)	Operating	Cameron	Oil	10.4	19	0.0%	NA	27.5	2.2	3.4	NA	59,381	96% (89)	67% (86)	192
Sim Gideon (3601)	Operating	Bastrop	Natural gas	623	55	8.1%	14.9	10.4	0.6	1.7	2.9%	4,476	38% (32)	39% (55)	72
Sky Global Power One (59938)	Operating	Colorado	Natural gas	51	4	9.9%	NA	9.5	0.6	25.5	NA	372	18% (11)	24% (33)	55
Spencer (4266)	Unknown	Denton	Natural gas	126.5	65	1.1%	5.9	13.0	0.8	0.8	7.4%	79,284	43% (37)	44% (62)	166
Stryker Creek (internal combustion unit)[31] (3504)	Operating	Cherokee	Oil	10	54	0.2%	NA	7.3	0.6	29.1	NA	359	34% (27)	48% (67)	82
Stryker Creek (steam turbine unit)[32] (3504)	Operating	Cherokee	Natural gas	703.4	62	1.8%	9	12.3	0.7	1.1	1.0%	359	34% (27)	48% (67)	82
T.H. Wharton (gas turbine unit)[33] (3469)	Operating	Harris	Natural gas	526.3	53	0.8%	4.5	21.3	0.8	4.4	2.6%	100,058	75% (66)	36% (51)	185
Tradinghouse Creek Gas Project (3506)	Proposed; cancelled?	McLennan	Natural gas	460	NA	NA	NA	NA	NA	NA	NA	590	18% (12)	34% (48)	119
Trinidad (3507)	Operating	Henderson	Natural gas	239.3	55	1.2%	11	14.2	0.8	2.4	0.4%	827	18% (11)	57% (77)	85
Ty Cooke (gas turbine unit)[34] (3602)	Operating	Lubbock	Natural gas	40.5	56	2.0%	NA	15.1	0.9	3.5	NA	3,475	76% (67)	54% (74)	172

[30] Internal combustion unit at 146 MW gas combined cycle plant.
[31] Internal combustion unit at 712 MW gas plant.
[32] Steam turbine unit at 712 MW gas plant.
[33] Gas turbine unit at 1,001 MW gas plant.
[34] Gas turbine unit at 338 MW gas plant.

Ty Cooke (steam turbine unit)[35] (3602)	Operating	Lubbock	Natural gas	97.6	55	1.8%	NA	11.6	0.7	1.0	NA	3,475	76% (67)	54% (74)	172
V.H. Braunig (gas turbine unit)[36] (3612)	Operating	Bexar	Natural gas	244	10	5.4%	7.7	9.8	0.6	0.1	3.0%	3,693	66% (57)	42% (61)	180
V.H. Braunig (steam turbine unit)[37] (3612)	Operating	Bexar	Natural gas	894	54	6.1%	25.1	11.1	0.7	1.8	3.7%	3,693	66% (57)	42% (61)	180
Van Alstyne Energy Center (59617)	Proposed	Grayson	Natural gas	579	NA	NA	NA	NA	NA	NA	NA	7,011	15% (8)	24% (33)	119
Victoria City Power (61241)	Operating	Victoria	Natural gas	100	0	NA	NA	NA	NA	NA	NA	27,790	77% (67)	55% (75)	212
Victoria Port Power (61242)	Operating	Victoria	Natural gas	100	1	NA	NA	NA	NA	NA	NA	808	45% (39)	36% (51)	158
Wilkes (3478)	Operating	Marion	Natural gas	882	56	7.3%	393	10.9	0.6	1.4	0.0%	379	26% (19)	29% (41)	79
Winchester Power Park (56674)	Operating	Fayette	Natural gas	242	10	2.3%	5.5	9.1	0.5	0.1	1.1%	466	13% (6)	19% (26)	55

[35] Steam turbine unit at 338 MW gas plant.
[36] Gas turbine unit at 1,138 MW gas plant.
[37] Steam turbine unit at 1,138 MW gas plant.