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Public Utility Commission of Texas

TO: Interested Persons

FROM: Therese Harris, Director, Director, Infrastructure Division

DATE: November 14, 2022

RE: Project No. 38578 – Avoided Cost of Capacity and Energy 2023 Program Year

Avoided Cost of Capacity and Energy for the 2023 Program Year

Avoided Cost of Capacity

As shown below from the United States Department of Energy's Energy Information Administration's (EIA) Cost and Performance Characteristics of New Central Station Electricity Generating Technologies associated with EIA's Annual Energy Outlook 2022, the base overnight cost of a combustion turbine—industrial frame is $692 per kilowatt (kW) in the Texas Reliability Entity or Electric Reliability Council of Texas (ERCOT) region. Because this amount is less than the $700 per kW threshold set by 16 Texas Administrative Code (TAC) § 25.181(d)(2)(A)(ii), the avoided cost of capacity is $80 per kW-year for 2023.

Avoided Cost of Energy

As stated in its filing on October 31, 2022 in this project, ERCOT calculated the avoided cost of energy for 2023 in compliance with the Commission's Order in Docket No. 52871 which required ERCOT to use the winter peak periods of December 2019 through February 2020 and December 2021 through February 2022 and the summer peak periods of June 2020 through September 2020 and June 2022 through September 2022 to calculate the avoided cost of energy for energy efficiency programs for the 2023 program year.[1] Using the methodology in 16 TAC § 25.181(d)(3)(A), ERCOT calculated an avoided cost of energy for 2023 of $91.15 /MWh, which is equivalent to $0.09115/kWh.

[1] Commission Staff's Petition for a Good Cause Exception to 16 Texas Administrative Code § 25.181 (d)(3) (A) and to set the Avoided Cost of Energy under § 25.181 (d)(3)(A) for 2022 Electric Utility Energy Efficiency Programs, Docket No. 52871, Ordering Paragraph No. 5 (May 12, 2022).

Table 1. Cost and performance characteristics of new central station electricity generating technologies

Technology	First available year[a]	Size (MW)	Lead time (years)	Base overnight cost[b] (2021$/kW)	Techno-logical optimism factor[c]	Total overnight cost[d,e] (2021$/kW)	Variable O&M[f] (2021 $/MWh)	Fixed O&M (2021$/ kW-y)	Heat rate[g] (Btu/kWh)
Ultra-supercritical coal (USC)	2025	650	4	$4,074	1.00	$4,074	$4.71	$42.49	8,638
USC with 30% carbon capture and sequestration (CCS)	2025	650	4	$5,045	1.01	$5,096	$7.41	$56.84	9,751
USC with 90% CCS	2025	650	4	$6,495	1.02	$6,625	$11.49	$62.34	12,507
Combined-cycle—single-shaft	2024	418	3	$1,201	1.00	$1,201	$2.67	$14.76	6,431
Combined-cycle—multi-shaft	2024	1,083	3	$1,062	1.00	$1,062	$1.96	$12.77	6,370
Combined-cycle with 90% CCS	2024	377	3	$2,736	1.04	$2,845	$6.11	$28.89	7,124
Internal combustion engine	2023	21	2	$2,018	1.00	$2,018	$5.96	$36.81	8,295
Combustion turbine—aeroderivative[h]	2023	105	2	$1,294	1.00	$1,294	$4.92	$17.06	9,124
Combustion turbine—industrial frame	2023	237	2	$785	1.00	$785	$4.71	$7.33	9,905
Fuel cells	2024	10	3	$6,639	1.09	$7,224	$0.62	$32.23	6,469
Nuclear—light water reactor	2027	2,156	6	$6,695	1.05	$7,030	$2.48	$127.35	10,443
Nuclear—small modular reactor	2028	600	6	$6,861	1.10	$7,547	$3.14	$99.46	10,443
Distributed generation—base	2024	2	3	$1,731	1.00	$1,731	$9.01	$20.27	8,923
Distributed generation—peak	2023	1	2	$2,079	1.00	$2,079	$9.01	$20.27	9,907
Battery storage	2022	50	1	$1,316	1.00	$1,316	$0.00	$25.96	NA
Biomass	2025	50	4	$4,524	1.00	$4,525	$5.06	$131.62	13,500
Geothermal[i, j]	2025	50	4	$3,076	1.00	$3,076	$1.21	$143.22	8,813
Conventional hydropower[j]	2025	100	4	$3,083	1.00	$3,083	$1.46	$43.78	NA
Wind[e]	2024	200	3	$1,718	1.00	$1,718	$0.00	$27.57	NA
Wind offshore[i]	2025	400	4	$4,833	1.25	$6,041	$0.00	$115.16	NA
Solar thermal[i]	2024	115	3	$7,895	1.00	$7,895	$0.00	$89.39	NA
Solar photovoltaic (PV) with tracking[e, i, k]	2023	150	2	$1,327	1.00	$1,327	$0.00	$15.97	NA
Solar PV with storage[i, k]	2023	150	2	$1,748	1.00	$1,748	$0.00	$33.67	NA

Source: We primarily base input costs on a report provided by external consultants: Sargent & Lundy, December 2019. We most recently updated hydropower site costs for non-powered dams for AEO2018 using data from Oak Ridge National Lab

Note: MW=megawatt, kW=kilowatt, MWh=megawatthour, kW-y=kilowatt-year, kWh=kilowatthour; Btu=British thermal unit

[a] The first year that a new unit could become operational.

[b] Base cost includes project contingency costs.

[c] We apply the technological optimism factor to the first four units of a new, unproven design; it reflects the demonstrated tendency to underestimate actual costs for a first-of-a-kind unit.

[d] Overnight capital cost includes contingency factors and excludes regional multipliers (except as noted for wind and solar PV) and learning effects. Interest charges are also excluded. The capital costs represent current costs for plants that would come online in 2022.

[e] Total overnight cost for wind and solar PV technologies in the table are the average input value across all 25 electricity market regions, as weighted by the respective capacity of that type installed during 2020 in each region to account for the substantial regional variation in wind and solar costs (Table 4). The input value used for onshore wind in AEO2022 was $1,411 per kilowatt (kW), and for solar PV with tracking, it was $1,323/kW, which represents the cost of building a plant excluding regional factors. Region-specific factors contributing to the substantial regional variation in cost include differences in typical project size across regions, accessibility of resources, and variation in labor and other construction costs throughout the country.

[f] O&M = Operations and maintenance.

[g] The nuclear average heat rate is the weighted average tested heat rate for nuclear units as reported on the Form EIA-860, *Annual Electric Generator Report*. No heat rate is reported for battery storage because it is not a primary conversion technology; conversion losses are accounted for when the electricity is first generated; electricity-to-storage losses are accounted for through the additional demand for electricity required to meet load. For hydropower, wind, solar, and geothermal technologies, no heat rate is reported because the power is generated without fuel combustion, and no set British thermal unit conversion factors exist. The module calculates the average heat rate for fossil-fuel generation in each year to report primary energy consumption displaced for these resources.

[h] Combustion turbine aeroderivative units can be built by the module before 2023, if necessary, to meet a region's reserve margin.

[i] Capital costs are shown before investment tax credits are applied.

[j] Because geothermal and hydropower cost and performance characteristics are specific for each site, the table entries show the cost of the least expensive plant that could be built in the Northwest region for hydro and the Great Basin region for geothermal, where most of the proposed sites are located.

[k] Costs and capacities are expressed in terms of net AC (alternating current) power available to the grid for the installed capacity.

Table 2. Total overnight capital costs of new electricity generating technologies by region

2021 dollars per kilowatt

Technology	1 TRE	2 FRCC	3 MISW	4 MISC	5 MISE	6 MISS	7 ISNE	8 NYCW	9 NYUP	10 PJME	11 PJMW	12 PJMC	13 PJMD
Ultra-supercritical coal (USC)	$3,786	$3,897	$4,259	$4,371	$4,422	$3,918	$4,721	NA	$4,614	$4,763	$4,064	$5,120	$4,385
USC with 30% CCS	$4,777	$4,903	$5,294	$5,437	$5,480	$4,935	$5,846	NA	$5,729	$5,883	$5,094	$6,254	$5,477
USC with 90% CCS	$6,252	$6,411	$6,841	$7,072	$7,078	$6,473	$7,495	NA	$7,303	$7,508	$6,601	$7,994	$7,015
CC—single-shaft	$1,085	$1,107	$1,235	$1,246	$1,277	$1,117	$1,441	$1,912	$1,445	$1,443	$1,197	$1,446	$1,377
CC—multi-shaft	$944	$968	$1,098	$1,117	$1,146	$979	$1,259	$1,725	$1,238	$1,266	$1,037	$1,327	$1,170
CC with 90% CCS	$2,668	$2,693	$2,877	$2,884	$2,928	$2,718	$3,021	$3,422	$2,953	$2,996	$2,756	$3,124	$2,871
Internal combustion engine	$1,898	$1,940	$2,073	$2,155	$2,131	$1,966	$2,209	$2,769	$2,125	$2,209	$1,980	$2,408	$2,056
CT—aeroderivative	$1,145	$1,168	$1,354	$1,357	$1,398	$1,193	$1,456	$1,864	$1,405	$1,448	$1,242	$1,591	$1,317
CT—industrial frame	$692	$707	$822	$826	$851	$723	$886	$1,144	$854	$882	$753	$971	$800
Fuel cells	$6,933	$7,041	$7,362	$7,680	$7,534	$7,159	$7,815	$9,201	$7,498	$7,748	$7,138	$8,261	$7,358
Nuclear—light water reactor	$6,636	$6,779	$7,157	$7,807	$7,530	$7,000	$7,964	NA	$7,430	$7,781	$6,878	$8,556	$7,158
Nuclear—small modular reactor	$7,032	$7,197	$7,841	$8,176	$8,173	$7,287	$8,441	NA	$8,040	$8,459	$7,376	$9,438	$7,660
Distributed generation—base	$1,563	$1,595	$1,779	$1,795	$1,840	$1,609	$2,076	$2,754	$2,081	$2,079	$1,724	$2,083	$1,984
Distributed generation—peak	$1,839	$1,877	$2,174	$2,180	$2,246	$1,916	$2,339	$2,994	$2,257	$2,326	$1,995	$2,555	$2,116
Battery storage	$1,316	$1,320	$1,301	$1,364	$1,319	$1,347	$1,357	$1,351	$1,321	$1,325	$1,313	$1,329	$1,325
Biomass	$4,198	$4,313	$4,669	$4,824	$4,835	$4,348	$5,372	$7,292	$5,389	$5,483	$4,611	$5,493	$5,255
Geothermal	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Conventional hydropower	$4,498	$5,495	$2,186	$1,453	$2,959	$4,378	$2,025	NA	$4,144	$4,305	$3,752	NA	$3,808
Wind	$2,757	NA	$1,552	$1,411	$1,690	$1,411	$1,870	NA	$2,281	$1,870	$1,411	$2,055	$1,948
Wind offshore	$5,901	$7,080	$6,984	NA	$7,234	NA	$7,047	$6,079	$7,370	$6,755	$5,524	$7,999	$6,293
Solar thermal	$7,616	$7,731	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Solar PV with tracking	$1,304	$1,279	$1,323	$1,372	$1,357	$1,290	$1,370	$1,612	$1,357	$1,397	$1,320	$1,440	$1,317
Solar PV with storage	$1,692	$1,710	$1,761	$1,817	$1,792	$1,727	$1,828	$2,078	$1,796	$1,832	$1,721	$1,905	$1,781