Case 20 EIA – Capital Cost Estimates – 2019 $s		
Configuration		**Onshore Wind – Large Plant Footprint: Great Plains Region** 200 MW | 2.8 MW WTG
Hub Height (m)		90
Rotor Diameter (m)		125
	Units	
Typical Project Timelines		
Development, Permitting, Engineering	months	12
Plant Construction Time	months	9
Total Lead Time Before COD	months	21
Operating Life	years	25
Cost Components (Note 1)		**Total**
Civil/Structural/Architectural Subtotal	$	24,297,000
WTG Procurement and Supply	$	155,209,000
WTG Erection	$	7,502,000
Mechanical Subtotal	$	162,711,000
Electrical – Substation Electrical Equipment	$	7,679,000
Electrical – Pad Mount Transformers and Collection System	$	10,711,000
Electrical Subtotal	$	18,390,000
Project Indirects	$	5,183,000
EPC Total Before Fee	$	210,581,000
EPC Fee	$	16,846,000
EPC Subtotal	$	227,427,000
Owner' Cost Components (Note 2)		
Owner's Cost Subtotal	$	15,919,890
Project Contingency	$	9,734,000
Total Capital Cost	**$**	253,080,890
	$/kW net	**1,265**
Capital Cost Notes		
1. Costs based on EPC contracting approach. Direct costs include equipment, material, and labor to construct the civil/structural, mechanical, and electrical/I&C components of the facility. Indirect costs include distributable material and labor costs, cranes, scaffolding, engineering, construction management, startup and commissioning, and contractor overhead. EPC fees are applied to the sum of direct and indirect costs. 2. Owner's costs include project development, studies, permitting, legal, owner's project management, owner's engineering, and owner's startup and commissioning costs. Other owner's costs include electrical interconnection costs.		

20.4 O&M COST ESTIMATE

O&M cost estimates reflect a full-service agreement arrangement under which an O&M contractor provides labor, management, and parts replacement (including unscheduled parts replacement) for the WTGs, collection system, and substation. Our cost estimate excludes site-specific owner's costs such as land lease royalties, property taxes, and insurance. However, average land lease cost in Great Plains region is $2.84/kW-yr. Table 20-2 summarizes the average annual O&M expenses projected for an assumed 25-year project life.

Table 20-2 — Case 20 O&M Cost Estimate

Case 20 EIA – Non-Fuel O&M Costs – 2019 $s		
Onshore Wind – Large Plant Footprint: Great Plains Region		
Fixed O&M – Plant (Note 1)		
WTG Scheduled Maintenance	$/year	2,294,000
WTG Unscheduled Maintenance	$/year	2,167,000
Balance of Plant Maintenance	$/year	806,000
Subtotal Fixed O&M	$/year	5,267,000
$/kW-year	$/kW-year	**26.34 $/kW-year**
Variable O&M (Note 2)	$/MWh	**0.00 $/MWh**
O&M Cost Notes		
1. Fixed O&M costs include labor, materials and contracted services, and G&A costs.		
2. O&M Costs estimates reflect Full Service Agreement and exclude site specific owner's costs such as land lease, royalties, property taxes, and insurance. Average land lease costs in Great Plains region is $2.80/kW-year.		
3. Average FSA term considered: 25 years		

20.5 ENVIRONMENTAL & EMISSIONS INFORMATION

Wind power projects do not produce regulated environmental air emissions. While other environmental compliance requirements may apply, only air emissions were considered for this report. Therefore, the emissions of NO_X, SO_2, and CO_2 are 0.00 lb/MMBtu.

CASE 21. ONSHORE WIND, SMALL PLANT FOOTPRINT, 50 MW

21.1 CASE DESCRIPTION

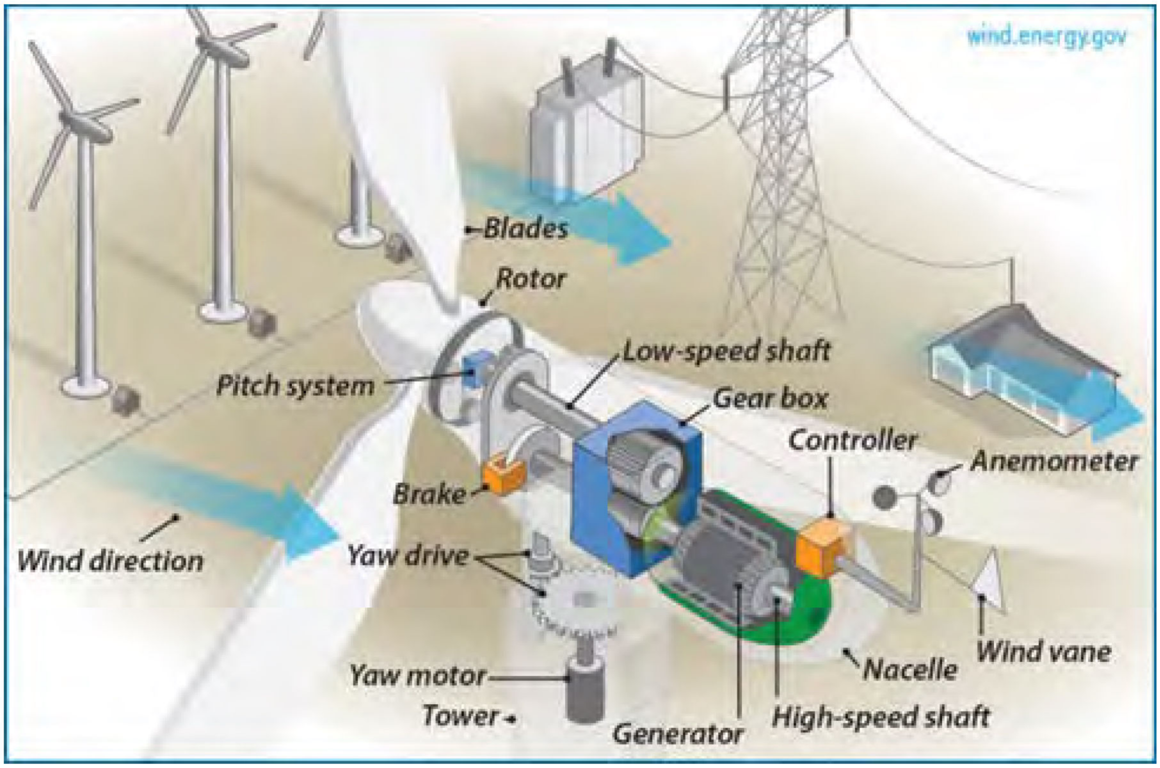
This case is an onshore wind project with a total project capacity of 50 MW. "Coastal" refers to the area that is reflective of the Mid-Atlantic, Northeast, and Pacific regions of the United States. Due to assumed land availability constraints for this region, the project capacity is limited.

21.1.1 Mechanical Equipment & Systems

The onshore wind project in the Coastal region is based on a 50-MW total project capacity. Parameters that affect project cost and performance include turbine nameplate capacity, rotor diameter, and hub height. The case configuration assumes 17 wind turbines with a nominal rating of 2.8 MW with 125-meter rotor diameters and 90-meter hub heights. These features reflect modern wind turbines that employ larger rotor diameter and greater hub heights. The primary advantage of taller hub heights and larger rotor diameters include access to better wind profiles at higher altitudes and increased turbine swept area, enabling the unit to capture more energy.

Wind turbine generators convert kinetic wind energy into electrical power. The most ubiquitous type of wind turbine used for electric power generation are those of the horizontal-axis three-bladed design. Lift is generated when wind flows around the turbine blades, resulting in rotation. The blades are connected to a central hub and drivetrain that turns a generator located inside of the nacelle, which is the housing positioned atop the wind turbine tower.

Figure 21-1 — Wind Turbine Generator Drivetrain



Source: Office of Energy Efficiency & Renewable Energy, Wind Energy Technologies Office – U.S. Department of Energy, *windTurbineLabels*, ND. Digital Image (Image 1 of 17).
Retrieved from Energy.gov, https://www.energy.gov/eere/wind/inside-wind-turbine (accessed May 31, 2019).

21.1.2 Electrical & Control Systems

Each WTG consists of a doubly-fed induction generator. The low-voltage output from the generator is stepped up to medium voltage through a transformer located either in the nacelle or at the tower base. A medium voltage collection system conveys the generated energy to an onsite substation that further steps up the voltage for interconnection with the transmission system with a voltage of 230 kV.

A SCADA system is provided for communications and control of the wind turbines and substation. The SCADA system allows the operations staff to remotely control and monitor each wind turbine and the wind project as a whole.

21.1.3 Offsite Requirements

Wind projects harness power from wind and therefore do not require fuel or fuel infrastructure. The offsite requirements are limited to construction of site and wind turbine access roads, the O&M building, and electrical interconnection to the transmission system.

21.2 CAPITAL COST ESTIMATE

The base cost estimate for this technology case totals $1677/kW. Table 21-1 summarizes the cost components for this case.

Capital cost estimates were broken down into the following categories:

- **Civil/Structural Costs:** These costs include the WTG spread footing and substation foundations, access roads, crane pads, road improvements, and O&M building.
- **Mechanical Costs:** These costs include the purchase price for the WTGs from the OEM (blades, hub, drivetrain, generator, tower, and electronics), transportation and delivery to the project site, and assembly and erection on site.
- **Electrical Costs:** These costs include pad-mounted transformers, collection system, and project substation.
- **Project Indirect Costs:** These costs include construction management, engineering, and G&A costs.
- **EPC Fee:** The EPC fee is a markup charged by the construction contractor.
- **Project Contingency Costs:** Contingency is an allowance considered to cover the cost of undefined or uncertain scope of work, including EPC change orders or costs associated with schedule delays.
- **Owner Costs:** These costs include Project development costs that cover project feasibility analyses, wind resource assessments, geotechnical studies, contracting for land access, transmission access, and permitting. However, estimates exclude project financing costs.

Table 21-1 — Case 21 Capital Cost Estimate

Case 21 EIA – Capital Cost Estimates – 2019 $s		
Configuration		**Onshore Wind – Small Plant Footprint: Coastal Region** 50 MW | 2.8 MW WTG
Hub Height (m)		90
Rotor Diameter (m)		125
	Units	
Plant Characteristics		
Net Plant Capacity	MW	50
Capital Cost Assumptions		
EPC Contracting Fee	% of Direct & Indirect Costs	8%
Project Contingency	% of Project Costs	6%
Owner's Services	% of Project Costs	10%
Electric Interconnection Costs		
Transmission Line Cost	$/mile	1,200,000
Miles	miles	1.00

Case 21 EIA – Capital Cost Estimates – 2019 $s		
Configuration		**Onshore Wind – Small Plant Footprint: Coastal Region** 50 MW | 2.8 MW WTG
Hub Height (m)		90
Rotor Diameter (m)		125
	Units	
Typical Project Timelines		
Development, Permitting, Engineering	months	12
Plant Construction Time	months	6
Total Lead Time Before COD	months	18
Operating Life	years	25
Cost Components (Note 1)		**Total**
Civil/Structural/Architectural Subtotal	$	10,529,000
WTG Procurement and Supply	$	44,881,000
Turbine Erection	$	3,539,000
Mechanical Subtotal	$	48,419,000
Electrical – Substation Electrical Equipment	$	510,000
Electrical – Pad Mount Transformers and Collection System	$	3,495,000
Electrical Subtotal	$	6,005,000
Project Indirects	$	1,618,000
EPC Total Before Fee	$	66,571,000
EPC Fee	$	5,326,000
EPC Subtotal	$	71,897,000
Owner's Cost Subtotal (Note 2)	$	7,189,700
Project Contingency	$	4,745,000
Total Capital Cost	**$**	83,831,700
	$/kW net	**1,677**
Capital Cost Notes		
1. Costs based on EPC contracting approach. Direct costs include equipment, material, and labor to construct the civil/structural, mechanical, and electrical/I&C components of the facility. Indirect costs include distributable material and labor costs, cranes, scaffolding, engineering, construction management, startup and commissioning, and contractor overhead. EPC fees are applied to the sum of direct and indirect costs.		
2. Owner's costs include project development, studies, permitting, legal, owner's project management, owner's engineering, and owner's startup and commissioning costs. Other owner's costs include electrical interconnection costs.		

21.3 O&M COST ESTIMATE

O&M cost estimates reflect a full-service agreement arrangement, under which an O&M contractor provides labor, management, and parts replacement (including unscheduled parts replacement) for the WTGs, collection system, and substation. Our cost estimates exclude site specific owner's costs such as land lease royalties, property taxes and insurance. However, average land lease costs in Coastal region is $3.60/kW-yr. Table 21-2 summarizes the average annual O&M expenses projected for an assumed 25-year project life.

Table 21-2 — Case 21 O&M Cost Estimate

Case 21 EIA – Non-Fuel O&M Costs – 2019 $s		
Onshore Wind – Small Plant Footprint: Coastal Region		
Fixed O&M – Plant ($/kW-year) (Note 1)		
WTG Scheduled Maintenance	$/year	765,000
WTG Unscheduled Maintenance	$/year	723,000
Balance of Plant Maintenance	$/year	269,000
Subtotal Fixed O&M	$/year	1,757,000
$/kW-year	$/kW-year	**35.14 $/kW-year**
Variable O&M ($/MWh) (Note 2)	$/MWh	**0.00 $/MWh**
O&M Cost Notes		
1. Fixed O&M costs include labor, materials and contracted services, and G&A costs.		
2. O&M Costs estimates reflect Full Service Agreement and exclude site specific owner's costs such as land lease, royalties, property taxes and insurance. Average land lease costs in Coastal region is $3.60/kW-year.		
3. Average FSA term considered: 25 years		

21.4 ENVIRONMENTAL & EMISSIONS INFORMATION

Wind power projects do not produce regulated environmental air emissions. While other environmental compliance requirements may apply, only air emissions were considered for this report. Therefore, the emissions of NO_X, SO_2, and CO_2 are 0.00 lb/MMBtu.

CASE 22. OFFSHORE WIND, 400 MW

22.1 CASE DESCRIPTION

This case is an offshore wind project with a total 400-MW project capacity. The case configuration assumes wind turbines rated at 10 MW each, located 30 miles offshore in waters with a depth of 100 feet, and assumes a five-mile onshore cable run.

22.1.1 Mechanical Equipment & Systems

The offshore wind project is based on a total project capacity of 400 MW. Parameters that affect project cost and performance include project size, turbine nameplate capacity, water depth, and distance to shore. The case configuration assumes wind turbines rated at 10 MW each. They are located 30 miles offshore in waters with a 100-foot depth. An onshore cable run of five miles is also assumed.

For the purposes of this study, it has been assumed that wind turbines installed employ fixed-type foundation structures; monopile substructures were taken into consideration. Generally, these are installed in relatively shallow waters, not exceeding 150 feet, consistent with our assumption. Water depth and distance to shore has a significant impact on the cost of fixed foundation structure due to the expenses related to cable lengths and installation costs.

Wind turbine generators convert kinetic wind energy into electrical power. The most ubiquitous type of wind turbine used for electric power generation are those of the horizontal-axis three-bladed design. Lift is generated when wind flows around the turbine blades, resulting in rotation. The blades are connected to a central hub and drivetrain that turns a generator located inside of the nacelle, which is the housing positioned atop the wind turbine tower.

22.1.2 Electrical & Control Systems

Each wind turbine consists of a doubly-fed induction generator with high-speed electrical slip rings that produces electricity from the rotational energy of wind. The converter converts DC to AC. The power collection system collects energy from all the wind turbines and increases the voltage to 33–66 kV through a dedicated transformer at the WTG. Array cables, which are buried in the sea floor, transmit electricity to the offshore substation where the voltage is increased to 138 kV. It is then transmitted to an onshore substation via export cables. The power from this substation is supplied for interconnection with the transmission system.

A SCADA system is responsible for communications between the wind turbines and substation. The SCADA system allows the operations staff to remotely control and monitor each wind turbine and the wind project as a whole.

22.1.3 Offsite Requirements

Since wind is a clean source of energy, scope of offsite works is limited to construction of offshore-to-shore submarine cables, port infrastructures, installation vessels (construction and cable laying) and electrical interconnection to the transmission system.

22.2 CAPITAL COST ESTIMATE

The base cost estimate for this technology case totals $4375/kW. Table 22-1 summarizes the cost components for this case.

Capital cost estimates were broken down into the following categories:

- **Civil/Structural Costs:** These costs include the port staging, WTG, and offshore substation foundations.
- **Mechanical Costs:** These costs include the purchase price for the WTGs from the OEM. This price includes the cost of the WTG equipment (blades, hub, drivetrain, generator, tower, and electronics), support vessels, transportation and delivery to port, and erection on site.
- **Electrical Costs:** These cost include interconnection, offshore and onshore transmission that includes inter array cabling, export cabling, and substations.
- **Project Indirect Costs:** These costs include construction management, engineering, and G&A costs.
- **EPC Fee:** The EPC fee is a markup charged by the construction contractor.
- **Project Contingency Costs:** Contingency is an allowance considered to cover the cost of undefined or uncertain scope of work, including EPC change orders or costs associated with schedule delays.
- **Owner Costs:** These costs include Project development costs that cover project feasibility analyses, wind resource assessments, offshore geotechnical and environmental loading studies, obtaining offshore leases, transmission access, and permitting. However, the estimates exclude project financing costs.

Table 22-1 — Case 22 Capital Cost Estimate

Case 22 EIA – Capital Cost Estimates – 2019 $s		
Configuration		**Fixed-bottom Offshore Wind: Monopile Foundations** 400 MW | 10 MW WTG
Offshore Cable Length (mi)		30
Onshore Cable Length (mi)		5
Water Depth (ft)		100
	Units	
Plant Characteristics		
Net Plant Capacity	MW	400
Capital Cost Assumptions		
EPC Contracting Fee	% of Direct & Indirect Costs	10%
Project Contingency	% of Project Costs	10%
Owner's Services	% of Project Costs	5%
Typical Project Timelines		
Development, Permitting, Engineering	months	24
Plant Construction Time	months	12
Total Lead Time Before COD	months	36
Operating Life	years	25
Cost Components (Note 1)		**Total**
Civil/Structural/Architectural Subtotal	$	240,648,000
WTG Procurement and Supply	$	653,008,000
WTG Assembly/Installation	$	125,792,000
Mechanical Subtotal	$	778,800,000
Interconnection	$	60,995,000
Offshore Transmission & eBOP	$	213,947,000
Onshore Transmission	$	60,172,000
Electrical Subtotal	$	335,114,000
Project Indirects	$	74,800,000
EPC Total Before Fee	$	1,429,362,000
EPC Fee	$	85,762,000
EPC Subtotal	$	1,515,124,000
Owner's Cost Subtotal (Note 2)	$	75,756,200
Project Contingency	$	159,088,000
Total Capital Cost	$	1,749,968,200
	$/kW net	**4,375**
Capital Cost Notes		
1. Costs based on EPC contracting approach. Direct costs include equipment, material, and labor to construct the civil/structural, mechanical, and electrical/I&C components of the facility. Indirect costs include distributable material and labor costs, cranes, scaffolding, engineering, construction management, startup and commissioning, and contractor overhead. EPC fees are applied to the sum of direct and indirect costs.		
2. Owner's costs include project development, studies, permitting, legal, owner's project management, owner's engineering, and owner's startup and commissioning costs. Other owner's costs include electrical interconnection costs.		

22.3 O&M COST ESTIMATE

Operating expenditures cover all maintenance expenses during operations, including management, labor, equipment and vessel rentals, parts, and consumables for both scheduled and unscheduled maintenance of the WTGs and BOP systems, as well as operations monitoring.

Table 22-2 — Case 22 O&M Cost Estimate

Case 22 EIA – Non-Fuel O&M Costs – 2019 $s		
Fixed-bottom Offshore Wind: Monopile Foundations		
Fixed O&M – Plant		
Subtotal Fixed O&M	$/kW-year	**110.00 $/kW-year**
Variable O&M	$/MWh	**0.00 $/MWh**

22.4 ENVIRONMENTAL & EMISSIONS INFORMATION

Wind power projects do not produce regulated environmental air emissions. While other environmental compliance requirements may apply, only air emissions were considered for this report. Therefore, the emissions of NO_X, SO_2, and CO_2 are 0.00 lb/MMBtu.

CASE 23. CONCENTRATING SOLAR PLANT, 100 MW, 8-HR STORAGE

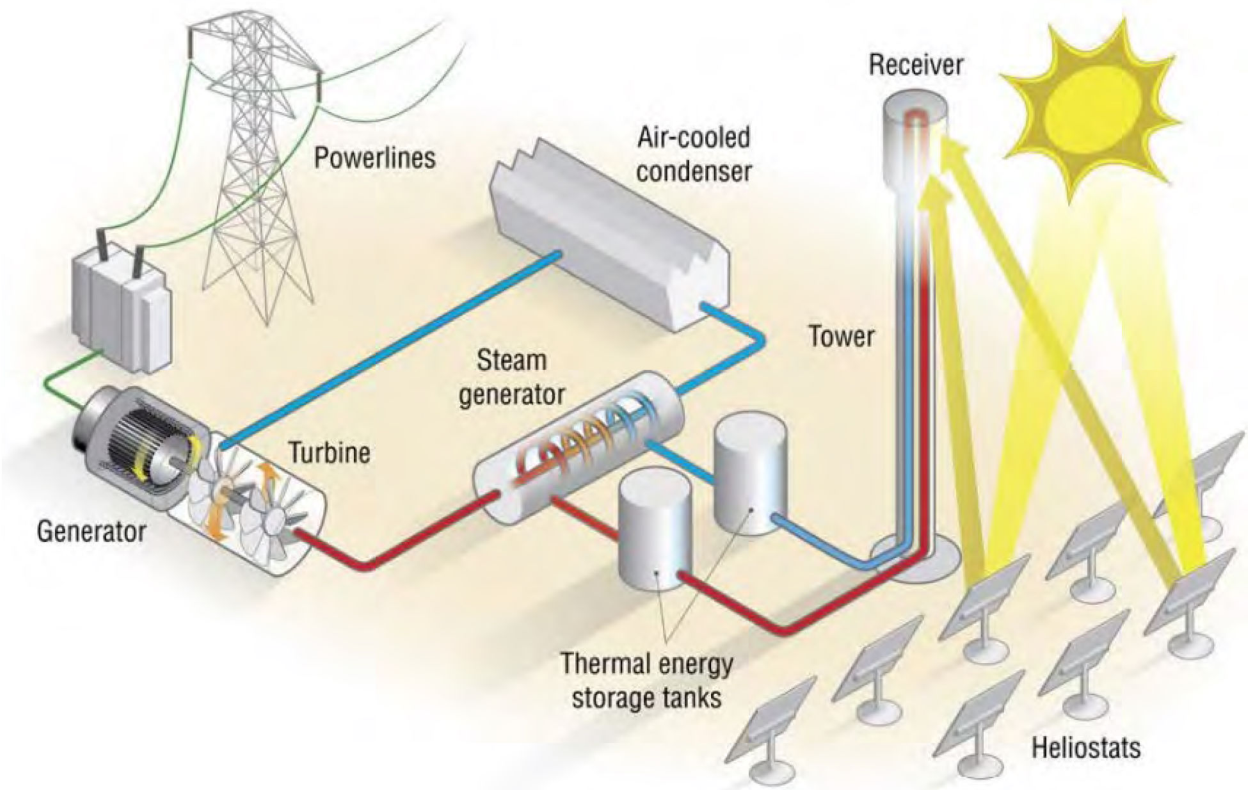
23.1 CASE DESCRIPTION

This case is a concentrating solar thermal power plant (CSP) with eight hours of thermal storage. This type of plant is typically referred to as a “solar power tower” due to the central receiver tower, which is surrounded by a field of reflectors. The solar power tower uses a field of thousands of solar reflectors, called heliostats, to direct solar radiation energy to a central receiver, which is located at the top of the tower. The heliostats can rotate and pitch to direct the sunlight toward the receiver as the sun passes across the horizon.

The plant for this case is rated for 115 MW gross power, and an auxiliary load of approximately 15 MW is expected. Power is generated at 15.5 kV and 60 Hz. It is stepped up to 230 kV for transmission.

Figure 23-1 shows a diagram of the system assumed for this case. The plant is equipped with two molten salt tanks: one hot tank and one cold tank. Molten salt pumps move molten salt from the cold salt tank to the heat exchanger in the receiver where it absorbs energy from the solar radiation concentrated on the surface of the receiver. The hot molten salt flows down the tower to the hot molten salt tank. A molten salt pump from the power block moves molten salt from the hot salt tank through a steam generating heat exchanger to the cold salt tank. Superheated steam is generated in the heat exchanger, which is used to drive a steam turbine to turn a generator. The steam is condensed in an ACC. The plant is equipped with water treatment facilities to support the steam cycle. The plant control system operates both the power block and the solar field. As mentioned, the solar field may consist of thousands of individual heliostat reflectors. Some solar power tower projects include more than 10,000 heliostats. Recent advances in control technology have eliminated the need for control and power cabling to each heliostat. Instead, each heliostat is equipped with a photovoltaic (PV) solar panel and BESS to power the heliostat movement. Each heliostat has a control unit that communicates with a central controller wirelessly.

Figure 23-1 — Concentrating Solar Power Tower System Diagram



Source: U.S. Department of Energy, *2014: The Year of Concentrating Solar Power*, May 2014. PDF. Retrieved from Energy.gov, https://www.energy.gov/sites/prod/files/2014/10/f18/CSP-report-final-web.pdf (accessed June 13, 2019)

The thermal storage system is based on the amount of "hot" molten salt that is stored in the hot salt tank when the solar resource is no longer available after the sun goes down. The duration of storage is contingent on the amount of hot molten salt and its temperature that can be collected in a "solar day," which depends on the solar resource available during that time.

Figure 23-2 shows an aerial view of a concentrating solar power tower plant. The central receiver can be seen on the top of a tower surrounded by thousands of heliostats. The ACC and hot and cold molten salt tanks are clearly shown. Buildings that house the control room, work shop, and spare parts warehouse are also shown.

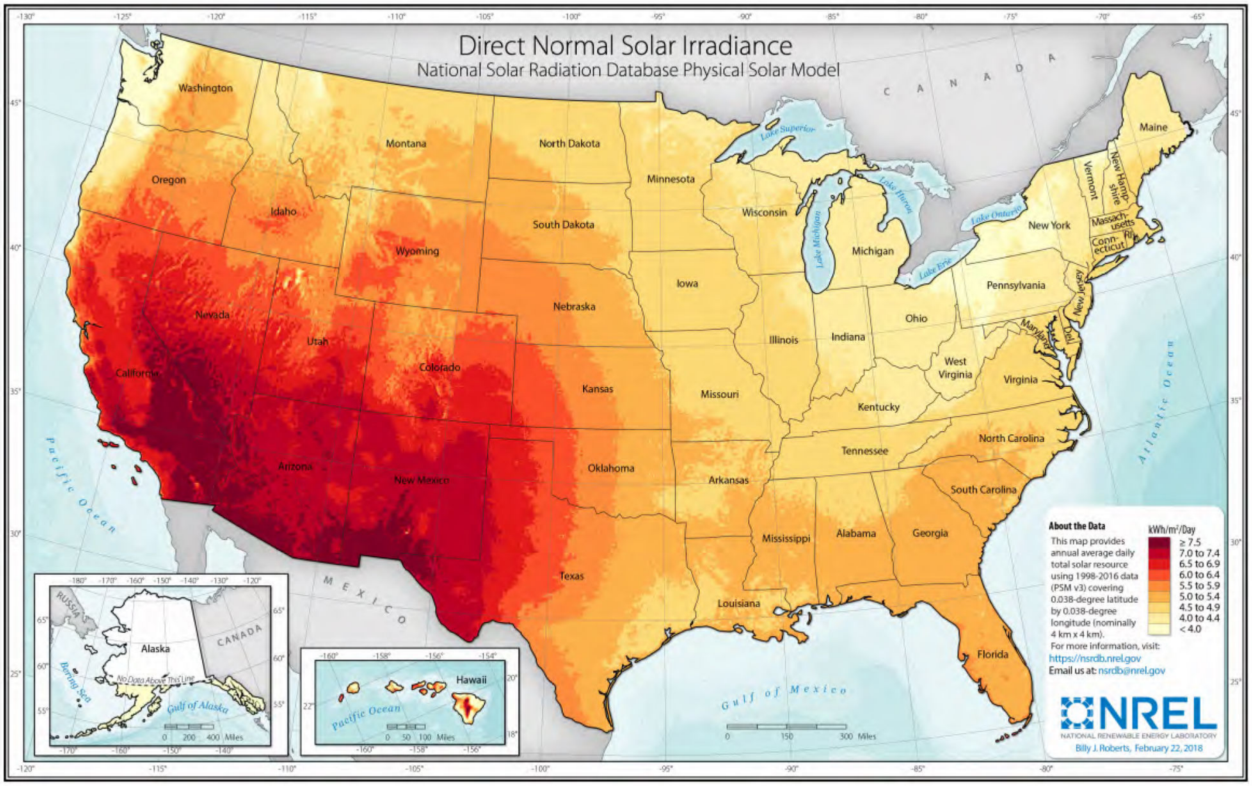
Figure 23-2 — Aerial View of Concentrating Solar Power Tower Project

Crescent Dunes

Source: Loan Programs Office – U.S. Department of Energy, *DOE-LPO_Project-Photos_CSP_Crescent-Dunes_02*, ND. Digital Image. Retrieved from Energy.gov, https://www.energy.gov/lpo/crescent-dunes (accessed June 5, 2019)

Figure 23-3 shows the direct normal solar irradiance across the United States. The solar irradiance is used to determine the best location to capture solar energy.

Figure 23-3 — United States Solar Resource



Source: U.S. Department of Energy, National Renewable Energy Laboratory, *Direct Normal Solar Irradiance*, ND. Retrieved from NREL.gov, https://www.nrel.gov/gis/images/solar/solar_ghi_2018_usa_scale_01.jpg (accessed June 5, 2019).

23.1.1 Offsite Requirements

The cost estimate assumes an allowance for a one-mile transmission line. The estimates include the cost of onsite roads and a connection to an existing nearby highway. The estimate includes the cost of water supply infrastructure onsite; however, potable water and sewer tie-in are nearby.

23.2 CAPITAL COST ESTIMATE

The base cost estimate for this technology case totals $7221/kW. Table 23-1 summarizes the cost components for this case. The capital cost is based on the latest cost information for mechanical and electrical components and considerations for implementing the latest available technology.

The cost estimate includes the cost for land, site clearing, civil works, drainage, roads on the plant site, and water supply infrastructure. The complete heliostat field cost includes the reflector, foundation pedestal, supports, and power and controls for each unit. The receiver tower is based on a concrete structure with an internal space for an elevator, molten salt piping, and related equipment. The molten salt circulation system includes the molten salt pumps, piping, heat tracing, insulation, and related controls equipment. The costs consider the construction of the hot and cold molten salt tanks, their foundations, insulation, heat tracing, the molten salt itself, and related equipment. The steam cycle equipment (i.e., the steam generating superheater, ACC, water treatment system, piping, valves, foundation, instrumentation and controls, and all related equipment) are included. All electrical BOP, fire protection equipment, and other equipment and materials needed to complete construction are included in the cost estimate. All labor and equipment needed for construction is included with the cost estimate.

In the past few years, concentrating solar power technology has been implemented in the Middle East more frequently than the United States. Therefore, much of the publicly available cost information indicates a $/installed kW significantly lower than the estimate in this report, which is for a project constructed in the United States. The installed project cost for an identical project in the Middle East (e.g., United Arab Emirates) can be expected to be lower by a significant amount. The lower costs are a result of several factors, including labor cost, which can be nearly half the cost as in the United States[3]; government assistance with financial costs (in the forms of favorable loan programs, low taxes, and other incentives); low profit margins; and aggressive contracting.

The capital cost estimate is based on an EPC contracting approach.

Typical project related costs are included, such as Owner's services, project development costs, studies, permitting, legal, project management, owner's engineering, and start-up and commissioning.

Table 23-1 — Case 23 Capital Cost Estimate

Case 23 EIA – Capital Cost Estimates – 2019 $s		
Configuration		**Concentrating Solar Power Tower with Molten Salt Thermal Storage**
	Units	
Plant Characteristics		
Gross Power Rating	MW	115
Net Power Rating	MW	100
Thermal Storage	hr	8
Capital Cost Assumptions		
EPC Contracting Fee	% of Project Costs	10%
Project Contingency	% of Project Costs	10%
Owner's Services	% of Project Costs	7%
Estimated Land Requirement	acres	2,000
Estimated Land Cost	$/acre	10,000

[3] https://arstechnica.com/science/2018/10/are-super-cheap-solar-fields-in-the-middle-east-just-loss-leaders/

Case 23 EIA – Capital Cost Estimates – 2019 $s		
Configuration		**Concentrating Solar Power Tower with Molten Salt Thermal Storage**
	Units	
Electric Interconnection Costs		
Transmission Line Cost	$/mile	1,200,000
Miles	miles	1.00
Typical Project Timelines		
Development, Permitting, Engineering	months	15
Plant Construction Time	months	30
Total Lead Time Before COD	months	33
Operating Life	years	30
Cost Components (Note 1)		**Total**
Direct Costs		
Site Preparation	$	18,474,000
Heliostat Field	$	157,437,000
Tower	$	24,816,000
Receiver	$	74,081,000
Thermal Energy Storage System (TES)	$	65,276,000
Balance of Plant – Steam System	$	11,310,000
Balance of Plant – Electrical, Instrumentation and Controls	$	9,186,000
Balance of Plant – Foundations & Support Structures	$	15,917,000
Power Block (Steam Turbine, steam cycle, related systems)	$	122,077,000
Direct Costs Subtotal	$	498,574,000
Project Indirect	$	37,135,000
EPC Total Before Fee	$	535,709,000
EPC Fee	$	53,571,000
EPC Subtotal	$	589,280,000
Owner's Cost Components (Note 2)		
Owner's Services	$	46,000,000
Land	$	20,000,000
Electrical Interconnection	$	1,200,000
Owner's Cost Subtotal	$	67,200,000
Project Contingency	$	65,648,000
Total Capital Cost	**$**	**722,128,000**
	$/kW net	**7,221**
Capital Cost Notes		
1. Costs based on EPC contracting approach. Direct costs include equipment, material, and labor to construct the civil/structural, mechanical, and electrical/I&C components of the facility. Indirect costs include distributable material and labor costs, cranes, scaffolding, engineering, construction management, startup and commissioning, and contractor overhead. EPC fees are applied to the sum of direct and indirect costs.		
2. Owner's costs include project development, studies, permitting, legal, owner's project management, owner's engineering, and owner's startup and commissioning costs. Other owner's costs include electrical interconnection costs, gas interconnection costs (if applicable), and land acquisition costs.		

23.3 O&M COST ESTIMATE

The O&M cost estimate incorporates the annual cost of the onsite O&M staff as well as contracted services for grounds keeping, mirror washing, water treatment, and computer maintenance. The O&M cost also incorporates the estimated annual water requirements, which will be purchased. The need for various consumables and replacement parts are also considered. Since the annual cost of consumables for the plant can be estimated, the entire O&M cost is captured as a fixed amount. The variable cost is considered to be $0.00/MWh.

Table 23-2 — Case 23 O&M Cost Estimate

Case 23 EIA – Non-Fuel O&M Costs – 2019 $s		
Concentrating Solar Power Tower		
Fixed O&M – Plant (Note 1)		
Subtotal Fixed O&M	$/kW-year	**85.39 $/kW-year**
Variable O&M (Note 2)	$/MWh	**0.00 $/MWh**
O&M Cost Notes		
1. Fixed O&M costs include labor, materials, utilities, and contracted services, and G&A costs. O&M Costs exclude property taxes and insurance.		
2. All costs tied to energy produced are covered in fixed cost.		

23.4 ENVIRONMENTAL & EMISSIONS INFORMATION

Concentrating solar power plants do not produce regulated environmental emissions. While other environmental compliance requirements may apply, only air emissions were considered for this report. Therefore, the emissions of NO_X, SO_2, and CO_2 are 0.00 lb/MMBtu.

CASE 24. SOLAR PHOTOVOLTAIC, 150 MW_{AC}

24.1 CASE DESCRIPTION

This case is a nominal 150-MW_{AC} solar photovoltaic (PV) facility with single-axis tracking. With continued advances in technical efficiency and lower module price, solar PV cost has decreased significantly in the past decade. This case uses 195 MW_{DC} of 1,500-V monocrystalline PERC modules with independent row trackers that are placed in a north-south orientation with east-west tracking. The case also uses 150 MW_{AC} of central inverters, resulting in a DC/AC ratio of 1.3. The simplicity of solar PV projects is that there is no fuel or waste and limited moving parts; however, single-axis tracking systems require considerable land commitments due to a low ground coverage ratio intended to limit self-shading and create room for tracking rotation. Many tracking companies offer advanced backtracking software that help to optimize yield and ground coverage ratio, though this was not considered in this estimate.

Figure 24-1 — Solar Photovoltaic Project

Foothills Solar Project using single-axis tracking in Loveland, Colorado.

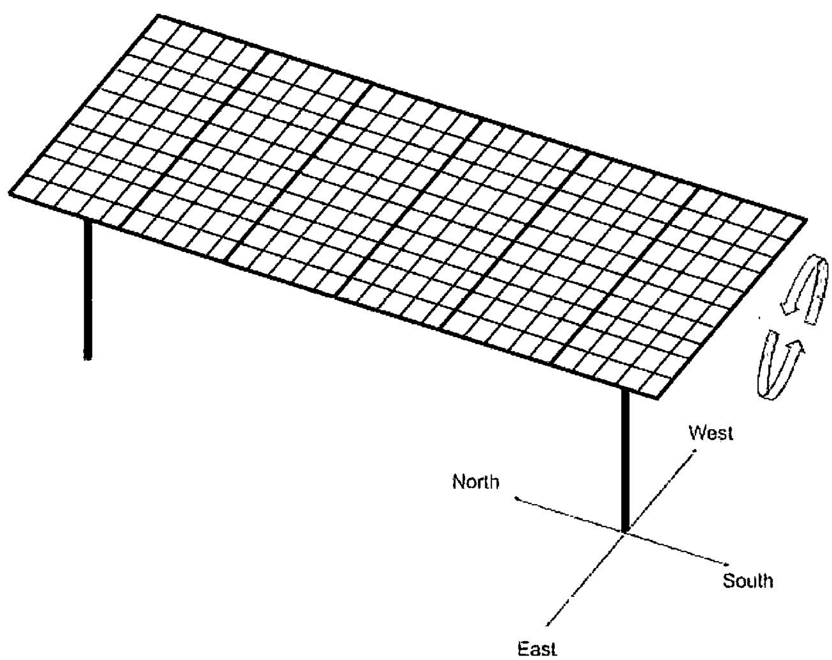
Source: American Public Power Association, *gray solar panel lot*, 2017. Digital Image.
Retrieved from: Unsplash.com, https://unsplash.com/photos/dCx2xFuPWks (accessed June 12, 2019).

24.1.1 Mechanical Equipment & Systems

PV refers to the conversion of light into electricity. Solar PV modules convert incident solar radiation into a potential difference within individual solar cells that produces DC electricity. The solar PV facility assumed for this study is comprised of 487,500 individual 400-watt, 1500-V monocrystalline solar modules with PERC architecture for increased efficiency. These modules are connected in series to each other in strings of 30 modules per string. The strings connect to each other in parallel to form large solar arrays, which make up the bulk of the facility. Arrays are often grouped together into distinct blocks throughout the plant with each block having a single designated inverter pad. Mechanical components of these arrays include the racking and solar tracking equipment. This estimate assumes the racking uses a driven pile foundation; however, depending on the site's geotechnical characteristics, ground screws and concrete foundations can also be used.

The tracking system's exact mechanics depend on the manufacturer. This system, and nearly all single-axis tracking systems currently being manufactured, use a north-south oriented tracking axis that is horizontally parallel with respect to the ground. This orientation allows the panels to track the sun as it crosses the sky east to west. One variation in tracking mechanics that can impact the overall price is linked versus unlinked row tracking. Linked row tracking connects multiple rows to a single tracker mechanism, thereby requiring them all to rotate at the same angle throughout the day. Unlinked row tracking allows individual rows to track the sun at different angles but require a solar tracker mechanism on each row. This case assumes an unlinked single-axis tracker technology.

Figure 24-2 — Single-Axis Tracking



24.1.2 Electrical & Control Systems

Each block within a PV is made up of identical components and functionality. Electrical components include:

- DC and AC wiring
- Combiner boxes
- Inverters
- Step-up transformers
- Control system
- Switchyard with electrical interconnection to the grid

As previously explained, modules are combined in series to form series strings. These strings are combined in parallel to form solar arrays. Arrays are then connected via combiner boxes to combine the current from each string of each array before feeding the DC power into an inverter. The number of arrays combined into each combiner box is dependent on the site layout, the current of each string, and the size of the combiner box. This estimate assumes one combiner box for every thirty strings. After DC cables from the combiner boxes are fed into the inverter, the inverter then converts the DC electricity from the combiner boxes into AC electricity. Inverters currently used in new projects are typically rated between 1,500 kW and 4000 kW. There are also two types of solar inverters: central and string. This system uses two 2500-kW central inverters with one 5.05-MW medium voltage transformer within each PV block.

A solar facility's nominal capacity is typically defined by the net AC capacity of the inverters across all blocks. In general, there will always be more installed DC capacity from the modules than AC capacity from the inverters. The ratio of DC to AC capacity (DC/AC ratio) is typically between 1.2 and 1.4; however, some projects increase the DC/AC ratio with the intention of harnessing the DC power that is clipped by the inverter's maximum capacity into battery storage energy. On the other side of the spectrum, some projects will decrease the DC/AC ratio to allow for additional reactive compensation. This estimate assumes a DC/AC ratio of 1.3.

24.1.3 Offsite Requirements

Solar PV facilities require no fuel and produce no waste. The offsite requirements are limited to an interconnection between the PV facility and the transmission system as well as water for the purpose of cleaning the solar modules. Additionally, cleaning is regionally dependent. In regions with significant rainfall and limited dust accumulation, cleaning is often unnecessary because it occurs naturally. In dust heavy and dry regions (which often have higher solar irradiance), cleaning occurs proportionally to the dust accumulation from once or twice a year up to bi-monthly and typically uses offsite water that is brought in on trucks. This analysis assumes two cleanings per year.

24.2 CAPITAL COST ESTIMATE

The base cost estimate for this technology case totals $1313/kW. Table 24-1 summarizes the cost components for this case. Solar prices have been dropping due to reductions in equipment costs as well as the required construction labor. As solar modeling software advances, projects are able to optimize layouts and ground coverage for lowest levelized cost of energy, thereby allowing for reduced civil expenditures on a per kilowatt basis. Solar modules that are arriving on the market have a net potential of 1500 V rather than the previous standard of 1000 V. This increased net potential allows for lower wiring losses, which increases the net energy yield and lower wiring material costs to reduce the capital cost. Additionally, strides have been made to make modules more efficient to increase their power rating and lighter in weight to allow for reduced transportation and installation cost. Electrical components have been dropping in price, especially the inverters. As solar development advances and matures, EPC contractors and developers have also been bearing less contingency and overhead, further reducing a solar project's overall price.

Table 24-1 — Case 24 Capital Cost Estimate

Case 24 EIA – Capital Cost Estimates – 2019 $s		
Configuration		**Solar PV w/ Single Axis Tracking** 150 MW_{AC}
DC / AC Ratio		1.3
Module Type		Crystalline
	Units	
Plant Characteristics		
Net Plant Capacity	MW_AC	150
Capital Cost Assumptions		
EPC Contracting Fee	% of Direct & Indirect Costs	5%
Project Contingency	% of Project Costs	5%
Owner's Services	% of Project Costs	4%
Estimated Land Requirement (acres) (Note 1)	$	400
Typical Project Timelines		
Development, Permitting, Engineering	months	12
Plant Construction Time	months	6
Total Lead Time Before COD	months	18
Operating Life	years	30

Case 24 EIA – Capital Cost Estimates – 2019 $s			
Configuration		**Solar PV w/ Single Axis Tracking** 150 MW_{AC}	
DC / AC Ratio		1.3	
Module Type		Crystalline	
	Units		
Cost Components (Note 2)		**Breakout**	**Total**
Civil/Structural/Architectural Subtotal	$		7,935,000
Mechanical – Racking, Tracking, & Module Installation	$	36,391,000	
Mechanical Subtotal	$		36,391,000
Electrical – Inverters	$	9,430,000	
Electrical – BOP and Miscellaneous	$	28,328,000	
Electrical – Transformer, Substation, & MV System	$	17,756,000	
Electrical – Backup Power, Control, & Data Acquisition	$	3,733,000	
Electrical Subtotal	$		59,247,000
Project Indirects	$		2,114,000
EPC Total Before Fee	$		105,687,000
EPC Fee	$		5,284,000
EPC Subtotal	$		110,971,000
Owner's Cost Components (Note 3)			
Owner's Services	$		4,439,000
Modules (Note 3)	$		72,150,000
Owner's Costs Subtotal	$		76,589,000
Project Contingency	$		9,378,000
Total Capital Cost	**$**		196,938,000
	$/kW net		**1,313**
Capital Cost Notes			
1. Land is typically leased and not considered in CAPEX. Costs based on EPC contracting approach. Direct costs include equipment, material, and labor to construct the civil/structural, mechanical, and electrical/I&C components of the facility. Indirect costs include distributable material and labor costs, cranes, scaffolding, engineering, construction management, startup and commissioning, and contractor overhead. EPC fees are applied to the sum of direct and indirect costs. 2. Owner's costs include project development, studies, permitting, legal, owner's project management, owner's engineering, and owner's startup and commissioning costs. Other owner's costs include electrical interconnection costs. 3. Modules purchased by Owner			

24.3 O&M COST ESTIMATE

Operations and maintenance costs associated with 150-MW_{AC}, single-axis tracking solar PV project have also been decreasing. There are five main factors to solar PV O&M: preventative maintenance, unscheduled maintenance, module cleaning, inverter maintenance reserve, and the land lease. As technological reliability increases and designs become more focused on decreasing O&M costs, preventative maintenance gets less costly and unscheduled maintenance occurs less frequently. Examples of O&M-focused designs are DC harnesses for optimal wiring configurations, wireless communication and control systems, and central inverter locations for ease of access. Cleaning is also typically less expensive for PV fields with trackers using independent rows because a single truck can clean two rows at a time instead of one. Additionally, inverter manufacturers have begun to offer extended warranties up to a 10-year period and at roughly the same cost as the assumed inverter reserve amount. Decreasing inverter prices also allows for a smaller inverter reserve to be set aside. The final annual expense is the land lease. Solar PV projects typically rent, rather than purchase, the land for the project; therefore, it is an operating expense and not a capital cost.

Table 24-2 — Case 24 O&M Cost Estimate

Case 24 EIA – Non-Fuel O&M Costs – 2019 $s		
Solar PV w/ Single Axis Tracking		
Fixed O&M – Plant ($/year) (Note 1)		
Preventative Maintenance	$/year	1,104,000
Module Cleaning (Note 2)	$/year	613,000
Unscheduled Maintenance	$/year	96,000
Inverter Maintenance Reserve	$/year	342,000
Land Lease (Note 3)	$/year	133,000
Subtotal Fixed O&M	$/year	2,288,000
$/kW-year	$/kW-year	**15.25 $/kW-yr**
Variable O&M ($/MWh)	$/MWh	**0.00 $/MWh**
O&M Cost Notes		
1. Fixed O&M costs include labor, materials and contracted services, and G&A costs. O&M Costs exclude property taxes and insurance.		
2. Assume two module cleanings per year.		
3. Solar PV projects typically rent land rather than purchase it, this is considered to be a representative annual expense but varies across projects.		

24.4 ENVIRONMENTAL & EMISSIONS INFORMATION

Solar PV does not produce regulated environmental air emissions. While other environmental compliance requirements may apply, only air emissions were considered for this report. Therefore, the emissions of NO_X, SO_2, and CO_2 are 0.00 lb/MMBtu.

CASE 25. SOLAR PHOTOVOLTAIC WITH BATTERY ENERGY STORAGE SYSTEM, 150 MW_{AC}

25.1 CASE DESCRIPTION

This case is based on a nominal 150-MW_{AC} solar PV plant with 200 MWh of lithium-ion battery storage. Solar PV has increasingly been coupled with battery storage in recent years due to price reductions in solar PV and lithium-ion batteries. The factors driving cost reductions of solar PV projects are shared with systems coupled with battery storage: Modeling technology optimizes design and reduces civil costs per kW, higher power modules, lower priced inverters, and lower risk. Batteries can be either AC- or DC-coupled to the solar array. DC-coupled systems connect the battery directly to the solar array via DC wiring. This estimate assumes an AC-coupled system; this configuration is more prevalent in recent projects. AC-coupled systems offer higher efficiency when used in power AC applications, but they also have slightly lower efficiencies when charging the battery. The most common application for AC-coupled system is peak shaving, or energy arbitrage, where there is a limit on the power allowed into the grid and the peak of the solar generation is stored in a battery to be sold during the highest demand peaks for optimal profit.

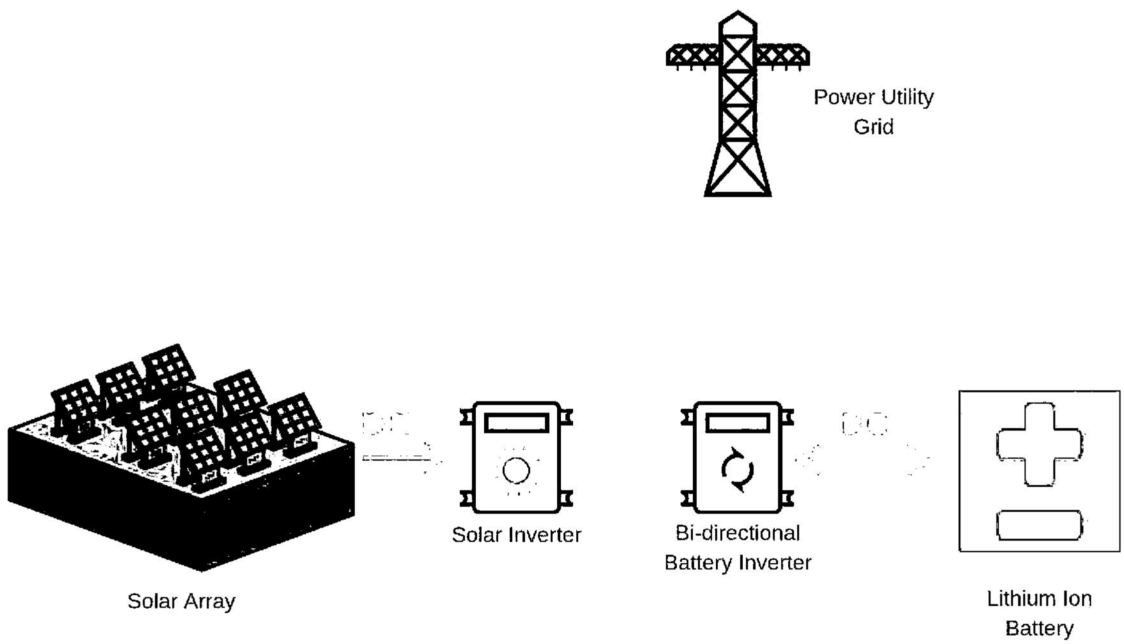
25.1.1 Mechanical Equipment & Systems

This case assumes a nominal 150-MW_{AC} solar PV plant with 200 MWh of lithium-ion battery storage. Batteries are typically sized by their output in kWh and not by their capacity in MW, which is defined by the AC capacity of the battery's inverters. The 200-MWh battery system in this estimate is comprised of four hours of 50 MW output. The mechanical equipment for the solar portion is the same as a stand-alone solar PV facility: 400-watt solar modules, ground mounted racking with driven pile foundations, and independent single-axis tracking equipment. The mechanical equipment associated with the battery storage is the batteries themselves, the containers they are placed in, the fire suppression system, and the concrete foundations for the battery containers. This estimate assumes the use of 40 containers, each 40 feet in length and containing 5,000 kWh of battery storage. Smaller 20-feet containers are sometimes used depending on constraints with site availability and project size. Both the 20-foot and 40-foot containers are always installed with extra space inside to allow for annual installation of more batteries so that the entire container keeps a constant year-on-year net output despite battery degradation. There are more containers in a PV system with battery storage over a standalone BESS due to the increased project life of PV. The additional containers allow for more augmentation over the life of the PV project rather than the life of the battery storage.

25.1.2 Electrical & Control Systems

When incorporating AC-coupled battery storage into a solar PV site, there is no change in the electrical components of the solar array and solar inverters. The solar modules are connected in series with DC wiring into solar strings. The solar strings are connected in parallel to combiner boxes that output the current into the solar inverters. The output of the solar inverter then enters a switchgear that feeds the AC current into either the grid or the battery inverter. It is also important to note that battery storage inverters are different from solar inverters in that they are typically bi-direction inverters that can alternate between inverting AC to DC and inverting DC to AC. Battery storage inverters also allow the batteries to be charged by either the solar array or the grid. This facility uses 150 MW of solar inverters plus 50 MW of battery inverters. Battery inverters are significantly more expensive than solar inverters.

Figure 25-1 — AC Coupled Solar PV and Battery Storage



Adapted from Clean Energy Reviews,
https://www.cleanenergyreviews.info/blog/ac-coupling-vs-dc-coupling-solar-battery-storage (accessed June 12, 2019).

Whether power is being used from the battery storage or the solar array, it passes through a switchyard that contains the circuit breaker, step-up transformer, and electrical interconnection with the grid.

25.1.3 Offsite Requirements

Solar PV and battery storage facilities require no fuel and produce no waste. The offsite requirements are limited to an interconnection between the facility and the transmission system as well as water for the purpose of cleaning the solar modules. Cleaning is regionally dependent. In regions with significant rainfall and limited dust accumulation, cleaning is often unnecessary and occurs naturally. In dust heavy and dry regions, cleaning typically occurs once or twice a year and uses offsite water that is brought in on trucks. This analysis assumes two cleanings per year.

25.2 CAPITAL COST ESTIMATE

The base cost estimate for this technology case totals $1755/kW. Table 25-1 summarizes the cost components for this case.

Table 25-1 — Case 25 Capital Cost Estimate

Case 25 EIA – Capital Cost Estimates – 2019 $s			
Configuration		Solar PV w/ Single Axis Tracking + Battery Storage	
Battery Configuration		AC Coupled	
DC / AC Ratio		1.3	
Module Type		Crystalline	
Battery Type		Lithium-ion	
	Units		
Plant Characteristics			
Net Solar Capacity	MW_AC	150	
Net Battery Capacity	MW_AC	50	
Capital Cost Assumptions			
EPC Contracting Fee	% of Direct & Indirect Costs	5%	
Project Contingency	% of Project Costs	5%	
Owner's Services	% of Project Costs	4%	
Estimated Land Requirement (acres) Note 1	$	401	
Typical Project Timelines			
Development, Permitting, Engineering	months	12	
Plant Construction Time	months	6	
Total Lead Time Before COD	months	18	
Operating Life	years	30	
Cost Components (Note 2)		**Breakout**	**Total**
Civil/Structural/Architectural Subtotal	$		17,596,000
Mechanical – Racking, Tracking, & Module Installation	$	36,391,000	
Mechanical Subtotal	$		36,391,000
Electrical – Batteries	$	40,037,000	
Electrical – Inverters	$	14,459,000	
Electrical – BOP and Miscellaneous	$	28,453,000	
Electrical – Transformer, Substation, & MV System	$	18,647,000	
Electrical – Backup Power, Control, & Data Acquisition	$	3,755,000	
Electrical Subtotal	$		105,350,000
Project Indirects	$		4,202,000
EPC Total Before Fee	$		163,539,000
EPC Fee	$		8,177,000
EPC Subtotal	$		171,716,000
Owner's Cost Components (Note 3)			
Owner's Services	$		6,869,000

Case 25 EIA – Capital Cost Estimates – 2019 $s		
Configuration		**Solar PV w/ Single Axis Tracking + Battery Storage**
Battery Configuration		AC Coupled
DC / AC Ratio		1.3
Module Type		Crystalline
Battery Type		Lithium-ion
	Units	
Modules (Note 3)	$	72,150,000
Owner's Cost Subtotal	$	79,019,000
Project Contingency	$	12,537,000
Total Capital Cost	**$**	263,272,000
	$/kW net	**1,755**
Capital Cost Notes		
1. Land is typically leased and not considered in CAPEX. Costs based on EPC contracting approach. Direct costs include equipment, material, and labor to construct the civil/structural, mechanical, and electrical/I&C components of the facility. Indirect costs include distributable material and labor costs, cranes, scaffolding, engineering, construction management, startup and commissioning, and contractor overhead. EPC fees are applied to the sum of direct and indirect costs. 2. Owner's costs include project development, studies, permitting, legal, owner's project management, owner's engineering, and owner's startup and commissioning costs. Other owner's costs include electrical interconnection costs. 3. Modules purchased directly by owner.		

25.3 O&M COST ESTIMATE

For this case, Sargent & Lundy grouped the O&M costs into the following categories: preventative maintenance, unscheduled maintenance, module cleaning, inverter maintenance reserve, battery maintenance reserve, and the land lease. Descriptions of all the factors except the battery maintenance reserve can be found in Section 24.3. The typical lifetime of a battery is 3000 cycles, which yields a lifetime of roughly 10 years (based on approximately one cycle per day). Battery systems typically account for degradation and a 10-year battery lifetime by leaving physical space within the BESS containers for additional batteries to be installed to augment the system each year. The battery reserve in this case is higher than standalone battery storage because it accounts for battery augmentation as well as additional battery replacements every 10 years to allow for a 30-year system life.

Table 25-2 — Case 25 O&M Cost Estimate

Case 25 EIA – Non-Fuel O&M Costs – 2019 $s		
Solar PV w/ Single Axis Tracking + Battery Storage		
Fixed O&M – Plant (Note 1)		
Preventative Maintenance	$/year	1,545,000
Module Cleaning (Note 2)	$/year	613,000
Unscheduled Maintenance	$/year	115,000
Inverter Maintenance Reserve	$/year	455,000
Battery Maintenance Reserve	$/year	1,963,000
Land Lease (Note 3)	$/year	134,000
Subtotal Fixed O&M	$/year	4,825,000
$/kW-year	$/kW-year	**32.17 $/kW-year**
Variable O&M	$/MWh	**0.00 $/MWh**
O&M Cost Notes		
1. Fixed O&M costs include labor, materials and contracted services, and G&A costs. O&M Costs exclude property taxes and insurance.		
2. Assume two module cleanings per year.		
3. Solar PV projects typically rent land rather than purchase it, this is considered to be a representative annual expense but varies across projects.		

25.4 ENVIRONMENTAL & EMISSIONS INFORMATION

Neither solar PV nor battery storage produce regulated environmental air emissions. While other environmental compliance requirements may apply, only air emissions were considered for this report. Therefore, the emissions of NO_X, SO_2, and CO_2 are 0.00 lb/MMBtu.

Appendix A. Location-Based Adjustment Factors

Location-Based Adjustment Factors

Capital Cost Study

Cost and Performance Estimates for New Utility-Scale Electric Power Generating Technologies

Prepared by
Sargent & Lundy

Prepared for
U.S. Energy Information Administration

FINAL

Contract No. 89303019CEI00022
Project No. 13651-005

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Table 1 1 — Location Adjustment for Non-New Source Performance Standard Compliant Ultra-Supercritical Coal (NSPS for NOX, Sox, PM, Hg) (2019 Dollars)
Case Configuration: 650 MW Net

State	City	Base Project Cost ($/kW)	Location Variation	Delta Cost Difference ($/kW)	Total Location Project Cost ($/kW)
Alabama	Huntsville	3,676	0.97	(128)	3549
Arizona	Phoenix	3,676	1.05	199	3875
Arkansas	Little Rock	3,676	0.96	(133)	3543
California	Bakersfield	3,676	1.26	973	4649
California	Los Angeles	3,676	1.27	989	4665
California	Modesto (instead of Redding)	3,676	1.28	1,017	4694
California	Sacramento	3,676	1.29	1,076	4752
California	San Francisco	3,676	1.37	1,367	5043
Colorado	Denver	3,676	1.03	100	3776
Connecticut	Hartford	3,676	1.24	877	4554
Delaware	Dover	3,676	1.22	801	4477
District of Columbia	Washington	3,676	1.08	307	3983
Florida	Tallahassee	3,676	0.95	(194)	3483
Florida	Tampa	3,676	0.97	(127)	3549
Georgia	Atlanta	3,676	0.99	(46)	3630
Idaho	Boise	3,676	1.03	105	3781
Illinois	Chicago	3,676	1.28	1,018	4694
Illinois	Joliet	3,676	1.24	869	4545
Indiana	Indianapolis	3,676	1.02	74	3750
Iowa	Davenport	3,676	1.05	173	3850
Iowa	Waterloo	3,676	0.97	(97)	3579
Kansas	Wichita	3,676	0.98	(85)	3592
Kentucky	Louisville	3,676	1.01	26	3702
Louisiana	New Orleans	3,676	0.97	(104)	3572
Maine	Portland	3,676	1.03	114	3790
Maryland	Baltimore	3,676	1.02	86	3762
Massachusetts	Boston	3,676	1.29	1,050	4726
Michigan	Detroit	3,676	1.12	459	4135
Michigan	Grand Rapids	3,676	1.05	168	3844
Minnesota	Saint Paul	3,676	1.11	411	4087
Mississippi	Jackson	3,676	0.95	(186)	3490
Missouri	St. Louis	3,676	1.13	461	4137
Missouri	Kansas City	3,676	1.08	297	3974
Montana	Great Falls	3,676	0.97	(104)	3572
Nebraska	Omaha	3,676	0.98	(78)	3599
New Hampshire	Concord	3,676	1.14	510	4186
New Jersey	Newark	3,676	1.24	881	4557
New Mexico	Albuquerque	3,676	0.99	(47)	3629
New York	New York	3,676	1.57	2,109	5785
New York	Syracuse	3,676	1.13	487	4163
Nevada	Las Vegas	3,676	1.15	556	4233
North Carolina	Charlotte	3,676	0.96	(144)	3532
North Dakota	Bismarck	3,676	1.04	133	3810
Oklahoma	Oklahoma City	3,676	1.01	30	3707
Oklahoma	Tulsa	3,676	0.93	(261)	3415
Ohio	Cincinnati	3,676	0.93	(262)	3414
Oregon	Portland	3,676	1.16	584	4261
Pennsylvania	Philadelphia	3,676	1.30	1,092	4769
Pennsylvania	Wilkes-Barre	3,676	1.15	561	4238
Rhode Island	Providence	3,676	1.21	781	4457
South Carolina	Charleston	3,676	0.96	(159)	3518
South Carolina	Spartanburg (Asheville, NC)	3,676	0.97	(116)	3561
South Dakota	Rapid City	3,676	0.98	(73)	3603
Tennessee	Knoxville (Nashville)	3,676	0.97	(104)	3573
Texas	Houston	3,676	0.93	(260)	3416
Utah	Salt Lake City	3,676	0.98	(60)	3617
Vermont	Burlington	3,676	1.05	167	3843
Virginia	Alexandria	3,676	1.08	280	3956
Virginia	Lynchburg	3,676	1.02	70	3746
Washington	Seattle	3,676	1.14	505	4182
Washington	Spokane	3,676	1.06	210	3886
West Virginia	Charleston	3,676	1.04	162	3839
Wisconsin	Green Bay	3,676	1.06	209	3886
Wyoming	Cheyenne	3,676	0.99	(20)	3656

Table 1 2 — Location Adjustment for New Source Performance Standard Compliant Ultra-Supercritical Coal (with 30% CCS or Other Compliance Technology) (2019 Dollars)

Case Configuration: 650 MW Net

State	City	Base Project Cost ($/kW)	Location Variation	Delta Cost Difference ($/kW)	Total Location Project Cost ($/kW)
Alabama	Huntsville	4,558	0.97	(155)	4,403
Arizona	Phoenix	4,558	1.05	250	4,808
Arkansas	Little Rock	4,558	0.97	(129)	4,429
California	Bakersfield	4,558	1.24	1,114	5,672
California	Los Angeles	4,558	1.25	1,132	5,690
California	Modesto (instead of Redding)	4,558	1.26	1,162	5,721
California	Sacramento	4,558	1.27	1,227	5,785
California	San Francisco	4,558	1.34	1,547	6,105
Colorado	Denver	4,558	1.03	139	4,697
Connecticut	Hartford	4,558	1.22	1,000	5,558
Delaware	Dover	4,558	1.20	905	5,463
District of Columbia	Washington	4,558	1.08	371	4,929
Florida	Tallahassee	4,558	0.95	(209)	4,349
Florida	Tampa	4,558	0.97	(135)	4,423
Georgia	Atlanta	4,558	0.99	(42)	4,516
Idaho	Boise	4,558	1.03	120	4,678
Illinois	Chicago	4,558	1.25	1,118	5,676
Illinois	Joliet	4,558	1.21	954	5,513
Indiana	Indianapolis	4,558	1.02	88	4,646
Iowa	Davenport	4,558	1.04	190	4,748
Iowa	Waterloo	4,558	0.98	(107)	4,451
Kansas	Wichita	4,558	0.98	(93)	4,465
Kentucky	Louisville	4,558	1.01	35	4,593
Louisiana	New Orleans	4,558	0.98	(101)	4,458
Maine	Portland	4,558	1.03	128	4,686
Maryland	Baltimore	4,558	1.02	96	4,654
Massachusetts	Boston	4,558	1.26	1,191	5,749
Michigan	Detroit	4,558	1.11	504	5,062
Michigan	Grand Rapids	4,558	1.04	184	4,742
Minnesota	Saint Paul	4,558	1.10	444	5,002
Mississippi	Jackson	4,558	0.96	(202)	4,356
Missouri	St. Louis	4,558	1.11	523	5,081
Missouri	Kansas City	4,558	1.07	327	4,885
Montana	Great Falls	4,558	0.97	(116)	4,442
Nebraska	Omaha	4,558	0.98	(85)	4,473
New Hampshire	Concord	4,558	1.13	603	5,162
New Jersey	Newark	4,558	1.21	970	5,528
New Mexico	Albuquerque	4,558	0.99	(37)	4,521
New York	New York	4,558	1.52	2,351	6,910
New York	Syracuse	4,558	1.12	567	5,125
Nevada	Las Vegas	4,558	1.14	623	5,182
North Carolina	Charlotte	4,558	0.97	(158)	4,400
North Dakota	Bismarck	4,558	1.03	139	4,697
Oklahoma	Oklahoma City	4,558	1.01	32	4,590
Oklahoma	Tulsa	4,558	0.94	(288)	4,270
Ohio	Cincinnati	4,558	0.94	(289)	4,269
Oregon	Portland	4,558	1.15	687	5,245
Pennsylvania	Philadelphia	4,558	1.27	1,234	5,793
Pennsylvania	Wilkes-Barre	4,558	1.14	649	5,208
Rhode Island	Providence	4,558	1.20	896	5,455
South Carolina	Charleston	4,558	0.97	(144)	4,414
South Carolina	Spartanburg (Asheville, NC)	4,558	0.97	(119)	4,439
South Dakota	Rapid City	4,558	0.98	(88)	4,470
Tennessee	Knoxville (Nashville)	4,558	0.98	(100)	4,458
Texas	Houston	4,558	0.94	(285)	4,273
Utah	Salt Lake City	4,558	0.99	(52)	4,506
Vermont	Burlington	4,558	1.05	210	4,768
Virginia	Alexandria	4,558	1.07	341	4,899
Virginia	Lynchburg	4,558	1.02	108	4,666
Washington	Seattle	4,558	1.12	569	5,127
Washington	Spokane	4,558	1.05	236	4,795
West Virginia	Charleston	4,558	1.04	178	4,736
Wisconsin	Green Bay	4,558	1.05	221	4,779
Wyoming	Cheyenne	4,558	0.99	(25)	4,533

Table 1 3 — Location Adjustment for Ultra-Supercritical Coal (with 90% CCS)
(2019 Dollars)
Case Configuration: 650 MW Net

State	City	Base Project Cost ($/kW)	Location Variation	Delta Cost Difference ($/kW)	Total Location Project Cost ($/kW)
Alabama	Huntsville	5,876	0.98	(126)	5750
Arizona	Phoenix	5,876	1.04	232	6108
Arkansas	Little Rock	5,876	0.98	(99)	5777
California	Bakersfield	5,876	1.22	1,278	7153
California	Los Angeles	5,876	1.22	1,300	7176
California	Modesto (instead of Redding)	5,876	1.23	1,333	7209
California	Sacramento	5,876	1.24	1,408	7284
California	San Francisco	5,876	1.30	1,778	7654
Colorado	Denver	5,876	1.02	99	5974
Connecticut	Hartford	5,876	1.19	1,114	6990
Delaware	Dover	5,876	1.17	972	6848
District of Columbia	Washington	5,876	1.06	381	6257
Florida	Tallahassee	5,876	0.96	(235)	5640
Florida	Tampa	5,876	0.98	(143)	5733
Georgia	Atlanta	5,876	1.00	(21)	5855
Idaho	Boise	5,876	1.03	155	6031
Illinois	Chicago	5,876	1.22	1,310	7186
Illinois	Joliet	5,876	1.19	1,118	6994
Indiana	Indianapolis	5,876	1.02	126	6001
Iowa	Davenport	5,876	1.04	221	6097
Iowa	Waterloo	5,876	0.98	(125)	5751
Kansas	Wichita	5,876	0.98	(111)	5765
Kentucky	Louisville	5,876	1.01	64	5939
Louisiana	New Orleans	5,876	0.99	(74)	5802
Maine	Portland	5,876	1.03	157	6033
Maryland	Baltimore	5,876	1.02	118	5993
Massachusetts	Boston	5,876	1.23	1,341	7216
Michigan	Detroit	5,876	1.10	590	6466
Michigan	Grand Rapids	5,876	1.04	214	6090
Minnesota	Saint Paul	5,876	1.08	497	6372
Mississippi	Jackson	5,876	0.96	(230)	5645
Missouri	St. Louis	5,876	1.11	667	6543
Missouri	Kansas City	5,876	1.07	383	6259
Montana	Great Falls	5,876	0.98	(142)	5734
Nebraska	Omaha	5,876	0.98	(99)	5777
New Hampshire	Concord	5,876	1.12	682	6558
New Jersey	Newark	5,876	1.20	1,146	7022
New Mexico	Albuquerque	5,876	1.00	3	5879
New York	New York	5,876	1.46	2,675	8551
New York	Syracuse	5,876	1.10	602	6477
Nevada	Las Vegas	5,876	1.13	772	6648
North Carolina	Charlotte	5,876	0.97	(186)	5690
North Dakota	Bismarck	5,876	1.02	137	6013
Oklahoma	Oklahoma City	5,876	1.01	32	5908
Oklahoma	Tulsa	5,876	0.94	(341)	5535
Ohio	Cincinnati	5,876	0.94	(342)	5534
Oregon	Portland	5,876	1.13	782	6658
Pennsylvania	Philadelphia	5,876	1.24	1,382	7258
Pennsylvania	Wilkes-Barre	5,876	1.12	700	6576
Rhode Island	Providence	5,876	1.17	1,005	6881
South Carolina	Charleston	5,876	0.99	(72)	5804
South Carolina	Spartanburg (Asheville, NC)	5,876	0.98	(113)	5763
South Dakota	Rapid City	5,876	0.98	(128)	5748
Tennessee	Knoxville (Nashville)	5,876	0.99	(71)	5804
Texas	Houston	5,876	0.94	(331)	5545
Utah	Salt Lake City	5,876	1.00	(18)	5858
Vermont	Burlington	5,876	1.06	334	6209
Virginia	Alexandria	5,876	1.06	346	6222
Virginia	Lynchburg	5,876	1.01	71	5947
Washington	Seattle	5,876	1.12	713	6589
Washington	Spokane	5,876	1.05	298	6173
West Virginia	Charleston	5,876	1.04	206	6082
Wisconsin	Green Bay	5,876	1.04	229	6105
Wyoming	Cheyenne	5,876	0.99	(40)	5836

Table 1 4 — Location Adjustment for Internal Combustion Engines (Natural Gas or Oil-fired Diesel)
(2019 Dollars)
Case Configuration: 20 MW (4x 5.6 MW)

State	City	Base Project Cost ($/kW)	Location Variation	Delta Cost Difference ($/kW)	Total Location Project Cost ($/kW)
Alabama	Huntsville	1,810	0.97	(48)	1,762
Arizona	Phoenix	1,810	0.98	(32)	1,778
Arkansas	Little Rock	1,810	0.98	(32)	1,777
California	Bakersfield	1,810	1.16	292	2,102
California	Los Angeles	1,810	1.17	303	2,112
California	Modesto (instead of Redding)	1,810	1.16	292	2,102
California	Sacramento	1,810	1.17	314	2,124
California	San Francisco	1,810	1.26	465	2,275
Colorado	Denver	1,810	0.97	(57)	1,752
Connecticut	Hartford	1,810	1.14	252	2,062
Delaware	Dover	1,810	1.10	176	1,985
District of Columbia	Washington	1,810	1.02	42	1,852
Florida	Tallahassee	1,810	0.96	(80)	1,730
Florida	Tampa	1,810	0.97	(61)	1,749
Georgia	Atlanta	1,810	0.99	(17)	1,793
Idaho	Boise	1,810	1.02	36	1,846
Illinois	Chicago	1,810	1.21	382	2,191
Illinois	Joliet	1,810	1.18	320	2,129
Indiana	Indianapolis	1,810	1.02	37	1,846
Iowa	Davenport	1,810	1.04	66	1,876
Iowa	Waterloo	1,810	0.98	(33)	1,777
Kansas	Wichita	1,810	0.98	(27)	1,782
Kentucky	Louisville	1,810	1.01	13	1,823
Louisiana	New Orleans	1,810	0.98	(27)	1,782
Maine	Portland	1,810	1.01	27	1,836
Maryland	Baltimore	1,810	1.02	36	1,845
Massachusetts	Boston	1,810	1.18	320	2,129
Michigan	Detroit	1,810	1.09	161	1,971
Michigan	Grand Rapids	1,810	1.02	42	1,852
Minnesota	Saint Paul	1,810	1.08	148	1,958
Mississippi	Jackson	1,810	0.96	(78)	1,731
Missouri	St. Louis	1,810	1.12	210	2,019
Missouri	Kansas City	1,810	1.07	118	1,928
Montana	Great Falls	1,810	0.98	(39)	1,770
Nebraska	Omaha	1,810	0.99	(24)	1,785
New Hampshire	Concord	1,810	1.06	117	1,927
New Jersey	Newark	1,810	1.19	342	2,152
New Mexico	Albuquerque	1,810	1.00	1	1,811
New York	New York	1,810	1.37	673	2,483
New York	Syracuse	1,810	1.05	96	1,906
Nevada	Las Vegas	1,810	1.12	224	2,034
North Carolina	Charlotte	1,810	0.97	(56)	1,754
North Dakota	Bismarck	1,810	1.00	8	1,818
Oklahoma	Oklahoma City	1,810	1.00	2	1,811
Oklahoma	Tulsa	1,810	0.94	(101)	1,709
Ohio	Cincinnati	1,810	0.94	(101)	1,709
Oregon	Portland	1,810	1.09	157	1,966
Pennsylvania	Philadelphia	1,810	1.18	326	2,136
Pennsylvania	Wilkes-Barre	1,810	1.06	108	1,918
Rhode Island	Providence	1,810	1.12	217	2,027
South Carolina	Charleston	1,810	0.99	(15)	1,795
South Carolina	Spartanburg (Asheville, NC)	1,810	0.98	(39)	1,770
South Dakota	Rapid City	1,810	0.98	(40)	1,770
Tennessee	Knoxville (Nashville)	1,810	0.99	(15)	1,794
Texas	Houston	1,810	0.94	(108)	1,702
Utah	Salt Lake City	1,810	1.00	0	1,809
Vermont	Burlington	1,810	1.05	94	1,904
Virginia	Alexandria	1,810	1.02	35	1,844
Virginia	Lynchburg	1,810	0.97	(57)	1,753
Washington	Seattle	1,810	1.13	231	2,041
Washington	Spokane	1,810	1.04	65	1,874
West Virginia	Charleston	1,810	1.03	55	1,864
Wisconsin	Green Bay	1,810	1.03	55	1,865
Wyoming	Cheyenne	1,810	0.99	(18)	1,791

Table 1 5 — Location Adjustment for Combined-Cycle Oil/Natural Gas Turbine
(2019 Dollars)
Case Configuration: 100 MW, 2 x LM6000

State	City	Base Project Cost ($/kW)	Location Variation	Delta Cost Difference ($/kW)	Total Location Project Cost ($/kW)
Alabama	Huntsville	1,175	0.96	(53)	1,122
Arizona	Phoenix	1,175	0.98	(26)	1,149
Arkansas	Little Rock	1,175	0.96	(49)	1,126
California	Bakersfield	1,175	1.16	192	1,367
California	Los Angeles	1,175	1.18	206	1,381
California	Modesto (instead of Redding)	1,175	1.17	199	1,374
California	Sacramento	1,175	1.19	218	1,393
California	San Francisco	1,175	1.31	359	1,534
Colorado	Denver	1,175	0.97	(39)	1,136
Connecticut	Hartford	1,175	1.15	172	1,347
Delaware	Dover	1,175	1.13	157	1,331
District of Columbia	Washington	1,175	1.02	28	1,203
Florida	Tallahassee	1,175	0.94	(67)	1,107
Florida	Tampa	1,175	0.96	(52)	1,123
Georgia	Atlanta	1,175	0.98	(29)	1,145
Idaho	Boise	1,175	1.01	14	1,189
Illinois	Chicago	1,175	1.23	270	1,445
Illinois	Joliet	1,175	1.20	234	1,409
Indiana	Indianapolis	1,175	1.01	9	1,184
Iowa	Davenport	1,175	1.03	39	1,214
Iowa	Waterloo	1,175	0.96	(41)	1,133
Kansas	Wichita	1,175	0.97	(38)	1,137
Kentucky	Louisville	1,175	0.99	(6)	1,168
Louisiana	New Orleans	1,175	0.96	(45)	1,130
Maine	Portland	1,175	1.00	6	1,181
Maryland	Baltimore	1,175	1.02	19	1,194
Massachusetts	Boston	1,175	1.20	229	1,404
Michigan	Detroit	1,175	1.11	128	1,303
Michigan	Grand Rapids	1,175	1.03	35	1,210
Minnesota	Saint Paul	1,175	1.09	106	1,281
Mississippi	Jackson	1,175	0.94	(65)	1,109
Missouri	St. Louis	1,175	1.11	129	1,304
Missouri	Kansas City	1,175	1.07	82	1,256
Montana	Great Falls	1,175	0.96	(42)	1,133
Nebraska	Omaha	1,175	0.97	(32)	1,142
New Hampshire	Concord	1,175	1.05	59	1,233
New Jersey	Newark	1,175	1.22	253	1,428
New Mexico	Albuquerque	1,175	0.98	(27)	1,148
New York	New York	1,175	1.43	500	1,675
New York	Syracuse	1,175	1.06	69	1,244
Nevada	Las Vegas	1,175	1.12	146	1,321
North Carolina	Charlotte	1,175	0.96	(49)	1,126
North Dakota	Bismarck	1,175	1.02	22	1,196
Oklahoma	Oklahoma City	1,175	1.00	(1)	1,173
Oklahoma	Tulsa	1,175	0.93	(82)	1,092
Ohio	Cincinnati	1,175	0.93	(83)	1,092
Oregon	Portland	1,175	1.08	96	1,271
Pennsylvania	Philadelphia	1,175	1.21	251	1,426
Pennsylvania	Wilkes-Barre	1,175	1.06	73	1,248
Rhode Island	Providence	1,175	1.12	138	1,313
South Carolina	Charleston	1,175	0.95	(55)	1,120
South Carolina	Spartanburg (Asheville, NC)	1,175	0.96	(47)	1,128
South Dakota	Rapid City	1,175	0.97	(33)	1,142
Tennessee	Knoxville (Nashville)	1,175	0.97	(31)	1,144
Texas	Houston	1,175	0.93	(84)	1,091
Utah	Salt Lake City	1,175	0.97	(34)	1,141
Vermont	Burlington	1,175	1.02	27	1,202
Virginia	Alexandria	1,175	1.02	21	1,195
Virginia	Lynchburg	1,175	0.96	(52)	1,123
Washington	Seattle	1,175	1.14	160	1,334
Washington	Spokane	1,175	1.04	45	1,220
West Virginia	Charleston	1,175	1.04	43	1,218
Wisconsin	Green Bay	1,175	1.04	44	1,219
Wyoming	Cheyenne	1,175	0.99	(14)	1,161

Table 1 6 — Location Adjustment for Combined-Cycle Oil/Natural Gas Turbine
(2019 Dollars)
Case Configuration: 1 x 240 MW, F-Class

State	City	Base Project Cost ($/kW)	Location Variation	Delta Cost Difference ($/kW)	Total Location Project Cost ($/kW)
Alabama	Huntsville	713	0.95	(33)	680
Arizona	Phoenix	713	0.98	(16)	696
Arkansas	Little Rock	713	0.96	(30)	683
California	Bakersfield	713	1.17	122	834
California	Los Angeles	713	1.18	130	843
California	Modesto (instead of Redding)	713	1.18	126	839
California	Sacramento	713	1.19	138	851
California	San Francisco	713	1.32	227	940
Colorado	Denver	713	0.97	(25)	688
Connecticut	Hartford	713	1.15	109	821
Delaware	Dover	713	1.14	99	811
District of Columbia	Washington	713	1.03	18	731
Florida	Tallahassee	713	0.94	(42)	670
Florida	Tampa	713	0.95	(33)	680
Georgia	Atlanta	713	0.97	(18)	695
Idaho	Boise	713	1.01	9	722
Illinois	Chicago	713	1.24	170	883
Illinois	Joliet	713	1.21	147	860
Indiana	Indianapolis	713	1.01	6	719
Iowa	Davenport	713	1.03	25	738
Iowa	Waterloo	713	0.96	(26)	687
Kansas	Wichita	713	0.97	(24)	689
Kentucky	Louisville	713	0.99	(4)	709
Louisiana	New Orleans	713	0.96	(28)	685
Maine	Portland	713	1.01	4	717
Maryland	Baltimore	713	1.02	12	725
Massachusetts	Boston	713	1.20	145	857
Michigan	Detroit	713	1.11	81	794
Michigan	Grand Rapids	713	1.03	22	735
Minnesota	Saint Paul	713	1.09	66	779
Mississippi	Jackson	713	0.94	(41)	672
Missouri	St. Louis	713	1.12	82	795
Missouri	Kansas City	713	1.07	51	764
Montana	Great Falls	713	0.96	(27)	686
Nebraska	Omaha	713	0.97	(20)	692
New Hampshire	Concord	713	1.05	37	750
New Jersey	Newark	713	1.22	160	873
New Mexico	Albuquerque	713	0.98	(16)	696
New York	New York	713	1.44	315	1,028
New York	Syracuse	713	1.06	43	756
Nevada	Las Vegas	713	1.13	92	805
North Carolina	Charlotte	713	0.96	(31)	682
North Dakota	Bismarck	713	1.02	13	726
Oklahoma	Oklahoma City	713	1.00	(1)	712
Oklahoma	Tulsa	713	0.93	(52)	661
Ohio	Cincinnati	713	0.93	(52)	661
Oregon	Portland	713	1.09	61	774
Pennsylvania	Philadelphia	713	1.22	159	871
Pennsylvania	Wilkes-Barre	713	1.06	46	759
Rhode Island	Providence	713	1.12	88	800
South Carolina	Charleston	713	0.95	(33)	679
South Carolina	Spartanburg (Asheville, NC)	713	0.96	(29)	683
South Dakota	Rapid City	713	0.97	(21)	692
Tennessee	Knoxville (Nashville)	713	0.97	(19)	694
Texas	Houston	713	0.93	(53)	660
Utah	Salt Lake City	713	0.97	(21)	692
Vermont	Burlington	713	1.03	18	731
Virginia	Alexandria	713	1.02	13	726
Virginia	Lynchburg	713	0.95	(33)	680
Washington	Seattle	713	1.14	101	814
Washington	Spokane	713	1.04	29	742
West Virginia	Charleston	713	1.04	27	740
Wisconsin	Green Bay	713	1.04	27	740
Wyoming	Cheyenne	713	0.99	(9)	704

Table 1 7 — Location Adjustment for Combined-Cycle Oil/Natural Gas Turbine
(2019 Dollars)
Case Configuration: 1100 MW, H-Class, 2x2x1

State	City	Base Project Cost ($/kW)	Location Variation	Delta Cost Difference ($/kW)	Total Location Project Cost ($/kW)
Alabama	Huntsville	958	0.95	(51)	907
Arizona	Phoenix	958	1.05	50	1,008
Arkansas	Little Rock	958	0.95	(49)	910
California	Bakersfield	958	1.28	270	1,229
California	Los Angeles	958	1.30	285	1,243
California	Modesto (instead of Redding)	958	1.29	278	1,236
California	Sacramento	958	1.31	298	1,256
California	San Francisco	958	1.46	442	1,401
Colorado	Denver	958	1.04	36	994
Connecticut	Hartford	958	1.26	252	1,210
Delaware	Dover	958	1.25	238	1,196
District of Columbia	Washington	958	1.11	104	1,063
Florida	Tallahassee	958	0.93	(64)	894
Florida	Tampa	958	0.95	(50)	908
Georgia	Atlanta	958	0.97	(29)	929
Idaho	Boise	958	1.01	13	971
Illinois	Chicago	958	1.27	257	1,216
Illinois	Joliet	958	1.23	223	1,181
Indiana	Indianapolis	958	1.01	8	966
Iowa	Davenport	958	1.04	38	996
Iowa	Waterloo	958	0.96	(40)	919
Kansas	Wichita	958	0.96	(36)	922
Kentucky	Louisville	958	0.99	(7)	951
Louisiana	New Orleans	958	0.95	(45)	913
Maine	Portland	958	1.01	5	963
Maryland	Baltimore	958	1.02	18	977
Massachusetts	Boston	958	1.32	310	1,269
Michigan	Detroit	958	1.13	122	1,081
Michigan	Grand Rapids	958	1.03	33	992
Minnesota	Saint Paul	958	1.11	102	1,061
Mississippi	Jackson	958	0.93	(62)	896
Missouri	St. Louis	958	1.13	120	1,079
Missouri	Kansas City	958	1.08	78	1,036
Montana	Great Falls	958	0.96	(40)	919
Nebraska	Omaha	958	0.97	(31)	927
New Hampshire	Concord	958	1.14	134	1,092
New Jersey	Newark	958	1.25	241	1,200
New Mexico	Albuquerque	958	0.97	(28)	931
New York	New York	958	1.61	589	1,548
New York	Syracuse	958	1.15	146	1,105
Nevada	Las Vegas	958	1.14	137	1,095
North Carolina	Charlotte	958	0.95	(47)	912
North Dakota	Bismarck	958	1.02	22	980
Oklahoma	Oklahoma City	958	1.00	(1)	957
Oklahoma	Tulsa	958	0.92	(78)	880
Ohio	Cincinnati	958	0.92	(79)	880
Oregon	Portland	958	1.09	90	1,048
Pennsylvania	Philadelphia	958	1.35	333	1,292
Pennsylvania	Wilkes-Barre	958	1.16	150	1,109
Rhode Island	Providence	958	1.23	217	1,175
South Carolina	Charleston	958	0.94	(57)	901
South Carolina	Spartanburg (Asheville, NC)	958	0.95	(46)	912
South Dakota	Rapid City	958	0.97	(30)	929
Tennessee	Knoxville (Nashville)	958	0.97	(32)	927
Texas	Houston	958	0.92	(80)	878
Utah	Salt Lake City	958	0.96	(35)	924
Vermont	Burlington	958	1.02	21	979
Virginia	Alexandria	958	1.10	96	1,055
Virginia	Lynchburg	958	1.02	22	981
Washington	Seattle	958	1.16	150	1,108
Washington	Spokane	958	1.04	42	1,001
West Virginia	Charleston	958	1.04	41	999
Wisconsin	Green Bay	958	1.05	43	1,002
Wyoming	Cheyenne	958	0.99	(13)	945

Table 1 8 — Location Adjustment for Combined-Cycle Single Shaft
(2019 Dollars)
Case Configuration: 430 MW, H-Class 1x1x1

State	City	Base Project Cost ($/kW)	Location Variation	Delta Cost Difference ($/kW)	Total Location Project Cost ($/kW)
Alabama	Huntsville	1,084	0.96	(49)	1,035
Arizona	Phoenix	1,084	1.10	114	1,197
Arkansas	Little Rock	1,084	0.96	(47)	1,036
California	Bakersfield	1,084	1.30	324	1,407
California	Los Angeles	1,084	1.31	337	1,421
California	Modesto (instead of Redding)	1,084	1.31	331	1,415
California	Sacramento	1,084	1.32	350	1,434
California	San Francisco	1,084	1.45	489	1,573
Colorado	Denver	1,084	1.09	100	1,184
Connecticut	Hartford	1,084	1.28	308	1,391
Delaware	Dover	1,084	1.27	296	1,380
District of Columbia	Washington	1,084	1.15	166	1,249
Florida	Tallahassee	1,084	0.94	(60)	1,024
Florida	Tampa	1,084	0.96	(47)	1,037
Georgia	Atlanta	1,084	0.97	(28)	1,056
Idaho	Boise	1,084	1.01	11	1,095
Illinois	Chicago	1,084	1.22	238	1,322
Illinois	Joliet	1,084	1.19	206	1,290
Indiana	Indianapolis	1,084	1.01	6	1,090
Iowa	Davenport	1,084	1.03	35	1,119
Iowa	Waterloo	1,084	0.97	(37)	1,047
Kansas	Wichita	1,084	0.97	(34)	1,050
Kentucky	Louisville	1,084	0.99	(8)	1,076
Louisiana	New Orleans	1,084	0.96	(43)	1,040
Maine	Portland	1,084	1.00	4	1,088
Maryland	Baltimore	1,084	1.02	17	1,100
Massachusetts	Boston	1,084	1.34	364	1,447
Michigan	Detroit	1,084	1.10	113	1,197
Michigan	Grand Rapids	1,084	1.03	31	1,115
Minnesota	Saint Paul	1,084	1.09	96	1,180
Mississippi	Jackson	1,084	0.95	(58)	1,026
Missouri	St. Louis	1,084	1.10	108	1,192
Missouri	Kansas City	1,084	1.07	72	1,156
Montana	Great Falls	1,084	0.97	(36)	1,047
Nebraska	Omaha	1,084	0.97	(29)	1,055
New Hampshire	Concord	1,084	1.18	192	1,276
New Jersey	Newark	1,084	1.21	223	1,306
New Mexico	Albuquerque	1,084	0.97	(27)	1,056
New York	New York	1,084	1.58	634	1,717
New York	Syracuse	1,084	1.19	206	1,290
Nevada	Las Vegas	1,084	1.11	124	1,208
North Carolina	Charlotte	1,084	0.96	(43)	1,040
North Dakota	Bismarck	1,084	1.02	22	1,105
Oklahoma	Oklahoma City	1,084	1.00	(1)	1,083
Oklahoma	Tulsa	1,084	0.93	(72)	1,011
Ohio	Cincinnati	1,084	0.93	(72)	1,011
Oregon	Portland	1,084	1.21	229	1,313
Pennsylvania	Philadelphia	1,084	1.36	387	1,470
Pennsylvania	Wilkes-Barre	1,084	1.19	210	1,294
Rhode Island	Providence	1,084	1.25	273	1,357
South Carolina	Charleston	1,084	0.95	(57)	1,027
South Carolina	Spartanburg (Asheville, NC)	1,084	0.96	(43)	1,040
South Dakota	Rapid City	1,084	0.98	(26)	1,058
Tennessee	Knoxville (Nashville)	1,084	0.97	(32)	1,052
Texas	Houston	1,084	0.93	(74)	1,009
Utah	Salt Lake City	1,084	0.97	(34)	1,050
Vermont	Burlington	1,084	1.01	15	1,098
Virginia	Alexandria	1,084	1.15	158	1,242
Virginia	Lynchburg	1,084	1.08	87	1,171
Washington	Seattle	1,084	1.13	136	1,220
Washington	Spokane	1,084	1.03	38	1,122
West Virginia	Charleston	1,084	1.04	38	1,122
Wisconsin	Green Bay	1,084	1.04	42	1,126
Wyoming	Cheyenne	1,084	0.99	(11)	1,072

Table 1 9 — Location Adjustment for Combined-Cycle Gas Turbine (with 90% CCS)
(2019 Dollars)
Case Configuration: 430 MW, H-Class 1x1x1

State	City	Base Project Cost ($/kW)	Location Variation	Delta Cost Difference ($/kW)	Total Location Project Cost ($/kW)
Alabama	Huntsville	2,481	0.98	(49)	2,432
Arizona	Phoenix	2,481	0.99	(26)	2,454
Arkansas	Little Rock	2,481	0.98	(42)	2,439
California	Bakersfield	2,481	1.08	191	2,672
California	Los Angeles	2,481	1.08	205	2,685
California	Modesto (instead of Redding)	2,481	1.08	198	2,679
California	Sacramento	2,481	1.09	217	2,697
California	San Francisco	2,481	1.14	353	2,834
Colorado	Denver	2,481	0.98	(39)	2,442
Connecticut	Hartford	2,481	1.07	169	2,650
Delaware	Dover	2,481	1.06	152	2,632
District of Columbia	Washington	2,481	1.01	28	2,509
Florida	Tallahassee	2,481	0.97	(66)	2,415
Florida	Tampa	2,481	0.98	(50)	2,431
Georgia	Atlanta	2,481	0.99	(26)	2,454
Idaho	Boise	2,481	1.01	15	2,496
Illinois	Chicago	2,481	1.11	264	2,745
Illinois	Joliet	2,481	1.09	228	2,709
Indiana	Indianapolis	2,481	1.00	12	2,492
Iowa	Davenport	2,481	1.02	38	2,519
Iowa	Waterloo	2,481	0.98	(41)	2,440
Kansas	Wichita	2,481	0.98	(38)	2,443
Kentucky	Louisville	2,481	1.00	(4)	2,477
Louisiana	New Orleans	2,481	0.98	(40)	2,441
Maine	Portland	2,481	1.00	6	2,487
Maryland	Baltimore	2,481	1.01	19	2,500
Massachusetts	Boston	2,481	1.09	225	2,706
Michigan	Detroit	2,481	1.05	125	2,606
Michigan	Grand Rapids	2,481	1.01	34	2,515
Minnesota	Saint Paul	2,481	1.04	101	2,582
Mississippi	Jackson	2,481	0.97	(64)	2,417
Missouri	St. Louis	2,481	1.05	131	2,612
Missouri	Kansas City	2,481	1.03	80	2,561
Montana	Great Falls	2,481	0.98	(42)	2,439
Nebraska	Omaha	2,481	0.99	(31)	2,449
New Hampshire	Concord	2,481	1.02	61	2,542
New Jersey	Newark	2,481	1.10	248	2,729
New Mexico	Albuquerque	2,481	0.99	(22)	2,459
New York	New York	2,481	1.20	489	2,970
New York	Syracuse	2,481	1.03	67	2,548
Nevada	Las Vegas	2,481	1.06	146	2,627
North Carolina	Charlotte	2,481	0.98	(48)	2,433
North Dakota	Bismarck	2,481	1.01	19	2,499
Oklahoma	Oklahoma City	2,481	1.00	(2)	2,479
Oklahoma	Tulsa	2,481	0.97	(81)	2,400
Ohio	Cincinnati	2,481	0.97	(81)	2,400
Oregon	Portland	2,481	1.04	98	2,579
Pennsylvania	Philadelphia	2,481	1.10	246	2,727
Pennsylvania	Wilkes-Barre	2,481	1.03	72	2,552
Rhode Island	Providence	2,481	1.06	137	2,618
South Carolina	Charleston	2,481	0.98	(42)	2,438
South Carolina	Spartanburg (Asheville, NC)	2,481	0.98	(44)	2,437
South Dakota	Rapid City	2,481	0.99	(35)	2,446
Tennessee	Knoxville (Nashville)	2,481	0.99	(25)	2,456
Texas	Houston	2,481	0.97	(82)	2,399
Utah	Salt Lake City	2,481	0.99	(28)	2,453
Vermont	Burlington	2,481	1.01	35	2,516
Virginia	Alexandria	2,481	1.01	21	2,502
Virginia	Lynchburg	2,481	0.98	(51)	2,430
Washington	Seattle	2,481	1.06	160	2,641
Washington	Spokane	2,481	1.02	46	2,527
West Virginia	Charleston	2,481	1.02	42	2,523
Wisconsin	Green Bay	2,481	1.02	40	2,521
Wyoming	Cheyenne	2,481	0.99	(15)	2,466

Table 1 10 — Location Adjustment for Fuel Cell (Molten Carbonate or Other Commercially Viable Technology)
(2019 Dollars)
Case Configuration: 10 MW (4 x 2.8 MW MCFC)

State	City	Base Project Cost ($/kW)	Location Variation	Delta Cost Difference ($/kW)	Total Location Project Cost ($/kW)
Alabama	Huntsville	6,700	0.99	(66)	6,634
Arizona	Phoenix	6,700	0.99	(74)	6,626
Arkansas	Little Rock	6,700	1.00	10	6,710
California	Bakersfield	6,700	1.13	858	7,558
California	Los Angeles	6,700	1.14	907	7,607
California	Modesto (instead of Redding)	6,700	1.13	892	7,592
California	Sacramento	6,700	1.14	953	7,652
California	San Francisco	6,700	1.19	1,284	7,983
Colorado	Denver	6,700	0.98	(157)	6,543
Connecticut	Hartford	6,700	1.11	729	7,429
Delaware	Dover	6,700	1.07	463	7,163
District of Columbia	Washington	6,700	1.02	144	6,844
Florida	Tallahassee	6,700	0.97	(205)	6,495
Florida	Tampa	6,700	0.98	(136)	6,564
Georgia	Atlanta	6,700	1.00	32	6,731
Idaho	Boise	6,700	1.02	147	6,847
Illinois	Chicago	6,700	1.16	1,051	7,750
Illinois	Joliet	6,700	1.13	874	7,573
Indiana	Indianapolis	6,700	1.02	161	6,861
Iowa	Davenport	6,700	1.03	190	6,890
Iowa	Waterloo	6,700	0.99	(63)	6,637
Kansas	Wichita	6,700	0.99	(57)	6,643
Kentucky	Louisville	6,700	1.01	97	6,797
Louisiana	New Orleans	6,700	1.00	14	6,713
Maine	Portland	6,700	1.01	97	6,797
Maryland	Baltimore	6,700	1.02	131	6,831
Massachusetts	Boston	6,700	1.14	905	7,605
Michigan	Detroit	6,700	1.07	455	7,154
Michigan	Grand Rapids	6,700	1.02	119	6,819
Minnesota	Saint Paul	6,700	1.06	391	7,091
Mississippi	Jackson	6,700	0.97	(205)	6,495
Missouri	St. Louis	6,700	1.10	684	7,384
Missouri	Kansas City	6,700	1.05	338	7,038
Montana	Great Falls	6,700	0.98	(106)	6,594
Nebraska	Omaha	6,700	0.99	(39)	6,661
New Hampshire	Concord	6,700	1.07	450	7,150
New Jersey	Newark	6,700	1.14	961	7,661
New Mexico	Albuquerque	6,700	1.02	108	6,808
New York	New York	6,700	1.27	1,834	8,533
New York	Syracuse	6,700	1.04	254	6,954
Nevada	Las Vegas	6,700	1.10	693	7,393
North Carolina	Charlotte	6,700	0.98	(138)	6,562
North Dakota	Bismarck	6,700	1.00	9	6,708
Oklahoma	Oklahoma City	6,700	1.00	0	6,700
Oklahoma	Tulsa	6,700	0.96	(268)	6,431
Ohio	Cincinnati	6,700	0.96	(270)	6,430
Oregon	Portland	6,700	1.07	496	7,196
Pennsylvania	Philadelphia	6,700	1.13	892	7,592
Pennsylvania	Wilkes-Barre	6,700	1.05	325	7,024
Rhode Island	Providence	6,700	1.10	650	7,349
South Carolina	Charleston	6,700	1.02	156	6,856
South Carolina	Spartanburg (Asheville, NC)	6,700	0.99	(56)	6,644
South Dakota	Rapid City	6,700	0.98	(111)	6,589
Tennessee	Knoxville (Nashville)	6,700	1.01	51	6,751
Texas	Houston	6,700	0.96	(270)	6,429
Utah	Salt Lake City	6,700	1.02	113	6,813
Vermont	Burlington	6,700	1.07	458	7,157
Virginia	Alexandria	6,700	1.02	124	6,824
Virginia	Lynchburg	6,700	0.98	(118)	6,582
Washington	Seattle	6,700	1.11	705	7,405
Washington	Spokane	6,700	1.04	243	6,943
West Virginia	Charleston	6,700	1.02	149	6,848
Wisconsin	Green Bay	6,700	1.02	113	6,812
Wyoming	Cheyenne	6,700	0.99	(66)	6,633

Table 1 11 — Location Adjustment for Advanced Nuclear AP 1000 (Brownfield Site)
(2019 Dollars)
Case Configuration: 2 x 1117 MW, PWR

State	City	Base Project Cost ($/kW)	Location Variation	Delta Cost Difference ($/kW)	Total Location Project Cost ($/kW)
Alabama	Huntsville	6,041	0.99	(53)	5,988
Arizona	Phoenix	6,041	0.98	(147)	5,894
Arkansas	Little Rock	6,041	1.02	122	6,163
California	Bakersfield	6,041	1.22	1,305	7,346
California	Los Angeles	6,041	1.22	1,339	7,380
California	Modesto (instead of Redding)	6,041	1.22	1,358	7,399
California	Sacramento	6,041	1.24	1,443	7,484
California	San Francisco	6,041	1.30	1,830	7,871
Colorado	Denver	6,041	0.96	(227)	5,815
Connecticut	Hartford	6,041	1.16	946	6,987
Delaware	Dover	6,041	1.10	602	6,643
District of Columbia	Washington	6,041	1.02	146	6,188
Florida	Tallahassee	6,041	0.95	(280)	5,761
Florida	Tampa	6,041	0.97	(151)	5,890
Georgia	Atlanta	6,041	1.01	61	6,103
Idaho	Boise	6,041	1.04	258	6,300
Illinois	Chicago	6,041	1.23	1,415	7,456
Illinois	Joliet	6,041	1.20	1,207	7,249
Indiana	Indianapolis	6,041	1.05	274	6,315
Iowa	Davenport	6,041	1.04	231	6,272
Iowa	Waterloo	6,041	0.98	(134)	5,907
Kansas	Wichita	6,041	0.98	(130)	5,912
Kentucky	Louisville	6,041	1.03	204	6,245
Louisiana	New Orleans	6,041	1.02	95	6,137
Maine	Portland	6,041	1.04	217	6,258
Maryland	Baltimore	6,041	1.03	160	6,202
Massachusetts	Boston	6,041	1.20	1,216	7,257
Michigan	Detroit	6,041	1.10	634	6,675
Michigan	Grand Rapids	6,041	1.04	225	6,267
Minnesota	Saint Paul	6,041	1.06	389	6,430
Mississippi	Jackson	6,041	0.95	(294)	5,747
Missouri	St. Louis	6,041	1.18	1,061	7,103
Missouri	Kansas City	6,041	1.07	418	6,459
Montana	Great Falls	6,041	0.97	(186)	5,855
Nebraska	Omaha	6,041	0.98	(100)	5,941
New Hampshire	Concord	6,041	1.11	649	6,690
New Jersey	Newark	6,041	1.21	1,297	7,338
New Mexico	Albuquerque	6,041	1.03	196	6,237
New York	New York	6,041	1.42	2,560	8,601
New York	Syracuse	6,041	1.06	344	6,385
Nevada	Las Vegas	6,041	1.18	1,095	7,136
North Carolina	Charlotte	6,041	0.97	(203)	5,838
North Dakota	Bismarck	6,041	1.00	(4)	6,037
Oklahoma	Oklahoma City	6,041	1.00	4	6,045
Oklahoma	Tulsa	6,041	0.94	(387)	5,654
Ohio	Cincinnati	6,041	0.94	(389)	5,652
Oregon	Portland	6,041	1.13	777	6,818
Pennsylvania	Philadelphia	6,041	1.20	1,204	7,245
Pennsylvania	Wilkes-Barre	6,041	1.08	463	6,504
Rhode Island	Providence	6,041	1.15	893	6,935
South Carolina	Charleston	6,041	1.07	407	6,448
South Carolina	Spartanburg (Asheville, NC)	6,041	0.99	(50)	5,992
South Dakota	Rapid City	6,041	0.95	(287)	5,754
Tennessee	Knoxville (Nashville)	6,041	1.03	197	6,238
Texas	Houston	6,041	0.94	(339)	5,703
Utah	Salt Lake City	6,041	1.04	239	6,280
Vermont	Burlington	6,041	1.15	892	6,933
Virginia	Alexandria	6,041	1.02	110	6,151
Virginia	Lynchburg	6,041	0.96	(214)	5,827
Washington	Seattle	6,041	1.18	1,059	7,100
Washington	Spokane	6,041	1.07	447	6,488
West Virginia	Charleston	6,041	1.03	210	6,252
Wisconsin	Green Bay	6,041	1.01	63	6,105
Wyoming	Cheyenne	6,041	0.98	(107)	5,935

Table 1 12 — Location Adjustment for Small Modular Reactor (SMR) Nuclear Power Plant
(2019 Dollars)
Case Configuration: 600 MW

State	City	Base Project Cost ($/kW)	Location Variation	Delta Cost Difference ($/kW)	Total Location Project Cost ($/kW)
Alabama	Huntsville	6,191	0.97	(204)	5,987
Arizona	Phoenix	6,191	0.98	(97)	6,094
Arkansas	Little Rock	6,191	0.97	(166)	6,025
California	Bakersfield	6,191	1.20	1,242	7,433
California	Los Angeles	6,191	1.21	1,270	7,461
California	Modesto (instead of Redding)	6,191	1.21	1,309	7,500
California	Sacramento	6,191	1.23	1,402	7,593
California	San Francisco	6,191	1.30	1,855	8,046
Colorado	Denver	6,191	0.97	(212)	5,979
Connecticut	Hartford	6,191	1.17	1,033	7,224
Delaware	Dover	6,191	1.14	850	7,041
District of Columbia	Washington	6,191	1.02	135	6,326
Florida	Tallahassee	6,191	0.94	(345)	5,845
Florida	Tampa	6,191	0.96	(228)	5,963
Georgia	Atlanta	6,191	0.99	(70)	6,121
Idaho	Boise	6,191	1.03	202	6,392
Illinois	Chicago	6,191	1.27	1,673	7,864
Illinois	Joliet	6,191	1.23	1,429	7,620
Indiana	Indianapolis	6,191	1.03	165	6,356
Iowa	Davenport	6,191	1.05	282	6,473
Iowa	Waterloo	6,191	0.97	(160)	6,031
Kansas	Wichita	6,191	0.98	(142)	6,049
Kentucky	Louisville	6,191	1.01	85	6,276
Louisiana	New Orleans	6,191	0.98	(135)	6,056
Maine	Portland	6,191	1.03	202	6,393
Maryland	Baltimore	6,191	1.02	151	6,342
Massachusetts	Boston	6,191	1.21	1,311	7,502
Michigan	Detroit	6,191	1.12	754	6,944
Michigan	Grand Rapids	6,191	1.04	274	6,465
Minnesota	Saint Paul	6,191	1.10	628	6,819
Mississippi	Jackson	6,191	0.95	(340)	5,851
Missouri	St. Louis	6,191	1.14	867	7,058
Missouri	Kansas City	6,191	1.08	490	6,681
Montana	Great Falls	6,191	0.97	(182)	6,009
Nebraska	Omaha	6,191	0.98	(126)	6,065
New Hampshire	Concord	6,191	1.08	510	6,701
New Jersey	Newark	6,191	1.24	1,467	7,658
New Mexico	Albuquerque	6,191	0.99	(37)	6,154
New York	New York	6,191	1.47	2,941	9,132
New York	Syracuse	6,191	1.07	404	6,595
Nevada	Las Vegas	6,191	1.16	999	7,189
North Carolina	Charlotte	6,191	0.96	(238)	5,953
North Dakota	Bismarck	6,191	1.03	170	6,361
Oklahoma	Oklahoma City	6,191	1.01	40	6,231
Oklahoma	Tulsa	6,191	0.93	(436)	5,755
Ohio	Cincinnati	6,191	0.93	(438)	5,753
Oregon	Portland	6,191	1.10	634	6,825
Pennsylvania	Philadelphia	6,191	1.22	1,359	7,550
Pennsylvania	Wilkes-Barre	6,191	1.08	525	6,716
Rhode Island	Providence	6,191	1.15	902	7,093
South Carolina	Charleston	6,191	0.98	(127)	6,064
South Carolina	Spartanburg (Asheville, NC)	6,191	0.97	(187)	6,004
South Dakota	Rapid City	6,191	0.97	(168)	6,023
Tennessee	Knoxville (Nashville)	6,191	0.99	(84)	6,107
Texas	Houston	6,191	0.93	(422)	5,769
Utah	Salt Lake City	6,191	1.00	(16)	6,175
Vermont	Burlington	6,191	1.07	444	6,635
Virginia	Alexandria	6,191	1.01	93	6,284
Virginia	Lynchburg	6,191	0.96	(245)	5,946
Washington	Seattle	6,191	1.15	923	7,114
Washington	Spokane	6,191	1.06	385	6,576
West Virginia	Charleston	6,191	1.04	263	6,454
Wisconsin	Green Bay	6,191	1.05	285	6,476
Wyoming	Cheyenne	6,191	0.99	(53)	6,138

Table 1 13 — Location Adjustment for Dedicated Biomass Plant
(2019 Dollars)
Case Configuration: 50 MW, Wood

State	City	Base Project Cost ($/kW)	Location Variation	Delta Cost Difference ($/kW)	Total Location Project Cost ($/kW)
Alabama	Huntsville	4,097	0.96	(160)	3,937
Arizona	Phoenix	4,097	1.11	457	4,554
Arkansas	Little Rock	4,097	0.96	(144)	3,953
California	Bakersfield	4,097	1.30	1,247	5,344
California	Los Angeles	4,097	1.32	1,318	5,415
California	Modesto (instead of Redding)	4,097	1.31	1,259	5,356
California	Sacramento	4,097	1.33	1,360	5,457
California	San Francisco	4,097	1.47	1,907	6,004
Colorado	Denver	4,097	1.09	381	4,478
Connecticut	Hartford	4,097	1.29	1,203	5,300
Delaware	Dover	4,097	1.27	1,124	5,221
District of Columbia	Washington	4,097	1.17	685	4,782
Florida	Tallahassee	4,097	0.95	(214)	3,883
Florida	Tampa	4,097	0.96	(170)	3,927
Georgia	Atlanta	4,097	0.98	(71)	4,026
Idaho	Boise	4,097	1.02	73	4,170
Illinois	Chicago	4,097	1.23	947	5,044
Illinois	Joliet	4,097	1.20	806	4,903
Indiana	Indianapolis	4,097	1.02	77	4,174
Iowa	Davenport	4,097	1.04	153	4,250
Iowa	Waterloo	4,097	0.98	(96)	4,001
Kansas	Wichita	4,097	0.98	(81)	4,016
Kentucky	Louisville	4,097	1.00	(2)	4,095
Louisiana	New Orleans	4,097	0.97	(127)	3,970
Maine	Portland	4,097	1.02	72	4,169
Maryland	Baltimore	4,097	1.03	121	4,218
Massachusetts	Boston	4,097	1.34	1,403	5,500
Michigan	Detroit	4,097	1.10	418	4,515
Michigan	Grand Rapids	4,097	1.03	142	4,240
Minnesota	Saint Paul	4,097	1.09	385	4,482
Mississippi	Jackson	4,097	0.95	(210)	3,887
Missouri	St. Louis	4,097	1.11	464	4,562
Missouri	Kansas City	4,097	1.07	291	4,388
Montana	Great Falls	4,097	0.97	(106)	3,991
Nebraska	Omaha	4,097	0.99	(52)	4,045
New Hampshire	Concord	4,097	1.19	774	4,872
New Jersey	Newark	4,097	1.22	891	4,988
New Mexico	Albuquerque	4,097	1.00	(1)	4,096
New York	New York	4,097	1.61	2,505	6,602
New York	Syracuse	4,097	1.19	782	4,879
Nevada	Las Vegas	4,097	1.14	553	4,650
North Carolina	Charlotte	4,097	0.96	(161)	3,936
North Dakota	Bismarck	4,097	1.01	56	4,153
Oklahoma	Oklahoma City	4,097	1.00	(12)	4,085
Oklahoma	Tulsa	4,097	0.93	(272)	3,825
Ohio	Cincinnati	4,097	0.93	(273)	3,824
Oregon	Portland	4,097	1.22	919	5,016
Pennsylvania	Philadelphia	4,097	1.37	1,531	5,629
Pennsylvania	Wilkes-Barre	4,097	1.21	853	4,950
Rhode Island	Providence	4,097	1.26	1,055	5,152
South Carolina	Charleston	4,097	0.96	(151)	3,946
South Carolina	Spartanburg (Asheville, NC)	4,097	0.97	(124)	3,973
South Dakota	Rapid City	4,097	0.98	(66)	4,031
Tennessee	Knoxville (Nashville)	4,097	0.97	(124)	3,973
Texas	Houston	4,097	0.93	(297)	3,801
Utah	Salt Lake City	4,097	0.98	(65)	4,032
Vermont	Burlington	4,097	1.02	93	4,190
Virginia	Alexandria	4,097	1.16	661	4,758
Virginia	Lynchburg	4,097	1.09	353	4,451
Washington	Seattle	4,097	1.13	542	4,639
Washington	Spokane	4,097	1.04	144	4,241
West Virginia	Charleston	4,097	1.04	152	4,249
Wisconsin	Green Bay	4,097	1.04	154	4,251
Wyoming	Cheyenne	4,097	1.00	(6)	4,091

Table 1 14 — Location Adjustment for Biomass Co-firing Retrofit onto Existing Coal Plant
(2019 Dollars)
Case Configuration: 300 MW_{net} with 30 MW of Added Biomass

State	City	Base Project Cost ($/kW)	Location Variation	Delta Cost Difference ($/kW)	Total Location Project Cost ($/kW)
Alabama	Huntsville	705	0.94	(43)	662
Arizona	Phoenix	705	0.98	(15)	690
Arkansas	Little Rock	705	0.94	(41)	664
California	Bakersfield	705	1.21	145	850
California	Los Angeles	705	1.23	159	864
California	Modesto (instead of Redding)	705	1.21	148	852
California	Sacramento	705	1.24	168	873
California	San Francisco	705	1.39	278	983
Colorado	Denver	705	0.96	(25)	680
Connecticut	Hartford	705	1.20	138	843
Delaware	Dover	705	1.18	125	830
District of Columbia	Washington	705	1.05	35	740
Florida	Tallahassee	705	0.92	(53)	652
Florida	Tampa	705	0.94	(44)	661
Georgia	Atlanta	705	0.97	(23)	682
Idaho	Boise	705	1.02	15	720
Illinois	Chicago	705	1.30	214	919
Illinois	Joliet	705	1.26	182	887
Indiana	Indianapolis	705	1.02	15	720
Iowa	Davenport	705	1.05	35	740
Iowa	Waterloo	705	0.97	(22)	683
Kansas	Wichita	705	0.97	(18)	687
Kentucky	Louisville	705	1.00	(2)	702
Louisiana	New Orleans	705	0.95	(36)	668
Maine	Portland	705	1.02	16	720
Maryland	Baltimore	705	1.04	27	732
Massachusetts	Boston	705	1.25	178	883
Michigan	Detroit	705	1.13	95	799
Michigan	Grand Rapids	705	1.05	32	737
Minnesota	Saint Paul	705	1.13	89	794
Mississippi	Jackson	705	0.93	(52)	653
Missouri	St. Louis	705	1.14	101	806
Missouri	Kansas City	705	1.09	66	770
Montana	Great Falls	705	0.97	(24)	681
Nebraska	Omaha	705	0.98	(12)	693
New Hampshire	Concord	705	1.07	50	755
New Jersey	Newark	705	1.28	201	905
New Mexico	Albuquerque	705	0.99	(8)	696
New York	New York	705	1.57	400	1,105
New York	Syracuse	705	1.08	55	759
Nevada	Las Vegas	705	1.17	122	827
North Carolina	Charlotte	705	0.95	(36)	668
North Dakota	Bismarck	705	1.02	15	719
Oklahoma	Oklahoma City	705	1.00	(2)	702
Oklahoma	Tulsa	705	0.91	(61)	644
Ohio	Cincinnati	705	0.91	(61)	643
Oregon	Portland	705	1.11	79	784
Pennsylvania	Philadelphia	705	1.29	205	909
Pennsylvania	Wilkes-Barre	705	1.10	69	774
Rhode Island	Providence	705	1.15	108	813
South Carolina	Charleston	705	0.93	(46)	658
South Carolina	Spartanburg (Asheville, NC)	705	0.95	(34)	670
South Dakota	Rapid City	705	0.98	(13)	692
Tennessee	Knoxville (Nashville)	705	0.95	(32)	673
Texas	Houston	705	0.90	(67)	638
Utah	Salt Lake City	705	0.97	(18)	687
Vermont	Burlington	705	1.02	14	719
Virginia	Alexandria	705	1.04	30	735
Virginia	Lynchburg	705	0.96	(31)	673
Washington	Seattle	705	1.17	119	824
Washington	Spokane	705	1.04	31	736
West Virginia	Charleston	705	1.05	35	739
Wisconsin	Green Bay	705	1.05	37	742
Wyoming	Cheyenne	705	1.00	(1)	704

Table 1 15 — Location Adjustment for Geothermal (Representative Plant Excluding Exploration and Production of Resource)
(2019 Dollars)
Case Configuration: 50 MW

State	City	Base Project Cost ($/kW)	Location Variation	Delta Cost Difference ($/kW)	Total Location Project Cost ($/kW)
Alabama	Huntsville	N/A	N/A	N/A	N/A
Arizona	Phoenix	N/A	N/A	N/A	N/A
Arkansas	Little Rock	N/A	N/A	N/A	N/A
California	Bakersfield	2,521	1.14	356	2,877
California	Los Angeles	2,521	1.15	377	2,898
California	Modesto (instead of Redding)	2,521	1.15	373	2,894
California	Sacramento	2,521	1.16	401	2,922
California	San Francisco	2,521	1.22	560	3,081
Colorado	Denver	N/A	N/A	N/A	N/A
Connecticut	Hartford	N/A	N/A	N/A	N/A
Delaware	Dover	N/A	N/A	N/A	N/A
District of Columbia	Washington	N/A	N/A	N/A	N/A
Florida	Tallahassee	N/A	N/A	N/A	N/A
Florida	Tampa	N/A	N/A	N/A	N/A
Georgia	Atlanta	N/A	N/A	N/A	N/A
Idaho	Boise	2,521	1.02	50	2,571
Illinois	Chicago	N/A	N/A	N/A	N/A
Illinois	Joliet	N/A	N/A	N/A	N/A
Indiana	Indianapolis	N/A	N/A	N/A	N/A
Iowa	Davenport	N/A	N/A	N/A	N/A
Iowa	Waterloo	N/A	N/A	N/A	N/A
Kansas	Wichita	N/A	N/A	N/A	N/A
Kentucky	Louisville	N/A	N/A	N/A	N/A
Louisiana	New Orleans	N/A	N/A	N/A	N/A
Maine	Portland	N/A	N/A	N/A	N/A
Maryland	Baltimore	N/A	N/A	N/A	N/A
Massachusetts	Boston	N/A	N/A	N/A	N/A
Michigan	Detroit	N/A	N/A	N/A	N/A
Michigan	Grand Rapids	N/A	N/A	N/A	N/A
Minnesota	Saint Paul	N/A	N/A	N/A	N/A
Mississippi	Jackson	N/A	N/A	N/A	N/A
Missouri	St. Louis	N/A	N/A	N/A	N/A
Missouri	Kansas City	N/A	N/A	N/A	N/A
Montana	Great Falls	N/A	N/A	N/A	N/A
Nebraska	Omaha	N/A	N/A	N/A	N/A
New Hampshire	Concord	N/A	N/A	N/A	N/A
New Jersey	Newark	N/A	N/A	N/A	N/A
New Mexico	Albuquerque	N/A	N/A	N/A	N/A
New York	New York	N/A	N/A	N/A	N/A
New York	Syracuse	N/A	N/A	N/A	N/A
Nevada	Las Vegas	2,521	1.11	277	2,798
North Carolina	Charlotte	N/A	N/A	N/A	N/A
North Dakota	Bismarck	N/A	N/A	N/A	N/A
Oklahoma	Oklahoma City	N/A	N/A	N/A	N/A
Oklahoma	Tulsa	N/A	N/A	N/A	N/A
Ohio	Cincinnati	N/A	N/A	N/A	N/A
Oregon	Portland	2,521	1.07	183	2,704
Pennsylvania	Philadelphia	N/A	N/A	N/A	N/A
Pennsylvania	Wilkes-Barre	N/A	N/A	N/A	N/A
Rhode Island	Providence	N/A	N/A	N/A	N/A
South Carolina	Charleston	N/A	N/A	N/A	N/A
South Carolina	Spartanburg (Asheville, NC)	N/A	N/A	N/A	N/A
South Dakota	Rapid City	N/A	N/A	N/A	N/A
Tennessee	Knoxville (Nashville)	N/A	N/A	N/A	N/A
Texas	Houston	N/A	N/A	N/A	N/A
Utah	Salt Lake City	N/A	N/A	N/A	N/A
Vermont	Burlington	N/A	N/A	N/A	N/A
Virginia	Alexandria	N/A	N/A	N/A	N/A
Virginia	Lynchburg	N/A	N/A	N/A	N/A
Washington	Seattle	2,521	1.11	276	2,797
Washington	Spokane	2,521	1.04	89	2,610
West Virginia	Charleston	N/A	N/A	N/A	N/A
Wisconsin	Green Bay	N/A	N/A	N/A	N/A
Wyoming	Cheyenne	N/A	N/A	N/A	N/A

Table 1 16 — Location Adjustment for 30-MW Internal Combustion Engines (4 x 9.1MW)
(2019 Dollars)
Case Configuration: 1100 MW, H-Class, 2x2x1

State	City	Base Project Cost ($/kW)	Location Variation	Delta Cost Difference ($/kW)	Total Location Project Cost ($/kW)
Alabama	Huntsville	1,563	0.98	(39)	1,525
Arizona	Phoenix	1,563	0.98	(28)	1,536
Arkansas	Little Rock	1,563	0.99	(23)	1,540
California	Bakersfield	1,563	1.16	249	1,812
California	Los Angeles	1,563	1.16	258	1,821
California	Modesto (instead of Redding)	1,563	1.16	248	1,812
California	Sacramento	1,563	1.17	267	1,831
California	San Francisco	1,563	1.25	394	1,957
Colorado	Denver	1,563	0.97	(49)	1,515
Connecticut	Hartford	1,563	1.14	213	1,776
Delaware	Dover	1,563	1.09	146	1,709
District of Columbia	Washington	1,563	1.02	36	1,599
Florida	Tallahassee	1,563	0.96	(67)	1,497
Florida	Tampa	1,563	0.97	(50)	1,513
Georgia	Atlanta	1,563	0.99	(12)	1,551
Idaho	Boise	1,563	1.02	32	1,595
Illinois	Chicago	1,563	1.20	320	1,884
Illinois	Joliet	1,563	1.17	268	1,831
Indiana	Indianapolis	1,563	1.02	33	1,596
Iowa	Davenport	1,563	1.04	55	1,619
Iowa	Waterloo	1,563	0.98	(27)	1,536
Kansas	Wichita	1,563	0.99	(23)	1,540
Kentucky	Louisville	1,563	1.01	13	1,576
Louisiana	New Orleans	1,563	0.99	(20)	1,543
Maine	Portland	1,563	1.01	23	1,586
Maryland	Baltimore	1,563	1.02	31	1,594
Massachusetts	Boston	1,563	1.17	270	1,833
Michigan	Detroit	1,563	1.09	135	1,698
Michigan	Grand Rapids	1,563	1.02	36	1,599
Minnesota	Saint Paul	1,563	1.08	122	1,685
Mississippi	Jackson	1,563	0.96	(66)	1,497
Missouri	St. Louis	1,563	1.12	180	1,744
Missouri	Kansas City	1,563	1.06	99	1,663
Montana	Great Falls	1,563	0.98	(34)	1,530
Nebraska	Omaha	1,563	0.99	(20)	1,543
New Hampshire	Concord	1,563	1.06	101	1,664
New Jersey	Newark	1,563	1.18	288	1,851
New Mexico	Albuquerque	1,563	1.00	4	1,567
New York	New York	1,563	1.36	566	2,129
New York	Syracuse	1,563	1.05	81	1,644
Nevada	Las Vegas	1,563	1.12	191	1,755
North Carolina	Charlotte	1,563	0.97	(47)	1,517
North Dakota	Bismarck	1,563	1.00	5	1,568
Oklahoma	Oklahoma City	1,563	1.00	1	1,564
Oklahoma	Tulsa	1,563	0.95	(85)	1,479
Ohio	Cincinnati	1,563	0.95	(85)	1,478
Oregon	Portland	1,563	1.09	135	1,698
Pennsylvania	Philadelphia	1,563	1.18	274	1,838
Pennsylvania	Wilkes-Barre	1,563	1.06	91	1,654
Rhode Island	Providence	1,563	1.12	184	1,747
South Carolina	Charleston	1,563	1.00	(5)	1,558
South Carolina	Spartanburg (Asheville, NC)	1,563	0.98	(31)	1,532
South Dakota	Rapid City	1,563	0.98	(35)	1,528
Tennessee	Knoxville (Nashville)	1,563	0.99	(9)	1,554
Texas	Houston	1,563	0.94	(90)	1,473
Utah	Salt Lake City	1,563	1.00	3	1,567
Vermont	Burlington	1,563	1.06	86	1,650
Virginia	Alexandria	1,563	1.02	30	1,593
Virginia	Lynchburg	1,563	0.97	(48)	1,516
Washington	Seattle	1,563	1.13	198	1,761
Washington	Spokane	1,563	1.04	56	1,619
West Virginia	Charleston	1,563	1.03	46	1,609
Wisconsin	Green Bay	1,563	1.03	44	1,607
Wyoming	Cheyenne	1,563	0.99	(16)	1,547

Table 1 17 — Location Adjustment for Hydroelectric (Representative Plant in New-Stream-Reach Location)
(2019 Dollars)
Case Configuration: 100 MW

State	City	Base Project Cost ($/kW)	Location Variation	Delta Cost Difference ($/kW)	Total Location Project Cost ($/kW)
Alabama	Huntsville	N/A	N/A	N/A	N/A
Arizona	Phoenix	N/A	N/A	N/A	N/A
Arkansas	Little Rock	N/A	N/A	N/A	N/A
California	Bakersfield	5,316	1.16	871	6,187
California	Los Angeles	5,316	1.12	659	5,975
California	Modesto (instead of Redding)	5,316	1.21	1,100	6,417
California	Sacramento	5,316	1.21	1,092	6,408
California	San Francisco	5,316	1.27	1,420	6,737
Colorado	Denver	5,316	1.02	94	5,410
Connecticut	Hartford	5,316	1.17	920	6,236
Delaware	Dover	N/A	N/A	N/A	N/A
District of Columbia	Washington	N/A	N/A	N/A	N/A
Florida	Tallahassee	N/A	N/A	N/A	N/A
Florida	Tampa	N/A	N/A	N/A	N/A
Georgia	Atlanta	N/A	N/A	N/A	N/A
Idaho	Boise	5,316	0.75	(1,345)	3,971
Illinois	Chicago	N/A	N/A	N/A	N/A
Illinois	Joliet	N/A	N/A	N/A	N/A
Indiana	Indianapolis	N/A	N/A	N/A	N/A
Iowa	Davenport	N/A	N/A	N/A	N/A
Iowa	Waterloo	N/A	N/A	N/A	N/A
Kansas	Wichita	N/A	N/A	N/A	N/A
Kentucky	Louisville	N/A	N/A	N/A	N/A
Louisiana	New Orleans	N/A	N/A	N/A	N/A
Maine	Portland	5,316	1.03	163	5,479
Maryland	Baltimore	N/A	N/A	N/A	N/A
Massachusetts	Boston	N/A	N/A	N/A	N/A
Michigan	Detroit	N/A	N/A	N/A	N/A
Michigan	Grand Rapids	N/A	N/A	N/A	N/A
Minnesota	Saint Paul	N/A	N/A	N/A	N/A
Mississippi	Jackson	N/A	N/A	N/A	N/A
Missouri	St. Louis	5,316	1.15	771	6,088
Missouri	Kansas City	5,316	1.06	332	5,648
Montana	Great Falls	5,316	0.97	(141)	5,175
Nebraska	Omaha	N/A	N/A	N/A	N/A
New Hampshire	Concord	N/A	N/A	N/A	N/A
New Jersey	Newark	N/A	N/A	N/A	N/A
New Mexico	Albuquerque	N/A	N/A	N/A	N/A
New York	New York	N/A	N/A	N/A	N/A
New York	Syracuse	N/A	N/A	N/A	N/A
Nevada	Las Vegas	N/A	N/A	N/A	N/A
North Carolina	Charlotte	5,316	0.97	(161)	5,155
North Dakota	Bismarck	N/A	N/A	N/A	N/A
Oklahoma	Oklahoma City	N/A	N/A	N/A	N/A
Oklahoma	Tulsa	N/A	N/A	N/A	N/A
Ohio	Cincinnati	5,316	0.94	(318)	4,998
Oregon	Portland	5,316	1.11	565	5,881
Pennsylvania	Philadelphia	N/A	N/A	N/A	N/A
Pennsylvania	Wilkes-Barre	N/A	N/A	N/A	N/A
Rhode Island	Providence	N/A	N/A	N/A	N/A
South Carolina	Charleston	N/A	N/A	N/A	N/A
South Carolina	Spartanburg (Asheville, NC)	N/A	N/A	N/A	N/A
South Dakota	Rapid City	5,316	0.96	(198)	5,119
Tennessee	Knoxville (Nashville)	N/A	N/A	N/A	N/A
Texas	Houston	N/A	N/A	N/A	N/A
Utah	Salt Lake City	N/A	N/A	N/A	N/A
Vermont	Burlington	N/A	N/A	N/A	N/A
Virginia	Alexandria	N/A	N/A	N/A	N/A
Virginia	Lynchburg	N/A	N/A	N/A	N/A
Washington	Seattle	5,316	1.15	780	6,096
Washington	Spokane	5,316	1.06	329	5,645
West Virginia	Charleston	N/A	N/A	N/A	N/A
Wisconsin	Green Bay	N/A	N/A	N/A	N/A
Wyoming	Cheyenne	N/A	N/A	N/A	N/A

Table 1 18 — Location Adjustment for Battery Storage: 4 Hours
A battery energy storage project designed primarily to provide resource adequacy and bulk energy storage.
(2019 Dollars)
Case Configuration: 50 MW / 200 MWh

State	City	Base Project Cost ($/kW)	Location Variation	Delta Cost Difference ($/kW)	Total Location Project Cost ($/kW)
Alabama	Huntsville	1,389	1.02	24	1,413
Arizona	Phoenix	1,389	0.99	(15)	1,374
Arkansas	Little Rock	1,389	1.04	56	1,445
California	Bakersfield	1,389	1.04	57	1,446
California	Los Angeles	1,389	1.04	60	1,449
California	Modesto (instead of Redding)	1,389	1.04	55	1,444
California	Sacramento	1,389	1.04	57	1,446
California	San Francisco	1,389	1.04	60	1,449
Colorado	Denver	1,389	0.99	(12)	1,377
Connecticut	Hartford	1,389	1.02	23	1,412
Delaware	Dover	1,389	0.99	(17)	1,373
District of Columbia	Washington	1,389	1.01	9	1,398
Florida	Tallahassee	1,389	1.00	0	1,389
Florida	Tampa	1,389	1.01	7	1,396
Georgia	Atlanta	1,389	1.02	25	1,414
Idaho	Boise	1,389	1.01	19	1,408
Illinois	Chicago	1,389	1.01	15	1,404
Illinois	Joliet	1,389	1.01	12	1,401
Indiana	Indianapolis	1,389	1.02	29	1,418
Iowa	Davenport	1,389	1.00	1	1,390
Iowa	Waterloo	1,389	1.00	(1)	1,388
Kansas	Wichita	1,389	1.00	(2)	1,387
Kentucky	Louisville	1,389	1.02	28	1,417
Louisiana	New Orleans	1,389	1.03	44	1,434
Maine	Portland	1,389	1.01	11	1,400
Maryland	Baltimore	1,389	1.01	8	1,397
Massachusetts	Boston	1,389	1.02	32	1,421
Michigan	Detroit	1,389	1.00	5	1,394
Michigan	Grand Rapids	1,389	1.00	0	1,390
Minnesota	Saint Paul	1,389	0.99	(21)	1,368
Mississippi	Jackson	1,389	1.00	(4)	1,385
Missouri	St. Louis	1,389	1.05	71	1,460
Missouri	Kansas City	1,389	1.00	5	1,394
Montana	Great Falls	1,389	0.99	(8)	1,381
Nebraska	Omaha	1,389	1.00	1	1,390
New Hampshire	Concord	1,389	1.03	47	1,436
New Jersey	Newark	1,389	1.02	23	1,412
New Mexico	Albuquerque	1,389	1.04	49	1,438
New York	New York	1,389	1.03	37	1,426
New York	Syracuse	1,389	1.00	5	1,394
Nevada	Las Vegas	1,389	1.04	56	1,445
North Carolina	Charlotte	1,389	1.00	(2)	1,387
North Dakota	Bismarck	1,389	0.98	(29)	1,360
Oklahoma	Oklahoma City	1,389	1.00	(6)	1,383
Oklahoma	Tulsa	1,389	0.99	(8)	1,381
Ohio	Cincinnati	1,389	0.99	(8)	1,381
Oregon	Portland	1,389	1.04	53	1,442
Pennsylvania	Philadelphia	1,389	1.02	22	1,411
Pennsylvania	Wilkes-Barre	1,389	1.01	8	1,397
Rhode Island	Providence	1,389	1.02	33	1,422
South Carolina	Charleston	1,389	1.08	114	1,503
South Carolina	Spartanburg (Asheville, NC)	1,389	1.02	22	1,411
South Dakota	Rapid City	1,389	0.98	(31)	1,358
Tennessee	Knoxville (Nashville)	1,389	1.04	57	1,446
Texas	Houston	1,389	1.00	0	1,389
Utah	Salt Lake City	1,389	1.04	54	1,443
Vermont	Burlington	1,389	1.08	109	1,498
Virginia	Alexandria	1,389	1.01	9	1,398
Virginia	Lynchburg	1,389	1.00	(4)	1,385
Washington	Seattle	1,389	1.04	61	1,450
Washington	Spokane	1,389	1.02	26	1,415
West Virginia	Charleston	1,389	1.00	(1)	1,389
Wisconsin	Green Bay	1,389	0.98	(33)	1,356
Wyoming	Cheyenne	1,389	0.99	(13)	1,376

Table 1 19 — Location Adjustment for Battery Storage: 2 hours
(2019 Dollars)
Case Configuration: 50 MW / 100 MWh

State	City	Base Project Cost ($/kW)	Location Variation	Delta Cost Difference ($/kW)	Total Location Project Cost ($/kW)
Alabama	Huntsville	845	1.02	15	860
Arizona	Phoenix	845	0.99	(9)	836
Arkansas	Little Rock	845	1.04	34	879
California	Bakersfield	845	1.04	35	880
California	Los Angeles	845	1.04	36	881
California	Modesto (instead of Redding)	845	1.04	33	878
California	Sacramento	845	1.04	34	880
California	San Francisco	845	1.04	37	882
Colorado	Denver	845	0.99	(7)	838
Connecticut	Hartford	845	1.02	14	859
Delaware	Dover	845	0.99	(10)	835
District of Columbia	Washington	845	1.01	5	851
Florida	Tallahassee	845	1.00	0	845
Florida	Tampa	845	1.00	4	849
Georgia	Atlanta	845	1.02	15	860
Idaho	Boise	845	1.01	12	857
Illinois	Chicago	845	1.01	9	854
Illinois	Joliet	845	1.01	7	853
Indiana	Indianapolis	845	1.02	18	863
Iowa	Davenport	845	1.00	1	846
Iowa	Waterloo	845	1.00	(1)	844
Kansas	Wichita	845	1.00	(1)	844
Kentucky	Louisville	845	1.02	17	862
Louisiana	New Orleans	845	1.03	27	872
Maine	Portland	845	1.01	6	852
Maryland	Baltimore	845	1.01	5	850
Massachusetts	Boston	845	1.02	19	865
Michigan	Detroit	845	1.00	3	848
Michigan	Grand Rapids	845	1.00	0	845
Minnesota	Saint Paul	845	0.99	(13)	833
Mississippi	Jackson	845	1.00	(3)	843
Missouri	St. Louis	845	1.05	43	888
Missouri	Kansas City	845	1.00	3	848
Montana	Great Falls	845	0.99	(5)	840
Nebraska	Omaha	845	1.00	0	846
New Hampshire	Concord	845	1.03	28	874
New Jersey	Newark	845	1.02	14	859
New Mexico	Albuquerque	845	1.04	30	875
New York	New York	845	1.03	23	868
New York	Syracuse	845	1.00	3	848
Nevada	Las Vegas	845	1.04	34	879
North Carolina	Charlotte	845	1.00	(1)	844
North Dakota	Bismarck	845	0.98	(18)	827
Oklahoma	Oklahoma City	845	1.00	(4)	841
Oklahoma	Tulsa	845	0.99	(5)	840
Ohio	Cincinnati	845	0.99	(5)	840
Oregon	Portland	845	1.04	32	877
Pennsylvania	Philadelphia	845	1.02	14	859
Pennsylvania	Wilkes-Barre	845	1.01	5	850
Rhode Island	Providence	845	1.02	20	865
South Carolina	Charleston	845	1.08	69	914
South Carolina	Spartanburg (Asheville, NC)	845	1.02	13	859
South Dakota	Rapid City	845	0.98	(19)	826
Tennessee	Knoxville (Nashville)	845	1.04	34	879
Texas	Houston	845	1.00	0	845
Utah	Salt Lake City	845	1.04	33	878
Vermont	Burlington	845	1.08	66	911
Virginia	Alexandria	845	1.01	5	850
Virginia	Lynchburg	845	1.00	(2)	843
Washington	Seattle	845	1.04	37	882
Washington	Spokane	845	1.02	16	861
West Virginia	Charleston	845	1.00	0	845
Wisconsin	Green Bay	845	0.98	(20)	825
Wyoming	Cheyenne	845	0.99	(7)	839

Table 1 20 — Location Adjustment for Onshore Wind, Large Plant Footprint: Great Plains Region
(2019 Dollars)
Case Configuration: 200 MW, 2.8-MW WTG

State	City	Base Project Cost ($/kW)	Location Variation	Delta Cost Difference ($/kW)	Total Location Project Cost ($/kW)
Alabama	Huntsville	1,265	1.01	12	1,277
Arizona	Phoenix	1,265	0.99	(16)	1,249
Arkansas	Little Rock	1,265	1.03	35	1,301
California	Bakersfield	1,265	1.05	60	1,325
California	Los Angeles	1,265	1.05	63	1,329
California	Modesto (instead of Redding)	1,265	1.05	58	1,323
California	Sacramento	1,265	1.05	62	1,327
California	San Francisco	1,265	1.06	76	1,342
Colorado	Denver	1,265	0.99	(13)	1,252
Connecticut	Hartford	1,265	1.03	32	1,298
Delaware	Dover	1,265	1.00	(1)	1,265
District of Columbia	Washington	1,265	1.01	9	1,274
Florida	Tallahassee	1,265	1.00	(6)	1,259
Florida	Tampa	1,265	1.00	0	1,265
Georgia	Atlanta	1,265	1.01	14	1,280
Idaho	Boise	1,265	1.01	16	1,281
Illinois	Chicago	1,265	1.03	37	1,302
Illinois	Joliet	1,265	1.03	32	1,297
Indiana	Indianapolis	1,265	1.02	23	1,288
Iowa	Davenport	1,265	1.00	4	1,269
Iowa	Waterloo	1,265	0.99	(7)	1,259
Kansas	Wichita	1,265	1.00	(6)	1,259
Kentucky	Louisville	1,265	1.01	19	1,284
Louisiana	New Orleans	1,265	1.02	28	1,293
Maine	Portland	1,265	1.01	8	1,274
Maryland	Baltimore	1,265	1.01	7	1,272
Massachusetts	Boston	1,265	1.04	46	1,311
Michigan	Detroit	1,265	1.01	15	1,281
Michigan	Grand Rapids	1,265	1.00	3	1,268
Minnesota	Saint Paul	1,265	1.00	(5)	1,261
Mississippi	Jackson	1,265	0.99	(9)	1,256
Missouri	St. Louis	1,265	1.05	63	1,328
Missouri	Kansas City	1,265	1.01	12	1,277
Montana	Great Falls	1,265	0.99	(9)	1,256
Nebraska	Omaha	1,265	1.00	(3)	1,263
New Hampshire	Concord	1,265	1.03	38	1,304
New Jersey	Newark	1,265	1.03	42	1,307
New Mexico	Albuquerque	1,265	1.03	33	1,298
New York	New York	1,265	1.06	74	1,339
New York	Syracuse	1,265	1.01	11	1,277
Nevada	Las Vegas	1,265	1.04	55	1,320
North Carolina	Charlotte	1,265	1.00	(6)	1,259
North Dakota	Bismarck	1,265	0.98	(21)	1,245
Oklahoma	Oklahoma City	1,265	1.00	(5)	1,260
Oklahoma	Tulsa	1,265	0.99	(13)	1,252
Ohio	Cincinnati	1,265	0.99	(13)	1,252
Oregon	Portland	1,265	1.04	47	1,312
Pennsylvania	Philadelphia	1,265	1.03	41	1,306
Pennsylvania	Wilkes-Barre	1,265	1.01	11	1,276
Rhode Island	Providence	1,265	1.03	37	1,302
South Carolina	Charleston	1,265	1.06	76	1,342
South Carolina	Spartanburg (Asheville, NC)	1,265	1.01	11	1,277
South Dakota	Rapid City	1,265	0.98	(25)	1,240
Tennessee	Knoxville (Nashville)	1,265	1.03	36	1,301
Texas	Houston	1,265	0.99	(8)	1,257
Utah	Salt Lake City	1,265	1.03	34	1,300
Vermont	Burlington	1,265	1.06	79	1,345
Virginia	Alexandria	1,265	1.01	8	1,273
Virginia	Lynchburg	1,265	0.99	(9)	1,257
Washington	Seattle	1,265	1.05	57	1,323
Washington	Spokane	1,265	1.02	21	1,286
West Virginia	Charleston	1,265	1.00	4	1,269
Wisconsin	Green Bay	1,265	0.99	(19)	1,247
Wyoming	Cheyenne	1,265	0.99	(10)	1,255

Table 1 21 — Location Adjustment for Onshore Wind, Small Plant Footprint: Coastal Region (2019 Dollars)
Case Configuration: 50 MW, 2.8-MW WTG

State	City	Base Project Cost ($/kW)	Location Variation	Delta Cost Difference ($/kW)	Total Location Project Cost ($/kW)
Alabama	Huntsville	1,677	1.01	14	1,691
Arizona	Phoenix	1,677	0.99	(23)	1,653
Arkansas	Little Rock	1,677	1.03	46	1,722
California	Bakersfield	1,677	1.05	89	1,765
California	Los Angeles	1,677	1.06	94	1,770
California	Modesto (instead of Redding)	1,677	1.05	86	1,762
California	Sacramento	1,677	1.05	91	1,768
California	San Francisco	1,677	1.07	116	1,793
Colorado	Denver	1,677	0.99	(19)	1,658
Connecticut	Hartford	1,677	1.03	50	1,727
Delaware	Dover	1,677	1.00	4	1,680
District of Columbia	Washington	1,677	1.01	13	1,689
Florida	Tallahassee	1,677	0.99	(11)	1,666
Florida	Tampa	1,677	1.00	(3)	1,674
Georgia	Atlanta	1,677	1.01	18	1,695
Idaho	Boise	1,677	1.01	22	1,699
Illinois	Chicago	1,677	1.04	61	1,737
Illinois	Joliet	1,677	1.03	53	1,729
Indiana	Indianapolis	1,677	1.02	32	1,709
Iowa	Davenport	1,677	1.00	7	1,683
Iowa	Waterloo	1,677	0.99	(11)	1,666
Kansas	Wichita	1,677	0.99	(10)	1,667
Kentucky	Louisville	1,677	1.02	25	1,702
Louisiana	New Orleans	1,677	1.02	36	1,712
Maine	Portland	1,677	1.01	11	1,688
Maryland	Baltimore	1,677	1.01	10	1,686
Massachusetts	Boston	1,677	1.04	71	1,747
Michigan	Detroit	1,677	1.02	25	1,702
Michigan	Grand Rapids	1,677	1.00	5	1,681
Minnesota	Saint Paul	1,677	1.00	(2)	1,674
Mississippi	Jackson	1,677	0.99	(15)	1,662
Missouri	St. Louis	1,677	1.05	90	1,767
Missouri	Kansas City	1,677	1.01	19	1,695
Montana	Great Falls	1,677	0.99	(14)	1,663
Nebraska	Omaha	1,677	1.00	(5)	1,672
New Hampshire	Concord	1,677	1.03	54	1,731
New Jersey	Newark	1,677	1.04	67	1,743
New Mexico	Albuquerque	1,677	1.03	44	1,720
New York	New York	1,677	1.07	118	1,795
New York	Syracuse	1,677	1.01	18	1,695
Nevada	Las Vegas	1,677	1.05	80	1,756
North Carolina	Charlotte	1,677	0.99	(10)	1,666
North Dakota	Bismarck	1,677	0.98	(27)	1,649
Oklahoma	Oklahoma City	1,677	1.00	(7)	1,670
Oklahoma	Tulsa	1,677	0.99	(21)	1,656
Ohio	Cincinnati	1,677	0.99	(21)	1,655
Oregon	Portland	1,677	1.04	67	1,744
Pennsylvania	Philadelphia	1,677	1.04	65	1,742
Pennsylvania	Wilkes-Barre	1,677	1.01	17	1,694
Rhode Island	Providence	1,677	1.03	55	1,732
South Carolina	Charleston	1,677	1.06	101	1,778
South Carolina	Spartanburg (Asheville, NC)	1,677	1.01	14	1,690
South Dakota	Rapid City	1,677	0.98	(35)	1,642
Tennessee	Knoxville (Nashville)	1,677	1.03	46	1,723
Texas	Houston	1,677	0.99	(14)	1,662
Utah	Salt Lake City	1,677	1.03	45	1,722
Vermont	Burlington	1,677	1.06	108	1,785
Virginia	Alexandria	1,677	1.01	11	1,688
Virginia	Lynchburg	1,677	0.99	(14)	1,663
Washington	Seattle	1,677	1.05	83	1,760
Washington	Spokane	1,677	1.02	29	1,705
West Virginia	Charleston	1,677	1.00	6	1,683
Wisconsin	Green Bay	1,677	0.99	(24)	1,653
Wyoming	Cheyenne	1,677	0.99	(15)	1,662

Table 1-22 — Location Adjustment for Offshore Wind
(2019 Dollars)
Case Configuration: 40 x 10 MW WTG

State	City	Base Project Cost ($/kW)	Location Variation	Delta Cost Difference ($/kW)	Total Location Project Cost ($/kW)
Alabama	Huntsville	N/A	N/A	N/A	N/A
Arizona	Phoenix	N/A	N/A	N/A	N/A
Arkansas	Little Rock	N/A	N/A	N/A	N/A
California	Bakersfield	4,375	1.03	152	4,527
California	Los Angeles	4,375	1.58	2,548	6,923
California	Modesto (instead of Redding)	4,375	1.52	2,264	6,639
California	Sacramento	4,375	1.58	2,538	6,912
California	San Francisco	4,375	1.90	3,944	8,318
Colorado	Denver	N/A	N/A	N/A	N/A
Connecticut	Hartford	4,375	1.01	41	4,416
Delaware	Dover	4,375	1.31	1,344	5,719
District of Columbia	Washington	N/A	N/A	N/A	N/A
Florida	Tallahassee	N/A	N/A	N/A	N/A
Florida	Tampa	N/A	N/A	N/A	N/A
Georgia	Atlanta	4,375	1.02	87	4,462
Idaho	Boise	N/A	N/A	N/A	N/A
Illinois	Chicago	4,375	1.00	(7)	4,368
Illinois	Joliet	4,375	1.65	2,842	7,217
Indiana	Indianapolis	4,375	1.06	277	4,652
Iowa	Davenport	N/A	N/A	N/A	N/A
Iowa	Waterloo	N/A	N/A	N/A	N/A
Kansas	Wichita	N/A	N/A	N/A	N/A
Kentucky	Louisville	N/A	N/A	N/A	N/A
Louisiana	New Orleans	N/A	N/A	N/A	N/A
Maine	Portland	4,375	1.01	31	4,405
Maryland	Baltimore	4,375	1.04	180	4,555
Massachusetts	Boston	4,375	1.64	2,815	7,190
Michigan	Detroit	4,375	1.32	1,409	5,784
Michigan	Grand Rapids	4,375	1.07	318	4,693
Minnesota	Saint Paul	4,375	1.29	1,286	5,661
Mississippi	Jackson	N/A	N/A	N/A	N/A
Missouri	St. Louis	N/A	N/A	N/A	N/A
Missouri	Kansas City	N/A	N/A	N/A	N/A
Montana	Great Falls	N/A	N/A	N/A	N/A
Nebraska	Omaha	N/A	N/A	N/A	N/A
New Hampshire	Concord	N/A	N/A	N/A	N/A
New Jersey	Newark	4,375	1.01	27	4,402
New Mexico	Albuquerque	N/A	N/A	N/A	N/A
New York	New York	4,375	1.01	27	4,402
New York	Syracuse	4,375	1.22	962	5,337
Nevada	Las Vegas	N/A	N/A	N/A	N/A
North Carolina	Charlotte	4,375	1.00	0	4,375
North Dakota	Bismarck	N/A	N/A	N/A	N/A
Oklahoma	Oklahoma City	N/A	N/A	N/A	N/A
Oklahoma	Tulsa	N/A	N/A	N/A	N/A
Ohio	Cincinnati	N/A	N/A	N/A	N/A
Oregon	Portland	4,375	1.00	(12)	4,363
Pennsylvania	Philadelphia	N/A	N/A	N/A	N/A
Pennsylvania	Wilkes-Barre	N/A	N/A	N/A	N/A
Rhode Island	Providence	4,375	1.01	27	4,402
South Carolina	Charleston	4,375	0.81	(819)	3,556
South Carolina	Spartanburg (Asheville, NC)	4,375	0.89	(494)	3,881
South Dakota	Rapid City	N/A	N/A	N/A	N/A
Tennessee	Knoxville (Nashville)	N/A	N/A	N/A	N/A
Texas	Houston	4,375	0.98	(102)	4,273
Utah	Salt Lake City	N/A	N/A	N/A	N/A
Vermont	Burlington	N/A	N/A	N/A	N/A
Virginia	Alexandria	4,375	1.04	182	4,557
Virginia	Lynchburg	4,375	0.91	(375)	4,000
Washington	Seattle	4,375	1.35	1,531	5,905
Washington	Spokane	4,375	1.05	209	4,584
West Virginia	Charleston	N/A	N/A	N/A	N/A
Wisconsin	Green Bay	4,375	1.02	81	4,455
Wyoming	Cheyenne	N/A	N/A	N/A	N/A

Table 1 23 — Location Adjustment for Concentrated Solar Thermal Plant (CSP), Power Tower, 8-hour Thermal Storage (2019 Dollars)
Case Configuration: 100 MW

State	City	Base Project Cost ($/kW)	Location Variation	Delta Cost Difference ($/kW)	Total Location Project Cost ($/kW)
Alabama	Huntsville	7221	1.01	67	7288
Arizona	Phoenix	7221	0.97	(201)	7021
Arkansas	Little Rock	7221	1.05	370	7591
California	Bakersfield	7221	1.17	1,220	8441
California	Los Angeles	7221	1.18	1,269	8490
California	Modesto (instead of Redding)	7221	1.17	1,242	8463
California	Sacramento	7221	1.18	1,307	8529
California	San Francisco	7221	1.24	1,738	8959
Colorado	Denver	7221	0.97	(241)	6980
Connecticut	Hartford	7221	1.11	782	8003
Delaware	Dover	7221	1.05	346	7568
District of Columbia	Washington	7221	1.02	144	7365
Florida	Tallahassee	7221	0.97	(212)	7009
Florida	Tampa	7221	0.99	(88)	7134
Georgia	Atlanta	7221	1.02	151	7372
Idaho	Boise	7221	1.03	247	7468
Illinois	Chicago	7221	1.14	1,030	8252
Illinois	Joliet	7221	1.12	881	8102
Indiana	Indianapolis	7221	1.04	305	7527
Iowa	Davenport	7221	1.02	144	7365
Iowa	Waterloo	7221	0.98	(129)	7092
Kansas	Wichita	7221	0.98	(138)	7083
Kentucky	Louisville	7221	1.04	256	7477
Louisiana	New Orleans	7221	1.04	275	7496
Maine	Portland	7221	1.02	138	7359
Maryland	Baltimore	7221	1.02	128	7350
Massachusetts	Boston	7221	1.14	1,040	8261
Michigan	Detroit	7221	1.07	470	7692
Michigan	Grand Rapids	7221	1.02	132	7353
Minnesota	Saint Paul	7221	1.02	128	7350
Mississippi	Jackson	7221	0.97	(244)	6978
Missouri	St. Louis	7221	1.16	1,126	8347
Missouri	Kansas City	7221	1.04	313	7535
Montana	Great Falls	7221	0.97	(206)	7015
Nebraska	Omaha	7221	0.99	(105)	7117
New Hampshire	Concord	7221	1.09	666	7888
New Jersey	Newark	7221	1.14	1,027	8248
New Mexico	Albuquerque	7221	1.05	355	7577
New York	New York	7221	1.27	1,982	9203
New York	Syracuse	7221	1.04	255	7477
Nevada	Las Vegas	7221	1.14	1,033	8254
North Carolina	Charlotte	7221	0.98	(175)	7046
North Dakota	Bismarck	7221	0.98	(180)	7041
Oklahoma	Oklahoma City	7221	0.99	(38)	7184
Oklahoma	Tulsa	7221	0.95	(332)	6889
Ohio	Cincinnati	7221	0.95	(333)	6888
Oregon	Portland	7221	1.11	829	8050
Pennsylvania	Philadelphia	7221	1.14	986	8207
Pennsylvania	Wilkes-Barre	7221	1.05	326	7548
Rhode Island	Providence	7221	1.11	791	8012
South Carolina	Charleston	7221	1.12	865	8086
South Carolina	Spartanburg (Asheville, NC)	7221	1.01	58	7280
South Dakota	Rapid City	7221	0.94	(409)	6812
Tennessee	Knoxville (Nashville)	7221	1.06	452	7673
Texas	Houston	7221	0.96	(255)	6966
Utah	Salt Lake City	7221	1.06	408	7630
Vermont	Burlington	7221	1.16	1,174	8396
Virginia	Alexandria	7221	1.02	114	7335
Virginia	Lynchburg	7221	0.97	(196)	7025
Washington	Seattle	7221	1.16	1,124	8345
Washington	Spokane	7221	1.06	442	7664
West Virginia	Charleston	7221	1.02	140	7361
Wisconsin	Green Bay	7221	0.98	(167)	7054
Wyoming	Cheyenne	7221	0.98	(174)	7048

Note: Location adjustment factors are provided for all locations for the Concentrated Solar Power case. However, concentrated solar power is only feasible in locations with sufficient solar resource; therefore, it is unlikely that a concentrated solar power plant would be built in some of the locations for which factors are provided.

Table 1 24 — Location Adjustment for Solar Photovoltaic, Single-Axis Tracking (with 1.3 Inverter Loading Ratio)
(2019 Dollars)
Case Configuration: 150 MW

State	City	Base Project Cost ($/kW)	Location Variation	Delta Cost Difference ($/kW)	Total Location Project Cost ($/kW)
Alabama	Huntsville	1,313	0.95	(68)	1,244
Arizona	Phoenix	1,313	0.97	(40)	1,273
Arkansas	Little Rock	1,313	0.98	(29)	1,284
California	Bakersfield	1,313	1.07	87	1,400
California	Los Angeles	1,313	1.09	116	1,429
California	Modesto (instead of Redding)	1,313	1.06	74	1,386
California	Sacramento	1,313	1.08	99	1,412
California	San Francisco	1,313	1.18	235	1,548
Colorado	Denver	1,313	0.98	(28)	1,285
Connecticut	Hartford	1,313	1.08	104	1,417
Delaware	Dover	1,313	1.04	56	1,369
District of Columbia	Washington	1,313	1.02	24	1,337
Florida	Tallahassee	1,313	0.96	(50)	1,263
Florida	Tampa	1,313	0.97	(37)	1,276
Georgia	Atlanta	1,313	0.98	(24)	1,289
Idaho	Boise	1,313	0.98	(32)	1,281
Illinois	Chicago	1,313	1.08	108	1,421
Illinois	Joliet	1,313	1.09	124	1,437
Indiana	Indianapolis	1,313	1.01	15	1,328
Iowa	Davenport	1,313	1.01	20	1,333
Iowa	Waterloo	1,313	0.97	(40)	1,273
Kansas	Wichita	1,313	0.98	(27)	1,286
Kentucky	Louisville	1,313	0.99	(8)	1,305
Louisiana	New Orleans	1,313	0.98	(27)	1,286
Maine	Portland	1,313	1.00	4	1,317
Maryland	Baltimore	1,313	1.01	13	1,326
Massachusetts	Boston	1,313	1.10	137	1,450
Michigan	Detroit	1,313	1.04	55	1,368
Michigan	Grand Rapids	1,313	1.01	13	1,326
Minnesota	Saint Paul	1,313	1.04	55	1,368
Mississippi	Jackson	1,313	0.97	(41)	1,272
Missouri	St. Louis	1,313	1.06	83	1,396
Missouri	Kansas City	1,313	1.03	38	1,351
Montana	Great Falls	1,313	0.98	(25)	1,288
Nebraska	Omaha	1,313	0.98	(21)	1,292
New Hampshire	Concord	1,313	1.02	20	1,333
New Jersey	Newark	1,313	1.11	151	1,464
New Mexico	Albuquerque	1,313	1.00	(5)	1,308
New York	New York	1,313	1.22	287	1,600
New York	Syracuse	1,313	1.03	34	1,347
Nevada	Las Vegas	1,313	1.07	87	1,399
North Carolina	Charlotte	1,313	0.97	(38)	1,274
North Dakota	Bismarck	1,313	0.99	(17)	1,296
Oklahoma	Oklahoma City	1,313	0.98	(29)	1,284
Oklahoma	Tulsa	1,313	0.95	(60)	1,253
Ohio	Cincinnati	1,313	0.95	(61)	1,252
Oregon	Portland	1,313	1.05	65	1,378
Pennsylvania	Philadelphia	1,313	1.13	173	1,486
Pennsylvania	Wilkes-Barre	1,313	1.02	24	1,337
Rhode Island	Providence	1,313	1.04	55	1,368
South Carolina	Charleston	1,313	1.03	44	1,357
South Carolina	Spartanburg (Asheville, NC)	1,313	1.04	55	1,368
South Dakota	Rapid City	1,313	0.96	(50)	1,263
Tennessee	Knoxville (Nashville)	1,313	1.00	(1)	1,312
Texas	Houston	1,313	0.99	(19)	1,294
Utah	Salt Lake City	1,313	0.97	(41)	1,272
Vermont	Burlington	1,313	0.97	(40)	1,273
Virginia	Alexandria	1,313	1.00	(6)	1,307
Virginia	Lynchburg	1,313	0.98	(25)	1,288
Washington	Seattle	1,313	1.03	41	1,354
Washington	Spokane	1,313	0.97	(43)	1,269
West Virginia	Charleston	1,313	1.06	77	1,390
Wisconsin	Green Bay	1,313	0.99	(16)	1,297
Wyoming	Cheyenne	1,313	1.01	13	1,326

Table 1 25 — Location Adjustment for Solar Photovoltaic, Single-Axis Tracking (with 1.3 Inverter Loading Ratio) with Battery Hybrid (2019 Dollars)

Case Configuration: PV with tracking150 MW PV50 MW/200 MWh BESS

State	City	Base Project Cost ($/kW)	Location Variation	Delta Cost Difference ($/kW)	Total Location Project Cost ($/kW)
Alabama	Huntsville	1,755	0.98	(42)	1,713
Arizona	Phoenix	1,755	0.98	(36)	1,719
Arkansas	Little Rock	1,755	0.99	(11)	1,744
California	Bakersfield	1,755	1.07	129	1,884
California	Los Angeles	1,755	1.09	151	1,906
California	Modesto (instead of Redding)	1,755	1.07	116	1,871
California	Sacramento	1,755	1.08	137	1,892
California	San Francisco	1,755	1.14	243	1,998
Colorado	Denver	1,755	0.98	(32)	1,723
Connecticut	Hartford	1,755	1.07	125	1,881
Delaware	Dover	1,755	1.04	64	1,819
District of Columbia	Washington	1,755	1.02	29	1,785
Florida	Tallahassee	1,755	0.97	(45)	1,710
Florida	Tampa	1,755	0.98	(31)	1,724
Georgia	Atlanta	1,755	0.99	(11)	1,744
Idaho	Boise	1,755	1.00	(3)	1,753
Illinois	Chicago	1,755	1.09	162	1,918
Illinois	Joliet	1,755	1.09	152	1,908
Indiana	Indianapolis	1,755	1.01	26	1,781
Iowa	Davenport	1,755	1.02	28	1,783
Iowa	Waterloo	1,755	0.98	(32)	1,723
Kansas	Wichita	1,755	0.99	(18)	1,737
Kentucky	Louisville	1,755	1.00	5	1,760
Louisiana	New Orleans	1,755	0.99	(10)	1,745
Maine	Portland	1,755	1.01	14	1,769
Maryland	Baltimore	1,755	1.01	18	1,773
Massachusetts	Boston	1,755	1.09	164	1,919
Michigan	Detroit	1,755	1.04	68	1,824
Michigan	Grand Rapids	1,755	1.01	19	1,775
Minnesota	Saint Paul	1,755	1.04	68	1,823
Mississippi	Jackson	1,755	0.98	(41)	1,714
Missouri	St. Louis	1,755	1.06	114	1,869
Missouri	Kansas City	1,755	1.03	53	1,808
Montana	Great Falls	1,755	0.99	(23)	1,732
Nebraska	Omaha	1,755	0.99	(16)	1,740
New Hampshire	Concord	1,755	1.03	47	1,802
New Jersey	Newark	1,755	1.10	173	1,928
New Mexico	Albuquerque	1,755	1.01	12	1,768
New York	New York	1,755	1.19	332	2,087
New York	Syracuse	1,755	1.03	48	1,803
Nevada	Las Vegas	1,755	1.07	118	1,873
North Carolina	Charlotte	1,755	0.98	(33)	1,722
North Dakota	Bismarck	1,755	0.99	(11)	1,744
Oklahoma	Oklahoma City	1,755	0.99	(18)	1,737
Oklahoma	Tulsa	1,755	0.97	(59)	1,696
Ohio	Cincinnati	1,755	0.97	(60)	1,696
Oregon	Portland	1,755	1.05	84	1,839
Pennsylvania	Philadelphia	1,755	1.10	181	1,937
Pennsylvania	Wilkes-Barre	1,755	1.02	42	1,797
Rhode Island	Providence	1,755	1.05	93	1,848
South Carolina	Charleston	1,755	1.01	13	1,768
South Carolina	Spartanburg (Asheville, NC)	1,755	1.00	(7)	1,748
South Dakota	Rapid City	1,755	0.99	(26)	1,729
Tennessee	Knoxville (Nashville)	1,755	0.99	(16)	1,739
Texas	Houston	1,755	0.97	(56)	1,699
Utah	Salt Lake City	1,755	1.01	16	1,771
Vermont	Burlington	1,755	1.02	43	1,798
Virginia	Alexandria	1,755	1.02	33	1,788
Virginia	Lynchburg	1,755	0.98	(43)	1,712
Washington	Seattle	1,755	1.06	114	1,869
Washington	Spokane	1,755	1.01	17	1,772
West Virginia	Charleston	1,755	1.01	21	1,776
Wisconsin	Green Bay	1,755	1.01	12	1,767
Wyoming	Cheyenne	1,755	1.00	(6)	1,749

Appendix B. Combustion Turbine Capacity Adjustments

Performance Adjustment Factors

Capital Cost Study

Cost and Performance Estimates for New Utility-Scale Electric Power Generating Technologies

Prepared by
Sargent & Lundy

Prepared for
U.S. Energy Information Administration

FINAL
Contract No. 89303019CEI00022
Project No. 13651-005

55 East Monroe | Chicago, IL 60603 | sargentlundy.com

Gas Turbine Based Capacity and Heat Rate Adjustments

LOCATION		Adjustment Basis			Simple Cycle		Combined Cyle		2 x LM6000PF+		1 x 7F.05		1 x 7HA.01 WCT		1 x 7HA.01 ACC		2 x 7HA.02 WCT		2 x 7HA.02 ACC	
State	City	ASHRAE Station	Alt (ft)	Ave T (F)	MW Adj SC	HR Adj SC	MW Adj CC	HR Adj CC	MW Net	HR Net	MW Net	HR Net	MW Net	HR Net	MW Net	HR Net	MW Net	HR Net	MW Net	HR Net
ISO	ISO	-	0	59.0	100.0%	100.0%	100.0%	100.0%	105.1	8,220	232.6	8,923	418.3	5,793	406.9	5,955	1,083.3	5,739	1,026.5	6,056
Alabama	Huntsville	723230	624	61.7	96.8%	100.3%	97.2%	100.3%	101.7	8,242	225.1	8,947	406.4	5,809	395.3	5,971	1,052.5	5,754	997.4	6,072
Alaska	Anchorage	997381	10	37.4	108.6%	97.8%	105.4%	98.9%	114.1	8,042	252.6	8,730	440.7	5,731	428.7	5,891	1,141.4	5,677	1,081.6	5,991
Alaska	Fairbanks	702610	432	28.0	110.7%	96.9%	106.1%	98.5%	116.3	7,965	257.5	8,646	443.9	5,709	431.8	5,868	1,149.6	5,655	1,089.4	5,967
Arizona	Phoenix	722780	1,107	75.2	89.9%	101.6%	92.2%	101.0%	94.5	8,353	209.1	9,068	385.8	5,853	375.3	6,017	999.1	5,798	946.8	6,118
Arkansas	Little Rock	723400	563	61.6	97.0%	100.3%	97.4%	100.2%	101.9	8,241	225.7	8,946	407.4	5,808	396.3	5,970	1,055.0	5,753	999.8	6,071
California	Los Angeles	722950	97	63.2	98.0%	100.4%	98.6%	100.2%	103.0	8,254	227.9	8,961	412.5	5,807	401.3	5,969	1,068.3	5,752	1,012.3	6,070
California	Redding	725920	497	62.8	96.8%	100.4%	97.3%	100.3%	101.7	8,251	225.1	8,957	407.1	5,810	396.0	5,973	1,054.3	5,755	999.1	6,073
California	Bakersfield	723840	489	65.7	95.7%	100.7%	96.6%	100.4%	100.5	8,275	222.5	8,983	404.2	5,819	393.2	5,981	1,046.9	5,764	992.1	6,082
California	Modesto	724926	73	63.0	98.1%	100.4%	98.7%	100.2%	103.1	8,253	228.3	8,959	413.0	5,806	401.8	5,968	1,069.7	5,751	1,013.7	6,069
California	Sacramento	724839	23	61.9	98.8%	100.3%	99.2%	100.1%	103.8	8,244	229.7	8,949	414.9	5,802	403.6	5,964	1,074.6	5,747	1,018.3	6,065
California	San Francisco	724940	8	58.1	100.3%	99.9%	100.2%	100.0%	105.4	8,212	233.4	8,915	419.1	5,791	407.7	5,953	1,085.4	5,736	1,028.6	6,053
Colorado	Denver	725650	5,414	51.0	83.6%	99.2%	82.7%	100.7%	87.9	8,154	194.6	8,852	345.8	5,833	336.4	5,996	895.6	5,778	848.7	6,097
Connecticut	Hartford	725087	19	52.3	102.6%	99.3%	101.6%	99.7%	107.8	8,165	238.7	8,863	425.0	5,774	413.4	5,936	1,100.7	5,720	1,043.0	6,036
DC	Washington	745940	282	56.4	100.0%	99.7%	99.7%	99.9%	105.1	8,199	232.7	8,900	416.8	5,789	405.5	5,951	1,079.6	5,735	1,023.0	6,051
Delaware	Dover	724088	28	56.1	101.1%	99.7%	100.6%	99.9%	106.2	8,196	235.1	8,897	420.9	5,785	409.4	5,947	1,090.1	5,731	1,033.0	6,047
Florida	Tallahassee	722140	55	68.2	96.1%	100.9%	97.5%	100.5%	101.0	8,295	223.6	9,005	407.9	5,821	396.8	5,983	1,056.3	5,766	1,001.0	6,084
Florida	Tampa	722110	19	73.5	94.1%	101.5%	96.3%	100.7%	98.9	8,339	219.0	9,052	402.8	5,836	391.9	5,999	1,043.3	5,781	988.7	6,100
Georgia	Atlanta	722190	1,027	63.0	94.9%	100.4%	95.4%	100.4%	99.7	8,253	220.7	8,959	399.2	5,817	388.3	5,980	1,033.9	5,762	979.8	6,080
Hawaii	Honolulu	911820	7	77.8	92.5%	101.9%	95.3%	100.9%	97.2	8,374	215.1	9,091	398.5	5,848	387.7	6,012	1,032.1	5,793	978.1	6,113
Idaho	Boise	726810	2,814	52.9	92.4%	99.4%	91.5%	100.3%	97.0	8,170	214.8	8,869	382.8	5,808	372.4	5,971	991.5	5,753	939.6	6,071
Illinois	Chicago	997338	663	50.0	101.2%	99.1%	99.9%	99.7%	106.3	8,146	235.4	8,843	417.8	5,775	406.4	5,937	1,081.9	5,720	1,025.3	6,037
Indiana	Indianapolis	724380	790	53.6	99.3%	99.5%	98.5%	99.9%	104.4	8,175	231.1	8,875	412.2	5,787	401.0	5,949	1,067.5	5,732	1,011.6	6,049
Iowa	Davenport	725349	753	49.7	101.0%	99.1%	99.6%	99.7%	106.1	8,143	234.9	8,840	416.7	5,775	405.4	5,937	1,079.2	5,721	1,022.7	6,037
Iowa	Waterloo	725480	686	47.9	101.9%	98.9%	100.3%	99.6%	107.1	8,129	237.1	8,824	419.6	5,769	408.1	5,931	1,086.6	5,715	1,029.7	6,030
Kansas	Wichita	724500	1,321	57.6	95.9%	99.9%	95.7%	100.2%	100.8	8,208	223.1	8,911	400.3	5,805	389.4	5,967	1,036.8	5,750	982.5	6,068
Kentucky	Louisville	724230	488	58.3	98.6%	99.9%	98.5%	100.1%	103.6	8,214	229.3	8,917	411.8	5,797	400.6	5,959	1,066.6	5,742	1,010.8	6,060
Louisiana	New Orleans	722316	2	68.7	96.1%	101.0%	97.6%	100.5%	101.0	8,300	223.6	9,010	408.1	5,822	397.0	5,984	1,056.9	5,767	1,001.6	6,085
Maine	Portland	726060	45	47.1	104.6%	98.8%	102.8%	99.4%	109.9	8,122	243.3	8,817	430.0	5,760	418.3	5,921	1,113.7	5,705	1,055.4	6,020
Maryland	Baltimore	724060	56	56.0	101.0%	99.7%	100.6%	99.9%	106.1	8,195	234.9	8,896	420.6	5,785	409.1	5,947	1,089.3	5,731	1,032.2	6,047
Massachusetts	Boston	725090	12	52.0	102.8%	99.3%	101.7%	99.7%	108.0	8,162	239.0	8,861	425.4	5,773	413.8	5,935	1,101.8	5,719	1,044.1	6,035
Michigan	Detroit	725375	626	51.0	100.9%	99.2%	99.8%	99.7%	106.1	8,154	234.8	8,852	417.3	5,778	405.9	5,939	1,080.7	5,723	1,024.1	6,039
Michigan	Grand Rapids	726350	803	48.9	101.1%	99.0%	99.6%	99.7%	106.3	8,137	235.2	8,833	416.8	5,773	405.4	5,935	1,079.4	5,719	1,022.9	6,035
Minnesota	Saint Paul	726584	700	46.6	102.4%	98.8%	100.6%	99.5%	107.6	8,118	238.2	8,812	420.7	5,766	409.2	5,927	1,089.5	5,711	1,032.4	6,027
Mississippi	Jackson	722350	330	65.1	96.4%	100.6%	97.3%	100.4%	101.3	8,270	224.3	8,977	407.1	5,815	396.1	5,978	1,054.4	5,760	999.2	6,078
Missouri	St. Louis	724340	531	57.5	98.7%	99.9%	98.5%	100.0%	103.8	8,208	229.7	8,910	412.0	5,795	400.8	5,957	1,067.1	5,741	1,011.2	6,058
Missouri	Kansas City	724463	742	57.0	98.2%	99.8%	97.9%	100.0%	103.2	8,203	228.4	8,905	409.4	5,796	398.3	5,958	1,060.4	5,742	1,004.9	6,059
Montana	Great Falls	727750	3,364	45.2	93.1%	98.6%	91.3%	100.0%	97.8	8,106	216.6	8,800	381.8	5,792	371.4	5,954	988.7	5,737	936.9	6,055
Nebraska	Omaha	725530	1,332	51.6	98.2%	99.3%	97.1%	99.9%	103.2	8,159	228.3	8,857	406.1	5,787	395.1	5,949	1,051.9	5,733	996.8	6,050
Nevada	Las Vegas	724846	2,203	69.1	88.6%	101.0%	90.0%	100.9%	93.1	8,303	206.0	9,013	376.3	5,848	366.0	6,012	974.5	5,793	923.5	6,113
New Hampshire	Concord	726050	346	47.0	103.5%	98.8%	101.8%	99.5%	108.8	8,121	240.8	8,816	425.6	5,763	414.0	5,924	1,102.3	5,708	1,044.5	6,024
New Jersey	Newark	725020	7	55.8	101.3%	99.7%	100.8%	99.8%	106.4	8,194	235.5	8,894	421.5	5,784	410.0	5,946	1,091.7	5,730	1,034.5	6,046
New Mexico	Albuquerque	723650	5,310	58.1	81.7%	99.9%	81.6%	101.0%	85.9	8,212	190.1	8,915	341.3	5,852	332.0	6,016	883.9	5,797	837.6	6,117
New York	New York	725053	130	55.3	101.0%	99.6%	100.5%	99.8%	106.2	8,189	235.0	8,890	420.2	5,784	408.8	5,946	1,088.3	5,730	1,031.3	6,046
New York	Syracuse	725190	413	48.9	102.5%	99.0%	101.0%	99.6%	107.8	8,137	238.5	8,833	422.6	5,769	411.1	5,930	1,094.6	5,714	1,037.3	6,030
North Carolina	Asheville	723150	2,117	56.2	93.6%	99.7%	93.2%	100.3%	98.4	8,197	217.8	8,898	390.0	5,810	379.4	5,972	1,010.0	5,755	957.1	6,073
North Carolina	Charlotte	723140	728	61.3	96.6%	100.2%	96.9%	100.3%	101.5	8,239	224.6	8,944	405.3	5,809	394.2	5,971	1,049.6	5,754	994.6	6,072
North Dakota	Bismarck	727640	1,651	43.3	100.1%	98.4%	97.9%	99.5%	105.2	8,091	232.9	8,783	409.6	5,767	398.4	5,928	1,060.7	5,712	1,005.2	6,028
Ohio	Cincinnati	724297	490	55.0	99.9%	99.6%	99.3%	99.9%	104.9	8,187	232.3	8,887	415.2	5,788	403.9	5,949	1,075.3	5,733	1,019.0	6,050
Oklahoma	Oklahoma City	723530	1,285	61.2	94.7%	100.2%	95.0%	100.4%	99.5	8,238	220.2	8,943	397.3	5,815	386.5	5,977	1,028.9	5,760	975.0	6,078
Oklahoma	Tulsa	723560	650	61.3	96.8%	100.2%	97.2%	100.2%	101.8	8,239	225.2	8,944	406.4	5,808	395.3	5,970	1,052.5	5,753	997.4	6,071
Oregon	Portland	726980	19	54.6	101.7%	99.6%	101.0%	99.8%	106.9	8,184	236.6	8,884	422.6	5,781	411.1	5,943	1,094.5	5,726	1,037.2	6,043
Pennsylvania	Philadelphia	724080	10	56.6	100.9%	99.8%	100.6%	99.9%	106.1	8,200	234.8	8,902	420.6	5,787	409.2	5,948	1,089.4	5,732	1,032.3	6,049
Pennsylvania	Wilkes-Barre	725130	930	50.3	100.1%	99.1%	98.8%	99.8%	105.2	8,148	232.9	8,845	413.5	5,779	402.2	5,941	1,070.8	5,724	1,014.7	6,041
Puerto Rico	San Juan	994043	16	80.3	91.4%	102.1%	94.6%	101.1%	96.1	8,395	212.7	9,113	395.8	5,855	385.0	6,019	1,025.0	5,800	971.3	6,121
Rhode Island	Providence	997278	33	53.0	102.3%	99.4%	101.4%	99.7%	107.5	8,171	237.9	8,870	424.1	5,776	412.5	5,938	1,098.3	5,722	1,040.7	6,038
South Carolina	Charleston	722080	40	66.5	96.9%	100.8%	98.0%	100.4%	101.8	8,282	225.3	8,990	409.9	5,816	398.7	5,978	1,061.5	5,761	1,005.9	6,079
South Carolina	Spartanburg	723120	943	61.2	95.8%	100.2%	96.2%	100.3%	100.7	8,238	223.0	8,943	402.2	5,811	391.3	5,973	1,041.8	5,756	987.2	6,074
South Dakota	Rapid City	726620	3,160	47.4	93.1%	98.8%	91.5%	100.0%	97.8	8,125	216.5	8,820	382.8	5,796	372.4	5,958	991.4	5,742	939.5	6,059
Tennessee	Knoxville	723260	962	59.5	96.4%	100.1%	96.5%	100.2%	101.3	8,224	224.3	8,928	403.7	5,806	392.7	5,968	1,045.5	5,751	990.7	6,069
Tennessee	Nashville	723270	600	60.2	97.4%	100.1%	97.6%	100.2%	102.4	8,230	226.6	8,934	408.3	5,804	397.2	5,966	1,057.3	5,749	1,002.0	6,067
Texas	Houston	722436	32	70.6	95.3%	101.2%	97.0%	100.6%	100.1	8,315	221.6	9,027	405.7	5,827	394.6	5,990	1,050.7	5,772	995.7	6,091
Utah	Salt Lake City	725720	4,225	53.5	87.1%	99.5%	86.4%	100.6%	91.5	8,175	202.6	8,874	361.3	5,826	351.5	5,989	935.8	5,771	886.8	6,090

									Gas Turbine Based Capacity and Heat Rate Adjustments												
LOCATION		Adjustment Basis			Simple Cycle		Combined Cyle		2 x LM6000PF+		1 x 7F.05		1 x 7HA.01 WCT		1 x 7HA.01 ACC		2 x 7HA.02 WCT		2 x 7HA.02 ACC	
State	City	ASHRAE Station	Alt (ft)	Ave T (F)	MW Adj SC	HR Adj SC	MW Adj CC	HR Adj CC	MW Net	HR Net	MW Net	HR Net	MW Net	HR Net	MW Net	HR Net	MW Net	HR Net	MW Net	HR Net
Vermont	Burlington	726170	330	46.6	103.7%	98.8%	101.9%	99.4%	109.0	8,118	241.3	8,812	426.3	5,761	414.7	5,922	1,104.0	5,707	1,046.1	6,022
Virginia	Alexandria	724050	10	58.7	100.1%	100.0%	100.0%	100.0%	105.2	8,217	232.8	8,920	418.4	5,793	407.1	5,955	1,083.7	5,738	1,027.0	6,055
Virginia	Lynchburg	724100	940	56.6	97.6%	99.8%	97.3%	100.1%	102.6	8,200	227.1	8,902	406.9	5,797	395.9	5,959	1,053.9	5,743	998.7	6,060
Washington	Seattle	994014	7	53.2	102.3%	99.4%	101.4%	99.7%	107.5	8,172	238.0	8,871	424.2	5,777	412.7	5,938	1,098.7	5,722	1,041.2	6,038
Washington	Spokane	727850	2,353	48.1	95.8%	98.9%	94.3%	99.9%	100.6	8,130	222.8	8,826	394.3	5,789	383.6	5,951	1,021.1	5,734	967.7	6,051
West Virginia	Charleston	724140	910	55.9	98.0%	99.7%	97.6%	100.0%	103.0	8,194	228.0	8,895	408.1	5,795	397.0	5,957	1,056.9	5,740	1,001.6	6,057
Wisconsin	Green Bay	726450	687	45.5	102.9%	98.7%	100.9%	99.5%	108.1	8,109	239.3	8,803	422.0	5,762	410.5	5,923	1,092.9	5,708	1,035.7	6,023
Wyoming	Cheyenne	725640	6,130	46.6	82.4%	98.8%	81.0%	100.6%	86.6	8,118	191.8	8,812	338.7	5,828	329.5	5,991	877.2	5,773	831.3	6,092

NATIVE FILES UPLOADED TO THE PUC INTERCHANGE

- ccgt built in texas in last 30 years 3_1_Generator_Y2021.xlsx
- csg Sales_Ult_Cust_1997.xlsx
- csg Sales_Ult_Cust_1998.xlsx
- csg Sales_Ult_Cust_1999.xlsx
- csg Sales_Ult_Cust_2000.xlsx
- csg Sales_Ult_Cust_2001.xlsx
- csg Sales_Ult_Cust_2002.xlsx
- csg Sales_Ult_Cust_2003.xlsx
- csg Sales_Ult_Cust_2004.xlsx
- csg Sales_Ult_Cust_2005.xlsx
- csg Sales_Ult_Cust_2006.xlsx
- csg Sales_Ult_Cust_2007.xlsx
- csg Sales_Ult_Cust_2008.xlsx
- csg Sales_Ult_Cust_2009.xlsx
- csg Sales_Ult_Cust_2010.xlsx
- csg Sales_Ult_Cust_2011.xlsx
- csg Sales_Ult_Cust_2012.xlsx
- csg Sales_Ult_Cust_2013.xls
- csg Sales_Ult_Cust_2014.xls
- csg Sales_Ult_Cust_2015.xlsx
- csg Sales_Ult_Cust_2016.xlsx
- csg Sales_Ult_Cust_2017.xlsx
- csg Sales_Ult_Cust_2018.xlsx
- csg Sales_Ult_Cust_2019.xlsx
- csg Sales_Ult_Cust_2020.xlsx
- csg Sales_Ult_Cust_2021_Data_Early_Release.xlsx
- csg Sperandeo Direct_Exhibits BRS-1 through 48.xlsx
- eti rankings and distance from mean.xlsx
- gas rate relationship RNGWHHDa (1).xls
- H_2022_10_21.xlsx

The following files are not convertible:

ccgt built in texas in last 30 years
3_1_Generator_Y2021.xlsx
csg Sales_Ult_Cust_1997.xlsx
csg Sales_Ult_Cust_1998.xlsx
csg Sales_Ult_Cust_1999.xlsx
csg Sales_Ult_Cust_2000.xlsx
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gas rate relationship RNGWHHDa (1).xls
H_2022_10_21.xlsx

Please see the ZIP file for this Filing on the PUC Interchange in order to access these files.

Contact centralrecords@puc.texas.gov if you have any questions.