Solar Energy Zone Market Analysis for the Afton Region of New Mexico

David Hurlbut, Heather Buchanan, and Jesse Cruce

National Renewable Energy Laboratory

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List of Acronyms

AC	alternating current
ACC	Arizona Corporation Commission
ATC	Available Transfer Capacity
BLM	Bureau of Land Management
Btu	British thermal unit
DC	direct current
DNI	direct normal irradiance
DOI	Department of the Interior
EIA	Energy Information Administration
EIS	Environmental Impact Statement
ELCC	effective load carrying capability
EPE	El Paso Electric
ETA	Energy Transition Act
FERC	Federal Energy Regulatory Commission
GHI	global horizontal irradiance
IRP	Integrated Resource Plan
kV	kilovolts
kW	kilowatts
kWh	kilowatt-hours
kWh/m^2/day	kilowatt-hours per square meter per day
L&R	load and resource
LC	least cost
MW	megawatts
MWh	megawatt-hours
NMPRC	New Mexico Public Regulation Commission
NREL	National Renewable Energy Laboratory
O&M	operation and maintenance
PNM	Public Service Company of New Mexico
PPA	power purchase agreement
PV	photovoltaics
REA	Renewable Energy Act (New Mexico)
ROW	right-of-way
SAM	System Advisor Model
SEZ	solar energy zone
SSP	separate system planning
SWAT	Southwest Area Transmission
TEP	Tucson Electric Power
TSGT	Tri-State Generation and Transmission Association
TWh	terawatt-hours
WAPA	Western Area Power Administration
WECC	Western Electricity Coordinating Council

Executive Summary

The Bureau of Land Management (BLM) may designate a solar energy zone (SEZ) on federal land that it manages in order to expedite environmental review and permitting for solar energy projects. The Afton SEZ, located in southern New Mexico, has attracted extensive developer interest because of current and future robust demand for clean energy (particularly photovoltaics [PV]), proximity to transmission, and the cost competitiveness of PV compared to other generation sources. This report examines the commercial viability and the potential near-term to mid-term extent of solar development in the Afton SEZ based on market conditions in 2022.

Market demand for solar projects in the region is expected to remain strong. The New Mexico Legislature passed legislation in 2019 that accelerates the timetable by which the state's electric utilities must reduce carbon emissions from their generation fleets. The most recent integrated resource plans filed by El Paso Electric (EPE) and Public Service Company of New Mexico (PNM) reflect the new mandate, and both New Mexico utilities expect increases in their procurement of solar and other renewable resources. Based on their geographic proximity and carbon emission goals, EPE and PNM could likely be the primary market for new solar energy development until new transmission projects come online.

The SEZ is adjacent to existing transmission, with much of the transmission capacity obligated to the utilities most likely to benefit from solar capacity built in the SEZ. In addition, the SEZ is close to two planned major transmission lines that are expected to begin construction in 2023 and 2025. The SEZ thus has access to the likely utility markets in El Paso, New Mexico, and Arizona.

The new transmission lines—Southline and SunZia—will provide access to Arizona, where future demand for solar is also expected to grow. Tucson Electric Power (TEP) is part owner of Southline and a likely Arizona purchaser of solar power from the Afton SEZ. Although Arizona does not have an aggressive decarbonization statute like New Mexico, TEP has a voluntary decarbonization target that increases the utility's expected demand for solar resources in the future.

The National Renewable Energy Laboratory (NREL) estimates the cost of a hypothetical, generic solar plant in the Afton SEZ at between 3.2 and 4.2 cents per kilowatt-hour, based on current technology costs. However, that estimate was prepared before U.S. Congress passed the Inflation Reduction Act of 2022,[1] which renews and expands tax credits for solar and other clean energy resources. Consequently, the likely cost of a qualifying solar plant in the SEZ could be less than the NREL estimate. A revised estimate was not prepared because of the complexity of the incentives and the number of unknown factors that would affect the incentive level. Nevertheless, the original estimate compares favorably to the 2021 average cost of generation for EPE (5.7 cents), PNM (7.4 cents), and TEP (9 cents).

Of the three constraints analyzed in this report, transmission to move generation to load is the most likely constraint on near-term solar development on the Afton SEZ. Southline and SunZia

[1] Inflation Reduction Act of 2022, H.R. 5376 (Pub. L. No. 117-169), signed August 16, 2022, https://www.congress.gov/bill/117th-congress/house-bill/5376/actions.

are expected to add 2,500 megawatts (MW) of transfer capacity to Afton and nearby areas by 2025.[2] The Afton SEZ has about 5,000 MW of technically developable potential. Although these projects could be competitive with the utilities' average cost of power, there is also a large amount of private and state land across southeastern New Mexico could provide renewable energy at a similar cost. Assuming economics are equal, the portions of the SEZ that could be permitted most quickly would have a competitive advantage.

[2] The first phase of SunZia will add 3,000 MW of transfer capability but will be inaccessible to projects in the Afton SEZ.

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1 Introduction

This report examines the commercial viability of new solar development in solar energy zones (SEZs) in southern New Mexico based on market conditions in 2022. Pursuant to the Federal Land Policy and Management Act of 1976 (43 U.S.C. §§ 1701–1787) and the Federal Land Policy and Management Act Rights-of-Way Regulations (43 C.F.R. §§2801–2809.19), the Bureau of Land Management (BLM) may designate a SEZ on federal land to expedite environmental review and permitting for solar energy projects. The purpose of the analysis reported here is to understand whether current market conditions support the need for new solar development in SEZs in the area.

The analysis comprises three parts:

- **An assessment of demand:** Who are the load-serving utilities (or other potential energy purchasers) that might want the output from a solar project in the SEZ? Have they indicated any desire for new power purchase agreements (PPAs) for energy?
- **An assessment of transmission:** Is it possible to get energy from the SEZ to market using existing transmission? Is there existing transmission near the SEZ, and, if so, does it have available transmission capacity sufficient to accommodate the potential SEZ development?[3]
- **An assessment of project economic competitiveness:** Is it likely that a SEZ solar project could provide energy to load-serving utilities at a lower cost than what the utilities could procure from non-SEZ projects? Does the SEZ have terrain that would increase or decrease the cost of development? Is the annual solar exposure better or worse than at other potential sites?

Figure 1 illustrates how these three factors affect the likelihood that a SEZ will stimulate commercial interest among solar project developers. If there is no proximate market appetite for a SEZ project, if there is no way to get the energy to market, or if there are simply better (e.g., more cost-effective) opportunities elsewhere, developer demand for SEZ land will be weak and a competitive auction for the SEZ might draw little interest. Only if all three factors are positive will there be predictable developer interest.

[3] Available transmission capability is a line's total capability in megawatts, minus the megawatts of capability already obligated to other transmission customers.

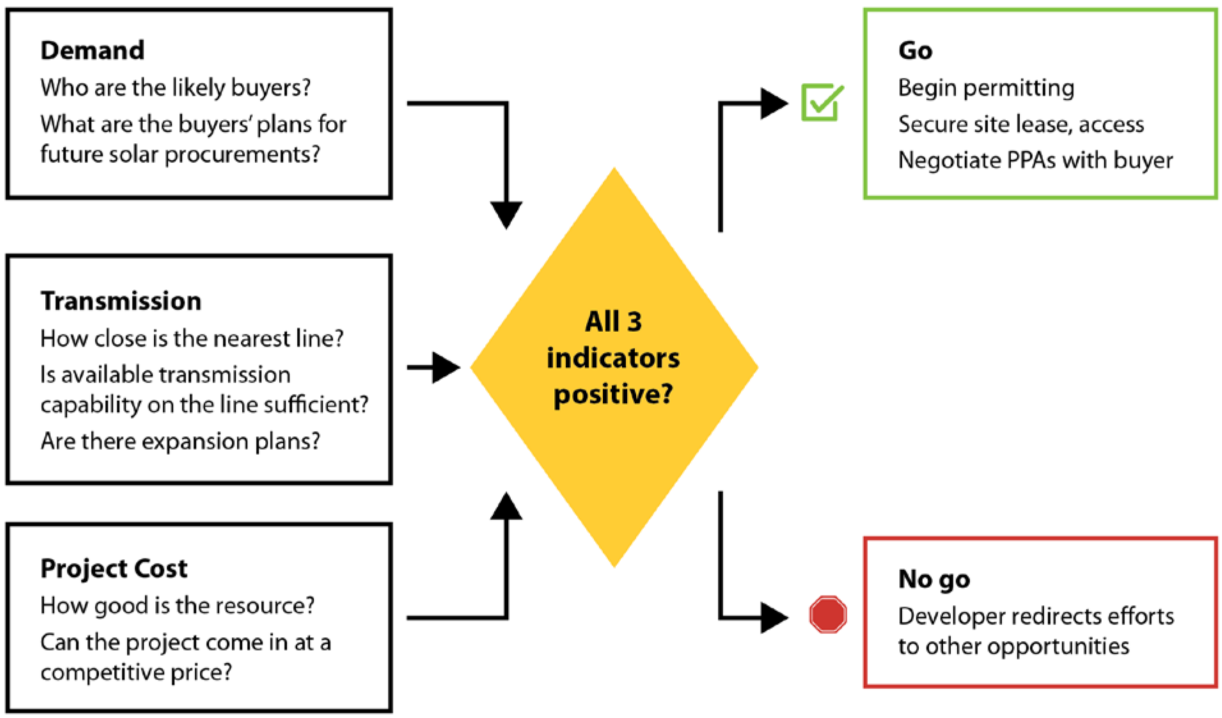

Figure 1. Decision steps for solar project viability

Table 1 shows the answers to some of the key market questions posed in Figure 1. El Paso Electric (EPE) and Public Service Company of New Mexico (PNM) are the largest load-serving utilities in New Mexico. Most of EPE's load is in nearby El Paso, Texas, but its network is on both sides of the state line and has more electrical connection with New Mexico than with the rest of Texas. In addition, Tucson Electric Power (TEP) in Arizona has transmission connections extending into New Mexico. EPE, PNM, and TEP are the largest sources of demand for renewable energy originating in the Afton area and southern New Mexico.

As shown in Table 1, the 2021 overall cost of generation was $74/megawatt-hour (MWh) for PNM, $57/MWh for EPE, and $90/MWh for TEP. This includes fuel costs for all generators in the utility's fleet, the cost of power purchased from renewable energy providers and other merchant generators, the cost of reliability services, and other direct costs. A typical solar project built in the Afton SEZ could potentially provide energy at a cost lower than any of the three utilities' benchmarks based on analysis included in Section 3 of this report. The next section looks more closely at whether the utilities are seeking more renewable energy resources.

Table 1. Market Characteristics Affecting Demand for Solar Projects in the Afton Solar Energy Zone

	Utility	Retail Sales[a] (terawatt-hours [TWh], 2021)	Revenue[b] (¢/kilowatt-hours [kWh], 2021)
Nearest Customer-Serving Utilities with the Largest Load	PNM	9.2	11.5
	EPE	1.7	10.9
	TEP	8.7	11.6
Utilities' Average Electricity Production Cost (2021)[c]	PNM	$74/MWh (7.4¢/kWh)	
	EPE	$57/MWh (5.7¢/kWh)	
	TEP	$90/MWh (9.0¢/kWh)	
Estimated Levelized Cost for a Typical Solar Project in Afton SEZ[d]		$32.3/MWh–$41.5/MWh (3.2¢–4.2¢/kWh)	
Transmission Utilities with Lines near Afton SEZs	EPE		
	PNM		
	Southline (50% Tucson Electric)		
	SunZia		

[a] U.S. Energy Information Administration (EIA), EIA Form 861 database (2021 data for retail sales, average rates).

[b] 2021 Federal Energy Regulatory Commission (FERC) Form 1 (2022), Page 304.

[c] 2021 FERC Form 1 (2022); figures shown are total power production expenses (Page 320, Line 80) divided by total energy sold to retail customers (Page 304, Line 43), including the cost of purchased power.

[d] See Appendix A.

1.1 Characteristics of the Afton Solar Energy Zone and Surrounding Area

The Afton SEZ is near El Paso and close to elements of the EPE transmission network. It is also close to two major proposed transmission projects that will significantly increase renewable energy deliveries to load centers in Arizona. The eastern terminus of the 345-kilovolt (kV) Southline project will be a new substation located in the Afton SEZ, providing direct access to Tucson and other load served by TEP.

Figure 2 shows the Afton SEZ and the relevant transmission infrastructure in the Southwest.

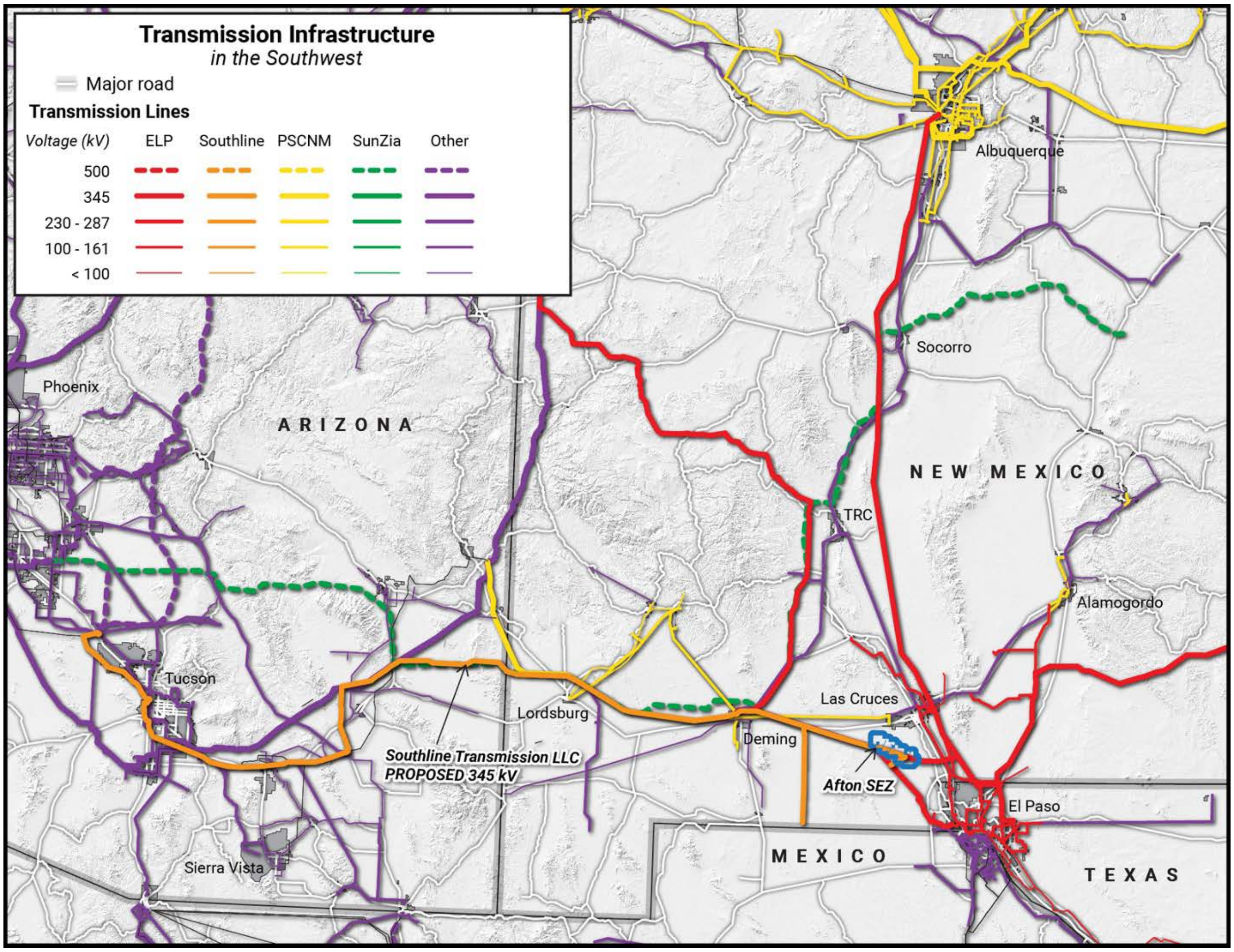

Figure 2. Afton solar energy zone and transmission lines.

National Renewable Energy Laboratory (NREL) map by Billy Roberts.

ELP is El Paso Electric. PSCNM is Public Service Company of New Mexico.

1.2 Need for Future Updates

Market conditions change over time. Therefore, although the findings of this study are valid for the short term, they should be revisited if circumstances change. Utilities normally account for future load growth, plant retirements, and regulatory requirements when determining their future procurement needs, and this study reflects the current outlooks of the relevant utilities. All the load-serving utilities that could purchase solar power generated in the Afton SEZ maintain integrated resource plans. Any change in market conditions that would affect a utility's procurement plans would be reflected in the utility's integrated resource plan.

2 Demand for New Solar Energy Projects

The resource plans of the major utilities in and near the Afton SEZ show that the utilities are anticipating an increase in solar acquisitions in the coming years. One factor driving the plans for PNM and EPE is New Mexico's renewable energy standard and carbon reduction goals in its 2019 Energy Transition Act (ETA), which requires utilities to make incremental progress toward providing 100% of their retail sales of electricity from net-zero-carbon resources according to the following timetable:

- No later than January 1, **2025**, renewable energy must make up at least **40%** of each public utility's total retail sales of electricity to New Mexico customers.
- No later than January 1, **2030**, renewable energy must make up at least **50%** of each public utility's total retail sales of electricity to New Mexico customers.
- No later than January 1, **2040**, renewable energy resources must make up at least **80%** of all retail sales of electricity in New Mexico if compliance with this standard until December 31, 2047, shall not require the public utility to displace zero-carbon resources in the utility's generation portfolio on the effective date of this 2019 act.
- No later than January 1, **2045, 100%** of all retail sales of electricity in New Mexico must come from zero-carbon resources. Reasonable and consistent progress shall be made over time toward this requirement.[4]

Arizona's statewide renewable energy goals are less aggressive than those in New Mexico, but Arizona's largest utilities have adopted voluntary plans to increase their use of renewable resources beyond the state mandate. The Arizona Corporation Commission's (ACC) Renewable Energy Standard and Tariff requires that 15% of regulated utilities' energy come from renewable sources by the year 2025 (ACC, n.d.). All of Arizona's biggest electric utilities—TEP, Arizona Public Service, and Salt River Project—have committed to switching a larger amount of their key power sources from fossil fuels to renewable options. As discussed next, TEP announced that it plans to provide more than 70% of its electricity from zero-carbon resources by 2035, which includes retiring the coal-fired Springerville Generating Station in 2032. Arizona Public Service plans to retire all its coal generation by 2031 and supply 100% of its electricity from renewable resources by 2050. Salt River Project plans to retire its various coal plants between 2027 and 2032 and reduce its carbon emissions by 65% of its 2005 levels by 2035 and by 90% of its 2005 levels by 2050. ACC noted in a press release that these voluntary plans from the state's largest utilities represent a shift in how utilities are making business decisions regarding renewable resources because utilities of this size would not previously have decided to commit to these changes unless prompted by a state mandate. Previously, ACC noted that clean energy technologies were "too cost-prohibitive and unreliable to add in large amounts to the grid," but it said that Arizona utilities are now favoring these resource types voluntarily because of their reliability and cost benefits (ACC 2022).

[4] New Mexico Energy Transition Act, Senate Bill 489 (New Mexico Legislature 2019) (emphasis added).

In addition, a recent bill signed into law by President Biden has the potential to drive future solar energy demand. The Inflation Reduction Act, signed August 16, 2022, introduced a variety of measures applicable across many industries, including tax incentives for clean energy. Some of those measures that may affect future solar demand include modifying and extending tax credits for producing electricity from renewable resources such as solar through 2024 and creating a new tax credit for producing clean electricity and investing in zero-emissions electric generation facilities.[5]

Utilities in the West are increasing their use of battery storage to help manage the variability of solar and wind resources. Current utility best practice is to find an optimal systemwide balance between hybrid solar-plus-storage projects, stand-alone battery storage, flexible fast-response resources such as natural gas combustion turbines, and demand response. Consequently, there will likely be demand both for conventional solar capacity and for hybrid solar-plus-storage projects.

This section analyzes the resource plans for EPE, PNM, and TEP to get a sense of potential solar demand in the Afton SEZ. Although all three utilities have plans to increase their use of renewable resources to serve their customers, the Afton SEZ's proximity to much of EPE's service area suggests that EPE may be the most likely to look to the Afton SEZ for additional solar capacity. However, despite the Afton SEZ's geographic distance, PNM and TEP are both aiming to eliminate their use of coal in their current planning periods and could look to the Afton SEZ for potential replacement resources in the future.

2.1 El Paso Electric

EPE submitted its most recent integrated resource plan (IRP) to the New Mexico Public Regulation Commission (NMPRC) on September 16, 2021, with a corrected IRP filed on January 7, 2022.[6] When EPE prepared its 2021 IRP, it included a load and resource (L&R) balance assessment of future needs for additional generation capacity on the system. The utility forecasted annual loads, estimated its available resources, and determined whether the available resources would be sufficient to meet load plus its planning reserve margin requirement across its 20-year planning period (EPE 2022).

EPE's 2021 IRP is its first that addresses the ETA's requirements to incrementally reduce carbon emissions from utilities' portfolios by providing 80% of electricity from renewable energy resources by 2040 and 100% by 2045. In addition to meeting the statewide clean energy requirements, EPE also plans to reach the 80% milestone by 2035, 5 years sooner than required by the state. EPE noted that its carbon footprint is already lower than that of many others in the utility industry, citing EPE's 2016 exit from coal generation as well as its ownership in the Palo Verde nuclear generation facility. EPE's IRP includes four potential portfolios that would all allow EPE to meet the requirements of the ETA; those portfolios are discussed next (EPE 2022).

[5] Inflation Reduction Act of 2022, H.R. 5376 (Pub. L. No. 117-169), signed August 16, 2022, https://www.congress.gov/bill/117th-congress/house-bill/5376/actions.
[6] EPE noted in its corrected submission that it had amended its 2021 IRP to include capital cost information for existing resources that had been left out of the original submission (EPE 2022).

Table 2 shows EPE's L&R forecast for the planning period, including the capacity of its existing resources compared against the total resources needed to meet its planning reserve margin requirement over the 20-year planning period.

Table 2. EPE Total Net Resources and Total System Demand, 2022–2040 (megawatts [MW])

	2022	2023	2024	2025	2026	2027	2028	2029	2030	
Total Demand	2,156	2,183	2,203	2,237	2,269	2,304	2,335	2,382	2,425	
Total Net Resources	2,303	2,338	2,337	2,376	2,375	2,057	2,056	2,055	2,054	
Net Need[a]	*(176)*	*(172)*	*(196)*	*(196)*	*(234)*	*593*	*629*	*684*	*734*	
	2031	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
Total Demand	2,470	2,509	2,568	2,625	2,688	2,750	2,837	2,928	3,036	3,158
Total Net Resources	1,990	1,976	1,831	1,798	1,798	1,797	1,794	1,780	1,779	1,779
Net Need[a]	*850*	*909*	*977*	*(1,188*	*1,293*	*1,366*	*1,469*	*1,588*	*1,712*	*1,853*

Source: EPE 2022

[a]Margin over reserve, which is equal to the margin over total demand (total net resources minus total system demand) minus planning reserve of 15% of total demand (EPE 2022).

EPE's resource needs assessment also resulted in the following conclusions:

- In the short term (i.e., by 2023), EPE's planned resources, —either under contract or under development, —include 270 megawatts (MW) of solar.
- Peak solar generation occurs several hours before EPE's system peak, meaning that additional battery storage would be required for additional solar to serve the nighttime load.

EPE plans to meet its clean energy goals through a combination of solar and other renewable resources paired with storage as well as its existing carbon-free nuclear resources. EPE noted that meeting its goal of carbon-free resources by 2045 would require the use of gas- or hydrogen-fueled combustion turbines (EPE 2022).

EPE developed and considered four portfolio options in its IRP analysis: 1) Total System Least Cost (LC); 2) Least Cost + NM Dedicated Resources (LC+REA[7]); 3) Separate System Planning (SSP) with Gas; and 4) SSP with No Gas. EPE's recommended portfolio is the LC+REA resource portfolio, which reoptimizes the LC portfolio (no constraints on resources beyond reliability requirement) to add renewable energy and storage resources serving New Mexico customers to satisfy the state's REA requirements. Under the LC+REA portfolio, EPE anticipates adding 786 MW of new solar resources in New Mexico and Texas between 2031 and 2045 (EPE 2022).

[7] REA refers to New Mexico's Renewable Energy Act.

The solar resources that EPE currently owns total less than 9 MW and include a 3-MW system at the Texas Community Solar Facility near the EPE-owned Montana Power Station (gas facility) in El Paso; a 5-MW system in Holloman that serves the Holloman Air Force Base in New Mexico; and six small solar photovoltaic (PV) systems that together total less than 1 MW. Those six small facilities comprise the following:

- Rio Grande in Sunland Park, New Mexico
- Newman in northeast El Paso
- Wrangler Substation in east El Paso
- The El Paso Community College – Valle Verde Campus in El Paso's Lower Valley
- EPE's Van Horn customer service center
- The rooftop of EPE's headquarters in downtown El Paso.

In addition to its owned solar resources, EPE has six solar PPAs currently in service that total 107 MW and another four solar PPAs totaling 270 MW that all have in-service dates in 2022 (EPE 2022). NMPRC approved PPAs for two of the 2022 projects in 2020: a 100-MW solar facility in Santa Teresa, New Mexico, based on a fixed rate of $14.99 per MWh; and a 100-MW solar facility with 50 MW of battery storage in Otero County, New Mexico, based on a fixed rate of $20.99 per MWh and a $5.46 per-kilowatt (kW)-month capacity payment for the storage (NMPRC 2020a; NMPRC 2020b). Finally, EPE also offers net metering and renewable energy credit programs for customer-owned solar (EPE 2022).

The utility's IRP also considered candidate solar resources in nine zones across its service area, which are areas where new solar could be added and interconnected to EPE's system. EPE's IRP included simulated hourly production profiles for each zone that were developed using the National Solar Radiation Database's hourly insolation data for the 2008 through 2018 and NREL's System Advisor Model (SAM).[8] The IRP noted that solar could be added in a variety of locations that are close to load centers (EPE 2022). Table 3 lists the candidate solar resource zones and the capacity factor for each zone, which was the ratio of average annual power output, excluding potential curtailment, to the maximum power output.

[8] sam.nrel.gov.

Table 3. EPE Solar PV Candidate Resource Zones

Resource Zone	State	Capacity Factor[a]
Eastside	TX	33.2%
Van Horn	TX	31.9%
Santa Teresa	TX	33.1%
Holloman	NM	32.3%
Hatch	NM	32.5%
Luna	NM	32.5%
Hidalgo	NM	32.7%
Chaparral	NM	32.7%
Las Cruces Airport	NM	33.0%

Source: EPE 2022

EPE noted that the capacity factor did not correspond to a resource's effective load carrying capability (ELCC)—a resource's magnitude and generation affect its ability to reduce loss-of-load events, which in turn determines the resource's ELCC.

Because of the proximity of its service area to the Afton SEZ, EPE may consider using solar energy resources in the Afton SEZ in the coming years.

2.2 Public Service Company of New Mexico

PNM submitted its most recent IRP to NMPRC on January 29, 2021, with a corrected IRP filed on November 4, 2021.[9] PNM remarked that its 2020 IRP included a greater scope and challenge to prepare than its previous IRPs because of the utility's public commitment to achieve a carbon emissions-free portfolio by 2040, which is 5 years sooner than required by the ETA. Therefore, PNM's 2020 IRP includes plans to eliminate coal from its portfolio by 2024. PNM plans to retire the San Juan Generating Station (San Juan) in 2022, replacing its power with approved carbon-free resources, and divest from the Four Corners Generation Station (Four Corners) by the end of 2024. PNM plans to add 650 MW of solar with 300 MW of colocated storage as replacement resources for the closure of San Juan in 2022 (PNM 2021). PNM reported that the COVID-19 pandemic hindered bringing some of the planned replacement resources online in time for the anticipated closure of the facility, so PNM asked to extend operation for 3 more months (i.e., keeping one of the two remaining units in service) to make up for a 120-MW shortfall in generation capacity during the summer (Moses 2022). San Juan's Unit 1 closed in June 2022, and Unit 4 closed in September 2022 (PNM Resources 2022). A permanent retirement of Four Corners would require unanimous agreement from the other participants, who stated their intent to continue operating the plant. Instead, PNM sought and received approval from NMPRC to

[9] PNM noted in its corrected submission that typographical errors were not included in the modeling data, only in the IRP document itself.

transfer its ownership share in Four Corners to the Navajo Transitional Energy Company at the end of 2024 (PNM 2021).

When PNM prepared its 2020 IRP, it included an assessment of future needs for additional generation capacity on the system (L&R). PNM determines whether it needs additional generation capacity for system reliability by forecasting whether it can maintain its planning reserve margin requirement across its 20-year planning period (PNM 2021). Table 4 shows PNM's L&R forecast for the planning period, including the capacity of its existing resources compared against the total resources needed to meet its planning reserve margin requirement over the 20-year planning period.

PNM's resource needs assessment also resulted in the following conclusions:

- As the PNM portfolio's emphasis on renewables grows, the most challenging time for retaining reliability will shift from the afternoon peak time to the evening after sunset—so PNM must include resources that can sustain stable output during nondaylight hours.
- PNM will rely on its existing resources, demand-side programs, and future investments in additional generation capacity to meet future needs. PNM is considering a wide variety of additional generation options, including incremental energy efficiency and demand response, wind, solar, battery storage, pumped storage, and hydrogen-ready combustion turbines.
- PNM reported that there are currently "ample generation resources" in the southern part of the state to serve the utility's loads in that region (PNM 2021).

Table 4. PNM Existing Resource Dependable Capacity and Incremental Resource Needs (MW)

	2022	2023	2024	2025	2026	2027	2028	2029	2030	
Total Need	2,355	2,368	2,380	2,398	2,483	2,508	2,519	2,532	2,537	
Total Generation Resources	2,184	2,192	2,084	1,881[a]	1,880	1,879	1,733	1,732	1,731	
Net Need	*165*	*284*	*338*	*517*	*603*	*629*	*786*	*800*	*806*	
	2031	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
Total Need	2,549	2,566	2,592	2,619	2,645	2,669	2,698	2,731	2,766	2,788
Total Generation Resources	1,581	1,526	1,524	1,523	1,506	1,504	1,503	1,502	1,501	864
Net Need	*967*	*1,040*	*1,068*	*1,097*	*1,139*	*1,165*	*1,195*	*1,229*	*1,265*	*1,924*

Source: PNM 2021.

2025 is the first year that PNM plans to have fully eliminated coal generation from its portfolio.

PNM mapped out two potential portfolio options that would lead to carbon-free portfolios by 2040. A **Technology Neutral scenario** would comply with the ETA and meet PNM's standards for reliability and environmental quality while relying on hydrogen-ready combustion turbines that will be fueled by natural gas when first brought online in this decade and converted to burn hydrogen by 2040. This scenario would include installing a total of 989 MW of solar resources and 523 MW of storage between 2021 and 2025. A **No New Combustion scenario** would prohibit any new combustion resources and instead rely on investing only in new renewables, storage, and incremental demand-side management, which comes with a risk of inadequate reliability. This scenario would require adding 1,051 MW of solar and 806 MW of storage between 2021 and 2025 (PNM 2021).

PNM's existing solar resources have a capacity of 385 MW, and it plans to add 650 MW of solar with 300 MW of colocated storage as replacement resources for San Juan. PNM noted that additional solar has a relatively limited capacity value beyond the solar already in PNM's portfolio because the timing of PNM's net peak period has moved "nearly entirely into the evening hours when solar resources will not be available to produce" (PNM 2021).

PNM's 2020 IRP stated that specific transmission expansion projects have not been proposed between southern and northern New Mexico and that such projects would be expensive with long lead times. The plan noted that there are several regional transmission lines in various phases of development that stem from the significant commercial interest from buyers who are looking to bring the benefit of New Mexico's renewable energy potential to load centers throughout the region. Some of these projects include the Southline and SunZia projects, discussed in Section 3 of this report. However, PNM said that these two lines in particular do not provide a significant opportunity for PNM to develop renewables within New Mexico because these projects are configured to deliver renewable electricity regionally to utilities in California, Arizona, and potentially elsewhere. It also noted that additional studies could show opportunities to better integrate the facilities to serve local loads and that PNM would continue to monitor transmission projects as they arise for potential to develop renewables locally (PNM 2021).

Although PNM is planning to add solar resources to replace its future coal retirements, analysis of PNM's most recent IRP and consideration of the utility's existing transmission facilities in other regions of the state indicate that PNM may not be looking to serve its local load using solar sited in the Afton SEZ.

2.3 Tucson Electric Power Company

TEP does not serve customers near the Afton SEZ, but it is part owner of the Southline Transmission Project that originates in the SEZ. TEP submitted its most recent IRP to the ACC on June 26, 2020. When TEP prepared its 2020 IRP, it included an assessment of future needs for additional generation capacity on the system across its 15-year planning period (TEP 2020).

Arizona does not have statewide renewable energy goals that match those in New Mexico; instead, the ACC's Renewable Energy Standard and Tariff requires that 15% of regulated utilities' energy come from renewable sources by 2025 (ACC, n.d.). In the absence of a renewable energy standard requirement that requires a high percentage of a utility's electricity to come from renewable sources, the three largest utilities in the state have each pledged its own voluntary renewable energy goals (ACC 2022). TEP announced that it plans to provide more than 70% of its power from renewable resources by 2035, and, as part of that goal, TEP plans to retire all its coal units by 2032. TEP closed its single San Juan Generating Station unit in July

2022 and plans to close its two Four Corners Power Plant units by 2031 (TEP 2022a; TEP 2020). TEP is also planning to retire its two Springerville Generating Station units by 2027 and 2032, respectively, and to offset those two units' output with a mix of new wind, solar, and storage resources (TEP 2020).

Table 5 shows TEP's L&R forecast for the planning period, including the capacity of its existing resources compared against the total resources needed to meet its planning reserve margin requirement over the 15-year planning period.

Table 5. TEP Existing Resource Capacity and System Peak Demand Forecast (MW)

	2022	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**
Total Firm Load Obligation	2,876	2,846	2,928	2,828	2,906	2,900	2,964
Total Firm Resources	3,067	3,068	3,069	3,087	3,098	3,117	3,007
Net Need	*(191)*	*(222)*	*(141)*	*(259)*	*(192)*	*(217)*	*(43)*
	2029	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
Total Firm Load Obligation	2,977	3,059	3,055	3,160	3,081	3,123	3,144
Total Firm Resources	3,026	3,037	3,060	2,970	2,867	2,869	2,871
Net Need	*(49)*	*22*	*(5)*	*190*	*214*	*254*	*273*

Source: TEP 2020

Between 2024 and 2035, TEP plans to add another 2,000 MW of wind and solar resources and 1,400 MW of storage capacity to offset coal and gas retirements planned for that period (TEP 2020). In the preferred portfolio outlined in its 2020 IRP, TEP analyzed trends and predictions for technology cost, tax incentive policies, and solar insolation values in southern Arizona and identified utility-scale PV single-axis tracking solar as the least-cost resource. TEP identified higher-capacity-factor wind resources in eastern New Mexico as the next least-cost option. TEP also noted that it would continue to track factors affecting the cost-effectiveness of renewable energy resource options and update its plans accordingly on an ongoing basis (TEP 2020).

In the time since filing its 2020 IRP, TEP has brought four renewable energy projects online in 2021 and 2022:

- The Oso Grande wind project (250 MW, TEP-owned) in southeast New Mexico
- The Borderlands wind project (99 MW, PPA) in New Mexico, just east of Springerville, Arizona
- The Wilmot Energy Center's solar-plus-storage project (100-MW solar array and 30 MW of storage, PPA) in Tucson
- The Raptor Ridge solar array (12.5 MW, TEP-owned) in Tucson (TEP 2022b).

Finally, regional transmission projects that are coming online in the future could also affect demand for solar, especially two regional projects that are very close to the Afton SEZ, which are discussed more in depth in Section 3.2. TEP acquired the rights to develop a portion of the

Southline Transmission Project that will span across Arizona and New Mexico. Although the portion of the line that TEP is responsible for is on the end opposite the Afton SEZ, TEP noted in its IRP that the Southline project, as well as the SunZia project, could affect TEP's future resource plans and decisions (TEP 2020).

Although TEP does not serve customers near the Afton SEZ, it is part owner of the Southline Transmission Project that originates in the SEZ and could likely look to use the SEZ for solar resources in the future, especially as major regional transmission projects come online.

2.4 Key Takeaways

Analysis of the resource plans of the major utilities in and near the Afton SEZ indicates that they are anticipating an increase in solar deployment in the coming years, driven by state and voluntary renewable energy requirements and federal incentives for solar deployment in the future. New Mexico's renewable energy standard and carbon reduction goals require utilities in the state (PNM and EPE) to make incremental progress toward zero-carbon retail portfolios by 2045, although both PNM and EPE announced plans to hit that target sooner. Although Arizona's statewide renewable energy standard requirements (i.e., 15% of regulated utilities' energy from renewable sources by 2025) are less strict than New Mexico's, TEP joined the two other large utilities in the state to set its own voluntary clean energy goals. Based on those announcements, TEP plans to provide more than 70% of its electricity from zero-carbon resources by 2035, which includes retiring the Springerville Generating Station in 2032. In addition, the 2022 Inflation Reduction Act introduced several measures that may affect future solar demand, including modifying and extending tax credits for producing electricity from solar through 2024 and creating a new tax credit for producing clean electricity and investing in zero-emissions electric generation facilities.

Meeting these clean energy goals in the coming decades will require additional renewable energy capacity for these three utilities, and solar energy from the Afton SEZ could provide a solution. Although all three utilities have plans to increase their use of renewable resources to serve their customers, the Afton SEZ's proximity to the majority of EPE's service area suggests that EPE may be the most likely to look to the Afton SEZ for additional solar capacity. However, despite the Afton SEZ's geographic proximity, PNM and TEP are both aiming to eliminate their use of coal in their current planning periods and could look to the Afton SEZ for potential replacement resources. Large amounts of private land in southeastern New Mexico, as well as available state land in the region, could compete with the Afton SEZ for future solar development. Current and planned transmission, as discussed in the next section, could also affect demand for Afton SEZ solar resources.

3 Transmission Capability

The Afton SEZ is located along an existing 345-kV transmission corridor, which includes a substation at Afton. This corridor includes three natural gas generating stations—one at Afton and one at either end of the corridor—for a combined capacity of about 1,200 MW. A second 345-kV line also crosses the southern tip of the SEZ, and both lines interconnect to the Luna Substation near Deming, New Mexico, at the western end of their corridors 60 miles northwest of the SEZ. The prevailing flow along both corridors is from west to east (i.e., from Arizona through New Mexico and into the load centers at El Paso, Texas, and Las Cruces, New Mexico).

Significant transmission capacity exists from the SEZ west to the Luna Substation: Up to 473 MW from the Afton to Luna Substations and up to 868 MW if the southern 345-kV line corridor is included. However, it is uncertain how much (if any) firm transmission capacity is available beyond the western end of these SEZ corridors (i.e., from Luna into Arizona). Furthermore, there is no capacity available going east from the Afton SEZ because both 345-kV lines are limited by utility transmission rights and committed uses.

Alternatively, two new transmission projects are expected to come online later this decade, which may provide more transmission opportunities. First, Southline (345 kV, 1,000 MW) has its eastern terminus at the existing Afton Substation and has a planned in-service date of 2025. Next, Phase 2 of the SunZia project (500 kV, 1,500 MW) will pass through Deming and has plans for a new substation there. Although an in-service date for Phase 2 has not yet been publicly announced, right-of-way (ROW) permitting for both SunZia phases occurred simultaneously, and Phase 2 will likely see operation this decade. (SunZia Phase 1 is planned for 2025 operation but is wholly owned by a wind developer and is not expected to have additional capacity available.) Both Southline and SunZia have their western termini near load centers in Arizona.

3.1 Existing Transmission

Both existing 345-kV transmission lines through the Afton SEZ are wholly owned by EPE. Prevailing flow in both lines is west to east. As seen in Figure 3, the northern line runs east from the Luna Substation (near Deming), through the existing substation at Afton, to the Newman Substation between El Paso and Las Cruces. Both the Afton and Luna Substations serve relatively new combined-cycle natural gas power plants at 287 MW (built in 2002) and 650 MW (built in 2006), respectively.[10] The Newman Substation serves an old natural gas steam plant (built in 1960), which will be replaced in 2023 by a 228-MW simple-cycle turbine with greater load-following flexibility.[11]

The southern line runs through the southern edge of the Afton SEZ, connecting the Luna to the Diablo Substation. The Diablo Substation primarily serves the (lower-voltage) distribution system for El Paso (EPE 2014a, 2014b). There is no substation near the SEZ along this line corridor.

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[10] Afton is wholly owned by PNM, while Luna is evenly split between PNM, TEP, and Samchully Power & Utilities.

[11] Called Newman Unit 6, wholly owned by EPE.

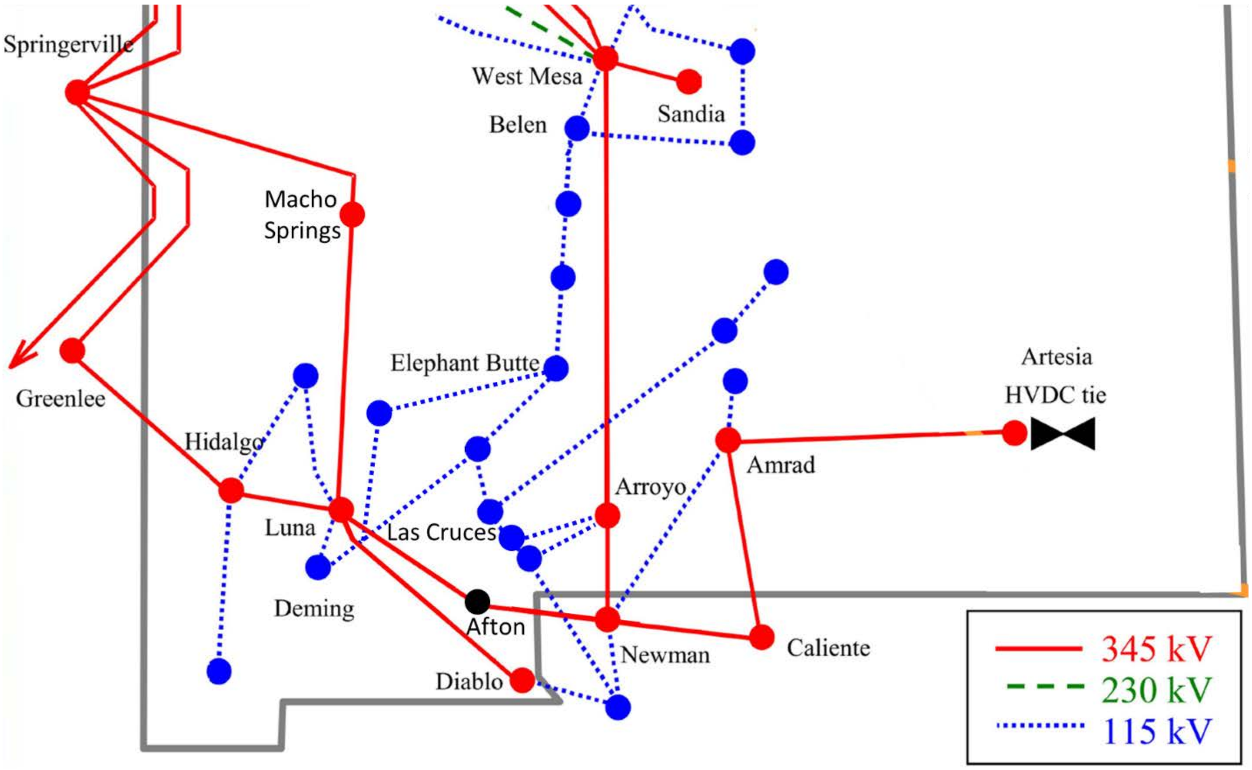

Figure 2. The high-voltage transmission network in southern New Mexico.

The 345-kV Afton Substation is shown in black near the bottom.

(Figure adapted from PNM 2006, Slide 12).

At the western end of the SEZ line corridors, the Luna Substation serves two of the three branches of Western Electricity Coordinating Council (WECC) Path 47, called the Southern New Mexico Transmission System. Path 47 generally brings power from the north and west into EPE's service territory, especially from the Palo Verde nuclear and the Four Corners coal generating stations of which EPE has partial ownership. EPE wholly owns the northwestern branch (Springville-Macho Springs-Luna), while ownership of the southwestern branch (Greenlee-Hidalgo-Luna) is jointly shared with PNM. Both branches interconnect with lines/service territory of TEP.[12] To the east, the Newman Substation (in Texas) serves the third branch of Path 47 via the West Mesa-Arroyo-Newman line. The West Mesa Substation, near Albuquerque, interconnects with the PNM system. This line is wholly owned by EPE.

WECC Path 47 also includes the 115-kV system owned by Tri-State Generation and Transmission (TSGT/Tri-State) that generally parallels the EPE West Mesa-Newman line (i.e., running south from Albuquerque, with branches to Las Cruces and Luna/Deming). Altogether, the four branches of WECC Path 47 are rated at 940 MW (simultaneous, or 1,048 MW nonsimultaneous). Of this, EPE owns 645 MW, Tri-State owns 110 MW, and PNM owns 185 MW.

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[12] Line descriptions, ownership, and interconnections are detailed in EPE's Available Transfer Capacity (ATC) document from the Open Access Same-Time Information System (oatioasis.com) (EPE 2014a).

The EPE 345-kV system has a few other interconnections of note, including the following:

- EPE 115-kV and 69-kV systems serving the El Paso and Las Cruces areas from multiple substations, including Arroyo, Diablo, and Newman
- The Southwest Power Pool through a high-voltage direct current (DC) terminal at Artesia (Eddy County, New Mexico)
- 115-kV interconnections at the Luna, Arroyo, and Hidalgo Substations with the PNM and Tri-State systems
- Comisión Federal de Electricidád in Mexico through a (normally open) connection to the Diablo Substation.

The available transfer capacity (ATC) available for development of the Afton SEZ is primarily contingent on four existing routes:

1. Afton SEZ to Luna and from Luna to Springerville (EPE only); note that the Afton SEZ to Luna capacity may include both the Afton Substation-Luna and the Diablo-Luna (EPE only) lines
2. Afton SEZ to Luna (EPE only) and from Luna to Greenlee (EPE and PNM)
3. Afton Substation to Newman and Newman to West Mesa (EPE only)
4. Tri-State's 115-kV system to West Mesa, with branches to Luna/Deming and Las Cruces; in addition, PNM has a separate 115-kV link between Luna and Las Cruces.

Flow duration data from WECC suggest that ample available capacity exists against prevailing flows out of Path 47 (Routes 1–3 above) (WECC 2013). However, actual ATCs on each route are limited, as discussed relative to ownership next.

3.1.1 El Paso Electric

For EPE, only the 345-kV system was assumed to be relevant for transmission capacity for the Afton SEZ. Transmission capacities for line segments within this system are shown in Table 6. Note that except for the Afton-Newman and Luna-Diablo paths, all other paths in Table 6 are against prevailing flow.

To summarize the table: Significant transmission capacity exists going west from Afton to Luna (473 MW), especially if developers could also use the Diablo to Luna line (395 MW, for a total of 868 MW). However, available capacity out of Luna is limited. TEP holds rights on the entirety of EPE's portion of the Luna-Greenlee branch, while the Luna-Springerville path is fully subscribed on a firm basis (although significant nonfirm ATC is available). Furthermore, there is very little to no capacity available going east from the SEZ, unless EPE decides to procure some of its generation directly from the SEZ (EPE 2014a).

Table 6. Transmission Capacity Within EPE's System

Transmission Path	Line and Direction	Voltage (kV)	Owner	Total Transfer Capacity	Available Transfer Capacity	Known Existing Rights (MW)
West from SEZ	Afton to Luna	345	EPE	523	473	Tri-State (50)[b]
	Diablo to Luna	345	EPE	395	395	N/A
Luna to Greenlee	Luna to Hidalgo	345	EPE (57.2%) and PNM	286	36	TEP (200)[a] Tri-State (50)[b]
	Hidalgo to Greenlee	345	EPE (40%) and PNM	200	0	TEP (200)[a]
Luna to Springerville	Luna to Macho Springs	345	EPE	658	0[c]	Fully subscribed
	Macho Springs to Springerville	345	EPE	658	0[c]	Fully subscribed
East from SEZ	Afton to Newman*	345	EPE	585	<54[d]	EPE (376 + 125 set-aside) PNM (30 + 111 generation dependent)
	Luna to Diablo*	345	EPE	395	0	EPE (395 for parallel flow of Luna-Newman)
Newman to West Mesa	Newman to Arroyo	345	EPE	260	0	EPE (260)
	Arroyo to West Mesa	345	EPE	30	30	Limited by phase-shifting transformer at Arroyo

Source: EPE 2014a

* These are the only paths listed that follow prevailing power flows.

[a] Under the 1982 *Tucson-El Paso Power Exchange and Transmission Agreement*, EPE has assigned TEP 200 MW of firm transmission rights on the Springerville-Luna-Hidalgo-Greenlee directional path (EPE and TEP, 1982).

[b] Under the 1994 *Long-Term Firm Transmission Service Agreement Between EPE and Plains Electric Generation and Transmission Cooperative* (now Tri-State), a delivery point at Hidalgo was established, requiring power from either Springerville or West Mesa—necessitating 50 MW of committed use along this segment (EPE and Plains Electric, 1994).

[c] EPE confirmed via email that the Luna-Spring path is fully subscribed on a firm basis, so only nonfirm ATC is available. Nonfirm ATC varies day-to-day and within the day itself. For example, on July 27, 2022, nonfirm ATC ranged from 323 to 554 MW during the day.

[d] The listed ATC excludes the generation-dependent usage. According to the 2003 EPE/PNM Settlement Agreement, PNM has long-term rights to 30 MW plus another 111 MW generation dependent on this line. Because this line/direction serves the Afton and Luna natural gas plants (in which PNM has ownership), these are likely the generation-dependent sources referenced.

3.1.2 Public Service Company of New Mexico

PNM has two transmission paths of interest for the Afton SEZs: its partial ownership of the 345-kV Luna-Hidalgo-Greenlee line, and its 115-kV Luna-Deming-Las Cruces line (sections of which may be co-owned with Tri-State). Transmission capacities for both paths are shown in Table 7. As shown, PNM has significantly more directionally available capacity on the 345-kV line than does EPE, with about 160 MW available for the entire length of the path. Alternatively, although about 74 MW is available from Luna/Deming to Las Cruces, there is currently no availability for the Luna 345-kV to 115-kV step-down transformer. This may limit access from the Afton SEZ unless substation upgrades are undertaken (PNM 2022).

Table 7. Relevant Transmission Capacity for PNM's System

Transmission Path	Line and Direction	Voltage (kV)	Owner	Total Transfer Capacity	Available Transfer Capacity	Known Existing Rights (MW)
Luna to Greenlee	Luna to Hidalgo	345	PNM (42.8%) and EPE	214	194	PNM (20)
	Hidalgo to Greenlee	345	PNM (60%) and PNM	300	160	PNM (50), Tri-State (50+40)
Luna to Las Cruces	Luna 345 kV to 115kV	115/345	PNM	162	0	PNM (108), Tri-State (54)
	Luna 115 kV to Deming[a]	115	PNM	200	76	PNM (70), Tri-State (54)
	Deming[a] to Las Cruces[b]	115	PNM & Tri-State	133	74	PNM (43), Tri-State (16)

Source: PNM 2022

[a] PNM has two substations near Deming. The one that interconnects to Las Cruces is known as Mimbres (not to be confused with the unincorporated community of Mimbres, located 60 miles north of Deming).

[b] Consists of three line segments: Deming to Picacho (PNM only), Picacho to Dona Ana (PNM and Tri-State), and Dona Ana to Las Cruces (PNM and Tri-State). PNM reports ATC and total transfer capability only for the entire path, not for each line segment individually.

3.1.3 Tri-State Generation and Transmission

Tri-State's system runs south from West Mesa/Albuquerque and splits at Elephant Butte, with branches to Luna/Deming and Las Cruces. Table 8 shows transmission capacities for four paths: Luna/Deming to the junction at Elephant Butte, from the junction north to the Belen Substation (which interconnects with West Mesa),[13] and both directions to/from the junction and Las Cruces (Tri-State 2022).

As the table shows, there may be some available capacity on Tri-State's system in both directions from the Elephant Butte junction. Once again, however, access to this capacity is contingent on PNM's Luna 345-kV to 115-kV step-down transformer, which currently has no availability.

Table 8. Transmission Capacity on Tri-State's 115-kV System

Transmission Path	Line and Direction	Voltage (kV)	Owner	Total Transfer Capacity	Available Transfer Capacity	Known Existing Rights (MW)
Luna/Deming to Junction	Deming[a] to Caballo	115	Tri-State	47	47	N/A
	Caballo to Elephant Butte	115	Tri-State	60	60	N/A
Las Cruces to Junction	Las Cruces to Picacho	115	PNM and Tri-State	91	91	N/A
	Picacho to Elephant Butte	115	Tri-State	49	49	N/A
Junction to Las Cruces	Elephant Butte to Picacho	115	Tri-State	48	48	N/A
	Picacho to Las Cruces	115	PNM and Tri-State	91	91	N/A
Junction to West Mesa	Elephant Butte to Belen	115	Tri-State	(60)[b]	(60)[b]	N/A

Source: Tri-State 2022.

[a] From the PNM Mimbres Substation.

[b] See Footnote 13.

3.1.4 Tucson Electric Power

TEP holds rights on the lines going west from the Springerville and Greenlee Substations but did not respond to requests for ATC information. Given the currently limited capacity to reach these substations from the Afton SEZ, available capacity on the TEP system is not expected to be a driver of transmission access for SEZ development.

[13] However, it is unclear whether there is available capacity from the Belen 115-kV to West Mesa 345-kV substations because no utility reports on this connection directly. PNM does report on the Willard Substation, which may connect with Belen, and gives a total capacity of 100 MW but no available capacity.

3.2 Planned New Transmission

The Southline and SunZia projects share several similarities. Both projects have their western termini at substations between Tucson and Phoenix, Arizona. Both began planning and development in the mid-to-late 2000s but will not see operation until at least the mid-2020s. Finally, both projects follow similar corridors west from Deming, New Mexico, to the Arizona border.

Despite these similarities, there are key differences between the projects with respect to their planning and applicability for development of the Afton SEZ. Southline is intended to be bidirectional, with primary goals of improving reliability, relieving congestion, and linking load centers at either end of the line. In contrast, SunZia focuses more on long-distance export of renewable energy generation from central New Mexico to load centers in Arizona. These differences influence each line's planned corridor, design, and potentially available transmission capacity for new renewable generation. Each line is discussed next.

3.2.1 Southline

The Southline project is likely the better of the two projects for near-term transmission access for development of the Afton SEZ. It is expected to be fully online in 2028 and will provide approximately 1,000 MW of east-to-west capacity along the entire length of its corridor (Southline Transmission Project 2022).[14] As shown in Figure 4, Southline consists of two distinct segments:

- A new 345-kV double-circuit line running between existing substations at Afton, Hidalgo, and Apache (southwest of Greenlee). Note that this line does not connect to the Luna Substation but does include a new 5-mile single-circuit loop between the Afton Substation and the existing Luna-Diablo line, which was required for reliability. It also includes a 30-mile spur with a new substation east of Deming ("Midpoint North" in the figure) to serve renewable energy development in southern New Mexico.
- An upgrade of existing Western Area Power Administration (WAPA) 115-kV lines between the existing substations at Apache and Saguaro/Tortolita (between Tucson and Phoenix), with the upgrade making the lines double-circuit 230 kV.

[14] Officially, the project is directionally rated east to west for 1,037 MW for Afton-Apache and 1,000 MW for Apache-Saguaro. For the west-to-east direction, the ratings are 971 MW for Apache-Afton and 430 MW for Saguaro-Apache (Southline Transmission Project 2017).

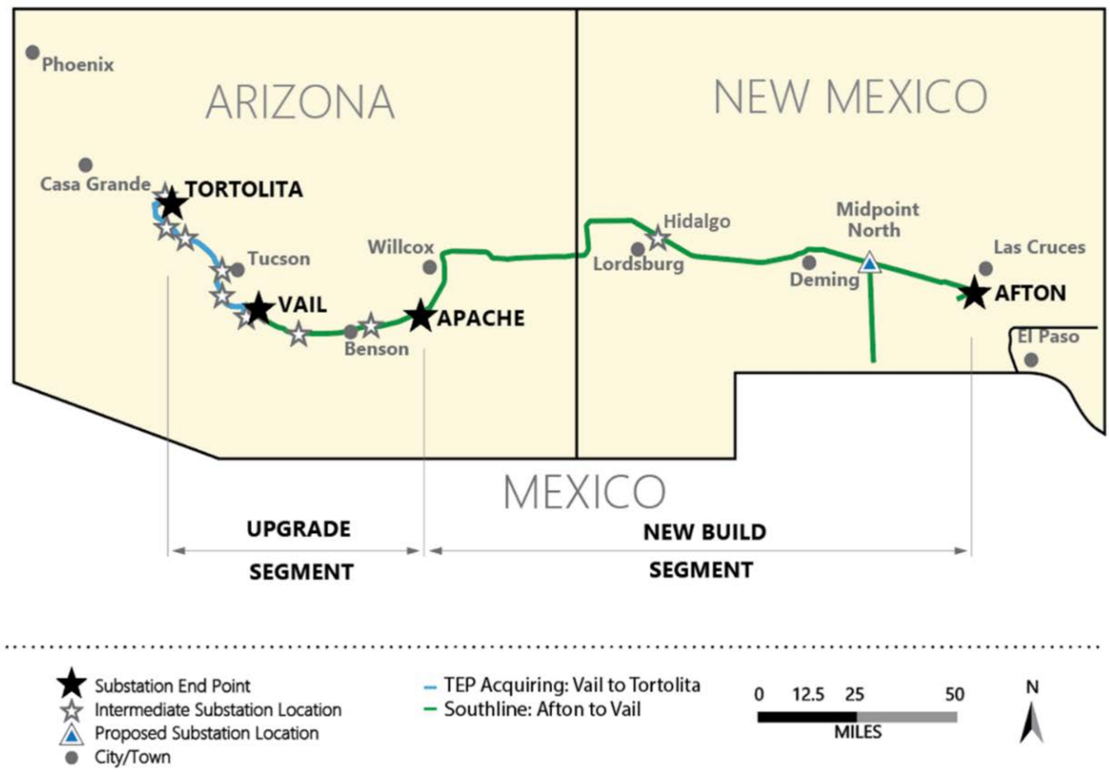

Figure 3. The Southline Transmission Project Corridor.

The line connects to existing stations at Afton, Hidalgo, and Apache and then on through existing substations before terminating between Tucson and Phoenix.

(Figure adapted from "Building America's Next Generation Infrastructure to Power Our Future," Southline Transmission Project," www.southlinetransmissionproject.com. See also WAPA and BLM 2015).

It is unclear whether, or how much, available capacity on the Southline project is open for new development. In 2016, Southline held an open solicitation for capacity on its project, with a plan to offer 100% of line capacity rights. Expressions of Interest were required to be submitted that year, followed by bilateral agreements with interested entities (SU FERC, LLC 2016).

Southline is being developed by two entities. The project is sponsored by Southline Transmission LLC, a subsidiary of Hunt Power LP. The project manager is Black Forest Partners LP. A separate entity called SU FERC (also owned by Hunt Power) will own and manage the transmission capacity rights. An advanced funding agreement and Memorandum of Understanding were also signed with WAPA related to development costs, land rights, and capacity rights on the upgrade segment (Southline Transmission 2015). However, the development rights for the Vail-Tortolita portion of the upgrade segment were instead purchased by TEP in January 2021. TEP plans to develop this section in partnership with WAPA.

Planning for Southline began in 2008. The study area for routing was defined from the beginning by the line's endpoints—again, with a focus on bidirectional flow to improve reliability, relieve congestion, link load centers, and allow for renewable energy development along the line's path. The line is planned to connect up to 14 existing substations, and 85% of the line follows existing corridors. BLM National Environmental Policy Act reviews began in 2012, with the draft Environmental Impact Statement (EIS) released in 2013 and the final EIS signed in 2016

(Southline Transmission Project 2022; Southline Transmission Project 2017; Southwest Area Transmission [SWAT] 2022; SU FERC 2016).. As of March 2024, the project is fully permitted with NEPA and New Mexico and Arizona state approvals secured (Southline Transmission Project 2024). Construction is anticipated to begin in 2025, with the first phase possibly operational by 2027 (Southline Transmission 2024)..

3.2.2 SunZia

The SunZia project is planned for two phases with a total capacity of 4,500 MW:

- Phase 1: 525 kV DC, 3,000 MW
- Phase 2, also called El Rio Sol Transmission, 500 kV alternating current (AC), 1,500 MW.

Both phases will follow the same general route, as shown in Figure 5. The lines will start in Torrance County in central New Mexico, near the major wind resource area southeast of Albuquerque. The lines will then travel west to the I-25 corridor, then south to Deming, before following the general Luna-Hidalgo corridor into Arizona. From there, the lines will connect to the Pinal Central Substation between Tucson and Phoenix. Although some sources state that line flows will be bidirectional, the lines are expected to generally run east to west (i.e., delivering wind and solar energy generation from New Mexico into load centers in Arizona). Phase 2 is planned to have a new substation near Deming.

Only Phase 2 is likely to provide transmission capacity for development of the Afton SEZ. As of July 2022, Pattern Energy owns development rights to the entirety of Phase 1 to support its Western Spirit Wind Farm Project at the eastern terminus.[15] The planned capacity for Pattern Energy's wind development is 3,000 MW—i.e., all of the transmission capacity of Phase 1 (Pattern Energy Group LP 2022). Alternatively, capacity rights for Phase 2 have not yet been auctioned or publicly announced. Given the ample transmission capacity on the existing Afton-Luna and Diablo-Luna lines, it is likely that developers of the Afton SEZ would have access to SunZia Phase 2 at its planned new substation near Deming.

[15] In 2011, FERC issued an order allowing SunZia to commit 50% of its project capacity to an "anchor tenant." First Wind was secured as the initial anchor tenant in 2013 (for 1,500 MW) but went bankrupt in 2016. Pattern Energy/Western Spirit Wind Farm was then secured as a replacement anchor tenant (for 3,000 MW) later that year and subsequently bought Phase 1 of the project in its entirety in 2022 (Pattern Energy Group LP 2022; Stanfield 2016).

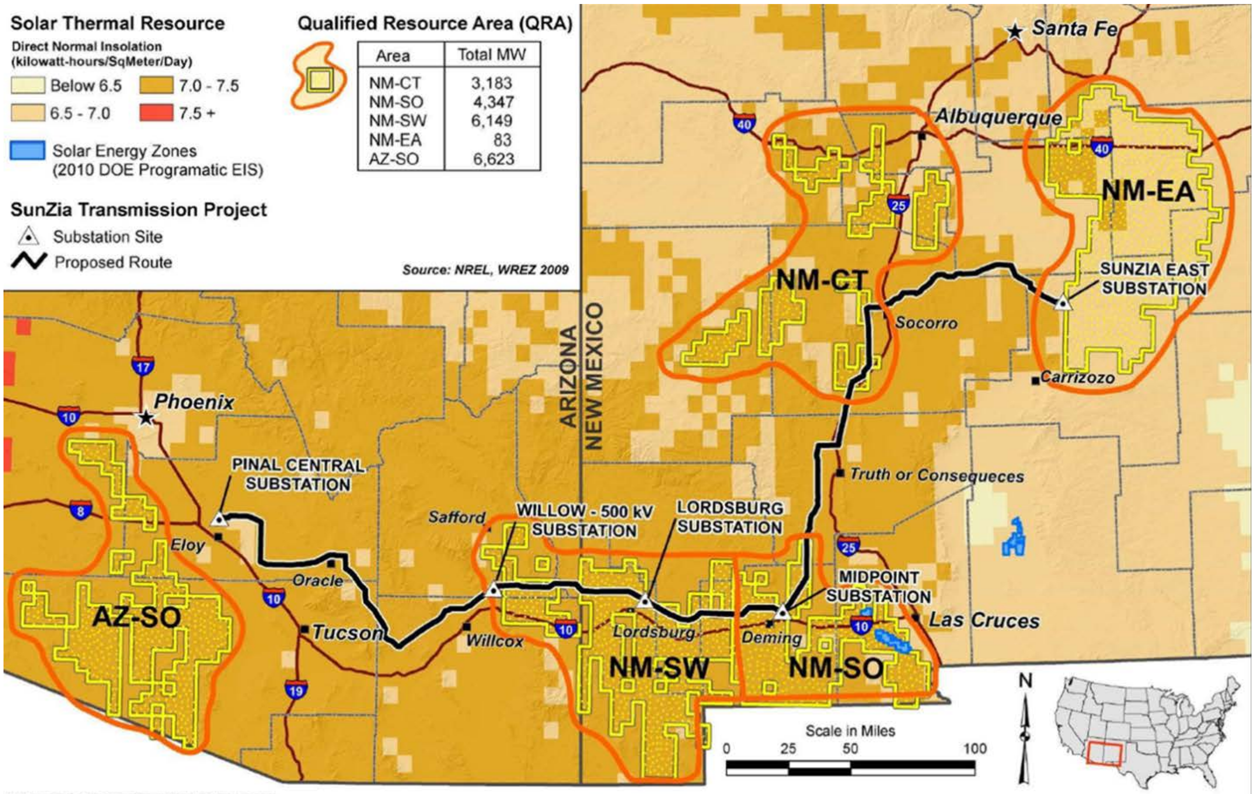

Figure 4. General overview of the planned SunZia corridor along with solar energy resources along its path.

Both Phase 1 and Phase 2 will follow the route shown.

Figure adapted from SunZia (2016).

Although permitting for both phases occurred simultaneously, final development and construction of Phase 2 was not planned to begin until Phase 1 was completed and fully online. It is uncertain whether Pattern Energy's purchase of Phase 1 will now expedite Phase 2.

The SunZia project is being developed by SouthWestern Power Group, a wholly owned subsidiary of MMR Group. Initially, ownership of the project was split between MMR Group (80%), Salt River Project (13%), Shell WindEnergy (5%), and TEP and Tri-State (1% each). Between 2018 and 2020, MMR bought out all the other owners except Salt River Project. It is unclear whether Pattern Energy's purchase of Phase 1 impacted the ownership structure of the project.

The SunZia project originated with planning efforts by the SWAT regional planning group, with a focus on increasing reliability and transfer capacity between Arizona and New Mexico and facilitating the development of renewable resources (especially in New Mexico). In 2006, a planning workshop identified long-term renewable resource locations (Figure 5), and the general route was developed from there. The initial ROW application was submitted to BLM, with the final EIS signed in 2013. However, final ROW approvals encountered some difficulties, which ultimately delayed the project by several years.[16]

With the proposed reroute, the lines now cross through the Sevilleta National Wildlife Refuge when they turn south at the I-25 corridor. There are two existing transmission line corridors/ROWs through Sevilleta (EPE's Arroyo-West Mesa 345-kV line and Tri-State's 115-kV line). Both existing ROWs are relatively narrow; neither is wide enough to allow both phases of SunZia on the same corridor. Instead, SunZia plans to restring both existing lines to double-circuit, specifically, Phase 1 on the 115-kV corridor and Phase 2 on the 345-kV corridor. The draft EIS for the reroute was released in April 2022, and final approvals were issued in May 2023 (Department of the Interior [DOI] 2023). Phase 1 received final construction approvals in late 2023. In January 2024, several groups filed a lawsuit challenging the federal approvals for the project that were dismissed by a judge in April 2024. The project is expected to begin commercial service in 2026 (Mindock 2024).

3.3 Key Takeaways

Key takeaways related to transmission availability for development of the Afton SEZ include:

1. Two existing 345-kV lines cross the Afton SEZ. Both lines interconnect with the Luna Substation near Deming at the western ends of their corridors, and the northern line includes a substation at Afton. The prevailing direction of power flow for these lines is from west to east—i.e., from Arizona into the El Paso/Las Cruces region.
2. There is ample available capacity west from Afton to Luna (up to 868 MW if both 345-kV lines are used). However, available transmission capacity continuing west from Luna is much more limited: There is no firm capacity available on EPE's portions of these routes, although nonfirm capacity may be available. Similarly, PNM may have some firm capacity available on its owned portion of this route (up to 160 MW) but did not respond to requests to confirm these values. As such, utilization of these routes depends on the transmission capacity rights-holding utilities (EPE, PNM, TEP, or Tri-State) procuring energy from the Afton SEZ itself.
3. Similarly, there is no available transmission capacity going east from Afton toward El Paso/Las Cruces, unless EPE or PNM decide to procure energy from the SEZ.
4. Finally, there may be some capacity from the Luna Substation to Albuquerque or El Paso/Las Cruces on the 115-kV system, but this capacity is contingent on the availability of the 115-kV/345-kV step-down transformer at Luna.

Despite the limitations of the current system, a significant increase in capacity is expected later this decade—first from the Southline project (1,000 MW) and then later from SunZia Phase 2

[16] First, the original planned route of the east-west section from the eastern terminus to I-25 ran through the "Northern Call-Up Area" of the White Sands Missile Range. The initially planned solution was to bury 5 miles of the line to avoid low-flying aircraft in this area. However, after BLM issued the ROW in 2016, the Department of Defense continued to raise concerns about the line's proximity to White Sands. Ultimately, SunZia voluntarily proposed to evaluate a new corridor and applied to BLM to shift the corridor north to avoid White Sands entirely. This new corridor parallels the new Western Spirit Transmission Line (built in 2021) and no longer requires burying the line. The new application was submitted to BLM in 2020.

(1,500 MW). Both lines connect to major load centers in Arizona at their western termini. Southline will connect directly to the existing Afton Substation, providing some transmission opportunities for development of the Afton SEZ. SunZia Phase 2 will pass through Deming, so the SEZ may use the existing 345-kV lines (again, with 868 MW of currently available capacity). Both projects may allow the SEZ to market to out-of-state offtakers in Arizona or California. However, it is unclear whether these lines have sold or auctioned their expected capacities yet.

Based on the above, potential transmission capacity from the SEZ after completion of Southline and SunZia could be up to approximately 2,500 MW.

4 Project Economics

Even if demand exists and transmission is sufficient, solar developers still might have little interest in a SEZ if they have economically superior alternatives elsewhere. Factors affecting the economic competitiveness of a SEZ project are the utility's wholesale cost of power, the expected cost of a solar project in a SEZ, and site factors that make development in a SEZ easier or more difficult than development on nearby private land.

Table 9 shows the recent history of wholesale power costs for PNM, EPE, and TEP. The averages shown in the table include fuel and other variable costs of generating power from the utilities' own plants as well as the cost of power purchased from other suppliers.

Table 9. New Mexico and Arizona Utilities' Wholesale Cost of Power, 2017–2021 (nominal $/MWh)

	2017	2018	2019	2020	2021
PNM	$53	$52	$51	$54	$74
EPE	$47	$44	$37	$43	$57
TEP	$67	$81	$81	$71	$90

Source: FERC Form 1 reports for 2018 through 2022 for PNM, EPE, and TEP. Figures shown are total power production expenses (Page 320, Line 80) divided by total energy sold to retail customers (Page 304, Line 43), including the cost of purchased power.

An 80% increase in the cost of fuel for generation (mostly coal and natural gas) helped push EPE's wholesale power costs to $57/MWh in 2021. PNM and TEP, whose costs are generally higher than EPE's, experienced similar increases. The cost drivers included an increase in natural gas prices, which averaged $3.89/million British thermal units (Btu) nationally in 2021 and $2.03/million Btu in 2020. Another cost driver was increased electricity demand after the easing of restrictions related to the COVID-19 pandemic (EIA 2022).

Solar power in the Afton SEZ compares favorably to utilities' current and recent historical costs. We simulated the cost of a hypothetical solar plant in the Afton SEZ, using current equipment costs and the best available data on the solar resource at the site. The analysis, exclusive of IRA-related tax credits, indicated that a typical solar plant would likely cost between $32.3/MWh and $41.5/MWh.[17] (Costs may be higher for projects sited on the west end of the SEZ because of additional construction costs to drill through rocky terrain, based on on-site observations made by the authors of this report.) Comparing these results to the utilities' cost of power, holding all other factors constant, suggests that adding solar power from the Afton SEZ would reduce overall costs. (See Appendix A for a detailed description of the assumptions used in the simulation.)

[17] These estimates were prepared before Congress passed the Inflation Reduction Act. The tax credits that were extended and enhanced by the law were complex and are still under study by NREL as of this writing. Therefore, the estimates were not recalculated for this report. Instead, the model used assumed the 26% federal investment tax credit (SEIA 2022). See Appendix A.

In addition, the cost of energy from a solar plant is less volatile than the cost of natural gas. Because a solar plant has no fuel inputs, its all-in cost is largely the annualized finance cost of project development (plus a rate of return) divided by the amount of energy the project is expected to generate over a typical year. A solar project deal often includes an annual escalation factor to account for the project's loss of efficiency over time, but these adjustments are gradual. The impact is much different for a generator using natural gas. Not only can fuel costs fluctuate quickly, but most utilities pass these changes on to customers directly through an energy cost adjustment that is updated every 3 months.

The quality of solar exposure is measured as a function of unobstructed sunlight falling on a square meter of land during the year, in direct normal irradiance (DNI) and global horizontal irradiance (GHI). New Mexico's highest-quality solar resources are in the southern part of the state, where the Afton SEZ is located. The map in Figure 6 shows GHI across New Mexico. The Afton SEZ, which is indicated on the map, has a GHI of 6.02 kilowatt-hours per square meter per day (kWh/m^2/day) and a DNI of 7.85 kWh/m^2/day.

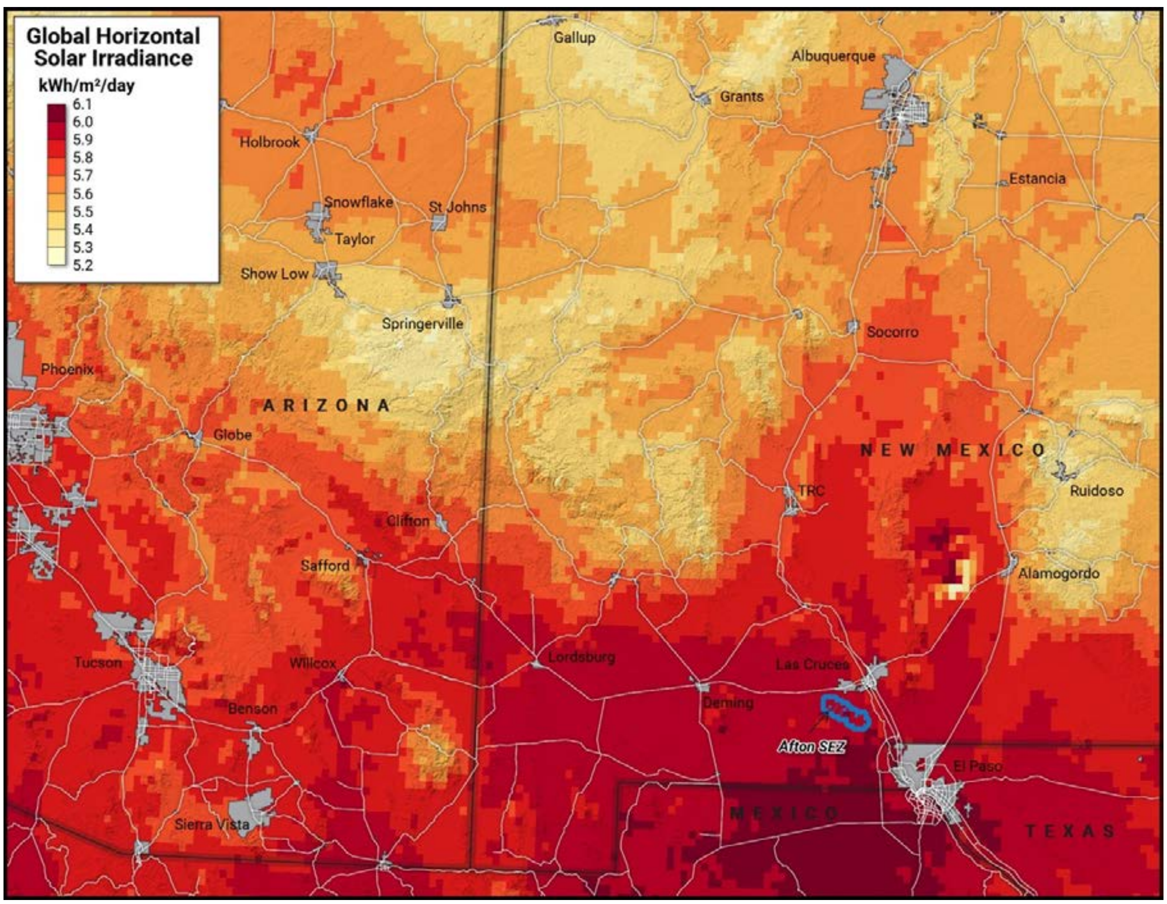

Figure 5. GHI for Afton SEZ compared to other New Mexico areas.

Source: NREL National Solar Radiation Database[18]

[18] nsrdb.nrel.gov

Although solar development in the Afton SEZ could be competitive with the utilities' average cost of power, there is a large amount of private land across southeastern New Mexico, which could provide a similar cost of energy. In addition, there is state land in this part of the state that could be leased for solar development.

5 Findings

This market assessment provides some insight into the commercial viability of future solar development in the Afton SEZ. We offer the following observations based on the findings of our analysis:

1. Load-serving utilities in New Mexico and Arizona anticipate future demand for more renewable resources because of both required and voluntary clean energy goals and because the expected wholesale cost of new solar projects sited in the Afton SEZ is less than the utilities' current wholesale cost of electricity.
2. Unobligated transmission availability from the SEZ to offtakers is somewhat limited currently, but much of the obligated capacity is held by the utilities most likely to benefit as offtakers of solar resources in the Afton SEZ. The 115-kV system may have some availability capacity, but this capacity is contingent on the 115-kV/345-kV step-down transformer at Luna.
3. A significant increase in transmission capacity is expected later this decade, especially from the Southline project (which terminates at the Afton Substation). SunZia Phase 2 may also provide additional capacity by using the existing Afton-Luna 345-kV lines. Both lines terminate near load centers in Arizona and may allow for out-of-state marketing of generation from the Afton SEZ.

In summary, the market demand for a solar project built in the Afton SEZ is robust. Solar development in the SEZ is likely more cost-effective than the major utilities' current resources. The zone has good transmission access, but mostly for EPE, TEP, and PNM, who hold much of the committed transmission capacity.

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Appendix A. Assumptions Used in Hypothetical Solar Project Economic Analysis

The following inputs were used to model a hypothetical 500 megawatts direct current (MW_{dc}), 2,500-acre, single-axis tracking photovoltaic system at the Afton Solar Energy Zone (SEZ) leased by the Bureau of Land Management. The National Renewable Energy Laboratory's System Advisor Model (SAM) version 2020.11.29r1 was used for the analysis.[19]

A.1 Resource, Equipment, and System Costs

Coordinates: 32.13°, –106.86°, elevation 1,277 meters.

Solar Irradiance: Weather file from the National Solar Radiation Database's Typical Meteorological Year[20] at the above coordinates, which indicates a multiyear mean direct normal irradiance (DNI) of 7.85 kWh/m^2/day and global horizontal irradiance (GHI) of 6.02 kilowatt-hours per square meter per day (kWh/m^2/day).

Module: A premium, crystalline-silicon module was selected with the default nominal efficiency of 20.1%.

Inverter: A high-efficiency, California Energy Commission 2018-listed, central inverter was modeled with a California Energy Commission weighted efficiency of 98.8%.

DC to alternating current (AC) Ratio: 1.3.

Annual Degradation: The SAM default of 0.5% per year was used.

Total Installed Costs: A range of expected costs for 2020 from Bolinger et al. (2021) was used: \$0.85/W_{dc} (20th percentile) – \$1.25/W_{dc} (80th percentile).

Operation and Maintenance (O&M) Cost: The 2020 mean O&M from Lawrence Berkeley National Laboratory's "Utility-Scale Solar, 2021 Edition" was \$15.8/kW_{ac}-year (Bolinger et al. 2021).

Internal Rate of Return: The target was adjusted from the SAM default of 11% to 8%.[21] The internal rate of return target year default of Year 20 was adjusted to Year 25.

A.2 Taxes

The default SAM sales tax rate of 5% was used.

The federal income tax was adjusted from the SAM default of 35% to 21% to reflect the new tax legislation.[22]

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[19] sam.nrel.gov.
[20] maps.nrel.gov/nsrdb-viewer.
[21] Based on ranges from Feldman and Schwabe (2017) and GTM (2017).
[22] "2018 Fiscal-year Blended Tax Rates for Corporations: Notice 2018-38," IRS, https://www.irs.gov/pub/irsdrop/n-18-38.pdf.

A state income tax SAM default of 7% was used.

A.3 Financial Parameters

The insurance rate (annual) was dropped from the 0.5% of installed cost default to 0.1%[23].

The power purchase agreement's (PPA's) price escalation was adjusted to 0%. The default analysis period of 25 years was kept.

The net salvage value was adjusted from the default of 0% to 10% of installed cost to reflect the value of the facility and generation "tail" after the 25-year project term when electricity could be sold onto the market as well as the salvage value of materials such as aluminum and steel.

Project Term Debt: The default debt service coverage ratio of 1.3 was changed to 1.25 (Feldman and Schwabe 2017); the default tenor of 18 years was changed to 23 years assuming refinancing of the loan during the PPA's term; the annual interest rate default of 7% was adjusted to 3.5% (Feldman and Schwabe 2017, p. 3); and the upfront fee was adjusted from 2.75% of total debt to 1.5%. Debt closing costs were assumed to be covered in the cost of acquiring financing, and this line item was left at $0.

The cost of acquiring financing was adjusted from the default of $0 to $1,000,000 (Feldman and Schwabe 2017, p 3).

The construction period debt was adjusted to reflect one loan of 75% of installed costs.

Reserve Accounts: Interest on reserves was changed to 1.5% per year, with the working capital reserve of 6 months lowered to 3 months of operating costs. The same adjustment was made to the debt service reserve account to reflect 3 months of principal and interest payments.

A replacement reserve account cost of $0.05 per watt with a frequency of 12 years was included to reflect the cost of inverter replacement.

The model used assumed the 26% federal investment tax credit (SEIA 2022).

Depreciation of qualifying solar energy equipment was calculated using a modified accelerated cost recovery system methodology with a 5-year cost recovery period.[24] Bonus depreciation was not included.

[23] A rate of $0.001 * total insurable value (reported value of physical assets + annual business income) is offered as a cost benchmark (Walter 2016).
[24] "Publication 946 (2021), How To Depreciate Property," IRS, https://www.irs.gov/publications/p946/ch04.html.