Considerations for the Austin Energy Resource, Generation and Climate Protection Plan to 2035

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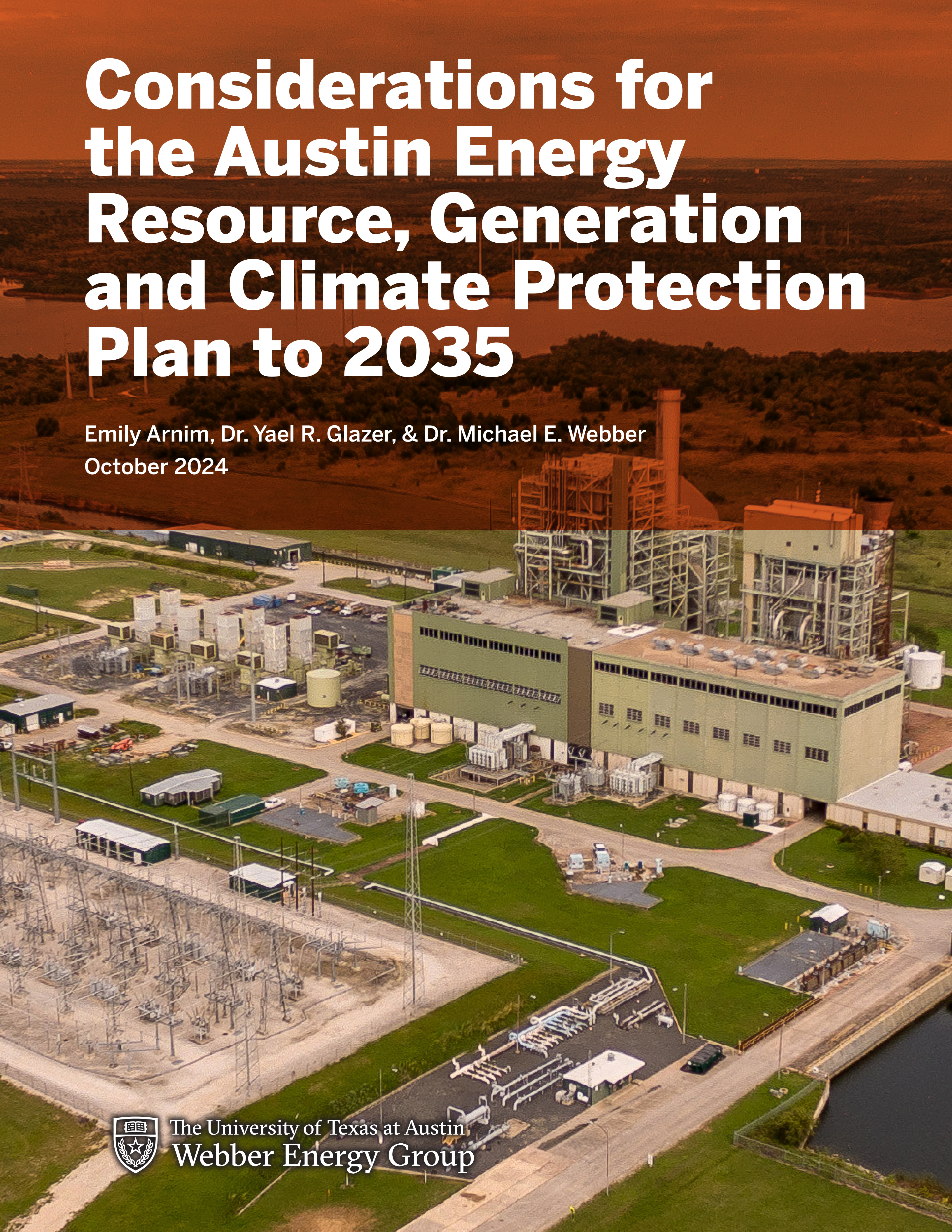

The University of Texas at Austin
Webber Energy Group

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Executive Summary

This report examines how Austin Energy (AE) can manage increasing electricity demand through 2040 while ensuring clean, reliable, and affordable power. With AE peak demand projected to reach up to 7,800 MW by 2040 under a high load growth scenario—from about 3,000 MW in 2023—the utility faces the multi-pronged challenge of expanding and decarbonizing its energy supply while operating in a warming world.

AE must address the expiration of renewable power purchase agreements (PPAs) and rising power demand driven by four main factors: population and economic growth; electrification of home heating and cooking; large load growth (e.g., data center growth); and electric vehicle (EV) adoption.

Our analysis identifies unmanaged EV charging as the most significant driver of peak demand growth. If EV charging remains unmanaged, it could account for nearly half of the total peak load. Smart-charging technologies will be a crucial component of AE's resource plan, with the potential to shave 3,600 MW off of peak demand. Data centers could also emerge as drivers of peak demand growth, though their individual power requirements are uncertain. Data center expansion will therefore necessitate careful monitoring and adaptable strategies from AE.

To effectively meet future demand, AE must evaluate options through the lens of trade-offs, considering a diverse range of supply and demand solutions that ensure resource adequacy and reliability while minimizing pollution and mitigating exposure to price volatility and transmission congestion fees.

Key strategies might include: enhancing energy efficiency; expanding renewable energy sources; deploying distributed solutions such as solar, energy storage, and demand response; and installing dispatchable power sources in the AE service area—with a preference for carbon-free options. In addition, short-term solutions might need to be incorporated as part of the plan to ensure resource adequacy despite import capacity limitations and the retirement of local generation.

Additionally, addressing equity and environmental concerns, such as reducing fenceline pollution and outages that disproportionately affect marginalized communities, will also play a vital role in optimizing overall system performance and achieving AE's sustainability goals. With technologies available today and on the near-term horizon, a balanced mix of carbon-neutral and carbon-free solutions often proves cheaper, faster, and more equitable to implement than solely zero-carbon options.

Policymakers reviewing AE's resource generation plan should recognize the need to balance affordability, reliability, and environmental goals. Effective policies will avoid prescriptive mandates and instead set outcome-based standards, allowing AE flexibility to meet targets while accommodating the potential to integrate innovative solutions in the future. This approach enables AE to pursue emissions reductions and reliability improvements while managing costs, creating an adaptable path forward that minimizes unintended consequences—like cost spikes or reliability concerns—that rigid mandates might cause. Standards-based policies thus support AE's ability to innovate in its resource planning, meeting community and environmental goals amid shifting energy demands and technologies.

1. Introduction and Scope

Austin Energy (AE), like many utilities across the country, faces the multi-pronged challenge of providing reliable and affordable energy to meet growing demand while also decarbonizing and operating its resources in a warming world.

AE has built its strategy around four key pillars: sustainability, safety, affordability, and reliability.[1] Today, nearly 75% of energy generation from AE assets is carbon-free (see Figure 1),[2] significantly higher than the U.S. average of 40%.[3] As the population and economic activity of the greater Austin area continue to grow, electricity consumption and peak demand is likely to rise accordingly. In fact, AE continues to set new peak demand records almost annually, with the latest record set in 2023 reaching 3,064 MW (see Figure 2).[4] Maintaining a high level of carbon-free generation in the face of this growth will require thoughtful consideration of various options.

This report aims to provide multiple demand growth scenarios through 2040 in the AE service area and identify several viable generation and efficiency strategies that AE can implement to meet demand.

AE is a publicly-owned municipal utility serving approximately 540,000 customers—more than one million people—between Travis and Williamson counties and is a critical part of the local community. In 2023, with an approved budget of $1.72B and 1,897 full-time employees, AE earned $1.5B in revenue and generated over 14 TWh of electricity for ERCOT.[5] In the process, AE provided $115M in funds to the city.[6]

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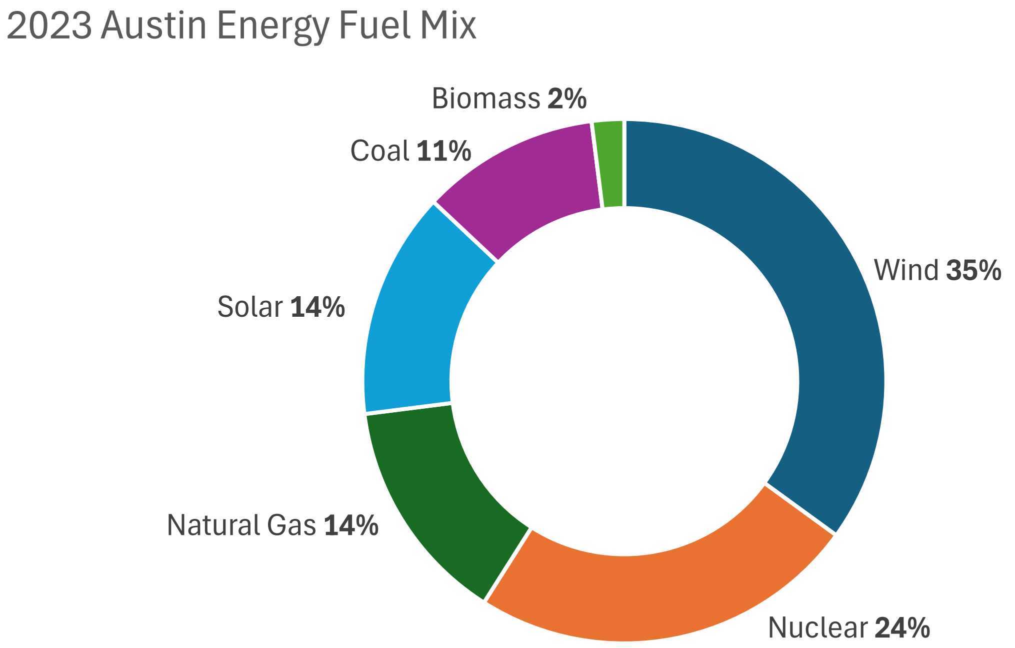
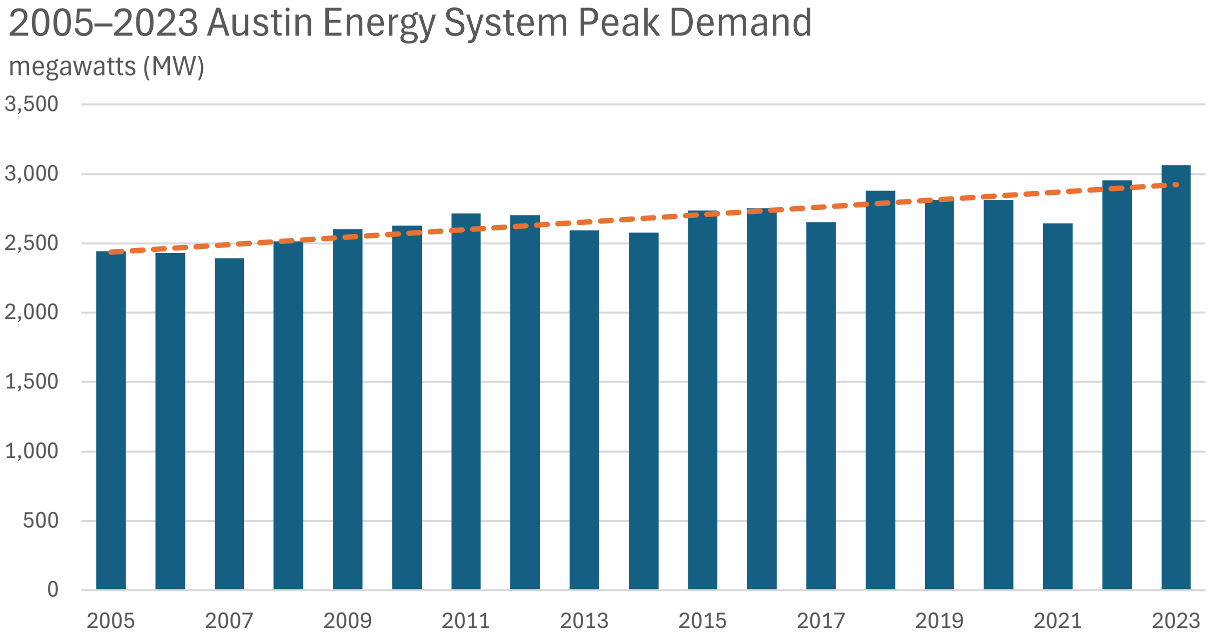
[1] https://austinenergy.com/about/company-profile/benefits-of-public-power
[2] https://austinenergy.com/-/media/project/websites/austinenergy/about/2023_annual_report.pdf
[3] https://www.weforum.org/agenda/2023/03/us-electricity-energy-carbon-renewables/
[4] https://austinenergy.com/-/media/project/websites/austinenergy/about/2023_annual_report.pdf
[5] https://austinenergy.com/-/media/project/websites/austinenergy/about/2023_annual_report.pdf
[6] https://austinenergy.com/about/company-profile/numbers



Source: [Austin Energy FY2023 Annual Report]

Figure 1: Electricity in Austin Energy's service area in 2023 came from a range of primary resources, including wind, solar, nuclear, natural gas, coal and biomass.

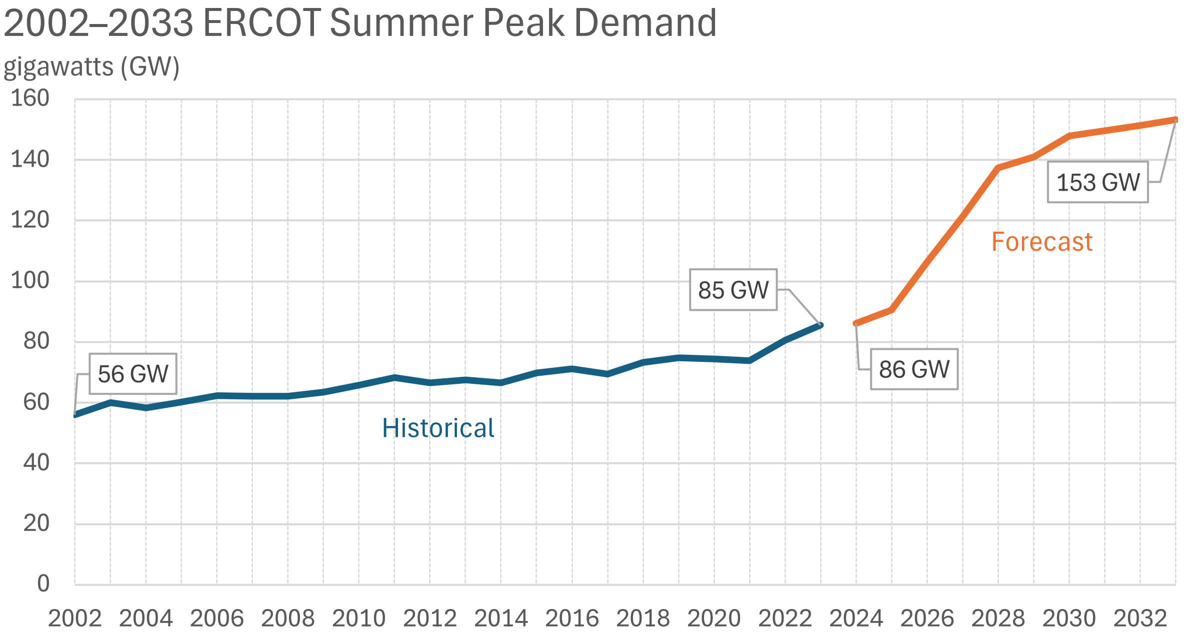


Source: [The City of Austin]

Figure 2: System peak demand in the Austin Energy service area has increased 25% from 2005 to 2023.

1.1 Larger Trends in the Energy Transition

Industry groups, political leaders, and environmental groups agree: power demand is rapidly increasing. As a consequence, load growth is not unique to AE or the greater Austin area. ERCOT is predicting, and already seeing, significant growth in demand (GW), consumption (GWh), and transmission congestion.[7] By 2033, ERCOT predicts peak demand will reach over 153 GW, up from 85.5 GW in 2023 (see Figure 3). Similarly, electricity consumption is projected to reach 1,058 TWh by 2030, growing nearly 140% in the next seven years (see Figure 4).[8]



Source: ERCOT

Figure 3: ERCOT Summer Peak Demand Forecast shows significant expected growth in the next decade.

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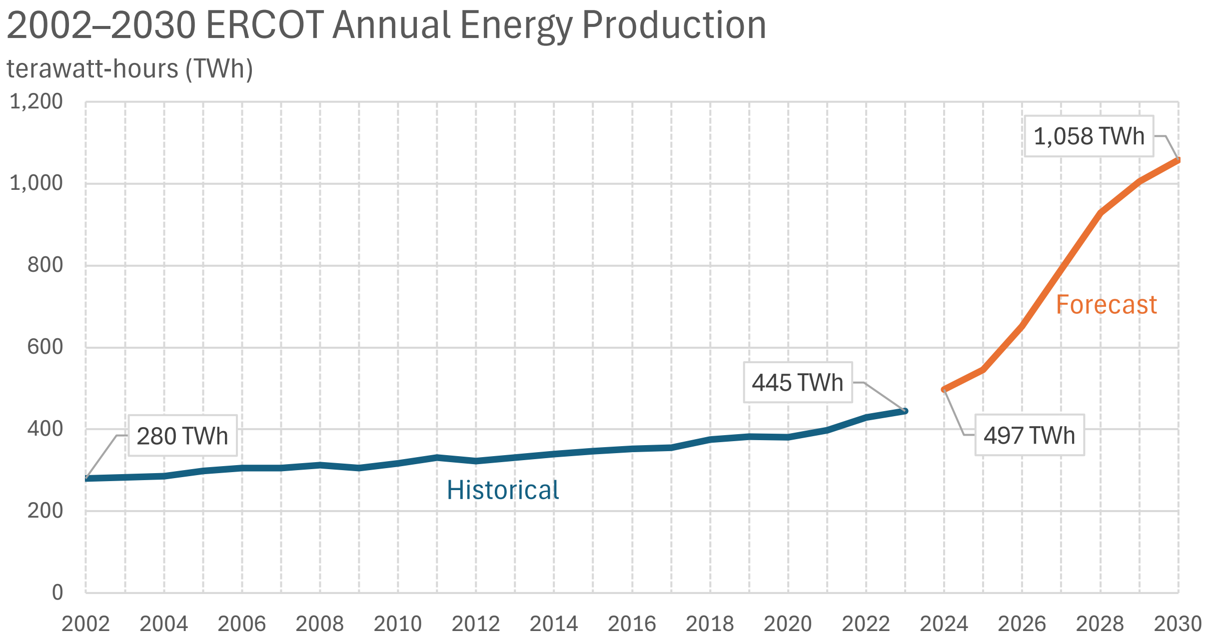
[7] https://www.ercot.com/gridinfo/load/forecast

[8] https://www.ercot.com/gridinfo/load/forecast



Source: [ERCOT]

Figure 4: ERCOT Annual Energy Forecast shows significant expected growth in the next decade.

Load growth is expected to increase rapidly for a few key reasons, including:

- Electrification of transportation, industrial loads, and home heating and cooking;
- Population and economic growth; and
- Changing climate/weather patterns, including heat domes and polar vortices, which lead to increased power usage for climate control in the built environment.

Below, we break these larger trends into four categories for analysis in the AE service area: Population growth, electrification of home heating and cooking, large load growth (e.g., data center growth), and electric vehicle (EV) adoption.

Compounding these challenges is the fact that ERCOT's transmission capacity has become increasingly scarce as more generation comes online in locations far from load centers.[9] This additional strain on the grid from load growth and increasing pressure on transmission capacity underscores the importance of balancing remote renewable energy expansion with grid infrastructure limitations. As such, options within the Austin Energy service area are worthy of special consideration.

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[9] https://www.ercot.com/files/docs/2023/12/22/2023-Report-on-Existing-and-Potential-Electric-System-Constraints-and-Needs.pdf

1.1.1 Decarbonization Tradeoffs

Decarbonization aims to reduce or eliminate carbon dioxide (CO_2) emissions, but the approach taken involves tradeoffs between cost, speed, and equity. There are two primary decarbonization strategies:

- **Carbon-Free (Zero-Carbon) Solutions**: These technologies, such as wind, solar, geothermal and nuclear power, produce no emissions at the point of generation. They provide clean energy, but often require significant investment in transmission infrastructure or construction costs and take time to scale.
- **Carbon-Neutral (Net-Zero) Solutions**: These approaches focus on removing CO_2 rather than eliminating them entirely at the point of generation. Strategies such as reforestation and technologies like carbon capture, utilization, and storage (CCUS) or direct air capture (DAC) remove CO_2 either at the source of production or from the atmosphere.

Tradeoffs between net-zero and carbon-free strategies revolve around environmental and economic performance, equity implications, and speed of implementation. With technologies available today and in the near-term horizon, a mix of carbon-neutral and carbon-free solutions tends to be cheaper, faster, and more equitable to implement than solely zero-carbon options.[10]

Importantly, decarbonization efforts are compatible with economic growth. A variety of organizations, including the U.S. Department of Energy,[11] the International Energy Agency,[12] Princeton University,[13] and the University of Texas at Austin,[14] have conducted studies on how to decarbonize the economy at the state, national, and global levels. These studies have a variety of similar and overlapping conclusions, including potential trade offs between strategies, but all find that a decarbonized economy can and does prosper.

1.1.2 Priority Order for Decarbonization

Decarbonizing the grid requires strategic decision-making and can be summarized by the guiding principle, "Do your best, clean up the rest." This approach outlines a logical order for tackling emissions in the most cost-effective and impactful way.

At the forefront is energy efficiency: ensuring resources are maximized and waste is minimized. The second priority is electrification, which replaces direct-use fossil fuels with cleaner, electric-powered alternatives. For energy services for which electrification isn't feasible, clean molecules—such as clean hydrogen, hydrogen carriers or sustainable fuels—can be used. Finally, carbon management addresses residual emissions, ensuring that any remaining carbon footprint is mitigated.

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[10] https://cockrell.utexas.edu/images/pdfs/UT_Texas_Net_Zero_by_2050_April2022_Full_Report.pdf

[11] https://www.energy.gov/industrial-technologies/doe-industrial-decarbonization-roadmap

[12] https://www.iea.org/reports/net-zero-by-2050

[13] https://netzeroamerica.princeton.edu

[14] https://cockrell.utexas.edu/images/pdfs/UT_Texas_Net_Zero_by_2050_April2022_Full_Report.pdf

Efficiency

Programs that promote greater energy efficiency from our buildings, appliances, devices and lighting reduce the need for more electricity and have the added benefit of keeping homes at a safer and more comfortable temperature for longer durations if there is a power outage during a weather event.

Electrification

Electric light-duty vehicles, home heating, and cooking have environmental and human health benefits and get cleaner with time as the grid decarbonizes. However, electrifying these activities might require expanding the grid to accommodate greater peak power demands (GW) and annual consumption (GWh).

Clean Molecules

Clean molecules—biomethane, hydrogen, hydrogen carriers, and so forth—may be used for the parts of the economy that are hardest to electrify (e.g., shipping, aviation, industry, space heating in older buildings, etc.) and for power generation when other options aren't available.

Carbon Management

Carbon management includes options such as point-source capture, reforestation, direct air capture, and marine carbon dioxide removal to prevent the release of greenhouse gases to the atmosphere and remove ambient CO_2.

1.2 The Challenges Facing Austin Energy

Amid the nationwide challenge of simultaneously expanding and decarbonizing the grid, AE faces three specific challenges in developing a renewable resource generation plan in the coming years:

- Aligning generation with peak demand or times of greatest power scarcity, especially as the economy continues to electrify;
- Addressing the expiration of solar and wind power purchase agreements (PPAs) over the next 15 years; and
- Delivering renewable power—which is often generated far from load centers—to Austin given the challenges of transmission congestion.

1.2.1 Austin Energy's supply forecast

Today, AE has a total adjusted generation capacity[15] of 2,560 MW, with coal, natural gas, and nuclear energy providing more than 60% of power. Of that, 873 MW, or 34% of capacity, is supplied by renewable resources, including wind and solar (see Figure 5).

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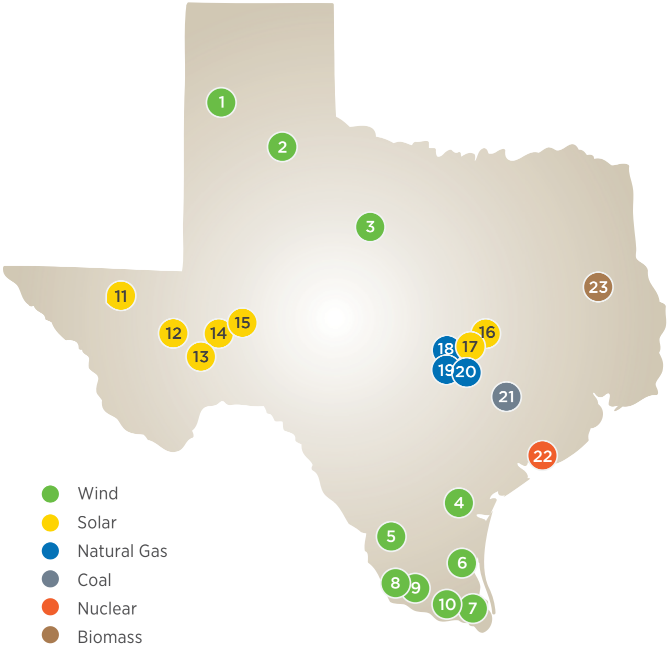
[15] Adjusted for capacity factors for each type of energy generation using ERCOT's July 2024 Unit Capacity data

Austin Energy Generation Details and Locations

	Name	Type	Installed Capacity (MW)
1	**Jumbo Road**	**Wind**	299.7
2	**Whirlwind Energy Center**	**Wind**	59.8
3	**Hackberry Wind Project**	**Wind**	165.6
4	**Karankawa**	**Wind**	206.6
5	**Whitetail**	**Wind**	92.3
6	**Gulf Wind**	**Wind**	170.0
7	**Los Vientos 2**	**Wind**	201.6
8	**Los Vientos 3**	**Wind**	200.0
9	**Los Vientos 4**	**Wind**	200.0
10	**Raymond**	**Wind**	200.0
11	**Aragorn**	**Solar**	180.0
12	**Roserock**	**Solar**	157.5
13	**Waymark**	**Solar**	178.5
14	**East Pecos**	**Solar**	118.5
15	**Upton**	**Solar**	157.5
16	**East Blackland**	**Solar**	144.0
17	**Webberville Solar Project**	**Solar**	30.0
18	**Decker Creek Power Station**	**Natural Gas**	200.0
19	**Mueller Energy Center**	**Natural Gas**	5.0
20	**Sand Hill Energy Center**	**Natural Gas**	595.0
21	**Fayette Power Project**	**Coal**	600.0
22	**South Texas**	**Nuclear**	430.0
23	**Nacogdoches**	**Biomass**	105.0



Source: [Austin Energy FY2023 Annual Report]

Figure 5: Austin Energy nameplate capacity ratings and locations. On-peak adjusted capacity is slightly lower to reflect real-world weather conditions.

All but three of AE's renewable resources have PPAs that will expire on or before 2040.

Even now, AE does not produce enough power to meet demand, and therefore must rely on the ERCOT power market. As PPA expiration dates approach and as demand grows, AE will need to weigh whether to build new, dispatchable generation in its load center or rely increasingly on the ERCOT market for power.

To better understand AE's supply forecast, we first look at the expiration date of current PPAs, which begin as early as 2027 and continue through 2043. Available generating capacity will decrease further when Fayette Power Project (FPP) closes. While the date for FPP closure is not yet known, we illustrate two scenarios: One showing AE's generating capacity assuming FPP closes in 2032, per EPA rules, and another showing generating capacity assuming FPP closes in 2029 (see Figure 6). The rolloff of PPAs is also graphically shown in each of the peak demand scenarios (see Figure 10). For the purpose of the load forecast graphs, we assume FPP closes in 2030.

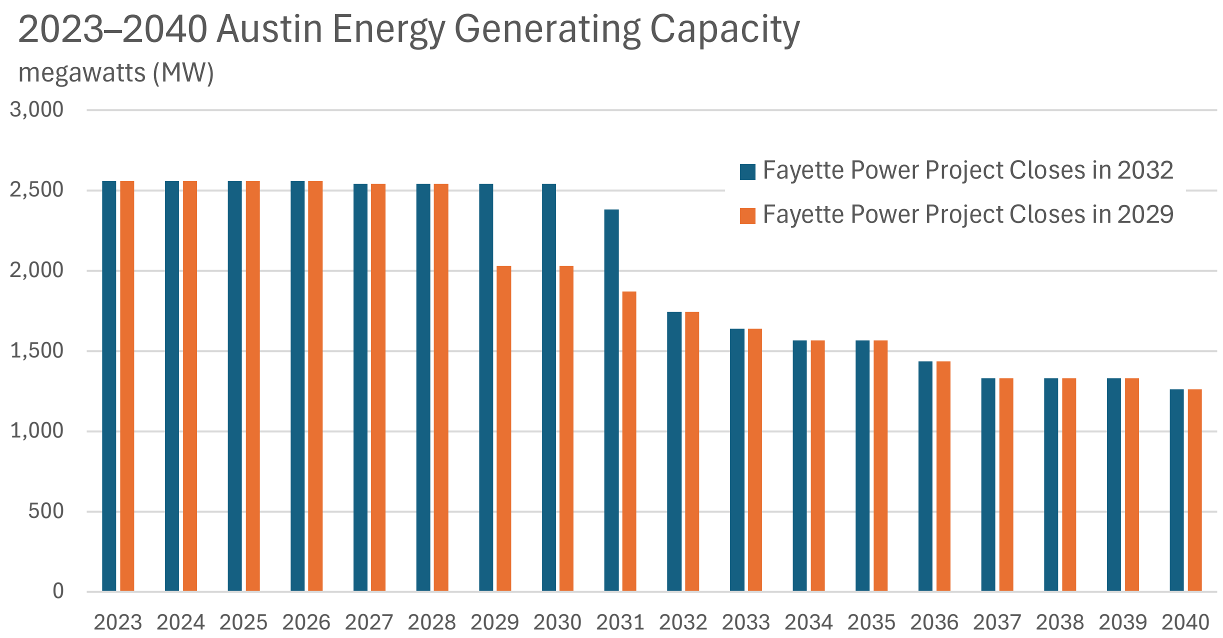


Figure 6: Austin Energy's generating capacity based on PPA contract expiration demonstrates the impact future closures will have on supply. This figure shows PPA rolloff for all AE generators with the exception of Decker, Mueller, Sand Hill, South TX, and Nacogdoches.

2. Data and Methods

To understand load growth in AE, we forecasted peak demand and energy consumption in the AE service area. In our forecast, we considered four main drivers of load growth:

- Population and economic growth
- EV adoption
- Electrification of home heating and cooking
- Growth of data centers and other large loads

In the next few subsections, we describe how growth for each of these four drivers was calculated and analyzed.

2.1 Population Growth

Considering an aggressive population growth scenario, we found that population growth alone could cause peak demand to reach nearly 3,500 MW in 2040, exceeding AE's current record of just over 3,000 MW.

2.1.1 Population Growth Calculations

Population growth projections were sourced from the 2022 Texas Population Projections Program from the Texas Demographics Center.[16] The Texas Demographics Center offers two population growth scenarios: One assumes future migration rates will be similar to those between 2010 and 2020 and another assumes migration rates half of those between 2010 and 2020. Because we are calculating peak demand—and "worst-case scenarios"—we utilize the first, more aggressive population growth scenario.

Historical Travis County population data was sourced from Nielsberg Research.[17] Though the AE service area includes parts of both Travis and Williamson Counties (see Figure 7), we focused exclusively on Travis County and AE customer data (from 2020,[18] 2021,[19] 2022,[20] and 2023[21]) for projecting population growth due to data limitations.

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[16] https://demographics.texas.gov/Projections/2022/

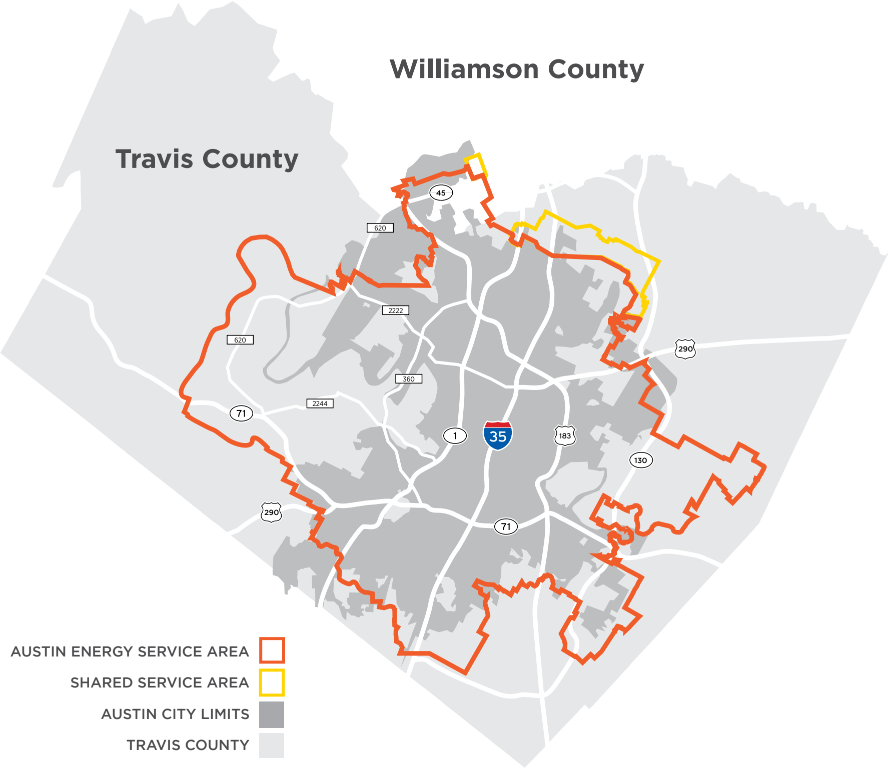
[17] https://www.neilsberg.com/insights/travis-county-tx-population-by-year/

[18] https://austinenergy.com/-/media/project/websites/austinenergy/about/fy_2020_annual_report.pdf

[19] https://austinenergy.com/-/media/project/websites/austinenergy/about/2021_annual_report.pdf

[20] https://austinenergy.com/-/media/project/websites/austinenergy/about/2022_annual_report.pdf

[21] https://austinenergy.com/-/media/project/websites/austinenergy/about/2023_annual_report.pdf



Source: [Austin Energy]

Figure 7: About half of the Austin Energy service area encompasses the City of Austin, and the other half encompasses the area surrounding the Austin city limits.

2.1.2 Peak Demand from Population Growth

Peak power demand data were available for 2000, 2005, 2010, and 2018 through 2023 from AE. These data were cross-referenced with peak demand data posted by the City of Austin for 2006 through 2019 (see Figure 2).[22] To extrapolate peak demand for the years without posted data, we conducted an exponential regression analysis (See Figure 8). We employed an exponential, rather than linear, regression analysis because we seek to assess peak demand based on the aggressive population growth scenario discussed above. Under this assumption, we found that population growth alone could cause peak demand to reach nearly 3,500 MW in 2040.

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[22] https://data.austintexas.gov/Utilities-and-City-Services/Austin-Energy-System-Peak-Demand/a6pm-qynf/data

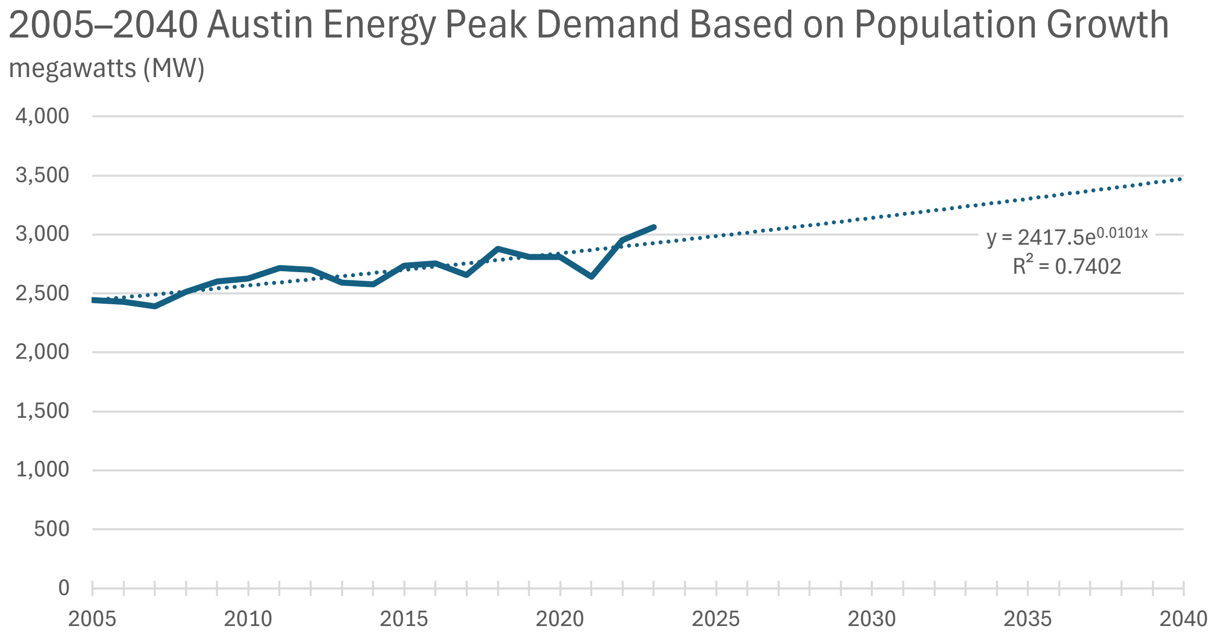

Figure 8: An exponential regression analysis suggests that Austin Energy's peak demand due to population growth is projected to grow significantly.

2.2 Data Centers

Based on current ERCOT projections and existing or planned data centers for the AE service area, we assume that 500 MW (0.5 GW) could be added to peak load by 2040.

As of today, 124 MW of data centers are reportedly running or planned for the AE service area.[23] However, as noted in Table 1, demand information is not available for 27 data centers (~50%) that will be, or already are, located in the AE service area. The lack of information regarding data center power requirements leaves uncertainty as to their future power and energy needs.

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[23] https://www.datacenters.com/locations/united-states/texas/austin

Table 1: Austin Energy service area data centers require approximately 126 MW of power

Note: Power demand is unknown for data centers that do not have a demand value listed (represented by '-').

Data Center Name	Demand (MW)
DataBank	0.4
Thin-nology Helios Way Data Center	2
Element Critical Austin One Data Center	5
American Tower Edge Data Center Austin	0.096
Enzu AUS4 Austin Data Center	–
Lumen Austin 2 Data Center	–
LightEdge Austin I Data Center	2.5
Lumen Austin 3 Data Center	–
Enzu AUS1 Austin Data Center	–
Data Foundry Austin 1 Data Center	–
Enzu AUS2 Austin Data Center	–
MOD Mission Critical AU1 - Data Foundry Data Center PoP	–
Switch Data Centers - Austin 1 Data Center	–
Enzu AUS3 Austin Data Center	–
MOD Mission Critical AU2 - DRT Austin Data Center PoP	–
Digital Realty Austin AUS11 Data Center	16
CyrusOne AUS3 Austin Data Center	24
Otava Austin Data Center	2.25
Data Canopy Austin 2	9
CyrusOne AUS2 Data Center	9
LightEdge Austin II Data Center	2.5
Lumen Austin 1 Data Center	–
Data Foundry Austin 2 Data Center	36
Data Foundry Texas 1 Data Center	24
Data Foundry The Data Ranch	–
Switch Data Centers Texas 2 Data Center	–
Switch Data Centers Texas 1 Data Center	–
TOTAL Demand	**124**

Source: Austin Data Centers Locations

We estimate that data centers could require an additional 500 MW in the AE service area by 2040. This figure is derived from ERCOT's projection that roughly 40 GW of additional load will be added by data centers by 2030, up from about 1 GW in 2024.[24] High load growth scenarios predicted by ERCOT suggest that by 2039, demand from large loads could reach 104 GW, with non-industrial large loads accounting for approximately 80% of that demand, or roughly 80 GW.[25]

Because Austin Energy has a 4% share of the ERCOT market, we determined that Austin could see up to 3 GW of growth from data centers.[26] However, this high-level estimate was reduced to 0.5 GW because of the expectation that land and cost constraints would limit how much demand is sited in the AE service area. As a result, we estimate AE will need to prepare for an additional 500 MW for data centers by 2040.

Because data center growth is a relatively new phenomenon, rate of growth and data center locations are hard to predict. It is possible that data center growth within the AE service area will be higher than our prediction, given that companies may want to locate their data systems near their physical offices and workforce or due to faster utility hook-up times or to benefit from AE's relative cleanliness and reliability. It is also possible that data centers will move just outside of the AE service area to take advantage of different electricity rate structures. A data center's individual size and power requirements are also difficult to predict, but are anticipated to grow.

2.3 Home Electrification

Home electrification, though ultimately a small portion of electricity demand in the coming years, will account for roughly 30 MW of added peak demand in the AE service area by 2040, according to our analysis. However, some variation is expected, since human behavior and weather patterns can vary.

Polar vortices and cold snaps in the Austin area mean that home heating could account for unusually large portions of peak demand for hours or days at a time in the winter months. Higher temperatures could mean increased demand for air conditioning during the summers. Electric and induction stove top demand, though less volatile than demand for home heating and cooling, often correlates with peak demand times, as customers tend to cook meals when demand is highest (early evenings in the summer or early mornings in the winter).

2.3.1 Electrification of Heating

Around 56% of Travis County homes currently use electricity for heating.[27] We assume 1% growth per year, based on historical trends of building electrification.[28] For the purpose of this analysis, we also assume that growth remains linear, and that by 2040, 72% of buildings will have electrified heating. To determine how much energy is required to satisfy peak demand assuming electric heat pump use, we utilized 2023 research performed by Matthew Skiles, Joshua Rhodes, and Michael Webber (see Figure 9).[29]

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[24] https://www.ercot.com/gridinfo/load/forecast

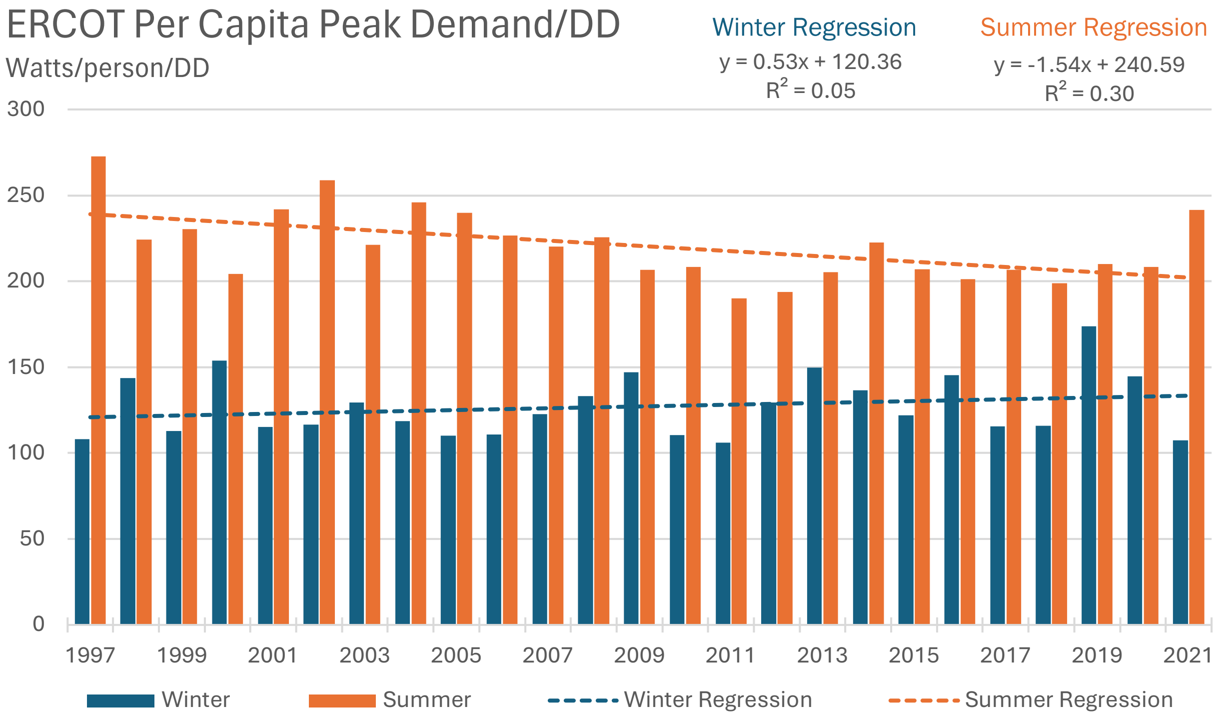
[25] https://www.ercot.com/files/docs/2024/06/07/2024%20Long-Term%20System%20Assessment%20(LTSA)%20High%20Load%20Growth%20Scenario_June11_2024.pdf

[26] https://austinenergy.com/rates/residential-rates

[27] https://www.census.gov/acs/www/about/why-we-ask-each-question/heating/

[28] https://www.washingtonpost.com/climate-environment/interactive/2023/home-electrification-heat-pumps-gas-furnace/

[29] https://doi.org/10.1016/j.tej.2023.107254



Source: Perspectives on peak demand: How is ERCOT peak electric load evolving in the context of changing weather and heating electrification?

Figure 9: Per capita peak demand per degree day (DD) is increasing over time for winter peak demand days.

Our calculations found that based on the growth of heating degree days (HDD) in ERCOT, per capita peak demand for heating could move from 0.136 kW/person/HDD in 2024 to 0.148 kW/person/HDD in 2040. Based on our population growth projections, total peak demand for electrified heating in the AE service area could reach 195 MW by 2040.

For the purpose of displaying these results graphically in Figure 10, we found the difference in demand for each year between 2024 and 2040 to show actual demand growth.

2.3.2 Electrification of Cooking

Based on our estimates detailed in this section, electrification of cooking could add 25 MW of additional demand by 2040. For our analysis, we make the following assumptions:

- Electric and induction stovetops and ovens use between 1,000 and 3,000 W, depending on the mode of cooking (e.g., boiling a pot of water versus self-cleaning an oven).[30] For our calculations, we use the average of 2,000 W.
- 71–90% of Texans cook with an electric stove, according to the 2020 Energy Information Administration (EIA) Residential Energy Consumption Survey of 18,500 U.S. households.[31]

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[30] https://www.directenergy.com/en/learn/home-energy-management/how-much-energy-does-oven-and-electric-stove-use

[31] https://www.statista.com/chart/29082/most-common-type-of-stove-in-the-us/

Because there is no information detailing electric versus gas stove use for Travis or Williamson counties, we use the Texas average of 80%.

- Electric stovetops are anticipated to grow in tandem with the development of new buildings, similar to the growth of heating electrification (about 1% per year). This analysis did not include the possibility that gas stovetops would be regularly replaced by electric stovetops in existing homes, though if that happens, perhaps because of incentives or policies requiring the change, then the peak demand growth for electric cooking would be even higher than shown here.
- 79% of households prepare at least one hot meal at home per day, according to a 2020 EIA survey.[32] (It is worth noting that these data could be skewed given that the survey was conducted during the COVID-19 pandemic, when people were more likely to cook at home than eat out. However, for the purpose of this analysis, we assume that 79% is representative of average household behavior.)

The calculations used to determine peak demand growth based on the above assumptions can be found in Appendix A.

2.4 Electric Vehicle Adoption

According to our forecasts, the greatest factor (and variability) in potential peak demand growth is from different EV charging patterns. For this reason, we analyzed three EV charging scenarios:

- Load forecast without any smart-charging management, and assuming every single EV plugs in at peak times (100% vehicles charging at once): **3,773 MW of new demand**

  While it is unlikely that every AE resident plugs in their EV at the same time of day, our goal is to model the worst-case scenario. It is also worth noting that humans often can and do act synchronously.[33]
- Load forecast based on ERCOT's assumed hourly EV charging patterns, which suggest that roughly 10% of electricity consumption from EVs will occur at once:[34] **377 MW of new demand**
- Load forecast with smooth, round-the-clock charging management of EVs, which assumes smart-charging technology: **157 MW of new demand**

To calculate these EV charging peak demand scenarios, we first determined the rate of adoption of EVs in Travis County. In 2023, there were 0.76 cars per person in Travis County, according to the Texas Department of Transportation.[35] If we assume this value stays constant, and per population growth projections, there will be approximately 1.3M vehicles registered in Travis County in 2040. Today, of the roughly 1M vehicles registered in Travis County, 42,000 are EVs.[36]

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[32] https://www.eia.gov/todayinenergy/detail.php?id=53439

[33] https://www.scientificamerican.com/article/electric-car-owners-charge-at-once/

[34] https://www.ercot.com/files/docs/2018/12/21/2018_LTSA_Report.pdf

[35] https://www.dot.state.tx.us/apps-cg/discos/default.htm?dist=AUS&stat=vr

[36] https://app.powerbi.com/view?r=eyJrIjoiYTRlY2M2MTctZDYwZC00MDNjLThkZDMtZjY5N2Y1YzlkNzA5IiwidCI6IjJmNWU3ZWJjLTIyYjAtNGZiZS05MzRjLWFhYmRkYjRlMjliMSIsImMiOjN9

To estimate future EV penetration, we used goals outlined by the Austin Joint Sustainability Committee and ERCOT EV projections: [37,38,39]

- There will be 100,000 EVs in Travis County by the end of 2025;
- 40% of miles driven in the county will be electric by 2030; and
- EV adoption will grow linearly through 2040, at which point EVs account for 50% of registered vehicles in Travis County.

To calculate peak demand using the above goals and projections, we employed the following assumptions:

- The average Travis County citizen drives 14,000 miles per year;[40]
- EV owners will use a typical 5.7 kW Level 2 home charger; and
- The average EV travels 3.6 miles per kWh of electricity.

The calculations used to determine peak demand growth for each of the three EV charging scenarios can be found in Appendix A.

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[37] https://services.austintexas.gov/edims/document.cfm?id=270550&ref=austindaily.com
[38] https://www.ercot.com/files/docs/2022/02/14/2022_LTSA_Update_02152022.pdf
[39] https://www.ercot.com/files/docs/2023/08/28/ERCOT-EV-Adoption-Final-Report.pdf
[40] https://www.fhwa.dot.gov/policyinformation/statistics/2019/

3. Results

Our results reveal that unmanaged EV charging has the largest potential impact on peak demand out of the four load growth drivers we analyzed. In Figure 10, we demonstrate this impact against AE's generation capacity, including PPA rolloffs.[41]

In our first scenario, EV charging accounts for nearly half of total peak load if not managed (See Figure 10).

Reducing the number of EVs charging at once to 10% of total vehicles has a considerable effect on overall peak demand, reducing the total peak demand from 7,800 MW to 4,400 MW (See Figure 10). Under this second scenario, the reduction in demand from EV charging elevates the relative potential impact of data centers on peak demand.

Finally, our third scenario with uniform EV charging demonstrates that smart-charging technology could have an outsized impact on total peak demand. In this scenario, uniform charging shaves an estimated 3,600 MW off of peak demand, lowering the total peak demand to 4,200 MW (See Figure 10).

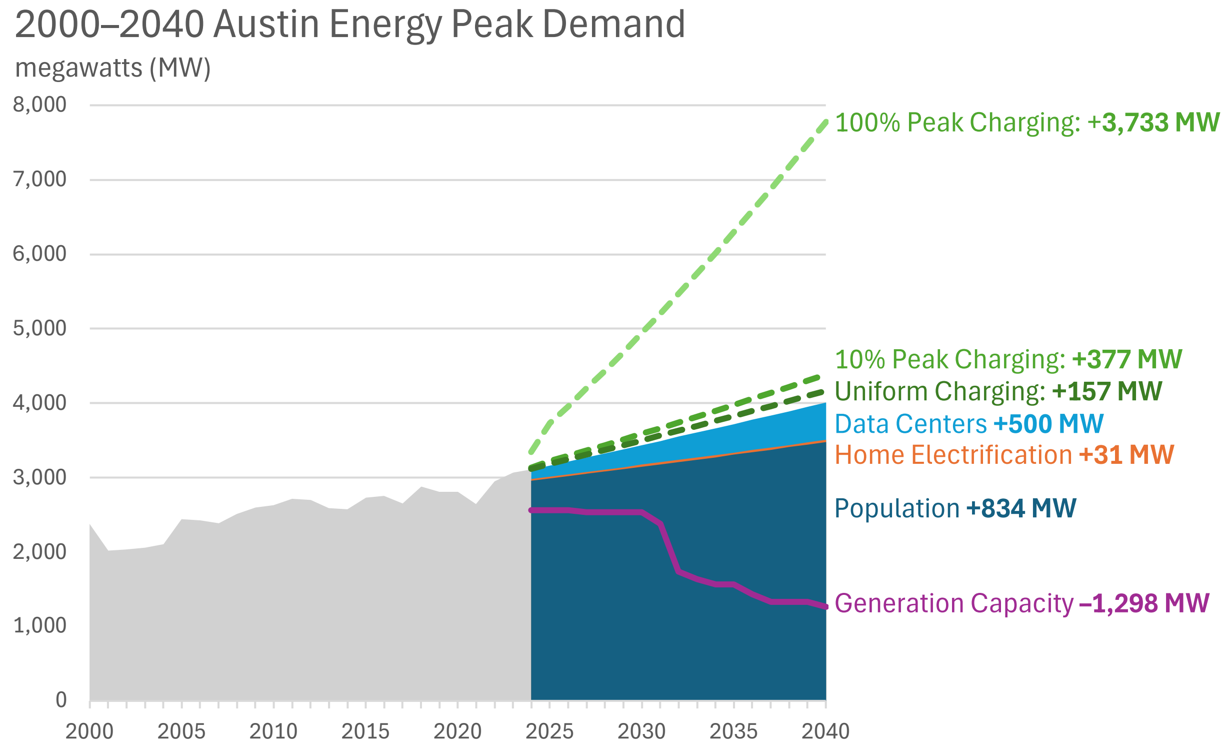

Figure 10: Projected peak demand for Austin Energy under three EV charging scenarios: Scenario 1 assumes unmanaged charging with 100% of EVs charging during peak times, leading to the highest demand increase; Scenario 2 models 10% of EVs charging at peak times, moderating demand spikes; Scenario 3 envisions a fully managed charging approach, distributing EV charging uniformly throughout the day to flatten peak demand.

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41 In Figure 10, the line entitled, "Population" represents all sources of electricity demand from 2000 through 2023 (e.g., A/C, heating, lighting, EV charging, etc.). Starting in 2024, the data split based on the four sources of load growth outlined in the previous section so that each of their contributions to peak demand can be analyzed.

4. Discussion and Key Considerations

4.1 Options to Meet AE Resource Adequacy Needs

Understanding and assessing trade-offs are key to evaluating options to meet future demand. AE should consider expediting the deployment of a variety of supply and demand solutions to ensure resource adequacy while minimizing exposure to out-of-service area price volatility and transmission congestion fees. These solutions include a *combination* of non-generators, variable renewable generators, and dispatchable sources.

4.1.1 Non-Generators

- **Energy efficiency** helps offset demand growth by reducing overall consumption, easing strain on the grid and delaying the need for costly infrastructure expansion.
- In terms of balancing supply and demand, turning loads off is just as useful as turning on power plants. Customers can participate in **demand response (DR)** by turning off non-essential loads, such as hot water heaters or pool pumps during peak hours. Residential DR may also include turning off essential loads, such as heating and cooling, on a rotating basis.
- **Batteries and other storage systems**, while helpful, are typically constrained by their limited durations of two to four hours. Longer-duration options are emerging and are likely to be available in the late 2020s and early 2030s.

4.1.2 Renewables

- **Renew or replace existing, out-of-service area PPAs** for wind and solar. It may also be possible to increase the power output of current wind and solar generation through repowering. However, PPAs with remote power plants do not alleviate transmission congestion concerns.
- To alleviate congestion concerns, **new solar** systems could be built in the AE service area. Commercial locations, such as parking lots or warehouses, are especially attractive because of their low cost.[42] It may also be possible to expand solar outside of the AE service area but to locations nearby in less transmission-congested areas.

4.1.3 Dispatchable Sources

- Regardless of whether AE adopts the aforementioned options to meet resource adequacy needs, **dispatchable, carbon-free generation** (with a low capacity factor) is likely still needed to affordably serve customers when wind and/or solar availability is low. Similarly, local, dispatchable generation that has the potential to be carbon-free or carbon-neutral in the near term is a practical solution. Dispatchable generation also provides other reliability services, such as voltage support.

- Near-term options for dispatchable sources include:
  - Gas with carbon removal at Nacogdoches or elsewhere
  - Gas with carbon capture onsite

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[42] https://emp.lbl.gov/tracking-the-sun

  - Gas with flexible fuel (to accommodate blending with hydrogen, etc.)
  - Biomethane
  - Hydrogen
  - Ammonia
  - FPP but with wood pellet blending, carbon capture, etc.

- Longer-term options may include:
  - Geothermal
    - Difficult to do in the AE service area

  - Nuclear Fission (technology used at STP Nuclear, of which AE is a partial owner)
    - Slow to build, expensive, and hard to do in the AE service area
    - AE could potentially install small modular reactors (SMR) or traditional Gen III or Gen IV plus-up systems at STP

  - Nuclear Fusion
    - Technically immature and hard to estimate construction times, cost, regulatory context, etc.

4.2 Special Considerations for Austin Energy

In meeting future demand, AE has the opportunity to improve overall system performance and maintain low costs for customers. Though there are many possibilities for meeting peak demand, not all are viable for AE. Similarly, there is not one "correct" solution. AE will need to deploy a *variety* of generation options (thermal, commercial solar, etc.) and demand side controls (storage, demand response, efficiency, etc.) to effectively serve customers.

Below, we outline special considerations for AE and address common questions regarding the feasibility of solutions for AE.

4.2.1 Opportunities for Efficiency

In an effort to reduce electricity use, AE has prioritized efficiency measures and programs over the last two decades. As such, AE has already capitalized on many of the low-lift efficiency plays such as financial assistance for weatherizing homes and rebates for installing LED light bulbs and energy-efficient appliances.[43] While additional energy efficiency options exist, they will likely be more challenging and costly to implement compared to the measures already in place.

Demand Response

AE currently operates a thermostat-based DR program, helping to manage residential load during peak times. As EV adoption increases, more opportunities for DR will emerge, with EVs potentially acting as mobile batteries and offering flexible energy storage and grid support.

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[43] https://savings.austinenergy.com/residential/offerings

However, EVs will also compete with smaller, stationary batteries installed at the meter, creating a dynamic where multiple resources could vie for grid support roles.

Regardless, it's likely that DR efforts will continue to focus on residential customers, as industrial and commercial users tend to have more predictable, less variable loads, making them easier for utilities to serve without the same level of demand management.

Geothermal Efficiency Opportunities

Geothermal energy generation is not a practical option for AE due to geological limitations, but geothermal efficiency for heating and cooling via ground source heat pumps and cooling or heating districts is a prospect worth exploring further. In developments like Whisper Valley in East Austin, geothermal systems are being utilized as an efficiency measure rather than a large-scale energy source.[44] These systems tap into the stable temperatures underground to provide more efficient heating and cooling for homes, reducing overall energy consumption and lowering demand at peak times. However, additional research is needed to determine whether geothermal efficiency opportunities are feasible for AE, given varying types of bedrock and soils throughout the Austin area.

4.2.2 Benefits of Local Dispatchable Power

Building dispatchable power within the AE service zone not only reduces exposure to significant financial risk from bulk grid price volatility and transmission congestion pricing, but also improves service reliability. Eventually, expanding the transmission grid to accommodate growing demand within ERCOT will be essential. However, because the process of permitting and building new statewide transmission lines is complex, upgrading the transmission system takes longer than building new power plants. As such, near-term, local solutions might be especially desirable for AE.

Hydrogen and Flexible Fuel Combustion

Depending on how it is produced, stored and transported, hydrogen could provide a cleaner alternative to natural gas, reducing carbon emissions and contributing to AE's sustainability goals. Flexible fuel combustion, allowing the use of various fuel sources, could enhance energy security by reducing dependence on any single energy source.

However, hydrogen infrastructure is expensive to develop, requiring new production systems, pipelines, storage, and fueling systems, which could drive up costs. Flexible fuel systems might also lead to emissions if fossil fuels remain part of the mix, complicating efforts to achieve net-zero targets. Lastly, the technology and infrastructure needed for these options are still in development and might not be ready for widespread deployment in the near term. However, it is worth noting that there is substantial federal government support for hydrogen, so it is possible that its availability will improve dramatically.

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[44] https://www.thinkgeoenergy.com/texas-neighborhood-to-be-built-atop-largest-residential-geothermal-grid/

Rotating Machines

Rotating machines, like turbines at thermal power plants and synchronous condensers, could play a critical role in helping AE meet growing demand while enhancing grid stability. These machines are helpful for voltage and frequency control, which could have been beneficial during events like Winter Storm Uri, potentially mitigating brownouts.

A combination of rotating machines and strategically placed batteries, such as at each substation, could help balance demand and improve grid resilience while reducing 4CP peak demand charges.

Repowering

While PPAs remain relevant, they have become less attractive due to recent tax transferability rules, which provide greater incentive for direct ownership.[45] Nevertheless, renewing, repowering, or replacing existing wind and solar PPAs might be an effective strategy for AE to quickly address growing demand while meeting sustainability goals. Repowering and renewing PPAs can enhance capacity and efficiency but do not necessarily resolve transmission congestion issues.

4.2.3 Management of EV Charging

It has been a known risk that whether EVs strain or enhance grid performance depends on what time of day they are charged.[46] Our analysis demonstrates that implementing a method of smart charging to limit EV charging to no more than 10% of vehicles at once could cut 2040 peak demand projections by more than 3,400 MW.

Therefore, implementing time-of-use rates,[47] smart-charging technology,[48] or other approaches that reduce how many EVs charge at times of scarce supply will be beneficial to maintaining grid stability.

4.2.4 Holistic View of Equity

Equity is an important consideration to the AE resource generation plan, particularly when considering the impacts of local generation. While the impact of emissions and fenceline pollution are critical issues, focusing equity discussions solely around these topics overlooks many other equity challenges, including electricity reliability, workforce participation, affordability, and economic growth. For instance, a new power plant near a low-income neighborhood could make it a point to hire locally, offering new employment opportunities to residents. Balancing each of these factors with cost-effectiveness—using least-cost optimization—helps ensure a fair approach.

Future iterations of this work could include a more detailed analysis of net-zero versus zero-carbon equity benefits, the burden of pollution, and opportunities for improved reliability and affordability and economic growth, particularly for low-income Austin residents.

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[45] https://www.whitehouse.gov/cleanenergy/clean-energy-tax-provisions/
[46] https://www.ercot.com/files/docs/2022/08/04/2022_LTSA_Update_08092022.pdf
[47] https://doi.org/10.1016/j.egyr.2022.06.048
[48] https://afdc.energy.gov/fuels/electricity-infrastructure-development

4.2.5 Environmental Considerations

Electrifying transportation and home energy systems by replacing gasoline, diesel, and natural gas with electricity or adding CCUS technologies provides distinct environmental advantages. In particular, gasoline tailpipes are the biggest air quality concern in the AE service area. Given this fact, it is noteworthy that charging an EV with electricity—even if generated from FPP—is actually cleaner than driving a gasoline-powered car, owing to the timing and location of emissions. While internal combustion engines (ICEs) release pollutants from tailpipes at ground level in densely-populated urban areas during the day, EVs charged using power from a coal power plant at night shift emissions to rural areas, where smokestacks release pollutants at higher altitudes, allowing for greater dispersion and avoiding the formation of photochemical smog, which requires sunlight to form.

This transition to electricity-powered systems, even with fossil-fuel-derived electricity, lessens both direct human health impacts and broader environmental concerns. While carbon-neutral generation is the goal, these tradeoffs will be important for AE to consider as the utility prepares for unprecedented demand.

Carbon Management

There are several strategic pathways to reduce carbon emissions, each with unique tradeoffs in terms of cost, environmental impact, and reliability. For instance, vegetative carbon management and seabed meadows offer promising nature-based methods for carbon sequestration, but may not be feasible inside the Austin area.

Additionally, carbon offsets offer a flexible tool to address those emissions that are more challenging or expensive to eliminate directly. Offsets could help manage costs while maintaining progress toward carbon reduction goals. Ultimately, a hybrid approach that incorporates both immediate, cost-efficient solutions and long-term investments in carbon removal will help AE meet its decarbonization targets while ensuring reliability and economic sustainability.

4.3 Key Considerations for Policymakers

For policymakers, understanding the inevitable trade-offs among affordability, reliability, and environmental goals is essential to crafting effective policy. For instance, policies focused solely on emission reductions could lead AE to invest heavily in renewable generation and storage, which might increase rates for customers or reduce system reliability if adequate backup generation isn't available. Conversely, policies that prioritize low rates above all else could lead to reliance on cheaper, fossil-based generation that contradicts decarbonization targets. Balancing these priorities requires a nuanced approach that allows AE to work toward its ambitious climate goals without compromising rate affordability or grid reliability. Policymakers should prioritize designing policies that encourage diverse pathways for achieving clean and reliable energy, rather than mandating specific fuels or technologies, as flexibility often leads to better outcomes.

Standards-based policies, which set high-level requirements for labor, environmental quality, and reliability, have historically proven effective because they enable market participants to innovate and select the best pathways to compliance. For example, the Clean Air Act

Amendments in the early 1990s successfully addressed acid rain by requiring utilities to limit sulfur emissions without dictating how.[49] Utilities could reduce emissions by choosing among a range of options—such as installing scrubbers, burning cleaner coal, or fuel-switching to natural gas—leading to a 40:1 benefit-cost ratio and faster-than-expected mitigation of acid rain.[50]

Conversely, prescriptive policies, such as the mandates on corn ethanol for reducing U.S. dependence on fossil fuels, have shown how rigid requirements can lead to unintended consequences that may undermine the original policy goals. In the case of the corn ethanol policy, mandates drove resource competition and impinged significantly on land and water resources, with limited environmental benefits. Mandates also failed to anticipate (or incentivize) the rise of electric vehicles, which are environmentally beneficial.[51] Policymakers should therefore consider the benefits of flexibility to enable efficient, innovative responses while minimizing unintended consequences.

For policymakers considering AE's resource generation plan, this means setting clear, outcome-based standards for sustainability, reliability, and affordability that enable AE to make strategic, context-sensitive decisions that balance its unique operational needs with public policy goals. By establishing ambitious yet flexible targets for AE's energy mix, rather than dictating specific technologies or fuel sources, policymakers can support AE in innovating within its resource portfolio to meet community and environmental standards. This approach can mitigate the risk of unintended consequences, such as cost spikes or reliability issues, that may arise from prescriptive mandates and allows AE to adapt its resources in response to evolving energy markets, technological advancements, and the diverse needs of its customer base.

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[49] https://www.epa.gov/acidrain/acid-rain-program-results

[50] https://www.epa.gov/clean-air-act-overview/highlights-clean-air-act-40th-anniversary

[51] https://doi.org/10.5547/01956574.34.4.1

5. Conclusion

Utilities, including AE, must brace for a period of significant growth in electricity demand. Our analysis shows scenarios in which AE could see peak demand more than double by 2040. Unmanaged EV charging is projected to have the largest impact on growth, driving total peak demand up more than 4,500 MW, to 7,800 MW. Fortunately, EV charging can be managed, reducing EV-related peak demand 3,800 MW to just 150 MW.

Still, in the next 15 years, there is anticipated to be a fundamental mismatch between energy demand in the AE service area and AE-owned or contracted power generation. To ensure resource adequacy and reduce the impact of price volatility and transmission congestion fees, AE should accelerate the deployment of solutions to address both supply and demand. Key to this strategy is evaluating energy options through the lens of trade-offs, balancing various considerations—such as the benefits and drawbacks of local, dispatchable power, the necessity of EV charging management, and the feasibility of new efficiency measures—to optimize overall system performance and cost-effectiveness for customers. This approach involves incorporating a mix of generation and storage resources alongside efficiency improvements. A strategic approach that prioritizes decarbonization and equity will not only strengthen AE's financial health, but also provide customers with greater reliability, affordability, and sustainability.

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Appendix A: Peak Demand Calculations

Home Electrification

Home Heating

Research done by Skiles et al. was used to determine peak demand for AE based on customer electric heat pump use. Skiles et al.'s research applies linear fit estimations to seasonal peak demand in ERCOT. We employ their winter regression formula, since we are concerned primarily with heat pump use (See Figure 9). Though Skiles et al.'s data are derived from ERCOT total peak electricity demand from 1997 through 2021, we assume, for the purposes of our research, that ERCOT winter peak demand is a reasonable representation of Austin winter peak demand. To tailor the results to Austin, however, we use Skiles et. al's method of normalizing peak demand data by population.

Per capita demand was calculated as follows:

$$\text{Per Capita Peak Demand (kW/person/HDD)}_{\text{Year}} = (0.77) \times (\text{Year in the Model}) + 115.83$$

Peak demand for the AE service area was calculated as follows:[52]

$$\text{Total AE Peak Demand}_{\text{Year}}\,(\text{MW}) = (\text{Per capita peak demand})_{\text{Year}} \times (\text{Travis County population})_{\text{Year}} \times (\text{\% of buildings with electric heat pumps})_{\text{Year}}$$

Home Cooking

Peak demand for electric cooking was calculated as follows:[53]

$$\text{Peak Demand for Electric Cooking}_{\text{Year}}\,(\text{MW}) = ((\text{\% Households that Prepare} \geq 1 \text{ Hot Meal per Day}) \times (\text{Number of AE Households with Electric Stovetops})_{\text{Year}} \times (2\text{ kW})) / 1{,}000$$

$$\text{Difference in Peak Demand for Electric Cooking}_{\text{Year}}\,(\text{MW}) = (\text{ Peak Demand })_{\text{Year}-1} - (\text{ Peak Demand})_{\text{Year}}$$

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[52] Calculations do not account for heat pump efficiency.

[53] Calculations do not account for stovetop efficiency.

EV Adoption

To estimate peak demand and electricity consumption, we utilized the following equations:[54]

$$\text{Peak Demand Year (MW)} = ((\text{\# of EVs})_{\text{year}} \times (5.7\text{ kW}) \times \\ (\text{\% of Vehicles Charging at Once})) / 1{,}000$$

$$\text{Electricity Consumption Year (MWh)} = ((\text{Total Electric Miles Driven})_{\text{Year}} \times \\ (1 / 3.6\text{ Miles per kW Hour})) / 1{,}000$$

Assuming:

$$\text{Total Electric Miles Driven}_{\text{Year}}\text{ (Miles)} = (\text{Total Miles Driven})_{\text{Year}} \times \\ (\text{\% of Miles Driven That Are Electric})_{\text{Year}}$$

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[54] Calculations do not account for EV charging efficiency.