Decarbonization in the El Paso Region

A Commentary on Technical and Economic Feasibility

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Executive Summary

On May 6, 2023, El Paso Residents will decide whether to pass a local climate ordinance that will require that all energy used by the municipal city government of El Paso is generated by 80% clean renewable energy by 2035 and 100% by 2045. The El Paso Chamber of Commerce recently published a study, entitled "El Paso Climate Charter Economic Impact Assessment" to assess the implications of the climate ordinance and found that its implementation would result in an almost complete collapse of the El Paso economy. This report seeks to accomplish two goals 1) assess the Chamber study's assumptions and 2) provide context of that other studies have found. We find that:

- The economic impact assessment commissioned by the El Paso Chamber of Commerce makes fundamentally flawed assumptions about scope of the ordinance and energy availability, which in turn drives their projections for massive economic disruption.
- The studies' stark predictions of economic collapse stem from the assumption that El Paso would lose over 70% of their energy by 2045, which is egregious and displays a fundamental misunderstanding of how energy systems work, particularly in Texas.
- El Paso Electric's own modeling has indicated that achieving 100% clean electricity for the entire region by 2045 is entirely possible and completely within the bounds of reality.
- El Paso Electric's own modeling indicated that achieving that they could achieve these goals while also being able to match supply and demand.
- Prior studies have shown that electrifying the end-uses of energy in municipal vehicles and buildings is reasonable given the timeline given and the natural turnover of building HVAC systems and vehicles.
- El Paso could position itself to be a major hub for carbon-free energy, manufacturing, and support for these industries as well as play a larger role in the global economy as more regions look for low-carbon or carbon-neutral goods.
- A recent study from the University of Texas showed that a wide range of net-zero pathways for Texas by 2050 each resulted in higher levels of GDP and associated employment relative to a baseline BAU case of not following a net-zero pathway in the El Paso region.
- The electric sector is more than capable of expanding renewable power supplies, energy storage, hydrogen, and transmission, all of which is expected to exceed fossil fuel job losses.

Introduction

In 2016, El Paso Electric became the first utility in Texas and New Mexico to generate electricity without coal-fired power. El Paso Electric has since made a goal to achieve 80% carbon-free electricity by 2035 and 100% by 2040. On May 6, 2023, El Paso Residents will decide whether to pass a local climate ordinance. El Paso's climate ordinance (No. 019437) renewable energy goal would extend this target to require that all energy used by the municipal city government is generated by 80% clean renewable energy by 2035 and 100% by 2045.[1][2]

The authors of this memo are not taking a "for" or "against" position on the proposed local ordinance. This memo is commentary on several technical and economic feasibility studies of net-zero decarbonization and the potential impact on jobs in the El Paso area. For reference, some specific language from the ordinance is given below.

The Renewable Energy Goal in The Climate Ordinance

The City of El Paso shall employ all available methods to require that energy used within the City is generated by clean renewable energy, with the goals of requiring (1) 80% clean renewable energy by 2030 and (2) 100% clean renewable energy by 2045.

Renewable Energy Definition

Clean renewable energy: energy generated without burning carbon or releasing greenhouse gases. Includes renewable energy sources such as solar, wind, hydroelectric, and geothermal. Includes hydrogen energy that is produced by splitting water by electrolysis ("green" hydrogen) or hydrogen produced by solar driven processes but does not include hydrogen energy produced using natural gas ("blue" or "grey" hydrogen) or nuclear ("pink" hydrogen).

Critique of the El Paso Climate Charter Impact Assessment

While the main purpose of this memo is to summarize the climate ordinance and discuss previous analyses that have looked at the net impact of net-zero pathways, it is also instructive to assess how other studies have approached this specific issue.

The El Paso Chamber of Commerce commissioned a study to assess the implications of the climate ordinance and found that its implementation would result in an almost complete collapse of the El Paso economy[3]. While the results of the study are stark, their conclusions mainly stem from the assumption that "*El Paso's available energy decreases by a stunning 69% by 2030 and 72% by 2045*." These losses are almost entirely driven by an economy-wide collapse in productivity as entire business and sectors shutter or move away. Table 3 from the study shows an estimated $29.8 Billion in lost output from "all other industry", out of $32.8 Billion total (90% of all losses) and 195,000 out of 198,000 estimated lost jobs (98% of all jobs lost).

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[1] https://www.elpasotexas.gov/assets/Documents/CoEP/EP-Charter/Climate-Policy-Petition-Ordinance.pdf
[2] https://elpasomatters.org/2023/04/12/el-paso-city-official-says-proposition-k-would-not-ban-gas-appliances/
[3] https://el-paso-chamber-production.s3.amazonaws.com/documents/files/000/000/026/original/El_Paso_Climate_EIA_FINAL_030123.pdf?1678211670

Table 3: Detailed Economic Impacts to El Paso in 2045

	Output	Earnings	Jobs
Total	($32,830,612,000)	($9,177,028,000)	(198,000)
Utilities	($863,738,000)	($104,164,000)	(679)
Refineries	($1,160,419,000)	($30,270,000)	(121)
Natural Gas Companies	($239,780,000)	($36,273,000)	(215)
City Government	($750,707,000)	($192,912,000)	(2,000)
Households	--	($4,011,789,000)	--
All Other Industries	($29,815,964,000)	($5,165,239,000)	(195,000)

Source: Points Consulting, 2022, using IMPLAN

The assumption that El Paso loses most of its energy supply—and does not replace it—is fundamentally flawed from a technological, economic, and policy standpoint. If we understand the study's analysis correctly, it hinges on another assumption that El Paso could only manage to build 12 MW of solar per year[4] and does not buy power from elsewhere. This assumes that El Paso would only be able to build 288 MW of solar between now and 2045 to replace other energy sources.

This assumption is not compatible with reality for multiple reasons: 1) El Paso is not an island, and is well connected in electricity and energy networks (meaning it can sign agreements to import power from any area it is networked to via transmission line or pipeline), 2) there are other ways to generate carbon-free electricity (such as wind and hydrogen), 3) the rest of Texas is already scheduled to build over 8,000 MW per year over the next three years (including about 1,800 MW in neighboring counties), and 4) there are currently 157 solar projects with signed interconnection agreements in the ERCOT generator interconnection queue and their average size is 230 MW each.[5]

The Chamber's study also assumes that every home and business in El Paso would have to transition all end-uses of energy, such as heating and transportation, to electricity. However, the ordinance only applies to energy used by the municipal city government[6] and thus its modeling of the entire region is flawed.

Further, El Paso Electric's own modeling, which is discussed below, indicates that it is very possible to power a growing El Paso economy while vastly reducing emissions. The assumption that energy sources cannot be replaced, and the downstream effect being that much of the city's businesses shut down or move, is irrational.

This report is not meant to be a comprehensive peer review of the Impact Assessment, but it is important for us to point out that the primary conclusions of the "Critique of the El Paso Climate

[4] The average size of the 157 solar projects with currently signed interconnection agreements in ERCOT is 230 MW.

[5] While we recognize that El Paso resides outside of ERCOT, activity in the ERCOT region should nonetheless be a good proxy for what is possible in El Paso.

[6] https://elpasomatters.org/2023/04/12/el-paso-city-official-says-proposition-k-would-not-ban-gas-appliances/

Charter Impact Assessment" are based on multiple fundamentally flawed assumptions and thus does not represent reality. This report is meant to provide additional commentary to inform the discussion and voters to the technical and economic feasibility of decarbonizing El Paso.

Impact And Challenges of Decarbonization in the El Paso Region

While the authors of this report have not modeled the impacts of this climate ordinance specifically, we have been a part of multiple other of net zero studies, including ones that focus on Texas, and use that experience to offer our thoughts on the possibility of going net-zero in El Paso.[7,8]

Existing Energy Sources in El Paso

Electricity sources

Much of El Paso Electric's current electricity comes from natural gas. However, eight of the fifteen natural gas units online in 2021 were set to retire prior to the 2045 deadline.[9] A further seven generating units have planned retirement dates between 2058 and 2061 and would thus need to be retired early or retrofitted to use clean renewable fuel to comply with the renewable energy goal.[10] El Paso Electric has indicated that Newman Power Station's newest unit could be converted to use 100% hydrogen by 2045. [11]

In total, natural gas units comprise about 1,500 MW capacity and provided about 45% of electricity generated in 2020. Nuclear and solar account for about approx. 1,000 MW of capacity and 54% of electricity generated. The rest mostly comes from a landfill gas to energy facility and electricity produced from rooftop solar systems.[12]

Previous Decarbonization Estimates

El Paso Electric modeled decarbonization scenarios in their 2021 Integrated Resource Plan. Table 2 shows the five scenarios most relevant to the utility's carbon-free goals and the renewable energy goal of the climate ordinance. The capacity additions and estimated cost for each scenario is included in Figure 1, and Figure 2 shows energy mix (in GWh) and associated cost) for these scenarios. These are scenarios modeled for El Paso Electric are generally aligned with the intent

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

[8] https://www.energypolicy.columbia.edu/publications/electrification-path-net-zero-comparison-studies-examining-opportunities-and-barriers-united-states/

[9] El Paso Electric. 2022. El Paso Electric Company's amended 2021 Integrated Resource Plan. https://www.epelectric.com/files/html/21-00242-UT%20EPE%27s%20Amended%20IRP%20w%20COS%20%28Compressed%29.pdf

[10] The natural gas steam turbines use 1.3B gallons of water per year according to reporting to the Energy Information Administration (EIA forms 860 and 923). Retiring these plants will assist with meeting the climate ordinance water targets.

[11] https://www.epelectric.com/company/news/mitsubishi-power-and-el-paso-electric-to-develop-roadmap-toward-carbon-free-energy-mix-by-2045

[12] https://www.epelectric.com/files/html/21-00242-UT%20EPE%27s%20Amended%20IRP%20w%20COS%20%28Compressed%29.pdf

the climate ordinance renewable energy goal, though for all energy customers served (i.e. not just the municipal government).

Table 1 El Paso Electric Owned Generating Stations

Generating Station	Location	Nominal Capacity (MW)	Primary Fuel Type	Secondary Fuel Type	In-Service Date	Planned Retirement Date	Unit Age at Planned Retirement
PVNGS Unit 1 Unit 2 Unit 3	Phoenix, AZ	622	Uranium	N/A	February 1986 September 1986 January 1988	June 2045 April 2046 November 2047	59 60 59
Montana Unit 1 Unit 2 Unit 3 Unit 4	El Paso, TX	352	Natural Gas	Fuel Oil	March 2015 March 2015 May 2016 September 2016	December 2060 December 2060 December 2061 December 2061	45 45 45 45
Rio Grande Unit 6 (1) Unit 7 Unit 8 Unit 9	Sunland Park, NM	323	Natural Gas	N/A	June 1957 June 1958 July 1972 May 2013	December 2021 December 2022 December 2033 December 2058	64 64 61 45
Newman Unit 1 Unit 2 Unit 3 Unit 4 Unit 5 – CTs Unit 5 – HRSG	El Paso, TX	729	Natural Gas	N/A	May 1960 June 1963 March 1966 June 1975 May 2009 April 2011	December 2022 December 2022 December 2026 December 2026 December 2061 December 2061	62 59 60 51 52 50
Copper Unit 1	El Paso, TX	63	Natural Gas	N/A	July 1980	December 2030	50
EPE-owned Solar Texas Community Solar Holloman Solar Small Solar Systems	EPE Service Territory	3 5 < 1	N/A	N/A	May 2017 Oct 2018 2009 – 2011	May 2047 October 2048 2029 – 2032	Various

(1) Rio Grande Unit 6 is subject to a pending abandonment proceeding in Case No. 20-00194-UT.

Table 2 Decarbonization Scenarios Modeled in El Paso Electric's 2021 Integrated Resource Plan[13]

Portfolio Name	Portfolio Description	Carbon Free (%)	Renewable (%)
80%	80% Carbon Emission Reduction by 2040	94%	55%
100% H2	100% Carbon Emission Reduction by 2040 with Hydrogen Fuel	100%	59%
100%, No CT	100% Carbon Emission Reduction by 2040 with Only Renewables and Existing Nuclear	100%	61%

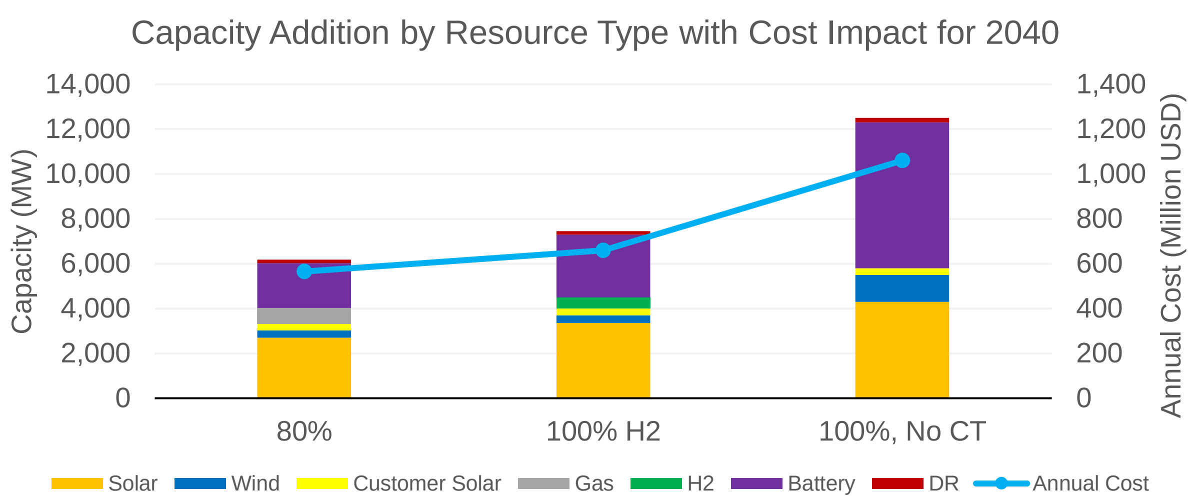

Figure 1 Capacity Addition by Resource Type with Cost Impact for 2040[14]

The biggest difference between the ordinance and El Paso Electric's IRP is that 80% carbon emission reduction is modeled by 2040 and not 2030. Additionally, they do not prescribe the exact path needed to reach renewable energy goals. However, they do illustrate the ability to cost-effectively achieve 100% carbon-free electricity generation via multiple pathways. **Additionally, and most importantly, all these pathways meet anticipated future loads.** Furthermore, El Paso Electric estimates that they can achieve 80% carbon-free electricity with almost no change to rates and 100% carbon-free electricity with a 1.2-5.8 cent increase on rates in 2040.

[13] Table reproduced from data in https://www.epelectric.com/files/html/21-00242-UT%20EPE%27s%20Amended%20IRP%20w%20COS%20%28Compressed%29.pdf
[14] Figure reproduced from data in https://www.epelectric.com/files/html/21-00242-UT%20EPE%27s%20Amended%20IRP%20w%20COS%20%28Compressed%29.pdf

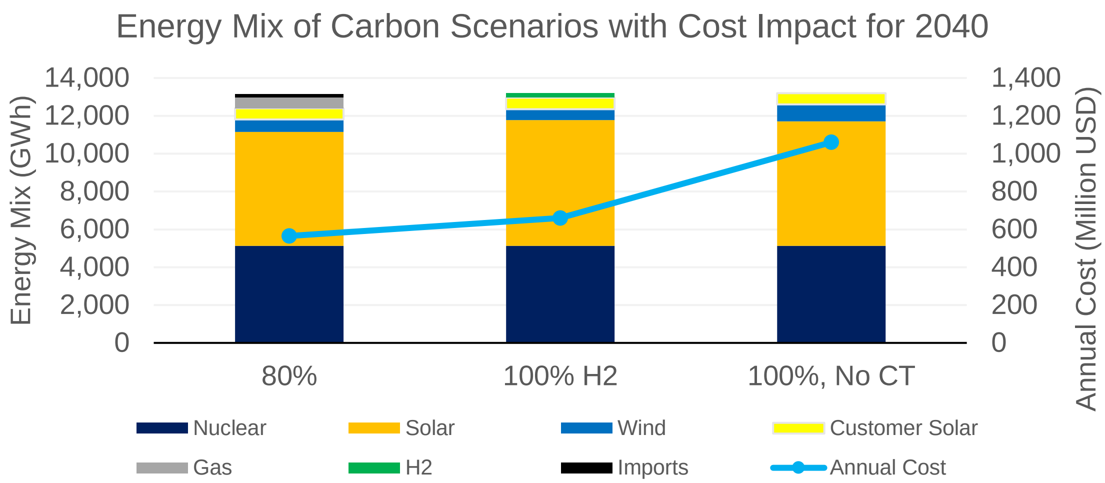

Figure 2 Energy Mix for Decarbonization Scenarios in 2040[15]

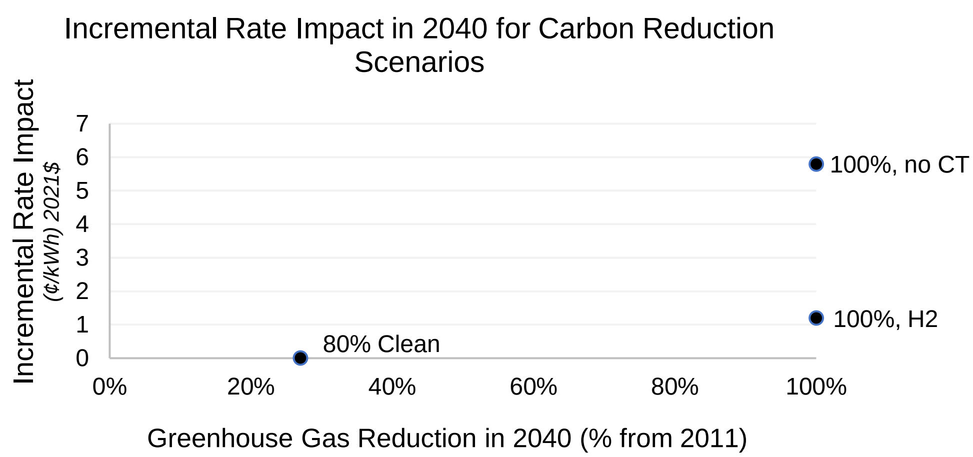

Figure 3 Incremental Rate Impact in 2040 for Carbon Reduction Scenarios[16]

It should also be noted that the increased electrification would increase total electricity demands. In reducing fossil fuel use in power generation, El Paso will also need to consider how to replace natural gas generation and add additional supplies to meet increased demand from electrification as well as any future population growth.

As indicated by El Paso Electric's own modeling, there are multiple pathways to providing clean energy, including nuclear, solar, wind, and geothermal. There are also well understood ways of smoothing supply and demand imbalances using energy storage and hydrogen. Each of these topics are discussed further in the Appendix for additional context.

[15] Figure reproduced from data in https://www.epelectric.com/files/html/21-00242-UT%20EPE%27s%20Amended%20IRP%20w%20COS%20%28Compressed%29.pdf
[16] Figure reproduced from data in https://www.epelectric.com/files/html/21-00242-UT%20EPE%27s%20Amended%20IRP%20w%20COS%20%28Compressed%29.pdf

Energy Efficiency and Demand Response

El Paso could further ease achievement of these goals by also instituting additional energy efficiency and demand response programs to assist with reducing total energy demand across the community. Reducing peak electricity demand means less power plants are required to match demands, which also reduces total cost for the utility and its customers.

El Paso Electric incorporates energy efficiency programs required by both New Mexico and Texas. Incorporating additional easily implemented efficiency standards can assist with decreasing energy demand, helping to reduce energy bills and, with wide scale application, the total amount of generation needed for the utility.[17] Energy efficiency can make energy use more affordable for low-income residents, reducing energy burdens or, if residents had been rationing their energy use to avoid high energy bills, it can make it possible for these residents to use the amount of energy they need for safety and comfort. Studies have shown that updating homes across the United States to median energy efficiency levels could eliminate 35% of excess energy burden.[18] El Paso should take care to make energy efficiency options available for renters, as incentives and programs that target building owners leave out tenants and miss out on these energy savings. El Paso should also ensure that its local Low-Income Home Energy Assistance Program (LIHEAP) and Weatherization Assistance Program (WAP) are used to their full extent, maximizing the impact on home energy use. These programs employ strategies like wall and attic insulation and efficient appliances or windows to upgrade homes for qualifying low-income residents.

El Paso could implement additional demand response programs, including incentives for consumers to use electricity outside of peak times. El Paso Electric currently incentivizes residents to use a smart thermostat and enroll in a program to reduce peak demand between 1pm and 7pm over the summer.[19] In implementing demand response, El Paso should avoid only using price signals during peak times for residential users as they might penalize low-income residents who might not be able to avoid energy use during this time or might sacrifice comfort or safety to ration their energy use to avoid charges.[20,21]

Job Impacts

Multiple studies at the national and state levels as well as El Paso Electric's own local Integrated Resource Plan indicate that it is possible to reach carbon-free or fully renewable electricity. Decarbonization is expected to lead to net job growth according to multiple net-zero

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[17] Gee, I., Glazer, Y., Rhodes, J., Deetjen, T., Webber, M., Choukulkar, A., Cote, B., Clack, C., & Lewandowski, B. (2022). *Don't Mess with Texas: Getting the Lone Star State to Net-Zero by 2050*. University of Texas at Austin.

[18] Drehobl, A. & Ross, L. Lifting the High Energy Burden in America's Largest Cities: How Energy Efficiency Can Improve Low Income and Underserved Communities. American Council for an Energy-Efficient Economy. https://www.aceee.org/research-report/u1602 (2016).

[19] https://www.epelectric.com/company/news/el-paso-electric-launches-first-ever-energy-efficiency-marketplace-and-offers-a-new-smart-thermostat-program-with-25-incentive-to-enroll

[20] Gyamfi, S., Krumdieck, S. & Urmee, T. Residential peak electricity demand response—Highlights of some behavioural issues. Renew. Sustain. Energy Rev. 25, 71–77 https://doi.org/10.1016/j.rser.2013.04.006 (2013).

[21] White, L. V. & Sintov, N. D. Varied health and financial impacts of time-of-use energy rates across sociodemographic groups raise equity concerns. Nat. Energy 5, 16–17 https://doi.org/10.1038/s41560-019-0515-y (2020).

studies.[22,23,24,25] While there are some job losses to be expected with any energy transition, it is expected that there will be job growth in other sectors of the economy, including other parts of the energy sector.

The electric sector is expected to rapidly expand renewable power supplies, energy storage, hydrogen, and transmission, all of which is expected to exceed fossil fuel job losses. The solar, transmission and distribution, wind, and energy storage industries are expected to see the largest job growth both nationally and in Texas net zero analyses. Moreover, using hydrogen in a decarbonization strategy has the largest impact on job growth in the Texas analysis because of the need for a large new electrolysis industry for hydrogen production.[26]

In fact, a recent study from the University of Texas showed that a wide range of net-zero pathways for Texas by 2050 each resulted in higher levels of GDP and associated employment relative to a baseline BAU case of not following a net-zero pathway in the El Paso region, as well as all nearly all other regions of the state.

El Paso could prepare for the impending energy transition by training workers in these fields, prioritizing any necessary reskilling for those in the fossil fuel industries. The city is unlikely to experience job losses related to oil and gas exploration as there is no oil or gas production in El Paso county as per the Texas Railroad Commission.[27] Conversely, because of the high solar resource potential and intent on increasing solar power generation for the community, El Paso could very likely become a major hub for solar generation in both the Western Interconnect and ERCOT grids, not to mention the potential to export power to Mexico. Community leaders might also want to investigate options for manufacturing solar panels in the area given the domestic production provisions in the Inflation Reduction Act of 2022. Similarly, El Paso should plan for the electrolysis infrastructure and jobs needed to produce the volume of hydrogen needed for its transition.

Conclusions

This report discusses the implication of El Paso choosing to achieve net-zero emissions by 2045 based on prior comprehensive peer reviewed decarbonization reports that evaluated national as

[22] Gee, I., Glazer, Y., Rhodes, J., Deetjen, T., Webber, M., Choukulkar, A., Cote, B., Clack, C., & Lewandowski, B. (2022). *Don't Mess with Texas: Getting the Lone Star State to Net-Zero by 2050*. University of Texas at Austin.
[23] Larson, E., C. Greig, J. Jenkins, E. Mayfield, et al. 2020. "Net-Zero America: Potential Pathways, Infrastructure, and Impacts." Princeton University.
[24] Williams, J. H., R. A. Jones, B. Haley, G. Kwok et al. 2021. "Carbon-Neutral Pathways for the United States." AGU Advances 2, no. 1: e2020AV000284.
[25] Blanford, G., T. Wilson, and J. Bistline. 2021. "Powering Decarbonization: Strategies for NetZero CO2 Emissions." Electric Power Research Institute. https://wdeawebsite.blob.core.windows.net/usrfiles/documents/powering%20decarbonization_%20strategies%20for%20net_zero%20co2%20emissions.pdf.
[26] Gee, I., Glazer, Y., Rhodes, J., Deetjen, T., Webber, M., Choukulkar, A., Cote, B., Clack, C., & Lewandowski, B. (2022). *Don't Mess with Texas: Getting the Lone Star State to Net-Zero by 2050*. University of Texas at Austin.
[27] https://www.rrc.texas.gov/media/czjhzpdy/2023-01-monthly-production-county-oil.pdf

well as Texas-specific net zero pathways. Previous studies and analyses have shown that doing so is possible and those same analyses have found net-zero pathways to be net job creators, not economy destroyers.

We also find some serious flaws in the methodology and assumptions of a study that was commissioned to study this ordinance, including the unreasonable assumption that taking a net-zero pathway would mean El Paso would have 72% less energy by 2045.

Lastly, while municipal decarbonization was not specifically modeled, it is a logical to infer from this report is that decarbonization of the energy used by the municipal city government of El Paso, let alone the entire economy, is technically feasible and potentially economically beneficial.

Acknowledgements

This work is supported by Texas Consumer Association and funded by the Consumer Fund of Texas, a 501(c)(3) research organization.[28]

About Us

IdeaSmiths LLC[29] was founded in 2013 to provide clients with access to professional analysis and development of energy systems and technologies. Our team focuses on energy system modeling and assessment of emerging innovations, and has provided support to investors, legal firms, and Fortune 500 companies trying to better understand opportunities in the energy marketplace.

[28] https://www.texasconsumer.org/

[29] https://www.ideasmiths.net/

Appendix

Below is a summary of carbon-free energy resources available to the El Paso region, as well as additional discussion on decarbonizing transportation and buildings. Other potential sources of energy for El Paso's future include nuclear, solar, wind, geothermal as well as the utilization of ways to smooth supply and demand imbalances using energy storage and hydrogen. This information is provided for additional background context on technical and economic feasibility for full decarbonization.

Solar Power

Solar is an abundant resource in the El Paso area, as shown in Figures 4 and 5. However, as of 2021, El Paso Electric owned less than 10 MW of solar and purchased electricity from solar installations at a capacity of 377 MW. To achieve decarbonization goals, El Paso Electric estimates nearly 3 GW of solar installations would be needed to achieve 80% carbon-free electricity and 3-4 GW of solar installations would be needed to achieve 100% carbon-free electricity. While this might seem like a lot of solar compared to the current installed capacity, the rest of Texas[30] is expected to have well over 40,000 MW of utility-scale solar installed by 2026,[31] over 1,800 MW of which is planned for the ten counties closest to El Paso in West Texas.[32] El Paso may be able to connect to or import power from projects in these counties for additional supply.

Because of the intermittent nature of the resources, scenarios with heavy reliance on solar and wind power have more total electricity capacity installed than scenarios that rely on multiple types of electricity sources, and thus can have higher overall total costs.

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[30] The ERCOT region.

[31] Resource Capacity Trend Charts, March 2023: https://www.ercot.com/gridinfo/resource

[32] GIS Report for March 2023: https://www.ercot.com/mp/data-products/data-product-details?id=PG7-200-ER

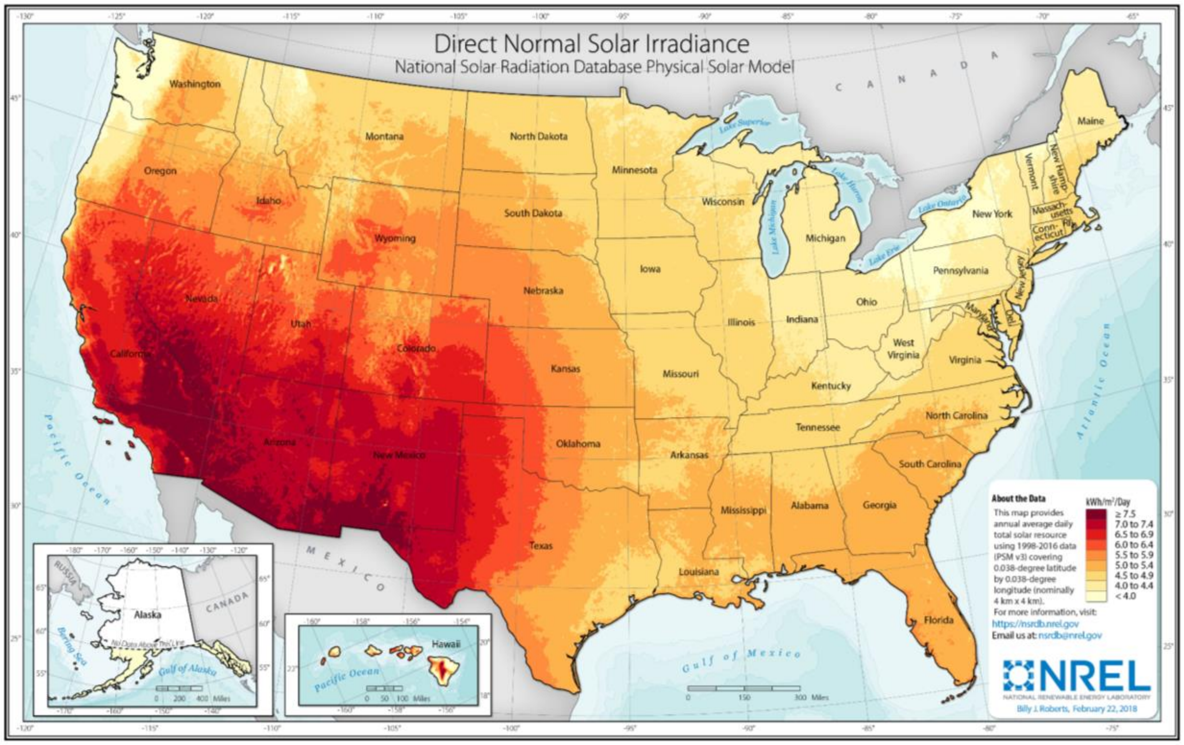

Figure 4 Direct Normal Solar Irradiance in the United States[33]

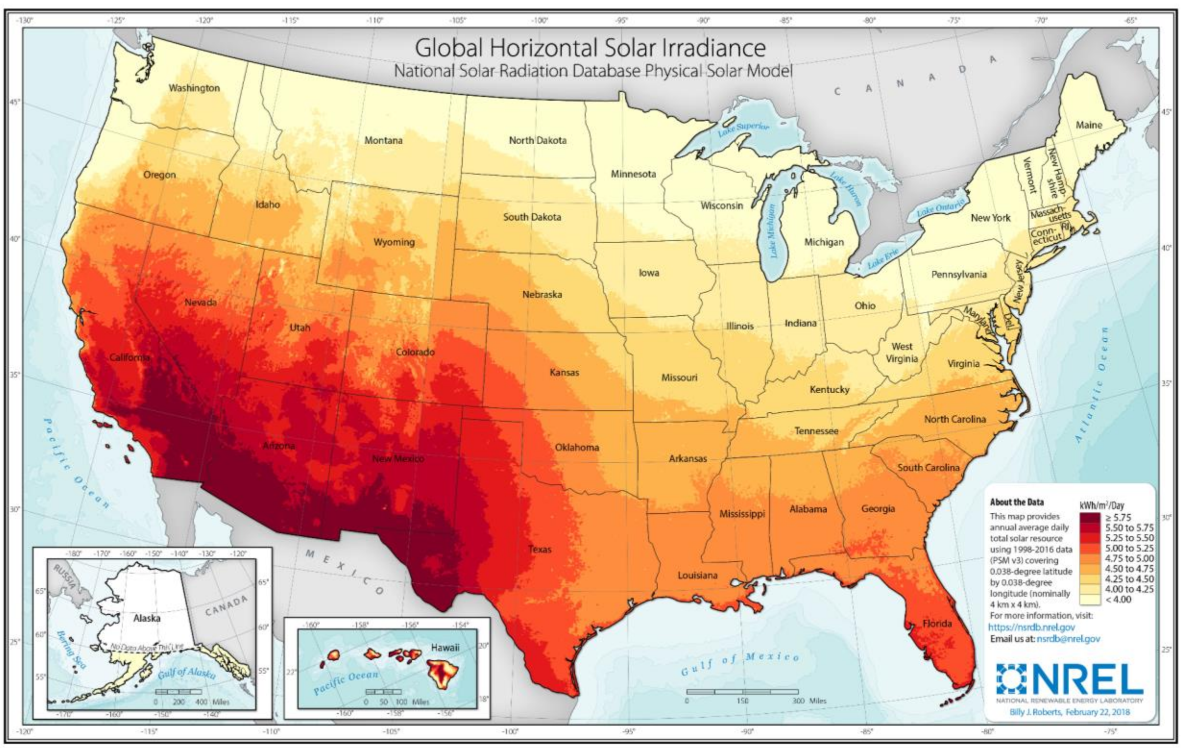

Figure 5 Global Horizontal Solar Irradiance in the United States[34]

[33] https://www.nrel.gov/gis/solar-resource-maps.html
[34] https://www.nrel.gov/gis/solar-resource-maps.html

Net zero analyses for the entire United States show that utility scale solar is more cost-effective than rooftop solar installations. Utility scale solar installations benefit from economies of scale of a larger system. However, both utility and rooftop solar can provide clean renewable energy needed for a community.

To achieve the rapid scale of solar installation that might be required, El Paso could evaluate solar incentive programs that have resulted in widespread solar installations. For example, in South Australia, one in every three homes has rooftop solar panels. South Australia has over 2 gigawatts of solar installed, including rooftop and utility solar projects, and over 20% of South Australia's electricity generation was provided by solar in 2020-21 for its population of 1.7 million residents.[35] In addition, many homes have solar water heating. The capacity of solar installed nationally has increased rapidly, quadrupling from 7.3 GW at the start of 2018 to 29.7 GW at the end of 2022.[36] El Paso could consider incentives[37] and marketing strategies[38] in Australia and other locations with high solar proliferation, keeping in mind differences in the market such as the price difference for panels in these areas. It will be important to keep in mind equity issues that can occur as a result of programs or incentives to promote decarbonization, including rooftop solar or other initiatives like electric vehicles, efficient appliances, and building retrofits due to targeting homeowners over renters[39] or incentive design that benefits already affluent individuals. In the short-term, El Paso residents can take advantage of existing federal incentives for solar that expanded under the Inflation Reduction Act of 2022.

Wind Power

Wind resources are not ideal in the El Paso area, but good wind resources exist just a few counties to the east. Figure 6. shows annual average wind speed across the state of Texas. Major wind installations in Texas exist in the areas shaded with purple and red in west Texas around Big Spring, Lubbock, and Amarillo and around the red shaded areas along the coast near Corpus Christi. El Paso Electric reports that the peak electricity demand months of May to August have the lowest average wind output profiles. Similarly, during El Paso's peak hours of demand, wind output would be lowest. However, even if wind resources in the region are less available during peak demand times, wind can provide large amounts of low-cost energy of ther the year that can also acta as a hedge against high fuel prices, such as natural gas.[40] El Paso

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[35] https://www.energymining.sa.gov.au/industry/modern-energy/large-scale-generation-and-storage/solar-energy-in-south-australia

[36] https://pv-map.apvi.org.au/analyses

[37] Zander, K. K., Simpson, G., Mathew, S., Nepal, R., & Garnett, S. T. (2019). Preferences for and potential impacts of financial incentives to install residential rooftop solar photovoltaic systems in Australia. *Journal of Cleaner Production*, *230*, 328-338.

[38] Simpson, G. (2018). Looking beyond incentives: the role of champions in the social acceptance of residential solar energy in regional Australian communities. *Local Environment*, *23*(2), 127-143.

[39] Gee, I., Glazer, Y., Rhodes, J., Deetjen, T., Webber, M., Choukulkar, A., Cote, B., Clack, C., & Lewandowski, B. (2022). *Don't Mess with Texas: Getting the Lone Star State to Net-Zero by 2050*. University of Texas at Austin.

[40] https://www.ideasmiths.net/wp-content/uploads/2022/10/IdeaSmiths_CFT_ERCOT_RE_FINAL.pdf

Electric estimates moderate wind installation in future decarbonization scenarios, between about 200 and 1,500 MW of capacity installations depending on the scenario.

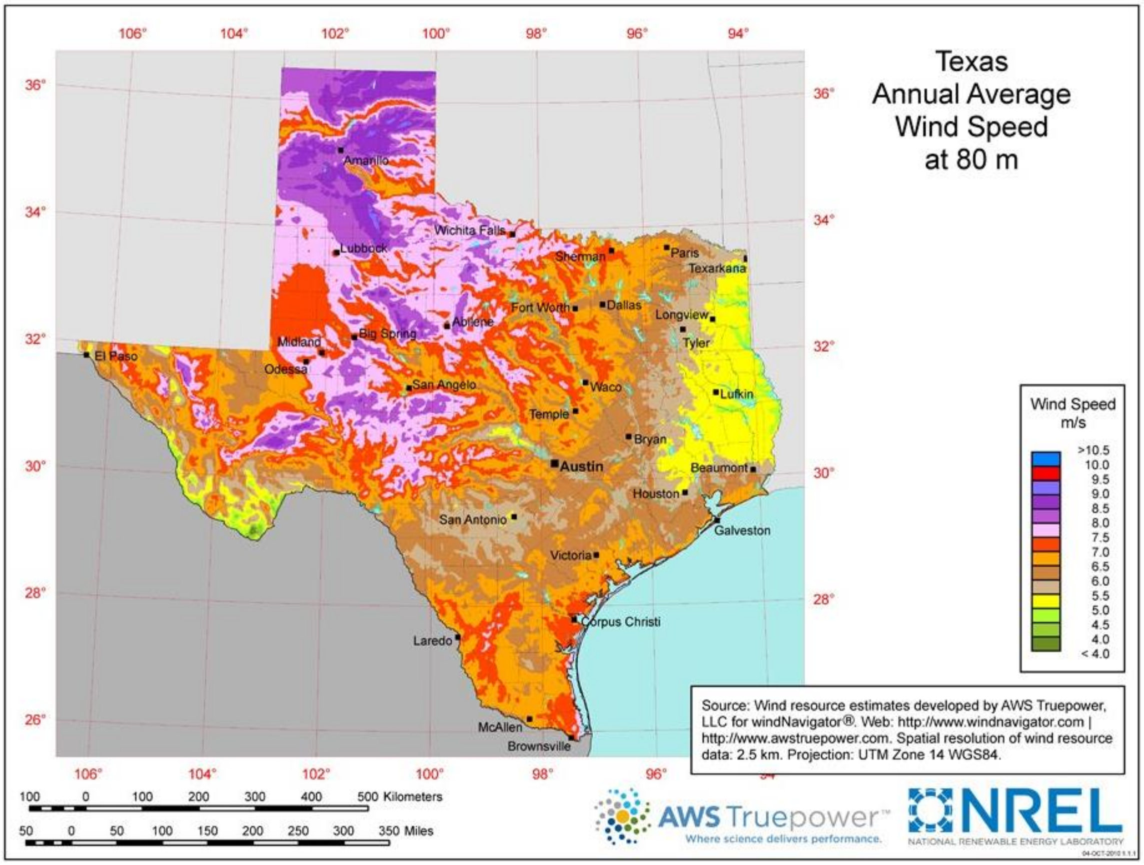

Figure 6 Wind Resources in Texas[41]

Geothermal Power

El Paso does not currently generate electricity using geothermal resources. However, recent state-wide studies[42] have shown that the El Paso region of is a good candidate for geothermal power generation, as shown in Figure 7. The resources identified in the figure could be used for hydrothermal or deep enhanced geothermal systems. Geothermal can provide a dispatchable supply of energy that can be deployed as needed rather than when it is available (such as for solar and wind power). This aspect can assist with bridging the gap for when other renewable resources are unavailable.

[41] https://windexchange.energy.gov/maps-data/122

[42] https://energy.utexas.edu/research/geothermal-texas

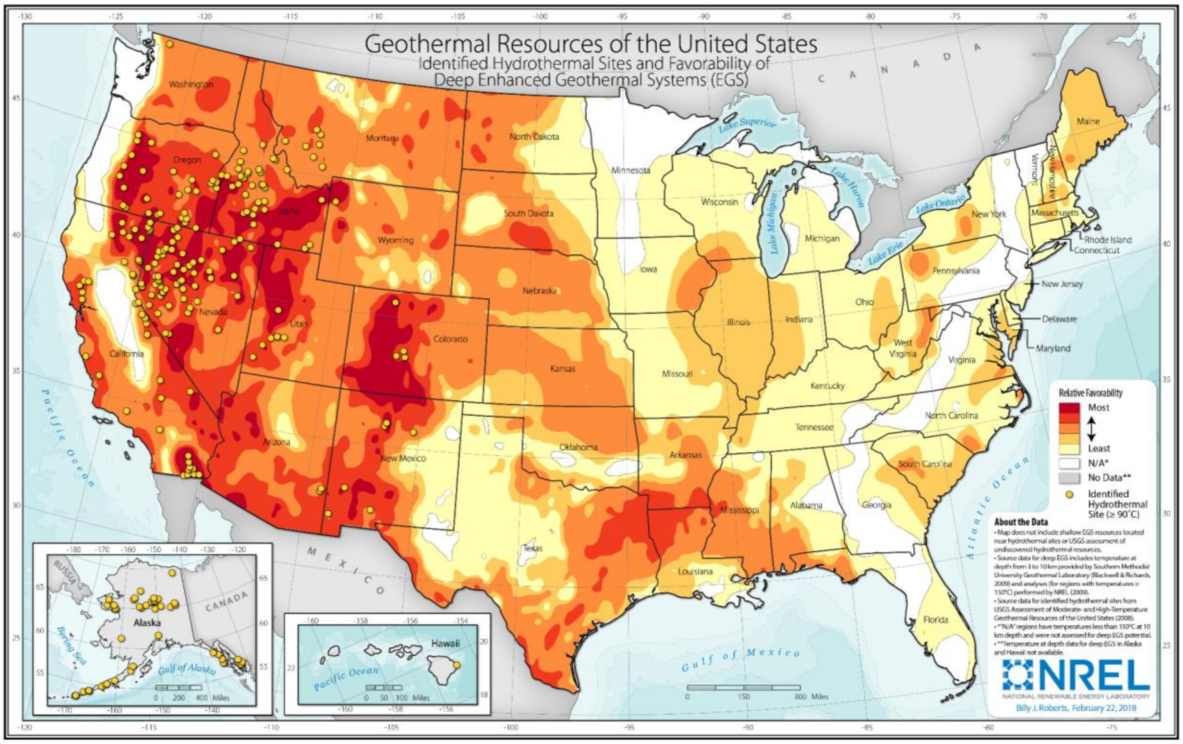

Figure 7 Geothermal Resources in the United States[43]

Energy Storage

El Paso Electric's decarbonization estimates include substantial installations of energy storage. Approximately 2 GW of energy storage is needed to reach 80% decarbonization, and approximately 3-6.5 GW of energy storage is needed to reach 100% decarbonization depending on the scenario. Less energy storage is needed with more reliance on hydrogen. For reference, the ERCOT region of Texas is expected to install over 14 GW of energy storage capacity by 2025.

In net zero analyses across the United States, short- and long-term energy storage is a dominant strategy if there is a strict requirement for 100% renewable electricity.[44] However, these studies note that progress in ramping up energy storage may be constrained by the development of ultracheap long-duration energy storage as well as siting projects.[45] El Paso could reduce its need for energy storage with flexible, non-critical energy demands that are able to use energy when there is a surplus and reduce their energy use when there might be a shortage due to the intermittency of wind and solar power.

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[43] https://www.nrel.gov/gis/assets/images/geothermal-identified-hydrothermal-and-egs.jpg

[44] Cook, M., Davidson, F.T., Fell, H., Glynn, J., Lott, M.C., & Rhodes, J. (2022). Electrification on the Path to Net Zero: A Comparison of Studies Examining Opportunities and Barriers in the United States. https://www.energypolicy.columbia.edu/wp-content/uploads/2022/10/Electrification-CGEP_Report_010423-3.pdf

[45] Cook, M., Davidson, F.T., Fell, H., Glynn, J., Lott, M.C., & Rhodes, J. (2022). Electrification on the Path to Net Zero: A Comparison of Studies Examining Opportunities and Barriers in the United States. https://www.energypolicy.columbia.edu/wp-content/uploads/2022/10/Electrification-CGEP_Report_010423-3.pdf

Hydrogen

El Paso Electric has indicated that it will include hydrogen resources in implementation of its carbon-free electricity goals for 2035 and 2045.[46] Natural gas combustion generators can be retrofitted to use hydrogen and projects are underway that will blend hydrogen into existing natural gas combustion power plants, starting at 30% today and increasing to 100% by 2045.[47] While the utility does not have specific plans in place yet, an initial press release indicates that Newman Power Station's newest unit could be converted to use 100% hydrogen by 2045.[48] El Paso Electric's decarbonization estimate in 2021 shows approximately 200 MW of hydrogen capacity additions. Of the scenarios modeled, this hydrogen scenario is the cheapest pathway to 100% decarbonization. El Paso Electric found that not using hydrogen significantly increases the cost of the last 10% of decarbonization, which is similar to what other 100% clean energy studies have found.[49]

Production and use of hydrogen can function as a form of energy storage, providing an important reliability service to an electric grid highly dependent on renewables like wind and solar.[50] When wind and solar production is high, there may be excess electricity generated beyond the energy needs for the community. This excess power can be used to produce hydrogen or stored in other energy storage mechanisms like batteries. When wind and solar production fall short of energy demands, hydrogen and other energy storage can be deployed to fill the gap in supply. This flexibility is important for maintaining energy supplies for the community.

Hydrogen can also be used as a fuel for vehicles. Medium- and heavy-duty vehicles such as freight trucks and buses can use hydrogen as a fuel, rather than relying on battery electric vehicles. Because hydrogen offers a higher energy density than battery storage, these vehicles can travel longer distances on hydrogen than they would with battery storage. Buses, freight, and vehicles with high-mileage travel that would be hindered by frequent stops to charge would benefit from using hydrogen as a clean fuel.

Hydrogen can also be used as a fuel or feedstock for industry. Industry uses hydrogen mainly as in ammonia production, oil refining, and methanol production.[51] Because industry is more difficult to electrify than residential and commercial buildings or transportation, using hydrogen instead of fossil fuels is often seen as a critical component of decarbonization pathways.

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[46] https://www.epelectric.com/company/news/mitsubishi-power-and-el-paso-electric-to-develop-roadmap-toward-carbon-free-energy-mix-by-2045

[47] https://www.ipautah.com/ipp-renewed/

[48] https://www.epelectric.com/company/news/mitsubishi-power-and-el-paso-electric-to-develop-roadmap-toward-carbon-free-energy-mix-by-2045

[49] Cook, M., Davidson, F.T., Fell, H., Glynn, J., Lott, M.C., & Rhodes, J. (2022). Electrification on the Path to Net Zero: A Comparison of Studies Examining Opportunities and Barriers in the United States. https://www.energypolicy.columbia.edu/wp-content/uploads/2022/10/Electrification-CGEP_Report_010423-3.pdf

[50] Cook, M., Davidson, F.T., Fell, H., Glynn, J., Lott, M.C., & Rhodes, J. (2022). Electrification on the Path to Net Zero: A Comparison of Studies Examining Opportunities and Barriers in the United States. https://www.energypolicy.columbia.edu/wp-content/uploads/2022/10/Electrification-CGEP_Report_010423-3.pdf

[51] https://www.iea.org/reports/the-future-of-hydrogen

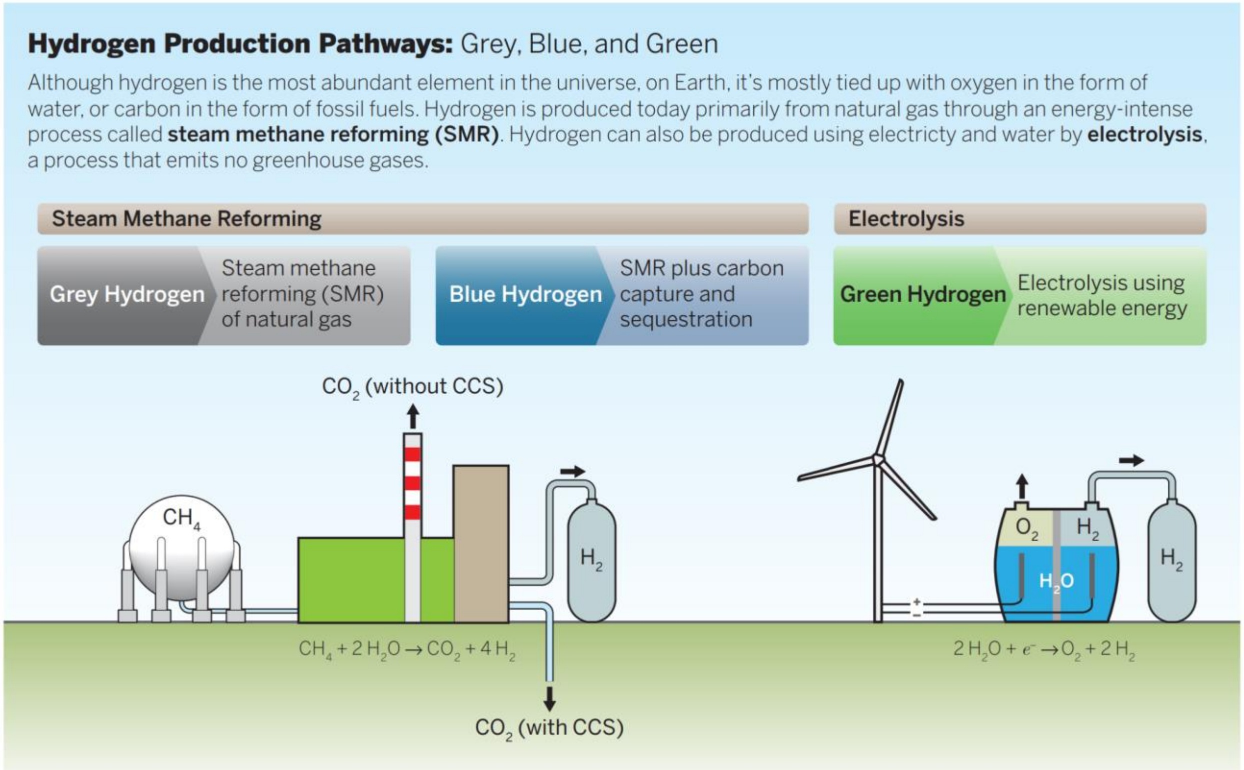

Figure 8 Hydrogen Production Pathways[52]

Today, nearly all hydrogen is produced from natural gas and carbon.[53] However, the clean renewable energy definition requires that hydrogen be produced by electrolysis or solar-driven processes, but not from natural gas or nuclear. These cleaner hydrogen production mechanisms are currently more expensive, but tax credits available from the Federal Inflation Reduction Act can exceed $3/kg[54] for green hydrogen production which reduces its final costs significantly. The mandate for these types of hydrogen will require advancing existing technology and utilizing available tax credits to ensure El Paso's energy supplies remain affordable.

Nuclear Power

Nuclear power is not generally considered a renewable energy since uranium is a finite resource. However, it is considered clean energy because there are no emissions associated with the generation of electricity. Nuclear power generation is not listed as an example of clean renewable energy in the above excerpt of the climate ordinance. However, the broad definition of clean renewable energy as not burning carbon or releasing greenhouse gases could leave room to continue to include nuclear generation as clean energy for El Paso.

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[52] Gee, I., Glazer, Y., Rhodes, J., Deetjen, T., Webber, M., Choukulkar, A., Cote, B., Clack, C., & Lewandowski, B. (2022). *Don't Mess with Texas: Getting the Lone Star State to Net-Zero by 2050*. University of Texas at Austin.
[53] IEA. (2019). The Future of Hydrogen. https://www.iea.org/reports/the-future-of-hydrogen
[54] If it also includes certain labor and equity bechmarks.

This distinction is important because of the large portion of El Paso's electricity supply provided by nuclear power. The generating units retire after the 2045 deadline, meaning, taking the definition as written, the nuclear plants would be able to contribute to goal progress for the full timeline, significantly reducing the additional clean energy resources needed for the community.

Other energy demands

In addition to electricity supplies, El Paso residents and visitors use fossil fuels for transportation, building energy uses such as heating and cooking, and in industry. To achieve decarbonization goals broader than the scope of the climate ordinance (i.e. extending the renewable goals to include non-municipal government property), El Paso would also need to address existing uses of natural gas and petroleum in buildings, transportation, and industry. The American Community Survey (ACS) records data on vehicle use per household and heating fuels as part of their census. Based on ACS estimates of vehicle use, there are over 400,000 personal vehicles in El Paso.[55] Nearly 3,000 of those vehicles are electric,[56] or less than 1%. Additionally, only 26.4% of El Paso residents use electricity for heating. An additional 0.3% use solar energy. The majority, about 71.6%, use gas and the remaining residents use propane and other heating fuels. These statistics indicate a substantial amount of effort will be needed to electrify these sectors. El Paso would need to assist residents in electrifying their residential or commercial property and vehicles or in using hydrogen for fuel. Without a comprehensive and concerted electrification program or early-stage policy to support the replacement of equipment and upgrades to buildings and services, the target values may not be achieved purely on the basis of lagging demand.[57]

Vehicle electrification

Vehicle fleets turnover with time. The average car lasts for about 12 years.[58] Thus, the vehicle fleet in the El Paso region will, on average, turn over almost twice before 2045. While choices for EVs are currently limited, it is expected that there will be around 50 makes and models of EVs available by the end of this decade.[59] Thus, introducing incentives to encourage individuals and companies to make the switch to EVs and making sure that adequate charging infrastructure is available would serve to hasten this transition as the existing fleet naturally ages out.

Building Electrification

Electrifying buildings will take effort as these changes require each building owner to update items powered by natural gas and petroleum to electricity. For example, El Paso would need residential and commercial building owners to switch to efficient heat pumps and induction or

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[55] https://data.census.gov/table?q=race&g=160XX00US4824000&d=ACS+5-Year+Estimates+Data+Profiles&tid=ACSDP5Y2021.DP04
[56] https://www.dfwcleancities.org/evsintexas
[57] Larson, E., C. Greig, J. Jenkins, E. Mayfield, et al. 2020. "Net-Zero America: Potential Pathways, Infrastructure, and Impacts." Princeton University.
[58] https://www.capitalone.com/cars/learn/finding-the-right-car/how-long-do-cars-last/1512
[59] https://cars.usnews.com/cars-trucks/advice/future-electric-cars

other electric cookstoves and away from natural gas units. Net zero analyses generally assume these changes would be made in new building construction and at the end of the lifecycle of fossil fueled appliances.

Implementing high-performance minimum building efficiency standards will be an important component to ensuring these changes are implemented. While there will be costs to upgrading these systems, there are pathways to minimize these impacts. For example, the average air-conditioner or heat pump lasts about 20 years.[60] Thus, simply implementing minimum HVAC efficiency standards for new builds and replacement systems today would naturally result in almost all systems meeting the city's goals by 2045 with minimal impacts to the homeowner. Note that it will be extremely important for these minimum HVAC efficiency standards to include cold weather-rated heat pumps to avoid the peak power demand issues of lesser efficient units switching to electric resistant heat during winter storms.[61]

Further, converting natural gas water heating to heat pump water heaters no longer requires an electrical system upgrade.[62] However, converting cooking ovens and ranges to electric might require some additional electrical system upgrades, but the city could offer rebates to counter those costs. Additionally, electrifying appliances reduces the air pollution and adverse health impacts associated with use of natural gas indoors, so there could also be ancillary benefits from reduced levels of asthma and other respiratory issues[63,64].

These changes will require significant public support and buy-in. Net zero analyses also acknowledge these challenges as well as the rapid pace of implementation needed for these technology upgrades could be major hurdles to full implementation.[65] El Paso would need to implement replacement pathways for these technologies soon, as well as building public support and lowering barriers to funding, possibly through additional local incentives. In the short-term, El Paso residents can take advantage of existing programs including weatherization programs for low-income households, utility energy efficiency programs, and the incentives made available for energy efficiency and heat pumps in the Inflation Reduction Act.

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60 https://www.bobvila.com/articles/how-long-do-hvac-systems-last/

61 https://www.ideasmiths.net/wp-content/uploads/2019/09/IdeaSmiths-Final-Report-2019.pdf

62 https://cleantechnica.com/2022/09/26/rheem-releases-120v-plug-in-heat-pump-water-heater-that-can-be-plugged-into-typical-outlet/

63 Seals, B., & Krasner, A. (2020). Gas Stoves: Health and Air Quality Impacts and Solutions. *RMI. Rocky Mountain Institute. https://rmi. org/insight/gas-stoves-pollution-health*.

64 Hasselblad, V., Eddy, D. M., & Kotchmar, D. J. (1992). Synthesis of environmental evidence: nitrogen dioxide epidemiology studies. *Journal of the Air & Waste Management Association*, *42*(5), 662-671.

65 Cook, M., Davidson, F.T., Fell, H., Glynn, J., Lott, M.C., & Rhodes, J. (2022). Electrification on the Path to Net Zero: A Comparison of Studies Examining Opportunities and Barriers in the United States.
https://www.energypolicy.columbia.edu/wp-content/uploads/2022/10/Electrification-CGEP_Report_010423-3.pdf

While the renewable energy goal will require a massive concerted effort in transitioning power supplies, electrification, and strategic job training and planning for growth in specific sectors, it is also important to note that an energy transition in El Paso could position itself to be a major hub for carbon-free energy, manufacturing, and support for these industries and to play a larger role in the global economy as more regions look for low-carbon or carbon-neutral goods.[66]

It is further expected that a holistic approach to such an energy transition would include multitudes of jobs in supporting fields such as increasing the energy efficiency of buildings and changing out current end-uses of fossil fuels, such as heating and cooking, with electrified substitutes.

[66] Gee, I., Glazer, Y., Rhodes, J., Deetjen, T., Webber, M., Choukulkar, A., Cote, B., Clack, C., & Lewandowski, B. (2022). *Don't Mess with Texas: Getting the Lone Star State to Net-Zero by 2050*. University of Texas at Austin.