**State of Minnesota**
**Before the Public Utilities Commission**

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| Katie Sieben | Chair |
| Valerie Means | Commissioner |
| Matthew Schuerger | Commissioner |
| Joseph Sullivan | Commissioner |
| John Tuma | Commissioner |

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| In the Matter of Northern States Power Company's, d/b/a Xcel Energy, 2020-2034 Upper Midwest Integrated Resource Plan | Docket No. E002/RP-19-368 |

**Comments of the Citizens Utility Board of Minnesota**

## A. Introduction

Xcel Energy (Xcel or the Company) has committed to an aggressive carbon reduction goal, pledging to reduce carbon emissions 80% by 2030 from 2005 levels, and achieve 100% carbon-free generation by 2050. In Minnesota, specifically, Xcel's Supplement Preferred Plan calls for a phaseout of Xcel's coal-fired power plants, a modest expansion of utility-scale solar and wind resources, an increase in efficiency and other demand-side measures, and, most significantly, the construction of a new 835 MW combined-cycle gas-fired power plant at its Sherburne County (Sherco) site. While Xcel's Preferred Plan, which meets an ambitious "80 by 30" carbon-reduction goal, is to be commended, the Citizens Utility Board of Minnesota (CUB) believes that there is opportunity for greater cost-savings and consumer benefits through accelerated fossil fuel retirements, rapid and immediate clean energy deployments, and a focus on consumer-centric demand-side resources.

CUB enlisted the support of Vibrant Clean Energy (VCE),[1] a leading expert in power systems modeling, to assess Xcel's Supplement Preferred Plan and produce an alternative plan that reliably serves Xcel's customers with clean, affordable generation. CUB's *Consumers Plan* models a rapid, five-year phaseout of Xcel's coal-fired power plants, accompanied by a dramatic near-term expansion of utility-scale wind, solar, and battery storage, plus a robust buildout of distributed resources and new electrified loads. Importantly, VCE's model finds that load can be reliably met in all hours of the simulated planning period without the need for new fossil fuel-fired power plants. The CUB *Consumers Plan* not only calls for a substantial utility-scale renewable buildout but also empowers Xcel consumers with greater demand-side resource options and increased demand-side flexibility, which reduces overall system costs and optimizes the distribution system to help reliably serve customer load. While CUB commends Xcel's Preferred

[1] Vibrant Clean Energy, https://www.vibrantcleanenergy.com/

Plan for its carbon reduction goals, the plan saddles ratepayers with a potential stranded asset in the form of a new natural gas power plant, which presumably will need to be quickly retired in order for Xcel to meet its future carbon reduction goals and reduce the burden of fuel price risk and pollution externalities on its consumers. At the same time, Xcel's plan fails to evaluate the economy-wide electrification measures that are necessary for the state to achieve its greenhouse gas reduction goals and the manner in which such electrification can benefit Xcel's system and its ratepayers. CUB's analysis suggests the Company can move aggressively towards a low-carbon future while empowering consumers with greater demand-side resource options at more affordable rates.[2]

### B. CUB *Consumers Plan* - Executive Summary

CUB retained Vibrant Clean Energy (VCE), an internationally recognized power systems consulting firm that specializes in energy systems modeling. VCE utilized its WIS:dom® - P modeling suite, a state-of-the-art capacity expansion and production cost model that has been used in jurisdictions across the country, including in nationally-recognized energy systems studies, utility Integrated Resource Plans, and at the Midwestern Independent System Operator (MISO). VCE modeled a core scenario, the *Consumers Plan*, to serve as an alternative to Xcel Energy's Upper Midwest Integrated Resource Plan, Supplement Preferred Plan (#9) (the Preferred Plan). Importantly, VCE's modeling takes into account the energy system's dynamics across the entire Eastern Interconnection, providing a detailed assessment of the Xcel territory while simultaneously evaluating its neighboring regions and the complex operations of the entirety of MISO. This strategy ensures that Xcel is meeting its specified energy goals to provide reliable, affordable power to Xcel customers while effectively evaluating how neighboring operations impact all Minnesota residents. VCE's analysis models the *Consumers Plan* through the year 2040, which helps the model consider long-term system impacts and investment costs beyond the existing IRP planning period.

The *Consumers Plan* models decarbonization for the entirety of Minnesota, ensuring the state is on a pathway to achieve its 80% by 2050 (from 2005 levels) greenhouse gas reduction goal.[3] The *Consumers Plan* similarly constrains the Xcel territory to achieve Xcel's 80% by 2030 (from 2005 levels) decarbonization goal. The *Consumers Plan* relies on a number of core assumptions based on Xcel's Supplement Preferred Plan and updates some of those assumptions in accordance with the most up-to-date cost and technology information publicly available. The *Consumers Plan* similarly relies on a number of additional assumptions, including enhanced demand-side resources and increased electrification, that ensures both Minnesota and the Company are on a path to achieve their aggressive decarbonization goals. Critically, once our analysis determined that new fossil-fuel fired power plants were not necessary to operate the system, our modeling prevented the addition of new coal or gas generation, in order to ensure that consumers will not

[2] These comments were prepared with support from Taylor McNair and Ric O'Connell of GridLab, a nonprofit organization that provides technical grid expertise to enhance policy decision-making and to ensure a rapid transition to a reliable, cost-effective, and low-carbon future.

[3] Minnesota Statutes § 216H.02, subd. 1

be saddled with likely future stranded assets. The full report is attached to these comments in Appendix A.

The *Consumers Plan* details a path forward for Xcel that stands in contrast to Xcel's Preferred Plan. Our modeling demonstrates that Xcel can achieve more aggressive carbon reduction and clean energy goals while substantially reducing total system costs and retail rates over the next 20 years. The *Consumers Plan* results in an 86% reduction in carbon emissions by 2030 (from 2005 levels), cumulative cost savings for Xcel consumers of $6.45 billion by 2040, and a 36% reduction in retail rates. The *Consumers Plan* rapidly retires the uneconomic coal fleet in the next five years, replacing retired fossil-fuel generating capacity with approximately 4,700 MW of new wind, 3,900 MW of new utility-scale solar PV, 1,900 MW of distributed solar PV, and 1,300 MW of 8-hour battery storage over the next 15 years. By 2035, 89% of electricity generation in Xcel's service territory is carbon free in the *Consumers Plan*.

The *Consumers Plan* positions Xcel to be a leader in demand-side electrification while driving economy-wide decarbonization, ensuring the state of Minnesota can achieve its aggressive greenhouse gas emissions goals while reducing costs for consumers. This enables the utility to squarely center its consumers in the 15-year resource plan, ensuring that the utility reduces the health and economic burdens of local fossil fuel power plants and provides greater demand-side opportunities, all while lowering costs. More than anything, the *Consumers Plan* showcases a more thoughtful and creative approach to power systems planning, utilizing the full suite of tools available to the utility, from cheap, reliable renewable energy to increased distribution system optimization and smarter utilization of the transmission network.

The *Consumers Plan* ensures reliability and resource adequacy in accordance with both Xcel's and the North American Electric Reliability Council's (NERC) reliability standards. Even while operating with over 75% variable renewable energy, power needs are met at every five-minute interval of the planning period. A critical component of ensuring this level of reliability is better utilization of both the distribution system and the transmission network. The *Consumers Plan* unlocks increased efficiency through the co-optimization of the distribution system with the bulk power system. This co-optimization, which allows distributed energy resources (DER) to reshape demand and utility-scale generation to serve that demand more effectively, results in a total of 2.6 GW of distributed PV and 1.4 GW of distributed storage by 2035. Finally, effective transmission expansion ensures that the utility is able to access high-quality renewable resources across the MISO region, including significant in-state transmission expansion, providing increased reliability and greater system throughput, keeping costs low.

Our analysis proves that Xcel can move far more aggressively on its clean energy goals but must take advantage of the increased system efficiencies gained through demand-side electrification and distribution-system co-optimization. The accelerated retirement of the coal fleet, coupled with the immediate expansion of wind, solar, and battery storage, ensures that total system costs remain low and that retail rates actually decrease for consumers. At the same time, aggressive electrification measures, which Xcel can pursue through transportation and building electrification

initiatives, help provide valuable demand flexibility while setting Minnesota on a path to achieve its economy-wide greenhouse gas reduction goals.

### C. The *Consumers Plan* resource mix calls for rapid retirement of the coal fleet and immediate buildout of wind, utility-scale and distributed solar, and storage, in contrast to the Preferred Plan

The *Consumers Plan* was produced by VCE's customized grid planning modeling software, WIS:dom ® - P, a state-of-the-art capacity expansion and production cost model that simultaneously co-optimizes utility-scale generation, storage, transmission, and DER. The *Consumers Plan* details a resource planning path from 2020 through 2040 with results produced in five-year timesteps. The clearest outcome of our model details that Xcel's existing coal fleet is severely uneconomic relative to other generating assets. WIS:dom retires the entirety of Xcel's coal fleet by 2025. Because WIS:dom does not resolve interim years, it is not possible to pinpoint exact retirement dates, but the analysis demonstrates that the coal fleet is not cost competitive. As coal is retired, the model replaces the retiring capacity largely with utility-scale wind generation, plus additional utility-scale and distributed solar. At the same time, an additional 550 MW of gas-fired combustion turbines are retired. Specifically, to help replace retiring coal and gas capacity in 2025, WIS:dom installs 3,000 MW of wind, as well as 333 MW of distributed PV and 1,400 MW of utility-scale PV, including the 460 MW of utility-scale PV included in Xcel's plan at the Sherco site. Over the 15-year period, as our analysis retires existing fossil-fuel generation and replaces it with clean resources, the model installs a total of 5,038 MW of wind, 2,287 MW of utility-scale PV, 2,589 MW of distributed PV, and 1,368 MW of battery storage. These new resources replace 2,683 MW of retired coal and 745 MW retired gas combustion turbines. The high-penetration of renewables is commensurate with the ambitious carbon goals set by the state of Minnesota, and is far more aggressive than the 75% carbon-free generation achieved in Xcel's Preferred Plan. This path of carbon-free generation is also consistent with a number of rigorous, national-scale modeling efforts that suggest the U.S. can achieve high-renewable penetrations in the next 15 years. For example, the *2035 Report,* produced by GridLab and the University of California Berkeley, details how the U.S. can achieve 90% clean electricity nationwide by 2035, at no extra cost to consumers and without new fossil fuel plants.[4] The *Consumers Plan* details a similar finding for Xcel Energy.

[4] *2035 Report: Plummeting Solar, Wind, and Battery Storage Costs Can Accelerate Our Clean Energy Future* (https://www.2035report.com/), 2020, UC Berkeley and GridLab.

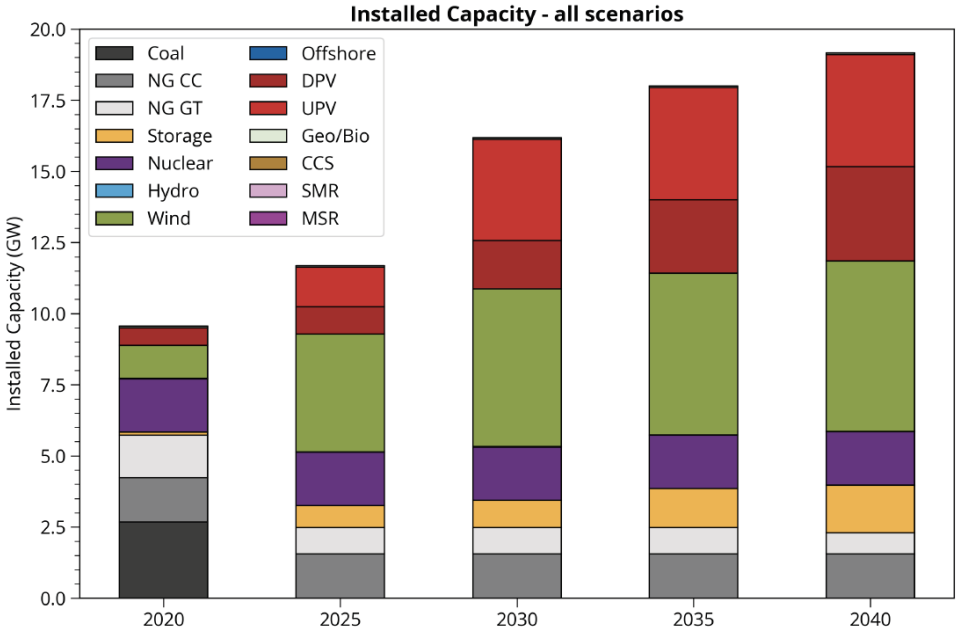


Figure 3.6: WIS:dom-P installed capacities for the scenarios modeled in the NSPM territory.

The evolution of electricity generation in the *Consumers Plan* closely mirrors the changes in capacity expansion and replacements. By 2035, 89% of all electricity is generated from carbon-free sources. As detailed in Section E of these comments, increased electrification of transportation and buildings has the effect of adding an additional winter peak (additional to Xcel's existing summer peak), largely due to the increase in heating demand during the colder temperatures. In the *Consumers Plan,* Xcel utilizes its existing coal generation in the winter to help meet load, while largely mothballing those units when cheaper imports are more readily available in the summer months. Specifically, coal switches exclusively to seasonal operation and generates electricity strictly in the winter months, largely due to high heat rates and associated lower effective fuel costs. Retiring the entire coal fleet next year is both technically and logistically infeasible. However, Xcel has the opportunity to ramp down coal generation in advance of retiring the entire coal fleet by 2025. As coal transitions to winter operations, and renewable resources continue to get built in the first five years of the study period, existing combustion turbines step in to meet daily peaks, increasing gas generation. Over the course of the next 15 years, as coal and gas generation phase out, existing nuclear power accompanied by increased renewable generation and storage make up the difference. By 2030, Xcel is a net energy exporter, increasing off-system sales revenue while providing reliable power to Minnesotans and neighboring MISO states. The *Consumers Plan* also relies on the existing nuclear fleet to provide significant, year-round clean energy generation. All existing nuclear generation is retained until 2040, and each plant is relicensed at costs based on the Nuclear Energy Institute's estimates.[5]

[5] *Nuclear Costs in Context,* (https://www.nei.org/CorporateSite/media/filefolder/resources/reports-and-briefs/nuclear-costs-context-201810.pdf), *2018,* Nuclear Energy Institute.

The daily electricity dispatch curve looks far different in 2040 than it does today. In our modeled analysis, in 2020, Xcel relies on its thermal generation fleet to meet winter loads, turning to low-cost imports during the summer. In 2020, the *Consumers Plan* relies on net imports of approximately 13% to meet load, which gradually decreases over the next 10 years as the utility transitions to a net exporter. This is less than the technical import limit of approximately 2,300 MW from the broader MISO region that Xcel makes available in its IRP modeling. The *Consumers Plan* limits off-system sales to 25% of retail load based on the *Preferred Plan* assumption. To meet daily peaks, the system relies almost exclusively on natural gas combustion turbines. By 2040, fossil fuel generation is only deployed to meet system peaks a few times during the year. Carbon-free nuclear generation serves as a near-constant generation source, while wind generation contributes the largest overall share of generation (41% in 2040). Solar PV plays a significant role in meeting demand during the summer, while battery storage is consistently deployed to meet daily peaks (instead of the gas combustion turbines relied on in 2020). Even at the most challenging demand periods throughout the analysis, the *Consumers Plan*, which relies on 78% variable renewable energy and 86% carbon-free energy, is able to reliably serve load at all hours of the year. At the period of highest-system strain,[6] which occurs during the week of January 1st, 2040, wind generation drops dramatically while gas combustion turbines, battery storage, and imports increase to reliably meet load.

The generation and production profiles of wind, solar, and battery storage change dramatically as we transition from today's Xcel system. By 2040, wind and solar serve as strong compliments to each other in both the winter and summer seasons. Wind generation is at its strongest during winter evenings, while solar helps to meet load during the day. Storage primarily serves to support the "transition periods," during which solar generation ramps down as the sun goes down and before wind generation picks up. In the winter, Xcel is a consistent net exporter of energy. In both summer and winter, storage charges largely during the day, soaking up excess solar generation, and then discharges in the early morning and nighttime when demand is rising.

[6] Highest-system strain is the period in which thermal generators are operating at their highest utilization, variable renewable generation is at its lowest utilization, and demand is at its highest.

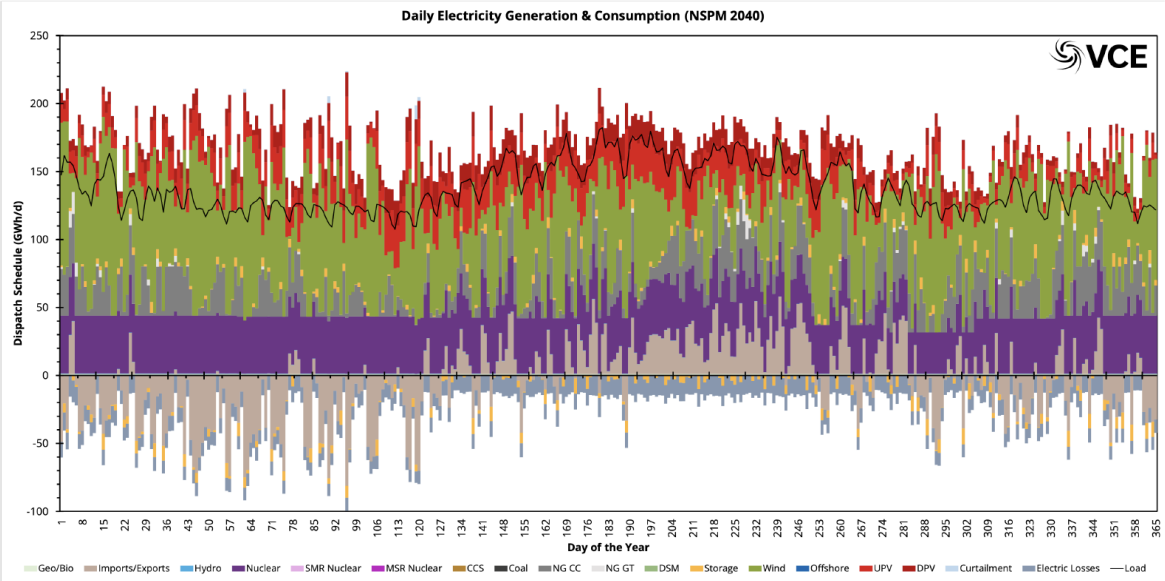


Figure 3.13: The daily generation of over the NSPM region in 2040.

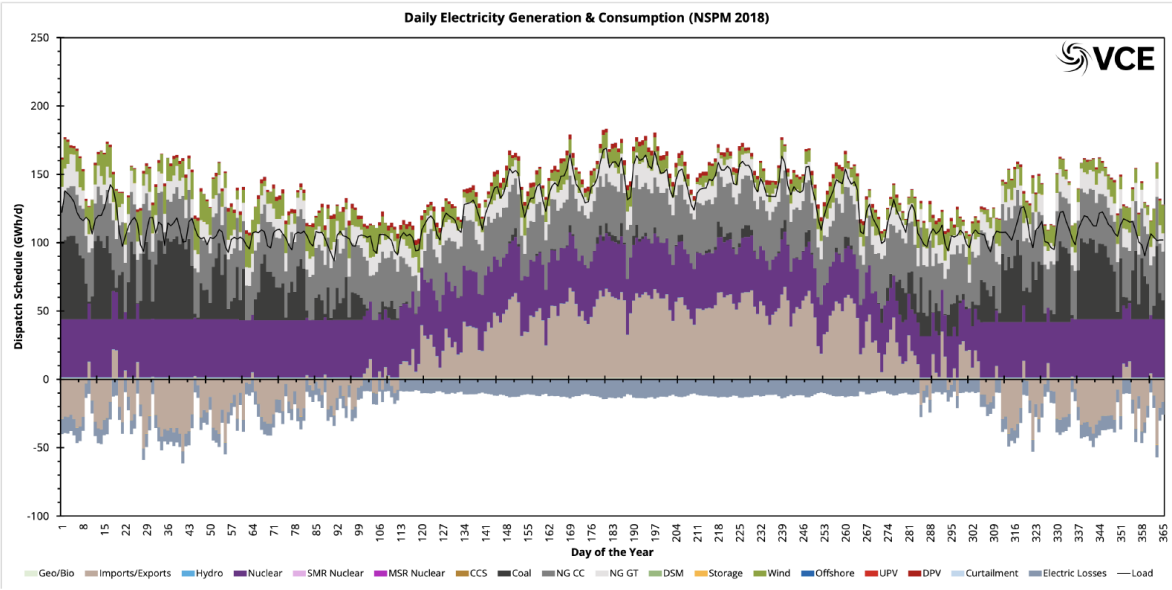


Figure 3.12: The daily generation over the NSPM territory in 2020.

The rapid retirement of the coal fleet and subsequent replacement with clean energy resources has dramatic implications for in-state emissions. In the *Consumers Plan,* Xcel's carbon emissions fall 86% relative to 2005 levels by 2030, compared to just 81% in the Preferred Plan. As fossil fuel generation winds down, the *Consumers Plan* cumulatively avoids 140 mmT of $CO_2$ from Xcel operations by 2040 relative to continuation of business-as-usual. In addition to replacing carbon-emitting generation, the *Consumers Plan* simultaneously relies on the electrification of end-uses that currently produce carbon emissions, particularly natural gas appliances and gasoline- and

diesel-powered vehicles. As the grid rapidly decarbonizes, the transportation and building sectors electrify in parallel, helping to drawdown carbon emissions economy-wide, resulting in far greater emissions benefits compared to the Preferred Plan. Electrification of the building and transportation sectors also helps drive down economy-wide carbon emissions, reducing economy-wide emissions in Xcel's territory 45% by 2035 from 2020 levels on the way to an 80% reduction by 2050. The *Consumers Plan* also results in significant human health gains as the system retires polluting fossil fuel resources. The rapid retirement of the coal fleet drops $SO_2$, $PM_{10}$, and $PM_{2.5}$ emissions to near-zero by 2025, bringing immediate and dramatic public health gains to Minnesotans.

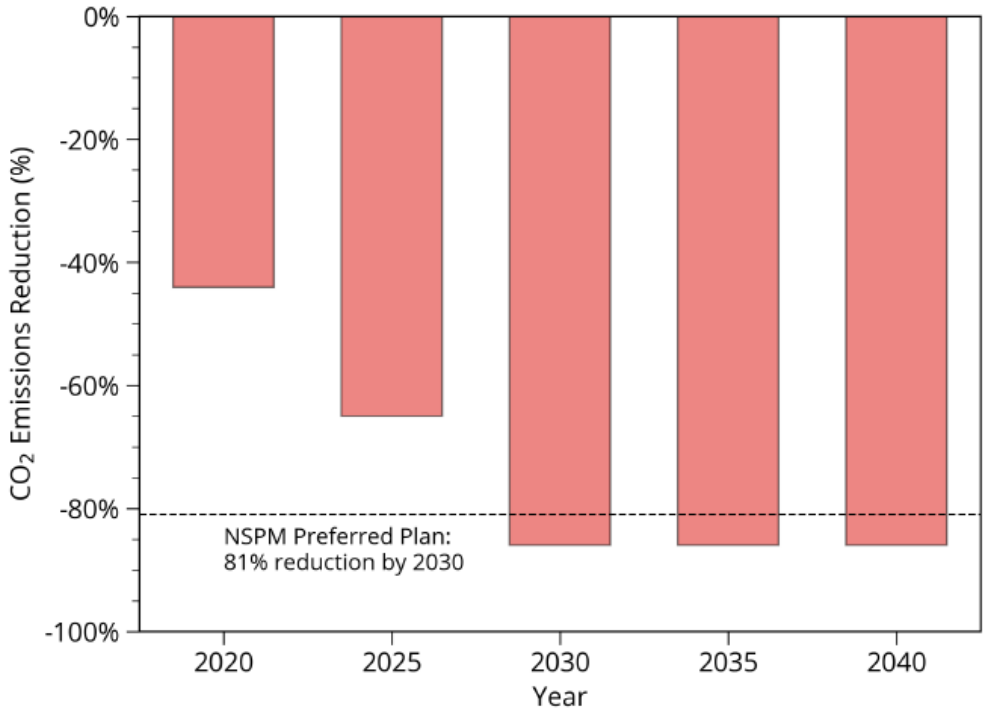


Figure 3.20: Percentage change in annual emissions in NSPM territory compared to 2005 levels.

The *Consumers Plan* resource mix and overall decarbonization strategy diverges significantly from the pathway laid out in the Preferred Plan. The Preferred Plan retains coal generation until 2029, while adding only modest amounts of new wind and solar in the late 2020s. In the early years, Xcel adds additional demand response and energy efficiency, plus small amounts of distributed PV. In 2025, the Preferred Plan ramps up renewable energy capacity with the addition of 1 GW of new solar resources. Xcel then adds the 835 MW Sherco gas-fired combustion turbine, followed by significant utility-scale wind and solar resource additions. By delaying its coal retirement and delaying much of its renewable acquisition, Xcel adds significant costs (both in terms of retail rates and associated emissions burdens) to consumers that can be avoided.

Instead of taking advantage today of cheap, reliable clean energy resources, Xcel delays acquiring significant renewable capacity, despite the fact that those resources are already competitive against existing coal operating costs. This approach stands in stark contrast to CUB's proposal in the *Consumers Plan,* which dramatically ramps down coal generation almost immediately, helping to reduce emissions and consumer costs, followed by early retirement. By investing early in the aggressive adoption of clean energy resources, including 3,000 MW of wind, 333 MW of distributed PV, and 1,400 MW of utility-scale PV in the next five years, the *Consumers Plan* provides immediate consumer cost savings.

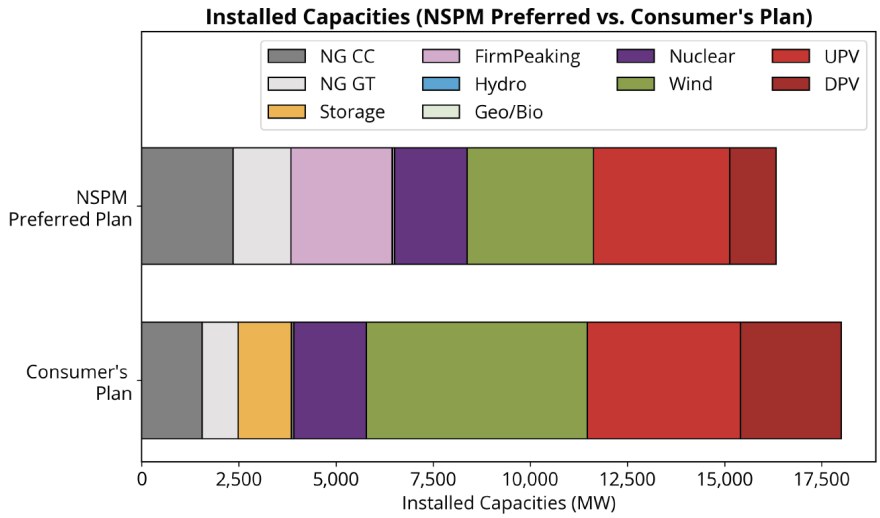


Figure 3.7: Comparison of installed capacities from the NSPM Preferred Plan (year 2034) to Consumers Plan (year 2035).

Perhaps most notably, the *Consumers Plan* clearly demonstrates that new fossil fuel generating assets are not necessary and are not in the best interest of Xcel consumers. Sensitivity analysis and robust production cost modeling suggests that Xcel can achieve its carbon reduction goals - and can go further in reducing emissions over the next ten years - without the new 835 MW Sherco combined cycle generator, while keeping rates low and reliably meeting energy demand. Though the legislature granted Xcel "sole discretion" to build and own the Sherco plant,[7] our modeling suggests that it is not in the best interest of Minnesota ratepayers.

Despite the Sherco law, the Commission is not without tools to work with Xcel to approve a resource plan, such as the *Consumers Plan*, that does not include or rely on the Sherco plant, or that relies on a combined cycle generator that is significantly smaller than Xcel's proposed 835 MW facility. The legislature specifically did not exempt the Sherco plant from the typical criteria the Commission applies to determine whether a utility may recover the cost of its investments, including the "used and useful" standard.[8] Crucially, while the law requires the Commission to

[7] Laws of Minnesota 2017, chapter 5 – H.F. No. 113, section 1
[8] *Id*. at (b), citing Minn. Stat. Section 216B.16

give due consideration to a utility's costs of providing utility service, "including adequate provision for depreciation of its utility property used and useful in rendering service to the public, and to earn a fair and reasonable return upon the investment in such property," nothing requires the Commission to allow Xcel to recover its depreciation expenses or a reasonable return on the value of a plant that is not used and useful.[9] Thanks to Xcel's and Minnesota's aggressive carbon reduction targets, as well as recently introduced legislation that would require Minnesota electric utilities to provide 100 percent clean energy by 2040,[10] there is a very real risk that the Sherco combined cycle generator will either need to be retired long before it is fully depreciated or will operate at a very low capacity factor in the future. In addition, economics alone may lead to the same result. A recent report from RMI suggests that "by 2035, over 90 percent of proposed combined-cycle gas plants, if built, would be uneconomic to run compared to the cost of building a new clean energy portfolio."[11] If any of these likely scenarios comes to pass, the Sherco combined cycle generator would no longer be "used and useful," and ratepayers should not be required to continue paying for it - especially given the evidence, apparent today, that the plant is not necessary to serve load and would needlessly increase carbon emissions.

CUB recommends that the Commission put Xcel on notice that, if it chooses to move forward with the Sherco combined cycle generator, the Commission will not permit Xcel to recover any undepreciated costs of the plant if and when the plant is no longer used and useful, and will not permit Xcel to recover any costs attributable to oversizing the plant if it is run at a low capacity factor. The Commission should also clarify that, if Xcel ever needs to retrofit the Sherco plant to use carbon free fuels such as hydrogen, Xcel will not be permitted to recover any costs that could have been avoided had Xcel invested in carbon-neutral resources from the outset, and the plant will be required to meet the ordinary certificate of need and permitting requirements.[12] Based on such a directive, Xcel can then decide whether it would like to exercise its "sole discretion" and build the plant at significant risk to its future profits. Further, the Commission can also work with Xcel and stakeholders to evaluate opportunities for utility ownership of renewable and storage resources that would provide Xcel with comparable or superior profit opportunities as its proposal to build and own the 835 MW Sherco combined cycle facility.

Undoubtedly, the *Consumers Plan* details an aggressive energy transition pathway for Xcel. However, the *Consumers Plan* saves consumers billions of dollars in avoided electricity system costs while encouraging Xcel to pursue a far more ambitious steel-for-fuel strategy,[13] in which the utility rapidly retires uneconomic coal and replaces it with renewable resources. Over the course of the next five years, our modeling suggests that Xcel can ramp down coal generation through more targeted seasonal dispatch, an exercise the utility is already exploring. At the same time,

[9] Minn. Stat. § 216B.16, subd. 6.

[10] HF 278.

[11] *A Bridge Backward? The Risky Economics of New Natural Gas Infrastructure in the United States* (https://rmi.org/a-bridge-backward-the-risky-economics-of-new-natural-gas-infrastructure-in-the-united-states/), 2019, RMI.

[12] The Sherco law (Laws of Minnesota 2017, chapter 5 – H.F. No. 113, section 1) only exempts a natural gas combined cycle plant from the certificate of need and permitting requirements found at Minn. Stat. Sections 216B.243 and 216E, respectively.

[13] Steel For Fuel: Opportunities for Investors and Customers (https://energyinnovation.org/wp-content/uploads/2018/11/Steel-for-Fuel-Brief_12.3.18.pdf), 2018, Energy Innovation.

the utility would purchase or contract for approximately 600 MW of new wind and 280 MW of new utility-scale solar each year for the next five years. The level of renewable deployment, totaling around 4,400 MW of new wind and 3,500 MW of new utility-scale PV over the next ten years, is commensurate with the annual capacity additions that the Xcel Preferred Plan intends to build in just the 2025-2030 time period to achieve its total of approximately 4,300 MW of new resources. Accelerating Xcel's clean energy deployment in the next five years can ensure the utility achieves its ambitious carbon reduction goals without the risks inherent in investing in new fossil fired power plants.

Critically, this strategy removes an additional ratepayer risk that is evident in the Preferred Plan. After 2030, following the deployment of significant wind and solar resources, as well as the proposed gas combined cycle plant, Xcel intends to build significant "firm peaking" capacity, which it has modeled as zero-emissions gas plants, despite the fact that such plants are not proven technically or economically viable yet. This "firm peaking" capacity is an unidentified, zero-carbon technology that will presumably reach cost-competitiveness in the next 10 years. While it is a convenient strategy to delay zero-carbon resource procurement into the near-future, it is a risky proposition for ratepayers, who will presumably be saddled with the cost of expensive, unproven technologies, such as green hydrogen or long-duration battery storage, according to the IRP. Xcel also offers no contingency plan if these unidentified, zero-emission, "firm peaking" technologies are not actually developed or are not cost-competitive at the time Xcel plans to acquire them in the 2030s. Instead, the *Consumers Plan* relies on an aggressive, near-term clean energy resource procurement, in which Xcel rapidly retires its existing coal fleet and immediately replaces it with zero-carbon technologies that are both proven and affordable *today.* In doing so, the *Consumers Plan* eliminates the risk of delaying decarbonization for 10 years until new alternatives are available. Simply put, an aggressive clean energy procurement in the next ten years can put Xcel on a path towards rapid, affordable, and reliable power sector decarbonization.

### D. The *Consumers Plan* is affordable compared to Xcel's Preferred Plan

The *Consumers Plan* centers ratepayer impacts above all, ensuring that rapid decarbonization in the Xcel territory has a positive effect on rates and overall total system costs. Over the 20-year analysis period, the *Consumers Plan* results in approximately $6.5 billion in electricity savings. Total system costs, which includes the cost of generating and delivering electricity to Xcel customers, steadily fall from today through 2025, as Xcel's most uneconomic generating assets -- the coal fleet -- are retired. In the subsequent years, total system costs rise modestly as the utility adds new zero-carbon, zero-marginal cost wind and solar resources. Importantly, this rise in total system costs does not result in increased retail rates. A key facet of the *Consumers Plan* is robust economy-wide electrification coupled with additional demand-side measures, such as energy efficiency and flexible demand-side investments. This increased electricity demand allows Xcel to spread new generation investments across additional megawatt-hour sales. While total system costs rise between 2025 and 2030, average retail rates continuously decline, indicating that beneficial electrification reduces overall costs for consumers. As Xcel transitions to a net energy exporter in the 2030 timeframe, increasing exports allows Xcel to pass through additional

revenue to consumers, helping to keep rates low. In 2035, retail rates average 7.6 ¢/kWh, a 36% decline relative to 2020.[14]

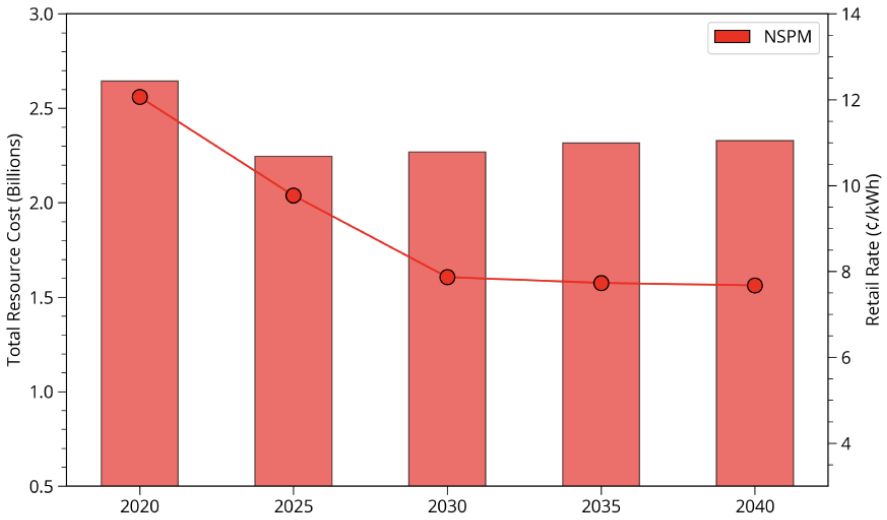


Figure 3.2: Total system cost (bars, left) and retail rates (solid line, right) for the NSPM footprint in Minnesota.

Retail rates provide a clear picture of the *Consumer Plan*'s benefits, but do not tell the full story. In order to directly compare the impacts of the *Consumers Plan* to Xcel's Preferred Plan, VCE calculated the Present Value Revenue Requirement (PVRR) utilizing similar input assumptions. In the early years of the study period, the PVRR of the Preferred Plan immediately exceeds the PVRR of the *Consumers Plan*, as the *Consumers Plan* quickly ramps down coal generation and does not build new fossil generating assets. As the *Consumers Plan* continues to rely more and more on renewable resources with zero-marginal cost, the PVRR delta between the *Consumers Plan* and Xcel's Preferred Plan increases. By 2035, the *Consumers Plan* is 2.15 ¢/kWh cheaper than the Preferred Plan. This results in $1 billion in annual savings by 2035.

The importance of demand-side electrification measures in keeping costs low for consumers should not be understated. While a large share of the cost savings in the *Consumers Plan* are a result of retiring the coal fleet, the distribution system similarly provides substantial cost savings. Even as new load is added to the system due to newly electrified appliances and vehicles, distribution system costs steadily decrease as a result of deferred distribution system upgrades and increased throughput. Once the majority of the marginal cost assets are retired, the *Consumers Plan* relies increasingly on zero-marginal cost renewable resources, which means the cost of delivered electricity remains constant, as the system does not have to pay for significant ongoing expenses.

[14] All costs referenced in this section are in 2018 dollars.

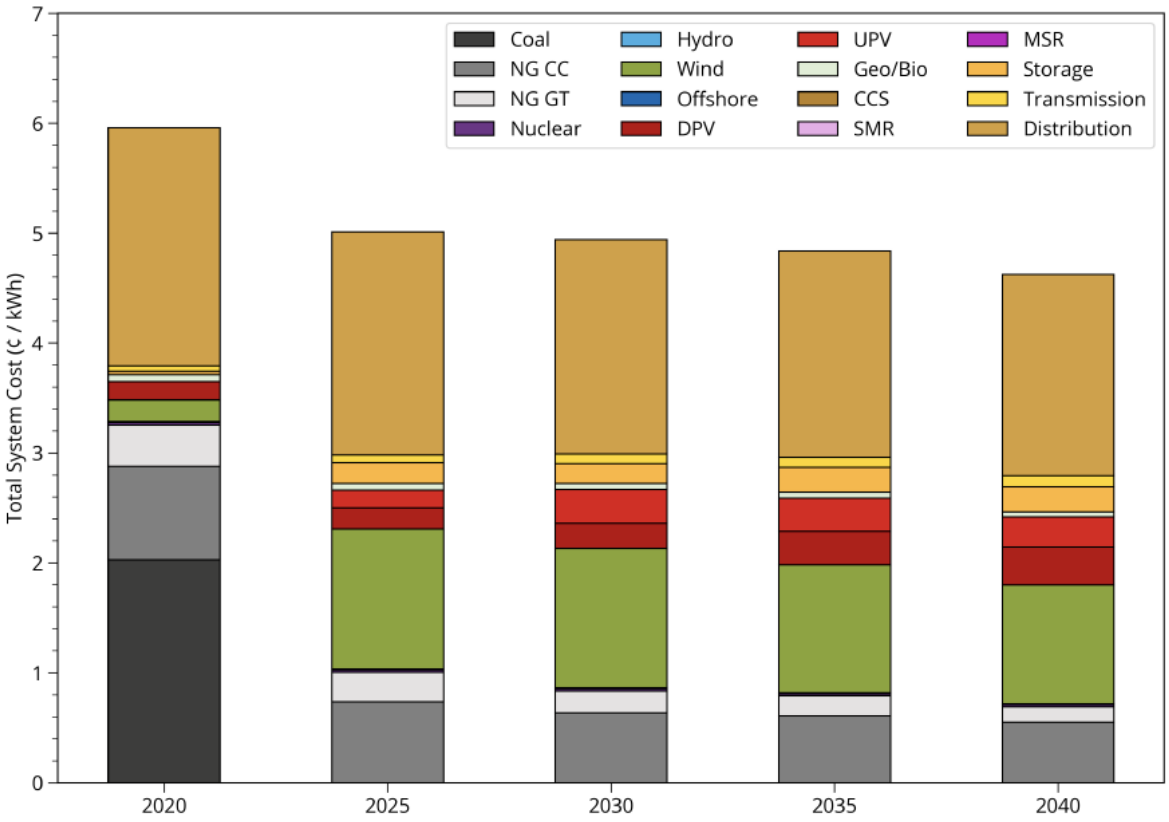


Figure 3.3: System cost per kWh load for each technology.

### E. Demand-side resources play a key role in contrast to Xcel's Preferred Plan

Perhaps the clearest divergence of the *Consumers Plan* from Xcel's Preferred Plan is an increased commitment to consumer-side distributed energy resources (DER). Many energy systems experts increasingly view DER as a critical resource that will complement and ease the transition to a fully decarbonized electricity sector.[15] The *Consumers Plan* utilizes more aggressive electrification assumptions than Xcel's Preferred Plan, ensuring both the utility and the state as a whole are on a path to achieve Minnesota's economy-wide greenhouse gas reduction goals. The assumptions utilized in the *Consumers Plan* are borrowed from the *Minnesota Smarter Grid* study.[16] The *Minnesota Smarter Grid* study, released in 2018 by Vibrant Clean Energy and GridLab, details pathways for the state to achieve economy-wide greenhouse gas reductions of 80% from 2005 levels by 2050.

[15] The Role of Distributed Energy Resources in Today's Grid Transition (http://gridlab.org/wp-content/uploads/2019/04/GridLab_RoleOfDER_online-1.pdf), 2018, GridLab.

[16] Minnesota's Smarter Grid (https://www.mcknight.org/programs/midwest-climate-energy/mn-smarter-grid/https:/www.mcknight.org/programs/midwest-climate-energy/mn-smarter-grid/), 2018, Vibrant Clean Energy and GridLab.

Between 2020 and 2040, conventional load remains somewhat static as a result of increasing levels of energy efficiency. Increased energy efficiency offsets the increased demand from new electrified loads such as efficient heat pumps replacing electric resistive heating, gas space and water heaters, and vehicles swapping out internal combustion engines for batteries. Increasing electrification across the economy also has the effect of adding a new winter peak in addition to Xcel's existing summer load peak. The demand profiles are borrowed directly from *Minnesota Smarter Grid,* and thus already incorporate significant energy efficiency measures in the form of converted resistive heating and other space and water heating efficiency gains. These cumulative energy reductions amount to approximately 622 GWh of avoided electricity each year, lower than Xcel's assumed 780 GWh of energy efficiency measures. Because the *Consumers Plan* did not model the specific energy efficiency programs offered by the utility, it is likely that further efficiency gains could be achieved.

The *Consumers Plan* additionally relies on increasing amounts of demand flexibility, which allows the opportunity for electrified demand-side measures to shape and shift load. The demand flexibility modeled in the *Consumers Plan* is different from the demand response assumed in Xcel's Preferred Plan, given that WIS:dom models the temporal availability and allows newly electrified loads to shift or respond to changes in weather or grid operations. By 2040, the *Consumers Plan* calls on a peak capacity of approximately 650-1,000 MW of demand flexibility depending on the season. WIS:dom relies on different assumptions than Xcel does in regards to demand response flexibility, which helps to highlight the divergence of the *Consumers Plan* from the 1,500 MW of demand response by 2034 modeled in Xcel's Preferred Plan. First, WIS:dom utilizes demand flexibility assumptions derived from the *MN Smarter Grid Study,* which was produced in 2018. It is possible that increased system flexibility has been made available since these figures were first produced. One key difference in these assumptions is a lower reliance on assumed industrial demand response in the *Consumers Plan*, suggesting that the *Consumers Plan* could potentially rely on additional demand flexibility from the industrial sector, a core component of Xcel's energy efficiency assumptions. Second, the demand flexibility in WIS:dom is constrained by both weather and demand capacity. In 2040, there are 2,134 MW of available non-peak coincident demand flexibility capacity; however, not all of that capacity is able to be dispatched at once due to physical limitations modeled by WIS:dom. WIS:dom models more granularity, detailing the available MW of demand flexibility at every timestep of the analysis (every hour of the year). The combination of coincident peak and weather constraints thus limits how much flexibility is available. In essence, while WIS:dom models more megawatts of flexible capacity available each year, the model more accurately represents how and when that flexibility can be dispatched (based on physical weather constraints and coincident-peaks), which may result in fewer overall megawatt-hours of demand response dispatched. We believe this more targeted approach more appropriately models the physical realities of the electricity system.

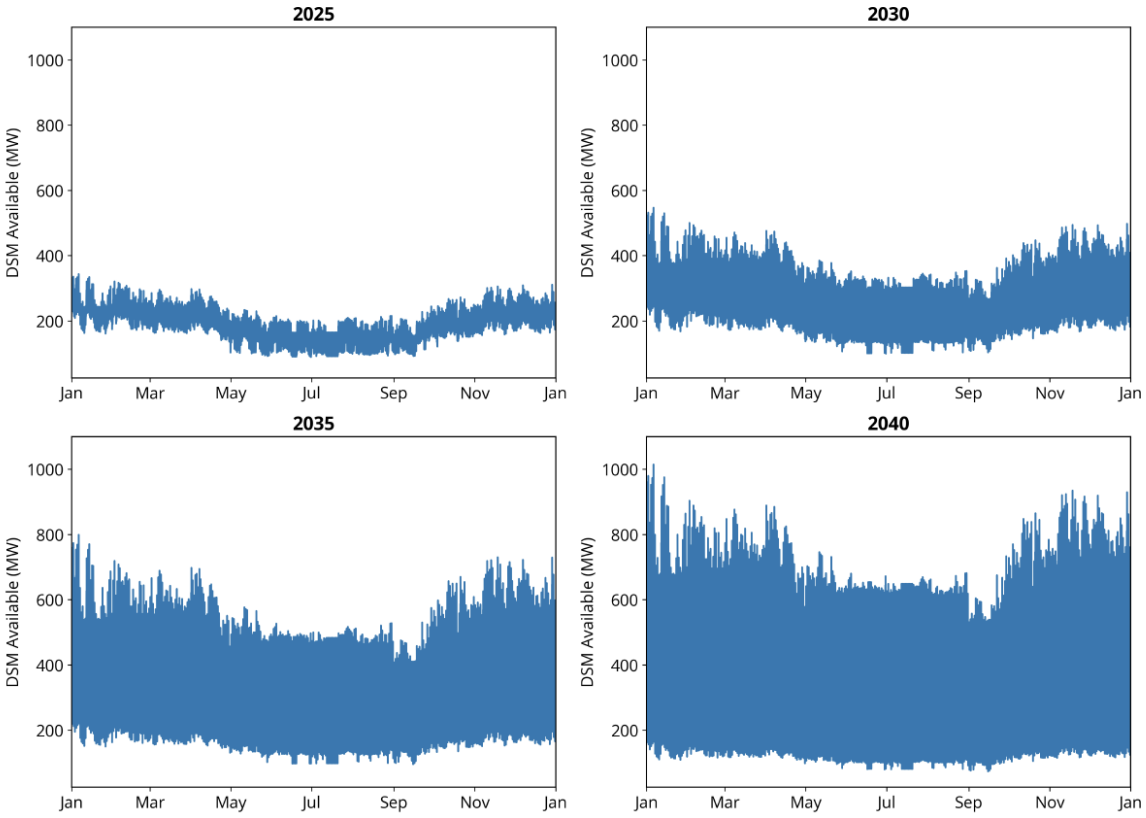


Figure 2.6: Available demand flexibility during each time period of the year over the investment periods.

Electrification of transportation serves as the largest load modifier, adding approximately 1.8 TWh of new load by 2040. The WIS:dom model is able to take advantage of this newly electrified transportation load, allowing it to shift and shape load in response to changing conditions on the electricity grid such as increased wind and solar generation. Broadly speaking, electrification eases the integration of more wind and solar on the system and reduces total system costs, as the variable resources are able to take advantage of newly electrified flexible loads. By 2035, the *Consumers Plan* serves 49.4 TWh of total load, compared to 45 TWh in Xcel's Preferred Plan, an increase of 9%. Electrification of the building and transportation sectors also helps drive down economy-wide carbon emissions, reducing economy-wide emissions in Xcel territory 45% by 2035 from 2020 levels on the way to an 80% reduction by 2050.

The *Consumers Plan* utilizes WIS:dom's unique ability to co-optimize distribution-level system operations with grid-scale generation and transmission. WIS:dom disaggregates DER on the distribution system, and then presents those technologies at the "grid edge," where electricity passes across to the bulk power system (on transmission lines larger than 69 kV). This results in two distinct model features: DER coordinates to shape and shift demand, while utility-scale generation and transmission coordinate to meet load that appears at the "grid-edge." The concept and modeling parameters are further described in Section 2.2 of the attached report. Further, WIS:dom's distribution co-optimization minimizes peak load and overall energy flow while

minimizing back-flow of energy from the distribution system to the utility-interface. Inherent in this optimization is a calculation of hosting capacity, which WIS:dom calculates based on the nodal load, distributed DPV penetration, and load flexibility available. The model can increase and pay for increased hosting capacity through system upgrades or the installation of distributed storage. Using this information, as well as detailed weather, rooftop, and available land analysis, the model sites optimal combinations of distributed PV and storage to minimize system costs, meet load reliably, and prevent back-flow.

The robust distribution modeling has the effect of greatly elevating the overall impact and importance of distributed energy resources to meet the demands of Xcel consumers. As noted earlier, the distribution co-optimization coupled with increased electrification reduces energy costs for Xcel consumers. As a result of this co-optimization and the various economic and technical benefits it provides, the *Consumers Plan* installs increasing levels of DER relative to Xcel's IRP Preferred Plan.[17] In 2025, the *Consumers Plan* adds 333 MW of distributed PV, plus an additional 740 MW by 2030. By 2035, the *Consumers Plan* adds 2,589 MW of distributed PV, as well as 1,368 MW of battery storage, all of which is located on the distribution system (i.e., 69-kV lines and smaller). This distribution-level storage dispatches exclusively from behind the distribution system, which is a critical resource to help meet periods of high-demand, and reduces the peak load that the bulk power system must meet. Once WIS:dom identifies all the high-quality utility-scale solar sites and installs large solar, it turns to distributed solar and storage to meet demand, which has the effect of reducing transmission losses and deferring additional infrastructure upgrades on both the bulk power and distribution systems. As a result, DER significantly modifies the load that the bulk system "sees," reducing the effective peak demand for Xcel's bulk generating resources. In the *Consumers Plan* modeling, Xcel must meet a peak system load of 6,900 MW in 2040, a 24.7% decrease relative to today's 9,164 MW peak, as a result of DER shifting or shaping the load to decrease demand.

[17] Distributed solar or storage refers to any resource sited on the distribution system (below 69-kV). The distributed PV systems reach a maximum size of 40 MW in a 3-km grid region.

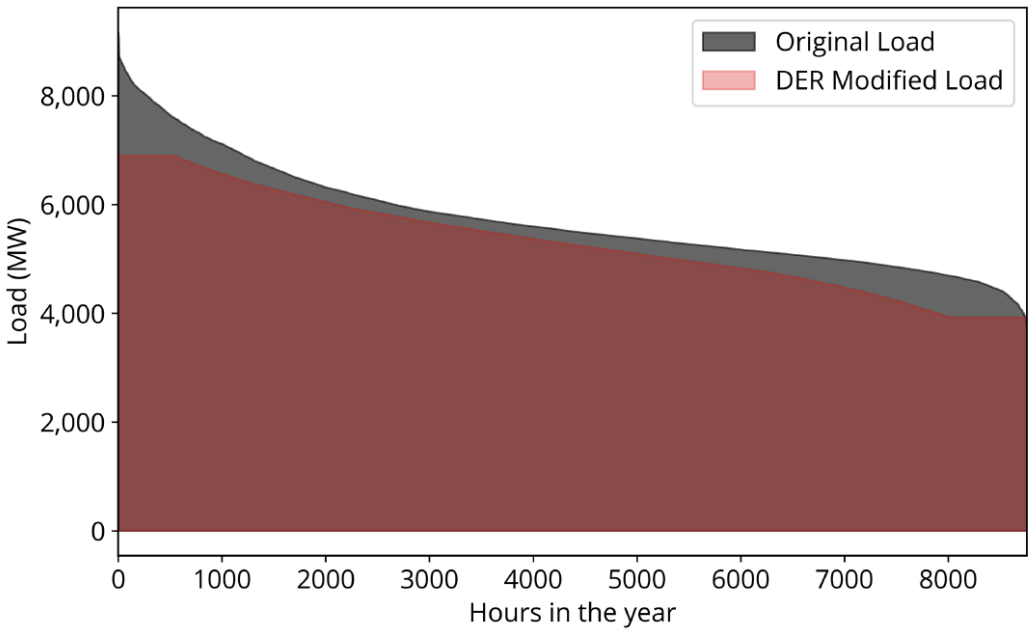


Figure 3.17: Duration curves of the original load and the DER modified load in 2040.

Notably, WIS:dom installs a range of distributed systems, suggesting that, while a significant portion of the additional distributed PV is rooftop solar, much of that load can also be supplied by community or larger-scale solar projects. The average distributed solar installation in 2040 is 880 kW. The buildout of distributed energy resources in the *Consumers Plan* diverges significantly from the Preferred Plan, in which Xcel installs only 575 MW by 2035, or just 600 MW in the high-electrification scenario.

The *Consumers Plan* demonstrates that pursuing a substantial expansion of distributed energy resources and demand-side measures coupled with economy-wide electrification efforts is cost-effective, clean, beneficial to Xcel consumers, and ensures a reliable power system. The WIS:dom model presents a picture of the electric grid that is achievable but not yet realized. As such, it is incumbent on the Commission, Xcel, and stakeholders to explore these issues in concert through the development and evaluation of comprehensive Integrated Distribution Planning, beneficial electrification, DER and demand-side programming, and distribution system operations.

First, Xcel should pursue a robust expansion of DER, coupled with additional energy efficiency and demand flexibility measures. Through innovative ratemaking, incentives, and appropriate valuation of distributed energy services, Xcel can leverage large amounts of private investment in small-scale solar and battery storage projects to the benefit of all consumers. Despite suggestions that DER burden other ratepayers with increased distribution costs, WIS:dom modeling suggests that this expansion largely serves to benefit all ratepayers and mitigate costs and grid impacts. In order to achieve these benefits, Xcel and the Commission should carefully

evaluate appropriate mechanisms to encourage thoughtful and equitable DER expansion. Such measures might include a thorough evaluation of the locational value of DER to ensure the full value of distributed resources is captured and remitted to consumers, as well as appropriate Integrated Distribution Planning, so that grid impacts are holistically evaluated and mitigated. Xcel can also take advantage of increased DER, replacing retiring fossil fuel assets with not just utility-scale renewables but also small resources connected to the distribution system. Appropriate support of community solar-plus-storage projects would benefit ratepayers, empower communities with local, on-site generation, and support Xcel's reliability and decarbonization goals.

Xcel should also continue and increase its electrification efforts, considering expansive electrification efforts to encourage consumers to retire gas water heaters, gas space heaters, and internal combustion engine vehicles in the many instances that it is cost-effective to do so. In order for the state to achieve its ambitious, economy-wide decarbonization goals, electricity providers have a crucial role to play in both supporting the infrastructure buildout and accompanying grid and end-use investments. The *Consumers Plan* demonstrates such electrification will significantly reduce the cost of Xcel's clean energy transition while providing additional benefits to consumers. Xcel and the Commission should continue to consider investments that will enable greater demand-side electrification, as well incentives, rebates, and rate structures that encourage electrification.

Perhaps most importantly, the WIS:dom modeling suggests the need for Xcel to more carefully consider how to optimize its generation and distribution systems and to begin to implement tools and processes that ensure the full value of DER is captured. Xcel should integrate key components of this optimization through continued improvement in Integrated Distribution Planning (IDP). A well-designed and transparent distribution planning process can unlock new capabilities on the distribution system and ensure system costs remain low, to the benefit of consumers.

The *Consumers Plan* modeling makes clear that a rapid expansion in both DER and distribution system flexibility are paramount to achieving both Xcel's and Minnesota's decarbonization goals. However, such a rapid expansion in DER requires a thoughtful approach to distribution system planning, in which the costs and benefits of grid investments are carefully evaluated to ensure Xcel ratepayers benefit. Utilities across the country, including Xcel, are increasingly turning towards the distribution system as areas of growth, as opposed to more traditional investments in bulk transmission and generation.[18] In Xcel's last IDP, the Commission certified $626 million of distribution system investment.[19] The Commission should ensure that Xcel captures the promised consumer benefits of these investments, in part through avoiding unnecessary spending on

[18] How Dumb Distribution Spending Crowds Out a Smart Clean Energy Future (https://www.greentechmedia.com/articles/read/how-dumb-distribution-spending-crowds-out-a-smart-clean-energy-future), 2018, GreentechMedia.

[19] Commission Order Accepting Integrated Distribution Plan, Modifying Reporting Requirements, and Certifying Certain Grid Modernization Projects, Docket No. E-002/M-19-666, July 23, 2020.

centralized generation and transmission-level resources, as opposed to simply gold-plating the distribution system.

Increasingly, regulators and key stakeholders are recognizing the opportunity to create customer value by harmonizing resource, transmission, and distribution planning processes by collectively evaluating the identified needs and coordinating solutions that provide the best value on a consolidated basis. This approach evaluates the gross needs of the system, considers all alternatives, both traditional and non-traditional, and then selects the most cost-effective solutions to produce an optimized portfolio of incremental resources and transmission and distribution assets to reliably and affordably operate the grid. The growth of distributed generation, for example, in a location where a transmission or distribution upgrade is necessary to accommodate growing loads could both offset the need for large-scale generation and defer or eliminate the need for grid upgrades. In this case, one solution addresses two needs, thus directly benefiting customers. Similarly, customer adoption of solar-plus-storage systems may offset the need to increase hosting capacity through traditional distribution upgrades if these systems are operated to benefit the circuit. Indeed, the WIS:dom model demonstrates that smart distribution co-optimization will minimize grid investments and thus ratepayer impacts through improved bulk system integration and increased system flexibility. At the level of DER penetration suggested in the *Consumers Plan,* Xcel Energy will rapidly approach Stage 2 of 3 of "Distribution System Evolution," as detailed in a report from Lawrence Berkeley National Laboratory (LBNL), *Distribution Systems in A High Distributed Energy Resources Future*.[20] At this stage, when DER begins providing grid services, it is important for the utility to consider substantial changes to grid planning and operations, a number of options of which are laid out in the LBNL report.

Both Xcel and the Commission have a key role to play in ensuring resource planning fully accounts for the value and importance of the distribution system to serve load and achieve emission reduction goals. While the Commission should approve an IRP that is far more aggressive in DER penetration than Xcel's Preferred Plan, simple approval is not enough to ensure that the vision laid in the *Consumers Plan* is achieved. The Commission and Xcel should continue to work towards a comprehensive, open, and stakeholder-driven distribution planning framework.

### F. Transmission implications

While the distribution system remains a critical tool to support Xcel's decarbonization efforts, substantial bulk system investment is necessary to ensure that costs remain low and the utility can reliably serve load. WIS:dom uses the existing transmission topology and invests in the infrastructure according to the needs developed throughout the capacity expansion and dispatch modeling. Unique to the modeling performed by VCE in this analysis is the ability for the model to capture the interplay of the entirety of the MISO region. While this analysis is focused on Xcel territory and the implications for Xcel consumers, it is important to model the system in aggregate,

[20] Distribution Systems in a High Distributed Energy Resources Future (https://eta-publications.lbl.gov/sites/default/files/lbnl-1003797.pdf), 2015, Lawrence Berkeley National Laboratory.

as Xcel and Minnesota sit within an Independent System Operator, and operations in one utility territory may have significant implications for another utility in a connected territory. This is particularly true in the northern MISO region, in which significant amounts of energy and capacity are traded across multiple transmission ties, suggesting that it is difficult for a single utility to appropriately plan its system without considering its neighbors and the broader MISO footprint.

The *Consumers Plan* details a substantial but attainable transmission expansion over the 20-year study period, part of which is dependent on Xcel's actions, and part of which is dependent on broader MISO transmission expansion. By 2035, in the *Consumers Plan,* Xcel builds 227 MW of new transmission connecting Xcel's territory to other areas of Minnesota, helping to connect the state's rich renewable resources with load centers in the Xcel territory. While WIS:dom models all incremental transmission capacity as new infrastructure, and models its cost as new infrastructure, much of this additional capacity could be achieved through existing infrastructure upgrades or grid enhancing technologies such as dynamic line rating.[21] On top of this 227 MW of additional transmission capacity within Minnesota, WIS:dom also builds an additional 1,804 MW of transmission capacity connecting Xcel's territory to Iowa by 2035, enabling the utility to access high-quality wind resources and export excess solar generation. By 2035, Xcel adds additional in-territory transmission capacity known as spur lines, which connect utility-scale wind and solar resources to the broader transmission system for delivery into load centers. The additional transmission capacity is equivalent to 181.5 GW-miles of bulk transmission and 395 GW-miles of spur line transmission capacity built in order to connect new renewable projects to substations and load centers.

As Xcel notes in its supplement IRP filing, the utility "does not presume that transmission spend necessarily is a negative outcome, and we do anticipate future transmission investments that will support our and other utilities' goals."[22] While these transmission goals may seem daunting, our modeling indicates that Xcel must pursue an aggressive transmission expansion plan in order to achieve its ambitious clean energy goals. Importantly, Xcel's transmission benefits have the effect of not only enabling greater renewable penetration but also allowing Xcel to export excess generation to neighboring MISO states. MISO has a robust transmission planning process, and the ISO is currently in the process of modeling updates to ensure that clean energy goals are reached across the region. It is reasonable to assume that additional transmission capacity will be available by 2040 to help enable Xcel's renewable energy buildout, as proposed in the *Consumers Plan.* The cost of new transmission investments is a negligible component of the cost of delivered electricity for Xcel, and much of Xcel's investment can be returned directly to consumers through increased off-system sales. Transmission investments represent just a tenth of one cent per-kWh of total system costs by 2040.

[21] Dynamic Line Ratings (https://cleanenergygrid.org/wp-content/uploads/2014/08/Dynamic-Line-Ratings.pdf), American's For a Clean Energy Grid.
[22] Upper Midwest Integrated Resource Plan. 2020, Northern States Power Company. 44/78.

**Conclusion**

CUB's *Consumers Plan* indicates that there is opportunity for substantial cost-savings for Xcel consumers by accelerating coal plant retirements, rapidly deploying clean energy, and maximizing Xcel's distribution system investments with demand-side resources. The *Consumers Plan* matches Xcel's reliability needs, meeting system needs at every five-minute interval of the planning period. It reduces system emissions more rapidly and by a greater amount than Xcel's Preferred Plan. It avoids the significant risk of multi-decade investments in new fossil fuel generation as Xcel pursues its "carbon-free by 2050" vision. And the *Consumers Plan* results in $1 billion of cumulative savings by 2035 compared with Xcel's Preferred Plan.

CUB respectfully recommends that the Commission direct Xcel to implement the *Consumers Plan* to meet the energy needs of its customers.

Thank you for your consideration.

Sincerely, February 11, 2021

*/s/ Annie Levenson-Falk*
Annie Levenson-Falk
Executive Director
Citizens Utility Board of Minnesota
651-300-4701, ext. 1
annielf@cubminnesota.org

*/s/ Scott Dunbar*
Scott Dunbar
Partner, Keyes & Fox LLP
Counsel to Citizens Utility Board of Minnesota
949-525-6016
sdunbar@keyesfox.com