APPENDIX N10 – NUCLEAR WORKER TRANSITION PLAN

I. INTRODUCTION

Minn. Stat. § 3.8851, subd. 4 requires Northern States Power Company, doing business as Xcel Energy, to submit to the Minnesota Public Utilities Commission updates periodically, with the resource plan filing, of the Worker Transition Plan (WTP) required under Minn. Stat. § 116C.772, subd. 3. The WTP is required to address the event of a shutdown of Prairie Island nuclear generating plant for longer than six months.

The 1995 WTP (the original filing of this plan) reported that the conditions that could lead to a short lead-time reactive worker transition due to an unplanned immediate shutdown were not typical of the scenario facing Minnesota. Minnesota's Monticello and Prairie Island Nuclear generating plants have a long history of being well-maintained resulting in safe, reliable and economic operations. The WTP described in 1995 assumed a long lead-time, proactive approach. Monticello and Prairie Island Units 1 and 2 continue to have strong operating records and are expected to operate until at least 2030, 2033 and 2034 respectively. This update continues to assume the long lead-time proactive approach to a WTP.

II. TRANSITION PLAN PHILOSOPHY

Monticello will reach the end of its current operating license in 11 years, or 2030. As part of our preferred plan, we are proposing to extend Monticello operations through 2040 or 21 years from now. Prairie Island Unit 1 will reach the end of its current operating license in 14 years, or 2033, and Prairie Island Unit 2 will reach the end of its current operating license in 15 years, or 2034. These extended operating periods and Xcel Energy's commitment to employees affords the opportunity to plan for employee transition resulting from a planned plant closure. Xcel Energy will continue to base staffing decisions on operational excellence and Nuclear Regulatory Commission (NRC) requirements that may result in changed staff assignments and levels.

Monticello and Prairie Island nuclear generating plants are operated by dedicated nuclear professionals. The extended plant lives, the fact that many workers will reach retirement age well before the extended licenses will expire, and a strong management commitment are critical to the success of the Xcel Energy Worker Transition Plan. This strategy provides employees the opportunity to develop their skills inventories so they are congruent with the changing needs of the company and the marketplace.

The proactive approach to managing human resources produces a workforce that is motivated, cross-functional and flexible. This approach greatly reduces the need for reactive planning.

Should Prairie Island or Monticello close, there are four transition paths available. They are:

1. Stay with Xcel Energy in a similar job/career path.
2. Stay with Xcel Energy in a different job/career path.
3. Retire.
4. Leave Xcel Energy for outside employment opportunities.

The proactive strategy for managing human resources allows employees to prepare for each path, and thus position themselves for a number of potential outcomes. Xcel Energy acknowledges that a proactive transition requires prior planning, total management support, complete understanding and support throughout all levels of the corporation and a comprehensive guiding process.

Xcel Energy values its employees and recognizes that they make the nuclear operations excellent. Xcel Energy has an obligation to help employees plan for the future. The result of effective planning is a partnership that yields strong nuclear operations and satisfied employees. Approximately 1,150 permanent, skilled positions would be eliminated or restructured should Monticello and Prairie Island close. Providing these employees with avenues to enhance their skills prior to plant closing will make the transition to new jobs (inside or outside of Xcel Energy) easier, but not painless. Xcel Energy's objective is to structure and develop its work force to meet the challenges inherent in a competitive business environment. That objective will be accomplished by:

1. Establishing Business Plan workforce effectiveness goals.
2. Translating those goals into an effective Human Asset Plan.
3. Producing employee development plans.

A breakdown of the number of employees that work at Monticello and Prairie Island appears in Table 1 below.

Table 1: Nuclear Employee Breakdown

	Nuclear Department		Total
	Bargaining	Non-bargaining	
Monticello	185	325	510
Prairie Island	335	311	646
Total	520	636	1,156

III. XCEL ENERGY TRANSITION PROCESSES

The transition processes described below apply to both non-bargaining and bargaining unit employees at Monticello and Prairie Island. For bargaining unit employees the transition plan is in accordance with the collective bargaining agreement and Xcel Energy programs and processes as described below.

IV. INTERNAL PLACEMENT

A. Job Opportunity Bulletin

Xcel Energy provides online notification of employment and career development opportunities in all new or replacement positions. This process, in accordance with our collective bargaining agreement, is used prior to outside hiring.

B. Leadership Essentials

Xcel Energy has a program to identify employees interested in becoming a member of the Xcel Energy management team, and provides assessment and development to them. Leadership Essentials is an on-line resource designed to help both beginning and experienced leaders learn, and continue to develop various leadership skills. All union employees are invited to participate.

C. Corporate Training Programs

Xcel Energy offers employees training and development courses for skills needed to stay current in their present job and development courses to prepare them for future positions. This training covers technical, computer and business skills.

D. Apprenticeship Training Programs

An apprentice is a person engaged in training for one of the skill areas covered in the current labor agreement. Programs are State of Minnesota registered and provide on-the-job training and related instruction in all areas of the apprenticeship being served.

E. Tuition Reimbursement

The Tuition Reimbursement Program gives employees financial assistance to take courses offered by accredited schools and institutions of higher learning to complete a degree program.

F. Severance

1. The severance pay agreement for bargaining unit employees is covered in the current labor agreements with IBEW locals 160 and 949.
2. The Company has a severance plan for non-bargaining employees which covers regular, full-time or part-time employees of the Company not covered by a current labor agreement. To be eligible for severance, certain eligibility requirements must be met.

V. SUMMARY

The foundation for this type of worker transition program is based on the availability of long-term planning. If a premature closure of Prairie Island or Monticello were to occur, the results would be less favorable. In that case, employees would be afforded less time to prepare themselves for other employment within Xcel Energy or for careers outside of the company. No amount of prior planning can alleviate employees' personal hardships should a valuable and efficient plant be forced to close prematurely. Such an occurrence would be highly speculative, and it would not be cost-effective to prepare contingencies based on scenarios that are not likely to occur.

VI. CONCLUSIONS

1. Xcel Energy is committed to its employees. That commitment is reflected in the scope of resources available to employees. Xcel Energy will continue to invest heavily in employees' training and development so that the transition to a business environment will be proactive.
2. Xcel Energy's commitment to excellence in operations is unequivocal, as is the Company's commitment to operate Monticello and Prairie Island

Units 1 and 2 until 2030, 2033 and 2034, respectively. In addition, as part of our preferred plan we are proposing to extend Monticello another 10 years through 2040.

3. The long lead-time prior to potential plant closings affords Xcel Energy and its employees an opportunity to plan for the transition.
4. An orderly transition is possible through Business and Human Asset Planning as performed by Xcel Energy.

VII. COMMITMENTS

1. Xcel Energy will continue to account for changes in the workforce through business planning and Human Asset Planning.
2. Xcel Energy will continue to work with affected unions to promote the retention and training of its highly skilled and dedicated workforce.

APPENDIX O1 – SUMMARY OF IRP STAKEHOLDER ENGAGEMENT

Our plans for the future of our integrated system impact five states, millions of customers, thousands of employees, and hundreds of communities. We understand the interest and desire for stakeholders to be involved and help shape the future of our system. In light of this interest, we developed our Integrated Resource Plan through a robust external stakeholder process. This includes holding stakeholder workshops, engaging third party consultants, participating in studies that evaluate the impact of plant retirements on host communities, and working with the labor unions to ensure smooth transitions for our impacted employees. Below we discuss our stakeholder work to date in more detail.

I. STAKEHOLDER WORKSHOPS

The Company made a concerted effort to work with stakeholders in developing the Resource Plan, through both workshops and one-on-one meetings. We sent email invitations to over 300 individual stakeholders or organizations and held 13 public workshops that provided a forum for productive dialogue and education. Our goal was to educate stakeholders on the resource planning process and our Upper Midwest system – as well as gather stakeholder feedback and perspectives for incorporation into our Resource Plan. We also wanted to increase accessibility to our subject matter experts and the supporting data while enhancing collaboration. The meetings also revealed stakeholders' desire for additional, deeper discussions about our system, our Resource Plan, and the broader context of statewide decarbonization pathways.

Our meetings covered a variety of topics and featured external speakers and stakeholders including Chris Clack with Vibrant Clean Energy, Jesse Jenkins with Massachusetts Institute of Technology,[1] MISO, the Center for Energy and Environment, the Coalition of Host Communities, and Community Power. Table 1 below lists the Workshops we hosted.

[1] Now at the Harvard University Center for the Environment.

Table 1: Stakeholder Workshops

Workshop Topic	Date
The Evolving Integrated Planning Process	6/26/19
The Evolving Electric System - Part 1	8/22/18
The Evolving Electric System - Part 2	8/28/18
Economic and Technical Considerations – Part 1	9/10/18
Economic and Technical Considerations – Part 2	9/24/18
Recap 9/10 Workshop Webinar (Economic and Technical Considerations – Part 1)	10/5/18
Preliminary Results – Part 1	10/22/18
Preliminary Results – Part 2	10/23/18
Demand-Side Management, Storage and Q&A Panel	12/14/18
Modeling Inputs & Assumptions Webinar	2/11/19
Host Community Considerations	2/12/19
Xcel Energy Non-Technical Overview Session	4/2/19
E3 Modeling Results	4/17/19
Xcel Energy Preliminary Preferred Plan	5/20/19

We also filed all supporting documents and presentations from the workshops in Docket No. E002/RP-15-21.

As this Resource Plan contemplates the long-term resource mix for five states, as discussed in the Planning Landscape section, we have also had discussions with various regulatory agencies in multiple jurisdictions to hear and understand their needs and concerns and incorporate those where possible.

As a result of all of this stakeholder collaboration, we made changes to several inputs and modeling approaches and also kept this in mind as we prepared the narrative supporting our proposed plan. For instance, in response to input from energy efficiency stakeholders and using the results from the *Minnesota Energy Efficiency Potential Study*,[2] we modeled energy efficiency as a supply side resource for the first time in this Resource Plan, an innovation that led to significantly more energy efficiency being selected than in prior plans. We also changed the source for our renewable pricing assumptions in response to stakeholder feedback. And in response to stakeholders' strong interest in electrification as a possible pathway to accelerate progress on the State's greenhouse gas goals, we created a load forecast sensitivity exploring the potential energy and peak demand impacts on our system of a scenario with aggressive electrification of transportation, water heating and space heating. We

[2] *Minnesota Energy Efficiency Potential Study: 2020–2029*. Conservation Applied Research and Development (CARD) FINAL Report. Prepared for the Minnesota Department of Commerce, Division of Energy Resources, by Center for Energy and Environment, Optimal Energy and Seventhwave. December 2018.

appreciate the time and input stakeholders have provided to date and believe the proposed plan—and this filing— has benefitted from it. We look forward to continued discussions as this process progresses.

II. EXTERNAL CONSULTANTS

We engaged a national expert on energy policy and economics, Dr. Susan Tierney with Analysis Group, to facilitate and host our Resource Plan stakeholder workshops as well as several smaller stakeholder meetings. Dr. Tierney not only brought a national perspective into the conversation but was also an independent third party that helped facilitate engaging and productive dialogue with stakeholders.

We also retained a consultant, Energy and Environmental Economics, Inc. (E3), to perform independent modeling and analysis of our system in order to ensure transparent work and access to the data and models for stakeholders. E3 is a recognized industry-leading firm based in San Francisco and consults extensively with utilities, developers, government agencies, and environmental groups on clean energy issues. E3's experience analyzing the impacts of deep decarbonization on utility systems in other parts of the country was very valuable to us in evaluating the impacts of decarbonizing our Upper Midwest System. E3 used three types of models to provide perspective on our Resource Plan:

- The RESOLVE model, which evaluates and optimizes the least-cost portfolios of resources to meet system demand considering carbon and other constraints,
- The RECAP model, which evaluates the reliability of electric energy and system capacity of the optimized resource portfolios over thousands of simulated weather years, and
- The PATHWAYS model, an economy-wide representation of infrastructure, energy use, and emissions within a specific jurisdiction used to create emissions accounting scenarios and model energy and climate policies. PATHWAYS was used in this project to evaluate scenarios for meeting Minnesota's statutory goal of 80 percent economy-wide reduction in greenhouse gases below 2005 levels by 2050.

E3's independent modeling results, which were generally consistent and supportive of our Strategist modeling results, were presented to, and discussed with, stakeholders in a workshop, and the results were made publicly available via the eDockets filing system after the stakeholder workshops. In addition, their completed RESOLVE and RECAP reports are also included with this Resource Plan submission as Appendix P2.

Working with E3 on their PATHWAYS to model scenarios to achieve Minnesota's 80 percent economy-wide greenhouse gas reduction goal provided a broader context for our Resource Plan, exploring the potential not only to decarbonize the statewide electricity system but also spread the benefit of low-carbon electricity to other economic sectors. E3's PATHWAYS Report is provided as Appendix P3. E3 modeled two mitigation scenarios – High Electrification and High Biofuels – and three sensitivities, as summarized in Appendix F4. Stakeholder feedback, both in the September 23 and October 24, 2018 stakeholder workshops and in individual meetings, informed the assumptions and modeling approach. In addition, the Company and E3 met with the Minnesota Pollution Control Agency (PCA) and Minnesota Department of Transportation (MnDOT) during the modeling process to acquire state-specific emissions, transportation, and econometric data, discuss assumptions and methodology, and present results. We offered to make the PATHWAYS model, now calibrated for Minnesota, available to the State for future analyses supporting the statewide greenhouse gas goals. As an immediate outgrowth of this effort, MnDOT is now working with E3 in the Pathways to Decarbonizing Transportation project, where E3 is using PATHWAYS to model strategies for reducing greenhouse gas emissions from the transportation sector.[3] Analyses for other sectors may follow.

III. HOST COMMUNITY WORK

The Company is participating in a study overseen by the Center for Energy and Environment (CEE) that will examine the impacts of the large baseload generation plants in Minnesota on the host communities. The other participants in the study include the Coalition of Utility Cities, Minnesota Power, and the Prairie Island Indian Community. The study will consist of a quantitative and qualitative component. The quantitative component of the study is similar to the study we conducted for Sherco 1 and 2 in our last IRP. For the qualitative component, CEE will engage with host community residents and business to gauge awareness, opinions and concerns around potential power plant closures. Efforts on both components are underway and we will supplement this IRP filing when each component is completed. As this docket progresses, we expect to be able to incorporate further findings and hold additional discussions incorporating the finalized report outcomes. Further discussion of the scope and status of this study is included as Appendix O2.

In addition, we also worked with the Nuclear Energy Institute (NEI) to evaluate the impact of our nuclear fleet on the Minnesota Economy. Our nuclear plants employ approximately 1,400 staff in and around the Monticello and Redwing communities,

[3] See http://www.dot.state.mn.us/sustainability/pathways.html.

which translates into an estimated 4,200 additional jobs in other industries across Minnesota. The plants are also important sources of tax base for their host communities, resulting in a combined total of approximately $42 million in state and local taxes annually. In total, Xcel Energy's nuclear operations contribute approximately $1 billion in annual economic benefits throughout the state. These and other benefits area summarized in NEI's April 2017 report titled "The Impact of Xcel Energy's Fleet on the Minnesota Economy," which looked at data from 2014-2016[4] and is attached as Appendix O3.

We acknowledge the role our plants play in the communities in which they are located and look forward to working with these stakeholders on transition plans as this Resource Plan progresses and plant closure dates draw nearer.

IV. LABOR

We are also working closely with labor unions and that work has resulted in support from the Infrastructure Union (LIUNA) for our preferred plan. LIUNA has stated that they appreciate and acknowledge that Xcel Energy has provided high-quality jobs that have sustained families and communities for generations and appreciate our commitment to supporting communities and employees through this energy transition.

Moving forward we will continue to work with local unions and set a course to negotiate multiskilling for the plants that are impacted by this Resource Plan. This skill set will position our employees for other job opportunities within Xcel Energy. As we get closer to plant closure dates, temporary work force will be utilized to back-fill impacted employees who have moved to other positions within the Company. This strategy lessens the burden and stress for impacted employees to find positions, as plant near closure dates.

In addition, plant management, Work Force Relations and Human Resources will work together with other business organizations within Xcel Energy to help coordinate interviews for affected employees.

[4] The 1,400 staff and $42 million in state and local taxes referenced above reflects updated information as through 2018.

V. CONCLUSION

We understand the interest and desire for our stakeholders to be involved and help shape the future of our system. We have put forward a concerted effort to engage these stakeholders at the outset and believe we have done a good job at doing so—but this work is just beginning. As this process unfolds and the plant closure dates approach, we will continue our successful track record of engaging parties, transitioning our workforce, looking for new investments, creating new jobs, and working with impacted communities and employees on transition plans.

APPENDIX O2 – SCOPE & OUTLINE: CENTER FOR ENERGY & ENVIRONMENT STUDY

The Company is participating in a study overseen by the Center for Energy and Environment (CEE) that will examine the impacts of the large baseload generation plants in Minnesota on the host communities. The other participants in the study include the Coalition of Utility Cities (CUCs), Minnesota Power, and the Prairie Island Indian Community. The CUCs are a coalition of communities that host large baseload generation plants in Minnesota and include: Becker, Monticello, Red Wing, Oak Park Heights and Cohasset. With the support of the McKnight Foundation, the Just Transition Fund, and the Initiative Foundations of Minnesota, the CUCs contracted with CEE to oversee a study on the direct and indirect financial and social impacts of hosting a baseload power plant on the host communities.

A portion of the host community impact study will be similar to the study conducted for Sherco 1 and 2 in our last Resource Plan. The study will evaluate alternative retirement and replacement scenarios for our remaining baseload facilities. The study will also evaluate the impacts of Minnesota Power's Boswell plant on the Cohasset area. In addition, the study will provide a qualitative component that will include interviews and surveys of key stakeholders in the local area of each plant. The independent oversight of CEE and the direct participation of impacted communities are important components that we believe will lend additional credibility to the study. On February 12, 2019, we hosted a workshop as part of the Resource Plan process on the scope of this study as part of our outreach efforts in advance of our July 1 filing. At that workshop, the CUC presented on issues facing host communities and included individual presentations by representatives from Becker, Oak Park Heights, Red Wing, Monticello, and the Prairie Island Indian Community. The study scope and process was well received by attendees of the workshop.

The study will consist of a quantitative and qualitative component. Efforts on both components are underway and we will supplement this Resource Plan filing when each component is complete. We expect to provide a supplement on the quantitative component within the next 60 days. A report on the qualitative component is expected to be completed in November.

To support the quantitative effort, CEE has contracted with the University of Colorado to conduct economic modeling of the local and statewide impacts of the retirement of the baseload generation plants in Minnesota. The Company retained the University of Colorado to conduct the study for Sherco 1 and 2 in our last IRP. The Business Research Division (BRD) of the Leeds School of Business at the University of Colorado Boulder will analyze the economic impact of alternative plant

retirement scenarios on their respective host communities. The purpose of this part of study is to provide third-party research examining the economic positive and negative effects of different scenarios. The scenarios analyzed will reflect five plant retirement scenarios as summarized below, including our preferred plan.

Scenarios to be Analyzed in the Host Community Impact Study								
Strategist Scenario	**Description**	**Coal Retirements**				**Nuclear**		
		Sherco 1	Sherco 2	Sherco 3	AS King	Monticello	Prairie Island 1	Prairie Island 2
1	**Reference**	2026	2023	2040	2037	2030	2033	2034
2	**Early King**	2026	2023	2040	2028	2030	2033	2034
4	**Early Coal**	2026	2023	2030	2028	2030	2033	2034
9 Pref. Plan	**Early Coal; Extend Monti**	2026	2023	2030	2028	2040	2033	2034
10	**Early King; Extend Monti**	2026	2023	2040	2028	2040	2033	2034
12	**Early Coal; Extend All Nuclear**	2026	2023	2030	2028	2040	2043	2044

This quantitative analysis will examine the baseload retirement scenarios, above, and the added resources based on the resource expansion plans in each scenario, which correspond to scenarios analyzed using the Strategist model. The analysis will consider operating expenditures, capital expenditures, and consumer rate costs for each scenario above relative to the reference scenario.

The research analysis method to be used for this study is the Regional Economic Models, Incorporated's (REMI) input-output, general equilibrium, econometric, and economic geography model, using state and national economic and demographic data, as well as data from the Company including capital expenditures, operating expenditures, and revenue requirements for each scenario. The study will look at near-term, mid-term, and long-term impacts and will capture the economic activity related to decommissioning and the construction of replacement generation.

While the specific location of replacement generation is unknown, a portion of the replacement generation will be assumed to be constructed within Minnesota and the study will examine impacts on the State of Minnesota. The REMI modeling will analyze the economic impacts on each host county and well as the state of Minnesota. The model allows for the analysis of changes in spending, investment, and employment in each region. We will supplement our IRP filing with the report from the BRD as soon as it is available.

The Host Community Impact study will also contain a qualitative component. CEE will collect responses to a questionnaire from community residents to gauge awareness, opinions and concerns around potential power plant closures. CEE will also conduct interviews with community members and leaders in each affected community, key stakeholders representing labor, and other impacted stakeholders. CEE will develop a report that identifies overarching themes and findings including issues that may be unique for specific communities. We will supplement our Resource Plan filing with the qualitative report once it is available.

We are grateful to CEE for overseeing this study and to the study participants for engaging in this constructive exercise. As we move forward with our carbon reduction goals, we are cognizant that phasing out some of our legacy generation has a significant impact not only on our energy mix, but on the economies of communities where those plants are located and the employees who work in those plants. We are dedicated to working with our employees, communities, and stakeholders to manage community impacts throughout our clean energy transition. Our baseload generation plants are prominent places of employment and contributors to the property tax base in the host communities. This is why we make efforts to spur economic development in locations where our current units will eventually be phased out.

For example, since our most recent Resource Plan, where we proposed to retire the Sherco 1 and 2 coal units in Becker, we have worked extensively with the local government, community stakeholders, and the state to draw new development to support the local economy. This includes a planned combined cycle generating unit at the Sherco site, the Northern Metal Recycling facility, and, prospectively a new Google data center with energy matched by a wind facility. Some of that activity (e.g. the Google data center) is also anticipated to spur new renewable energy development on our system.

In addition to the community impacts, we are also aware that these plant closures impact our employees and their families. With this in mind, and consistent with our past practices, we will work with these impacted employees to transition them to other Xcel Energy plants or areas of the company. In the past, when plants have been closed or converted (and impacted headcount) we have provided résumé writing services, support for interview practice, job training, and job shadowing opportunities. Through natural attrition and job re-locations, we have been able to successfully "re-home" nearly all impacted employees from plant closures and conversions to date.

As we continue toward achievement of our aggressive carbon goals, we will continue to make significant investments in clean energy in the states we serve. As we do so, we will look for opportunities to create fair access to clean energy programs, jobs and economic development opportunities. The Host Community Impact study will provide further context and opportunities for engagement with our communities, employees, and stakeholder as we continue to work together on the clean energy transition.

The Impact of Xcel Energy's Nuclear Fleet on the Minnesota Economy

An Analysis by the Nuclear Energy Institute

April 2017

NUCLEAR ENERGY INSTITUTE

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Contents

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Executive Summary

Xcel Energy Inc. (Xcel Energy) owns and operates two nuclear energy facilities, including three reactors, in Minnesota and has its headquarters in Minneapolis, Minnesota. The two nuclear energy facilities are:

- Monticello Nuclear Generating Plant in Monticello, Minnesota
- Prairie Island Nuclear Generating Plant in Red Wing, Minnesota

Almost 6,100 jobs in Minnesota result from Xcel Energy's nuclear operations.

The two nuclear facilities have been an integral part of the region's clean energy portfolio and economic fabric since the 1970s. They have generated reliable emission-free electricity, thousands of jobs, and billions of dollars of economic activity while Xcel Energy has been deeply involved in its local communities, proving the plants' value as economic contributors to Minnesota and the Upper Midwest.

To quantify the employment and economic impact of these facilities, the Nuclear Energy Institute (NEI) conducted an independent analysis. Based on data provided by Xcel Energy on employment, operating expenditures, revenues and tax payments, NEI conducted the analysis using a nationally recognized model to estimate the facilities' economic impacts on the Minnesota economy. Regional Economic Models, Inc. (REMI) developed the Policy Insight Plus (PI+) economic impact modeling system, the methodology employed in this analysis. (See section 5 of this report for more information on the REMI methodology.)

Key Findings

Xcel Energy's nuclear operations support:

Xcel Energy's nuclear operations are estimated to generate $1 billion of total economic output annually in Minnesota.

Economic stimulus. Xcel Energy's nuclear operations are estimated to generate $1 billion of total economic output annually, which contributes $600 million to Minnesota's gross state product each year. This study finds that for every dollar of output from Xcel Energy's nuclear operations, the state economy produces $1.98.

Tax impacts. NEI estimates that Xcel Energy's nuclear facilities in Minnesota contribute about $33 million in state and local taxes annually. In 2015, Xcel Energy reported over $34.5 million in state and local taxes paid. Xcel Energy is the largest property tax payer in Minnesota. NEI estimates that Xcel Energy's nuclear facilities contribute over $113 million in federal taxes each year.

Thousands of high-skilled jobs. Approximately 1,700 jobs exist at Xcel Energy's nuclear energy facilities, which includes 140 nuclear support positions at its headquarters in Minneapolis. This direct employment creates about 4,200 additional jobs in other industries in Minnesota. A total of

nearly 6,100 jobs in Minnesota are a result of Xcel Energy's nuclear operations.

Xcel Energy's nuclear operations result in a total tax impact of approximately $146 million to the local, state and federal governments each year.

Clean electricity for Minnesota. Xcel Energy's nuclear facilities generate about 21 percent of Minnesota's electricity and about 54 percent of the state's carbon-free electricity. Without the carbon-free electricity produced by these nuclear plants, an estimated 12 million metric tons of carbon dioxide would be released annually, the equivalent of putting more than 2.6 million additional cars on Minnesota's roadways each year, or double the number of passenger cars in all of Minnesota. By 2030, these nuclear plants will have provided almost $9 billion in avoided emissions benefits.

Reliability leaders. During full-power operations, the three reactors provide 1,770 megawatts of around-the-clock electricity for Minnesota homes and businesses. Over the last 10 years, the facilities have operated at approximately 85 percent of capacity, which is significantly higher than all other forms of electric generation. This reliable production helps offset potential price volatility of other energy sources (e.g., natural gas) and the intermittency of renewable electricity sources. Nuclear energy provides reliable electricity to businesses and consumers and helps prevent power disruptions which could lead to lost economic output, higher business costs, potential loss of jobs, and losses to consumers.

Without the carbon-free electricity produced by these nuclear plants, an additional 12 million metric tons of carbon dioxide would be released annually, the equivalent of the emissions from over 2 million cars each year.

Community and environmental leadership. Xcel Energy is a corporate leader in its neighboring communities, supporting education initiatives, environmental and conservation projects, and numerous charitable organizations.

Section 1
Background and Generation History

Monticello Nuclear Generating Plant

Dates of commercial operation
1971

Location
40 miles northwest of the Twin Cities

License Expiration Year
2030

Reactor Type
Boiling water

Total Electrical Capacity (Megawatts)
671

Prairie Island Nuclear Generating Plant

Dates of commercial operation
Prairie Island 1 - 1973
Prairie Island 2 - 1974

Location
40 Miles southeast of the Twin Cities

License Expiration Years
Prairie Island 1 - 2033
Prairie Island 2 - 2034

Reactor Type
Pressurized water

Total Electrical Capacity (Megawatts)
Prairie Island 1 - 550
Prairie Island 2 - 550

The Monticello Nuclear Generating Plant (Monticello) is located on 215-acre site in Monticello, Minnesota. It consists of a single, Boiling Water Reactor (BWR) that produces 671 MW of non-emitting baseload power.

The Prairie Island Nuclear Generating Plant (Prairie Island) is located on a 575-acre site in Red Wing, Minnesota. It consists of two Pressurized Water Reactors (PWRs) that together produce 1,100 MW of non-emitting base-load power.

Reliable Electricity Generation

Over the past decade, the three reactors operated at an average capacity factor of 85 percent. Capacity factor, a measure of electricity production availability, is the ratio of actual electricity generated to the maximum possible electric generation during the year.

Xcel Energy's nuclear plants typically generate nearly over 13 million megawatt-hours of electricity ever year. In 2015, Xcel Energy's reactors generated over 20 percent of the electricity in Minnesota. The three reactors provide enough electricity for approximately 1.4 million Minnesota households (if all of the electricity went to the residential sector).

Monticello and Prairie Island operate in the Midcontinent Independent System Operator (MISO) region, which stretches from Louisiana to Canada which covers portions of 15 states and Manitoba. Along with 14 other nuclear reactors in that operate in MISO, nuclear power keeps wholesale prices 9 percent lower in MISO than they would be without nuclear power.[1]

Thousands of High-Skilled, Well-Paying Local Jobs

Xcel Energy's nuclear operations employ nearly 1,600 full-time workers at the plants, and 140 support and executive positions at its Minneapolis headquarters. This employment supports an additional 4,200 jobs in other economic sectors in Minnesota. In total, these plants support 6,100 jobs across Minnesota (including those at the plant). The annual payroll for the direct jobs is approximately $240 million. Most jobs at nuclear power plants require technical training and are typically among the highest-paying jobs in the area. Nationwide, nuclear energy jobs pay 36 percent more than average salaries in a plant's local area according to an NEI analysis.[2]

[1] *The Nuclear Industry's Contribution to the U.S. Economy*, The Brattle Group, July 2015.

[2] *NEI Factsheet: Job Creation and Economic Benefits of Nuclear Energy*.

Safe and Clean for the Environment

Nuclear facilities generate large amounts of electricity without emitting greenhouse gases or other air pollutants. State and federal policymakers recognize nuclear energy as an essential source of safe, reliable electricity that meets both our environmental needs and the state's demand for electricity.

In 2015, the operation of these three reactors prevented the emission of 12 million metric tons of carbon dioxide,[3] about the same amount emitted by over 2 million cars each year. Overall, Minnesota's electric sector emits more than 32 million metric tons of carbon dioxide annually. The three reactors also prevent the emission of more than 11,100 tons of nitrogen oxide, equivalent to that released by 1.2 million cars, and 16,800 tons of sulfur dioxide. Sulfur dioxide and nitrogen oxide are precursors to acid rain and urban smog.

[3] Emissions prevented are calculated using regional fossil fuel emission rates from the U.S. Environmental Protection Agency and plant generation data from the U.S. Energy Information Administration.

Section 2

Economic Benefits in Minnesota

NEI used the REMI PI+ model to analyze economic and expenditure data provided by the plants to develop estimates of their economic benefits (more information on REMI can be found in Section 5).

The economic impacts of the Monticello and Prairie Island plants and the nuclear operations at Xcel Energy headquarters consist of direct and secondary impacts. The main variables used to analyze these impacts are:

Output
The direct output is the value of power produced by the Xcel Energy facilities. In the case of Xcel Energy's headquarters, it is the value of the nuclear support operations. The secondary output is the additional economic activity created as a consequence of the electricity generation. The direct output will impact the economic activity in other industries and how those employed at the facilities influence the demand for goods and services within the community.

Employment
The direct employment is the number of jobs at the Xcel Energy facilities. Secondary employment is the number of jobs in the other industries supported as a result of Xcel Energy's operations.

Gross State Product
Gross state product is the value of goods and services produced by labor and property at the Xcel Energy facilities—e.g., sales (i.e., output) minus intermediate goods. In the REMI model, operations is the final good from an Xcel Energy nuclear plant. Intermediate goods are the components purchased to make that electricity due to projected increases in electricity prices.

Xcel Energy's nuclear facilities are predicted to provide nearly $16 billion in economic benefits and $3.5 billion in disposable personal income benefits over the next 15 years.

Disposable Personal Income
Disposable personal income is the total after-tax income that residents in the analyzed region would receive. This value is available for purchases on groceries and clothing or for saving and investing for the future in things like college education, retirement or a mortgage.

Substantial Economic Drivers

The direct output in 2016 of the Xcel Energy nuclear facilities were estimated to total $531 million (the value of the electricity produced at the plants), with a total economic output on the state of $1.05 billion. In other words, for every dollar of output, the state economy produced $1.98. By 2030, the total economic output is estimated to increase to $1.11 billion.

In 2016, Xcel Energy's nuclear facilities were estimated to contribute $595 million to Minnesota's gross state product (GSP) and, by 2030, the GSP stays constant at almost $600 million.

Figure 2.0
Xcel Energy Nuclear Operations' Total Output and Gross State Product Contributions to Minnesota
*(dollars in 2015 billions)**

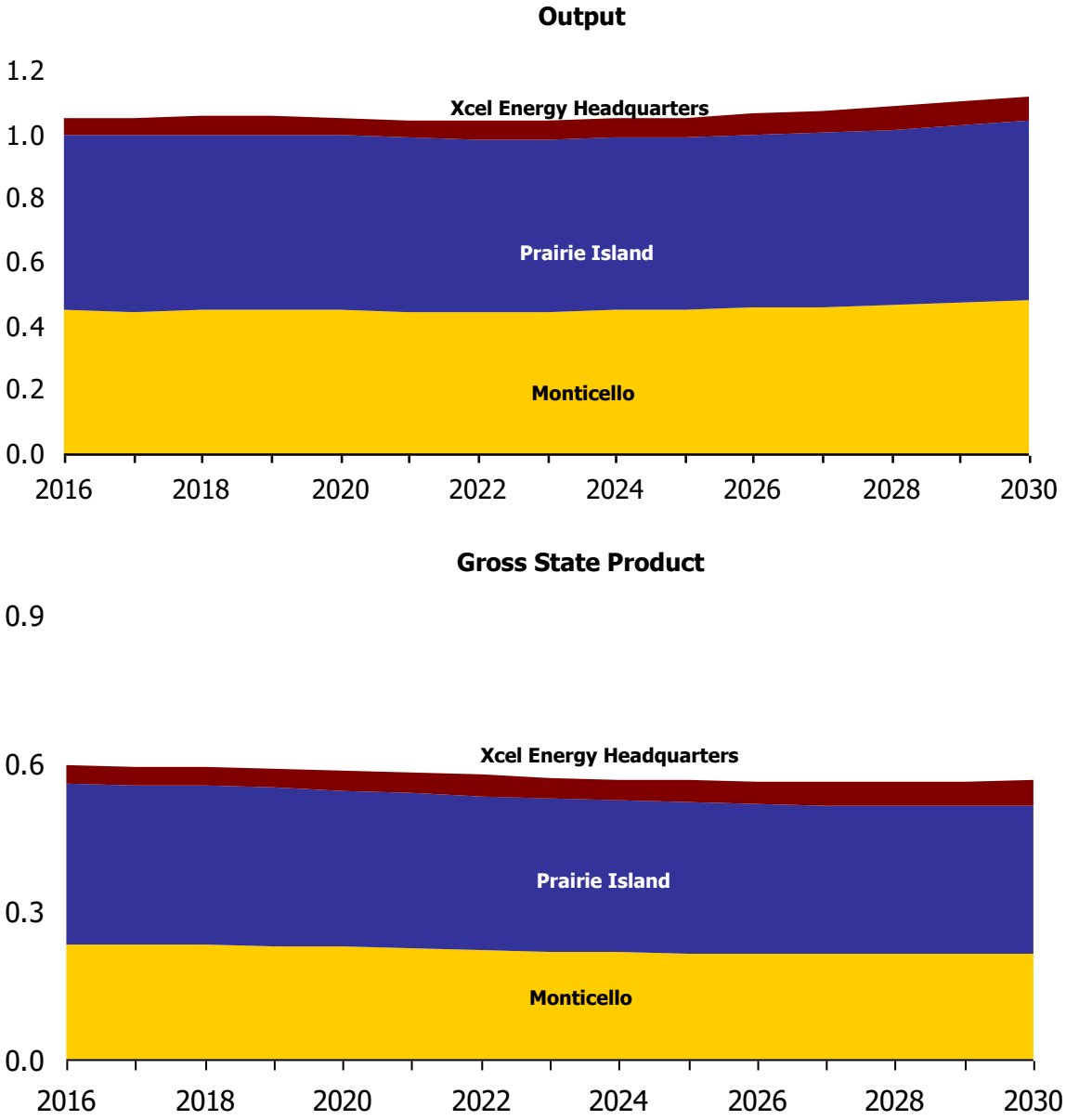


Figure 2.0 shows the value of total output and contributions to GSP from the operation of Xcel Energy's nuclear facilities through 2030, using spending data provided by Xcel Energy.

The three reactors' largest impacts are on the utilities sector, while the headquarters' greatest impact is on the corporate management sector. Xcel Energy's facilities have a substantial impact on the professional, scientific, and technical services sector—because of the volume of specialized services required to operate and maintain a nuclear power plant. Finally, there are beneficial impacts in Minnesota on the manufacturing and administrative and waste management sectors. Other sectors that benefit from the facilities' operations in Minnesota include finance and insurance, health care, retail trade, and real estate.
A full depiction of the sectors in Minnesota that benefit from the facilities is in Table 2.0.

Table 2.0
Estimated Total Output of Xcel Nuclear Operations on Minnesota's Economic Sectors in 2016 *(in millions of 2015 dollars)*

Sector Description	Monticello	Prairie Island	Xcel Energy HQ	Total
Utilities	220	311	0	531
Professional, Scientific, and Technical Services	51	52	3	106
Manufacturing	33	34	2	69
Administrative and Waste Management Services	32	32	1	65
Other Services, except Public Administration	27	28	1	56
Finance and Insurance	18	20	4	42
Management of Companies and Enterprises	3	4	31	38
Retail Trade	12	13	2	27
Health Care and Social Assistance	11	13	2	26
Real Estate and Rental and Leasing	11	12	3	26
All Other Industries	29	31	5	65
Total	**447**	**550**	**54**	**1,051**

Job Diversity and Creation

Xcel Energy's nuclear business activities stimulate the state's labor income and employment. Over 1,600 people work at Xcel Energy's nuclear plants and 140 more are employed at its Minneapolis headquarters for nuclear operations. These jobs stimulate another 4,200 jobs in other sectors in the state. All told, Xcel Energy's operations support nearly 6,100 jobs in Minnesota.

Table 2.1
Xcel Energy's Estimated Support in Direct and Secondary Jobs in Minnesota in 2016

Occupation	Monticello	Prairie Island	Xcel Energy HQ	Total
Utilities	807	870	1	1,678
Administrative and Waste Management Services	474	479	14	967
Professional, Scientific, and Technical Services	396	400	24	820
Other Services, except Public Administration	351	365	21	737
Retail Trade	159	185	33	377
Health Care and Social Assistance	133	154	25	312
Finance and Insurance	80	87	18	185
Management of Companies and Enterprises	16	17	147	180
Manufacturing	85	87	4	176
Accommodation and Food Services	64	73	16	153
Construction	66	66	2	134
Arts, Entertainment, and Recreation	34	38	9	81
Wholesale Trade	30	33	5	68
Transportation and Warehousing	28	30	4	62
Real Estate and Rental and Leasing	23	25	6	54
All Other Industries	31	37	9	77
Total	**2,777**	**2,946**	**338**	**6,061**

As discussed earlier in Section 2, the types of jobs supported by Xcel Energy's nuclear operations are diverse. Jobs supported range from office jobs in the professional, scientific, and technical services, finance and insurance, and public administration jobs to blue-collar jobs in construction and manufacturing to life-saving jobs in healthcare.

Table 2.1 details the numbers and types of jobs that Xcel Energy are supported in 2016. Xcel Energy's workers are included in the occupation categories in the table.

Economic Stimulus Through Taxes

Xcel Energy's nuclear operations resulted in an estimated annual total tax impact of $146 million to the local, state and federal governments. This includes the direct impact and secondary impacts, because plant expenditures increase economic activity, leading to additional income and value creation and, therefore, to additional tax revenue from other sectors.

Xcel Energy's impacts on the state economy are substantial. In addition to the $595 million in gross state product, the company is estimated to generate over $33 million in taxes from the plants and their activities for Minnesota and its local governments. See Table 2.2.

Extra Income for Residents

The economic activity and low-cost electricity the plants create, to which Xcel Energy's nuclear operations at its headquarters contributes, also provide a boost to incomes of residents of Minnesota. In a consumer-driven economy, this is of the utmost importance. This boost is estimated to be $237 million annually in disposable personal income greater than if the plants and headquarters did not exist. This extra income provides Minnesotans with extra money to purchase necessities such as groceries and clothing for their families or save for college or retirement. More detail of this contribution to disposable personal income is in Table 2.3.

Large Multiplier Effects for Economic Activity and Jobs

By producing affordable, reliable electricity, Xcel Energy's nuclear operations are hubs of economic activity for Minnesota. Table 2.4 provides the multipliers and summarizes the total effects from each plant. The multipliers show that for every dollar of output generated, the plants stimulate between $2.03 and $2.30 in economic output in the state, while Xcel Energy headquarters produces $1.74 for every dollar. Minnesota employment multipliers range between 3.39 and 3.44 at the plants and 2.49 at Xcel Energy headquarters.

Table 2.2
Estimated Total Tax Impacts in 2016
*(in 2015 millions of dollars)**

Facility	State and Local	Federal	Total
Monticello	12	44	56
Prairie Island	18	62	80
Xcel Energy HQ	2	7	9
Total Taxes	**33**	**113**	**146**

** Calculated based on a percentage of gross state product.*

Table 2.3
Estimated Total Personal Disposable Income Impacts in 2016
(in 2015 millions of dollars)

Facility	Total
Monticello	96
Prairie Island	116
Xcel Energy HQ	25
Total	**237**

Table 2.4
Xcel Energy's Impacts on the Minnesota Economy in 2016 *(in 2015 millions of dollars)*

Facility (Description)	Direct	Secondary	Total	Multiplier
Monticello				
Output (Utilities)	$220	$227	$447	2.03
Employment	807	1,970	2,777	3.44
Gross State Product			$232	
Prairie Island				
Output (Utilities)	$311	$239	$550	2.30
Employment	870	2,076	2,946	3.39
Gross State Product			$326	
Xcel Energy Headquarters				
Output (Management of Companies and Enterprises)	$31	$23	$54	1.74
Employment	136	202	338	2.49
Gross State Product			$37	

Section 3
Protecting the Environment

Like all nuclear power plants, Monticello and Prairie Island produce carbon-free electricity. Nuclear power produces 62 percent of the United States' carbon-free electricity and nearly 20 percent of total electricity generated. Hydro, wind and solar produce 19, 15, and 2 percent of carbon-free electricity, respectively. Nuclear power plants avoided 564 million metric tons of carbon dioxide in 2015, while hydro, wind and solar avoided 327 million metric tons combined. Annually, the avoided emissions from nuclear power is similar to adding 128 million cars to the nation's roads. Nuclear power plants also avoided hundreds of thousands of tons of nitrogen oxide and sulfur dioxide. The Environmental Protection Agency estimates that the Clean Power Plan will reduce carbon emissions by 414 million tons annually by 2030, or 73 percent of current carbon avoidance of the nuclear industry.

Xcel Energy employee holding a Peregrine Falcon chick.

Xcel Energy's Nuclear Plants Contribution

In 2015, the operation of these three reactors prevented the emission of 12 million metric tons of carbon dioxide, about the same amount emitted by over 2 million cars each year. According to the Minnesota Pollution Control Agency's most recent data from 2012, Minnesota's electric sector emitted 47.6 million tons of carbon dioxide. The three reactors also prevent the emission of more than 11,100 tons of nitrogen oxide, equivalent to that released by 1.2 million cars, and 16,800 tons of sulfur dioxide. Sulfur dioxide and nitrogen oxide are precursors to acid rain and urban smog.

Clean Air Benefits of Xcel Energy Nuclear

Monticello and Prairie Island are the two largest carbon-free sources of generation in Xcel Energy's portfolio. In 2015, Monticello and Prairie Island produced over 12 million megawatt hours of electricity which avoided the emission of 11.6 million metric tons of carbon dioxide. They also prevent the release of thousands of tons of Nitrogen Oxide and Sulfur Dioxide.

In August 2016, the U.S. Court of Appeals for the Seventh Circuit validated the Social Cost of Carbon as a legitimate method to place a value on the benefits of carbon reduction.[1] Between 2016 and 2030, assuming Monticello and Prairie Island avoid the emission of 11.6 million metric tons of CO2 every year, these avoided emissions would represent an $8.67 billion in cumulative benefits. NEI calculated this value using the Social Cost of Carbon values from the Interagency Working Group Technical Support Document that was revised in July 2015. The values are in 2007 dollars and were inflated using the GDP deflator to 2015 dollars. The calculation is based on the 2015 carbon intensity of electricity generation in NERC's Midwest Reliability Organization.[2]

[1] *Zero Zone, Inc., et al., v. U.S. Department of Energy*

[2] *The Minnesota Public Utilities Commission is currently updating its CO2 externality range. Therefore, NEI has used the federal Social Cost of Carbon values as the Commission has not yet finalized its decision. The specific reference to the docket is: In the Matter of the Further Investigation into Environmental and Socioeconomic Costs Under Minn. Stat. § 216B.2422, Subd. 3. Minnesota Public Utilities Commission Docket No. E-999/CI-14-643.*

Section 4

Community Leadership and Environmental Protection

In addition to the economic benefits that Xcel Energy's nuclear operations contribute to Minnesota in the form of jobs, income and taxes, the company and its employees contribute to local communities in many other beneficial ways. Xcel Energy strengthens Minnesota communities through hiring veterans, charitable contributions, educational programs that teach and promote the benefits of nuclear energy, environmental programs that improve the quality of the environment, and civic engagement activities that build trust and goodwill.

Children using Monticello mobile simulator at open house event.

Corporate Citizenship

At a corporate level, Xcel Energy contributes significant time and resources to charitable endeavors. Over the past 10 years, Xcel Energy has raised $2.5 million annually for the United Way. Xcel Energy matches this amount, which means over $50 million has been contributed to local communities in the past decade. This annual campaign raises money with various events such as chili cook-offs and sporting tournaments. Each year, employees, contractors and retirees continue the tradition of giving, advocating and volunteering in the community.

The 2016 United Way campaign broke all previous records with the highest combined total of donations, surpassing the goal of $3 million. The result will be more than $5.6 million in matched contributions.

Prairie Island employees volunteering at Red Wing Memorial Park.

Below are further examples of contributions of Xcel Energy and its employees:

- In September 2015, more than 3,500 volunteers pitched in and spent 10,300 hours painting, sorting, planting and otherwise supporting 80 local non-profits during Xcel Energy's fifth annual Day of Service, making it the company's largest event ever.
- The Xcel Energy Foundation awarded $3.8 million in grants to nearly 430 non-profits benefitting four community focus areas that include STEM education, economic sustainability, environmental stewardship and access to arts and culture.
- Even after they retire, former Xcel Energy employees are giving back. The Pioneers in Public Service (PIPS) retiree volunteer program has been operating for over 30 years. PIPS members have dedicated more than 80,000 volunteer hours serving in communities.

Environmental Stewardship

Xcel energy generates 55 percent of its Upper Midwest electricity using carbon-free generation. Thirty percent of that generation is from its two nuclear plants in Minnesota, 15 percent is from wind energy, and 10 percent is from a combination of hydro/biomass/solar sources. Beyond its nuclear program, Xcel Energy has been the number one utility provider of wind energy for 12 straight years.

Xcel Energy employees volunteering for Habitat for Humanity.

In 2016, the U.S. Environmental Protection Agency awarded Xcel Energy the Climate Leadership Award for achieving its self-identified goal of 20 percent reduction in carbon by 2020 (which it achieved in 2014). Xcel Energy achieved these reductions through increasing renewable energy investment, modernizing its generation fleet, and offering incentives for customers to save energy.

Employment of Veterans

In 2016, Xcel Energy set a goal of hiring veterans as 15 percent of new hires. The company exceeded this goal. Military Times Magazine rated Xcel Energy as a top company for hiring veterans. Xcel Energy was listed among the Top 100 Military Friendly Employers by GI Jobs Magazine and ranked number 8 on Monster and Miltary.com's list of best companies for veteran hiring. Also, in 2016, the Minnesota Employer Support of the Guard and Reserve recognized Xcel Energy with the Pro Patria and Above and Beyond Awards for providing beneficial leave and support rules for military members required to perform military duties.

Contributions & Sponsorships

Xcel Energy nuclear plant employees volunteer and contribute to numerous community and local organizations and events. For example, Prairie Island engages in an annual golf tournament that benefits the United Way and a Make-A-Wish summer series. Both plants support Habitat for Humanity and both the Boy and Girl Scouts of America.

Section 5

Xcel Energy Nuclear Operations and the U.S. Nuclear Energy Industry

The three reactors play a vital role in helping Minnesota meet its demand for affordable, reliable and sustainable energy.

In 2015, electricity production from U.S. nuclear power plants was about 800 billion kilowatt-hours—nearly 20 percent of America's electricity supply. In Minnesota, nuclear energy generates approximately 21 percent of the state's electricity, and Xcel Energy's three reactors generated about 13 billion kilowatt-hours of electricity, which is approximately 54 percent of Minnesota's carbon-free electricity generation.

Xcel Energy's nuclear plants provide 54 percent of the carbon-free electricity generation in Minnesota.

Over the past 25 years, America's nuclear power plants have increased output and improved performance significantly. Since 1990, the industry has increased total output equivalent to that of 26 additional 1,000-MWe nuclear power plants, when in fact only five new reactors have come online. This is due to the fact that in 1990, U.S. nuclear plants were operating approximately 66 percent of the time compared to achieving a record capacity factor of over 92 percent in 2015.

Nuclear Energy's Value Proposition

Nuclear energy's role in the nation's electricity portfolio was especially valuable during the 2014 "polar vortex," when record cold temperatures gripped the United States and other sources of electricity were forced off the grid. Nuclear power plants nationwide operated at an average capacity factor of 96 percent during the period of extreme cold temperatures. During that time, supply volatility drove natural gas prices in many markets to record highs and much of that gas was diverted from use in the electric sector so that it could be used for home heating.

Some of America's electricity markets, however, are structured in ways that place some nuclear energy facilities at risk of premature retirement, despite excellent operations. It is imperative that policymakers and markets appropriately recognize the full strategic value of nuclear energy in a diverse energy portfolio.

That value proposition starts with the safe and reliable production of large quantities of electricity around the clock.

One of nuclear energy's key benefits is the availability of low-cost fuel (which does not need to be delivered continuously and the ability to produce electricity under virtually all weather conditions. Renewable energy, an emerging part of the energy mix, is intermittent (the sun doesn't always shine and the wind

doesn't always blow when generation is needed) and therefore cannot be readily dispatched to meet demand; natural gas-fired generation depends on fuel being available (both physically and at a reasonable price); and on-site coal piles can freeze.

Nuclear power plants also provide clean-air compliance value. Minnesota's Next Generation Energy Act of 2007 set a goal that would reduce greenhouse gas emissions 15 percent below the 2005 level in 2015, and 30 and 80 percent below that level in 2025 and 2050, respectively.

Nuclear plants provide voltage support to the grid, helping to maintain grid stability. They have portfolio value, contributing to fuel and technology diversity. And they provide a tremendous local and regional economic development opportunity, including large numbers of high-paying jobs and significant contributions to the local and state economies and tax base.

Based on more than 50 years of experience, the nuclear industry is one of the safest industrial working environments in the nation.

Stable Prices for Consumers

In addition to increasing electricity production at existing nuclear energy facilities, power from these facilities is affordable and stable for consumers. Compared to the cost of electricity produced using fossil fuels—which are heavily dependent on market fuel prices—nuclear plants' fuel costs are relatively stable, making consumers' electric bills more predictable. Uranium fuel is only about one-third of the production cost of nuclear energy, while fuel costs have historically made up between 75-85 percent of coal-fired and natural gas production costs. Production costs for a nuclear plant have historically been $0.03/kWh or lower. Natural gas production costs are currently historically low at $0.03/kWh, but have been over $0.08/kWh in 2000, 2001, 2005 and 2008.

Safety and Security

Safety is the highest priority for the nuclear energy industry. Based on more than 50 years of experience, the industry is one of the safest industrial working environments in the nation. Through rigorous training of plant workers and increased communication and cooperation among nuclear plants and federal, state and local regulating bodies, the industry is keeping the nation's 99 nuclear plants safe for their communities and the environment.

The U.S. Nuclear Regulatory Commission (NRC) provides independent federal oversight of the industry and tracks data on the number of "significant events" at each nuclear plant. (A significant event is any occurrence that challenges a plant's safety systems.) The average number of significant events per reactor declined from 0.45 per year in 1990 to 0.01 in 2014, illustrating the emphasis on safety throughout the nuclear industry.

General worker safety is also excellent at nuclear power plants—far safer than in the manufacturing sector. U.S. Bureau of Labor Statistics data show that, in 2013, nuclear energy facilities achieved an incidence rate of 0.3 per 200,000

work hours, compared to 1.8 for fossil-fuel power plants, 1.8 for electric utilities and 4.0 for the manufacturing industry.

All American nuclear plants are designed and operated with public safety first and foremost in mind. The plants have redundant and diverse safety systems which are backed by multiple power sources.

U.S. nuclear plants also have over 9,000 highly trained paramilitary personnel protecting the plants from external threats. These plants also maintain emergency response plans that are reviewed and approved by the Nuclear Regulatory Commission and coordinated with the Federal Emergency Management Agency. In order to maintain this high level of safety and security within its community, each plant coordinates with its local police, fire, and EMS departments.

Industry Trends: License Renewal and New Plants

The excellent economic and safety performance of U.S. nuclear power plants has demonstrated the value of nuclear energy to the electric industry, the financial community and policymakers. This is evidenced by the increasing number of facilities seeking license renewals from the NRC.

Of the currently operating reactors nationwide, 84 out of 99 have received license renewal. The Nuclear Regulatory Commission found no technical limitations to prevent a nuclear plant from operating for 80 years.

Originally licensed to operate for 40 years, nuclear energy facilities can operate safely for longer. The NRC granted the first 20-year license renewal to the Calvert Cliffs plants in Maryland in 2000. As of March 2017, 84 currently operating reactors had received license extensions, and operators of 13 additional reactors either had submitted applications or announced that they will seek renewal. License renewal is an attractive alternative to building new electric capacity because of nuclear energy's low production costs and the return on investment provided by extending a plant's operational life.

The Nuclear Regulatory Commission has found that there are no technical reasons to prevent a nuclear plant from operating for 80 years. In 2014, the Nuclear Regulatory Commission found that its current regulatory structure regarding initial license renewal is suitable for second license renewal. In 2015, Dominion announced that it will apply in 2019 for a second license renewal for its Surry Power Station in Virginia. If granted, this will allow the plant to operate for an additional 20 years (80 years in total). Exelon announced in June 2016 that it will pursue second license renewal for its Peach Bottom plant.

Besides relicensing nuclear plants, energy companies are building new, advanced-design reactors. Georgia Power and South Carolina Electric & Gas are building two advanced reactors each, near Augusta, Ga., and Columbia, S.C. These facilities are nearly halfway through their construction programs. These projects employ more than 5,000 workers each now that construction is peaking. In addition, Tennessee Valley Authority began operation of the Watts Bar 2 reactor in Tennessee in June 2016.

Section 6

Economic Impact Analysis Methodology

This analysis uses the REMI model to estimate the economic and fiscal impacts of Xcel Energy's nuclear facilities.

Regional Economic Models, Inc. (REMI)

REMI is a modeling firm specializing in services related to economic impacts and policy analysis, headquartered in Amherst, Mass. It provides software, support services, and issue-based expertise and consulting in almost every state, the District of Columbia, and other countries in North America, Europe, Latin America, the Middle East and Asia.

REMI's software has two main purposes: forecasting and analysis of alternatives. All models have a "baseline" forecast of the future of a regional economy at the county level. Using "policy variables," in REMI terminology, provides scenarios based on different situations. The ability to model policy variables makes it a powerful tool for conveying the economic "story" behind policy. The model translates various considerations into understandable concepts like GDP and jobs.

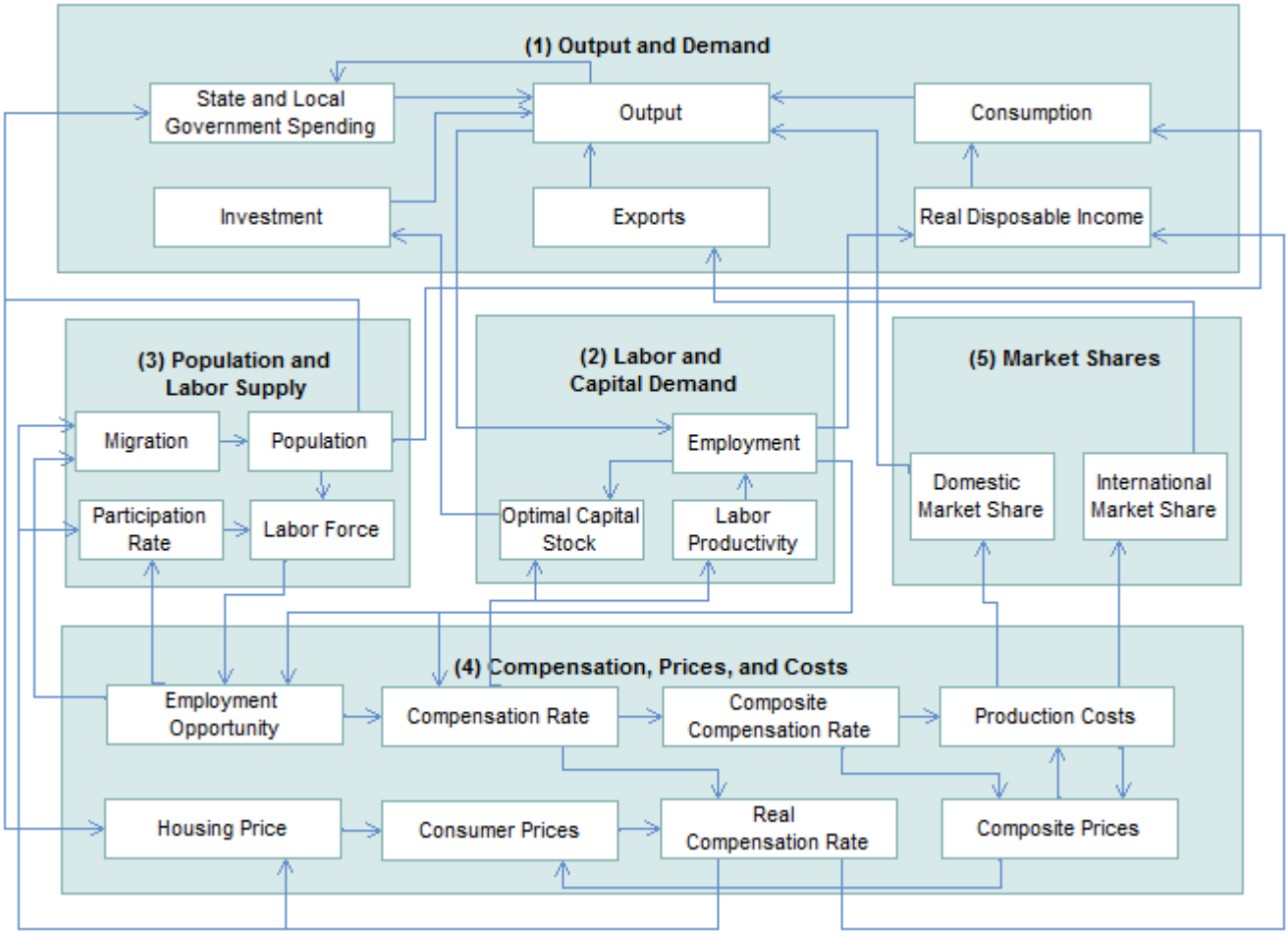
REMI relies on data from public sources, including the Bureau of Economic Analysis, Bureau of Labor Statistics, Energy Information Administration and the Census Bureau. Forecasts for future macroeconomic conditions in REMI come from a combination of resources, including the Research Seminar in Quantitative Economics at the University of Michigan and the Bureau of Labor Statistics. These sources serve as the main framework for the software model needed to perform simulations.

Policy Insight Plus (PI+)

REMI's PI+ is a computerized, multiregional, dynamic model of the states or other sub-national units of the United States economy. PI+ relies on four quantitative methodologies to guide its approach to economic modeling:

1. Input/output tabulation (IO)—IO models, sometimes called "social accounting matrices" (SAM), quantify the interrelation of industries and households in a computational sense. It models the flow of goods between firms in supply-chains, wages paid to households, and final consumption by households, government and the international market. These channels create the "multiplier" effect of $1 going farther than when accounting for its impact on enabling subsequent value..
2. Computable general equilibrium (CGE)—CGE modeling adds market concepts to the IO structure. This includes how those structures evolve over time and how they respond to alternative policies. CGE incorporates con-

Figure 6.0



This diagram represents the structure and linkages of the regional economy in PI+. Each rectangle is a discrete, quantifiable concept or rate, and each arrow represents an equation linking the two of them. Some are complex econometric relationships, such as the one for migrant, while some are rather simple, such as the one for labor force, which is the population times the participation rate. The change of one relationship causes a change throughout the rest of the structure because different parts move and react to incentives at different points. At the top, Block 1 represents the macroeconomic whole of a region with final demand and final production concepts behind GDP, such as consumption, investments, net exports and government spending. Block 2 forms the "business perspective": An amount of sales orders arrive from Block 1, and firms maximize profits by minimizing costs when making optimal decisions about hiring (labor) and investment (capital). Block 3 is a full demographic model. It has births and deaths, migration within the United States to labor market conditions, and international immigration. It interacts with Block 1 through consumer and government spending levels and Block 4 through labor supply. Block 4 is the CGE portion of the model, where markets for housing, consumer goods, labor and business inputs interact. Block 5 is a quantification of competitiveness. It is literally regional purchase coefficients (RPCs) in modeling and proportional terms, which show the ability of a region to keep imports away while exporting its goods to other places and nations.

cepts on markets for labor, housing, consumer goods, imports and the importance of competitiveness to fostering economic growth over time. Changing one of these will influence the others—for instance, a new knife factory would improve the labor market and then bring it to a head by increasing migration into the area, driving housing and rent prices higher, and inducing the market to create a new subdivision to return to "market clearing" conditions.

3. Econometrics—REMI uses statistical parameters and historical data to populate the numbers inside the IO and CGE portions. The estimation of the different parameters, elasticity terms and figures gives the strength of various responses. It also gives the "time-lags" from the beginning of a policy to the point where markets have had a chance to clear.

4. New economic geography—Economic geography provides REMI a sense of economies of scale and agglomeration. This is the quantification of the strength of clusters in an area and their influence on productivity. One example would include the technology and research industries in Seattle. The labor in the area specializes to serve firms like Amazon and Microsoft and, thus, their long-term productivity grows more quickly than that of smaller regions with no proclivity towards software development (such as Helena, Mont.). The same is true on the manufacturing side with physical inputs, such as with the supply-chain for Boeing and Paccar in Washington in the production of transportation equipment. Final assembly will have a close relationship and a high degree of proximity to its suppliers of parts, repairs, transportation and other professional services, which show up in clusters in the state.

Conclusion

The estimated total economic impacts (direct and secondary) to Minnesota from Xcel Energy's nuclear operations at its three reactors and support operations at Xcel Energy headquarters are over $1 billion in output and approximately $600 million in gross state product every year. These operations also contribute $240 million in after-tax income to residents of Minnesota. The nuclear operations and their secondary effects also account for over 6,000 jobs in Minnesota.

The plant's economic benefits—on taxes and through wages and purchases of supplies and services—are considerable. In addition, plant employees further stimulate the local economy by purchasing goods and services from businesses around the area, supporting many small businesses throughout the region.

The facilities generated nearly 13 billion kilowatt-hours of emission-free electricity in 2015, enough to serve the yearly needs for 1.4 million homes. This low-cost, reliable electricity helped keep electricity prices in check in Minnesota.

Xcel Energy's nuclear plants are leaders economically, fiscally, environmentally and socially within Minnesota.

APPENDIX P1 – E3 SUMMARY

I. OVERVIEW OF ANALYSIS CONDUCTED BY ENERGY AND ENVIRONMENTAL ECONOMICS

We retained Energy and Environmental Economics, Inc. (E3) to provide analysis to inform our Resource Plan. E3 is a recognized industry-leading firm based in San Francisco and consults extensively with utilities, developers, government agencies, and environmental groups on clean energy issues. E3's experience analyzing the impacts of economy-wide decarbonization and the impacts of decarbonization on utility systems in other parts of the country was very valuable to us in evaluating the impacts of decarbonizing our Upper Midwest System and developing our Preferred Plan.

E3's analysis is provided in two reports. The first report provides their analysis on decarbonizing our Upper Midwest System (System Study). For this analysis, E3 performed an electricity portfolio optimization analysis that identifies a range of strategies to meet our greenhouse gas reductions goals. The second report provides E3's analysis on achieving the Minnesota economy-wide goal of an 80 percent reduction in greenhouse gases below 2005 levels by 2050 (Pathways Study). E3 presented its analysis at stakeholder workshops in September and October of 2018 and April 2019.

A. Upper Midwest System Study

For the System Study, E3 performed independent modeling and analysis of our system to inform our Resource Plan using two models:

- The RESOLVE model, which evaluates and optimizes the least-cost portfolios of resources to meet system demand considering carbon and other constraints,
- The RECAP model, which evaluates the reliability of electric energy and system capacity of the optimized resource portfolios over thousands of simulated weather years.

E3 used scenario analysis to examine the impacts of achieving deep carbon reductions in our generation portfolio in accordance with our long-term goals. Each scenario examined was designed to achieve carbon reduction milestones of 85% below 2005 levels by 2030 and 95% below 2005 levels by 2045. As discussed in detail in the report, these scenarios varied assumptions on the retirement of our nuclear and coal plants and the ability to add new gas-fired resources, the impacts of high electrification, gas prices, technology costs, and the ability to sell surplus generation into the MISO market.

The System Study contains several key findings that inform our Resource Plan:

1. **The study suggests that we can achieve substantial reductions in carbon emissions from our Upper Midwest portfolio at relatively low cost.** Across the 21 scenarios examined in this study that achieve deep carbon reductions during the study horizon, the lowest-cost scenarios reduce carbon at a levelized cost of $15-20 per ton. The ability to achieve such large emissions reductions at such a relatively low cost results from several converging factors: (1) low natural gas prices, which enable low-cost fuel switching from coal to gas; (2) the relatively low (and falling) costs of new wind and solar resources due to technology improvements over the past decade; (3) a potential to increase deployment of energy efficiency and other demand-side programs to manage load growth; and (4) anticipated reductions in future battery storage costs, which enable integration of high penetrations of renewable generation.
2. **The lowest-cost near-term opportunity to reduce carbon in Xcel's Upper Midwest system is to replace coal generation with a combination of renewables, storage, natural gas and efficiency.** E3's analysis suggests that accelerating the retirement of our remaining coal plants and replacing them with a portfolio of efficiency, renewables, storage, and natural gas generation provides the least-cost pathway to reducing emissions consistent with our 2030 goals.
3. **A diverse portfolio of resources—including nuclear—offers the least-cost long-term pathway to deep carbon reductions.** The scenario analysis conducted in this study suggests that under most circumstances, extending the licenses of both Monticello and Prairie Island to allow continued operation provides a least-cost option to meeting long-term carbon goals. This is due not only to the plants' ability to generate carbon-free electricity at relatively low cost but also, and perhaps more significantly, to the fact that nuclear generation (unlike wind, solar, or energy storage), as a "firm" resource, can generate at its full nameplate capacity for sustained periods when needed to meet reliability needs. This unique combination of characteristics makes existing nuclear plants inherently valuable to meeting our long-term carbon goals. All else equal, levelized cost of carbon abatement was higher in scenarios that did not allow nuclear relicensing.
4. **While new resources like wind, solar, and storage will play a central role in supplying carbon-free energy to Xcel's customers, these resources alone cannot meet Xcel's resource adequacy needs at reasonable costs.** The reliability analysis conducted in the study highlights the limitations of renewable and storage resources to meet resource adequacy needs: due to

variability of renewable generation and limits on duration of energy storage with today's technologies, these resources offer less capacity value than firm resources that can produce at full capacity when needed. Further, because their marginal capacity value declines with increasing penetration, wind, solar, and storage offer a relatively poor substitute for traditional firm capacity resources in meeting reliability needs at scale. Taken to an extreme, this study shows that a system designed to rely solely on renewables and storage to meet reliability needs would require prohibitively large investments. These findings underscore the need for an evolving approach to resource adequacy as the system as a whole incorporates greater amounts of renewables and storage. Such an approach would ensure that sufficient resources are available even when variable renewables and storage alone cannot produce sufficient levels of generation to meet load.

5. **Natural gas plants will be useful to ensure a reliable system but will operate at low capacity factors.** Some form of firm, dispatchable capacity is likely necessary to complement large anticipated investments in efficiency, renewables, and storage that will be necessary to decarbonize Xcel's energy supply. **Error! Reference source not found.** shows that among all low-carbon scenarios considered in this study, the least-cost options rely heavily on firm capacity resources to meet resource adequacy needs. In Xcel's case, investing in 2,000 to 4,000 MW of new gas generation capacity will lower the costs of achieving long-term carbon goals. All else equal, the levelized cost of carbon abatement was higher in scenarios that did not allow new gas. In the extreme, providing reliable electricity in a scenario with no dispatchable gas was modeled to require 36 GW of wind and solar, 24 GW of storage, and impose $4.4 billion per year in incremental fixed costs. As technology continues to improve, some of the electricity system values provided by gas generation may be able to be provided by a combination of longer-duration storage, demand response, and carbon-free dispatchable technologies that are not commercial today.

B. PATHWAYS Study

For the PATHWAYS study, E3 developed a set of long-term economy-wide, deep decarbonization scenarios for the state of Minnesota. These scenarios provide an exploration of the cross-sectoral implications of meeting economy-wide carbon reduction goals, and highlight the role of Xcel Energy, and the electric sector as a whole, in meeting the state's economy-wide carbon goal. The PATHWAYS study highlights the central role of the electric sector in reducing economy-wide greenhouse gas emissions by supplying clean energy to new loads as more fossil-fueled end uses convert to electricity.

Key finds from the PATHWAYS study include:

1. **Electrification and low-carbon electricity are necessary (but not sufficient) to reach statewide goals.** The analysis demonstrates how increased reliance on low-carbon electricity enables emission reductions by avoiding direct combustion of fossil fuels in households, businesses, and vehicles across a number of scenarios. Under a high electrification scenario, switching multiple end uses to very low-carbon electricity could enable an estimated 35 million tons of CO_2 reductions per year in other sectors by 2050, in addition to reductions in the electric sector itself.
2. **Buildings and transportation have significant potential to drive load growth, especially after 2025.** The analysis also highlights the significant potential for adoption of new electric appliances and vehicles, and the potential impact on total electricity requirements for Minnesota utilities. Transportation and building electrification drive electric load growth, especially after 2030, particularly in a future with constraints on bioenergy. Electrification of space heating has a particularly large impact on both total load (MWh) and peak demand (MW), primarily due to two factors: cold-climate efficiency challenges with electric air source heat pumps, and the greater difficulty (compared to electrified transportation or water heating) of limiting heating loads to off-peak hours.
3. R**easonable electric rates and low costs for new electric devices are essential for electrification.** The levels of electrification modeled in buildings and transportation are dependent on consumer adoption, which will benefit from reductions in capital costs and reasonable electric rates, even as the electric grid continues to decarbonize.

C. Relation to the Company's Resource Plan Analysis

By design, the scope of analysis conducted in E3's System Study overlaps considerably with the internal analysis conducted to develop our Preferred Plan. Wherever possible, the E3 studies relied on the same numerical inputs and assumptions as used to develop our Preferred Plan, supplemented by publicly available data sources where necessary. This approach was chosen to test the hypothesis that Xcel's internal analysis should generally align with the results obtained by an unbiased third-party using rigorous industry-standard approaches.

The PATHWAYS study provides context for the role of the electricity sector in reducing statewide carbon emissions. The PATHWAYS study explores scenarios that

could achieve an 80 percent reduction in economy-wide greenhouse gas emissions, but it is not a least-cost optimization. As discussed in Appendix F4, the PATHWAYS study was also used to develop a high electrification load forecast sensitivity that was analyzed in E3's System Study and our Strategist modeling.