

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

An Analysis by the Nuclear Energy Institute

April 2017



NUCLEAR ENERGY INSTITUTE

www.nei.org

Contents

Executive Summary	3
Section 1 Background and Electricity Generation History	5
Section 2 Economic Benefits in Minnesota	7
Section 3 Protecting the Environment	13
Section 4 Community Leadership and Environmental Protection	15
Section 5 Xcel Energy and the U.S. Nuclear Industry	17
Section 6 Economic Impact Analysis Methodology	20
Conclusion	23

Nuclear Energy Institute
1201 F St., NW, Suite 1100,
Washington, DC 20004-1218
202.739.8000

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:

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

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

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

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 baseload 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).



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

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.

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.

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.

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

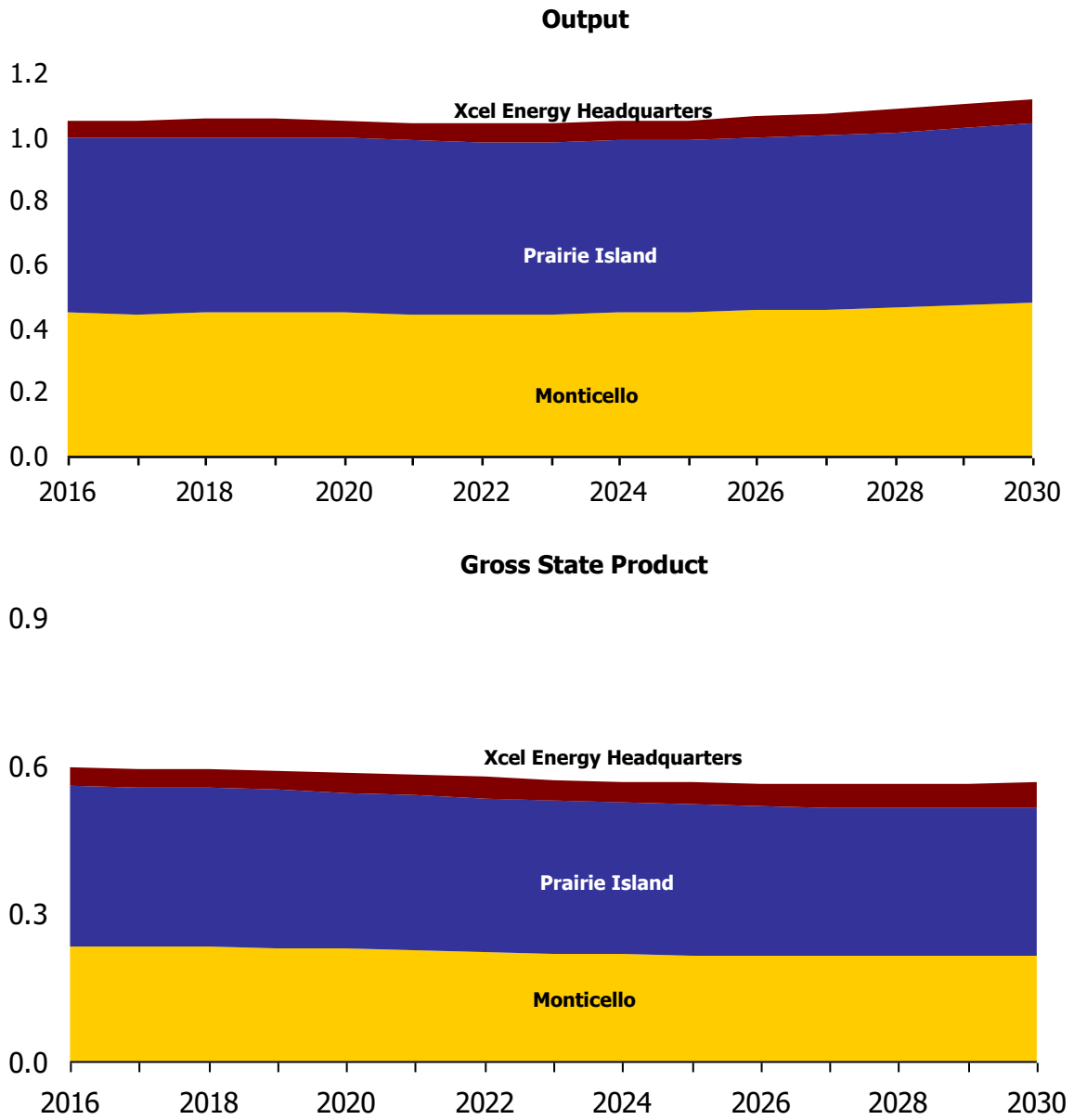


Figure 2.0 shows the value of total output and contributions to GSP from the operation of Xcel Energy's nuclear facilities through 2030, using spending data provided by Xcel Energy.

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.

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



Prairie Island employees volunteering at Red Wing Memorial Park.

- 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 Military.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.

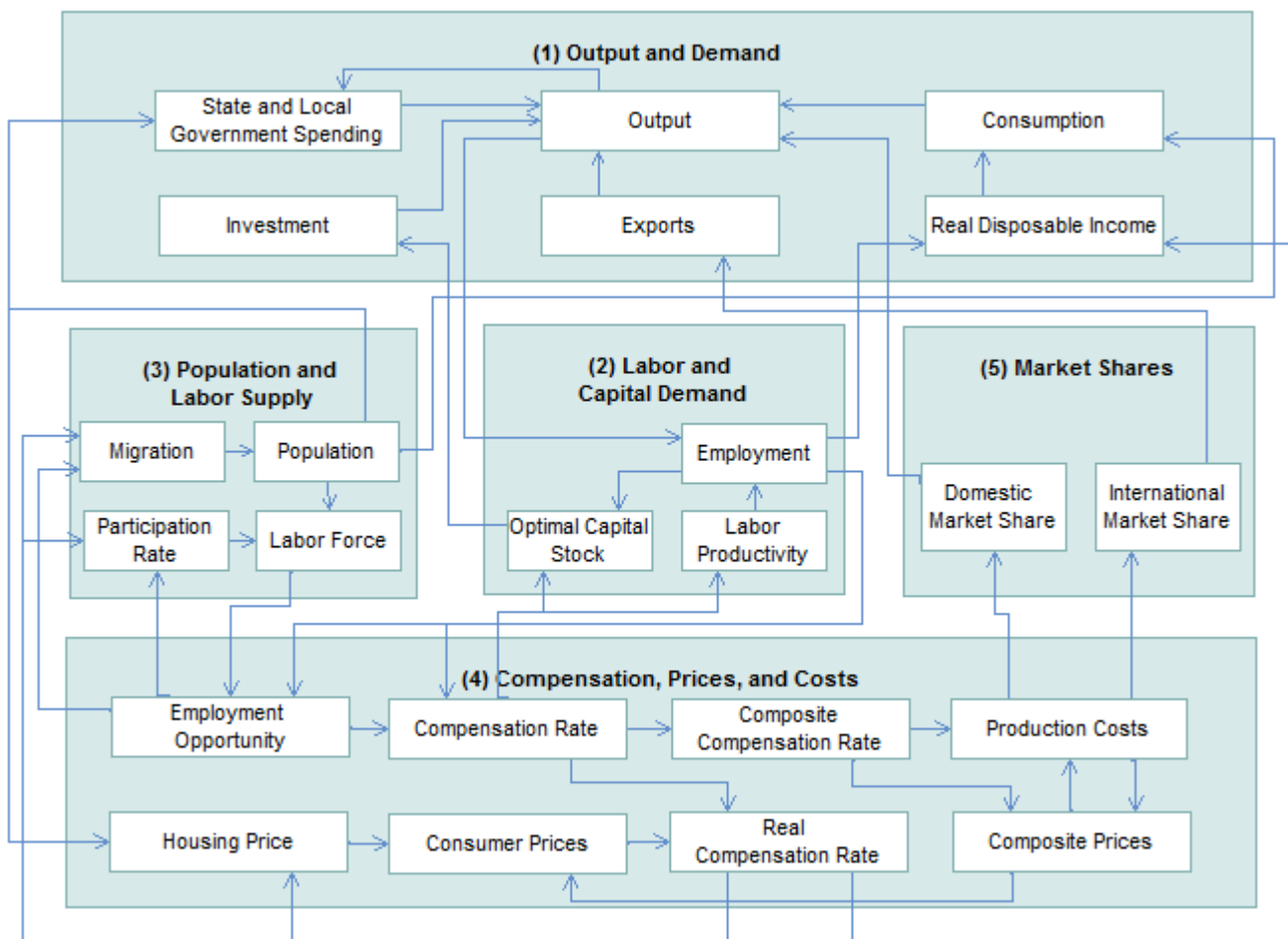
REMI relies on data from public sources, including the Bureau of Economic Analysis, Bureau of Labor Statistics, Energy Information Administration and the Census Bureau. Forecasts for future macroeconomic conditions in REMI come from a combination of resources, including the Research Seminar in Quantitative 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.



