COMMERCE DEPARTMENT
ENERGY RESOURCES

# Energy Policy and Conservation Quadrennial Report, 2020

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Prepared by
Minnesota Department of Commerce, Division of Energy Resources

Pursuant to Minnesota Statute § 216C.18

# *Acknowledgements*

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## Disclaimer

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# Minnesota Department of Commerce

### With You Every Day

Wherever you are in Minnesota, the Department of Commerce is with you every day. Whether you're filling up on gas, purchasing a home, working to reduce energy consumption, or rebuilding after a disaster—we are with you, no matter what.

The Minnesota Department of Commerce oversees more than 20 regulated industries, ensuring that Minnesota consumers are protected, and businesses are strong. Our mission is to protect the public interest, advocate for Minnesota consumers, ensure a strong, competitive, and fair marketplace, strengthen the state's economic future, and serve as a trusted public resource for consumers and businesses. Learn more at mn.gov/commerce

# Chapter 1: The Quad Report

In accordance with Minnesota Statute §216C.18, the Minnesota Department of Commerce (Commerce), with inputs from other state agencies, organizations, and the Minnesota Public Utilities Commission (PUC), produces a State Energy Policy and Conservation Report. Informally referred to as the Quadrennial or Quad Report, it documents status and major emerging trends and issues in Minnesota's energy supply, consumption, conservation, and costs to the fullest extent possible. The U.S. State Energy Program was the primary source of funding for this Quadrennial Energy Report.

Due to resource constraints posed by the worldwide pandemic in 2020, Commerce obtained an extension for filing the report. As a result, although the report predominantly covers 2016 through 2019, aspects of 2020 also were addressed where feasible.

Multiple statutes provide the powers and responsibilities assigned to the commissioner of Commerce over the production, distribution, and sale of energy in Minnesota. The primary statutes are:

- §216A: Public Utility Regulators
- §216B: Public Utilities
- §216C: Energy Planning and Conservation
- §216E: Electric Power Facility Permits
- §216F: Wind Energy Conversion Systems
- §216G: Pipelines
- §216H: Greenhouse Gas Emissions

Commerce serves as the lead entity to coordinate cooperation, resources, and information among State agencies with responsibility for matters relating to energy and represents the public interest to maintain affordable and reliable energy. In general, Commerce is charged with:

- Evaluating electric and gas utilities' rate increase requests and evaluating utility plans to add new power generation, power lines, or natural gas distribution pipelines;

- Serving as an advocate for the public interest in PUC proceedings to assure that utilities provide reliable, cost-effective, and environmentally sound service to ratepayers;
- Assuring that utilities achieve Minnesota's Renewable Electricity Standard (RES) in a cost-effective manner;
- Assuring that utility energy conservation programs are cost-effective and help Minnesota consumers achieve energy savings through energy efficiency;
- Directing all aspects of environmental review and permitting of large energy projects;
- Administering the federally funded Low-Income Home Energy Assistance Program and Low-Income Weatherization Assistance Program to help resource-constrained families with their winter energy bills, and make their homes healthier and more energy efficient;
- Maintaining State emergency energy planning and recovery plans;
- Maintaining the Energy Information Center, an energy data repository for the State and free resource for all Minnesotans to access scientifically sound information about how to save energy through conservation and efficiency improvements, and providing technical assistance on options to access renewable energy resources; and
- Monitoring liquid fuel supplies, including petroleum and biofuels.

The critical role that energy plays in the economic, environmental, and social vitality of Minnesota is demonstrated on a daily basis. Commerce is dedicated to ensuring that Minnesota has a reliable energy system well into the future — an energy system that meets the state's economic needs, provides energy resources at costs that are reasonable, and minimizes environmental impacts from production and consumption. Commerce also works to ensure the State meets laws and goals established by the Legislature. Commerce's primary focus is assuring Minnesota's current and long-term energy reliability, including the long-term adequacy of supply. The Department works to ensure the security, quality, and sufficiency of the electricity transmission grid and local electric distribution systems, as well as supply and distribution systems for natural gas and petroleum products sold in the state.

# *Overview of Minnesota's Energy Landscape*

Minnesota is part of a larger network in the delivery of energy across the Midwest and beyond. About 30% of all U.S. crude oil imports flow through Minnesota on the way to refineries in the state and to other U.S. markets. Minnesota consumes about one-fifth of the natural gas from interstate pipelines that cross the state. Minnesota also consumes more electricity than is generated within the state. Over the past decade Minnesota has imported about one-fifth of annual electricity use from other states and Canada via the regional electric grid.[1]

Minnesota has no indigenous fossil fuel reserves to supply its energy needs. Most of the energy consumed within Minnesota comes from other states and Canada. Over 73% of all energy consumed in Minnesota comes from fossil fuels used for heating, industrial processes, transportation, and electricity generation. More than half of imported electricity is generated with fossil fuels.

Minnesota has an abundant supply of wind, solar, and bio-based energy. Minnesota ranks among the top five states in the nation for ethanol production capacity, according to U.S. Energy Information Administration (EIA) data. In addition, Minnesota ranks among the top 10 states in electricity generation from wind and solar energy.[2] Renewable resources continue to make up an increasing share of the state's energy supply. A diagram, below, of Minnesota's energy use in 2018 shows how energy flows from primary fuel sources and how it is used, including where energy is lost due to system inefficiencies. Notably, more than half of the energy consumed in the state is wasted, rendering only 42.3% (661 trillion Btu) of the energy useful.

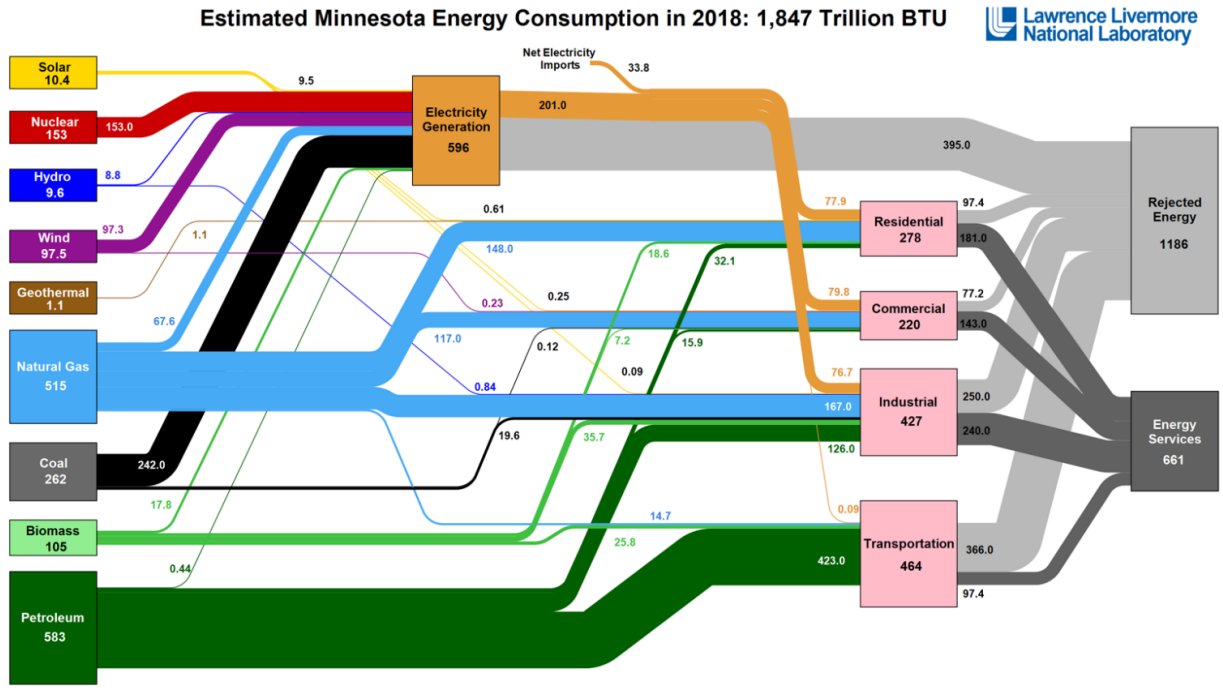



**Figure 1-A: Out of all energy consumed in Minnesota in 2018, over 57% went unused as waste heat.**

Figure 1-A shows Minnesota's estimated energy consumption in 2018. Of the 1,847 trillion Btu consumed that year, more than 57% went unused as waste heat.

*Source: Lawrence Livermore National Laboratory.*

## Renewable Energy Goal for Total Energy Use

*Goal: Derive 25% by 2025 of total energy used in the state from renewable resources for heating, industrial processes, transportation, and electricity generation (Minnesota Statute §216.05).*

**Status: Minnesota obtained 16% of its *total* energy from renewable resources in 2018 and is at risk of missing its 25% by 2025 goal.**

In 2018, 16% of the total energy consumed in Minnesota for heating, industrial processes, transportation, and electricity generation came from renewable sources, compared with a United States average of 11% renewable consumption. Minnesota is at risk of missing the State goal to provide one-fourth of its total energy consumption from renewable sources by 2025. Achieving this goal could be possible with a long-term decrease in total energy consumption (reducing the denominator) or a 5 to 10% increase in renewable energy consumption (increasing the numerator).

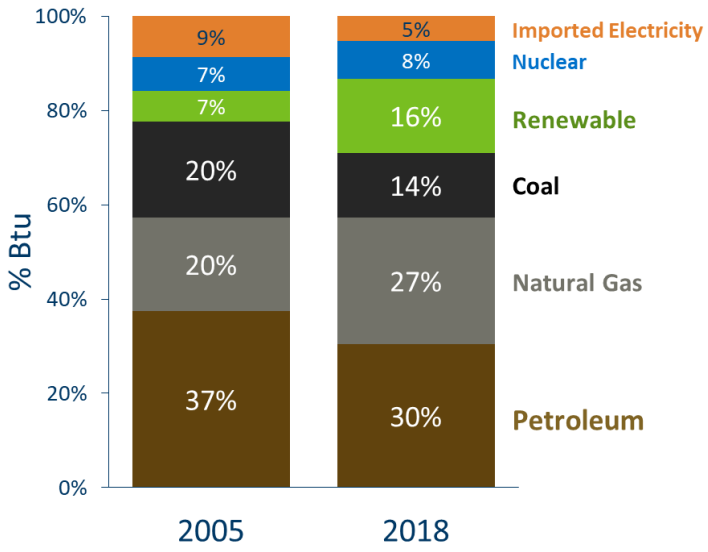



**Figure 1-B: In 2018, 16% of all energy consumed in Minnesota came from renewable sources.**

*Source: U.S. EIA*

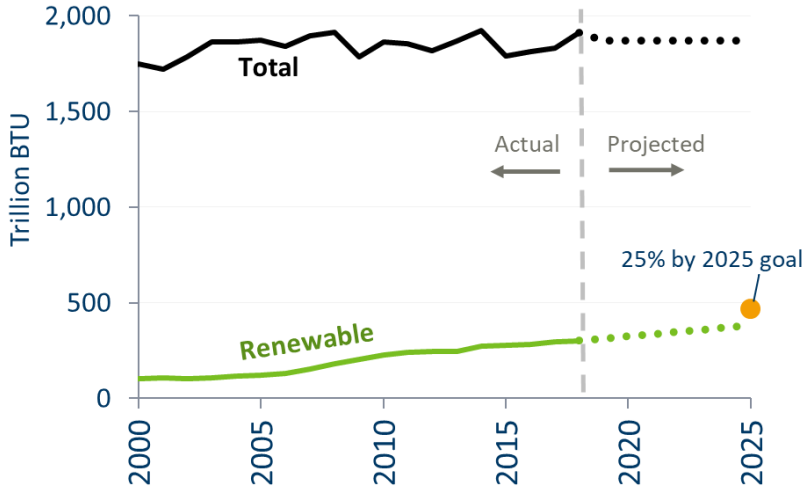



**Figure 1-C: Minnesota is at risk of missing its goal of 25% of total energy use from renewables by 2025.**

*Source: U.S. EIA*

## Greenhouse Gas Emissions Reduction Goal

*Goal: To reduce greenhouse gas emissions (GHG) statewide to a level at least 15% below 2005 base levels by 2015, 30% by 2025, and 80% by 2050 (Minn. Stat. §216H.02).*

**Status: Minnesota missed the 2015 milestone and is not on track to meet 2025 goals.**

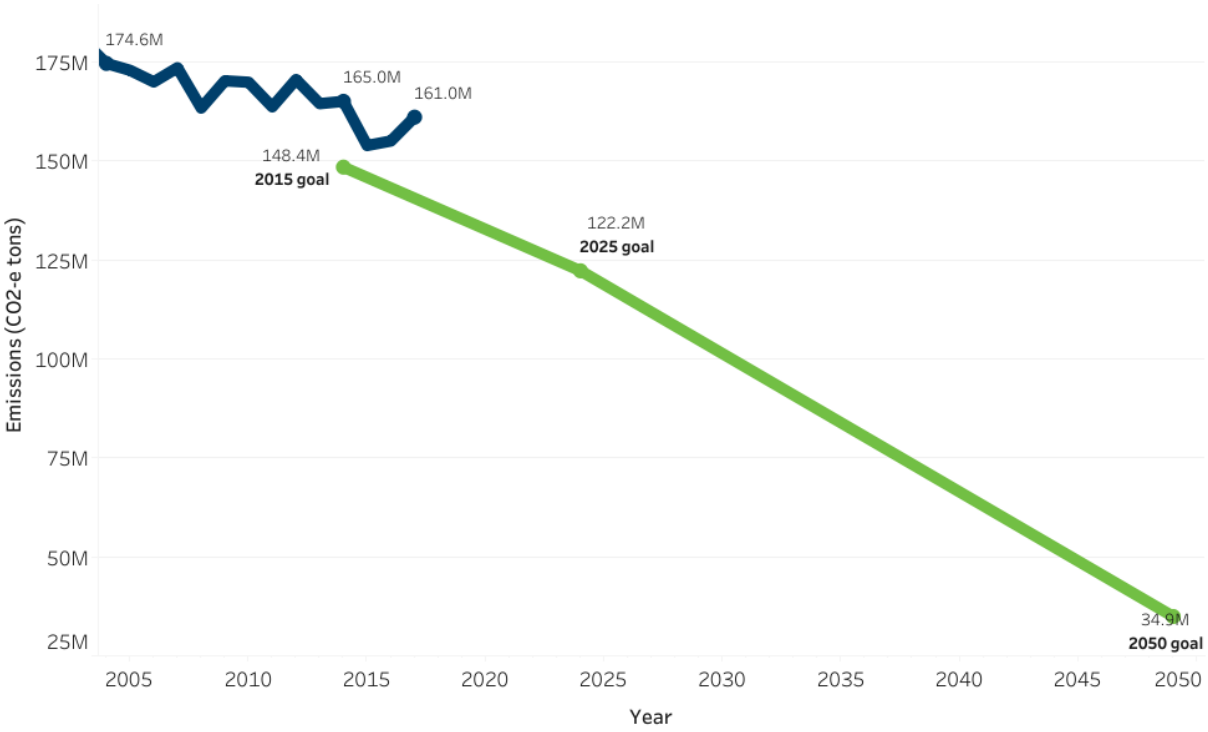



**Figure 1-D: Minnesota is not on track to meet its 2025 GHG emissions goals.**

*Source: Minnesota Pollution Control Agency*

In 2007, Governor Tim Pawlenty signed the bi-partisan Next Generation Energy Act into law, setting statutory goals to reduce greenhouse gas (GHG) emissions by 15% from 2005 levels by 2015, 30% by 2025, and 80% by 2050. Minnesota missed its goal in 2015 and currently is not on track to meet future goals. Since 2005, overall GHG emissions overall have declined by just 8%.[3]

The positive progress in Minnesota so far has been concentrated in the electricity generation sector. Between 2005 and 2018, the carbon intensity of electricity delivered for Minnesota consumption decreased by 29%. In the same timeframe, all other parts of the economy have seen only modest reductions or emission increases. Emissions attributable to industrial, residential, and commercial activity have all increased by 15% or more.

Minnesota continues to see excellent progress in reducing emissions from electricity consumption because of growth in renewable electricity and reduction in coal-fired electricity, primarily from generation within state borders. Future emissions reduction in the power sector will depend on the resources chosen within and outside state borders to serve load in Minnesota as aging power plants continue to retire.

Additional discussion of the State's policies, programs, research, and initiatives to decarbonize electricity generation can be found in Chapters 3, 4, and 6.

## Energy Savings Goal and the Conservation Improvement Program

*Goal: Energy savings of 1.5% of average annual retail sales each year for electric and natural gas utilities, unless adjusted by the commissioner to no less than 1.0% (Minn. Stat. §216.241).*

**Status: Utilities are meeting and exceeding their energy efficiency goals.**

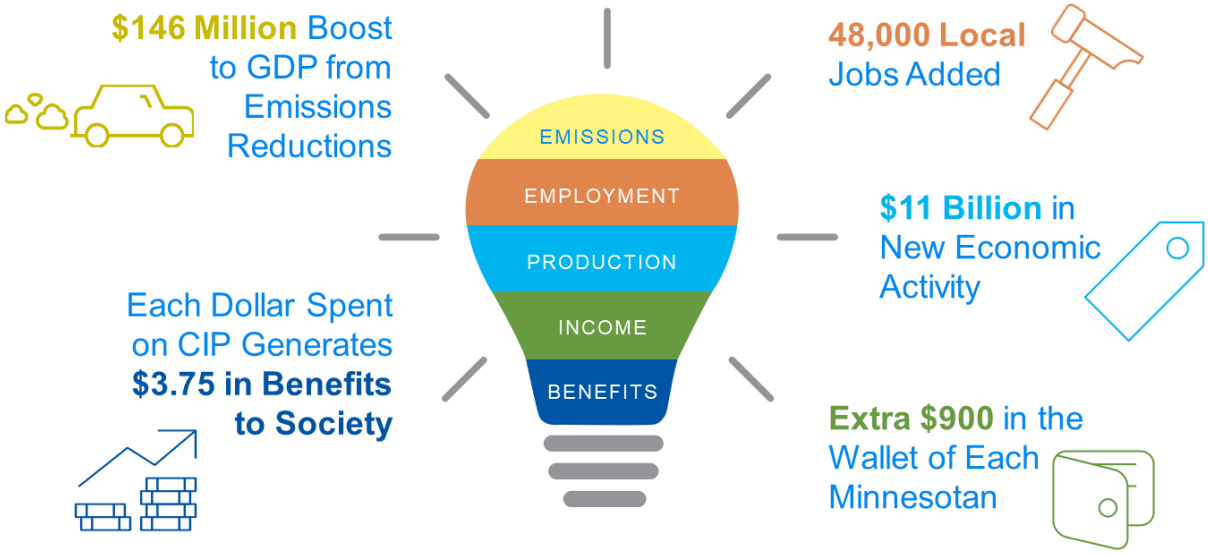



**Figure 1-E: Each dollar spent on CIP generates $3.75 in benefits to society.**

*Source: Cadmus Group*

Minnesota's Conservation Improvement Program (CIP) establishes an annual savings goal of 1.5% of average retail sales for electric and natural gas utilities. During 2017 and 2018, electric utilities exceeded the CIP goal of 1.5%, and natural gas utilities exceeded the statutory minimum of 1.0% energy savings. In total, in years 2017 and 2018, energy conservation programs benefited Minnesota's environment and economy by:

- Saving around 15.2 trillion Btu of energy — enough energy to heat, cool and power more than 160,000 Minnesota homes for a year;[4]
- Reducing $CO_2$ emissions by 1.79 million tons, equivalent to removing over 350,000 vehicles from the road for one year;[5]
- Saving Minnesota's businesses and residents over $279 million in energy costs;[6] and
- Supporting over 48,000 energy efficiency jobs, representing the largest share of Minnesota's clean energy employment.

CIP brings positive economic and societal benefits to Minnesota, according to an independent 2020 study of CIP investments made from 2013 to 2018. The study found that each dollar spent on CIP generates $3.75 in benefits to society.[7] The study also showed that CIP generates numerous immediate and persistent positive economic effects on energy bill savings, job growth, and environmental benefits.

Additional discussion of the State's policies, programs, research, and initiatives to support energy efficiency and conservation can be found in Chapters 2, 3, 4 and 5.

## Building Energy Use

*Goal: Energy savings of 1.5% of annual electricity and natural gas retail sales through conservation improvement programs and rate design, energy codes and appliance standards, and programs designed to transform the market or change consumer behavior and other efforts (Minn. Stat. §216B.2401).*

**Status: Utilities are meeting their energy savings goals, but overall emissions and energy use from buildings are increasing.**

As a cold-climate state, energy efficiency is critical. Minnesota has some of the coldest winter weather in the nation, coupled with hot, humid summers.[8] Buildings require of large amounts of energy to heat and cool. In 2017, Minnesota's buildings consumed 40.6% of the total energy use in the state, 19.5% of which was from commercial buildings, including large multifamily buildings.[9]

**Buildings consume over 40% of the energy used in Minnesota**.

In Minnesota, the average energy burden is 2%, while low-income households average an energy burden of 8% and some Minnesotans face an energy burden exceeding 30%.[10] The federally funded Low-income Weatherization Assistance Program supports home energy efficiency upgrades, lowering the energy burden of households with income at or below 200% of the federal poverty level.

Minnesota's growing population combined with long-term housing shortages are driving new building construction in the state.[11] From 2016 to 2019, Minnesota's population and number of households increased by 2.7%.[12] From 2018 to 2032, Minnesota's population is estimated to increase by 7%.[13] Between 2016 and 2018, between 11,000 and 14,000 homes were built each year.[14] During the same timeframe, more than 5 million square feet of commercial building space was added each year in the Twin Cities area.[15]

Building codes provide a significant opportunity to reduce energy consumption and reduce energy bills. The relationship between building codes and energy use intensity (EUI) in buildings has been well documented.[16,17] On March 31, 2020, the Minnesota Department of Labor and Industry updated the commercial building energy code from the 2012 International Energy Conservation Code (IECC) to the 2018 IECC. The U.S. DOE estimated that the new building standards will result in more than 8% energy cost savings and 6% energy savings.[18] The 2021 IECC building code was approved in 2020 is expected to further improve efficiency by 10% in residential and commercial buildings for decades to come.[19]

Minnesota's policies and programs work together to support cost-effective energy conservation and efficiency in new and existing buildings. Minnesota is the only Midwestern state that consistently ranks in the top 10 states nationwide in the American Council for an Energy-Efficient Economy (ACEEE) State Energy Efficiency Scorecard.[20] As a result of these efforts, Minnesota's per capita energy consumption is lower than nearly two-fifths of other states.[21]

The remaining chapters of this report address the State's policies, programs, research, and initiatives to increase the production of renewable energy, and to decarbonize and reduce energy consumption.

## Renewable Electricity Standards

*Goal: Derive 25% of retail electricity sold in the state from renewable resources by 2025; 30% for Xcel Energy by 2020 (Minn. Stat. §216B.1691, Subdivision 2a).*

**Status: Utilities retired renewable energy credits (REC) representing more than 20% of 2019 retail electricity sales in Minnesota. Utilities are planning for renewable generation to meet or exceed future RES milestones.**

Minnesota's utilities are on track to meet and exceed their RES milestones of 30% by 2020 for Xcel Energy and 25% by 2025 for other electric utilities. In 2019, utilities retired RECs for more than 20% of the electricity sold in Minnesota.[22,23]

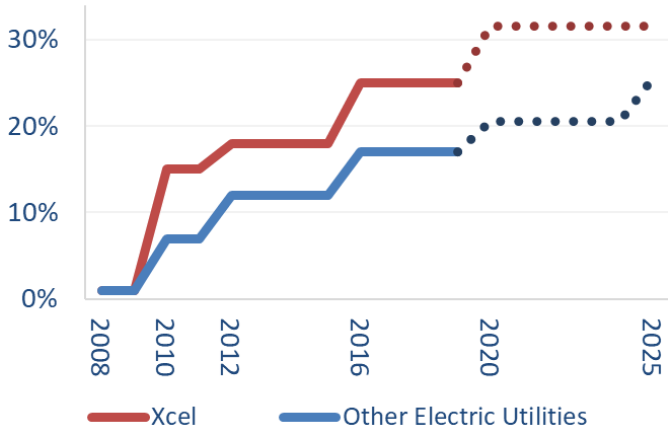



**Figure 1-F: Utilities are on-track to meet and exceed the Renewable Electricity Standards.**

*Source: Minnesota Department of Commerce*

Historically, Minnesota and the Midwest have relied on coal as the primary fuel source for electricity generation. However, Minnesota's suite of energy policies, combined with the low cost of natural gas and ongoing reductions in renewable energy technology costs, have led to a rapidly changing mix of resources used to generate electricity within state borders.

*Preliminary data for 2020 shows that Minnesota may be at a pivot point where renewable energy is becoming the primary source of electricity generated within the state.*

Between 2005 and 2020, electricity generated within Minnesota from renewable sources increased four-fold from 6% of electricity generated in 2005 to 29% in 2020, based on preliminary 2020 data.

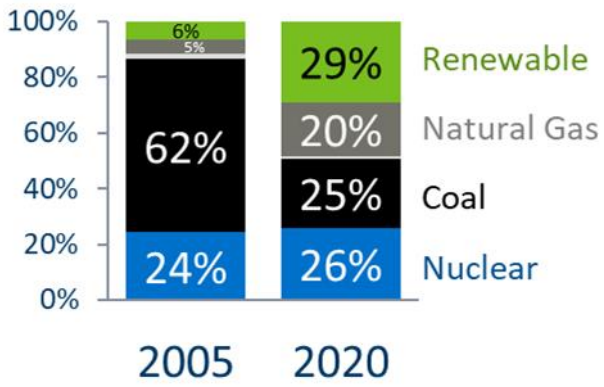



**Figure 1-G: Electricity generation within Minnesota's borders is transforming.**

*Source: U.S. EIA*

## Solar Electricity Standard

*Goal: Generate 1.5% of public utility retail electricity sales from solar energy by 2020, and 10% of all retail electricity sales from solar energy by 2030 (Minn. Stat. §216B.1691, Subd. 2f).*

**Status: Utilities are planning for solar generation to meet or exceed the 1.5% standard.**

Power generated from solar energy in the state has increased significantly in recent years. In 2013 the State amended the Renewable Energy Objectives Statute to include a Solar Electricity Standard of 1.5% by the end of 2020 for three investor-owned utilities: Minnesota Power, Otter Tail Power Co., and Xcel Energy. The SES also sets a state goal that by 2030, 10% of all electricity sales in Minnesota must be generated by solar energy.

According to preliminary data from the U.S. EIA, solar electricity accounted for nearly 3% of electricity generated within Minnesota in 2020, mainly from Xcel's Energy's community solar garden programs and utility-scale facilities that have at least 1 MW of generating capacity.[24]

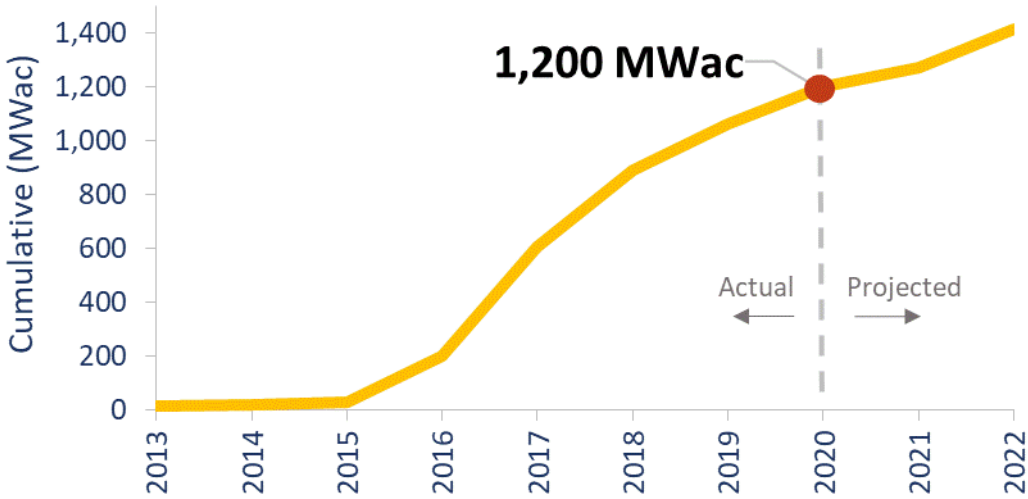



**Figure 1-H: Minnesota's solar generating capacity has grown rapidly since 2015.**

Figure 1-H shows Minnesota's cumulative solar power capacity from 2013 - 2020, with growth through 2022 projected to continue at a similar rate.

*Source: Minnesota Department of Commerce*

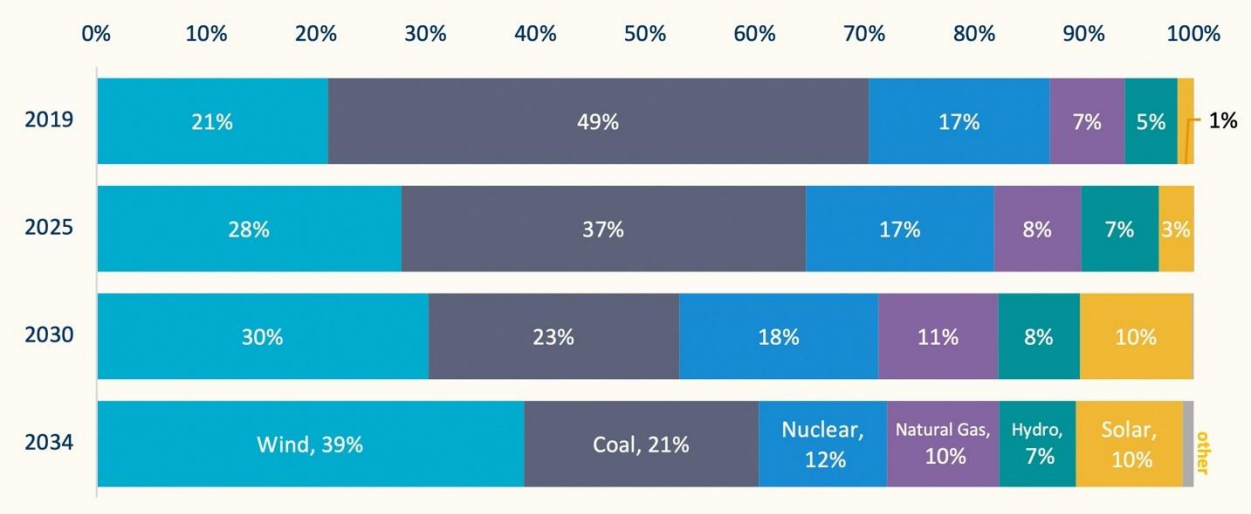
## Preference for Renewable Energy in Resource Planning

*Goal: Electric generation and transmission utilities that serve load in Minnesota are required to identify options for renewable energy resources in their long-term plans to serve customer needs (Minn. Stat. §216B.2422, Subd. 4).*

**Status: Utilities are evaluating potential system options to pursue least-cost, environmentally sound, and efficient resources consistent with current State and federal laws and goals**.

Eleven electric generation and transmission utilities that serve Minnesotans are required to file long-term plans on the resources needed to meet customer needs. An aggregated forecast of electric energy generation – including energy generated both inside and outside of Minnesota – based on Xcel, Minnesota Power, Otter Tail Power, and Great River Energy resource plans and announced retirements predicts a renewable electricity mix that includes more than 70% carbon-free resources by 2034, with 56% renewable resources (7% hydro, 10% solar, and 39% wind).

Future emissions reduction in the power sector will depend on the resources chosen to serve load as aging power plants continue to retire. Additional discussion of the state's policies, programs, research, and initiatives to decarbonize electricity generation can be found in Chapters 3, 4 and 6.




## Figure 1-I: Utilities are planning to transition to an energy mix that is over 70% carbon free by 2034

Figure 1-I shows the projected resource mix between 2019 and 2034 for power delivered to Minnesota – including energy generated both inside and outside of the state – based on Xcel, Minnesota Power, Otter Tail Power, and Great River Energy resource plans and announced retirements.

# *Clean Energy Policy Proposals*

Governor Walz and Lieutenant Governor Flanagan announced the One Minnesota Path to Clean Energy set of policy proposals in March 2019. This plan was updated in 2020 to prioritize proposals that help the State's electricity sector reach 100% carbon-free energy by 2040.

The clean energy package aims to drastically cut air pollution while creating jobs and opportunity for people across Minnesota. The plan includes proposals designed to achieve this goal while keeping energy costs low for Minnesota families as well as maintaining reliability of the state's electricity grid.

The Clean Energy Package has four main provisions:

1. 100% Carbon-Free Electricity by 2040 Standard
2. Clean Energy First
3. Energy Conservation and Optimization
4. 50% Carbon Reduction by 2035 in Existing Buildings Goal

**100% Carbon-Free Electricity by 2040 Standard:** By transitioning to 100% carbon-free electricity by 2040, Minnesota utilities would establish a leadership position in reducing emissions. The options and timing in this proposal are intended to give utilities the planning time and flexibility they need to reach 100% while maintaining reliable and affordable electricity for all of Minnesota. The proposal emphasizes jobs by requiring the Minnesota PUC to consider requiring employers to set worker pay based on prevailing wages as a condition of receiving site permits for large wind projects.

**Clean Energy First:** The Walz administration anticipates that planned retirements and closures of many of Minnesota's aging power plants create an opportunity to build a new energy infrastructure across the state that is better for Minnesota's health, environment, and economy. The Clean Energy First proposal seeks to broaden Minnesota's current renewable preference statute so that a utility can look first to zero-carbon energy resources for new electric power generation. This policy mechanism establishes a regulatory pathway to achieve the 100% carbon-free electricity standard and address other intersecting energy policy issues.

**Energy Conservation and Optimization:** Minnesota's Conservation Improvement Program (CIP) has successfully delivered savings on customer energy bills, providing more than $6 billion in net benefits to the State. The Energy Conservation and Optimization Act seeks to build on the success of CIP. Specifically it would allow consumers to further reduce total energy costs by modifying the timing of their energy consumption through load-management programs and by switching to more efficient technologies and lower-carbon fuels.

**50% Carbon Reduction by 2035 in Existing Buildings Goal:** The Walz administration intends the newly proposed carbon reduction goals for existing buildings goal to be realized by continuing the most effective current energy savings programs and by developing new programs that prioritize highest overall carbon reduction solutions.

# *COVID-19 Response and Energy Policy*

The 2020 political climate combined with the pandemic and civil unrest amplified social and economic disparities in Minnesota. The Minnesota Department of Commerce continues to monitor emerging trends in the energy sector with a focus on relief and recovery efforts for low-income households and businesses affected by civil unrest.

**COVID-19 Timeline**

| | |
|---|---|
| December 2019 | Coronavirus disease 2019 (COVID-19) variant was identified in Wuhan, China.[25] |
| March 6, 2020 | Health officials confirmed the first known case of COVID-19 infection in Minnesota. |
| March 13, 2020 | Governor Walz issued Emergency Executive Order 20-01, declaring a peacetime emergency. |
| March 25, 2020 | The Minnesota Department of Commerce and Public Utilities Commission (PUC) issued a joint letter to electric and gas utilities requesting voluntary extension of cold weather rule protections to suspend shut-offs.[26] More than 130 municipal utilities and cooperatives that are not state-regulated responded to a March request from the PUC to suspend disconnections, offer payment plans, and remove late fees during the pandemic.[27] |
| March 27, 2020 | Congress approved the $2.2 trillion *Coronavirus Aid, Relief, and Economic Security (CARES) Act* including $900 million of additional funds for the U.S. DOE Low-Income Home Energy Assistance Program (LIHEAP) nationwide. |
| May 27, 2020 | The IRS extended a Safe Harbor provision for energy Production Tax Credits (PTC) and Investment Tax Credits (ITC). |
| Aug. 13, 2020 | The PUC issued an order requiring regulated gas and electric utilities to suspend disconnections and provide additional consumer protections.[28] |
| Dec. 21, 2020 | Congress passed the $2.3 trillion *Consolidated Appropriations Act, 2021* including the *2020 Energy Act* with significant changes in climate and energy policy (see below). |

## Electricity Consumption Trends

Initial analysis shows that 2020 changes in electricity consumption were most pronounced among commercial and industrial energy users. EIA estimates nationwide retail sales of electricity to the commercial and industrial sectors fell by 6.0% and 7.9%, respectively. Despite a mild winter, overall residential consumption of electricity across the U.S. increased 1.3% in 2020, with people spending more time at home because of the pandemic.[29]

## Natural Gas Consumption Trends

The EIA estimated that U.S. natural gas consumption declined 2.5% in 2020 compared to 2019 levels because of reduced commercial and industrial consumption, reduced electricity generation, and milder winter weather.[30]

# 2020 Federal Energy Policy Changes

## IRS Extends Safe Harbor for PTC and ITC

The pandemic caused widespread supply-chain disruptions and worker shortages that delayed the construction of some solar and wind power projects.[31] In response, the Internal Revenue Service issued a notice on May 27, 2020 extending the safe harbors for the renewable energy production tax credit (PTC) and investment tax credit (ITC).[32, 33]

COVID also prompted factory shutdowns in China early in the pandemic, which led to supply chain problems that constrained solar supplies. However, factories restarted production in April 2020, creating excess capacity on the manufacturing side. Less expensive modules could benefit solar developers in the short term.[34] The pandemic's long-term effects on renewable energy projects in Minnesota remain unclear.

## Coronavirus Aid, Relief, and Economic Security Act

Congress approved the Coronavirus Aid, Relief and Economic Security (CARES) Act on March 27, 2020, providing $900 million of additional funding for the Low-Income Home Energy Assistance Program (LIHEAP) to support households with mounting energy bills driven by COVID-related unemployment. In late January 2021, the National Energy Assistance Directors' Association estimated that an additional $10 billion in emergency funding would be needed to help four million families pay off growing utility debt and to help seven million families pay current bills through Sept. 30, 2021.[35]

## Consolidated Appropriations Act

Congress passed a $2.3 trillion appropriations package on Dec. 21, 2020 by combining a $1.4 trillion omnibus government funding bill with a $900 billion pandemic relief package. In addition, the legislation requires an 85% reduction over 15 years in hydrofluorocarbons, a potent group of greenhouse gases, and includes significant energy policy changes.[36]

The 2020 Energy Act, which was incorporated into the Dec. 21 spending bill, includes:

- A reauthorization of the U.S. DOE Low-Income Weatherization Assistance Program through 2025, with FY2021 funding at $310 million (a 2% increase over FY2020) to help low-income families improve home energy efficiency and cut energy bills, while improving their home health and safety;[37]
- FY 2021 funding for the U.S. DOE State Energy Program at $62.5 million, the same as FY 2020, to enhance energy security and support state efficiency and renewable energy goals (the U.S. State Energy Program was the primary source of funding for this Quadrennial Energy Report);[38]
- An extension of credits for energy-efficient homes, up to $2,000 for new energy-efficient homes, through 2021;
- Making permanent the 179D energy efficiency tax deduction for commercial buildings.[39]
- An extension of the production tax credit at 60% of the full credit amount, or $18/MWh, for an additional year through Dec. 31, 2021;[40]
- An extension of the investment tax credit at 26% for two years through 2022, and an expansion of the tax credit to include waste heat-to-power investments;[41] and
- $35 billion in funding for clean energy research and development.[42]

**References – Chapter 1**

[1] Minnesota State Energy Profile, U.S. Energy Information Administration (accessed Jan. 31, 2021).
[2] *Minnesota State Fact Sheet*, American Clean Power Association, April 2020.
[3] Minnesota Greenhouse Gas Emissions Data, Minn. Pollution Control Agency website (*accessed Jan. 14, 2021*).
[4] "Table CE3.3: Annual Household Site End-Use Consumption in the Midwest – Totals and Averages 2015," *2015 Residential Energy Consumption Survey*, U.S. Energy Information Administration, May 2018.
[5] Used an electric carbon dioxide emissions rate of 1,183 pounds of CO2/MWh for 2018 and 1,220 pounds of CO2/MWh for 2017. Previous years utilize a rate of 1,823 pounds of CO2 per MWh (2009 through 2012), 1,437/MWh (2013 through 2014), 1,419/MWh (2015), and 1,220/MWh (2016) of electricity saved. Applied a gas CO2 emissions rate equal to 117 pounds of CO2/Dth for years 2014 through 2018. Previous years used a rate of 121 pounds of CO2 per Dth of natural gas saved (2009 through 2013). See U.S. Environmental Protection Agency Emissions & Generation Resource Integrated Database (2020); EPA Greenhouse Gas Equivalencies Calculator (2020); and How Much Carbon Dioxide is Produced When Different Fuels Are Burned?, U.S. EPA (2020).
[6] A $6.35 and $6.43 price of natural gas (Dth) in Minnesota for 2017 and 2018 was derived by calculating a weighted average price of natural gas in the residential, commercial, and industrial sectors. See U.S. EIA Natural Gas Price History, and U.S. EIA Natural Gas Consumption by End Use, 2014 through 2018. Calculations used average electricity prices of 10.27 and 10.37 cents per kWh in Minnesota during 2017 and 2018, respectively. See U.S. EIA Minnesota State Electricity Profile, 2019.
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# Chapter 2: Minnesota Energy Leadership

Over the last four years, state, local, and tribal governments, as well as multiple non-governmental organizations have supported efforts to establish and implement energy and greenhouse gas emission reductions. The Department of Commerce supports state, local, and tribal government efforts through technical assistance, loans, grants, and project development assistance.

## State-Operations, Energy and Water Reduction Activities

In April 2019, Gov. Walz issued Executive Order 19-27 titled "Directing State Government to Conserve Energy and Water, and Reduce Waste to Save Money." The executive order continued work started under Gov. Dayton's EO 17-12 and EO 18-01. EO 19-27 establishes three sustainability workgroups, including the Energy, Water, and Greenhouse Gas (EWG) workgroup, for which the Department continues in its leadership role, supporting implementation of energy efficiency and renewable energy strategies to achieve the state's goal to reduce energy consumption by 30% per square foot by 2027, relative to a 2017 adjusted baseline.

Through this partnership, the EWG workgroup has improved accuracy of energy tracking, completed multiple enterprise sustainability reports, released a solar master contract, worked with agencies to complete baseline review and goals in the B3 benchmarking program, and completed the enterprise-wide Energy Action Plan.

Commerce provided technical assistance via the Guaranteed Energy Savings Program (GESP) to State agencies, through June 2020 resulting in eight GESP projects under contract totaling $29.2 million, saving $1.3 million in annual energy costs in 83 buildings.[1]

One example is the $2.7 million City of Rochester Mayo Civic Center project, which realizes $193,000 in annual guaranteed savings. In addition, by utilizing the GESP master contract and the process of competitive bidding, the city saw an additional $60,000 in up-front contract savings.

## State of Minnesota Energy Intensity

Funded through a grant from the U.S. Department of Energy, Minnesota's 2025 Energy Action Plan, completed in 2016, called for the reduction of the energy intensity of more than 3,000 owned and leased buildings occupied for State government operations. Energy intensity reduction, also identified in EO 19-27, is part of the sustainability goals in five other focus areas: fleet, solid waste, greenhouse gases, sustainable procurement, and water. Each of the 24 cabinet-level state agencies update a plan addressing the six focus areas on an annual basis. The action plan for facilities focuses on energy conservation and energy efficiency, while the other areas focus on fuel use.

| Facility Size ($ft^2$) | Percent of Total kBtu | Percent of Total $ft^2$ | kBtu/$ft^2$ | Number of Meters | Average Original Occupancy |
|---|---|---|---|---|---|
| Campus | 25 | 24 | 119 | 193 | 1957 |
| 33,500 to 442,000 $Ft^2$ | 28 | 45 | 73 | 560 | 1983 |
| 16,500 to 33,500 $Ft^2$ | 4 | 10 | 52 | 391 | 1978 |
| 9,500 to 16,500 $Ft^2$ | 3 | 6 | 54 | 347 | 1978 |
| 5,000 to 9,500 $Ft^2$ | 2 | 3 | 72 | 323 | 1984 |
| Up to 5,000 $Ft^2$ | 3 | 6 | 59 | 1,418 | 1987 |
| Equipment, Process, & Met Council | 35 | 7 | - | 405 | 1992 |
| **Total** | **3,866,596,822** | **33,294,754** | **116** | **3,637** | **1988** |

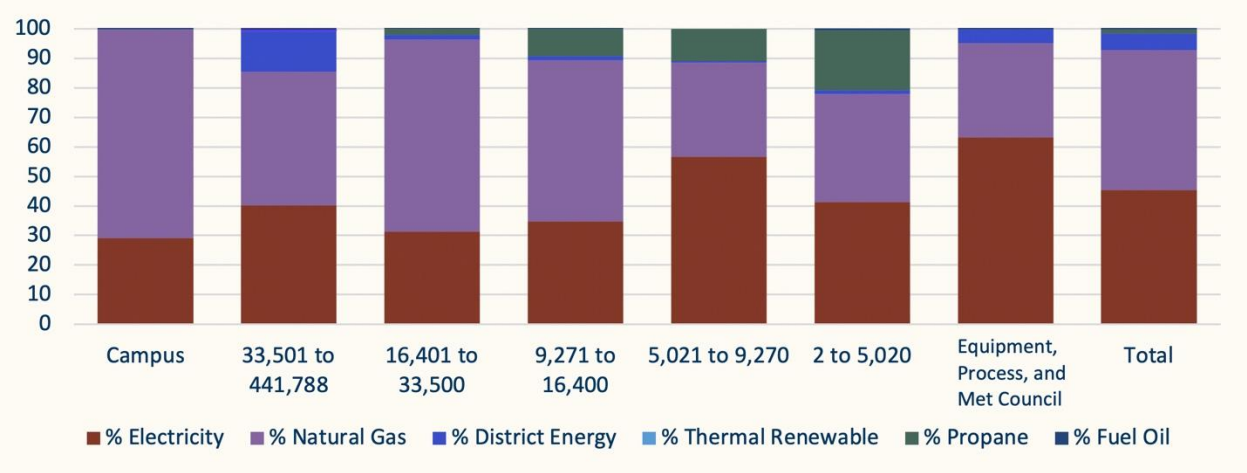
## Figure 2-A: Energy Use by Facility (2018)

Figure 2-A describes energy sources by facility across the enterprise in 2017. Enterprise facilities consumed 3.8 billion kBtu in 2018, up from 3.4 billion kBtu in 2017. Of the energy consumed, 46% was natural gas and 45% was electricity. Note: Energy use is not weather-normalized.

*Source: Minnesota Department of Administration*

Enterprise building stock varies greatly by size, age, and use. A campus is a group of buildings that operate on one set of energy meters. More than 300 State buildings are located on campuses represented by 193 meters. Reducing energy intensity on campuses requires tracking energy use at the building level. Of the enterprise building stock, campuses are the most energy intensive in at 119 kBtu per square foot because they operate almost entirely on a combination of electricity (32%) and natural gas (68%). Campuses also have the oldest original occupancy date, and some have historic significance that can make them more challenging to retrofit with efficiency improvements.

Energy intensity generally increases with building size. However, buildings that are 5,000 to 9,500 square feet in size have a disproportionately high energy intensity. Most enterprise buildings are fewer than 5,000 square feet. The energy source by building size also varies. For example, buildings in size up to 5,000 square feet have the highest percentage of propane use at 22% while 13% of the energy source for the largest buildings comes from District Energy St. Paul thermal supplies.

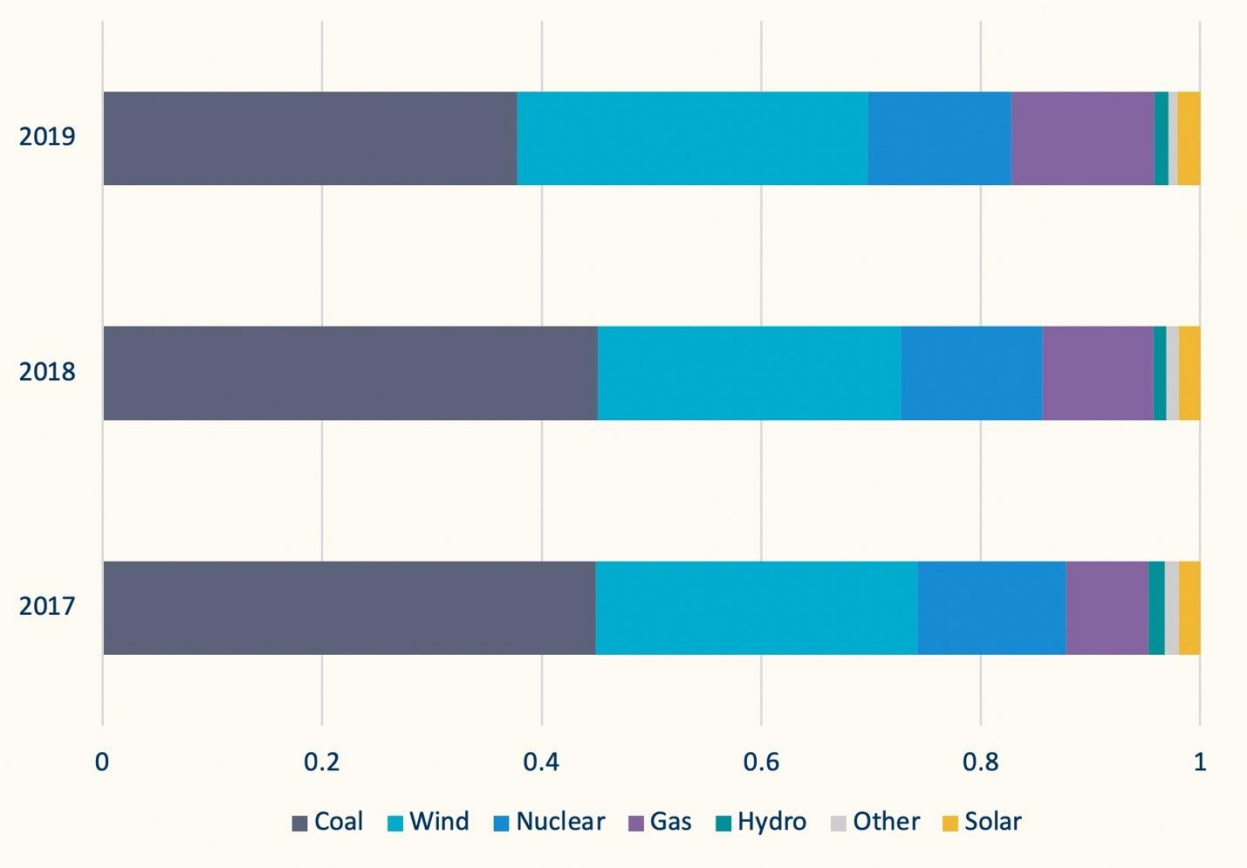



## Figure 2-B: Energy Use by Source and Facility Type ($ft^2$)

Figure 2-B depicts energy use by source among State facilities and equipment of various types and sizes ($ft^2$). The Equipment, Process and Met Council category includes energy meters that serve equipment, the Metropolitan Council's buildings, and the Met Council's Wastewater Treatment operations. Specifically, wastewater treatment accounts for 25% of enterprise energy use.

*Source: Minnesota Department of Administration*

The enterprise's primary sources of energy are electricity and natural gas: 45% and 46%, respectively. The next largest source of energy is from District Energy,[2] which provides heating and cooling to the Capitol Complex and other buildings in Downtown St. Paul. District energy provides 4% of the enterprise's energy use. Renewable thermal energy, largely from the combustion of biosolids in wastewater treatment, provides 3% of the energy used by the enterprise, propane provides 1%, and fuel oil provides less than 1%.




## Figure 2-C: Enterprise Electricity Fuel Mix (2018)

Figure 2-C compares the State's electricity mix by energy source. The enterprise electricity fuel mix reflects the aggregate of the fuel mix of the electricity being delivered to each electricity-consuming facility around the state and the on-site or procured renewable energy.

*Source: Minnesota Department of Administration*

Each utility's fuel mix is different, so a facility in northwestern Minnesota will have a different fuel mix than a facility in the metropolitan area. Different facilities also have varying amounts of additional renewable energy. For example, on the Capitol Complex, approximately 34% of electricity is renewable above and beyond the grid mix. This additional renewable energy is a mix of solar and wind energy that comes from Xcel Energy's renewable energy purchasing program for government agencies.[3]

Of all electricity consumed by the enterprise, 45% is generated from coal, 28% is from wind, 13% is from nuclear, 10% is from natural gas, 2% is from solar, 1% is from other sources such as petroleum, and 1% is from hydro. Renewable electricity – wind, solar and hydro – accounts for 31%. The total for carbon-free energy – renewable plus nuclear – is 44%. Overall, the enterprise's renewable energy consumption is 16.95% of the State's total energy use. Renewable electricity accounts for 13.95% and renewable thermal is an additional 3%.

State agencies are both tracking energy intensity and striving to reduce use. For instance, the Department of Administration completed energy efficiency projects at the Transportation Building in the Capitol Complex, reducing energy use by 13% and avoiding $181,000 in annual utility costs. The Department of Administration also added three more solar installations to the Capitol Complex for a total of 303 kW DC capacity and, as a result, expects to avoid 230 metric tons of $CO_2e$ per year. Other

agencies created schedules for retro-commissioning buildings, a process that examines building functions and implements low-cost and no-cost energy efficiency measures. The State initiated a feasibility study of solar development at closed landfills with results still pending when this report was being produced.

## Sustainable Buildings 2030

Minnesota Statute 16B.325, enacted in 2001, required the use of sustainable building design guidelines for all buildings receiving state bond funds after 2004. The guidelines were required to focus on strategies that ensured all new state buildings exceeded the existing energy code by 30%, employed life-cycle cost methods, and implemented measures to reduce waste and material costs as well as to increase daylighting, improve indoor air quality and human productivity, and use of renewable energy sources.

*Minnesota State agencies created schedules for retro-commissioning buildings, examining building functions and implementing low-cost and no-cost energy efficiency measures.*

In 2008 the Legislature enacted a mandate for the State to establish an energy performance standard to achieve reductions in energy consumption by least 90 percent in 2025 and 100% by 2030 for buildings that used the sustainable building design guidelines. The standard must be cost-effective based upon established practices used in evaluating utility energy-savings measures under the Conservation Improvement Program. The Sustainable Building 2030 energy standard was incorporated into the sustainable building design guidelines in 2009; starting in 2010, buildings that received bond funds were designed to be 60% more energy efficient than the baseline, and 70% more efficient in 2015. Case studies are developed on buildings going through the process to assist architects and building owners, with ongoing training of architects, engineers, and builders.[4] (See Chapter 4 for further information about Sustainable Buildings 2030 and new building energy standards.)

Commerce has continued to promote renewable energy and conservation in State government, in accordance with executive orders from Gov. Walz and the past three governors.[5] Such efforts include enforcing regulations that require buildings utilizing public bond funds be constructed to the SB2030 energy standard and use renewable energy resources.

Since 2016, Commerce also supported the U.S. DOE Zero Net Energy School Accelerator program, which includes a workgroup that tracks ongoing school ZNE building work nationwide.

While Commerce efforts through the GESP program have had to be minimized due to funding cuts, existing funding through the Exxon Petroleum Escrow Account has afforded continued technical and project assistance to local units of government choosing to develop ESPCs.

## Supporting Community-Led Efforts

Communities throughout Minnesota launched or continued ongoing initiatives to improve their energy sustainability and promote development resilient and renewable energy infrastructure. Programs and initiatives supported by the State of Minnesota have helped to facilitate many communities' initiatives, most notably through the Clean Energy Resource Teams partnership, the GreenStep Cities program, the Local Energy Efficiency Program, and Climate-Smart Municipalities.

## Clean Energy Resource Teams (CERTs)

The Clean Energy Resource Teams (CERTs)[6] is a partnership between the Minnesota Department of Commerce, Great Plains Institute, Southwest Regional Development Commission, and University of Minnesota Extension and Regional Sustainable Development Partnerships created by section 216C.385. The mission of the partnership is to connect individuals and communities in Minnesota to the resources they need to identify and implement community-based clean energy projects.

Since it was established in 2003, the CERTs partnership has helped citizens to obtain the resources they need to identify and implement community-scale renewable energy and energy efficiency projects.

CERTs initially was funded by a grant from the Minnesota Legislative Citizen Commission on Minnesota Resources (LCCMR). At present, approximately half of CERTs core funding comes from the Conservation Improvement Program (CIP) Research and Development fund. It continues as a public-private partnership staffed and operated by each of it's the four organizations who together offer a full menu of resources and opportunities.

*From 2016 through 2019, Clean Energy Resource Teams efforts saved or offset 345.8 billion Btu of energy use.*

The University of Minnesota Extension Regional Sustainable Development Partnerships (RSDP)[7] connect Greater Minnesota communities to the University of Minnesota to support local sustainability projects. RSDP brings together community and University knowledge and resources to drive sustainability in four focus areas: agriculture and food systems, clean energy, natural resources and resilient communities. We support local projects through five regional boards made up of community members and University faculty and staff. They also support multi-region food systems and clean energy work across Greater Minnesota.

Great Plains Institute[8] is a non-partisan, nonprofit organization that takes a pragmatic approach to our energy and climate change challenges – working with diverse interests to transform the way we produce, distribute, and consume energy to be both environmentally and economically sustainable. Through research and analysis, consensus policy development, and technology acceleration, GPI is leading the transition to clean, efficient and secure energy.

The Southwest Regional Development Commission[9] (SRDC) provides professional expertise and leadership to enhance regional opportunities. SRDC is a nine-county planning and development agency providing services to local units of government, non-profit agencies, and various individuals and groups both public and private sectors throughout the region. Membership is comprised of 36 representatives of townships, cities, counties, school boards and public interest groups.

The Commerce State Energy Office[10] works to promote and advance energy efficiency and renewable energy to Minnesota consumers, businesses and policymakers through educational outreach and technical assistance, targeted financial incentives, and demonstrations of market-ready new technologies. The State Energy Office is predominantly funded by the U.S. Department of Energy State Energy Program and Low-Income Weatherization Assistance Program (WAP).

In this past four years, CERTs has focused its work and programmatic design to provide support and guidance to key focus sectors that include: cities and counties, utilities, farmers, businesses and organizations, schools, underserved communities and residents, and tribal nations.

Since its start in 2003, CERTs has grown to support and engage communities in seven regions, each of which are guided by a regional steering committee and a CERTs staff person. From 2016 through 2019, CERTs saved or offset 345.8 billion Btu of energy use, hosted 138 events with over 14,000 attendees, funded 81 community-based clean energy projects (for a total of $280,000 in seed grant funds), and connected with an additional 27,000 community members through 1,100 meetings, presentations, and other outreach activities across the state.

## GreenStep Cities

During fall 2007, CERTs convened regional sessions around the state to discuss community-based energy opportunities and the Next Generation Energy Act of 2007. During these sessions, stakeholders suggested creating a sustainable cities program, free to cities, that would challenge, assist, and recognize cities for sustainability leadership. This 2008 Legislature adopted the idea and directed the Minnesota Pollution Control Agency (MPCA), Commerce, and CERTs to recommend actions that cities could take on a voluntary basis. Partner organizations submitted an initial report to the Legislature In 2009, MPCA, CERTs, Commerce, Great Plains Institute, Urban Land Institute Minnesota, League of Minnesota Cities, Isaak Walton League, Minnesota Environmental Quality Board, and Rethos comprise the current GreenStep Cities steering committee.

Minnesota GreenStep Cities focuses on helping cities achieve their sustainability goals through implementation of 29 best practices. Each best practice can be implemented by completing one or more specific actions at a 1, 2, or 3-star level, from a list of four to eight actions. These actions are tailored to all Minnesota cities, focusing on cost savings and energy-use reduction, and encouraging civic innovation.

*GreenStep initiatives in 137 cities and four tribes yield more than $8 million in energy savings each year.*

The Minnesota GreenStep Cities program celebrated its 10-year anniversary in 2020.[11,12] As of 2020, GreenStep cities were fairly representative of Minnesota as a whole in terms of geographic distribution, politics, education, and income, as well as city size with populations of 255 to more than 300,000. 48% of the state's population resides in the 137 GreenStep cities and four GreenStep tribes. A total of 16% of Minnesota's 853 cities are GreenStep cities.

GreenStep initiatives in these communities yield more than $8 million in energy savings each year, with nearly 230 certified green buildings, 587 renewable energy facilities, and 130 EV charging stations. 78% of GreenStep Cities use B3 Benchmarking to track their energy use; for comparison, only 31% of Minnesota cities in general use B3 Benchmarking.

Since 2016, the program added Steps 4 and 5 to encourage cities to report metrics based on actions taken and identify areas that have improved over time. The Great Plains Institute coordinated a series of cohort engagements for GreenStep cities as a part of the greater CERTs partnership. In addition, GreenStep Schools K-12 program was launched in collaboration with the University of Minnesota. In partnership with Commerce, the program hosted a State Fair "Clean Energy Communities" exhibit in both 2018 and 2019.

In recent years, multiple communities have joined the GreenStep Cities program and set goals for energy savings and sustainability. For example, in 2018 the City of Morris became a GreenStep City and set goals to reduce energy consumption by 30% and to locally produce 80% of its energy consumed by 2030. The City of Northfield also became a GreenStep City, and established goals to achieve 50% reduction in energy-related carbon emissions from 2015 levels by 2030, and to achieve 100% carbon-

neutrality by no later than 2050. Also, the City of Red Wing set a goal to reduce its emissions from 2015 levels by 80% by 2040.

## Local Energy Efficiency Program & Energy Savings Partnership

Commerce operates both the Local Energy Efficiency Program (LEEP) and the Energy Savings Partnership (ESP). The LEEP provides local units of government with technical services to conduct energy project studies. The ESP is a standard energy project financing agreement for local units of government managed by the Saint Paul Port Authority through a contract with Commerce. These combined programs enable local governments to easily identify and implement energy conservation measures that help meet locally identified energy and greenhouse gas emissions goals as well as to reduce the financial burden from utility bills and operations and maintenance costs. LEEP was formally launched in 2016 with the purpose of conducting energy project studies and technical review of projects. However, despite significant efforts from 2016 through 2018, no studies were completed due to a number of barriers faced by local governments to implement long-term projects. In 2019, Commerce refocused its work on identifying the challenges and existing barriers that affect the ability of local government units' ability to move forward with energy efficiency projects for their publicly owned buildings. Commerce and partners conducted discussions and surveys with communities to identify critical issues and explore ways to address barriers for a successful restart of the program in 2020.

*The Energy Savings Partnership loan-loss reserve has leveraged more than $5.2 million in private capital for community energy projects.*

Commerce's efforts to restart program have included a focus on expanded support and technical services to local units of government that are interested in undertaking energy efficiency and renewable energy projects within their communities. Technical assistance support is achieved through connecting participants to Commerce's energy experts and planning partners who provide information and guidance toward project development. While guidance offered still includes assistance toward obtaining free or low-cost energy assessments, it also offers practical guidance for action planning to implement energy cost-saving recommendations, procuring contractors, negotiating agreements, applying for rebates and grants, arranging financing, and it makes available qualified building energy professionals and engineers for calculating savings.

In 2021, Commerce plans to implement an expanded outreach process to local units of government to re-introduce the expanded program and assist them in reaching their building efficiency and energy savings goals. Additional staff time will be allocated for LEEP work through an expanded targeted wastewater treatment facilities cohort program for energy studies. The program will be offered in partnership with the University of Minnesota Technical Assistance Program (MnTAP) and using data and engagement through Commerce's U.S. DOE-funded Wastewater Treatment Accelerator program.

Additionally, as an active steering member of the Minnesota GreenStep Cities program, Commerce will work to integrate LEEP into the GreenStep program's list of best practices.

The ESP was created in 2012 as a standard lease-purchase financing agreement. Commerce dedicated $2 million in funding as a loan-loss reserve to make a wider range of energy project sizes and types financially viable for communities across Greater Minnesota. The ESP has funded several energy projects since inception through lease-purchase financing. ESP continued a portfolio of eight financed projects in 2019 totaling more than $5 million. The projects include three cities and five school districts, with investments ranging from $500,000 to $1.8 million.

Commerce reports metrics of the ESP to the U.S. DOE on a quarterly basis. Cumulatively the ESP loan loss reserve has leveraged more than $5.2 million in private capital with an estimated annual energy savings exceeding $296,000.

### Climate-Smart Municipalities

Led by the University of Minnesota's Institute on the Environment (IonE), the Climate Smart Municipalities initiative is a multi-stakeholder international renewable energy exchange between 12 cities in Minnesota and the German state of North-Rhine Westphalia, with support from Minnesota legislators, the private sector, and State agencies including Commerce. The initiative has resulted in six cities (Duluth, Elk River, Morris, Rochester, Warren, and White Bear Lake) launching and advancing energy, sustainability, and climate solutions since 2016. Examples include:

- The City of Warren established a drone thermography program, helping residents and business owners identify opportunities for increasing their buildings' energy efficiency;
- Morris and Elk River installed new municipal electric vehicle charging stations;
- Morris plans to acquire an electric school bus to transport students;
- Rochester Public Utilities in July 2019 announced a 100% renewable electricity by 2030 resource plan;
- Duluth, Rochester, and Morris created dedicated staff positions to coordinate sustainability and energy efforts;
- The Minnesota Credit Union Network in 2018 launched CU-Green, a clean energy lending platform to make clean energy more accessible to more Minnesotans.


**Figure 2-D: Climate-Smart Municipalities Exchange Program**

Figure 2-D depicts communities in Minnesota and Germany that participated in the Climate-Smart Municipalities exchange program. The international program brought together 12 Minnesota cities and the German state of North Rhine-Westphalia to exchange best practices and planning strategies to support renewable energy and efficiency initiatives.

These and other examples illustrate outcomes from the exchange with Germany. Participants learned that the most suitable solutions involve a systems approach that connects renewable energy generation, sustainability, efficient buildings, and low-carbon transportation with dedicated community education and outreach. Achievements resulting from the exchange build on non-partisan social values and new ways for communities to address energy and climate issues.

## Partnering with Tribal Nations

Executive Orders 19-01 and 19-24 are key to policies established in 2019 to foster stronger government-to-government relations between Commerce and the Native American tribes that share Minnesota's geography.

Gov. Walz issued Executive Order 19-01, updating the previous order (EO 16-01) in establishing the Minnesota Council on Diversity and Inclusion by expanding its focus to include equity issues, and calling for consultation to create equitable practices for the State to address the disparities and inequities throughout Minnesota. Under the order, Minnesota State policies and programs must ensure fair distribution of benefits, recognizing that historical, cultural, and institutional structures haven't consistently served all groups in society.

These issues are particularly problematic because Native Americans have the highest average energy burden (*e.g.*, percentage of income spent on energy resources) in the state; even after energy assistance is applied, their burden is still at 6%, compared to a national average of 3%.[13]

Tribes are sovereign nations with the inherent right and authority to regulate activities on their lands independently from state governments. Executive Order 19-24, "Affirming the Government-to-Government Relationship between the State of Minnesota and Minnesota Tribal Nations: Providing for Consultation, Coordination, and Cooperation" from April 2019 built upon a previous order (13-10) by establishing guidelines and dates for meeting the requirements of the order. In consultation with the Minnesota tribal nations, each cabinet-level executive-branch agency is required to develop and implement tribal consultation policies, designate a staff member to assume responsibility for implementing the tribal consultation policy, and to serve as the principal point of contact for Minnesota tribal nations. The order also requires training for designated staff in an effort to foster a collaborative relationship between the State of Minnesota and tribal nations.

As a result of Executive Orders 19-01 and 19-24, Commerce established tribal consultation policies and began engagements with tribal leaders, opening doors to new relationships and opportunities. Commerce leadership and staff received Tribal-State Relations Training (TSRT), whose purpose is to provide training and education for Minnesota State employees about tribal governments, histories, cultures and traditions, in order to empower state employees to work effectively with tribal members and "promote authentic and respectful relationships" among state agencies and tribes.

Tribal consultation resulted in joint efforts supporting the $46 million dollar Prairie Island Community Net Zero project funded by the Renewable Development Account (RDA).[14] It led to clarification of language in the Cold Weather Rule, and increased communication around energy burden, Department services, and partnerships.

Commerce funded a Conservation Applied Research and Development (CARD) study grant to the Indian Land Tenure Foundation to assess CIP opportunities and barriers for tribal governments and tribal members, estimate energy-savings and carbon-reduction potential, and identify steps to improve energy efficiency and reduce the carbon footprint of tribal governments and tribal members interested in utilizing CIP. The results from the study are expected to serve as a roadmap for Minnesota natural gas and electric utilities, and tribal governments and tribal members to jointly engage in implementing CIP. Results are expected by the spring of 2022.

Commerce also provides funding and other assistance to non-profit organizations working with tribal nations on sustainable energy programs. For example, CERTs worked with the Leech Lake Band of Ojibwe's tribal government and a consultant to produce a solar master plan for prospective projects at tribal government facilities. The Leech Lake Band used the State's Guaranteed Energy Savings Program (GESP) to make major energy improvements to its 22 tribal buildings, including mechanical systems upgrades, controls upgrades, LED lighting upgrades, water conservation improvements, and solar PV systems at the Leech Lake Government Center and the Northern Lights Casino. The $4.2 million energy improvement project was completed in the fall of 2019 and is expected to reduce the Tribe's annual

energy use by 10% and save more than $260,000 per year in energy costs. Through the U.S. DOE funded State Energy Strategies grant, in partnership with the Clean Energy States Alliance, Commerce provided four grants, averaging $24,000 each, for solar projects targeted to reduce the high energy burdens of low-income tribal households. Grants were awarded to Solar for Humanity, 8th Fire Solar, Ecolibribium3, and the Fond du Lac Band of Lake Superior Chippewa for residential solar and community solar projects. One project included training to increase the number of certified tribal solar air furnace installers.

In addition to pursuing increasing energy efficiency and renewable energy, some tribal nations are pursuing greater energy sovereignty by developing tribal energy strategies and forming their own utilities. The Red Lake Band of Ojibwe and Fond du Lac Band of Lake Superior Ojibwe, for example, were awarded federal grants in 2019 and 2020 to support development of legal infrastructure for managing their energy assets.[15]

*The proposed Tribal Energy Council could help reduce tribal members' energy burden, increase efficiency, and promote self-sufficiency.*

In 2019, legislation was proposed to develop a Tribal Energy Council comprised of representatives from the 11 tribal nations located in Minnesota's geography. If the legislation becomes State law, the tribal-led council would continue to facilitate more effective collaboration and partnerships, as well as recommendations for regulatory policy and legislative consideration. In particular, the council could help improve policies regarding the applicability of State standards and programs on tribal lands, as well as collaboration among tribes and Commerce's WAP and Energy Assistance programs to reduce tribal members' energy burden, increase efficiency, and promote self-sufficiency.

The Governor's 2021 legislative proposals include codifying Executive Order 19-24 into Minnesota Statute in order to solidify the State's commitment to building upon the government-to-government relationship with Native American tribes, in terms of policies, management, and legislative action. Meaningful consultation results in both parties coming into agreement and compromise, advancing the greater good for everyone living within Minnesota's geographic boundaries.

## Assisting Business-Led efforts

Efforts by Minnesota businesses to reduce their energy usage and emissions, and to increase reliance on sustainable energy resources, date back to the 1970s, with the creation of the U.S. Department of Energy's State Energy Program as well as the U.S. Environmental Protection Agency (EPA), when efforts nationwide to reduce reliance on imported fossil fuels began in earnest. Since that time, many businesses have realized economic benefits from energy conservation, efficiency, and renewable energy, as well as the marketing benefits of promoting their green-business efforts – both in terms of attracting customers and qualified workers.

The Department of Commerce created an Emerging Energy Technology Team (EET) within the State Energy Office to work with private businesses along with academia and the federal government to accelerate carbon-free energy technologies and investments that can promote industrial productivity, reduce costs, increase revenues, and create jobs. For example, with the rapid expansion of solar energy technology In Minnesota, EET provided technical assistance and outreach through the development of a solar business directory and by leading cutting-edge analysis through the Solar Pathways Initiative, which identified least-risk, best-value strategies to help Minnesota achieve its solar energy goals.

The Conservation Improvement Program provides support to industry through the Conservation Applied Research and Development (CARD) grants, and the Energy Market Transformation team provides

financing of energy efficiency and renewable energy measures in business through third-party administered financing. Two specific partnerships are the Southwest Regional Development Commission (SWRDC)'s Commercial Property Assessed Clean Energy (C-PACE) program and St. Paul Port Authority's Trillion Btu Program.

*Businesses and non-profits in Greater Minnesota have accessed more than $500,000 in energy project C-PACE loan funds, providing energy conservation improvements for 22 buildings.*

Commerce, SWRDC, and the Rural Minnesota Energy Board partnered in 2013 to provide financing for clean energy projects with the aim of job retention and creation, energy cost savings for businesses, and improved tax bases of communities in the 18-county Southwestern Minnesota area. Funded in part with an Energy Efficiency Conservation Block Grant and U.S. Department of Energy State Energy Program funds, the loan tool allows for project costs to be repaid through a special assessment on property tax, offset by the decrease in energy costs for minimal impact to businesses. From 2016 through 2019, 17 businesses and non-profit organizations in Greater Minnesota have accessed more than $500,000 in energy project C-PACE loan funds, providing energy conservation improvement in HVAC, lighting, insulation, and solar installation, for 22 buildings.

Ongoing energy and cost savings benefits from American Recovery and Reinvestment Act investments continue, as well as from the Saint Paul Port Authority's (SPPA) Trillion Btu program. The Trillion Btu program is a revolving loan fund for commercial and industrial businesses and non-profit organizations with low-cost capital to be used for investment in cost-effective energy efficiency and renewable energy projects. With more than $17.5 million in base funding from Commerce, SPPA has continued to build the program, providing more than 130 loans during the 2016 through 2019 period, and resulting in more than $3,000,000 in energy cost savings benefits to participants.

Commerce has also had a strong presence within the National Association of State Energy Officials (NASEO) as an advisory board member. NASEO leads numerous initiatives for cross-state collaboration and learning. In 2019, NASEO formed an advisory group to provide guidance to state energy offices and other stakeholders on advancing sustainable energy innovation and investments.[16]

## Clean Energy Jobs

During the funding of the American Recovery and Reinvestment Act (ARRA), Commerce received grant funding and dedicated staff resources to assist in the development of clean energy jobs throughout Minnesota. Since those funds expired, Commerce has continued to participate In the Minnesota Energy Consortium (MEC) and worked to both track and support workforce development initiatives.

*Sustainability jobs in Minnesota grew by 6% from 2017 through 2019 – three times faster than Minnesota's overall workforce.*

The MEC[17] was formed in 2005 by energy industry leaders and the Minnesota State Colleges and Universities as they analyzed projected workforce shortages regarding the field of energy generation. The partnership continues to work with multiple energy utilities, Minnesota State colleges and universities, and multiple State agencies to develop career pathways, build formal relationships within the workforce system, ensure a solid pipeline of students, improve accuracy of workforce data, and build relationships with contractors.

Commerce also continues workforce development tracking and training to meet specific workforce needs. For example, the U.S. DOE-funded WAP supports training of contractors, residential auditors, and

training and certification of quality-control inspectors (QCIs). All DOE-funded work completed for WAP meets DOE national Standard Work Specifications and is approved by a QCI. (See Chapter 5 for additional information about WAP.)

Minnesota State colleges and universities, as well as private institutions, continued to provide training for clean energy jobs throughout Minnesota. These and other sustainability jobs in Minnesota grew by 6% from 2017 through 2019. The industry grew three times faster than Minnesota's overall workforce during that same time period, based on data from Clean Jobs Midwest and the Bureau of Labor and Statistics.[18]

| Sector | Q4 2019 Employment | Unemployment Claims March-June 2020 |
|---|---|---|
| Energy Efficiency | 47,114 | 8,596 |
| Renewables | 7,920 | 1,575 |
| Clean Vehicles | 3,191 | 566 |
| Grid & Storage | 2,899 | 530 |
| Clean Fuels | 681 | 278 |
| **Total** | **61,805** | **11,546** |

## Figure 2-E: Clean-Energy Jobs Lost Due to COVID-19 Pandemic

Minnesota lost more than 11,000 clean-energy jobs between March and June 2020 as the coronavirus pandemic constrained project deployments and prompted payroll cuts.

*Source: Minnesota 2020 Clean Energy Jobs Report, Clean Jobs Midwest, based on the 2020 U.S. Energy Employment Report (2020 USEER)*

Energy efficiency jobs comprise the largest sector of clean energy jobs and employed 47,114 Minnesotans in 2019. Renewable energy employed 7,920 followed by the advanced transportation sector. Grid and storage jobs grew 4.9 percent as energy storage technologies began to mature and utilities pursued grid modernization investments. Jobs working in clean energy and sustainability industries are located throughout the state, with 37% of jobs located in Greater Minnesota.

Preliminary data indicates that from March through May 2020 when the COVID-19 pandemic struck Minnesota, 11,500 clean energy jobs were lost. However, given the strong historic growth of the industry, its reach across the state, and the diverse skill sets involved, clean energy businesses are expected to be a driving force in the state's post-pandemic economic recovery.

**References – Chapter 2**

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# Chapter 3: Minnesota Utility Rates

## *Minnesota Retail Rate Policy and Design*

### Background

Minnesota Statutes §216C.18 Subd. 1a requires the Minnesota Public Utilities Commission (PUC) to prepare a rate plan as part of this Quadrennial Report. This rate plan is intended to address the PUC's rate design policy pertaining to three statutory energy goals: cogeneration and small power production (Minn. Stat. §216B.164), energy conservation improvement (Minn. Stat. §216B.241) and the use of fossil fuels and renewable energy (Minn. Stat. §216C.05).

Although the statute requires the Quadrennial Report Rate Plan to address only a limited portion of the PUC's scope, many other considerations go into rate making decisions. When setting rates and implementing energy policy the PUC is directed to balance factors including: the cost to consumers, fairness to different groups of customers, utilities' financial needs, and reliability and environmental impact. Minn. Stat. Chapter 216B includes the following direction to the PUC in carrying out its energy utility rate-making responsibilities:

1. Rates shall be just and reasonable, not unreasonably preferential or discriminatory, and consistent with the financial need of public utilities to provide service (Minn. Stat. §216B.03).

1. Due consideration must be given to the public's need for adequate, efficient and reasonable service, and the need of the public utility for sufficient revenue to meet the cost of furnishing service, and to earn a fair and reasonable return on its investments (Minn. Stat. §216B.16 Subd. 6).

2. Rates shall, to the maximum extent possible, be set to encourage energy conservation and renewable energy use (Minn. Stat. §216B.03).

3. Cogeneration and small power production shall be encouraged consistent with the protection of ratepayers and the public (Minn. Stat. §216B.164).

The PUC has many additional responsibilities outside the scope of this report that are integral to implementing the State's energy policies. These responsibilities include reviewing electric utility resource plans and utility transmission plans, setting planning values for environmental pollutants, reviewing utility compliance with renewable electricity standards and solar electricity standards, and granting certificates of needs, site permits and route permits for energy generation facilities and transmission lines.

### Distributed Generation

#### Cogeneration and Small Power Production

##### *History prior to 2016*

In 1978, Congress enacted the federal Public Utilities Regulatory Policies Act (PURPA), which has among its requirements that retail electric utilities purchase power from cogeneration facilities and certain independent power producers, and it gives state regulatory authorities the responsibility to implement many of the law's provisions. In 1981, Minnesota enacted Minn. Stat. §216B.164 to frame

implementation of PURPA in the state. Provisions for net-metering were added in 1983. Substantive modifications and additions to this statute were enacted in 2013, 2015, and 2017.

PUC responsibilities with respect to implementation of PURPA and related State statutes include:

- Giving the maximum possible encouragement to cogeneration and small power production consistent with the protection of ratepayers and the public (Minn. Stat. §216B.164, Subd. 1).
- Setting rates for utility purchases of energy from cogeneration facilities and small power producers, collectively known as qualifying facilities, and for excess energy from net-metered customers (Minn. Stat. §216B.164, multiple subdivisions).
- Resolving disputes between electric utilities and qualifying facilities (Minn. Stat. §216B.164, Subd. 5).
- Developing a value of solar (VOS) rate that compensates solar customers for the value to the utility system, customers and society from interconnected small distributed solar photovoltaic resources (Minn. Stat. §216B.164, Subd. 10).
- Implementing a community solar garden program for Xcel Energy (Minn. Stat. §216B.1641).
- Adopting interconnection standards for distributed generation (Minn. Stat. §216B.1611).

The PUC first adopted cogeneration and small power production rules in 1983 (Minnesota Rules Chapter 7835). The PUC adopted amended rules in 2015 to implement the 2013 statutory changes and make other technical updates.

### *Activity and Policies after 2016*

A prohibition on public utilities imposing standby charges on facilities of 100 kW or less was included in the 2013 statutory amendments, and new utility tariffs were approved to reflect that change in 2014. Subsequently, the PUC opened an investigation to examine whether standby tariffs needed to be clarified or updated in other respects, and approved revised tariffs in 2017.[1] The Commission also adopted final changes to Xcel Energy's solar capacity credit for larger customers after extensive proceedings in a February 2020 Order.[2]

In 2017, subdivision 11 was added to Minn. Stat. §216B.164, which allows cooperative electric associations to assume the authority previously delegated to the PUC if it elects to do so by resolution and if it has rules in effect implementing the section, including provisions for dispute resolution. Minnesota-based electric cooperatives have chosen to assume this authority.

The PUC opened a general investigation into whether and how utilities may apply a charge to net-metered or distributed-generation (DG) customers that is not applied to other customers. After passage of the 2017 statutory amendments allowing cooperatives to opt-out of PUC oversight, the cooperatives were removed from the investigation. In a 2017 order, the PUC found that public utilities may charge qualifying facilities specific recurring, monthly metering service fees in tariffs under Minn. Stat. §216B.164, and clarified the contents of annual reports and approval processes under that statute.[3]

## Solar Programs and Tariffs: Value of Solar and Community Solar Gardens

### *History prior to 2016*

Amendments to Minn. Stat. §216B.164 in 2013 authorized utilities to ask for PUC approval of a value of solar (VOS) tariff to replace standard net-metering for solar facilities. It required the Department of Commerce to develop a methodology for calculating a VOS rate, to compensate customers who provide distributed solar photovoltaic electricity generation to their utility for the value to the utility, its customers, and society and to submit the methodology to the Commission for approval. On April 1, 2014, the Commission approved Commerce's proposed methodology to calculate the value of solar.

Legislation enacted in 2013, Minn. Stat. §216B.1641, required Xcel Energy to establish a community solar garden (CSG) program for PUC review and approval, which establishes uniform standards, fees, and processes for the interconnection of community solar garden facilities. Xcel Energy's CSG program began accepting applications in December 2014 with compensation at the applicable retail rate (ARR) because a VOS calculation had not yet been approved for Xcel's CSG program.

### *Activity and Policies after 2016*

To date, no electric utility has requested approval to use a VOS tariff in place of net metering for qualifying facilities. However, effective for 2017 and beyond, the PUC has required Xcel Energy to use a VOS rate for compensating customers in conjunction with its community solar garden program.[4] The VOS rate is updated each year and reviewed and approved by the PUC.

*At the end of the third quarter 2020, Xcel Energy's Solar* Rewards Community program had 739 MW of solar gardens online.*

The Xcel CSG program continues to be refined over time, and issues arise each year that need to be resolved by the PUC, including how to determine if facilities are co-located for determining size limits and interconnection disputes. At the end of the third quarter 2020, Xcel reported that Xcel Energy's Solar* Rewards Community program had 337 projects sites completed with 739 MW of connected solar garden generation online, and approximately 423 active project applications.[5]

| | ARR | | | | VOS* | | | |
|---|---|---|---|---|---|---|---|---|
| | **Residential** | **Small General Service** | **General Service** | **Other** | **Residential** | **Small General Service** | **General Service** | **Other** |
| **# of Subscriptions** | 19,903 | 1,185 | 1,449 | 472 | 35 | 99 | 241 | 47 |
| **# of Subscribers** | 19,188 | 309 | 597 | 159 | 35 | 43 | 138 | 19 |
| **DC Capacity Allocation (kW)** | 131,940 | 10,713 | 755,688 | 17,405 | 507 | 2,288 | 132,475 | 3,610 |
| **AC Monthly May Production Allocation (kWh)** | 18,851,903 | 1,505,704 | 105,739,549 | 2,466,544 | 79,563 | 328,281 | 19,342,302 | 528,007 |
| **August Bill Credits** | $2,933,620 | $220,611 | $13,292,210 | $318,438 | $4,019 | $16,265 | $969,455 | $26,472 |

## Figure 3-A: Subscription Metrics (ARR vs. VOS)

Figure 3-A depicts Xcel's completed solar gardens and participation under the different rates. As of August 2020, most of the completed solar gardens are operating under the applicable retail rate. August 2020 Snapshot from Xcel's Oct. 23, 2020 Compliance Filing.[5]

** Xcel reported no active gardens receiving the 2019 VOS as of October 2020.*

## Distributed Generation Standards

### *History prior to 2016*

In 2001, the Minnesota Legislature enacted Minn. Stat. §216B.1611, requiring the PUC to establish generic standards for interconnection and operation of onsite DG for facilities of no more than 10 megawatts of interconnected capacity. Following extensive stakeholder participation, the Commission issued its "Order Establishing Standards" in Docket No. E-999/CI-01-1023 on Sept. 28, 2004. The detailed 2004 interconnection standards contained the following sections: interconnection process, technical requirements, application, engineering data submittal, attachment, interconnection agreement, and rates.

### *Activity and Policies after 2016*

In an order from January 24, 2017, the PUC established a workgroup with representation from rate-regulated utilities, cooperative and municipal utilities, and stakeholders representing customers and DER industries to update and improve the statewide distributed generation interconnection standards previously established in 2004, in light of technological changes, updated federal standards, lessons learned over the last decade, and the requests of parties.[6] This work has been proceeding in several phases with a series of workgroup meetings and opportunities for written comments from stakeholders.

In its August 13, 2018, order on Phase 1, the PUC adopted the Minnesota Distributed Energy Resources Interconnection Process and Agreement (MN DIP and DIA) and reporting requirements.[7] On April 19, 2019, the PUC issued an order approving additional modifications to the MN DIP and DIA that resolved outstanding issues from the August 2018 order.[8, 9] The MN DIP and DIA went into effect statewide on June 17, 2019. Workgroups continue to meet to discuss and review implementation issues.

In its January 22, 2020 order on Phase 2 of its docket, the PUC established technical interconnection and interoperability standards (TIIR), including consideration of newly revised national technical standards, and required each utility to have a technical specifications manual (TSM).[10] The interim effective date for most of the TIIR was July 1, 2020. Several standards will not go into effect until after an interim period. In August 2020, the PUC issued a notice asking for comments related to Phase 3 of the docket, regarding the financial relationship between the utility and the distributed generator.

# CIP Cost Recovery, Incentives and Decoupling

### *History prior to 2016*

The Minnesota Department of Commerce has the responsibility for implementing and overseeing utility conservation improvement programs under Minn. Stat. §216B.241. The PUC has responsibility for:

1. Implementing cost recovery mechanisms to assure that public utilities recover expenses resulting from a Conservation Improvement Program (CIP) that has been approved by Commerce (Minn. Stat. §216B.241, Subd. 2b).

2. Developing and implementing energy conservation improvement incentive plans for public utilities related to meeting energy savings goals (Minn. Stat. §216B.16, Subd. 6c and §216B.241, Subd. 2c).

3. Developing criteria and standards for decoupling utility revenues from changes in energy sales to reduce a public utility's disincentive to promote energy efficiency and implement pilot programs (Minn. Stat. §216B.2412).

The PUC allows natural gas and electric public utilities to include their CIP-related costs in base rates established in rate cases. The PUC also allows these utilities to track the difference between the amounts built into base rates, and actual costs and incurred costs for true-up in a rider; a rider factor is established annually. As part of this annual review, the Commission approves utilities' financial incentives for inclusion in the rider.

As part of the Next Generation Energy Act passed in 2007, the Legislature directed the PUC to review its existing energy conservation incentive plans under Minn. Stat. §216B.16, Subd. 6c, and to adjust utility performance incentives to recognize progress in meeting newly established energy-savings goals. On January 27, 2010, the PUC issued an Order Establishing Utility Performance Incentives for Energy Conservation in response to this legislation. The Commission approved a new shared-savings financial incentive in 2010 that awards a utility a percentage of the net benefits created by a utility's energy conservation investments.

The PUC made adjustments in 2012 and asked Commerce to conduct an in-depth review of the program in three years. Based on Commerce's review of the shared-savings program and stakeholder comments, the PUC approved modifications to the incentive program in 2016 and requested another in-depth review by July 1, 2019.

In 2007, the legislature also enacted Minn. Stat. §216B.2412, which required the PUC to establish criteria and standards for the decoupling of energy sales from revenues and establish at least one pilot program for a rate-regulated natural gas or electric utility. Decoupling is intended to separate a utility's revenues from changes in energy sales, to make a regulated utility indifferent to the risk of lost revenues resulting from fewer energy sales due to customer or utility investments in cost-effective energy efficiency and other resources that reduce total customer energy consumption. The PUC issued an "Order Establishing Criteria and Standards to be Utilized in Pilot Proposals for Revenue Decoupling" on June 19, 2009.

### *Activity and Policies after 2016*

Based on the most recent in-depth review of the shared-savings incentive program by Commerce, and comments from utilities and other stakeholders, in October 2020 the PUC approved modifications to the overall design of the shared-savings performance incentives for natural gas and electric utilities under Minn. Stat. §216B.241. The modified incentive design will be effective starting with the 2021 through 2023 triennial CIP period. The Commission also asked Commerce to continue its stakeholder process to further explore improvements to the mechanism for review and potential adoption in the 2024–2026 triennium, and to develop an additional incentive for low-income CIP programs that could be implemented starting in 2022.

CenterPoint Energy was the first utility in the state to implement a pilot program for revenue decoupling. A partial decoupling pilot was implemented in 2010 and a full revenue decoupling pilot started in July 2015. In September 2016, CenterPoint began the first full decoupling rate adjustment on customer billing. The utility's revenue decoupling program, which has been modified over the years, continues.

*In September 2016, CenterPoint began the first full decoupling rate adjustment on customer billing.*

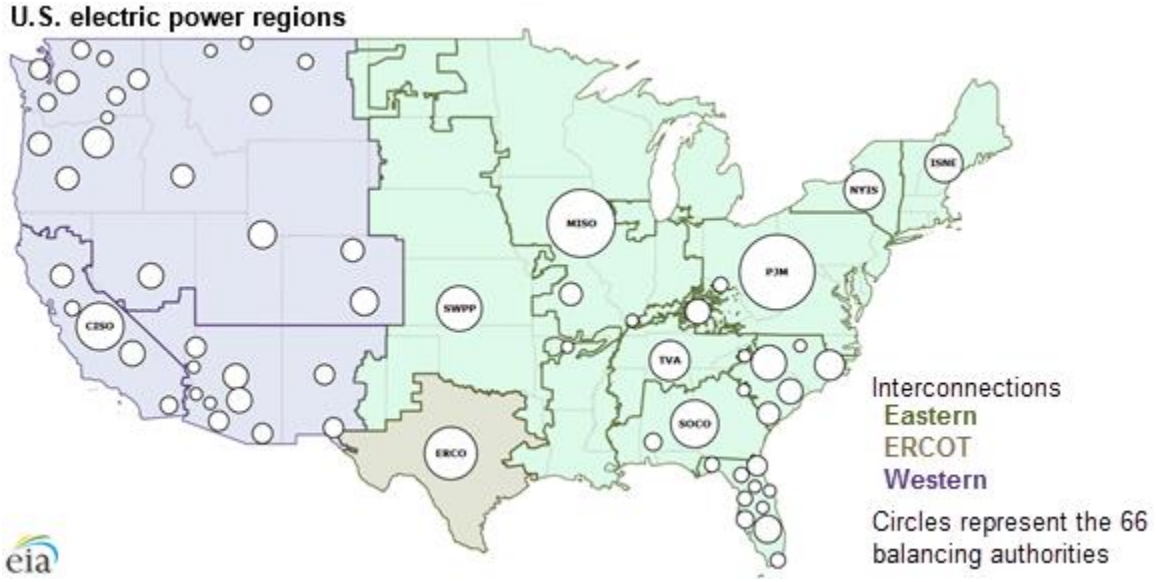
Minnesota Energy Resources, Great Plains Natural Gas Co., and Xcel Energy-Electric also currently have decoupling programs. Minn. Stat. §216B.2412 Subd. 3 requires the PUC to report annually to the

Legislature on decoupling programs. More detailed information on utility decoupling programs can be found in those reports.

# *Reliability and Resource Planning*

Being part of the North American power grid, which has been called "the world's largest machine," means that Minnesota's electrical grid and natural gas infrastructure extends beyond state borders both regionally and internationally.[11] It connects to every business and residence in the state.

To ensure adequate and reliable electric and natural gas service at reasonable rates, the Department of Commerce Division of Energy Resources relies on economists, scientists, accountants, financial analysts, lawyers, and planners in their expert capacities. Commerce also engages in technical, policy, and planning proceedings at federal, regional, and state levels, and participates in reliability and planning proceedings led by the Federal Energy Regulatory Commission (FERC), National Electric Reliability Council (NERC), Midcontinent Independent System Operator (MISO), and Minnesota Public Utilities Commission (PUC).




## Figure 3-B: U.S. Electric Power Regions

Figure 3-B depicts the three major national interconnections and control regions of the U.S. electric power grid. Electricity generated at power plants moves through a complex network of electricity substations, power lines, and distribution transformers before it reaches customers. In the United States, the power system consists of more than 7,300 power plants, nearly 160,000 miles of high-voltage power lines, and millions of low-voltage power lines and distribution transformers, which connect 145 million customers. Local electricity grids are interconnected to form larger networks for reliability and commercial purposes. At the highest level, the United States power system in the Lower 48 states is made up of three main interconnections, which operate largely independently from each other with limited transfers of power between them.

*Source: Energy Information Administration*

Through involvement in these organizations, Commerce works to make sure that the financial and economic requirements of public utilities are met, that utilities can construct or obtain energy from generation facilities in an environmentally sound, efficient, and least-cost manner, to support the wide range of electricity uses that power the state's economy.

Commerce, the PUC, utilities and stakeholders engage in several state-based processes that examine each utility's plans to generate, transmit and deliver electricity through integrated generation, transmission and distribution system planning. Minnesota statutes, including Minn. Stat. §216B.2422, require Commerce to evaluate five- to 15-year outlooks on how much electricity customers will need, how much electricity the utility is able to generate and purchase, and options for fulfilling future needs.

| **Utility** | **MN PUC Docket #** | **Status*** |
|---|---|---|
| Basin Electric Power Cooperative | 20-564 | O-IRP |
| Dairyland Power Cooperative | 20-558 | O-IRP |
| Great River Energy | 17-286 | Order Issued Nov. 28, 2018 |
| Interstate Power & Light Company | 17-374 | Order Issued April 2, 2019 |
| Minnesota Municipal Power Agency | 18-524 | Order Issued May 28, 2019 |
| Minnesota Power | 15-690 | Order Issued July 18, 2016 |
| Minnkota Power Cooperative Inc., Northern Municipal Power Agency | 19-416 | Order Issued May 21, 2020 |
| Missouri River Energy Services | 16-509 | Order Issued May 18, 2017 |
| Otter Tail Power Company | 16-386 | Order Issued April 26, 2017 |
| Southern MN Municipal Power Agency | 17-753 | Order Issued Oct. 24, 2018 |
| Xcel Energy | 19-368 | Pending |

## Figure 3-C: Minnesota Utility Resource Planning Processes (2017 – 2020)

Figure 3-C summarizes the 11 electric utility resource planning proceedings convened at the Minnesota Public Utilities Commission from 2017 through 2020.

**Minn. Public Utilities Commission Resource Planning website accessed Jan. 14, 2021*

Minnesota is a national leader in utility integrated planning processes, first with the establishment of its integrated resource planning (IRP) process in the 1980s, and more recently with the creation of distribution system planning requirements.[12] For decades Minnesota has pursued a progressive, inclusive, and successful process of resource planning to establish a reliable and resilient electric system. State processes, along with the Department of Commerce's scrutiny and evaluation of utilities' long-term plans, have led to a robust electrical system, enabled stakeholders to better understand system trade-offs, and helped to ensure the most sustainable and affordable solutions are implemented.

Utility resource planning processes are intended to answer such questions as whether and how utilities should invest in renewable resources; how to accommodate growing distributed energy resources (DER); whether large generation facilities are the most cost-effective option; whether long-distance regional transmission lines are needed; and the ideal pace for utilities to invest in new technologies.

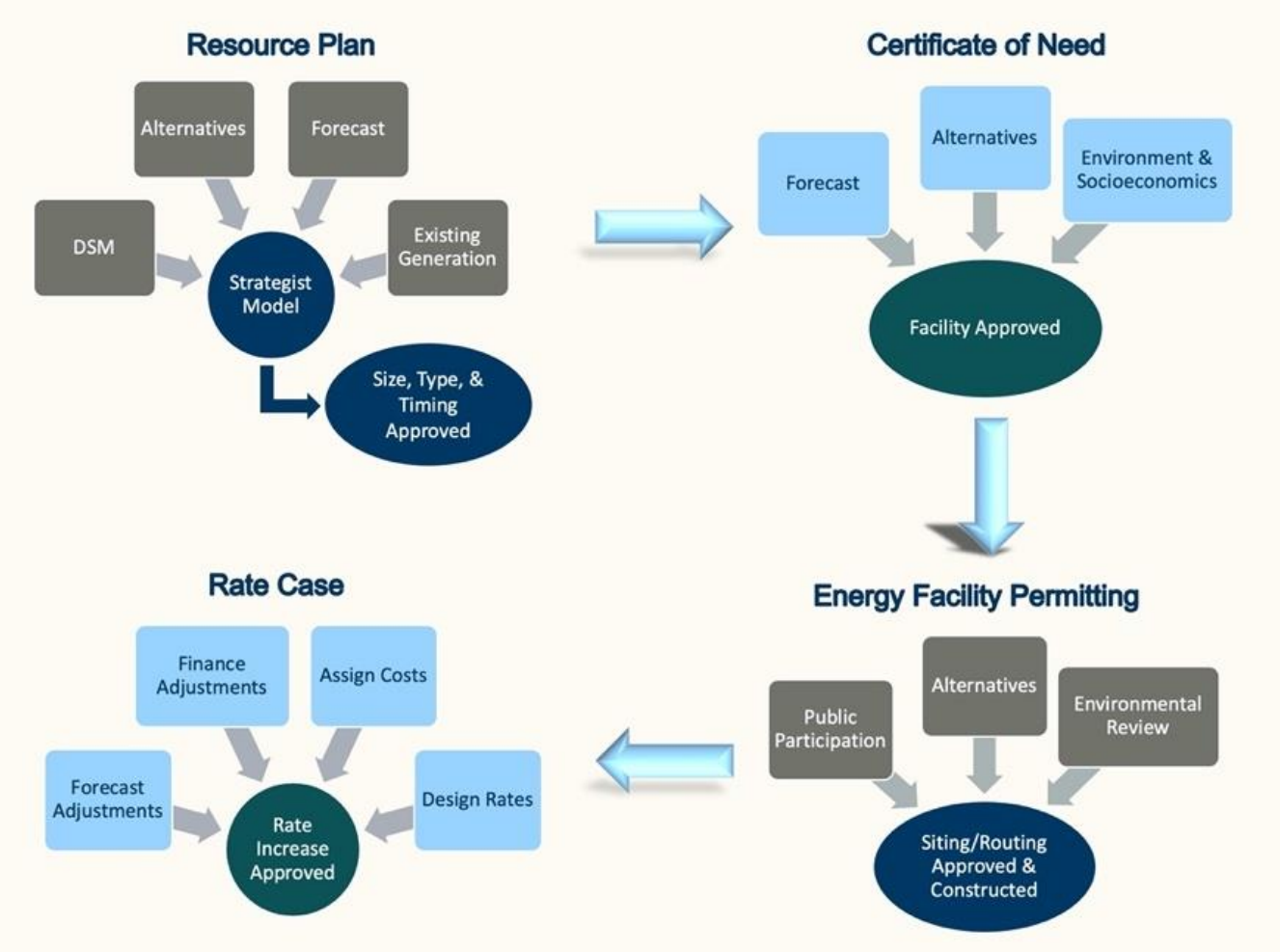



**Figure 3-D: Minnesota Four Major Energy Regulatory Processes**

Figure 3-D illustrates the four major energy regulatory processes that the Minnesota Public Utilities Commission uses to apply State policies in considering energy resource planning, certificates of need, construction permits and line routes, and utility rate adjustments.

## Activity and Policies

Utility planning in Minnesota has changed over time to adapt to the evolving energy landscape. Minnesota laws addressing resource planning and transmission planning turned out to be ahead of their time when they were first enacted. These laws provided a framework that offered Commerce the flexibility to evaluate changes as that have emerged. Commerce has continued to meet its regulatory obligations as policies and goals have changed. However, new policies and system changes have influenced how Commerce operates as well as the factors it has included in its analysis.

Some of the most notable changes from 2016 to 2019 include the U.S. Environmental Protection Agency's withdrawal of the Federal Clean Power Plan (CPP) policy to regulate greenhouse gas emissions that was adopted in 2015; renewals and changes in federal Production Tax Credit (PTC) and Investment Tax Credit (ITC) programs; and Minnesota's enactment of community solar garden (CSG) and value of solar (VOS) legislation.

In 2018, the U.S. EPA promulgated the Affordable Clean Energy rule to replace the federal Clean Power Plan (CPP). The Affordable Clean Energy rule significantly narrowed the GHG emission control options required for electric generating sources and affected regional evaluation of plans for generation and transmission as well as state-level utility resource planning. During the same time, renewable energy and conservation technologies continued improving, costs declined rapidly and shifting customer preferences encouraged utilities to continue investing in sustainable energy systems.[13] On January 19, 2021, a federal appeals court struck down the Affordable Clean Energy rule, finding that it failed to comply with the Clean Air Act and would have led to more power sector emissions. The court directed the U.S. EPA to start over with a new regulatory approach.[14] The State of Minnesota anticipates revising its policies to implement the pending EPA rules.

Initially the federal PTC helped utilities acquire wind resources as least-cost system resources. The extensions and phase-out of the PTC and ITC put pressure on utilities to maximize these inexpensive system resources and capture the value of tax-equity funded resources while program benefits were still available. In recent years, wind-generated energy has been more cost-competitive than power generated from burning natural gas or, in many cases, other existing system resources.[15] Costs for photovoltaics (PV) also have declined rapidly in recent years. This spurred a boom in large-scale wind and solar development in Minnesota and increased the need for new and upgraded transmission lines to allow for the transport and export of the state's wind resources in particular. These factors have a large effect on the resource and transmission plans that utilities have proposed.

Minnesota's CSG and VOS legislation also stimulated the growth of solar DERs connected to the distribution system, triggering the need for system upgrades in some locations, and changing the way utilities and regulators plan for distribution system investments and operations. These developments, combined with a new policy requiring that utilities study available distribution system capacity to accommodate new DERs, spurred the need for systematic distribution planning.

## Emerging Trends and Issues

Minnesota's electric systems are undergoing a period of transition in three key areas. First, the electric grid is moving from a system based on mechanical and analog parts to one that utilizes digital technologies, providing grid operators with greater visibility and control over the system. Second, the electrical grid is changing from a system designed for centralized large-scale generators, with one-way power flows, to a dynamic and distributed system with numerous smaller generators and increased two-way power flows. Third, the electric grid is changing due to environmental and economic pressures, including the push to end reliance on carbon-based resources, as well as the rapid decline in costs for renewable generation and energy storage systems. These three major shifts are transforming utilities' resource planning processes and state oversight of them.

### Digitalization

*System digitalization is transforming the ability of Minnesota utilities to provide new services.*

The electrical grid is transitioning from relying upon manual tools to integrating digital technologies all the way from the interstate transmission system level down to the distribution system for residential, commercial and industrial customers. Advanced technologies are providing real-time information, increased data access, and more system control and communication. These changes lead to additional resource options and, with them, greater complexity than ever before. System digitalization is transforming the ability of Minnesota utilities to provide new

services. State regulation and oversight of utilities has expanded to address new questions about such factors as data access, cybersecurity, modeling, grid integration, optimization, operations, and utility services.

## Decentralization

Decentralized resources include distributed wind, solar, and battery energy storage systems, plus controllable loads like smart thermostats and interruptible water heaters. Also, while utility-scale wind and solar fields aren't generally considered DERs, they are less centralized than the fossil-fired and nuclear plants that dominated power generation in the U.S. utility system for more than a century. These alternatives to conventional central power plants create new issues that utilities and State agencies must consider during resource planning processes, requiring utility planners and regulators to update their knowledge and expertise. The complex options, trade-offs, and considerations including security, privacy, and new policy directions present new challenges for Commerce and PUC staff.

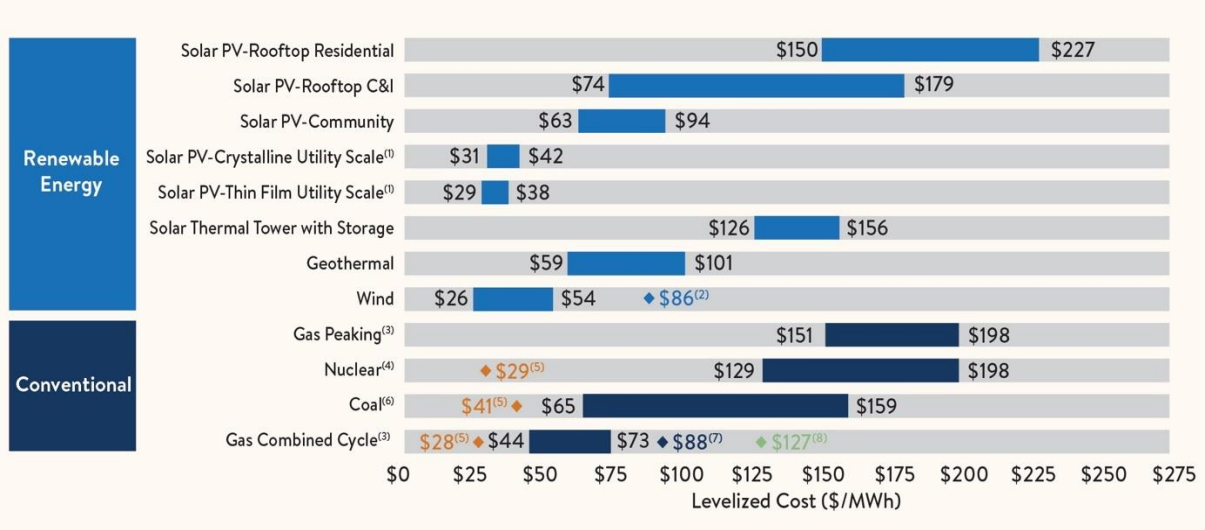
Distribution system investments likely will be a large part of utility spending in the next decade as new infrastructure, software, communication systems, and hardware are needed to provide visibility and control over an increasingly dynamic distribution system. However, with increased storm severity and greater customer demand for reliable power, utilities are also pursuing distribution system hardening, meaning system upgrades to increase resilience and reliability. In light of this trend, Commerce supports the continued evolution of distribution system planning to complement existing resource and transmission planning processes.

## Market Pressures

Environmental requirements, cost declines in technologies, and customer preferences are accelerating the rate of change in Minnesota's energy economy. Xcel's 2019 IRP[16] accounted for the concurrent retirement of some baseload coal-generating facilities and seasonal use of others, the integration of thousands of megawatts of wind and solar, and the installation of advanced meters as well as large increases in demand response. Xcel's plan went well beyond what historically has been considered in utility IRPs.

*Xcel's 2019 Integrated Resource Plan went well beyond what historically has been considered in utility IRPs.*

Minnesota's communities, institutions, and businesses increasingly are developing sustainability goals, many of which include procurements of carbon-free energy (See also Chapter 2).[17,18,19,20,21,22] These customer preferences are spurring trends toward renewable product offerings by utilities in the state, as well as power purchase agreements with independent producers. Both prompt utilities to plan for additional wind and solar power as well as high-voltage transmission lines.[23]




## Figure 3-E: Levelized Cost of Energy Comparison – Unsubsidized Analysis

Figure 3-E depicts the unsubsidized, levelized cost of various energy generation technologies. Renewable energy generation already is cost-competitive with conventional generation under certain circumstances. For details about this analysis including explanations of notations, see the Lazard Levelized Cost of Energy Report.[24]

*Source: Lazard*

Each planning process seeks to ensure that utilities are evaluating potential system options and pursuing least-cost, environmentally sound, and efficient resources consistent with state and federal laws and goals. The increasingly complex and dynamic planning environment challenges Commerce and PUC staff to continue building its capacity to support IRP processes.

Commerce continues applying planning priorities of affordability, least-cost planning, and minimization of environmental impact. Stakeholder processes are a key part of evaluating each utility's proposed IRP. Minnesota has pursued uniquely collaborative utility, regulator, stakeholder and public processes, including, for example, the e21 utility regulatory planning initiative[25] and the CapX2020 regional transmission planning program.[26,27] These and many other stakeholder processes have served to inform regulatory and policy making proceedings, clarified differing perspectives, and helped to identify challenges to planning objectives (See Sidebar: Stakeholder Processes and Resource Planning).

*The increasingly complex and dynamic planning environment challenges Commerce and PUC staff to continue building its capacity to support IRP processes.*

The Commerce Energy Regulation and Planning division expects to continue facilitating and participating in stakeholder processes and monitoring local and regional planning changes as well as best practices for new and emerging issues. Additionally, Commerce staff will continue supporting the PUC and other Minnesota agencies and utilities in addressing regional and federal issues on ratemaking, planning, economic and technical analysis, and other areas.

# *Site and Route Permitting*

The Minnesota Public Utilities Commission (PUC) has had responsibility for permitting certain energy facilities in Minnesota such as power plants, transmission lines, wind farms and pipelines since 2005, when the State Legislature transferred authority from the Environmental Quality Board. The PUC's permitting processes are defined in the following statutes and associated rules:

- Power plants, including solar farms, and transmission lines (Minn. Stat. Chapter 216E and Minn. Admin. Rules Chapter 7850);
- Large wind energy conversion systems with a combined nameplate capacity of 5,000 kW or more (Minn. Stat. Chapter 216F and Minn. Admin. Rules Chapter 7854); and
- Pipelines (Minn. Stat. Chapter 216G and Minn. Admin. Rules Chapter 7852).

The PUC's permitting decisions rely on the official record developed for each project, which includes information submitted by the applicant, involved parties, and participants in the docket, as well as from public input gathered during public meetings and hearings. The Minnesota Department of Commerce, Energy Environmental Review and Analysis (EERA) unit conducts environmental review for energy facilities that are being reviewed by the PUC. And an administrative law judge (ALJ) from the Minnesota Office of Administrative Hearings (OAH) oversees public and evidentiary hearings on behalf of the PUC.

Although the PUC's permitting processes vary with the type and size of the proposed energy facility, all review processes include two main parts:

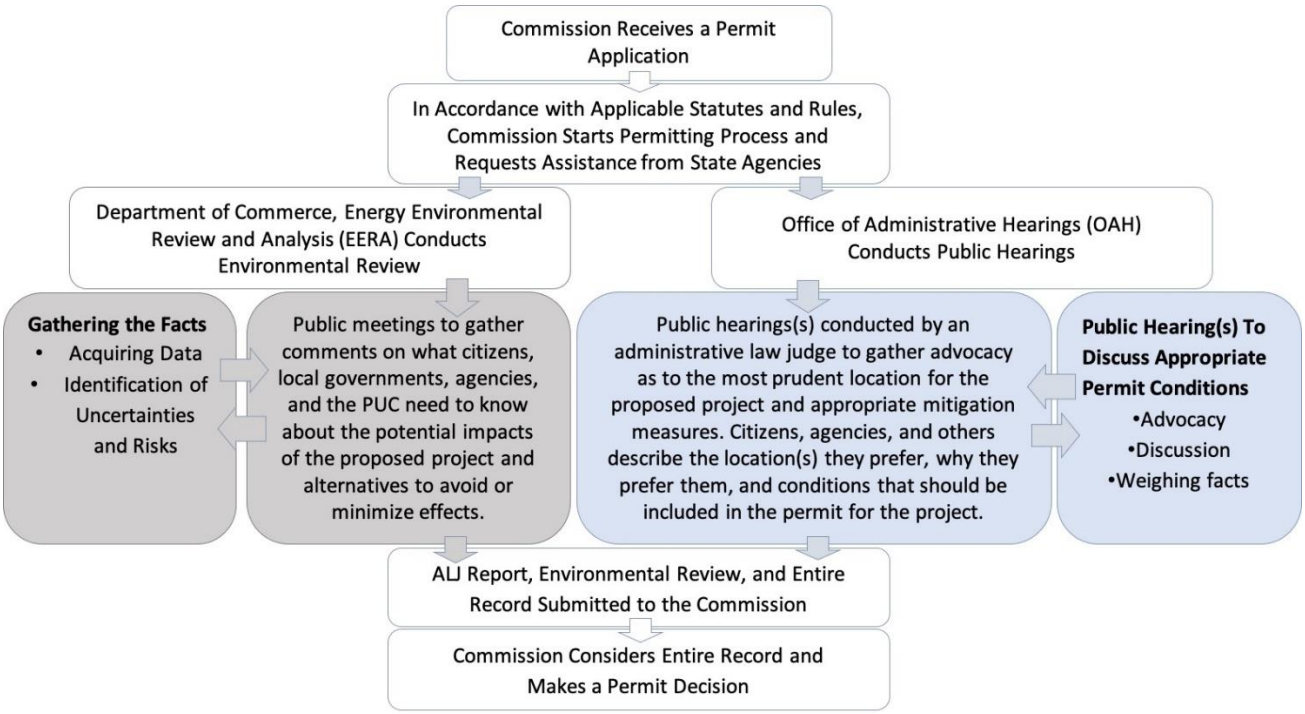
1. Gathering information about the project: This includes the merits of the proposed project, potential environmental impacts, community effects, and how such effects could be avoided or mitigated. Information on potential effects is gathered through public meetings and public comment periods. Information is also provided in permit applications by prospective permittees, in comments or testimony by other parties or participants, and in EERA's environmental review documents, such as environmental impact statements.

### *Stakeholder Processes and Resource Planning*

Commerce has participated in multiple stakeholder processes over the past four years, many of which provided group recommendations that should be considered in any future policy development. Examples include:

- Solar and Wind Decommissioning Working Group[28]
- Solar Siting in Agricultural Landscapes Stakeholder Process[29]
- Great Plains Institute and CEE Stakeholder Process on Xcel Energy's Demand Response Offerings[30]
- Great Plains Institute Stakeholder Process on Performance Metrics for Xcel Energy's Electric Utility Operations[31]
- Minnesota PUC Energy Utility Diversity Stakeholder Group[32]
- Xcel Energy Hosting Capacity Analysis Workgroup[33, 34, 35]
- Distribution planning order requirements[36, 37, 38]
- Interconnection Workgroup [39, 40]
- The Department has also hosted various proceedings including:
- Resource planning with multiple utilities[41]
- Avoided cost and value of solar[42]
- Environmental Externalities[43,44]
- Xcel Energy's AMI and FAN Investments[45]
- Solar Actions for Low-Income Households[46]
- Minnesota Solar Pathways[47]

2. Development and discussion of appropriate permit conditions for the project: Given information gathered about the project, its potential impacts and possible mitigation measures, proceedings seek to identify applicable permit conditions. These proceedings include public hearings and submission of public testimony. The ALJ for the hearing typically produces a report for the PUC that includes proposed findings of fact, conclusions of law, and recommendations regarding the project.




## Figure 3-F: Minnesota PUC Permitting Process

Figure 3-F illustrates permitting processes that the Minnesota Public Utilities Commission applies in considering applications for energy facility construction, including gathering and analyzing data, assessing environmental impacts, determining appropriate permit conditions, and weighing decisions whether to approve permits. Public hearings and reviews are included in each step of the process.

PUC permitting decisions are guided by criteria specified in statutes and rules. The PUC is generally charged with permitting energy facilities following systematic processes to ensure facilities are compatible with State policies for environmental preservation and the efficient use of resources.

# Activity and Policies

Over the past four years, the PUC has permitted 36 energy facilities in Minnesota. This total includes permit amendments for repowering existing wind farms. Energy facilities currently in the permitting process and those previously permitted are described on the Department of Commerce's website.[48]

| | Carbon-Based Power Plant | Solar Power Plant | Transmission Line | Wind Farm | Pipeline |
|---|---|---|---|---|---|
| **2016** | 2 | 2 | 5 | 1 | 0 |
| **2017** | 0 | 0 | 1 | 3 | 3 |
| **2018** | 0 | 0 | 1 | 6 | 2 |
| **2019** | 0 | 0 | 2 | 7 | 1 |
| **TOTALS** | 2 | 2 | 9 | 17 | 6 |
| **GRAND TOTAL** | **36** | | | | |

## Figure 3-G: Minn. PUC Permitting Actions (2016 – 2019)

Figure 3-G summarizes the power plant, transmission line, and pipeline permits issued by the Minnesota Public Utilities Commission from 2016 through 2019. The Commission issued a total of 36 permits, of which 17 were for wind farms, nine for transmission lines, six for pipelines, and two each for fossil-fueled and solar plants.

During this period, 17 of the 36 permits were for wind energy systems, both new projects and existing wind farms that being repowered. Starting in 2016, several wind farms in Minnesota began reaching the end of their service lives, and some of the permittees have chosen to repower their wind farms rather than fully decommissioning them. The repowering process typically includes updating electric generation equipment in wind turbine nacelles and replacing existing wind turbine rotors with longer blades.

From 2016 to 2019, the PUC also permitted several transmission lines and pipelines, including the 500-kV Great Northern Transmission Line and the Line 3 Petroleum Pipeline Project.[49] PUC permitting of power plants during this period includes two natural gas-fired power plants and two solar power plants.

*From 2016 to 2019, the PUC permitted several transmission lines and pipelines, including the 500-kV Great Northern Transmission Line and the Line 3 Petroleum Pipeline.*

### Solar on Prime Farmland

Solar farms have a larger footprint than conventional carbon-based power plants. They require approximately 7 to 10 acres per megawatt of capacity. This footprint means their development can raise concerns about land use conversion and adverse impacts to farmland, forests, and other natural lands.

When siting power plants, especially solar power plants, the PUC must consider the prime farmland exclusion of Minnesota Admin. Rule 7850.4400, subpart 4. With the exception of water storage reservoirs and cooling ponds, the rule prohibits siting a power plant on prime farmland if the plant utilizes more than 0.5 acres per MW of net generating capacity – unless no feasible and prudent alternative exists. Because solar power plants use more than 0.5 acres per MW of generation, the rule prevents the use of prime farmland for energy production rather than for agriculture.

The PUC in 2016 requested that EERA and the Minnesota Department of Agriculture (MDA) engage stakeholders to gather information on the use of prime farmland for solar power plants and to develop guidance on siting solar power plants in agricultural landscapes, particularly with respect to feasible and prudent alternatives.

At the request of MDA and EERA, Minnesota Management Analysis and Development (MAD) conducted a survey and convened two facilitated workshops during the summer of 2019 to discuss prime farmland and the siting of solar power plants. The workshops examined the stakeholders' issues, priorities, and preferences regarding siting solar power plants in agricultural landscapes and identified areas of potential agreement. Commerce and MDA published a report in September 2019 summarizing the results of this stakeholder process.[50] Subsequently, in May 2020, Commerce published guidance for solar developers on siting solar power plants.[51]

*Two workshops during the summer of 2019 examined stakeholders' issues, priorities, and preferences regarding siting solar power plants in agricultural landscapes.*

## Decommissioning of Solar Power Plants and Wind Farms

PUC site permits for solar and wind farms require permittees to develop and maintain decommissioning plans. Currently, site permits for other types of power plants, such as natural gas-fired generators, do not require a decommissioning plan. Decommissioning plans detail the steps required to remove the project and restore the site at the end of its life. Plans also provide an estimate of decommissioning costs and describe how sufficient funds would be made available to accomplish required decommissioning tasks.

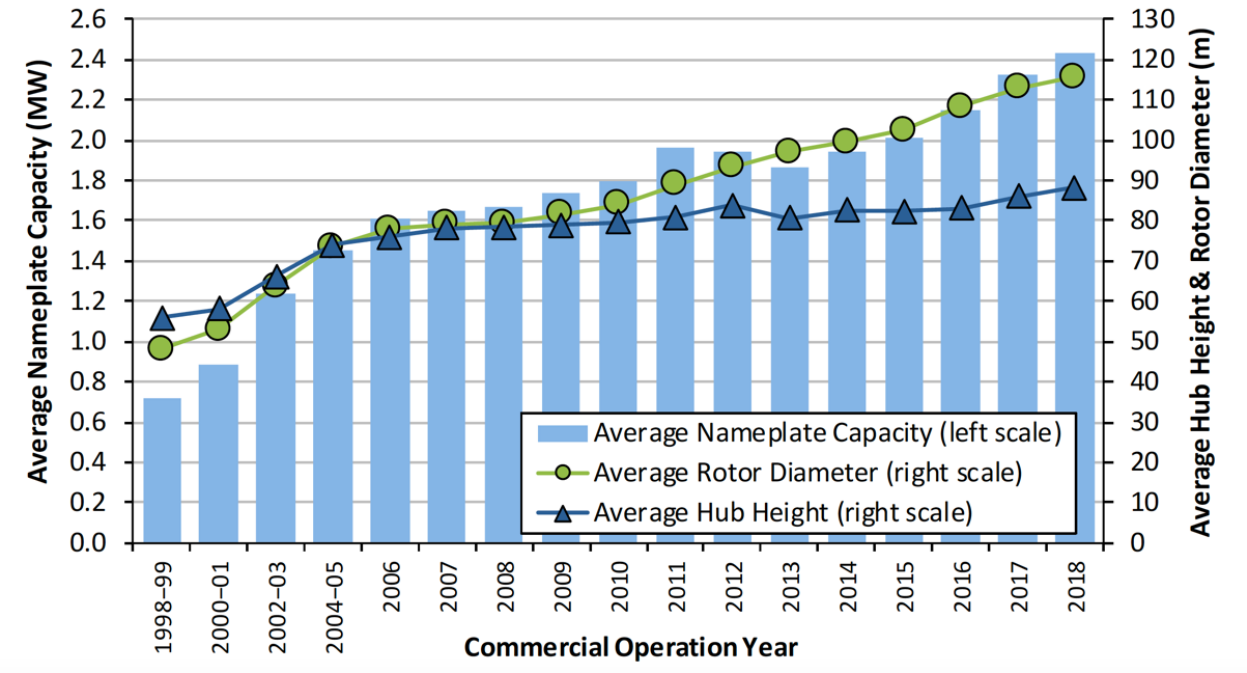
In March 2017, the PUC authorized EERA to convene a working group to examine decommissioning plans for solar power plants and wind farms. The working group published a report and recommendations in August 2018.[52] The working group recommended that decommissioning plans should be required, and that they should be detailed and adaptable. The PUC subsequently solicited comments on the working group report. Based on the report and comments, EERA established a schedule and process for reviewing decommissioning plans on behalf of the PUC.

## Guidance for Applicants and Permittees

In addition to guidance for solar developers, EERA has developed guidance for other aspects of the PUC's permitting processes. In July 2019, EERA released revised guidance for site permit applications for wind farms.[53] This guidance is intended to assist wind developers in preparing complete site permit applications. Also, in July 2019, EERA reissued its guidance for wind farm permittees on how to conduct and report post-construction noise monitoring.[54] The guidance is aimed at assisting permit-holders in developing and using a project-specific noise study protocol that guides post-construction noise monitoring, data analysis, and reporting.

During the past four years, two notable developments related to the PUC's energy facility permitting occurred: 1) continued growth in site permits for both new and repowered wind farms; and 2) new growth in site permits for solar power plants. The PUC's permitting activity from 2016 onward has been related primarily to wind farms. Electric generation from wind farms continues to grow in Minnesota.[55]

As noted above, many existing wind farms are being repowered. Repowered wind farms typically use the same turbine towers with longer wind turbine blades and updated generating equipment. Repowered wind farms generally have a greater capacity factor and produce more energy than their original configurations. This reflects a general trend toward larger turbines (i.e. turbines with greater nameplate generating capacity) being used for wind projects nationwide.




## Figure 3-H: Average Wind Turbine Nameplate Capacity, Rotor Diameter, and Hub Height

Figure 3-H shows a steady increase in wind turbine nameplate capacity and rotor diameter for land-based wind projects from the late 1990s to 2018. Meanwhile, since the early 2000s, average hub height has plateaued, indicating that towers of the same height are capable of hosting turbines of increasing capacity.

*Source: AWEA WindIQ, USWTDB*

In 2013, Minnesota established a solar electricity standard (SES), requiring electric utilities to obtain at least 1.5% of their total Minnesota retail sales from solar energy by the end of 2020, with a goal of obtaining 10% of Minnesota retail electric sales from solar energy by 2030. The SES, along with significant declines in prices for solar panels, is driving increasing solar power development in the state. The PUC has permitted only four non-wind power plants over the past four years, but two of them were solar power plants. EERA noted that two additional solar power plants applied for site permits in 2019 and were built in 2020. Further, utility resource plans indicate substantial additions of solar power generation in the next 10 years.[56]

*Without new transmission infrastructure, interconnection costs for individual wind and solar projects could become prohibitive.*

Commerce expects the trends observed over the last four year to continue. The PUC likely will receive applications for a growing number of wind farms and solar power plants across the state, and the wind farms will include repowered facilities. These new energy facilities must connect to the electric transmission grid, spurring the need for new transmission infrastructure. Without new transmission infrastructure, interconnection costs for individual wind and solar projects could become prohibitive. For example, in 2019 Dodge County Wind LLC withdrew its route permit application for the interconnection of the proposed Dodge County Wind Farm, citing prohibitive project interconnection costs. The developer subsequently announced plans to connect the wind farm via a new 161 kV

transmission line. The PUC expects to review its updated wind farm application and a new transmission line proposal in 2021, along with applications by other owners of new and repowered facilities.

# *Energy Assurance Planning*

While the owners and operators of energy infrastructure in Minnesota bear responsibility for ongoing maintenance and upgrades, State and local officials also are responsible for working with operators and stakeholders to assure public safety and mitigate the consequences of various threats to the state's energy economy. Such threats include severe weather events (e.g. tornados, straight-line winds, and floods), cyber threats, and changes in energy infrastructure and production that can affect deliverability of energy supplies to customers in Minnesota.

Commerce's roles in energy assurance include maintaining and updating the Minnesota Energy Assurance Plan, providing periodic supply forecasts and situational awareness bulletins, and coordinating inter-agency disaster drills. Commerce's energy assurance planning staff also supports threat-assessment and resiliency planning efforts among various agencies.

## Risk Assessment and Response

The goal of an energy assurance plan is to describe the strategy and objectives required to ensure the state's energy infrastructure is secure, reliable, and resilient, and can be restored to service rapidly in the event of a disaster. A 2007 Minnesota Department of Commerce Energy Emergency plan provided the framework for an updated plan that was completed in 2013 and funded through a 2009 American Recovery and Reinvestment Act (ARRA) grant. The 2013 Minnesota Energy Assurance Plan incorporated guidance from the National Association of State Energy Officials (NASEO). The plan also was based on a more comprehensive assessment of energy surety risks, compared to the 2007 plan's focus on regional blackouts and fossil fuel shortages, driven by the 2003 Northeastern United States blackout and the 1973 energy crisis.

During the process of developing the 2013 Energy Assurance Plan, Commerce staff identified recurring energy shortages that appeared to result from significant demands for diesel fuel, heating oil, and propane occurring at the confluence of certain seasonal factors – *e.g.,* crop harvesting, increased heating for livestock barns, and the onset of commercial, industrial, and residential space heating. These trends, along with data on propane use by agricultural sector, were documented in a 2011 Minnesota Department of Agriculture report to the Legislature.[57]

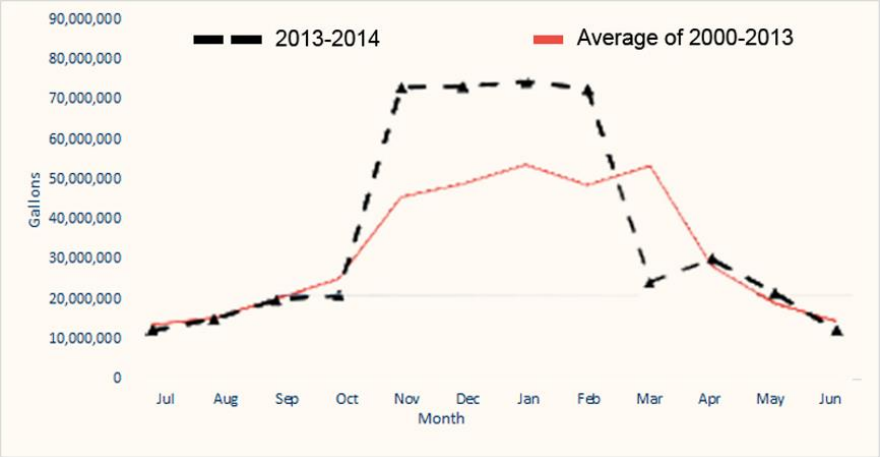
Changes in the use of the Kinder Morgan Cochin pipeline worsened the situation in 2013. The Cochin pipeline had been supplying approximately 35% of Minnesota's annual propane demand, shipping propane from Canada through Minnesota to supply two major Minnesota propane terminals. But in 2013 the operator reversed the flow to ship diluents northward, where they would be used to improve the flow characteristics of thick Canadian tar-sand oil.[58]

In addition to Cochin propane supply being taken off the market, the 2013 fall season brought a perfect storm of market constraints, including: a wetter-than-normal harvest season that led to higher fuel demand for corn drying; a lack of qualified drivers to transport liquefied propane; and a polar vortex that created unseasonably low temperatures and space heating requirements.

Federal and state agencies and industry organizations worked to alleviate the problem with several actions, including working to waive some trucking regulations and arrange for fuel deliveries from

markets across the country. In the wake of the crisis, U.S. Sen. Amy Klobuchar sponsored legislation that gave governors greater flexibility to address emergency heating situations. The *Reliable Home Heating Act* of 2014 gave state governors authority to declare a state of emergency due to heating fuel shortages that would trigger a 30-day exemption from federal regulations for trucking operators to allow more rapid fuel transportation. Gov. Walz exercised that authority in October 2019 when a wet and cold harvest season created a supply-demand imbalance similar to what was experienced in 2013. Along with Federal Energy Regulatory Commission (FERC) actions to prioritize fuel shipments to the Midwest in November 2019, these steps helped to quickly alleviate the emergency.[59]

The 2013 propane shortages prompted Commerce to re-evaluate its approach to assurance planning to help avoid such situations in the future. Specifically, Commerce staff developed processes to monitor supply and demand by collecting data and maintaining ongoing communications through other units of governments, corporations, and trade and industry associations.

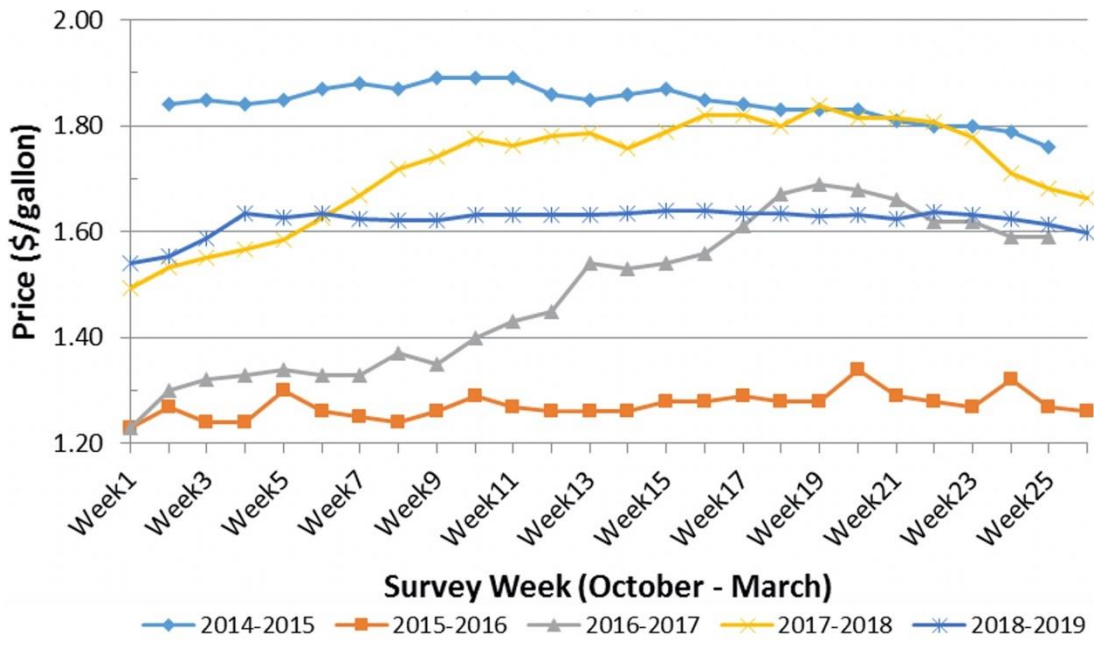



## Figure 3-I: Propane Consumption in Minnesota – Winter 2013-'14 vs. Average

Minnesota's propane demand typically increases in the fall and winter as fuel consumption rises for heating buildings and drying crop harvests for processing as food and fuel. As Figure 3-I illustrates, propane demand escalated at about double the average rate in the unseasonably wet and cold fall and winter seasons of 2013 and 2014.

*Source: Minnesota Department of Revenue Petroleum Collection Reports*

During the heating season, October through March, Commerce staff collects pricing information and contributes it to EIA's State Heating Oil and Propane Program (SHOPP) report, which is part of a national program of price collection and reporting.[60,61] Staff also compiles and distributes internally a Situational Awareness report as needed to keep leadership informed about potential fuel shortages and emergency conditions. Also, Commerce posts a weekly Fuels Monitoring Report on its website.[62] These reports support ongoing critical decision processes by State agencies and private companies and organizations.




## Figure 3-J: Residential Propane Prices in Minnesota (2014 – 2019)

Figure 3-J shows the average prices for heating oil and propane in the 2018-2019 heating season compared to recent years.
*Source: Minnesota Department of Commerce, State Energy Office*

Two Commerce staff members, trained and certified as emergency managers by the Minnesota Department of Homeland Security and Emergency Management, provide support during severe weather and other events that can cause emergency conditions affecting fuel infrastructure and supplies. They coordinate with other agency representatives on the Minnesota Emergency Preparedness and Response Committee, as required by Executive Order 19-22.

Additionally, cyber security has been an emerging activity demanding increased attention. Commerce participates with the Minnesota PUC in discussions with utilities related to cyber security threats and intrusion prevention measures.

Finally, over the past decade Minnesota's energy sources have become more diverse, as utilities have reduced their use of coal-fired power generation while increasing reliance on natural gas and renewables. This continues as utilities replace aging and uneconomic coal generating plants with more sustainable resources.

Shifting production resources creates new scenarios for energy assurance planning. Solar and to a lesser degree wind resources can provide the benefit of being distributed throughout the grid, reducing line losses. But because they are variable and non-dispatchable power sources, they require new approaches to resource forecasting and system balancing. Adaptation planning may become an increasingly important part of Commerce's energy assurance work in the years to come.

# Planning Ahead

Commerce's energy assurance staff continues its work to keep current the State's Energy Assurance Plan and provide situational awareness reports that inform both State agencies and private companies and organizations about issues affecting surety of energy supply and delivery. This work requires ongoing

research, monitoring, and engagement with numerous agencies and information sources, as well as responding to special requests related to energy assurance. The increasing complexity of Minnesota's energy economy calls for increasing staff resources focused on energy assurance efforts, as well as cross-training to strengthen the State's ability to monitor developments and respond accordingly.

In addition to continued trends involving delivered fuels and electric power resources, transportation electrification will raise new issues affecting energy assurance in Minnesota. Access to public charging stations is a primary factor affecting drivers' decisions to purchase electric vehicles (EV).[63] As more EVs enter Minnesota's roadways in the years to come, and as lawmakers focus policies and programs on supporting beneficial electrification, EV charging infrastructure will become an increasingly important factor for consideration in energy assurance planning.

More broadly, climate change creates growing risks to Minnesota's ecology, economy, and infrastructure, and many of these risks raise increasing energy assurance concerns. High-resolution long-term climate projections will help Minnesota's agencies, communities, and organizations in planning projects and adaptation strategies. Such strategies are necessary not only to maintain and protect our natural environment, but also to increase the climate resiliency of the state's physical infrastructure, economy, and public health. Existing climate projections, including lower-resolution and discontinuous time "slices" provided by the University of Minnesota,[64] should be viewed as an intermediate step. Further development of high-resolution, dynamically downscaled climate projections for Minnesota would assist Minnesota in developing climate resiliency plans.

### *Pandemic Effects on Energy Assurance*

The COVID-19 pandemic has demonstrated that in general the world, the United States, and the individual states have been less than adequately prepared to effectively address the challenges of a global pandemic. Lessons learned and after-action reports from various Minnesota State agencies are expected to highlight specific areas for improvement.

One implication for Minnesota's energy economy is that some utility personnel are essential workers. Personal protective equipment (PPE), including N95 or equivalent filtration masks, are vital tools to protect essential power control room operators and other key personnel without whom the state's energy supplies would be threatened. During the pandemic, PPE was in such short supply that specially trained workers needed to be sequestered to ensure they would remain available to carry out critical energy production, transmission, and control operations. The need for proper PPE equipment and qualified personnel will be addressed in forthcoming after-action reports.

Additional work also is needed to help guide investments in climate adaptation and resiliency. Such projects as vulnerability assessments, climate adaptation planning, and planning and design of resilient infrastructure merit focused resources that currently are scarce. Notably, such projects generally are not eligible for bond funding, and they will become increasingly important for energy assurance as climate change and other trends create new challenges for the state's energy supply and delivery systems. These trends support State funding support for a variety of adaptation and resiliency studies and projects, including for example:

- Studies, programs, incentives, guidelines, and criteria for investments in microgrids and other resilient electricity technologies for vulnerable populations as well as public facilities and businesses that are critical to the health and safety of Minnesota communities.

- Guidelines for community planning and building codes that ensure new subdivisions and buildings are designed with energy security in mind, and that they incorporate modern technologies enabling greater self-reliance and protection from large-scale emergencies.
- Resiliency improvement financing mechanisms, including for example a grant or cost-sharing program for local government units (LGU) to support assessment, planning, and design of microgrids and other resilient infrastructure for critical facilities;[65] Minnesota Public Facilities Authority (PFA)-administered bond funding for grants and loans to LGUs for resilient infrastructure; and credit systems to incentivize resilient and sustainable infrastructure.

Implementation of such programs should be equitably dispersed to support public health and environmental justice in urban, suburban, and rural communities. In this way, State support for climate adaptation and resiliency will help strengthen critical energy infrastructure statewide, including in agricultural and forest communities that are disproportionately affected by climate change and other trends affecting Minnesota's energy security.

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[55] See Chapter 6 for further information about growth in Minnesota wind power generation.
[56] See Chapter 6 for further information about growth in Minnesota solar power generation.
57 "Minnesota's Supply and Demand for Propane and Anhydrous Ammonia," Minn. Dept. of Agriculture, April 1, 2011.
58 Propane Conversion Strategies: Energy Alternatives for Minnesota Users of Propane Gas, Legislative Energy Commission report, Jan. 15, 2015.
[59] "Klobuchar, Smith Announce Support for Actions to Prioritize Propane Shipments to Alleviate Shortage in Midwest," Press Release, Office of U.S. Sen. Amy Klobuchar, Nov. 21, 2019.
[60] Minnesota Weekly Heating Oil and Propane Prices (October through March, 2020), U.S. Energy Information Administration.
[61] Weekly Heating Oil and Propane Update, U.S. Energy Information Administration (accessed Jan. 7, 2021).
[62] Minn. Dept. of Commerce Energy and Data Reports website (*accessed Jan. 26, 2021*).
63 "Survey says consumers avoid electric cars due to three myths: range, price, charging," *Electrek,* Aug. 20, 2019.

[64] Twine, T.E., et al., "Minnesota's Rapidly Changing Climate: Downscaled Projections from CMIP5 Using WRF," American Geophysical Union Fall Meeting 2019, December 2019.
[65] Burr, Michael T., et al., *Minnesota Microgrids: Minnesota Microgrids: Barriers, Opportunities, and Pathways Toward Energy Assurance,* prepared by Microgrid Institute for Minn. Dept. of Commerce, Sept. 30, 2013.

# Chapter 4: GHG Reduction Efforts in Power and Buildings Sectors

Minnesota's electricity generation mix has changed in recent years and decades as a result of early and ongoing stakeholder efforts and legislative policies to increase the use of efficient, renewable, and low-emission energy sources. The State's progress has relied on a long-term dialogue on setting goals for diversifying energy resources and reducing emissions and taking steps to reach those goals.

Minnesota's policies and programs work together to support cost-effective energy conservation and efficiency in new and existing buildings. However, while Minnesota's utilities are meeting their renewable and energy savings goals, overall emissions and energy use from buildings are increasing because of increased consumption of natural gas for heating.

## *Power Generation Transition*

The state's current transition toward renewable energy and away from coal-fired power generation began in 1994, when the Legislature established a wind power mandate, Minn. Stat. §216B.2424, requiring Xcel Energy to acquire 825 MW of wind power – 425 MW by year-end 2002 and an additional 400 MW by 2006. In 1994, the Legislature set a biomass power mandate, Minn. Stat. §216B.2423, requiring Xcel Energy to acquire 110 MW of biomass power by the end of 2002. Legislation changes in 2017 allowed the early termination of power purchase agreements from two projects used to meet the biomass power mandate.

In 2001, the Legislature passed Minn. Stat. §216B.1692 establishing an emission-reduction rider program to encourage large electricity generation sources in the state to undertake emission reduction projects. As a result, Xcel Energy replaced two coal-burning units at its Black Dog Plant with a natural gas-fired turbine generator in 2003. Xcel in 2008 replaced the coal-fired High Bridge Plant with a natural gas fired combined-cycle turbine generator, and the following year did the same at the coal-fired Riverside Plant. The last two coal-fired generators at Xcel's Black Dog Plant were retired in 2015.

The first utility green pricing programs in Minnesota were offered in 1999 by Great River Energy and Moorhead Public Service, providing consumers with the option to purchase electricity made from renewable and high-efficiency energy sources. A 2001 law required all utilities operating at retail in Minnesota to offer green pricing programs that allow customers to encourage additional renewable energy production above and beyond the utilities' renewable energy objectives. Starting in 2010, Minnesota laws changed green pricing programs from a mandatory utility service to a voluntary one, leaving the decision whether to offer a green power option up to utilities.

The Legislature enacted renewable energy objectives in Minn. Stat. §216B.1691 in 2001. Originally this statute required electric utilities to make a good-faith effort to obtain 1% of their Minnesota retail energy sales from eligible energy sources starting in 2005, 10% starting in 2015, and to obtain 0.5% of their renewable energy from biomass technologies. The Legislature updated these standards in 2007 with the Next Generation Energy Act (NGEA), which amended State Statute §216B to increase

*All electric utilities subject to the Renewable Electricity Standard have met their statutory milestones through 2019 and are on track to meet or exceed their 2025 targets.*

efficiency and renewable energy goals while reducing carbon emissions.

Minn. Stat. §216B.241 set efficiency and conservation requirements of 1.5% energy savings per year for electric utilities and 1% energy savings per year for gas utilities. The Renewable Electricity Standard established by Minn. Stat. §216B.1691 calls for 30% of retail sales from renewable energy sources by 2020 for Xcel Energy and 25% by 2025 for other electric utilities. In addition, Minn. Stat. §216C.05 established the goal of 25% of total energy consumption from renewable sources by 2025. To reduce carbon, Minn. Stat. §216H.02 set increasing greenhouse gas (GHG) reduction goals against 2005 emissions levels: 15% by 2015, 30% by 2025 and 80% by 2050. All electric utilities subject to the Renewable Electricity Standard have met their statutory milestones through 2019, and the utilities are on track to meet or exceed their 2025 targets.[1,2] Additional information about the Renewable Electricity Standard can be found in Chapter 6.

In 2013, Minn. Stat. §216B.1691 was amended to establish a Solar Electricity Standard (SES), requiring investor-owned utilities to generate or procure 1.5% of their retail sales from solar energy by 2020. Utilities must meet a portion of their SES requirement from small solar facilities – the small solar carve-out. The legislation also set a statewide goal of 10% solar electricity by 2030, and a community solar program requirement for Xcel Energy.[3] The Legislature modified the SES in 2017 and 2018, increasing the size limit for the small solar carve-out and allowing Otter Tail Power and Minnesota Power to use community solar program subscriptions to meet the small solar carve-out requirement. See Chapter 6 for more details about the SES.

In 2018, the U.S. EPA proposed the Affordable Clean Energy rule to replace the federal Clean Power Plan (CPP), a federal rule adopted in 2015 to regulate GHG emissions from electric generating sources. The Affordable Clean Energy rule significantly narrowed the GHG emission control options required for electric generating sources and affected regional evaluation of plans for generation and transmission as well as state-level utility resource planning. During the same time, renewable energy and conservation technologies continued improving, costs declined rapidly and shifting customer preferences encouraged utilities to continue investing in sustainable energy systems.[4] On January 19, 2021, a federal appeals court struck down the Affordable Clean Energy rule, finding that it failed to comply with the Clean Air Act and would have led to more power sector emissions. The court directed the U.S. EPA to start over with a new regulatory approach.[5] The State of Minnesota anticipates revising its policies to implement the pending EPA rules.

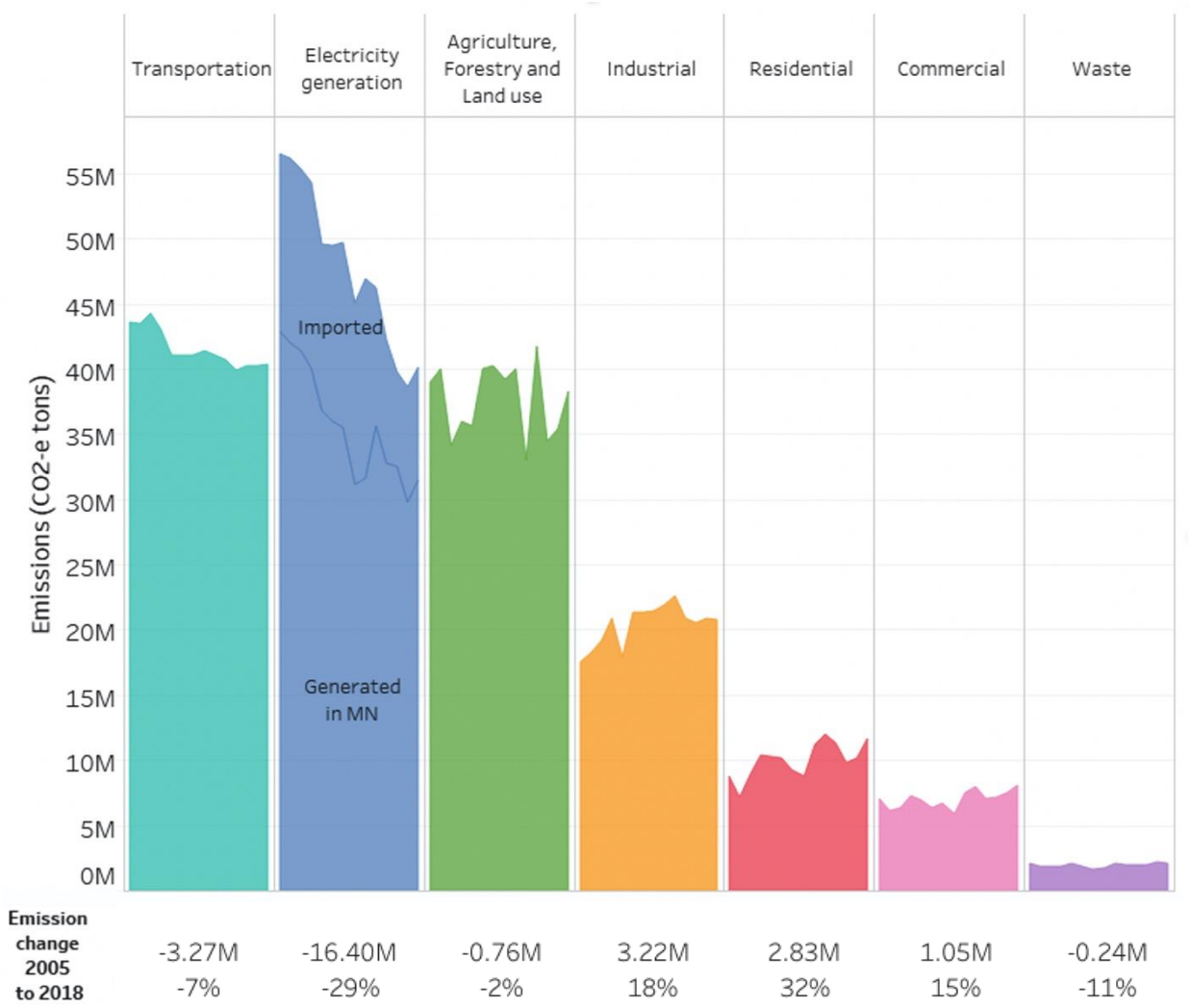
## Emissions Reduction Progress

Minnesota did not reach its goal of reducing emissions by 15% by 2015 and is not on track to meet the next goal of reducing emissions 30% by 2030. The Minnesota Pollution Control Agency's greenhouse gas inventory shows that, between 2005 and 2018, overall GHG emissions declined by only 8%.[6] This overall decline was largely driven by emissions reductions of 29% from electricity generation. In the same timeframe, other parts of the economy have seen only modest reductions or emission increases. Emissions from industrial, residential, and commercial activity all have increased by 15% or more, due primarily to increased use of natural gas in these sectors.

*Minnesota did not reach its goal of reducing emissions by 15% by 2015 and is not on track to meet the next goal of reducing emissions 30% by 2030.*

Minnesota's reduced emissions from electricity generation have resulted primarily from increased reliance on renewable electricity and reduced coal-fired generation primarily within state borders. Before 2016, electricity consumption was the largest source of GHG emissions in Minnesota. Starting in 2016 and continuing through 2018, emissions from electricity

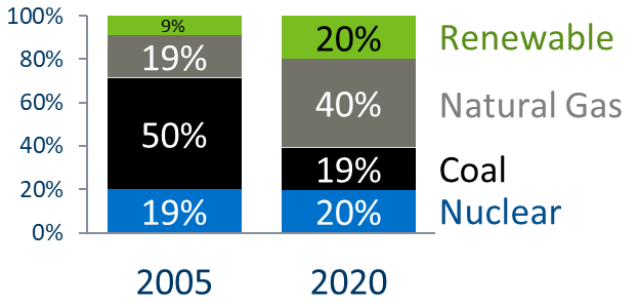
consumption – including imported and in-state generation – were a close second to emissions from transportation.




## Figure 4-A: Minnesota's Greenhouse Gas Emissions by Activity (2005 – 2018)

Figure 4-A compares changes in Minnesota's greenhouse gas emissions attributable to various activities during the period from 2005 through 2018. Emissions from power consumption have declined substantially, while emissions from other sectors have declined slightly or even increased during the same period. The blue line in the column for the electricity generation sector represents the division between emissions from electricity generated in Minnesota below the line and emissions from net-imports of electricity above the line. Nearly 25% of Minnesota's power supply is imported. Emissions from imported electricity are higher on a kilowatt-hour basis, as neighboring states haven't reduced their emissions as much as Minnesota.[7]

Historically coal has been the primary fuel source for electricity generation in many U.S. regions. Over the past decade, concerns about toxic air emissions and GHGs from coal, the ongoing need to replace aging power plants, and a drop in natural gas prices all contributed to a shift toward natural gas for electricity generation nationally. However, the transition away from coal has been slower across the Midwest, where coal, nuclear, and natural gas continue to fuel most of the region's electricity.

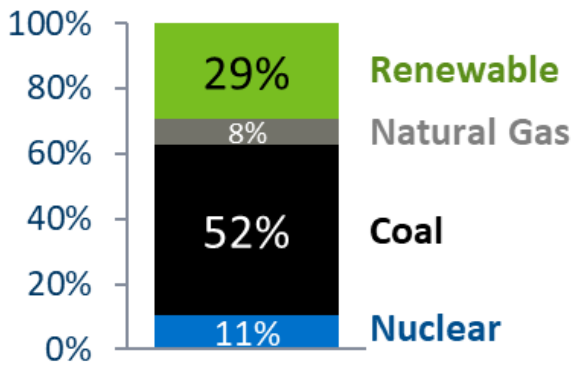



## Figure 4-B: United States Electricity Generation Mix (2005 and 2020)

Figure 4-B compares the mix of U.S. power generation from various sources in 2020 and 2005. Nationwide, coal's share declined by more than half from 50% to 19%, while the share of generation from natural gas and renewables both more than doubled, from 19% to 40% and 9% to 20%, respectively. The 2020 percentage figures are based on preliminary monthly data from January 2020 through December 2020.

*Source: U.S. Energy Information Administration.*

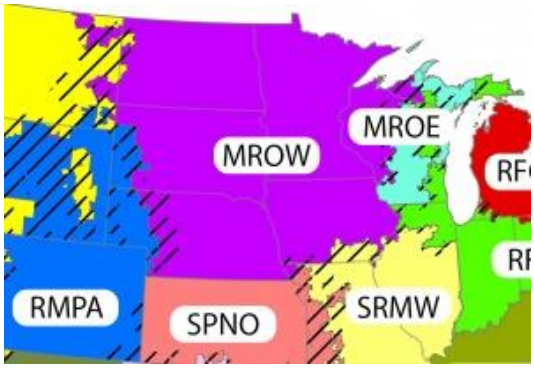
Minnesota remains a net importer of electricity. Over the past decade Minnesota imported an over one-fifth of total electric retail sales. As utilities close coal-fired power plants in other states in the Midwest, it should help reduce air pollution that reaches Minnesota.[8] This transition is especially important to reduce the amount of mercury emitted outside the state but deposited in Minnesota, as well as the amount of GHGs associated with imported electricity.




## Figure 4-C: Midwest Electricity Generation Mix (2018)

Figure 4-C shows the proportions of renewables, natural gas, coal, nuclear, and other sources of power generation in the MROW subregion of the Midwestern grid in 2018. Coal still dominates the region's power supply with 52%, but renewables have expanded rapidly to comprise 29% of the total.

*Source: U.S. Environmental Protection Agency*



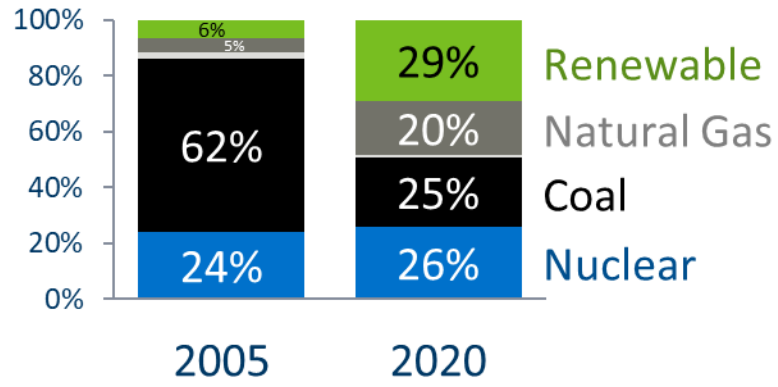

## Figure 4-D: Midwest Power Grid Subregions

Figure 4-D illustrates the Midwestern U.S. subregions delineated by the U.S. EPA in its Emissions & Generation Resource Integrated Database (eGRID), a comprehensive source of data on the environmental characteristics of almost all electric power generated in the United States.

*Source: U.S. Environmental Protection Agency*

Minnesota's energy policies before 2016, along with the low cost of natural gas and ongoing reductions in renewable energy technology costs, led to a rapidly changing mix of resources used to generate electricity within state borders. As a result, Minnesota has transitioned to electricity generation from renewable sources faster than the national average. Preliminary data showed that 2020 may be the first year that renewable energy is the primary source of electricity generated within Minnesota.

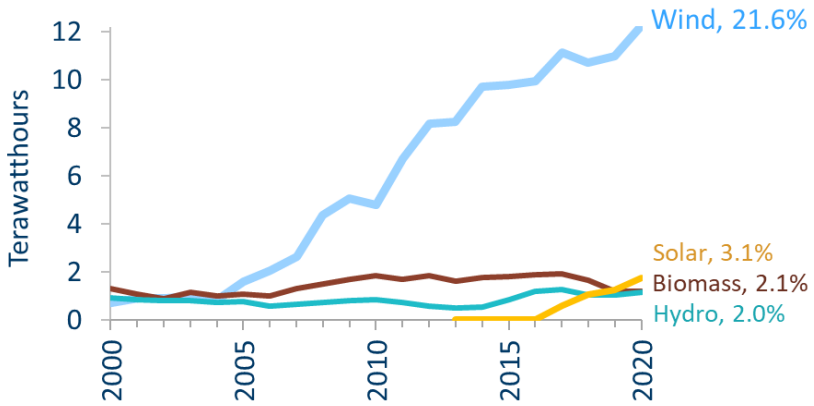
Minnesota's utilities continue retiring coal-fired power plants and replacing them with a mix of renewables and natural gas. The proportion of electricity generated in Minnesota from coal decreased from 62% in 2005 to 25% in 2020. In the same timeframe, renewable sources increased from 6% to 29%.




## Figure 4-E: Electricity Generated in Minnesota (2005 vs. 2020)

Figure 4-E compares the mix of resources serving Minnesota electricity loads in 2020 and 2005. During that 15-year period, coal's share declined from 62% to 25%, while the share of generation from natural gas and renewables each increased more than four-fold, from 5% to 21% and 6% to 29%, respectively. Renewables in 2020 were the state's single largest source of electricity, exceeding nuclear energy's 26% share. The 2020 percentage figures are based on preliminary monthly data through December 2020.

*Source: U.S. Energy Information Administration.*

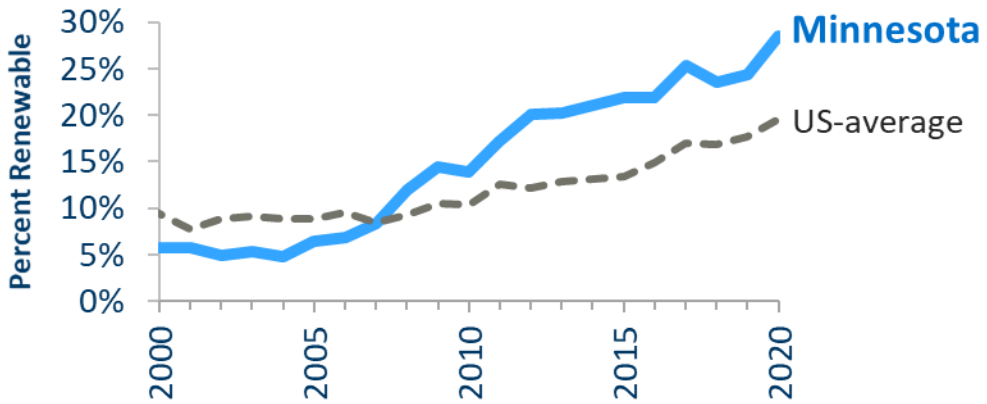



## Figure 4-F: Minnesota Renewable Electricity Generation (2000 – 2020)

Figure 4-F illustrates trends in total generation from various renewable energy sources during the period from 2000 through 2020. During that period, wind energy's share grew rapidly, from less than 2% in 2000 to 22% in 2020. Meanwhile most other renewable sources of generation remained relatively flat until 2016, when solar power began growing from a fraction of a percent to reach nearly 3% of the total in 2020. The 2020 percentage figures are based on preliminary monthly data through December 2020.

*Source: U.S. Energy Information Administration.*

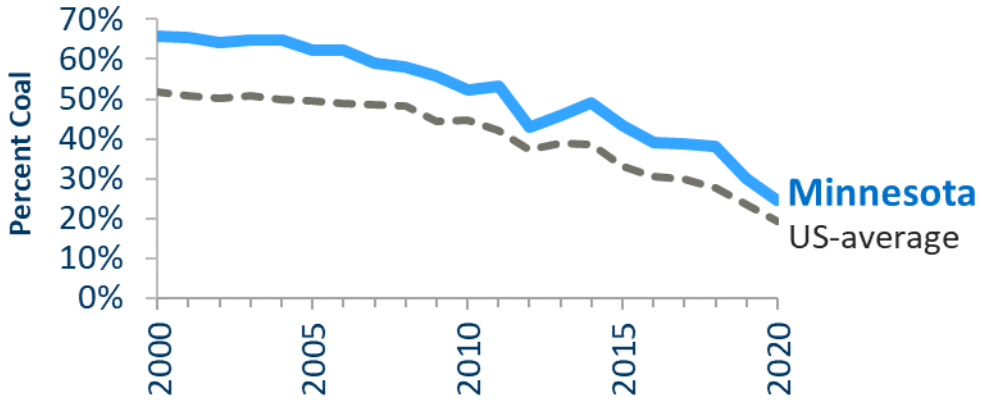
Minnesota's electric power sector emissions reductions are the result of statewide policies working in tandem with market forces. While most of the United States has turned primarily to natural gas generation while coal plants shut down, Minnesota has taken advantage of low-cost wind resources within the region to meet electricity demands in the transition away from coal.




## Figure 4-G: Minnesota and U.S. Renewable Electricity (2000 – 2020)

Figure 4-G illustrates how growth in renewable-powered electricity in Minnesota has outpaced the national average in most years since 2004. The 2020 percentage figures are based on preliminary monthly data through December 2020.

*Source: U.S. Energy Information Administration.*




## Figure 4-H: Minnesota and U.S. Coal Electricity (2000 – 2020)

Figure 4-H illustrates the narrowing gap between Minnesota's use of coal-fired electricity and the national average, with coal's share in the state's electricity supply declining from nearly 70% in 2000 to about 25% in 2020, while the national average declined from just over 50% to about 20% during the same period. Like the rest of Midwest, Minnesota uses more coal than the rest of the country for electricity generation, but the state is reducing coal-powered electricity at a slightly faster rate than the U.S. average. The 2020 percentage figures are based on preliminary monthly data through December 2020.

*Source: U.S. Energy Information Administration.*

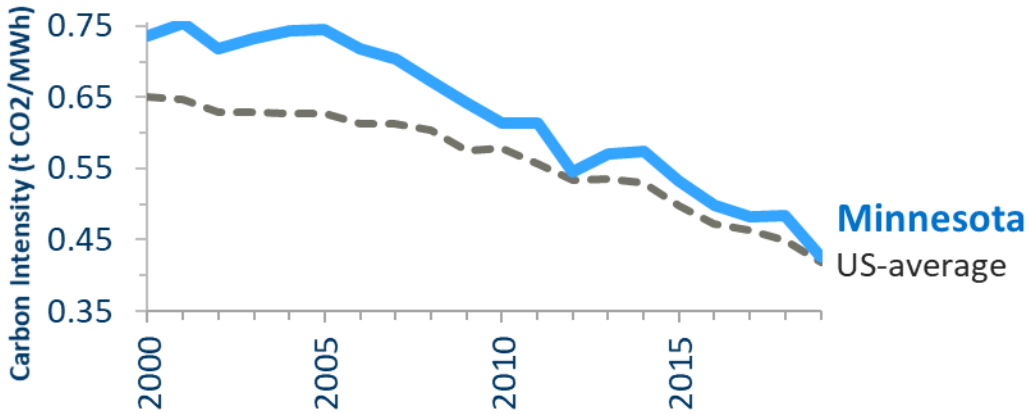



**Figure 4-I: Minnesota and U.S. Carbon Intensity of Electricity (2000 – 2019)**

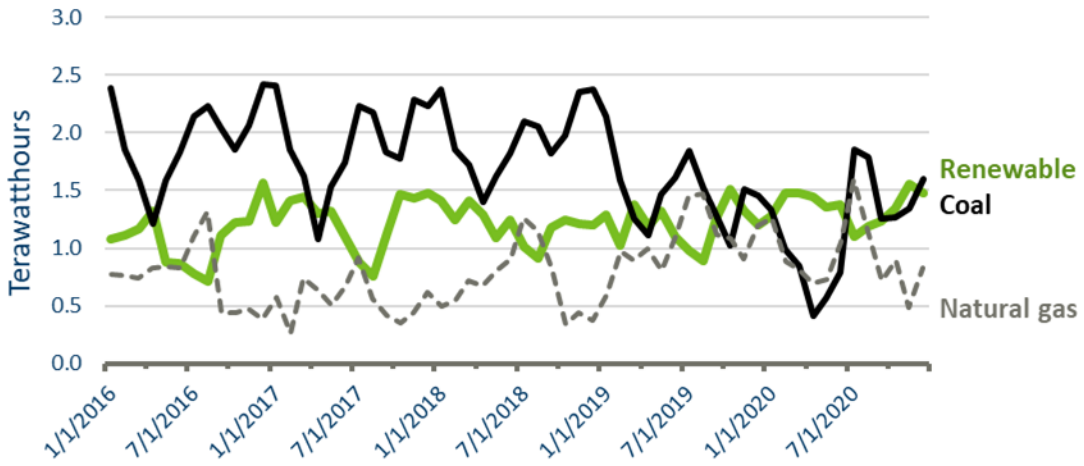
Figure 4-I compares the declining carbon intensity of electricity in Minnesota to the national average, in terms of metric tons of $CO_2$ per megawatt-hour. Increased renewable generation and decreased coal generation put Minnesota on a trajectory to reduce its emissions intensity below the national average in 2020.

*Source: U.S. Energy Information Administration*

## Changing Coal Plant Operations

Low wholesale electricity prices are prompting Minnesota's utilities to change how their coal plants are run to improve economic operations with the potential for lower emissions. In 2019, Xcel Energy began to transition some of their coal plants from must-run to economic dispatch based on market prices, which resulted in fewer operating hours for two coal plants. In December 2019, Xcel Energy proposed a seasonal operation plan for two of its coal power units: Allen S. King Generating Station and Unit 2 of the Sherburne County Generating Station. Starting in 2020, Xcel Energy began idling the two plants for six months of the year during the spring and the fall. The utility estimated that switching to seasonal operation will save ratepayers $1.453 million in 2020 and reduce greenhouse gas emissions by as much as 4.1 million tons in 2020 and 7.3 million tons by 2023. The PUC estimated that this decrease could represent one fifth to one quarter of the total GHG emissions reduction needed to meet the State's 2025 goal of a 30% reduction below 2005 levels.[9]

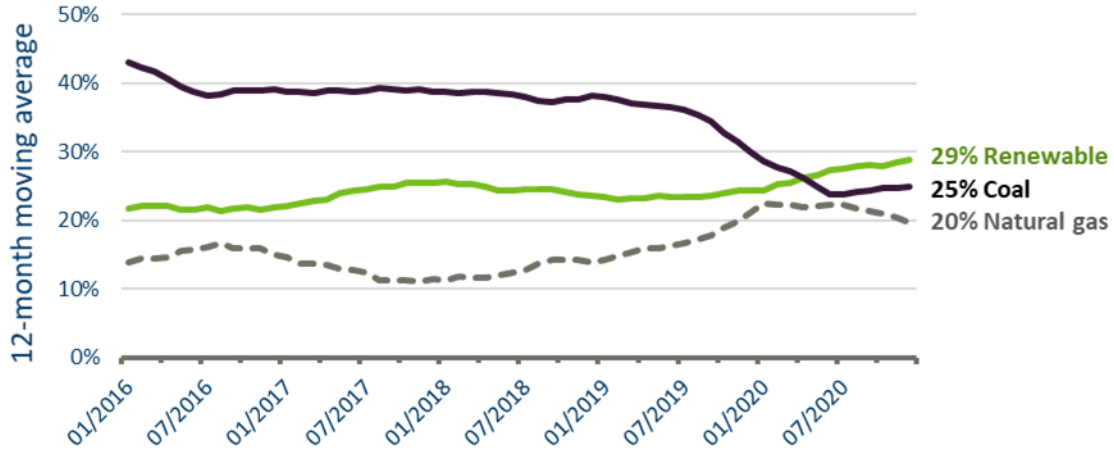
Minnesota Power and Otter Tail Power also are evaluating a shift to economic or seasonal dispatch at coal plants within their fleets[10] Historic low natural gas prices from 2019 to 2020 resulted in weeks-long stretches of financial losses at some coal plants that operated in must-run status. The EIA forecast an increase in natural gas pricing in 2021 and 2022, but market pricing is difficult to predict and other factors could result in continued low natural gas pricing, driving power companies to dispatch coal plants in response to market conditions.




## Figure 4-J: Economic and Seasonal Dispatch of Coal

Figure 4-J depicts seasonal trends in power generation in Minnesota for coal, renewable, and natural-gas fueled generation from 2016 through 2020. Starting in 2019 the change in coal-fired power plant operation from must-run to seasonal dispatch is evident in the shift from historic pattens of seasonal energy generation.

*Source: U.S. Energy Information Administration*




## Figure 4-K: Power Generation Transition in Minnesota (2016 – 2020)

Figure 4-K illustrates the average share of total electricity generation in Minnesota by renewable energy, coal, and natural gas-fueled power plants from 2016 through 2020. Starting in mid-2019, monthly electricity generation data through December 2020 shows a statewide shift in the electricity mix – away from coal and toward renewables and natural gas – in response to low natural gas prices and a change in coal plant operations.

*Source: U.S. Energy Information Administration*

## Declining Carbon Intensity

Facing the threat of extreme weather and damages from climate change, local governments, institutions, and businesses are setting targets to reduce greenhouse gases and increase reliance on renewable energy beyond business-as-usual scenarios. Efforts to reduce the carbon intensity of Minnesota's economy are being led by the State of Minnesota, 141 participants in the Minnesota GreenStep Cities voluntary program, and roughly half of the Fortune 500 companies based in the state.[11,12,13]

As they manage and measure the results of planning decisions and efforts to meet their sustainability goals, governments and businesses are seeking data from utilities on greenhouse gas emissions from electricity generation.[14] In response, the Edison Electric Institute released a database in June 2020 with carbon emissions intensity rates for individual utilities, including the carbon dioxide offset by participation in green pricing programs.[15] As of January 2021, two Minnesota utilities had entered their emissions data into the database. Commerce and the Minnesota Pollution Control Agency have calculated emissions intensity for three additional utilities.

**Electric Sector Emissions** publications and analysis

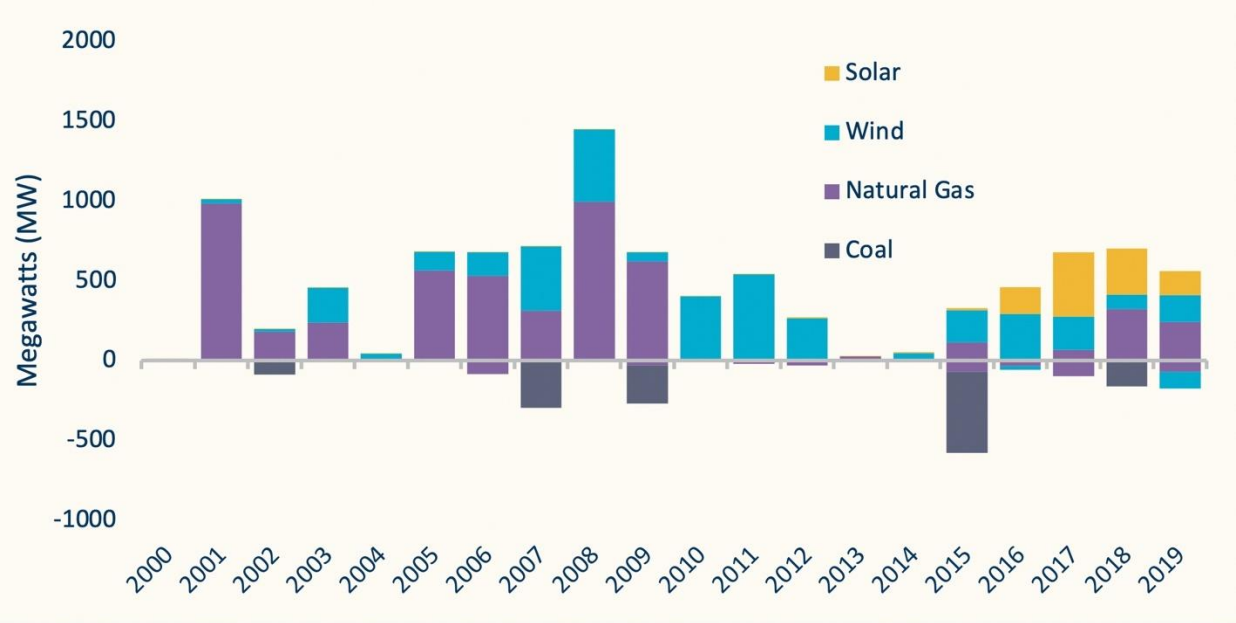
- Bettering your GHG and Renewable Energy Reporting Webinar: A Coalition Case Study, Sustainable Growth Coalition, July 23, 2020.
- Case Study: Utility/Customer Collaboration on Uniform GHG and Renewable Energy Reporting, Sustainable Growth Coalition. May 2020.
- Electric Sector Emissions: How Geographic Choices Impact Modeling & Analysis, Great Plains Institute, March 4, 2020
- Carbon Dioxide ($CO_2$) Emission Intensities Information Sheet, 2019 data, Xcel Energy.
- Marginal Emissions Factors for Electricity Generation in the Midcontinent ISO, Maninder P. S. Thind, Elizabeth J. Wilson, Inês L. Azevedo, and Julian D. Marshall. *Environmental Science & Technology.* 11/20/2017.
- Marginal Emissions and Beneficial Electrification, Nancy L. Seidman. 11/8/2018.
- Marginal Emission Factors Considering Renewables: A Case Study of the U.S. Midcontinent Independent System Operator (MISO) System, Mo Li, Timothy M. Smith, Yi Yang, and Elizabeth J. Wilson. *Environmental Science & Technology.* 9/1/2017.
- The Regional Indicators Initiative | RII

| **Utility** | **Average Emissions Rate** ($tCO_2$ /MWh) | **2019 MN Retail Sales** (MWh) | **% of State Sales** |
|---|---|---|---|
| Xcel Energy* | 0.36 | 29,161,074 | 45.5% |
| Great River Energy** | 0.80 | 10,550,858 | 16.4% |
| Minnesota Power* | 0.63 | 9,676,563 | 15.1% |
| SMMPA** | 0.79 | 2,904,495 | 4.5% |
| Otter Tail Power** | 0.83 | 2,678,956 | 4.2% |

### Figure 4-L: Utility Emissions Intensities in Minnesota

Figure 4-L shows utility emissions intensities for the five utilities with the largest share of Minnesota retail sales. Xcel Energy's electricity supply is the least carbon-intensive, with an emissions rate of 0.36 metric tons of $CO_2$ per megawatt-hour of electricity. Otter Tail Power's electricity is the most carbon-intensive at 0.83 $tCO_2$/MWh.

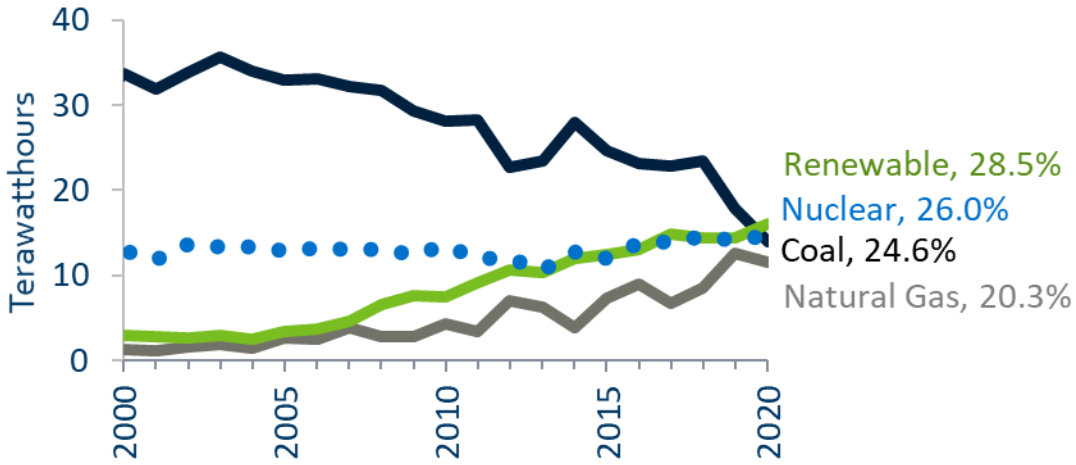
*Sources: *The Edison Electric Institute's electric carbon emissions database and utility-reported 2019 emissions intensity. **Commerce and Minnesota Pollution Control Agency analysis of 2018eGRID, EIA, and utility-reported data.*




## Figure 4-M: Minnesota Capacity Additions and Retirements (2000 – 2019)

Figure 4-M shows trends in power plant additions and retirements from 2000 through 2019. Most of the power capacity added from 2001 through 2009 was fueled by natural gas. Wind power contributed a growing percentage starting in 2005 and took the lead from 2010 through 2016, when solar additions took the lead together with natural gas in 2018 and 2019. All capacity retirements over the same period were for coal-fired plants, except in 2019 when some of the oldest wind generators were retired.

*Sources: U.S. Energy Information Administration 860m Generator Inventory and Minn. Dept. of Commerce.*




## Figure 4-N: Minnesota Electricity Generation by Source (2000 – 2020)

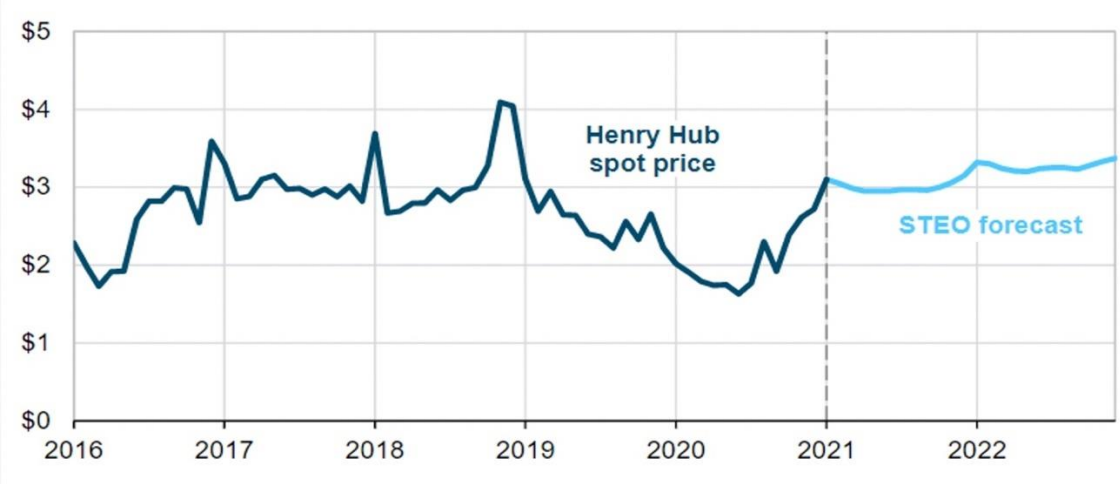
Figure 4-N depicts 20-year trends in fuel sources for electricity generation in Minnesota. From 2000 through 2020, coal's share of in-state generation declined, while renewables and natural gas increased substantially and nuclear remained relatively flat. The 2020 percentage figures are based on preliminary monthly data from January 2020 through December 2020.

*Source: U.S. Energy Information Administration.*

## Increase in Electricity from Natural Gas

The amount of electricity generated with natural gas in Minnesota has increased as a result of coal plant replacements, new capacity additions, and sustained low natural gas prices. Ongoing seasonal market supply and pricing changes caused by weather also affect year-to-year fluctuations in electricity generation from natural gas. In 2017, natural gas prices increased 17% over 2016 pricing, leading to an 11% increase in MISO energy prices.[16] Electricity generated from coal and natural gas increased in 2018 because of increased demand for electricity for heating and cooling in response to weather. February, April, October, and November 2018 were significantly colder than usual, and the third warmest May-to-September stretch on record was book-ended by heat waves in late May and September.[17,18]

In 2019, low natural gas prices resulted in an uptick in natural gas electricity generation and a drop in electricity from coal.[19] Natural gas prices in 2020 were the lowest in decades.[20] However, the EIA predicted that natural gas pricing will increase in 2021 and that electricity generation from natural gas will decline from 2021 to 2022.[21]




### Figure 4-O: Monthly Henry Hub Natural Gas Spot Price (2016 – 2022)

Figure 4-O illustrates the price of natural gas measured in dollars per 1 million Btu from 2016 through 2021, followed by forecasts from EIA's Short-Term Energy Outlook. Although spot prices for natural gas declined in the first half of 2020, they recovered to normal levels by 2021. EIA's outlook anticipates gradually increasing gas prices for the short-term future.

*Source: U.S. Energy Information Administration*

## Nuclear Generation

Nuclear generation remains an important source of carbon-free power in Minnesota. Xcel Energy operates nuclear plants at Monticello and Prairie Island. The company proposes to extend the Monticello reactor license by 10 years so it can continue operation through 2040. Xcel also indicated plans to request a 10-year license extension for the two Prairie Island reactors; their current licenses are set to expire in 2033 and 2034. The outcomes of Xcel's license applications will have a significant effect on Minnesota's power generation emissions. (See Chapter 2 for details on utility resource planning and siting processes.)

*Image used with permission of the Prairie Island Indian Community*

Like coal, nuclear power faces challenging economics due to low costs for natural gas and utility-scale renewables. Since 2013, 10 U.S. nuclear power plants have closed nationwide, and the owners of at least 10 more have announced pending closures by 2022 due to economic challenges.[22]

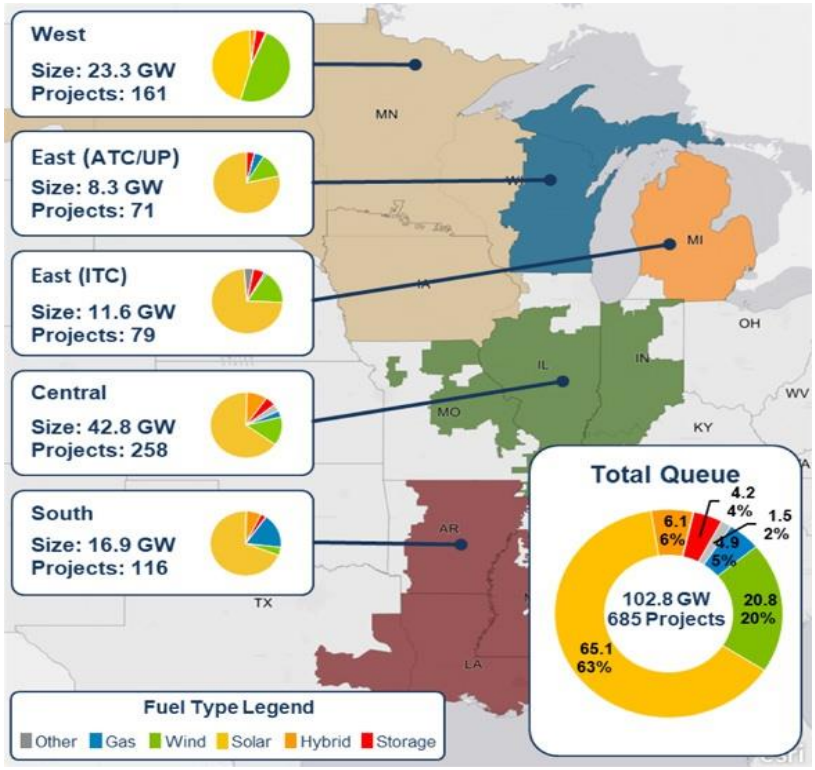
## Renewable Generation

From 2016 through 2020, costs for solar photovoltaics, wind turbines, and energy storage systems continued declining steadily, signaling continued future expansion of wind and solar generation in Minnesota and neighboring states. Most of Minnesota's wind generation, located in high wind resource areas, is more economical than the national average, which has led to steady growth in the state's wind generation.

## Figure 4-P: MISO Active Queue by Study Area

Figure 4-P shows the share of various energy resources in the Midcontinent Independent System Operator (MISO) interconnection queue for five regions. The interconnection queue represents new generation projects seeking utility interconnection approvals, and projects a dramatic expansion of wind and solar PV in Minnesota and neighboring states. Of 102.8 gigawatts of queued capacity, 65.1 GW or 63% is comprised of solar projects, with another 20.8 GW or 20% represented by wind power proposals.

*Source: MISO Generator Interconnection Overview, Jan. 1, 2021.*




## Figure 4-Q: MISO Queue Historical Trend

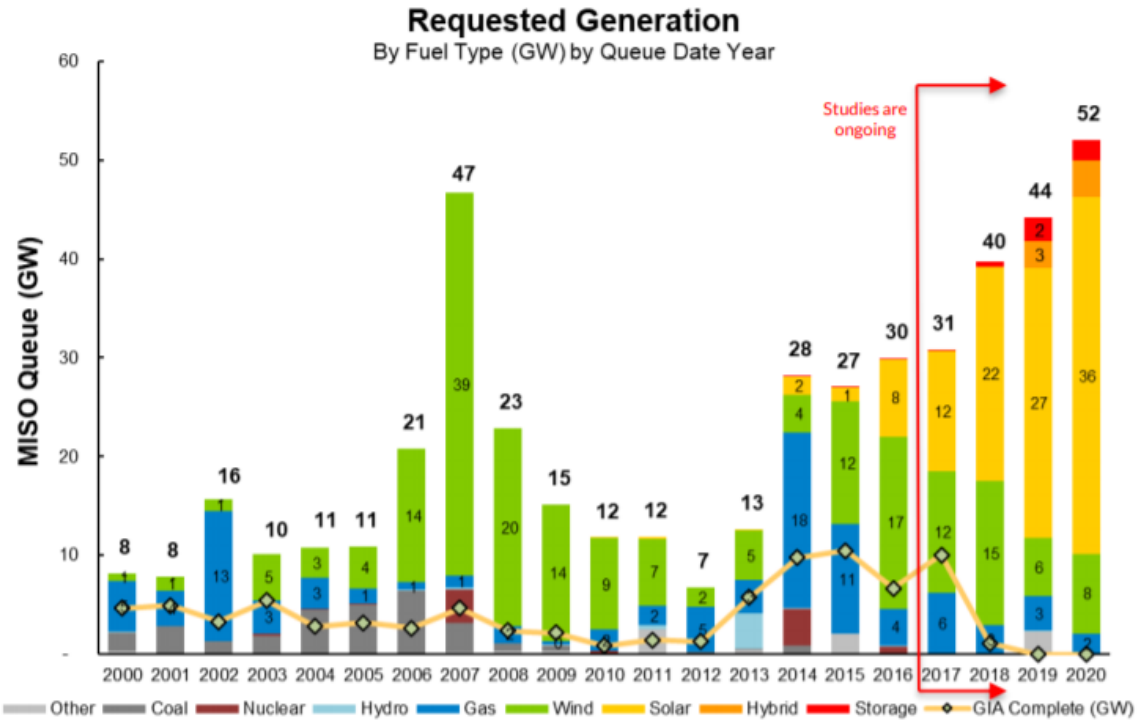
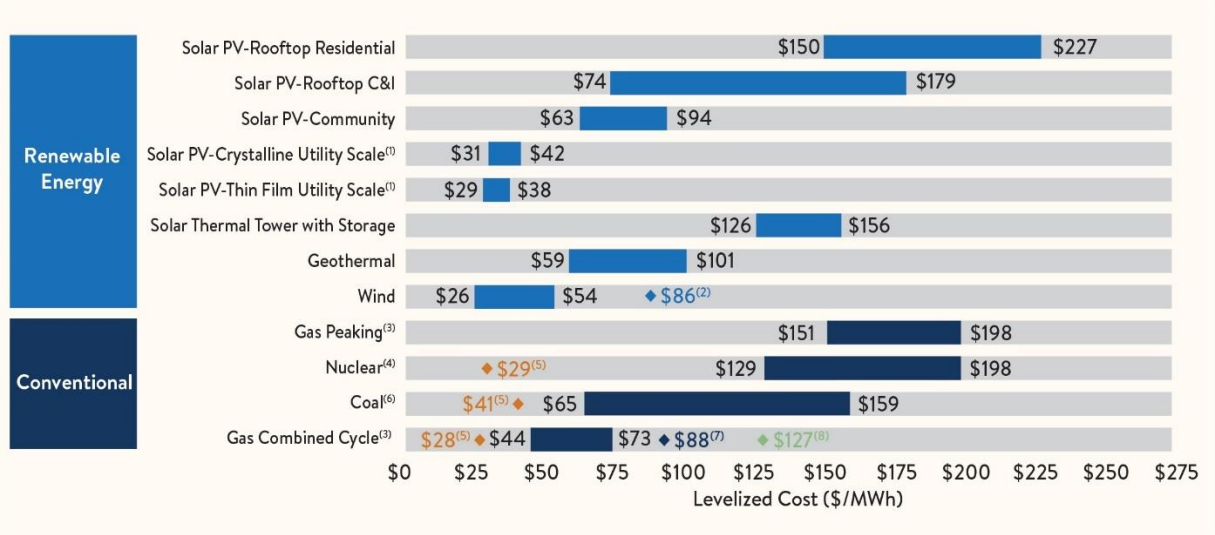



Figure 4-Q illustrates interconnection queue trends in the Midcontinent Independent System Operator (MISO) grid from 2000 through 2020. Wind projects dominated in the late 2000s, and natural gas surged in 2014 and 2015, after which wind and increasingly solar projects dominated the queue.

*Source: MISO Generator Interconnection Overview, Jan. 1, 2021.*




## Figure 4-R: Levelized Cost of Energy Comparison

Figure 4-P compares the levelized unsubsidized cost of energy from various generation technologies. Wind is the lowest cost resource for new capacity and solar is close behind.

*Source: Lazard's Levelized Cost of Energy Analysis version 14.0*

# Studies and Initiatives

## Minnesota Solar Pathways

The Minnesota Solar Pathways initiative, funded by the U.S. Department of Energy Solar Energy Technologies Office, was a three-year project designed to explore least-risk, best-value strategies for meeting the State of Minnesota's solar goals.[23] As part of this aim, the Pathways team modeled renewable generation costs, examined ways to streamline interconnection, and evaluated technologies that could increase solar hosting capacity on the distribution grid.

The solar capacity analysis explored the cost-effectiveness of scenarios with extra solar and wind capacity Installed within Minnesota to ensure sufficient generation when solar or wind resources are low – such as a cloudy hot week in the summer or during a polar vortex when the wind calms down.

A second solar potential analysis scenario (SPA-MISO) expanded to include the entire MISO region was completed for the Pathways project on Sept. 30, 2020. The SPA-MISO analysis found that the cost of 95% renewable generation by 2050 could be equivalent to present-day wholesale electricity pricing, or $30 per megawatt-hour. The analysis also showed that it can be cheaper to add extra capacity of solar and wind facilities and curtail surplus renewable production than to size just enough generation capacity and storage to meet energy needs. National models indicate that excess zero-margin electricity could create opportunities for thermal storage, renewable hydrogen, ammonia, and other chemicals produced with renewable energy.[24]

In addition to the technical analysis, the Pathways project developed and supported a variety of partnerships to address key issues, particularly those involving siting, and identified strategies that help meet Minnesota's solar electricity goals. (See Chapter 6 for further information about the Pathways project and renewable development.)

## Efficient Fuel-Switching and Electrification Action Plan

As electricity generation continues to decarbonize, stakeholders in Minnesota and nationally have identified end uses where electrification could reduce carbon dioxide emissions, decrease customer costs, and provide energy savings over the lifetime of the equipment. Market growth is encouraging some electrification, specifically electric vehicle sales. Efficient fuel-switching has garnered increasing attention from stakeholders as a strategy that could provide benefits to the public such as carbon reductions, cost savings, and efficiency while improving the grid. To better understand electrification and fuel-switching opportunities, Commerce dedicated competitive Conservation Applied Research and Development (CARD) program funds and DOE competitive grant funding toward research and stakeholder engagement. More information about efficient fuel-switching and the electrification action plan can be found in Chapter 5.

## Energy Storage

Energy storage is emerging as a potential alternative to natural gas generation, especially for supporting short-term peak demand conditions. Instead of dispatching relatively inefficient simple-cycle gas-fired turbine generators, utilities can discharge batteries or other systems that store power either from the grid or from directly connected renewable energy facilities. In the 2019 special session, the Legislature enacted HF2, which in part required Commerce to engage stakeholders and complete a study on the potential costs and benefits of energy storage systems in Minnesota.[25] Commerce engaged consulting firm Energy + Environmental Economics, Inc. (E3), and delivered the report to the Legislature in December 2019.[26] The study found solar plus storage is cost-effective today; stand-alone storage could become cost-effective in 2025; and about 324 MW of the state's peak-serving power capacity could be replaced with energy storage systems capable of discharging their power capacity for four hours or more.

As renewable capacity grows to capture a greater share of Minnesota's power market, utilities will need more fast-ramping resources to maintain system balance, given the variable and non-dispatchable nature of solar and wind power capacity. Energy storage technologies may become increasingly capable of serving those balancing requirements, but the Minnesota Solar Pathways study concluded that building extra solar and wind capacity and curtailing the excess generation in some conditions could be a more cost-effective alternative than pairing renewables with storage.

*Building extra solar and wind capacity and curtailing the excess generation could be more cost-effective than pairing renewables with storage.*

The effect of energy storage on greenhouse gas emissions in Minnesota hasn't been quantified. However, an E3-supported analysis of California's Self-Generation Incentive Program (SGIP) – a utility-funded program that supports installation of distributed generation and energy storage – found that even in California's low-carbon grid, battery storage funded by SGIP from 2014 to 2017 resulted in a slight increase in GHG emissions.[27] Subsequently, in August 2019, the California PUC amended SGIP to require new storage systems to demonstrate emissions reductions. The program now provides program participants with a real-time and forecasted "GHG signal," informing dispatch schedules to ensure energy storage systems are charged with clean electricity at the time it is generated, and then discharged to displace grid power when it is being generated by higher-emitting sources.[28, 29, 30]

### Host Community Transitions

In February 2020, the Center for Energy and Environment completed a study of the social and economic effects from five power plants on the communities that host them.[31] The study found that more than half of Minnesota's electric generation is eligible for retirement in the next 20 years, and host communities and power plant workers face significant uncertainty around the state's energy transition. Planned retirements allow the communities that currently host these facilities to adapt. In March 2020, the Legislature provided a one-time $2 million appropriation from the Renewable Development Account to create the Host Community Energy Transition fund, to be administered by the Department of Employment and Economic Development. Grants up to $500,000 from the fund will be provided to Minnesota communities hosting Xcel Energy power plants that have been proposed or scheduled for closure.[32] These grants may be used to plan and implement activities that assist workers and attract new employers to the community.

## Projections

Future emissions reductions in Minnesota's power sector depend on which resources enter the market as utilities retire aging power plants. In Minnesota and across the MISO region, utilities have favored new natural gas combined-cycle plants for intermediate capacity and resource adequacy as they retire uneconomic coal plants. Ongoing investments in wind and solar power, as well as transmission systems to bring those resources to load centers, can meet energy needs at costs that are competitive with natural gas.[33] However, near-term transmission capacity constraints remain a key barrier to the large amounts of solar and wind capacity in the interconnection queue.

### Transmission Planning

The regional high-voltage transmission system continues to deliver reliable electricity to Minnesota residents. However, limits on transmission capacity could slow the long-term growth of wind and solar energy development in the region. Therefore, more effective regional transmission planning in the 10- to 20-year range is needed for evaluating the best ways to deliver low-cost wind and solar energy to consumers.[34]

#### *MISO Long-Range planning*

On June 13, 2019, the Organization of MISO States Board approved a statement of principles for long-range transmission planning to help guide MISO away from reliability-based, short-term incremental transmission planning.[35] In addition, on Sept. 17, 2019, the governors of Minnesota, Iowa, Michigan, Arkansas, and Wisconsin and the premier of Manitoba submitted a letter to MISO requesting a new long-range study of the transmission system.[36] In September 2020, MISO began developing this long-range study to assess which upgrades over the next 20 years may be needed to accommodate rapidly changing electricity generation technology and economics.[37]

### *CapX2050 Transmission Vision Study*

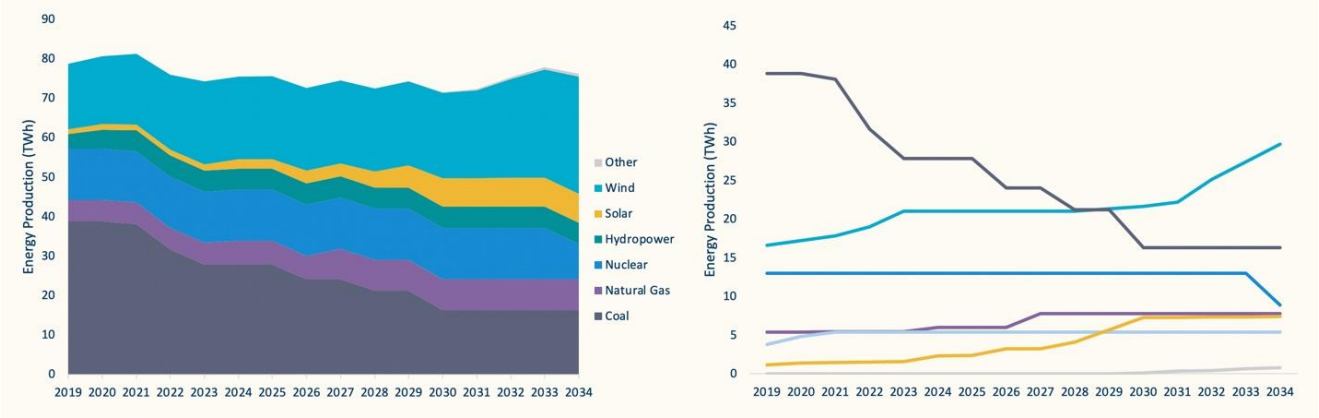
*More robust transmission capacity can help address needs for system balancing by providing access to a greater diversity of energy supplies.*

In addition to the MISO long-range study, a joint initiative of 10 transmission system owners in the Upper Midwest that assembled to support the CAPX2020 series of transmission projects now is evaluating changing transmission needs through 2050 as more carbon-free energy sources are added and carbon-based generation is removed. The CAPX2020 group is cooperating with MISO in evaluating challenges and solutions for long-term transmission planning. The group issued a report in March 2020 that among other things concluded that more robust transmission capacity can help address needs for system balancing by providing access to a greater diversity of energy supplies.[38]

## Planning for Carbon-Free Electricity

Eleven electric generation and transmission utilities that serve load in Minnesota are required to file long-term plans on the resources needed to meet customer needs including options for renewable energy resources (per Minn. Stat. §216B.2422, Subd. 4). Based on Xcel, Minnesota Power, Otter Tail Power, and Great River Energy aggregated resource plans and announced retirements – including energy generated both inside and outside of Minnesota – utilities are forecasting electricity mix that includes more than 70% carbon-free resources by 2034, as shown in figure 4-T, below.

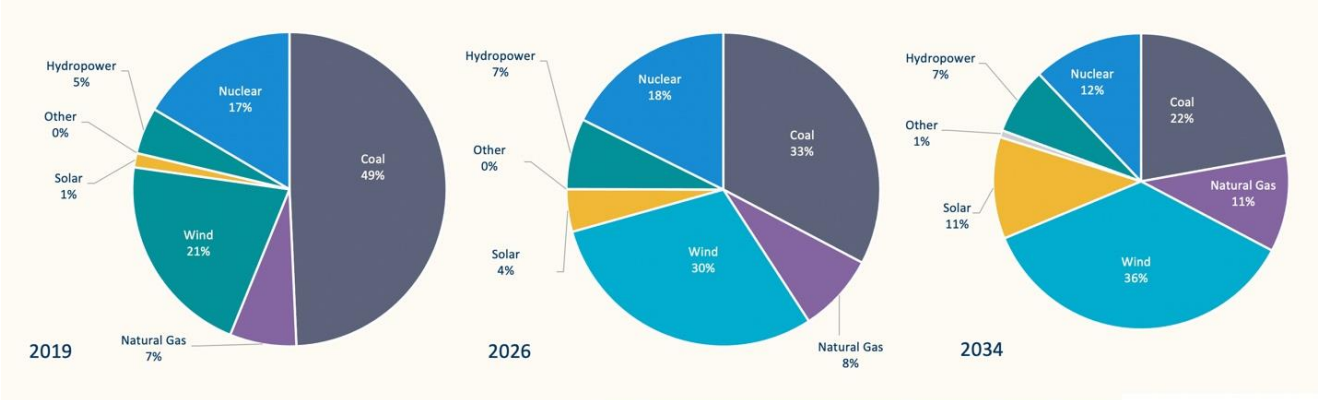
Utilities are planning to retire coal in their business-as-usual and preferred planning scenarios. Utility integrated resource planning forecasts through 2034 indicate that wind and solar resources will steadily increase to displace declining fossil-fired and nuclear sources of electricity. By 2034, renewable sources are expected to generate more than 50% of the electricity in the Upper Midwest.




## Figure 4-S: Energy Generation by Source (2020 – 2034)

Figure 4-S provides two illustrations of the same data, which forecast electric energy production in megawatt-hours by energy resource for the Upper Midwest, based on utilities' integrated resource plans through 2034. The Figures show how coal-fired generation is expected to continue declining until it reaches a plateau in 2030. Wind, solar, and to a lesser degree natural gas-fired power facilities are expected to provide increasing amounts of generation. During the same period nuclear generation is expected to remain steady until 2034 when more than one-third of nuclear capacity will be decommissioned.

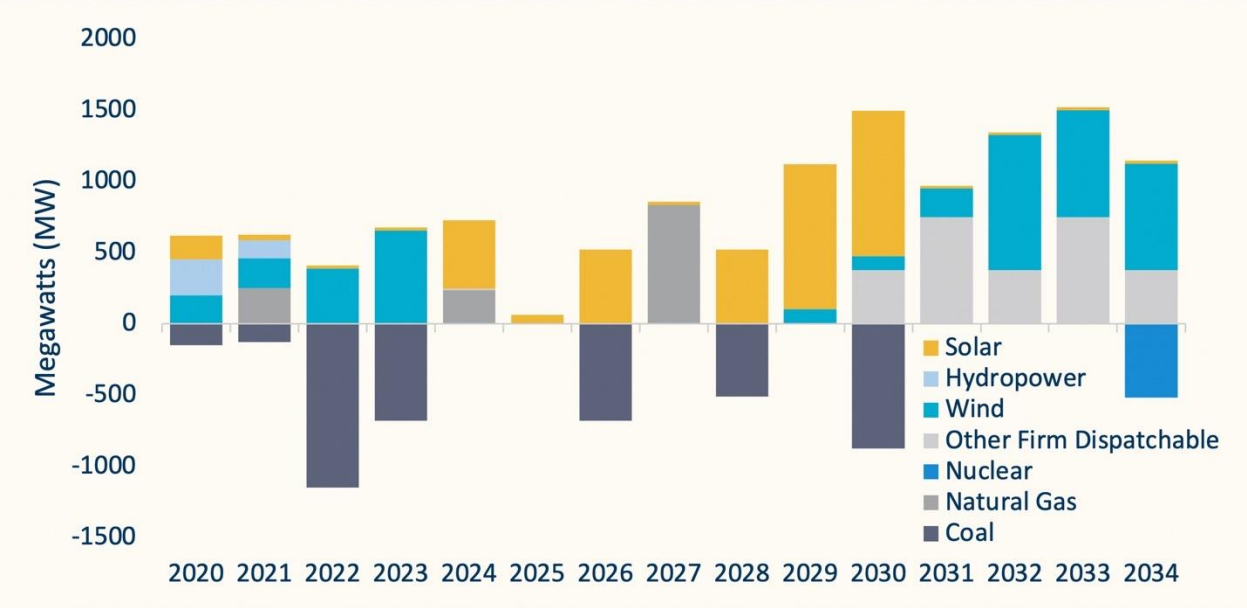
*Sources: Resource plans from Xcel Energy, Otter Tail Power Company, and Great River Energy*




## Figure 4-T: Upper Midwest Electric Energy Production by Energy Resource (2019, 2026, and 2034)

Figure 4-T shows the projected resource mix between 2019 and 2034 for power delivered to Minnesota – including energy generated both inside and outside of the state – indicating utilities are planning to transition to an energy mix that is over 70% carbon free by 2034. Coal's share of the total declines from nearly half of the total to just over one quarter, while wind power and solar grow to virtually displace coal's former share.

*Sources: Business as usual resource plans and announced retirements from Xcel Energy, Minnesota Power, Otter Tail Power Company and Great River Energy*




## Figure 4-U: Capacity Additions and Retirements 2020–2034

Figure 4-U shows the forecasted Upper Midwest electric generating capacity additions and subtractions in megawatts from 2020 through 2034. Most of the capacity retirements over this period are for coal-fired power, with nuclear retirements at the end of the period. Capacity additions are dominated by wind, solar, and some natural gas-fired generation, with "other firm dispatchable" resources coming online starting in 2030.

*Sources: Resource plans from Xcel Energy, Minnesota Power, Otter Tail Power Co., and Great River Energy*

Recent utility proposals, pending evaluation and approval, may further reduce GHG emissions. The Minnesota Public Utilities Commission in 2018 issued an order increasing the social cost of carbon (SCC) that utilities are required apply when planning for new resources to serve the state's energy requirements.[39] The Commission uses the SCC values – $9.05 to $43.06 per short ton, up from $0.44 to $4.53 – in evaluating and selecting resource options. The updated price signals are expected to prompt continued focus on energy conservation and carbon-free resources to meet the state's energy needs.

*Utilities are planning to transition to an energy mix that is more than 70% carbon-free by 2034.*

Such efforts continue the state's progress toward a more sustainable and diverse electricity supply. In 2005, Minnesota Power generated 95% of its electricity from coal-fired power plants. Over the past seven years, the utility has retired seven of nine coal plants. In January 2021, Minnesota Power announced plans to eliminate coal from its operations by 2035, in pursuit of its goal to achieve 100% carbon-free electricity by 2050. These trends, combined with other plans to retire coal-fired plants, indicate that utilities are forecasting electricity mix for delivery to Minnesota customers that includes more than 70% carbon-free resources by 2034. The state is on track to significantly reduce emissions from electric power generation in the next 10 to 15 years.

| Facility | Owned Capacity<br>MW (% share) | Status |
|---|---|---|
| **Basin Electric Power Company** | | |
| Antelope Valley Station (North Dakota) | 900 MW | Operating |
| Leland Olds Station (North Dakota) | 666 MW | Operating |
| **Dairyland** | | |
| Genoa 3 (Wisconsin) | 288 MW | Operating, full retirement in 2021 |
| John P. Madgett (Wisconsin) | 343 MW | Operating |
| Weston 4 (Wisconsin) | 167 MW (17%) | Operating |
| **Great River Energy** | | |
| Coal Creek Station 1 & 2 (North Dakota) | 1,151 MW | Operating, proposed retirement by 2022 |
| Spiritwood Station (North Dakota) | 99 MW | Operating, proposed conv. to NG (TBD) |
| **Hibbing Public Utilities Commission** | | |
| Hibbing 3,5,6 | 36 MW | Standby/backup |
| **Minnesota Power** | | |
| Boswell unit 3 | 365 MW | Operating, proposed retirement by 2030 |
| Boswell unit 4 | 558 MW | Operating, proposed retirement by 2035 |
| Taconite Harbor Energy Center unit 1 & 2 | 150 MW | Standby/backup |
| **Minnkota** | | |
| Coyote Station (North Dakota) | 128 MW (30%) | Operating |
| Milton R. Young (North Dakota) | 228 MW (34%) | Operating |
| **Otter Tail Power Company** | | |
| Hoot Lake 2 | 54 MW | Operating, full retirement by 2021 |
| Hoot Lake 3 | 75 MW | Operating, full retirement by 2020 |
| Big Stone Plant (South Dakota) | 255 (54%) | Operating |
| Coyote Station (North Dakota) | 150 (35%) | Operating |
| **Southern Minnesota Municipal Power Association** | | |
| Sherburne County 3 | 359 MW (41%) | Operating, proposed retirement by 2030 |
| **Xcel Energy** | | |
| Sherburne County 1 | 680 | Operating, full retirement by 2026 |
| Sherburne County 2 | 682 | Operating, full retirement by 2023 |
| Sherburne County 3 | 516 MW (59%) | Operating, proposed retirement by 2030 |
| Allen S King | 511 | Operating, proposed retirement by 2028 |

## Figure 4-V: Coal-Fired Electricity Generating Units Serving Minnesota Customers

Figure 4-V summarizes the status of coal-fired generating units supplying electricity to Minnesota utility customers as of January 2021. Many of the units are scheduled for retirement between 2021 and 2035.

# *Building Energy Use*

Energy efficiency is especially critical in cold-climate states. Minnesota has some of the coldest winter weather in the nation, coupled with hot, humid summers. Operating and maintaining buildings involves the consumption of large amounts of energy. In 2017, buildings in Minnesota consumed 40.6% of the total energy consumed in the state, 19.5% of which was from commercial buildings, including large multifamily buildings.

*Between 2005 and 2018, GHG emissions increased by 32% from residential buildings and 15% from commercial buildings.*

Minnesota's policies and programs work together to support cost-effective energy conservation and efficiency in both new and existing buildings. Minnesota is the only midwestern state that consistently ranks in the top 10 states nationwide in the American Council for an Energy-Efficient Economy (ACEEE) State Energy Efficiency Scorecard.[40] Despite this progress, overall emissions and energy use from buildings are increasing. The Minnesota Pollution Control Agency's greenhouse gas (GHG) inventory shows that, between 2005 and 2018, GHG emissions increased by 32% from residential buildings and 15% from commercial buildings.

Building codes, policies, and programs related to new construction, renovations, and upgrades all represent tools that the State of Minnesota and local jurisdictional agencies use to improve the performance of Minnesota's various types of buildings.

## Policies for New Construction

### Building Energy Codes

Minnesota has had a State Building Code, including a building energy code, for almost 50 years. The code includes minimum, uniform, least-cost, and safe standards for construction. Minnesota law requires the State building code to conform as much as possible to model building codes that are generally accepted and in use throughout the United States. Minnesota law states that the commissioner of the Minnesota Department of Labor and Industry (DLI) shall by rule and in consultation with the Construction Codes Advisory Council establish a code of building standards, of which energy standards are addressed in chapters 1323 and 1322. Even though the State Building Code is established by rule using model codes, the Legislature can still enact specific requirements to regulate the construction of buildings.[41]

Minnesota's current model energy codes are based on the International Energy Conservation Code (IECC), developed by the International Codes Council through a voting process, which eventually incorporates standards established by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE).[42] The U.S. Department of Energy (DOE) participates in industry processes to develop model building energy codes, issue determinations as to whether updated codes result in energy savings, and provide technical assistance to states to implement and comply with the codes.[43]

The current residential code, 2012 IECC with amendments, became effective Feb. 14, 2015, and the current commercial code, 2018 IECC and optional AHSRAE Standard 90.1-2016, became effective March 31, 2020.[44] The new code is expected to produce more than 8% savings in energy costs and 6% savings in energy use.[45]

Beginning with the 2018 edition of the model building codes and every six years thereafter, the DLI is required to review the new model building codes and adopt DOE-approved model codes as amended for use in Minnesota within two years of the published edition date. The commissioner may adopt amendments to advance construction methods, technology, or materials; protect the health, safety, and welfare of the public; or improve the efficiency or use of a building.[46] When a new, more efficient residential energy code becomes available, if DOE hasn't yet adopted it, Minnesota is only required to review and consider adopting the new code.[47]

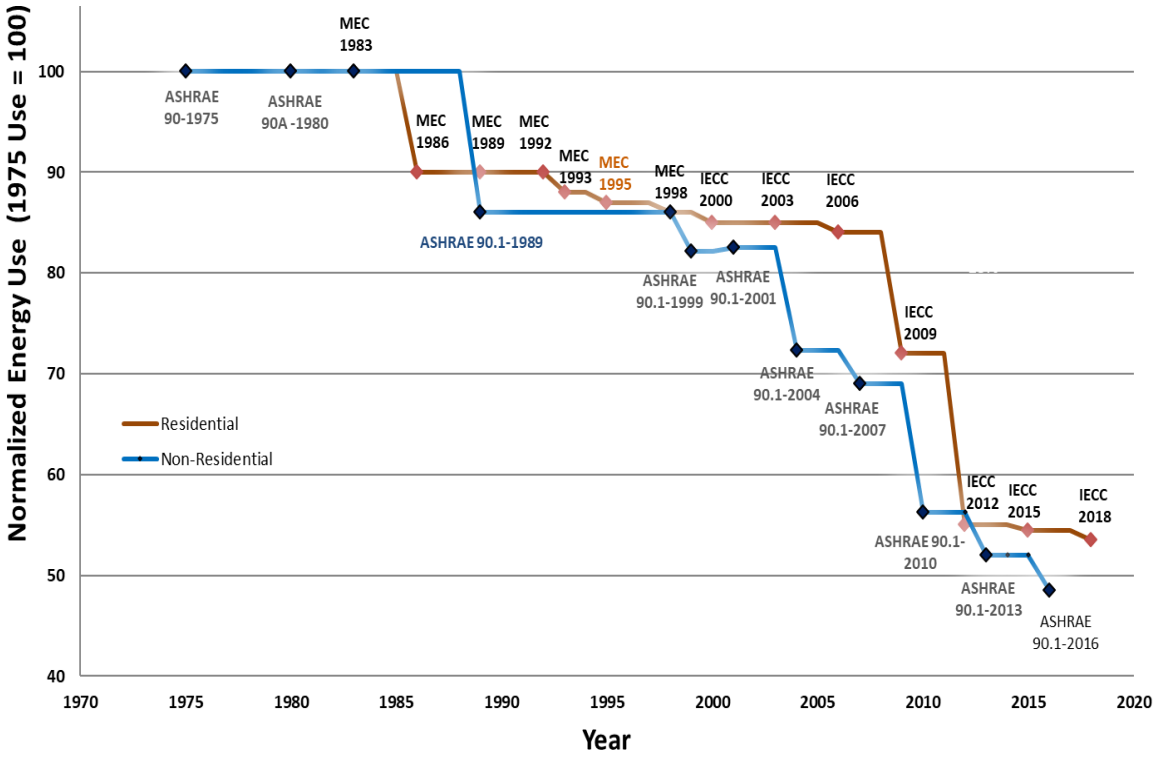
Although development occurs at national and state levels, Minnesota's building energy codes are enforced locally by those counties and cities that have passed local ordinances. Throughout Minnesota, 507 municipalities enforce the State Building Code. This includes 432 out of 852 cities, 59 of 1,790 townships, and 16 of 87 counties.[48]

*The 2018 building energy codes are expected to produce more than 8% savings in energy costs and 6% savings in energy use.*

As a result of adopting the 2012 IECC residential and commercial codes, energy cost savings for Minnesota are estimated to be approximately $207 million annually by 2030.[49]

The relationship between building codes and energy use intensity (EUI) in buildings has been well documented.[50,51] Although significant variation exists in the EUI for different types of buildings (*e.g.,* industrial production, hospital, office, residential), the research suggests that the average EUI trends steadily downwards as new model building energy codes are developed and implemented, such as between the 2004 and 2016 editions of ASHRAE 90.1. For building code provisions with payback periods of 12 years or less, National Renewable Energy Lab estimates that EUI can be reduced as low as 22,000 Btu per square foot (sf) per year.[52] Based on Minnesota cost-effectiveness testing, energy efficiency measures with a 15-year payback or less are implemented from 2015 through 2019 in Minnesota buildings designed to the Sustainable Buildings 2030 70% performance standard.[53] Such buildings include:

- DNR Area Office, Glenwood: 35.85 kBtu/sf/year[54]
- Minnesota Correctional Facility, St. Cloud – Health Services Expansion: 33.73 kBtu/sf/year[55]
- Minnesota Senate Building: 36.36 kBtu/sf/year[56]
- NHCC Bioscience and Health Careers Center: 68.71 kBtu/sf/year[57]




## Figure 4-W: Improvement in Residential and Non-Residential Model Energy Codes (1975 – 2018)

Figure 4-W tracks the improvement in building energy use established by model energy codes from national and international standards organizations for residential and non-residential buildings from 1975 through 2018. Normalized building energy use standards improved by about 50% over that 43-year period.

*Source: Pacific Northwest National Laboratory*

## Sustainable Buildings 2030 Performance Standards

In 2000, the Minnesota Legislature required the Departments of Administration and Commerce to develop sustainable building design guidelines that would become mandatory for all new buildings receiving funding from bond proceeds after January 1, 2004. In 2008, the guidelines expanded to include the Sustainable Building 2030 (SB 2030) Performance standards – cost-effective, energy-efficiency performance standards. SB 2030 is administered by the Center for Sustainable Building Research at the University of Minnesota with annual funding provided through a utility rate assessment and managed by Commerce. All new and substantially renovated buildings funded in whole or part by Minnesota bonds must comply with the SB 2030 standards. Further, after design, building owners are required to track and report the buildings' energy use in B3 Benchmarking for 10 years, and if the building is not performing to the standard, it must apply the B3 energy efficient operations manual to achieve compliance.

While the Sustainable Building 2030 standards are voluntary for all other buildings, they have served as a model for reducing both energy use and carbon emissions. The model can be cost-effective and beneficial for building owners, citizens, and utilities throughout Minnesota. SB 2030 reflects the goals of the national Architecture 2030 program, though it is tailored to Minnesota buildings. Architecture 2030 established a goal to achieve net-zero energy use in buildings by 2030 and outlined specific incremental performance targets in order to meet this goal. The SB 2030 program required that all State bond-

financed projects that began schematic design in 2015 through 2019 must meet the SB 2030 70% reduction standard, to reduce net use of energy (total consumption minus renewable energy generated onsite) by 70% compared to a 2003 building.

As of 2016, 126 buildings in Minnesota were designed to the SB 2030 standard, saving approximately $9.8 million in energy costs, 634 million kBtu of energy, and 71,000 tons of $CO^2e$ each year.[58] As of 2019, 185 Minnesota buildings were designed to the SB 2030 standard, saving approximately $15.7 million, 1.023 billion kBtu, and 116,000 tons of $CO^2e$ each year.[59] Buildings transitioned to a 70% SB 2030 standard, from 60%, from January 2015 through 2019. The 80% performance standard took effect in January 2020.

The Minnesota Environmental Quality Board (EQB), Pollution Control Agency, and Department of Commerce, along with partners in 2016 studied the effects of implementing SB 2030 as a building energy code. The *Climate Solutions and Economic Opportunities* study showed that with investment in supportive programs, over a 15-year period the policy would create on average 2,500 or more new jobs annually, reduce almost 20% of the emissions needed to achieve the 2030 net-zero energy goal, and would save $2 billion.[60]

The report summarized several possible ways to advance progress toward implementing SB 2030 in the State Building Code:

- Implement SB 2030 requirements in multiple steps for all new and renovated commercial buildings, all new one- and two-family dwellings, and multifamily residential buildings;
- Make available technical assistance and training on SB 2030 implementation for local units of government, architects, engineers, builders, and developers;
- Adopt SB 2030 as an appendix in the Minnesota Building Code, make the standards available for local jurisdictions to use; and
- Enact legislation requiring all State-licensed buildings to use SB 2030 design guidelines and provide funding for technical assistance and training to support the required changes.

# Policies for Existing Buildings

Building code affects new construction, but a high-performing building not only needs to be designed energy efficiently, but also operated efficiently. Further, building design doesn't always address plug-load energy consumption from appliances and other plug-in devices, which can account for approximately one-third to one-half or more of the energy used in Minnesota residential and commercial buildings.[61,62]

## Appliance & Equipment Standards

Federal Appliance and Equipment Standards dictate appliance efficiency. In 1975, the Energy Policy and Conservation Act (EPCA) was enacted among other things to develop, revise, and implement minimum energy efficiency standards. The U.S. DOE reviews standards and test procedures for 60 products that encompass 90% of home energy use and 60% of commercial building energy use.[63] Some states have adopted additional appliance and equipment standards, but Minnesota is not among them. Any new appliance and equipment standards that states might consider must accommodate federal authority to set standards for the country.[64]

## Financial Programs/Incentives

The federal and state government, along with non-profit organizations focused on energy issues, offer a variety of financial programs and other incentives that include criteria for efficiency and renewable energy use in residential and commercial buildings. Examples include:

- Federal tax credits for energy efficient home retrofits;
- Minnesota's enabling legislation for Property Assessed Clean Energy (PACE) programs, which many Minnesota counties have joined;[65] and
- Minnesota Housing's Qualified Allocation Plan, which distributes low-income housing tax credits.

Other policies that affect buildings' greenhouse gas emissions include the Conservation Improvement Program and Weatherization Assistance Program – both managed by Commerce – as well as ordinances and programs implemented by local units of government in Minnesota. Also, through a grant from the U.S. Department of Energy Commerce has been managing a public stakeholder process to assess potential approaches to supporting beneficial electrification of fossil fuel-burning systems, including building energy systems, to reduce costs and greenhouse gas emissions. See Chapter 2 for more information about these and related policies and programs.

## Conservation Applied Research and Development (CARD) Studies

CARD funds projects to identify new technologies or strategies to maximize energy savings, improve the effectiveness of energy conservation programs, or document the carbon dioxide reductions from energy conservation projects.[66] Several major building studies funded between 2016 and 2019 examined potential for improving building energy efficiency.

- **Minnesota Energy Efficiency Potential Study (2020 – 2029):** This study discussed how utilities could cost effectively achieve additional energy savings beyond current energy savings goals, which included a breakdown of cost-effective building end-use energy savings for electricity and natural gas through 2029. Electricity savings for commercial buildings can primarily be found through lighting, refrigeration, and system efficiency, and for residential buildings in space heating, appliances, and water heating. Natural gas savings for both commercial and residential buildings can primarily be found in space heating upgrades.[67]
- **Air Source Heat Pumps:** Two recent CARD research projects focused on air source heat pumps and found that cold-climate air source heat pumps have performed to their specifications for efficiency and capacity in Minnesota. With proper installation, for homes with propane or electric heating, cold climate air source heat pumps are a viable option.[68]
- **Minnesota Commercial Energy Baseline and Market Characterization Study:** Statewide approximately $9,733,000 in energy savings have been achieved for commercial buildings relative to 2015 Energy Code of IECC 2012, with an electrical savings of 73,089,700 kWh and a natural gas savings of 3,274,500 therms. To achieve greater energy savings, the study suggests applying the recommendations of previous CARD studies, and identifies three key areas for programs that can improve the compliance and enforcement process – support for officials who are responsible for code compliance inspections and enforcement; guidance for design teams to improve understanding of codes and documentation practices; and improved documentation of mechanical and lighting control code elements and commissioning efforts. The study estimates that approximately $6,340,400 in energy savings are achievable for commercial buildings beyond energy

code, with an electrical savings of 47,730,700 kWh and a natural gas savings of 2,115,400 therms. Some of the beyond-code measures include upgrades to fan motors, lighting, and air barriers for different types of commercial buildings.[69]

- **Energy Savings Opportunities in New and Renovated Minnesota Homes:** The study revealed similar energy performance between homes built in non-enforcement jurisdictions compared to those in enforcement areas. Further, energy costs for the average new home are modeled to be about 4% lower than they would be if all homes were built exactly to energy code. Correcting below-code items would have minor implications as the average homeowner would save only about $30 per year. For beyond-code measures, statewide new homes could save $7 million in annual energy cost savings for the estimated construction of 13,500 new homes or 33 million kWh and 4.2 million therms of natural-gas savings potential annually. Some of the beyond-code measures include R-30 insulation in above-grade walls, triple-pane windows, 100% LED lighting, and air-source heat pumps.[70]

See Chapters 2 and 5 for more information about CIP and CARD projects.

# Local Governments

## Participation in IECC 2021 Development

In 2020, the IECC completed the process of establishing the 2021 IECC model building code. The IECC is updated every three years and is the most commonly adopted energy code by states and local governments.[71] Cities from across the country participated in the process by reviewing and casting votes on whether to approve the new codes. The 2021 IECC update garnered great interest among municipalities, who turned out several times as many votes as previous voting cycles.[72] 2021 IECC established standards yielding the second biggest efficiency gain in the last decade for the IECC.[73]

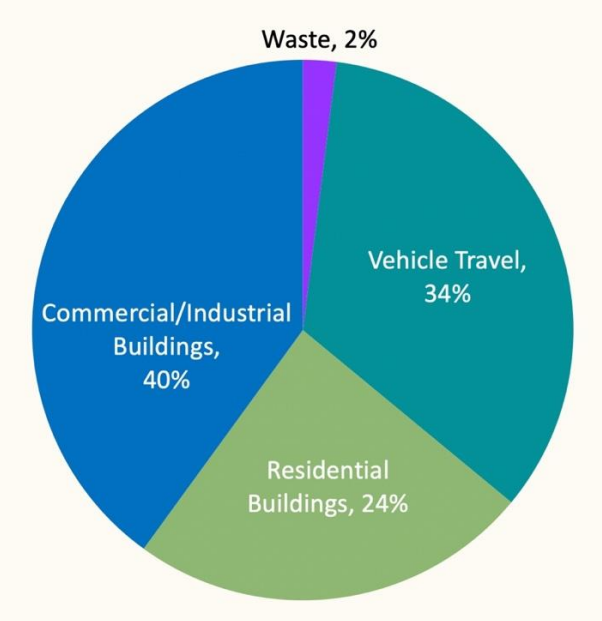



**Figure 4-X: Greenhouse Gas Emissions in Minnesota Cities (2017)**

Figure 4-X compares the percentages of GHGs from various sources in 20 Minnesota cities. Commercial and industrial buildings represent the largest source of GHGs, producing 40% of the total, with vehicles producing 34%, residential buildings 24%, and the remaining 2% emitted by waste products.

*Source: Regional Indicators Initiative, 2021. Includes data from 37 cities representing one-third of Minnesota's population.*

## Local Planning for Energy and GHG Reduction

Starting in 2016, the Local Government Project on Energy Planning (LoGoPEP), funded by the U.S. Department of Energy, built upon existing efforts to engage local governments, such as the Regional Indicators Initiative, in committing to actionable strategies for energy efficiency and GHG emission reductions. LoGoPEP provided communities with planning tools and methods for measuring progress toward their goals. As of 2018, LoGoPEP engaged 45 cities with scenario planning using the wedge tool to understand GHG

emissions citywide, provided 29 cities with detailed reports on their existing energy conditions, and tracked clean energy goals in 28 cities.[74]

According to data collected through the Regional Indicators Initiative, in cities, buildings are usually the largest aggregate source of greenhouse gas emissions.[75]

*In cities, buildings are usually the largest aggregate source of greenhouse gas emissions.*

### Local Existing Building Policies

Local governments throughout Minnesota have enacted ordinances and implemented programs to increase existing building energy efficiency and renewable energy generation to meet city-wide energy or GHG reduction goals. Examples of such local programs and policies affecting existing buildings include:

- **Benchmarking Ordinances:** The Hennepin County Efficient Buildings Collaborative works with the county, cities, and building owners to perform energy benchmarking. The county program helps cities to adopt an energy benchmarking ordinance and develop and implement related programs and provides building owners can get help on how to benchmark their buildings. Participating cities include Rochester, St. Louis Park, Edina, and St. Paul.[76]
- **Financial Programs:** The City of Minneapolis's Green Cost Share Program offers matching funds for commercial, industrial, multifamily, and single-family properties undertaking energy efficiency, solar, or innovative pollution reduction projects.[77]
- **Truth in Sale of Housing & Energy Disclosure:** The Minneapolis City Council in February 2019 enacted an ordinance to provide homeowners and prospective buyers with the general energy performance information of a home.[78]

See Chapter 2 for more information about community-led efforts to support energy efficiency and emissions reductions.

## Demographic and Building Trends

Minnesota's population and economy have grown since 2016, and so has commercial and residential building space in the state.

Minnesota's population grew 3.5% in the past 5 years.[79] In 2018, Minnesota had a population of more than 5.6 million people. The total population is estimated to exceed 6 million by 2032.[80] In 2035, the population 65 and older is expected to eclipse the under-18 population for the first time in the state's history[81] – which has implications especially for residential building trends.

The rate of population growth is forecasted to be greater in the metro area versus Greater Minnesota.[82] On average, more than 5 million square feet of commercial building space was added each year in the Twin Cities area from 2016 through 2019.[83] In 2016, commercial buildings consumed 349,594 billion Btu of energy and in 2018 consumed 377,688 billion Btu.[84]

More than 31 million square feet of multifamily buildings were built in Minnesota since 2015.[85] In 2017, there were more than 2,115,000 households, 28% of which were renter householders and 72% were owner households.[86] In 2019, Minnesota had more than 2,153,000 households, of which 28% were

renters and 72% were homeowners.[87] The median home value was $199,700 in 2017, which has increased 15% since 2000.[88]

Between 2016 and 2018, between 11,000 and 14,000 homes were built each year in Minnesota.[89] In 2016, residential buildings consumed 375,256 billion Btu of energy and in 2018, consumed 431,647 billion Btu.[90] In 2018, more than 65% of households' primary energy source for house heating was natural gas and about 18% was electricity. Other primary energy sources included fuel oil and propane.[91]

# Recommendations for Commercial Building Energy Use

## Improving Building Energy Efficiency in Commercial and Multi-family Construction

With support from cities, Rep. Jamie Long and Sen. David Senjem in 2019 introduced legislation that proposed to give local units of government the option to adopt the SB 2030 performance standards as an advanced energy building standard applied to all new commercial and large multifamily buildings. Although the legislation was not enacted, DLI and Commerce convened a Building Efficiency Workgroup, an informal stakeholder process from 2019 through 2020 to examine the potential for allowing local units of government to voluntarily promote or prescribe greater energy efficiency measures for commercial and large multi-family buildings. The formation of this workgroup also provided the opportunity to consider how new commercial and large multifamily buildings can be built to mitigate climate change through the use of renewable energy and energy efficiency, while taking into account affordability (short and long term) and user comfort.[92]

| Date | Electricity – (GWh/year) | |
|---|---|---|
| | Commercial Buildings | Residential Buildings |
| 2019 | 22,575.65 | 21,905.45 |
| 2018 | 23,398.56 | 22,837.14 |
| 2017 | 23,273.9 | 21,573.8 |
| 2016 | 23,501.74 | 21,803.79 |

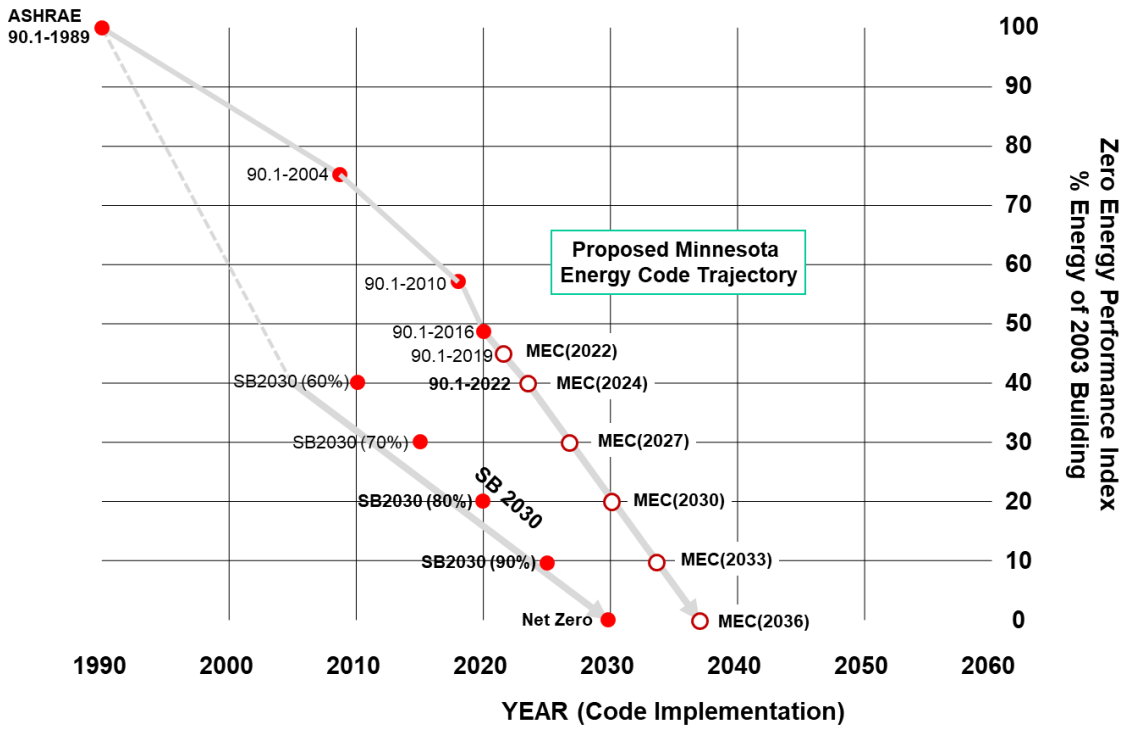
### Figure 4-Y: Minnesota Buildings Electricity Use (2016 – 2019)

Figure 4-Y summarizes the total annual electricity use of commercial and residential buildings in Minnesota for the years 2016 through 2019. In commercial buildings, total consumption declined slightly each year, and over four years fell by nearly 1 gigawatt-hour – from 23.5 GWh in 2016 to 22.56 GW in 2019. In residential buildings, consumption fluctuated from year to year, but over the four-year period grew slightly from 21.8 gigawatts to 21.9 GW.

*Source: Energy Information Administration*

The process yielded a report with recommendations for the Office of the Governor.[93] The report details the informal workgroup process and input from experts and stakeholders that led the departments to make the following policy recommendations:

- Institute an adoption framework for the statewide commercial building energy code that ensures that all new commercial and large multifamily construction meets the net-zero energy standard by 2036. To accomplish this, the State would adopt the ASHRAE 90.1 standard for commercial buildings every three years, beginning with adoption of the ASHRAE 90.1-2019, coupled with necessary energy efficiency performance requirements to meet the goal of net-zero by 2036.
- Provide the resources needed for these recommended code improvements to be successful, including conducting cost analysis and market analysis.[94]




## Figure 4-Z: Minnesota Energy Codes – Proposed Net-Zero Trajectory

Figure 4-Z illustrates possible paths toward achieving building codes that effect net-zero energy consumption for new construction in Minnesota, based on the Zero Performance Index for Energy Codes from the New Buildings Institute.

*Source: Center for Sustainable Building Research, University of Minnesota*

The departments' recommendations identify resources needed to further support the success of recommended code improvements, and other recommended areas of future research and engagement including:

- Develop a cost analysis for different building types
- Research the markets' ability to design, build, and operate more efficient buildings
- Develop and deliver a curriculum to augment current training in the energy-efficient building space
- Address how to continue to provide efficiency resources to keep project costs down
- Continue further stakeholder engagement
- Explore ways to pilot or test new and emerging building models
- Learn more about other building segments
- Explore separate, but complementary, incentives and benchmarking policies
- Examine state building code enforcement.

# Additional Studies, Analysis, and Recommendations

Additional detailed analysis and recommendations from 2016 through 2019 can be found in the studies below.

## Minnesota's 2025 Energy Action Plan

In 2016, The Department of Commerce and Legislative Energy Commission completed a DOE-funded project working with over 50 stakeholders across the state to identify consensus-driven, near-term strategies to help meet Minnesota's energy goals. The Department continues to work with stakeholders to implement the action plan strategies, including the following related to building energy use: [95]

- ***Mapping Thermal Grid Integration Opportunities in Minnesota***
  In 2019 the Department of Commerce worked with Barr Engineering and Evergreen Energy to improve statewide mapping of existing heat supply and use for thermal energy grids (a.k.a. district energy). The report lays out a framework and identifies next steps to support local government analysis of opportunities for using waste heat when planning for other community systems and infrastructure.[96]

- ***Combined Heat & Power Action Plan Implementation***
  Details on implementation of the CHP Action Plan are available on the Department of Commerce website.[97]

- ***Enhance Energy Data Access***
  Stakeholders identified strategies for standardized, timely, and automated energy data access as a key cross-sector opportunity to unlock further efficiency and conservation opportunities including benchmarking, optimized building operation, and behavioral strategies. In addition, governments and businesses are seeking data from utilities on greenhouse gas emissions from electricity generation to monitor and measure progress on the GHG impacts from buildings (for further details, see above: Declining Carbon Intensity and Electric Sector Emissions publications and analysis).

## Minnesota Commercial Energy Baseline and Market Characterization Study

In a CARD-funded study, *Minnesota Commercial Energy Baseline and Market Characterization Study,* consulting firm Slipstream Inc. recommended conducting a market analysis of commercial building energy modeling in Minnesota, which would help State institutions to make better use of energy modeling tools for building energy performance analysis – which in turn could help inform future codes, enforcement approaches, design tools, and resources.[98]

To support adoption of a 2036 net-zero commercial building code, the Slipstream study also recommended performing cost analysis of energy code levels across different buildings in climate zones 6 and 7. Ideally this cost analysis for different building types would occur before the new energy code versions were launched, so that their results could be used in implementing the codes.

Based on stakeholder input, the Slipstream study also recommends researching the markets' ability to design, build, and operate more efficient buildings. In addition, a stakeholder council could be created to conduct ongoing communications and education.[99]

# *Public Water System Energy Use*

## Opportunities Prior to 2016

Nationally, water and wastewater utilities typically use 35% of municipal energy budgets. Electricity costs make up a significant portion of wastewater treatment plant (WWTP) operating budgets, typically 25 to 40%.[100] In Minnesota, many municipal wastewater and water treatment plants seek funding from Minnesota's State Revolving Fund (SRF). The fund is managed by the Minnesota Public Facilities Authority (PFA), a multi-agency authority governed by a board consisting of commissioners representing the Minnesota Departments of Employment and Economic Development, Management and Budget, Pollution Control Agency, Health, Agriculture and Transportation.

*Feasibility assessments showed four to 10-year payback periods for combined heat and power investments at wastewater treatment plants.*

PFA and Minnesota Pollution Control Agency (MPCA) staff jointly administer the wastewater and stormwater aspects of the State Revolving Fund. WWTPs are funded by the Clean Water Revolving Fund (CWRF), which provides below-market-rate loans to finance projects.[101] The PFA is responsible for the financial elements of the program and the MPCA is responsible for its environmental and technical components.[102] The PFA and the Minnesota Department of Health (MDH) administer the water treatment components of the SRF, known as the Drinking Water Revolving Fund, which provides below-market-rate loans to upgrade and construct public drinking water systems.[103] The CWRF includes the Green Project Reserve that may forgive up to 25% of loan principal up to $1 million if the project uses green infrastructure, water or energy efficiency or other environmental innovations.[104]

Minnesota's public wastewater treatment plants, including small and mid-sized energy-intense WWTPs, present opportunities for cost-effective energy efficiency and renewable energy projects. The Minnesota Technical Assistance Program (MnTAP) at the University of Minnesota helps businesses in the state prevent pollution, use resources efficiently and reduce energy use while reducing costs. MnTAP in 2018 completed a project supported by Commerce and the Minnesota Pollution Control Agency to perform energy assessments at 11 mid-sized wastewater treatment facilities and recommended operational strategies. As a result of the study, WWTP facilities have implemented or plan to implement recommendations that will save more than 4 million kWh per year, out of the 5.5 million kWh of potential annual energy savings identified in the report.[105]

MnTAP also evaluated potential for biogas energy production at Minnesota WWTP facilities in collaboration with the U.S. DOE's Midwest Combined Heat and Power Technical Assistance Partnership (CHP TAP), based at the University of Illinois at Chicago. The evaluations targeted facilities that had anaerobic digestion operations and a flow greater than 5 million gallons per day. To widen the pool of applicable candidates in Minnesota, the two organizations also targeted facilities with moderate to high biological oxygen demand loading or with access to compatible high-load industrial waste. Then the partners used the State's discharge monitoring report to find sites practicing anaerobic digestion with flow greater than 1 million gallons per day and high biological oxygen demand load between 2,500 and 25,000 pounds per day.

Twenty-five sites were approached, and four completed the feasibility assessment by providing operations data that were analyzed by Midwest CHP TAP. The feasibility assessments showed

investment payback periods for site CHP investments from four to 10 years. This return on investment period is within the range of many wastewater treatment plants' major capital improvement project guidelines. Similar payback periods also were found to be available at smaller facilities, which make up most of Minnesota's wastewater infrastructure.[106]

Commerce published an action plan in 2015 that summarized key findings from the department's combined heat and power work and provided recommendations to assist with potential implementation.[107] The plan incorporated combined heat and power research conducted by the Conservation Applied Research and Development (CARD) grant program.[108] Examples of wastewater treatment plants in Minnesota that implemented CHP include:

- **Metropolitan Council's Blue Lake Wastewater Treatment Plant:** Methane biogas recovered from the digester facility is used to replace 9 million BTU per hour of natural gas powering the solids facility.[109]
- **City of St. Cloud Wastewater Treatment Facility:** Biofuel conditioning equipment and a 633 kW AC generator convert organic waste to electricity and heat.[110]
- **City of Rochester Wastewater Reclamation Plant:** The 2,000-kW CHP system consists of two 1,000-kW Waukesha engines that have dual-fuel capability for operating on either biogas from the digesters or natural gas. The plant has two anaerobic digesters that create enough biogas to produce 550 to 750 kW of electric power, depending on the time of year.[111]
- **City of Albert Lea Wastewater Treatment Facility:** The 120-kW CHP system integrates four Capstone C-30 microturbines that operate on methane gas created in an anaerobic digester. This system generates approximately 800,000 kWh per year.[112]

# Activities and Policies after 2016

## Water Energy Nexus Retreat Action Plan

In August 2018, the National Governors Association Center for Best Practices hosted a Water Energy Nexus Retreat for the State of Minnesota. Local and national experts gave presentations and discussed water utility energy efficiency opportunities as well as constraints. Participants included State agencies, the University of Minnesota, cities or regional wastewater treatment plant organizations and State water utility associations. The retreat produced an action plan for four key strategy areas: policy, finance, technical assistance and workforce development.

## Clean Water Revolving Fund Requirements

Beginning in fiscal year 2016, due to a requirement under §602(b)(13) of the Federal Water Pollution Control Act, Clean Water Revolving Fund recipients needed to select a project or activity that maximizes the potential for energy conservation, as well as efficient water use, reuse, recapture, and conservation. Projects had to take into account a variety of costs, including construction, operation and maintenance over the life of the project or activity, as well as replacement.[113] The MPCA developed processes for ensuring project cost-effectiveness, and provided references and resource lists to support project planning and implementation.

## Sustainable Buildings 2030 WWTP Review

The University of Minnesota's Center for Sustainable Building Research, Commerce and MPCA developed the Buildings, Benchmarks, and Beyond (B3) Sustainable Buildings 2030 (SB 2030) WWTP Review, an energy review process and set of minimum energy conservation measures that should be considered for applicable WWTP designs using tools established under Minn. Stat. §216B.241. The review outlined a five-part compliance process, including: data entry into B3 Benchmarking and an energy audit of existing facility; documentation of energy conservation measures that were considered for inclusion in the project even if they are not implemented; anticipated performance metrics under several load conditions; evaluation of opportunities for renewable energy generation onsite; and evaluation of water savings potential.[114]

Through this process, project engineers are expected to develop technical memoranda to document their energy efficiency and renewable energy reviews, and then to submit that information to MPCA. In this way, MPCA can track the information to understand what energy efficiency and renewable energy decision-making is occurring during new construction of wastewater treatment plants as well as during major renovations.

## Cohort Training and Implementation Plan

Building on the successful identification and implementation of operational energy efficiency improvements at mid-sized municipal wastewater treatment plants through MnTAP's previous work, a CIP CARD grant funded an energy market characterization and developed a cohort training program for WWTP operators to learn about and assess energy use at their facility and implement improvements.

The market characterization estimated the electricity consumption – the primary energy source for Minnesota wastewater treatment plants – of the 210 largest and most energy-intensive WWTPs in the state. The characterization also looked at which facilities had staff or other resources to work on reducing energy use and which did not. A cohort training program was developed for energy intensive WWTPs that lack staff resources for energy-reduction efforts. This training builds on the collaborative nature of the State's WWTP sector to help to create a culture of energy efficiency at these facilities.[115] Work is proceeding to implement the training program through the Minnesota State Energy Office over the next several years.

## Large Wastewater Treatment Plants

*The Metropolitan Council set a goal to reduce fossil fuel energy purchases 10% by 2020.*

The Sustainable Water Infrastructure of the Future (SWIFt) Accelerator from the U.S. DOE's Better Buildings initiative provided state, regional and local agencies with information and networking over three years to explore best-practice approaches in data management, technologies and financing for WWTP energy efficiency and renewable energy. In Minnesota, the City of St. Cloud, Western Lake Superior Sanitary District and Metropolitan Council Environmental Services participated.[116] Through the accelerator, Western Lake Superior Sanitary District created an energy communication plan that detailed energy work they had completed and future work they were interested in doing. With enough funding, the plan identified energy and process improvements that could result in more than 11,601 MWh annual savings through 2022, and improvements in plants that could produce additional annual energy savings for 2023 through 2028.[117]

The Metropolitan Council's Environmental Services division established energy-improvement goals for its nine wastewater treatment plants. After successfully meeting its 2007 targets, the Met Council set a new goal to reduce fossil fuel energy purchases by 25% by 2015 using 2006 as the baseline year. Although the division did not meet the goal, it did reduce its energy purchases by 23%, saving the organization about $4 million in energy costs per year starting in 2015. Subsequently Met Council set a goal to reduce fossil fuel energy purchases by 10% of its 2015 energy purchases by 2020.[118] In addition, recently the Met Council has been coordinating with other State agencies to meet the state energy and greenhouse gas reduction goals outlined in Executive Order 19-27: a 30% reduction of greenhouse gas emissions by 2025 relative to a 2005 calculated baseline and a 30% reduction in consumption of energy per square foot by 2027 relative to a 2017 adjusted baseline.[119]

### Small Wastewater Treatment Plants

The Minnesota Rural Water Association has continued providing technical assistance, training, and development support for rural water system owners. The association's energy efficiency technical advisor provides training and technical assistance to small municipal and non-municipal systems, rural water districts and wastewater districts with populations under 10,000 to identify energy efficiency opportunities.[120]

## Emerging Trends

### Wastewater Treatment

As of 2018, there were more than 730 public wastewater treatment plants serving the majority of the state's population. Of these plants, 50% are pond systems. In general, pond systems, particularly non-aerated ones, are less energy intensive than mechanical systems.[121] Secondary aeration systems for activated sludge treatment are likely the largest source of energy use in a plant, representing 40 to 60% of total plant electricity.[122] The 210 largest and most energy-intensive municipal wastewater treatment plants in Minnesota consume an estimated 388 million kWhs annually and are primarily powered by electricity. The six largest WWTPs in the state consume an estimated 64% of that electricity.[123]

| Year | CWRF requested | IUP Projects: Fundable Range | GPR Eligible Estimate |
|---|---|---|---|
| 2016 | ~$236 million | 104 | ~$23 million |
| 2019 | ~307 million | 92 | ~$39 million |

**Figure 4-AA: Minnesota Clean Water Revolving Loan Fund Intended Use Plan (IUP)**

Figure 4-AA summarizes the funding requested from Minnesota's Clean Water Revolving Fund from 2016 and 2019.
*Source: Minnesota Public Facilities Authority.*

Minnesota's wastewater treatment plants are aging. WWTPs in the state range from under 10 years old to more than 40 years old, but the majority are at least 20 years old.[124] Based on recent needs surveys conducted by MPCA and the U.S. EPA, Minnesota cities will need an estimated $4.3 billion to support wastewater treatment over the next 20 years.[125]

### Characterizing the WWTP Energy Market

The Commerce's Conservation Applied Research and Development program provided funding for a study currently in progress to document WWTP energy use and characterize the energy market for Minnesota's water treatment facilities.[126]

Based on recent needs surveys conducted by MDH and the U.S. EPA, Minnesota cities will need to invest an estimated $7 billion for over the next 20 years to support water treatment facilities.[127]

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# Chapter 5: Energy Efficiency and Affordability

The Minnesota Department of Commerce implements policies and programs to support efforts to improve efficiency and conserve energy in the state's households and businesses and to help reduce the energy cost burdens of Minnesota's low- and moderate-income households. Commerce's energy efficiency and affordability program work is funded primarily by Minnesota utility ratepayers and the federal government, and fulfills requirements established under federal and Minnesota law.

## *Conservation Improvement Program*

Minnesota's Conservation Improvement Program (CIP) is funded by ratepayers and administered by electricity and natural gas utilities. The program helps Minnesota households and businesses lower their energy costs by using electricity and natural gas more efficiently. It also supports reductions in carbon dioxide and other emissions and helps utilities to optimize or defer investments in distribution system capacity. Commerce oversees each utility's CIP to ensure that ratepayer dollars are used effectively and that energy savings are reported accurately. The programs are intended to incentivize energy savings by consumers and businesses through activities such as purchasing energy-efficient equipment and changing behaviors.

Typical programs for residential customers include energy audits, rebates, and air conditioner cycling programs. For each energy audit, a trained energy consultant examines the home and shares specific advice on energy improvements. Rebates are offered on high-efficiency heating, cooling, and water heating appliances, as well as CFL and LED lighting, and low-flow showerheads and faucet aerators. Air-conditioner cycling programs allow the utility to manage its peak energy demand in return for electric bill discounts.

Common programs for commercial and industrial customers include rebates, building recommissioning studies, and manufacturing process improvements that reduce energy intensity and improve productivity. Rebates are offered for high-efficiency boilers, chillers, and rooftop units, high-efficiency motors and drives, and high-efficiency lighting and lighting control systems.

*An independent study in 2020 found that each dollar spent on Conservation Improvement Program investments generates $3.75 in benefits to society.*

As part of a Conservation Applied Research and Development (CARD) study, the Cadmus Group consulting firm conducted a quantitative economic analysis of CIP investments from 2013 through 2018.[1] The study found that each dollar spent on CIP generates $3.75 in benefits to society. The study also showed that CIP generates numerous immediate and persistent positive economic impacts to customer energy bill savings, job growth, and environmental benefits.

### Regulatory Requirements

Efficiency programs have been operating throughout Minnesota since the early 1980s. The Next Generation Energy Act of 2007 established energy-saving goals for electric and gas utilities that operate in Minnesota. The passage of the 2007 Next Generation Energy Act established Minnesota's Energy Efficiency Resource Standard (EERS) required utilities, beginning in 2010, to develop CIP plans to achieve energy savings equal to 1.5% of average annual retail sales each year,[2] unless adjusted by the Commissioner to no less than 1.0%.[3]

Under the law, utilities can achieve the annual savings goal directly through their CIP. Every electric and natural gas utility in the state develops its own CIP plan, which includes a variety of programs to assist residential and business customers in becoming more energy efficient. In the past, utility CIPs mainly focused on incentivizing energy-efficient products. However, as utilities work to meet energy savings goals, many are piloting new approaches by offering packaged services and measuring savings from building operation and maintenance as well as behavioral changes including fine-tuning building control systems or turning off lights when not in use.

Utilities are required to submit CIP plans to Commerce for review and approval prior to implementation, and they are subsequently required to report their CIP's annual spending and savings performance to demonstrate compliance with the requirements in Minn. Stat. §216B.241.[4]

## Energy Savings Requirements

Minnesota Statutes §216B.241, subd. 1c(b) establishes an annual savings goal of 1.5% of average retail sales for electric and natural gas utilities, calculated based on the most recent three-year weather normalized average retail sales, excluding sales to CIP-exempt customers. The statute allows the Deputy Commissioner to adjust the goal based on several factors, including historical conservation investment experience, customer class makeup, load growth, a conservation potential study, or other factors the Deputy Commissioner determines warrant an adjustment. However, the statute does not allow the Deputy Commissioner to approve a savings goal of less than 1% for the IOUs.

The law also establishes an allowance for electric utility infrastructure (EUI) project savings. Minn. Stat. §216B.241 subd. 1c (d) allows an electric utility to claim energy savings resulting from EUI projects on top of a minimum energy savings goal of 1% from energy conservation improvements, provided that the EUI projects result in energy efficiencies greater than what would occur through normal maintenance activity.

## Program Requirements

Gas and electric utilities each have minimum spending requirements. Minn. Stat. §216B.241 subd. 1a requires each electric utility to invest a minimum of 1.5% of its Minnesota gross operating revenues (GOR), excluding revenue from any CIP-exempt customers, on CIP. The statute requires that natural gas utilities invest a minimum of 0.5% of their Minnesota gross operating revenues (GOR), excluding revenue from any CIP-exempt customers, on CIP.

In addition, gas and electric utilities are subject to low-income spending requirements. Minn. Stat. §216B.241 subd. 7(a) requires that each electric utility invest a minimum of 0.2% of its residential Minnesota GOR on CIP programs that directly serve the needs of low-income residents, including renters. Similarly, each natural gas utility is required to invest a minimum of 0.4% of its residential Minnesota GOR on CIP programs for low-income residents.

Each utility and association is allowed to spend as much as 10% of the utility's minimum spending requirement on research and development (R&D) projects under Minn. Stat. §216B.241, subd. 2(c). At the same time, Minn. Stat. §216B.241 subd. 1(a) allows each utility and association to spend as much as 5% of the utility's minimum spending requirement on distributed and renewable generation (DRG).

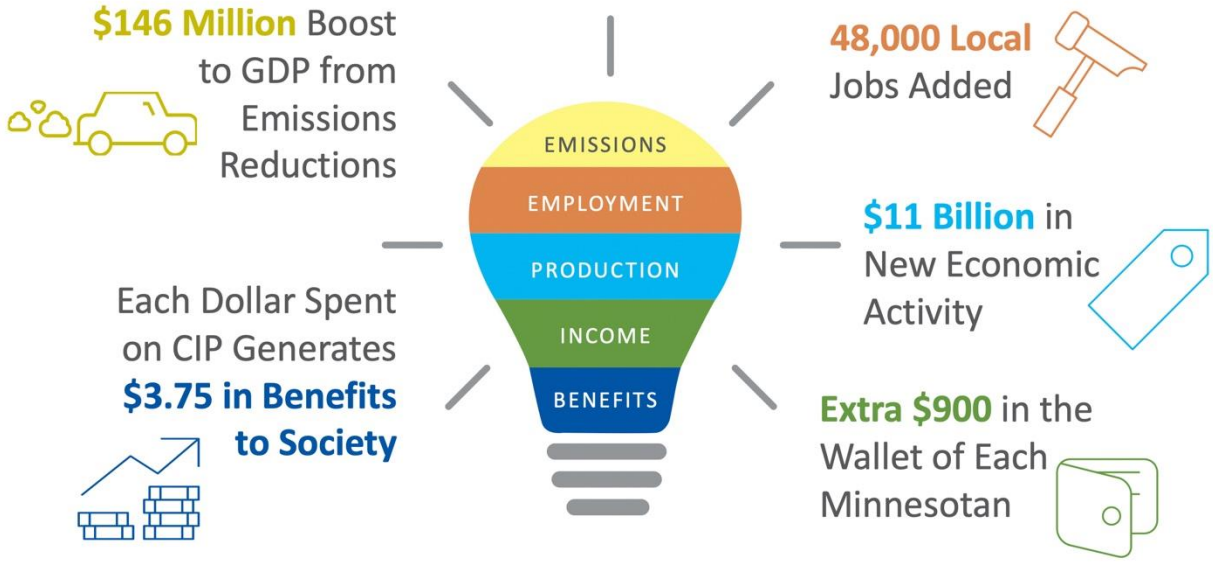
Minn. Stat. §216B.241 subd. 1f(c) and subd. 9(e) require that each utility and association offer one or more programs that support the green building certification of commercial buildings along with goals consistent with Sustainable Building 2030 performance standards.[5,6]

## Activity and Policies

During both 2017 and 2018, electric utilities exceeded the CIP goal of 1.5% and natural gas utilities exceeded the statutory minimum of 1.0% energy savings. In total, in years 2017 and 2018, energy conservation programs benefited Minnesota's environment and economy by:

- Saving around 15.2 trillion-Btu of energy – enough energy to heat, cool and power more than 160,000 Minnesota homes for a year;[7]
- Reducing CO2 emissions by 1.79 million tons, equivalent to removing over 350,000 vehicles from the road for one year;[8]
- Saving Minnesota's businesses and residents over $279 million in energy costs; [9] and
- Supporting over 48,000 energy efficiency jobs, representing the largest sector of Minnesota's clean energy employment.

CIP brings positive economic and societal benefits to Minnesota. An independent 2020 study estimated the net economic impacts of CIP investments made from 2013-2018. The study found that each dollar spent on CIP generates $3.75 in benefits to society.[10] Each year CIP investments generate immediate and sustained positive economic effects on customer energy bill savings, job growth, and the environment.




### Figure 5-A: Net Economic Impacts of 2013-2018 Conservation Improvement Program Investments

Figure 5-A illustrates savings and benefits accruing from CIP investments, in terms of emissions reductions, jobs created, economic activity, and customer cost savings. An independent study by the Cadmus Group in 2020 estimated that each dollar of CIP investments generates $3.75 in benefits to society.

## Low-Income Assistance

Current statutory requirements place a minimum spending requirement on low-income programs for residents, including renters. What is considered low income is determined at the discretion of utilities. Utilities tend to use the Weatherization Assistance Program (WAP) and the Energy Assistance Program (EAP) eligibility thresholds. WAP eligibility is based on 200% of the Federal poverty income guidelines. EAP is for households with income at or below 50% of the state median income. Minnesota's statutory provision for low-income programs is aimed at improving equity by requiring utilities to ensure that low-income customers benefit from CIP investments.

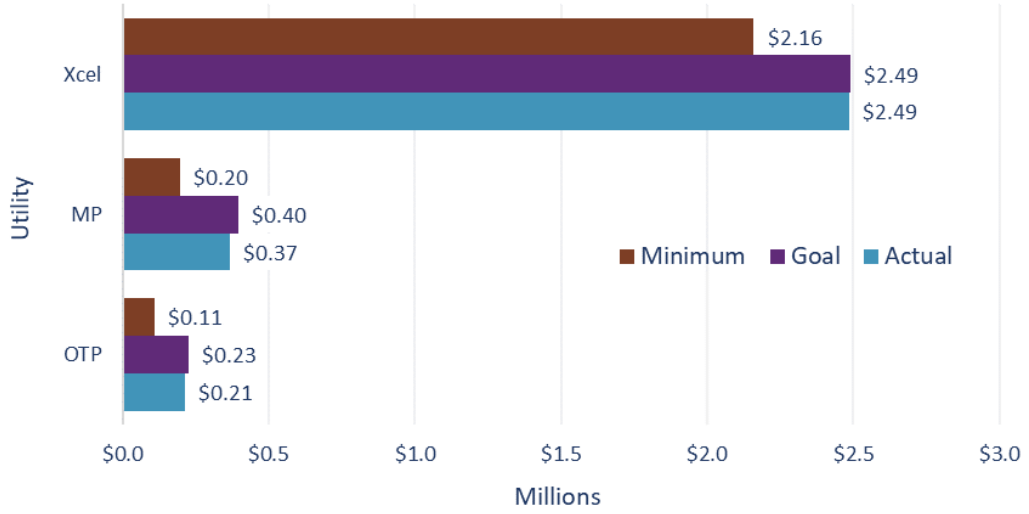



**Figure 5-B: 2019 Electric Low-income CIP Spending (Total $3.07 million)**

Figure 5-B shows the 2019 electric CIP spending by Xcel Energy, Minnesota Power (MP), and Otter Tail Power (OTP).

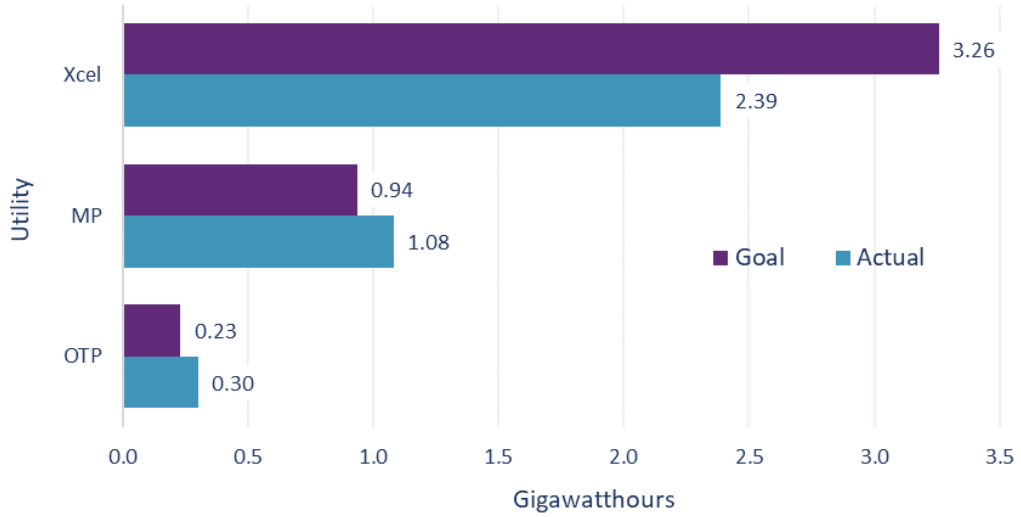
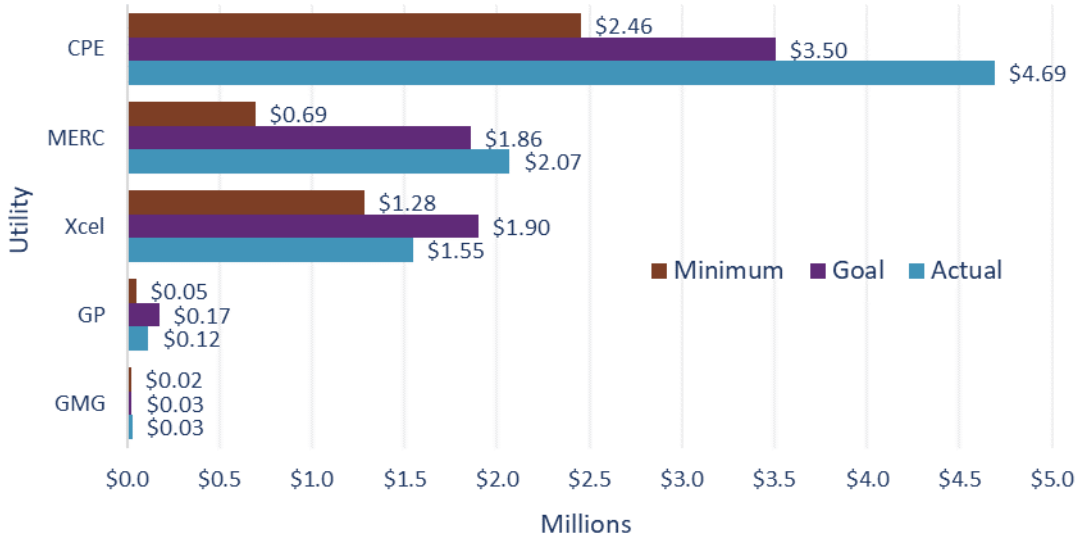


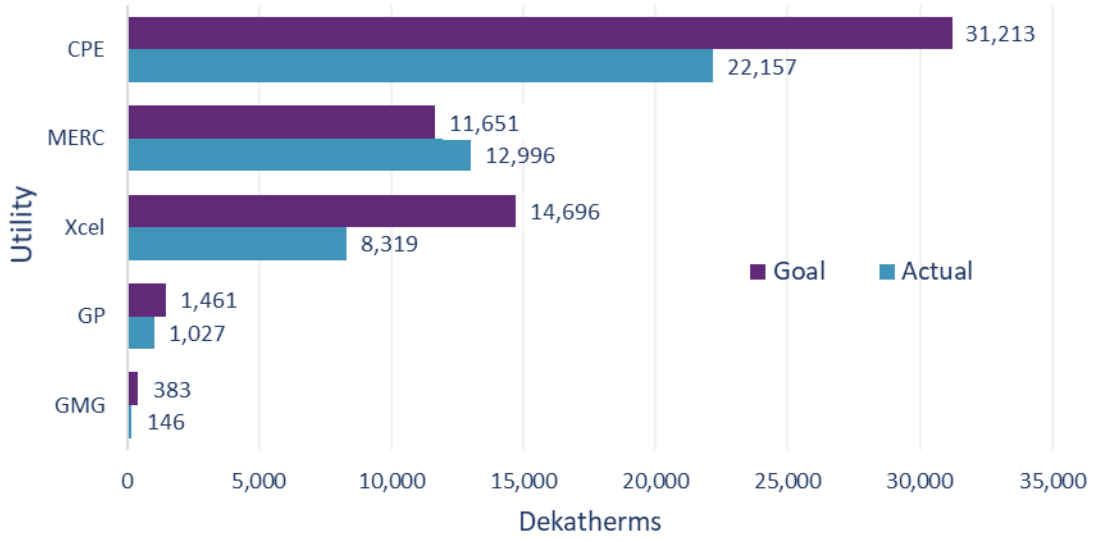

**Figure 5-C: 2019 Electric Low-income CIP Savings (Total 3.77 GWh)**

Figure 5-C shows the 2019 electric energy saved (in gigawatt-hours) through CIP measures implemented by Xcel Energy, Minnesota Power (MP), and Otter Tail Power (OTP).




## Figure 5-D: 2019 Natural Gas Low-income CIP Spending (Total $8.45 million)

Figure 5-D shows the 2019 CIP spending by Minnesota natural gas utilities – CenterPoint Energy (CPE), Xcel, Minnesota Energy Resources Corp., Great Plains (GP), and Greater Minnesota Gas (GMG).




## Figure 5-E: 2019 Natural Gas Low-Income CIP Savings (Total 44,645 Dth)

Figure 5-C shows the 2019 energy saved (in dekatherms) through CIP measures implemented by Minnesota natural gas utilities – CenterPoint Energy (CPE), Xcel, Minnesota Energy Resources Corp., Great Plains (GP), and Greater Minnesota Gas (GMG).

Examples of low-income programs include energy audits followed by air sealing, weatherization, and equipment replacement. Some utilities provide furnace replacements and tune-ups or customer rebates for purchasing and installing energy efficiency measures in multifamily buildings or nonprofit affordable housing. Typically, CIP income eligibility is proposed by utilities and evaluated by Commerce during the plan review process. Commerce also works with utilities to identify other programs with established income thresholds and verification procedures that could be used. Examples include such programs as

WAP and EAP, discussed later in this chapter, as well as subsidized affordable housing programs. Most utilities are meeting or exceeding their low-income spending requirements.

Administering low-income programs can be challenging for utilities and their vendors. Challenges include finding eligible and interested customers, perceived challenges in meeting U.S. DOE WAP requirements, accommodating the needs of both WAP and CIP, and working with many different Community Action Partnership (CAP) agencies throughout the utility's service territory. Commerce continues identifying areas of improvement and working with stakeholders to effectively deliver these programs.

## Technical Reference Manual

The Minnesota Technical Reference Manual (TRM) comprises a set of standard methodologies and inputs for calculating the savings impacts of energy conservation improvement programs in Minnesota. The manual started with TRM 1.3 in 2016 and has been updated several times to include revisions and new measures. TRM Version 3.1 is valid for Jan. 1, 2021, through Dec. 31, 2021.[11]

The TRM is developed by Commerce in conjunction with a group of technical experts who comprise the TRM Advisory Committee, which includes representatives from utilities, advocacy groups, engineering consultants, and non-profit organizations. For the most recent update process, Commerce worked with more than 25 organizations throughout the state to complete updates, taking into account the measures and technologies that have the greatest potential to contribute to energy efficiency in Minnesota during the next decade. The process includes committee meetings and public comment periods to ensure everyone has a chance to contribute.

## Conservation Applied Research and Development Program

To help achieve the State energy conservation goal on a sustained basis, the Next Generation Energy Act of 2007 authorized the commissioner to assess utilities $3.6 million annually for grants for applied research and development projects. That total included $500,000 to fund activities coordinated by the Center for Sustainable Building Research related to Sustainable Building 2030 Building Standards. Another $500,000 funds community energy technical assistance and outreach through Clean Energy Resources Teams.[12] An additional $2.6 million funds the Conservation Applied Research and Development (CARD) grant program, which awards research grants in a competitive request for proposal process.

| Description | Number/Dollars |
|---|---|
| CARD grant funding cycles | 13 |
| Request for Proposals (RFP) issued | 25 |
| Request for Information (RFI) issued | 2 |
| Letters of Intent (LOI) to propose reviewed | 655 |
| Full proposals evaluated | 557 |
| R&D projects funded | 162 |
| Completed research projects | 117 |
| Dollars awarded | $34,149,718 |
| Matching funds provided by grantees | $8,012,286 |

### Figure 5-F: CARD program summary (through 2020)

Since the creation of CARD, Commerce has issued 25 requests for proposals, evaluated more than 550 proposals, and funded more than 160 R&D projects. The funded projects represent over $34 million in awards supplemented by more than $8 million in matching funds provided by grantees.

CARD projects identify new technologies or strategies to maximize energy savings, improve the effectiveness of energy conservation programs, and document carbon dioxide reductions from energy conservation projects. Results from CARD research provides utilities with timely information to enhance energy-efficiency program designs within their CIP portfolios.

In addition to demonstrating innovative technologies and providing data to enhance utility programs, the CARD program regularly contributes to TRM development as well as funding for major efforts such as assessing the economic effects of CIP, determining statewide demand-side management potential for energy efficiency and carbon savings, and exploring barriers to robust utility codes and standards.

Examples of projects that were funded from 2016 to 2020 include:

**Statewide commercial behavior segmentation and potential study:** Completed in 2017, the study's main objective was to understand the human and technical potential of utility programs focused on behavior changes in the small commercial sector. Focusing on six key business segments and 10 behavior-based energy saving measures, the project identified the greatest potential in thermostat setbacks, kitchen exhaust control, refrigeration measures, and power management and lighting. Recommendations from the study inform utilities on how to design more effective energy conservation behavior-change programs.

**White paper updating the energy-efficiency cost-effectiveness framework in Minnesota:** The standard energy-efficiency cost-effectiveness framework used in Minnesota, and many other states, had not been reviewed for many years. The objective of this white paper, completed in 2018, was to describe how Minnesota could apply the key elements from a new National Standard Practice Manual to CIP energy-efficiency cost-effectiveness analyses. The study examined Minnesota's current energy-efficiency screening practices, policies and goals; included interviews with key stakeholders; and reviewed laws, statutes, rules, and orders regarding the application and evaluation of cost-effectiveness in Minnesota. The project recommended how Minnesota practices could be modified to better align with national standards.

**Market study on barriers and opportunities for cold-climate air source heat pumps in residential households:** Cold-climate air source heat pumps provide the single-largest opportunity for residential electric savings. However, many barriers prevent greater adoption of this technology among residential households. This market study completed in 2020 assessed awareness of heat pump technology among consumers and revealed challenges and opportunities for increased adoption. Recommendations included designing educational campaigns, utilizing community-based outreach campaigns, targeting messaging to customers based on their existing heating systems, and collaborating with manufacturers to provide training specific to heat pumps.

*Cold-climate air source heat pumps provide the single-largest opportunity for residential electric savings.*

**Field study of stand-alone dehumidification and efficiency opportunities in Minnesota single-family homes:** Despite periodic studies of the topic over the years, many uncertainties remain about portable dehumidification in Minnesota single-family housing, including operating characteristics, household behaviors, and energy performance. This project seeks to fill those gaps. Completed in 2020, results indicate that portable dehumidifiers use more energy than anticipated to remove water in Minnesota basements. In addition, at least one-third of existing dehumidifiers are in need of replacement with newer energy-efficient models, which could reduce energy use for dehumidification by about half.

**Energy efficiency potential of nanofluids study:** Heat transfer fluids that contain stably suspended nanoparticles are able to increase the rate of heat transfer and are applicable to a wide range of HVAC applications. Case studies conducted in other countries and studies by academic labs suggest that the energy consumption of chilled water and hot water systems can be reduced by 10% to 35% by replacing existing water or water–glycol mixtures with nanofluids. This Minnesota field study aims to quantify the energy savings and performance associated with the use of nanofluids as a heat-transfer medium in several HVAC applications under actual operating conditions. Results from this project are expected at the end of 2021.

**Market study to determine the energy-efficiency opportunity at Minnesota drinking water utilities:** This study, due to be completed by the fall of 2021, seeks to define the energy use and efficiency opportunities for municipal drinking water supply operations. The objectives are to establish the economic and achievable energy efficiency potential of the drinking water supply systems in Minnesota, to assess market adoption barriers for energy-efficiency measures, to confirm energy use and energy intensity for procurement, treatment and supply of safe, clean drinking water in Minnesota, and to scope broadly applicable efficiency measures.

**Optimized installations of cold-climate air source heat pumps for single-family homes:** The Minnesota Energy Efficiency Potential Study identified cold-climate air source heat pumps as a technology that is expected to provide 25% of total residential electrical savings in the state in the coming decade, which would be essential for meeting Minnesota's 1.5% conservation goal. Based on the results of a previously funded CARD field assessment along with continued support from product manufacturers, several Minnesota electric utilities modified their existing heat pump programs or created pilot programs to increase installations of cold-climate air source heat pumps. However, installations have been slow due to lack of familiarity with the technology on the part of Minnesota contractors and consumers. The goal of this project is to develop and validate design, installation, and operational protocols necessary for this type of heat pump to achieve high market acceptance and maximum energy savings. Results are expected by the end of 2022.

*Refrigeration represents nearly 20% of the potential electric commercial and industrial program savings, but less than 5% of electric commercial and industrial CIP savings achieved by Minnesota's three largest electric investor-owned utilities.*

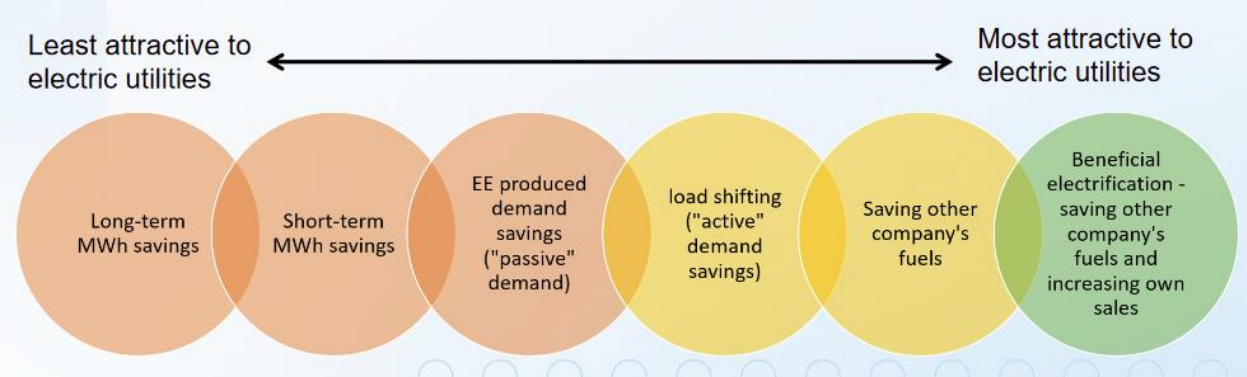
**Commercial and industrial refrigeration market assessment:** The Minnesota Energy Efficiency Potential Study showed that refrigeration represents nearly 20% of the potential electric commercial and industrial program savings in Minnesota through 2029. Yet a recent review of CIP programs indicated that refrigeration represents less than 5% of the combined total electric commercial and industrial CIP savings achieved by Minnesota's three largest electric investor-owned utilities. This study will help utilities tap into this area of opportunity by generating comprehensive information about the state's medium- and large-sized commercial and industrial refrigeration market and by identifying specific program measures and approaches. The project is due to be complete in the first quarter of 2021.

**Minnesota Codes and standards Program: Concept to Realization Roadmap:** Due for completion in the first quarter of 2021, the goal of this study is to provide a foundation for developing a robust Minnesota codes and standards program that will deliver cost-effective contributions towards the 1.5% energy savings goal. It further seeks to establish a clear pathway to position Minnesota utility program administrators to participate in and claim savings from future codes and standards program activities.

## Efficient Fuel Switching

Commerce convened a series of stakeholder meetings in 2019 to address issues related to the prohibition on targeted fuel-switching in the Minnesota Conservation Improvement Program.[13] Commerce determined in 2005 that rebates would be based on reductions in utility sales, and savings from fuels other than utility-delivered electricity and natural gas (*i.e.,* delivered fuels such as propane and fuel oil) would not be counted toward efficiency improvements. A 2012 modification allowed electric utilities to provide fuel-switching solutions for low-income customers in conjunction with the Weatherization Assistance Program. The stakeholder engagement process, facilitated by Burr Energy LLC, solicited inputs from industry stakeholders and provided Commerce with guidance for consideration regarding future fuel-switching policy in CIP.

Historically, states tended to discourage utilities from pursuing fuel-switching to prevent load building and inter-utility competition using ratepayer funds. The concept of including fuel-switching – and electrification – in utility energy-efficiency efforts is still in the early stages of development in a handful of states. Numerous economic, environmental and equity benefits can be gained from taking advantage of efficient fuel switching. But there are also significant risks such as inefficient load building and incentives for utilities to neglect efficiency measures that would reduce their own sales in favor of those that would reduce other fuel providers' sales.




### Figure 5-G: Efficiency Measures and Utility Incentives

Figure 5-G illustrates how different energy-saving measures interact with utility business incentives. Utilities tend to favor measures that increase their own sales and reduce their competitors' sales, and they favor those that shift loads or reduce them only for short periods, versus those that create long-term or permanent savings.

*Source: Martin Kushler, ACEEE presentation, Sept. 11,2019*

The stakeholder process convened by Commerce involved discussions about how to realize efficient fuel-switching regulation. While some stakeholders advocated for a legislative route, others indicated preferences for a regulatory approach. Some wanted CIP to provide for fuel-switching measures, while others recommended a separate initiative. What remains clear is that while efficient fuel-switching carries many potential benefits, the concept requires careful development.

## Electrification Action Plan

Stakeholders in Minnesota and nationwide have identified end uses where electrification could reduce carbon dioxide emissions, decrease customer costs, and provide energy savings over the lifetime of equipment. Market growth is driving some electrification, specifically electric vehicle sales. The surge of interest in electrification stems from a new understanding of electrification providing societal benefits. Beneficial electrification, as this subset of electrification is known, describes instances when electrifying specific fossil fuel-burning technologies reduces total lifecycle carbon dioxide emissions, reduces cost and carries benefits to consumers and the public.

*Some electric technologies have been shown to pollute less, cost less, and be more efficient than their fossil fuel-burning counterparts.*

Some electric technologies have been shown to pollute less, cost less, and be more efficient than their fossil fuel-burning counterparts. Trends suggest that electric options may continue becoming more competitive with the growth of renewable generation, technology improvements, and greater ability to control and schedule consumption for time periods when electricity supplies are cheaper and produce lower emissions. These trends have driven policymakers, environmental advocates, consumers, and electric utilities toward strategies that electrify more of the economy.

To better examine the opportunity of beneficial electrification – *e.g.,* electrification that yields benefits and avoids negative consequences – Commerce funded a white paper, *The Electrified Frontier*, and received a grant from the U.S. Department of Energy to examine use of electrification as a tool for increasing energy efficiency, reducing carbon emissions, maximizing grid optimization, and developing recommendations for policy makers, regulatory agencies, and utilities.[14] Commerce contracted Michaels Energy to execute both projects, with stakeholder-engagement support from the nonprofit organization Environmental Initiative.[15] In response to interviews conducted for the white paper, stakeholders agreed that electrification could be a path to reducing carbon emissions, especially in the transportation sector. Many stakeholders also expressed interest in the potential growth of residential heat pumps for space and water heating. Stakeholders agreed that CIP's prohibition on using incentives for fuel-switching measures limits a utility's role in supporting consumer adoption of these technologies. Stakeholders also asserted that regulators should consider ways to support beneficial electrification, especially as a part of broader grid modernization effort.

Stakeholders responded that they see challenges facing electrification in Minnesota. Market adoption and consumer interest in heat pumps and other technologies were recognized as a challenge, and so was lack of contractor familiarity with the technologies. Others identified challenges with grid infrastructure and electricity supply, especially in meeting the winter heating peak. Many questioned whether electrification can be pursued without increasing Minnesotans' energy costs. Another challenge is the technical methodology for determining when and how electrification would be beneficial.

*Stakeholders asserted that regulators should consider ways to support beneficial electrification, especially as a part of broader grid modernization effort.*

Finally, stakeholders were asked whether electrification should be included within CIP. Some respondents stated that it should because CIP is an existing, high-functioning program that would serve as a good template. They expressed that electrification serves CIP goals well enough that it logically should be part of the program. Others felt that electrification does not belong in CIP, saying that it would compete with investments in energy efficiency. They suggested a standalone carbon-reduction

program, parallel to and perhaps modeled on CIP, would be best for achieving carbon-reduction goals at the lowest cost. Other respondents were split on the topic; they saw room for a small set of measures to fit within CIP, and also saw justification for a broader effort to address carbon reduction through electrification. Commerce found the exercise valuable in raising important questions that must be addressed to support progress on beneficial electrification.

### Minnesota Codes and Standards

Codes and standards (C&S) programs include strengthening energy efficiency regulations, improving compliance with existing codes and standards, and assisting local governments to develop ordinances that exceed statewide minimum requirements and coordinate with other programs and entities to support state policy goals. At some level, a Minnesota C&S program would affect all new residential, commercial, and industrial buildings, as well as building retrofits of significant magnitude – not just energy retrofits – and most new energy-using equipment purchased in the state.

A Lawrence Berkeley National Laboratory report from June 2018 found that C&S programs are the most cost-effective of any energy efficiency program funded by utility customers in the United States.[16] Specifically, the program administrator cost of saved electricity for C&S programs (approximately $0.0028/kWh) is nearly an order of magnitude less than the U.S. average for all efficiency programs ($0.025/kWh), and 83% lower than the Minnesota state average ($0.016/kWh). Commerce funded a study to explore the regulatory, institutional, and market barriers to developing a Minnesota C&S program and to provide specific recommendations for addressing potential barriers. The project builds on past and current codes and standards efforts, and focuses on comprehensive program issues that were not previously addressed. A report detailing the findings of this study was pending at the time this report was being produced.[17]

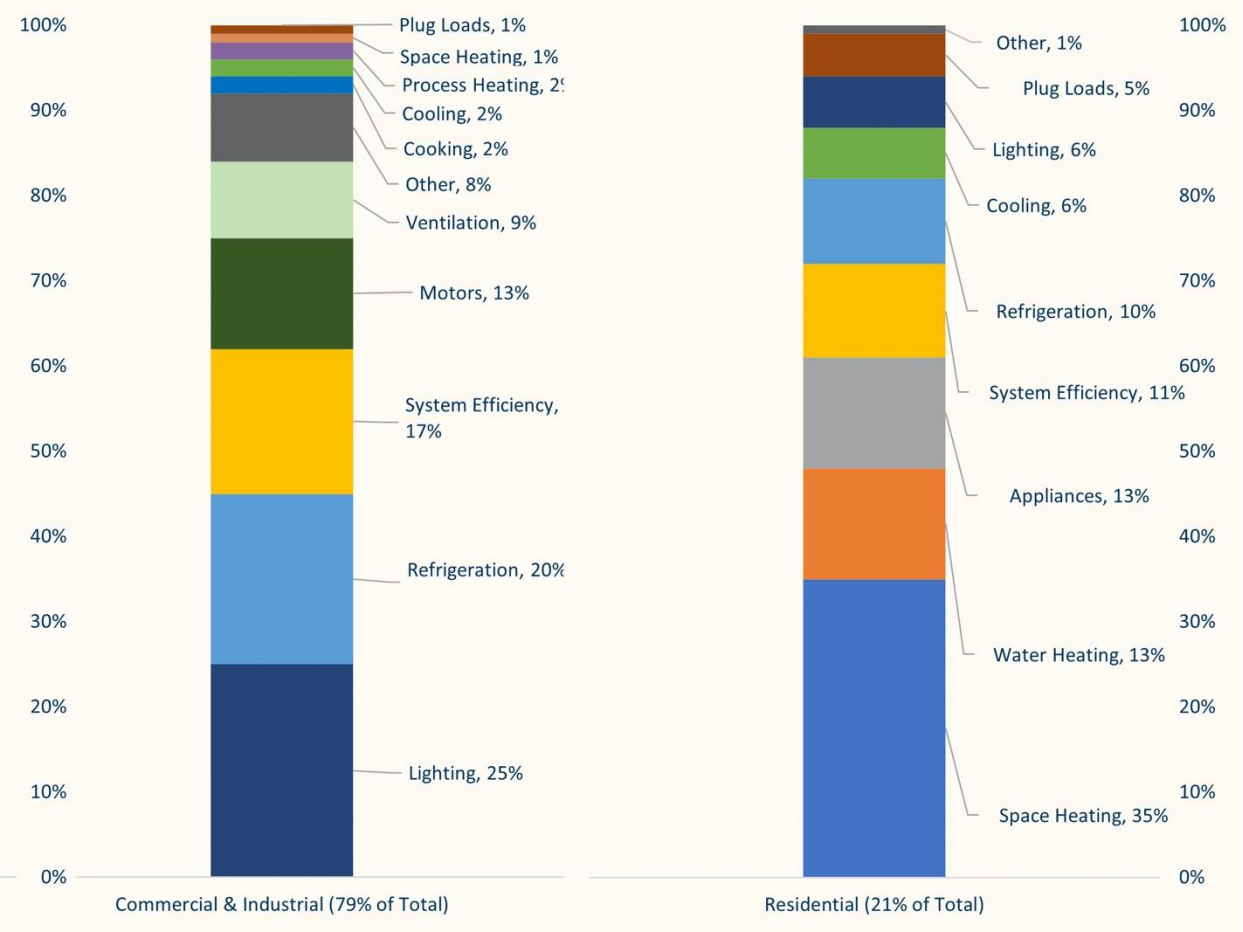
## Projections

To continue maximizing the benefits of cost-effective energy efficiency resource acquisition by utilities, a project team consisting of consulting firm Optimal Energy and the non-profit organizations Center for Energy and Environment and Seventhwave was funded through CARD to estimate the statewide electric and natural gas energy efficiency and carbon-saving potential for 2020 through 2029.[18] This study also produced data-driven and stakeholder-informed resources defining market segments, end uses, measures and programs that could be targeted in the next 10 years to realize Minnesota's cost-effective energy efficiency potential.

The study estimated that by 2029 state-wide the economic potential of energy efficiency could decrease the forecasted electric load by 33%, and that program potential could reduce the load by 14%. ("Economic potential" represents the total potential if all possible measures were installed that meet cost-effectiveness criteria. "Program potential" is the subset of economic potential that can be achieved with specific program funding levels, designs, and considering market barriers.)

*Residential electric programs will need to transition from lighting to cold-climate air-source heat pumps in order to capture the largest potential savings.*

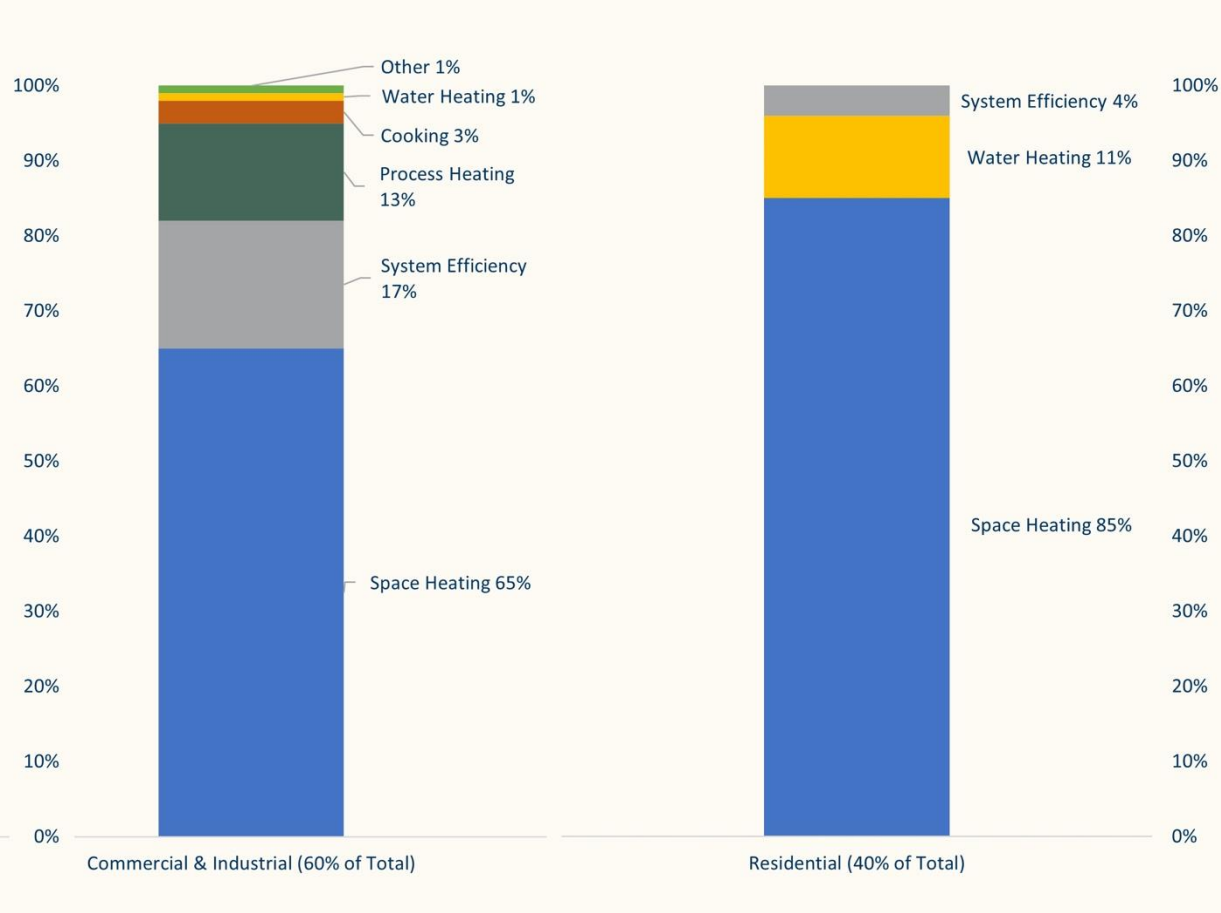
Within end uses, space heating is responsible for nearly half of residential savings at the end of the study period, while lighting declines to a small fraction of total savings. Therefore, residential electric programs will need to transition from lighting to cold-climate air-source heat pumps in order to capture the largest potential savings. In the commercial and industrial sector, lighting, refrigeration, and system energy are expected to account for approximately 60% of total program potential in 2029.




## Figure 5-H: Electric Savings Program Potential by End Use (2029)

Figure 5-H shows the cumulative annual electric energy savings by end use in 2029 as a percentage of total savings for the residential and commercial & industrial sectors. Savings figures are based on program potential estimated in the 2018 Minnesota Energy Efficiency Potential Study.

For natural gas, the study estimated economic potential to decrease forecasted gas sales by 33%, with program potential representing about one-third of that, or 11%, by 2029. Space heating is likely to dominate the end-use potential for the residential sector as well as the commercial and industrial sectors for natural gas utilities, with smart thermostats yielding the largest new source of potential savings.




## Figure 5-I: Natural Gas Savings Program Potential by End Use (2029)

Figure 5-I shows the cumulative annual natural gas energy savings by end use in 2029 as a percentage of total savings for the residential and commercial & industrial sectors. Savings figures are based on program potential estimated in the 2018 Minnesota Energy Efficiency Potential Study.

The pandemic created increased uncertainty about future projections and expectations. In general, Americans' patterns of electricity and natural gas consumption across sectors changed. According to a report from the U.S. Energy Information Administration from May 2020, weekday electricity demand in the Midwest fell between 9% and 13% in March and April due to shutdowns and changes to normal routines.[19] The EIA report also mentioned that, nationwide, schools and business closures caused commercial and industrial electricity usage to decrease, while stay-at-home orders increased residential electricity usage. Preliminary data from summer 2020 indicates energy usage generally tracked changes in public health restrictions. As a result, the pandemic skewed energy usage metrics during most of 2020, complicating analysis of energy efficiency program results during this period. Any long-term effect the pandemic may have on energy consumption and efficiency programs remains unclear. Commerce will continue monitoring the situation and providing guidance.

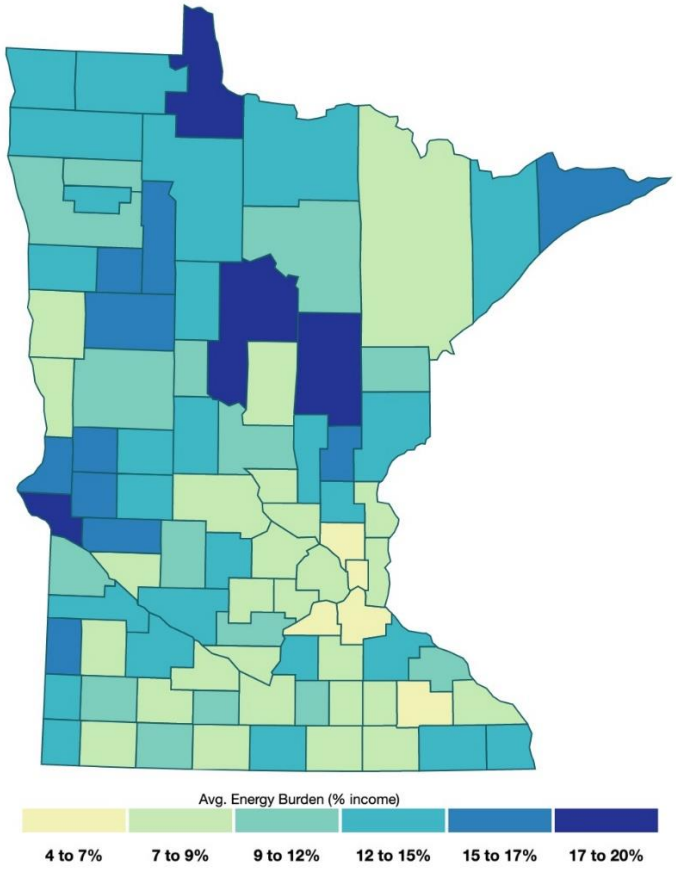
# *Energy Affordability Efforts*

To help reduce the energy cost burden for Minnesota's low- and moderate-income residents, Commerce manages the federally funded the Low-Income Energy Assistance Program (EAP) and Weatherization Assistance Program (WAP)s, as well as efforts to improve access to renewable energy and efficiency technologies for low-income households.

## Reducing Energy Burdens for Low-Income Minnesotans

Energy burden is the average annual housing energy costs divided by the average annual household income.[20] According to the American Council for an Energy Efficient Economy (ACEEE) energy burden above 6% is considered a high energy burden.[21] Drivers of energy burdens include "the physical condition of the home, a household's ability to invest in energy-efficient upgrades, and the availability of energy efficiency programs and incentives." Nationwide, "low-income households experience high energy burdens almost three times more than the average household, and 13 times more than non-low-income counterparts."

Low-income households[22] in Minnesota have an average energy burden of 8%, while the average for the rest of Minnesota households – *e.g.,* those over 200% of the federal poverty level – is 2%.[23] These percentages are similar to the national average (9% and 3%, respectively). At a county level, six Minnesota counties have an average energy burden for low-income households over 11%, and 15 counties carry average burdens of 10% to 11%. Further, for the roughly 30% of Minnesota's households that are at or below the federal poverty line, the average energy burden statewide is 15%. In seven Minnesota counties, the county-wide energy burden for the poorest Minnesotans is as high as 22%, though some low-income Minnesotans face an energy burden exceeding 30%.




### Figure 5-J: Energy Burdens for Low-Income Minnesota Households by County

Figure 5-J illustrates the percent of income spent on energy by Minnesota households in each county with annual incomes at or below 200% of the federal poverty line. Northern and far western Minnesota counties have disproportionately high average energy burdens (exceeding 12%) among low-income households.

*Source: Low-Income Energy Affordability Data (LEAD) Tool, U.S. DOE*

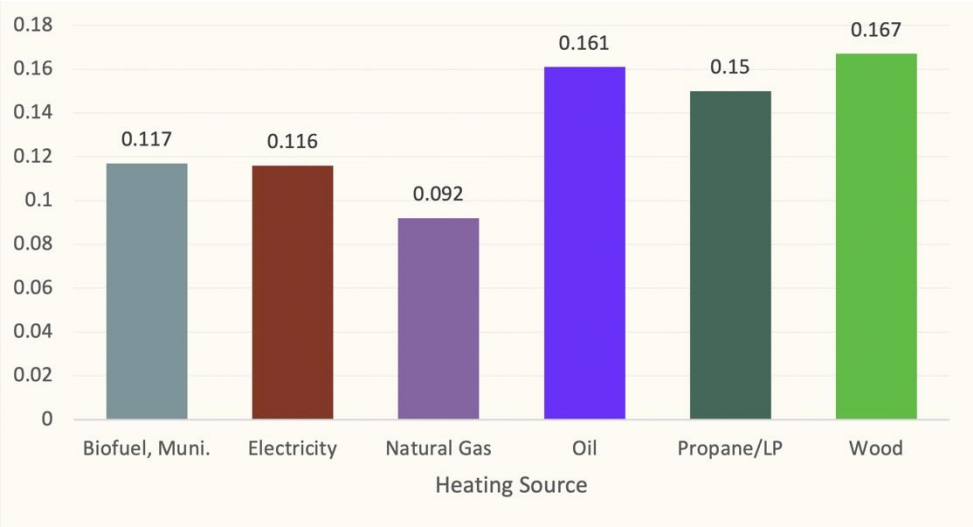
EAP and WAP reduces the energy burden for Minnesota households receiving assistance. EAP is paid annually, as needed, and focuses on immediate energy needs of low-income households, while WAP is a

one-time but long-term home modification solution. Both programs target households with high energy burdens for service. On average, households receiving EAP benefits in program year 2018 saw nearly a 40% reduction in their energy burdens.[24]

Households receiving weatherization assistance under the WAP program see long-term energy cost reductions averaging 30%, and significant reductions in their energy burdens. However, neither of these programs is able to assist every low-income household in Minnesota. Approximately 20% to 30% of low-income Minnesotans apply for EAP assistance, and due to funding limitations, WAP has been able to weatherize only 9% of the eligible households in Minnesota over the last 15 years.

*Households receiving EAP benefits in program year 2018 saw nearly a 40% reduction in their energy burdens.*

For EAP program year 2019 (October 1, 2018 through September 30, 2019) the pre-benefit energy burden for Twin Cities metro income-qualified households receiving EAP benefits was 9.4% vs. 11.7% for income-qualified households in greater Minnesota.[25] When viewed by type of heating fuel used, households in dwellings heated by wood, fuel oil, or propane carry burdens higher than 15%. When the data is analyzed by type of housing, households in manufactured homes carry the highest energy burden, on average, of 12.9%.[26] Lastly, when viewed demographically, Native American households[27] in Minnesota receiving EAP benefits carried the highest energy burden at 15.4%. (See Chapter 3 for further information about efforts focused on improving energy costs, sustainability, and self-sufficiency for members of Native American tribes that share Minnesota's geography.)




## Figure 5-K: Minnesota Low-Income Household Energy Burdens by Heating Fuel Type (Program Year 2018)

Figure 5-K compares energy burdens by heating fuel type for Minnesota households eligible for Energy Assistance Program benefits. Homes heated by wood, oil, and propane had the highest energy burdens in the 2018 program year.

# Low-Income Home Energy Assistance Program

The Low-Income Home Energy Assistance Program (LIHEAP) is a federally funded U.S. Department of Health and Human Services program authorized as part of the Omnibus Budget Reconciliation Act of 1981 (42 U.S.C. §§ 8621 through 8630) that aims to assist low-income households in meeting their

immediate home energy needs. The program's direct benefits include making payments to energy vendors on behalf of eligible households to reduce their home energy burdens, providing payments that prevent or resolve the loss of heat due to utility disconnection or running out of fuel, and repairing or replacing malfunctioning or non-functioning heating systems.

By federal statute, state programs funded by LIHEAP are required to target households with seniors, disabled members, or children under age six; each year over 65% of eligible households include at least one member from one or more of these target groups. Two-thirds of annual funding for Minnesota's Energy Assistance Program is spent in Greater Minnesota, with the remaining one-third provided to households in the Twin Cities area. Commerce manages EAP through contracts with 29 service providers in service territories covering the entire state, including 21 Community Action Agencies, five tribal governments, two counties, and one non-profit organization.

*Two-thirds of annual funding for Minnesota's Energy Assistance Program is spent in Greater Minnesota.*

From 2007 through 2016, Minnesota EAP funding totaled an average of $125 million annually, including $20 million from the State of Minnesota in 2014. During this time, Minnesota's EAP served an average of 147,000 households each year, providing direct benefits as well as services such as case management, referral, energy education, and advocacy with energy vendors.

From 2011 to 2016, EAP went from serving nearly one-third of the estimated income eligible households to serving only 27%. As a result, EAP increased and improved program outreach, particularly to targeted groups, increased the average primary heat benefit to more effectively reduce energy burdens of low-income Minnesotans, and piloted new approaches to reduce long-term household energy burden. Due to these changes, EAP was able to halt declining enrollment after 2017, with slight increases in the subsequent years. Increased benefit amounts helped reduce energy burdens for eligible households more significantly than in past years. In 2012, EAP reduced the average household's energy burden by 25%, but by 2019, EAP reduced the average household's energy burden by more than 35% due to increased benefit amounts. Finally, EAP's pilot initiatives built local capacity, improved coordination of existing resources, and provided more holistic benefits and services to eligible households.

From 2016 through 2019, the EAP received nearly $116 million in federal appropriations annually, and provided benefits and services to more than 126,000 households each year. During this period, Commerce saw trends demonstrating the need for a significant overhaul of EAP's web-based application processing system, eHEAT. Namely, inputs from EAP's policy advisory committee, local EAP service providers, consumer advocates, and national trends indicated that barriers to applying for and accessing services contributed to keeping program enrollment around only 25% of the estimated income-eligible population. Additionally, due to eHEAT's long lifespan by technology standards, EAP needed a more modern information security infrastructure to ensure its continued viability. As a result, in 2017, EAP initiated a sweeping system modernization project, called eHEAT Next Generation.

*Increased benefit amounts after 2017 helped reduce energy burdens for eligible households more significantly than in past years.*

## Low-Income Weatherization Assistance Program

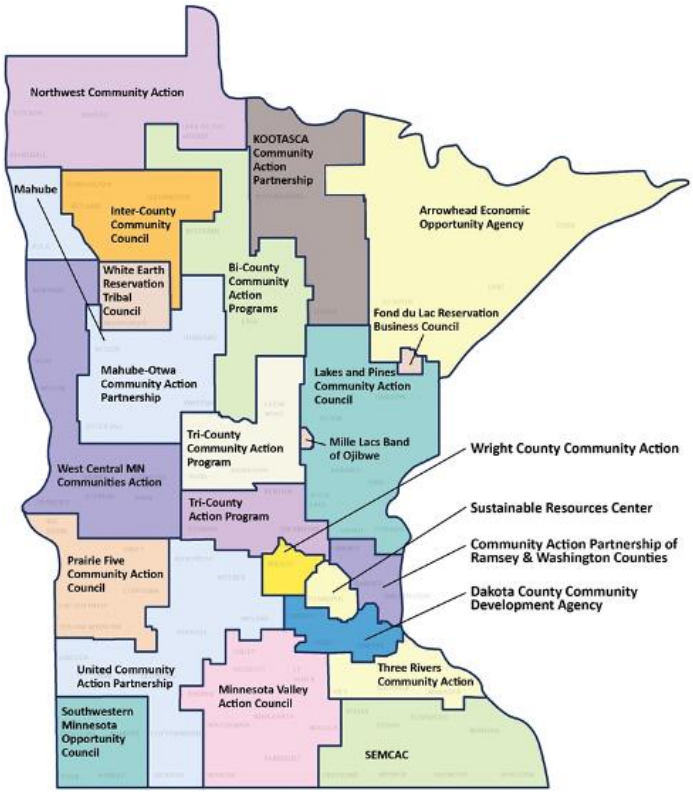
The Low-Income Weatherization Assistance Program (WAP) is a federally funded U.S. Department of Energy (DOE) program to create weatherization jobs and improve the energy efficiency of homes occupied by low-income residents. Enabling legislation was enacted in 1976 under Title IX of the Energy Conservation Act[28] and is aligned with Minnesota statutes.[29] In addition to DOE, WAP receives an annual

transfer of EAP (HHS) funding to further increase the number of households served, as well as a small fund targeted to increase the number of propane heated households.

WAP energy measures improve the household's indoor environment and result in long-term reductions in energy use and annual household energy cost, allowing those funds to be re-directed to other key living expenses. The weatherization program aims to improve occupants' health, safety, comfort, and mental and physical well-being, allowing a better quality of life for those served.

*At completion, all weatherization work requires inspection and sign-off by a certified quality-control inspector.*

WAP in-home weatherization work begins with an advanced energy audit and building systems diagnosis, followed by energy measures such as insulation, ventilation, air sealing, and mechanical systems repair or replacement. Prior to beginning work, measures must meet a minimum savings-to-investment ratio (SIR)[30]; the value of the energy savings from each measure and the project overall must be greater than the cost of the work. The program is subject to federal and State regulations, and requires fully licensed, bonded, and certified personnel who adhere to nationally defined standard work specifications to maintain high-quality work while ensuring the health and safety of household occupants. At completion, all work requires inspection and sign-off by a certified quality-control inspector.




## Figure 5-L: Minnesota Weatherization Service Providers (2020)

Figure 5-L illustrates the Minnesota regions served by 23 service providers that Commerce contracts to deliver weatherization services. The service provider network employs more than 220 people and more than 500 independent contractors to weatherize the households of WAP clients.

WAP serves an estimated 3,500 Minnesotans annually. Homes with children, elderly, or disabled occupants, or having a high energy burden or a high energy use, receive priority service. As with EAP, two-thirds of the annual funding is spent in greater Minnesota, with one-third spent on improving Twin Cities' metro area homes. Weatherization assistance is available to homeowners and renters, for single-family site-built, and manufactured homes, as well as multi-family buildings.

Commerce contracts with 23 regional service providers across Minnesota to deliver weatherization services. Service providers are primarily community action partner agencies, with three tribal nations, one county development agency, and one non-profit organization also delivering

services. In total, the service provider network employs more than 220 people and more than 500 independent contractors to weatherize the households of WAP clients.

Minnesota WAP receives an average of $17.4 million annually, with roughly half of the funding from the U.S. DOE, and the remaining amount from U.S. Department of Health and Human Services as a transfer from the EAP budget. In Minnesota's fiscal year 2019, a total of 1,604 homes received whole-dwelling weatherization at an average household unit cost of $6,121. An additional 472 homes were served with "stand-alone" work on mechanical systems, with an average unit cost of $2,816.

## Weatherization Deferrals

In fiscal year 2019, 47% of the households receiving a WAP energy audit were deferred from receiving weatherization work. Households must be deferred from receiving work for two reasons: either the forecasted energy savings associated with the needed weatherization work does not deliver a SIR of at least 1.0, or factors in the home make immediate weatherization work impossible – *e.g.,* unsafe conditions, presence of vermiculite insulation (which usually contains hazardous asbestos), deferred maintenance, structural issues, moisture and mold, etc.

*Commerce is exploring a streamlined process for insulating attics while isolating asbestos-laden vermiculite from occupants.*

The prevalence of natural gas heating in urban areas contributed to the high deferral rate, as declining natural gas prices have made it more difficult for weatherization investments to meet the required SIR. At households with potentially dangerous conditions or other factors preventing immediate work, such conditions must be resolved before WAP funds can be used for weatherization measures. Although federal program funds can be used for some non-energy measures necessary to improve a residence's health and safety, the amount is limited. Issues such as deferred maintenance, extensive repairs, and presumed asbestos-containing insulation generally are costlier than WAP funds can cover. These health and safety measures need to be covered by other sources; little funding exists to help with these conditions, and as a result many deferred homes never become eligible for weatherization assistance.

### *Healthy AIR (Asbestos Insulation Removal) Program*

Since program year 2017, Commerce has utilized $450,000 in allocated State funding to remove asbestos-laden insulation under the Healthy AIR (Asbestos Insulation Removal) Program, which safely and completely removes all particles of insulation from a home. This program has cleared 51 houses of vermiculite insulation, at an average cost of $8,429, allowing comprehensive weatherization measures to follow. The Healthy AIR program was de-funded in June of 2020 due to budget constraints brought on by the COVID-19 pandemic.

## Solar Options for Income-Eligible Households

Low-income Minnesotans rely on a variety of heating sources, including wood, propane, fuel oil, electricity, and natural gas. Renewable heating technologies such as solar and geothermal systems generally have historically been too costly for low-income residents to afford. However, as the installation cost of solar systems has continued to decrease solar has become more economically viable for programs to support installation on low-income houses.

In late 2019, Minnesota WAP introduced a pilot program to increase low-income households' access to renewables by supporting the installation of solar PV systems on 50 WAP homes.[31] U.S. DOE policies

allow WAP funding to be spent on a portion of PV system installation costs. Minnesota's solar WAP pilot program leverages funding from Xcel Energy's Income-Qualified Solar*Rewards rebate program to augment allowable WAP funds. PV installations averaging 3.6 kW in system size can offset approximately 38% of a household's energy usage, reducing the annual energy cost by $535 and reducing low-income Minnesotans' high energy burdens. Moreover, using U.S. Environmental Protection Agency's health benefits-per-kWh (BPK) value for solar energy,[32] the value of the associated health benefits for a solar array installed under the WAP solar pilot totals from $134 to $303 a year.

In March 2020, Commerce designed and implemented the Solar Resource Assessment Project (SRAP) to remotely assess the solar resource potential of 105,000 households of EAP-eligible applicants. The project allowed WAP personnel to continue serving WAP-eligible households during pandemic restrictions and accomplished foundational work for future low-income solar projects. The results of the SRAP assessment of low-income residences will be used to prioritize sites for solar PV installations, given available funding, to broaden access to solar energy for low-income Minnesotans beyond the current WAP pilot program.

### *Strategies for Increasing Access to Solar for LMI Households*

From 2016-2020, Commerce focused numerous efforts on reducing barriers to solar for low-income Minnesotans targeting funding for low-income solar projects, working collaboratively to develop and launch a model low-income solar incentive program, collaborate with national organizations to expand access to community solar gardens, develop a solar + weatherization effort, explore alternative financing mechanisms, and expand outreach and data gathering.

A few highlights from this period include:

- **Develop a Model Income-Eligible Solar Program:** Xcel Energy, in partnership with Commerce and multiple stakeholders developed an Income-Qualified Solar*Rewards program to better assist eligible low-income customers in accessing solar. In 2019, over $2.3 million was reserved for 55 qualified projects, with installation of over 1.5 MW (DC) of solar. Minnesota Power recently added their own Low-Income Solar Program to offer grant funding for solar installation of 40 kW or less.
- **Expand Access to Community Solar Gardens:** The Department was selected by the National Association of State Energy Officials (NASEO) and the National Energy Assistance Directors' Association (NEADA) in late 2020 as a state partner in the Inclusive Shared Solar Initiative (ISSI). ISSI, a partnership between NASEO, NEADA, and NYSERDA (NY State Energy Research and Development Authority), is designed to support development of innovative models which reduce hurdles and increase accessibility for low-income participants. Work will commence in early 2021.
- **Identify and Expand Opportunities by Targeting Funds for Income-Eligible Projects:** The Department was able to leverage funds to provide grants for LMI solar projects statewide, including:
    - **Ecolibrium3 Lincoln Park Solar Garden** located in an urban Duluth neighborhood historically home to numerous environmental injustices and which is currently undergoing a four-year interstate highway reconstruction. Revenues from this CSG energy generation will be shared between Minnesota Assistance Council of Veterans / Veterans' Place transitional housing and with the Emergency Energy Fund, used to protect low-income families from utility disconnect; while serving as a park, garden, art, and community gathering space.
    - **Solar for Humanity Project**: Two Solar for Habitat income-qualified residential projects – one, a veteran's home in St. Cloud, Minn., and the other, an Iron Range family in Crosby, Minn. – were made possible, supporting a partnership between Central Minnesota Habitat for Humanity, Lakes Area Habitat for Humanity, the Rural Renewable Energy Alliance, and REAL Solar. In addition to

reducing the energy burden for the homeowners, these demonstration projects will be used for educational purposes.

- **Solar Training Project:** 8th Fire Solar is a Solar Thermal Air Furnace manufacturing company owned and operated by White Earth Band of Ojibwe tribal members. Two solar air furnace installation workshops were held in late fall of 2020 to train and certify 10 tribal members as solar thermal air furnace installers, with participants coming from Leech Lake Band of Ojibwe and Bois Forte Band of Chippewa. These training seminars, and the increased size of the pool of certified solar air furnace installers, have increased 8th Fire's ability to market their products and increase their ability to take advantage of potential market opportunities as these opportunities arise.
- **Fond du Lac Gitigaaning Farm Solar PV project**: The Fond du Lac Band of Lake Superior Chippewa installed 5.5 kW of solar PV at their Gitigaaning Food Sovereignty Farm. The Farm is a community training center built around teaching food sovereignty and sustainable living for tribal members, providing self-sufficiency training and support to lessen tribal member's daily cost of living expenditures. The value of the energy offset will allow the Farm to shift the cost savings to additional community training programs at the Farm.

### *Connecting Low-Income Communities to Efficiency and Renewable Sources*

The Clean Energy for Low-Income Communities Accelerator (CELICA) was a voluntary partnership between U.S. Department of Energy and state and local governments to lower the energy burdens of low-income communities.[33] CELICA supported states in examining energy equity, requiring quantitative goals for reducing the energy burdens of low- and moderate-income households via increased use of renewable energy and efficiency improvements. Through the CELICA and a U.S. DOE Solar Technologies Office (SETO) grant via the Clean Energy States Alliance, Commerce and partners, launched a state-based initiative in 2017known as Connecting Low-Income Communities through Efficiency and Renewable Sources (CLICERS) Through this initiative, Commerce performed data and gap analysis, stakeholder engagement, and one-on-one interviews, as well as reviews of literature and best practices. The initiative resulted in collaboration with other states participating in CELICA and the CESA grant, and engagement with other low-income programs managed by Commerce, including WAP, EAP, and the Conservation Improvement Program (CIP).

Through the CLICERS initiative, five barriers were identified in preventing increased use of renewable energy in low- and moderate-income (LMI) communities. From there, the Commerce-led team developed an action plan with short and long-term strategies to address these barriers:[34]

### *LMI Barriers to Solar*

- Accessing community solar garden (CSG) subscriptions is more difficult for income-qualified households;
- Accessing on-site solar incentive programs is more difficult among income-eligible households;
- Housing types among income qualified households often limit access to renewables;
- Needs greatly exceed funding, causing competition for limited resources; and
- Integration, awareness, and availability of services is inconsistent statewide.

## Manufactured Homes

In fiscal year 2019, 17% of the WAP household units weatherized were manufactured homes. Commerce funded a 2016 Conservation Applied Research and Development (CARD) project titled "Minnesota Manufactured Homes Characterization and Performance Baseline Survey."[35] After analysis of the 80,000 manufactured homes in Minnesota at the time, the findings indicated that 45% of these households were income-qualified to receive weatherization services, and they carry a high energy burden. In addition, 40% of the households reported using portable space heaters to augment their primary heat sources. The 2016 analysis found that energy efficiency and weatherization could cost-effectively reduce annual energy bills in manufactured homes by 25%.

The procedures WAP uses to insulate manufactured homes were changed in 2017, increasing potential energy bill savings for Minnesota's manufactured housing residents.

*Energy efficiency and weatherization could cost-effectively reduce annual energy bills in manufactured homes by 25%.*

## Renters

Weatherization assistance is available through WAP to both homeowners and renters alike. Annually, 16% of the homes weatherized under Minnesota's program are rentals, while overall, rental households make up approximately 25% of the households statewide.[36] Successful weatherization projects for rental units require joint alignment and cooperation among landlords and tenants, and often the parties have different incentives regarding weatherization assistance. Additionally, complex program requirements apply to weatherizing large multi-family buildings, which comprise most urban rental housing.

The Minnesota WAP program seeks to increase the number of rental units weatherized. The lower-than-desired rental participation rate is an energy-equity issue, because members of under-resourced communities are more likely to be apartment renters than single-family homeowners. For example, according to the Minnesota Housing Partnership, years of discrimination in housing policies, real estate, and lending practices have resulted in Minnesotans who identify as African-American being less than one-third as likely to own a home as those who identify as white.[37]

## Workforce opportunities

Minnesota WAP service providers face a continual challenge to maintain a workforce of experienced weatherization and mechanical contractors, electricians, energy auditors, and quality-control inspectors (QCI). While WAP has earned and maintained a reputation for doing high-quality work, complying with quality-control standards and federal and State program requirements results in additional burdens for independent contractors working with WAP households vs. other housing clients. WAP has access to many high-quality and committed contractors, auditors, and QCIs, but an expanded workforce is needed in each discipline. These trades all have good job growth potential as WAP expands to reach additional homes. In much of greater Minnesota, for example, the number of electricians overall is low, which means few electricians participate in WAP. This is especially problematic as further expansion of low-income solar is considered; more electricians will be needed in Greater Minnesota with experience and knowledge on wiring new PV installations to help households throughout the state gain access to renewable energy opportunities.

**References – Chapter 5**

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[2] As defined in Minn. Stat. 216B.241 subd. 1 (g), "gross annual retail sales" exclude sales to CIP-exempt customers.
[3] Minn. Stat. 216B.241 subd. 1c (d) allows the Commissioner to adjust a public utility's savings goal to a minimum of 1.0%.
[4] Minnesota Statute §216B.241 Energy Conservation Improvement
[5] "B3 Sustainable Building 2030 Energy Standards," SB 20230 Energy Standards website, (*accessed Jan. 19, 2021*).
[6] See Chapter 4 for further information about building codes and standards related to energy resources.
[7] Calculation uses an average total annual energy consumption per home of 95.2 MMBtu for very cold/cold climate region from Table CE3.3 in 2015 Residential Energy Consumption Survey: Energy Consumption and Expenditures Tables, U.S. Energy Information Administration, May 2018.
[8] Used an electric $CO_2$ emissions rate of 1,183 pounds of $CO_2$/MWh for 2018 and 1,220 pounds of $CO_2$/MWh for 2017. Previous years utilize a rate of 1,823 pounds of $CO_2$ per MWh (2009 through 2012), 1,437/MWh (2013 through 2014), 1,419/MWh (2015), and 1,220/MWh (2016) of electricity saved. Applied a gas $CO_2$ emissions rate equal to 117 pounds of $CO_2$/Dth for years 2014 through 2018. Previous years used a rate of 121 pounds of $CO_2$ per Dth of natural gas saved (2009 through 2013). See U.S. Environmental Protection Agency Emissions & Generation Resource Integrated Database (2020); EPA Greenhouse Gas Equivalencies Calculator (2020); and How Much Carbon Dioxide is Produced When Different Fuels Are Burned?, U.S. EPA (2020).
[9] A $6.35 and $6.43 price of natural gas (Dth) in Minnesota for 2017 and 2018 was derived by calculating a weighted average price of natural gas in the residential, commercial, and industrial sectors. See U.S. EIA Natural Gas Price History, and U.S. EIA Natural Gas Consumption by End Use, 2014 through 2018. Calculations used average electricity prices of 10.27 and 10.37 cents per kWh in Minnesota during 2017 and 2018, respectively. See U.S. EIA Minnesota State Electricity Profile, 2019.
[10] *Ibid.,* Cadmus 2020
[11] *Technical Reference Manual,* Minnesota Minn. Dept. of Commerce website (*accessed Jan. 19, 2021*).
[12] Clean Energy Resource Teams website, (*accessed Jan. 19, 2021*).
[13] "Minnesota 2019 Fuel-Switching Stakeholder Process," Burr Energy LLC website, (*accessed Jan. 19, 2021*).
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[15] "Electrification Action Plan," Michaels Energy website (*accessed Jan. 19, 2021*).
[16] Hoffman, Ian M. *et al. The Cost of Saving Electricity Through Energy Efficiency Programs Funded by Utility Customers: 2009–2015*, Berkeley Lab, June 2018.
[17] "Roadmap to a Minnesota Codes & Standards Program," project website, Minnesota Department of Commerce, 2050 Partners, Slipstream, LHB Corp., Midwest Energy Efficiency Alliance (*accessed Jan. 19, 2021*).
[18] *Minnesota Energy Efficiency Potential Study: 2020–2029*, Conservation Applied Research and Development final report prepared by the Center for Energy and Environment, Optimal Energy and Seventhwave for the Minnesota Department of Commerce, Division of Energy Resources, Dec. 4, 2018.
[19] "Daily Electricity Demand Impacts from COVID-19 Mitigation Efforts Differ by Region," *Today in Energy*, May 7, 2020, U.S. Energy Information Administration (*accessed Jan. 19, 2021*).
[20] Energy burden generally means the total energy burden for a household, combining the burden accruing from the electrical load and the burden accruing from heating sources, but not including the burden from transportation energy.
[21] Understanding Energy Affordability, American Council for an Energy Efficient Economy, 2019.
[22] Low-Income households under WAP are households with household income at or below 200% of the federal poverty level.
[23] Low-Income Energy Affordability Tool, U.S. DOE Office of Energy Efficiency and Renewable Energy (*accessed Jan. 31, 2021*).

[24] LIHEAP Performance Management Database, Energy Burden Before and After Receiving LIHEAP – Fiscal Year 2018 report, U.S. Department of Health and Human Services (*accessed Feb. 1, 2021*).
[25] One-third of the EAP benefits paid out in EAP Program Year 2019 went to recipients in the Twin Cities area.
[26] Households residing in manufactured housing represented 10% of EAP-eligible applications in Program Year 2019. Households in site-built single-family homes comprised 50% of the applications, and apartment dwellers represented 25% of the applications.
[27] Applications from Native American households make up 5% of EAP applications annually.
[28] U.S. Code 42 Part A – Weatherization Assistance for Low-Income Persons
[29] Minnesota Statutes §216C.05
[30] The minimum SIR required for work to proceed is 1.0.
[31] Weatherization work must be complete or in progress before the solar PV array can be installed.
[32] Estimating the Health Benefits per-Kilowatt Hour of Energy Efficiency and Renewable Energy, U.S. Environmental Protection Agency (*accessed Jan. 31, 2021*)
[33] Clean Energy for Low Income Communities, U.S. DOE Better Buildings Solutions Center website (accessed Feb. 4, 2021).
[34] Strategic Solar Actions for Income-Eligible Minnesota Households, Minn. Dept. of Commerce, June 29, 2018.
[35] Minnesota Manufactured Homes Characterization and Performance Baseline Survey, Prepared by Seventhwave for Minn. Dept. of Commerce, Oct. 20, 2016.
[36] State of the State's Housing 2019: Biennial Report of the Minnesota Housing Partnership
[37] 2017 Minnesota Statewide Health Assessment p. 29, Minn. Dept. of Health, updated February 2019.

# Chapter 6: Renewable Energy in Minnesota

Several key State programs and policies encourage renewable energy development and use in Minnesota. The Next Generation Energy Act of 2007 established state policies for increasing the proportion of renewable energy consumption, increasing energy efficiency measures, and reducing greenhouse gas (GHG) emissions.

### *More renewables:*

- Goal of 25% of total energy consumption from renewable sources by 2025 (Minn. Statutes §216C.05); and
- Renewable Electricity Standard (Minn. Statutes §216B.1691), requiring 30% by 2020 for Xcel energy and 25% by 2025 for other electric utilities.

### *More efficiency:*

Efficiency and conservation requirements (Minn. Statutes §216B.241) reduce the denominator for reaching the percent of energy consumed from renewable sources set by state goals.

- 1.5% energy savings per year for electric utilities; and
- 1% energy savings per year for gas utilities.

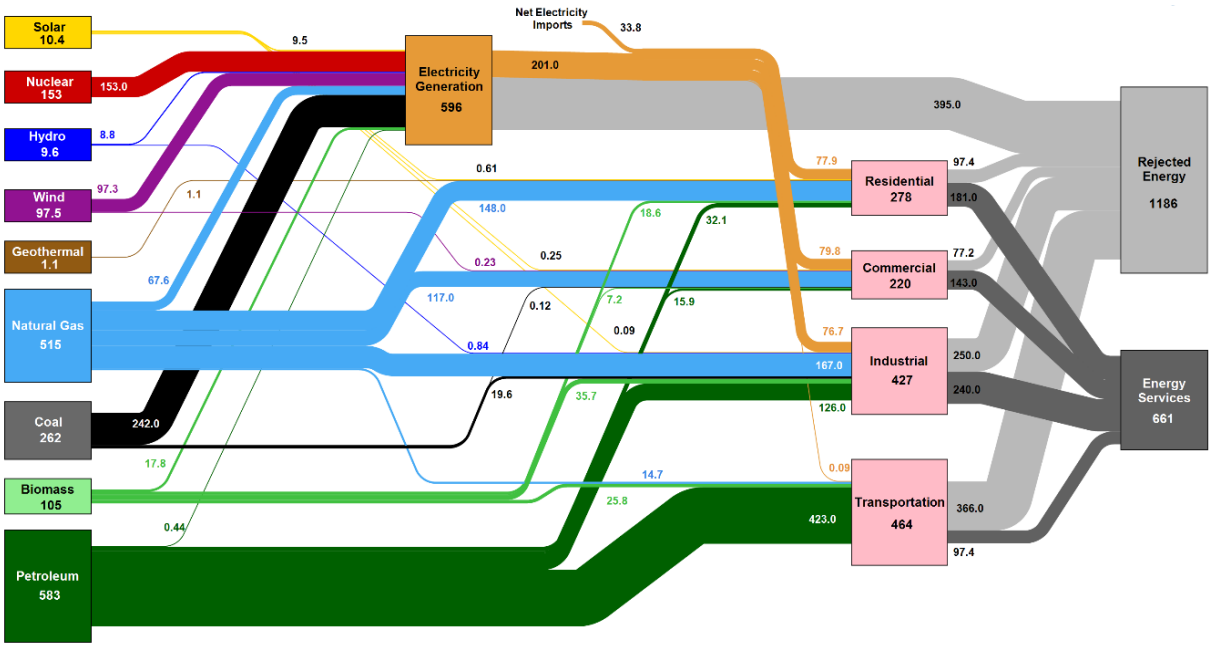
### *Less carbon:*

Greenhouse gas emissions reduction goals (Minn. Statutes §216H.02) set increasing GHG reduction goals compared to 2005 emissions levels:

- 15% by 2015;
- 30% by 2025; and
- 80% by 2050.

## *Total Energy Consumption from Renewable Sources*

Minnesota has no indigenous fossil fuel reserves to supply its energy needs, however, Minnesota has an abundant supply of wind, solar, and bio-based energy. Minnesota ranks among the top five in the nation in ethanol production capacity, according to U.S. Energy Information Administration data. In addition, Minnesota ranks among the top 10 states in electricity generation from wind, and renewable resources continue to make up an increasing share of the state's energy supply.

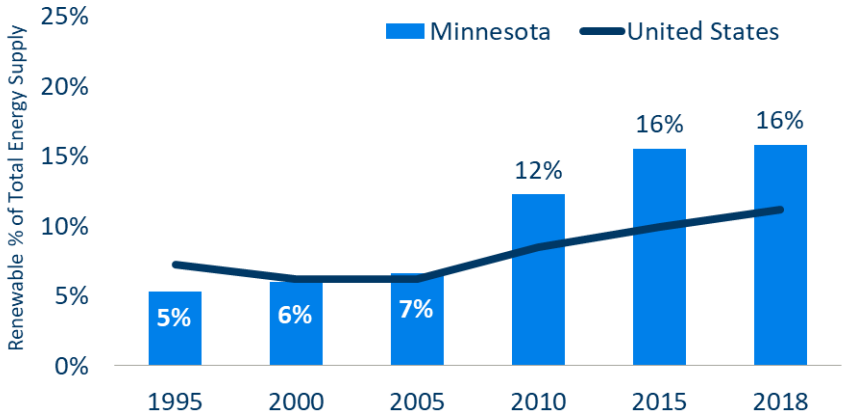



## Figure 6-A: Minnesota Energy Flow

Figure 6-A illustrates Minnesota's energy use and shows how energy flows from primary fuel sources, through energy use by sector, to losses due to system inefficiencies. Notably, more than half of the energy that is produced in the state is wasted due to system inefficiencies, rendering only 42.3 percent of the energy produced useful. The figure is based on Minnesota's estimated 2018 energy consumption (1,847 Trillion Btu).

*Source: Lawrence Livermore National Laboratory and U.S. Department of Energy*[1]

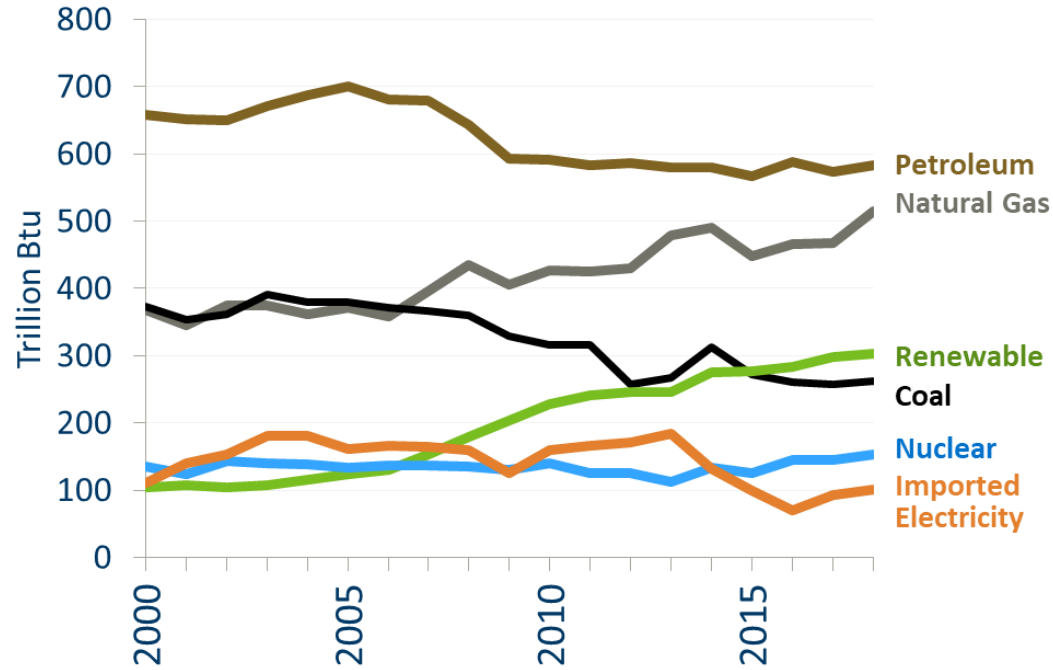
Renewable energy consumed for heating and electricity generation in Minnesota comes primarily from wind, wood, ethanol, and by-products of ethanol production re-purposed as an industrial energy source (Figure 6-E). In 2018, 16% of the total energy consumed in Minnesota came from renewable sources, compared with a United States average of 11% renewable consumption (Figure 6-B). Minnesota is at risk of missing the State's goal of 25% of total energy consumption from renewable sources by 2025, but reaching this goal could be possible with a long-term decrease in total energy consumption or a 5% to 10% increase in renewable energy consumption.




## Figure 6-B: Renewables as % of Minnesota's Total Energy Supply (1995 – 2018)

Figure 6-B shows the percentage of Minnesota's total energy supply derived from renewable sources compared to the national average, during the period from 1995 through 2018. Minnesota's renewable percentage roughly tracked the national average from 2000 to 2005, in the 6% to 7% range, after which the renewable share of the state's energy grew faster than the national average.

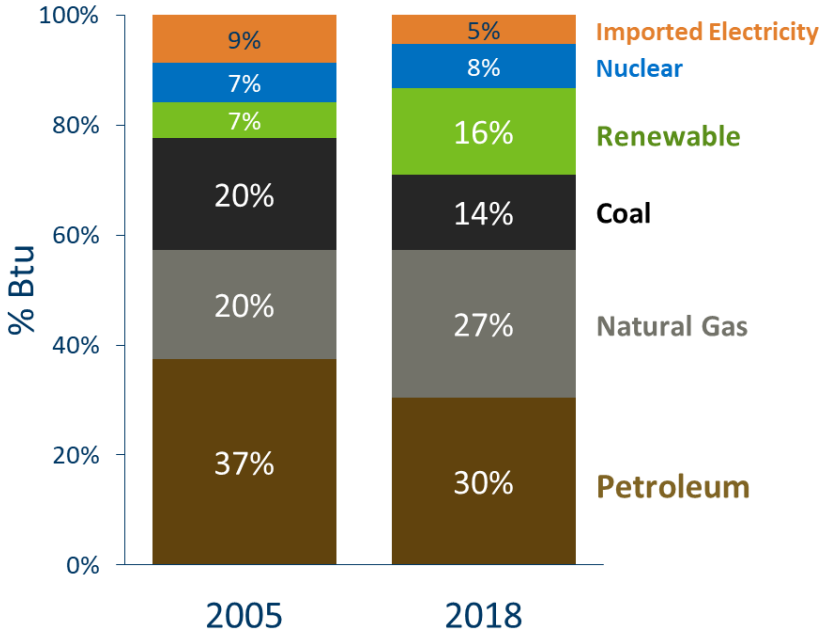
*Source: U.S. Energy Information Administration*




## Figure 6-C: Minnesota Total Energy Consumption by Source (2008 – 2018)

Figure 6-C illustrates Minnesota's total energy consumption by source, from 2008 through 2018. Trend lines show declining consumption of petroleum and coal and increasing use of natural gas and renewable energy.

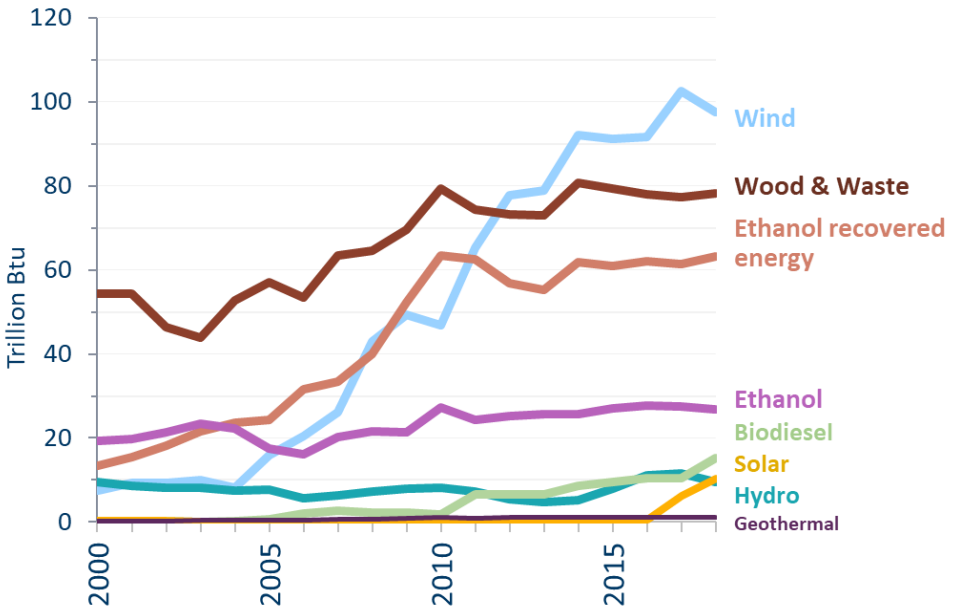
*Source: U.S. Energy Information Administration*




## Figure 6-D: Minnesota Total Energy Consumption by Source (% Btu) (2005–2018)

Figure 6-D compares the percentage by source of total energy consumed in Minnesota, for the years 2005 and 2018. Renewables' share of energy consumed grew from 7% to 16%, while natural gas grew from 20% to 27%, while coal's share declined from 20% to 14%, and petroleum declined from 37% to 30%.

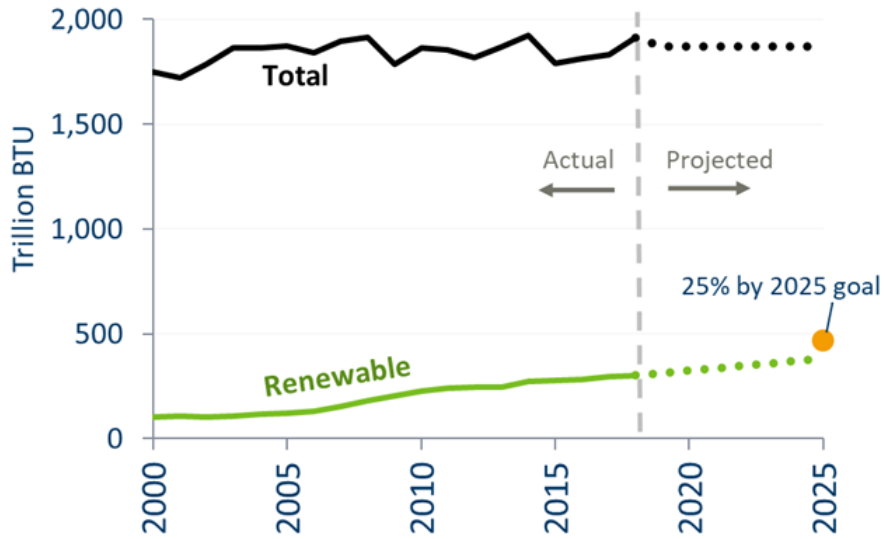
*Source: U.S. Energy Information Administration*




## Figure 6-E: Minnesota Total Energy Consumption by Renewable Source (2000 – 2018)

Figure 6-E illustrates Minnesota's total renewable energy consumption by source, from 2000 through 2018. Wood and waste fueled the largest share of the state's renewable consumption until 2012, when wind took the lead.

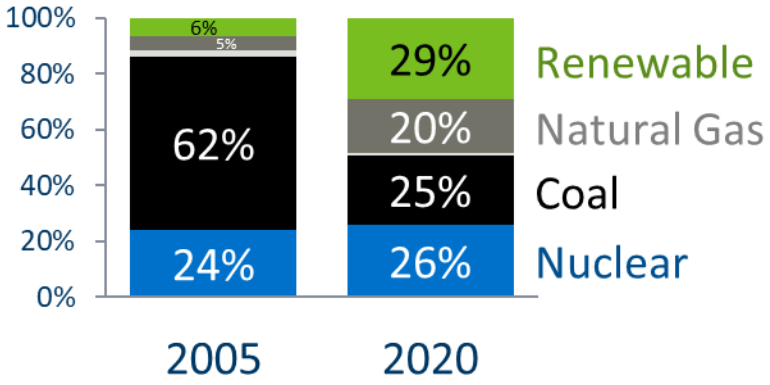
*Source: U.S. Energy Information Administration*




## Figure 6-F: Minnesota's Total Energy Consumption from Renewables – Actual and Projected (2000 – 2025)

Figure 6-F illustrates that if the current trend continues, Minnesota is at risk of missing the State's goal of 25% of total energy consumption from renewable sources by 2025.

Since 2016, Minnesota has made significant progress to increase the proportion of renewable energy in electricity generation. Preliminary data for 2020 shows that Minnesota may be at a pivot point where renewable energy is becoming the primary source of electricity generated within the state. Utilities have met their statutory milestones through 2019 and are on track to meet or exceed their 2025 targets.[2,3]




## Figure 6-G: Electricity Generated in Minnesota (2005 vs. 2020)

As Figure 6-G illustrates, Minnesota has reduced reliance on fossil fuels and increased use of renewable sources. Between 2005 and 2019, electricity generated within Minnesota from renewable sources increased four-fold, from 6% of electricity generated in 2005 to 29% in 2020. The 2020 percentage figures are based on preliminary monthly data through December 2020.

*Source: U.S. Energy Information Administration.*

Minnesota has not reached its goal of reducing emissions 15% by 2015, and is not on track to meet the next goal of reducing emissions 30% by 2030. The Minnesota Pollution Control Agency's Greenhouse Gas Inventory finds that between 2005 and 2018, Minnesota has only seen a modest decrease in total GHG emissions: an approximately 8% reduction overall.[4] This modest overall decline is driven largely by

significant emissions reductions from electricity generation. Other sectors have seen emission increases or small emission decreases relative to the 2005 baseline. The trend in emissions indicates Minnesota will not meet its Next Generation Energy Act goals without significant action in all sectors.

Prior to 2016, electricity generation was the largest source of GHG emissions in Minnesota. Starting in 2016 and continuing through 2018, emissions from electricity generation (including imported and in-state generation) declined to become a close second to emissions from transportation. Minnesota continues to see excellent progress in reducing emissions from electricity generation because of the increase in renewable electricity and reduction in coal-fired electricity.[5]

A 2019 report by the Minnesota Department of Transportation provided recommendations on how to decarbonize transportation in Minnesota while supporting the bipartisan Next Generation Energy Act (NGEA) of 2007.[6] Multiple scenarios were modeled as strategies to reduce transportation carbon pollution:

1. Improve vehicle efficiency – *e.g.,* promote driving vehicles that pollute less per mile and driving fewer miles each year, especially in urban and suburban areas with transit, walking, and biking options;
2. Increase vehicle electrification – *e.g.,* promote sales of light, medium, and heavy-duty of EVs;
3. Use more low-carbon fuels – *e.g.,* support development of advanced biofuels, and use cleaner electricity for transportation; and
4. Stop using mobile refrigerants with high global warming potential (GWP) – *e.g.,* support federal regulation of refrigerants with high GWP12.

The report also provided detail on recommendations generated through technical expert and stakeholder engagement, including the following:

- Find Integrated Solutions
- Build an EV Market and Provide More EV Options
- Promote Biofuels to Reduce GHG Emissions and Support Rural Minnesota
- Fund EV Infrastructure
- Provide EV Incentives
- Provide More Transportation Options on Projects

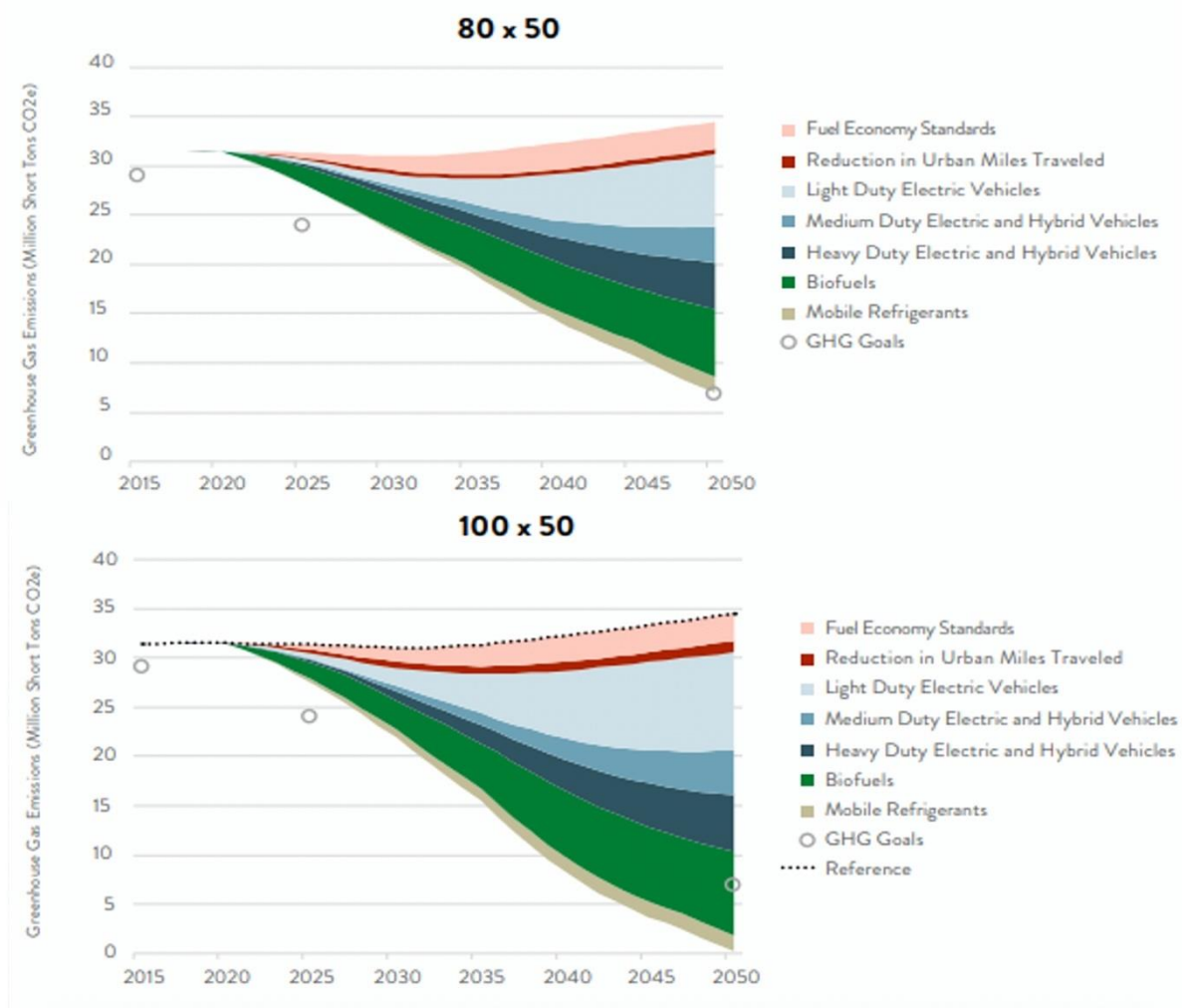



**Figure 6-H: Reducing Transportation GHGs by 2050 – 80% and 100% Scenarios**

Figure 6-H illustrates how improvements in vehicle efficiency, electrification, mobile refrigerants, and use of low-carbon fuels could be combined to reduce transportation GHG emissions 80% and 100% by 2050. The key difference is that under the 80% scenario, the largest GHG reductions would come from electrifying light-duty vehicles, whereas under the 100% scenario substantial reductions would be needed in all types of surface transportation.

*Source: Minnesota Department of Transportation*

# *Biofuels*

Biofuels are important tools for achieving Minnesota's renewable energy development and GHG reduction goals. Biofuels primarily include ethanol and biodiesel, and now increasingly compressed renewable natural gas. Enabling legislation promotes renewable liquid fuels under Minn. Stat. §239.7911, which set petroleum replacement goals of 25% for 2020 and 30% for 2025. Also, §239.791 created a biofuels content mandate and §297.77 created a content mandate for biodiesel.

An August 2019 report from the Minnesota Department of Transportation described how biofuels could be used in the transition to electric vehicles fueled by renewable grid energy. "Biofuels are important for Minnesota and modeling showed that action is needed across all vehicle classes and sectors, including increased use of biofuels, to achieve the state's NGEA GHG goals," the report stated.[7]

In September 2019, Gov. Walz signed Executive Order 19-35 establishing the Governor's Council on Biofuels, in part to recommend policies that accelerate Minnesota's petroleum replacement goals, and that utilize biofuels to help achieve GHG reduction goals under the NGEA.[8] On Nov. 2, 2020, the council published a report making several recommendations, including new infrastructure for E15 and mid-level blends, biodiesel, and other biofuels. The council also suggested policies for increasing the use of biofuels in the State fleet.[9]

Minnesota remains one of the top five ethanol-producing states in the country, according to the latest EIA data.[10] The state's 19 fuel ethanol production plants use corn as a feedstock. Ethanol use has increased along with more widespread availability of E15 gasoline, which includes up to 15% ethanol. The Minnesota Department of Agriculture has managed two grant programs totaling $17.11 million for ethanol infrastructure, such as storage tanks and fuel pumps that can deliver E15 and other higher blends of ethanol. In May 2020, the federal government introduced the Higher Blends Infrastructure Incentive Program (HBIIP), offering $100 million in funding for activities to expand the sale and use of ethanol and biodiesel fuels.[11]

## Renewable Natural Gas

Renewable natural gas (RNG) is pipeline-quality gas, sometimes called upgraded biogas or biomethane, produced from biomass sources using a biochemical process.[12] Some Minnesota utilities are pursuing RNG programs, where the gas is sourced primarily from landfill methane capture.

*The PUC approved CenterPoint Energy's plan to create a renewable natural gas supply system, interconnecting prospective producers with its distribution network.*

Public discussion of RNG began intensifying in 2018. CenterPoint Energy filed a green tariff proposal with the PUC in August of that year that would give customers the option of purchasing RNG produced from livestock manure or organic landfill waste.[13] The PUC unanimously rejected the proposal in July 2019, citing concerns about the increased cost to ratepayers with even a voluntary program, but urged CenterPoint Energy to continue working on the concept.[14] In November 2020, the PUC approved CenterPoint Energy's plan to create an RNG supply system in the state, interconnecting prospective producers with its distribution network.[15]

Early in 2020, CenterPoint Energy backed State legislation that would allow natural gas utilities to add alternative fuels such as RNG to their distribution systems. The Minnesota State Senate passed the Natural Gas Innovation Act in May 2020, but the House did not take action prior to adjourning.[16] The legislation is expected to be reintroduced in 2021.[17]

In May 2020, Xcel Energy issued a request for information to identify the locations and cost of capturing and purifying RNG, and injecting it into the natural gas pipeline for use in customers' homes and businesses across the Upper Midwest and Colorado.[18] At that time, Xcel Energy planned to explore the development of a voluntary RNG customer program.

# *Renewable Electricity*

The percentage of electricity generated from renewables within state borders is an indicator of progress on the renewable electricity standard, but not a direct measure. Minnesota consumes more electricity than is generated in-state and imports electricity from both renewable and non-renewable sources. Accordingly, the percentage of renewable energy in retail electricity sold and delivered to consumers does not equate to the amount of renewable electricity generated in Minnesota.

Between 2005 and 2020, the percentage of renewable electricity generated within the state's borders increased from 6% to 29%, while the percentage of coal decreased from 62% to 25%. In 2020, the total electricity generated in Minnesota decreased 5% from 2019 levels. In-state electricity generation from renewable sources came primarily from wind (21.6%), followed by solar (3.1%), biomass (2.1%), and hydropower (2.0%) in 2020.

EIA data show that Minnesota's percentage of renewable-powered electricity is higher than the national average. At the same time, the state uses more coal for electricity generation than the national average, but coal-powered electricity is declining at a rate similar to the national average. (Refer to Chapter 4 for more information about Minnesota's electricity resource mix.)

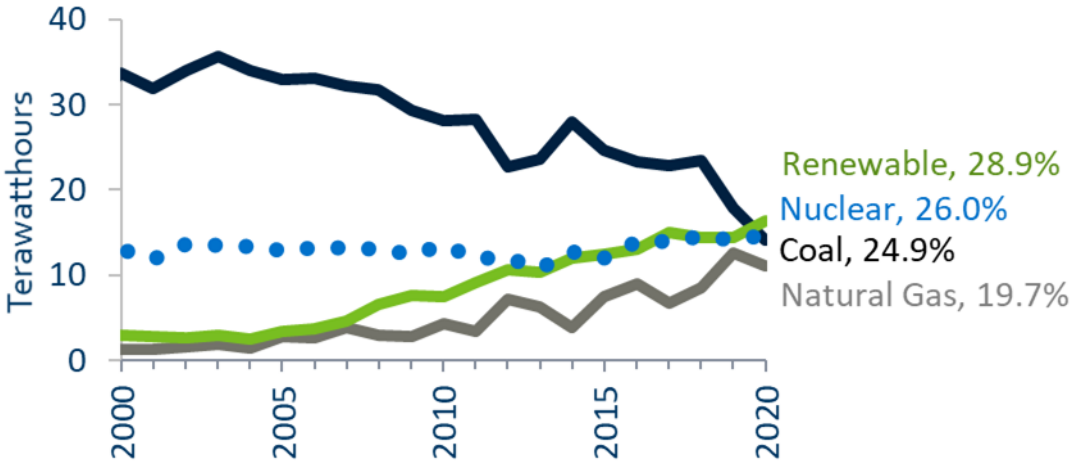



**Figure 6-I: Minnesota Electricity Generation by Source (2000 – 2020)**

Figure 6-I shows how fuel sources for electricity generation in Minnesota have changed from the years 2000 through 2020.

*Source: U.S. Energy Information Administration*

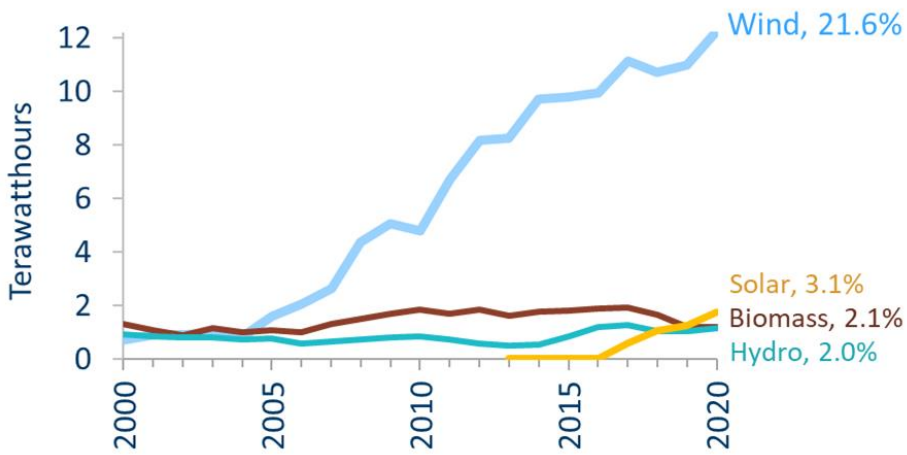



**Figure 6-J: Minnesota Renewable Electricity Generation by Source (2000 – 2020)**

Figure 6-J shows changes in Minnesota's renewable electricity generation from 2000 through 2020. The trend lines show rapid growth in wind power generation starting in about 2005, and solar generation starting in 2016, while biomass and hydro sources remained relatively flat during most of the period. The 2020 percentage figures are based on preliminary monthly data through December 2020.

*Source: U.S. Energy Information Administration*

## Green Pricing Programs

Minnesota's voluntary green pricing program gives consumers the option of purchasing renewable energy beyond the minimum standard set by the state. By paying a premium on their electricity bill, consumers support increased development of renewable energy projects and reduce their reliance on fossil fuels. Increased use of renewable energy sources also benefits the local economy and improves Minnesota's energy security.

Commerce regulates green pricing programs (Minn. Stat. §216B.169) in the state to protect consumer interests. Renewable energy procured on behalf of green pricing customers cannot be sold twice or counted toward any state's Renewable Energy Standard. Utilities must report on renewable energy procured for green pricing customers to verify that green pricing sales do not exceed green pricing generation. Utilities record RECs for green pricing generation in the Midwest Renewable Energy Tracking System to verify compliance and ensure that the energy is not double-counted.

## Renewable Electricity Standards

Renewable energy objectives are codified in Minn. Stat. §216B.1691, which defines eligible energy technology as coming from the following renewable energy sources: solar, wind, hydroelectric with a capacity of less than 100 MW, hydrogen produced from renewable sources, and biomass. In 2007 the statute was amended to establish a renewable electricity standard with mandated goals that began in 2010. As of Dec. 10, 2020, 16 generation and transmission utilities in are subject to the RES.[19,20]

The standard requires utilities to ensure that a minimum percentage of their total retail electric sales to retail customers in the state is generated by eligible energy technologies by the end of the specified year: 12% by 2012, 17% by 2016, 20% by 2020, and 25% by 2025. However, any electric utility that owned a nuclear generating facility as of Jan. 1, 2007, is required to meet these percentages: 15% by 2010, 18% by 2012, 25% by 2016, and 30% by 2020. Only Xcel falls into this category due to its ownership of the Prairie Island and Monticello nuclear facilities.[21]

The statute required the PUC to establish a trading system for renewable energy credits, also called renewable energy certificates (REC), to track compliance with the RES. In 2007 the PUC adopted the Midwest Renewable Energy Tracking System (M-RETS), where each certificate represents all the non-energy attributes of 1 MWh of electricity generated by a power producer.[22] Since 2009, Minnesota utilities register renewable energy systems in the M-RETS, track renewable generation from those facilities in the form of RECs, and retire RECs to demonstrate compliance with the renewable energy standard.

*What are RECs?*

Once energy is added to the grid, renewable electrons cannot be distinguished from electrons generated from fossil fuels. However, when renewable electricity is generated, it can be metered to track two valuable components – the electricity itself and its renewable aspect. Renewable Energy Credits (REC) allow tracking and verification of the environmental attributes associated with renewable energy. Utilities and other energy providers are required to procure and retire RECs each year to demonstrate compliance with the Minnesota Renewable Energy Standard (RES).

Utilities may petition the PUC for the modification or delay of a RES requirement, but none have done so to date. According to the most recent compliance filing on June 8, 2020, all utilities subject to the RES have met the annual requirements.

| Utility | Compliance through year (2016 Reporting) | Compliance through year (2018 Reporting) | Compliance through year (2020 Reporting) |
|---|---|---|---|
| Great River Energy | 2026 | 2039 | 2055 |
| Minnesota Power | 2049 | 2053 | 2053 |
| Heartland Power District | 2029 | 2045 | 2044 |
| Dairyland Power Cooperative | 2025 | 2030 | 2040 |
| Southern MN Municipal Power Agency | 2021 | 2040 | 2040 |
| Xcel Energy | 2024 | 2040 | 2040 |
| Central MN Municipal Power Agency (CMMPA) | 2028 | 2028 | 2033 |
| Basin Electric | 2025 | 2030 | 2030 |
| Otter Tail Power Company | 2025 | 2034 | 2028 |
| East River Power Cooperative | 2025 | 2025 | 2025 |
| Minnkota Power Cooperative | 2025 | 2025 | 2025 |
| L&O Power Cooperative | 2025 | 2025 | 2023 |
| Minnesota Municipal Power Agency (MMPA) | 2020 | 2020 | 2023 |
| Southern Minnesota Electric Cooperative (SMEC) | 2016 | 2019 | 2023 |
| Missouri River Energy Services (MRES) | 2019 | 2020 | 2021 |

## Figure 6-K: Utility Renewable Electricity Standard Compliance Outlook

In even-numbered years, utilities are required to report on the estimated year that they can continue to comply with the RES using existing and planned resources. Figure 6-K shows the change in utilities' reported estimates from 2016 through 2020. Most utilities have secured sufficient resources to achieve compliance through the mid-2020s, with some prepared for compliance through the 2030s, '40s, and '50s.[23]

Biomass-fueled power plants provide a small portion of Minnesota's renewable electricity. Under the RES, the definition of biomass includes gaseous biofuels – such as landfill gas and anaerobic digester gas

– as well as organic components of wastewater effluent from publicly owned treatment works (but not sludge incineration), and municipal solid waste (MSW) and refuse-derived fuels from mixed MSW.

The biomass statute has been amended numerous times over the past 25 years, including amendments allowing or requiring different fuel sources and specific generating facilities. In 2017 the Legislature passed an amendment allowing Xcel Energy to petition the Commission for approval of a new or amended PPA, the early termination of a PPA, or the purchase and closure of certain biomass facilities.[24] In December 2017, the PUC approved Xcel's proposed contract buy-outs, based on estimated savings for ratepayers.[25,26]

## Solar Electricity Standards

Solar energy is a significant and growing resource for electric power generation in Minnesota. In 2013 the State amended the RES that had been codified by Minn. Stat. §216B.1691 to include a solar electricity standard (SES). Three investor-owned utilities are subject to the SES: Minnesota Power, Otter Tail Power Co., and Xcel Energy. The SES requires that by the end of 2020 these utilities must obtain 1.5% of retail electricity sales from solar energy, and 10% by 2030.

Initially, the SES included a 10% carve-out for small-scale solar PV projects with a capacity under 20 kW. The Minnesota Legislature increased that to 40 kW for all utilities subject to the standard. By law, a public utility with 50,000 and 200,000 retail electric customers must meet at least 10% of the 1.5% goal with solar energy from devices that have a nameplate capacity of 40 kW or less.

Cooperative and municipal utilities are excluded from the SES requirements. In addition, for the 1.5% calculation, the statute excludes retail sales to iron mining extraction and processing facility customers as well as paper mills, wood products manufacturers, sawmills, and oriented strand board manufacturers.

The three utilities subject to the SES have pursued different paths to meeting their solar requirements. Minnesota Power and Xcel have either built or acquired power purchase agreements from utility-scale solar facilities. Otter Tail Power continues to evaluate utility-scale projects. In the meantime, the utility purchased solar renewable energy credits (SREC) to meet its 2020 compliance requirement.

## Community Solar Gardens and Value of Solar

In 2013, Minnesota became the first state in the country to establish a statewide methodology for calculating the value of solar energy through amendments to Minn. Stat. §216B.164. State law allows utilities to voluntarily use the value of solar (VOS) tariff in lieu of net metering.[27,28]

Under a VOS rate, utilities would use a formula to reimburse solar generators for their power output.[29] The law required the Department of Commerce to develop a methodology for calculating a VOS rate to compensate owners of distributed solar PV generation for the value that generation produces for the utility, its customers, and society. On April 1, 2014, the PUC approved Commerce's proposed methodology.[30,31]

The 2013 Legislature also enacted Minn. Stat. §216B.1641 requiring Xcel Energy to establish a community solar garden (CSG) program. This allows utility retail customers who might not otherwise have the ability to install solar panels on their property to subscribe to output from a ground-mounted or rooftop-mounted PV system. Subscribers receive credits on their bills, and the utility may apply subscriptions of 40 kW or less toward the 10% SES goal.

The legislation required that Xcel establish a CSG program using VOS as a bill credit rate or, until that rate for the utility was approved by the Commission, the applicable retail rate. In early 2014, the PUC approved Xcel's new program. Since a VOS calculation had not been approved at that point, Xcel began accepting applications in December 2014 with compensation at the applicable retail rate (ARR).

To date, no electric utility has requested approval to use a VOS tariff in place of net metering for qualifying facilities. However, effective for 2017 and beyond, the PUC required Xcel to use a VOS rate for compensating customers in conjunction with its CSG program. [32] The VOS rate is updated each year and reviewed and approved by the PUC.

Xcel and the PUC continue working with stakeholders to refine Xcel's CSG program. Ongoing issues include annual rate changes, criteria to determine size limits for program eligibility, and grid interconnection requirements. At the end of the third quarter 2020, Xcel reported that its solar garden program had 337 projects completed with 739 MW of connected solar garden capacity online, and 423 active project applications.[33]

| | ARR | | | | VOS* | | | |
|---|---|---|---|---|---|---|---|---|
| | **Residential** | **Small General Service** | **General Service** | **Other** | **Residential** | **Small General Service** | **General Service** | **Other** |
| **# of Subscriptions** | 19,903 | 1,185 | 1,449 | 472 | 35 | 99 | 241 | 47 |
| **# of Subscribers** | 19,188 | 309 | 597 | 159 | 35 | 43 | 138 | 19 |
| **DC Capacity Allocation (kW)** | 131,940 | 10,713 | 755,688 | 17,405 | 507 | 2,288 | 132,475 | 3,610 |
| **AC Monthly May Production Allocation (kWh)** | 18,851,903 | 1,505,704 | 105,739,549 | 2,466,544 | 79,563 | 328,281 | 19,342,302 | 528,007 |
| **August Bill Credits** | $2,933,620 | $220,611 | $13,292,210 | $318,438 | $4,019 | $16,265 | $969,455 | $26,472 |

## Figure 6-L: Subscription Metrics (ARR vs. VOS)

Figure 6-L shows Xcel Energy's completed solar gardens and participation under applicable retail rates (ARR) compared to value-of-solar (VOS) tariffs. As of August 2020, most of the completed solar gardens were operating under ARR.

**Xcel reported no active solar gardens receiving the 2019 VOS rate as of October 2020.[34]*

| **Service Type** | **2019 ARR** |
|---|---|
| Residential | $0.15583 |
| Small GS | $0.14509 |
| General Service | $0.12405 |

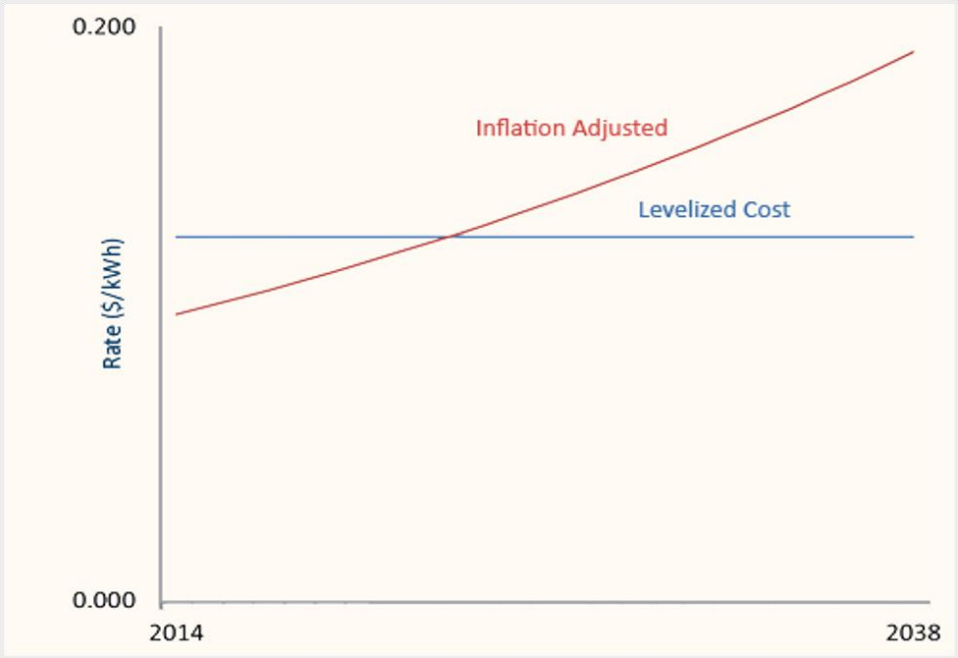
## Figure 6-M: Xcel Energy Applicable Retail Rate (Pre-2017 applications)

Figure 6-M shows Xcel Energy's current applicable retail rate (ARR) for solar garden (CSG) applications approved before 2017. While the ARR is differentiated by class – residential, small general service, and general service – a single value-of-solar (VOS) rate applies to all CSG subscribers irrespective of class.

| Year | Levelized VOS | 1st year VOS credit |
|---|---|---|
| 2017 | $0.1275 | $0.1033 |
| 2018 | $0.1202 | $0.0976 |
| 2019 | $0.1109 | $0.0904 |

## Figure 6-N: Xcel Energy VOS Rates by year

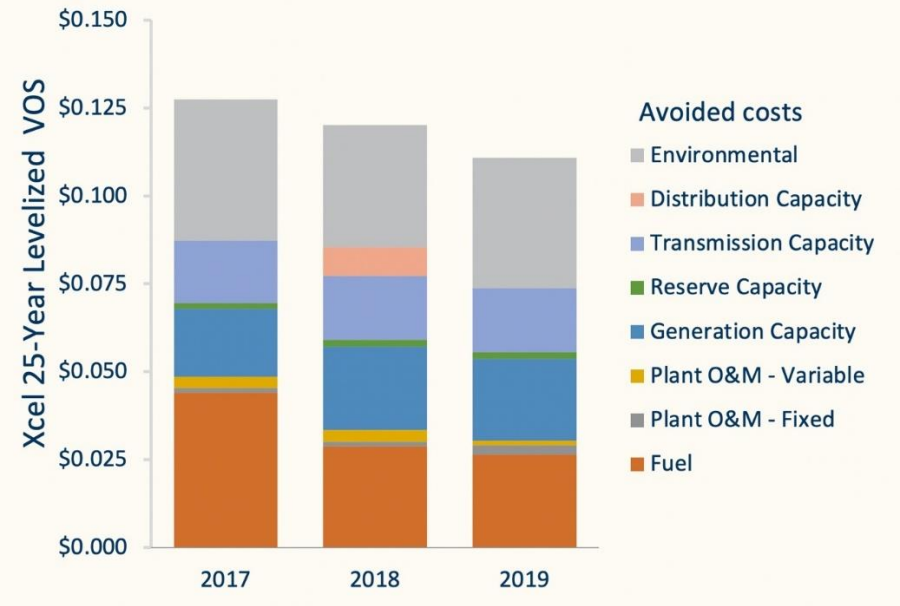
Figure 6-N summarizes the levelized and first-year VOS payment rates for Xcel Energy.[35] VOS rates declined from 12.75 cents in 2017 to 11.09 cents in 2019, with first-year VOS credits declining from 10.33 cents to 9.04 cents.




## Figure 6-O: Inflation-Adjusted VOS (Example)

Figure 6-O illustrates the inflation-adjusted value of solar from 2014 through 2038. The utility converts the levelized VOS rate to a 25-year annual credit payment schedule that is adjusted for inflation.

The VOS methodology is intended to calculate the value of distributed solar electricity to the utility, ratepayers, and society. The components of the VOS include the following avoided costs: fuel, O&M, generation capacity, reserve capacity, transmission capacity, distribution capacity, and environmental costs.




## Figure 6-P: Xcel Energy Value-of-Solar Rates by Year

Figure 7 summarizes the value-of-solar component values for 2017 through 2019.

| VOS Component 25 Year Levelized Values ($/kWh) | 2017 | 2018 | 2019 |
|---|---|---|---|
| Fuel | $0.0441 | $0.0288 | $0.0265 |
| Plant O&M - Fixed | $0.0013 | $0.0013 | $0.0025 |
| Plant O&M - Variable | $0.0032 | $0.0033 | $0.0014 |
| Generation Capacity | $0.0194 | $0.0237 | $0.0232 |
| Reserve Capacity | $0.0015 | $0.0019 | $0.0019 |
| Transmission Capacity | $0.0178 | $0.0182 | $0.0183 |
| Distribution Capacity | $0.0000 | $0.0082 | $0.0000 |
| Environmental | $0.0402 | $0.0348 | $0.0371 |
| Voltage Control | | | |
| Solar Integration | | | |
| **VOS Rate** | **$0.1275** | **$0.1202** | **$0.1109** |

## Figure 6-Q: Xcel Energy Value-of-Solar Components ($/MWh)

Figure 6-Q quantifies the value-of-solar component values for 2017 through 2019. Reductions in avoided fuel cost have resulted in a reduction in the value-of-solar rate from 2017 to 2019.

## Minnesota Solar Pathways Initiative

The Minnesota Solar Pathways initiative, funded in part by the U.S. Department of Energy (DOE) Solar Energy Technologies Office (SETO), was a three-year project designed to explore least-risk, best-value strategies for meeting the State of Minnesota's solar goals.[36] As part of this aim, the Pathways project

team modeled renewable generation costs, examined ways to streamline interconnection, and evaluated technologies that can increase solar hosting capacity on the distribution grid.

The Solar Capacity Analysis explored the cost effectiveness of scenarios with extra solar and wind capacity Installed within Minnesota to ensure sufficient generation when solar or wind resources are low - such as a cloudy hot week in the summer or during a polar vortex when the wind calms down.

A second solar potential analysis scenario (SPA-MISO) expanded to the entire MISO region was completed for the Pathways project on September 30, 2020. The SPA-MISO found that the cost of 95% renewable generation by 2050 could be equivalent to present-day wholesale electricity pricing, or $30 per megawatt-hour. The analysis also showed that it can be cheaper to add extra capacity of solar and wind facilities and curtail surplus renewable production, than to size just enough generation capacity and storage to meet energy needs. National models indicate that excess zero-margin electricity could create opportunities for thermal storage, renewable hydrogen, ammonia, and other chemicals produced with renewable energy.[37]

in addition to technical analysis, the Pathways project created and supported a variety of partnerships to address key issues, particularly involving siting, and identified strategies that help meet Minnesota's solar electricity goals.

## Changing Economics for Solar and Wind


## Figure 6-R: Levelized Cost of Electricity – Unsubsidized Comparison

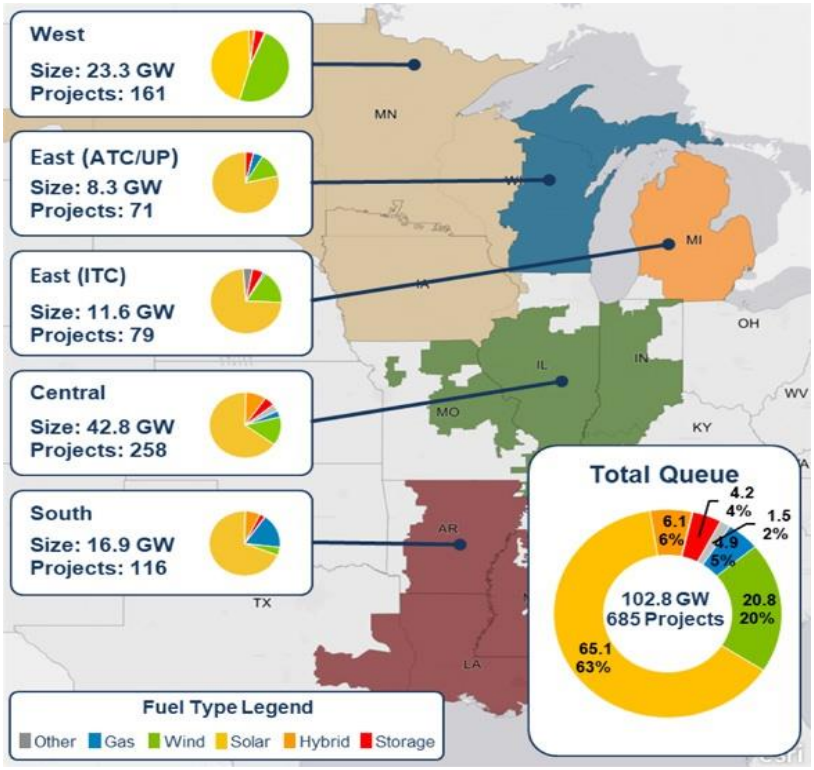
Figure 6-R illustrates the levelized cost of unsubsidized energy from various energy sources. The analysis shows that some renewable generation technologies are cost-competitive with conventional generation under certain circumstances. For details about this analysis, including explanatory notes, see the Lazard Levelized Cost of Energy and Storage Report.[38]

*Source: Lazard*

## Figure 6-S: MISO Active Queue by Study Area

Figure 6-S illustrates the share of various energy resources in the Midcontinent Independent System Operator (MISO) interconnection queue for five regions. The interconnection queue represents new generation projects seeking utility interconnection approvals, and projects a dramatic expansion of wind and solar PV in Minnesota and neighboring states. Of 102.8 gigawatts of queued capacity, 65.1 GW or 63% is comprised of solar projects, with another 20.8 GW or 20% represented by wind power proposals.

*Source: MISO Generator Interconnection Overview, Jan. 1, 2021.*




## Figure 6-T: MISO Queue – Historical Trend

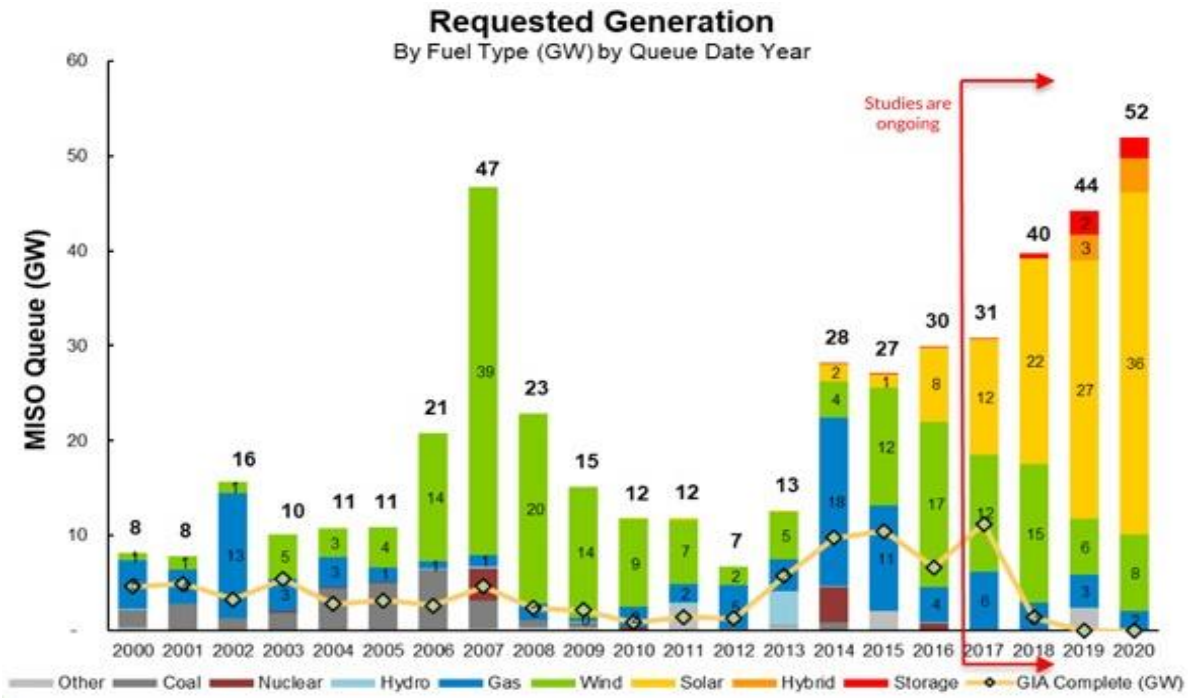



Figure 6-T illustrates interconnection queue trends in the Midcontinent Independent System Operator (MISO) grid from 2000 through 2020. Wind projects dominated in the late 2000s, and natural gas surged in 2014 and 2015, after which wind and increasingly solar projects dominated the queue.

*Source: MISO Generator Interconnection Overview, Jan. 1, 2021.*

### *Wind*

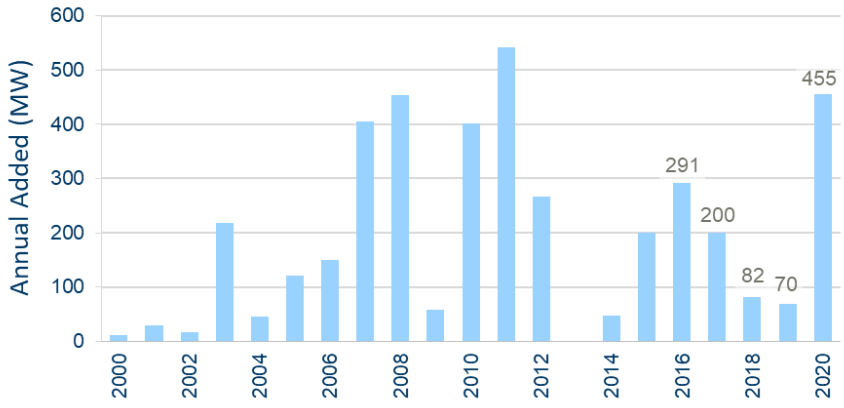
Minnesota has the advantage of winds moving unobstructed across broad southern prairies. Additionally, the Buffalo Ridge geologic formation causes strong and steady winds in the southwestern portion of the state. In 2020, wind supplied 19% of the state's net electricity generation, according to EIA, which also placed Minnesota in the top 10 states nationwide for installed generating capacity and net generation from wind.[39]

Technological advancements and declining wind prices have made wind generation at favorable resource sites economically competitive with coal and natural gas generation. Minnesota embraced wind energy early on, and several companies based in the state have since become national leaders in the industry. They include the construction companies Mortenson in Golden Valley and Blattner Energy in Avon, and the wind turbine component transporter Anderson Trucking Service (ATS) based in St. Cloud.[40,41,42]

New wind capacity in the state has been driven by planned coal plant retirements as well as extensions of the federal production tax credit (PTC).[43] Regionally, wind energy growth also was facilitated by the 800 mile-long CapX2020 transmission project, completed in September 2017, one of the largest energy infrastructure investments in Minnesota history.[44]

Wind prices continue declining, resulting in additional wind deployment above and beyond the amounts necessary to meet the RES requirement. Nationally, the average levelized price of wind has fallen from approximately $40 per MWh in the mid-1990s to less than $20 per MWh in 2018.[45] Wind is the lowest-cost resource for new capacity, with solar close behind. Lazard's annual levelized cost of energy analysis showed in 2020 that onshore wind maintained competitiveness with the marginal cost of conventional generation technologies.[46] Minnesota's wind resources are among those on the lowest end of the range reflected in Lazard's analysis.

Increasingly, wind is being chosen over natural gas generation facilities in resource planning scenarios. In addition, the combination of declining natural gas and wind prices has encouraged utilities to limit coal generation facilities' operation to annual peak demand periods, or to retire them altogether. By the end of 2020, Minnesota had a total installed wind capacity of 4,310 MW.[47]

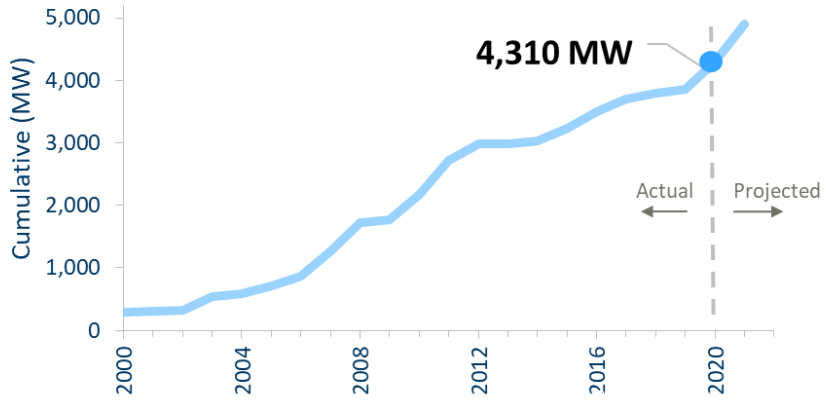



## Figure 6-U: Minnesota Annual Wind Installations (2000 – 2020)

Figure 6-U shows the amount of wind power generating capacity added per year from 2000 through the end of 2020.

*Source: Minnesota Department of Commerce*

In December 2020, Minnesota Power activated the Nobles 2 wind farm, bringing the utility's owned and contracted wind power to around 870 MW and increasing the utility's percentage of electricity from renewable sources to 50% – which includes 250 MW of hydropower from Manitoba Hydro, delivered via the Great Northern Transmission line that was completed in June 2020.[48] Minnesota Power became the first utility in the state to reach the 50% renewable milestone.



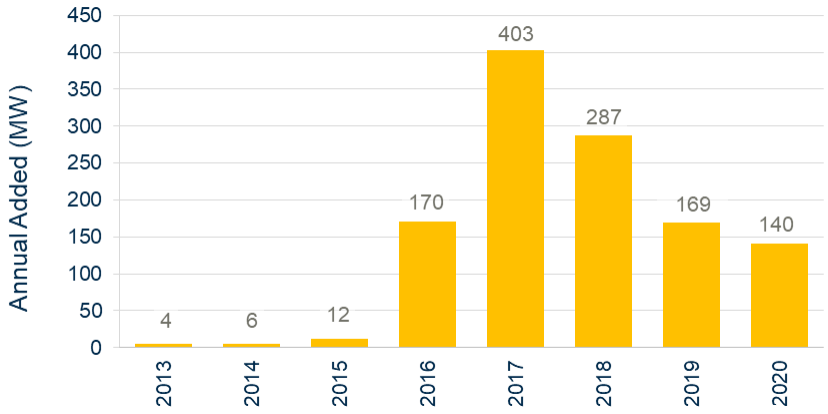

## Figure 6-V: Minnesota Wind Power Capacity (2000 – 2020)

Figure 6-V shows the annual growth of Minnesota wind power capacity from 2000 through the end of 2020. During this 20-year period, wind generation capacity grew from 283 MW to more than 4,300 MW. Growth is projected to continue at recent rates.

*Source: Minnesota Department of Commerce*

### *Solar*

Power generated from solar energy in the state has increased significantly in recent years. According to preliminary data from the EIA, in 2020, solar electricity accounted for nearly 3% of Minnesota's net generation, mainly from utility-scale facilities that have at least 1 MW of generating capacity.[49]




## Figure 6-W: Minnesota Annual Solar Installations (2013 – 2020)

Figure 6-W shows the annual solar power capacity added per year from 2013 through December 2020 (preliminary estimate).

*Source: Minnesota Department of Commerce*

Data from Commerce show that solar market activity in the state grew rapidly in 2017, adding 403 MWac of capacity compared to 170 MWac in 2016. The Solar Energy Industries Association (SEIA)

ranked Minnesota 15th for cumulative capacity, sixth for the largest state solar market, and third for largest non-residential solar market in 2017.[50] After a peak that year, solar capacity increased by 287 MWac in 2018 and 152 MWac in 2019. In 2020, preliminary data from Xcel Energy shows that developers added 140 MWac of community solar gardens for a total of more than 1,200 MWac as of December 2020 (based on preliminary estimates). Most of the installed capacity comes from community solar gardens in Xcel's territory.

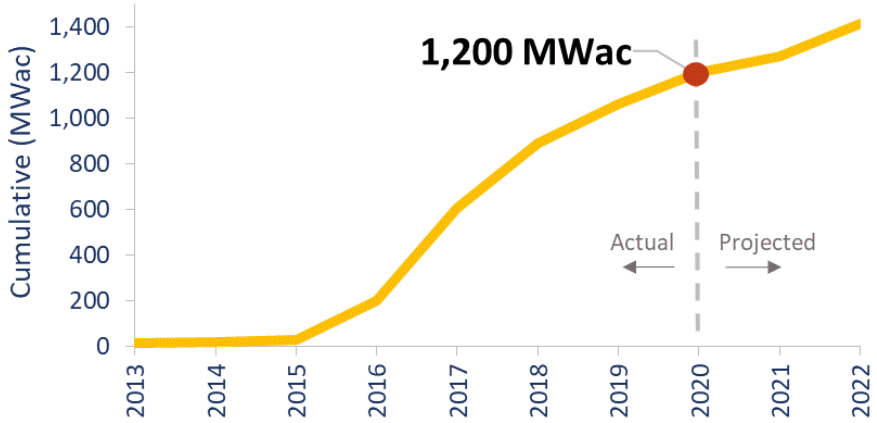



**Figure 6-X: Minnesota Solar Power Capacity (2013 – 2020)**

Figure 6-X shows the annual growth of solar power capacity from 2013 through the December 2020 (preliminary estimate). Growth is projected to continue at recent rates.

*Source: Minnesota Department of Commerce*

As with wind, the cost of solar energy has declined. Nationally, the installed price of solar fell from more than $5 per Watt in 2010 to $1.64 per Watt in 2018. Lazard's levelized cost analysis shows how both crystalline and thin-film utility-scale solar-PV technologies have become competitive with conventional generation technologies. In Minnesota, the SEIA found that solar prices dropped 45% over the past five years.

# Supply Chain Disruptions

## U.S. Trade Disputes

The Trump administration approved a tariff on solar components in 2018 as part of an intensifying trade dispute with China. For Minnesota, where the solar market had been growing dramatically since 2012, solar energy supporters in the state expressed concern that the tariff could create uncertainty for projects and increase the costs associated with solar installation.[51,52] In 2018, the administration also imposed 30% tariffs on imports of Canadian solar energy modules, prompting lawsuits and a request for review under the North American Free Trade Agreement.[53,54]

High tariffs prompted one Ontario-based solar panel manufacturer to move some of its manufacturing to Minnesota.[55] Tariff exemptions and federal moves to revoke them added to the uncertainty for solar manufacturing and installation companies.[56] The tariffs are set to expire in 2022, potentially influencing the availability of solar panels, wind turbines, and other generation components that, in turn, may affect renewable development efforts in Minnesota.[57]

### COVID-19

The pandemic caused widespread supply-chain disruptions and worker shortages that delayed the construction of some solar and wind power projects.[58] In response, the Internal Revenue Service issued a notice on May 27, 2020 extending the safe harbors for the renewable energy PTC and investment tax credit (ITC).[59] Specifically, projects that began construction in calendar year 2016 or 2017 will see the "Continuity Safe Harbor" extended from four years to five.[60]

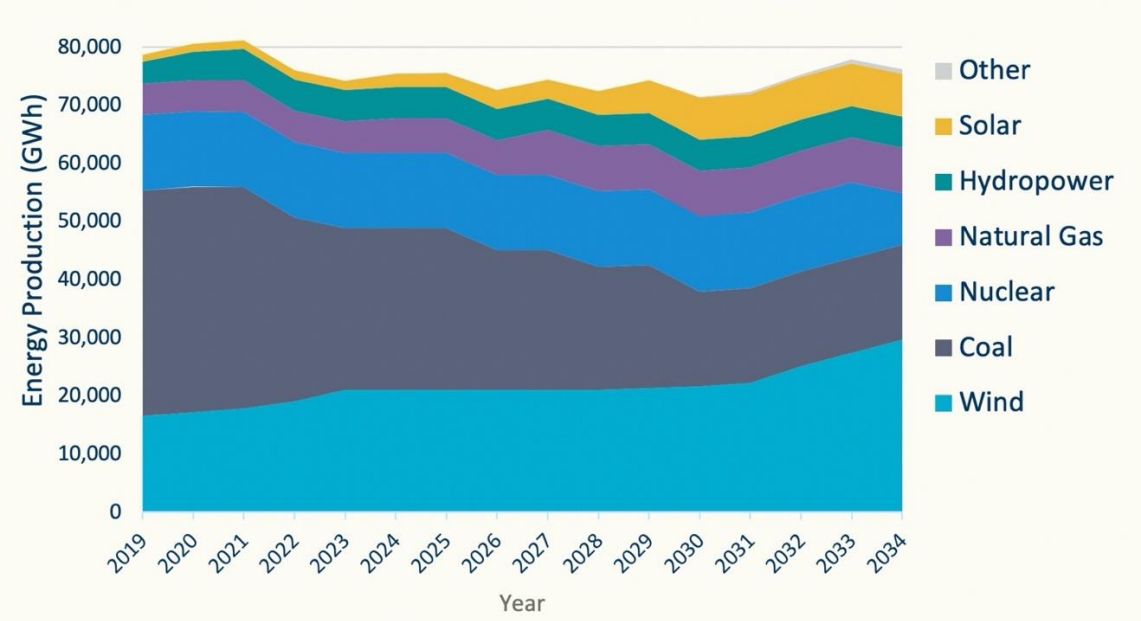
COVID also prompted factory shutdowns in China early in the pandemic, which led to supply chain problems that constrained solar supplies. However, in April the factories restarted production, creating excess capacity on the manufacturing side. Less expensive modules could benefit solar developers in the short term.[61] The pandemic's long-term effects on renewable energy projects in Minnesota remain unclear.

## Projections

Because the economics for solar power, wind power, and battery energy storage improved dramatically between 2016 and 2020, renewable generation is expected to continue growing rapidly in Minnesota and neighboring states. Looking ahead, Commerce expects new deployments of renewables and the ongoing retirement of coal generation facilities, despite recent international trade disputes and supply-chain disruptions during the pandemic.

Utility resource plans project that by 2034, coal-fired power will contribute only 10% of the total generating capacity, while wind will account for 34% and solar 16%. In addition to variable solar and wind capacity,[62] new firm dispatchable resources also likely will grow, including for example battery storage, demand response, and power plants burning renewable fuels or natural gas.

In terms of total electric energy production, coal-fueled generation is expected to decline to 22% by 2034. Natural gas-fired production is projected to rise slightly to 11% in 2034. During the same time frame, solar production is expected to grow to 11%, with wind production increasing to 36%.




## Figure 6-Y: Upper Midwest Electric Production by Resource (2020 – 2034)

Figure 6-Y depicts the Upper Midwest electric fuel mix through 2034, based on resource plans by four major Minnesota utilities. Coal's share of generation will shrink through 2030, while wind and solar produce a growing share of electric supplies.

*Sources: Xcel Energy, Minnesota Power, Otter Tail Power, and Great River Energy*

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# Appendix: Key to Acronyms

| Acronym | Definition |
|---|---|
| ASHRAE | American Society of Heating, Refrigerating and Air-Conditioning Engineers |
| B3 | Buildings, Benchmarks, and Beyond |
| Btu | British thermal units |
| CARD | Conservation Applied Research and Development |
| CEE | Center for Energy and Environment |
| CERT | Clean Energy Resource Teams |
| cf | cubic feet |
| CHP TAP | Combined Heat and Power Technical Assistance Partnership |
| CIP | Conservation Improvement Program |
| CPP | Clean Power Plan |
| CSG | community solar garden |
| CWRF | Clean Water Revolving Fund |
| DG | distributed generation |
| DOE | U.S. Department of Energy |
| DPS | Minnesota Department of Public Safety |
| Dth | dekatherms = 1 million Btu = the approximate energy content of 1,000 cf of natural gas |
| ECM | energy conservation measure |
| EO | Executive Order |
| ESCO | energy service company |
| ESP | Energy Savings Partnership |
| ESPC | energy savings performance contracting |
| EWG | Energy, Water, and Greenhouse Gas workgroup |
| FEMA | Federal Emergency Management Agency |
| FERC | Federal Energy Regulatory Commission |
| GESP | Guaranteed Energy Savings Program |
| GHG | greenhouse gas |
| HELP | Home Energy Loan Program |
| HSEM | Minnesota Division of Homeland Security and Emergency Management |
| IECC | International Energy Conservation Code |
| IGA | investment-grade audit |
| ITC | Investment Tax Credit |
| kBtu | kiloBtus = 1,000 Btus |
| LEEP | Local Energy Efficiency Program |
| LLR | Local Reliability Requirement |
| LoGoPEP | Local Government Project for Planning Energy |

| | |
|---|---|
| LTFM | Long Term Facilities Maintenance |
| LUG | local units of government |
| MDA | Minnesota Department of Agriculture |
| MISO | Midcontinent Independent System Operator |
| MMB | Minnesota Department of Management and Budget |
| MN DIP and DIA | Minnesota Distributed Energy Resources Interconnection Process and Agreement |
| MNTAP | Minnesota Technical Assistance |
| MPCA | Minnesota Pollution Control Agency |
| NERC | National Electrical Reliability Council |
| PACE | Property Assessed Clean Energy |
| PBEEEP | Public Buildings Enhanced Energy Efficiency Program |
| PFA | Minnesota Public Facilities Authority |
| PIMs | performance incentive metrics |
| PTC | Production Tax Credit |
| PUC | Minnesota Public Utilities Commission |
| RES | Renewable Energy Standard |
| RNG | renewable natural gas |
| SCC | social cost of carbon |
| SEO | State Energy Office |
| SEP | State Energy Program |
| SES | Solar Energy Standard |
| SWRDC | Southwest Regional Development Council |
| TIIR | technical interconnection and interoperability standards |
| TSRT | tribal-state relations training |
| TSM | technical specifications manual |
| VOS | value of solar |
| WWTP | wastewater treatment plant |
| ZNE | zero net energy |