

# **Generating Electricity: Minnesota's Changing Fuel Mix**

The fuels used to generate electricity in Minnesota have changed significantly since 2000. Propelled by advancing technologies, economics, and public policies, renewable fuels and natural gas have almost quintupled their share of the state's fuel generation mix, while coal's market share has fallen from two-thirds to under 40 percent. This information brief describes these changes, the forces driving them, and the outlook for future generation sources.

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## **Mixture of Fuels for Electricity Generation**

### **Minnesota's Electricity Fuel Generation Mix Has Changed Significantly Since 2000**

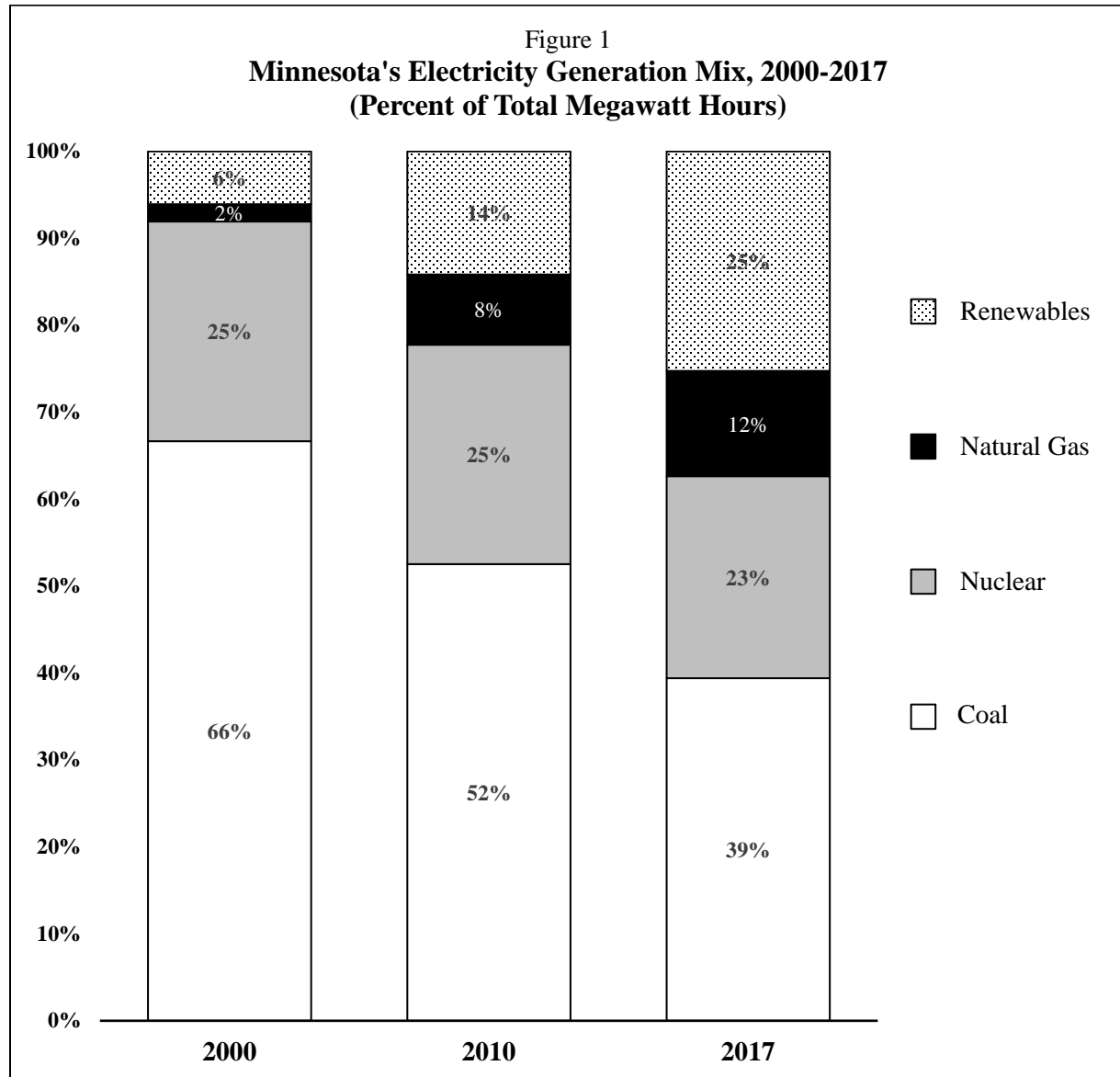
The mix of fuels that generates Minnesota's electricity supplies remained remarkably stable for a generation, but has changed significantly in the last decade.

From the mid-1970s through 2000, over 90 percent of the state's electricity was generated from a combination of coal and nuclear power, with the former supplying about two-thirds of the total. Other fuels, such as oil, natural gas, and renewables, played strictly minor roles.

That stability ended in the first decade of the 21<sup>st</sup> century, as shown in Figure 1. Coal's share of the mix fell 14 percentage points between 2000 and 2010, while the proportion of natural gas quadrupled to 8 percent, and the share of renewable fuels (wind, biomass, and solar) more than doubled to 14 percent. That trend has continued to accelerate. In 2017, coal's share fell below 40 percent, while renewables (mostly wind) provided 25 percent and natural gas accounted for 12 percent of the total.<sup>1</sup>

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<sup>1</sup> While these changes reflect national trends, Minnesota's electric generation profile continues to differ from the national average, which in 2016 stood at: coal, 30 percent; nuclear, 20 percent; natural gas, 32 percent; and renewables, 17 percent. U.S. Energy Information Administration, "Frequently Asked Questions: What is U.S. electricity generation by energy source?" [www.eia.gov/tools/faqs/faq.php?id=427&t=3](http://www.eia.gov/tools/faqs/faq.php?id=427&t=3).



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Source: Minnesota Department of Commerce, *Minnesota Renewable Energy Update*, 2015 and 2017

## Forces Driving the Changes

### New Technologies, Market Economics, and Public Policy Have Propelled These Changes

- **New drilling techniques greatly increased supplies of natural gas, lowering prices, while coal prices rose.** The development and spread of horizontal drilling and hydraulic fracturing methods in both oil and gas drilling resulted in a 50 percent increase in U.S. natural gas production between 2005 and 2015. As a result, the average price paid by

U.S. utilities for natural gas during this period decreased by 61 percent, while coal prices increased by 63 percent.<sup>2</sup>

- **Improvements to wind technology have increased the amount of energy generated by newer wind turbines, allowing areas with lower quality wind resources to be exploited.** Between 2006 and 2016, the nameplate capacity (maximum output) of wind turbines increased by 34 percent, the length of blades by 38 percent, and capacity factors—the ratio of energy generated to the amount of energy that would be generated if the system operated continuously at its maximum output level—by 33 percent. This increased productivity has resulted in declining prices per unit of output. Power purchase agreements between utilities and wind developers in the Plains region have fallen by approximately 64 percent (from approximately \$55/MWh to about \$20/MWh) between 2009 and 2016.<sup>3</sup>
- **Substantial declines in the cost of solar energy system components—including the importation of Chinese solar panels subsidized by that country's government—and increases in efficiency led to a reduction in the median installed price of utility-scale solar by about 60 percent between 2008 and 2015.**<sup>4</sup> These costs continue to fall: by 30 percent between Q1 2016 and Q1 2017, according to a National Renewable Energy Laboratory study.<sup>5</sup>
- **Federal and state financial subsidies for wind and solar energy have further reduced costs for those technologies.** Federal tax credits for solar systems reduce costs by about 20 percent. The federal production tax credit for wind lowers its cost by about 33 percent.<sup>6</sup>

Minnesota provided a subsidy of 1.5 cents per kilowatt-hour generated for 200 MW of wind development in 2004.<sup>7</sup> Two state programs—one initiated in 2010 and terminated in 2015, the other enacted in 2013 and terminated in 2017—subsidized solar panels manufactured in Minnesota and installed by residential and commercial customers

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<sup>2</sup> Natural gas supplies: U.S. Energy Information Administration, *U.S. Natural Gas Marketed Production*, [www.eia.gov/dnav/ng/hist/n9050us2A.htm](http://www.eia.gov/dnav/ng/hist/n9050us2A.htm). Prices: U.S. Energy Information Administration, *Electric Power Annual*, Table 7.4, [www.eia.gov/electricity/annual/html/epa\\_07\\_04.html](http://www.eia.gov/electricity/annual/html/epa_07_04.html). Coal prices are for subbituminous coal.

<sup>3</sup> U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, *2016 Wind Technologies Market Report*, pp. 26, 39, 59. At a meeting of Minnesota's Legislative Energy Commission held on September 14, 2017, an Xcel Energy representative testified that the company was paying \$15 to \$20 per MW for new wind projects.

<sup>4</sup> Mark Bolinger and Joachim Seel, *Utility-Scale Solar in 2015*, Lawrence Berkeley National Laboratory, August 2016, p. I, [https://emp.lbl.gov/sites/default/files/lbnl-1006037\\_report.pdf](https://emp.lbl.gov/sites/default/files/lbnl-1006037_report.pdf).

<sup>5</sup> Ran Fu et. al., *U.S. Solar Photovoltaic System Cost Benchmark: Q1 2017*, National Renewable Energy Laboratory, September 2017, Figure ES-1, p. vi, <https://www.nrel.gov/docs/fy2017osti/68925.pdf>.

<sup>6</sup> *Lazard's Levelized Cost of Energy Analysis – Version 10.0*, December 2016, p. 4. Both of these federal credits are being phased out. See fn. 22.

<sup>7</sup> *Minn. Stat. § 216C.41*. Minnesota's total wind capacity stood at 3,699 MW at the end of 2017, seventh highest among all states. American Wind Energy Association, <http://awea.files.cms-plus.com/FileDownloads/pdfs/Minnesota.pdf>.

generating electricity for their own use. A solar subsidy program initiated in 2013 applies only to residential and commercial customers of Xcel Energy.<sup>8</sup>

- **Minnesota's Renewable Energy Standard (enacted in 2007) and its Solar Energy Standard (enacted in 2013) require utilities to generate 25 percent of retail electricity sales from renewable energy sources by 2025 (30 percent by 2020 for Xcel Energy), and an additional 1.5 percent from solar energy by 2020.**<sup>9</sup> Utilities subject to this requirement have met, and in some cases exceeded, the interim 2016 target of 17 percent (25 percent for Xcel).
- **Federal environmental regulations reducing air and water pollution from coal-burning power plants have contributed to some utility decisions to retire coal plants rather than invest in pollution control equipment.**<sup>10</sup>
- **Electricity demand has been flat for a decade, forcing older and more expensive coal plants to compete against both cheaper natural gas plants and policy-mandated lower-cost renewable additions to the state's generating fleet in a static market.** Minnesota's electricity sales were lower in 2016 than in 2006.<sup>11</sup> Minimal demand growth is a result of a host of factors: price responses to rising retail electricity prices; increased efficiency of electricity-using appliances and lighting; Minnesota law requiring utilities to make energy efficiency investments that result in annual savings equal to 1.5 percent of retail sales.<sup>12</sup>

Minnesota utilities have responded to those forces, in part, by retiring coal-fired generating plants or converting them to natural gas, as shown in Table 1. Conversions to gas eliminated 1,219 MW of coal capacity, while past and announced retirements account for an additional 2,168 MW. Collectively, these plants represent about 29 percent of Minnesota's electric-generating capacity for all electric utilities in 2016.<sup>13</sup>

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<sup>8</sup> [Minn. Stat. §§ 116C.7791 and 216C.412-216C.415](#) (the terminated programs) and [§ 116C.7792](#).

<sup>9</sup> [Minn. Stat. § 216B.1691](#), subsds. 2a and 2f.

<sup>10</sup> Trevor Houser, Jason Bordoff, and Peter Marsters, Columbia University Center on Global Energy Policy, *Can Coal Make a Comeback?* April 2017, pp. 20-22, <http://energypolicy.columbia.edu/sites/default/files/energy/Center%20on%20Global%20Energy%20Policy%20Can%20Coal%20Make%20a%20Comeback%20April%202017.pdf>.

<sup>11</sup> U.S. Energy Information Administration, *Detailed State Data: Annual Data, 1990-2016, Retail Sales of Electricity by State by Sector (EIA-861)*, [www.eia.gov/electricity/data/state](http://www.eia.gov/electricity/data/state).

<sup>12</sup> [Minn. Stat. § 216B.241](#), subd. 1c.

<sup>13</sup> U.S. Energy Information Administration, *Minnesota Electricity Profile 2016*, <https://www.eia.gov/electricity/state/minnesota/>.

**Table 1  
 Coal Plants Converted to Natural Gas or  
 Scheduled for Retirement by Minnesota Utilities**

<b>Generating Plant</b>	<b>Utility</b>	<b>Year Built</b>	<b>Coal Capacity (MW)</b>	<b>Converted/Retired/Year</b>
Black Dog, Units 1 & 2	Xcel Energy	1952	176	Converted to natural gas/2002
Willmar Power Plant, Unit 1	Willmar Municipal Utilities	1949	4	Retired/2006
High Bridge Station	Xcel Energy	1923	243	Converted to natural gas/2008
Riverside Station	Xcel Energy	1911-1969	387	Converted to natural gas/2009
Austin Northeast	Austin Utilities	1971	32	Converted to natural gas/2012 Retired 2016
Laskin, Units 1 & 2	Minnesota Power	1953	110	Converted to natural gas/2015
Black Dog, Units 3 & 4	Xcel Energy	1955/1960	253	Idled 2015/Conversion to natural gas by 2019
Taconite Harbor, Unit 3	Minnesota Power	1967	75	Retired/2015
Silver Lake	Rochester Public Utilities	1949	100	Retired/2015
Stanton Station*	Great River Energy	1960	189	Retired/2017
Willmar Power Plant, Unit 3	Willmar Municipal Utilities	1970	18	Converted to natural gas/2018
Boswell, Units 1 & 2	Minnesota Power	1958/1960	140	Retirement scheduled/ 2018
Taconite Harbor, Units 1 & 2	Minnesota Power	1957	150	Idled 2016; retirement scheduled/2020
Hoot Lake	Otter Tail Power	1921-1964	148	Retirement scheduled/2021
Sherco, Unit 2	Xcel Energy	1977	682	Retirement scheduled/2023
Sherco, Unit 1	Xcel Energy	1976	680	Retirement scheduled/2026

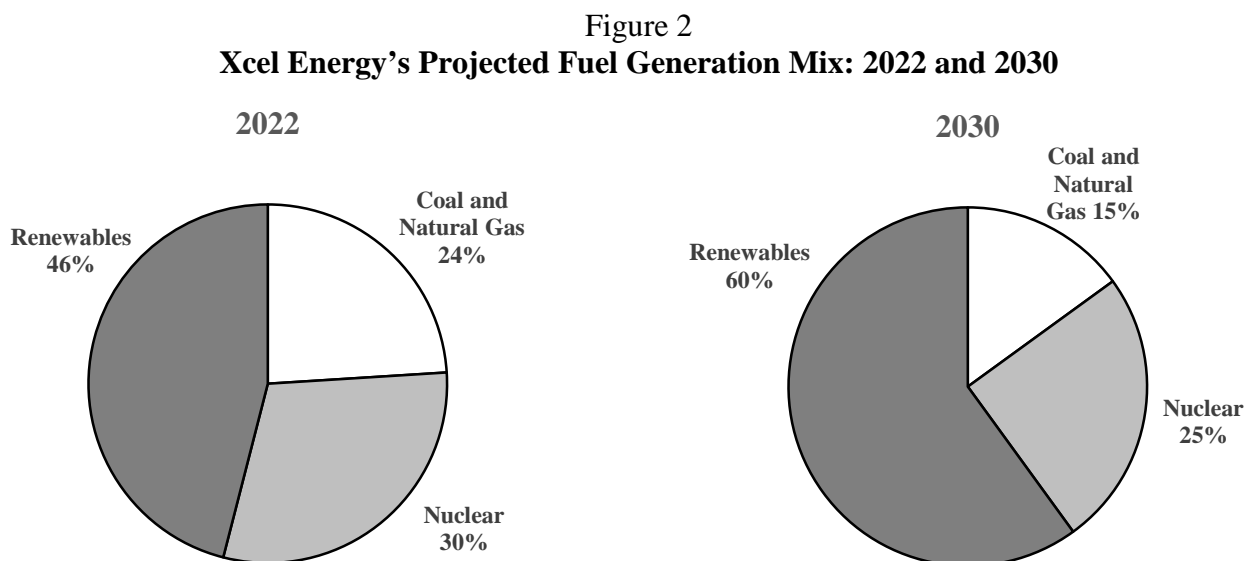
\* This plant is located in South Dakota.  
 Source: Minnesota Public Utilities Commission

## Medium-term Trends for Minnesota

### For Minnesota's Largest Utilities, These Trends Are Set to Continue

Minnesota's largest utilities plan to continue replacing fossil fuels with renewable energy sources in the coming decade, as reflected in their most recent Integrated Resource Plans and renewable targets they have voluntarily adopted that go well beyond the requirements of the state's Renewable Portfolio Standard.

The Integrated Resource Plans submitted to the Public Utilities Commission approximately every three years project how a utility will meet its customers' demands for electricity for the next 15 years. Xcel Energy, which accounts for half the state's retail electricity sales, satisfied about 24 percent of its demand from renewable resources (including hydropower) in 2015. The commission ordered the company to acquire at least 1,000 MW of wind by 2019 and 650 MW of solar by 2021, concluding that "the record clearly showed that acquisition of wind and possibly solar in the next five years represents the least-cost method of meeting Xcel's near-term resource needs."<sup>14</sup> In 2018, Xcel owned and purchased more than 2,600 MW of wind capacity in the region, and had specific plans to increase that portfolio by an additional 1,850 MW, a 70 percent rise.<sup>15</sup> As shown in Figure 2, as of 2018, the company projects renewables to account for 46 percent of its sales by 2022, and to represent 60 percent by 2030.<sup>16</sup>



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Source: Xcel Energy, *Xcel Energy Vision* slide show, 2018

<sup>14</sup> Minnesota Public Utilities Commission, In the Matter of Xcel Energy's 2016-2030 Integrated Resource Plan, *Order Approving Plan with Modifications and Establishing Requirements for Future Resource Plan Filings*, Docket No. E-002/RP-15-21, January 11, 2017, p.7.

<sup>15</sup> Xcel Energy, *Upper Midwest Wind Power*, [www.xcelenergy.com/energy\\_portfolio/renewable\\_energy/wind/upper\\_midwest\\_wind\\_power](http://www.xcelenergy.com/energy_portfolio/renewable_energy/wind/upper_midwest_wind_power).

<sup>16</sup> The 2022 breakdown is wind, 35 percent; solar, 2 percent; other renewables, 9 percent.

Minnesota Power achieved its 2025 Renewable Energy Standard goal of 25 percent ten years early.<sup>17</sup> The company's *EnergyForward* strategy contained in its 2015 Integrated Resource Plan proposed going beyond that level to a portfolio of one-third renewable resources, one-third coal, and one-third natural gas and other fuels. The commission's June 2016 *Order* called for the company to initiate a competitive bidding process for 100 to 300 MW of additional wind by the end of 2017 and up to 100 MW of solar by 2022, in addition to the 33 MW of solar that would fulfill its Solar Energy Standard target.<sup>18</sup> By 2018, Minnesota Power had increased its 2025 renewables target to 44 percent.<sup>19</sup>

The commission approved Otter Tail Power's 2017 Integrated Resource Plan that proposed adding 200 MW of wind and 30 MW of solar by 2020,<sup>20</sup> bringing the company's proportion of generation from renewable fuels to more than 26 percent. The commission also modified the company's plan to include an additional 100 to 200 MW of wind in the 2022-2023 timeframe, raising its renewable portfolio above 30 percent.

These trends are also evident among Minnesota's cooperative electric utilities. Great River Energy generates electricity that is sold to 28 member cooperatives that serve 685,000 Minnesota customers. The utility met its 2025 Renewable Energy Standard goal of 25 percent renewable energy in 2017. In 2018 its board of directors announced a commitment to achieve 50 percent renewable retail sales by 2030 through investing in an additional 500 megawatts of wind and contracting for 200 additional megawatts of hydroelectric power.<sup>21</sup>

## Factors Affecting Future Generation Sources

### Factors That May Affect Minnesota's Future Electricity Fuel Generation Mix

Minnesota's future sources of electric generation will continue to be determined by the interactions of technological change, economic competitiveness, and public policy. Among the factors to watch are the following:

- The tapering and termination of federal subsidies for solar and wind energy<sup>22</sup>

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<sup>17</sup> Minnesota Public Utilities Commission, In the Matter of Minnesota Power's 2016-2030 Integrated Resource Plan, *Minnesota Power's 2015 Integrated Resource Plan*, Docket No. E-015/RP-15-690, September 1, 2015, Appendix H, "Minnesota's Renewable Energy," p. 2.

<sup>18</sup> Minnesota Public Utilities Commission, In the Matter of Minnesota Power's 2016-2030 Integrated Resource Plan, *Order Approving Resource Plan With Modifications*, Docket No. E-015/RP-15-690, July 18, 2016, p. 15.

<sup>19</sup> [www.mnpower.com/energyforward](http://www.mnpower.com/energyforward).

<sup>20</sup> Minnesota Public Utilities Commission, In the Matter of Otter Tail Power Company's 2017-2031 Integrated Resource Plan, *Order Approving Plan with Modifications and Setting Requirements for Next Resource Plan*, Docket No. E-017/RP-16-386, April 26, 2017, pp. 3, 10.

<sup>21</sup> Frank Jossi, "Q&A: Great River Energy executive on utility's renewable pledge," *Energy News Network*, June 8, 2018, <https://energynews.us/2018/06/08/midwest/qa-great-river-energy-executive-on-utilities-renewable-pledge/>.

<sup>22</sup> The production tax credit for wind (originally set at 2.4 cents per kwh) is reduced by 20 percent each year for projects constructed in 2017 through 2019. The investment tax credit for wind (which may be elected in lieu of the



- The shelving of the federal Environmental Protection Agency's Clean Coal Plan
- The rate of adoption of electric vehicles, which will raise electricity demand
- Improvements in energy storage technologies and their price competitiveness, which will boost the economics of renewable fuels
- The net impact of the 30 percent tariff placed on foreign-made solar panels in February 2018, which is to continue through 2022, declining by 5 percent annually

*For more information about electric utilities, visit the utility regulation area of our website, [www.house.mn/hrd/](http://www.house.mn/hrd/).*

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production tax credit) declines from 30 percent for projects constructed in 2016 to 24 percent for those begun in 2017, 18 percent in 2018, and 12 percent in 2019. Both credits terminate in 2020. The solar investment tax credit of 30 percent applies to projects whose construction begins before the end of 2019, falling to 26 percent for those begun in 2020, 22 percent for projects constructed in 2021, and 10 percent thereafter, at which point residential projects are no longer eligible.