

Contents

1. Bird's eye view of Minnesota's power sector 3  
 2. Sustainable Energy Deployment 5  
 3. Opportunities 8  
 About us 11

State energy factsheet: Minnesota

This report provides a fact-based overview of Minnesota's power sector. It presents key metrics, highlights recent trends and discusses the outlook and opportunities for clean energy.

- Minnesota remains a net electricity importer and consumed an estimated 67TWh in 2018 while generating 58TWh in state. Imports have fluctuated since 2001 but the general trend has been downward since 2013 as more in-state capacity has been added, including renewables.
- Minnesota scored well in terms of its overall energy efficiency programs and policies, ranking eighth out of all the states in 2018 (up from ninth the preceding year), according to an assessment by the American Council for an Energy-Efficient Economy (ACEEE).
- From 2014 to 2018, natural gas-fired power production in Minnesota has more than doubled, from 3.9TWh to 8.8TWh. Natural gas's contribution to the generation mix on a percentage basis has grown similarly, from 6.8% in 2014 to 15.3% in 2018. Natural gas use in power has been rising nationally as well, but at a somewhat slower pace than in Minnesota.
- Output from renewables jumped 37% from 2013 to 2018, reaching an estimated 14.6TWh, or 25.2% of the total generation mix. Wind alone produced 18% of total Minnesota power in 2018. Biomass, hydro, and solar accounted for the balance of renewable generation.
- Minnesota aims to cut its economy-wide greenhouse gas emissions to 30% below 2005 levels by 2025 as part of a longer-term goal of cutting 80% by 2050. The state has slashed emissions from the power sector 34% since 2005 meaning the power sector is already making its contribution to the overall 2025 emissions reduction target. However, the emissions intensity of its power sector is just slightly higher than the national average.
- With its mandatory renewable energy standard (RES) essentially achieved, Minnesota policy-makers are contemplating more ambitious plans, including legislative proposals boosting the state's clean energy target to 100% by 2050.
- Minnesota has access to some of the best wind resources in the U.S. As a result, new wind build in the state is already at parity with new combined-cycle natural gas plants even without incentives. When federal tax credits are included in the equation, wind and solar technologies can deliver the lowest cost electricity.
- Minnesota-based corporations are stepping up efforts to procure renewable energy. 3M Co., Cargill Inc., Ecolab Inc., Target Corp., and General Mills have signed agreements to power their operations with either wind or solar. 3M is a member of the RE100 coalition of firms seeking to be 100% clean energy powered and has set an interim target of 50% renewables by 2025.
- In 2018, Minnesota's largest utility Xcel Energy made a key sustainable energy announcement. Xcel, which operates utilities in eight states, said it would deliver 100% carbon-free power to all of its customers by 2050, and cut carbon emissions 80% by 2030 company-wide.

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**Table 1: Key power system metrics, Minnesota v. U.S. average, 2018**

Metric	Units	MN	U.S. average	Comment	Rank
Total retail electricity sales	TWh	67	75	<b>Below average</b> electricity demand	23
Total in-state generation	TWh	58	75	<b>Below average</b> in-state generation	29
Retail electricity sales per capita	MWh	12	12	<b>Roughly average</b> per capita demand	29
Retail electricity prices	¢/kWh	11	11	<b>Roughly average</b> electricity prices	20
Generation from natural gas	%	15	36	<b>Below average</b> reliance on natural gas for electricity	38
Generation from renewables (incl. hydro)	%	25	17	<b>Above average</b> reliance on renewables	17
Energy efficiency score	ACEEE index	32	20	<b>Above average</b> on efficiency efforts	8
Utility electricity efficiency budget (2017)	% state revenue	2.4	1.7	<b>Above average</b> utility efficiency budget	12
CO2 emissions rate	tCO2/MWh	.45	.44	<b>Above average</b> power sector emissions rate	21

Source: BNEF, EIA, U.S. Census Bureau, ACEEE Notes: U.S. ranks are in descending order (i.e., 1 = highest, 50 = lowest). For some metrics it is 'good' to have a high ranking, while for others it is 'good' to have a low ranking (e.g., retail electricity prices, CO2 emissions rate).

## 1. Bird’s eye view of Minnesota’s power sector

Minnesota (MN) is a net electricity importer and consumed an estimated 67TWh in 2018 while generating 58TWh in state. The state's imports have fluctuated since 2001 from a high of 17.3TWh in 2013 to a low of 6.5TWh in 2016. However, the general trend for imports has been downward since 2013 as more in-state capacity has been added (Figure 1).

Electricity demand ticked up just 0.2% year-on-year in Minnesota while electricity demand nationwide rose 2.2% in 2018 thanks to faster economic growth and extreme weather conditions throughout the year that prompted greater use of air conditioning than in 2017.

Meanwhile, retail electricity prices in the state have ticked up over the past five years, rising from an average of 9.51 cts/KWh in 2014 to 10.63 cts/KWh in 2018. Year-on-year, the average retail price rose 1.4% from 10.27 cts/KWh in 2017 (Figure 2). The change brings Minnesota directly in line with average retail prices across the MISO region and the U.S. more broadly.

The total average monthly electricity bill for Minnesota households was \$97.58 for 2017, the last year for which complete data is available from the U.S. Energy Information Administration (EIA). This was 13% below the national average.

Figure 1: MN electricity sales and generation

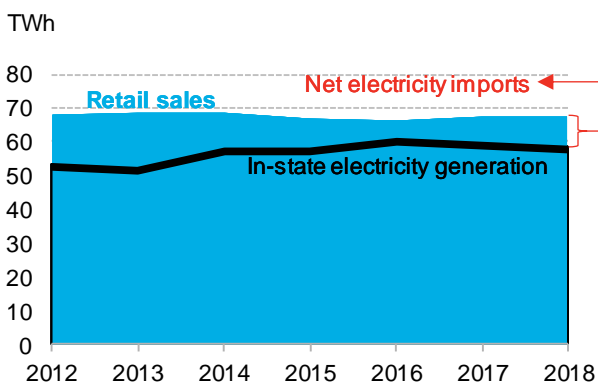
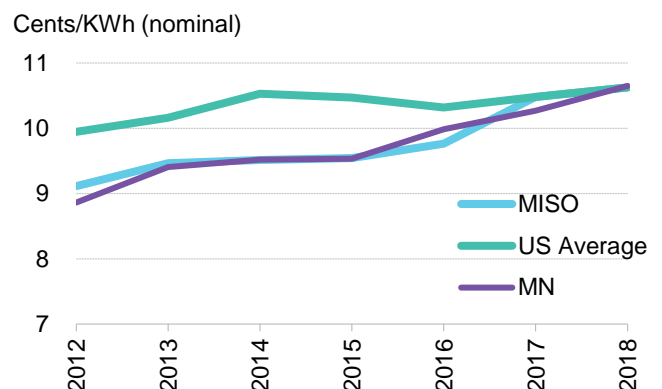


Figure 2: MN retail electricity prices relative to regional (MISO) and U.S. averages (covers residential, commercial, industrial, and transportation customer segments)



Source: BloombergNEF, EIA. Notes: 2018 values are projected, accounting for seasonality, based on the latest monthly values from EIA (available through November 2018). MISO is the electric power market in the Midwest, comprised of part or all of 16 states, including Minnesota.

Renewables have made notable strides in expanding their share of Minnesota’s growing electricity generation mix. Output from renewables including hydropower jumped 42% from 2013 to 2017 to reach a high of 25.9% of total power generation that year. From 2017 to 2018, renewables’ contribution slipped 0.7% to 25.2% (Figure 3). The decline appears due to a 7% drop in hydro production and an 8% decline in biomass generation. The latter is likely due to the closure of the Benson Power Biomass Plant in Swift County.

Overall, wind accounted for 17.9% of total Minnesota generation in 2018, up from 16.2% in 2013, 9% in 2010, and 3.2% in 2005. The contribution from biomass hit 3.2% in 2018, down from 3.8% in 2017 but up from 2.7% in 2005.

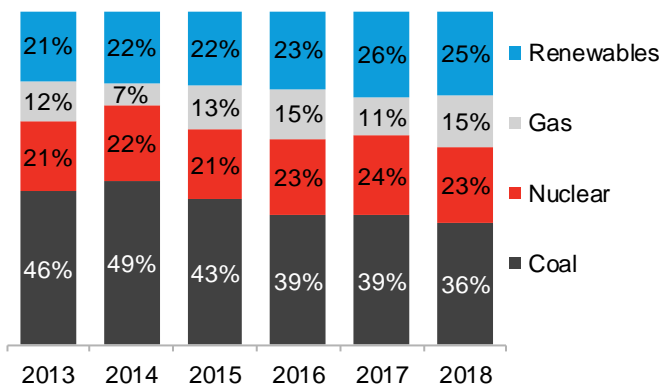
From 2014 to 2018, natural gas-fired power production in Minnesota has more than doubled, from 3.9TWh to 8.8TWh. Natural gas's contribution to the generation mix on a percentage basis has grown similarly, from 6.8% in 2014 to 15.3% in 2018. That is more than five times the fuel's contribution of 2.8% as recently as 2004.

From 2005 to 2009, the natural gas sector experienced a construction boom as the state added 2.4GW of new gas-fired capacity while retiring only 100MW (Figure 4). For most years since then, renewables (especially wind and solar) have dominated new build, with the state adding 3GW of mainly wind and solar from 2010 to 2018 including 1.8GW in the past five years alone. In 2018, however, Minnesota saw the largest volume of new natural gas capacity added since 2009 with 300MW commissioned.

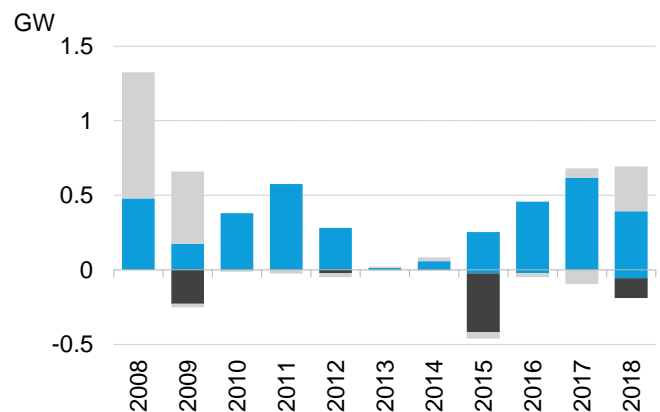
In 2015, for the first time, renewables including large hydro projects accounted for a larger proportion of Minnesota's overall generation than nuclear power, by just 1%. In 2018, the gap between the two widened with renewables generating 25.2% of the state's power compared with 23% for nuclear.

Minnesota saw the first retirement of coal-fired capacity in 2018 in three years as 135MW was shuttered. This contributed to lower coal-fired generation in the year and foreshadows smaller coal contributions in coming years due to planned retirements.

**Figure 3: Minnesota electricity generation mix by technology**



**Figure 4: Minnesota capacity additions (build, above x-axis) and retirements (below x-axis)**



Source: BloombergNEF, EIA Note: 2018 values are projected, accounting for seasonality, based on the latest monthly values from EIA (available through November 2018).

**Table 2: MN policies relevant to sustainable energy sectors**

Renewables
<p><b>Renewable energy standard (RES)</b></p> <p>Requires all electric utilities to obtain 25% of electricity from renewable sources by 2025 (30% by 2020 for Xcel Energy)</p>
<p><b>Solar energy standard</b></p> <p>Requires IOUs to have 1.5% of retail electric sales from solar by 2020 (in addition to RES target); also, statewide goal of 10% solar by 2030</p>
<p><b>Net metering</b></p> <p>Provides customers with net excess generation (NEG) from eligible systems &lt;40kW with a monthly credit on their bill equal to the retail rate; systems 40kW-1,000kW receive avoided cost rate</p>
<p><b>Value of solar tariff (VOST)</b></p> <p>Alternative offered to net metering, compensates customers for net value of solar PV on the distribution system</p>
Energy efficiency
<p><b>Energy efficiency resource standard (EERS)</b></p> <p>Yearly energy savings goal for electric and gas utilities of 1.5% of average retail sales beginning in 2010 (no statutory end date)</p>
<p><b>Property assessed clean energy (PACE)</b></p> <p>Authorizes certain MN local governments to provide property owners with upfront capital for energy efficiency improvements, which is in turn repaid through additional charges on homeowner property taxes</p>

Source: Source: BloombergNEF, DSIRE, Minnesota Department of Commerce

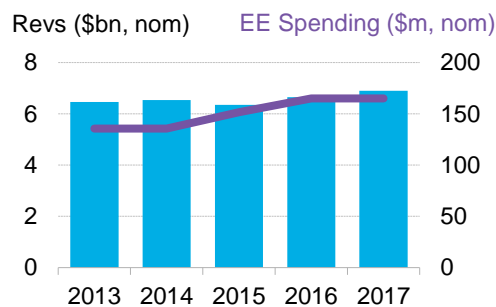
## 2. Sustainable energy deployment

### 2.1. Energy efficiency

Minnesota continues to be a leader in pursuing energy efficiency measures. In 2018, the American Council for an Energy-Efficient Economy (ACEEE) ranked the state 8<sup>th</sup>, with a score of 32 out of 50, for its overall energy efficiency programs and policies. Figure 5 shows Minnesota’s annual electricity revenues (blue bars, left axis, \$bn) and energy efficiency spending (purple line, right axis, \$m) from 2013 to 2017 (the most recent year for which complete data is available).

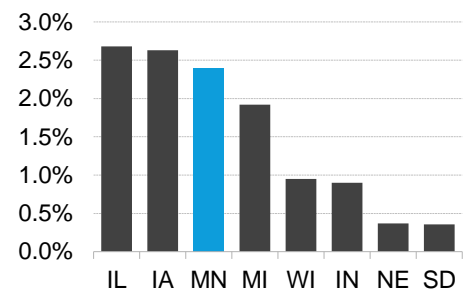
Energy efficiency spending compared to overall revenues totaled 2.4% in 2017, down slightly from 2.5% in 2016, but up from 2.1% in 2014. Compared with other states in the Midwest, Minnesota had the third highest ratio of efficiency spending vs. total revenues.

**Figure 5: Minnesota utility electricity revenues (left axis) and electricity efficiency spending (right axis)**



Source: ACEEE, EIA

**Figure 6: States’ utility electricity efficiency spending as a fraction of state-wide electricity revenue, 2017**



Efficiency spending, overseen by the Minnesota Department of Commerce through the Conservation Improvement Program (CIP), has paved the way for Minnesota to cost-effectively achieve the savings required by its annual 1.5% energy efficiency resource standard (EERS). Through 2017, Minnesota electric utilities have met or exceeded the 1.5% annual savings goal each year since 2011, according to a recent [study](#) prepared for the Minnesota Department of Commerce by the Center for Energy and Environment and others. The state’s natural gas utilities have met a required 1% minimum improvement each year but only exceeded the 1.5% goal in 2017. The study also found that meeting or exceeding, on average, the current CIP goal of 1.5% for electric utilities and the statutory minimum of 1.0% for gas utilities is achievable for the next decade.

2.2. Natural gas

Minnesota’s overall consumption of natural gas ticked up from 448bcfd in 2017 to 453bcfd in 2018, a 1.1% increase. Overall natural gas consumption in past five years has fluctuated from as low as 421bcfd in 2015 to as high as 462bcfd in 2014.

Natural gas is consumed by homes, businesses, industrial facilities, vehicles, and power plants. It is also counted by the U.S. EIA in terms of its deliveries over pipelines for distributed usage. Natural gas consumption from power plants has in recent years surged in the Midwest region (Iowa, Illinois, Indiana, Minnesota, Nebraska, South Dakota and Wisconsin), according to the EIA. Overall, natural gas used for power across the area has jumped 155% since 2014. In Minnesota, power sector natural gas use jumped 116% over that same five-year period (

Figure 7).

Across all consumer segments (residential, commercial, industrial, vehicles, and power), natural gas use in Minnesota rose 0.9% from 2017 to 2018. A 12% jump in use in the power sector was slightly more than offset by declines in demand from other segments.

Figure 7: MN and neighboring states’ natural gas consumption from the power sector

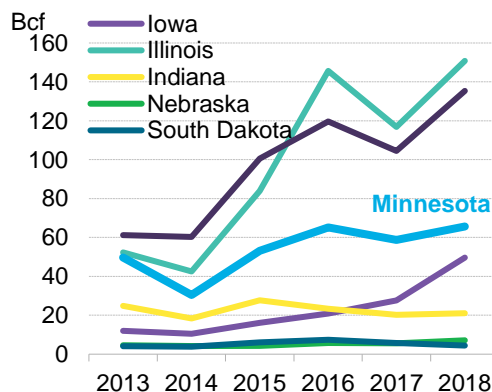
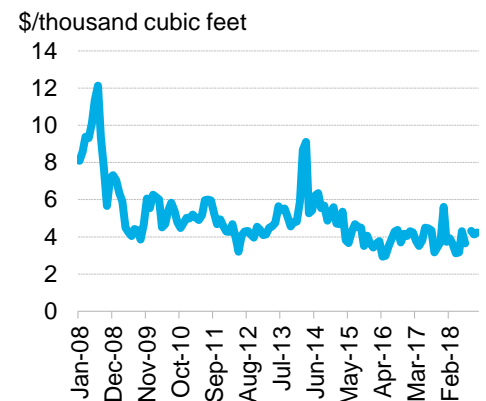


Figure 8: MN natural gas price (citygate)



Source: BloombergNEF, EIA. Note: 2018 values are projected, accounting for seasonality, based on the latest monthly values from EIA (available through November 2019).

Historically, natural gas plants in Minnesota have run primarily to meet peak electricity demand – as opposed to baseload demand. Accordingly, their operations remained largely concentrated in the summer months, when hot temperatures call for high electricity use to meet cooling needs. However, low natural gas prices have allowed natural gas-fired generators to underprice coal even for baseload use during certain seasons in recent years. This trend, combined with coal retirements, will serve to reduce the state’s dependence on coal and increase its reliance on other sources of electricity such as natural gas and renewables.

### 2.3. Renewables

Minnesota has a mandatory renewable energy standard (RES) that requires most of the state's investor-owned utilities (IOUs) to obtain 25% of their retail electricity sales from renewable sources by 2025 (Table 2), plus an additional 1.5% from solar under a solar carve-out. Xcel Energy, the largest utility in the state, is required to meet an even higher target of 30% by 2020, plus the 1.5% solar carve-out. With the state essentially meeting its RES goals there are now calls to boost the overall target to 100% clean energy. Meanwhile, Xcel has voluntarily pledged to achieve 100% clean energy by 2050 across all its service territories, which includes Minnesota along with seven other states.

In 2018, wind was the largest renewable energy resource at 17.9% of generation. Solar technologies provided another 2.2%, biomass/waste 3.2%, and hydro 1.6%.

From 2014 through 2018, Minnesota built 1.8GW of renewables capacity, composed of an estimated 935MW of solar (including utility-scale, commercial, industrial, and residential installations), 803MW of wind, and 40MW of biomass/biogas/waste-to-energy (Figure 10). This brought cumulative installed renewables capacity to 4.8GW in 2018 (Figure 11).

In 2017, more solar than wind capacity was completed in Minnesota for the first time since 2013 as 417MW of new solar capacity was added compared to 200MW of wind. In 2018, new build for solar (331MW) again exceeded new wind capacity additions (63MW) but by a wider margin.

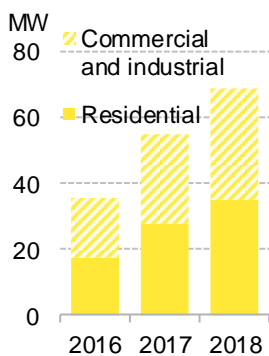
A 2013 law that created the solar carve-out under the state's RES also established a framework to promote community solar. This led to a boom in community solar activity, particularly in 2017 when new solar build of all kinds achieved an all-time high. In 2018, over 100 new community solar gardens were added in the state, according to the Minnesota Department of Commerce.<sup>1</sup> Minnesota now has 508MW of community solar online, the most of any state in the nation. In addition, small-scale solar now accounts for 69MW of capacity, split evenly between the residential and the commercial/industrial segments (Figure 9).

As wind costs continue to decline in this wind-rich part of the country, utilities are also looking to contract or own wind resources based on economics rather than mandates. Xcel Energy in particular is pursuing ownership of wind resources in Minnesota and surrounding states. The utility announced a target of 60% renewable energy in Minnesota by 2030, which, when coupled with its two nuclear plants, would make its electricity mix 85% carbon free by 2030. It later upped its overall long-term commitment to provide 100% carbon-free electricity across all its service territories by 2050.

### 2.4. Energy storage

As electric vehicle sales drive down lithium-ion battery prices, the economics of batteries for stationary storage continues to improve. In Minnesota, Connexus energy completed a solar-plus-storage project in 2018 for the purpose of shifting solar generation to the most valuable hours. The 10MW of solar PV and 15 MW/30MWh of energy storage became operational in December. Similarly, in 2018 Great River Energy issued an RFP for energy storage co-located with solar PV that would be interconnected to the Dakota Electric distribution system in 2019.

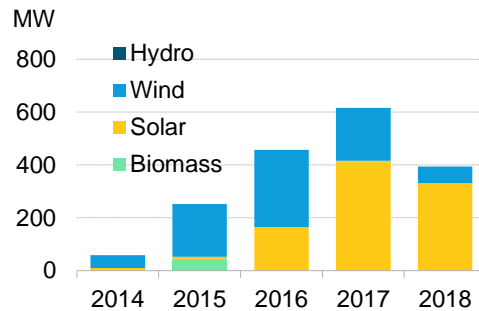
**Figure 9: MN cumulative installed residential and commercial solar capacity**



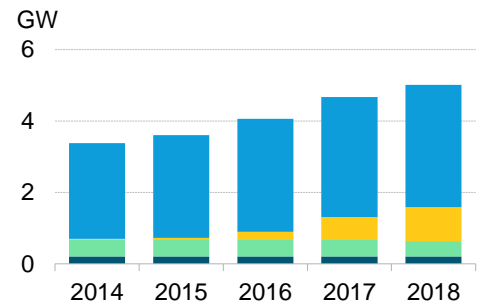
Source: BloombergNEF

<sup>1</sup> <https://mn.gov/commerce/media/news/?id=17-324916#/detail/appld/2/id/373200>.

**Figure 10: Minnesota renewable capacity additions**



**Figure 11: Minnesota cumulative renewable capacity**



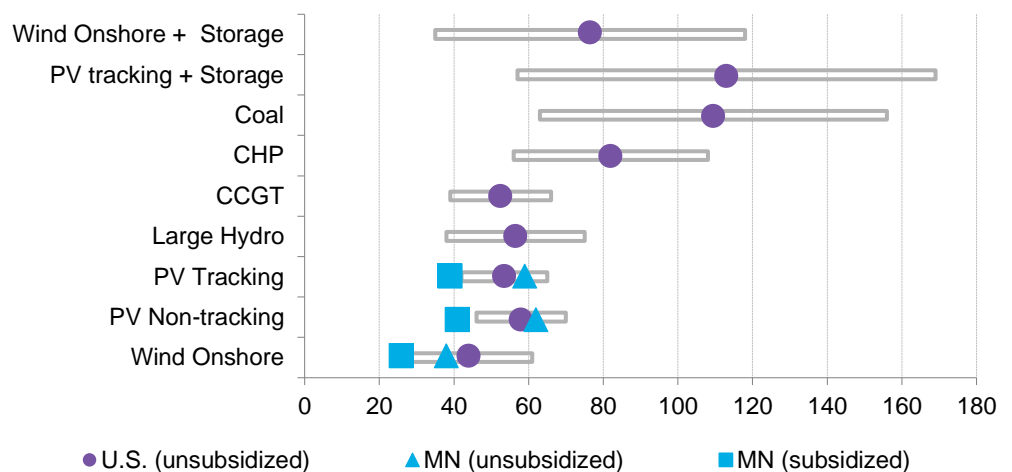
Source: BloombergNEF, EIA Note: Includes BNEF data on distributed (i.e., residential, commercial, and industrial) solar capacity.

Wind power is already economically viable in Minnesota without the benefit of subsidies. With the help of federal tax credits and accelerated depreciation, wind and solar offer the lowest-cost solutions in the state.

### 3. Opportunities

The BloombergNEF levelized cost of electricity (LCOE) analysis compares the cost of producing electricity from different technologies in the U.S. (Figure 12). The purple circles in the following chart show U.S. averages (prior to the inclusion of policy – i.e., unsubsidized) where possible, and regional or global averages otherwise. The blue triangles and squares show subsidized and unsubsidized Minnesota-specific LCOEs, respectively, for onshore wind and solar PV without tracking.

**Figure 12: Unsubsidized levelized cost of electricity (LCOE) of select technologies in the U.S. compared to subsidized and unsubsidized LCOE of onshore wind and solar PV in MN, 2H 2018**



Source: BloombergNEF. Notes: Variations in MN versus U.S. average result from variations in capacity factor, capex and financing rates. Bars indicate the range of unsubsidized LCOE for each technology in the U.S., AMER, or world-wide. Key policies such as the \$23/MWh Production Tax Credit (PTC) and accelerated depreciated (MACRS) bring down unsubsidized LCOEs to subsidized levels. LCOE for combined heat and power (CHP) is for reciprocating engines with CHP. Other technologies are not included due to lack of sufficient data.



### 3.1. Renewables

- Minnesota has access to some of the best wind resources in the U.S. As a result, LCOE analysis suggests that new wind build in the state is likely already at parity with new combined-cycle natural gas plants even without incentives (i.e., "unsubsidized"). 2018 estimates for Minnesota wind LCOEs came in at \$38/MWh unsubsidized, compared to a U.S.-wide mid-case estimate of \$52.5/MWh for combined-cycle natural gas. This represents a 16% decline in LCOE relative to last year. With subsidies, Minnesota wind LCOEs came in even lower, at around \$26/MWh.
- The LCOE estimates for solar PV in Minnesota reached \$39/MWh after accounting for subsidies, which renders it competitive with the estimates for natural gas combined-cycle turbines.
- Other technologies like waste-to-energy, CHP (combined heat and power) and biomass have generally seen lower levels of policy support and deployment than wind and solar, which may contribute to their higher LCOEs.
- Potential costs for PV projects that are paired with energy storage capacity and wind projects coupled with storage vary widely. This range is attributable to the wide variety of battery sizes that can potentially be paired with projects.

### 3.2. Natural gas

- The LCOE analysis also highlights the economic merit of natural gas combined-cycle turbines, especially as increased natural gas production in the Northeast has pushed down gas prices nationwide. Minnesota imports much of its gas from its western neighbors (South and North Dakota), and will likely continue to do so – but as Northeast production increasingly displaces other sources of demand for Canadian gas, more abundant natural gas supplies could be on the horizon for Minnesota.
- The overall cost competitiveness of natural gas and renewables compared to coal-fired generation appears to be contributing to falling generation from the latter.

### 3.3. Energy efficiency

- Energy efficiency spending rose 22% in the five-year period from 2013 through 2017. As the state's cumulative energy savings goal grows (its 1.5% EERS compounds annually), electric utilities may have to expand existing customer programs and pilot new projects to meet goals.
- While Minnesota leads many states on efficiency, it has even further room for improvement. For example, a study prepared for the Minnesota Department of Commerce, found that investor-owned utilities could achieve a 10-year average annual energy savings of 1.9% under a typical planning scenario used in Minnesota that considers constraints in implementation, while cooperative and municipal utilities could achieve a 10-year average annual energy savings of 1.7%, respectively.

Minnesota is considering a variety of new policy options to accelerate clean energy deployment. This includes potential legislation to support development of projects that pair renewables with energy storage capacity. One such bill before the state legislature would require investor-owned utilities to consider storage when developing their integrated resources plans and allow them to rate-base pilot projects. It would also potentially direct the Minnesota Department of Commerce to study the implications of adding storage to the grid.

Since meeting its RES seven years early, there have also been calls for Minnesota to up its current renewable energy standard to mandate 100% clean energy, potentially by 2050. This comes on the heels of California approving such legislation in 2018.

Minnesota is also taking steps to increase adoption of electric vehicles. In 2018, the Minnesota Public Utilities Commission requested that Minnesota's electric utilities file detailed plans by June 2019 on how they will help increase electric vehicle adoption in the state. Further, in early 2019, the Minnesota Department of Transportation, the Minnesota Pollution Control Agency, and the Great Plains Institute released, "Accelerating Electric Vehicle Adoption: A Vision for Minnesota". The document called for 20% of the state's light-duty vehicles (200,000 cars) to be EV's by 2030. The report also called for greater education of consumers on the benefits of EVs, improved EV charging infrastructure in the state, better coordination with regional and national efforts to expand EV charging, and the prioritization of renewable energy to charge EV's.

Minnesota is an active participant in the United States Climate Alliance, a coalition of 21 states and Puerto Rico that under the leadership of their governors have pledged to cut greenhouse gas emissions in an effort to have the U.S. overall meet the obligations of the Paris Agreement.

Finally, Minnesota is home to at least five companies who have all signed agreements to purchase renewable energy generation -- 3M Co., Cargill, Ecolab Inc., General Mills, and Target Corp. Between them, these five companies have signed deals to secure enough power to require 640MW of wind/solar capacity. Nationally, a record 8.6GW of new clean energy power purchase agreements were signed in 2018. That represents a record, by far for such activity.

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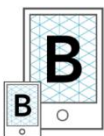
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