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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 (MN) is a net importer of electricity, although this generation gap has narrowed over the past five years. In-state generation jumped 16% while retail sales of electricity declined by 4% over that timeframe, thereby cutting the amount of electricity the state imported by 63%.
- Renewables' share of in-state electricity generation also rose during that time, from 21% to 25%. Coal remains the largest generation source, although its share in the generation mix has fallen to 39% in 2017, down from 46% in 2013. Natural gas' contribution stood at 12% in 2017.
- Strong state policy support and the improving economics of wind and solar resources in the region have touched off a boom in renewable build. Minnesota added 1.6GW of renewables between 2013 and 2017, putting the state on track to meet its renewable portfolio standard. Solar additions also overtook wind installations in 2017, on the back of a jump in community solar deployment.
- Minnesota scored well in terms of its overall energy efficiency programs and policies, ranking ninth out of all the states in 2017 (up from tenth the preceding year), according to an assessment by the American Council for an Energy-Efficient Economy (ACEEE).
- Minnesota aims to cut its economy-wide greenhouse gas emissions to 30% below 2005 levels by 2025, as part of a longer-term plan of achieving 80% below 2005 levels by 2050. The state's power sector slashed its emissions 27% from 2005 to 2017, meaning that it is only three percentage-points away from meeting its proportional contribution to the state's broader 2025 emissions target. However, the carbon emissions rate of the state's generation fleet is still higher than the national average.

Table 1: Key power system metrics, Minnesota v. U.S. average, 2017

Metric	Units	MN	U.S. average	Comment	Rank
Total retail electricity sales	TWh	66	72	***Below average*** electricity demand	23
Total generation	TWh	59	79	***Below average*** in-state generation	27
Retail electricity sales per capita	MWh	12	11	***Above average*** per capita demand	29
Retail electricity prices	¢/kWh	11	11	***Roughly average*** electricity prices	20
Generation from gas	%	12	32	***Below average*** reliance on gas for electricity	38
Generation from renewables (incl. hydro)	%	25	18	***Above average*** reliance on renewables	16
Energy efficiency score	ACEEE index	33	19	***Above average*** on efficiency efforts	9
Utility electricity efficiency budget (2016)	% state revenue	2.5	1.7	***Above average*** utility efficiency budget	10
CO2 emissions rate	tCO2/MWh	.48	.45	***Above average*** power sector emissions rate	19

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, consuming an estimated 66TWh in 2017 while only generating 59TWh. But this generation gap is narrowing: in the five years from 2013 through 2017, retail electricity sales fell 4% while in-state generation soared 16% (Figure 1). This cut Minnesota's net electricity imports to 6TWh, down from 17TWh.

Meanwhile, the average retail electricity price across all retail segments in Minnesota also rose over the past five years, jumping 13% from 2013 to 2017 to an estimated 10.6¢/kWh (Figure 2). The uptick brought Minnesotan retail electricity prices to the U.S. average in 2017, and above the regional (MISO) average of 9.7¢/kWh.

The *residential* retail electricity price rose an estimated 5% in 2017. EIA data for 2016 indicates that the total electricity bill for the average Minnesotan household was $97/month, 14% below the national average. Preliminary data through November 2017 suggest that bills remained below the U.S. average, despite the modest year-on-year rise in the average residential retail price.

Figure 1: MN electricity sales and generation

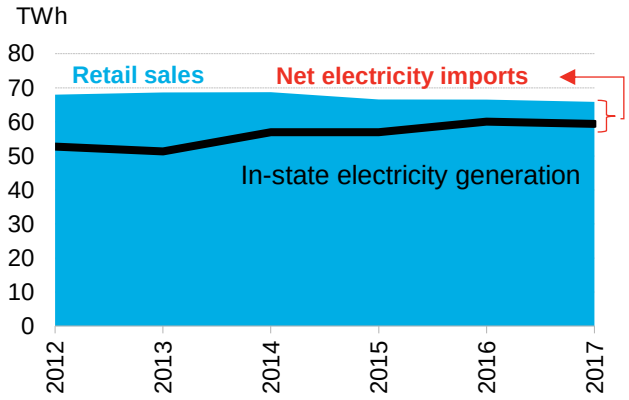
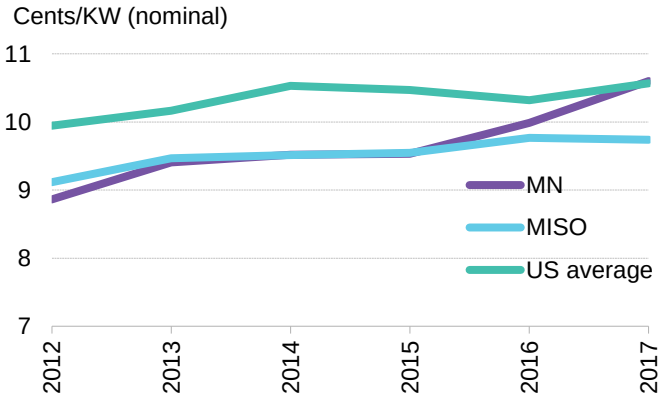


Figure 2: MN retail electricity prices relative to regional (MISO) and U.S. averages (covers residential, commercial, industrial, and transportation customer segments)



Source: Bloomberg New Energy Finance, EIA Notes: 2017 values are projected, accounting for seasonality, based on the latest monthly values from EIA (available through November 2017). 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, reaching an estimated 15TWh or 25% of the total generation mix (Figure 3). Wind alone produced 18% of total Minnesota generation in 2017, up slightly from 16% in 2013. Biomass's contribution ticked up to 3% from 2% over the same time frame, while contributions from other renewable resources reached 5%, up from 2%.

Renewables and nuclear have been neck-and-neck over the past five years, trading places as the second largest contributor to Minnesota's generation mix. In 2017, renewables edged out nuclear by two percentage points – or, in absolute terms, a difference of 1.2TWh. The upsurge came on the back of rapid renewable build: the state added an estimated 200MW of wind and 417MW of solar that year.

From 2013 to 2017, natural gas-fired generation increased in absolute terms by 13%, up to 7.2TWh in 2017 from 6.3TWh in 2013. However, total electricity output from the Minnesota fleet also grew rapidly, so natural gas' share of the total stayed at around 12%.

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). Since then, however, renewables (especially wind and solar) have dominated new build, with the state adding 2.8GW from 2010 to 2017 including 1.6GW in the past five years alone. In comparison, the state only added 138MW of gas-fired capacity since 2010.

Meanwhile, coal's contribution to the Minnesotan grid has fallen off since 2013, dropping to 39% of the power mix in 2017 from 46% in 2013 due to competition from low-priced natural gas, the growth of renewables, and the retirement of 396MW in coal capacity in 2015.

Figure 3: Minnesota's electricity generation mix by technology

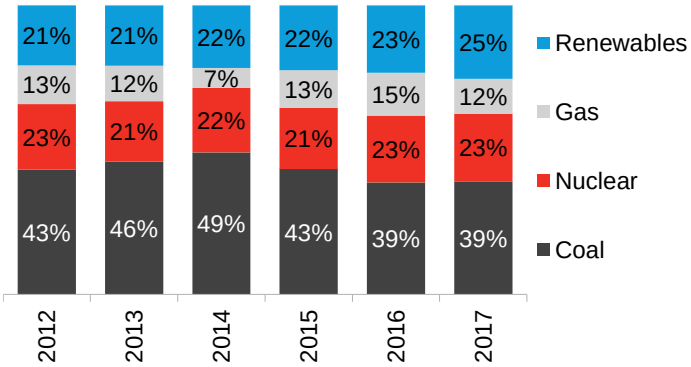
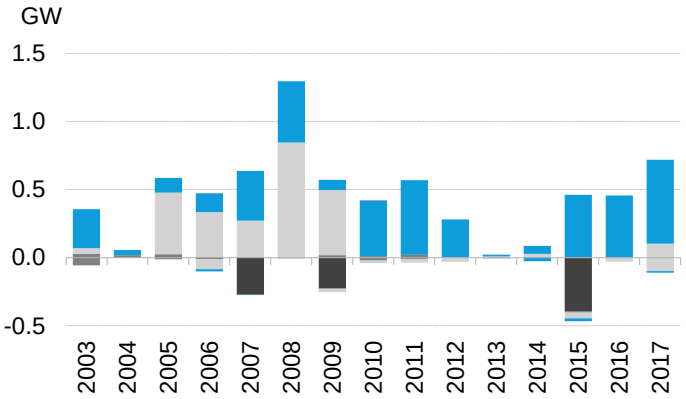


Figure 4: Minnesota's capacity additions (build, above x-axis) and retirements (below x-axis)



Source: Bloomberg New Energy Finance, EIA Note: 2017 values are projected, accounting for seasonality, based on the latest monthly values from EIA (available through November 2017).

2. Sustainable Energy Deployment

Table 2: MN policies relevant to sustainable energy sectors

Renewables
Renewable energy standard (RES)
Requires all electric utilities to obtain 25% of electricity from renewable sources by 2025 (30% by 2020 for Xcel Energy)
Solar energy standard
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
Net metering
Provides customers with net excess generation (NEG) from eligible systems <40kW with a monthly credit on their bill equal to the retail rate; systems 40kW-1,000kW receive avoided cost rate
Value of solar tariff (VOST)
Alternative offered to net metering, compensates customers for net value of solar PV on the distribution system
Energy efficiency
Energy efficiency resource standard (EERS)
Yearly energy savings goal for utilities of 1.5% of average retail sales beginning in 2010 (no statutory end date)
Property assessed clean energy (PACE)
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

Source: Source: Bloomberg New Energy Finance, DSIRE, Minnesota Department of Commerce

2.1. Natural gas

Minnesota's power sector consumed 12% more natural gas in 2017 than five years prior (in 2013), representing a compounded annual growth rate of 3%. The Midwest has generally seen an uptick in the use of gas within its power sector, with consumption levels jumping 180% in Illinois and 87% in Indiana during that same time period (Figure 5). Greater natural gas production flowing out of the Northeast has driven down gas prices nationwide, including in Minnesota (Figure 6), improving the economics of the state's gas fleet.

Figure 5: MN and neighboring states' natural gas consumption from the power sector

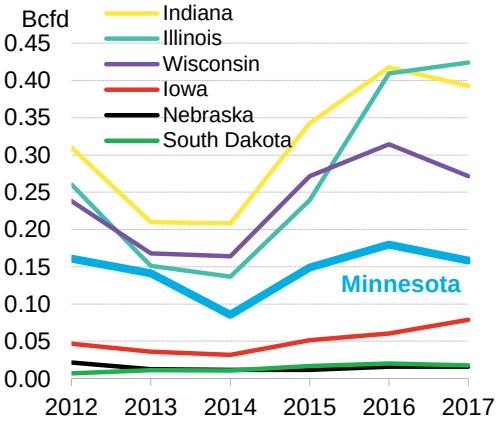
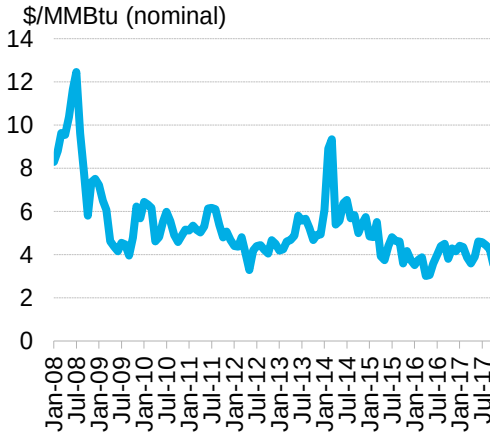


Figure 6: MN natural gas price (citygate)



Source: Bloomberg New Energy Finance, EIA Note: 2017 values are projected, accounting for seasonality, based on the latest monthly values from EIA (available through November 2017).

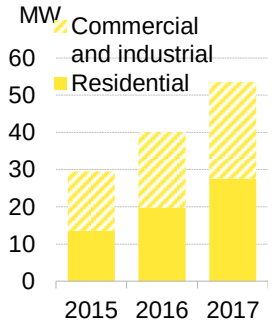
Historically, gas plants in Minnesota have run primarily to meet peak electricity demand – as opposed to baseload demand. Accordingly, their operations remained largely concentrated in the summer months, when hot temperatures call for high electricity use to meet cooling needs. However, low gas prices have allowed 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.

2.2. 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. The state is on track to meet its RES goals, although a legislative effort began in 2017 to raise the general standard to 50% by 2030, from 25% by 2025.

In 2017, renewables provided 25% of the state's overall electricity *generation* (as opposed to retail sales), with wind as the largest renewable energy resource. From 2013 through 2017, Minnesota built 1.6GW of renewables capacity, composed of an estimated 609MW of solar (including utility-scale, commercial, industrial, and residential installations), 945MW of wind, 48MW of biomass/biogas/waste-to-energy, and 0.5MW of hydropower (Figure 8). This brought cumulative installed renewables capacity to 5GW in 2017 (Figure 8).

Figure 7: MN cumulative installed residential and commercial solar capacity



Source: Bloomberg New Energy Finance

In 2017, annual solar capacity additions overtook those for wind in Minnesota. The 2013 law that created the solar carve-out also established a framework to promote community solar. The explosive rise of community solar in 2017 contributed to the leap in solar installations in the state – the Minnesota Department of Commerce counted 245MW of new community solar additions in that year, nearly five times more than the 42MW added in 2016.[1] BNEF has tracked the announcement of another 285MW of such projects (this number may change as applications are submitted or withdrawn). In addition, small-scale solar has contributed an estimated 43MW to renewable build from 2013 through 2017, 55% of which serves MN households (Figure 7).

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 recently announced a new 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. The utility's decarbonization push will further help to drive renewables growth in Minnesota.

Figure 8: MN renewable capacity additions

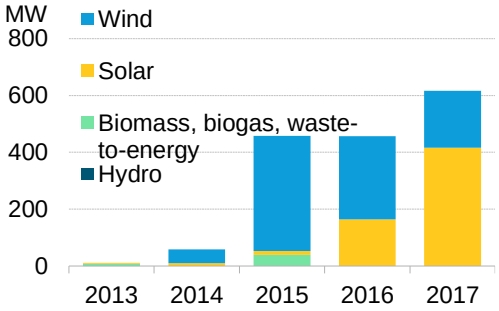
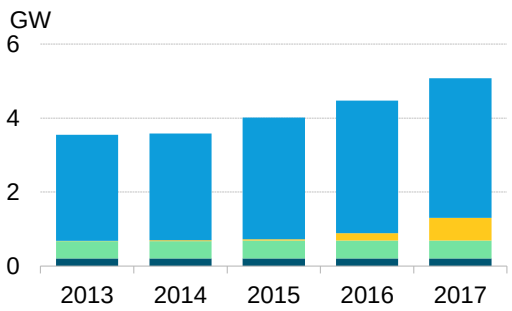


Figure 9: MN cumulative renewable capacity



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

MN achieved the 9th highest score out of all U.S. states for its overall energy efficiency programs and policies, according to the ACEEE.

2.3. Energy efficiency

Minnesota continues to be a leader in pursuing energy efficiency measures. In 2017, the American Council for an Energy Efficient Economy (ACEEE) ranked the state 9th, with a score of 33 out of 50, for its overall energy efficiency programs and policies. Figure 10 shows Minnesota's annual electricity revenues (blue bars, left axis, $bn) and the steady rise in energy efficiency spending (purple line, right axis, $m) from 2012 to 2016. The states' utilities devoted 2.5% of state-wide electricity revenues towards efficiency spending in 2016, the second-highest share in its region after its neighbor, Iowa (Figure 11).

[1] The Minnesota Department of Commerce article on community solar can be found here.

Figure 10: MN utility electricity revenues (left axis) and electricity efficiency spending (right axis)

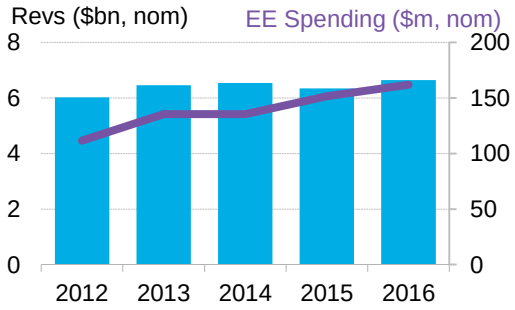
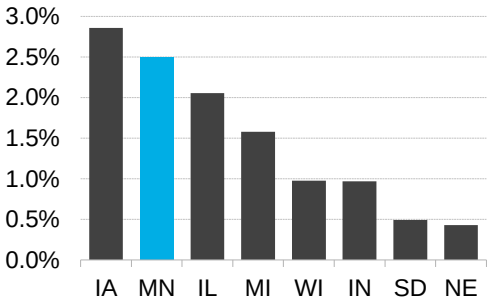


Figure 11: States' utility electricity efficiency spending as a fraction of state-wide electricity revenue, 2016



Source: ACEEE

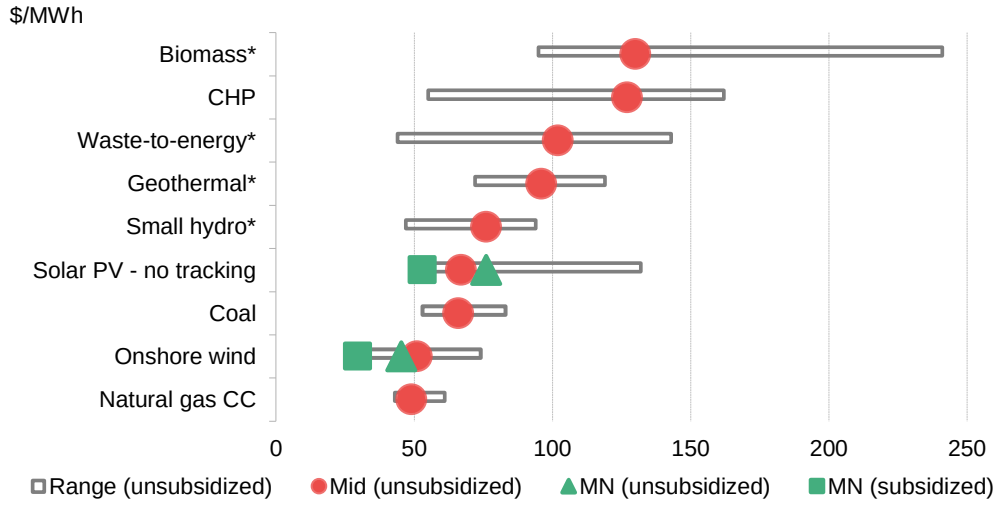
This efficiency spending helped pave the way for Minnesota to achieve the savings required by its annual 1.5% energy efficiency resource standard (EERS). Annual electric savings from actions taken from 2008-13 under the state's utilities' Conservation Improvement Programs reached 4.2TWh in 2014, with a benefit-cost ratio of 4.01 in 2013 alone, according to a study commissioned by the Minnesota Department of Commerce.

3. Opportunities

Wind and solar PV are already, or on the verge of becoming, economically viable in Minnesota.

The Bloomberg New Energy Finance levelized cost of electricity (LCOE) analysis compares the cost of producing electricity from different technologies in the U.S. (Figure 12). The red 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 green 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, 1H 2017



*Source: Bloomberg New Energy Finance Notes: *LCOE for waste-to-energy in this report is a global estimate; biomass, small hydro, and geothermal are Americas region estimates; all other LCOEs are either U.S. or MN-specific. 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.*

Renewables

- Minnesota has access to some of the best wind resources in the country. 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). 2017 estimates for Minnesota wind LCOEs came in at $45/MWh unsubsidized, compared to a U.S.-wide mid-case estimate of $49/MWh for combined-cycle natural gas. With subsidies, Minnesotan wind LCOEs came in even lower, at around $30/MWh.
- The LCOE estimates for solar PV in Minnesota reached $53/MWh after accounting for subsidies, which renders it competitive with the higher end of LCOE 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.

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 most 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.

Energy efficiency

- While MN leads many states on efficiency, it has even further room for improvement: for example, a study prepared for Xcel Energy, the state's largest utility, places "technically" and "economically" achievable cumulative annual energy savings in MN at 10TWh and 7TWh per year by 2020, respectively.
- Energy efficiency spending rose 45% in the five-year period from 2012 through 2016 (Figure 10). 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.

Outside of these three areas, Minnesota is also testing other measures that can support the exploration and deployment of clean energy technologies. In 2017, the Minnesota Public Utilities Commission decided to raise the social cost of carbon to the range of $9.05- $43.06/short ton, up from $0.44-$4.53/short ton. The change will affect the commission's evaluation of the relative economics of renewables versus fossil fuel facilities. The state is also piloting a time-of-use program to assess its ability to curb peak demand. With regards to the testing of new technologies, a Minnesotan electricity co-op, Connexus Energy, began exploring a 20MW/40MWh energy storage system for uses such as frequency regulation, peak shaving, and demand response. If established, this would be the largest energy storage facility in the state.

About us

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