Minnesota Tax Expenditure Evaluation of Wind Energy Conversion Systems and Solar Energy Systems Sales and Use Tax Exemptions

Prepared for the Tax Expenditure Review Commission

By the Legislative Budget Office

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Prepared by the Legislative Budget Office (LBO) on behalf of the Tax Expenditure Review Commission.

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Executive Summary

The Tax Expenditure Review Commission (TERC) is responsible for reviewing the effectiveness and efficiency of Minnesota's tax expenditure policies. The TERC has elected to review and evaluate Minnesota's sales and use tax exemption of wind energy conversion systems and solar energy systems.[1] This report provides an assessment of the exemptions with consideration to the first eight components of tax expenditure review required under Laws of Minnesota 2025, 1st Spec. Sess., chapter 13, article 8, section 5. The Commission may consider the findings of this report to recommend whether the expenditure be continued, repealed, or modified.

Wind and solar energy systems have both been implemented and utilized at an increasing rate over the last several decades. What is not clear is the explicit role that these two tax expenditures have played in that process. This evaluation views these two tax expenditures as part of a larger policy initiative, which takes place at the federal and state levels of government, as well as some private sector utilities companies. As outlined in component 8, this wide array of tax policies and other programs are aligned with the objectives of both the wind energy conversion and solar energy system tax expenditure objectives. After reviewing the tax expenditures, it does appear that the tax expenditures do incentivize and promote the implementation and utilization of wind energy installations and solar energy installations contributing to the growth of renewable energy production in Minnesota. In this way, it is achieving its objective. As these policies exist within the context of other federal and state policies and programs with similar objectives, this evaluation was not able to determine the extent to which these policies contributed to achieving the stated objective.

Components of Review

The intent of this evaluation is to understand the effectiveness and efficiency of the wind energy conversion systems and solar energy systems sales and use tax exemptions in incentivizing and promoting the implementation and utilization of wind energy conversion and solar energy systems in Minnesota. Ultimately, these exemptions seek to achieve a greater percentage of renewable energy contributions to the state's electricity fuel generation mix.

This evaluation addresses the review components outlined in Laws of Minnesota 2025, 1st Spec. Sess. chapter 13, article 8, section 5, and provides additional analysis. The findings are listed in order to correspond with the statute.

[1] Minnesota Statutes 2024, section 297A.68, subdivision 12; Minnesota Statutes 2024, section 297A.67, subdivision 29.

Component 1. Estimate of the Annual Revenue Lost

The estimated fiscal impact of the wind energy conversion systems sales and use tax exemption in fiscal year 2024 is $11,300,000.[2] See Figure 14 on page 29 for more detail.

The estimated fiscal impact of the solar energy systems sales and use tax exemption in fiscal year 2024 is $9,000,000. See Figure 14 for more detail.

The LBO developed an alternative estimate of the foregone revenue for the exemption on solar energy systems for calendar years 2010 through 2023 using industry data reported by utility providers. Compared to previous estimates, there is a significant increase in fiscal impact between 2016 and 2022 as a result of interconnection costs related to community solar gardens. See Figure 15 on page 30 for more detail.

Component 2. Objective of the Tax Expenditure

The objective of the wind energy conversion general sales and use tax exemption is to incentivize and promote the implementation and utilization of wind energy systems in Minnesota. The exemption is intended to achieve a greater percentage of renewable energy contributions to the state's electricity fuel generation mix.

The objective of the solar energy systems general sales and use tax exemption is to incentivize and promote the implementation and utilization of solar energy systems in the state of Minnesota to achieve a greater percentage of renewable energy contributions to the state's electricity fuel generation mix.

Both objectives were approved and adopted by the Tax Expenditure Review Commission on March 15, 2024, for the purpose of evaluating the respective exemptions.

Component 3. Estimating the measurable impacts and efficiency of the tax expenditure in accomplishing the objective of the tax expenditure

This evaluation determines that both sales and use tax exemptions meet their objectives in that they contribute to a broader policy initiative. However, estimating the measurable impacts and efficiency of the two tax expenditures in accomplishing their respective objectives is complicated for two primary reasons.

First, due to the complexity of the renewable energy policy area, it is difficult to empirically assess the measurable impacts of one specific piece of renewable energy policy. For example, multiple state, federal, and private programs incentivize the utilization of wind and solar energy systems, making it difficult to parse out the impact of

[2] Minnesota Department of Revenue Tax Research Division. State of Minnesota Tax Expenditure Budget Fiscal Years 2024-2027. Page 154.

a specific policy. Thus, we assume that these policies overlap to encourage the uptake of renewable energy. This is discussed in greater detail in component 8.

Second, there are significant data limitations that inhibit the ability of the LBO to conduct a comparative analysis at the level required to estimate the measurable impacts of a single tax expenditure. This is further expanded on in the “limitations” portion of the Methodology section of the report found on page 39.

Component 4. Comparing the effectiveness of the tax expenditure and a direct expenditure

An alternative to an upfront sales tax exemption is a direct payment incentive like a grant or a loan. There are key differences between each policy design that are worth noting. It can be argued that a tax exemption has the potential to reach a larger population based on the assumption that it is less administratively burdensome to obtain and it is not capped at a certain dollar amount. However, the benefit per entity is likely to be smaller in comparison to a grant or loan program. An advantage of a direct payment incentive is that it is likely to address financial barriers for targeted populations that would otherwise not be in a position to participate in a particular activity. An underlying assumption here is that the benefit per entity is much larger than the benefit of a sales tax exemption. Additionally, there is the potential for the participant pool to be smaller based on either eligibility criteria necessary to target a specific group or financial resource limitations associated with direct expenditure programs. Several of these elements play out in the two federal grant programs highlighted in this evaluation.

Component 5. Potential modifications to the tax expenditure to increase its efficiency or effectiveness

Sales and use tax exemptions are an administratively efficient type of tax expenditure. These exemptions take place at the time of sale and require no additional action on behalf of the consumer. Any additional requirements to improve tracking of utilization for future evaluation may reduce the efficiency of the program if the requirements prove to be burdensome for consumers.

The energy contribution of wind and solar to the state’s electricity fuel generation has increased over the last several decades. As such, this evaluation determines that both sales and use tax exemptions meet their objectives in that they contribute to a broader policy initiative. What is less clear is the explicit role that these two tax expenditures have played in that process given the multitude of policies aimed at promoting the uptake of renewable energy. Therefore, modifications could not be identified that would lead to increased effectiveness for these two policies in particular.

Component 6. Estimating the amount by which the tax rate for the relevant tax could be reduced if the revenue lost due to the tax expenditure were applied to a rate reduction

The Minnesota Department of Revenue Tax Research (DOR Tax Research) calculated a revenue-neutral tax rate that would reduce the current rate by 0.009 percent for the wind energy conversion systems exemption and 0.007 percent for the solar energy system exemption. Revenue-neutral rates are the tax rates necessary to raise approximately the same revenue for the state of Minnesota if the tax expenditure were repealed. The current general sales and use tax rate is 6.875 percent.

Component 7. The incidence of the tax expenditure and the effect of the expenditure on the incidence of the state's tax system

Tax incidence refers to who ultimately bears the relative burden of a tax that is levied. An incidence analysis is not available for wind energy conversion systems or solar energy systems sales and use tax exemptions.

DOR Tax Research assumes the incidence of both exemptions to be similar to the incidence of the business sales tax. A brief analysis of the incidence of the business sales tax is provided in this report based on an incidence breakdown found on page 135 of the 2024 Tax Expenditure Budget.

Based on claims for the Residential Clean Energy Credit at the federal level, the LBO estimates that 67 percent of the value of these exemptions are realized by households with adjusted gross income in the top 24 percent.

Component 8. Cumulative fiscal impacts of other state and federal taxes providing benefits to taxpayers for similar activities

The cumulative fiscal impacts of other state and federal taxes providing benefits to taxpayers for similar activities in calendar year 2023 are about $77 million for solar and roughly $1.3 million for wind. These estimates include the Minnesota Solar Energy Production Incentive program, the federal Residential Clean Energy Credits, and federal grants under the Rural Energy for America Program. The estimates of fiscal impact are not comprehensive of all available programs given data limitations. Examples of programs not included in these estimates are incentive programs offered by utility providers and federal exclusions from income on utility-provided subsidies. The full analysis of cumulative fiscal impacts is outlined in a subsequent section within the report. See pages 33-38 for more detail. See Appendix C for an overview of federal changes made in the One Big Beautiful Bill Act (OBBBA).

Introduction

The Tax Expenditure Review Commission (TERC) directed the Legislative Budget Office (LBO) to evaluate a subset of tax expenditures in 2024 to meet the requirements outlined in Minnesota Statutes 2024, section 3.8855, subdivision 5. Two of the tax expenditures selected for evaluation focus on renewable energy products: the exemption of wind energy conversion systems and solar energy systems from the state's general sales and use tax. Both tax expenditures can be found in the 2024 Tax Expenditure Budget published by the Minnesota Department of Revenue Tax Research Division (DOR Tax Research) on page 154.[3]

The evaluation conducted by the LBO aims to address whether each policy is meeting its respective objective as determined by the TERC on March 15, 2024.

The objective of the sales tax exemption on wind energy conversion systems is to incentivize and promote the implementation and utilization of wind energy systems in Minnesota. The objective of this exemption is to achieve a greater percentage of renewable energy contributions to the state's electricity fuel generation mix. Likewise, the objective of the sales tax exemption on solar energy systems is to incentivize and promote the implementation and utilization of solar energy systems in the state of Minnesota to achieve a greater percentage of renewable energy contributions to the state's electricity fuel generation mix.

This evaluation does not include utility-scale installations, as purchase and installation costs of that equipment would likely fall under the capital equipment exemption from general sales and use tax under Minnesota Statutes 2024, section 297A.68, subdivision 5.[4] This caveat is included in the tax expenditure budget entry for the wind energy conversion system sales tax exemption. The evaluation team applied this logic to the solar energy systems tax expenditure and was confirmed by DOR Tax Research. These assumptions informed the scope of the evaluation.

The scope of this evaluation is limited to distributed wind and solar energy installations that interconnect to a utility provider's distribution grid.[5] Distributed energy resources (DER) can be customer-owned systems like solar panels, wind turbines, and energy storage devices that are located at the site of use to offset the energy required from a utility provider. They can also be front-of-the-meter installations that are not located with a particular customer or at the site of use, such as a community solar garden (CSG).

An analysis is provided on trends in renewable energy production and installation of qualifying equipment in the state. U.S. Energy Information Administration (EIA) data are analyzed to understand the changing composition of the state's electricity fuel

[3] Minnesota Department of Revenue Tax Research Division. State of Minnesota Tax Expenditure Budget Fiscal Years 2024-2027. Page 154.
[4] See the definition of Utility Scale Installations in the Key Terms section in Appendix A.
[5] See the definition of Distributed Energy Resources in the Key Terms section in Appendix A.

generation mix over time. Geographic data are used to illustrate regional installations across Minnesota.

Per statute, the exemption on wind energy conversion systems also applies to the materials used to manufacture, install, construct, repair, and replace wind energy conversion systems.[6] The evaluation of this tax expenditure is limited to purchase and installation costs. Manufacturing, repair, and replacement costs are not included in the evaluation of wind conversion systems as this information was not readily accessible.

This report provides background information on the two state sales and use tax expenditures, a description of the methodology applied to evaluate the tax expenditures separately, and a summary of evaluation findings for the Commission to consider.

Background

Mechanics

In order to receive either exemption, a purchaser is required to fill out Form ST3, Certificate of Exemption, made available by the Department of Revenue (DOR), and provide it to the seller as part of the transaction. On the form, the purchaser indicates the reason for the exemption. For these two tax exemptions, recipients will indicate the reason for the exemption as “O – Other,” and in a corresponding line enter code “34” for solar energy systems or “44” for wind energy systems. Sellers are directed to keep the certificate as part of their records should there ever be a need to verify whether a transaction was eligible for a transaction.

If the certificate is not completed, the seller must charge sales tax. If the form is completed, the seller does not charge and remit a sales tax. The seller may be required to provide the ST3 exemption certificate to the DOR to verify the exemption. As form ST3 is not required to be submitted to DOR for every transaction, data on each qualifying transaction is not available. This is generally the case for any exemption from the sales and use tax.

Overview of Exemptions and State Efforts in the Renewable Energies Sector

A common wind energy conversion system is a wind turbine, which may be found as a solitary installation or as part of a wind energy farm with multiple installations. A wind energy system can also encompass windmills or wind chargers. A solar energy system includes photovoltaic solar energy devices, such as solar panels, and concentrated solar-thermal devices like power towers that use mirrors to harness and concentrate the sun’s heat. The exemption of wind and solar energy conversion devices from sales and use tax are two among several efforts the state is making to promote the use of

[6] Minnesota Statutes 2024, section 297A.68, subdivision 12.

renewable energy. State policies enacted to promote renewable energy sources can be categorized as supporting supply, supporting demand, and encouraging technological developments.

Examples of strategies to increase supply include establishing renewable energy targets; setting minimum standards for utility providers to source from renewable energy systems; limiting the Public Utilities Commission's ability to approve more nonrenewable energy facilities; and requiring the state's largest utility provider to acquire certain levels of megawatts from specific renewable energy sources.[7] The two sales and use tax exemptions evaluated by the LBO can be understood to fall into the category of supporting supply.

Policies that promote demand include a requirement that electric utilities purchase power from smaller cooperative or municipal producers if they are interconnected; and an inactive requirement that a utility provider offer their retail customers the choice of buying electricity that was generated through renewable energy sources.[8]

State policies that promote investments in renewable technologies include direct incentive payments under the Renewable Energy Production Incentive, made to small renewable energy producers that sell excess energy to utility providers; allocation of funds to support those direct payment incentives; and a requirement of the state's largest utility provider to make specific contributions to the Renewable Development Account to fund renewable energy projects.[9]

These state policies, even if expired, should be kept in mind as they play a role in molding the renewable energy industry sector for the state and as an acknowledgment that the sales and use tax exemptions for wind and solar energy systems do not exist in a vacuum. Additionally, there are federal programs that should be considered in the evaluation of these two state tax expenditures. Further discussion of the federal programs is continued in the evaluation section of the report. The interactions of multiple policies may be taken into consideration when choosing to invest further in wind and solar energy systems in Minnesota.

The Cost to Produce Renewable Energy

The cost of producing renewable energy has changed dramatically within the past decade. Both wind and solar energy systems have become less expensive and more competitive with fossil fuels and other energy sources.[10] The levelized cost of energy (LCOE) is often cited as a key metric for comparing the relative cost of energy sources.

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[7] Minnesota Statutes 2024, section 216B.1691, subdivision 2f; Minnesota Statutes 2024, section 216B.2422, subdivision 4; Minnesota Statutes 2024, section 216B.2423, subdivision 1.
[8] Minnesota Statutes 2024, section 216B.164, subdivision 4; Minnesota Statutes 2008, section 216B.169, subdivision 2
[9] Minnesota Statutes 2024, section 216C.41; Minnesota Statutes 2024, section 116C.779
[10] International Renewable Energy Agency, "Renewable Power Generation Costs in 2022", 34-36, https://www.irena.org/Publications/2023/Aug/Renewable-Power-Generation-Costs-in-2022; Lazard, "Lazard Levelized Cost of Energy Version 17.0"

The calculation of LCOE for a certain generation source is the cost to produce electricity using that source over energy produced.[11] This allows for comparison between sources while taking varying costs and levels of production into account. When comparing two energy sources using LCOE, the lower of the two is assumed to be more competitive due to a lower ratio of cost to production.

The global weighted average LCOE of wind was 85 percent higher than the most affordable fossil fuel in 2010. By 2022, the LCOE of wind was 52 percent lower than the cheapest fossil fuel. The shift in LCOE for solar was significantly larger. The global weighted average LCOE of solar was 670 percent higher than the cheapest fossil fuel in 2010. By 2022, this metric dropped to be 28 percent lower than the cheapest fossil fuel. This particular calculation of LCOE does not account for financial support for renewable technologies, which makes the estimates more sensitive to market trends.[12] The LCOE does vary to some degree between different types of wind and solar generation. For example, the LCOE of onshore wind is slightly less than offshore wind and the LCOE of rooftop residential solar is roughly twice that of utility-scale solar.[13] Overall, these market shifts indicate that renewable energies have become more competitive forms of energy, but challenges with cost still remain for some sources such as residential solar.

Trends in Distributed Wind Energy in Minnesota

The exemption on wind energy conversion systems from the Minnesota general sales and use tax was established in 1992. Wind installations have been licensed and sited in Minnesota since the 1980s, seeing significant growth in the late 2000s.

Through the 1980s, four unique distributed wind energy facilities were installed and interconnected in Minnesota. Three of these facilities were properties of residential utility customers and one facility belonged to a commercial customer. Seven additional facilities were interconnected in the 1990s, five of those being residential-owned installations, one owned by a commercial customer, and the first installation owned by a utility. The first decade of the 2000s saw a significant increase with 148 new interconnected facilities – 98 of those coming online between 2007 and 2009. This growth trend continued through the next decade with 145 new interconnected facilities between 2010 - 2019. Since 2020, the number of installations has slowed with 19 unique facilities being interconnected through 2023. Three hundred and fifty-seven distributed wind energy facilities have been installed and interconnected in Minnesota since the 1980s, with 47 facilities being decommissioned over the same period.[14]

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[11] International Renewable Energy Agency, “Renewable Power Generation Costs in 2022”, 191-193.
[12] International Renewable Energy Agency, “Renewable Power Generation Costs in 2022”, 34-36, https://www.irena.org/Publications/2023/Aug/Renewable-Power-Generation-Costs-in-2022; Lazard, “Lazard Levelized Cost of Energy Version 17.0”.
[13] International Renewable Energy Agency, “Renewable Power Generation Costs in 2022”, 191-193.
[14] Minnesota Public Utilities Commission (MPUC). "Annual Distributed Generation Report, Minnesota Data through December 31, 2022." Accessed on January 17, 2025.

Trends in Distributed Solar Energy in Minnesota

Photovoltaic devices have been exempted from the sales and use tax in Minnesota since 1992; however, the current solar energy systems sales and use tax exemption was enacted in 2005.[15] Solar energy systems have been implemented into the state's distributed energy system since 1996. Two distributed energy installations were interconnected in the 1990s. Distributed solar energy increased significantly in the 2000s, with 324 installations becoming newly interconnected through 2009. There has since been exponential growth with 8,356 reported interconnections of unique installations in the 2010s and 16,312 new interconnections from 2020 through 2024. The majority of these installations are owned by residential customers, followed by commercial customers, and a growing number of CSGs.[16]

History of Solar and Wind Incentives from the Federal Government

The U.S. federal government also issued policies to promote the uptake of renewable energies. This includes exclusions from individual and corporate income tax on subsidies received by taxpayers for the installation of energy conservation measures, like solar-thermal and photovoltaic systems.[17] Another policy promoting renewable energy production is the Residential Clean Energy Tax Credit, which provides a credit of up to 30 percent for the purchase of renewable energy systems and installations for residential use – extended by the Inflation Reduction Act of 2022 (IRA).[18] A similar credit is allowed to businesses investing in renewable energy projects through the Investment Tax Credit for Energy Property – a credit of up to 30 percent of project costs with additional bonuses available for meeting certain requirements. This credit was also modified and expanded by the IRA.[19] The credit is set to be replaced by the Clean Energy Investment Tax Credit in 2025. The two policies are designed to function similarly, but the new policy will apply to more renewable energy technologies.

Additionally, businesses can benefit from depreciation deductions of their investments and can accelerate those depreciations through the Modified Accelerated Cost-Recovery System – enhanced in 2017 by the Tax Cuts and Jobs Act.[20] Alternatively, individuals and businesses can choose to forgo the credit on 30 percent of their investment and claim the Renewable Electricity Production Tax Credit (PTC), enacted in 1992 and recently extended by the IRA to 2025. Under the PTC, a credit is provided based on a per kilowatt hour of energy production through the means of renewable energies. In addition to extending the expiration date, the IRA created bonus tax credits

[15] Laws of Minnesota 1992, chapter 511, article 8, section 20, subdivision 47; Minnesota Statutes 2024 216C.01, subdivisions 16; Laws of Minnesota 2005, 1st Spec. Sess. chapter 3, article 5, section 6; Minnesota Statutes 2024 216C.01, subdivisions 17.
[16] MPUC. "Annual Distributed Generation Data"
[17] DSIRE, "Residential Energy Conservation Subsidy." Programs. Accessed on October 8, 2024.
[18] DSIRE, "Residential Energy Tax Credit." Programs. Accessed on October 8, 2024.
[19] DSIRE, "Business Energy Investment Tax Credit." Programs. Accessed on October 8, 2024; Internal Revenue Service. Clean Energy Tax Incentives for Businesses, Publication 5885. Accessed on October 8, 2024.
[20] DSIRE, "Modified Accelerated Cost-Recovery System." Programs. Accessed on October 8, 2024.

contingent on meeting certain requirements like wage minimums and implementing apprenticeship programs.[21] The PTC is set to be replaced with the Clean Electricity Production Tax Credit starting in 2025. Like the investment credits, the two production-based policies are designed to function similarly, but the Clean Electricity Production Tax Credit is more expansive as it is not technology specific.[22]

Review of Other States

Thirty-two U.S. states offer a sales tax incentive for the purchase of a distributed renewable energy system. Below, Figure 1 illustrates the 32 states with a sales tax incentive for renewable energy systems. These include sales tax exemptions and deductions from use tax on production and storage equipment. Twenty-six states offer sales tax incentives specific to solar energy – see Figure 2. Sixteen states offer sales tax incentives for small wind energy systems – see Figure 3.[23] These programs vary significantly in both program structure and the sectors eligible for the incentive. To be clear, color concentration and counts in Figures 1-3 indicate the number of policies adopted by a state, not number of installations.

Where Minnesota has developed tax exemptions to specifically target wind and solar energy systems, several states have developed incentives that cover a broader renewable energy sector. In 1999, Vermont implemented a broad sales tax exemption for renewable energy systems. Most qualifying technology is exempt for systems up to 500 kW (kilowatt) in capacity.[24] Utah exempts purchases of alternative energy sources, including both wind and solar. Utah's exemption is structured for use by industrial and utility companies. To qualify, facilities in Utah must have a capacity of more than 2 MW (Megawatt) (or 1 MW for expansions). [25]

[21] DSIRE, "Renewable Electricity Production Tax Credit." Programs. Accessed on October 8, 2024.
[22] Environmental Protection Agency. "Summary of Inflation Reduction Act provisions related to renewable energy." Last updated July 29, 2025. Available at https://www.epa.gov/green-power-markets/summary-inflation-reduction-act-provisions-related-renewable-energy#:~:text=Through%20at%20least%202025%2C%20the,additional%20credit%20amounts%2C%20described%20below.
[23] DSIRE, "Sales Tax Incentive." Programs. Accessed on January 1, 2025. https://programs.dsireusa.org/system/program?type=81&
[24] DSIRE, "Renewable Energy Systems Sales Tax Exemption." Programs. Accessed on October 22, 2024.
[25] DSIRE, "Alternative Energy Sales Tax Exemption." Programs. Accessed on October 22, 2024.

Figure 1. Thirty-two States with Sales Tax Incentives for Renewable Energy Resources

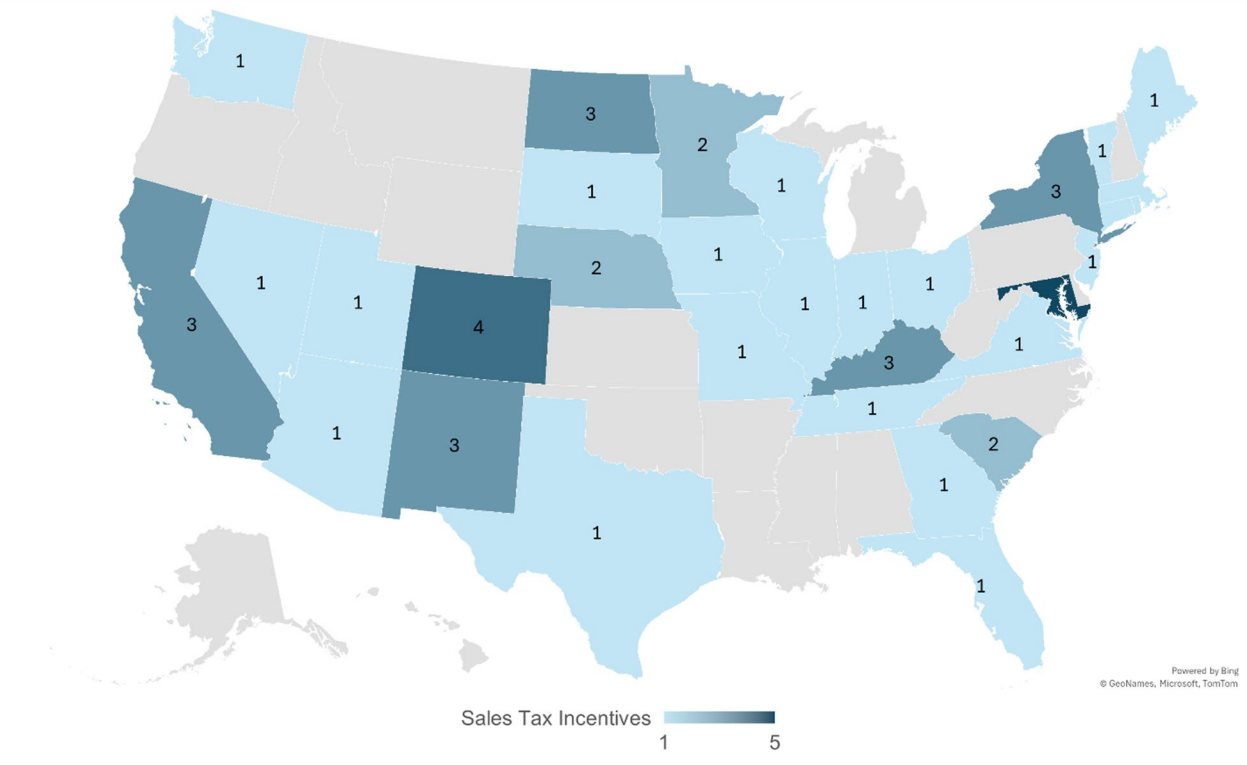


Figure 2. Twenty-six States with a Sales Tax Incentive for Solar Energy Systems

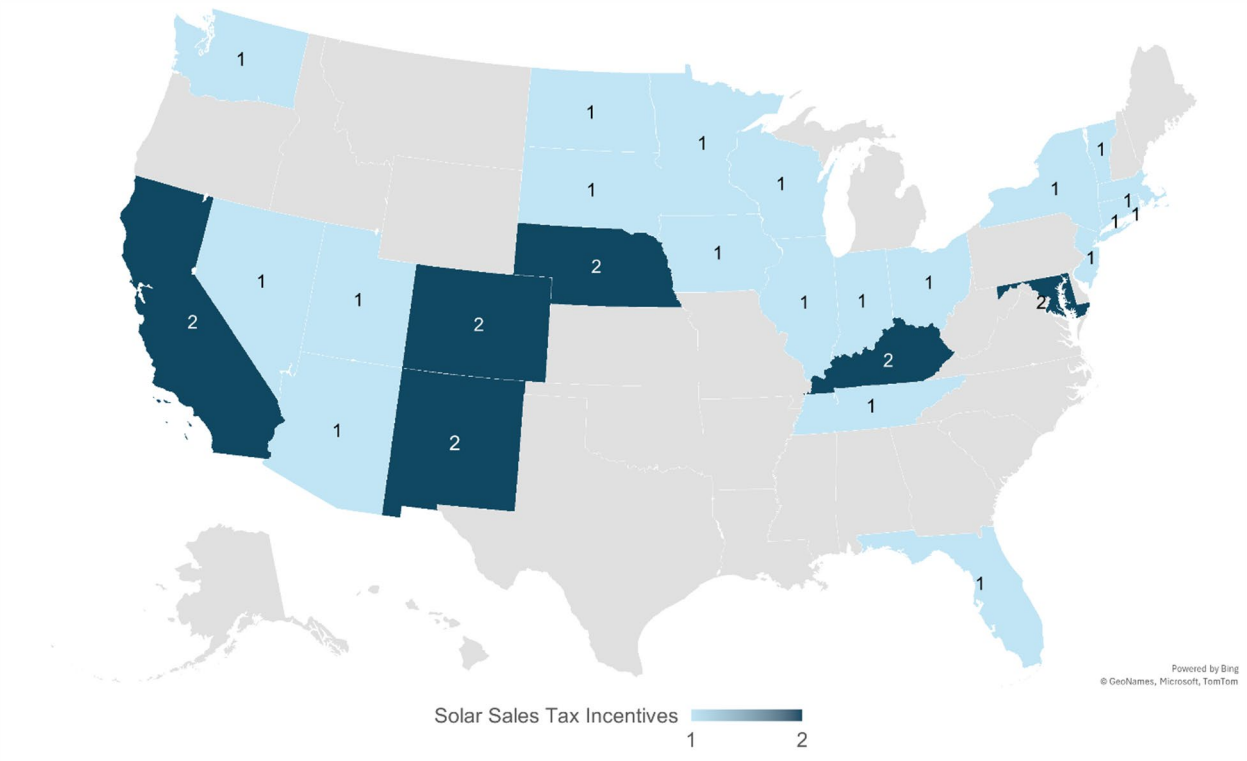
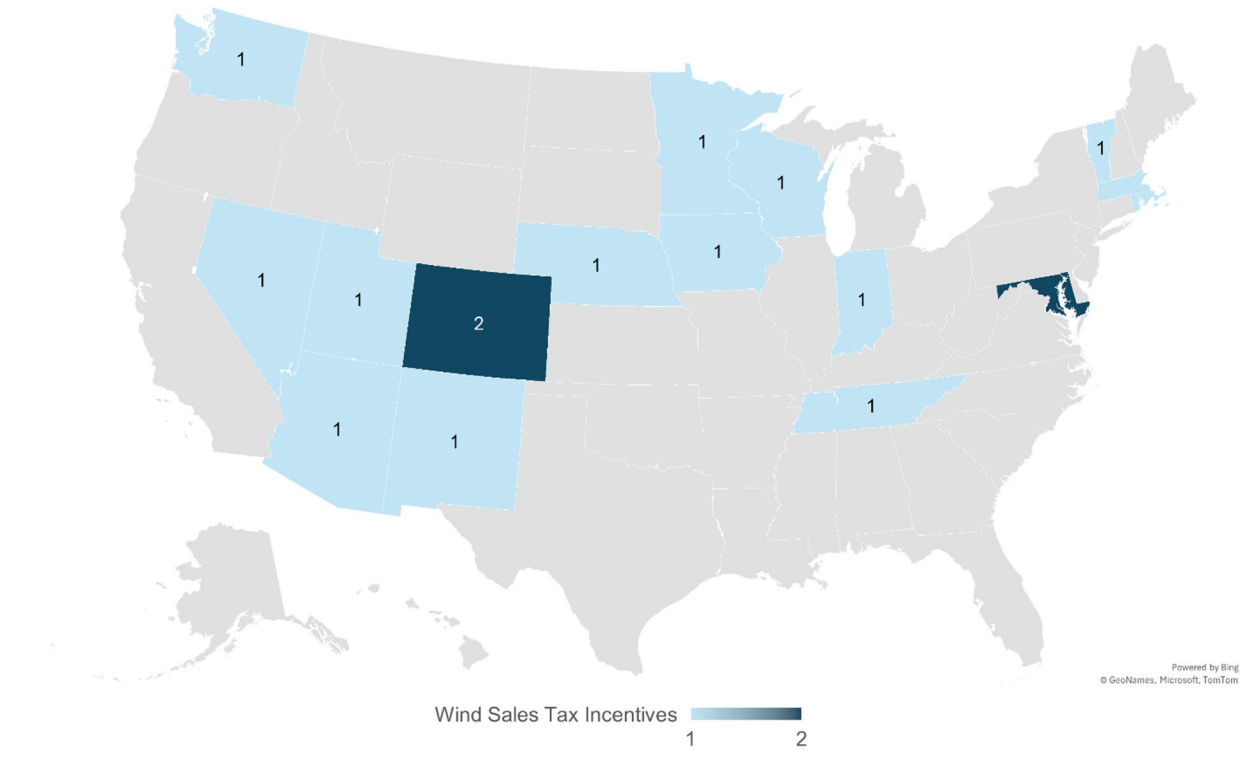


Figure 3. Sixteen States with a Sales Tax Incentive for Small Wind Energy Installations

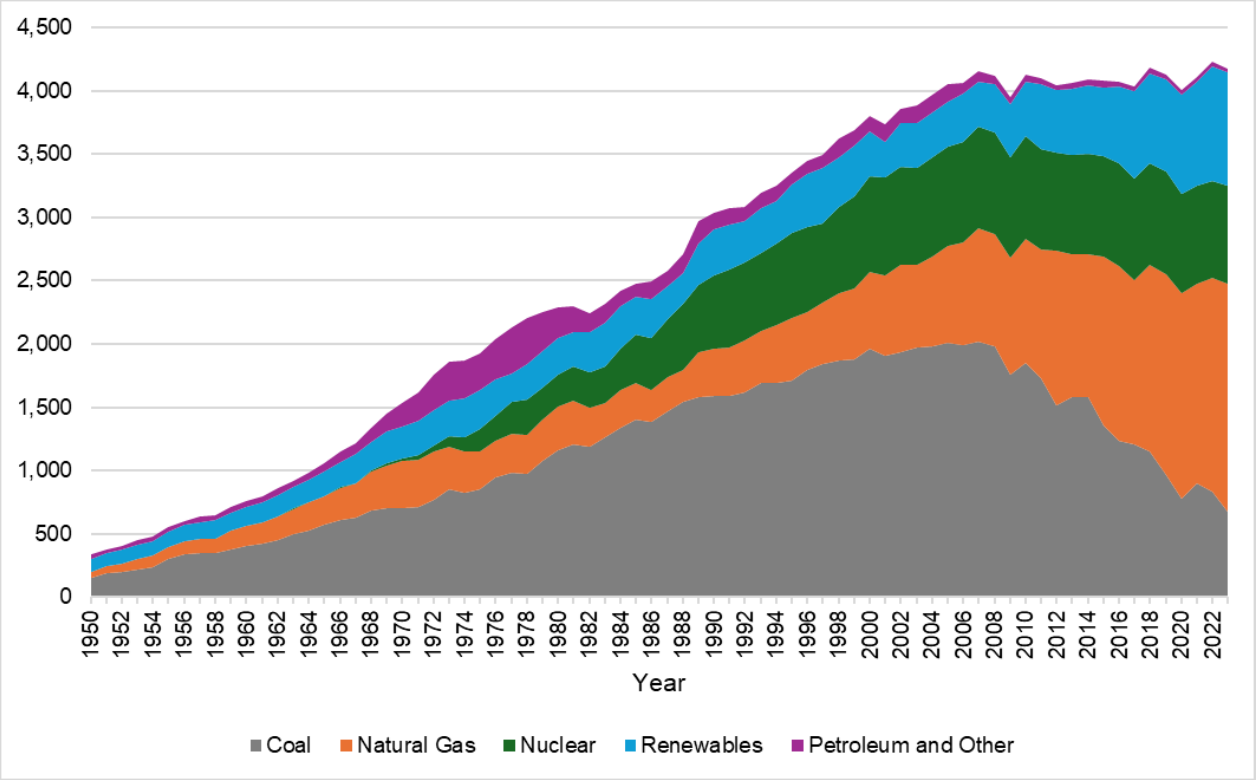


Evaluation

Electricity Fuel Generation Mix

Part of the objective of the general sales and use tax exemptions on wind energy conversion systems and solar energy systems is to increase the utilization of these technologies and ultimately contribute a greater percentage of renewable energy to the state's electricity fuel generation mix. For a national context, Figure 4 displays the electricity mix and increase in energy demand of the United States going back to 1950. Data on Minnesota's electricity fuel generation mix is presented in Figure 5. The trends in source of electricity generation in Minnesota largely mirrors national trends; however, Minnesota did produce more electricity from renewable sources (about 3 percent) in 2020. Figure 5 is presented in a bar chart format to provide for more detailed information on the state's generation mix over time.

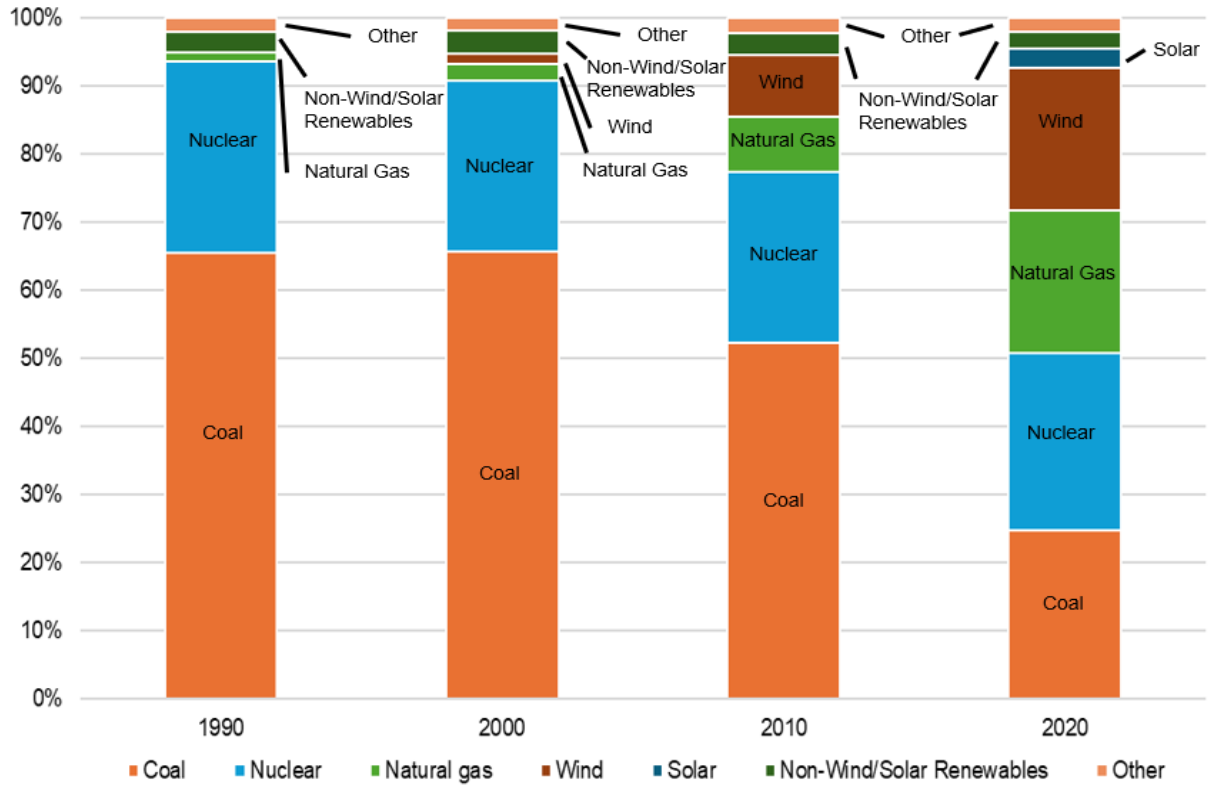
Figure 4. U.S. Electricity Generation by Major Energy Source, 1950 – 2023 (Billion KW/hr)



Data Source: U.S. Energy Information Administration, Monthly Energy Review and Electric Power Monthly, February 2024, preliminary data for 2023

Focusing on Figure 5, Minnesota's electricity fuel generation mix has gone through significant changes over the past three decades. In 1990, coal was Minnesota's primary energy source, and it contributed just over 65 percent of total generation. This share has steadily declined to just under 25 percent in 2020. Nuclear energy, while experiencing a slight decrease from about 28 percent in 1990 to 26 percent in 2020, has maintained its overall contribution. In contrast, natural gas saw a dramatic increase, rising from just 1 percent in 1990 to almost 21 percent by 2020. Wind energy also experienced sizeable growth, rising from zero in 1990 to 21 percent in 2020, reflecting its growing importance in the energy mix. Solar energy, initially nonexistent in the early years, has increased to about 3 percent share by 2020. Non-wind renewables saw a slight decline from 3 percent in 1990 to 2 percent in 2020, while the share of other sources remained relatively stable. Overall, these shifts highlight a transition towards renewable energy sources, specifically illustrated by the proportion of energy generated via wind - and to a lesser degree solar systems.

Figure 5. Minnesota Electricity Fuel Generation Mix, 1990 – 2020 (% of total MWh)



Data Source: U.S. Energy Information Administration, Form EIA-923, Power Plan Operations Report and predecessor forms.

Installed Capacity

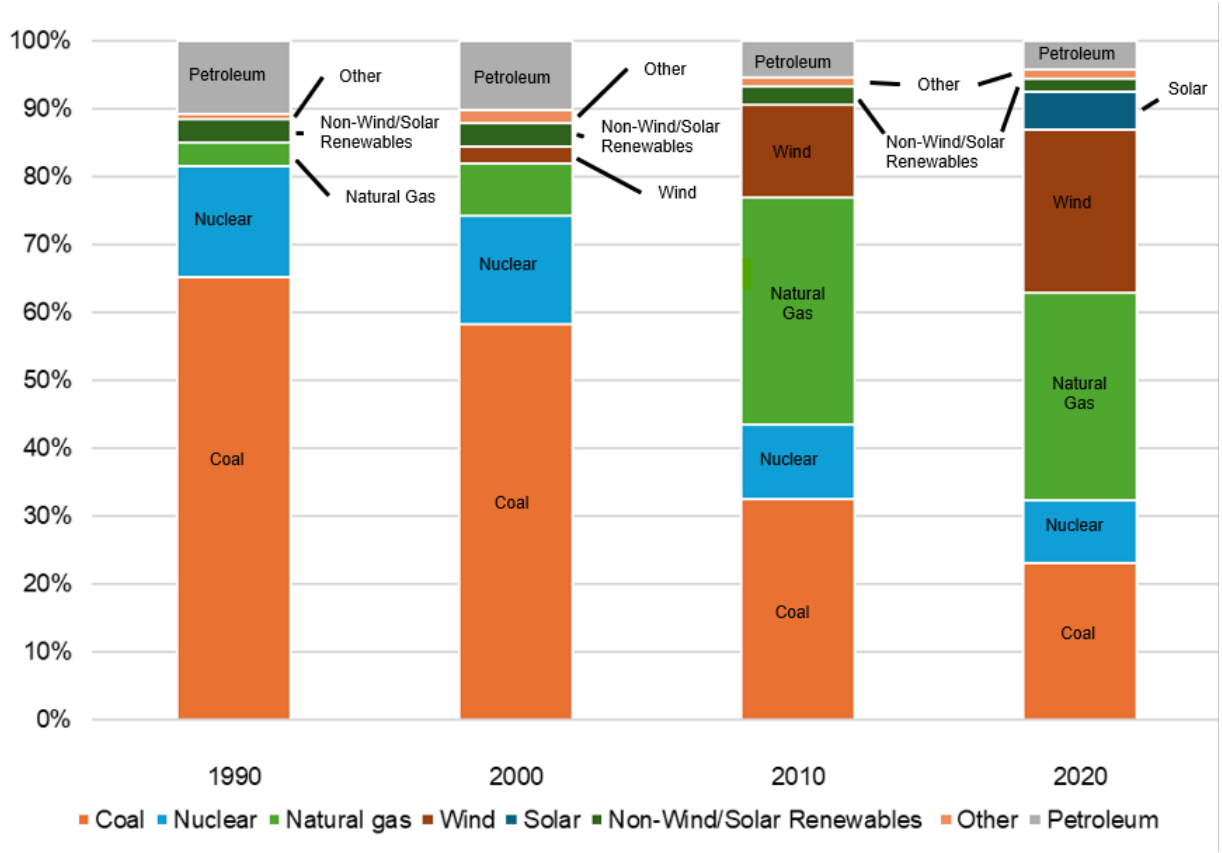
In addition to increasing renewable energy contributions to the state's electricity fuel generation mix, part of the objective for the general sales and use tax exemptions is to increase the implementation of wind energy systems and solar energy systems across Minnesota. Implementation is measured as installed capacity as reported by the EIA. Installed capacity refers to the amount of energy output a system would produce if it were operating at full capacity.[26]

Figure 6 includes three decades of Minnesota's electric power industry capacity data. There are several important items to note regarding installed capacity. Petroleum has a relatively significant portion of installed capacity, which was around 10 percent between 1990 and 2000 but generated less than 1 percent in each reported year. Additionally, coal's decreasing installed capacity indicates a reduction in coal-powered power plants. Lastly, wind and solar saw steady increases in installed capacity between 2010 and 2020, where wind increased by just over 10 percent and solar increased by 3 percent.

26 U.S. Energy Information Administration. "What is the Difference Between Electricity Generation Capacity and Electricity Generation?" https://www.eia.gov/tools/faqs/faq.php?id=101&t=3.

These trends reflect those highlighted in Minnesota's electricity fuel generation mix in Figure 5, but there are limitations to the conclusions that can be drawn from the similarities between electricity generation and capacity. Capacity is a calculation of a fuel source's maximum generation potential. Thus, the total megawatts hours generated, as reflected in Figure 5, could be much higher than past performance based on installed capacity alone.

Figure 6. Electric Power Industry Capacity in Minnesota, 1990 - 2020 (% of total MW)



Data Source: U.S. Energy Information Administration, Form EIA-860, Annual Electric Generator Report.

Location of installations

Figures 7 through 10 depict the concentration of site locations and energy capacity for distributed wind and solar in Minnesota. These maps were developed using available data from the Minnesota Public Utilities Commission (MPUC), Xcel Energy, and Minnesota Power.

Figure 7 depicts DER solar sites in Minnesota, which are primarily clustered around the Twin Cities metro, with lower density in the areas around Duluth and Rochester. The solar capacity depicted in Figure 8 varies from the solar site count map, in that capacity is spread more broadly across the southern and southeast regions of the state.

Figures 9 and 10 show that wind energy installations and wind energy generation is mostly located around the southern and western areas of Minnesota. There is also wind energy activity clustered along the North Shore of Lake Superior, though this area sees a lower DER capacity than the southern and western regions of Minnesota. In a National Renewable Energy Laboratory (NREL) report discussing the economic potential of distributed wind in Minnesota, average wind speed and turbine siting availability are shown to be concentrated on the western edge and notably the southwestern corner of the state. [27] Figures 9 and 10 show that Minnesota is largely aligned with these NREL models. This correlation points toward effective DER wind site placement in Minnesota.

[27] National Renewable Energy Laboratory. “Assessment of the Economic Potential of Distributed Wind in Colorado, Minnesota and New York.” https://www.nrel.gov/docs/fy18osti/70547.pdf

Figure 7. Map of Solar Energy Site Locations in Minnesota 1

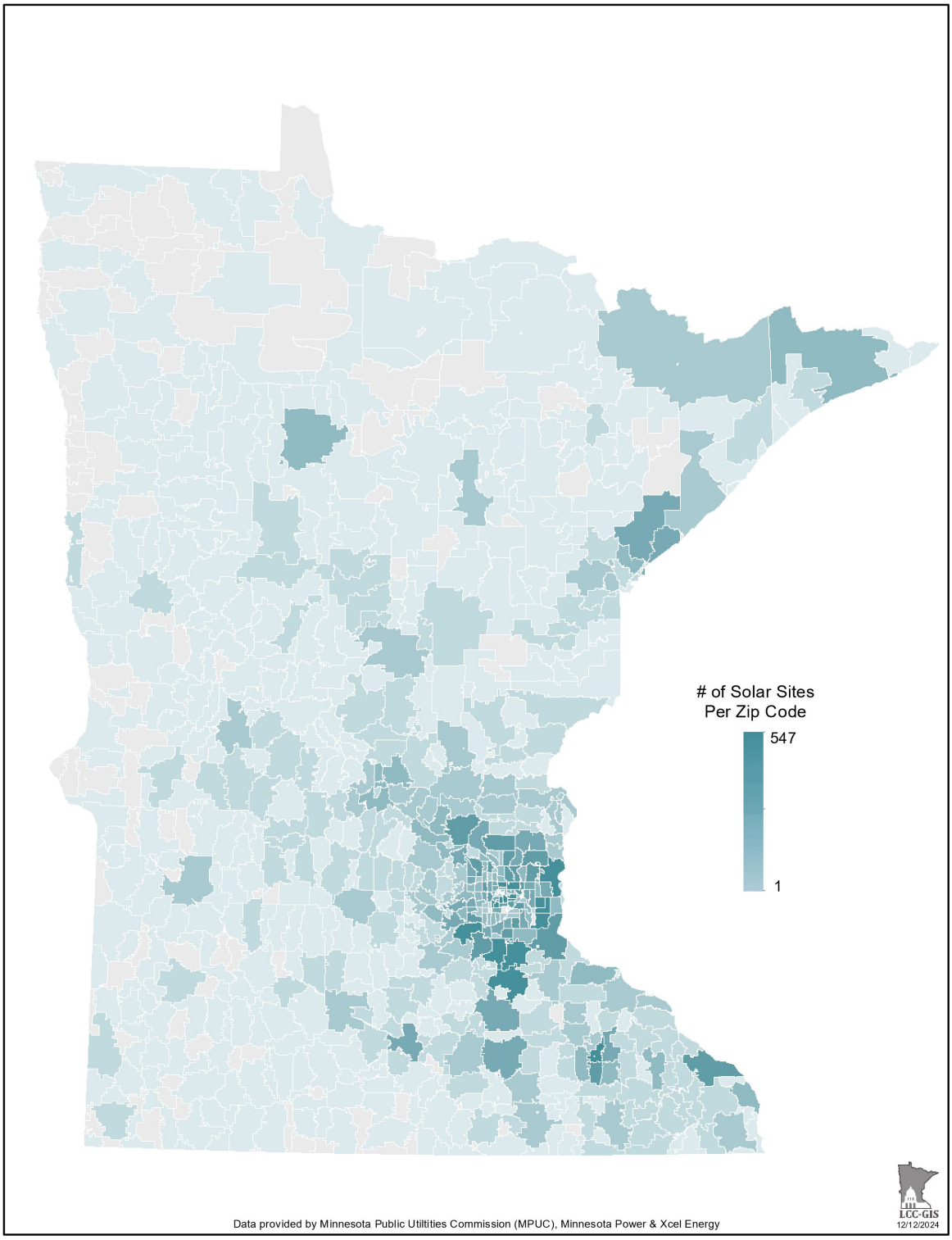


Figure 8. Sum of Distributive Energy Solar Capacity in Minnesota

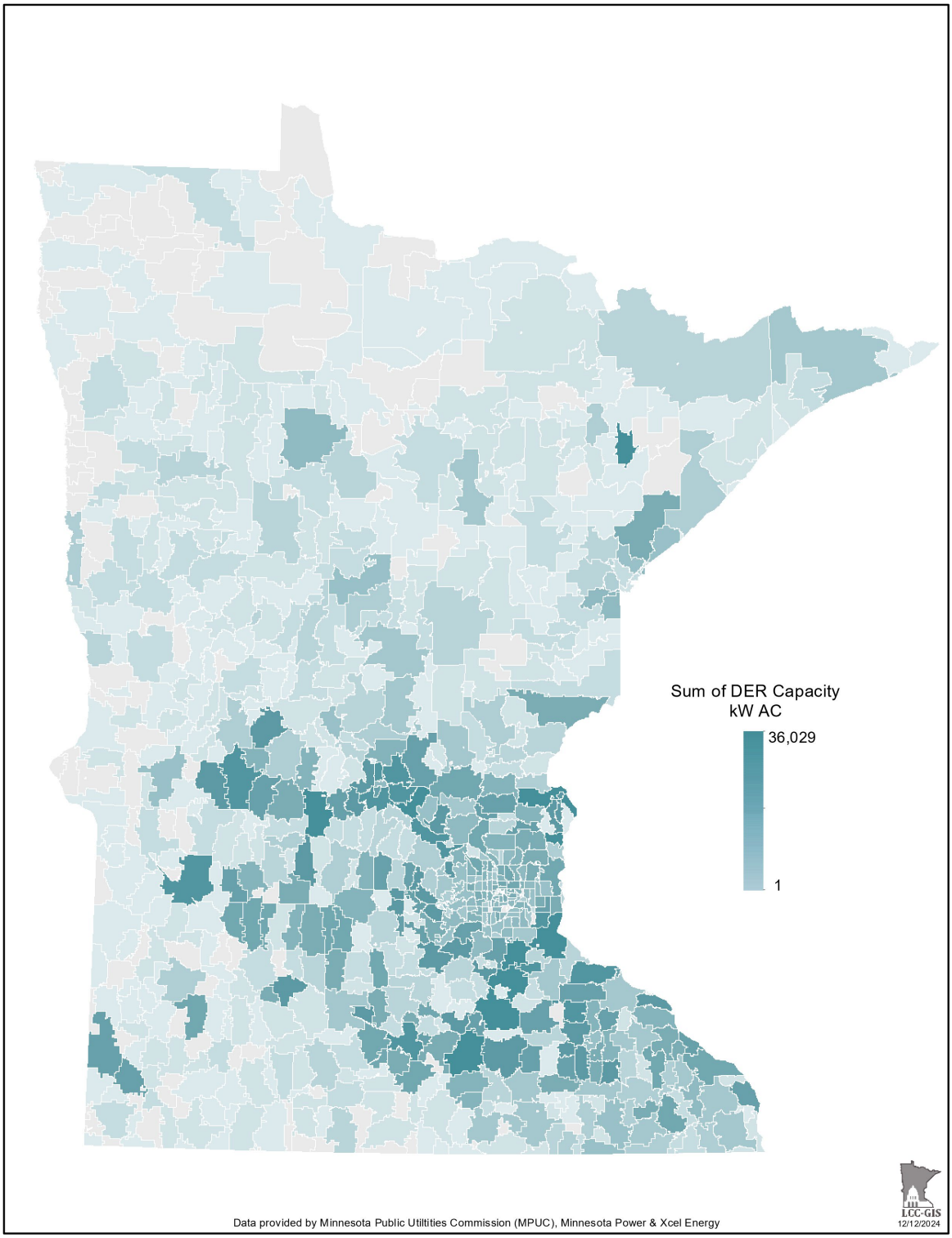


Figure 9. Map of Wind Energy Site Location in Minnesota

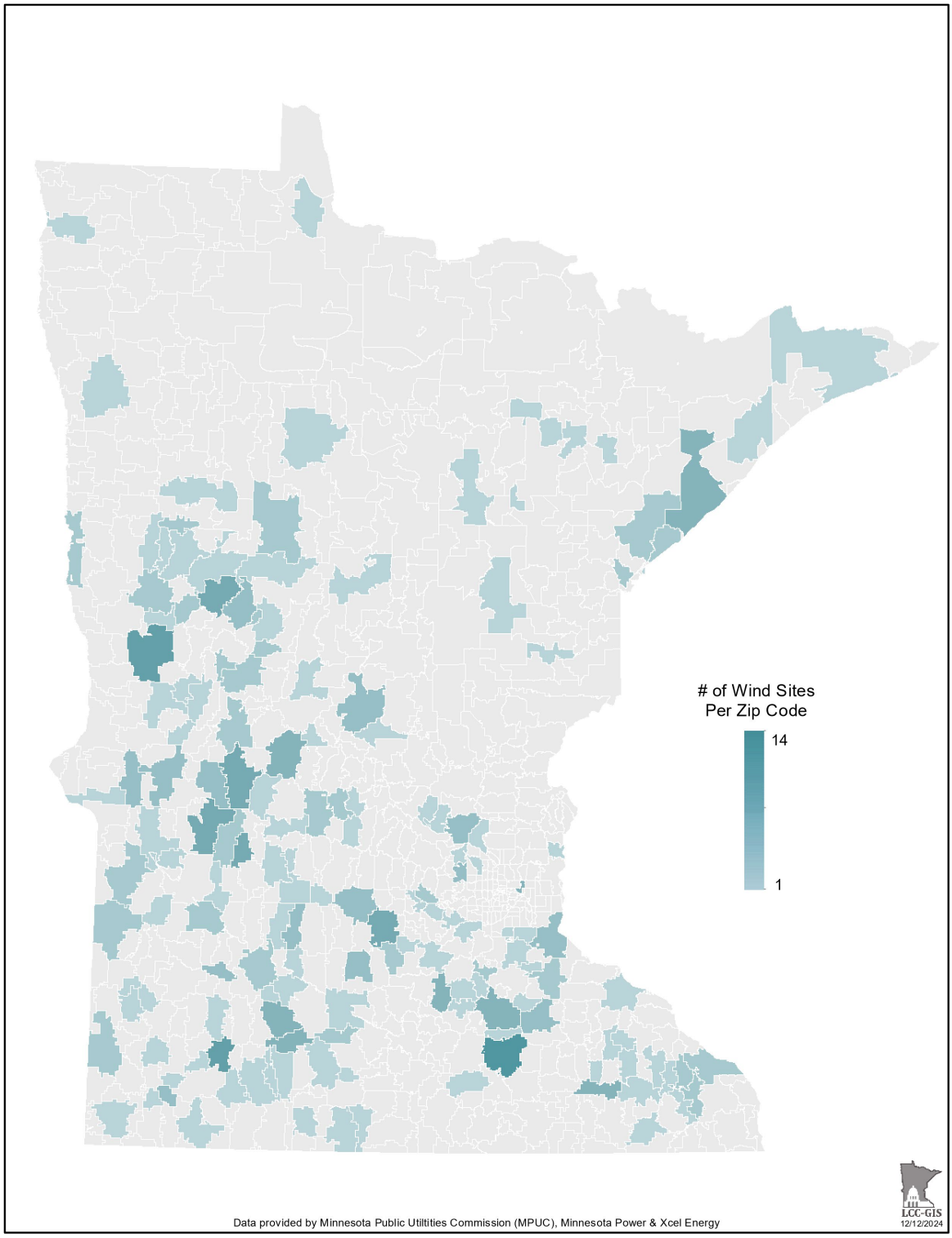
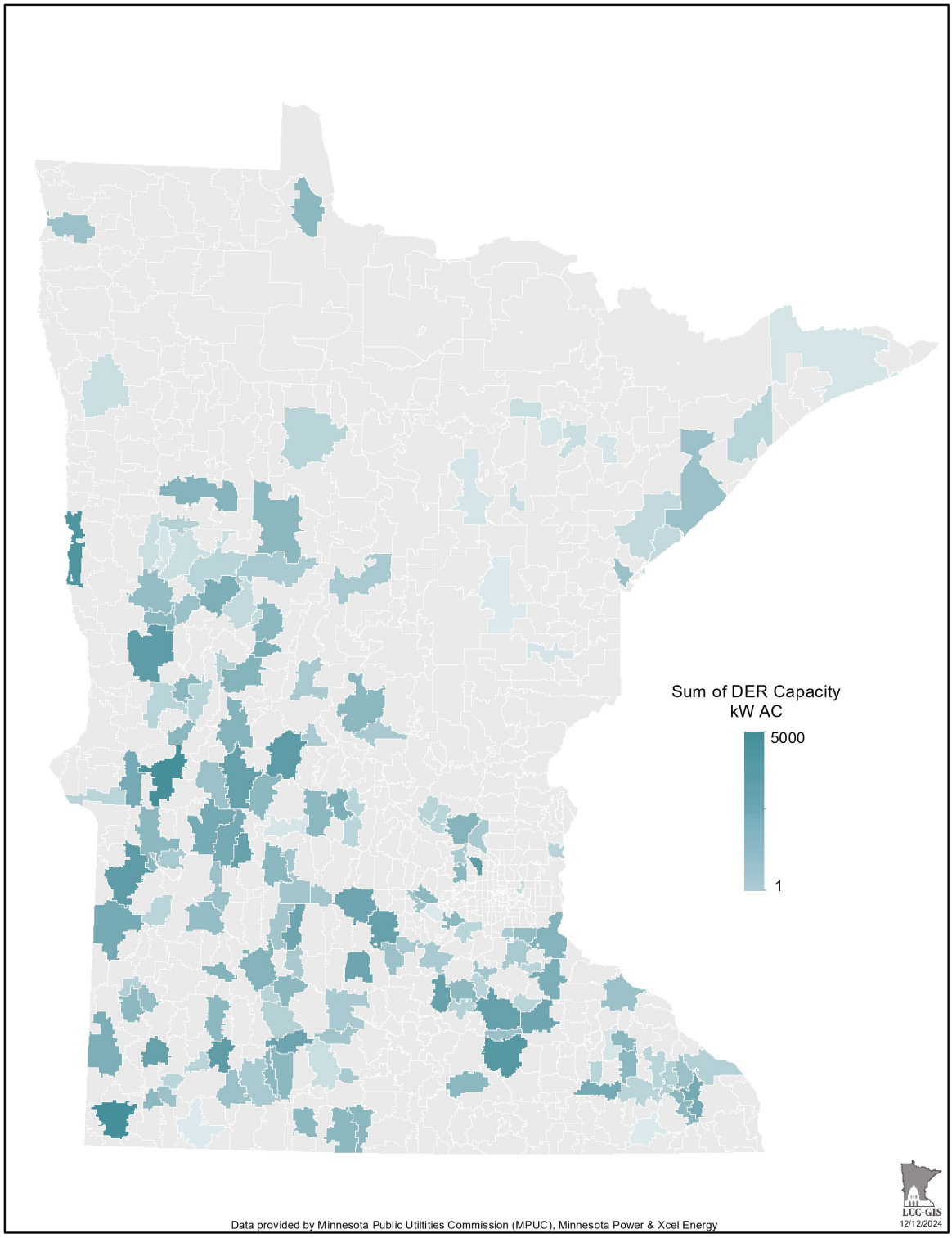


Figure 10. Sum of Wind Distributive Energy Capacity (kW AC)



Customer Type

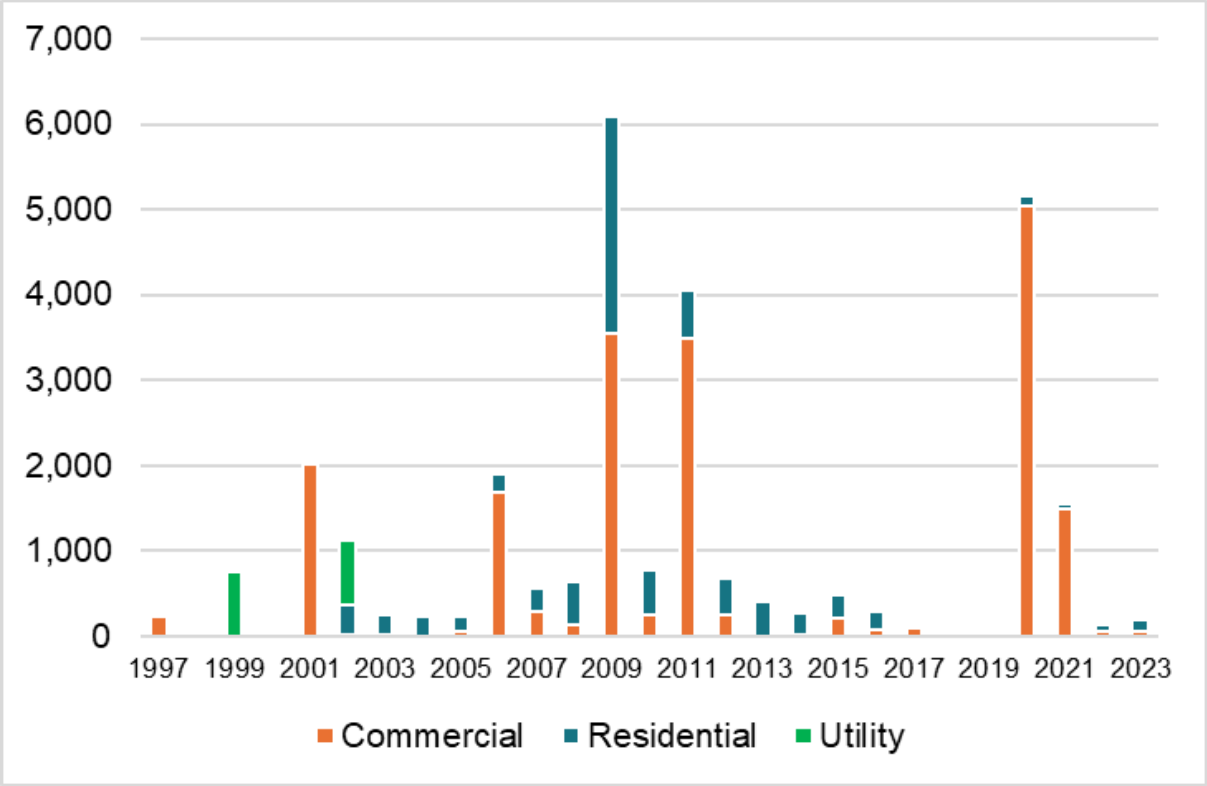
Information on customer type is presented using annual added capacity across customer types as reported by the MPUC Annual Distributed Generation Report.[28] Annual added capacity is used in place of the count of annual installations as it provides a detailed window into the distributed energy landscape. This is primarily because it illustrates the additional quantity of potential generated energy each year. Using a count of annual installations would be misleading as it would mute the scale of these systems. This is especially true for wind systems, as single systems often produce a greater amount of energy than a single solar energy system.

Annual wind capacity uptake in Minnesota by customer type is presented in Figure 11. There is significant variation in the frequency at which wind energy systems are installed. Most customers fall within the commercial category, though there was a higher uptake of residential wind systems between 2005 and 2015. Differences between solar and wind in the amount of added capacity each year are likely due to the fact there are much fewer locations of wind systems (n=440) than solar (n=37,492) included in the dataset. Solar is a more affordable and, overall, more accessible distributed energy system, thus making it the more popular choice among residential customers.[29]

As depicted in Figure 12, solar installations were minimal until 2016. The primary drive of the sharp uptake in installation is CSGs, which accounted for the majority of added capacity in 2016-2020. CSGs are shared solar panel systems, which allow individuals to benefit from distributed energy systems without bearing the full cost of installation and maintenance.[30]

[28] MPUC. "Annual Distributed Generation Report, Minnesota Data through December 31, 2022."
[29] World Economic Forum. “Solar vs wind power: The ultimate showdown.” https://www.weforum.org/stories/2022/03/solar-wind-power-renewable-energy-climate-change/#:~:text=Wind%20power%20takes%20up%20far,the%20top%20residential%20solar%20panels.
[30] Minnesota Commerce Department. “Community Solar Gardens”. https://mn.gov/commerce/energy/consumer/energy-programs/community-solar-gardens.jsp

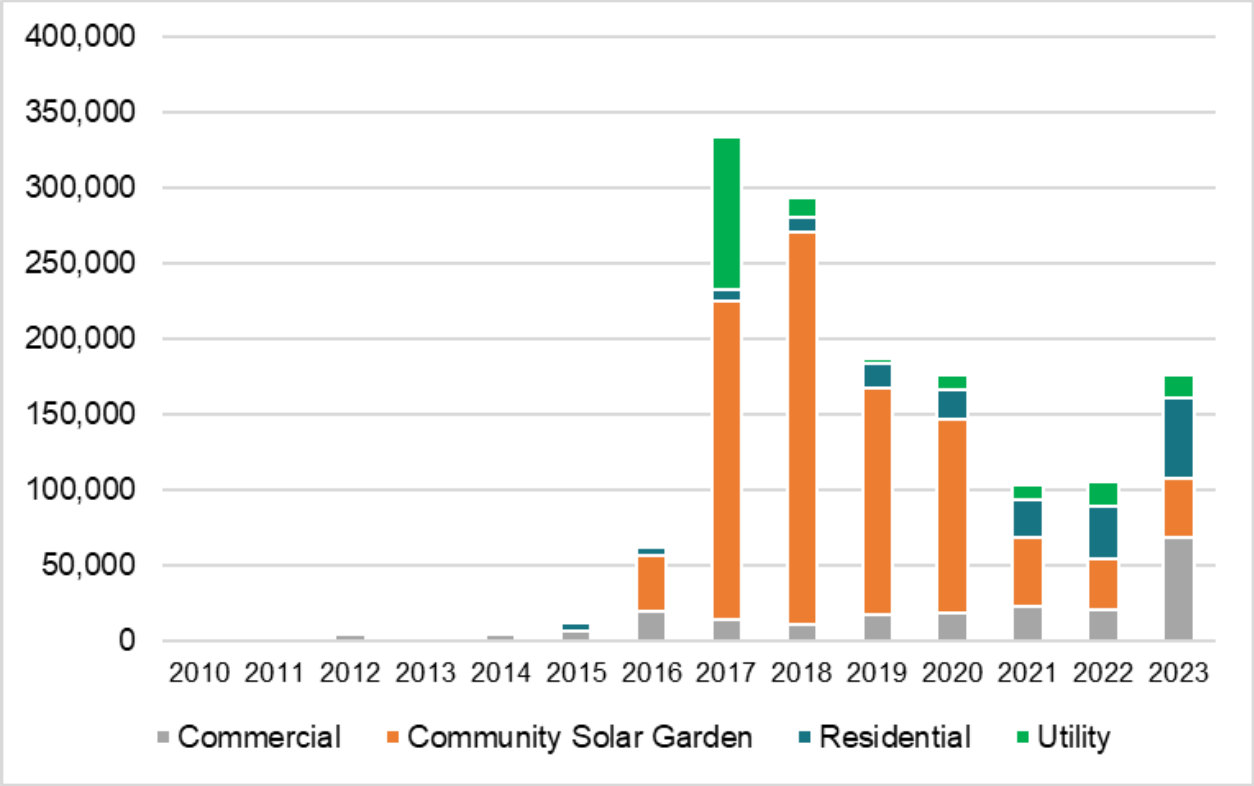
Figure 11. The Sum of Annual Added Wind Capacity (kW AC), 1997 – 2023, *total installations* = 440



Data Source: Minnesota Public Utilities Commission (MPUC). 2024. "Annual Distributed Generation Report, Minnesota Data through December 31, 2023."; Minnesota Power; Xcel Energy.

Note: Data prior to 1997 are negligible relative to what is included here and have been excluded.

Figure 12. The Sum of Annual Added Solar Capacity by Customer Type (kW AC), 2010 – 2023, *total installations* = 37,492



Data Source: Minnesota Public Utilities Commission (MPUC). 2024. "Annual Distributed Generation Report, Minnesota Data through December 31, 2023."; Minnesota Power; Xcel Energy

Note: Data prior to 2010 are negligible relative to what is included here and have been excluded.

Installed Costs

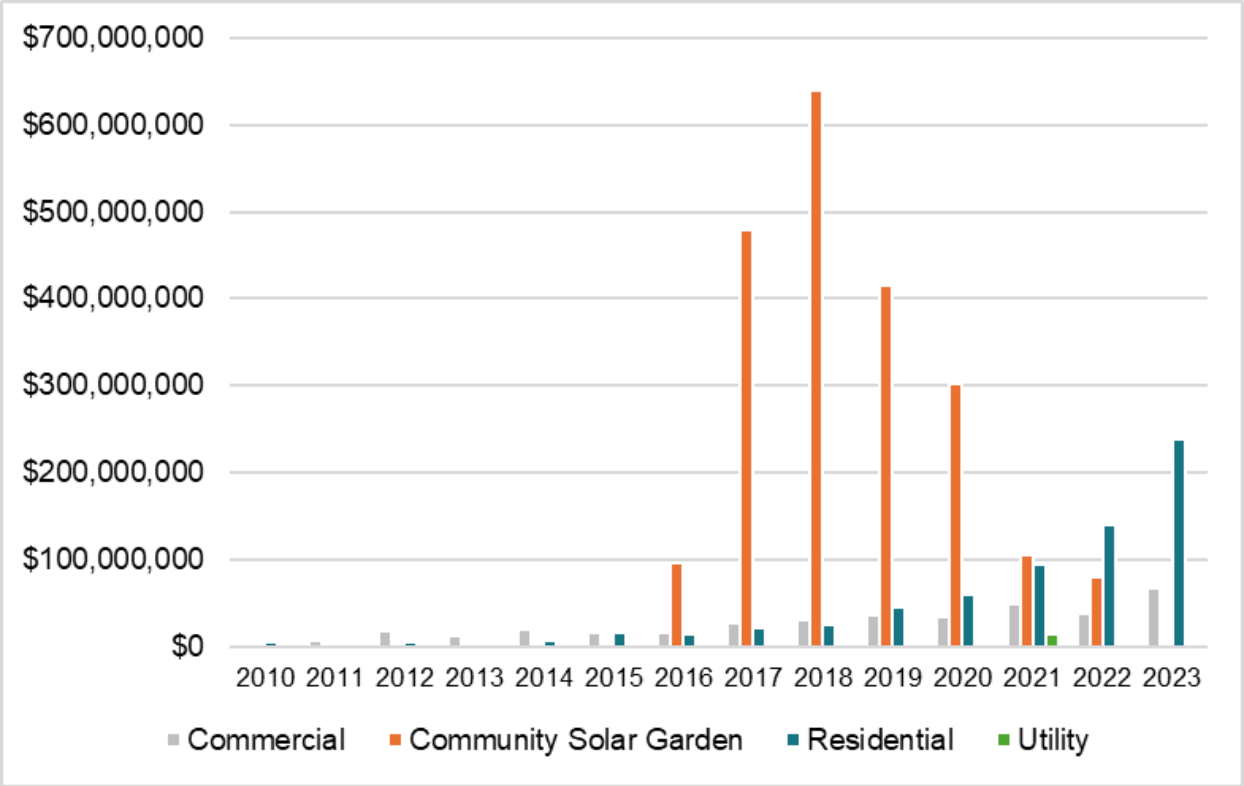
The total installed cost of solar and wind energy systems was included in the MPUC dataset. These are estimates made by the customer and reported to the utility company, not the exact cost of each respective energy system. Additionally, MPUC cannot verify whether interconnection costs are included as part of installation costs in these self-reported figures. Xcel Energy alone accounts for about 70 percent of the distributed energy systems reported in the dataset. Figure 13 illustrates the magnitude of installed costs of distributed solar energy systems. Only installed costs of distributed solar energy systems are included in this analysis due to inconsistencies with the reported costs of distributed wind energy systems.

The total installed cost of solar equipment has increased rapidly within the last 10 years. Before 2016, investment in solar equipment was minimal and experienced sluggish growth. Beginning in 2016, investment skyrocketed from just under $100 million to just over $600 million in 2018. It has declined since then except for 2020, where it

underwent a slight increase. The variation in investment is likely due to the different types of customers installing solar panels.

Looking at installation costs by customer type reveals huge investments from CSG customers within the 2016 to 2022 range.[31] These costs, as depicted in Figure 13, are exclusively the costs that the CSGs paid Xcel Energy to interconnect their solar arrays to Xcel Energy's electricity grid. Xcel Energy clarified that these numbers include only interconnection costs, not installation costs of each solar garden. Thus, these estimates are likely lower than the actual amount of foregone revenue.

Figure 13. Total Installed Cost of Solar Installations by Customer Type, 2010 - 2023



Data Source: Minnesota Public Utilities Commission (MPUC). 2024. "Annual Distributed Generation Report, Minnesota Data through December 31, 2023."; Minnesota Power; Xcel Energy.

[31] Minnesota passed a law in 2013 that prioritized the construction of community solar gardens. See Minnesota Statutes 2024, section 216B.1641.

Estimates of Foregone Revenue

Figure 14 displays the DOR Tax Research estimates of foregone revenue for each tax expenditure included in the evaluation for fiscal years 2024 through 2027. These estimates are published in the 2024 Tax Expenditure Budget and are based on data from the Minnesota Department of Commerce, the U.S. Department of Energy, U.S. Energy Information Administration, The Energy Markets and Policy Berkeley Lab, and EnergySage.

Figure 14. Estimates of Foregone Revenue

Fiscal Year	2024	2025	2026	2027
Wind	$11,300,000	$11,600,000	$12,000,000	$12,500,000
Solar	$9,000,000	$9,300,000	$10,000,000	$10,700,000

Note: These estimates come from the 2024 Tax Expenditure Budget.

The LBO estimated foregone revenue of previous calendar years using the total installed costs of DERs as reported to MPUC. It is understood that reported costs include system and installation costs. Additional interconnection cost data was received from Minnesota Power and Xcel Energy for the purposes of this evaluation.[32] This interconnection cost data was reported as non-public data to MPUC, but was made available to the LBO upon request.[33] Figure 15 displays LBO estimates of foregone revenue with and without the estimates associated with CSGs.[34] Estimates from 2016 to 2022 are much higher due to the interconnection costs associated with new solar gardens.

Though there was a rapid increase in foregone revenue due to CSG, this is not likely to continue and may even decrease for several reasons. First, the growth in CSG is due to Minnesota's CSG program, which, as a result of legislative changes made in 2023, is likely to slow in growth.[35] This decrease in growth is already evident in the decreases in

[32] DOR Tax Research confirmed that interconnection costs would be exempt from sales tax based on the broad definition of the solar energy system exemption in Minnesota Statutes, section 216C.06, subdivision 17, and an understanding that costs associated with performing interconnection services would not be taxable based on Minnesota Statutes, section 297A.61, subdivision 3(j). In cases where verification may be necessary, billing documents are reviewed to verify the eligibility of purchased products.

[33] Utility companies are allowed to deem certain data "not for public consumption" when submitting to MPUC. Minnesota Power and Xcel both filed their reasoning when they remitted the data. Therefore, some interconnection cost estimates were not available when estimates of foregone revenue were calculated for the 2024 Tax Expenditure Budget. Both companies privately agreed to share this data with the LBO at a higher level of aggregation through the course of this evaluation.

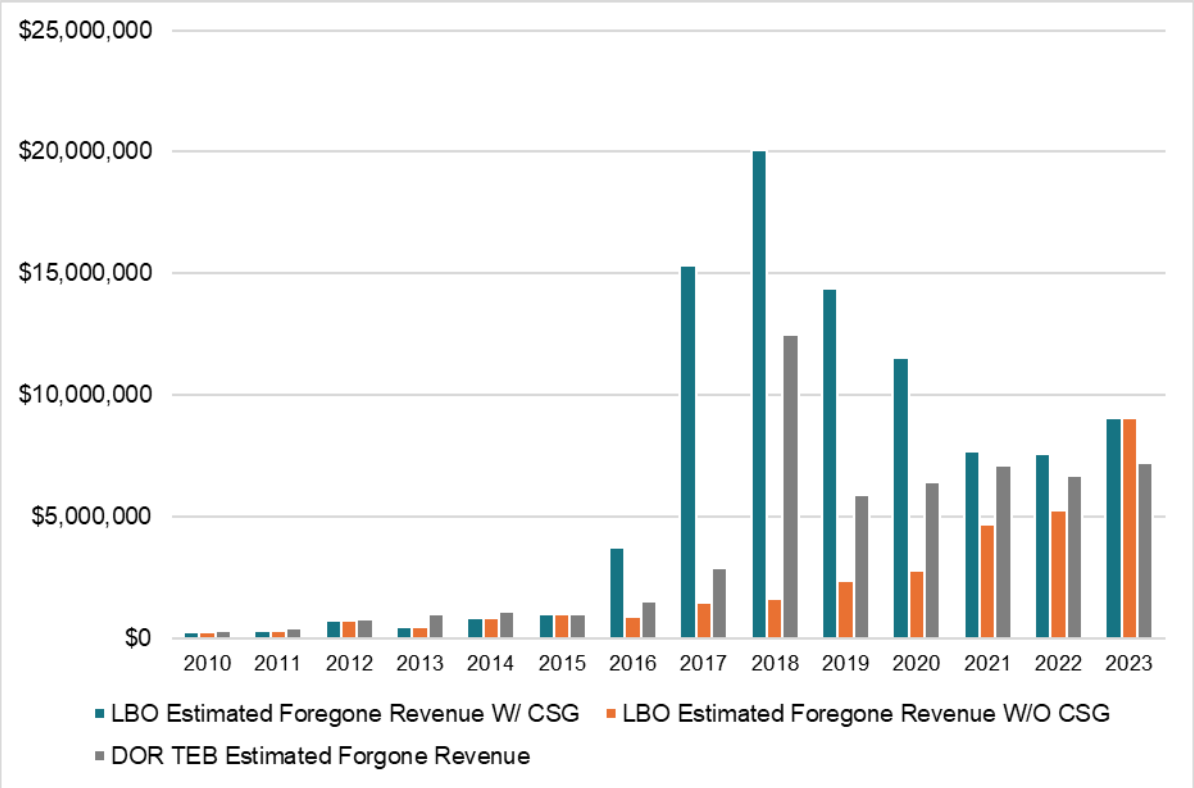
[34] These estimates assume that 58% of CSG costs and 57% of other PV costs are attributed to labor, thus not taxable. These labor cost estimates are based on a report by the National Renewable Energy Lab (NREL). National Renewable Energy Lab. "U.S. Solar Photovoltaic System and Energy Storage Cost Benchmarks, With Minimum Sustainable Price Analysis: Q1 2023." September 2023.

[35] Bob Eleff, "Changes to Xcel Energy's Community Solar Garden Program: 2023-2024." MN House Research, December 2024.

annual added capacity in recent years.[36] Lastly, changes in federal policy are likely to drastically decrease the number of clean energy projects, including CSGs.[37]

Estimates from the latest and of previously published Tax Expenditure Budgets are also plotted on Figure 15 to illustrate trend lines; though it is important to note that estimates from the Tax Expenditure Budget are reported in fiscal years. For visualization purposes, these estimates have been plotted alongside calendar year estimates to illustrate trends in fiscal impact.

Figure 15. Comparison of LBO estimated Foregone Revenue with CSG Interconnection costs, without, and TEB Estimates



Data Source: Minnesota Public Utilities Commission. 2024. "Annual Distributed Generation Report, Minnesota Data through December 31, 2023."; Minnesota Power; Xcel Energy; Minnesota Department of Revenue Tax Research Division. Tax Expenditure Budget. Editions 2010, 2012, 2014, 2016, 2018, 2020, 2022.

Note: Estimates from the Tax Expenditure Budget are reported in fiscal years. For visualization purposes, these estimates have been plotted alongside calendar year estimates to illustrate trends in fiscal impact.

[36] Minnesota Public Utilities Commission, Distributed Energy Resources in Minnesota (2023 data)".
[37] Rhodium Group, "What Passage of the "One Big Beautiful Bill" Means for US Energy and the Economy." July 11, 2025.

Revenue Neutral Rate

DOR Tax Research identified revenue-neutral rates for the sales and use tax exemptions on wind energy conversion systems and solar energy systems. A revenue-neutral rate means the state could maintain its current revenue levels even if a specific tax expenditure was repealed. Minnesota's general sales and use tax rate has been set at 6.875 percent since July 1, 2009. [38] If the exemption for Wind Energy Conversion Systems was repealed, the general sales and use tax rate would have to decrease to 6.866 percent to maintain current state revenue levels. Similarly, repealing the exemption for Solar Energy Systems would require reducing the tax rate to 6.868 percent. These rates were calculated independently, assuming one exemption is repealed while the other remains in place.

Incidence

A tax incidence analysis is not available for either of the tax exemptions directly. Tax incidence refers to who ultimately bears the relative burden of a tax. As a proxy, we analyze incidence of sales tax paid by businesses and the incidence of claims for the Residential Clean Energy Credit.

DOR Tax Research assumes the incidence of these two sales tax exemptions to be similar to the incidence of the business sales tax, as explained in the 2024 Tax Expenditure Budget.[39] For an overview of the business sales tax incidence, please see Figure 16, originally published on page 135 of the 2024 Tax Expenditure Budget. The LBO understands the Business Portion of Sales and Use Tax to mean the sales tax on business purchases paid by a business that is not expected to be fully reflected in the price paid by consumers. This is separate from sales tax paid by households whether they be Minnesota residents or nonresidents.

Figure 16 provides a breakdown of the business portion of Minnesota's general sales and use tax paid by population decile.[40] Excluding non-residents, 74 percent of the business portion of the general sales and use tax is paid by the top half of Minnesota businesses, deciles six through ten. This aligns with the LBO's expectations of a heavier distribution of incidence to land in the top half of the population, considering the high cost of wind and solar renewable energy technology. In other words, the upfront costs of equipment is likely to limit who can afford to buy and install such equipment; therefore, who is most likely to benefit from both exemptions from the general sales and use tax.

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[38] Laws of Minnesota 2009, chapter 88, article 4, section 4; Minnesota Statutes 2024, section 297A.62, subdivisions 1, 1a.

[39] Minnesota Department of Revenue Tax Research Division. State of Minnesota Tax Expenditure Budget Fiscal Years 2024-2027. Page 154.

[40] Population deciles rank the sample population into 10 equal segments by ascending levels of income, each segment containing the same number of observations. In this case, the first segment, or decile, includes businesses with the lowest levels of income, while the tenth decile includes businesses with the highest levels of income.

Figure 16. Tax Incidence of the Business Portion of General Sales and Use Tax in Minnesota[41]

General Sales Tax, Business Portion

Population Decile	Sales & Use Tax	Business Portion of Sales & Use Tax	Share of Business Portion
$15,544 & Under	$275,989,456	$108,858,170	2.7%
$15,545 - $24,961	$321,365,571	$119,743,208	2.9%
$24,962 - $35,168	$369,752,647	$139,471,032	3.4%
$35,169 - $45,808	$417,394,917	$159,742,201	3.9%
$45,809 - $58,014	$465,046,347	$178,530,355	4.4%
$58,015 - $73,668	$526,644,412	$201,895,886	4.9%
$73,669 - $95,360	$641,957,246	$248,497,825	6.1%
$95,361 - $127,780	$802,412,748	$311,867,360	7.6%
$127,781 - $183,475	$988,123,559	$386,770,698	9.5%
$183,476 & Over	$2,041,065,136	$882,501,822	21.6%
Nonresidents	$1,605,124,031	$1,354,771,928	33.1%
All	**$8,454,900,000**	**$4,092,700,000**	**100%**

The Statistics of Income (SOI) program at the Internal Revenue Service published several statistic tables on claims for the Residential Clean Energy in tax year 2023. SOI's Table 2 lists out Residential Energy Credits, by size of adjusted gross income. This table was analyzed as a proxy for the incidence of the sales tax exemptions on solar and wind energy for residential households. For reference, Table 2 is provided in Appendix D.

There were 1,246,440 claims for the Residential Clean Energy Credit, totaling to $6,337,122,000 ($6.3 billion), in tax year 2023. This represents almost one percent of the population that completed Form 1040 for their 2023 income tax filing. In the case of Residential Clean Energy Tax credits being a proxy for households, the majority of claims go to the top quarter of households. With respect to the state's sales and use tax exemptions for solar energy and wind energy conversion systems, this can be interpreted to mean that 67 percent of the benefit of these exemptions goes to the top quarter of earners. An analysis of claims and credit values is provided in the following paragraph.

Thirty-three percent of the value of Residential Clean Energy Credits went to households with adjusted gross income between $25,000 - $100,000. Fifty-four percent of claims for the credit come from the same income range. Roughly 49 percent of the tax filing population falls within this income range. Meanwhile, 40 percent of the value of credits went to households with adjusted gross income between $100,000 - $200,000, representing nearly 30 percent of the claims. About 17 percent of the tax filing

[41] Minnesota Department of Revenue Tax Research Division. State of Minnesota Tax Expenditure Budget Fiscal Years 2024-2027. Page 135.

population falls in this income range. The final 27 percent of the value of credits went to households with adjusted gross income above $200,000, about 14 percent of claims for the credit. Seven percent of the tax filing population falls in this income range. Ultimately, about 44 percent of the claims for the Residential Clean Energy Credit come from households in the top 24 percent of the population. These claims receive 67 percent of the value of credits issued. This exceeds the expectations described above that claims would fall heavily in the top half of the population.

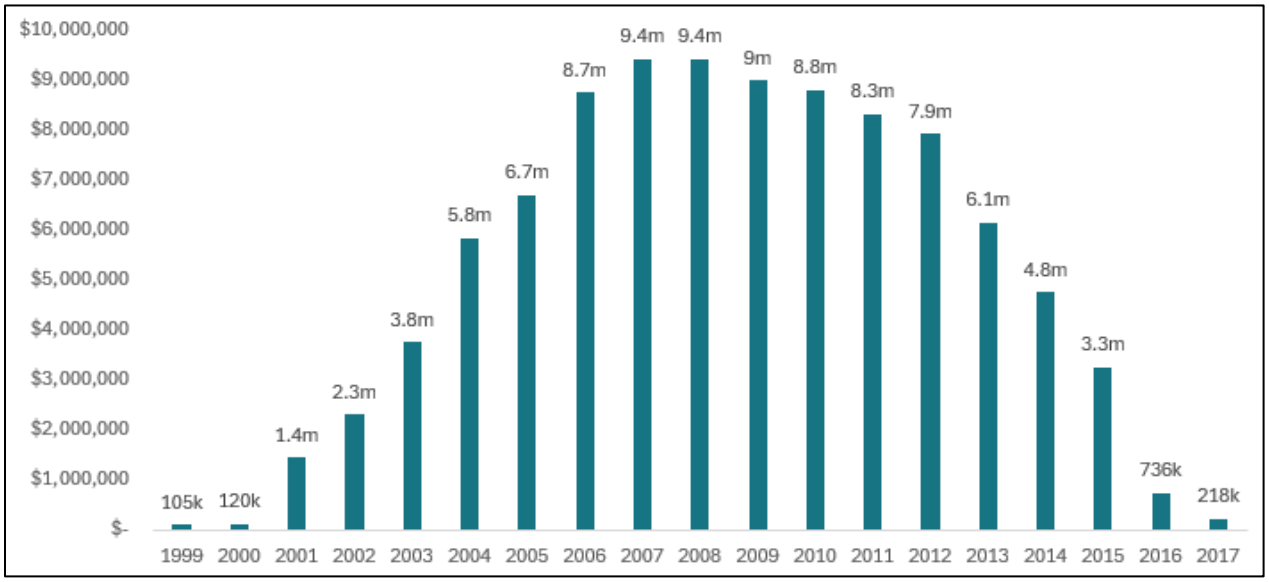
Cumulative Fiscal Impacts of other State and Federal Programs

Minnesota's general sales and use tax exemptions for solar and wind energy systems operate within a broader policy landscape that includes various state and federal incentives aimed at promoting renewable energy in the State of Minnesota. Understanding the cumulative fiscal impacts of these incentives provides an important context for evaluating the effectiveness of Minnesota's exemptions for solar and wind systems. This section examines key state production incentives, as well as federal tax policies and grants that encourage contributions to Minnesota's renewable energy goals. This section covers both past and current incentives.

Under Minnesota Statutes 1996, section 216C.41, subdivision 2, the state provided incentive payments for electricity produced by wind energy conversion facilities from 1999 to 2017 under the Renewable Energy Production Incentive. During this time, the state made 2,069 incentive payments totaling approximately $97 million.[42] The Department of Commerce estimates that 194 – 200 different wind facilities and producers benefitted from these incentive payments. The program was designed to expire, per statute, on December 21, 2018. Figure 17 depicts annual incentive payments as reported by the Department of Commerce.

[42] Jack Kluempke, Minnesota Department of Commerce Email Response to LBO Research Team. December 13, 2024.

Figure 17. Wind Energy Incentive Payments, 1999 – 2017 (amounts in USD)



In 2013, the Solar Energy Production Incentive program was created by the Minnesota Legislature to be administered jointly by the Department of Commerce and Xcel Energy starting in 2014. This program provides production-based payments to Xcel customers who own and operate a qualifying solar energy system, and is funded by payments made from Xcel Energy to the state Renewable Development Account for nuclear cask storage.[43] Additionally, owners receive credits on their monthly utility bill through the net metering benefit for any excess energy produced by the solar energy system that is directed to the interconnected utility provider for redistribution across the utility grid. To qualify for production incentive payments, a solar energy system cannot exceed a total aggregate nameplate capacity of 40 kilowatts and must be sized to produce up to 120 percent of the owner's annual energy consumption.

The Legislature initially set aside $5 million annually for production incentives and planned for the program to run for five consecutive years.[44] The program has since been extended and the allocated amounts have been adjusted across years. Payments are allowed through 2035 to cover production incentives to owners of solar energy systems. Five million dollars is allocated annually to cover incentive payments from 2026 through 2035, with unspent amounts being transferred to the state's renewable development account on January 1, 2038.[45]

At the federal level, tax expenditures and grants have been available to individuals and businesses choosing to install renewable energy equipment on their property. DOR Tax Research estimates that Minnesota taxpayers received over $69.5 million through the Residential Clean Energy Tax Credit in tax year 2023 for the purchase and installation

[43] Minnesota Statutes 2024, section 216C.41; Minnesota Statutes 2024, section 116C.779
[44] Laws of Minnesota 2013, chapter 85, article 10, section 1. Minnesota Statutes 2024, section 116C.7792.
[45] Laws of Minnesota 2025, 1st Spec. Sess. chapter 7, article 3, section 1.

of qualifying renewable energy technology. DOR Tax Research estimates that $63.5 million of these credits were for the purchase of solar energy systems, which would also qualify for the state's sales and use tax exemption. This includes solar electric and solar heating equipment. With respect to wind energy conversion systems, DOR Tax Research estimates that Minnesota taxpayers received over $526 thousand in Residential Clean Energy tax credits.[46] Figure 18 displays estimates of Residential Clean Energy credits to Minnesota taxpayers by qualifying renewable energy sources. These estimates are based on clean energy tax statistics published by the Internal Revenue Service SOI program. [47]

[46] Ben Pults. DOR Tax Research Email Response to LBO Research Team. January 23, 2025.
[47] Internal Revenue Service Statistic of Income Division. Clean Energy Tax Credit Statistics – Table 3. Form 5695 Residential Energy Credits, by State, Tax Year 2023. Accessed on February 07, 2025. https://www.irs.gov/statistics/soi-tax-stats-clean-energy-tax-credit-statistics.

Figure 18. Estimates of Residential Clean Energy Tax Credits to MN Taxpayers in Tax Year 2023

Eligible Purchases for Residential Clean Energy Credit	Estimates of Residential Clean Energy Tax Credit to MN Taxpayer
Qualified solar electric property	$61,296,026
Qualified solar water heating property	$2,212,599
Qualified small wind energy property	$526,392
Qualified geothermal heat pump property	$1,781,768
Qualified battery technology	$2,129,508
Qualified fuel cell property	$1,534,989
Total	$69,481,282

The federal PTC is a tax credit for generating electricity from renewable energy sources. It is available to taxable businesses and some tax-exempt entities. The LBO cannot provide estimates for any credits received by Minnesota taxpayers through the federal PTC. There are several challenges in trying to estimate this amount. First, there is a lack of summary filing data made available on this credit to understand the proportion of claims taken by Minnesotans. Second, it can be assumed that the PTC is more advantageous to large scale producers likely to benefit from the capital equipment exemption for any eligible solar energy system or wind energy conversion system purchases, meaning that estimates from these facilities would not be included in this evaluation. This introduces a third challenge of delineating claims between large scale producers and smaller distributed energy facilities on available nationwide data.

It is important to note that taxpayers must choose between claiming the Residential Clean Energy Credit or the PTC. Analysis of IRS summary filing data suggests that most owners of a distributed energy facility are likely to elect the Residential Clean Energy Credit. The most recent available data from the IRS reports that in tax year 2022 there were 3,491 claims for the PTC under the individual income tax, resulting in $2,784,000 in credits granted across the US.[48] Compared to over 1.4 million claims for the Residential Clean Energy Credits, accounting for over $7.7 billion in estimated credit amounts. It can be inferred that most individuals are likely to choose the Residential Clean Energy Credit to be reimbursed for up to 30 percent of their upfront investment.

The Residential Clean Energy Credit, the Clean Electricity Investment Credit, and the Clean Electricity Production Credit were impacted by recent federal changes under H.R. 1, The One Big Beautiful Bill Act (OBBBA). The Residential Clean Energy Credit was

[48] Internal Revenue Service Statistics of Income. 2022 Individual Income Tax Returns Line-Item Estimates. Internal Revenue Service. Pages 98-99. Available online at https://www.irs.gov/pub/irs

previously scheduled to sunset at the end of 2034, but is now scheduled to sunset at the end of 2025. The Clean Electricity Investment and Production Tax Credits changed in several ways. Most notably, solar and wind energy systems were singled out to sunset earlier than other qualifying energy systems. The sunset date was changed from 2032 to 2027. These changes do not impact the above estimates but will eliminate these programs after the new sunset dates. See Appendix C for additional information.

In addition to credits, grants have been afforded to Minnesotans interested in establishing renewable energy systems on their property. Two grant programs with reported grant distributions in Minnesota include the US Department of Agriculture's Rural Energy for America Program (REAP) and the US Department of Energy's Office of Indian Energy Policy and Programs.

USDA provided annual grant amounts for the last four calendar years specific to wind and solar energy project recipients of REAP grants. The largest grant distributions came in calendar year 2024 with nearly $22 million in grants for 261 solar energy projects and nearly $1.4 million in grants for eight wind energy projects.[49] See Figure 19 for distributions to Minnesota grant recipients between 2021 and 2024.

Figure 19. USDA REAP Grant Distribution in Minnesota

Renewable Technology Type	CY2021	CY 2022	CY 2023	CY 2024
Wind	$331,891	$160,250	$773,861	$1,387,144
Solar	$765,998	$2,210,722	$8,405,844	$21,919,799

The US Department of Energy's Office of Indian Energy Policy and Programs issued a one-time competitive grant in 2022 to the Leech Lake Band of Ojibwe for a solar energy project in the amount of $1,048,735.[50]

An estimate of cumulative fiscal impact of other state and federal programs aimed at promoting the same activity is provided in Figure 20. This estimate is limited to programs with data that was available across the same time period, calendar year 2023. These programs include Minnesota's Solar Energy Production Incentive program, the federal Residential Clean Energy Credits, and the USDA REAP grants. For the purpose of this visual, we are assuming the amounts reported for the Residential Clean Energy

[49]Ron Omann. U.S. Department of Agriculture Email Response to LBO Research Team. February 10, 2025.
[50] Office of Indian Energy Policy and Programs. Leech Lake Band of Ojibwe – 2022 Project. US Department of Energy. Access on February 10, 2025. Available at https://www.energy.gov/indianenergy/leech-lake-band-ojibwe-2022-project.

Credits in tax year 2023 align with calendar year 2023. Minnesota residents benefitted from nearly $77 million in resources dedicated by the state and federal government to promote solar energy production at the residential or distributed energy level. Similarly, Minnesotans investing in wind energy conversion systems received $1.3 million in federal support.

Figure 20. Cumulative Fiscal Impacts of Other State and Federal Programs Promoting Wind and Solar in CY 23

Other State and Federal Programs	Solar Energy Systems	Wind Energy Conversion Systems
Minnesota Solar Energy Production Incentive	$5,000,000	NA
Federal Residential Clean Energy Credits	$63,508,625	$526,392
Federal Rural Energy for America Program (REAP) Grants	$8,405,844	$773,861
Total	$76,914,469	$1,300,253

This estimate is a cross-sectional look at investments in Minnesota and it is not a comprehensive estimate of all programs. There are incentive programs offered by private utility companies that promote the use of solar gardens. There are also exclusions from personal income at the federal level of subsidies offered by utility companies to promote installation of renewable energy equipment on personal property. Programs like these are not included in this estimate. The estimates that are provided are indicative of the broader policy landscape and the level of investment dedicated to promoting the installation of distributed wind and solar facilities.

Methodology

To assess Minnesota's general sales and use tax exemptions for wind energy conversion systems and solar energy systems, the LBO analyzed trends in the state's electricity fuel generation mix and installed capacity to determine if wind and solar

energy contributions had increased since the enactment of the sales tax exemptions. Additionally, this analysis provides an overview of the location of installations, customer types, and new estimates of foregone revenue based on previously unavailable data. This analysis utilized datasets published by MPUC and the EIA to evaluate the landscape of distributed energy in Minnesota as reported by utility providers. Lastly, the LBO evaluated the overlap and impact of the sales tax exemptions in tandem with other state and federal incentive programs based on reported installation costs.

Data and Methods

MPUC publishes the Annual Distributed Generation Report, which compiles utility-reported information on distributed electricity generation throughout Minnesota.[51]

Descriptive statistics were generated from the MPUC dataset to analyze trends in annual installations and added capacity by customer type and region. While the dataset contains limitations, it offers valuable insights into the scope and landscape of distributed wind and solar energy system installations across Minnesota, providing a clearer picture of how these technologies are being integrated into the state's overall energy mix. Two Minnesota utility companies, Minnesota Power and Xcel Energy, had installed costs that were not included in the public versions of their reports, meaning they were left out of the MPUC dataset. Both companies were willing to share their respective data with the LBO, which is included in the analysis of total installed cost and foregone revenue.

The EIA data was used to track long-term trends in the state's electricity fuel generation mix and installed capacity, focusing on the growth of wind and solar energy. The data begins before any significant contributions from wind and solar sources were enacted. The EIA data provides insight into how these renewable energy sources have evolved and their contributions to the state's energy grid.

Limitations

The solar energy systems sale and use tax exemption is available to all taxpayers who purchase a solar energy system, or components of a solar energy system. The data used in this evaluation are either at the state level (electricity fuel generation mix and state-level capacity) or are individual consumer data collected at the time each unit was installed (MPUC data). As a result, these data do not capture purchases of solar energy system components. Production and manufacturing data would be required to estimate the true extent of the exemption.

[51] Minnesota Public Utilities Commission, “DERs Data Dashboard. “(2023). https://mn.gov/puc/activities/economic-analysis/distributed-energy/der-data-dashboard/

Conclusion

The goal of this evaluation was to assess how well the wind energy conversion system and solar energy systems sales and use tax exemptions meet their stated objectives as identified by TERC. Based on this evaluation, it is evident that wind and solar energy systems have both been implemented and utilized at an increasing rate over the last several decades. The energy contribution of wind and solar to the state's electricity fuel generation has increased over the last several decades. What is less clear is the explicit role that these two tax expenditures have played in that process.

It is important to note that the production costs for both solar and wind have drastically decreased over the last 15 years independent of government incentives.[52] This fact further complicates determining the impact these tax expenditures have had on the increased utilization of renewable energy. Due to data limitations, it is empirically difficult to determine the degree to which decreases in production cost impacted utilization compared to economic incentives such as these tax expenditures. Despite the decreases in the cost to produce renewable energy, it is still likely that these sales and use tax exemptions have some impact given that the cost of renewable energy has decreased to a point where they are competitively priced compared to fossil fuel.

This evaluation views these two tax expenditures as part of a larger policy initiative, which takes place at the federal and state levels of government, as well as some private sector utilities companies. As outlined in component 8, this wide array of tax policies and other programs are aligned with the objectives of both the wind energy conversion and solar energy system tax expenditure objectives. As such, this evaluation determines that both sales and use tax exemptions meet their objectives in that they contribute to a broader policy initiative.

The conclusion that these exemptions meet their stated objectives applies only to the previous years that were included in the data. The OBBBA directly impacts the three federal tax credits that were considered in this conclusion. The LBO does not provide any forecast as to what the impact of these changes will be, but will consider the changes in future evaluations of these sales tax exemptions.

The Tax Expenditure Review Commission may choose to consider these findings in preparing a recommendation to the legislature to continue, repeal, or modify the tax expenditures, as is required of the Commission under Laws of Minnesota 2025, 1st Spec. Sess. chapter 13, article 8, section 5.

[52] International Renewable Energy Agency, "Renewable Power Generation Costs in 2022", 34-36.

Appendix A: Key Terms

Key Terms

Photovoltaic energy devices are solar panels that are composed of smaller cells. These smaller cells are made of semiconductor materials, designed to produce electric currents as ions transfer throughout the materials as a result of the energy transfer from sunlight. The transfer of ions creates an electric charge that is harnessed and made to flow throughout the panels and into a system that converts this direct current into alternating current for household or industrial use. A photovoltaic system can consist of one panel or a large grouping of solar panels, referred to as an array.[53]

Capacity refers to the amount of energy output a system would produce if it were operating at its full potential.[54]

Concentrated Solar Thermal systems use mirrors to direct and concentrate sunlight to create heat or thermal energy, which is used to produce other forms of usable energy like electricity, renewable fuels, and industrial process heat. Different configurations of these systems include power towers, linear mirror systems, and smaller dish engine systems.[55]

Distributed Energy Resources can be customer-owned systems like solar panels, wind turbines, and energy storage devices that are located at the site of use to offset the energy required from a utility provider. These systems are referred to as behind-the-meter systems. They can also be front-of-the-meter installations that are not located with a particular customer or at the site of use, such as a community solar garden. These systems are connected to a utility's distribution grid and can provide excess generated energy to a utility provider for compensation.[56] This definition is limited to systems that are less than 10 megawatts, interconnected with the distribution system, and operate in parallel with the utility.

Interconnection for the purposes of this evaluation, is the connection of a distributed energy resource to a utility's distribution grid.

Utility Scale Energy for the purpose of this evaluation refers to renewable energy systems that connected to the transmission grid and have a capacity of 10 megawatts or more.

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[53] U.S. Office of Energy Efficiency and Renewable Energy. 2019. PV Cells 101: A Primer on the Photovoltaic Cell. December 03. https://www.energy.gov/eere/solar/articles/pv-cells-101-primer-solar-photovoltaic-cell.

[54] U.S. Energy Information Administration. (2024). "What is the Difference Between Electricity Generation Capacity and Electricity Generation?" https://www.eia.gov/tools/faqs/faq.php?id=101&t=3.

[55]Office of Energy Efficiency and Renewable Energy. 2013. Concentrating Solar-Thermal Power Basics. November 02. Accessed March 24, 2024. https://www.energy.gov/eere/solar/concentrating-solar-thermal-power-basics.

[56] Minnesota Public Utilities Commission. 2024. Distributed Energy. March 08. Accessed March 27, 2024. https://mn.gov/puc/activities/economic-analysis/distributed-energy/

Appendix B. Literature Review Methodology

A literature review was performed to understand the landscape of renewable energy production in the state of Minnesota and across the country. This includes understanding what incentives have been enacted to spur investment in this industry, as well as what the industry's response has been in terms of installed capacity and dollars spent. This review was also conducted to understand the approaches used to evaluate incentive performance in Minnesota, other states, and at the federal level.

A broad search was conducted to include a range of published materials on renewable energy policies. Materials include summaries of Minnesota's enacted policies that promote renewable energies and administration data collected by the state's regulatory agencies involved in licensing utility projects. Industry-wide materials are included as well, such as market reports published by federal agencies, national trade organizations, academic institutions, and private firms discussing the national outlook for renewable energy production considering national and global supply chain issues.

The literature review began with a search of Minnesota House Research published briefs on solar, wind, and renewable energy policies enacted. Next, we referenced any resources of interest cited in those briefs to expand the literature review. This resulted in a review of several federal agency references – particularly materials published by the Department of Energy.

Key distinctions across wind energy production systems were identified through a review of Department of Energy materials. This review resulted in researching wind projects by two categories - distributed wind projects and large-scale utility wind projects. Background information on these two subsectors was compiled. Ultimately, materials focused on distributed wind resources were retained.

Market reports on the overall wind industry's performance and outlook projections helped focus the LBO's literature review on incentives for renewable energy that were recently extended and enacted under the Inflation Reduction Act of 2022.

The literature review was capped off by seeking out state-specific resources to understand the industry footprint in Minnesota. Maps and datasets of distributed renewable energy projects throughout the state were obtained through the MPUC.

Appendix C. One Big Beautiful Bill Act Changes to Federal Solar and Wind Policies

The One Big Beautiful Bill Act (OBBBA), formally known as H.R.1, was signed into law on July 4, 2025. Three of the federal programs covered in this evaluation were impacted by changes made in the OBBBA. The Residential Clean Energy Credit was originally set to sunset at the end of 2034 but is now set to sunset at the end of 2025. It is estimated that Minnesotans benefited from roughly $63,500,000 worth of credits through this program. Additionally, the Clean Electricity Investment Credit and the Clean Electricity Production Tax Credit changed in several ways. Most notably, solar and wind energy systems were singled out to sunset earlier than other qualifying energy systems. The sunset date was changed from 2032 to 2027 for both credits.

Figure 21. One Big Beautiful Bill Act changes to federal programs

Program	OBBBA Changes
Residential Clean Energy Credit	Changes the credit sunset date from December 31, 2034, to December 31, 2025.
Clean Electricity Production Tax Credit	Creates a placed in-service deadline (PIS) for solar and wind facilities of December 31, 2027. Changes phase out date for all energy sources to 2032, except for solar and wind which are singled out in the changes. The PIS deadline effectively eliminates the credit for solar and wind facilities that begin construction after July 4, 2026.
Clean Electricity Investment Tax Credit	Same changes as the Clean Electricity Production Tax Credit apply.

Note: There are numerous changes not included in this table. For simplicity, only the changes applicable to the tax exemptions covered in the evaluation have been included.

Appendix D. IRS Statistics of Income: Form 5695 Residential Energy Credits, by Size of Adjusted Gross Income

Table 2. Form 5695 Residential Energy Credits, by Size of Adjusted Gross Income, Tax Year 2023 (through Filing Season 2024 Cycle 21, May 23, 2024) [1]

[money amounts are in thousands of dollars]

	Number of Form 1040 returns [2]	Total returns with a residential clean energy credit, energy efficient home improvement credit, or both	Residential clean energy credit		Energy efficient home improvement credit	
			Number of returns	Amount	Number of returns	Amount
	(1)	(2)	(3)	(4)	(5)	(6)
All returns, total	**137,934,330**	**3,421,880**	**1,246,440**	**6,337,122**	**2,338,430**	**2,061,588**
Under $1 [3]	1,570,760	980	420	171	570	160
$1 under $10,000	12,855,540	3,610	1,510	533	2,160	706
$10,000 under $25,000	22,381,940	65,940	29,260	15,459	37,700	15,031
$25,000 under $50,000	32,288,800	443,880	217,880	352,630	242,280	172,364
$50,000 under $75,000	21,494,980	581,390	256,410	794,472	352,640	291,420
$75,000 under $100,000	13,782,230	521,150	199,440	927,665	346,830	297,426
$100,000 under $200,000	23,680,390	1,194,450	368,320	2,532,756	885,000	803,599
$200,000 under $500,000	8,491,930	526,980	145,640	1,392,169	409,910	412,137
$500,000 under $1,000,000	1,077,460	67,580	21,480	234,852	50,430	56,203
$1,000,000 or more	310,300	15,930	6,080	86,415	10,910	12,543

[1] This table presents aggregates of returns filed and processed through the Individual Master File (IMF) system during Calendar Year 2024 (through May 23rd) for Tax Year 2023. It does not include any returns filed for tax years preceding 2023.

[2] Number of returns have been rounded to the nearest ten.

[3] Includes returns with negative or zero AGI.

NOTE: Number of returns and amounts may not add to totals because of rounding.

This table is based on tax returns as initially processed by IRS and does not reflect amended returns or errors that were corrected after initial processing. In general, during administrative or Master File processing, taxpayer reporting discrepancies are corrected only to the extent necessary. The table reflects very limited editing of the data for statistical purposes. Future estimates may differ.

SOURCE: IRS, RAAS, August 2024