CADMUS

Wisconsin's Greening Grid

EFFECTS OF CARBON INTENSITY CHANGES ON THE VALUATION OF ENERGY EFFICIENCY

January 14, 2021

Prepared for:

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Executive Summary

The emissions reduction potential of an energy efficiency measure is dependent on the carbon intensity of the energy source. The carbon intensity of grid-supplied electricity is anticipated to decline over the next three decades as Wisconsin, its utilities, and their regional partners deploy renewables and retire fossil fuel-based generators. As this transition occurs, the emissions savings of an electricity-reducing energy efficiency measure will decline as the carbon intensity of electricity generation declines.

In its assessment of the cost effectiveness of energy efficiency investments, Focus on Energy (Focus) currently values associated emissions reductions of Carbon Dioxide (CO_2) at $15 per ton. The CO_2 valuation is applied to both emissions from electricity generation and natural gas usage. As the carbon intensity of electricity declines there is potential for the emissions reduction benefits associated with energy efficiency measures to also decline.

Reductions in CO_2 emissions resulting from electricity savings are currently calculated by assuming the electricity savings of an efficiency action is distributed evenly across every hour of the year. Marginal hourly emissions rates from EPA's AVERT model are then used to calculate emissions reductions which are summed across the whole year. This study uses forecasts of a "greening grid" in AVERT to evaluate how the deployment of renewables affects the emissions savings associated with energy efficiency.

Cadmus modelled electricity sector carbon emissions to forecast changes in the grid, and what the change of energy efficiency will be over time through a generator-level forecast though 2034, under the assumption that efficiency measures have a 15-year time horizon. Forecasts were based on planned retirements identified in the Wisconsin Strategic Energy Assessment (SEA) and U.S. Energy Information Agency (EIA), as well as additional changes necessary to approach carbon reduction targets.

This analysis forecasts a measurable reduction in the average annual grid carbon intensity (kg CO_2 per kWh) and annual emissions. However, this greening grid only modestly lowers the amount of emissions savings associated with an efficiency measure. This is because fossil fuel generation still plays a significant role in the near term, and also plays the role of marginal generators, compared to emergent renewables. Fossil fuel plants tend to be marginal generators because fossil generation is more flexible and has higher operating costs compared to renewables. The modest reduction in emissions savings per kWh is mostly due to the declining use of carbon-intensive coal in the MISO.

This study also shows that modeling energy savings in the top 10% of demand hours simulates more emissions reductions than if those same energy savings are modeled as evenly spread across the year. This is because the hours with the highest demand are often those that require additional fossil fuel generation resources to be dispatched, typically ones with the higher emissions intensity than the grid average (e.g., oil). However, this difference also declines relative to the evenly spread scenario as the grid becomes greener.

This work explored the intersection between Focus' efficiency programs and the larger decarbonization goals associated with renewable deployment. Given that expected near-term changes to the grid will have minimal impact on the emissions calculation, and given inherent uncertainties in how the impacts

of energy efficiency are currently modeled, there is no urgency in adopting an alternative methodology for estimating the emissions impact from energy efficiency at this time. However, Cadmus recommends the following areas for future research and analysis:

- Develop hourly energy savings profiles for efficiency measures will improve the resolution of the analysis and likely demonstrate that such measures have a larger impact than is currently accounted for. More importantly this will enable Focus to map energy efficiency savings to hourly marginal electricity prices, to better value the costs and benefits associated with its efficiency measures.
- Conduct a state- or region-level decarbonization study that better demonstrates the value of energy efficiency toward decarbonization of the entire energy system. Such benefits typically include:
    - cost savings from reduced equipment size needed for electric heating conversions;
    - a reduced need for distribution infrastructure associated with heating electrification; and,
    - a reduced need for additional renewable resources to support electrification.

  Such a study should be conducted to align with other state-level decarbonization activities (e.g., strategic electrification, renewable deployment).

Background

Energy efficiency plays an important role in decarbonization, by reducing the consumption for carbon-intensive energy sources such as fuel oil, natural gas or grid electricity. As the carbon-intensity of those energy sources diminish, so does the potential impact of an efficiency action. This is particularly relevant with electricity which has seen substantial declines in its carbon intensity over the past decade – primarily due to the retirement and replacement of coal plants with natural gas generators – and will continue to do so as renewable energy resources become more prevalent. As this transition accelerates, energy efficiency will still play a valuable, if not integral role, in achieving deep decarbonization. As decarbonizing energy sources becomes the predominant strategy for mitigating emissions, the role of efficiency will transition to be supportive of decarbonizing energy sources rather than a direct mitigation of emissions. Efficiency supports decarbonization efforts by:

- decreasing total demand and lowering operating costs
- reducing the need for additional energy resources by lowering total demand, decreasing renewable energy system-wide build-out costs
- lowering the electrification-driven growth of load on the distribution system by reducing demand at certain hours
- continuing to play a direct role in reducing emissions in end uses that have yet to or are hard to decarbonize, such as industrial processes

The goal of this study is to evaluate how a "greening grid" with more renewable energy will impact Focus on Energy's (Focus') current approach for valuing energy efficiency savings. Focus' evaluation of cost effectiveness currently incorporates emissions savings as a benefit. Emissions reductions from energy efficiency currently comprise 20% of the benefits associated with Focus' annual program evaluation, with the remaining 80% of benefits coming from avoided electric energy and natural gas costs. A greening grid, potentially reducing the emissions savings associated with energy efficiency, has the potential to impact the valuation of the program under the Modified Total Resource Cost (mTRC) test.

Role of Efficiency in the Focus on Energy Program

Focus on Energy provides a host of energy efficiency programs for both the residential and non-residential sectors. The residential portfolio includes both single family and multifamily housing, while non-residential incorporates commercial, government, industrial, and agricultural sectors. Examples of current program offerings include energy audits, LED lighting, direct install programs, and design assistance for new construction.

Within these programs and potential assessments, Focus utilizes the Modified Total Resource Cost test (mTRC) to determine the cost effectiveness of different energy efficiency efforts. This entails developing a benefit-cost (B/C) ratio for each program and determining if the ratio meets the threshold for cost-effectiveness, which is typically set at 1.0 or greater. The inputs to this calculation are outlined in Table 1. Emissions forecasting and carbon pricing are relevant to the mTRC, as avoided emissions benefits are part of its calculation. Based on this formulation, a higher cost of carbon would increase the B/C for any given program.

Table 1. Benefit Cost Ratio Calculation Components

Type	Component	Description
Cost	*Incremental Measure Costs*	Equipment and labor costs to purchase a measure and sustain savings over its estimated useful life
	Program Administration and Delivery Costs	Estimated as 20% of incremental costs, based on historic data
Benefit	*Avoided Energy Costs*	Include indirect energy savings, secondary benefits for measures that save energy on secondary fuels
	Avoided Emissions Benefits	Reflect the economic value of avoided emissions (CO_2, NO_x, SO_2)

In 2015 the PSC established a value of $15 dollars per ton of avoided carbon dioxide (CO_2) in the assessment of cost-effectiveness for the Focus energy efficiency and renewable resources program[1]. This value was based on a review of then market-based prices of CO_2 allowances in established cap-and-trade markets or associated with carbon taxes in other jurisdictions. This value is lower than other estimates of the social cost of carbon, such as those estimated by the EPA[2] (currently $54 per ton). A companion study has analyzed the impact of this value on Focus' programs.

In a highly renewable grid, the avoided emissions-related value of energy savings has the potential to decline substantially and potentially approach zero. This study seeks to assess the impact of an increasingly renewable – but not deeply decarbonized – grid on the emissions savings of energy efficiency to better understand the potential impacts to the mTRC calculation in the near term.

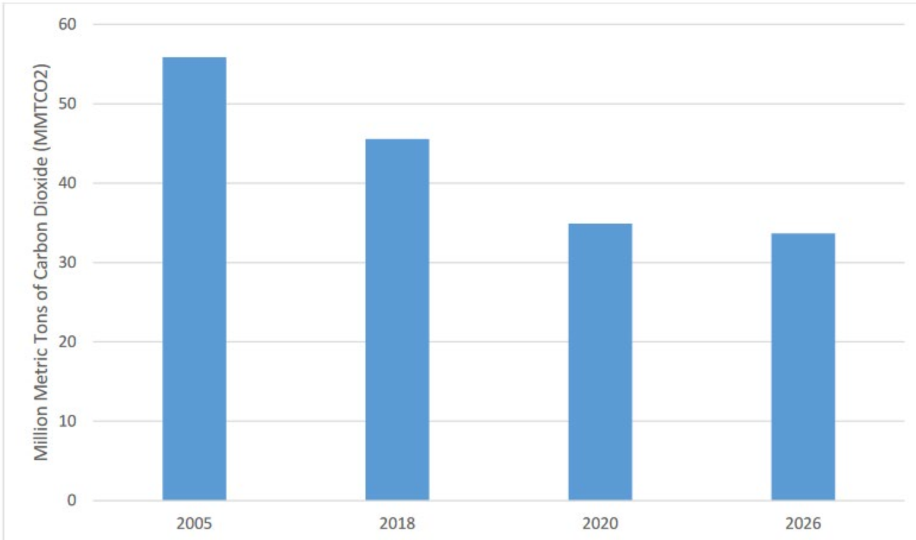
Greening Grid

Focus's current approach to evaluating emissions reductions associated from energy efficiency is static and does not account for the anticipated decline in carbon intensity of the grid over the next 15 years. Given recent trends in the retirement of aging fossil equipment as well as emerging renewable energy goals across the region, this assumption may be flawed from an analytical standpoint. Wisconsin utilities have projected reductions in the carbon intensity of their electricity generation, which are reflected in the 2020-2026 Strategic Energy Assessment (SEA), as shown in Figure 1. As this the carbon intensity (kg CO_2 per kWh) of the grid declines, so do the emissions avoided with every kWh saved by efficiency.

[1] PSC REF#279739 Quadrennial Planning Process II, December 23, 2015. https://apps.psc.wi.gov/pages/viewdoc.htm?docid=279739

[2] https://19january2017snapshot.epa.gov/climatechange/social-cost-carbon_.html

Figure 1: Anticipated emissions reductions from the Wisconsin Power Sector (2026 Strategic Energy Assessment)



Wisconsin Energy Overview

Wisconsin has historically relied heavily on coal as a primary electricity generation resource, but has been shifting toward natural gas in recent years. In 2018, coal was the primary electricity generation resource, contributing 50.5% of total energy generation, followed by natural gas at 25.5%. In addition, nuclear comprised 15.4% and renewables (including hydro, wind, solar, and biomass/wood) 8.4%[3]. However, in 2019, coal supplied less than half of the electricity generated in Wisconsin for the first time in over 30 years.

Renewable energy goals set forth by the state include the following:

- **Renewable Portfolio Standard (RPS)**: The WI RPS is established in Statute 196.378. It created a statewide renewable energy goal of 10% by 2015. Each electric provider has a unique RPS "baseline" determined by renewable electricity provided from 2001-2003[4]. The requirement increases according to the schedule outlined in Table 2. In this schedule, electric providers must currently maintain their baseline renewable requirements plus six percent. There are no scheduled increases above the current RPS level, but utilities have begun to exceed the requirements by bringing new solar projects online.

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[3] This generation mix, and subsequent references to state generation mixes, were sourced from the 1990-2018 Net Generation by State by Type of Producer by Energy Source (EIA-906, EIA-920, and EIA-923) file provided by EIA: https://www.eia.gov/electricity/data/state/

[4] RPS Percentage Requirements by Wisconsin Electric Provider: https://psc.wi.gov/Documents/rpsPercentageRequirements.pdf

Table 2. WI RPS Requirement Schedule

Year	Requirement
2006 - 2009	Maintain Baseline
2010	Baseline + 2%
2011 - 2014	Maintain Baseline + 2%
2015	Baseline + 6%
Beyond 2015	Maintain Baseline + 6%

- **Clean Energy**: In August 2019, Governor Tony Evers signed an executive order to set a statewide goal of 100% carbon-free energy consumption by 2050, as well as establish an Office of Sustainability and Clean Energy.

Despite unchanging RPS requirements, the 100% carbon-free energy consumption executive order establishes a long-term goal toward renewable displacement of fossil fuel generation.

In addition to state-established clean energy goals, electric providers have also established CO_2 reduction goals of 100% reduction by 2050, and intermediate goals of 50-80% by 2030 as outlined in Table 3. It should be noted that each provider includes different resources in these goals: some set the target for generation only, while others include generation plus purchased power. Achievement of these targets would reduce statewide emissions in 2050 by approximately 85% compared to statewide emissions in the 2005 baseline year, in the absence of the aforementioned executive order. These five utilities represent 85% of the electricity provided in Wisconsin.

Table 3. WI Electric Provider Carbon Dioxide Reduction Goals

Electric Provider	2030 Reduction Goal	2050 Reduction Goal
Xcel Energy	80%	100%
Madison Gas and Electric	--	100%
We Energies	70%	100%
Wisconsin Power and Light (Alliant)	50%	100%
Wisconsin Public Service Corporation	70%	100%

The Wisconsin Strategic Energy Assessment (SEA) outlines generator-level planned changes to capacity within the state, including planned capacity retirements and additions. Because the SEA is informational by nature and does not require utilities to disclose all steps they are taking to add or retire new plants, it is likely that these estimates are conservative. The SEA also has a very short time horizon (2026) which is not long enough to assess the lifetime impacts of efficiency programs.

Initiatives in Neighboring States

Given the nature of electricity generation, transmission, and distribution, the broader electricity resource mix in MISO territory will impact the emissions intensity of energy use. To further develop the anticipated changes to the electricity resource mix serving Wisconsin, current resource mixes and energy goals in neighboring MISO states have been investigated. *Appendix: Neighboring State Resource Mix* provides concise summaries of efforts taken in neighboring states.

Regional Initiatives

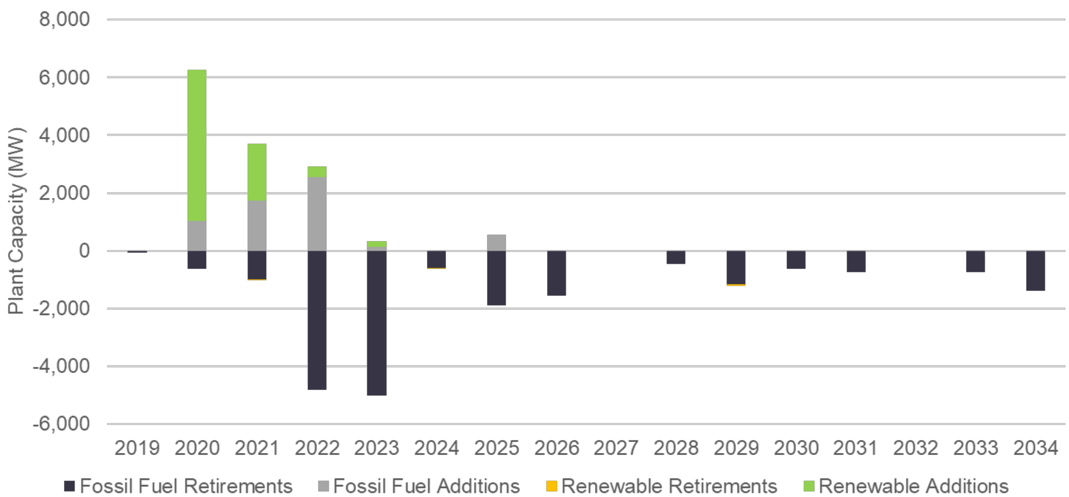
Within the MISO region, the energy resource mix has undergone and continues to undergo a notable shift. In 2005, nearly 80% of electricity was generated from coal, and only 7% by natural gas. As of 2019, less than 50% of electricity now comes from coal, natural gas has increased to 26%, and renewables make up about 7%. MISO's role as the ISO includes maintaining grid reliability and efficiency, with a stated goal to "evolve the markets and services to enable the grid today and the future's changing resource portfolio". As a result, MISO has revisited its planning processes to address these resource-related changes[5].

[5] MISO Forward: Delivering Reliability and Value in a 3D Future. 2019. MISO. https://cdn.misoenergy.org/MISO%20FORWARD324749.pdf

Methodology

Cadmus began its analysis by developing MISO generation forecasts based upon scheduled retirements, along with the longer-term goals described above. The scheduled retirements were sourced from the SEA as well as the EIA Electric Power Monthly report[6] and are shown below in Figure 2. The SEA includes retirements and additions for plants within Wisconsin only, and the EIA report includes retirements and additions for the entire MISO region.

Figure 2: Planned Additions and Retirements 2019 - 2034



In addition to planned retirements and additions, Cadmus forecasted the additional retirements and renewable additions necessary to represent a grid with a declining carbon intensity aligned with the goals described above. As fossil fuel plants are retired in future years that extend past the planning period, it is assumed that renewables will replace them at 1.75 times the capacity. This assumption was made because renewables do not replace fossil fuels at a one-to-one ratio on a capacity basis, due to their intermittent nature. It was also assumed that the breakdown between solar and wind in renewable growth would remain constant.

The emissions analysis leveraged EPA's Excel-based Avoided Emissions and Generation Tool (AVERT), which is currently used to estimate emissions savings from electricity reduction for the Focus program. Cadmus incorporated the planned and estimated fossil fuel retirements and additions into a central spreadsheet. It is important to note that in some cases, there were discrepancies between the list of power plants in the SEA/EIA reports and the list of plants in AVERT. If a power plant in the SEA/EIA reports was not in AVERT, a proxy plant was used in the same state. These scenarios were built in AVERT's Future Year Scenario Generator, which creates an AVERT input file representing a regional grid. Scenarios were then compared against a 2019 base year scenario to estimate average emissions savings.

[6] EIA Electric Power Monthly, Chapter 6. Capacity, Tables 6.5: Planned U.S. Electric Generating Units Additions and Table 6.6: Planned U.S. Electric Generating Retirements, https://www.eia.gov/electricity/monthly/

Decisions surrounding specific generators and the timing of their retirement are unlikely to have a large impact on the behavior of these scenarios.

In the AVERT Main Module, after importing the Midwest regional file representing future fossil retirements, Cadmus incorporated planned and estimated renewable additions and retirements. AVERT was then run to establish the emissions of the grid prior to the application of efficiency energy savings. A second run was conducted that applied the energy efficiency savings. Here Cadmus estimated that 781 GWh of energy per year would be saved due to Focus' energy efficiency measures, based on 2019 verified gross savings. The energy efficiency impacts were evaluated: 1) evenly across the year (*Evenly Distributed* scenario); and 2) allocating the savings to the top 10% of demand hours (*Peak 10%* scenario) to illustrate both ends of the range of potential emissions reductions. In practice, neither of these extreme scenarios are likely, as most energy efficiency measures act to reduce loads that have varying hourly profiles and/or reduce loads at different times throughout the year. However, if Focus programming began to place more emphasis on peak demand reduction, resulting carbon emissions savings would begin to trend toward the results of scenario 2.

Four key scenario years were modeled: 2019, 2025, 2030, 2034. Results were interpolated between these years to create a 15-year forecast. All information was consolidated in an Excel workbook developed by Cadmus, called the Carbon Price Calculator. Here, the results from various scenarios were interpolated and summarized.

Limitations

A key limitation of AVERT is that it does not include other non-emitting resources: nuclear, biomass or hydro. This is because AVERT is specifically designed to analyze the effects of energy efficiency and renewable energy policies on fossil fuel demand, not total demand. As such, any emissions intensity reported will be higher than the actual carbon intensity and is therefore solely used for comparative purposes. AVERT's Statistical Module also requires a significant amount of computational runtime, which is limiting in terms of the number of scenarios that can feasibly be run.

AVERT is also best suited for simulating incremental changes to electricity supply generation. AVERT's behavior is based on a statistical representation of the current generation behavior, which may not hold under large changes. Major adjustments to the generation mix may result in systematic changes stemming from evolving transmission needs, future price dynamics, new technologies, or operational restrictions. As such the analysis presented here provides a high-level illustration of the dynamics of energy efficiency in a greening grid while incorporating marginal emissions behavior. More resolved and computationally intensive methods will be needed to identify the impact of energy efficiency as the grid deeply decarbonizes.

The current assumption that energy reductions associated with energy efficiency are evenly distributed across all hours of the year is also a key limitation to this analysis. It is likely that certain actions such as lighting or building envelope retrofits impact some hours more than others, these often include higher demanding and more carbon intensive hours. This study utilizes a second, peak-demand scenario that allocates savings to the top 10% of hours to address this limitation. Future work should aim to better define the hourly profile of energy savings from Focus’ energy efficiency measures.

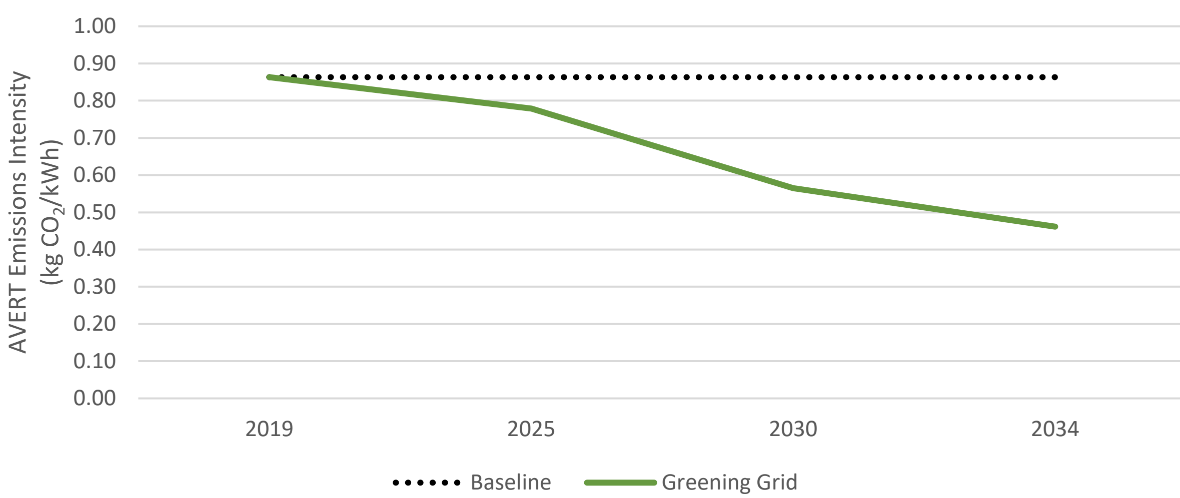
Results

Emissions Forecast Scenarios

In the *Baseline Scenario*, the Midwest's 2019 generation mix was assumed to remain constant for all future years. This portfolio would produce 441 million short tons of CO_2 across the region and result in a carbon intensity of 0.863 tons CO_2/MWh. This scenario represents Focus' current approach.

In the *Greening Grid* scenario, a net 9,050 MW of fossil fuel were retired and a net 5,709 MW of solar and wind were added by 2025. These numbers are based off the SEA's planned additions and retirements and reduce the renewables-adjusted carbon emissions intensity from 0.863 tons CO_2/MWh to 0.78 tons CO_2/MWh. In 2030, the amount of retired fossil fuel plants increased to 27,376 MW in capacity compared to the 2019 baseline, and the number of renewable plants brought online increased to 39,706 MW. These actions, which brought about the steepest change of the analysis, further reduced the adjusted carbon intensity to 0.56 tons CO_2/MWh. Finally, the 2034 Scenario Year experienced further shutdowns at a similar rate to previous years, totaling 27,234 MW of fossil fuels being shut down, compared to the 2019 baseline. The final count of renewables increased to 56,958 MW over the 2019 baseline. 2034's carbon emissions intensity decreased to 0.46 tons CO_2/MWh or a 47% reduction in carbon intensity. The impacts of fossil fuel plant shutdowns and renewable additions to the grid is visualized in Figure 3 below.

Figure 3: Carbon Intensity of grid scenarios

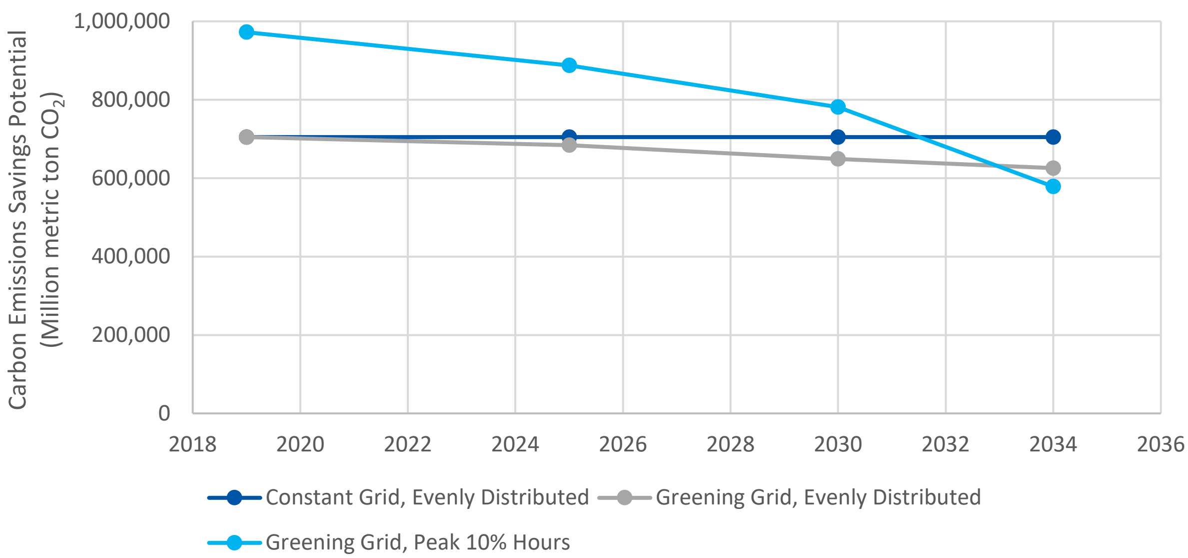


Impact on Emissions Reductions from Energy Efficiency

Focus' 2019 efficiency impact on electricity savings was used in this study to simulate energy savings from efficiency. This 781 GWh of electricity savings was simulated in AVERT using one of two approaches. First, it was assumed this savings was *Evenly Distributed* across every hour of the year, based upon Focus' current approach for estimating the emissions impact of energy efficiency. The second approach distributed this savings only across the *Peak 10% hours* of demand.

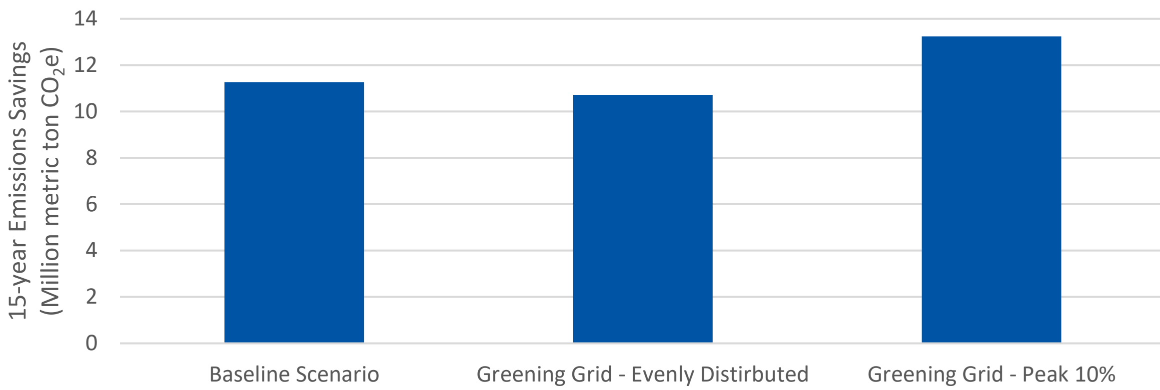
Figure 4 shows the impact of these scenarios on overall emissions avoided. The baseline scenario experiences a constant emissions savings over the course of the measure's lifetime. The greening grid scenario results in a modest reduction in annual emissions, amounting to an 11% reduction in 2034. Contrast this to the 47% reduction in the average carbon intensity of the grid. This difference arises because the energy efficiency actions as they are applied in AVERT reduce marginal energy generation that is often the most carbon-intensive. Renewables are generally fixed and have negligible operational costs, as such they are often the cheapest resources on a marginal basis while fossil fuel generators tend to be more expensive and are only used when needed. On a cumulative basis, the reduction in avoided emissions amounts to only 5% of the baseline scenario's emissions over the course of 15 years, suggesting that methodological adjustment has a modest impact on the final results.

Figure 4: Emissions savings associated with the three scenarios run.



Allocating the energy savings to the top 10% of demand hours results in an 37% increase in the modeled emissions savings in 2019 (Figure 4). Aggregated over the full 15 years studied, this peak allocation of savings amounts to 17% more avoided emissions than the baseline scenario (Figure 5). Over time the emissions savings associated with the Peak 10% scenario declines at a faster pace than that of the evenly distributed scenario, and by 2034 it reaches a lower level of emissions savings (Figure 4). This a result of total energy savings being concentrated in a small set of hours. These concentrated savings reduce the marginal carbon intensity to levels that are on average lower than the full year average. This effect is driven by the retirement of the most carbon intensive plants over the next 15 years, which tend to operate in those peak hours. As those generators retire though 2034, the potential for future carbon savings are reduced and there is less opportunity for mitigating the most carbon-intensive energy generators. Since savings are simulated to be ten times more concentrated in these hours, they eliminate a larger portion of the generation at these times, and in 2034 obviate generation that is lower than the grid average.

Figure 5. Total cumulative emissions savings by scenario, 2019-2034.



Both the *Evenly Distributed* and the *Peak 10%* scenarios are extreme bookends, but are used here, particularly in Figure 5, to demonstrate that changes in methodology (e.g., hourly resolution of energy efficiency actions), and significant changes in the energy generation mix and average carbon intensity of the grid are unlikely to impact the estimated emissions savings from energy efficiency in the near term.

Discussion and Next Steps

The results of this study suggest that Wisconsin's greening grid has, in the near term, a limited impact on emissions savings due to energy efficiency. Therefore, these findings do not indicate a need to adopt an alternative methodology for estimating emissions savings at this time. However, in light of recommendations described in the Wisconsin Energy Distribution and Technology Initiative (WEDTI) report[7] and energy-related climate solution strategies presented in the recently released Governor's Task Force on Climate Change Report[8] it may be advantageous for Focus on Energy to work towards: 1) a better understanding of the hourly impacts of its implemented efficiency measures, and 2) estimates of its potential contributions to statewide decarbonization goals. Both activities would help support WEDTI report recommendations #6 (Align Focus on Energy with Carbon-Reduction and Clean Energy Goals) and #8 (Shape Energy Consumption to Achieve Utility and State Goals).

Hourly Emissions Savings and End Use Load Shapes

A more precise calculation of hourly emissions savings would provide added insight into the impact of efficiency measures that Focus currently supports. Carbon emissions intensity changes throughout the day and year depending on the specific generation mix that is used to meet time-varying energy demand. Therefore, energy savings that occur during hours of peak demand are expected to have a greater impact on emissions reduction than those that occur primarily at other times.

Understanding energy consumption at each time of day and year for various end uses would help Focus develop energy efficiency and demand response programs that best match the state's needs, given available generation resources. A study that constructed and/or collected climate-appropriate load profiles for common end uses (e.g., cooling) and their associated energy efficiency measures would enable Focus to develop a more detailed understanding of hourly energy use and improve estimates of emissions savings. Additionally, as Wisconsin continues to offer programs that reduce consumption and promote renewable energy generation, Focus must be able to accurately predict usage patterns at the end-use level to fully understand the financial implications of those investments (e.g., offsetting the increased marginal costs of electricity generation during high demand hours) to ensure accurate representation of energy efficiency benefits and costs.

Data to support such a study might come from a combination of sources. A Department of Energy-funded NREL load profile study[9] is expected to conclude at the end of 2021. The study promises to deliver end-use load profiles for the U.S. building stock that represent all major end uses, building types,

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[7] Wisconsin Energy Distribution and Technology Initiative, Midwest Energy Research Consortium (M-WERC) and Great Plains Institute (GPI), July 2020, WEDTI Report_FINAL.pdf

[8] Governor's Task Force on Climate Change Report, State of Wisconsin, December 2020, USCA-WisconsinTaskForceonClimateChange_20201207-HighRes.pdf

[9] End-Use Load Profiles for the U.S. Building Stock, NREL, https://www.nrel.gov/buildings/end-use-load-profiles.html

and climate regions. Relevant Wisconsin-specific data could also be acquired through existing partnerships with utilities, or dedicated metering studies.

Future Decarbonization Planning

Energy efficiency plays an important role in decarbonization. Not only does efficiency directly reduce carbon emissions, it also reduces the amount of clean energy required to meet overall demand. Through measures such as improved air sealing, energy efficiency reduces equipment costs (e.g., HVAC sizing) and the need for increased distribution infrastructure that might accompany an otherwise growing demand.

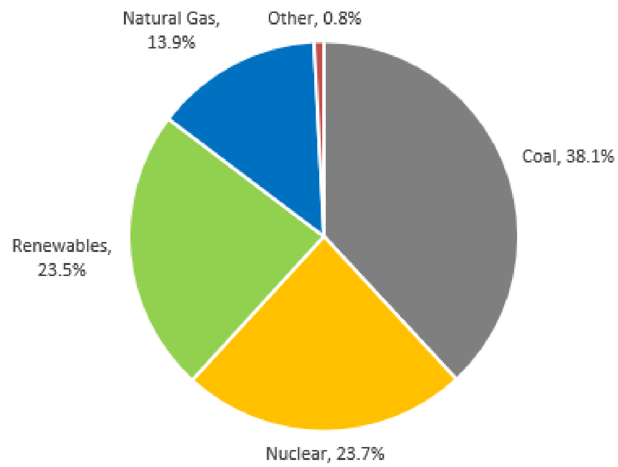
An analysis of the hourly emissions reductions produced by current Focus offerings would provide a solid foundation upon which to compare decarbonization scenarios as part of a statewide decarbonization study. Such a study would include planned grid generation shifts, distributed energy resource projections, and electric vehicle initiatives. A gap analysis to assess the difference between emissions reductions generated via current policies and those required to meet projected 2025 and 2050 goals would also help inform planned statewide decarbonization efforts.

Conversely, a more targeted study could be designed to help guide future Focus programming toward maximizing carbon savings (rather than energy savings). Investigated scenarios would primarily involve enhanced energy efficiency programming such as demand response and beneficial electrification initiatives. Whether conducted as an essential portion of a statewide decarbonization study or a stand-alone investigation, this type of research would help assess the various trajectories that Focus might take to contribute to statewide decarbonization goals.

Appendix: Neighboring State Resource Mix

MINNESOTA

2018 Resource Mix



Goals and Requirements

Per Capita Fossil Fuel Use (MS 216C.05): Established a goal to reduce fossil fuel use by 15% by 2015

Renewable Energy Goal - Total Energy (MS 216.05): Derive 25% of total energy used in the state from renewable sources by 2025

Greenhouse Gas Emissions Reduction (MS 216H.02): Reduce state GHG emissions 15% below 2005 levels by 2015, 30% by 2025, and 80% by 2050

Renewable Electricity Standard (MS 216B.1691): Derive 25% of retail electricity sold in the state from renewable sources by 2025; 30% for Xcel Energy by 2020

Solar Electricity Standard (MS 216B.1691): Generate 1.5% of public utility retail electricity sales from solar energy by 2020, with a goal of generating 10% of all retail electricity sails from solar energy by 2030.

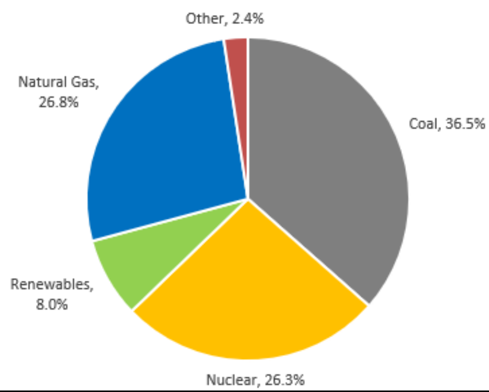
Utility Commitments

Electric Provider	2030 Reduction Goal	2050 Reduction Goal
Xcel Energy	80%	100%
Minnesota Power[10]	40%	--

[10] Sourced from https://www.mnpower.com/ResourcePackage

MICHIGAN

2018 Resource Mix



Goals and Requirements

Renewable Energy Program: This program has required electric utilities to meet a 10% renewable energy standard, based on RECs, since 2015. This has set subsequent requirements of 12.5% for 2019 and 2020, and increases to at least 15% by the end of 2021

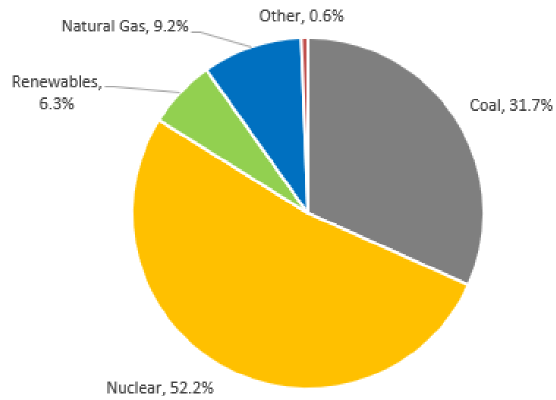
Electric and Natural Gas Efficiency Programs: These are designed to decrease the amount of energy needed for electricity and heating needs. The targets reflect a 1.0% reduction per year in retail electric sales, and 0.75% reduction per year for natural gas.

Utility Commitments

Utility	Carbon Reduction Target	Baseline Year	Target Year
American Electric Power	60%	2000	2030
	80%		2050
Consumers Energy	80%	2005	2040
DTE Electric	30%	2005	Early 2020s
	50%		2030
	80%		2040
Upper Peninsula Power Company	17%	N/A	2021
WEC	40%	2005	2030
	80%		2050
Xcel Energy	80%	2005	2030
	100%		2050

ILLINOIS

2018 Resource Mix



Goals and Requirements

In 2016, legislation called for the Illinois Power Agency Act to create and implement the Long-Term Renewable Resources Procurement Plan[11], outlining renewable energy resource procurement and programs. The Illinois Power Agency shall review and may revise the plan every two years. The current plan outlines a RPS in which 25% of electricity sales must be met with renewable energy or renewable energy credit procurement by 2025. The schedule for meeting the target includes 13% by 2017, increasing by 1.5% per year until 2024.

Illinois also created a Zero Emission Standard Procurement Plan[12] in 2007 to provide provisions of Zero Emissions Credits from zero emission facilities in order to “increase the State’s reliance on zero emission energy”.

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[11] Long-Term Renewable Resources Procurement Plan. 2020. Illinois Power Agency. https://www2.illinois.gov/sites/ipa/Documents/Draft%20Revised%20Plan%20-%20Summer%202019/Revised%20LTRRPP%20updated%20from%20ICC%20Order%20%2820%20April%202020%29.pdf

[12] Zero Emissions Standard Procurement Plan. 2017. Illinois Power Agency. https://www2.illinois.gov/sites/ipa/Documents/2018ProcurementPlan/Zero-Emission-Standard-Procurement-Plan-Approved.PDF