North Dakota Rate Design, Demand Response Analysis and Federal Funding Opportunities Review

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Prepared for the North Daokta
Public Service Commission

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Prepared by the
Midwest Energy Efficiency Alliance (MEEA)
& Regulatory Assistance Project (RAP)

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Executive Summary

The following report, created for the North Dakota Public Service Commission (PSC), is the product of a partnership between the Regulatory Assistance Project (RAP) and the Midwest Energy Efficiency Alliance (MEEA). It is intended to suggest pathways the PSC could take to improve North Dakota's utility rate design structure and demand response practices through policy intervention. In addition, this report also includes a list of currently available federal funding opportunities that might be used to help North Dakota implement policies and programs aligned with the suggested approaches to rate design structure and demand response while also fortifying the state's grid infrastructure and energy economies.

The rate design and demand response analysis and policy review section of this report, led by RAP, includes options for lowering energy system costs while maximizing the benefits of advanced metering investments through improved rate designs and demand response pricing programs with examples from other jurisdictions.

The review of federal funding opportunities of this report, led by MEEA, includes information on eleven funding opportunities that various funding recipients can take advantage of to implement policies and programs that will help North Dakota improve its rate design and demand responses, while also investing in the state's energy future. The final section of this report also includes resources that RAP and MEEA offer that may be useful to the PSC and state of North Dakota to achieve these desired outcomes.

Regulatory Assistance Project (RAP)

The Regulatory Assistance Project (RAP)® is an independent, non-partisan, non-governmental organization dedicated to accelerating the transition to a clean, reliable, and efficient energy future.

Midwest Energy Efficiency Alliance (MEEA)

The Midwest Energy Efficiency Alliance (MEEA) is a collaborative network, promoting energy efficiency to optimize energy generation, reduce consumption, create jobs and decrease carbon emissions in all Midwest communities. MEEA seeks an achievable pathway for all people and communities in the Midwest to receive the economic, environmental and societal benefits of energy efficiency and the larger clean energy economy. MEEA oversees a 13-state region including Ohio, Kentucky, Michigan, Indiana, Illinois, Missouri, Wisconsin, Minnesota, Iowa, North Dakota, South Dakota, Nebraska and Kansas.

Rate Design Context in North Dakota and Concepts to Consider

The electricity system is evolving rapidly in the United States. Across many dimensions, modern technology and data are expanding the capabilities of utilities, customers and other participants in the energy system. These capabilities allow for new opportunities to lower system costs and new pathways to cost-effectively achieve policy goals, such as economic development, reliability and emissions reductions. In particular, the widespread deployment of advanced metering infrastructure, along with communications networks, data storage and billing systems improvements, can enable the next generation of rate design reforms.[1] Rate design improvements are a key benefit of these investments as well, and taking advantage of these capabilities is a significant part of maximizing customer benefits of these investments. Of course, improving the marginal cost basis of rates must take place with proper attention paid to other ratemaking principles, and any tradeoffs should be weighed and managed appropriately. See Appendix A for a brief description of well-accepted ratemaking principles.

Existing rate designs in North Dakota have a number of sensible features to encourage efficient customer usage behavior in line with marginal cost pricing. This includes seasonal rate distinctions for both kWh charges and demand charges, time-of-day rate options and a range of interruptible and limited-service tariffs. See full summary of existing rates in Appendix B for Montana-Dakota Utilities, Northern States Power Company (Xcel Energy) and Otter Tail Power Company. These existing rates, and cost analysis underlying them, should provide a solid foundation for continuing improvement of rate structures over time. RAP has published several reports on ideas and options to continue to advance both cost allocation approaches and rate design in a modern electric system and economy. [2, 3]

[1] Demand response programs and pricing, as well as interruptible tariffs and utility control provisions, can be thought of as a subset of rate design generally, whether that is specifically designed for a limited set of end-uses or whole customer load.
[2] Smart Rate Design for Distributed Energy Resources: https://www.raponline.org/knowledge-center/smart-rate-design-distributed-energy-resources-2/
[3] Electric Cost Allocation for a New Era: https://www.raponline.org/knowledge-center/electric-cost-allocation-new-era/

Short-term concepts to consider with existing metering capabilities are:

- Phase out the Montana-Dakota declining block seasonal structures for residential and small general service in favor of the more general seasonal kWh rate structure used by Northern States and Otter Tail.
- Use the structure of the Otter Tail general service rate more broadly, with a specific demand charge to cover local facilities and connection costs.
- Narrow the peak period used by Northern States, currently a 12-hour period from 9 a.m. to 9 p.m., to a shorter window, such as the 8-hour period used by Montana-Dakota or the 5-hour period used in Oklahoma and Arkansas.

As Otter Tail and Northern States roll out advanced metering infrastructure (AMI) and Montana-Dakota considers AMI, additional options to consider include:

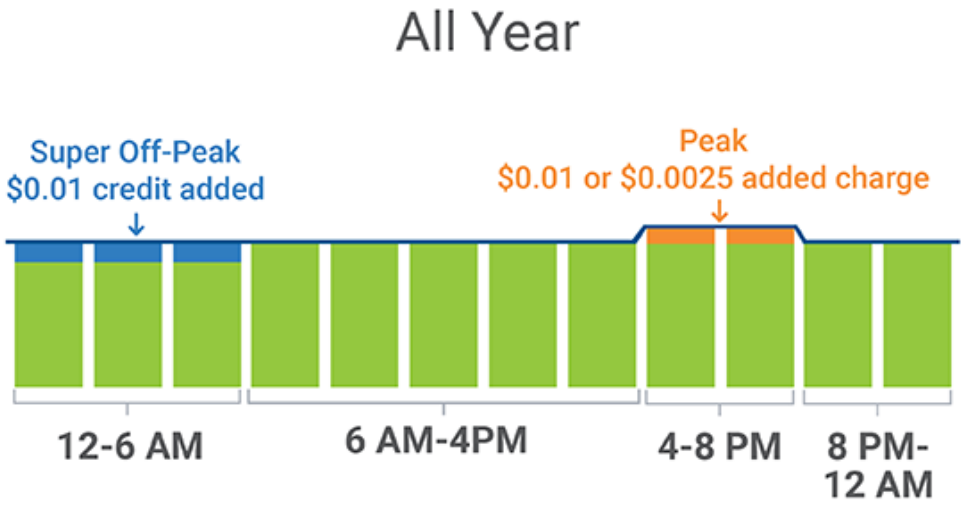
- Introduce a mild time-of-day rate structure for default rates for all customers as now being implemented in Missouri and Michigan.
- Move towards a three-period structure for optional time-of-day rates, with off-peak, mid-peak and on-peak prices within each billing period as implemented by Xcel in Colorado.
- Implement "peak-time rebates" for all residential and small general service customers as implemented in Maryland.
- Adopt an optional "variable peak pricing" rate for residential and small general service customers as in Oklahoma.
- Establish additional programs for demand response or direct utility load control for specific end-uses.
- Move towards real-time pricing structures for larger general service customers as implemented in Georgia.

The merits and other considerations in these five ideas are discussed briefly in the examples below.

Mild Default Time-of-Day Rates

Several states have taken advantage of advanced metering to introduce a mild default time-of-use rate. This respects the principle of gradualism and is a way to gently introduce the general concepts and incentives of time-varying rates to customers. After consideration of a more drastic initial approach, Missouri electric utilities are now introducing a very mild time-of-day rate as the default residential rate[4] as shown in the figure below.

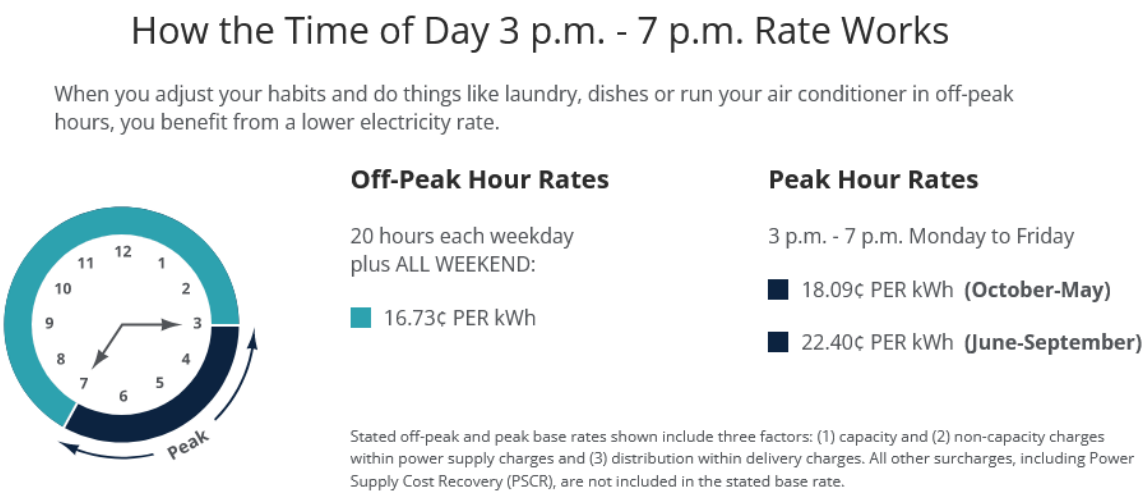
Figure 1. Evergy Missouri Default Residential Time-Based Rate Plan



Along the same lines, the two major electric utilities in Michigan have introduced mild time-of-day rates by default for all residential customers. For example, the default residential rate for DTE Electric currently has a modest 1.3-cent differential between off-peak and on-peak most of the year but has a more substantial 5.6-cent differential for its on-peak summer rate during the hours of 3 p.m. to 7 p.m. on non-holiday weekdays.[5]

[4] https://www.evergy.com/manage-account/rate-information-link/plan-options/default-time-based-plan
[5] https://solutions.dteenergy.com/dte/en/Products/Time-of-Day-3-p-m---7-p-m-/p/TOD-3-7

Figure 2. DTE Energy Default Residential Rate



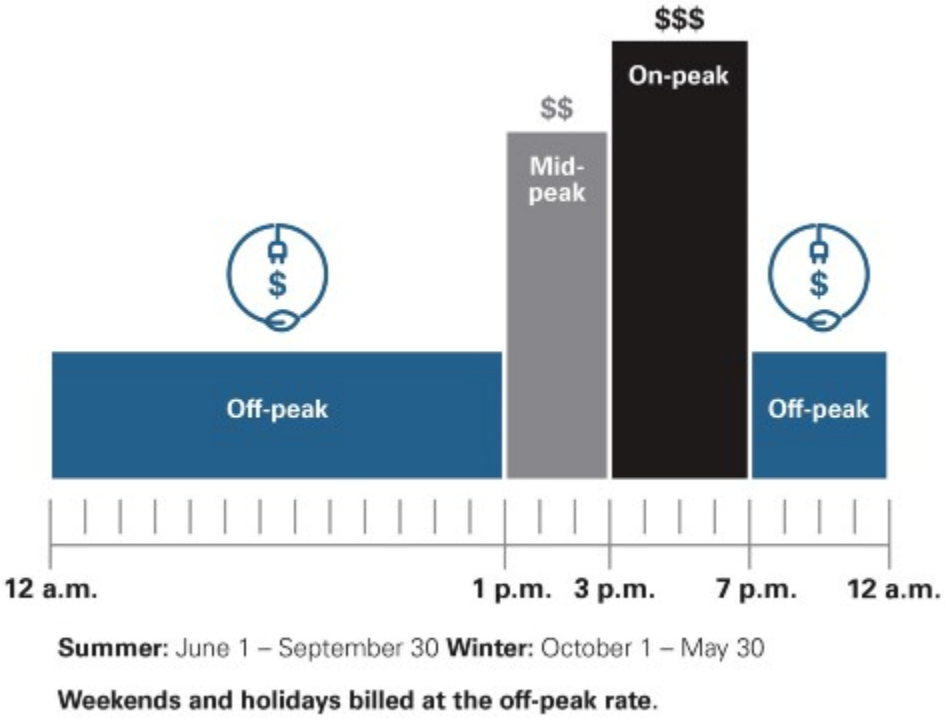
The Michigan Public Service Commission has chosen a formula-based method for setting these on-peak differentials, based on the percentage difference in wholesale market locational marginal prices during the relevant on-peak and off-peak hours. This percentage difference is then applied to the power supply portion of the rate and the distribution kWh rate is flat.[6]

Three-Period Time-of-Day Rates

Moving from two-period time-of-day rates to three-period time-of-day rates can provide a range of benefits. Three periods have significantly more flexibility than just two and, if implementable by metering and billing systems, avoids some of the difficult tradeoffs in setting the peak hours in a two-period system. For example, three periods can provide a gradual transition through having "mid-peak" prices that are close to the more typical flat default kWh rate while simultaneously having higher on-peak prices (discouraging consumption at expensive times) and lower off-peak prices (encouraging consumption at inexpensive times). Xcel Energy in Colorado provides an excellent example of modern three-period time-of-day rates, although the mid-peak hours and relative rate could be reasonably modified.[7]

[6] MPSC Case No. U-20836, 11/18/22 Order, pp. 399-400, https://mi-psc.my.site.com/sfc/servlet.shepherd/version/download/0688y0000058ilbAAI
[7] https://co.my.xcelenergy.com/s/billing-payment/residential-rates/time-of-use-pricing

Figure 3. Xcel Energy Three-Period Time-of-Day Rate Graphic



Since three-period time-of-day rates accomplish several objectives at once, the introduction of such a rate can be used to consolidate other rate structures and simplify customer choices. For example, the availability of a three-period time-of-day rate with low overnight prices accomplishes many of the same objectives as limited-service overnight rates.

Peak-Time Rebates

Peak-time rebates are a gradual way to provide demand-response-like incentives to all customers using advanced metering capabilities. Under this program structure, customers receive bill credits for usage reductions below their measured baseline on designated peak savings days and no customer is penalized for their usage above baseline. This structure has principally been adopted in Maryland.[8] Customers receive notifications of peak savings days by phone, text or email. Peak-time rebates can also be used to structure additional demand response programs, such as smart thermostat incentives.

[8] https://www.pepco.com/ways-to-save/for-your-home/maryland/peak-energy-savings-credit/about-peak-energy-savings-credit

Variable Peak Pricing Option for Residential and Small General Service

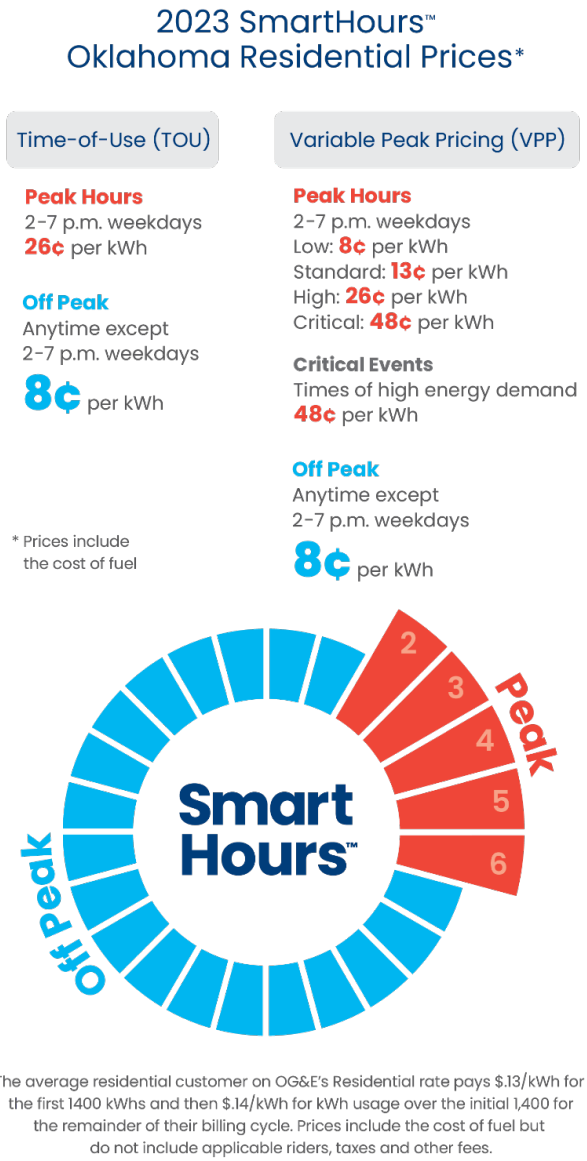
Variable peak pricing programs are essentially a dynamic evolution of typical time-of-day rate structures. Instead of a predetermined peak period price, the utility uses objective criteria to decide what the peak period price will be for the following day. This allows for more accurate marginal cost pricing signals and thus better customer responses.

Oklahoma Gas & Electric (OG&E) now has a variable peak pricing rate option available for residential customers in their Oklahoma and Arkansas territories, as well as a more traditional time-of-use rate.[9] During the summer, OG&E notifies customers on the variable peak pricing rate whether the following day will have a "low", "standard", "high" or "critical" price. Notification can take place by phone, text or email and is also on a dedicated website. OG&E also has a program to integrate smart thermostats with their pricing systems.[10]

[9] https://www.oge.com/wps/portal/ord/residential/pricing-options/smart-hours/!ut/p/z1/lZDNDoIwEISfhSfo0NaKxxqQVk1KjRTsxXAiJloejM9vryD-sLdNvtnZGeJJTXzfPLu2eXS3vrmE_eTFmapUqG0Ok5gDh13HjG5SxYyOSTUEjJMZLOPJstgfAQjiZ-lzu1sEPTLpOGcA-0-PDyMx0_8d8N_PV8SPLJxMQwIhjF4VFDIeAxMVDYGJDn59cb-WZVmj020UvQDYS5Sq/dz/d5/L2dBISEvZ0FBIS9nQSEh/

[10] https://ifttt.com/oge

Figure 4. Oklahoma Gas & Electric TOU and VPP residential rates



Demand Response Pricing and Direct Utility Load Control Programs for Additional Specific End-Uses

Tariffs in North Dakota already include options for demand response and direct utility load control,[11] such as water heater and controlled air conditioning riders. However, these programs could be expanded to other technologies and other

[11] Demand response and utility load control programs share some aspects in common, but to the extent they can be distinguished, a demand response program tends to emphasize pay for performance during specific events, while utility load control provides a more generalized ratepayer benefit (fixed payments or lower rates) in exchange for utility control of asset operation within agreed upon limits.

models may be worth exploring as well. A wide range of alternatives have been explored across the country, but we will describe two here, the Green Mountain Power (GMP) "bring your own device" program for home battery storage in Vermont[12] and the Connecticut Electric Vehicle program.[13]

In the GMP bring your own device program, customers are provided an incentive to help defray the cost of purchasing and installing a residential battery storage system in exchange for allowing the utility to utilize the asset during a peak event. Outside of peak events, customers are generally allowed to utilize the resource as they see fit, such as backup power during outages, provided it has sufficient charge for the utility during peak events. The Connecticut Electric Vehicle program offers upfront incentives to defray the customer cost of installing smart level 2 charging equipment and necessary wiring upgrades in exchange for charging off-peak and responding to utility-called events. This program has two tiers, a simpler one with lower payments and a more complex one with higher payments.

Real-Time Pricing for Large General Service

Real-time pricing based on actual electric system costs, whether estimated system lambda or wholesale market pricing, tends to be the most sophisticated and efficient pricing scheme available in many jurisdictions. In jurisdictions with full wholesale markets and retail competition, these signals can be incorporated directly. Jurisdictions that are vertically integrated have also taken steps to make such price signals available to large general service customers on an opt-in basis. A good example of such an optional rate is the Georgia Power Real-Time Pricing: Day Ahead Schedule.[14] This particular tariff provides incentives to adopting customers to change their baseline usage according to estimated marginal costs, including incremental generation running costs, losses, transmission and generation capacity costs.

[12] https://greenmountainpower.com/rebates-programs/home-energy-storage/bring-your-own-device/battery-systems/
[13] https://www.eversource.com/content/residential/save-money-energy/clean-energy-options/electric-vehicles/ev-charger-managed-charging/ct
[14] https://www.georgiapower.com/content/dam/georgia-power/pdfs/business-pdfs/tariffs/2023/rtp-da-9.pdf

Available Federal Funding Opportunities

Electric Infrastructure Loan & Loan Guarantee Program

Funding amount: $1 billion nationwide

Funding type: Loans and loan guarantees

Eligible recipients: States, local governments, federally recognized tribes, utilities/electric cooperatives

Eligible uses: Maintenance, upgrades and expansions of electricity infrastructure, replacement of distribution systems (e.g., transmission lines), energy efficiency and renewable energy systems

Funding availability: Through September 2031

Application due date: None; Applications accepted year-round

Description: The Electric Loans for Renewable Energy Program makes loans and loan guarantees to support financing for the construction of electric distribution, transmission and generation facilities. Funding can also be used to improve currently existing energy systems (especially in rural areas), demand side management, smart grid infrastructure, energy efficiency programs and develop both on-grid and off-grid renewable energy systems.

Energy Auditor Training Grant Program

Funding amount: $40 million nationwide

Funding type: Grants

Eligible recipients: States

Eligible uses: Covering costs associated with individuals being trained or certified to conduct energy audits by the state or a state-certified third-party training program

Funding availability: Until expended

Application due date: Concept papers due March 28, 2024; Applications due June 28, 2024

Description: The Energy Auditor Training Grant Program is designed to provide grants to train individuals to conduct energy audits or surveys of residential and commercial buildings to grow the clean energy workforce, save customers

money on their energy bills and reduce pollution from building energy use. Grants can be used to cover any cost associated with individuals undergoing training to conduct energy audits and pay the wages of a trainee during the period in which the trainee receives training and certification.

Energy Efficiency and Conservation Block Grant Program (EECBG)

Funding amount: $550 million nationwide; $1.72 million in formula funding to local governments of North Dakota (the deadline for state funding for EECBG has passed)

Funding type: Formula funding, competitive grants

Eligible recipients: Local governments, federally recognized tribes

Eligible uses: Designing and implementing programs and policies that conserve energy and increase energy efficiency.

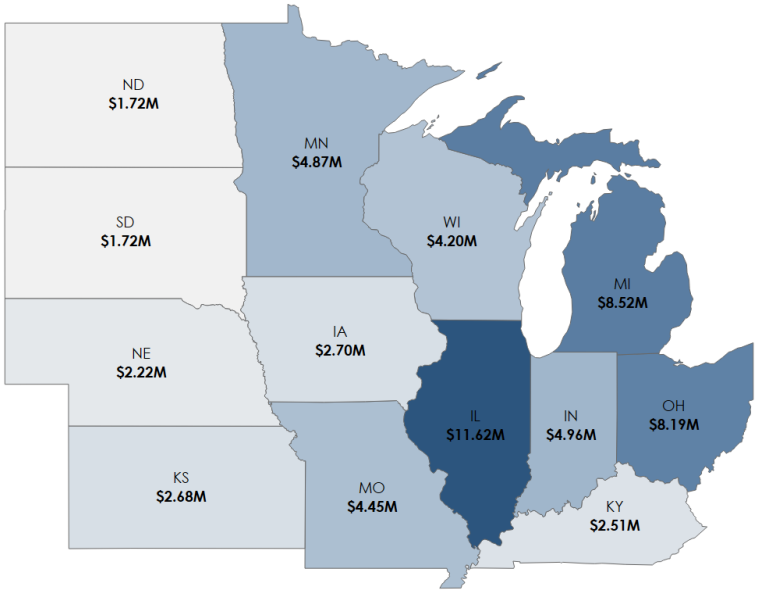
Funding availability: Until expended

Application due date: Local government and federally recognized tribe applications due April 30, 2024

Description: The Energy Efficiency Conservation Block Grant Program is designed to assist qualified entities to implement strategies to reduce energy use and greenhouse gas emissions and to improve energy efficiency. Funding is available in the form of both formula and competitive grants.

The application deadline for all local governments and tribes to apply for the EECBG Program formula funding has been extended from January 31, 2024, to April 30, 2024. $1.72 million in formula funding is available to local governments in North Dakota as shown in Figure 4 below.

Figure 4: Energy Efficiency Conservation Block Grant formula funding allocation across Midwest states (local governments only). Funding allocation source, U.S. Department of Energy.



Energy Storage Demonstration and Pilot Grant Program

Funding amount: $355 million nationwide

Funding type: Grant, cooperative agreement

Eligible recipients: States, local governments, federally recognized tribes, utilities/electric cooperatives

Eligible uses: Including, but not limited to, improving the reliability of transmission and distribution systems (particularly in rural areas), resource integration, supplying and reducing energy during periods peak periods of demand and energy efficiency.

Funding availability: Until expended

Application due date: Applications were expected to open in Q3 of 2023 but remain unavailable and as such, application due date to be determined

Description: Funding related to the Energy Storage Demonstration and Pilot Grant Program is intended to facilitate agreements between stakeholders to carry out a total of three energy storage demonstration projects.

Grid Resilience and Innovation Partnerships (GRIP) Program

Funding amount: $10.5 billion nationwide

Funding type: Competitive grants

Eligible recipients: States, public utility commissions, local governments, federally recognized tribes, utilities/electric cooperatives

Eligible uses: Improving energy infrastructure and grid resilience

Funding availability: Fiscal years 2022-2026

Application due date: January 12, 2024 (Concept Papers); April 17, 2024 (Topic Areas 1 & 3); May 22, 2024 (Topic Area 2)

Description: The Grid Resilience and Innovation Partnerships program is designed to enhance grid flexibility and improve the resilience of power grids during extreme weather events. GRIP is allocated through three programmatic funding mechanisms: Grid Resilience Utility and Industry Grants ($2.5 billion), Smart Grid Grants ($3 billion) and the Grid Innovation Program ($5 billion).

The Grid Resilience Utility and Industry Grants (Topic Area 1) provide financial assistance to support the implementation of technological solutions that will mitigate multiple hazards across a region or within a community. Hazards may include wildfires, floods, hurricanes, extreme heat, extreme cold, storms and other events that can disrupt power systems.

Smart Grid Grants (Topic Area 2) provide financial assistance to support the flexibility, efficiency, and reliability of the electric power system. This program has a particular focus on increasing capacity of the transmission system, preventing faults that may lead to wildfires or other system disturbances, and integrating renewable energy at the transmission and distribution levels.

The Grid Innovation Program (Topic Area 3) provides financial assistance to support collaboration between eligible program recipients with stakeholders that can help deploy grid resilience projects.

The awardees of the first round of competitive funding were announced in October 2023. A second competitive funding opportunity is expected to open during the first quarter of Fiscal Year 2024 and will include approximately $2 billion in federal funding through the GRIP program.

High-Efficiency Electric Home Rebate Program (HEEHRA)

Funding amount: $4.5 billion nationwide; $37.12 million in formula funding available to North Dakota

Funding type: Formula

Eligible recipients: States and federally recognized tribes

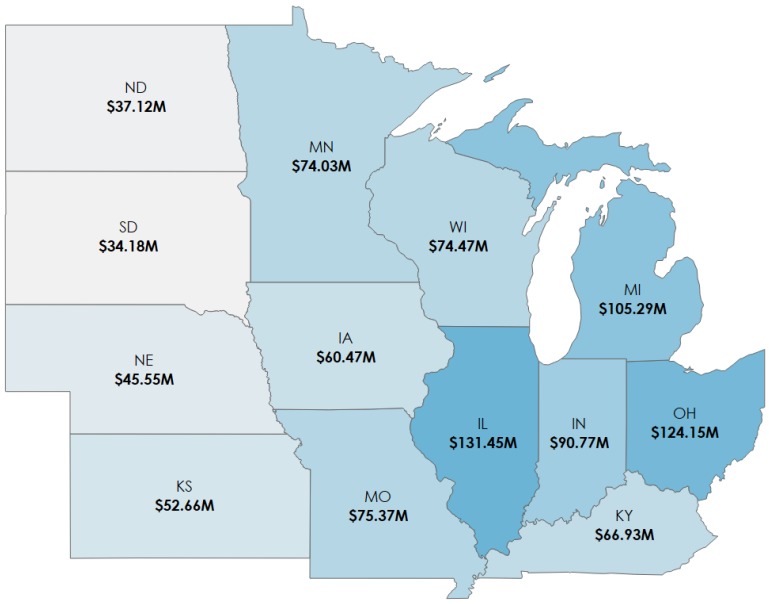
Eligible uses: Point-of-sale consumer rebates for eligible low- and moderate-income households to implement high efficiency and electrification home improvements such as, heat pumps, electric stoves and enabling measures such as upgrading circuit panels, insulation, air sealing, ventilation, wiring and more

Funding availability: Through September 2031

Application due date: There's a deadline of 5/31/24 for states to apply for early administrative funding. The full application needs to be submitted by 1/31/25. If states are choosing to decline the funds, that needs to be noted in a letter to DOE and submitted by 8/16/24.

Description: The HEEHRA program makes $4.5 billion in formula funding available to State Energy Offices (SEOs) to develop and implement home electrification rebates for low- and moderate-income households. Of that formula funding, $37.21 million is available to North Dakota as shown in Figure 5 below.

Figure 5: High-Efficiency Electric Home Rebate Program (HEEHRA) formula funding allocation across Midwest states. Funding allocation source, U.S. Department of Energy.



Home Energy Performance-Based Whole-House Rebates (HOMES)

Funding amount: $4.3 billion nationwide; $37.34 million available to North Dakota

Funding type: Formula grants

Eligible recipients: States

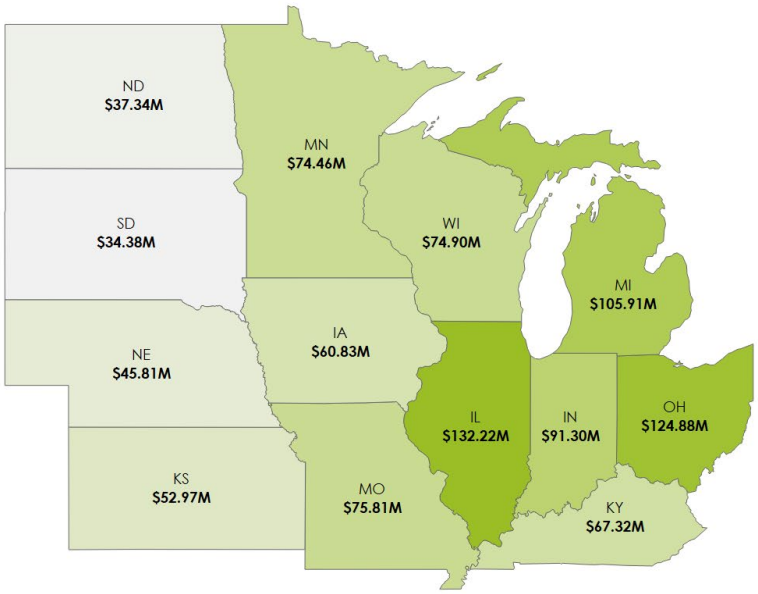
Eligible uses: Rebates for performance-based, whole-home retrofits that reduce energy use at least 15%

Funding availability: Through September 2031

Application due date: There's a deadline of 5/31/24 for states to apply for early administrative funding. The full application needs to be submitted by 1/31/25. If states are choosing to decline the funds, that needs to be noted in a letter to DOE and submitted by 8/16/24.

Description: The HOMES program makes $4.3 billion available to SEOs to develop and implement an energy efficiency rebate program for low- and moderate-income homes and multi-family buildings. Of this formula funding, $37.34 million is available to North Dakota as shown in Figure 6 below. A SEO may use up to 20% of awarded funds for planning, administration or technical assistance, and at least 80% of awarded funds must be used to provide single-family and multi-family households with discounts for efficiency upgrades that are predicted to save at least 20% of the home's energy use.

Figure 6: Home Energy Performance-Based Whole-House Rebates (HOMES) formula funding allocation across Midwest states. Funding allocation source, U.S. Department of Energy.



Tribal Energy Loan Guarantee Program

Funding amount: $20 billion nationwide

Funding type: Loan guarantees

Eligible recipients: Tribal governments and qualified lending institutions

Eligible uses: Projects and activities for the development of energy resources, products and services that utilize commercial energy technology, such as, renewable energies, battery storage, microgrids and virtual power plants, electric vehicle charging infrastructure and transmission/distribution.

Funding availability: Program available until August 2028; loan guarantees are non-expiring.

Application due date: No application.

Description: The Tribal Energy Loan Guarantee Program provides loan guarantees to federally recognized tribes and Tribal Energy Development Organizations to support a broad range of projects and activities for the development of energy resources, products and services that utilize commercial technology.

Weatherization Assistance Program (WAP)

Funding amount: $3.5 billion nationwide; $15.13 million in formula funding available to North Dakota

Funding type: Formula

Eligible recipients: States, federally recognized tribes

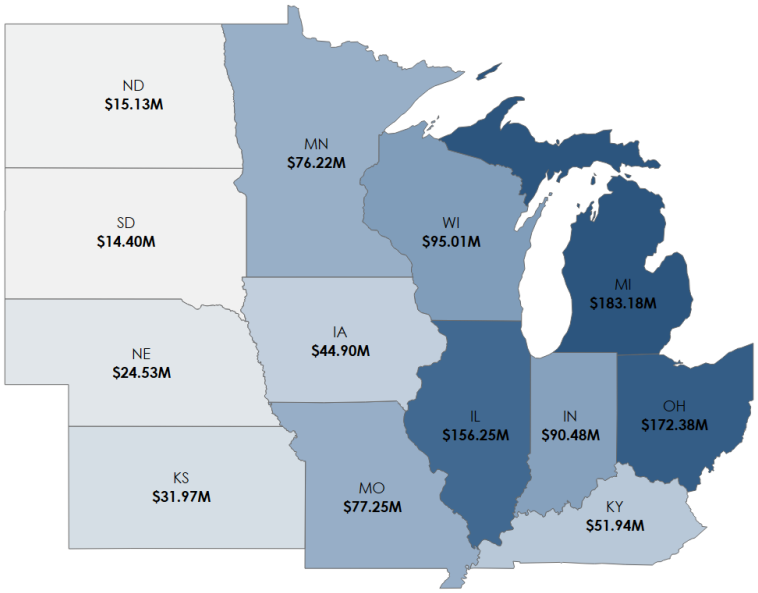
Eligible uses: Various energy efficiency and building-health related improvements

Funding availability: Until expended

Application due date: Application not applicable

Description: The Department of Energy's Weatherization Assistance Program is aimed at help low-income households increase the weatherization and energy efficiency of their homes. Of the $3.5 billion federal investment, $15.13 million in formula funding is available to North Dakota as shown in Figure 7 below.

Figure 7: Weatherization Assistance Program (WAP) formula funding allocation across Midwest states. Funding allocation source, U.S. Department of Energy.



Conclusion

Recommendations

As electricity systems continue to evolve in the United States, new technological and analytical capabilities are creating opportunities to lower utility rates through cost-effective policies and programs that are increasingly accessible to utilities, customers and other energy system participants.

This report offers the PSC and state of North Dakota many short and long-term options that can be implemented to achieve more desirable rate structures for North Dakota's utility customers. Short-term concepts may include phasing out the Montana-Dakota declining block seasonal structures in favor of more general seasonal kWh rate structures used by Northern States and Otter Tail. Long-term concepts may include rolling out policies that would complement Otter Tail and Northern States' potential AMI structures.

Within this report, RAP and MEEA recommend five concepts that could be implemented to facilitate more favorable rate design structures:

1. Introduce a mild time-of-day rate structure for default rates for all customers as now being implemented in Missouri.
2. Move towards a three-period structure for optional time-of-day rates, with off-peak, mid-peak and on-peak prices within each billing period as implemented by Xcel in Colorado.
3. Implement "peak-time rebates" for all residential and small general service customers as implemented in Maryland.
4. Adopt an optional "variable peak pricing" rate for residential and small general service customers as in Oklahoma.
5. Move towards real-time pricing structures for larger general service customers as implemented in Georgia.

To achieve more desirable rate structures, many North Dakota energy stakeholders, such as the state, local governments, utilities and the PSC can help achieve favorable rate outcomes by utilizing currently available federal funding resources. While this report provides nine funding opportunities that various funding recipients can take advantage of to improve North Dakota's electricity rates and energy systems, RAP and MEEA recommend the state's energy stakeholders especially consider seven federal funding opportunities:

1. Energy Storage Demonstration and Pilot Grant Program
2. Energy Auditor Training Grant Program
3. Grid Resilience and Innovation Partnerships (GRIP) Program

4. Weatherization Assistance (WAP) Program
5. Home Energy Performance-Based (HOMES)
6. High-Efficiency Electric Home Rebate Program (HEEHRA)
7. Energy Improvements in Rural or Remote Areas.

Services & Resources

Both RAP and MEEA offer many services and resources to states and their respective state agencies, including North Dakota and its PSC, to support the implementation of forward-thinking energy polies and programs. The following includes a list of resources offered by both organizations that could be utilized to help implement the policy recommendations offered within the scope of this report and beyond.

Services and resources offered by RAP:

- Educational webinars and blogs
- Policymaking assistance
- Research on topics such as:
    - distributed and demand-side resources,
    - electrification,
    - grid modernization and utility business models,
    - ratemaking,
    - resource planning
- Writing reports and policy memos

Services and resources offered by MEEA:

- Assisting states and municipalities in building code compliance
- Building Operator Certification (BOC) trainings
- Consulting on energy efficiency program design and development
- Specialized trainings or engagement opportunities for commission staff (e.g., energy efficiency trainings for PSC staff)
- Guidance on grant application development
- Identifying potential collaborations for program design and delivery through MEEA's vast network of members and partners
- Program administration and coordination
- Identification and facilitation of regional collaboration opportunities
- Regional energy contractor training network coordination
- Technical and/or policy research and reporting

Appendix A: Principles for Electric Utility Ratemaking

In the process of setting the rate structure, regulators and stakeholders refer to a wide range of principles or guidelines, many lists of which have been compiled by past analysts.[15] Many of these principles are still useful today, though it is also worth asking how changing circumstances may affect them. Some generally accepted principles that remain helpful in today's debates regarding rate structure include:

- **Effectiveness in yielding total revenue requirements.** Electric utilities should have an expectation that they will approximately recover their revenue requirement from customer rates, with a reasonable amount of stability from year-to-year.
- **Customer understanding and acceptance.** Electricity rates should not be overly complex or convoluted such that customers cannot understand how their bills are determined or how they should respond to manage their bills. Customers and the public should generally accept that the prices they are charged for electricity service are fair for the service they are receiving.
- **Equitable allocation of costs and the avoidance of undue discrimination.** The apportionment of total costs of service among different customers should be done fairly and equitably.
- **Efficient price signals that encourage optimal customer behavior.** On a forward-looking basis, electricity prices should encourage customers to use, conserve, store and generate energy in ways that are most efficient.

It should be noted that there may be trade-offs between these principles in many cases and the task of the regulator is to strike an overall balance in these objectives.

[15] The most famous of these are the Bonbright principles from Bonbright, J. C. (1961). *Principles of public utility rates.* Columbia University Press. https://www.raponline.org/knowledge-center/principles-of-public-utility-rates/. On Page 291, Dr. Bonbright lists eight frequently cited principles but immediately explains that "lists of this nature are useful in reminding the rate maker of considerations that might otherwise escape his attention, and also useful in suggesting one important reason why problems of practical rate design do not readily yield to 'scientific' principles of optimum pricing. But they are unqualified to serve as a base on which to build these principles because of their ambiguities … their overlapping character, and their failure to offer any rules of priority in the event of conflict." He goes on to discuss his preferred three criteria of "(a) the revenue-requirement or financial-need objective … (b) the fair-cost-apportionment objective … and (c) the optimum-use or consumer-rationing objective" (p. 292).

Appendix B: Summary of Existing Rate Structures

Montana-Dakota Utilities

Residential structures: The default rate structure has a declining block structure in the months of October to May, where consumption over 750 kWh in a month has a rate that is 3 cents lower than base usage. There are two optional rates that have time-varying features: a general optional time-of-day rate and an optional electric thermal energy storage rate.

The optional time-of-day rate has a higher basic service charge per day than the default rate and an on-peak/off-peak structure, with an on-peak period of 12 noon to 8 p.m. on weekdays. The rates themselves vary by season, with higher prices both on-peak and off-peak from June through September.

The optional thermal energy storage rate has a higher basic service charge per day than the default rate and a super off-peak kWh rate from 10 p.m. to 8 a.m. from October through May. Otherwise, this optional rate mimics the declining block prices of the default residential rate. Eligibility for this rate is limited to customers who have electric space heating as their primary heating source.

General service structures: These rates are divided into small general service and general service. For small general service, there is a default rate with a declining block kWh rate from October through May, with a kWh charge that is 3 cents lower after 750 kWh per month. This follows the default residential rate closely but with a higher basic service charge and lower kWh rates. There is an optional time-of-day rate for small general service as well, and its structure follows the residential time-of-day rate quite closely, again with a higher basic service charge and lower kWh rates.

There is a longer list of tariffs available to general service customers, including:

- General electric service for demand metered customers: The default rate which has separate rates for service received at primary voltage and secondary voltage. In both cases, the demand charge varies by season and is $3/kW higher from June through September.
- Optional time-of-day general electric service: This shares many features with the default and has a modestly higher kWh charge from 12 noon to 8 p.m. on weekdays, only 2.5 mills higher than the off-peak rate.
- General electric space heating service: This has similarities to the default general service rate but two major differences, a lower monthly basic service charge and a much lower demand charge from October through May. This rate may be designed to apply to specific heating and cooling

equipment since the customer is obliged to also take service under another general service rate.

- Interruptible large power demand response: Eligibility is limited to primary voltage customers with demand of 500 kW or more that can be interrupted for up to 100 hours per year. The structure is similar to the default general service rate with moderately lower demand and energy charges.
- Firm service economic development: This is limited to new customers over 200 kW and existing customers who will have an increased demand of 200 kW per month. The basic service charge and kWh charge are identical to the default general service rate, but the demand charge is negotiated. For existing customers, only incremental load is eligible for the negotiated demand charge.
- High density contracted demand response: This is for large high load factor customers, who may be interrupted for up to 200 hours per year. The rate itself will be determined in an electric service agreement and must be approved separately by the ND PSC. The tariff specifies that the service agreement must have a term between three and five years.

Otter Tail Power Company

Residential structures: The default rate structure has seasonality where the months of June through September have a higher kWh rate by approximately 2.5 cents than other months of the year. There is a farm service rate that is available for residential uses as well, which has higher customer charges and lower kWh rates than the default, and also seasonally differentiates the kWh charges.

Otter Tail has a series of related "fixed time of service" rates available to customers with electric heating and cooling, storage or electric vehicles. These fixed time of service rates feature a lower baseline kWh rate for electric service between 10 p.m. and 6 a.m. every day. At all other hours, it states that load will be controlled with a "penalty charge" that varies by hour.[16]

There is also a residential demand control rate, and several related "controlled service – interruptible load" rates. The demand control rate has a lower kWh energy charge than the default but a significant demand charge and provision for demand control of up to 14 hours within a 24-hour period. The interruptible load rates feature "penalty periods" when the utility sends a control signal to

[16] The description of this rate stipulates that the penalty provision is not intended as a "buy-through" option and thus not intended to be used routinely.

interrupt the customer's load. These penalty period prices are significantly higher than the fixed time of service rate, and there is also one version with a demand charge during the control period. Two of these rates also have a small facilities charge based on kW demand.

Lastly, there is a water heating control rider and an air conditioning control rider. The water heating control rider is a fully separate rate with a lower kWh charge than the default rate and a monthly credit but allows up to 14 hours of control within a 24-hour period. The air conditioner control rider provides a monthly credit from June through September in exchange for permission to cycle the relevant equipment up to 300 hours per year.

General service structures: Customers under 20 kW are eligible for the small general service rate, which looks similar to the residential default rate albeit with a higher customer charge and modestly lower kWh rates. The general service rate has seasonal distinctions for the kWh charge, with rates approximately 2.5 cents per kWh higher from June through September. The general service rate also has a small facilities charge based on kW demand with a 12-month ratchet. Both the small general service and general service rates make small distinctions between customers receiving primary or secondary voltage.

Large general service rates provide lower kWh rates than the small or general service rates but come with significantly higher customer charges and a substantial demand charge with a minimum of 80 kW. For large general service customers receiving secondary voltage or primary voltage service there is also a small facilities charge based on kW demand, again ratcheted 12 months with a minimum of 80 kW. Transmission service customers have no additional facilities charge. For these rates, all have energy charges that are slightly lower from June through September and demand charges that are higher from June through September.

General service customers are also permitted to opt in to fixed time of service rates and controlled service-interruptible load rates. These rates are structured similarly to the residential version and in some cases are exactly the same. General service customers are also eligible for the water heater control rider and air conditioning control rider. These are structured similarly to the residential version, but the prices differ somewhat.

Northern States/Xcel

Residential structures: The default rate structure has seasonal structure where the months of June through September have a higher kWh rate by approximately

1.5 cents than other months of the year. There is an electric space heating rate which is the same in most respects but the October to May kWh rate is 7 mills lower than the standard rate (mills are equal to 1/10 of one cent).

The residential time-of-day service rate has a modestly higher customer charge than the default rate. For all months, the off-peak hours have a low kWh charge from 9 p.m. to 9 a.m. on weekdays and all day on weekends. The on-peak rate applies from 9 a.m. to 9 p.m. on weekdays. From June to September, the on-peak rate is substantially higher than the other months. Electric heating customers on this rate also get a modestly lower on-peak kWh rate from October through May.

Energy-controlled service for residential customers is allowed for separately metered space and water heating loads. For a modest customer charge and lower kWh charges than the default rate, the customer must permit utility control interruptions for 12 hours or more. However, there is also an option for non-interruptible service from June through September at the same kWh rate as the residential default.

Limited off-peak service for residential customers is available for customers willing to limit their service to the hours between 10 p.m. to 6:30 a.m. For the same customer charge as energy-controlled service, these customers receive an even lower kWh rate. Energy usage during "non-authorized" hours carries a 31 cents per kWh rate, and if such non-authorized use occurs in three billing periods the customer may be removed from this rate.

The residential controlled air conditioning and water heater rider provides a monthly bill discount ($10 for air conditioning, $2 for water heating) in exchange for utility control.

General service structures: Customers under 25 kW are eligible for the small general service rate, which looks similar to the residential default rate albeit a modestly higher customer charge and without the possibility of the reduced rate for electric heating in the winter. There is a small general service time-of-day rate, which is structured similarly to the residential time-of-day rate.

The general service rate class for nonresidential customers above 25 kW has a modest $26.10 customer charge and is differed by four distinct voltage service levels. For secondary voltage service, there is a 4-cent kWh charge paired with a significant demand charge that varies by season. From June through September, this is approximately $15/kW. During the rest of the year, it is $11/kW. Service at higher voltages is structured as discounts from the secondary voltage service rates, namely a small reduction in the kWh rate and a more substantial reduction in the demand charge. Higher voltages receive larger discounts.

There is a 50% demand ratchet, but an off-season load rider is available to exclude the months of April, May, October or November from the ratchet.

The general service time-of-day rate has a slightly higher customer charge than default general service. On-peak kWh rates are on non-holiday weekdays from 9 a.m. to 9 p.m. and all other hours are off-peak. The demand charge levels are the same as the default general service rate but only apply during the peak period. However, there is also an "excess" demand charge for off-peak demand in excess of on-peak demand.

There is a peak-controlled service rate which builds off the default general service rate and a peak-controlled time-of-day service rate which builds off the general service time of day rate. In each case, the customer is allowed to subscribe to a level of firm demand at the typical demand charge level and pay for additional controllable demand at a lower demand charge rate. Customers must sign a service agreement with the utility that includes a number of additional provisions, such as minimum years of service, permissible hours of interruption, subscribed demand level and additional charges for failure to control demand to agreed level.

Energy-controlled service for commercial customers is allowed for space and water heating loads up to 50 kW on the same terms as residential customers. Similarly, limited off-peak service rates are available for general service, but there is also a differentiated customer charge by voltage level and an additional small energy charge discount for primary voltage service.

A commercial and industrial controlled air conditioning rider is available as a $5 per ton per month credit from June through September in exchange for letting the utility cycle or control the customer's air conditioner load.