



Summary Report

September 2013

Economic benefits of transmission

10-Year Transmission System Assessment

www.atc10yearplan.com





Industry dynamics add complexity to transmission planning

Projects assure reliability, deliver economic benefits

For transmission owners, reliability remains the top priority, but the need for transmission is no longer driven just by local load forecasts and reliability issues. Renewable energy, system congestion and load-shape changes all make transmission planning increasingly complex.

Traditionally, transmission systems were planned to meet peak demand hours when the system would be the most stressed. The assumption was that if the system could meet the peak demand, it could meet demands for all other conditions. Evolving regional energy markets along with increased use of renewable energy sources have presented new demands and stresses during off-peak periods, resulting in new challenges.

Renewable generation that produces more in the off-peak hours, combined with generally increasing flows during these hours, means that transmission planners now need

For projects installed over the past three years, including projects built solely for reliability, we estimate 99 percent of the cost will be offset by savings in energy prices over the life of the projects.

to analyze a host of system conditions in off-peak hours as well as peak demand requirements. These higher off-peak flows, which make it difficult to schedule maintenance outages, may become more widespread and continue to increase with the advent of new technologies.

Another variable that adds complexity in transmission planning is the potential for generator retirements due to new air quality regulations. Our customers are completing detailed surveys on load forecasts, demand-side resources and generation resources, year by year, for the next decade to help the Midcontinent Independent System Operator assess the issue.

As regional planning efforts evolve and become more sophisticated, the economic benefits of transmission solutions are becoming more evident. In addition, the regional energy market has enabled transmission owners and operators to identify where congestion on the system is causing customers to pay higher prices because of a lack of transmission options.

By easing congestion on the system and providing access to lower-cost sources of generation, transmission investments help keep electric rates in check. When the Midwest wholesale energy market was established in 2005, the average locational marginal price within our service area was more than \$10 higher per megawatt hour than the average in neighboring states. In 2012, the LMP was only 20 cents higher.

We also have determined that for projects installed over the past three years, including projects built solely for reliability, we estimate 99 percent of the cost will be offset by savings in energy prices over the life of the projects.

Our Pleasant Prairie-Zion Energy Center Project will help alleviate transmission congestion around the southern tip of Lake Michigan, allowing utility companies to buy and sell power when it is economically feasible. The transmission system between southeastern Wisconsin and northeastern Illinois was congested nearly one third of the year in the 2010 MISO day-ahead market. The project is expected to significantly reduce this level of congestion. It was designated by MISO as a Multi-Value Project in 2011 and approved by Wisconsin and Illinois regulators in 2012. We broke ground on the project in early 2013.

New technologies also have the potential to increase reliability and improve economic operation of the grid. A new high-voltage, direct current flow-control device is being built in St. Ignace, Mich., to better manage power flows between the Upper Peninsula and Lower Michigan. The facility will provide more stability to the system in the eastern U.P. Planning studies determined that the \$130 million project would be a less-expensive and faster option than the portfolio of transmission lines studied as alternatives.

The 2013 Assessment covers the years 2013 to 2022 and indicates a need for \$3 to \$3.6 billion in transmission system improvements.

The planning zone summaries included in this report detail specific projects identified to improve reliability, access to the market and renewable energy resources. A more comprehensive listing of these plans is available at www.atc10yearplan.com.

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Transmission investments The 10-year projections from past and current Transmission System Assessments

	2009	2010	2011	2012	2013
Specific Network Projects	\$1.0B	\$1.0B	\$1.0B	\$1.9B	\$1.2B
Regional Multi-Value Projects	\$0.0B	\$0.7B	\$0.7B	\$0.8B	\$0.5B
Asset Maintenance	\$0.7B	\$0.7B	\$1.0B	\$1.1B	\$1.1B
Other Capital Categories	\$0.8B	\$1.0B	\$1.1B/\$1.7B	\$0.1B/\$1.0B	\$0.2B/\$0.8B
Total 10-Year Capital Cost	\$2.5B	\$3.4B	\$3.8B/\$4.4B	\$3.9B/\$4.8B	\$3.0B/\$3.6B

Planning initiatives increasingly focus on regional and economic benefits

ATC is involved with several planning efforts that address regional, inter-regional and Eastern Interconnection-wide needs that could impact grid operations. Proposed legislation regarding renewable energy developments and greenhouse gas emission reductions continues to evolve at the federal level. ATC monitors these discussions and continues to undertake internal analyses and participate in regional studies to anticipate the future demands on the transmission system.

Eastern Interconnection Planning Collaborative

In 2010, the Department of Energy granted \$16 million to a group of registered planning authorities in the Eastern Interconnection (generally from the Atlantic Ocean to the Rocky Mountains) to form a collaborative to develop transmission expansion options under different scenarios. Conducted in two phases, the collaborative issued two reports, including both alternating current and direct current solutions, which were analyzed using North American Electric Reliability Corp. reliability criteria and traditional planning tools.

Currently, the EIPC organization has agreed to undertake two additional efforts. One is to fund and perform a continuing analysis on interconnection-wide transmission planning. The effort involves combining existing transmission plans from across the interconnection, looking for any areas that might benefit from more strategic transmission expansion and performing reliability analysis for scenarios developed with stakeholder input. This is a two-year effort with model development and scenario definition in 2013 and additional reliability analysis in 2014.

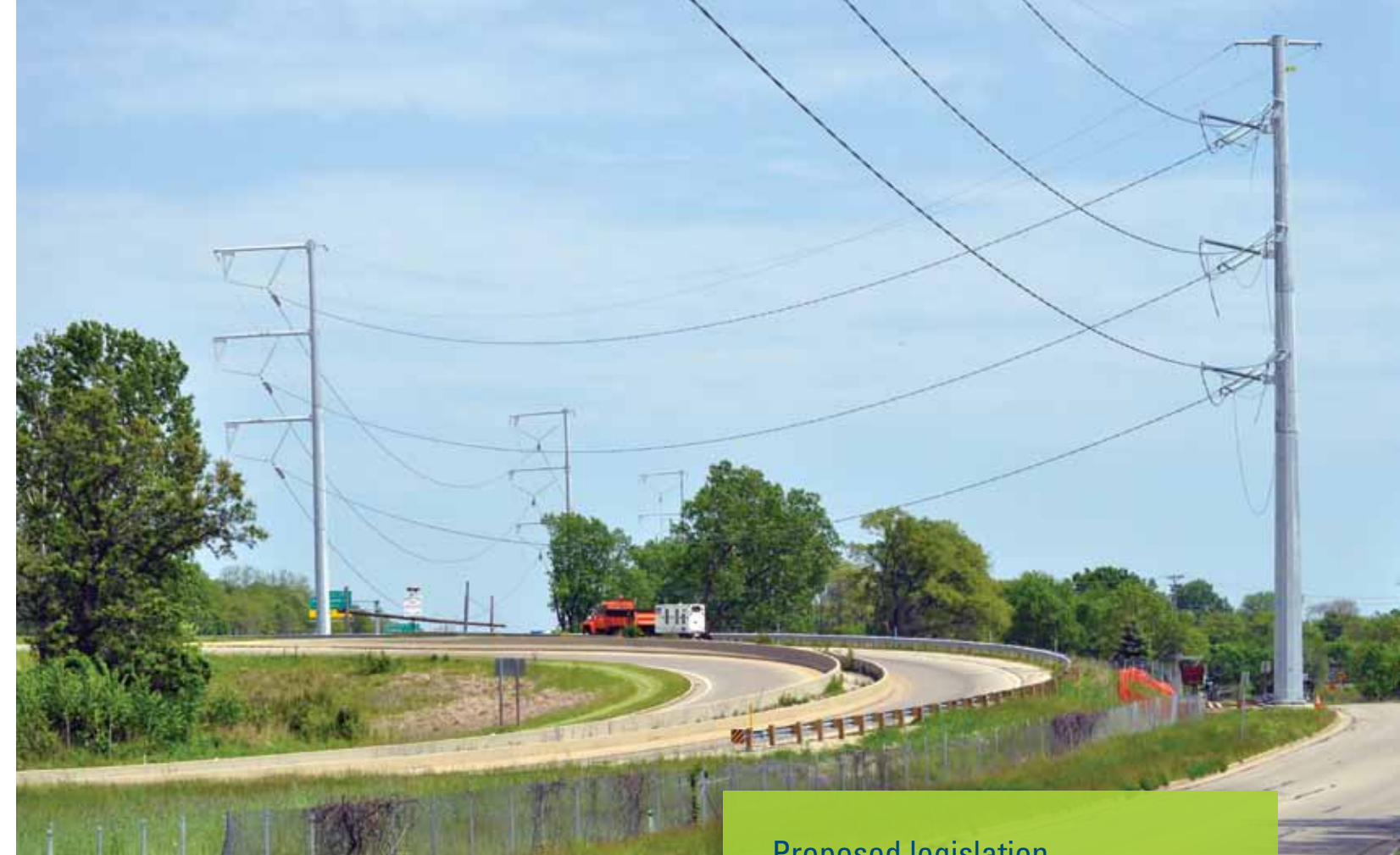
The second is a gas-electric coordination analysis that is being undertaken by a subset of the EIPC planning authorities to determine if, with significant numbers of natural gas plants anticipated, failures on the natural gas system will cause electric reliability issues. While ATC is not participating actively in this effort, we are monitoring its progress.

FERC Order 1000

ATC has continued to participate in stakeholder discussions to develop MISO's compliance plans with the Federal Energy Regulatory Commission's Order 1000. Issued in 2011, Order 1000 advances requirements in four major areas: participation in a regional transmission planning process that produces a regional plan and considers needs driven by public policy, improvements in inter-regional planning, removal of federal rights of first refusal for regionally cost-shared projects, and establishment of principle-based regional and inter-regional cost-allocation methodologies. Much of the MISO stakeholder discussion has centered on which types of projects will be open to competition and how developers will be selected for those projects.

In its regional compliance plan that was filed with FERC in October, MISO proposed a competitive bidding process for market efficiency projects and Multi-Value Projects. FERC conditionally approved MISO's compliance plan in March 2013, with an additional compliance filing due in mid-2013. ATC also was required to comply with the Order 1000 requirements related to considering transmission needs driven by public policy requirements in local planning processes. ATC in October 2012 submitted an initial compliance plan, which FERC conditionally approved in March 2013. ATC also submitted a compliance filing in 2013.

Order 1000 also requires MISO to coordinate its planning with PJM and other neighboring Regional Transmission Organizations and transmission providers, as well as develop cost-allocation methodologies with each neighbor for inter-regional projects. Proposed inter-regional compliance plans for MISO and most of its other neighboring regions were filed with FERC in July 2013.



Proposed legislation regarding renewable energy developments and greenhouse gas emission reductions continues to evolve at the federal level.

MISO Transmission Expansion Planning

MISO planning studies address long- and short-term issues as well as targeted needs. Long-term studies primarily look at value-based options that provide economic benefits in the 10- to 20-year horizon. Short-term planning is primarily driven by transmission owners' reliability and NERC compliance needs in a five- to 10-year period.

MTEP 13

Our staff participates in short-term planning by contributing project information, helping build and review planning models, and correlating the needs identified in the MISO analyses with specific ATC projects.

Market constraints

Two of the three narrowly constrained areas identified within the MISO footprint are in our service area. While congestion has eased within the Wisconsin and Upper Michigan System, we continue to see congestion in north to south flows between WUMS into the Commonwealth Edison system. The Pleasant Prairie-Zion Energy Center MVP is designed to relieve that congestion and provide greater access to economical sources of generation.

Northern Area Study

Last year, MISO began an economic evaluation of a number of transmission issues in North Dakota, South Dakota, Minnesota, Wisconsin, Michigan, and Manitoba, Canada, due in part to uncertainty or changing conditions regarding hydroelectric imports, potential generation retirements and multiple transmission line proposals in the region. The study, which concluded earlier this year, determined that large-scale transmission expansion is not cost-effective based on MISO-wide production cost savings under current business-as-usual conditions that were modeled. The study was not designed to address transmission system needs strictly for reliability purposes.

Major projects update

DOE Smart Grid technology update

In 2010, ATC was awarded two Department of Energy matching grants to invest in Smart Grid data communication technologies. Those projects are substantially complete. An \$11 million grant was used to install additional fiber optic cable and equipment to improve communication between substations and system operations centers. Through the use of overhead and underground fiber optic cable and back-up satellite technology, we have significantly reduced our dependence on leased communication services. This provides more secure and reliable operations and greatly enhances our ability to maintain operations in the event of a widespread telecommunications outage.

A \$1 million grant to equip substations with a new technology to monitor the status of the grid has enhanced operators' ability to analyze real-time events. Phasor measurement units provide a wider, more integrated and time-synchronized view of the transmission system. Thanks in large part to DOE funding, ATC now has more than 90 PMUs in service monitoring data on our entire 345-kV system. This data is being sent to MISO to augment regional operators' visualization and analysis tools. ATC also has shared data to help interconnected customers analyze events on their systems including generator control issues and customer voltage events.

Pleasant Prairie-Zion Energy Center

Construction began earlier this year on a Multi-Value Project approved by regulators in Wisconsin and Illinois last year. The 5.3 mile, 345-kV line between substations in Pleasant Prairie, Wis., and Zion, Ill., will relieve congestion in the region and provide savings to electric utilities and their customers by enabling the most efficient generators to supply power to the energy market. It also will increase local and regional reliability by providing another high-voltage interconnection between the two states.

Straits HVDC Flow-Control Project

A new substation adjacent to the Straits Substation in St. Ignace, Mich., was placed in service earlier this year. The Mackinac Substation provides another measure of operating flexibility in the area, and is an integral part of a larger project to install a high-voltage, direct current flow-control device to better manage power flows between Upper and Lower Michigan. The device will allow MISO to control power flow in and out of the Upper Peninsula, helping to accommodate the transmission of renewable wind energy being developed in the west. The flow control device is a less-expensive and faster solution compared to a portfolio of transmission lines studied as alternatives.

Bay Lake Project

As currently proposed, Bay Lake is a package of proposals to address a delicate, shifting balance between generation, load and transmission in the northern portion of our service area. The project includes:

North Appleton-Morgan

- ▶ A 345-kV and 138-kV line from the North Appleton Substation in Outagamie County to the Morgan Substation in Oconto County, Wis.
- ▶ A large voltage-control device located near the Amberg Substation in Marinette County, Wis.

Holmes-Old Mead Road

- ▶ A single 138-kV line from the Holmes Substation in Menominee County to the Old Mead Road Substation in Escanaba, Mich.

MISO approved these projects in 2012. A regulatory application will be filed for the Michigan facilities in fall 2013, and for the Wisconsin facilities in the first quarter of 2014. In-service dates are anticipated to be late 2016 and mid-2017, respectively.

Badger Coulee

ATC and Xcel Energy plan to file a regulatory application with the Public Service Commission of Wisconsin this fall. Badger Coulee also is one of 17 MVPs approved by MISO in late 2011. The 160- to 180-mile, 345-kV line between La Crosse and Dane County areas will deliver reliability, economic and public policy benefits. The project will

- ▶ offset the need for about \$160 million in lower-voltage upgrades in western Wisconsin,
- ▶ provide increased access to the wholesale energy market and could provide up to \$259 and \$841 million in net economic benefits over the life of the project and
- ▶ establish another pathway for renewable energy into Wisconsin with a connection to key load centers.



Cardinal Bluffs

Another MVP proposal between Madison, Wis., and Dubuque County, Iowa, is projected to provide benefits that exceed its cost. The 125-mile line would run from the Cardinal Substation to northern Dubuque County. The Cardinal Bluffs Project will improve local and regional reliability, deliver economic benefits by providing greater access to the wholesale market, and enable Iowa to bring more renewable generation to market.

The project is a joint venture between ATC and ITC Midwest LLC.

Branch River

The unexpected closure of the Kewaunee Nuclear Station significantly affected our plans for a new 345-kV line in east central Wisconsin. The original Barnhart-Branch River project included two new substations and a 50-mile, 345-kV transmission line to address equipment modifications and an associated increase in generating capacity at the nearby Point Beach Nuclear Plant in Manitowoc County, Wis. Current plans call for building a new Branch River Substation in Manitowoc County and short segments of 345-kV line to tie into the existing network. Additional facilities will be installed at the Point Beach Substation.



Our progress

We have invested more than \$2.8 billion in transmission infrastructure within our service area since we began operation in 2001. In addition to realizing improved reliability locally and, increasingly, regionally, we are seeing other economic benefits from this investment.

Traditional cost-benefit analysis of reliability projects focused on relatively easy-to-quantify production costs. The emergence of the wholesale market, along with evolving regulatory policy, has resulted in a new approach to determining other benefits of transmission investment. Planning activities

Transmission remains a good value for the electricity consumer. Transmission costs within our service area remain at about 8 to 9 percent of a retail customer's electric bill. (Retail customers pay for the generation, transmission and distribution of electricity, plus fuel costs, through regulated utility rates. Generation and fuel make up the major portion of the bill, followed by distribution infrastructure.) We don't anticipate that percentage to change in the near future; and, as noted earlier, the costs of projects installed in the last three years, including projects built solely for reliability, are expected to save about 99 percent of their total costs due to savings in energy prices.

We achieved a record in reliability performance in 2012, reducing overall unplanned outages by 17 percent, and ranked in the top 10 percent of our peer group for reliability performance on lines greater than 100 kV.

that encourage investments in broader, regional projects are seeing returns in areas other than just reliability: decreased costs in generation and reduced transmission congestion, as well as integration of renewable energy, also are being seen. Transmission planning models are beginning to capture and quantify these non-traditional metrics to determine the true value of investments in the transmission system.

When factoring in all the benefits of transmission expansion, project sponsors are recognizing the value of developing wind energy in resource-rich areas of the country and building transmission to deliver the energy to load centers. These types of transmission investments will become increasingly important as new air quality rules cause retirements of older coal-fired generating units. Transmission build-outs or reconfiguration of the system will play an important role as changes are made in generation.

Managing our existing assets goes hand in hand with our planning strategy for maintaining and improving reliability and cost-effectiveness. Equipment life cycles and replacement plans are driven by safety, regulatory compliance, reliability performance and environmental stewardship.

We achieved a record in reliability performance in 2012, reducing overall unplanned outages by 17 percent, and ranked in the top 10 percent of our peer group for reliability performance on lines greater than 100 kV. This improvement is due to monitoring leading failure indicators and targeting maintenance and equipment replacement programs.



Major accomplishments to date

Since we were formed in 2001 as a utility solely focused on electric transmission, we have:

- ▶ upgraded more than 1,748 miles of transmission line,
 - ▶ improved 161 electric substations and
 - ▶ built 46 new transmission lines (589 miles).
- Eau Claire-Arpin (Wood County, Wis.)
 - Gardner Park-Central Wisconsin (Marathon and Shawano, Wis. counties)
 - Kewaunee (Kewaunee County, Wis.)
 - Manistique-Hiawatha (Schoolcraft and Mackinac, Mich. counties)
 - Morgan-Werner West (Shawano, Waupaca, Outagamie and Oconto, Wis. counties)
 - North Madison-Huiskamp (Dane County, Wis.)
 - North Appleton-Lost Dauphin (Outagamie and Brown, Wis. counties)
 - North Appleton-White Clay (Outagamie and Shawano, Wis. counties)
 - Paddock-Rockdale (Dane and Rock, Wis. counties)
 - Paris-St. Martins (Kenosha, Racine and Milwaukee, Wis. counties)
 - Plains-Stiles (Oconto, Marinette, Menominee, Wis., and Dickinson, Mich. counties)
 - Rockdale-Cardinal (Dane County, Wis.)
 - Rhinelander area (Lincoln, Oneida and Langlade, Wis. counties)
 - Wemptown-Paddock (Rock County, Wis., and northern Illinois)
 - Whitewater-Mukwonago (Walworth and Waukesha, Wis. counties)

A more reliable transmission system has enabled us to:

- ▶ meet a new peak load in 2011 with no customer interruption,
 - ▶ reliably deliver electricity to customers in Wisconsin, Michigan and Illinois at all hours of the year including peak demand hours,
 - ▶ maintain top reliability performance,
 - ▶ support approximately 1,200 MW of new peak electric usage,
 - ▶ connect 6,048 MW of new generation at 24 sites,
 - ▶ increase the ability of our system to import power by 750 MW,
 - ▶ reduce energy losses over the 40-year lives of our completed projects at a level that equates to:
 - Approximately 15 million MW hours of electricity saved (enough to power about 36,000 homes each year)
 - Approximately 10 million tons of CO₂ emissions (associated with producing lost energy) eliminated
 - Averting the need for a 124 MW generating plant to serve peak demand
 - ▶ resolve problems in 19 specific areas to move power into or through our system:
 - Arrowhead-Weston (Northwestern Wisconsin)
 - Blackhawk-Colley Road (Rock County, Wis.)
 - Christiana-Kegonsa (Dane County, Wis.)
 - Cranberry-Conover-Plains (Northern Wisconsin and Upper Peninsula of Michigan)
- We have made progress by actively seeking input and making our plans and proposals public. To date, ATC has:
- ▶ produced and issued 18 transmission system assessments to the public,
 - ▶ held dozens of major public planning and siting meetings, and
 - ▶ participated in thousands of interactive local, state and industry discussions, both giving and receiving information to carry out our duties and responsibilities.

What drives the need for transmission system expansion?

Economics – We evaluate the impact of transmission congestion on wholesale power prices and study projects to determine economic savings to offset most or all of the congestion and loss costs. An example is evaluating increased access to markets outside our footprint.

Plans and actions: **Two** projects are planned, four are proposed, and another two provisional projects are being studied.

Renewables/public policy – All of the states in which we operate and most other Midwestern states have adopted renewable portfolio standards. At the national level, discussions are underway to expand the use of renewable energy and streamline federal permitting processes for transmission expansion.

Plans and actions: We are participating in several regional transmission studies to identify the transmission needed to integrate renewable generation, including wind, much of which could be located in areas remote from large load centers.

Generator retirements – Similar to new generator requests, when a large generator is retired due to age or other reasons, we will determine how system requirements will be affected. Recently issued EPA rules will impact retirements across the U.S. in the next 5 to 10 years.

Plans and actions: The closure of the Kewaunee Power Station earlier this year resulted in a major change to our proposed Barnhart-Branch River Project. Generation uncertainties are growing due to proposed Environmental Protection Agency regulations. We are working closely with generation owners and MISO to anticipate reliability impacts to our transmission system.

Distribution interconnections – The transmission system is dynamic; changes in the marketplace, as well as changes in generation – new plants coming on line, older units being retired – drive the need for additional transmission-to-distribution interconnections.

Plans and actions: **143** are planned in the next 10 years. More than **333** new or improved T-D interconnections have been made since 2001.

New generation – When a new generating facility is proposed, we conduct a system impact study and, if requested, a facilities study. If the existing transmission system is inadequate to ensure generator stability or reliable transmission service, we will determine what system expansion will be needed.

Plans and actions: **Eight** generators are active in our generation queue, and many reflect the growing

development of wind energy; **24** generators added since 2001 required construction of transmission facilities.

Asset renewal – Keeping transmission lines, substations and related equipment in good operating condition extends the life of the facilities, improves system performance and safety and minimizes the potential for outages. Part of the \$3 to 3.6 billion investment ATC will make over the next 10 years is dedicated to asset renewal. Major projects at substations include replacing circuit breakers, protective relays, lightning protection and transformers. Major work on transmission lines involves rebuilding or upgrading aging power lines, including the replacement of structures, conductors, insulators and other equipment.

Plans and actions: More than **110** projects to address asset renewal needs are planned in the next 10 years.

Transmission service requests – Virtually all entities that own power plants or provide electric service to customers, or both, seek to buy and sell electricity with other entities. We evaluate those requests to determine whether the transmission system will operate reliably if the request is granted. If the request can't immediately be granted, we will identify transmission system reinforcements needed to grant the request.

Plans and actions: More than **35** projects to meet transmission service requests have been completed since 2001.

Load growth – Demand for electricity during peak usage periods is projected to grow at a rate of approximately **0.9 percent** across our service territory from 2012 through 2021.

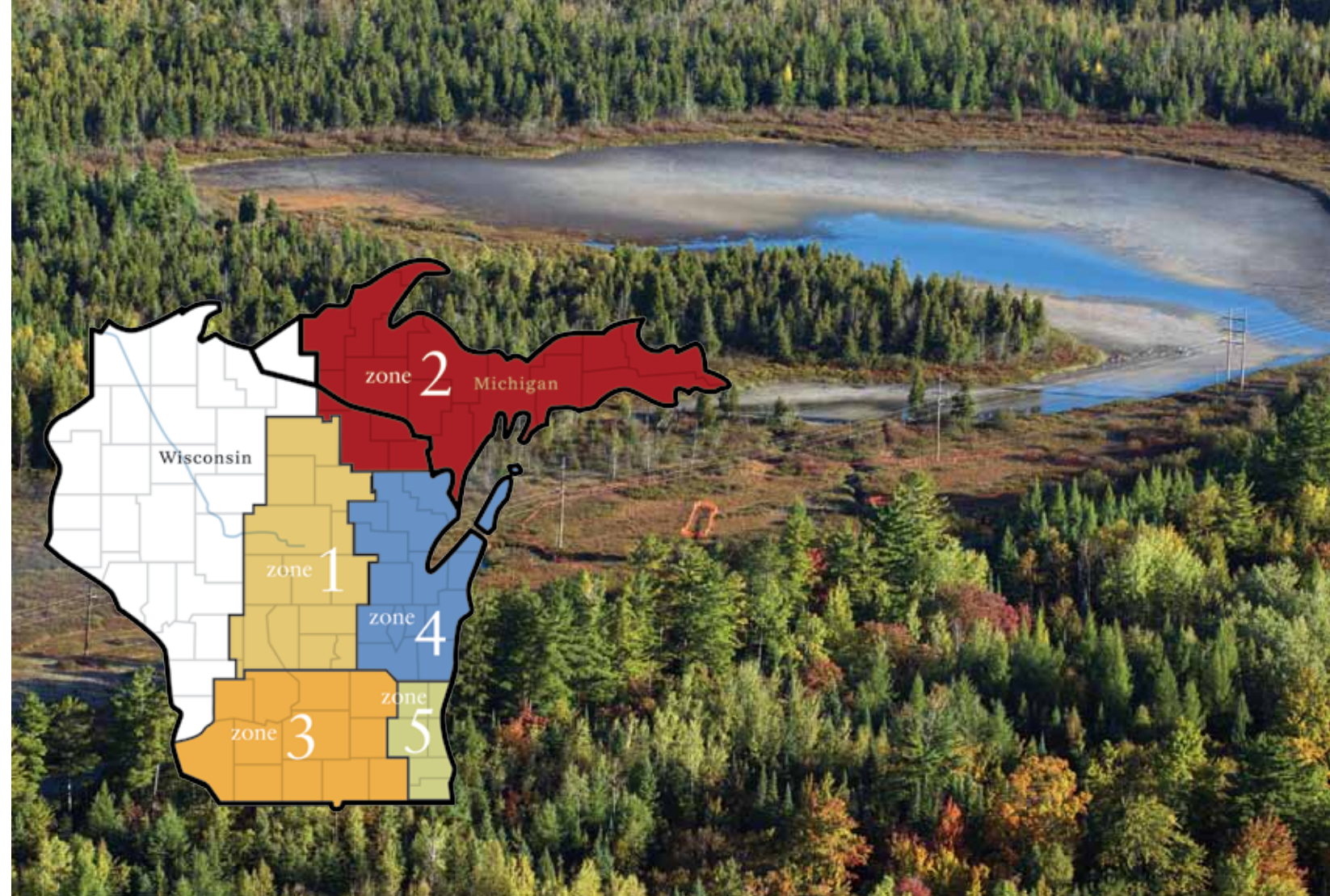
Plans and actions: Load growth has slowed in recent years and we have adjusted our project planning accordingly. About **110** projects are planned, at least in part, due to load growth.

Regulatory environment – Physical and cyber security and reliability standards continue to increase, which affect planning criteria.

Plans and actions: We are participating in the NERC standards process to help anticipate the future impacts of these changes on our planning processes and systems.

Integration of new technologies – Demand-side management, variable generation, distributed resources and smart grid technologies all require changes in how the grid is planned and operated to maintain reliability.

Plans and actions: The type of flow-control device between Upper and Lower Michigan will be one of few utilized in the U.S.



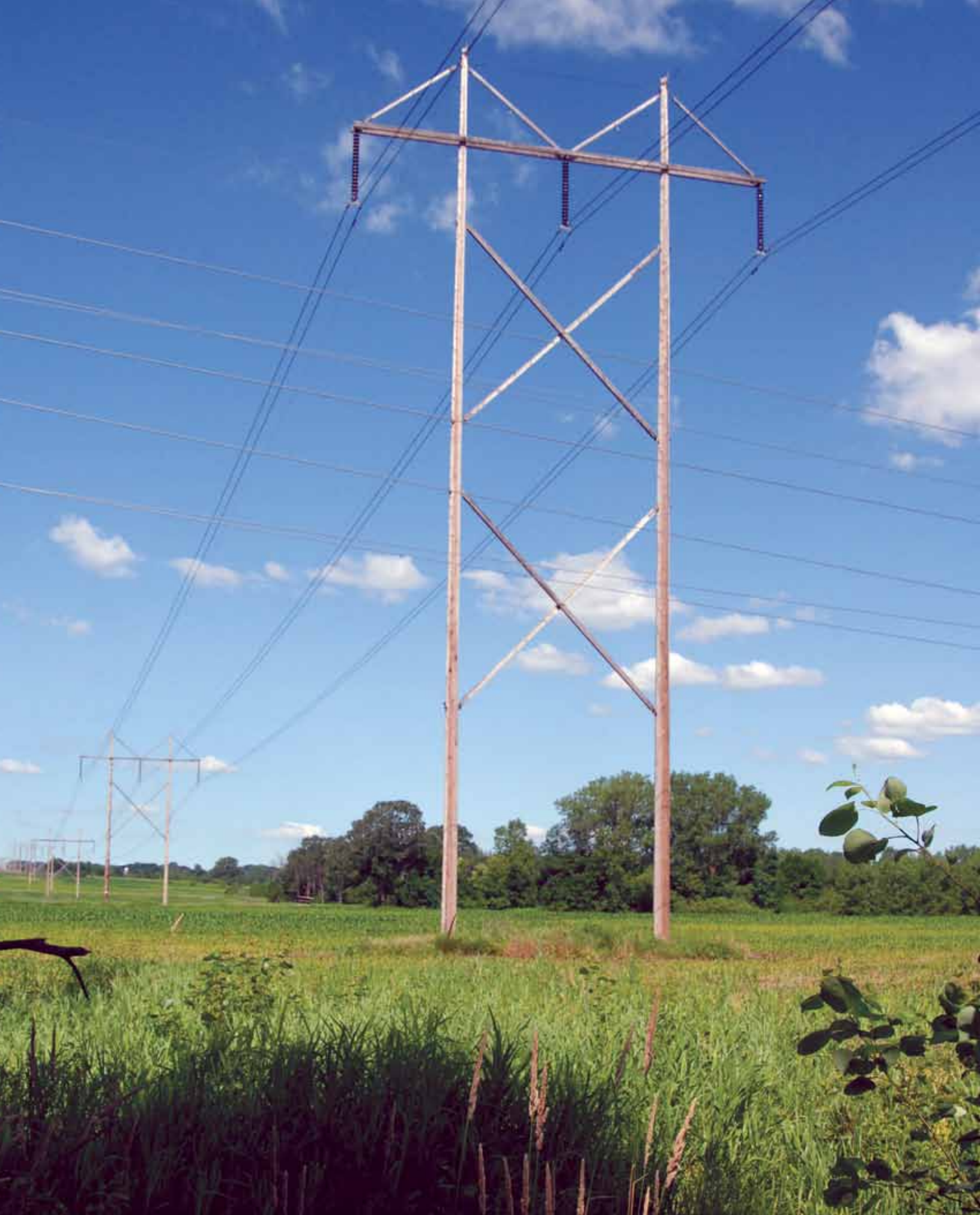
Plans and proposals for the transmission system

For planning purposes, we divide our service area into five zones representing distinct geographic or usage areas. Within each zone, we compile and assess the transmission system needs.

Project classifications

Within each zone, we have recommended network and asset renewal projects to address system limitations. The network projects are classified into one of three possible categories – **Planned, Proposed or Provisional** – depending upon the stage a project may be in. These categories are consistent with those used by MISO.

	Planned	Proposed	Provisional
Status of ATC planning activities	Studies complete	Studies not complete	Studies not complete
Application for regulatory approval	Application pending or issued	None	None
Project status	Project in construction planning phase or under construction	Project identified as preferred alternative	Placeholder project; not necessarily a preferred project alternative
System solution included in generation interconnection power flow models	Project included	Project not included	Project not included



North Central Wisconsin – Zone 1

Transmission system characteristics in Zone 1

ATC delivers power in Zone 1 with various transmission facilities including:

- ▶ East-west 345-kV line from Arpin Substation through Stevens Point extending to the Appleton area,
- ▶ 345-kV line extending from Wausau to northeastern Minnesota,
- ▶ 345-kV line extending from Wausau to Stevens Point to eastern Outagamie County (Highway 22),
- ▶ 115-kV network in the northern portion of the zone, and
- ▶ 138-kV and 69-kV network in the southern portion of the zone.

There are a number of transmission system performance issues in Zone 1, including overloaded lines and equipment, and low system voltages.

Transmission system limitations in Zone 1

Key system performance issues from this Assessment in Zone 1 include low voltages and thermal overloads in the southern portion of the zone. These issues will necessitate a combination of reinforcements. In addition, for the northern portion of the zone, other studies occurring in parallel with this Assessment, including Northern Area Studies performed by ATC and MISO, have identified several voltage and thermal limitations. The most severe limitations occur during off-peak periods.

Electric system overview

Slight increases expected in population, employment

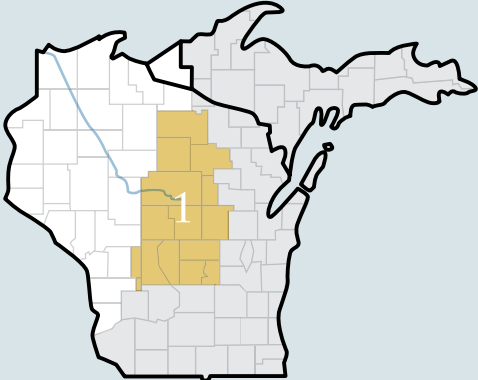
Population in Zone 1 is projected to grow at 0.6 percent annually between now and 2022. Employment is projected to grow at 1.0 percent annually between now and 2022. Marathon County will realize the largest increase in population and employment, while Adams County will have the highest growth rate.

Electricity usage growing

Peak electric demand typically occurs during the summer months, with some winter peaks appearing in the northern portion. Primary electricity users in Zone 1 include a number of large paper mills and food processing plants.

Electric load is projected to grow approximately 0.57 percent annually through 2022.

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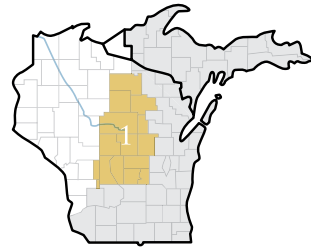


COUNTIES INCLUDED IN ZONE 1 – NORTH CENTRAL WISCONSIN

- ADAMS**
- FOREST**
(southwestern portion)
- FOND DU LAC**
(northwestern portion)
- GREEN LAKE**
- JUNEAU**
- LANGLADE**
- LINCOLN**
- MARATHON**
- MARQUETTE**
- MONROE**
(eastern portion)
- ONEIDA**
- PORTAGE**
- SHAWANO**
(western portion)
- VERNON**
(eastern portion)
- VILAS**
(southern portion)
- WAUPACA**
- WAUSHARA**
- WINNEBAGO**
(western portion)
- WOOD**

Transmission projects in Zone 1

North Central Wisconsin – Zone 1



We have implemented no network projects in Zone 1 since the 2012 Assessment.

Our current plans in Zone 1 include 16 system reliability and economic projects between 2013 and 2027, eight of which are related to our new Study-Based Ratings Methodology. These projects are in various stages of development. The most notable planned, proposed, provisional and asset renewal projects in Zone 1, along with their projected year of completion and the factors driving the need for the projects, are listed below.

	Project description	In-service year	Need driver
Planned projects			
1	Monroe County-Council Creek 161-kV line construction	2015	Low voltages, economics, avoid reconfiguration during emergencies
Provisional projects			
2	Fairwater-Mackford Prairie 69-kV line construction	2018	Overloads and low voltages
3	Bunker Hill-Black Brook 115-kV line rebuild	2019	Overloads
Asset renewal projects			
4	Montello-Wautoma 69-kV line rebuild	2015	Condition and performance
5	Mckenna-Lincoln Pumping 69-kV line rebuild	2018	Condition and performance
6	Plover-Whiting 115-kV line rebuild	2019	Condition and performance
7	Castle Rock-Mckenna 69-kV line rebuild	2019	Condition and performance
8	Chaffee Creek-Wautoma 69-kV line rebuild	2019	Condition and performance
9	Coyne-Saratoga 115-kV line partial rebuild	2020	Condition and performance
10	Wautoma-Harrison 69-kV line rebuild	2020	Condition and performance
11	Lincoln Pumping-Chaffee Creek 69-kV line rebuild	2021	Condition and performance
12	West Wisconsin Rapids-Sigel 69-kV line rebuild	2021	Condition and performance

System Solutions Key

SUBSTATION KEY

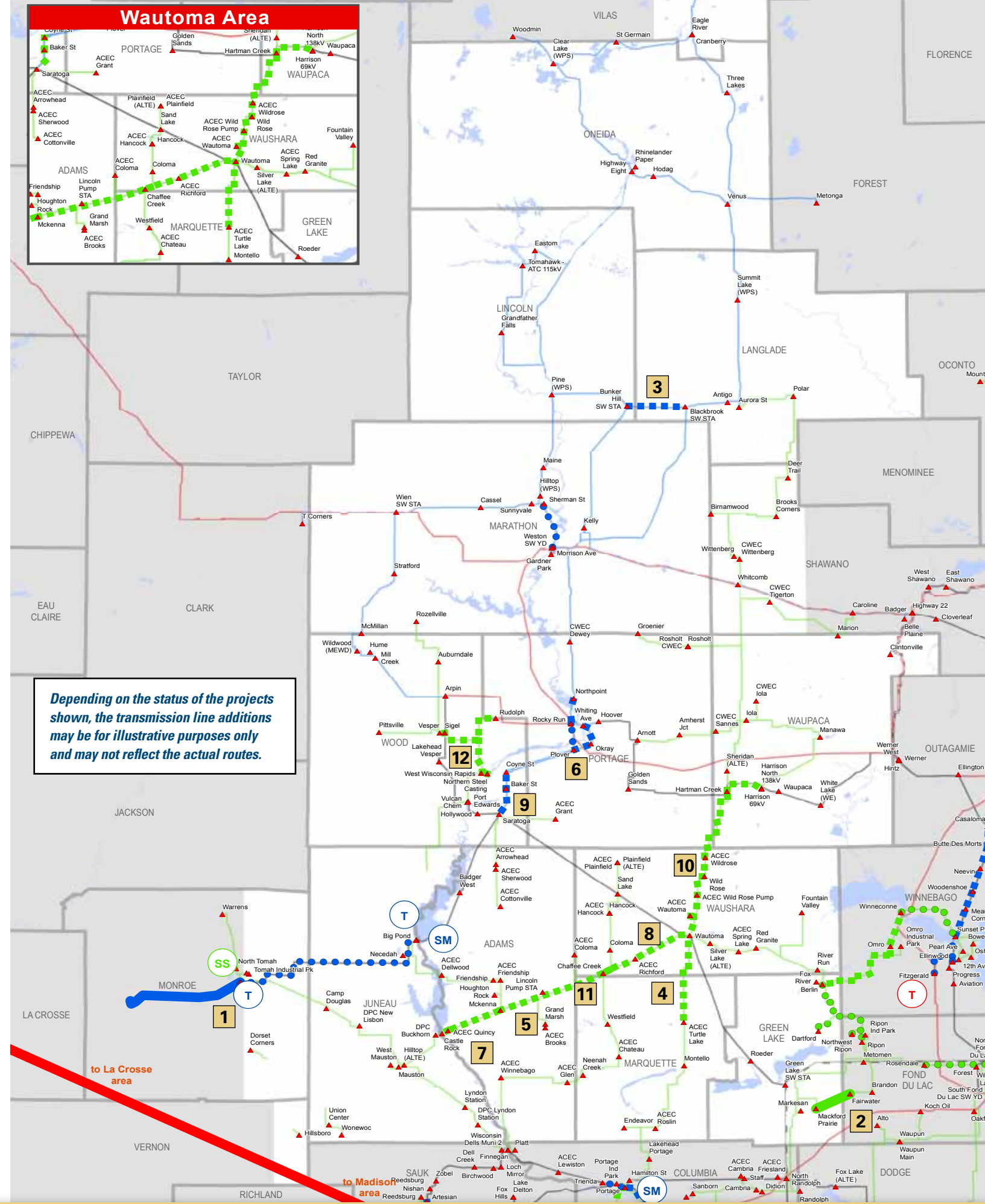
- SS** New substation
Supports transmission system expansion
- SM** Substation modifications
Upgrades equipment ratings to avert facility overloads
- T** Transformer
Supports local growth and improves voltage levels
- C** Capacitor bank or reactor
Relieves low voltages or high voltages
- T-D** T-D interconnection
Supports local growth

TRANSMISSION LINE KEY

- 345-kV transmission line
- 115-, 138- or 161-kV transmission line
- 69-kV transmission line
- Rebuilt 115- or 138-kV transmission line
- Rebuilt 69-kV transmission line
- 115- or 138-kV transmission line rating upgrade
- 69-kV transmission line rating upgrade

EXISTING TRANSMISSION LINES KEY

- 69 kV
- 115 kV
- 138 kV
- 161 kV
- 230 kV
- 345 kV





Michigan's Upper Peninsula and Northern Wisconsin – Zone 2

Transmission system characteristics of Zone 2

ATC delivers power in Zone 2 with various transmission facilities including:

- ▶ Morgan-Plains and Plains-Dead River 345-kV lines,
- ▶ Plains-Stiles 138-kV double-circuit line
- ▶ Lakota Road-Plains 138-kV line, and
- ▶ 138-kV facilities tying the Upper Peninsula of Michigan to the Lower Michigan.

There are a number of transmission system performance issues in Zone 2 including limited ability to import or export power, generator instability, overloaded lines and equipment, low system voltages and chronic limitations to transmission service. Primary drivers of these issues include a mismatch of load to generation in the Upper Peninsula and aging facilities in poor or obsolete condition.

Transmission system limitations in Zone 2

In the analysis of Zone 2, we identified low voltages, high voltages, transmission facility overloads and transmission service limitations. In addition, other studies occurring in parallel with this Assessment, including Northern Area Studies performed by ATC and MISO, have identified several voltage and thermal limitations. The most severe limitations occur during off peak periods.

Electric system overview

Small increases expected in population, employment

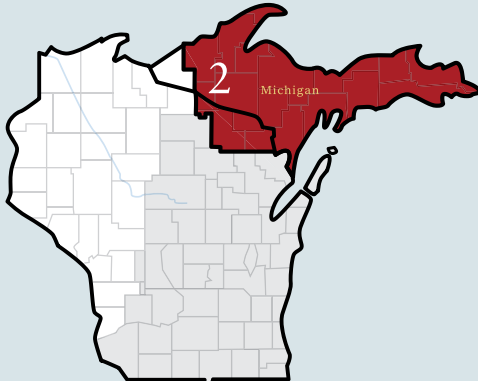
Population in Zone 2 is projected to grow about 0.4 percent annually between now and 2022, and employment is expected to grow about 0.8 percent each year in the same time period. Marquette County, Mich., is projected to realize the largest increase in employment, while Florence County, Wis., is projected to have the highest growth rate.

Electricity usage growing

Zone 2 typically experiences peak electric demand during the winter months. Ore mining and paper mills are the largest electricity users in the zone.

Electric load is projected to increase by 0.55 percent annually through 2022. Also, locally generated electricity is declining in the area with smaller, coal-fired generators most at risk. This includes generation owned by industry, municipalities and utilities.

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COUNTIES INCLUDED IN ZONE 2 – MICHIGAN'S UPPER PENINSULA AND NORTHERN WISCONSIN

- ALGER, MICH.
- BARAGA, MICH.
- CHIPPEWA, MICH.
- DELTA, MICH.
- DICKINSON, MICH.
- FLORENCE, WIS.
- FOREST, WIS. (northern portion)
- GOGEBIC, MICH. (eastern portion)
- HOUGHTON, MICH.
- IRON, MICH.
- KEWEENAW, MICH.
- LUCE, MICH.
- MACKINAC, MICH.
- MARINETTE, WIS. (northern portion)
- MARQUETTE, MICH.
- MENOMINEE, MICH. (northern portion)
- ONTONAGON, MICH. (eastern portion)
- SCHOOLCRAFT, MICH.
- VILAS, WIS. (northern portion)
- WOOD

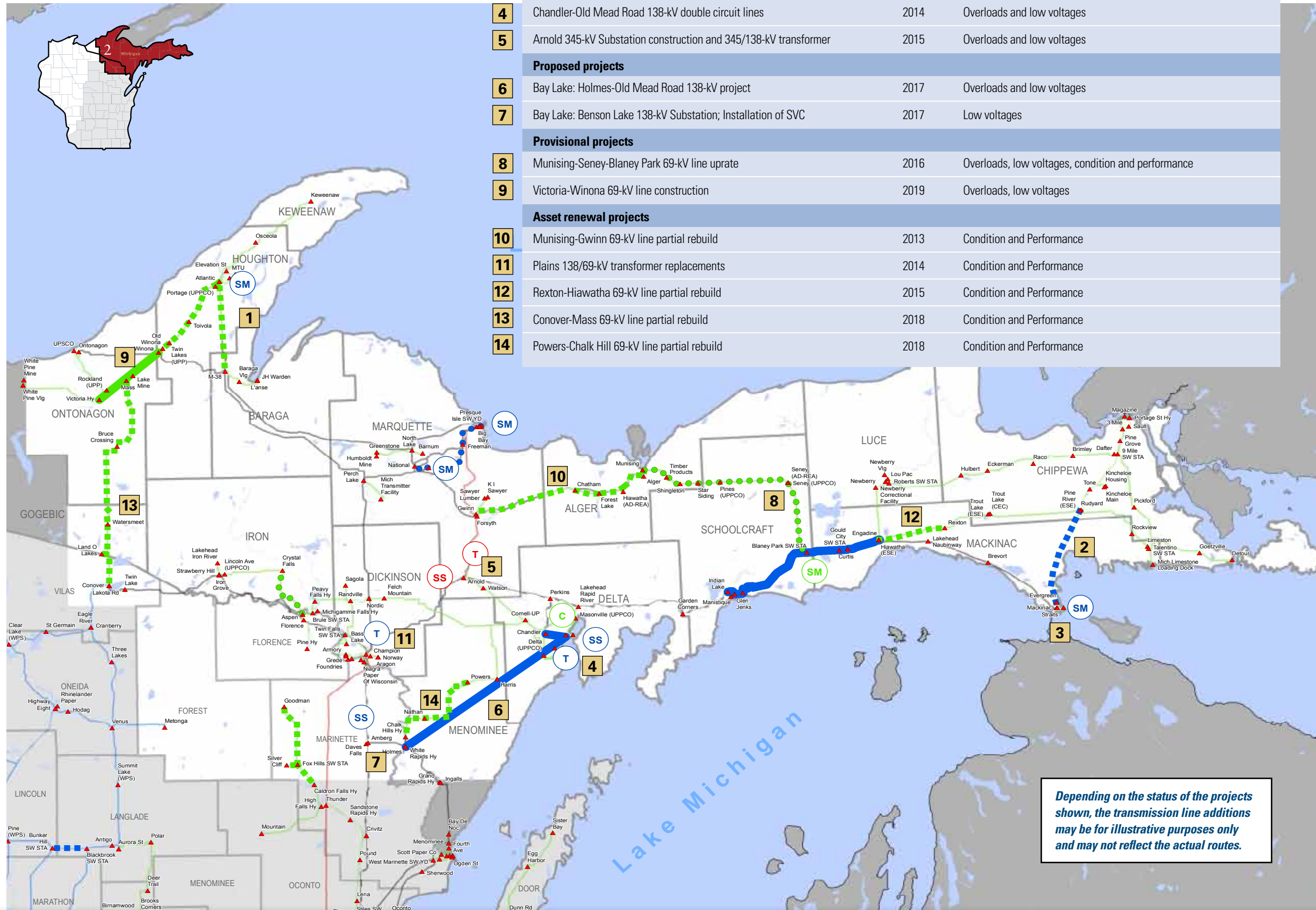
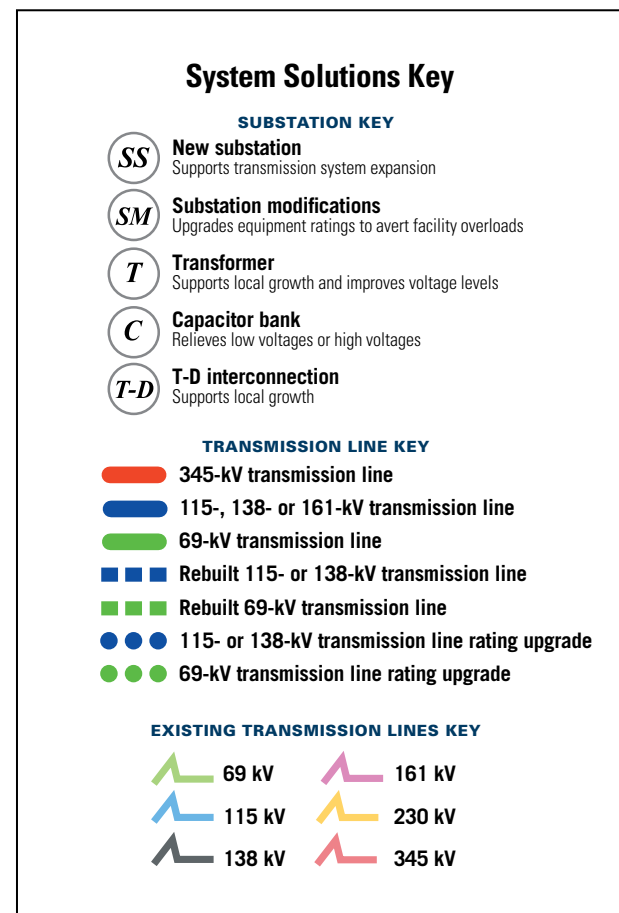
Transmission projects in Zone 2

Michigan's Upper Peninsula and Northern Wisconsin – Zone 2

Transmission projects in Zone 2

We have implemented two network projects in Zone 2 since the 2012 Assessment.

Our current plans in Zone 2 include 16 system reliability projects between 2013 and 2027, three of which are related to our new Study-Based Rating Methodology. These projects are in various stages of development. The most notable planned, proposed, provisional and asset renewal projects in Zone 2, along with their projected year of completion and the factors driving the need for the projects, are listed.



	Project description	In-service year	Need driver
Proposed projects			
1	Atlantic-M38 69-kV line rebuild	2013	Overloads, low voltages, condition and performance
2	Straits-Pine River 69-kV double circuit rebuild	2014	Overloads and low voltages
3	Mackinac 138-kV Substation; Install back-to-back HVDC flow control device	2014	Address/control flow across eastern U.P., overloads and low voltages
4	Chandler-Old Mead Road 138-kV double circuit lines	2014	Overloads and low voltages
5	Arnold 345-kV Substation construction and 345/138-kV transformer	2015	Overloads and low voltages
Proposed projects			
6	Bay Lake: Holmes-Old Mead Road 138-kV project	2017	Overloads and low voltages
7	Bay Lake: Benson Lake 138-kV Substation; Installation of SVC	2017	Low voltages
Provisional projects			
8	Munising-Seney-Blaney Park 69-kV line uprate	2016	Overloads, low voltages, condition and performance
9	Victoria-Winona 69-kV line construction	2019	Overloads, low voltages
Asset renewal projects			
10	Munising-Gwinn 69-kV line partial rebuild	2013	Condition and Performance
11	Plains 138/69-kV transformer replacements	2014	Condition and Performance
12	Rexton-Hiawatha 69-kV line partial rebuild	2015	Condition and Performance
13	Conover-Mass 69-kV line partial rebuild	2018	Condition and Performance
14	Powers-Chalk Hill 69-kV line partial rebuild	2018	Condition and Performance



South Central/Southwest Wisconsin and North Central Illinois – Zone 3

Transmission system characteristics in Zone 3

ATC delivers power in Zone 3 with various transmission facilities including:

- ▶ Columbia-North Madison 345-kV lines,
- ▶ Columbia-Rockdale 345-kV line,
- ▶ Paddock-Rockdale 345-kV line,
- ▶ Paddock-Wempletown 345-kV line,
- ▶ Rockdale-Wempletown 345-kV line
- ▶ Rockdale-Cardinal 345-kV line, which was energized in early 2013, and
- ▶ 138-kV facilities from the Nelson Dewey Power Plant, around the Madison area, and in the northwest and southeast portions of Zone 3.

Transmission system performance issues in Zone 3 include limited import capability, overloaded lines and equipment, high and low system voltages. The causes of these emerging issues include steady growth in certain areas, new power plants, power plant retirement and different generation dispatch scenarios.

Transmission system limitations in Zone 3

In our analysis of Zone 3, we identified low voltages, high voltages and transmission-facility overloads. Low voltages are located in the Verona, Beloit, Hustisford and Waunakee areas. Several overloads on 138 kV and 69 kV facilities in Zone 3 are emerging concerns.

Electric system overview

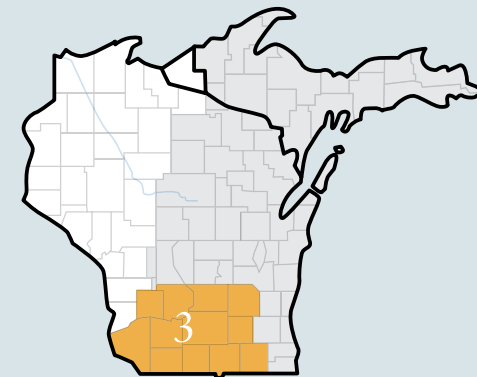
Increases expected in population, employment

Population in Zone 3 is projected to grow about 0.9 percent annually between now and 2022, and employment is projected to grow about 1.2 percent each year for the same time period. Dane County is projected to realize the largest increase in population and employment.

Electricity usage growing

Electric load is expected to grow approximately 1.12 percent annually through 2022 for all of Zone 3.

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COUNTIES INCLUDED IN ZONE 3 – SOUTH CENTRAL/SOUTHWEST WISCONSIN AND NORTH CENTRAL ILLINOIS

COLUMBIA

CRAWFORD
(southern portion)

DANE

DODGE

GRANT

GREEN

IOWA

LAFAYETTE

JEFFERSON

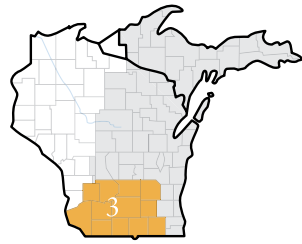
RICHLAND

ROCK

SAUK

WALWORTH

WINNEBAGO, ILL.
(northern portion)



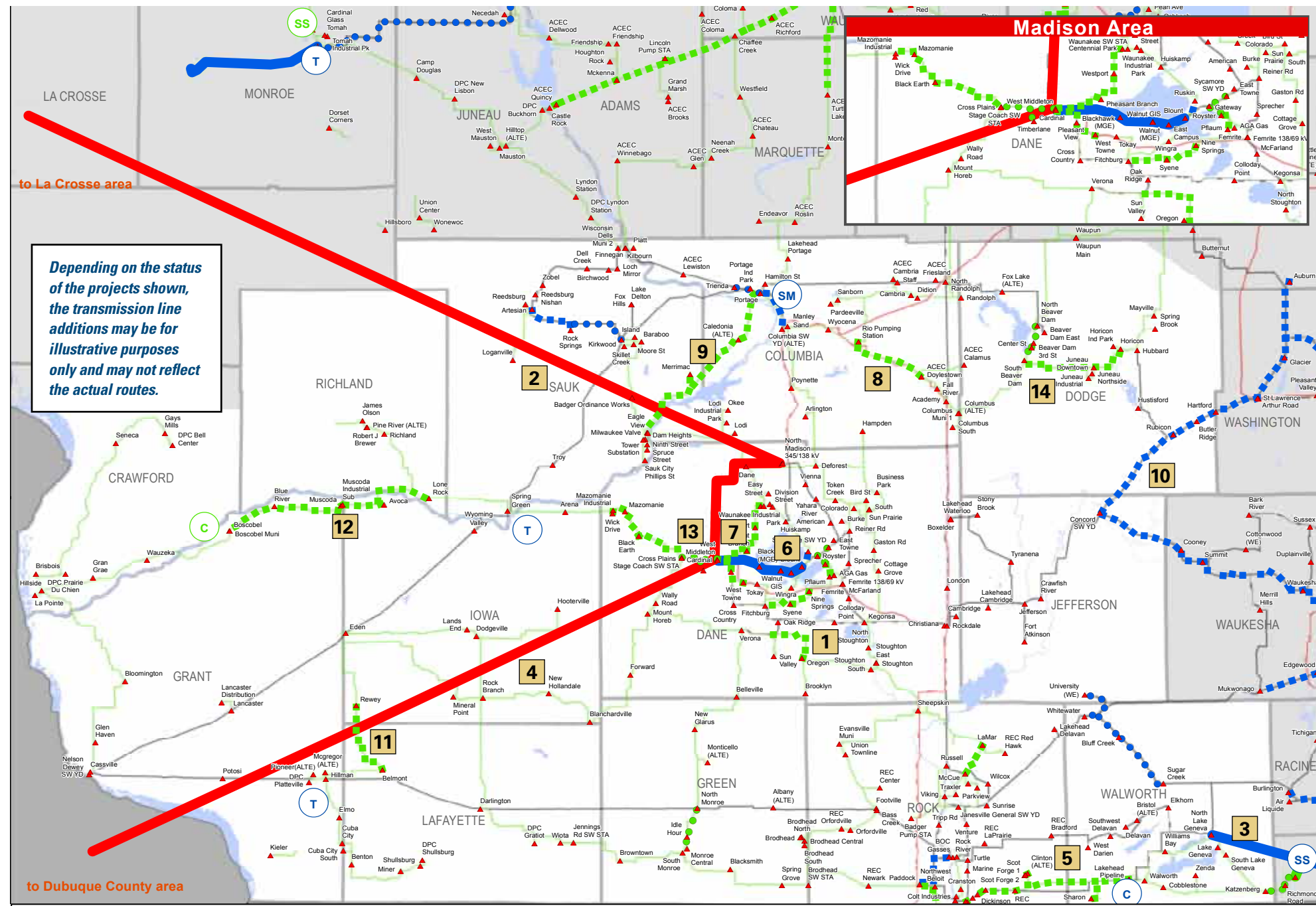
Transmission projects in Zone 3

South Central/Southwest Wisconsin and North Central Illinois – Zone 3

We have implemented four network projects in Zone 3 since the 2012 Assessment, most notably the Rockdale – Cardinal 345-kV line project and the Nine Springs/Pflaum area line uprate and capacitor bank project.

Our current plans in Zone 3 include 31 system reliability and economic projects between 2013 and 2027, 15 of which are driven by our new Study-Based Rating Methodology. These projects are in various stages of development. The most notable planned, proposed, provisional and asset renewal projects in Zone 3, along with their projected year of completion and the factors driving the need for the projects, are listed below.

	Project description	In-service year	Need driver
Proposed projects			
1	Sun Valley Tap-Oregon 69-kV line rebuild	2016	Overloads and improve line condition and area voltages
2	Badger Coulee: La Crosse area-North Madison-Cardinal 345-kV line construction	2018	Reliability, economics and public policy
3	Spring Valley-North Lake Geneva 138-kV line construction	2019	Overloads and low voltages, provide network service
4	Cardinal Bluffs: Dubuque County area-Cardinal 345-kV line construction	2020	Reliability, economics and public policy
Provisional projects			
5	Colley Road-Brick Church 69-kV line rebuild	2018	Overloads and low voltages
6	Cardinal-Blount 138-kV line construction	2024	Overloads and low voltages
7	West Middleton-Pheasant Branch 69-kV line rebuild	2025	Overloads and low voltages
Asset renewal projects			
8	Doylestown-Rio Pumping Station 69-kV line rebuild	2013	Condition and performance
9	Dam Heights-Portage 69-kV line rebuild	2016	Condition and performance
10	Concord-Rubicon-Butler Ridge-Hartford 138-kV line rebuild	2016	Condition and performance
11	Belmont-Rewey 69-kV line rebuild	2018	Condition and performance
12	Boscobel-Lone Rock 69-kV line rebuild	2018	Condition and performance
13	West Middleton-Stagecoach 69-kV underground cable replacement	2019	Condition and performance
14	South Beaver Dam-Horicon 69-kV line rebuild	2020	Condition and performance



System Solutions Key

SUBSTATION KEY	KEY	TRANSMISSION LINE KEY	EXISTING TRANSMISSION LINES KEY
SS New substation Supports transmission system expansion	C Capacitor bank or reactor Relieves low voltages or high voltages	Red line 345-kV transmission line	Green line Rebuilt 69-kV transmission line
SM Substation modifications Upgrades equipment ratings to avert facility overloads	T-D T-D interconnection Supports local growth	Blue line 115-, 138- or 161-kV transmission line	Light green line 69 kV
T Transformer Supports local growth and improves voltage levels		Green line 69-kV transmission line	Light blue line 115 kV
		Blue dashed line Rebuilt 115- or 138-kV transmission line	Light green line 138 kV
		Blue dashed line 115- or 138-kV transmission line rating upgrade	Light blue line 230 kV
		Green dashed line 69-kV transmission line rating upgrade	Light blue line 345 kV



Northeast Wisconsin – Zone 4

Transmission system characteristics in Zone 4

ATC delivers power in Zone 4 with various transmission facilities including:

- ▶ Four 345-kV lines extending from the Point Beach Nuclear Plant,
- ▶ Two 345-kV lines extending from the Edgewater Power Plant,
- ▶ Four 345-kV lines connecting the Gardner Park, Werner West, Morgan, and Plains Substations,
- ▶ Two 345-kV lines from North Appleton to Werner West and Fitzgerald,
- ▶ Three 345-kV lines connecting South Fond du Lac Substation to the Columbia, Edgewater and Fitzgerald Substations, and
- ▶ A 138-kV network in the Fox River Valley/Green Bay area.

Transmission system limitations in Zone 4

In our analysis of Zone 4 we identified low voltages in the Brown County area. In addition, other studies occurring in parallel with this Assessment, including Northern Areas Studies performed by ATC and MISO, have identified several voltage and thermal limitations. The most severe limitations occur during the off-peak periods.

Electric system overview

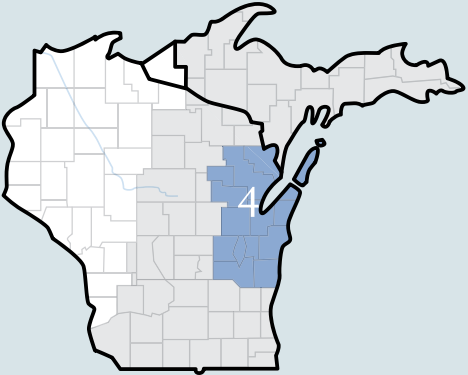
Increases expected in population, employment

Population in Zone 4 is projected to grow 0.8 percent annually between now and 2022. Brown County is expected to realize the largest increase in population. Employment is projected to grow 1.0 percent annually in the same time period, with the largest increase projected in Outagamie County.

Electricity usage growing

Peak electric demand typically occurs during the summer months, although the northern portion of Zone 4 typically experiences nearly equal summer and winter peaks. Paper mills and foundries in the Green Bay and Appleton metropolitan areas are some of the largest electricity users in the zone.

Electric load is projected to grow at approximately 0.74 percent annually through 2022. Also, locally generated electricity is declining in the area with smaller, coal-fired generators most at risk. This includes generation owned by industries, municipalities and utilities.



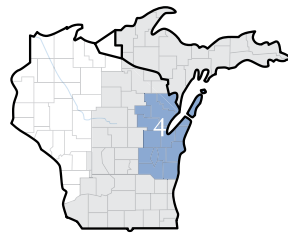
COUNTIES INCLUDED IN ZONE 4 – NORTHEAST WISCONSIN

- BROWN**
- CALUMET**
- DODGE**
(northeastern corner)
- DOOR**
- FOND DU LAC**
(eastern portion)
- KEWAUNEE**
- MANITOWOC**
- MARINETTE**
(southern portion)
- MENOMINEE, MICH.**(southern portion)
- MENOMINEE, WIS.**
- OCONTO**
- OUTAGAMIE**
- SHAWANO**
(eastern portion)
- SHEBOYGAN**
- WINNEBAGO**
(eastern portion)

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Transmission projects in Zone 4

Northeast Wisconsin – Zone 4



We have completed no network projects in Zone 4 since the 2012 Assessment. Our current plans in Zone 4 include 15 system reliability projects between 2013 and 2027, two of which are related to our new Study-Based Rating Methodology. These projects are in various stages of development. The most notable planned, proposed, provisional and asset renewal projects in Zone 4, along with their projected year of completion and the factors driving the need for the projects, are listed in the table below.

	Project description	In-service year	Need driver
Proposed projects			
1	Pulliam-Glory Road 138-kV line conversion	2016	Overloads and low voltages
2	Bay Lake: North Appleton-Morgan 345-kV and 138-kV line construction	2017	Overloads and low voltages
3	Branch River 345-kV Substation construction	2018	Accommodate new generation
Provisional projects			
4	Shoto-Custer 138-kV line	2022	Overloads and low voltage
Asset renewal projects			
5	North Appleton-Butte des Morts 138-kV rebuild	2014	Condition and performance
6	Lost Dauphin-Glenview 69-kV line partial rebuild	2014	Condition and performance
7	North Appleton-Kewaunee 345-kV line cross-arm replacement	2015	Condition and performance
8	Dyckesville-Sawyer 69-kV line rebuild	2016	Condition and performance
9	First Avenue-Redwood 69-kV submarine cable replacement	2017	Condition and performance
10	University-Danz Avenue 69-kV underground cable replacement	2018	Condition and performance
11	Pulliam-Sobieski-Pioneer 69-kV line rebuild	2018	Condition and performance
12	Oak Street-Highway V-Finger Road-Danz Ave 69-kV line rebuild	2018	Condition and performance
13	Caldron Falls-Goodman 69-kV line rebuild	2019	Condition and performance
14	Erdman-Lodestar 138-kV underground cable replacement	2019	Condition and performance
15	Custer-New Holstein 69-kV line rebuild	2019	Condition and performance
16	Wesmark-Manrap 69-kV line rebuild	2020	Condition and performance
17	Finger Road-Canal 69-kV line rebuild	2020	Condition and performance
18	Butte des Morts-Neevin-Woodenshoe-Mears Corners-Sunset Point 138-kV line rebuild	2020	Condition and performance
19	Edgewater-Erdman 69-kV underground cable replacement	2021	Condition and Performance

System Solutions Key

SUBSTATION KEY

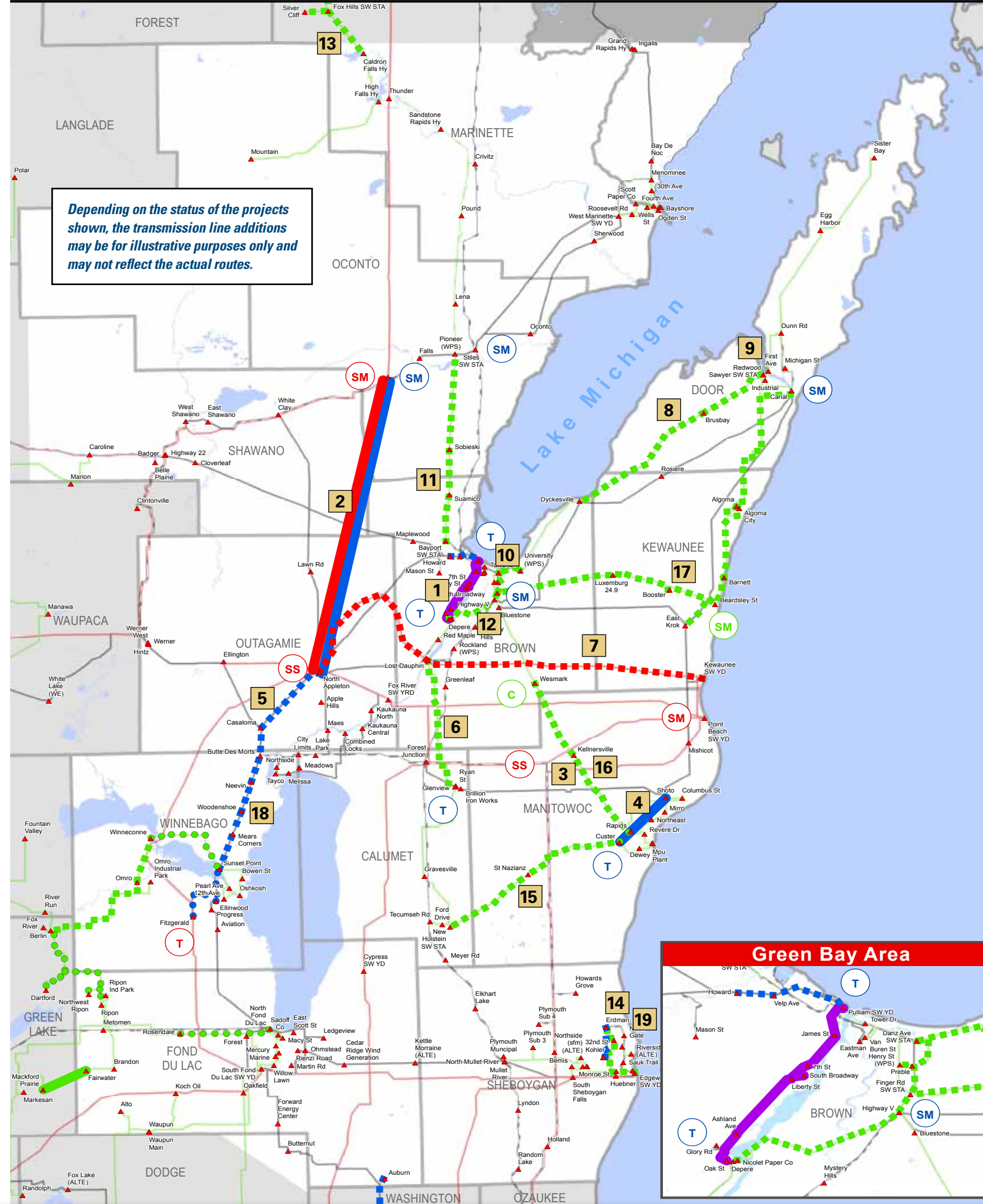
- SS** New substation
Supports transmission system expansion
- SM** Substation modifications
Upgrades equipment ratings to avert facility overloads
- T** Transformer
Supports local growth and improves voltage levels
- C** Capacitor bank or reactor
Relieves low voltages or high voltages
- T-D** T-D interconnection
Supports local growth

TRANSMISSION LINE KEY

- 345-kV transmission line
- 115-, 138- or 161-kV transmission line
- 69-kV transmission line
- Transmission line voltage conversion
- - - Rebuilt 345-kV transmission line
- - - Rebuilt 115- or 138-kV transmission line
- - - Rebuilt 69-kV transmission line
- 115- or 138-kV transmission line rating upgrade
- 69-kV transmission line rating upgrade

EXISTING TRANSMISSION LINES KEY

- 69 kV
- 161 kV
- 115 kV
- 230 kV
- 138 kV
- 345 kV





Southeast Wisconsin – Zone 5

Transmission system characteristics in Zone 5

- ATC delivers power in Zone 5 with various transmission facilities including:
- ▶ The southern portion of 345-kV lines from Point Beach and Edgewater,
 - ▶ The Saukville, Arcadian, Granville, Oak Creek and Racine 345/138-kV substations,
 - ▶ The transmission lines emanating from the Pleasant Prairie and Oak Creek power plants,
 - ▶ 230-kV facilities near Milwaukee, and
 - ▶ A significant 138-kV network in the Milwaukee area, a portion of which is underground.

Apart from the analysis performed in this Assessment, there is one major area event that could impact transmission plans in Zone 5. The proposed road rebuild of the Zoo interchange is moving forward with the following in-service dates:

- ▶ Expand/update Watertown Plank area (2013),
- ▶ Expand/update Highway 100/Highway 45 area (2014), and
- ▶ Expand/update remainder of freeway (2015-2018).

The road relocation project results in new projects to reconfigure the transmission system around Brookdale, Bluemound and 96th Street substations, as well as the construction of an 8-position ring bus at 96th Street.

Transmission system limitations in Zone 5

- Key system performance issues in Zone 5 include:
- ▶ Heavy flows on aging facilities,
 - ▶ Heavy flows from the west (Zone 3) resulting in heavily loaded 138-kV facilities in the western portion of Zone 5,
 - ▶ Heavy market flows from and to the south, resulting in high 345-kV and 138-kV line loadings and the need to monitor potential multiple contingency conditions, and
 - ▶ Sagging voltage profile in portions of Washington and Waukesha counties.

Load growth in Waukesha and Washington counties is projected to exceed the capabilities of the existing 138 kV system in those areas, signaling the need for future transmission system reinforcements.

Electric system overview

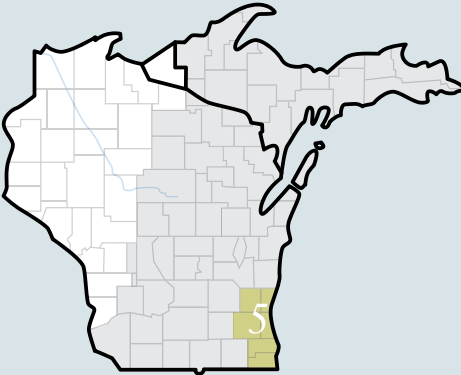
Increases expected in population, employment

Population in Zone 5 is projected to grow 0.6 percent annually between now and 2022, and employment is projected to grow 1.0 percent in the same time period. Waukesha County is projected to realize the largest increase in both population and employment.

Electricity usage growing

Peak electric demand typically occurs during the summer months. Large industrial loads in the Milwaukee metropolitan area, including Charter Steel and Miller Brewing, are among the largest electricity users in the zone.

Electric load is projected to grow approximately 1.04 percent annually through 2022.



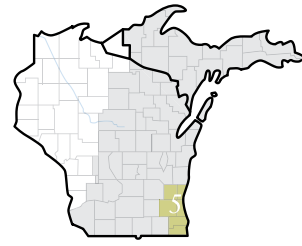
COUNTIES INCLUDED IN ZONE 5 – SOUTHEAST WISCONSIN

- KENOSHA**
- MILWAUKEE**
- OZAUKEE**
- RACINE**
- WASHINGTON**
- WAUKESHA**

ZONE 5

Transmission projects in Zone 5

Southeast Wisconsin – Zone 5



Our current plans in Zone 5 include 24 system reliability and economic projects between 2013 and 2027, 17 of which are related to our new Study-Based Rating Methodology. These projects are in various stages of development. The most notable planned, proposed, provisional and asset renewal projects in Zone 5, along with their projected year of completion and the factors driving the need for the projects, are listed below.

	Project description	In-service year	Need driver
Planned projects			
1	Pleasant Prairie-Zion Energy Center 345-kV line construction	2013	Economics
2	Milwaukee County T-D 138-kV lines	2015	T-D interconnection
Proposed projects			
3	Arcadian-Waukesha 138-kV line rebuilds	2019	Overloads
4	Spring Valley-North Lake Geneva 138-kV line construction	2019	Overloads and low voltages, provide network service
Provisional projects			
5	Arcadian 345/138-kV transformer replacement	2020	Overloads
Asset renewal projects			
6	Concord-Cooney 138-kV line rebuild	2015	Condition and performance
7	Waukesha-Merrill Hills 138-kV line partial rebuild	2016	Condition and performance
8	Paris-Albers 138-kV line rebuild	2016	Condition and performance
9	St. Lawrence-Hartford 138-kV line rebuild	2016	Condition and performance
10	Merrill Hills-Summit 138-kV line partial rebuild	2017	Condition and performance
11	Mukwonago-Edgewood-St. Martins 138-kV line rebuild	2017	Condition and performance
12	Oak Creek-Hayes 138-kV line rebuild	2019	Condition and performance
13	Summit-Cooney 138-kV line rebuild	2021	Condition and performance
14	Paris-Burlington 138-kV line rebuild	2021	Condition and performance
15	St. Lawrence-Barton-Auburn 138-kV line rebuild	2022	Condition and performance

SUBSTATION KEY

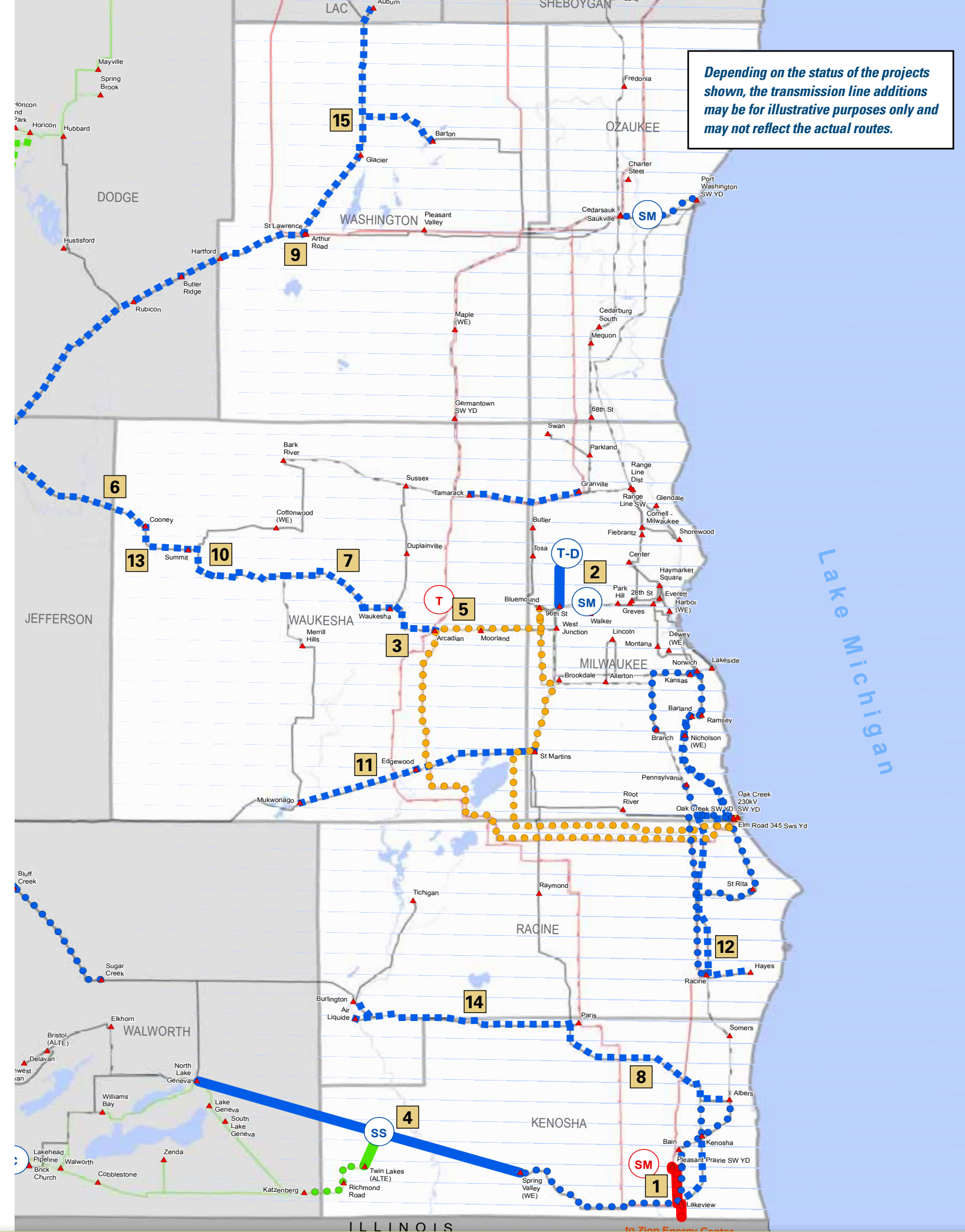
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Supports local growth

TRANSMISSION LINE KEY

- 345-kV transmission line
- 115-, 138- or 161-kV transmission line
- 69-kV transmission line
- - - Rebuilt 115- or 138-kV transmission line
- - - Rebuilt 69-kV transmission line
- 345-kV transmission line rating upgrade
- 230-kV transmission line rating upgrade
- 115- or 138-kV transmission line rating upgrade
- 69-kV transmission line rating upgrade

EXISTING TRANSMISSION LINES KEY

- 69 kV
- 115 kV
- 138 kV
- 161 kV
- 230 kV
- 345 kV





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- Meeting electric needs of more than **five million people** in 72 counties in four states: Wisconsin, Michigan, Minnesota and Illinois
- \$3.3 billion** in total assets

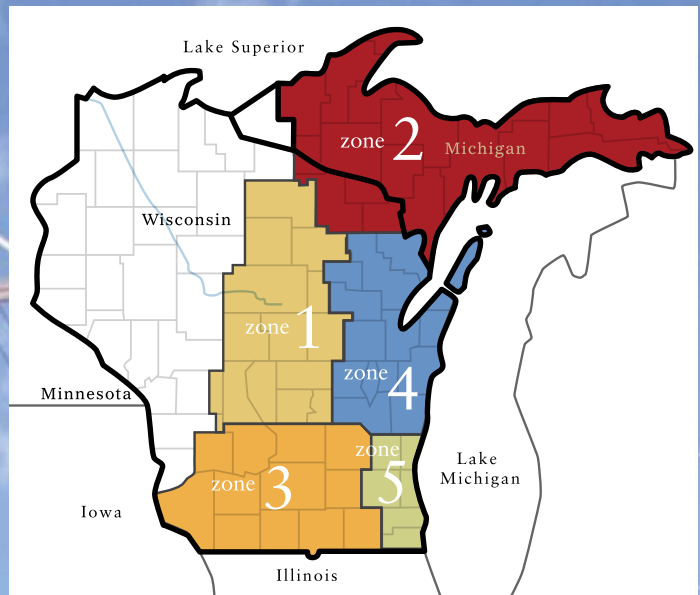
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