

September 2011

## **Economics, public policy increasingly influence**

# Mandatory reliability standards, renewable portfolio requirements affect plans

While reliably meeting the needs of electricity customers is the top priority for any transmission owner, market economics and public policy initiatives are playing a major role in how utilities plan for their system needs. Traditionally, transmission owners performed planning studies and analysis for their individual needs; today, however, while local reliability remains the responsibility of the owner, the trend is toward broader-based planning driven by regional transmission organizations, government agencies and electricity market economics.

Changing the way transmission system costs are allocated also affects the planning as well as permitting for system improvements. Regional planning initiatives increasingly focus on projects that provide additional benefits beyond local-area reliability. These multibenefit, or Multi-Value Projects (as defined by Midwest Independent System Operator, Inc.), also include economic savings and the ability to move renewable energy from where it is generated to where it can be used. As these projects are identified, regulators from multiple states will need to work together to determine cost sharing as well as permitting. We are working diligently with all stakeholders to design an incremental regional build-out of these projects to move forward efficiently and cost-effectively.

Three 345-kilovolt projects that MISO is considering for Multi-Value Project cost sharing were presented in the 2010 10-Year Assessment. These projects are the Badger Coulee, Dubuque-Spring Green-Cardinal and Pleasant Prairie (Bain)-Zion Energy Center projects. For an update, go to page 6.

Enforceable, mandatory reliability standards, developed by the North American Electric Reliability Corp. and approved by the Federal Energy Regulatory Commission in 2007, also play a role in how we plan, operate and maintain our system. Earlier this year, NERC



## transmission planning

issued a set of high-priority reliability issues to help the industry focus on standards setting, compliance, training and education. Several of those priorities, including a changing resource mix and the integration of new technologies, will impact the way we plan and operate our system.

Our planning process also is affected by pending Environmental Protection Agency regulations for electric generators and the recently issued FERC Order 1000 governing regional planning, public policy requirements and cost allocation. These issues, along with the internal identification of a new credible contingency scenario, have caused us to undertake a study on transmission reinforcements in northern Wisconsin and the Upper Peninsula. Later this year, we expect to identify a Northern Plan, some preliminary packages of projects that coordinate with the existing northeast Wisconsin and Upper Peninsula projects to address generation changes, load changes and developing transmission contingency concerns. As the EPA rules become clearer, additional studies may be undertaken to explore these need drivers in other areas of our service territory.

The 2011 Assessment covers the years 2011 through 2020 and indicates a need for \$3.8 to \$4.4 billion in transmission system improvements. The total includes \$1.0 billion in specific network projects, \$1.0 billion in asset maintenance, \$0.7 billion in multi-benefits projects, and this year a range of \$1.1 to \$1.7 billion in other capital categories. Other capital categories can include developing projects (i.e. Northern Plan), or unspecified network projects, interconnection projects and infrastructure relocation.

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 our website **www.atc10yearplan.com**.

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Director of Strategic Projects

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Director of System Planning

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Director of Asset Management



## Regional planning involves large-scale projects and

MISO MVP Candidates Study – Late last year, FERC conditionally approved a new cost-allocation methodology for proposals within MISO that are deemed "Multi-Value Projects." The methodology would spread the cost of the MVPs across the entire MISO region, with ATC customers paying about 10 to 15 percent of the project's cost. A task team is reviewing 17 such projects, including three ATC proposals. (See page 6 for more specific information.)

To qualify as an MVP, a project must meet one or more of these criteria:

- ▶ Reliably and economically enable regional public policy needs
- Provide multiple types of regional economic value
- Provide a combination of regional reliability and economic value

#### FERC Order 1000

FERC has recently issued an order that will have a significant impact on how transmission is planned and built in the U.S. The order impacts the way transmission is planned by requiring Regional Transmission Organizations to plan for public policy requirements such as Renewable Portfolio Standards and EPA regulations, and to coordinate their planning with their neighboring RTOs and other transmission providers. The order requires every RTO to have a regional cost-allocation method for regional and inter-regional projects. The order also opens the door to more competition in building regional, cost-shared transmission projects although state and local laws regarding transmission construction are not affected.

#### **Federal priorities**

In addition to creating reliability based standards, NERC has established a number of priorities for 2011. Integration of new technologies is one of the major priorities we are working on. We signed an agreement with the U.S. Department of Energy in 2010 for smart grid investment grants. A number of phasor measurement units have been installed on our system with a \$1.3 million grant. This smart grid technology helps us perform more detailed analysis of the system during events. An additional \$11.4 million grant is being used to extend fiber optic communication infrastructure. Both projects are on schedule.

Another NERC priority is to address a changing resource mix. Energy and environmental policies along with energy markets are



## multiple stakeholders

driving proposals toward unprecedented changes in the resource mix of the bulk power system. We are currently studying potential system impacts and initial results indicate reliability impacts that must be considered in the future.

Cyber security is also a NERC priority and under increasing FERC scrutiny. We are participating in the NERC standards process to help anticipate the future impacts of these changes on our planning processes and systems.

Energy and environmental policies along with energy markets are driving unprecedented changes in the resource mix of the bulk power system.

**Eastern Interconnection Planning Collaborative** – A group of 27 Planning Authorities is working with the DOE to develop conceptual interconnection-wide transmission plans. The collaborative has reached consensus on eight "resource expansion futures" that will guide the first, fully coordinated transmission planning exercise across the entire interconnection. An interim report is scheduled by the end of 2011. The second phase of the project will include the development of a transmission build-out to support each of three resource scenarios selected by stakeholders; a final project report is due to DOE by the end of 2012.

**Western Wisconsin Reliability Study** – In cooperation with Xcel Energy; Dairyland Power Cooperative; Great River Energy; International Transmission Co., Midwest; and Southern Minnesota Municipal Power Agency, ATC led a study of reliability needs and transmission options in western Wisconsin. Modeling, coordinated with MISO, showed many reliability needs in the region would be partially solved by 345-kV solutions in western Wisconsin.

**South Lake Michigan Congestion Study** – Market congestion issues impacting southeastern Wisconsin are part of a larger regional market congestion issue that extends south of Lake Michigan into Illinois and Indiana. We have worked with MISO and other stakeholders to identify short-, medium- and long-term solutions. For more information, please refer to the Pleasant Prairie-Zion Energy Center 345-kV project on page 8.







## **Emerging projects update**

In last year's Assessment, we introduced three emerging projects that provided benefits beyond local-area reliability. The projects are in various stages of development.

## Badger Coulee project launched to enhance regional reliability, deliver renewable energy and provide economic savings

We began public outreach for the Badger Coulee Project in 2010, and shared with local stakeholders the potential corridors for the 150-mile, 345-kV line between the La Crosse and northern Dane County areas.

Our studies indicate that this is a multi-benefit project that would deliver benefits to Wisconsin and the Midwest region in three important ways:

#### Improve electric system reliability locally and regionally

- ▶ Better enable Wisconsin to import power
- Offset the need for approximately \$180 million (\$140 million in the ATC service area) in lower-voltage upgrades in western Wisconsin communities
- Alleviate regional transmission grid stability issues

#### Deliver economic savings for Wisconsin utilities and electric consumers

- Provide utilities with greater access to the wholesale electricity market with potential savings that can be passed on to electric consumers
- ▶ Improve efficiency of the grid; more efficient grid reduces the cost to deliver energy
- Connect to high-quality renewable resources in the nation's western wind alley, which translates into hundreds of millions of dollars in potential savings
- ► Could provide \$75 million to \$560 million in energy cost savings to ATC customers over the life of the project, depending on the future studied (preliminary analysis)

#### Expand infrastructure to support public policy for greater use of renewables

- ► Establish another pathway for renewable energy into Wisconsin with connections to key load centers
- ► Match regional studies (Strategic Midwest Area Transmission Study and MISO Regional Generation Outlet Study) evaluating transmission options that best deliver renewable energy while also addressing reliability issues
- Could provide \$50 million to \$340 million in potential renewable investment savings to ATC customers over the life of the project depending on the future studied (preliminary analysis)

Badger Coulee has been identified as a Candidate Multi-Value Project by MISO, eligible for cost-sharing across the region. If the project is deemed an MVP by MISO, preliminary studies show the project will show a net benefit to our customers in all six futures studied. If the project is not deemed an MVP, the project will show a net benefit in five of six futures studied.

ATC anticipates filing an application with the Public Service Commission of Wisconsin in 2013.









#### **Dubuque-Spring Green-Cardinal 345-kV Project shows regional benefits**

We continue to study the benefits of a 345-kV line linking the Dubuque, lowa area to the Madison, Wis. area. We have examined six different future scenarios, and if deemed a Multi-Value Project, the analysis shows that this line would provide benefits that exceed the cost in all six futures. If deemed a stand-alone ATC project, benefits exceed costs in four of the six futures. If both the Badger Coulee and Dubuque-Spring Green-Cardinal projects are determined to be eligible for regional cost-sharing, the benefits of the combination exceed costs in all six scenarios.

Dubuque-Spring Green-Cardinal is being studied as a Candidate MVP by MISO. The MISO board will approve selected projects in December 2011.

## Pleasant Prairie-Zion Energy Center would facilitate regional access and alleviate congestion in three states

Transmission system congestion issues in southeastern Wisconsin are part of a larger, regional market congestion around the southern tip of Lake Michigan. This proposed, six-mile, 345-kV line between Pleasant Prairie, Wis., and Zion, III., will help solve some of those issues, providing regional benefits:

#### Provide savings for electric utilities and their customers

- ▶ Helps relieve transmission system congestion throughout the region and enables the most efficient generators to supply power to the energy market
- Allows utilities to buy and sell power when it's economic to do so

#### Improve electric system reliability, locally and regionally

- Adds an additional high-voltage line to strengthen the interstate transmission connection between Wisconsin and Illinois
- ▶ Allows for better regional access to emergency sources of power generation

Public outreach for the project was initiated in Spring 2011 and construction applications are anticipated to be filed with regulators in Wisconsin and Illinois by the end of the year.

Pleasant Prairie-Zion Energy Center is being studied as a Candidate MVP by MISO.



#### Barnhart-Branch River Electric Reliability Project addresses equipment upgrade

Also introduced as an emerging project in the 2010 Assessment, the Barnhart-Branch River project is being proposed to address equipment modifications and an associated increase in generating capacity at the Point Beach Nuclear Plant in Manitowoc County, Wis.

Public outreach began in 2011 to introduce the project to area residents, local officials and other stakeholders. The project includes two new substations and associated transmission lines.

#### Substations

Two new substations are required. The Branch River Switching Station would be constructed in Manitowoc County and the Barnhart Substation would be constructed in Sheboygan County.

#### Transmission lines

Options include:

Converting a 345-/138-kV double-circuit line that runs about 51 miles in Manitowoc, Calumet and Sheboygan counties to a double-circuit 345-kV line that will connect the new substations, and constructing a new, 18-mile, 138-kV line in Sheboygan County **or** 

Constructing a new 345-kV line that links the Branch River and Barnhart facilities (about 40 miles).

Potential corridor options for the transmission lines were presented at open houses in summer 2011. Feedback from the public and other data collection activities are underway in anticipation of filing a construction application in fall 2012. If approved, construction would begin in fall 2016, with a 2018 in-service date.

#### Straits Flow Control Project would aid Upper Michigan reliability

Despite significant upgrades to transmission infrastructure in the Upper Peninsula of Michigan in recent years, operational challenges remain due to the delicate balance that exists between generation, load, market flows and transmission.

A back-to-back, high-voltage, direct-current flow control project is being implemented near the Straits Substation in St. Ignace, Mich. The innovative, \$90 million project will enable the flows into and out of the U.P. to be controlled by MISO, maintaining appropriate thermal and voltage levels on the system in the peninsula. Approved by the MISO board of directors in June 2011, the project will be cost-shared as a baseline reliability project.





## **Our progress**

When we began operations in 2001, our system had only four high-voltage interconnections with neighboring states. The other states had between 10 and 18 connections. Our lone connection to Minnesota was the second-most congested transmission line in the country. Energizing the Arrowhead-Weston 345-kV line in 2008 — our second connection to Minnesota — greatly eased the constraints on the Arpin-Eau Claire-King transmission line. An additional 345-kV circuit to Illinois has also strengthened the backbone of our system.

By 2010, however, system flows on the two lines to Minnesota imported power into Wisconsin 92 percent of the time, and the Arpin-Eau Claire line once again has become a seriously congested line. The ties to Minnesota are but one example of the dynamic nature of operating a transmission system and the need for continuous analysis and planning. Our \$2.5 billion in investment since 2001 has created one of the most reliable transmission systems in the country. The investment has saved our customers more than \$200 million in reduced energy costs.

#### Transmission costs and economic benefits

Our customers — distribution utilities, independent power producers and power marketers — pay us through MISO for transmission delivery service. Our rates are set by the Federal Energy Regulatory Commission.

Retail consumers pay for the generation, transmission and distribution of electricity, plus fuel costs, through a regulated utility rate. In our service area, transmission cost is the smallest component of a retail customer's electric bill, about 10 or 11 percent. Generation and fuel costs make up the major portion, followed by distribution infrastructure.

Transmission construction provides direct and indirect economic benefits to communities in the form of labor, goods and materials, housing, food and other services. A recent study shows that \$1 billion invested in transmission supports about 13,000 jobs and \$2.4 billion in economic activity.

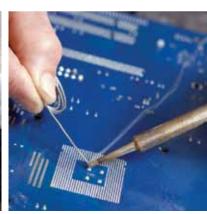
#### **Asset renewal**

Our asset management personnel work closely with system planning staff to maintain and improve system reliability. Focused on life-cycle management of our transmission system, asset renewal is the "replacement strategy" of the asset life cycle. Asset renewal is driven by public and worker safety, regulatory compliance, reliability performance and environmental stewardship.

Despite challenging weather in 2010, we continued to experience top-tier reliability performance. We participate in the SGS Transmission Reliability Benchmarking program with 26 other operators that represent nearly half of the nation's grid. In 2010, our 345-, 138- and 115-kV lines performed in the top 10 percent. We continue to refine our asset management system, including a comprehensive forced outage reduction program, which is one of several processes that direct targeted investments to meet reliability objectives. In addition, our asset planning and engineering staff provide progressive renewal and maintenance programs for oversight of those assets at or near their end of life.







#### Major accomplishments to date

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

- upgraded more than 1,700 miles of transmission line,
- ▶ improved 140 electric substations and
- built 40 new transmission lines (540 miles).

A more reliable transmission system has enabled us to:

- meet peak demand during an exceptionally hot summer 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 1,100 MW of new peak electric usage,
- connect 5,711 MW of new generation at 21 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:
  - 15-19 million megawatt hours of electricity saved (enough to power 36,000 – 45,500 homes each year)
  - 10-14 million tons of CO<sub>2</sub> emissions (associated with producing lost energy) eliminated,
  - avert the need for a 124-154 megawatt generating plant to serve peak demand,
- resolve problems in 18 specific areas to move power into or through our system.
  - Arrowhead-Weston (Northwestern Wisconsin)
  - Blackhawk-Colley Road (Rock County)
  - Christiana-Kegonsa (Dane County)
  - Cranberry-Conover-Plains (Northern Wisconsin and Upper Peninsula of Michigan)
  - Eau Claire-Arpin (Wood County)
  - Gardner Park-Central Wisconsin (Marathon and Shawano counties)
  - Kewaunee (Kewaunee County)
  - Manistique-Hiawatha (Schoolcraft and Mackinac Mich. counties)
  - Morgan-Werner West (Shawano, Waupaca, Outagamie and Oconto counties)
  - North Madison-Huiskamp (Dane County)
  - North Appleton-Lost Dauphin (Outagamie and Brown counties)

- North Appleton-White Clay (Outagamie and Shawano counties)
- Paddock-Rockdale (Dane and Rock counties)
- Paris-St. Martins (Kenosha, Racine and Milwaukee counties)
- Plains-Stiles (Oconto, Marinette, Menominee, Wis., and Dickinson, Mich. counties)
- Rhinelander area (Lincoln, Oneida and Langlade counties)
- Wempletown-Paddock (Rock County and northern Illinois)
- Whitewater-Mukwonago (Walworth and Waukesha counties)

We have made progress by actively seeking input and making our plans and proposals public. To date, ATC has:

- produced and issued 16 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.

#### **Duke-American Transmission Co. (DATC)**

Building on more than 10 years of success, we are looking for opportunities to grow our company beyond our current service area in the Upper Midwest. Earlier this year, we formed a partnership with Duke Energy in a joint venture to build, own and operate new electric

transmission infrastructure in North America. The Duke-American



Transmission Co. planning team, comprised of transmission planners from both companies, recently proposed a \$4 billion package of seven transmission line projects in five Midwestern states. These projects will provide additional economic, reliability, and public policy benefits to consumers. Thoughtful, well-designed transmission projects will afford customers, regulators and other stakeholders flexibility in determining which energy resources will help meet demand for electricity in the future. As such, they will serve as a springboard for next-generation energy technologies. For more information, please visit **www.datcllc.com**.

## What technical considerations drive the need for

**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 service area.

**Solution:** Three projects have been completed, two are proposed, and another provisional project is being studied.

**Renewables/Public Policy** – All of the states in which we operate and most other Midwestern states have adopted renewable portfolio standards. A national requirement also is being considered.

**Solution:** 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.

**Load growth** – Demand for electricity during peak usage periods is projected to grow at a rate of approximately 1.1 percent across our service territory from 2012 through 2021.

**Solution:** More than 77 projects are planned for assuring reliability at least in part due to load growth.

**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.

**Solution: 125** are planned in the next 10 years.

More than **275** 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.

**Solution**: **19** generators are active in our generation queue, and many reflect the growing development of wind energy. **21** generators added since 2001 required construction of transmission facilities.



## transmission expansion?

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 \$4.0 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.

**Solution:** More than **100** 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.

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

**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 Environmental Protection Agency rules will impact retirements across the U.S. in the next 5 to 10 years.

**Solution:** Generation uncertainties are growing due to proposed EPA regulations. We are working closely with generation owners and MISO to anticipate reliability impacts to our transmission system.

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

**Solution:** 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.

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







## **Environmental commitment guides work practices**

### Winter construction, mats and ice roads help minimize impacts.

We recognize that our construction and maintenance work may impact the environment. We take our commitment to environmental protection and stewardship seriously. Our goal is to avoid making impacts where we can, minimize those that can't be avoided, and restore the environment after the work is done. In some instances, we can improve conditions.

We adhere to local, state and federal laws regulating the construction or rebuilding of transmission lines. We obtain permits required to work in environmentally sensitive areas and use prescribed construction methods

to comply with permit requirements and reduce our impacts.

To create stable working areas and protect environmentally sensitive areas, we make use of protective construction mats to support heavy equipment. We often perform construction during winter months when the ground is frozen to minimize disturbance to soils and sensitive plant and animal life. Winter construction also allows for use of ice roads as an alternative to construction mats. Ice roads are constructed by removing the top, or insulating, layer of snow, then running equipment back and forth to effectively drive frost into the soil to create a stable road.

lce roads are an efficient and effective alternative to construction mats in wetland areas where organic material produces its own heat, thus negating cold temperatures that would usually freeze the soil.

We also use construction practices that reduce the spread of invasive species and transmittal of agricultural pests and diseases. In certain instances, we have used helicopters to access and work on transmission lines to avoid contacting environmentally sensitive areas on the ground.

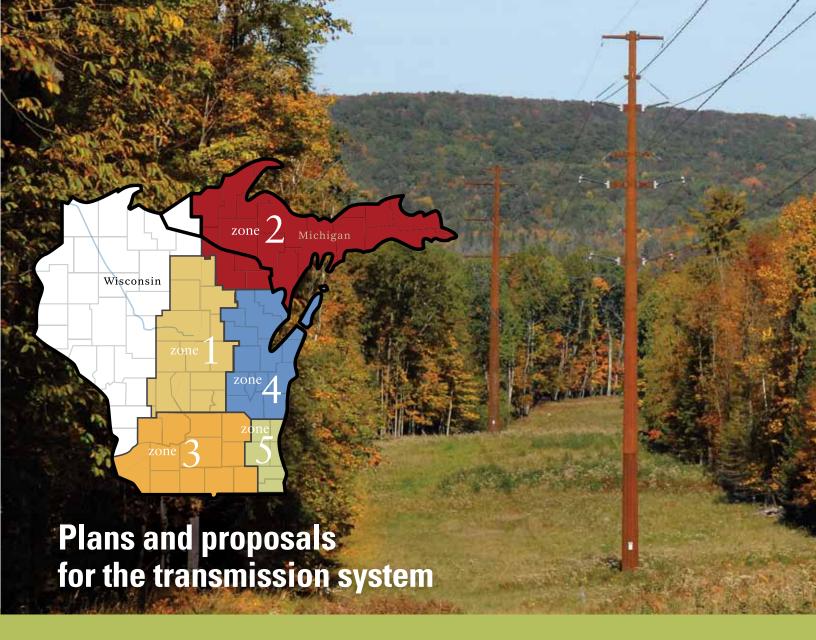
Inspections are performed during and after construction to ensure compliance and proper restoration. In some cases, we partner with conservation groups, municipalities and others to remove invasive species and improve habitat for wildlife.

Our dedication to the environment also is evidenced through our designation as a Green Tier company by the Wisconsin Department of Natural Resources. Green Tier recognizes businesses and organizations that demonstrate superior environmental performance and dedication to continual improvement, and strives to encourage responsible environmental decision making to protect and restore natural resources.









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



#### **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 in Zone 1 include low voltages and thermal overloads in the southern portion of the zone. These issues will necessitate a combination of reinforcements.

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ADAMS MARATHON
FOREST (southwestern portion) MARQUETTE

FOND DU LAC (northwest portion) MONROE (eastern portion)

GREEN LAKE ONEIDA
JUNEAU PORTAGE

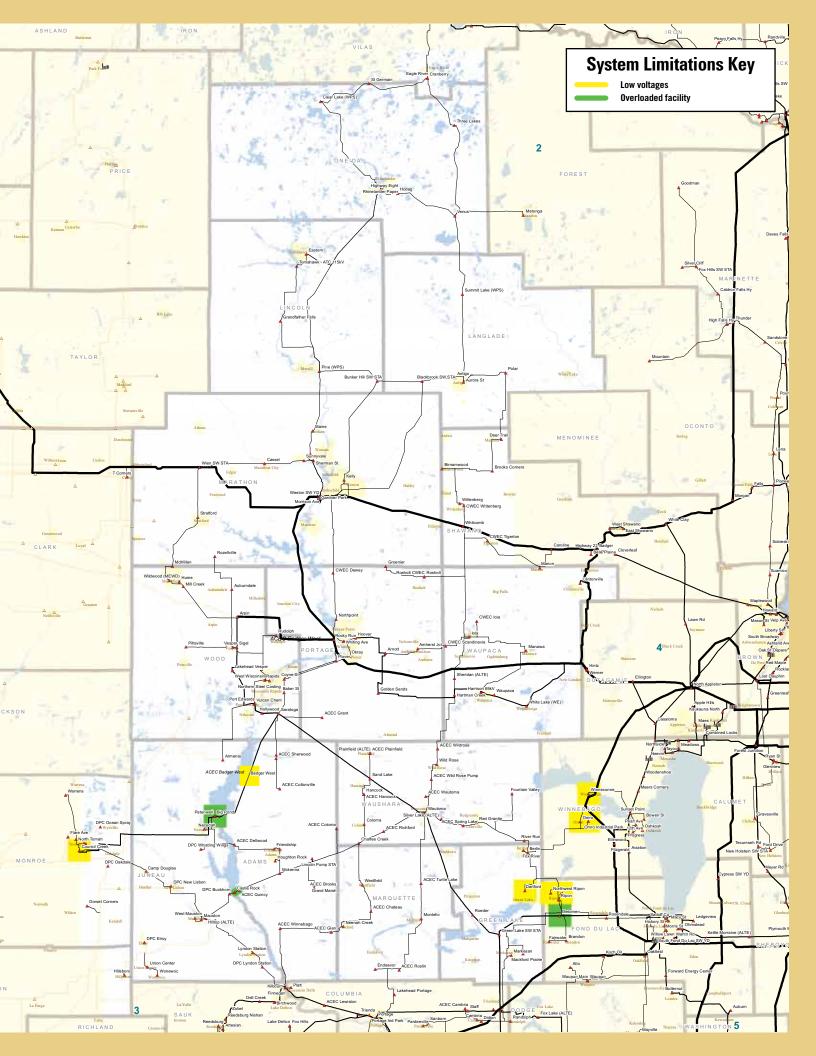
LANGLADE SHAWANO (western portion)

LINCOLN VERNON (eastern portion)

VILAS (southern portion)

WAUPACA
WAUSHARA
WINNEBAGO
(western portion)

WOOD



## Transmission projects in Zone 1 North Central Wisconsin — Zone 1

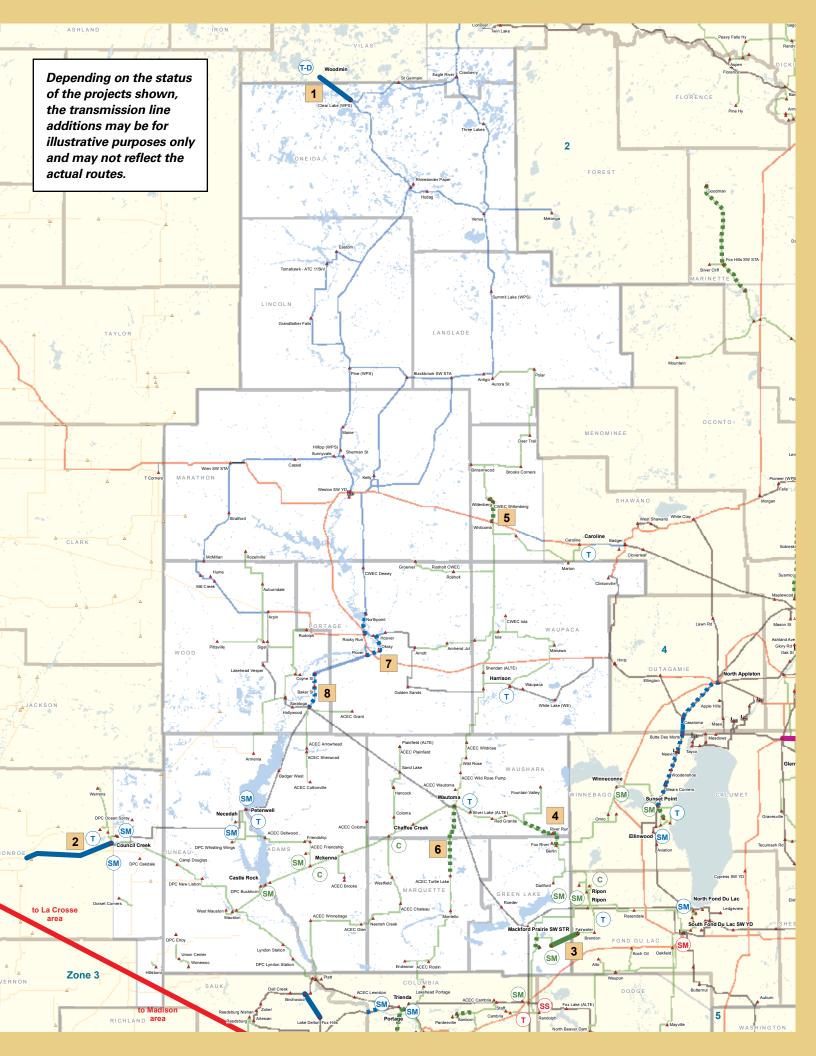


We have implemented one project in Zone 1 since the 2010 Assessment, which was the construction of a new 69-kV line to the new Warrens Substation tapped from the Council Creek-Tunnel City 69-kV line.

Our current plans in Zone 1 include 15 system reliability and economic projects between 2011 and 2025. 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	Clear Lake-Woodmin 115-kV line	2012	T-D interconnection
	Proposed projects		
2	Monroe County-Council Creek 161-kV line	2014	Low-voltage, economics, avoids reconfiguration during emergencies
	Provisional projects		
3	Fairwater-Mackford Prairie 69-kV line	2017	Overloads, low-voltages, and economic
	Asset Renewal projects		
4	Wautoma-Berlin 69-kV line rebuild	2011	Condition and performance
5	Whitcomb-Deer Trail 69-kV line partial rebuild	2011	Condition and performance
6	Montello-Wautoma 69-kV line rebuild	2017	Condition and performance
7	Plover-Whiting 115-kV line rebuild	2019	Condition and performance
8	Coyne-Saratoga 115-kV line partial rebuild	2020	Condition and performance

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SUBSTATION KEY  SS New substation Supports transmission system expansion	• • •	ANSMISSION LINE KEY  345-kV transmission line	<u> </u>	MISSION LINES KE
Substation modifications		115-, 138- or 161-kV transmission line	69 kV	161 kV
Upgrades equipment ratings to avert facility overloads  Transformer		Rebuilt 115- or 138-kV transmission line	115 kV	230 kV
Supports local growth and improves voltage levels		Transmission line voltage conversion	138 kV	345 kV
C Capacitor bank or reactor Relieves low voltages or high voltages		69-kV transmission line		
T-D T-D interconnection Supports local growth		Rebuilt 69-kV transmission line		





### **System Limitations**

## 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
- Conover-Plains 138-kV line, and
- ▶ 138-kV facilities tying the Upper Peninsula of Michigan to the Lower Peninsula.

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.

Our recently completed northern umbrella plan projects (Cranberry-Conover-Plains) began to address some of the identified issues, but efforts to upgrade the area are ongoing. To vet our planning assumptions for the intermediate- and long-term periods, we've engaged stakeholders in a collaborative process (known as the ATC Energy Collaborative – Michigan) to examine the bounds of several plausible futures. Please refer to **www.atc10yearplan.com**, ATC Energy Collaborative – Michigan for details.

#### **Transmission system limitations in Zone 2**

In the analysis of Zone 2, we identified low voltages, transmission facility overloads and transmission service limitations. In addition, heavily loaded facilities during off-peak periods continue to keep the system working with very small operating margins.

The potential for generation at Presque Isle Power Plant becoming unstable after certain disturbances to the transmission system has been a long-standing limitation and the reason for an automated tripping scheme in place at the plant. We are continuing to evaluate alternatives to this complex scheme. As part of the ATC Energy Collaborative — Michigan, we are also evaluating potential generation retirement scenarios. Please refer to **www.atc10yearplan.com**, ATC Energy Collaborative — Michigan for details.



#### Zone 2 includes the counties of:

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)

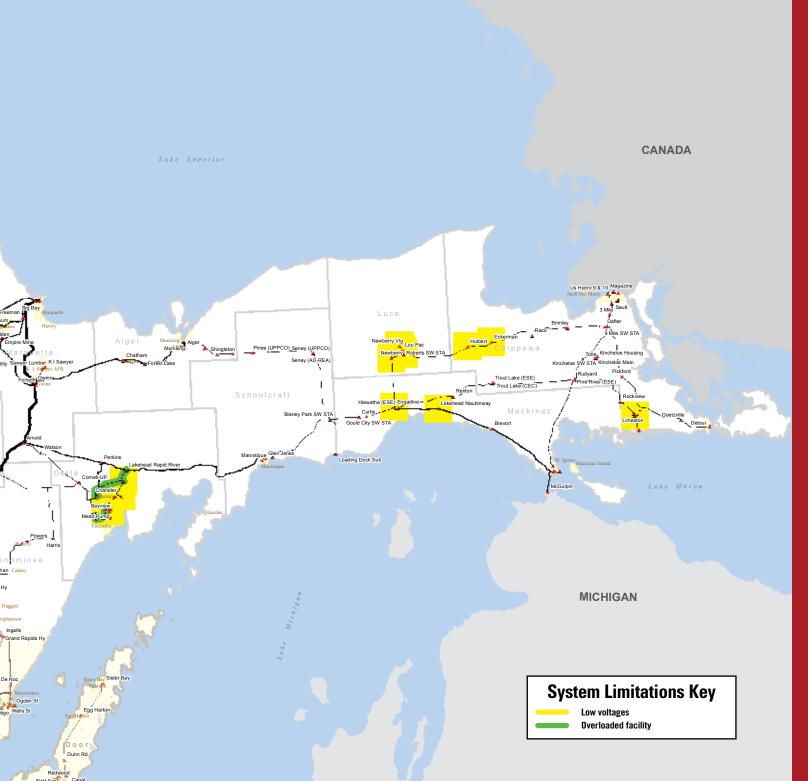
ONTONAGON, MICH.

(eastern portion)

SCHOOLCRAFT, MICH.

VILAS, WIS.

(northern portion)



### Transmission projects in Zone 2

## Michigan's Upper Peninsula and Northern Wisconsin – Zone 2

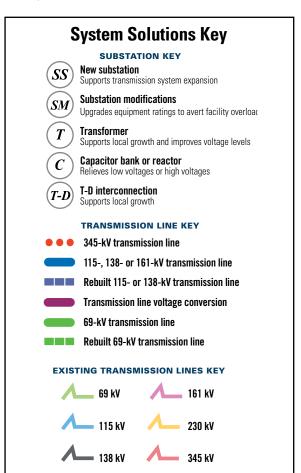


#### **Transmission projects in Zone 2**

We have implemented two projects in Zone 2 since the 2010 Assessment, including the installation of reactors at the Straits Substation.

Our current plans in Zone 2 include 13 system reliability and economic projects between 2011 and 2025. 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 at right.

We also are working on a package of projects (a Northern Plan) that coordinate with existing plans to address generation changes, load changes and developing transmission contingency issues. This plan also will affect infrastructure development in Zones 1 and 4.





	Project description	In-service year	Need driver
	Planned projects		
1	Atlantic-M38 69-kV line rebuild	2013	Overloads, low voltages, condition and performance
	Proposed projects		
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-18th Road 138-kV double circuit lines	2014	Overloads and low voltages
5	Arnold 345-kV Substation and 345/138-kV transformer	2015	Overloads and low voltages
6	Pine River-Nine Mile 69-kV line uprate and asset renewal	2016	Overloads, condition and performance
	Provisional projects		
7	Munising-Seney-Blaney Park 69-kV line uprate	2014	Overloads, low voltages, condition and performance
	Asset Renewal projects		
8	Nine Mile-Roberts 69-kV line partial rebuild	2012	Condition and performance
9	Forsyth-Munising 138-kV line re-insulation	2012	Condition and performance
10	Munising-Gwinn 69-kV line partial rebuild	2012-2013	Condition and performance
11	Rexton-Hiawatha 69-kV line partial rebuild	2015	Condition and performance
12	Conover-Mass 69-kV line partial rebuild	2018	Condition and performance
13	Powers-Chalk Hill 69-kV line partial rebuild	2018	Condition and performance
14	Straits-McGulpin 138-kV submarine cable replacements	2020	Condition and performance
Chandler SM T	Alger  Munising Alger Shingleton Star Siding  Chatham Forest Lake School craft  School craft  Callaney, Park SV  Curtis  Simple ton Star Siding  Curtis  Callaney, Park SV  Curtis  Indian Lake Indian	SM) [11]	Magazine  Us Hydro 9 & 10 Portage St Hy 3 Mile Pine Grove  Binnley Dafter  Trout Lake (CEC) Trout Lake (ESE) Rudyard  Pine River (ESE)  Rexton  Reco  Record  Record
inee s.Hy se Egg Harbo	islate Bay		MICHIGAN



#### **System Limitations**

## **South Central/Southwest Wisconsin and North**

#### **Transmission system characteristics in Zone 3**

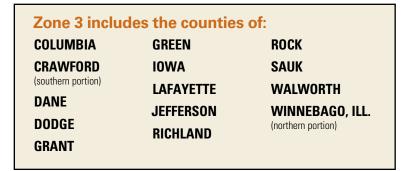
ATC delivers power in Zone 3 with various transmission facilities including:

- ► Columbia-North Madison 345-kV lines,
- ► Columbia-Rockdale 345-kV line.
- Paddock-Rockdale 345-kV line (in-service spring 2010),
- ► Paddock-Wempletown 345-kV line,
- ► Rockdale-Wempletown 345-kV line, and
- ▶ 138-kV facilities from the Nelson Dewey Power Plant, around the Madison area, and in the northwest and southeast portions of Zone 3.

There are a number of transmission system performance issues in Zone 3 including voltage instability, limited import capability, overloaded lines and equipment, and low system voltages. The causes of these emerging issues include steady growth in certain areas, import capability from Illinois, new power plants and different generation dispatch scenarios.

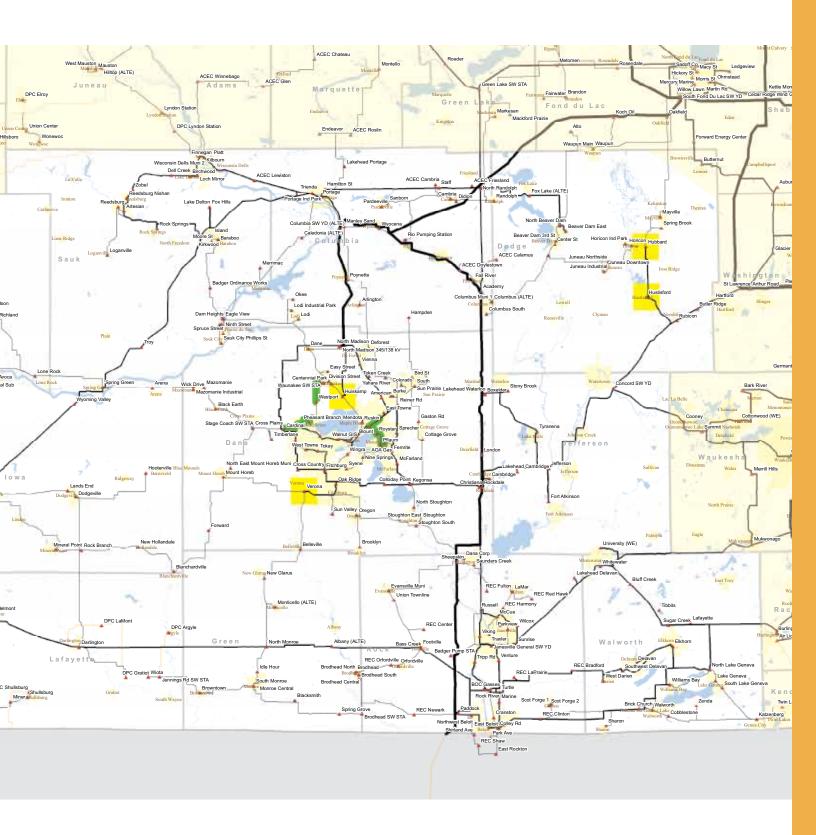
#### **Transmission system limitations in Zone 3**

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





## **Central Illinois – Zone 3**





### Transmission projects in Zone 3

### **South Central/Southwest Wisconsin and North**

We have implemented 11 projects in Zone 3 since the 2010 Assessment, most notably the Bass Creek 138/69-kV transformer project and the Blount-Ruskin underground cable project.

Our current plans in Zone 3 include 35 system reliability and economic projects between 2011 and 2025. 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
	Planned projects		
1	Brodhead-South Monroe 69-kV line rebuild	2011	Overloads and low voltages
2	Rockdale-West Middleton (Cardinal) 345-kV line	2013	Overloads and low voltages, improve transfer capability to Madison area, avert voltage collapse, lower system losses
	Proposed projects		
3	Badger Coulee 345-kV line	2018	Policy benefits
	Provisional projects		
4	Colley Road-Brick Church 69-kV line rebuild	2018	Overloads and low voltages
5	North Lake Geneva-South Lake Geneva 138-kV line	2018	Overloads and low voltages
6	Spring Valley-Twin Lakes-South Lake Geneva 138-kV line	2019	Overloads and low voltages, provide network service
7	Lake Delton-Birchwood 138-kV line	2020	Overloads and low voltages
8	Cardinal-Blount 138-kV line	2020	Overloads and low voltages
9	Sun Valley Tap-Oregon 69-kV line rebuild	2020	Improve line condition and area voltages
10	Dubuque-Spring Green-Cardinal 345-kV line	2020	Policy benefits
11	Hubbard-East Beaver Dam 138-kV line	2022	Overloads and low voltages
12	West Middleton-Pheasant Branch 69-kV line rebuild	2022	Overloads and low voltages
	Asset Renewal projects		
13	Pardeeville Tap-North Randolph/Rio 69-kV line partial rebuild	2011	Condition and performance
14	Spring Green-Stagecoach 69-kV line partial rebuild	2011	Condition and performance
<b>15</b>	Dane-Dam Heights 69-kV line partial rebuild	2012	Condition and performance
16	Sycamore-East Towne 69-kV underground cable replacements	2012	Condition and performance
<b>17</b>	Kirkwood-Trienda 138-kV line partial rebuild	2012	Condition and performance
18	Doylestown-Rio Pumping Station 69-kV line rebuild	2013	Condition and performance
19	Dam Heights-Portage 69-kV line rebuild	2016	Condition and performance
	Concord-Rubicon-Butler Ridge-Hartford 138-kV line rebuild	2016	Condition and performance
<ul><li>20</li><li>21</li><li>22</li><li>23</li></ul>	Darlington-Hillman 138-kV line rebuild	2016	Condition and performance
22	Belmont-Rewey 69-kV line rebuild	2018	Condition and performance
23	Boscobel-Lone Rock 69-kV line rebuild	2018	Condition and performance
24	West Middleton-Stagecoach 69-kV underground cable replacement	2019	Condition and performance



#### SUBSTATION



#### New substation

Supports transmission system expansion



#### **Substation modifications**

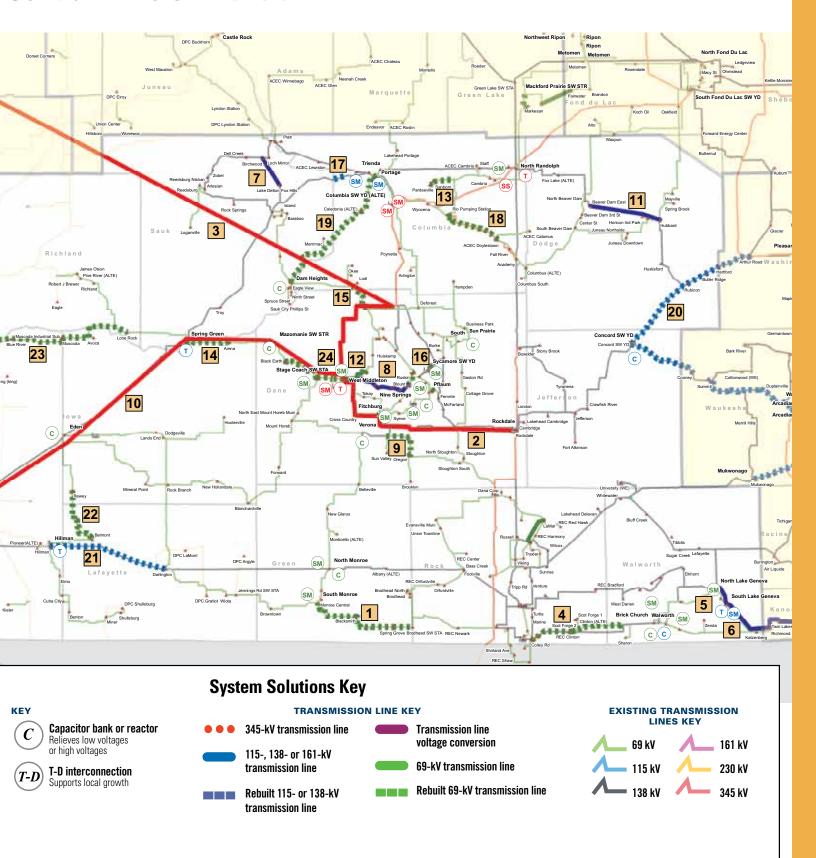
Upgrades equipment ratings to avert facility overloads



#### Transformer

Supports local growth and improvesvoltage levels

## **Central Illinois – Zone 3**





## System Limitations 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 Kewaunee and Point Beach nuclear units,
- ▶ 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, and
- ▶ 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 the analysis of Zone 4, we identified few voltage or thermal limitations as part of this Assessment. However, it should be noted that transmission service limitations during off-peak periods provide very small operating margins.

#### Zone 4 includes the counties of:

BROWN

CALUMET

DODGE

(northeast corner)

**DOOR** 

**FOND DU LAC** 

(eastern portion)

KEWAUNEE

**MANITOWOC** 

**MARINETTE** 

(southern portion)

MENOMINEE, MICH.

(southern portion)

MENOMINEE, WIS.

OCONTO

**OUTAGAMIE** 

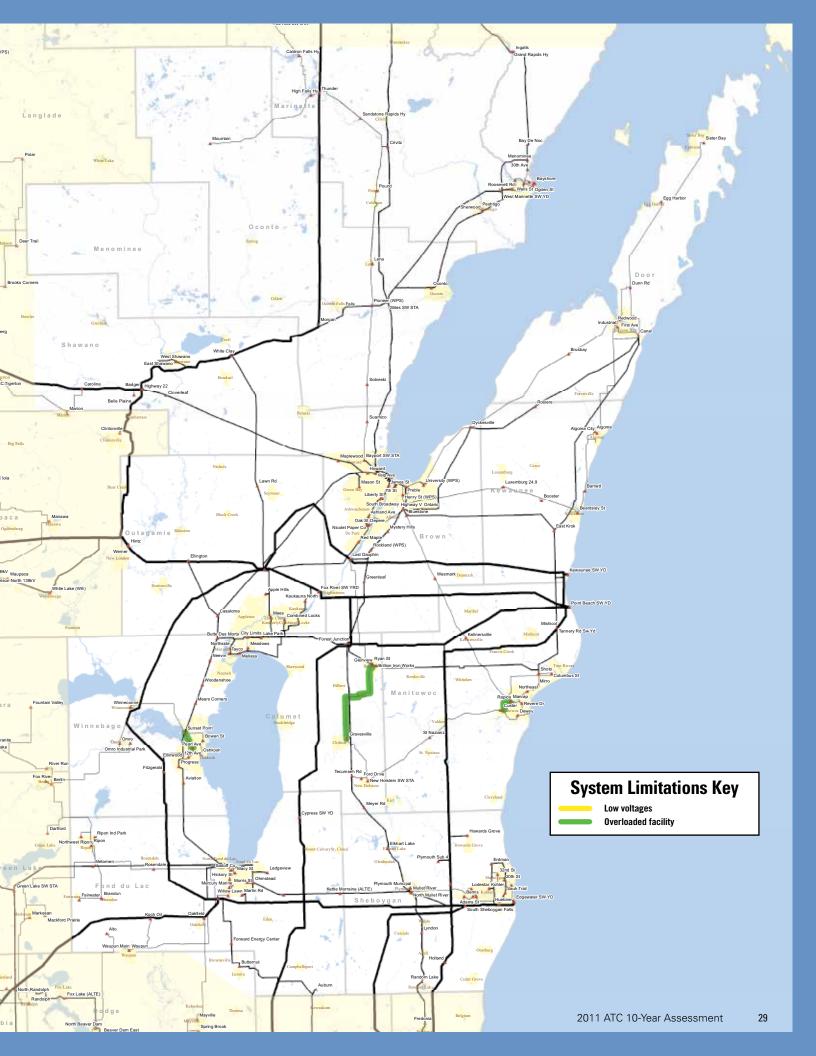
**SHAWANO** 

(eastern portion)

SHEBOYGAN

WINNEBAGO

(eastern portion)



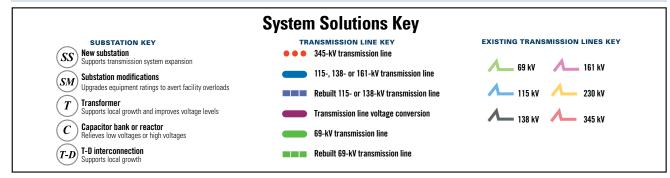
## **Transmission projects in Zone 4 Northeast Wisconsin – Zone 4**

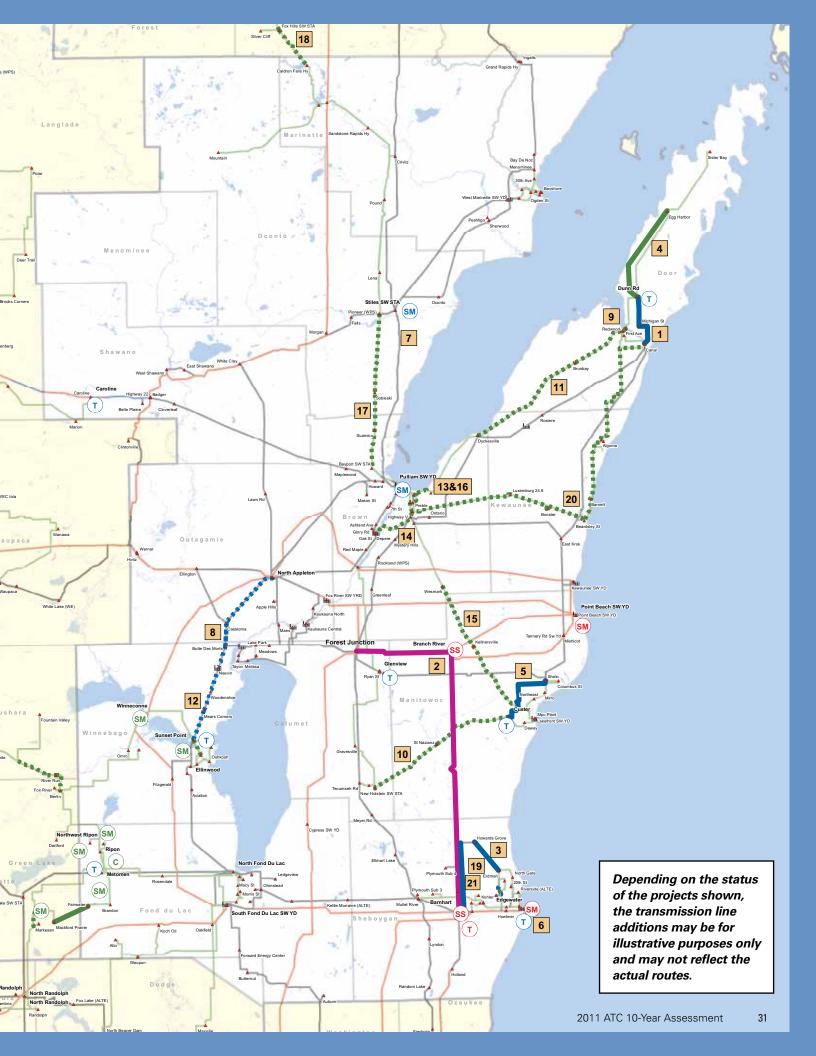


We have implemented one project in Zone 4 since the 2010 Assessment, which was the Kewaunee Substation bus reconfiguration and addition of a second 345/138-kV transformer.

Our current plans in Zone 4 include 14 system reliability and economic projects between 2011 and 2025. 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 below.

	Project description	In-service year	Need driver
	Planned projects		
1	Canal-Dunn Road 138-kV line	2012	Overloads and low voltages
	Proposed projects		
2	Barnhart-Branch River project	2018	Accommodate new generation
3	Barnhart-Plymouth-Howards Grove-Erdman 138-kV line*	2018	Accommodate new generation
	Provisional projects		
4	Dunn Road-Egg Harbor 69-kV line	2021	Low voltages and provide network service
5	Shoto-Custer 138-kV line	2022	Overloads
	Asset Renewal projects		
6	Replace Edgewater 138/69-kV transformers	2012	Condition and performance
7	Pulliam-Stiles 138-kV line replace shield wire	2013	Condition and performance
8	North Appleton-Butte des Morts-Neevin 138-kV line rebuild	2015-2017	Condition and performance
9	First Avenue-Redwood 69-kV submarine cable replacement	2015	Condition and performance
10	Custer-New Holstein 69-kV line rebuild	2015	Condition and performance
11	Dyckesville-Sawyer 69-kV line rebuild	2016	Condition and performance
12	Neevin-Woodenshoe-Mears Corners-Sunset Point 138-kV line rebuild	2016	Condition and performance
13	Finger Road-Danz Ave 69-kV line rebuild	2016	Condition and performance
14	Oak Street-Highway V 69-kV line rebuild	2016	Condition and performance
15	Wesmark-Manrap 69-kV line rebuild	2016	Condition and performance
16	University-Danz Avenue 69-kV underground cable replacement	2017	Condition and performance
17	Bayport-Sobieski-Pioneer 69-kV line rebuild	2018	Condition and performance
18	Caldron Falls-Goodman 69-kV line rebuild	2019	Condition and performance
19	Erdman-Lodestar 138-kV underground cable replacement	2019	Condition and performance
20	Finger Road-Canal 69-kV line rebuild	2020	Condition and performance
21	Edgewater-Erdman 69-kV underground cable replacement	2021	Condition and performance
	*This project is contingent on the route selected for the Barnhart-Branch River project		







#### **System Limitations**

## **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 analyses of this road relocation project will likely result in new projects to reconfigure the transmission system around Bluemound and 96th Street substations. Further projects may develop depending on the Department of Transportation's plans to rebuild the interchange. Studies are ongoing and plans will be finalized in the 2011-2012 timeframe.

#### Transmission system limitations in Zone 5

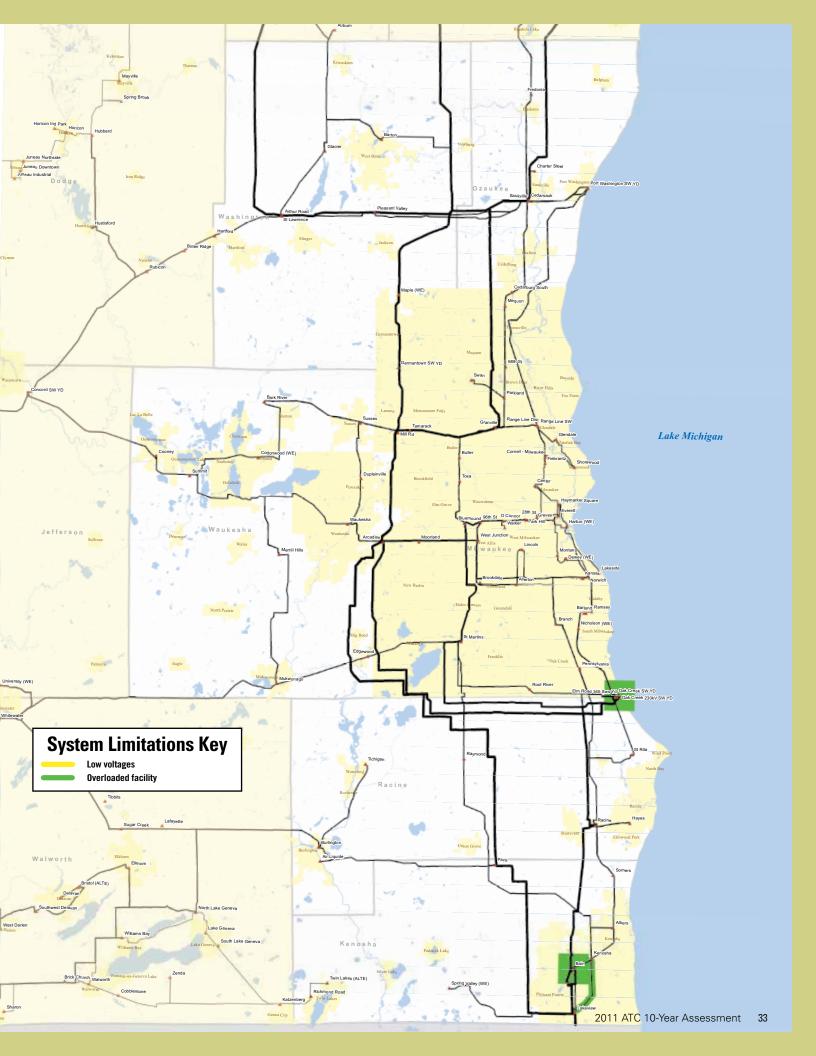
Key system performance issues in Zone 5 include:

- ► 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.

Transmission system reinforcements needed to interconnect and deliver the new generation at the Oak Creek Power Plant comprised much of the recent expansion to Zone 5. 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.

#### Zone 5 includes the counties of:

KENOSHA OZAUKEE WASHINGTON MILWAUKEE RACINE WAUKESHA



## Transmission projects in Zone 5 **Southeast Wisconsin – Zone 5**



We have implemented three projects in Zone 5 since the 2010 Assessment, most notably the interconnection of the new 650 MW (615 MW net) generator at the Oak Creek Power Plant.

Our current plans in Zone 5 include ten system reliability and economic projects between 2011 and 2025. 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
	Proposed projects		
1	Pleasant Prairie-Zion Energy Center 345-kV line	2014	Economics
2	Milwaukee County T-D 138-kV lines	2015	T-D interconnection
3	Arcadian-Waukesha 138-kV line rebuilds	2016	Overloads
	Provisional projects		
4	Spring Valley-Twin Lakes-South Lake Geneva 138-kV line	2019	Overloads and low voltages, provide network service
5	Replace Arcadian 345/138-kV transformers with single transformer	2020	Overloads
	Asset Renewal projects		
6	Replace Bluemound 230/138-kV transformers	2011-2012	Condition and performance
7	St. Lawrence-Hartford 138-kV line rebuild	2014	Condition and performance
8	Concord-Cooney 138-kV line rebuild	2015	Condition and performance
9	Waukesha-Merrill Hills 138-kV line partial rebuild	2015	Condition and performance
10	Paris-Albers 138-kV line rebuild	2016	Condition and performance
11	Merrill Hills-Summit 138-kV line partial rebuild	2017	Condition and performance
12	Edgewood-St. Martins 138-kV line rebuild	2017	Condition and performance
13	Mukwonago-Edgewood 138-kV line rebuild	2017	Condition and performance
14	Oak Creek-Hayes 138-kV line rebuild	2019	Condition and performance
6 7 8 9 10 11 12	Asset Renewal projects  Replace Bluemound 230/138-kV transformers  St. Lawrence-Hartford 138-kV line rebuild  Concord-Cooney 138-kV line rebuild  Waukesha-Merrill Hills 138-kV line partial rebuild  Paris-Albers 138-kV line rebuild  Merrill Hills-Summit 138-kV line partial rebuild  Edgewood-St. Martins 138-kV line rebuild  Mukwonago-Edgewood 138-kV line rebuild	2011-2012 2014 2015 2015 2016 2017 2017 2017	Condition and performance

	System Solutions Key	
SUBSTATION KEY  SS New substation Supports transmission system expansion  Substation modifications Upgrades equipment ratings to avert facility overloads  Transformer Supports local growth and improves voltage levels  Capacitor bank or reactor Relieves low voltages or high voltages  T-D J interconnection Supports local growth	TRANSMISSION LINE KEY  345-kV transmission line  115-, 138- or 161-kV transmission line  Rebuilt 115- or 138-kV transmission line  Transmission line voltage conversion  69-kV transmission line  Rebuilt 69-kV transmission line	69 kV 161 kV 115 kV 230 kV 138 kV 345 kV





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