Understanding Michigan's Transmission Needs

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Background

- Project purpose and background
  - Responsive to MPSC Jun 23 2022 order in docket #U-21099
  - Commission sought comment on actions / policies that might maximize benefits to the reliability of Michigan's transmission connections to MISO, PJM, IESO and how to boost those connections
- Core work contributions:
  - Assessment of regulatory documents and timeline
  - Power system analysis
  - Discussion on opportunities for Michigan

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Team description

Multi-disciplinary team with deep regulatory and analytical expertise

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5lakes energy

Lasher Energy Consulting

Warren Lasher, independent consultant

Potomac LAW GROUP

TELOS ENERGY

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Timeline of the Growth of Michigan's Grid and Regulatory Assessment

Potomac Law Group

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Timeline summary

First 50 years
Michigan-centered organic growth then consolidation into national holding companies with out-of-state ownership

Middle 50 Years
Michigan Utilities Serving Regional Interests within Michigan

New Millennium
Consolidation and Dawn of Meaningful Regional Transmission Planning

Unique features of Michigan transmission system post-1975 and post-2000s
Controlled interconnections with Ontario transmission system

(See appendix for more details on the timeline)

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Overview of regulatory documents

- relevant regulatory approaches and interregional coordination agreements were originally developed in historical context of individual franchised transmission companies and to address specific problems
- did not anticipate rise of Regional Transmission Organizations (RTOs)
- coordination agreements in RTO era originally emphasized avoidance of harm rather than promotion of regional benefits
- MISO's capacity auction has location requirements for generation
- new development is the MISO Transmission Expansion Planning (MTEP) regional planning approach, promotion of Multi-Value Projects (MVPs) and Long Range Transmission Project Initiative. MVPs are:
  - intended to reliably and economically enable regional public policy needs (for example state renewable portfolio standards)
  - provide multiple types of regional economic value
  - or provide a combination of regional reliability and economic value

Michigan-Ontario Phase Angle Regulators

US DOE Presidential Permits; ITC-Hydro One Interconnection Facilities Agreement (8/8/2011) and MISO and IESO Operating Instruction entitled "Operation of the Michigan-Ontario Tie Lines and Associated Facilities" (8/8/2011)

There are four international electric transmission lines that interconnect the electrical systems of The Detroit Edison Company (Detroit Edison) and Hydro One Networks, Inc. (Hydro One; formerly Ontario Hydro), the provincial utility of Canada's Province of Ontario. In Presidential Permit PP-221, the US Department of Energy (DOE) authorized Detroit Edison to construct, operate, maintain, and connect these international transmission facilities:

- B3N Facility: A 230,000-volt (230-kV) transmission line connecting Detroit Edison's Bunce Creek Station, located in Marysville, Michigan, with Hydro One's Scott Transformer Station located in Sarnia, Ontario (previously authorized in Presidential Permit PP-21)
- J5D Facility: A 230-kV transmission line connecting Detroit Edison's Waterman Station, located in Detroit, Michigan, with Hydro One's J. Clark Keith Generating Station, located in Windsor, Ontario (previously authorized in Presidential Permit PP-21)
- L4D facility: A 345-kV transmission line connecting Detroit Edison's St. Clair Generating Station, located in East China Township, Michigan, with Hydro One's Lambton Generating Station, located in Moore Township, Ontario (previously authorized in Presidential Permit PP-38)
- L51D facility: A 230-kV transmission line connecting Detroit Edison's St. Clair Generating Station, located in East China Township, Michigan, with Hydro One's Lambton Generating Station, located in Moore Township, Ontario (previously authorized in Presidential Permit PP-58)

In Order PP-221, DOE consolidated all of Detroit Edison's existing Presidential permits into one permit and authorized Detroit Edison to place in service the voltage-regulating autotransformer on the L51D facility. See Order 230-2 and PP230-4. plus Comments and Supplemental Documents detailing highly contested proceedings at DOE and FERC regarding operation and cost allocation applicable to the PARs.

By formal agreement among ITC, MISO, and PJM, and conditional support from IESO, NYISO, and other parties, the PARs are operated on a flow to schedule basis since 2012.

Key regulatory documents

MISO Tariff: limitation of MISO's capacity mechanism (Planning Resource Auction)

MISO maintains an annual capacity requirement for all load-serving entities (LSEs) based on the load forecast plus reserves.

- LSEs are required to specify to MISO what physical capacity, including demand resources, they have designated to meet their load forecast
- Location-specific approach
- requirement for presence of generation resource within Zone 7 (Michigan)

MISO Joint Operating Agreements: Affected System Study Standards in MISO-PJM and MISO-SPP JOAs

- **Issue:** Affected System study standard that will be applied to a generator interconnecting within MISO (direct connecting system) evaluating the effect on neighboring RTOs (i.e., Energy Resource Interconnection Service (ERIS)/Network Resource Interconnection Service (NRIS) modeling standards)
  - **ERIS:** connect a generating facility in a manner that allows it to deliver electric output using the existing firm or nonfirm capacity of the Transmission Provider's Transmission System on an as-available basis
  - **NRIS:** connect a generating facility in a manner that integrates with the Transmission Provider's Transmission System (1) in a manner comparable to that in which the Transmission Provider integrates its generating facilities to serve native load customers; or (2) in an RTO or ISO with market based congestion management, in the same manner as Network Resources
- MISO applies the ERIS modeling standard for its Affected System analysis of proposed generation located within and sinking in another RTO, regardless of whether the generator requests ERIS or NRIS in the host RTO (i.e., PJM or SPP)
- SPP and PJM evaluate the impacts to their respective systems using the thresholds associated with the same level of service that is requested on the host RTO.
- **Potential Effect:** more robust transmission infrastructure built in neighboring RTOs related to Affected System study approach for generator interconnection

See: Order on Complaint and Technical Conference, EDF Renewable Energy, Inc. v. MISO, PJM, SPP, 168 FERC ¶ 61,173 (2019)

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Power system analysis

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Transmission Analysis

Purpose

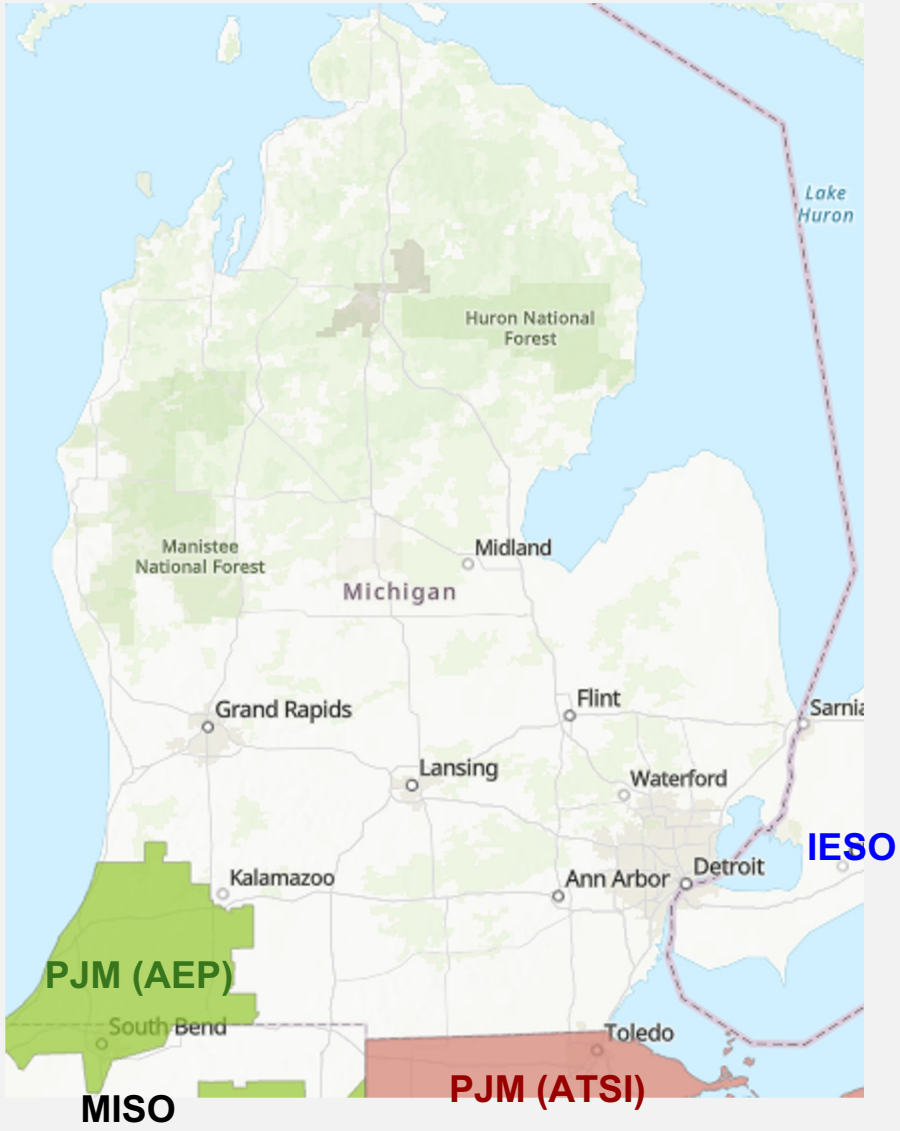
Assess the grid's physical capabilities and constraints for moving power into the lower peninsula

Basis

The MISO MTEP20 model, accessed enabled by Michigan PSC

Outlook

2025 and similar near-term scenarios with new renewables



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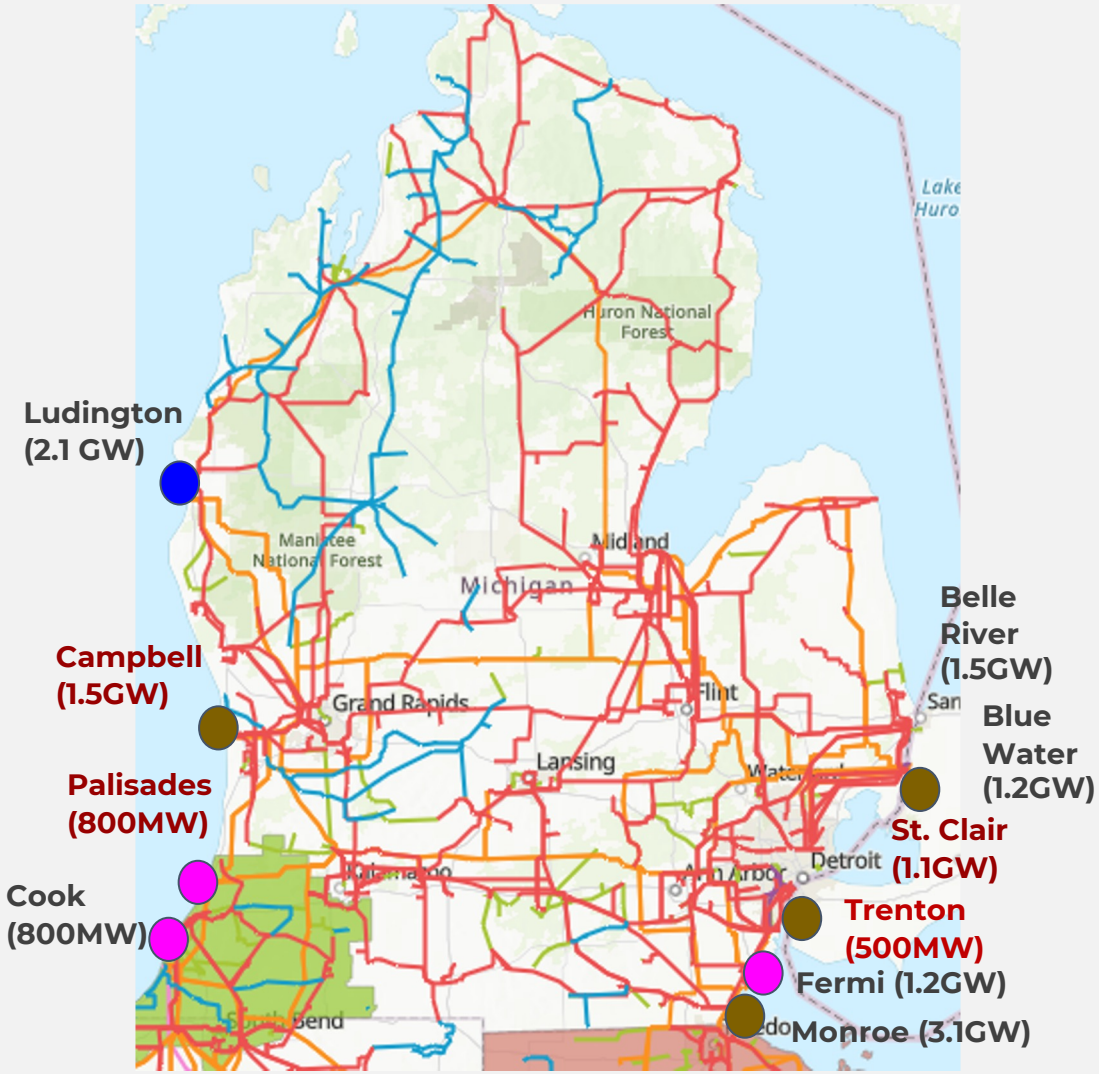
Transmission Analysis Assumptions

- Assumed Retirements: St. Clair, Trenton Channel, Palisades, Campbell (3.9GW)
- Assumed New Resources: 8.6GW solar, storage & wind, dispatched to 3.9GW, spread according to MISO Generator Interconnection Queue
- Analysis Conducted: AC Contingency Analysis (thermal and voltage violations) (method similar to MISO CIL/CEL Study)
- Study Scenarios of increasing imports for:
  - MISO Imports (like MISO CIL/CEL Study)
  - MISO, PJM, and IESO Imports
- Sensitivities: Tranche 1, Shoulder Case, Ludington Operations



Source: arcgis (HIFLD Public Database)

Major Transmission Analysis Findings

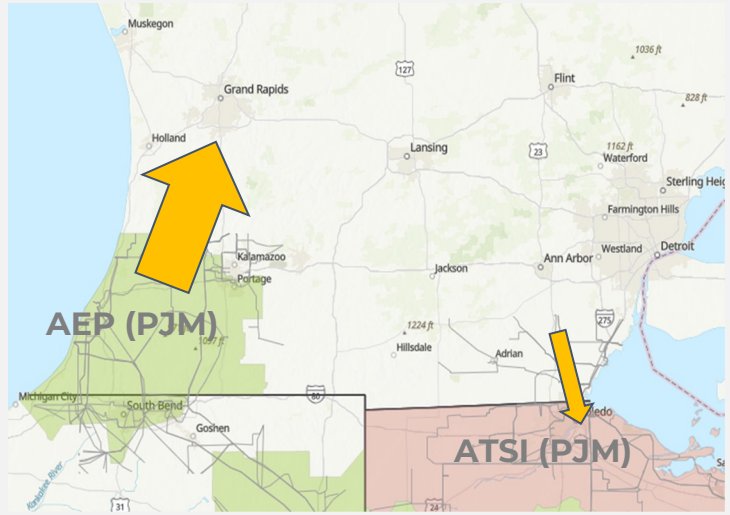
Power Flows to Michigan (Lower Peninsula)

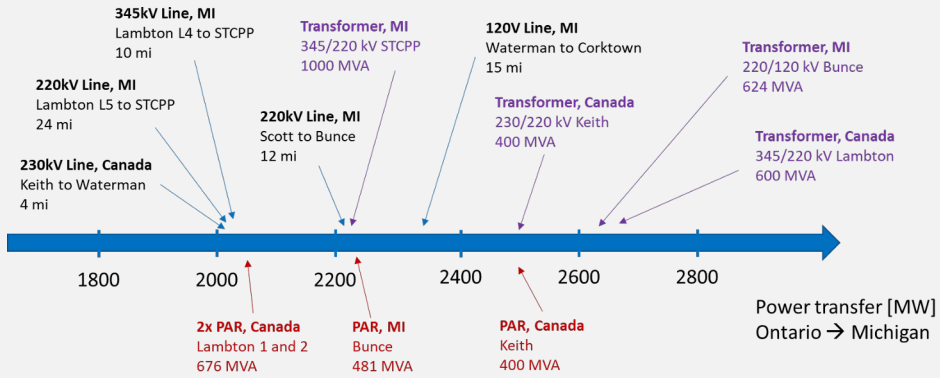
- Very little flow directly from MISO (without Tranche 1)
- Most imports (~4GW) would flow from PJM (AEP, SW Michigan)
- ~2 GW imports available from IESO
- 0.2 GW imports available from Upper Peninsula

When Pressing Imports Higher

- MI-IESO PARs and nearby lines reach thermal limits around 2GW
- Lake Erie loop flow (LEC) does not appear to be a constraint
- The first thermal violations that appear are mild (central Michigan, NW Ohio 138kV)
- Voltage violations are few and relatively small

Note: This is in-part due to the assumption of many new resources spread across the Lower Peninsula





Michigan - Ontario Interface, Incremental Overloads

Findings from Sensitivities

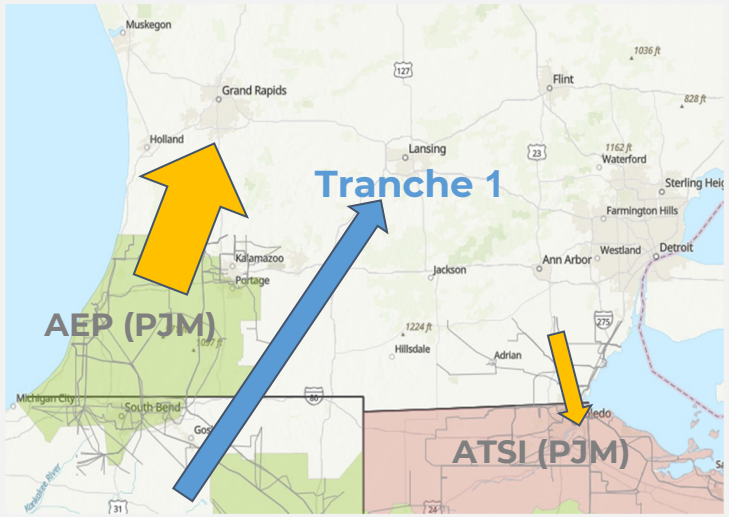
Tranche 1 Addition

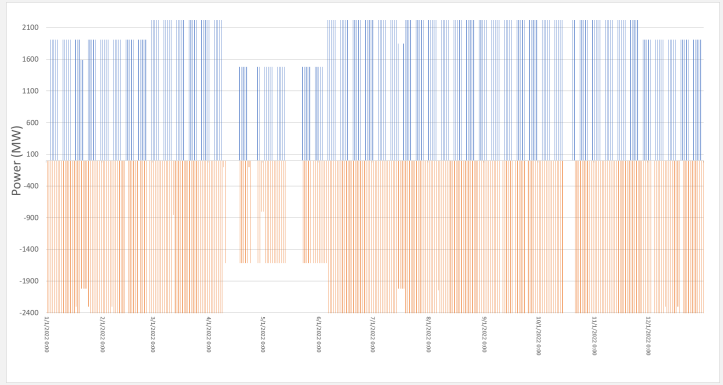
- Relieves central Michigan & NW Ohio thermal violations
- Enables ~1.7 GW of transfer from MISO territory and 2+ GW total increased imports

Ludington Operations

- MTEP Summer and shoulder cases assume full discharging (2.3GW)
- Full discharging cases show few transmission violations
- Full charging cases show moderate thermal violations near Grand Rapids

Shoulder Case - Findings are relatively similar to summer peak case





Ludington Operations, 2022

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Opportunities for Michigan

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Issues for Discussion

This analysis has indicated four areas that warrant further discussion.

1. Energy transfers across the border with Ontario
2. Energy transfers across the southern border with Ohio and Indiana
3. Resource Additions and Retirements
4. Other transmission considerations (Ludington, HVDC)

Overall, the availability of adequate transmission, both within lower Michigan and connecting lower Michigan with its neighbors, will be a major determining factor in how well Michigan achieves its clean energy goals.

And the challenge is not just to plan for the future. As technologies on the grid change, it is increasingly apparent that the established regulatory policies and market design procedures that were developed during an era characterized by large baseload thermal generation and inelastic customer demand may not be well-suited to the grid of the future. Planning for the future will need to include some reconsideration of past decisions and agreements.

Energy Transfers Across the Border with Ontario

The border between Michigan and Ontario presents near-term and long-term opportunities for economic energy transactions

Near term Opportunities

- Based on this analysis, imports and exports up to ~2,000 MW appear to be achievable given current infrastructure
- Impacts on other regions at these transfer levels appear to be mitigated through the operations of the Phase-angle regulators located on the border
- It does not appear that this import capacity is part of the MISO Capacity Import Limit calculations. As such, Michigan utilities are not able to utilize this import capacity in their resource planning to meet MISO Zone 7 capacity requirements.
- Inclusion of scheduled imports to meet MISO capacity requirements also may be limited due to a lack of a formal capacity sharing agreement between IESO and MISO.

Recommendation

- Initiate discussions with MISO and IESO to identify options to better utilize this import capacity
- Specifically, ask MISO for credit for the non-firm power flows between IESO and Michigan for calculating Michigan's local resource adequacy requirements

Energy Transfers Across the Border with Ontario

Long-term Opportunities

- Ontario represents a significantly diverse energy trading partner with increasing needs for energy and similar clean energy goals to Michigan.
- It will be easier for Michigan to achieve its clean energy goals if it has trading partners with renewable energy sources that have a certain amount of diversity from resources in Michigan, i.e, partners that can provide excess renewable energy when resources in Michigan are at low output, and who can purchase excess renewable energy when resources in Michigan are producing abundantly.

Recommendation

Establish a process with IESO and MISO - that considers long term decarbonization goals and implications for load and resource planning - to identify mutually beneficial projects to increase transmission capacity across the Michigan Ontario border. To the extent increased transfers have an impact on flows between Ontario and and other states, engage with these other regions to find appropriate solutions.

Energy Transfers Across the Southern Michigan Border

A majority of the transmission capacity for imports and exports across the southern border of Michigan involves circuits operated in the PJM market. Geographically, there is actually only a small portion of the southern border that connects into a portion of the MISO market.

Near-Term Opportunities

- Given the dependence on PJM circuits for imports across the southern border, Michigan will benefit by increased coordination between MISO and PJM
- It is likely that new resources interconnecting within Michigan face interconnection study delays because of the transmission capacity impacts in both market regions
- It is not clear what impact parallel flows on PJM circuits have on the determination of import capacity limits into Michigan across the southern border

Recommendation

- Michigan PSC should coordinate with MISO and PJM to determine the impacts that established joint operating agreements have on opportunities for Michigan utilities to incorporate out-of-state resources into integrated resource plans and MISO capacity requirements
- Ask MISO for credit for the non-firm power flows between PJM and Michigan for calculating Michigan's local resource adequacy requirements

Energy Transfers Across the Southern Michigan Border

Long-Term Opportunities

As the amount of renewable generation within and around Michigan grows, the value of transmission capacity for importing and exporting energy will increase. Joint operating agreements between MISO and PJM that limit availability of transmission will become increasingly burdensome.

Recommendations

- Review any MISO restrictions on capacity imports from regions outside MISO (these limitations are especially problematic for Michigan given its location on the edge of the MISO region and prevalence of transmission connections with PJM)
- Identify neighboring states with similar clean energy goals and diversity of renewable resources, and advocate in transmission planning processes for increased transmission capacity between these states and Michigan
- Engage in proactive discussions with MISO and PJM to identify opportunities for improving established joint operating procedures to better meet future challenges
  - Market design disparities between MISO and PJM may impact resource development decisions in Michigan and options for power imports
  - Long-term it may be warranted to explore the benefits of participating in the PJM market

Resource Additions and Retirements

Future resource decisions will have an impact on the availability of transmission capacity. Resource retirements could lead to limitations on system import and export capacity, while resource additions could require lengthy transmission development projects to be fully integrated. Resource changes should be studied holistically to quantify all of the expected future impacts.

Recommendation: Develop an action plan for holistic and integrated energy system planning as called for in the Michigan Healthy Climate Plan developed by EGLE.

- Require consideration of imported resources in IRPs
- Require the consideration of HVDC and other transmission assets proactively as resources in IRPs
- Require LSEs in their IRPs to do a calculation of the effects of resource additions/retirements on capacity import limits

This action plan should include stakeholders, Consumers Energy, DTE, ITC, MISO and PJM.

Transmission planning within the lower Michigan region should include a proactive assessment of future needs given additional increased integration of renewable resources and retirement of thermal generation.

Other Transmission Considerations

Ludington Pumped Storage: The Ludington facility will be increasingly valuable as the capacity of renewable resources in Michigan grows. This analysis indicates that insufficient transmission capacity may limit the operational capability of the facility under some conditions.

It's not clear how the operation of this unit is scheduled. In the future, a large storage resource can provide significant value by being operated to minimize operational risk and maximize utilization of clean energy resources.

Recommendations

- Transmission limitations affecting the operational capability of the Ludington pumped storage unit should be identified and addressed as appropriate.
- Operational scheduling procedures of the Ludington unit should be reviewed.

Other Transmission Considerations

Michigan has limited capability to import or export power. This study assessed import capability from the Ontario region and from the MISO and PJM regions along the southern border. The ability to export renewable energy when internal resources are abundant and to import renewable energy when internal resources are low will become increasingly valuable as renewable resource capacity grows as will the ability to trade power with a diversity of regions.

Recommendation

Advocate for transmission projects that will allow import and export of power with other regions, such as the proposed transmission line connecting the western part of Michigan with Wisconsin.

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Appendix Slides

Brief History of the Growth of Michigan's Transmission Grid (first 120 years)

First 50 years: Michigan-centered organic growth then consolidation into national holding companies with out-of-state ownership

- In 1883, the first incandescent light bulb in Detroit was installed at Metcalf Brothers dry goods store in Detroit.
- By 1900, the Edison Illuminating Co. and the Peninsular Electric Light Co. (which owned the electric distribution franchise in the area) provided all commercial electric lighting and power in the city of Detroit.
- In 1904, William Foote consolidated several power companies across Michigan under the name Commonwealth Power Co.
- In 1905, holding company American Light & Traction Co. acquired a majority of the Detroit City Gas Co.
  - American Light & Traction controlled utility and transportation interests across the Upper Midwest from Grand Rapids to Milwaukee. American Light and Traction had been founded in 1900 for the purpose for consolidating the utility industry's small, local power suppliers. By 1901, American Light and Traction owned and controlled over 40 gas producing plants, electric light, and traction (streetcar) companies.
- In 1920, the Michigan utilities owned by the Foote family were consolidated in new publicly traded company Consumers Power.
- In 1922 Consumers Power and the Michigan Light Company merged under the name Consumers Power.
- In 1929, Consumers Power became one of a myriad of companies owned by the New York City-based utility holding company conglomerate The Commonwealth and Southern Corporation. (Parts of Commonwealth & Southern became the forerunners of modern-day Consumers Energy, Southern Company, and Ohio Edison.)
- The 1930s-40s were marked by consolidation among gas and electric utility interests and infrastructure growth driven by support the WWII War effort and the expansion of America's dominant automotive industry.
- in 1949, Consumers Power became an independent company again upon separating from Commonwealth and Southern.

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Middle 50 Years Michigan Utilities Serving Regional Interests

- Expansion of Michigan economy to support US and allies in WWII and beyond
- Michigan's leadership in the US automotive industry
- In 1968, Consumers Power reincorporated as a Michigan corporation (was initially incorporated in Maine in 1910).
- In 1987, holding company CMS Energy was founded with subsidiary Consumers Power owning utility assets and CMS Enterprises owning non-utility and international assets.
- In January 1996, Detroit Edison established a holding company: DTE Energy.
- In 1997, Consumers Power changed its name to Consumers Energy Company.

New Millennium: Consolidation and Dawn of Meaningful Regional Transmission Planning

- In 2000, Michigan's electric restructuring law required the state's major electric utilities to either divest their electric transmission systems or turn over operating control to an independent entity by Dec. 31, 2001.
- On May 31, 2001 DTE Energy and MCN Energy Group completed a merger which created Michigan's largest energy company and a premier regional energy provider.
- Also in 2001, Consumers Energy sold its transmission assets to a partnership led by Trans-Elect (developer of electric and gas transmission systems focusing on the ownership and management of electric transmission systems through purchase and expansion of transmission assets).
- On December 20, 2001, Midcontinent Independent Transmission System Operator, Inc. (MISO) became the nation's first FERC-approved Regional Transmission Organization (RTO).
- In 2003, ITCTransmission was formed and acquired DTE's transmission assets.
- In 2005, ITCTransmission acquired Michigan Electric Transmission Company (METC) (i.e., Consumers Energy's former transmission assets previously sold to Trans-Elect). This marked the first time the Federal Energy Regulatory Commission authorized the acquisition of a stand-alone transmission company ("Transco") by another Transco.
- In 2011, MISO launched its Multi-Value Projects (MVP) portfolio of regionally planned transmission projects.
- In 2016, Canadian holding company Fortis, Inc. acquired ITC Holdings Corp.; its ITC Michigan subsidiary holds transmission assets of former ITC and METC
- In 2020, MISO launched its Reliability Imperative.
- In 2021, MISO approved Long-Range Transmission Project (Tranche 1: first tranche of transmission solutions developed as part of effort to provide reliable and economic energy delivery to address future reliability needs resulting from transformational changes in generation resource fleet).

Michigan-Ontario Phase Angle Regulators (PARs) Timeline

1975–Ontario Hydro's Keith PAR in Ontario enters service (first of the PARs on the Michigan-Ontario interface, originally installed to control local flows between Michigan and Ontario

Early 1990s–Unscheduled power flows on the transmission lines in Ontario, known as the Lake Erie Loop Flow (LELF), increase significantly, taking up transmission capacity and impacting power transfers between Ontario, New York and Michigan including transmission curtailments

1998–Detroit Edison, the former parent of ITC, and the former Ontario Hydro develop plans for Detroit Edison to install a PAR at BunceCreek in Michigan and Ontario Hydro to install two PARs at Lambton in Ontario. The Lambton PARs are for two separate lines that connect the Ontario and Michigan grids. Detroit Edison applies to U.S. Department of Energy (DOE) to modify a presidential permit to allow for installation of the Bunce Creek PAR

2000–Swiss-Swedish multinational manufacturer ABB delivers first PAR to Lambton; DOE grants presidential permit to ITC for Bunce Creek PAR

2001–First PAR at Lambton fails and is returned to ABB for rebuild

2002–ABB delivers second PAR to Lambton

2003–Original Bunce Creek PAR fails while in service in March 2003; the tower supporting the Canadian side of the Bunce Creek-Scott transmission line collapses in bad weather

2005–ABB delivers repaired first PAR back to Lambton

2006–Tower and line for the Bunce Creek-Scott line are replaced. ITC orders two new PARs from Smit Transformer (Netherlands) to replace the failed Bunce Creek PAR

2008–New York Independent System Operator alleges that LELF costs state's market almost $100 million in first seven months of the year and identifies operational PARs as a solution to reducing transmission congestion.

2009–ITC applies with DOE to amend presidential permit to replace the failed Bunce Creek PAR with two PARs; ITC completes installation of new Bunce Creek PARs in 2010

2011–ITC and MISO complete operatingagreements with Ontario power grid operator IESO and Hydro One; ITC and MISO seek cost-allocation agreements with New York ISO and PJM power grid operators before FERC, achieve agreement on operating protocols and settlement of presidential permit before DOE

2012–DOE approves presidential permit; PARs enter service

Ongoing monitoring and coordination shows LELF largely controlled and transmission "flow to schedule" over the Michigan-Ontario PARs since 2012

The Need for Holistic Planning

Holistic and integrated energy system planning

Improve energy system planning by fully integrating traditional resources, transmission, distribution, new and emerging resources, and considerations related to the interdependency of electric and natural gas systems. Elevate community health impacts and equitable access to infrastructure in energy planning and investment decisions. Continue to develop and refine innovative rate designs to incent behaviors that advance clean energy goals.

From Michigan Healthy Climate Plan (EGLE, April 2022)
Who is responsible for establishing this holistic planning process?

Availability of adequate transmission, both within lower Michigan, and connecting lower Michigan with its neighbors, will be a major determining factor in how well Michigan achieves its stated clean energy goals.

The challenge is not just to plan for the future. As technologies on the grid change, it is becoming increasingly apparent that the established regulatory, market and operational policies and procedures that were developed during and for another era, one characterized by large baseload thermal generation and inelastic customer demand, may not be well-suited to the grid of the future. Many of the accepted (and ingrained) ways of doing business do not serve customers well and need to be reconsidered in light of the changing grid.