

# Integration of Renewable Energy Michigan's Upper Peninsula

Michigan Wind Energy Resource Zone Board  
March 30, 2009





# Agenda

- Overview of the transmission system that serves Michigan's Upper Peninsula
- Previous G-T Interconnection Requests
- U.P. Renewable Energy Integration Plan
- Overview of ATC's Energy Collaborative



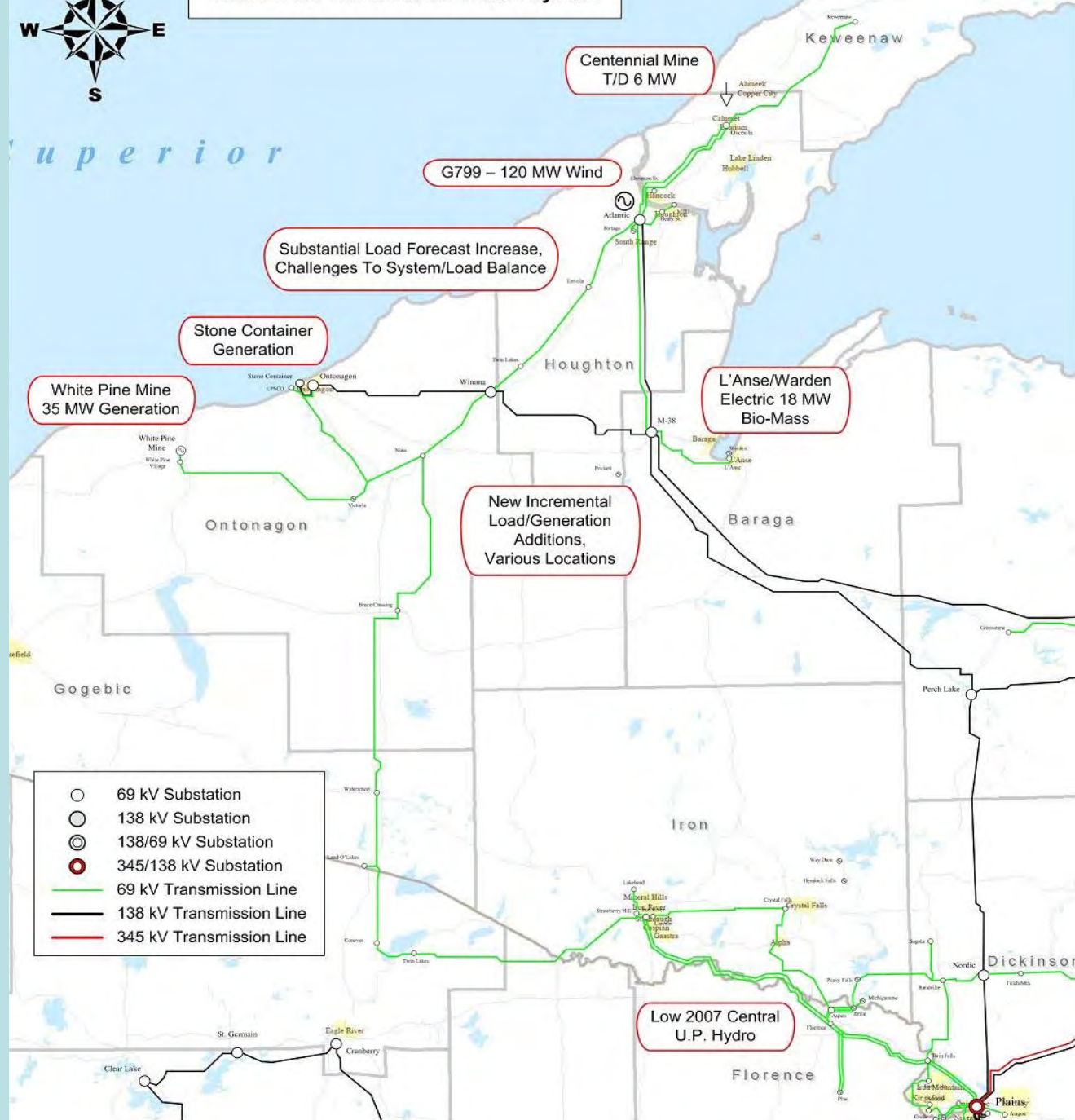
# Existing U.P. Transmission System



# U.P. Transmission System

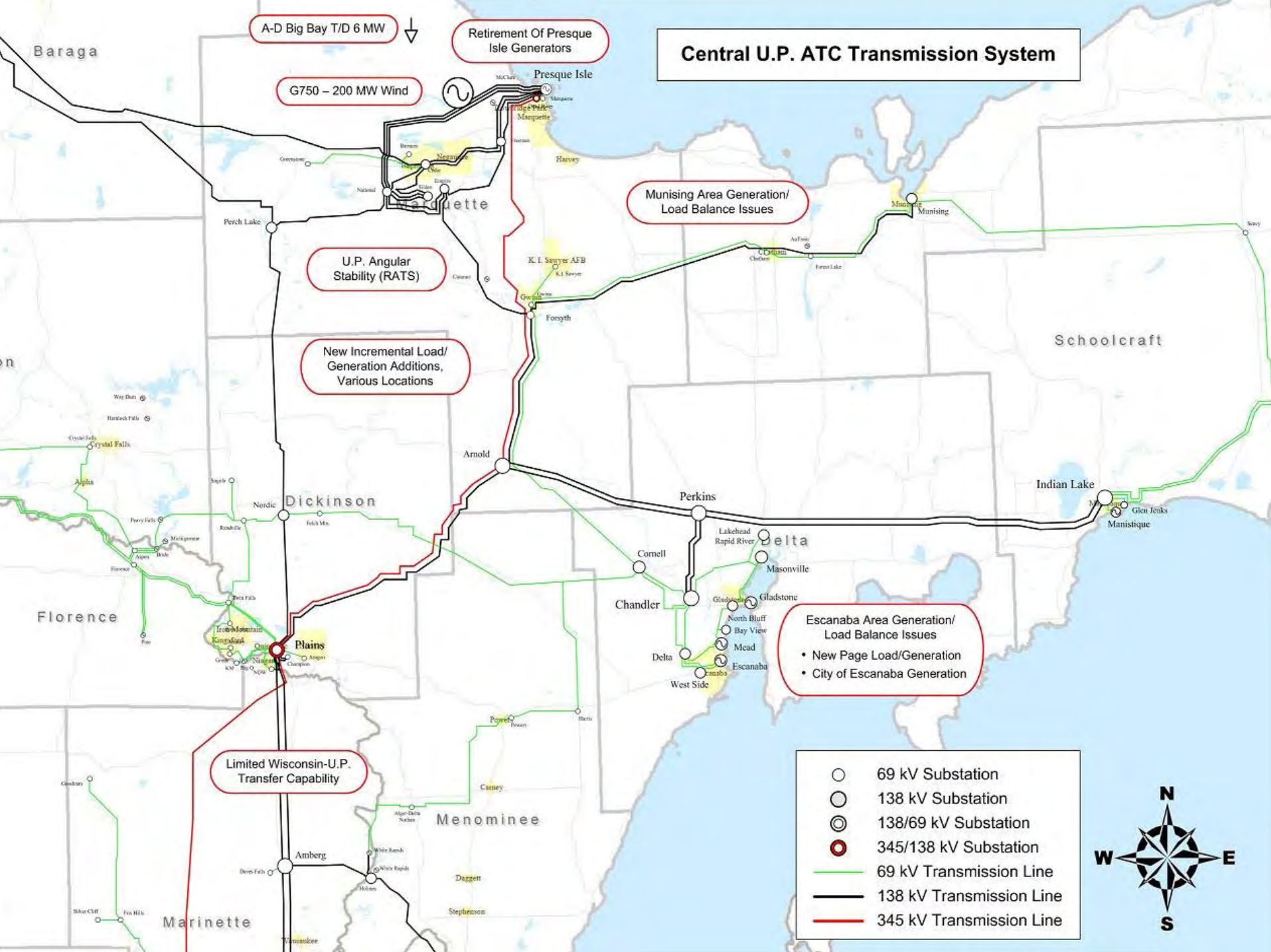
- Exhibits a delicate balance between existing generation and load
- Consists of 138-kV and 69-kV assets integrated beneath a single 345-kV line
- Limited import/export capacity
  - Single tie with Lower Peninsula at Straits
  - Three ties to Wisconsin
  - Fully subscribed system
- Limited capability to support new generation or load without considerable network upgrades

### Western U.P. ATC Transmission System





## Central U.P. ATC Transmission System



# Eastern U.P. ATC Transmission System



- 69 kV Substation
- 138 kV Substation
- ⊙ 138/69 kV Substation
- 69 kV Transmission Line
- 138 kV Transmission Line

Condition And Performance  
Assessment Of 69 kV  
Transmission Lines

Edison Sault/Cloverland  
Combined Peak Loads:  
Summer 139 MW  
Winter 148 MW

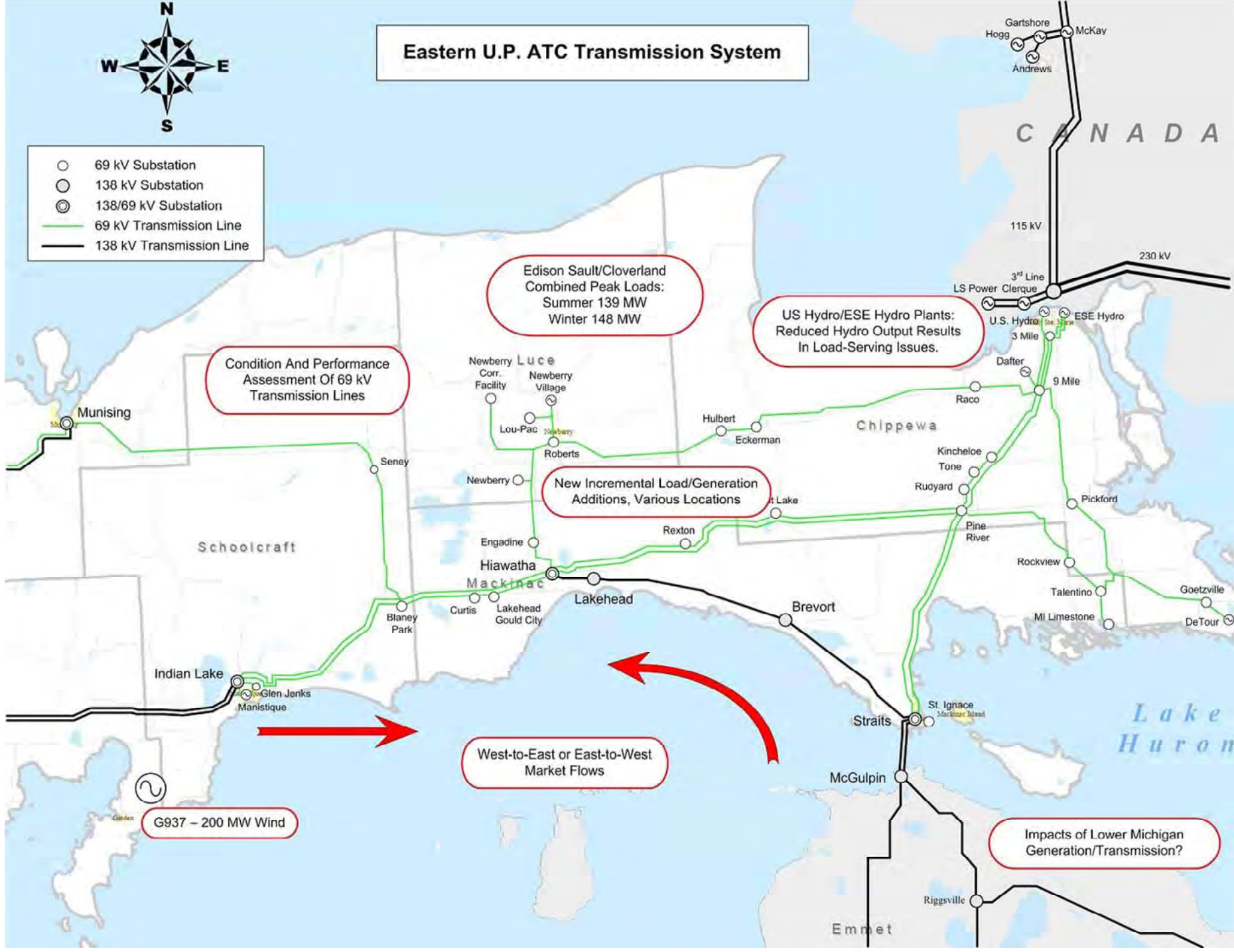
US Hydro/ESE Hydro Plants:  
Reduced Hydro Output Results  
In Load-Serving Issues.

New Incremental Load/Generation  
Additions, Various Locations

West-to-East or East-to-West  
Market Flows

G937 – 200 MW Wind

Impacts of Lower Michigan  
Generation/Transmission?





# G-T Interconnection Requests

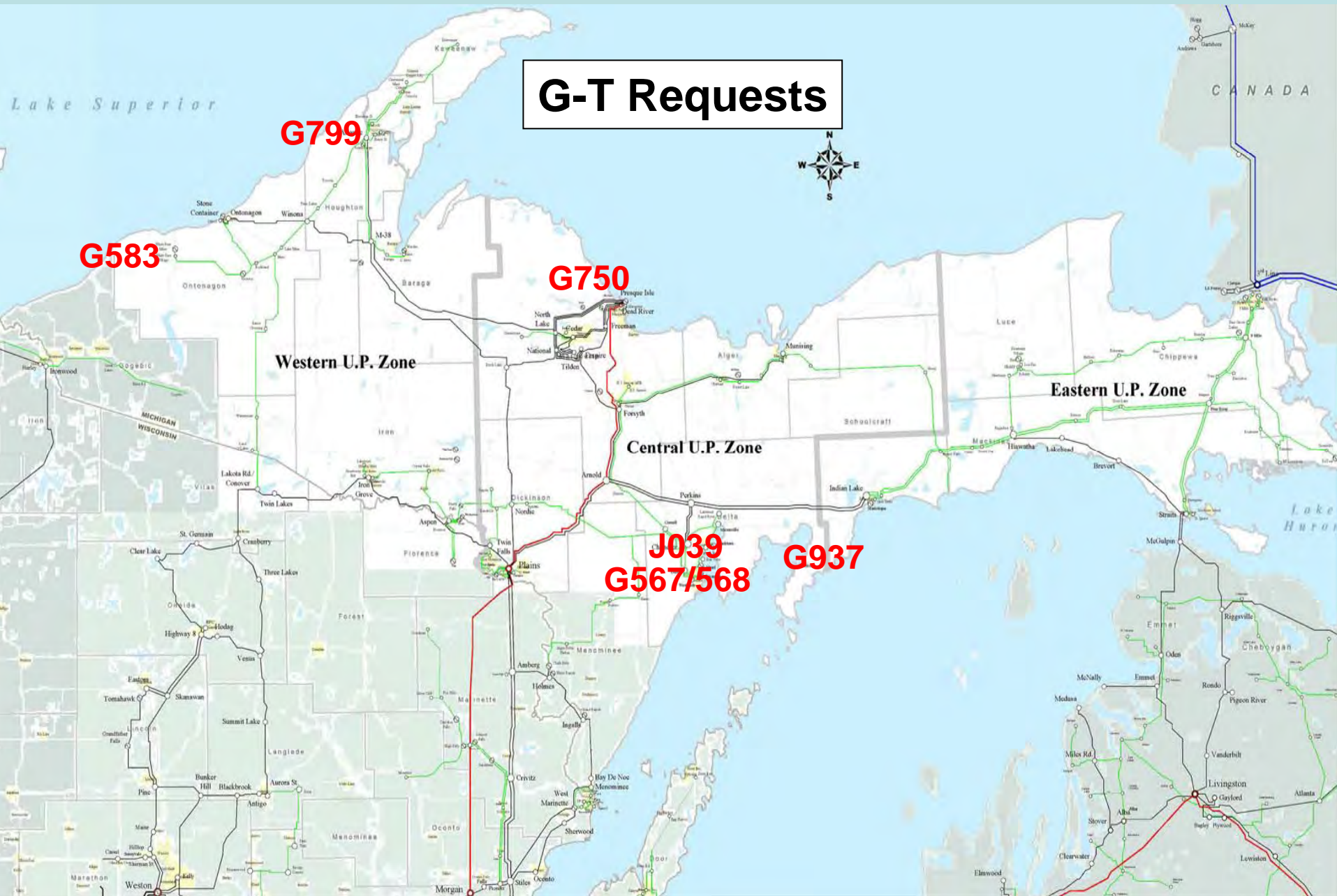




# G-T Requests

- Three G-T requests for Wind generators
  - G750 Marquette County – 201 MW
  - G799 Houghton County – 120.45 MW
  - **G937 Delta County – 200 MW**
- Two G-T requests for Biomass generators
  - G583 Ontonagon County – 16 MW
  - **J039 Delta County – 50 MW**
- Two G-T requests for baseload fossil fuel
  - G567 Delta County – 165 MW
  - G568 Delta County – 300 MW

# G-T Requests





# G-T Requests

- Substantial network upgrades were required to support all of the generation projects that have been studied to date (including the 16 MW Biomass project)
- G750 interconnection and network upgrade costs were estimated to be in excess of **\$1.16M per MW** of installed capacity (range of ~\$232M - \$252M)



# U.P. Renewable Energy Integration Plan





# Renewable Energy Integration Plan

- Objective: to stimulate and facilitate development of new renewable energy projects in the U.P.
- Developed via U.P. wide regional collaboration
- Stakeholders include:
  - Michigan Wind Energy Resource Zone Board
  - Regional Planning Authorities
  - Local Units of Government (County, Township, City)
  - Chambers of Commerce & Economic Dev. Authorities
  - Utilities (Investor, Municipally and Cooperatively Owned)
  - Large Industry and commercial businesses
  - Universities & Skill Development Centers
  - American Transmission Company



# Renewable Energy Integration Study

- Designed to screen for “right location” and “right size” for new generators
- “*Prospecting Tool*” - facilitates siting of new renewable energy generator projects (fuel neutral)
- Represents “high level” DC (thermal) analysis of the entire U.P. transmission system
- Does not include detailed AC or stability studies
- **Projects must be submitted to the MISO for detailed study via the MISO GIP**



# Modeling Assumptions

- 5 base models were studied
  - 50% of system peak w/Ludington “pumping mode”
  - 70% of system peak w/Ludington “pumping mode”
  - 70% of system peak w/Ludington “generating mode”
  - 100% of system peak w/Ludington in “generating mode”
  - 100% of system peak w/Ludington in “generating mode”
- Non-simultaneous, DC (linear) transfer analysis was performed for single contingencies
- AC and stability analyses were not completed with this study initiative

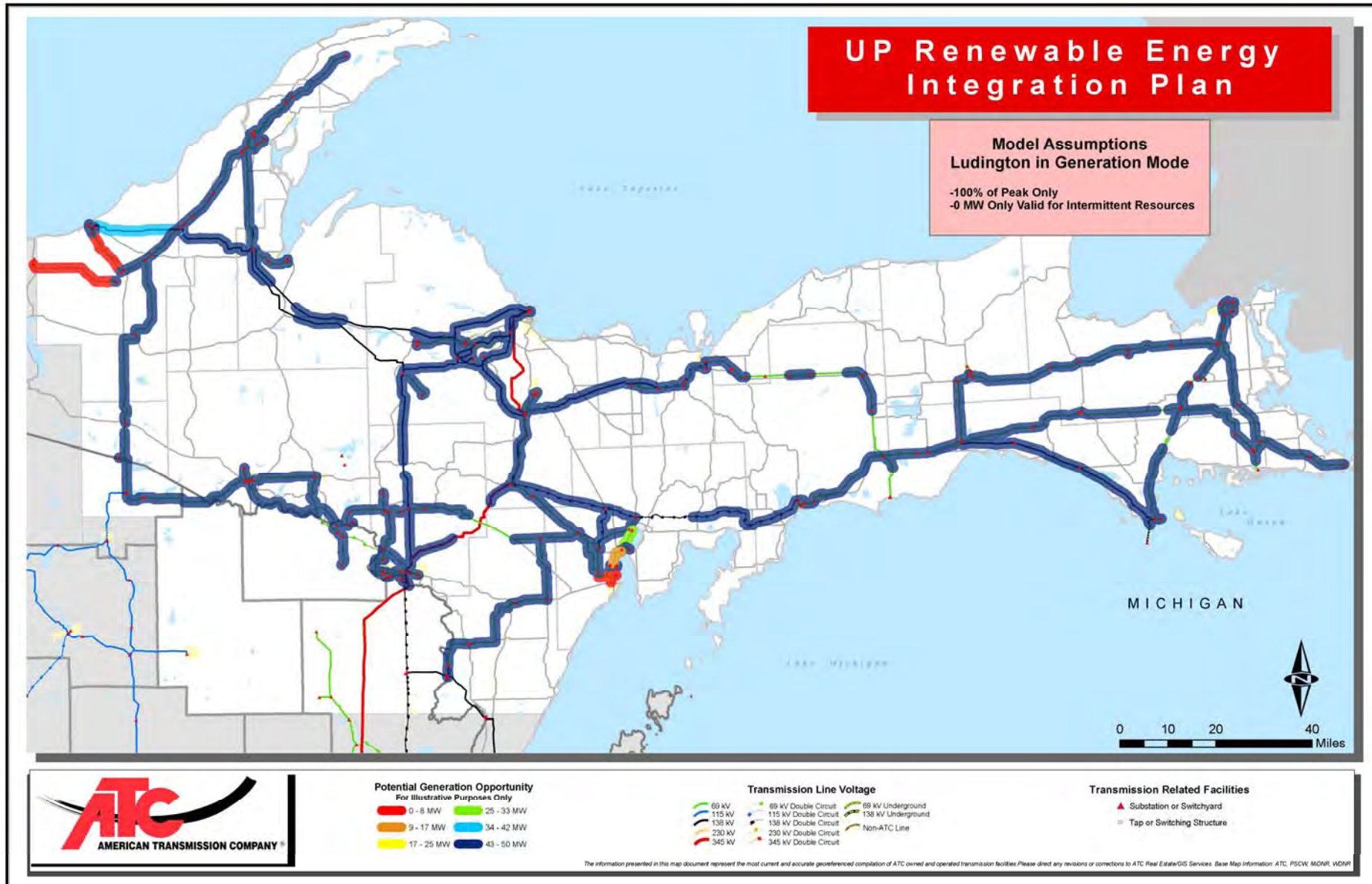


# Modeling Assumptions

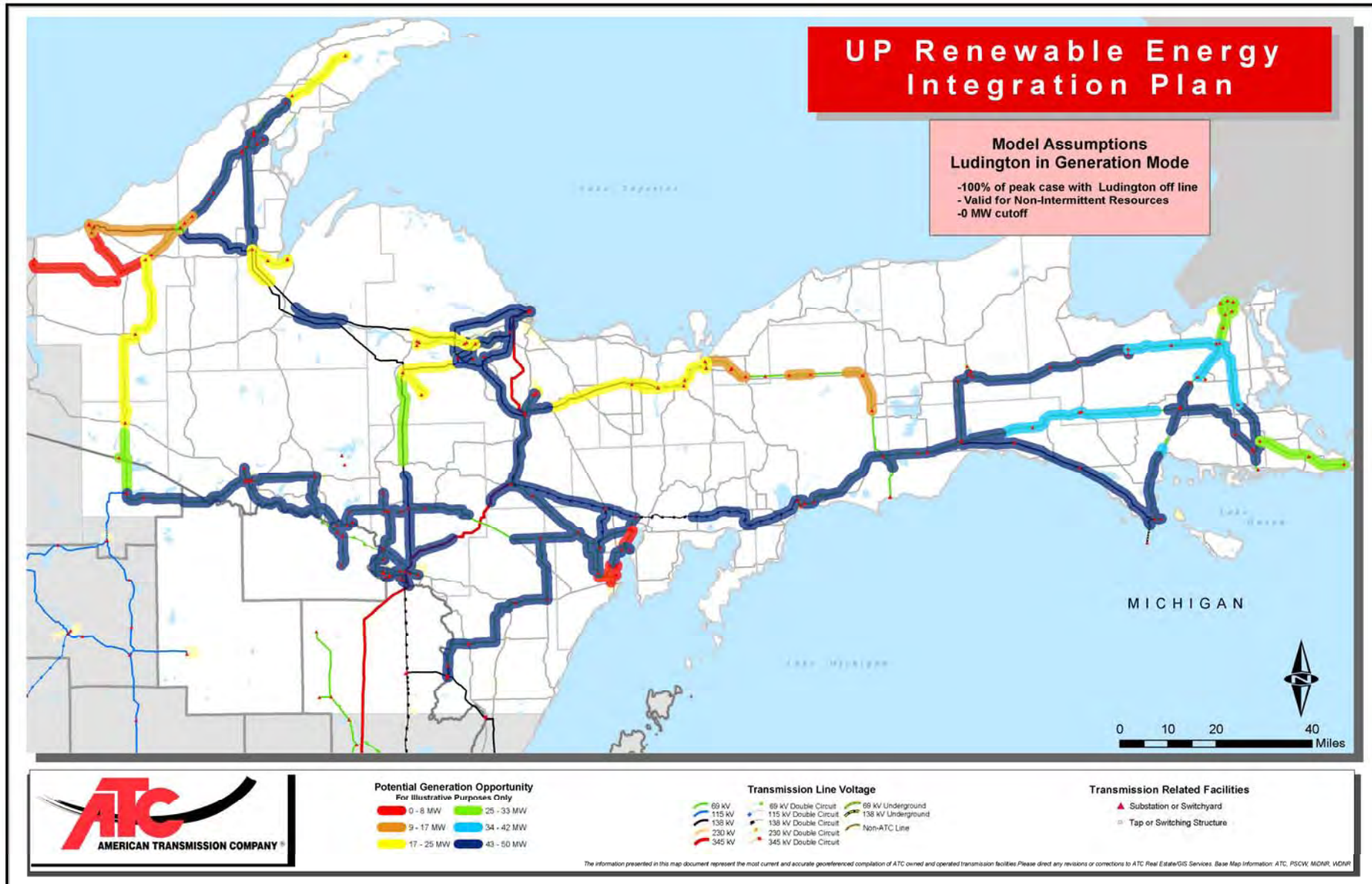
- Injections were incorporated at 69-kV, 138-kV and 345-kV buses that were created at the mid-point of each transmission line in the model
- All existing resources were fully dispatched to protect their existing delivery rights
- MISO Business Practice Manual rules for studying generator interconnections were utilized
- **Additional studies and assessments must be completed before any G-T interconnection would be permitted**



# DRAFT - For Illustrative Purposes Only

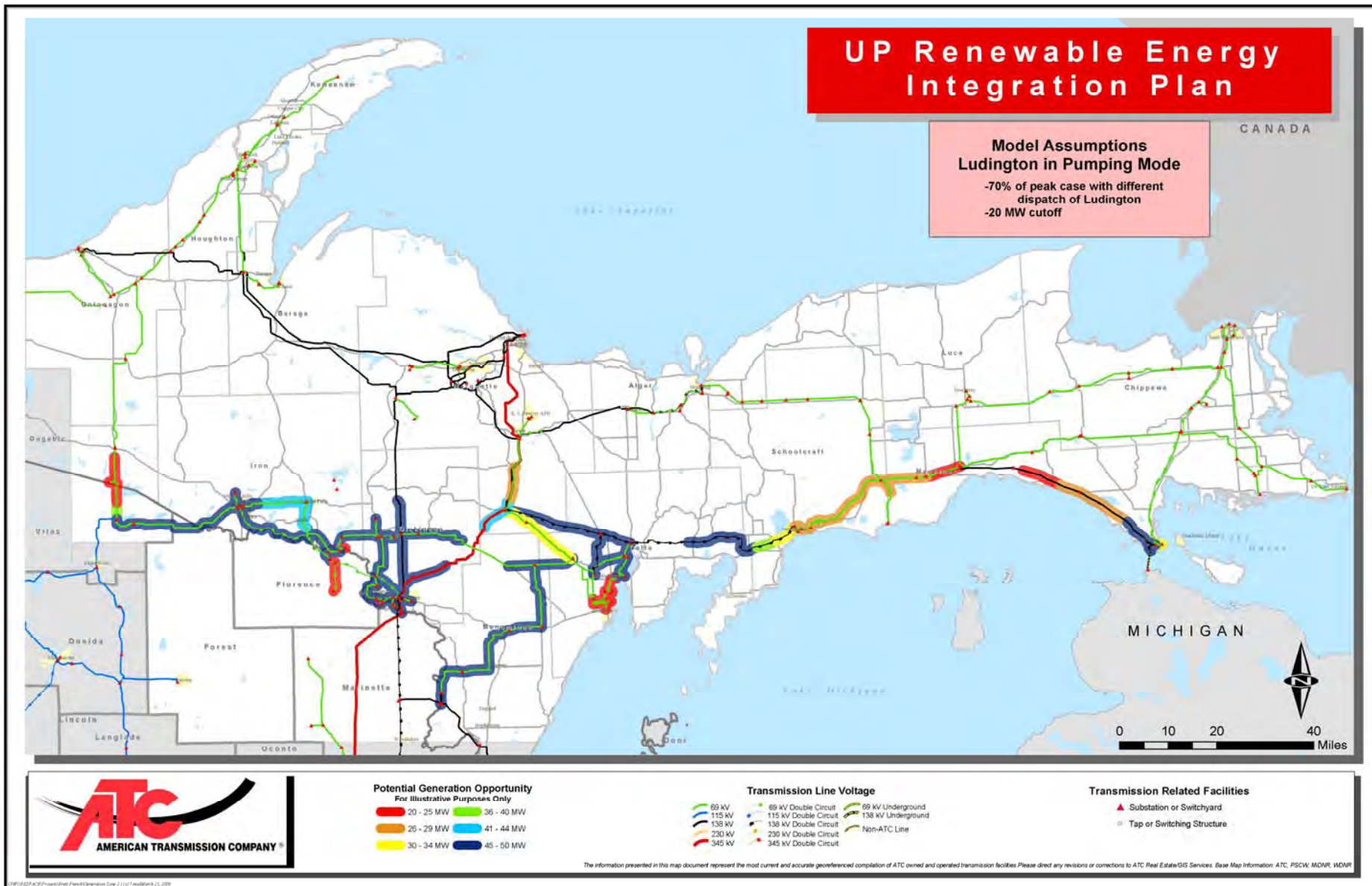


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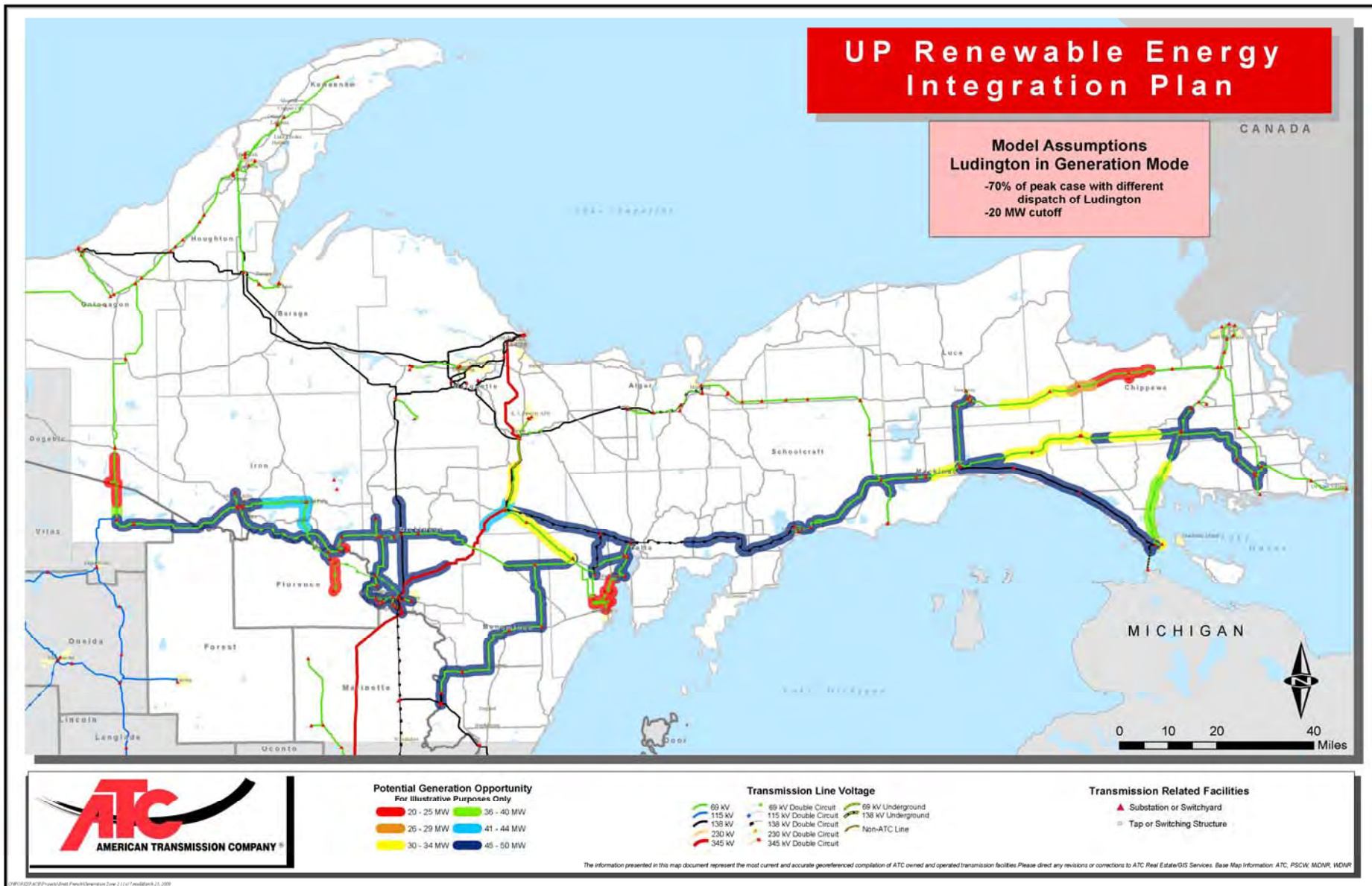




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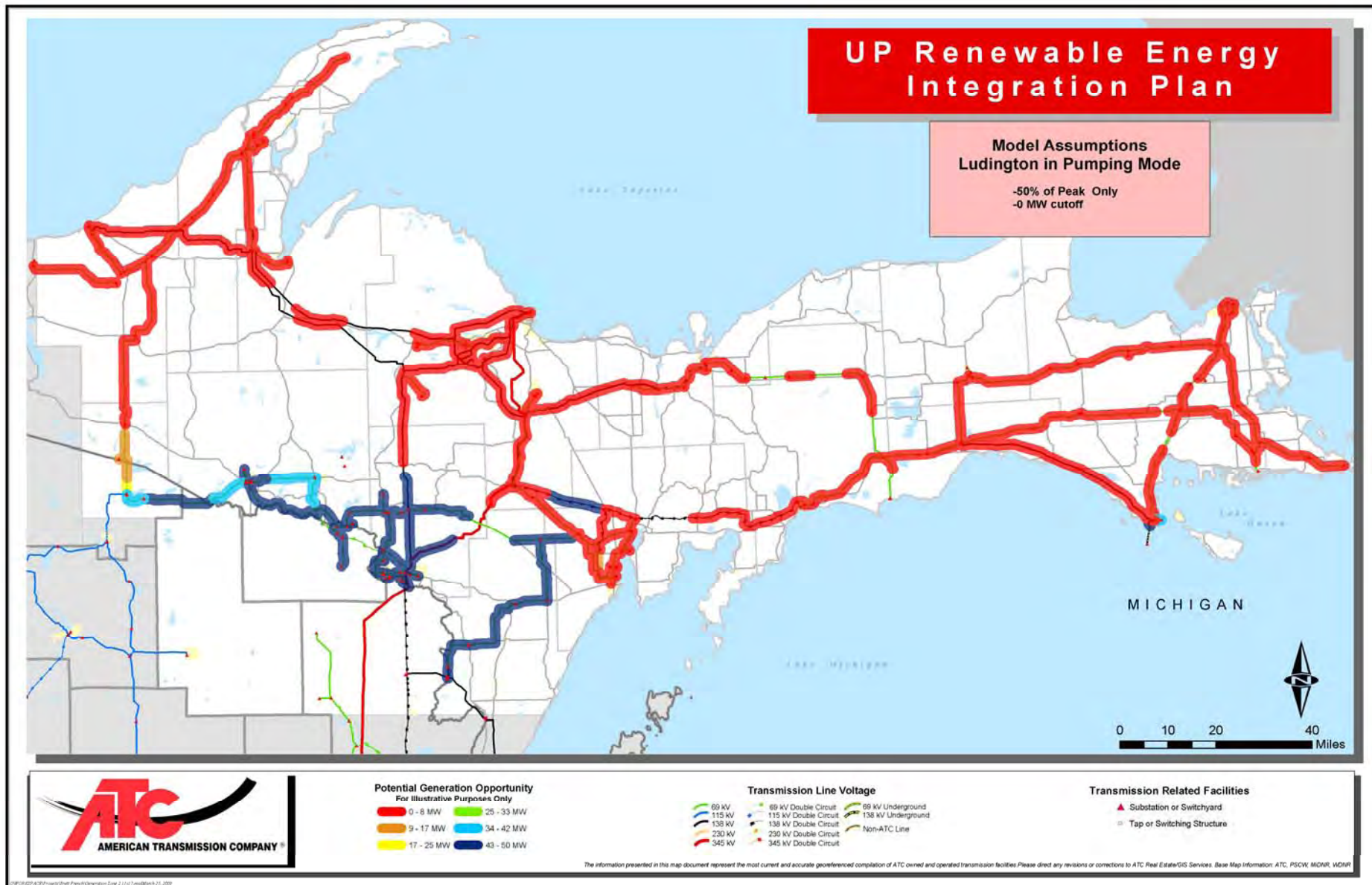


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# ATC's Energy Collaborative - Michigan



# ATC Energy Collaborative

- Developed/evaluated six “plausible futures” to identify transmission issues that may arise within 3 - 5 year (intermediate) and 5 - 15 year (long-term) timeframes
- Developing cost-effective and timely solutions to manage and mitigate the forecasted needs of Michigan’s Upper Peninsula



# Methodology

- “Strategic Flexibility” methodology was used for ATC’s Energy Collaborative
- Six “plausible futures” were developed
  - Based on MISO & ATC Planning Models
  - Incorporated stakeholder input
- Each “plausible future” was modified to reflect U.P. conditions and incorporate stakeholder input and feedback





# “Plausible Futures”

- Robust Economy
- Slow Economic Growth
- DOE 20% Wind
- High Retirements (generation)
- High Environmental Limitations
- Fuel & Investment Limitations

Details regarding ATC's Energy Collaborative and the various futures that were modeled can found at <http://oasis.midwestiso.org/documents/ATC/planning.html>



# Study Parameters

- Demand and Energy
  - Point loads (industrial/commercial)
  - Scalable loads (all others)
- Generation
  - Dispatch of existing generators
  - Addition of new generators
  - Retirement of existing generators
- Energy Market Flows



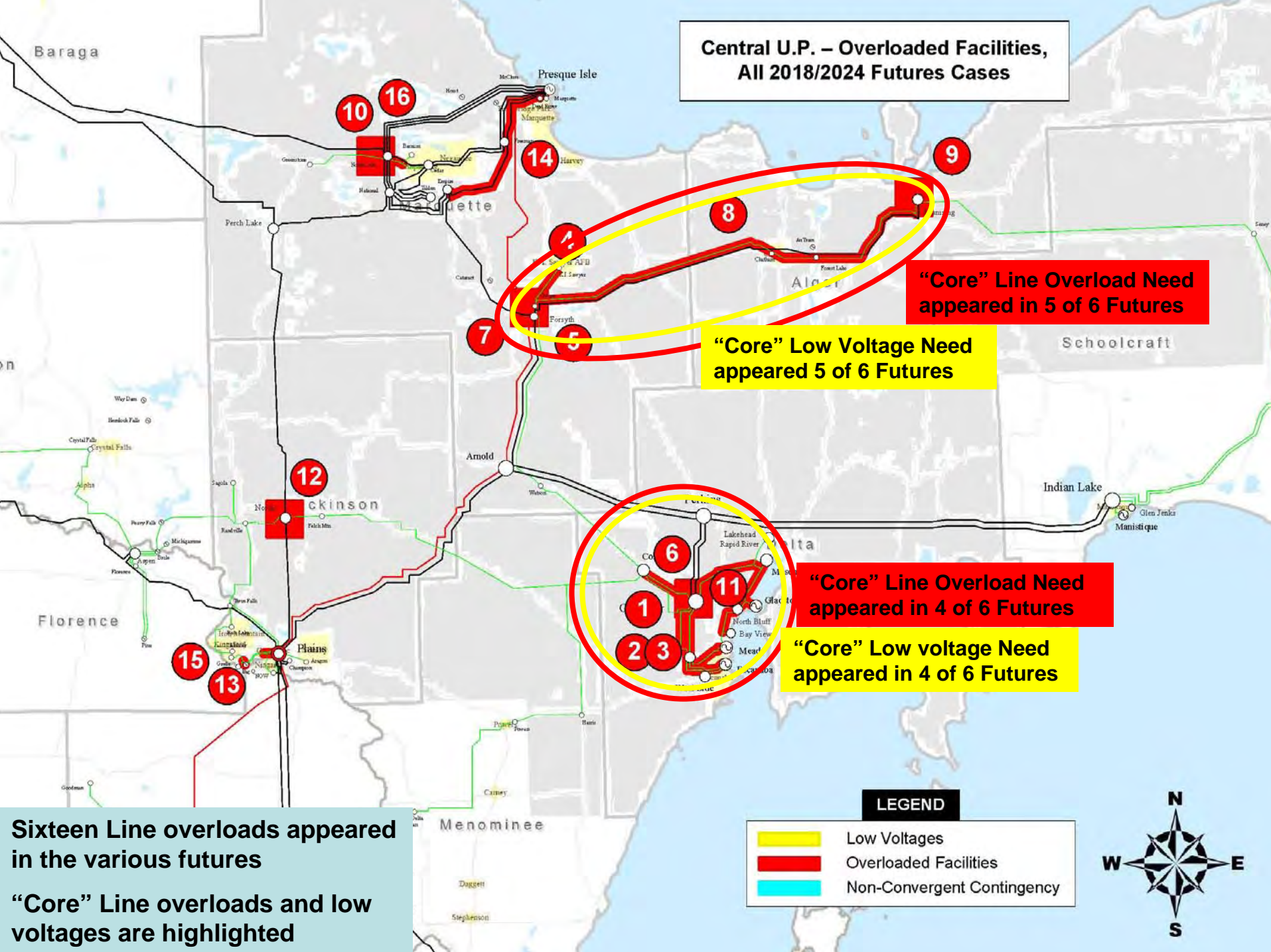
# Identification of Needs

- System “needs” are driven by:
  - *Planning*
    - Line loadings and voltages
  - *System Operations*
    - Special operation guides
    - Special protection schemes
  - *Asset Management*
    - Line performance
    - Transformers, circuit breakers and relays
  - *New Interconnections*
    - T-D load interconnections
    - G-T generator interconnections
  - *Smart Grid Initiatives*
    - Deployment of additional fiber optic
    - SCADA and RTU upgrades





**Central U.P. – Overloaded Facilities,  
All 2018/2024 Futures Cases**



**LEGEND**

- Low Voltages
- Overloaded Facilities
- Non-Convergent Contingency



**Sixteen Line overloads appeared in the various futures**

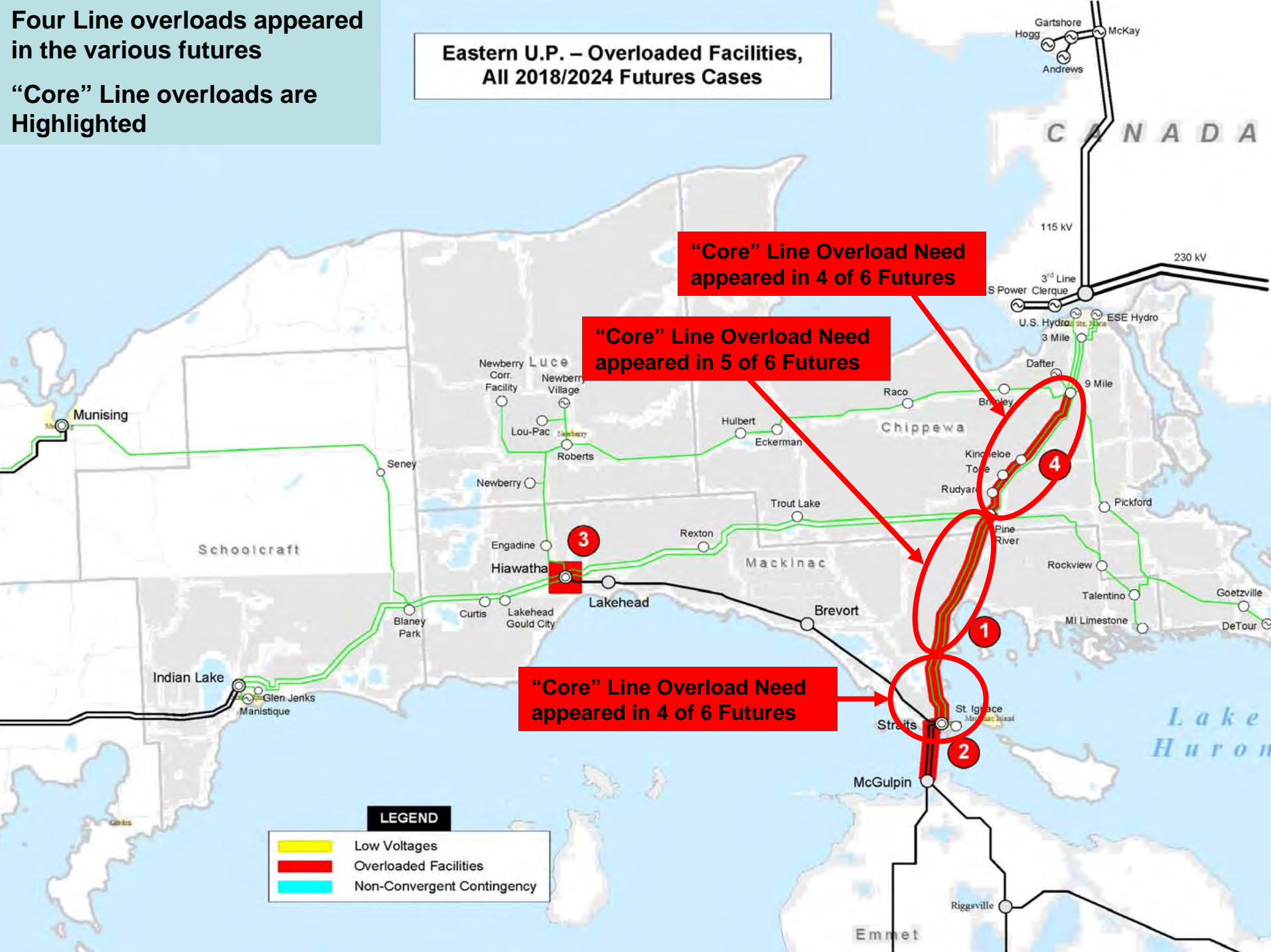
**“Core” Line overloads and low voltages are highlighted**



**Four Line overloads appeared in the various futures**

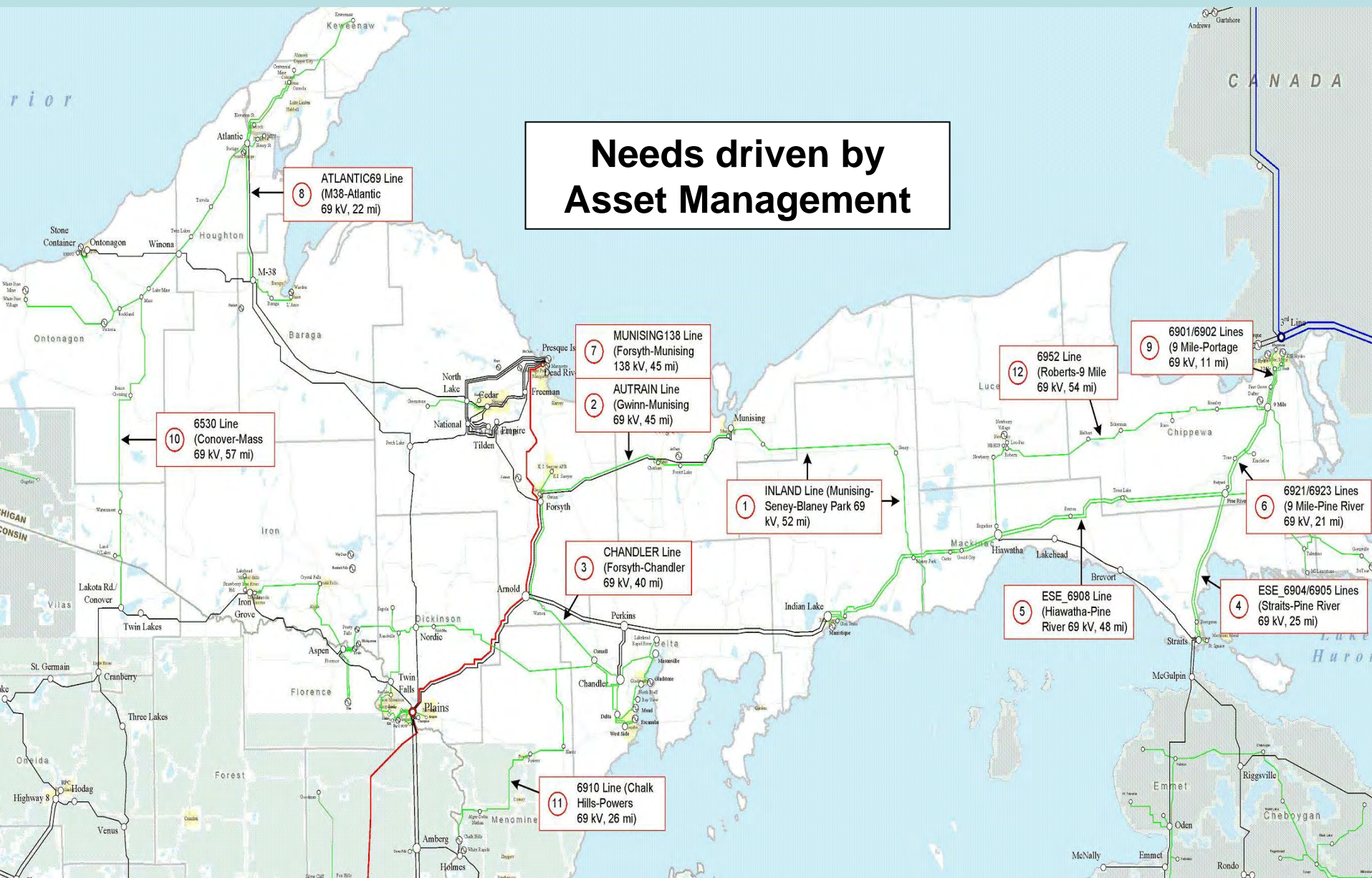
**“Core” Line overloads are Highlighted**

**Eastern U.P. – Overloaded Facilities,  
All 2018/2024 Futures Cases**





## Needs driven by Asset Management





# Next Steps

- Review “Needs” with stakeholders
- Solution screening
  - Preliminary development within ATC
    - Holistic approach
      - Planning, Operations, Asset Management, Project Management, Local Relations, Environmental
  - Stakeholder involvement
    - **Generation solutions**
      - **Right size & right location**
      - **UP Renewable Energy Integration Study**
    - Demand Response
- Decide upon portfolio of “Core Projects”





# Stakeholder Participation

To discuss any questions you may have or to arrange a convenient meeting time to review and discuss these materials please contact:

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# QUESTIONS?