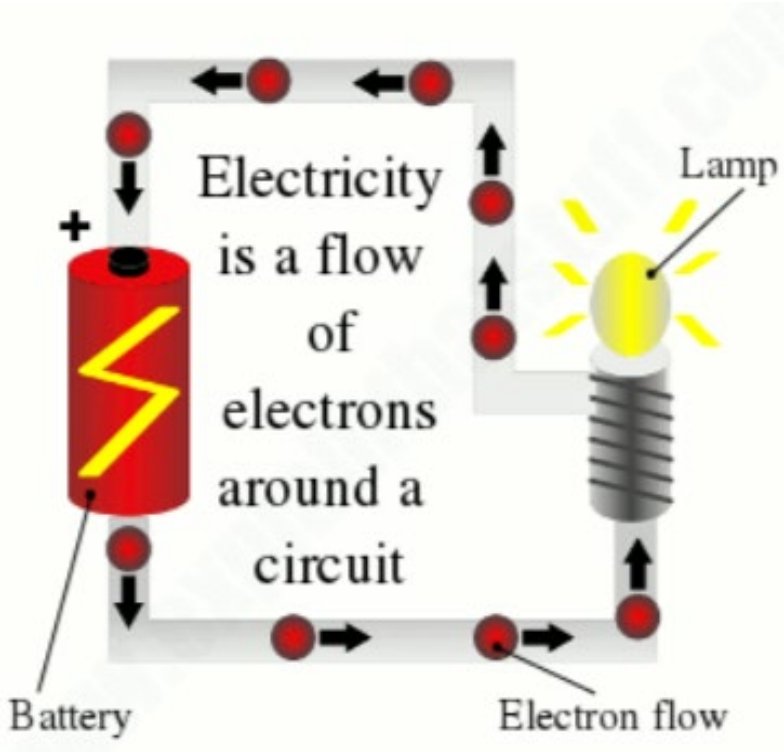
Electricity in the UP: An Intro

May 12, 2020

MPSC
Michigan Public Service Commission

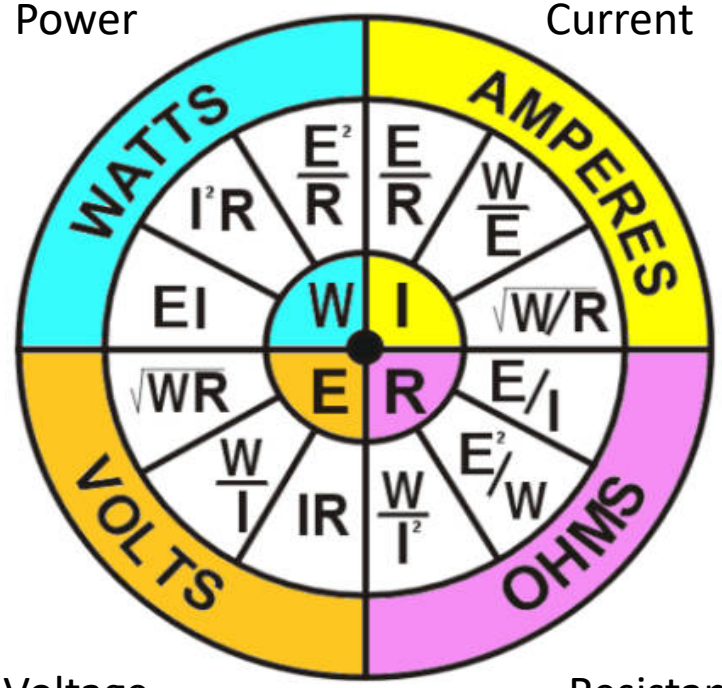
What is Electricity?



Ohm's Law

Power

Current

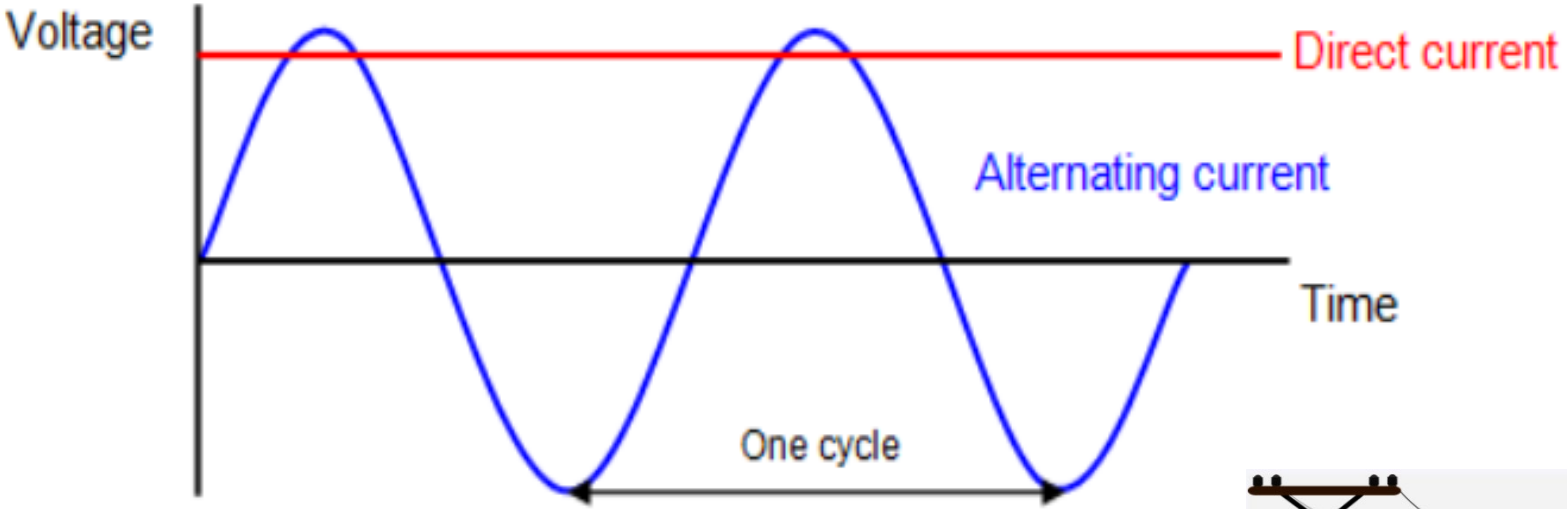


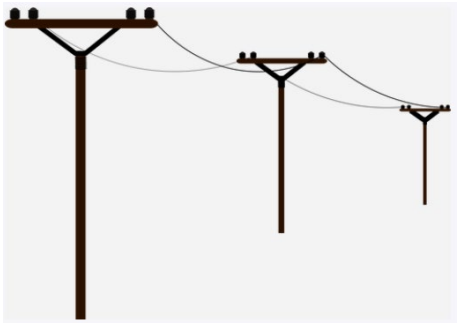
Voltage

Resistance

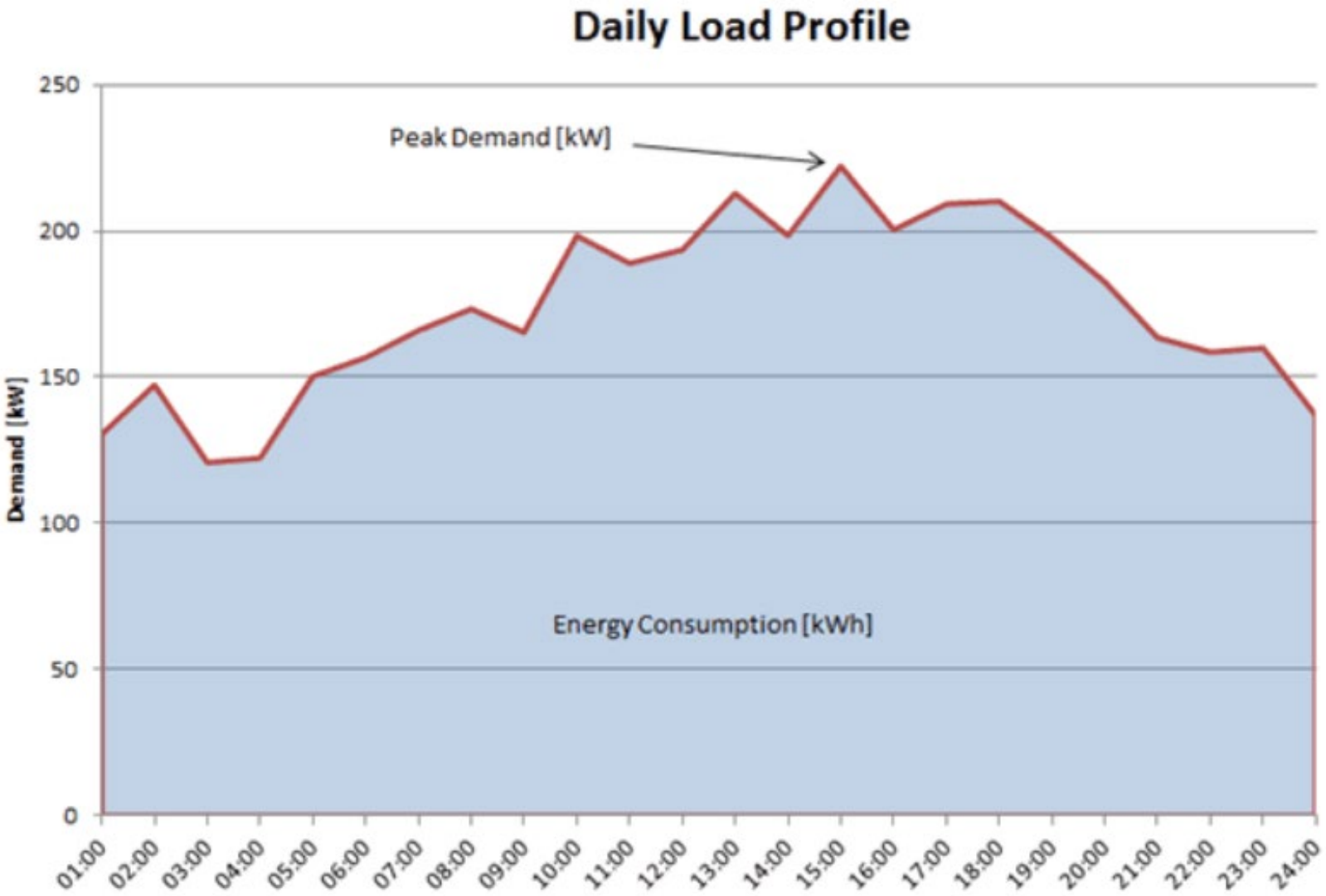
MPSC

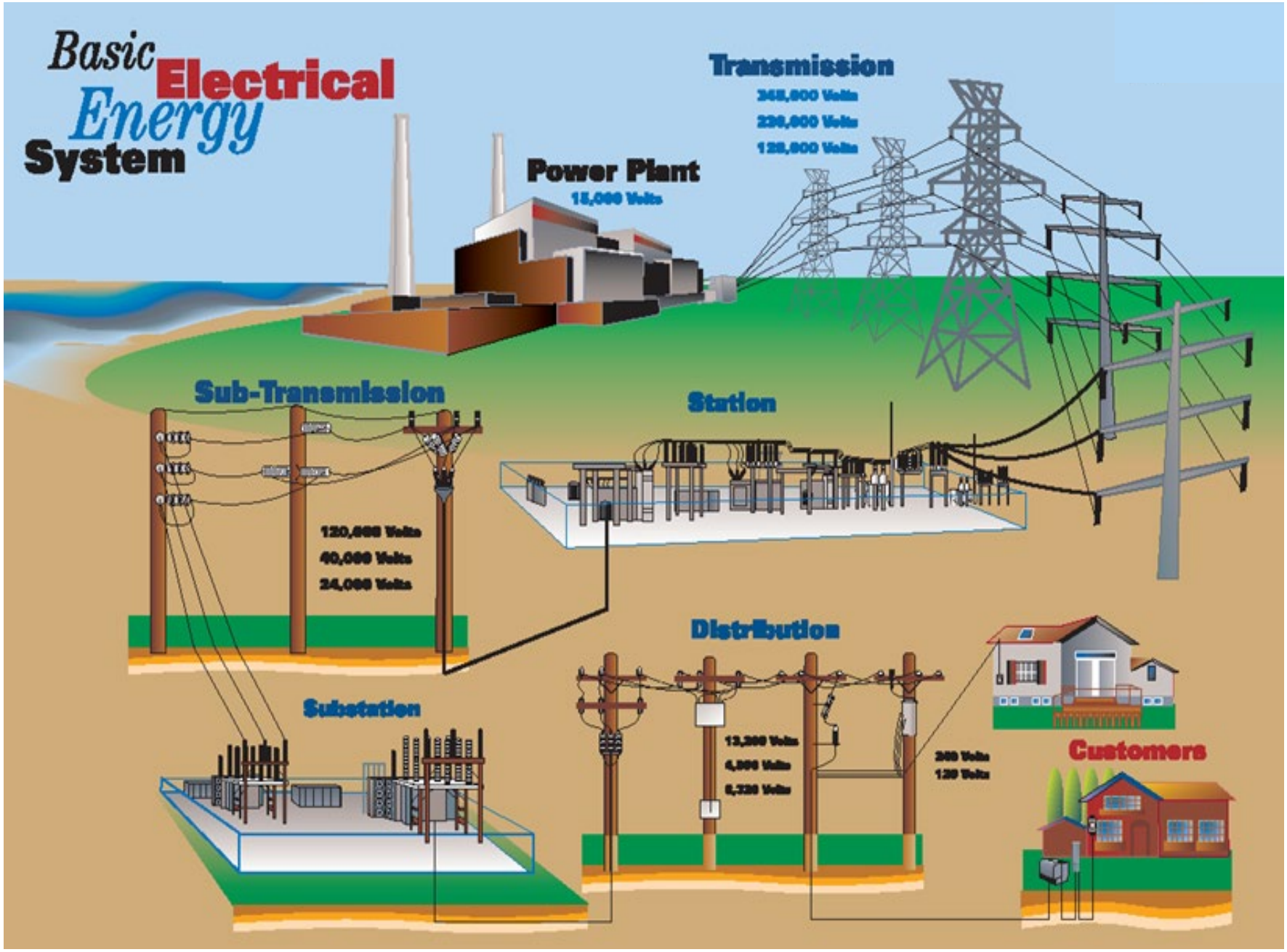
Alternating Current vs. Direct Current





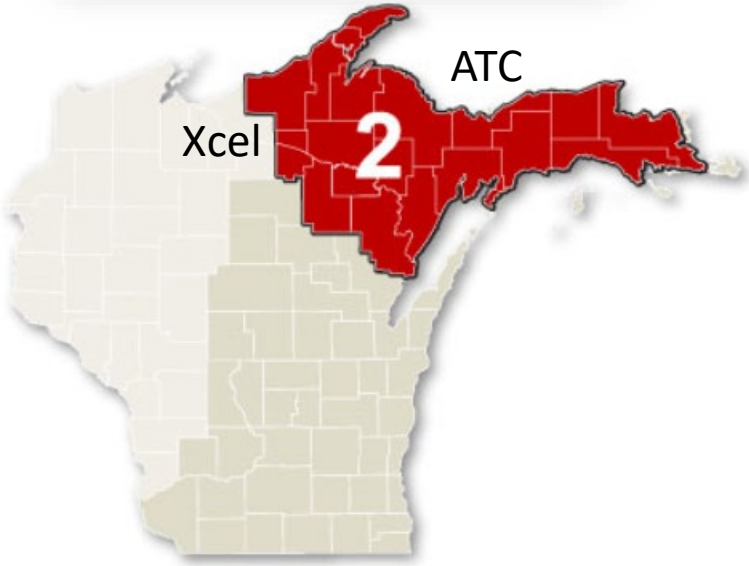
Demand (kW) vs. Energy (kWh)




Basic Electrical Energy System
Transmission
345,000 Volts
230,000 Volts
138,000 Volts
Power Plant
15,000 Volts
Sub-Transmission
120,000 Volts
40,000 Volts
24,000 Volts
Station
Distribution
13,200 Volts
4,800 Volts
2,400 Volts
240 Volts
120 Volts
Substation
Customers

How Electricity is Made

Electricity Transmission



- High voltage lines carry electricity from the generation sources over long distances to substations.
- Lines are 345 kV, 230 kV, 138 kV, 120 kV, and *69 kV.
- Regulated by FERC.
- Transmission lines in the UP owned by ATC and Xcel.
- Regional transmission operator: MISO www.misoenergy.org

Electricity Distribution

Substation:
Steps down voltage for distribution

Distribution Lines:
Lower voltage lines distribute power from substations to the end customer

Poles:
Support lines and other electrical equipment such as transformers

Meters:
Measures electrical usage at the customer site

When a distribution circuit is down, it's likely due to damaged elements.

Overhead Distribution Lines

- Overhead lines are configured into Distribution Circuits to provide power to a community or neighborhood.
- Comprised of poles, wires, fuses, reclosers, capacitors and transformers
- Easier to maintain than underground lines
- Requires periodic line clearing
- Typical distribution voltage levels range from 5kV to 25kV,
- Overhead lines are constructed using a variety of construction techniques to address reliability based on field conditions.
- Pole attachments by others include phone, cable TV, high speed internet, MDOT, other telecommunications

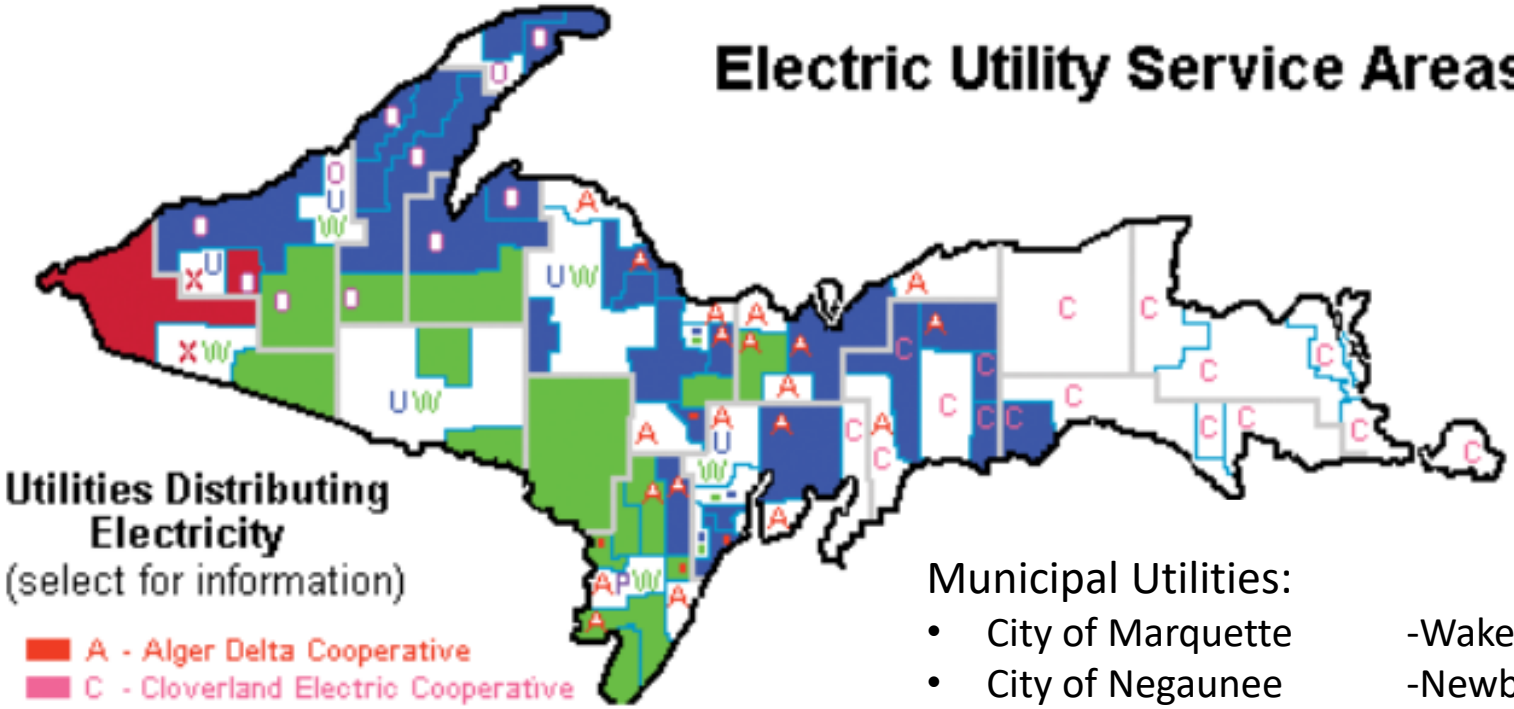
Underground Distribution Lines

- Underground lines are used in four primary situations:
- Substation exits
- Metropolitan (city) systems
- Residential subdivisions (direct buried)
- At customer's request with cost sharing
- Underground lines are 5 to10 times more expensive to install than overhead lines
- Less frequent, but longer outages
- Mandatory in some new subdivisions

Michigan Electricity Rates

- Customer charge
  - Monthly charge to compensate the utility for the cost of making sure that we always have access to electricity, such as the meter and billing.
- Distribution charge
  - Charge per Kwh for delivery of the electricity, utility plant, O&M, Taxes, etc.
- Power Supply Cost Recovery (PSCR) Charge
  - The fuel and purchased power expense. The rate is either set by the utility, or the alternative electric supplier (AES), depending on who you buy from, and will be labeled as such.

Electric Distribution Utilities

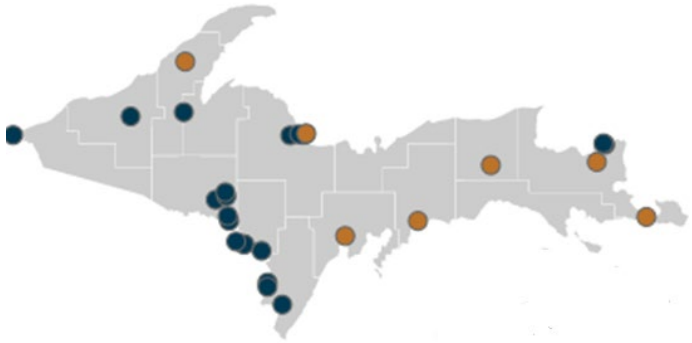


Municipal Utilities:

- City of Marquette
- City of Negaunee
- City of Crystal Falls
- City of Norway
- Village of L'Anse
- City of Gladstone
- Village of Baraga
- City of Escanaba

-Wakefield
-Newberry
-Daggett
-Stephenson

Upper Peninsula Power Plants
Investor Owned Utilities (IOUs)

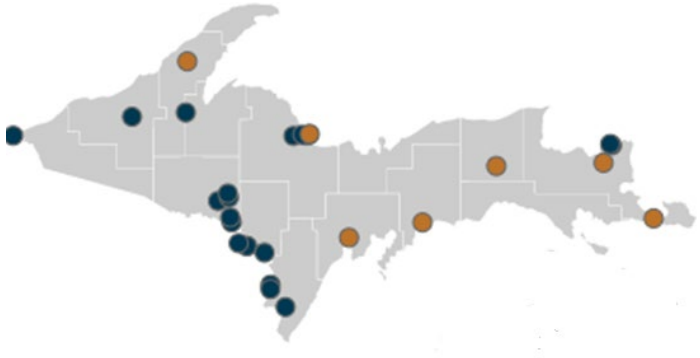


Largely Hydro Assets

Victoria Dam Power Plant

Northern States Power Co - Minnesota	Superior Falls	Hydro	1.5 MW
Upper Michigan Energy Resources Company	F.D. Kuester Generating Station	N. Gas	128 MW
Upper Michigan Energy Resources Company	A.J. Mihm Generating Station	N. Gas	54.9 MW
Upper Peninsula Power Company	Gladstone	Oil	22.5 MW
Upper Peninsula Power Company	McClure Dam	Hydro	8.5 MW
Upper Peninsula Power Company	Hoist	Hydro	3.4 MW
Upper Peninsula Power Company	Prickett	Hydro	2.0 MW
Upper Peninsula Power Company	Victoria Dam	Hydro	12.2 MW
Upper Peninsula Power Company	Portage	Oil	23.8 MW
Wisconsin Electric Power Co	Hemlock Falls	Hydro	2.8 MW
Wisconsin Electric Power Co	Michigamme Falls	Hydro	9.6 MW
Wisconsin Electric Power Co	Peavy Falls	Hydro	12 MW
Wisconsin Electric Power Co	Way Dam	Hydro	1.8 MW
Wisconsin Electric Power Co	Twin Falls (MI)	Hydro	9 MW
Wisconsin Electric Power Co	Big Quinnesec 92	Hydro	16 MW
Wisconsin Electric Power Co	Big Quinnesec 61	Hydro	4.4 MW
Wisconsin Electric Power Co	Kingsford	Hydro	7.2 MW
Wisconsin Electric Power Co	Presque Isle*	Coal	431 MW
Wisconsin Electric Power Co	Chalk Hill	Hydro	7.8 MW
Wisconsin Electric Power Co	White Rapids	Hydro	7.2 MW
Wisconsin Public Service Corp	Grand Rapids	Hydro	7.5 MW

Upper Peninsula Power Plants
Cooperative, Municipal and Independent Generators

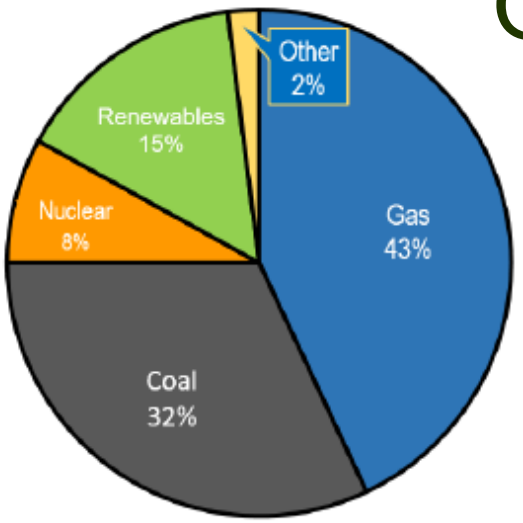


City of Crystal Falls	Crystal Falls	Hydro	1 MW
City of Marquette - (MI)	Plant Four	Diesel	24 MW
City of Marquette - (MI)	James R Smith	Hydro	3.2 MW
City of Marquette - (MI)	Shiras*	Coal	78 MW
City of Marquette - (MI)	Marquette Energy Center	Gas	52 MW
City of Norway	Norway (MI)	Hydro	6 MW
Cloverland Electric Co-op	Dafter	Hydro	9 MW
Cloverland Electric Co-op	Detour	Hydro	6 MW
Cloverland Electric Co-op	Manistique	Diesel	5 MW
Cloverland Electric Co-op	Edison Sault	Hydro	42 MW
Gichi Noodin Wind Farm, LLC	Gichi Noodin Wind Farm	Wind	72 MW
Heritage Garden Wind Farm I LLC	Heritage Garden Wind Farm I LLC	Wind	28 MW
L'Anse Warden Electric Company LLC	John H Warden	Bio	20 MW
N E W Hydro LLC	Menominee Mill Marinette	Hydro	1.8 MW
Newberry Water & Light Board	Newberry	IC	6 MW
Renewable World Energies LLC	Cataract (MI)	Hydro	2 MW
Verso Escanaba LLC	Escanaba Mill	Coal/Bio	54 MW
Verso Paper - Quinnesec	Verso Paper Quinnesec Mich Mill	Bio	28 MW

https://www.powermag.com/top-plants-edison-sault-hydroelectric-plant-sault-ste-marie-michigan/

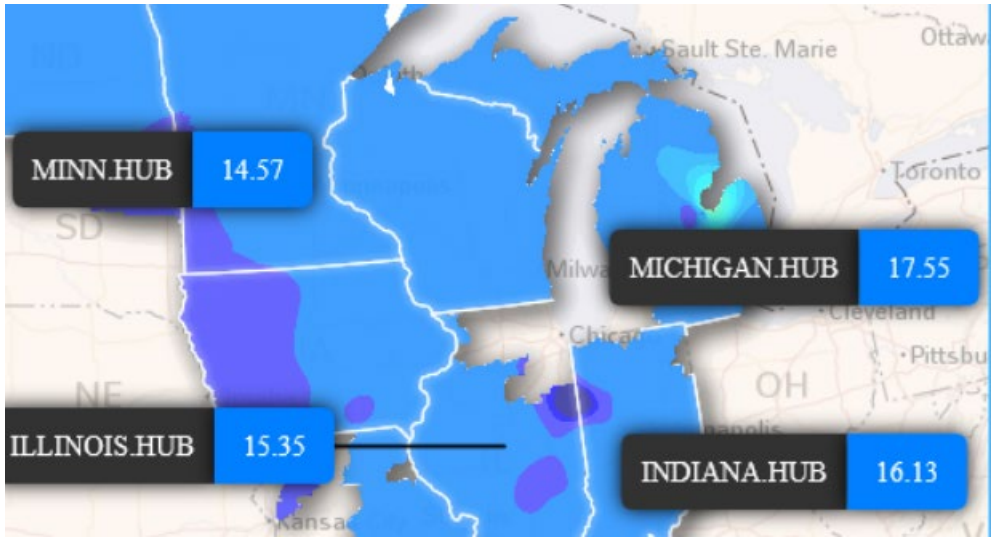
Edison Sault Hydroelectric Plant

MidContinent Independent System Operator (MISO)



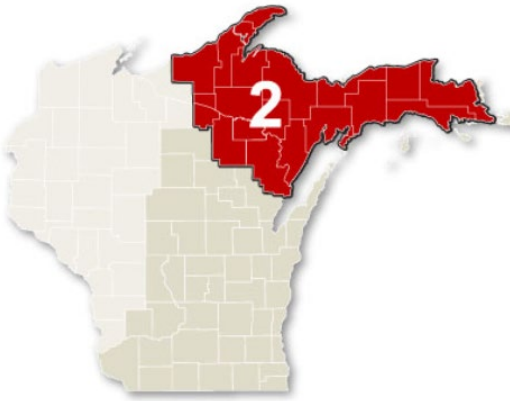
MARKET CAPACITY

- Energy and Operating Reserves Market
  - Security-constrained economic dispatch
  - Locational Marginal Prices (LMP)



- $29.9 billion annual gross market charges (2018)
- 468 Market Participants that serve approximately 42 million people

ATC's 10-Year Assessment



Zone 2 Planned Projects

Project Description	Project #	In-service year	Need driver
M-38 SS, new 138-kV inductor bank	1	2019	Reliability
Silver River SS, new 138-kV inductor bank	2	2019	Reliability
Hiawatha - Pine River 69-kV line (ESE_6908), replace select poles, cross arms	3	2020	Condition and performance
Mackinac - McGulpin 138-kV line (9901 and 9903), submarine cable replacement	4	2021	Condition and performance

Zone 2 Proposed Projects

Project Description	Project #	In-service year	Need driver
Atlantic SS, 138/69 kV bus reconfiguration and transformer addition	5	2022	Operational flexibility
NLKG31 Tap - Greenstone 138-kV line, construct new transmission line	6	2022	Condition and T-D interconnection
Presque Isle - Tilden 138-kV line, loop and uprate	7	2022	Reliability

History of UP Utilities

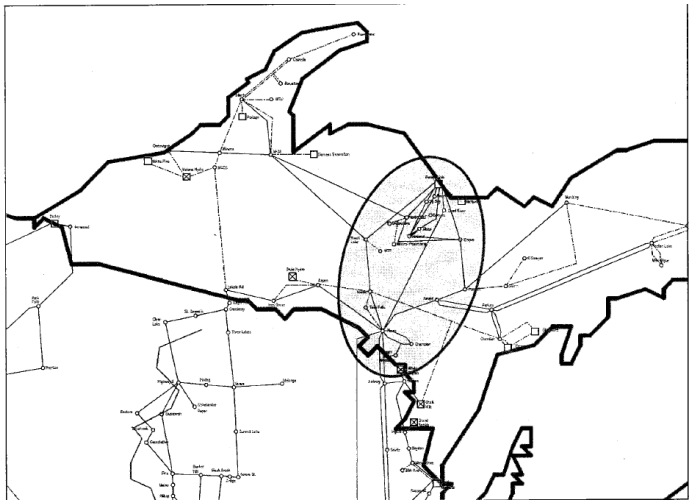
- **1961**: UPPCO joined a coalition lead by Wisconsin Public Service Corporation (WPS) to create a coordination of electrical service providers in Upper Michigan and Wisconsin.
- **1998**: UPPCO was acquired by Wisconsin Public Service.
- **2007**: Integrys Energy Group, formed including, among others, two UP utilities in its portfolio.
  - Upper Peninsula Power Company, an electric utility serving approximately 52,000 customers in Michigan's Upper Peninsula.
  - Wisconsin Public Service Corporation, an electric and natural gas utility serving approximately 446,000 electric customers and 330,000 natural gas customers in northeast and central Wisconsin.
- **2014**: Integrys announced its intention to sell Upper Peninsula Power to Balfour Beatty Infrastructure Partners LP which would lead to UPPCO's independence.
- **2014** Wisconsin Energy announced that it was purchasing Integrys Energy Group, parent company of Peoples Gas, North Shore Gas and Wisconsin Public Service, for $9.1 billion.
- **2014**: Presque Isle files an Attachment Y and becomes an SSR unit.
- **2014**: Creation of the MIUP LBA.
- **2015** Wisconsin Energy completes acquisition of Integrys Energy Group, forming WEC Energy Group.
- **2016**: UMERC receives approval to serve Michigan customers formerly served by WEPCo and WPS, operating under WEC.
- **2017**: UPPCO is re-established as an independent, UP-based utility, owned by a private equity firm.
- **2019**: UMERC's RICE units became operational and the Mines load is transferred from WEPCo to UMERC.

Coal Retirements: SSRs

When a utility requests to retire a generating unit within MISO, an Attachment-Y request is made. MISO conducts a study to determine whether any system upgrades would be required to maintain reliability if the unit is retired. When reliability upgrades are required, the unit is declared to be a system support resource (SSR) and is provided compensation to remain online until the upgrades are complete pursuant to the tariff.

MISO Tariff Schedule	FERC Docket #	SSR Unit(s)	Contract Start Date	Total Cost	Cost Allocation	File Links
43	ER13-1695 ER13-1699 ER13-38 ER13-37 ER14-2176 ER14-2180	City of Escanaba	6/15/2014	$4.3-5.3million	Load Shed of 109.1 MW to UPPC LBA and 6.8 MW to WEC LBA.	http://elibrary.ferc.gov/idmws/file_list.asp?document_id=14057417
43-D	ER14-109 ER14-111	Gaylord	**10/1/2013-9/30/2014 not required by MISO anymore**	$996,054	100% to CECO customers	http://elibrary.ferc.gov/idmws/file_list.asp?document_id=14154878
43-E	ER14-112 ER14-113	Straits	**10/1/2013-9/30/2014 not required by MISO anymore**	$328,962	100% to CECO customers	http://elibrary.ferc.gov/idmws/File_list.asp?document_id=14154911
43-G	ER14-1242 ER14-1243	Presque Isle	2/1/2014	$52.23 million	99.78% to UP customers	http://elibrary.ferc.gov/idmws/file_list.asp?document_id=14241812
43-G	ER14-2860 ER14-2862	Presque Isle	10/15/2014	$117,225,250.00	99.78% to UP customers	
43-H	ER14-1724 ER14-1725	White Pine No. 1	4/16/2014	$4,674,011.40	100% to U.P. Customers	http://elibrary.ferc.gov/idmws/File_list.asp?document_id=14205251

MIUP LBA Creation



To NERC: ***"The MPSC has serious concerns regarding the LBA split as it would shift millions of dollars annually from Wisconsin customers to Michigan customers without improving reliability."***

August 15, 2014

Reliability Drivers

- Based on the existing and near future planned transmission system upgrades, the Upper Peninsula of Michigan represents a "load pocket" where Bulk Electric System reliability is challenging.
- The Upper Peninsula currently utilizes 5 different Operating Guides to reliably manage 2 specific local area issues, overall area imports, loop flows, and export stability concerns.
- Although, creating metering boundaries of the MIUP Balancing Authority Area will not itself directly improve the physical reliability challenges, MISO, ATC and ESO will be able to clearly identify the actions required and entities involved.

Reliability Benefits

The MIUP BA is intended to enhance the management of reliability in the UP. Specifically:

- Increase the granularity incorporated in both Bulk Electric System (BES) operations and planning activities by Wisconsin Electric, ATC (the transmission owner/operator) and MISO (the transmission system operator and reliability coordinator).
- Provide operational focus and simplify administration of processes utilized to preserve BES reliability.
- Create metering boundaries that will improve the abilities of MISO, ATC and Wisconsin Electric to clearly identify the actions required and entities involved.
- Enhance the ability of operators to respond to reliability emergencies in the UP.

The MPSC filed complaints at FERC regarding the creation of the MIUP LBA and the allocation of the SSR costs for the Presque Isle Power Plant in late 2014.

Agreement Reached on PIPP Retirement

“Just as before, the new plant to replace [Presque Isle Power Plant] will be constructed no later than 2020, and will be supported by a series of business agreements”

“We look forward to working with legislative partners and the utilities to further cement Michigan’s energy independence, by enabling the creation of Michigan-only utilities when that is in the ratepayers’ best interest.” Press Release

UMERC Reciprocating Internal Combustion Engines (RICE)

April 4, 2018

September 12, 2018

Total net generating capacity

- F.D. Kuester Generating Station: 128.1 MW
- A.J. Mihm Generating Station: 54.9 MW

http://www.uppermichiganenergy.com/generation/fdkuester-generating-station-photos.htm

Evolving UP Energy Future

April 1, 2019

New natural gas–fueled generating stations provide power to Upper Peninsula of Michigan, allowing retirement of Presque Isle Power Plant

Iron Mountain – WEC Energy Group's subsidiary, Upper Michigan Energy Resources (UMERC), began commercial operation of the A.J. Mihm Generating Station and the F.D. Kuester Generating Station in the Upper Peninsula of Michigan March 31. The new natural gas-powered generating stations replace the energy from the company's coal-fueled Presque Isle Power Plant that was retired the same day.

"The new generating stations are good for our customers, good for business and good for electric reliability throughout the U.P.," said Kevin Fletcher, president and chief executive officer of WEC Energy Group. "Closure of the Presque Isle Power Plant also helps achieve our goal of reducing carbon dioxide emissions by 40 percent, well ahead of our 2030 target."

Plans for this transition date back to 2015 when Michigan Gov. Rick Snyder issued a call to action to solve the Upper Peninsula's energy crisis. WEC Energy Group answered that call and developed a reliable, affordable and clean energy solution.

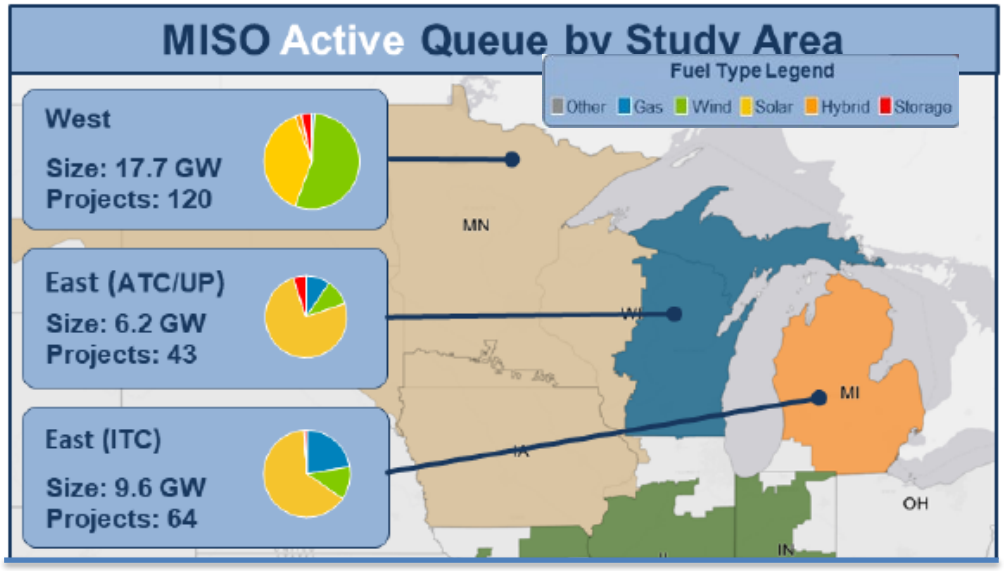
http://www.uppermichiganenergy.com/news/umerc-news-release-20190401.htm

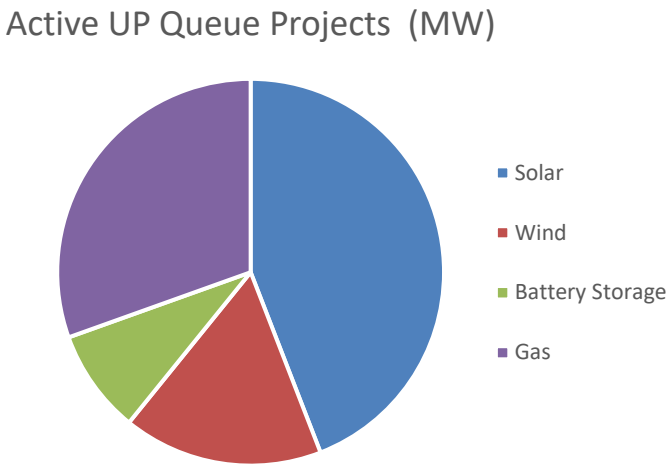
Approved IRPs

- UPPCO
  - 125 MW Solar PPA
  - Increased EWR to 1.65% in 2020 and 1.75% in 2021
- UMERC
  - New RICE units were already under construction
  - Required to file next IRP in two years
- NSP (Xcel)
  - Investigating increasing EWR to 1.5%

Notable Cooperative Plans: Cloverland investigating new gas units in Eastern UP due to added risk from damaged Straits cable.

MISO Interconnection Queue





Project #	Request Status	Queue Date	County	Summer MW	Fuel	Generating Facility
J1183	Active	3/12/2018	Delta County	1.35	Solar	PV Photovoltaic
J1244	Active	4/29/2019	Houghton County	38.4	Wind	WT Wind Turbine
J1251	Active	4/29/2019	Marquette County	100	Solar	PV Photovoltaic
J1252	Active	4/29/2019	Marquette County	20	Battery Storage	BS Battery Storage
J1264	Active	4/29/2019	Schoolcraft County	20	Gas	CT Combustion Turbine (Simple Cycle)
J1370	Active	4/29/2019	Chippewa County	50	Gas	CT Combustion Turbine (Simple Cycle)

Eastern UP Transmission Expansion Study

Request

- On August 17, 2016, Governor Snyder and the Michigan Agency for Energy (MAE) requested MISO to conduct an informational study to help Michigan understand the potential cost savings, reliability, and resource adequacy benefits of transmission and generation expansion in Michigan.
- The specific request was for MISO conduct an exploratory study to evaluate transmission expansion between the Upper Peninsula of Michigan and Ontario, as well as to Lower Michigan. MISO also received a request from MAE and the Michigan Public Service Commission to study two generation scenarios one in Kalkaska (Lower Peninsula) and one in Pine River (Upper Peninsula).

Results

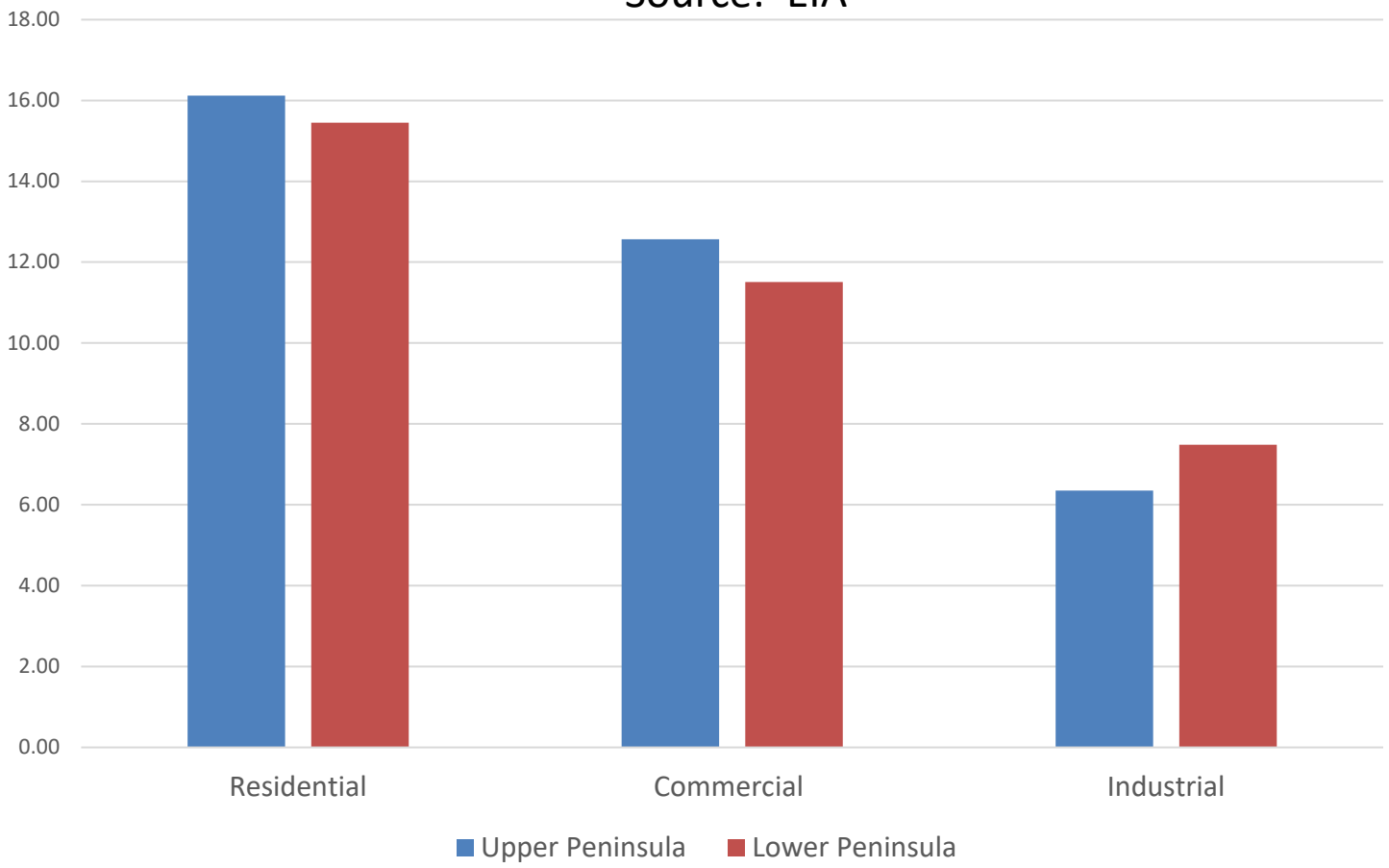
- Currently there's no transmission connection between Ontario and the UP. The study indicated that with a new intertie, 125 MW can be transferred between Ontario and the UP. Significant reliability upgrades would be needed on both systems to increase that transfer capability.
- With limited transfer capability and relatively high construction cost, none of the transmission ideas provided enough benefit to cover costs. A generator sited in the UP provides comparable benefit to transmission ideas but still not provide high enough benefit to outweigh its cost.
- Additionally, the intertie between Ontario and the UP did not have any impact to the Local Reliability Requirement or the Capacity Import Limit for Zones 2 and 7.

Michigan Retail Electricity Rates

2018 Average Retail Rate

by Customer Class (cents/kWh)

Source: EIA



Upper Peninsula Residential Rates

2018 Utility Bundled Retail Sales- Residential

(Data from forms EIA-861- schedules 4A & 4D and EIA-861S)

Electric Provider	Customers (Count)	2018 Sales (MWh)	2018 Average Price (cents/kWh)
Bayfield Electric Coop, Inc	67	174	30.06
Upper Peninsula Power Company	52,250	254,899	21.77
Alger-Delta Coop Electric Assn	9,507	49,287	20.61
City of Marquette - (MI)	14,924	96,470	17.27
City of Negaunee	1,959	11,296	17.22
City of Crystal Falls	1,336	7,744	15.81
City of Norway	1,843	13,660	15.04
Upper Michigan Energy Resources Corp.	32,763	234,233	14.51
Village of L'Anse - (MI)	987	4,879	13.62
City of Gladstone	2,521	16,570	13.42
Village of Baraga - (MI)	540	2,851	13.19
Cloverland Electric Co-op	34,383	278,697	12.73
City of Escanaba	6,035	36,105	12.12
Northern States Power Co	7,599	58,262	11.95

Source: EIA

UP Commercial and Industrial Rates

Source: EIA

2018 Utility Bundled Retail Sales- Commercial

(Data from forms EIA-861- schedules 4A & 4D and EIA-861S)

Entity	Customers (Count)	Sales (MWh)	Average Price (cents/kWh)
Alger-Delta Coop Electric Assn	539	13,795	15.95
City of Marquette - (MI)	2,168	190,888	15.67
Upper Peninsula Power Company	6,093	152,939	14.75
City of Crystal Falls	271	8,558	14.52
Upper Michigan Energy Resources Corp.	3,970	130,029	13.74
City of Norway	250	9,924	13.37
City of Negaunee	261	10,201	13.12
City of Gladstone	347	14,906	12.16
Village of L'Anse - (MI)	196	7,227	12.06
Northern States Power Co	1,344	52,017	10.83
Cloverland Electric Co-op	8,053	295,206	10.62
Cherryland Electric Coop Inc	2,764	124,139	9.69
City of Escanaba	1,159	43,813	9.60

2018 Utility Bundled Retail Sales- Industrial

(Data from forms EIA-861- schedules 4A & 4D and EIA-861S)

Entity	Customers (Count)	Sales (MWh)	Average Price (cents/kWh)
Alger-Delta Coop Electric Assn	1	14,218	17.49
Cloverland Electric Co-op	8	145,469	8.22
City of Escanaba	41	56,407	8.14
Upper Michigan Energy Resources Corp.	31	258,875	6.52
Northern States Power Co	2	30,246	6.30
Wisconsin Electric Power Co	1	1,254,338	6.21
Upper Peninsula Power Company	34	320,443	5.15

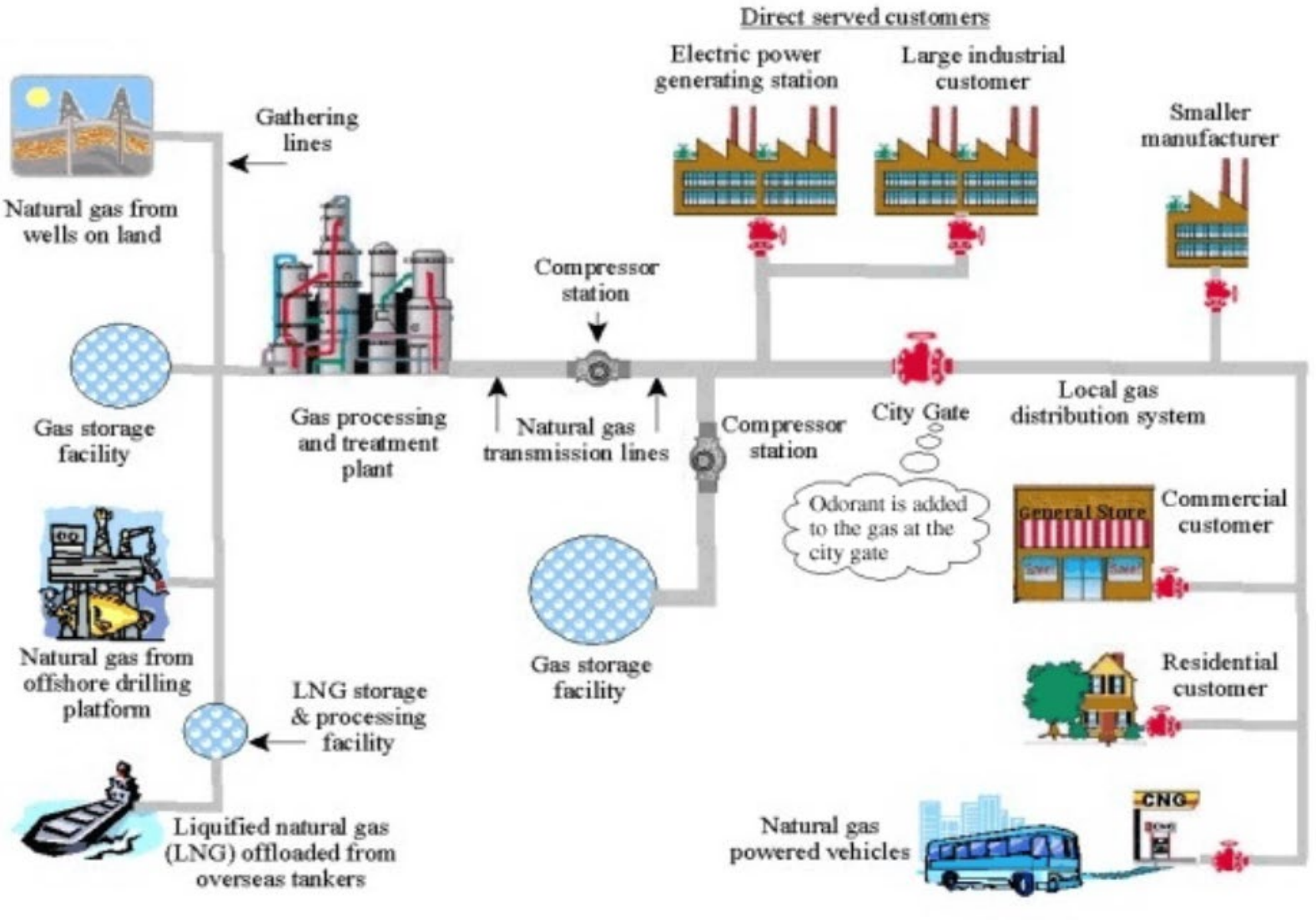
Electricity Issues

- Unprecedented number of coal plants retiring with shift to cleaner energy sources such as natural gas, wind, solar, and energy efficiency (energy waste reduction)
- Aging electric distribution equipment with upgrades in billions of dollars
- Marginal cost of new sources (except nuclear and coal) cheaper than existing generation supplies (incremental costs < embedded costs)
  - Combined with rate increases associated with infrastructure investment and stagnant growth in demand, this can challenge regulatory model by customers wanting to bypass the utility system
- Consumer interest in renewable energy, generating their own electricity
- Move to electrification – heating, transportation

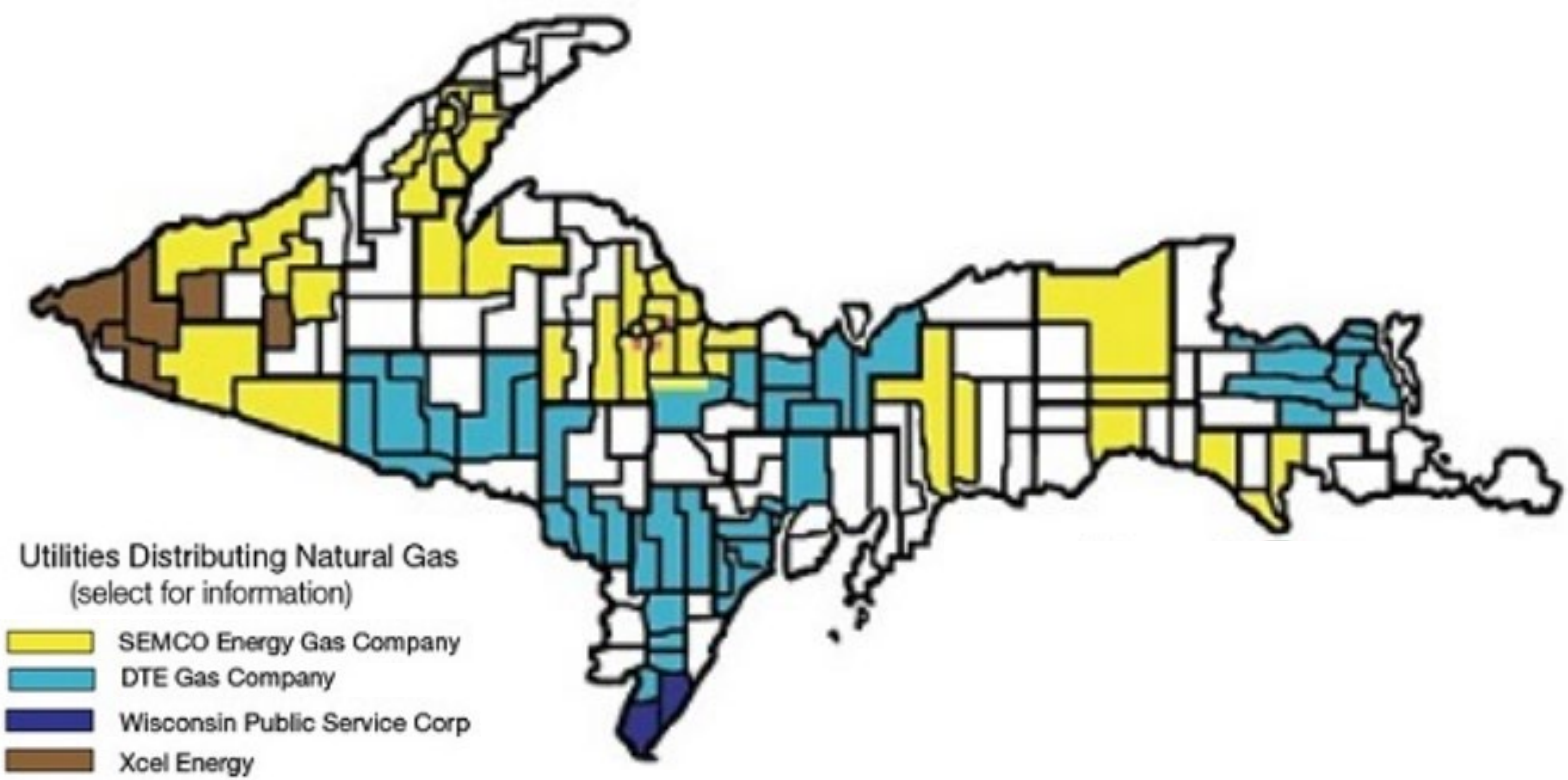
Electricity Proceedings

- Rate cases
- Power supply cost recovery plan and reconciliations (annual)
- Renewable energy plan and reconciliations (annual)
- Energy waste reduction plan and reconciliations (annual)
- Integrated resource plans (at least every 5 years)
- Depreciation
- Capacity demonstration/state reliability mechanism
- Electric choice
- Tariffs
- Alternative electric supplier licensing
- Securitization (as applicable)
- Mergers and acquisitions (as applicable)

Natural Gas Distribution System



UP Natural Gas Distribution Utilities



UP Electricity Delivery Systems

Questions?

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