Generation Resiliency Project

Presentation of Findings and Recommendations

To

City Council, City of Manitowoc

May 18, 2020

Prepared by

Manitowoc Public Utilities

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BLACK & VEATCH

Outline of Presentation

- Introduction
- Overview of the Existing System
- Generation Resiliency Options
- Electric Distribution System Energized (Resiliency)
- Conclusions of the Studies
- Project Financing
- MPU Commission Recommendations
- Questions/Discussion

Team Members

Manitowoc Public Utilities

- MPU Staff
  - Nilaksh Kothari: CEO & General Manager
  - Cindy Carter: Senior Manager - Business Services
  - Don Duenkel: Senior Manager – Utility Operations
  - Andy Onesti: Senior Manager – Technical Services

- Consultants
  - Dick Sterken: Black & Veatch
  - Marcus Chandrapal: Black & Veatch
  - Mike Borgstadt: Burns & McDonnell
  - Dave Seitz.: TRC Consulting
  - Larry Becker: Frontier Consulting

OVERVIEW OF EXISTING SYSTEM

- Vision/Goals/Strategic Focus of MPU
- Facts in Brief
- Sources of Capacity
- ATC/MPU Transmission Interconnections
- Electric Industry Changes and Challenges
- Summary of Existing System

Vision/Goals/Strategic Focus of MPU

Manitowoc Public Utilities

MISSION

MPU is committed to be the trusted primary resource for providing customer-focused utility services.

VISION

To be a thriving and innovative regional utility service provider that exceeds customer expectations.

Strategic Focus of Electric Utility

Goal

- Maintain best in class operations and focus on continuous improvement to provide safe, reliable, and efficient utility services.

Objective

- Implement improvements of electric facilities to increase reliability (resiliency) and customer classification.

Facts in Brief-2019

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- Annual Energy Sales: 518,927 MWH (retail)
  133,206 MWH (wholesale)
- Annual Steam Sales 210,000 klbs
- Annual Peak Demand 99.6 MW
- Electric Substations
  - Lakefront
  - Dewey Street
  - **Custer Street**
  - Northeast
  - **Rapids**
  - Revere Street
  - **Mirro (Supplies Skana only)**
- Distribution System
  - 250 Miles Overhead and Underground Wires
  - 13,200 Volts and 4,160 Volts (limited to a portion of downtown)
- Retail Electric Utility Revenues $ 41 million

Sources of Capacity (2004 versus 2020)

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Sources of Capacity -	**2004**	**2020**
– Steam Generating Plant	70.0 MW	77.0 MW
– **Diesel**	11.0 MW	0.0 MW
– Combustion Turbine (Gas)	22.0 MW	22.0 MW
– Market Purchases	20.0 MW	10.0 MW
Age of Facilities / Capacity		
– Boiler #5	50 Years / 15.0 MW	**Retired**
– Boiler #6	46 Years / 17.5 MW	**Retired**
– Boiler #7	38 Years / 17.5 MW	**Retired**
– Boiler #8	14 Years / 21.0 MW	30 Years / 21.0 MW
– Boiler #9	---	16 Years / 63.4 MW
– **Diesel**	11.0 MW	**Retired**
– Combustion Turbine (Refurbished)	22.0 MW	41 Years / 22.0 MW
– Steam Turbine Generator #2	---	**Retired**
– Steam Turbine Generator #3	---	**Retired**
– Steam Turbine Generator #4	51 Years	**Retired**
– Steam Turbine Generator #5	46 Years	62 Years
– Steam Turbine Generator #6	38 Years	Retired in-place
– Steam Turbine Generator #9	---	16 Years

Note: Diesel units used to start Boilers 5, 6, 7 & 8 in the event of a transmission system outage.

ATC Transmission / MPU Interconnection

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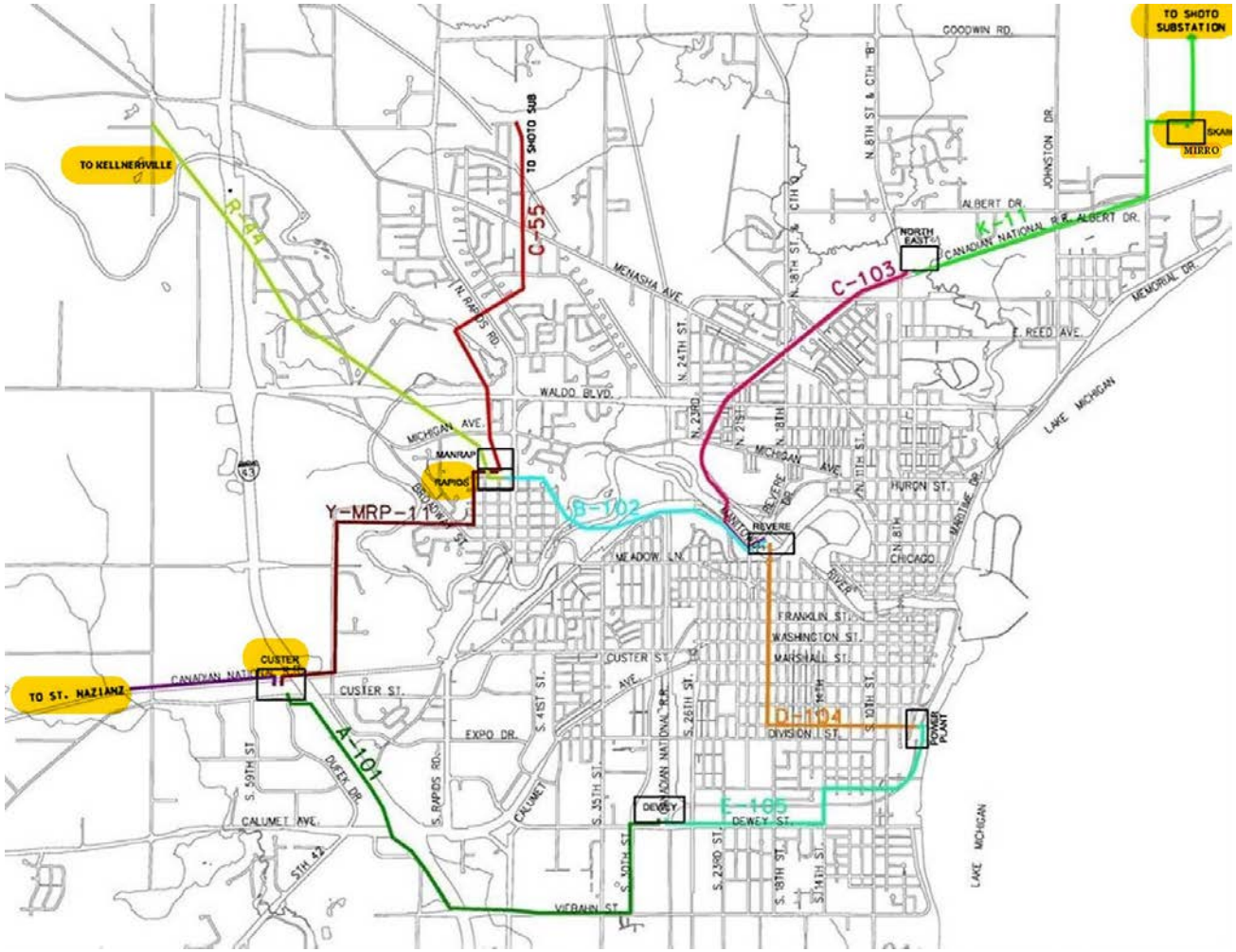

Three Interconnections

- Shoto substation on Hwy 310 to Mirro
- Kellnersville to Rapids Road
- St. Nazianz to Custer Street

Electric Industry Changes & Challenges

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- In the last decade dramatic changes in electric industry:
  - More wind and solar generation, i.e. intermittent power generation
  - Several nuclear and fossil fuel (coal) power plants shut down
  - New base load generation is almost exclusively using natural gas
- Other challenges include:
  - Boilers 8 & 9 dependent on transmission power to start up & operate
  - Climate change risks more natural disasters like tornados, flooding, etc.
  - Increase in cyber attacks
  - Distributed generation
  - Battery storage
  - Electric Vehicles
- All of the above increase risks:
  - Instability and reliability of transmission grid

A Major Transmission Failure – City Area With Power

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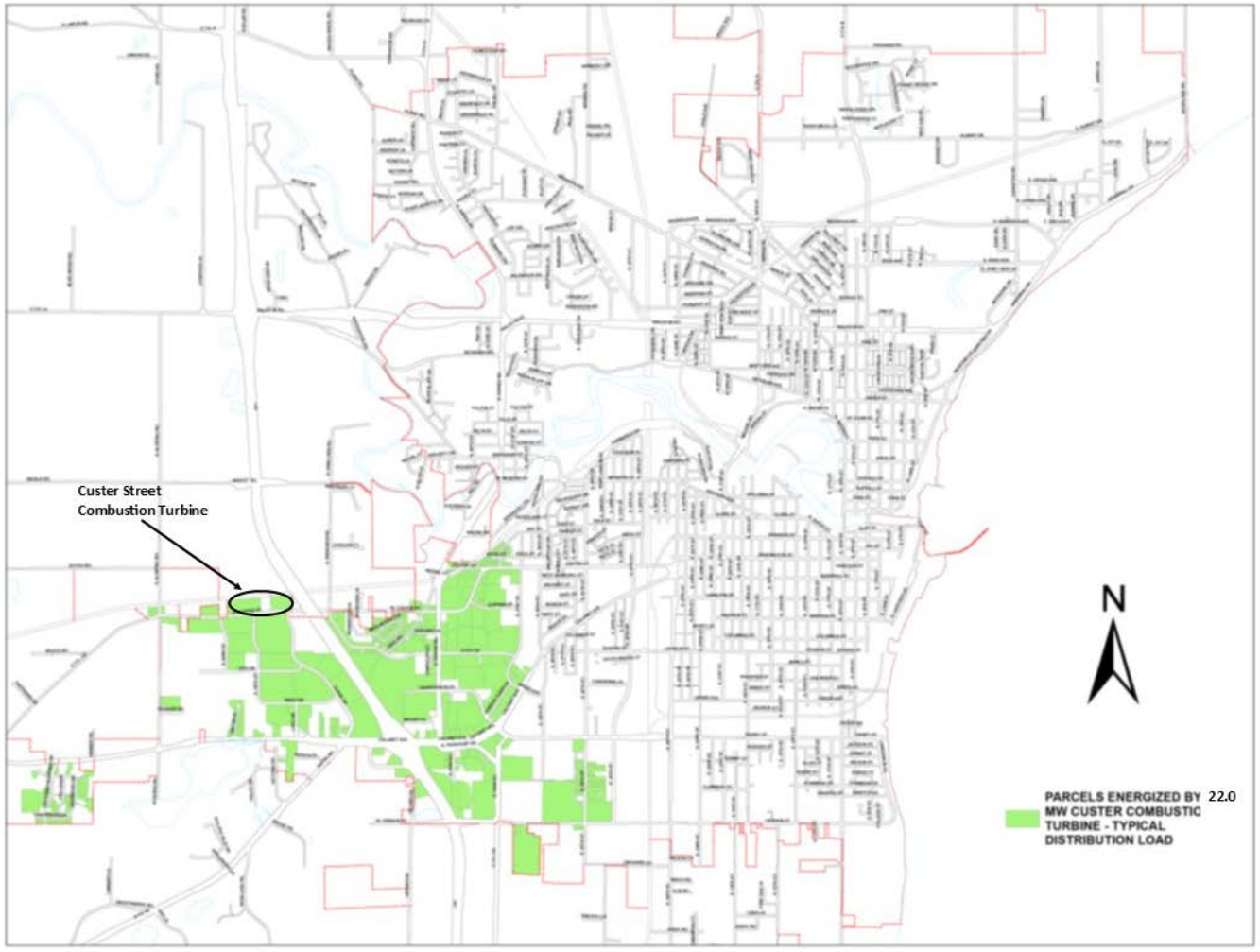


Summary – Existing Condition

- MPU historically has added and removed generating assets for more than 100 years depending on the needs and life of the equipment
- There are three interconnections between ATC & MPU
- In the last decade dramatic changes in electric industry with i.e. intermittent power generation such as wind and solar has potentially resulted in:
  - A decrease in stability and reliability of transmission grid
  - MPU's inability to start boilers and provide power to city
- MPU Commission concerned on the consequences of a major transmission system failure which include:
  - MPU has no back-up power to start boilers 8 and 9
  - Loss of water pressure may cause boil water advisory
  - Loss of Wastewater Treatment and Lift Stations
  - General concern of public health and safety
- August 2003 black out in eastern U.S. and Canada lasted more than 5 days

GENERATION RESILIENCY

- Summary of Planning and Engineering Studies
- Risk Assessment Findings
- Options Evaluated
- Costs
- Summary of Studies

Burns & McDonnell Study - 2013

- MPU Commission authorized multiple studies from 2013- 2019
- Burns & McDonnell retained to perform a Condition Assessment of Power Generation Facilities.
- Conclusions of the Study:
  - Confirmed Boiler 8 and 9 need power supply within 15 – 30 minutes to avoid plugging loop seal. Unplugging the loop seal may take several days.
  - Diesel #2 not adequate to start Boiler 8 or Boiler 9 and keeping it operational long term not feasible
  - Infrastructure is not in place to use the Custer CT to start Boiler 8 or Boiler 9
  - New fast start generation is best option to start Boiler 8 or 9

Black & Veatch Study – 2015-2016

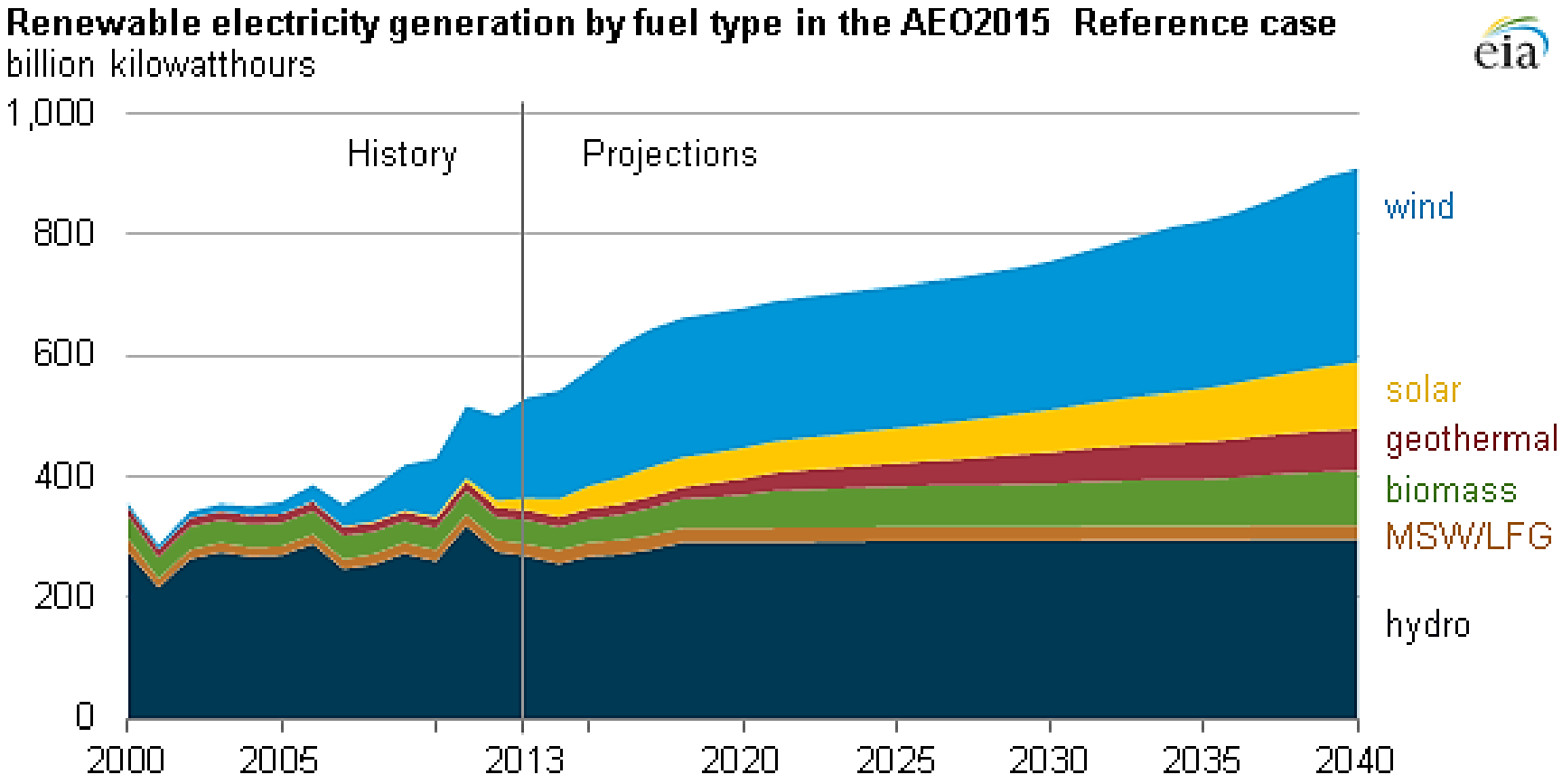
- Black & Veatch retained in 2015 to follow up on conclusions of previous study.

- Objectives of the Study:
  - Conduct high level risk assessment of disasters
  - Confirm the size of the generating unit required to start boiler(s)
  - Assess technologies for the new generating unit
  - Cost estimates of the proposed options
  - Present findings to MPU Commission

RISK ASSESSMENT

- Renewable Resources
- Natural & Man-Made Disasters
- Summary

RENEWABLE ENERGY GROWTH – RISK AREAS



Source: U.S. Energy Information Administration (April 2015).

IMPACTS OF RENEWABLE ENERGY

- Renewable targets of 30-50% in some states are likely to be problematic for transmission grid stability.
- Most of the renewable growth is from non-dispatchable sources (Wind and Solar)
- Because they are non-dispatchable these sources supplement base load generation (hydro, natural/gas, nuclear, and coal)
- Grid instability increases.

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RISK ASSESSMENT

- **Natural Disasters**
  - Tornado
  - Intense Wind Storm
  - Floods
  - Blizzard / Ice Storms
  - Lightning Strike
- **Man-made Disasters**
  - Cyber Attack
  - Fire at Power Plant
  - Chlorine gas leak
  - Human Failure

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SUMMARY OF DISASTERS

Following are MPU vulnerabilities from disasters

- A tornado or intense wind storm can knock out transmission system
- An ice storm can knock out above ground transmission system
- A cyber attach may or may not impact transmission or generation at MPU
- A lightning strike will most likely result in loss of generation
- A chlorine gas leak should not cause loss of power

SUMMARY OF RISK ASSESSMENT

- MPU is dependent upon the grid for restoration of power to Boilers 8 & 9
- Renewable energy resources has resulted in grid instability
- Impacts of an extended outage can be severe
  - J-valve solidification disabling boilers for 3 to 5 days
  - Customer Health and Safety (Loss of power for food refrigeration, normal health care services, traffic control normal police services etc.)
  - Loss of Water Distribution System Pressure
- *City of Manitowoc, as confirmed by County, does not have enough shelter facilities with back-up power generation.*

Generation Reliability Enhancement

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- ATC meeting September 22, 2016:
  - Cannot guarantee power into Manitowoc in 30 minutes or less
  - Confirm funding is not available for ATC/MISO for a fast start unit for MPU
  - ATC will allow MPU distribution system to be isolated from transmission grid with approval

- MPU needs to provide power to City of Manitowoc without ATC transmission line loop around the city.

OPTIONS ASSESSED

- Various Technologies Assessed
- Various Sites Assessed
- Cost Estimates at Alternative Sites

Options Assessed

- Following technologies were assessed:
  - Single Combustion Turbine (CT)
  - Single Reciprocating Internal Combustion Engine (RICE)
  - Multiple Reciprocating Engines
  - Express sub-transmission line from Custer CT to Columbus Street Power Plant

- Following sites were assessed:
  - Columbus Street near Power Plant
  - Lakefront across from WWTP
  - District Heat Site on South 7th Street

Cost Estimates of Options

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	CAPITAL COST	NPV
1 – Existing Columbus Street Plant	$16,990,000	($6,299,262)
2a – Lakefront Location #1 OH TL	$35,796,411	($26,630,269)
2b – Lakefront Location #1 UG TL	$36,282,560	($27,155,821)
3a – Downtown District Heat OH TL	$35,105,944	($25,883,826)
3b – Downtown District Heat UG TL	$35,430,044	($26,234,202)
4a – 8th St. Substation OH TL	$34,460,717	($25,186,293)
4b – 8th St. Substation UG TL	$34,703,792	($25,449,069)
5a – Custer to Columbus AG T-Line	$6,812,960	($7,365,274)
5b – Custer to Columbus UG T-Line	$9,045,280	($9,778,558)

Conclusions of the Study

- Columbus Street generation plant is important for local electricity reliability and a part of a system that people need and depend on 24/7.
- MPU is dependent upon the grid for restoration of power.
- Impacts of an extended outage can be severe.
- New generation to start boilers 8 & 9 is required when transmission service to the MPU territory is lost.
- 10-12 MW generator to start B9 with ID fan, PA fan, and Feed pumps with soft-start conversion.
- 8 MW generator needed for restart of Boiler 8.
- The various technologies and sites were evaluated.
- Benefit of supplementary power generating capacity – Water Plant & CBCWA water delivery; avoidance of capacity market purchases.

Conclusions of the Study – (Cont'd)

- Plant upgrades for island operation (micro-grid) include Generator 5 Excitation and Governor, Turbine 9 Governor, and Plant Tie Transformer Relaying
- A diesel and/or natural gas Reciprocating Internal Combustion Engine (RICE) will be the low cost option
- The estimated construction cost depending on technology varies from $ 17 to $35 million
- Custer Street (CT) express line to Power Plant does not have the lowest Net Present Value.
- Issues to be addressed: cost, emissions, permitting issues.

Black and Veatch Study – 2018

- October 2018 – Objectives of the Study
  - Assess the two selected RICE options:
    - Gray Market Wärtsilä Model 12V50DF: 1 unit, in new building
    - New Jenbacher JGC 620: 4 units, containerized
  - Locate either option at south end of Columbus Street Power Plant
  - Perform a detailed construction cost estimate
  - Perform a 20 year Net Present Value analysis of the two options
  - List Pros and Cons of each option

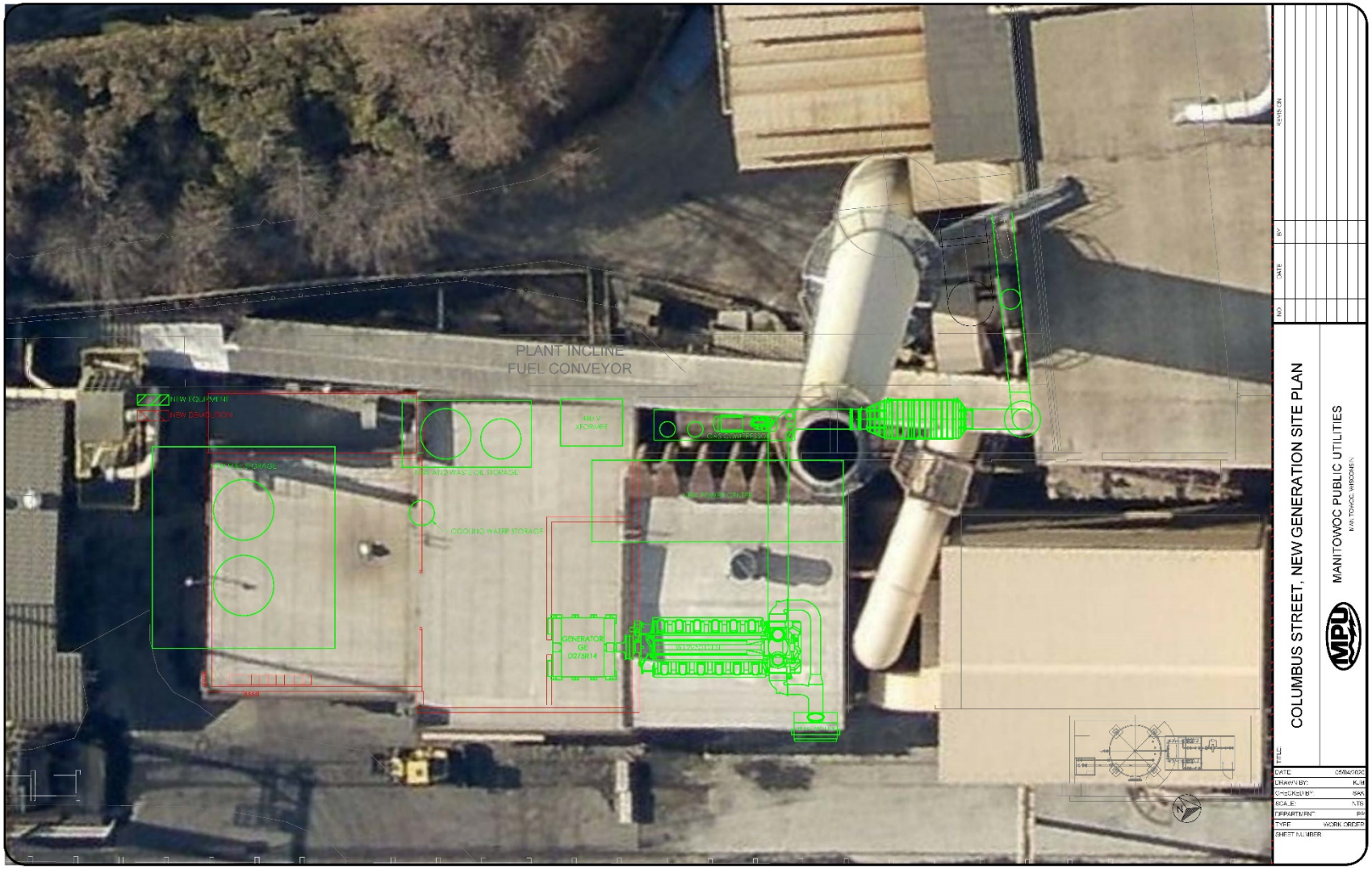
CAPITAL COSTS OF TWO SELECTED ALTERNATIVES

CAPITAL COST ESTIMATE SUMMARY		
ITEM DESCRIPTION	OPTION 1: WÄRTSILÄ TOTAL COST	OPTION 2: JENBACHER TOTAL COST
Civil/Structural	$ 1,401,693	$ 836,726
Mechanical/Piping	$ 8,501,838	$ 12,274,202
Electrical/Controls	$ 1,129,170	$ 1,417,242
Direct Total	**$ 11,032,701**	**$ 14,528,170**
Indirects		
Engineering	$ 1,560,000	$ 1,950,000
Construction Management	$ 551,635	$ 726,408
Start-up & Commissioning	$ 257,400	$ 400,400
Subtotal	**$ 13,401,736**	**$ 17,604,978**
Contingency	$ 1,340,264	$ 1,760,322
Grand Total	**$ 14,742,000**	**$ 19,365,300**

GENERATION OPTIONS SUMMARY

Option	Capital Cost	NPV	Advantages/Disadvantages
1 – One Wärtsilä Model 12V50DF – unused and Gray Market	$14,742,000.00	($13,067,000)	Advantages: • Lower NPV • Higher thermal efficiency: less fuel, lower operating cost • Full generation capacity on both primary and secondary fuel Disadvantages: • Requires an SCR
2 – Four Jenbacher JGC 620	$19,365,300.00	($14,232,000)	Advantages: • May not require an SCR • Start-up time will be less for the smaller gensets Disadvantages: • Derate on secondary fuel: 6.86MW at full capacity on propane

SITE LOCATION



Additional Project Cost Estimates

- Additional improvements needed at the Power Plant:
  - Steam By-Pass for B8 & B9 and other plant modifications required for Black Start = $1,833,000
  - New 13.8kV and 480V Black Start buses = $850,000
  - Equipment only cost for New Soft Starters on B9 ID & PA fan, B8 FD fan = $353,000
  - Allowance for demo/modifications to existing plant for VFD space and cable removal = $50,000
  - Indirect Costs (Contingency, Engineering) = $1,389,000

- TOTAL ESTIMATED COSTS = $4,475,000 - $5,200,000

Conclusions of Resiliency Generation

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- Generation with Gray Market Wärtsilä of 11.3 MW is the preferred option – lowest NPV.
- Wärtsilä provides a dual fuel option - natural gas and diesel fuel.
- The estimated construction cost is approximately $15 million.
- The generating unit will meet the following objectives:
  - Boiler 8 and 9 can continue to operate if dispatched
  - Following facilities will have power within 2 hours:
    - Water Treatment Plant/Wastewater Treatment Plant
    - City Fire and Police
    - County Jail & Dispatch Center
- Additional modifications required at the Power Plant for $5.0 million.
- Total project cost estimated at $20 million.

ELECTRIC DISTRIBUTION SYSTEM ENERGIZED/RESILIENCY

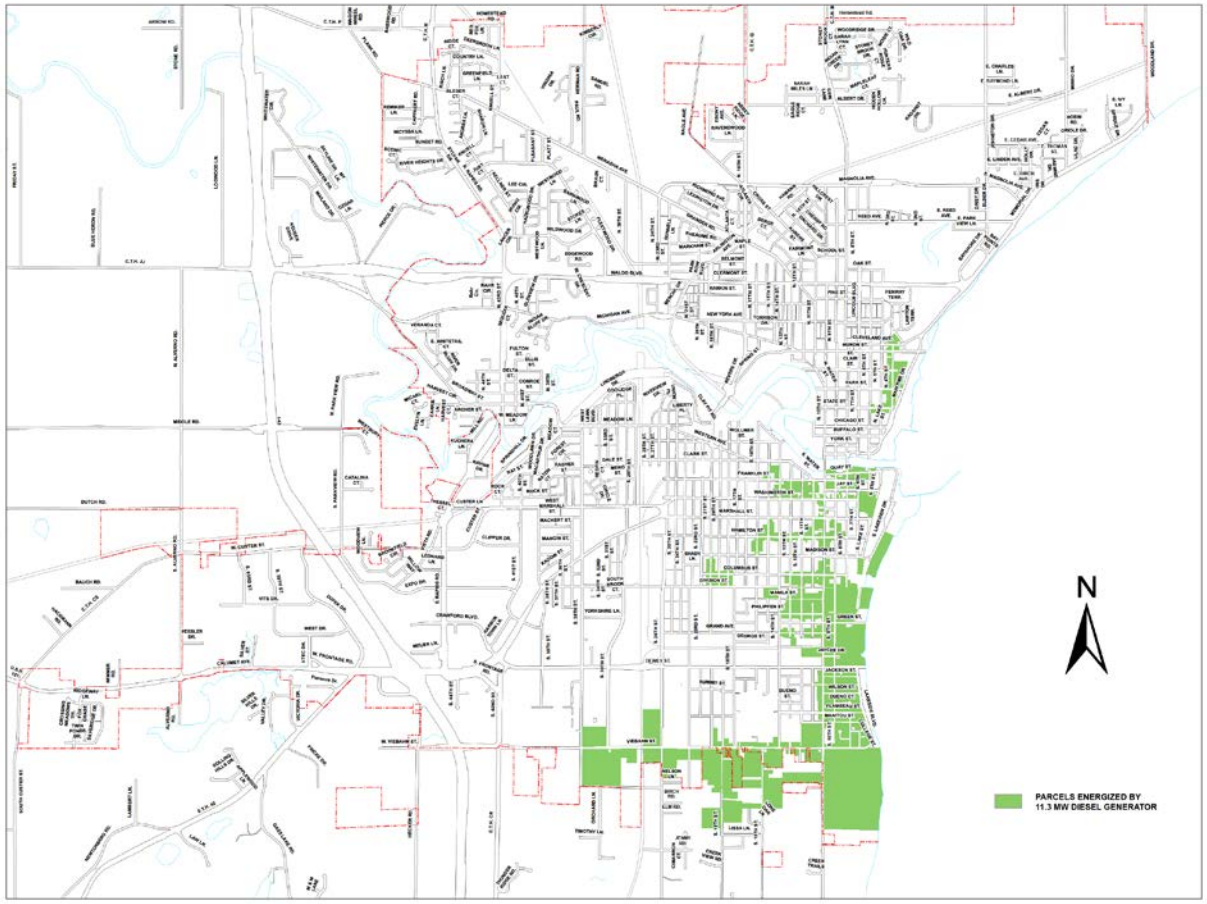
- Objectives
- City Areas Energized
- Summary

Objectives

- Since 1963-64 MPU distribution has been connected to the regional electric transmission system
- Identify what areas of the City can and cannot served in the event of a transmission system outage
- Identify areas that can be served based on availability of different generation resources
- Identify any areas of the City that cannot be served without the transmission system even if most generation is available

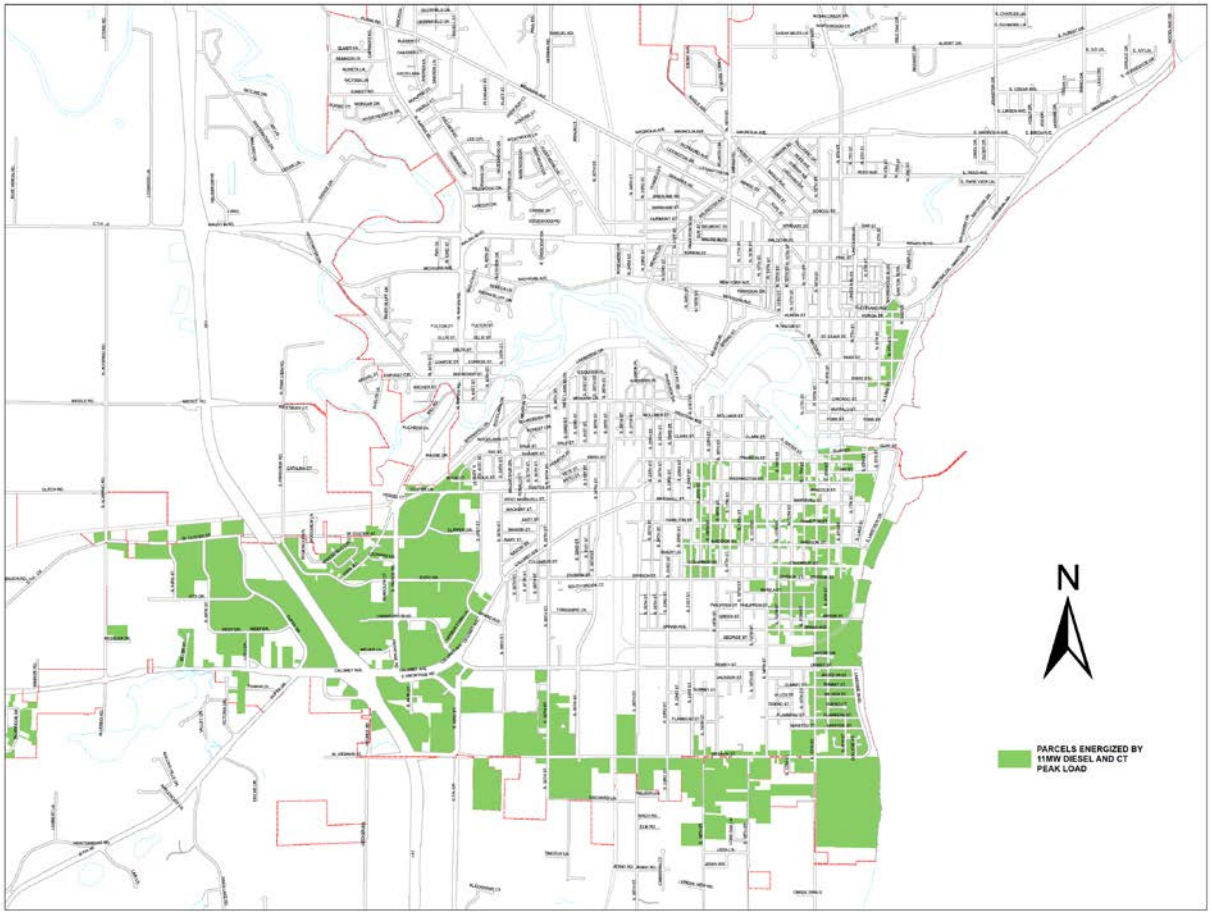
City Areas – Energized

- 11.3 MW (RICE) Generation only operating



City Areas – Energized (Cont'd)

- RICE + Custer CT



City Areas – Energized (Cont'd)

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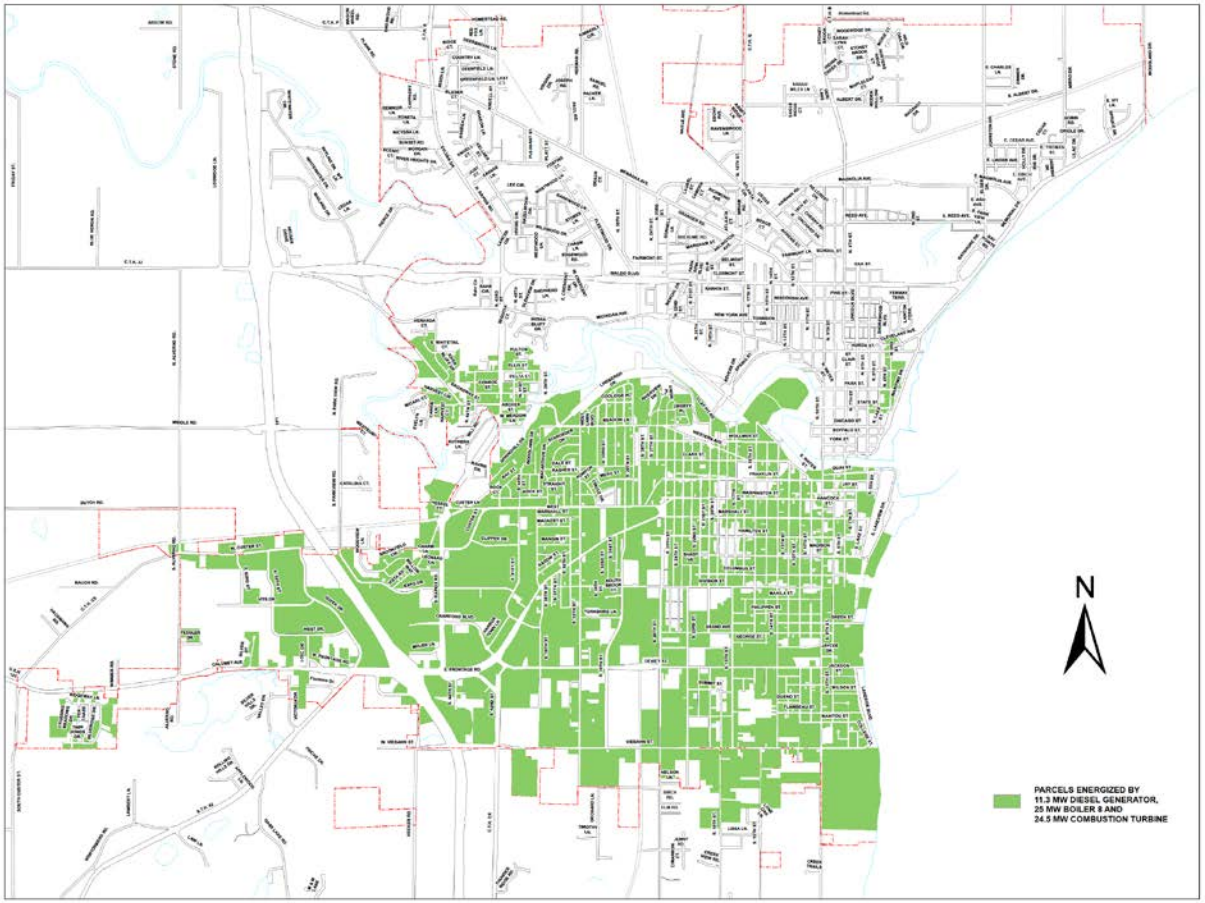
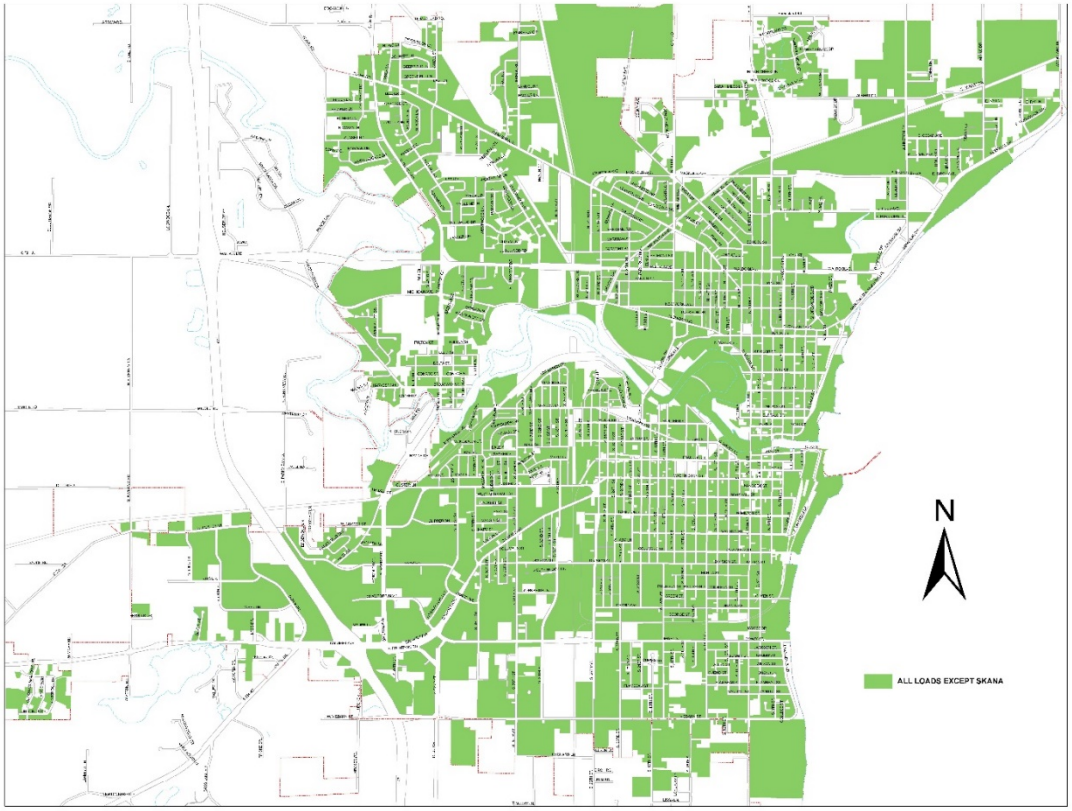
- RICE + B8/B9 + Custer CT



City Areas – Energized (Cont'd)

- RICE + CT + B8/B9 + SUBTRANSMISSION EXPRESS LINE
- No Power to SKANA



Summary – Distribution Resiliency

- A large portion of City can be energized without 69 kV transmission line with MPU electric distribution system intact.
- A sub-transmission line will be required from Power Plant Substation to Revere Substation at an estimated cost of $2 million with contingency to energize the NE part of the City, except SKANA.
- The objective is to first power those facilities that are important to health and safety within 2-4 hours of a major power outage.
- The remainder of City will have power within 16-24 hours of a major power outage.

CONCLUSIONS OF THE STUDY

Conclusions of the Study

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- Fast Start Generating Capability of 11.3 MW at Columbus Street Plant provides:
  - Ability to power large portion of City without 69 KV
  - Maintain Steam Customers
  - Ability to operate Water and Waste Water Facilities
  - Support Customer Health and Safety
  - Protect Power Plant Assets
- Wärtsilä Engine from Tote are apparent best option:
  - Lowest NPV
  - Ability to provide full power on secondary fuel (function in the event of a Natural Gas outage)
- A sub-transmission line from Power Plant to Revere Substation
- The total project cost for resiliency of generation and electric distribution is estimated at $22 million.

PROJECT FINANCING

- Project Financing
- Rate Impact

Project Financing

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- The project has been in planning since 2013
- The project is expected to be operational in Fall 2022 or Spring 2023.
- The total project cost is not to exceed $22 million which includes:
  - An 11.3 MW Wartsila engine generation - $15 million
  - Modifications at the Power Plant - $5 million
  - A subtransmission line from Lakefront Substation to Revere Substation - $2 million
- No borrowing is required for the project as MPU Commission has been planning for this major capital improvement

Rate Impact

- History of Rate Adjustments
  - May 2009: -4.0%
  - July 2014: -2.0%
  - October 2016: -3.5%
  - May 2020: -5.5%

- The projected rate increase in 2023 is between 0.0% - 3.0% depending on the following:
  - Energy prices in the market
  - Capacity price offset from market purchase

- MPU payment of PILOT to City increases by approximately $350,000 in 2023 annually.

MPU COMMISSION RECOMMENDATION TO CITY COUNCIL

Action Plan

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- The 11.3 MW boiler project will take 24-36 months, depending on the time it takes to obtain PSC and DNR permits
- Steps to be taken during the next 12 months include:
  - Submit filings with PSCW and WDNR to support construction of the project
  - Evaluate quotations received and negotiate contracts contingent on PSC/DNR approval
  - File a MISO/ATC generation-transmission interconnect agreement and obtain approval
  - Complete detailed engineering and bid the project

MPU Commission Recommendation

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- MPU Commission unanimously approved proceeding with the expansion of the local generating facility with 11.3 MW boiler project.

- MPU Commission is recommending that the Finance Committee and City Council approve the project for up to $22 million for resiliency of generation and electric distribution system.

QUESTIONS/DISCUSSION