Meeting Minnesota Energy Efficiency Requirements with Utility Infrastructure Projects

Minnkota Power
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Your Touchstone Energy® Partner

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Today’s Objectives

- Increase awareness and understanding of Minnesota’s energy-saving goals
- Add energy efficiency tools to our design toolbox
- Spur creative system planning and design solutions which consider efficiency and regulations
Minnesota CIP Overview
Say What???

- CIP
  - Conservation Improvement Program
  - NOT Critical Infrastructure Protection
- Electric Utility Infrastructure Project
  - Commonly referred to as EUI, UIP, or Supply Side projects
Why Conservation in MN?

- MN has no native fossil fuel resources\(^1\)
Why Conservation in MN?

- MN has no native fossil fuel resources\(^1\)
- Renewable resources remote from population centers
NREL MN Wind and Solar Resource Maps

Wind Speed
m/s

- >10.5
- 10.0
- 9.5
- 9.0
- 8.5
- 8.0
- 7.5
- 7.0
- 6.5
- 6.0
- 5.5
- 5.0
- 4.5
- 4.0
- < 4.0

Model estimates of monthly average daily total radiation, averaged from hourly estimates of direct normal irradiance over 8 years (1998-2005). The model inputs are hourly visible irradiance from the G(0)(3) geostationary satellites, and monthly average period of optical depth, precipitable water vapor, and ozone sampled at a 10km resolution.
Why Conservation in MN?

- MN has no native fossil fuel resources\(^1\)
- Renewable resources remote from population centers
- MN Energy Savings Policy Goal\(^2,3\)
  - Energy savings are an energy resource
  - Reduce utility costs/increased profitability for businesses and residents
  - Deferred utility infrastructure investments
  - Reduce fuel consumption and import costs
  - Reduce emissions
MN CIP Overview

- Established by the Next Generation Energy Act of 2007
- MN State Statutes
  - Utilities must spend 1.5% of gross operating revenue from MN customers
    - 2% for Xcel
  - Expenditure reporting is to “ensure that ratepayer dollars are used cost-effectively and that energy savings are measurable and verifiable”
Goal: Use expenditures to create 1.5% annual energy-savings of gross annual retail energy sales

Excess savings may be carried forward for 3 years
How Does MN Rank Nationally?

Source: ACEEE 2015 State Energy Efficiency Scorecard
Base definition of Energy Conservation Improvement is limited to demand-side management.

BUT

Up to 0.5% of the 1.5% can be met with UIPs, including qualified infrastructure improvements to:
- Generation
- Transmission
- Distribution
- A utility’s own facilities

UIP costs do not count as CIP expenditures
Supply Side Projects

Supply Side specifics

- Must achieve at least 1% savings through end-use conservation before supply side savings can be used.

- “Must result in increased energy efficiency greater than that which would have occurred through normal maintenance activity”\(^5\)

- Only one year’s worth of energy savings can be counted from a project.

- Energy savings can be carried over for 5 years.

- Requires State approval for each UIP, preferably before the project goes in service.
Supply Side Projects

- Proposal content
  - Include both incremental cost and energy savings
- Cost
  - Incremental installation cost
  - NPV of energy savings (B/C ratio)
- Energy
  - Annual energy savings
  - Measure at full utilization
Our Challenge

- MN utilities must find ways to reduce energy consumption by 1.5% each year.
- Efficiency standards are tightening, resulting in less potential for energy savings\(^6\).
- Each year a utility meets their target makes it a little harder the next year.
  - Customer interest spectrum.
  - Conservation options are reduced with each successful implementation.
Our Opportunity

- Help foster MN energy independence and strengthen the economy
- UIPs reduce the long term G&T costs
- Efficient designs are usually more robust
- UIPs reduce burden on staff dedicated to the consumer end of energy efficiency
Our Opportunity

(continued)

- CIP credits can be a Value Added for supply side projects already in the works
- UIPs create energy conservation without reducing revenue
- Possible dual credit for CIP and Clean Power Plan compliance?
“Listen up! Use those big brains of yours to think your way around the problem! Look for a new angle!” (Walt Disney’s Big Hero 6)

Unleash creativity in problem solving

Identify optimal solutions which balance economics, reliability, resiliency, efficiency, regulations, and more
Identifying CIP Credits

- What does beyond “normal maintenance activity” look like?
  - Project acceleration
  - Alternative project
  - High efficiency equipment selection
  - Replacement in kind

- Identifying a qualifying project often requires creative thinking and careful construction of a proposal
Measurement Options

- Measurement options
  - Theoretical
  - Regional
  - Specifications

- UIPs which result in > 1 million kWh savings are subject to measurement and verification requirements

7
Creating Energy Savings

- Requires only foundational electrical theory

- Voltage = Current x Resistance \( (V = I\times R) \)

- Power = Current x Voltage \( (P = I\times V) \)

- Power Loss = Current\(^2\) x Resistance \( (P = I^2\times R) \)
Other Considerations

- Considerations
  - The planning and design phase of system changes is the optimal time to identify a UIP
  - Compare energy savings against the minimally adequate cost/reliability design
  - 1 year of acceleration yields the same CIP credit as an permanent design modification
Examples
Minnkota CIP UIP Proposals
Minnkota CIP Projects

- **Coyote Turbine Replacement**
  - Replacement of HP/IP turbine rotor in 2009 with a new rotor that was more efficient
  - New rotor generated an additional 17 MW of electric energy with the same steam flow and fuel burned
  - Annual energy savings of 18,764,000 kWh
  - Type: Replacement in kind
Center to Grand Forks Conductor Upgrade

Need: New transmission to bring power from the Young Station to Minnkota’s member cooperatives and to support reliability in the northern RRV

Solution: A new 345 kV line from Center to Prairie (Grand Forks)

Various conductors evaluated
Minnkota CIP Projects

- Center to Grand Forks Conductor Upgrade
  - Energy savings inputs (theoretical)
    - Conductor impedances, line length, unity voltage, expected cruise loading, power factor
  - Discount factors applied
    - Cruise loading * 90% load factor
  - Annual energy savings estimated at 19,895,000 kWh
  - Type: High efficiency equipment
Transformer Tap Optimization Project

Need: Mitigate undervoltage issues on the Coyote – Maple River 345 kV line

Alternative solution #1: Capacitors (localized voltage increase)

Alternative solution #2: Tap changes on the transformers along the line to raise the operating voltage (voltage increase along entire length of line)
Transformer Tap Optimization Project

- Carrying the same power at a higher voltage level reduces the current, which reduces energy loss

Energy savings inputs (regional)

- The improved efficiency caused increased power flow on the 345 kV line and off-loaded parallel paths
- Total change in power loss in the region was measured in study cases to create a best fit curve
- Average cruise loadings were obtained to calculate loss savings
Transformer Tap Optimization Project
- Created two types of energy savings
- Project acceleration
  - Changed the tap settings in advance of the need date
  - CIP credit of 8,720,000 kWh
- Project alternative
  - Superior loss performance to a capacitor
  - CIP credit of 6,244,000 kWh
Minnkota CIP Projects

- Summary of Approved MPC Projects
  - Total supply side savings of 53.6 million kWh
  - Covers over 6 years of MPC’s annual 0.5% limit
Submitted Proposal

- **Young 2 GSU**
  - Need: Aging GSU with no available spare
  - Solution: Buy and install a new GSU, keep the old GSU as a spare
  - RFP for GSU of same size and with increased capacity
  - Included assumed cost of energy in RFP to encourage efficient GSU specs
Submitted Proposal

- Young 2 GSU
  - Which option should be chosen for a CIP UIP proposal?
    1. Efficiency of old GSU vs. new GSU
       - “Normal maintenance activity” recommended a spare
    2. Efficiency gained from increasing GSU capacity
       - Larger capacity transformer had the same efficiency
    3. Efficiency from choice of more efficient, more expensive GSU
       - Minnkota’s approach
Submitted Proposal

- Young 2 GSU
  - Energy savings inputs (theoretical)
  - Excitation, load, and auxiliary power losses from RFP submissions
  - Discount factors applied
    - Full Load Losses * (avg plant availability) * (GSU avg MVA / GSU rated MVA)^2
    - Auxiliary losses * (avg plant availability) * (cooling equipment avg operating time)
  - Annual energy savings of 1,746,000 kWh
  - Type: High efficiency equipment
Future of MN CIP

- Increasing baseline efficiency requirements
- Potential energy saving goal increase to 2% – 2.5%
  - Possible change to credits for long term projects
  - Could include Combined Heat and Power
- State RFP to expand Technical Reference Manual to define standard UIP assumptions
Recap

- Increased understanding of CIP
- Benefits of improving efficiency
- Tools for creating efficiency
- Tools for meeting State requirements
- Examples of accepted UIP projects

Go engineer our future with your minds wide open!
Questions?
Thanks for your time!
References and Resources

1. Final Combined Heat and Power Action Plan, MN Department of Commerce
2. MN Statute 216B.2401 Energy Savings Policy Goal
3. MN Department of Commerce website
5. MN Statute 216B.241 Energy Conservation Improvement
9. NREL Renewable Energy Resource Maps
10. ACEEE 2015 State Energy Efficiency Scorecard