June 29, 2018

Daniel P. Wolf  
Executive Secretary  
Minnesota Public Utilities Commission  
121 7th Place East, Suite 350  
St. Paul, Minnesota  55101-2147

RE:  2020-2034 UPPER MIDWEST RESOURCE PLAN  
JUNE 26, 2018 WORKSHOP PRESENTATIONS  
DOCKET NO. E002/RP-15-21

Dear Mr. Wolf:

Northern States Power Company, doing business as Xcel Energy, submits to the Minnesota Public Utilities Commission the five presentations that were presented at the June 26, 2018, The Evolving Integrated Planning Process workshop, regarding our 2020-2034 Upper Midwest Integrated Resource Plan (IRP) to be filed with the Commission by February 1, 2019.

We have electronically filed this document with the Commission, and copies have been served on the parties on the attached service list. Please contact Pamela Gibbs at 612-330-2889 or pamela.k.gibbs@xcelenergy.com or Bria Shea at (612) 330-6064 or bria.e.shea@xcelenergy.com if you have any questions regarding this filing.

Sincerely,

/s/  
BRIA SHEA  
DIRECTOR, REGULATORY AND STRATEGIC ANALYSIS

Enclosures  
cc: Service list
Agenda

Welcome, IRP and Outreach Overview - Bria Shea
Energy and Carbon Summary - Nick Martin
Distribution Planning - Chris Punt
Break
Transmission Planning - Mark Wehlage
Resource Planning - PJ Martin
Questions and Discussion
Adjourn
Stakeholder Engagement

- Workshops
- Surveys
- Host Communities
### Stakeholder Workshops

<table>
<thead>
<tr>
<th>Topic</th>
<th>Date</th>
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<tbody>
<tr>
<td>The Evolving Integrated Planning Process</td>
<td>Jun 2018</td>
</tr>
<tr>
<td>The Evolving Electric System – Part 1</td>
<td>Aug 2018</td>
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<tr>
<td>The Evolving Electric System – Part 2</td>
<td>Aug 2018</td>
</tr>
<tr>
<td>Economic and Technical Considerations</td>
<td>Sep 2018</td>
</tr>
<tr>
<td>Preliminary Results and Opportunity for Feedback</td>
<td>Oct 2018</td>
</tr>
<tr>
<td>Final Preferred Plan Overview</td>
<td>Feb 2019</td>
</tr>
</tbody>
</table>
Upper Midwest System

5 States
1,700,000+ Meters

Generation
~10,000 MW
70+ PPA’s
100+ Generation Interconnects

Transmission
150+ Tie-Ins
8,100+ Line Miles
550+ Substations

Distribution
DER, DR, DSM, etc.
1,500+ Feeders
36,500+ Circuit Miles
Xcel Energy Priorities

Lead the Clean Energy Transition

Enhance the Customer Experience

Keep Bills Low
2015 IRP Commission Order

-1,362 MW Coal

+1,000 MW Wind

+650 MW Solar

+400 MW DR

Retirement of Sherco Unit 2 (2023) and Sherco Unit 1 (2026)

Addition of 1,000+ MW of wind by 2019

Addition of 650 MW of solar by 2021

400 MW of Demand Response by 2023
2015 IRP Commission Order Cont.

- **Baseload Fleet Analysis**
  - Baseload Retirement Scenarios

- **Evaluate Alternatives**
  - Evaluate supply side, demand side and transmission solutions

- **CHP**
  - Explore the role of cost-effective CHP

- **Distribution Planning**
  - Account for distribution planning inputs

- **Explore 1,000 MW DR**
  - Study feasibility of 1,000 MW of Demand Response by 2025
The Future of Baseload

The 2019 IRP is expected to lay out future plans for our coal and nuclear fleets.
Energy & Carbon Summary: 
Progress to Date and Plans for the Future

June 26, 2018
Xcel Energy Priorities

- Lead the Clean Energy Transition
- Enhance the Customer Experience
- Keep Bills Low
**Leading the Clean Energy Transition**

**Significant progress**
- Company-wide 35% reduction in carbon emissions since 2005
- Surpasses U.S. Paris Accord commitment and Clean Power Plan goal

**Ambitious, industry-leading goal**
- 60% reduction in carbon emissions by 2030 – on path to 80% by 2050
- Aspirations to do more
  - In Upper Midwest, up to 80% reduction (85% carbon-free) by 2030

**Empowering customers, communities to achieve their goals**
- Energy options to enable them to go further faster
A Comprehensive Strategy
Upper Midwest Energy Mix

- **2005**
  - 44% Carbon Free
  - 28% Natural Gas
  - 13% Nuclear
  - 51% Other Renewable
  - 5% Wind
  - 5% Solar

- **2017**
  - 58% Carbon Free
  - 29% Natural Gas
  - 10% Nuclear
  - 30% Other Renewable
  - 12% Wind
  - 1% Solar

- **2022**
  - 76% Carbon Free
  - 35% Natural Gas
  - 19% Nuclear
  - 5% Other Renewable
  - 30% Wind
  - 9% Solar

Upper Midwest System
Integrating Renewable Energy

- Advanced forecasting
- Flexible natural gas as backup
- Operational changes to accommodate renewables
- Transmission investment
- System records
  - >70% on hourly basis
  - >58% on daily basis
Wind Expansion Plans
3,680 MW, including 1,850 in Upper Midwest – all online by 2022
Renewable Choice Programs

- Offering a growing number of programs
- Based on customer and state interests
- Helping customers achieve their objectives
  - Save money
  - Protect the environment
  - Meet clean energy or sustainability goals

<table>
<thead>
<tr>
<th>Program</th>
<th>Description</th>
<th>REC Owner</th>
<th>MN</th>
<th>WI</th>
<th>ND</th>
<th>SD</th>
<th>CO</th>
<th>NM</th>
<th>TX</th>
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<tr>
<td>Renewable*Connect®</td>
<td>A flexible and affordable way to subscribe to up to 100 percent renewable energy</td>
<td>Participant</td>
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<tr>
<td>Windsourc®</td>
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<td>Solar*Connect Community®</td>
<td>Subscribe to a solar garden and get full rights to the solar claims, plus a bill credit for choosing solar energy</td>
<td>Xcel Energy</td>
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<tr>
<td>Solar*Rewards Community®</td>
<td>Subscribe to third-party solar gardens and receive electric bill credit payments for solar energy produced</td>
<td>Xcel Energy</td>
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<tr>
<td>Solar*Rewards®</td>
<td>Install your private on-site solar system and earn an incentive for transferring the RECs to Xcel Energy</td>
<td>Xcel Energy</td>
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<tr>
<td>Net Metering</td>
<td>When you produce wind or solar energy through on-site equipment, you’re able to retain RECs and sell any excess energy back to the grid</td>
<td>Participant</td>
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</table>
Energy Efficiency Leadership
Offering 150 programs to help customers save energy, manage their bills

Cumulative Customer Energy Savings
Xcel Energy-wide

Since 1992, customers have saved enough electricity to avoid building 20 average-size power plants.
Carbon and Other Environmental Benefits

- 40% Reduction in Water Consumption
- 41% Reduction in Coal Ash Produced
- 72% Reduction in Sulfur Dioxide Emissions
- 76% Reduction in Nitrogen Oxide Emissions
- 35% Reduction in Carbon Emissions
Xcel Energy:
- Has publicly stated 60% reduction by 2030, making it tied for the most aggressive. On track to 80% or more by 2050.

DTE Energy:
- Has committed to extend the life of its Fermi nuclear plant in order to facilitate carbon reduction.

Ameren:
- Plans to retire half of its coal fleet by 2022 and add wind, solar, energy efficiency and grid modernization to replace it.

American Electric Power:
- Sold its generation in TX and OH since 2000, making emissions reduction from company-owned assets easier.

Duke Energy:
- Retired or plans to retire 54 coal units from 2011-2030. Retrofitting coal to burn natural gas and investing in renewables.

CMS Energy:
- Will retire entire coal fleet by 2040 and achieve more than 40% of energy from renewables by the same year.

PPL:
- Plans to retire coal and replace with natural gas. Counts sale of competitive generation as carbon reduction.

FirstEnergy:
- Actual target year is 2045. FirstEnergy is currently in the process of selling nearly all their generation.

Alliant Energy:
- Alliant’s updated its goal from 30% to 40% last year as it has already achieved 37% reduction as of 2016.

National Grid:
- Maintains its long standing commitment of achieving 80% carbon reductions by 2050.

WEC Energy Group:
- Plans to achieve its 40% reduction goal by retiring and converting coal plants and by investing in renewables.

Southern Company:
- Plans to extend the life on their 3,700 MW nuclear plants, investing in nuclear and renewable energy. Their 2050 goal is “low - to no – carbon operations”.

Note: Xcel Energy Upper Midwest aspirational goal of 80% reduction (85% carbon-free) by 2030
Comparing to State Goals

15% below 2005 by 2015, 30% by 2025, 80% by 2050

Minnesota's greenhouse gas emissions from economic sectors 2005-2014

Xcel Energy vs. Minnesota statewide goals

-17% -9.87M, -7% -2.98M, -2% -0.56M, 20% 3.70M, 19% 1.68M, 20% 1.42M, 8% 0.18M
Our EV Plan

Focus on 3 Market Segments:

- **Home Charging**
- **Charging for Fleet Operators**
- **Fast Charging**

Key Barriers to Address:

- Lack of Awareness and Information
- Initial upfront costs
- Suboptimal incentives to charge when energy costs are lowest

- **Lack of Awareness and Information**
  - Insufficient information on electric vehicles and charging infrastructure.

- **Initial upfront costs**
  - High initial investment for purchasing and installing charging infrastructure.

- **Suboptimal incentives to charge when energy costs are lowest**
  - Inadequate subsidies and tax incentives for electric vehicle owners to charge their vehicles when energy costs are lowest.

- **Home Charging**
  - Challenges for homeowners to install home charging stations, especially in multifamily buildings.

- **Charging for Fleet Operators**
  - Difficulty in coordinating charging requirements for fleet vehicles, balancing peak and off-peak charging.

- **Fast Charging**
  - Limited availability of fast charging stations, especially in remote areas.

- **Initial upfront costs**
  - High capital expenses for installing fast charging stations.

- **Suboptimal incentives to charge when energy costs are lowest**
  - Lack of incentivized charging strategies to encourage charging during off-peak hours.
### Electrification
Driving electric is clean today, even cleaner in the future

<table>
<thead>
<tr>
<th>Tons of Carbon Emissions Per Year</th>
<th>Conventional Car</th>
<th>EV charged on Xcel Energy system 2016</th>
<th>EV charged on Xcel Energy system 2030</th>
<th>EV charged on Xcel Energy renewables only</th>
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<tbody>
<tr>
<td></td>
<td>5.2</td>
<td>1.5</td>
<td>0.4</td>
<td>0</td>
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- Driving electric is clean today, even cleaner in the future.
- Conventional Car: 5.2 tons of carbon emissions per year.
- EV charged on Xcel Energy system 2016: 1.5 tons.
- EV charged on Xcel Energy system 2030: 0.4 tons.
- EV charged on Xcel Energy renewables only: 0 tons.
Capacity Plan and Budget Discussion

• Distribution Capacity Planning Process Overview
• Process Details
• Process Changes
  – Hosting Capacity
  – DER
  – Tools
Distribution Capacity Planning Process Overview

1. Load Forecast
2. Risk Analysis
3. Mitigation Plans
4. Budget Create
5. Memo
6. Design & Construct
1. Load Forecast

- Load Forecasting is conducted annually for the distribution system
  - Feeders
  - Substation Transformers
- Location specific information
  - High Load Scenario
  - Drivers of load changes
- Utilize Itron Distribution Asset Analysis (DAA) Tool
- Provide to Transmission Planning
2. Risk Analysis

- N-0: System intact
  - Feeders
  - Substation Transformers
- N-1: Contingency
  - Feeders
  - Substation Transformers
- Utilize Synergi Electric Power Flow and DAA Tools
2. Risk Analysis - Reliable Feeder Design

Feeder Breaker Feeder #1

Switch

Fault

Feeder 1 Section 1 Loading = 25%

Feeder 1 Section 2 Loading = 25%

Feeder 1 Section 3 Loading = 25%

Tie to Feeder #2

Tie to Feeder #3

Tie to Feeder #4

Key
- Switch - Normally Open
- Switch - Normally Closed
3. Mitigation Plans

Is the problem localized and solution straight forward?

- **Yes**
  - Identify the solution
  - Quantify the risk
  - Estimate costs

- **No**
  - Identify the options
  - Quantify the risk
  - Estimate costs
  - Obtain stakeholder input
  - Perform planning study
  - Select the solution

Enter into the budgeting tool
4. Budget Create

Operational Risk Management – Prioritize and Select

- Probability of Event
- Consequence of Event

- Uncertainty

- Operational Risk of Event

- 1. Load Forecast
- 2. Risk Analysis
- 3. Mitigation Plans
- 4. Budget Create
- 5. Memo
- 6. Design & Construct
5. Memo
6. Design and Construct

- Select the solutions
- Develop and update 5 year budget
- Layout Project Details
- Release projects for construction

System Data, Funding, Costs, Risks

Select Solutions and Plan Projects

Update the 5-Year Budget
Distribution Capacity Planning Process Changes

1. Load Forecast
2. Risk Analysis
3. Mitigation Plans
4. Budget Create
5. Memo
6. Design & Construct

- 1. Model Updates
- 2. Model Building
- 3. Hosting Capacity Analysis
- 4. Budget Create
- 5. Memo
- 6. Design & Construct
Distribution Capacity Planning Process Changes

1. Load Forecast
2. Risk Analysis
3. Mitigation Plans
4. Budget Create
5. Memo
6. Design & Construct

1. Model Updates
2. Model Building
3. Hosting Capacity Analysis

Xcel Energy
Distribution Capacity Planning Process Changes

1. Load Forecast
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6. Design & Construct

Solar/DG

1. Model Updates
2. Model Building
3. Hosting Capacity Analysis
4. Budget Create
5. Memo
Distribution Capacity Planning Process Changes

1. Load Forecast
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6. Design & Construct

1. Model Updates
2. Risk Analysis
3. Hosting Capacity Analysis

Solar/DG

Load Studies, Interconnection Studies, Long Range Plans

Alternative Solutions

3. Mitigation Plans

13
Distribution Capacity Planning Process Changes

1. Load Forecast
2. Risk Analysis
3. Mitigation Plans
4. Budget Create
5. Memo
6. Design & Construct

- DER: EVs, DSM, DR, etc.
- Load Studies, Interconnection Studies, Long Range Plans
- Alternative Solutions
- Model Updates
- Model Building
- Hosting Capacity Analysis
- Mitigation Plans

Complexity
## New Load Forecasting Tool

<table>
<thead>
<tr>
<th>TOOLS</th>
<th>Forecast</th>
<th>Risk Analysis</th>
<th>Mitigation Plans</th>
<th>Budget Create</th>
<th>Design and Construct / EDP Means</th>
<th>Long Range Plans</th>
<th>Future Planning Actions</th>
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<td>Synergi Electric</td>
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<td>Distribution Asset Analysis*</td>
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<td><strong>Expanded Tools</strong></td>
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<td>New Forecasting Tool*</td>
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* New Forecasting Tool replaces DAA and adds more functionality
** Planning has larger role in interconnection process
*** Hosting Capacity becomes integrated into planning process

[15]
Xcel Energy (NSP) Transmission Planning Process

Mark Wehlage - Manager, Transmission Planning (NSPM/NSPW)

June 26, 2018
Xcel Energy Transmission Facts

• Fourth largest transmission system in U.S., ~19,000 miles in parts of 10 states
• Transmission voltages range from 23 kV to 500 kV AC
• More than 1,200 substations
• Approximately 22,000 MW of load
• Belong to two Regional Transmission Organizations (RTO), MISO and SPP
NSP Transmission System - Part of Larger Grid
Transmission Planning Process

• Annual Assessment
  – NERC TPL-001-4 and other NERC standards R2. Each Transmission Planner and Planning Coordinator shall prepare an annual Planning Assessment of its portion of the BES. (Bulk Electric System)
• Requests from RTO, other utility, or internal
• Analyze the needs and define scenario cases
• Use Siemens PSSE and MUST, TSAT/PSAT (new software for stability) to determine potential transmission issues
  – Thermal, voltage, stability
• Determine potential solutions
• Test solutions for robustness and perform economic analysis
• Determine preferred solution
• Historic planning continues while many seek to understand future
Planning Coordination

• MISO Stakeholder meetings (NSP West MISO Sub-regional Planning Group) – open and transparent planning mandated by FERC Order 890 – stakeholder provide input
• Transmission Planning – Distribution – twice per year and day to day
• Transmission Planning – Resource Planning/Energy Supply – periodically and day to day
• Xcel Energy (NSP) Transmission Planning and other companies (twice per year)
• Other stakeholders provide input through public meetings and directly at times
• Studies reveal insights based on study assumptions
• Operating coordination of loads/other devices
Many Issues Must be Addressed Simultaneously for Reliable Operations

Both “traditional” and “non-traditional” transmission studies need to be performed to assess and address the issues.
Frequency Response / Inertia are Interconnection-Wide System Issues

• Frequency response requires a resource to have both controls capability and headroom
  – New February 2018 FERC Rule addresses future controls capability
  – Market/Operating rules will need to address headroom capability

• Frequency events can have large geographic impacts
  – Example below occurred in Florida in 2008, and frequency deviations occurred across the entire Eastern Interconnection

Range of Operational Impact

- Voltage (VARs) – Local
- Power (MW) – Regional
- Frequency (60 Hz) – N. American Interconnection
Changing Resource Mix – anticipating new

NERC
- Essential Reliability Services WG
- DER TF

Xcel Energy
- CO/MN/WI/TX Resource Plans
- Partial TPL/other

MISO
- Gen Int. Studies
- Renewable Integration Impact Assessment (RIIA)
- Y2 Studies

EPRI
- DER efforts (IEEE 1547/other)
- deep all inverter penetration
- DER today Grid Following/Supporting
- DER tomorrow Grid Forming

California

Hawaii

Germany
Typical Frequency Excursion and Recovery

\[ H_{sys} = \sum_{i \in I} H_i \cdot MVA_i \]  

(4)
# Summary of NERC ERS Recommendations

(Historic and forward looking measures – to be incorporated into LTRA)

<table>
<thead>
<tr>
<th></th>
<th>Recommendation</th>
<th>Measure Location</th>
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<tbody>
<tr>
<td>1.</td>
<td>Synchronous Inertial Response (SIR) at Int. Level</td>
<td>Interconnection</td>
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<tr>
<td>2.</td>
<td>Initial Freq. Deviation Following Largest Contingency</td>
<td>Interconnection</td>
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<tr>
<td>3.</td>
<td>Synchronous Inertial Response at BA Level</td>
<td>Balancing Authority [BA]</td>
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<td>4.</td>
<td>Frequency Response at Interconnection Level</td>
<td>Interconnection</td>
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<td>5.</td>
<td>Real Time Inertial Model</td>
<td>Industry Practice [BA]</td>
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<td>6.</td>
<td>Net Demand Ramping Variability</td>
<td>Industry Practice [BA]</td>
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<td>7.</td>
<td>Reactive Capability on the System</td>
<td>Transmission Operator [TOP]</td>
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<tr>
<td>8.</td>
<td>Voltage Performance of the System</td>
<td>No further action; planners need to consider</td>
</tr>
<tr>
<td>9.</td>
<td>Overall System Reactive Performance</td>
<td>Industry Practice [BA]</td>
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<tr>
<td>10.</td>
<td>System Strength (Short Circuit Contribution)</td>
<td>Planning Coordinator</td>
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</table>
Resource Planning Process

June 26, 2018
Agenda

- Integrated Resource Plan (IRP) Process
- IRP Objectives
- Strategist Model Overview
- Modeling Process
- Integrated Planning Coordination
- Vision Plan Aspiration
Integrated Resource Planning Process

Evolving to incorporate more front end coordination with internal & external stakeholders

- Stakeholder Feedback & Input
- Capacity & Energy Needs and Costs
- Resource Options
- Requirements & Objectives
- Increased Internal Coordination

**Resource Plan**
- 15 Year Plan filed every 2 years

**Commission Approval**

**Plan Implementation**
IRP Objectives

Our goal is to strike a balance between key priorities

- Minimize Loss of Load Risk
- Ensure G, T&D Coordination
- Ensure Asset Optimization

- Minimize Customer Rates
- Minimize Portfolio Costs
- Weigh ST vs. LT Costs

- Meet Policy Requirements
- Reduce Carbon Emissions
- Grow Renewable Energy

- Maintain Portfolio Diversity
- Retain Optionality
- Manage Market Exposure

Preferred 15 Year Plan

Reliability

Cost

Environmental

Risk
Strategist Model Overview

- Expansion Plan Optimization
- Revenue Requirements for Generation
  - (Fuel, O&M, Return/Recovery, PP, etc)
- Production Cost Modeling
  - Dispatch model based on typical week for each month

Size  Type  Timing  Location
Modeling Process

**Identify Needs**
- MISO Reserve Obligations
- DER & DSM, Electrification Forecasts
- Existing Generation

**Create Portfolios**
- New Resource Options
- Existing Generation Scenarios

**Assess Risks**
- Sensitivities

**Select Preferred Plan**
- Preferred 15 Year Plan
- 5 Year Action Plan

Reliability, Cost, Environmental, Risk
Identify Capacity Needs

No capacity needs expected in the 5 year action window
Create Portfolios – Future Resource Options

Supply Side Resources

- Variable Resources
  - Wind
  - Solar

- Flexible Resources
  - Thermal
  - Non-Thermal

Demand Side Resources

- Demand Response
- Energy Efficiency

- Utility PV
- Rooftop
- CSG
- CC
- Biomass
- CT
- Battery Storage
Sensitivities

Load Growth

High Load Growth*

Future Needs

Existing Resources

Low Load Growth*

Future Needs

Existing Resources

Natural Gas Prices

Natural Gas Price Forecast ($/MMBtu)

2017 - 2022

High: 12.5%

Base: 1.5%

Low: 9.0%

Carbon Costs

Carbon Costs ($/short ton)

*All charts are illustrative
Integrated Planning Coordination

Key Steps

Load Forecast & DER Forecast

Economic Modeling

Operational Feasibility

Teams Involved

Load Forecasting

Distribution Planning

DSM Strategy

Risk Strategy

Resource Planning (Strategist)

Transmission (PROMOD)

Commercial Ops (Plexos)

Transmission

Distribution

Energy & Gas Supply

Commercial Ops
### What’s Possible
Reducing Carbon Affordably

<table>
<thead>
<tr>
<th>2030 Existing Plan</th>
<th>2030 Vision</th>
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<tbody>
<tr>
<td>35% renewable</td>
<td>60% renewable</td>
</tr>
<tr>
<td>63% carbon free</td>
<td>85% carbon free</td>
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CERTIFICATE OF SERVICE

I, Jim Erickson, hereby certify that I have this day served copies or summaries of the foregoing document on the attached list of persons.

xx by depositing a true and correct copy thereof, properly enveloped with postage paid in the United States mail at Minneapolis, Minnesota;

xx by courier; or

xx by electronic filing.

Docket No.
E002/RP-02-15-21

Dated this 29th day of June 2018

/s/

Jim Erickson
Regulatory Administrator
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