

TABLE OF CONTENTS

Cover Letter

Table of Contents

The Resource Plan

Chapter 1: Executive Summary

Chapter 2: Planning Landscape

Chapter 3: Minimum System Needs

Chapter 4: Preferred Plan

Chapter 5: Economic Modeling Framework

Chapter 6: Customer Rate and Cost Impacts

Certificate of Service & Service Lists

Appendices

PREFERRED PLAN

| | |
|---|-----------|
| CHAPTER 1: EXECUTIVE SUMMARY | 1 |
| I. INTRODUCTION | 1 |
| II. EXECUTIVE SUMMARY | 4 |
| A. Proposed Resource Mix | 7 |
| B. Plan Priorities | 14 |
| III. CONCLUSION | 18 |
| CHAPTER 2: PLANNING LANDSCAPE | 19 |
| I. INTRODUCTION | 19 |
| II. PLANNING LANDSCAPE | 23 |
| A. Carbon Reduction Goals | 24 |
| B. Regional Reliability and Market Constructs | 25 |
| C. Distributed Energy Resources | 34 |
| D. Community and Employee Considerations | 36 |
| E. Customer Preferences | 37 |
| F. Supply and Technology Trends | 39 |
| G. Jurisdictional Updates | 40 |
| H. Conclusion | 44 |
| CHAPTER 3: MINIMUM SYSTEM NEEDS | 45 |
| I. MEETING CUSTOMER NEEDS | 45 |
| A. Customer Needs Forecast | 46 |
| II. MISO RESOURCE ADEQUACY REQUIREMENTS | 50 |
| A. MISO Footprint Capacity Obligation | 50 |
| B. Zonal Capacity Obligation | 51 |
| C. Capacity Obligations Derived From Forecasted Demands | 51 |
| D. Capacity Accreditation of Resources | 52 |
| III. DEMAND SIDE MANAGEMENT | 54 |
| IV. RELIABILITY REQUIREMENT | 55 |
| V. EXISTING RESOURCES | 56 |
| A. Renewable Resources | 56 |
| B. Nuclear | 57 |
| C. Coal | 57 |
| D. Natural Gas (and Oil-Fired) Fleet | 57 |
| VI. NET RESOURCE SURPLUS/DEFICIT | 58 |
| VII. MEETING RENEWABLE ENERGY REQUIREMENTS AND GOALS | 59 |

| | | |
|-------------------|---|-----------|
| | A. Minimum Compliance Requirements | 59 |
| | B. RES Compliance | 60 |
| | C. SES Compliance | 61 |
| VIII. | ENERGY POLICY AND COMPANY GOALS | 62 |
| IX. | REFERENCE CASE | 62 |
| CHAPTER 4: | THE PREFERRED PLAN | 65 |
| I. | PLANNING OBJECTIVES | 66 |
| | A. Environmental and Innovation | 67 |
| | B. Reliability | 68 |
| | C. Cost | 68 |
| | D. Risk and Flexibility | 69 |
| | E. Our Employees and Communities | 70 |
| II. | THE PREFERRED PLAN | 70 |
| | A. Transforming Our Energy Mix | 71 |
| | B. Fleet Transition | 72 |
| | C. Keeping Rates Affordable for Customers | 77 |
| III. | ACTION PLANS | 79 |
| | A. Five-Year Plan | 79 |
| | B. Long-Term Plan | 81 |
| IV. | NORTH DAKOTA PLAN | 83 |
| | A. Plan Components | 84 |
| | B. Resource Planning Framework Status | 86 |
| | C. North Dakota Combustion Turbine | 86 |
| V. | PUBLIC INTEREST ANALYSIS | 87 |
| | A. Reliability | 88 |
| | B. Impact to Customer Bills | 88 |
| | C. Environmental Effects | 89 |
| | D. Socioeconomic Impacts | 89 |
| | E. Flexibility to Respond to Change | 90 |
| | F. Limiting Risks | 90 |
| VI. | CONCLUSION | 91 |
| CHAPTER 5: | ECONOMIC MODELING FRAMEWORK | 92 |
| I. | ASSUMPTIONS | 92 |
| II. | SCENARIOS | 97 |
| | A. Reference Case Scenario | 97 |
| | B. Early Coal Family | 97 |
| | C. Early Nuclear Family | 98 |
| | D. Extend Nuclear Family | 98 |
| III. | FUTURES SCENARIOS AND SENSITIVITIES | 99 |

| | | |
|-------------------|--|------------|
| | A. Futures Scenarios | 99 |
| | B. Traditional Sensitivities | 104 |
| IV. | STRATEGIST ANALYSIS AND RESULTS | 106 |
| | A. Initial Full Optimization | 106 |
| | B. Revised Targeted Optimization | 108 |
| | C. Energy Efficiency and Demand Response Analysis | 109 |
| | D. Final Scenario Analysis | 110 |
| | E. Modeling Results and Conclusions | 111 |
| V. | PREFERRED PLAN SELECTION AND ASSESSMENT | 115 |
| | A. Baseload Study Analysis Results | 116 |
| | B. Early Retirement of Sherco 3 by 2030 | 117 |
| | C. Demand Response Adjustment to Scenario 9 | 118 |
| | D. Futures Scenarios Results | 118 |
| | E. Preferred Plan Benefits | 122 |
| VI. | CONCLUSION | 123 |
| CHAPTER 6: | CUSTOMER RATE AND COST IMPACTS | 124 |
| I. | REFERENCE CASE REVENUE REQUIREMENTS FORECAST METHODOLOGY | 126 |
| II. | ESTIMATED RATE IMPACTS AND METHODOLOGY | 127 |
| | A. Methodology | 127 |
| | B. Estimated Overall Rate Impacts | 128 |
| | C. Key Drivers | 129 |
| | D. These Estimates are not Directly Comparable to Rate Impact Analysis in a Rate Case | 130 |
| III. | ESTIMATED RATE IMPACTS BY CLASS PER YEAR | 131 |
| | A. Methodology and Calculations | 133 |
| | B. Fuel Costs and Purchased Energy | 134 |
| | C. Production Expense, Property Taxes, Deferred Income Taxes, Tax Depreciation and Removal Expense and Decommissioning Accrual | 134 |
| | D. Generation Rate Base Costs Including Plant in Service, Depreciation, CWIP and Accumulated Deferred Income Taxes | 136 |
| | E. Bulk Transmission Costs | 136 |
| IV. | DETERMINING CLASS RATE IMPACTS | 136 |
| V. | FACTORS IMPACTING NEAR-AND LONG-TERM RATE ESTIMATES | 138 |

APPENDICES

| | |
|---------------|--|
| Appendix A – | Compliance Matrix |
| Appendix B – | Acronyms & Terms |
| Appendix C – | About Xcel Energy |
| Appendix D – | Non-Technical Summary |
| Appendix E – | Xcel Energy Carbon Report: Building a Carbon-Free Future |
| Appendix F1 – | Load and Distributed Energy Resource Forecasting |
| Appendix F2 – | Strategist Modeling Assumptions & Inputs |
| Appendix F3 – | Scenario Sensitivity Analysis: PVRR & PVSC Summary |
| Appendix F4 – | High Electrification Scenario Description |
| Appendix F5 – | Generation Interconnection Costs Methodology |
| Appendix F6 – | Resource Options |
| Appendix F7 – | Minnesota Energy Storage Systems Assessment |
| Appendix G1 – | Demand Side Management |
| Appendix G2 – | Study: Potential for Load Flexibility at NSP (Brattle) |
| Appendix G3 – | DR Cost Effectiveness at NSP (Brattle) |
| Appendix G4 – | DR Stakeholder Engagement Summary (GPI) |
| Appendix H – | Environmental Regulations Review |
| Appendix I – | Supporting Infrastructure: Transmission & Distribution |
| Appendix J1 – | Baseload Study |

| | |
|----------------|--|
| Appendix J2 – | Reliability Requirement |
| Appendix J3 – | Y2 Study: King & Sherco Unit 3 Coal |
| Appendix J4 – | Y2 Study: Monticello, Prairie Island, & All Coal & Nuclear |
| Appendix K – | Xcel Energy Resources: Nuclear |
| Appendix L – | Xcel Energy Resources: Sherco CC |
| Appendix M – | Xcel Energy Corporate Responsibility Report |
| Appendix N1 – | Annual Report: Minnesota Electric |
| Appendix N2 – | 10-Year Plan: North Dakota Electric |
| Appendix N3 – | 10-Year Plan: South Dakota |
| Appendix N4 – | Renewable Energy Compliance Positions |
| Appendix N5 – | Biennial Report: Renewable Energy Obligation-Renewable Energy Standard Compliance Report |
| Appendix N6 – | Renewable Energy Standard: Rate Impact Report: |
| Appendix N7 – | Annual Report: Solar Energy Standard |
| Appendix N8 – | Monthly Report: Solar Gardens June 2019 |
| Appendix N9 – | Triennial Filing: Nuclear Decommissioning |
| Appendix N10 – | Nuclear Worker Transition Plan |
| Appendix O1 – | Summary of IRP Stakeholder Engagement |
| Appendix O2 – | Scope & Outline: Center for Energy & Environment Study |
| Appendix O3 – | Impact of Nuclear Fleet on the Minnesota Economy (NEI) |
| Appendix P1 – | E3 Summary |

Appendix P2 – RESOLVE & RECAP Low Carbon Scenario Analysis (E3)

Appendix P3 – Minnesota PATHWAYS Report June 2019 (E3)

Appendix Q – NSP Wind & Solar Integration Study (Enernex)

Appendix R – Study: Interconnection Cost Estimates – CC (Excel Engineering)

Appendix S – Combined Heat & Power Study (EPRI)

THE RESOURCE PLAN LIST OF TABLES AND FIGURES

| Number | Title | Page # |
|---------------|--|---------------|
| Figure 1-1 | Projected Carbon Emissions Through 2030 | 1 |
| Figure 1-2 | Preferred Plan Highlights | 2 |
| Figure 1-3 | Preferred Plan Energy Mix through 2034 | 8 |
| Figure 1-4 | NSP System Reliability Requirement Calculation | 16 |
| Figure 1-5 | Preferred Plan Average Rate Impact for the NSP System | 17 |
| Figure 2-1 | Xcel Energy Integrated Resource Plan Objectives | 19 |
| Figure 2-2 | Modeled Wind and Solar ELCC as Penetration Increases | 29 |
| Figure 3-1 | Net Resource Need/Surplus Calculation | 46 |
| Figure 3-2 | Forecasted Peak Load, After Energy Efficiency Adjustments (MW) | 47 |
| Figure 3-3 | Forecasted Net Energy Requirements, After Energy Efficiency Adjustments (GWh) | 48 |
| Figure 3-4 | MISO Planning Reserve Margin Calculation – NSP System Planning Year June 1, 2018 to May 31, 2019 | 52 |
| Table 3-1 | Capacity Obligation Calculation – 2020 Example | 52 |
| Figure 3-5 | NSP System Reliability Requirement Calculation – 2020 Example | 55 |
| Table 3-2 | Reference Case Load and Resources, 2020-2034 Planning Period | 58 |
| Figure 3-6 | Renewable Energy Requirements and Objectives – NSP System | 59 |
| Figure 3-7 | REC Production and Retirement Obligations for NSP System – Existing Resources Only | 61 |
| Figure 3-8 | NSP System SREC Production and Minnesota Annual Requirements | 62 |
| Table 3-3 | Reference Case Annual Expansion Plan (UCAP) | 63 |
| Table 3-4 | Reference Case Annual Expansion Plan (ICAP) | 63 |
| Figure 3-9 | Reference Case Energy Mix in 2020 and 2034 | 64 |
| Figure 4-1 | Xcel Energy Integrated Resource Plan Objectives | 67 |
| Figure 4-2 | Preferred Plan Energy Mix | 71 |
| Table 4-1 | Preferred Plan Resource Additions (MW) | 72 |
| Figure 4-3 | Preferred Plan Average Nominal Cost Comparison (NSP System) | 78 |
| Table 4-2 | Expansion Plan Comparisons Preferred Plan – North Dakota Plan – Summary of Differences | 85 |
| Figure 5-1 | Effective Reserve Margin Used in Strategist Modeling | 93 |
| Table 5-1 | 2019 Resource Plan Futures Scenarios | 100 |
| Figure 5-2 | Peak Demand, Net of EE Impacts, by Futures Scenario (MW) | 101 |

| | | |
|-------------|---|-----|
| Figure 5-3 | Fuel Price Assumptions, by Futures Scenario | 102 |
| Figure 5-4 | New Resource Cost Assumptions, by Futures Scenario (\$/MWh; \$/kW-mo) | 103 |
| Figure 5-5 | Carbon Emissions Cost Assumptions (\$/Short Ton) | 104 |
| Table 5-2 | Scenario 9 (Preferred Plan) DR and EE Cost Effectiveness Analyses (\$2019 millions) | 110 |
| Figure 5-6 | Expansion Plans by Scenario (GW, Cumulative Nameplate Capacity Resource Additions by Fuel Type) | 111 |
| Figure 5-7 | Scenario PVSC Deltas from Reference Case (\$2019 millions) | 112 |
| Figure 5-8 | Scenario PVRR Deltas from Reference Case (\$2019 millions) | 113 |
| Figure 5-9 | Cumulative PVRR Cost or Savings Deltas by Scenario, Compared to the Reference Plan (\$2019 million) | 114 |
| Table 5-3 | Scenario Modeling Portfolio Risk Metrics | 115 |
| Figure 5-10 | Scenario PVSC Deltas from Reference Case, PI Extension Cases Eliminated (\$2019 millions) | 116 |
| Table 5-4 | Preferred Plan NPV Savings under Different Futures Scenarios (\$2019 millions) | 118 |
| Figure 5-11 | Preferred Plan Annual Costs or Savings Compared to the Reference Case, by Scenario (\$2019 millions) | 120 |
| Table 5-5 | Preferred Plan Base Expansion Plan (MW) | 120 |
| Table 5-6 | High Electrification Scenario Expansion Plan (MW) | 121 |
| Table 5-7 | High Distributed Solar Scenario Expansion Plan (MW) | 121 |
| Table 5-8 | Cumulative 2020-2034 Additions by Resource Type and Scenario (MW) | 121 |
| Figure 6-1 | Preferred Plan Average Nominal Cost Comparison (NSP System) | 125 |
| Figure 6-2 | Preferred Plan Average Nominal Cost Comparison (State of Minnesota) | 126 |
| Figure 6-3 | Annual Percent Change in Revenue Requirements (2020-2040) Preferred Plan above Reference Case – State of Minnesota | 129 |
| Table 6-1 | Estimated Incremental Impact of Preferred Plan State of Minnesota – All Customers | 132 |
| Figure 6-4 | Incremental Rate Impact of Preferred Plan State of Minnesota – All Customers | 133 |
| Table 6-2 | E8760 Energy Allocator | 134 |
| Table 6-3 | Stratification Analysis by Plant Type | 135 |
| Table 6-4 | D10S Capacity Allocator | 135 |
| Figure 6-5 | Incremental Rate Impact of Preferred Plan by Customer Class – State of Minnesota | 137 |
| Table 6-5 | Preferred Plan Estimated Rate Impacts by Class per Year | 138 |

APPENDICES LIST OF TABLES AND FIGURES**Appendix C: About Xcel Energy**

| Number | Title | Page # |
|---------------|---------------------------------|---------------|
| Figure 1 | Xcel Energy Territory | 1 |
| Figure 2 | NSP System Generation Resources | 2 |

Appendix D: Non-Technical Summary

| Number | Title | Page # |
|---------------|---|---------------|
| Figure 1 | Xcel Energy Integrated Resource Plan Objectives | 2 |
| Figure 2 | Preferred Plan Highlights | 3 |
| Figure 3 | Net Resource Need/Surplus Calculation | 11 |
| Table 1 | Reference Case Load and Resources 2020-2034 Planning Period | 12 |
| Table 2 | Reference Case Annual Expansion Plan (MW) | 13 |
| Table 3 | Preferred Plan Resource Additions (MW) | 15 |
| Figure 4 | Preferred Plan Energy Mix | 15 |
| Figure 5 | Preferred Plan Average Nominal Cost Comparison NSP System | 18 |
| Figure 6 | Incremental Rate Impact of Preferred Resource Plan State of Minnesota – All Customers | 19 |

Appendix F1: Load and Distributed Energy Resources Forecasting

| Number | Title | Page # |
|---------------|---|---------------|
| Figure 1 | NSP System Total Median Net Energy (GWh) (Includes 1.5 Percent EE Adjustment) | 2 |
| Figure 2 | Gross Energy Requirements Forecast Compared to Net Energy Requirements Forecast | 3 |
| Figure 3 | NSP System Median Base Summer Peak Demand (MW) (Includes 1.5 Percent EE Adjustment) | 4 |
| Figure 4 | Gross Peak Demand Forecast Compared to Net Peak Demand Forecast | 5 |
| Figure 5 | Illustration of EE Adjustment – NSP System Demand (MW) | 8 |
| Figure 6 | NSP System Total Net Energy (MWh) (Includes 1.5 Percent EE Adjustment) | 11 |
| Figure 7 | NSP System Total Base Summer Peak Demand (MW) (Includes 1.5 Percent EE Adjustment) | 12 |

| | | |
|-----------|--|----|
| Figure 8 | NSP System Total Net Summer Peak Demand (MW) (Includes 1.5 Percent EE Adjustment) | 12 |
| Table 1 | Annual Net Energy (MWh) (Including 1.5 Percent EE Adjustment) | 13 |
| Table 2 | Annual Base Summer Peak Demand (MW) (Includes 1.5 Percent EE Adjustment) | 13 |
| Table 3 | Annual Net Peak Demand (MW) (Includes 1.5 Percent EE Adjustment) | 14 |
| Figure 9 | Net Energy Requirements (MWh) – Comparison of Current and Previous Energy Forecast Median (50th Percentile) Forecast | 15 |
| Figure 10 | Base Peak Demand (MW) – Comparison of Current and Previous Demand Forecast Median (50th Percentile) Forecast | 16 |
| Table 4 | Jurisdiction Abbreviations | 20 |
| Table 5 | Monthly MWh Sales Series | 20 |
| Table 6 | Monthly Customer Series | 20 |
| Table 7 | Monthly Economic and Demographic Series | 20 |
| Table 8 | Monthly Data Variables used in Demand Model | 21 |
| Table 9 | Monthly Weather Variables used in Sales Models | 21 |
| Table 10 | Other Monthly Variables | 21 |
| Table 11 | Monthly Binary Variables | 21 |
| Figure 11 | Reference Case – NSP System Distributed Solar PV Forecast (Nameplate MW/AC) | 28 |
| Figure 12 | High Forecast Case – NSP System Distributed Solar PV Forecast (Nameplate MW/AC) | 29 |
| Figure 13 | NSP System Distributed Energy Storage Systems Forecast | 30 |
| Figure 14 | NSP System Base Level Compared to High Electrification Sensitivity – 2020-2034 | 32 |

Appendix F2: Strategist Modeling Assumptions and Inputs

| Number | Title | Page # |
|---------|---------------------------------------|--------|
| Table 1 | Discount Rate and Capital Structure | 1 |
| Table 2 | CO2 Costs | 3 |
| Table 3 | Externality Costs | 4 |
| Table 4 | Strategist Demand and Energy Forecast | 6 |
| Table 5 | High Load Sensitivity | 7 |
| Table 6 | Low Load Sensitivity | 8 |
| Table 7 | Energy Efficiency Bundles | 10 |

| | | |
|----------|---|----|
| Table 8 | Demand Response Forecast | 11 |
| Table 9 | Fuel and Market Price Forecasts | 13 |
| Table 10 | Surplus Capacity Credit | 14 |
| Table 11 | Transmission Delivery Costs | 15 |
| Table 12 | Integration and Congestion Costs | 16 |
| Table 13 | Distributed Solar Forecast | 17 |
| Table 14 | Thermal Generic Information (Costs in 2018 Dollars) | 21 |
| Table 15 | Renewable Generic Information (Costs in 2018 Dollars) | 21 |
| Table 16 | Storage Generic Information (Costs in 2018 Dollars) | 22 |
| Table 17 | Levelized Capacity Costs by In-Service Year | 23 |
| Table 18 | Base Renewable Levelized Costs by In-Service Year | 24 |
| Table 19 | Low Renewable Levelized Costs by In-Service Year | 25 |
| Table 20 | High Renewable Levelized Costs by In-Service Year | 26 |
| Table 21 | 2018 FERC Heat Rates | 27 |
| Table 22 | Heat Rate Tests – 2015-2018 | 28 |
| Table 23 | Load and Resources Tables, 2020-2034 Planning Period | 30 |

Appendix F4: High Electrification Scenario

| Number | Title | Page # |
|---------------|---|---------------|
| Figure 1 | Incremental Annual Load under a High Electrification Scenario | 3 |
| Figure 2 | Incremental Peak Demand under a High Electrification Scenario | 4 |
| Figure 3 | Electricity Demand on a Peak Day in 2034 (Left) and 2050 (Right) under a High Electrification Sensitivity | 4 |

Appendix F6: Resource Options

| Number | Title | Page # |
|---------------|--|---------------|
| Table 1 | Existing Coal Resources | 2 |
| Table 2 | Existing Nuclear Resources | 3 |
| Table 3 | Existing Natural Gas and Oil Resources | 4 |
| Table 4 | Existing Biomass Resources | 5 |
| Table 5 | Existing Hydroelectric Resources | 6 |
| Table 6 | Existing and Near Term Wind Resources | 7 |
| Table 7 | Existing Solar Resources | 8 |

Appendix F7: Minnesota Energy Storage Systems Assessment

| Number | Title | Page # |
|---------------|--|---------------|
| Figure 1 | Clean Air Task Force – Smoothed Daily Load and Renewable Energy Generation, Mixed Renewable Scenario | 9 |
| Figure 2 | Battery Storage for Peak Demand Reduction | 11 |

Appendix G1: Demand Side Management

| Number | Title | Page # |
|---------------|--|---------------|
| Figure 1 | Demand Response Avoided Cost Benefits (2030) | 8 |
| Figure 2 | Cost-effective Demand Response Potential | 10 |
| Figure 3 | Controllable Demand (Gen. MW) | 15 |
| Table 1 | Demand Response Five-Year Action Plan | 17 |
| Figure 4 | Future Demand Response Growth in 5-Year Planning Period | 18 |
| Figure 5 | Historical Electric CIP Achievements 2004-2018 | 27 |
| Table 2 | Energy Efficiency Scenarios | 29 |
| Table 3 | Percent of Portfolio Energy | 31 |
| Table 4 | Present-Value of Revenue Requirements (PVRR) Energy Efficiency Scenarios (in Millions) | 32 |
| Table 5 | Present-Value of Societal Costs (PVSC) Energy Efficiency Scenarios (in Millions) | 33 |

Appendix H: Environmental Regulations Review

| Number | Title | Page # |
|---------------|--|---------------|
| Table 1 | Xcel Energy Upper Midwest CO2 Emission Reductions | 10 |
| Table 2 | Xcel Energy Upper Midwest System Status – NAAQS Attainment | 17 |

Appendix I: Supporting Infrastructure: Transmission & Distribution

| Number | Title | Page # |
|---------------|---|---------------|
| Figure 1 | Modeled wind and solar ELCC as penetration increases | 8 |
| Figure 2 | NSP System Reliability Requirement Calculation – 2020 Example | 12 |
| Figure 3 | Xcel Energy Strategic Priorities – Applied to Distribution | 21 |
| Figure 4 | Illustrative Electrical Grid | 22 |
| Figure 5 | Annual Distribution Planning Process | 25 |
| Figure 6 | Staged Approach to Enhanced Planning Analyses | 34 |
| Figure 7 | Platform Considerations | 35 |

| | | |
|----------|---|----|
| Figure 8 | Timing and Pace Considerations | 36 |
| Figure 9 | Potential Evolution in Planning Practices | 37 |

Appendix JI: Baseload Study

| Number | Title | Page # |
|----------|---|--------|
| Table 1 | Abbreviated List of NERC Event Category Definitions | 7 |
| Figure 1 | Net Capacity Additions, Excluding Wind and Solar | 40 |
| Table 2 | Stability Study – Renewable Generation Additions Modeled | 42 |
| Table 3 | Generation Turned Off In Analysis | 43 |
| Table 4 | Major Faults Analyzed | 43 |
| Figure 2 | Stability Plot – Importance of Resource Siting on Stability | 44 |
| Figure 3 | Stability Plot – Importance of Resource Siting on System Response | 45 |
| Figure 4 | Incremental Steps to Result in 3-Unit Metro Equivalent Services | 46 |
| Table 5 | Dispatch Assumptions | 47 |
| Table 6 | Generation Turned-Off in Analysis | 48 |
| Table 7 | Additional Generation Assumptions | 48 |
| Table 8 | Faults Analyzed | 49 |
| Table 9 | Thermal Overload Results | 51 |
| Table 10 | Voltage Violation Results | 51 |
| Figure 5 | Stability Plot – Insufficient System Damping Twin Cities Metro Area Voltage | 52 |
| Figure 6 | Stability Plot – Insufficient System Damping Outside Twin Cities Metro Area Voltage | 53 |
| Figure 7 | System Collapse – Summer 2023 P01 Case | 54 |
| Figure 8 | System Collapse – Summer 2023 P02 Case | 55 |
| Table 11 | Economic Analysis – Baseload Unit Retirement Date Assumptions | 57 |

Appendix J2: Reliability Requirement

| Number | Title | Page # |
|----------|---|--------|
| Figure 1 | MISO Local Resource Zones | 3 |
| Figure 2 | MISO RIIA Study Finding – Declining ELCC Value for Wind and Solar Resources | 8 |
| Figure 3 | E3 Marginal ELCC (%) – Four-Hour Demand Response | 9 |
| Figure 4 | Renewable Output and Load January 26 – February 8, 2019 | 10 |
| Figure 5 | Xcel Energy Wind Generation Actuals vs. Forecast January 28- | 12 |

| | | |
|----------|--|----|
| | 31, 2019 | |
| Figure 6 | Xcel Energy Solar Generation Actuals vs. Forecast January 28-31, 2019 | 13 |
| Figure 7 | Snow Impacting a Large Solar Installation | 14 |
| Table 1 | Hourly Wind and Solar Capacity Factors February 5, 2019 | 16 |
| Table 2 | Planning Parameters to Derive NSP System Level of Market Reliance – High Stress Scenarios | 22 |
| Figure 8 | NSP System Reliability Requirement Calculation – 2020 Example | 23 |

Appendix K: Xcel Energy Resources: Nuclear

| Number | Title | Page # |
|---------------|--|---------------|
| Figure 1 | Scenario PVRR Deltas from Reference Case (\$2019 millions) | 9 |

Appendix L: Xcel Energy Resources: Sherco CC

| Number | Title | Page # |
|---------------|---|---------------|
| Figure 1 | Projected Firm Capacity as Compared To Summer Peak and Reliability Requirement | 7 |

Appendix N4: Renewable Energy Compliance Positions

| Number | Title | Page # |
|---------------|--|---------------|
| Figure 1 | Annual RES & REO REC NSP System Obligation & Production | 2 |
| Figure 2 | State of Minnesota Annual SES REC Obligation & Production | 3 |

Appendix N6: Renewable Energy Standard: Rate Impact Report

| Number | Title | Page # |
|---------------|---|---------------|
| Table 1 | Annualized Historic RES Rate Impact (2005-2012) | 8 |
| Table 2 | Annualized Future RES Rate Impact (2013-2019) | 9 |
| Table 3 | Annualized Future RES Rate Impact (2020-2026) | 10 |
| Table 4 | Annualized Future RES Rate Impact (2027-2034) | 11 |
| Table 5 | Annualized SES Rate Impact (2017-2026) | 12 |
| Table 6 | Annualized SES Rate Impact (2027-2034) | 13 |
| Table 7 | Levelized RES Rate Impact | 14 |
| Table 8 | Levelized SES Rate Impact | 15 |
| Table 9 | Transmission Projects Attributable to the RES | 16 |

| | | |
|----------|---|----|
| Table 10 | Transmission Project Costs Attributable to the RES (70% of MPV Project Annual Revenue Requirements Assigned to RES) | 17 |
| Table 11 | MISO Data Used in RES Avoided Energy and Capacity Calculations | 18 |
| Table 12 | MISO Data Used in SES Avoided Energy and Capacity Calculations | 19 |

Appendix N10: Nuclear Worker Transition Plan

| Number | Title | Page # |
|---------------|----------------------------|---------------|
| Table 1 | Nuclear Employee Breakdown | 3 |

Appendix O1: Summary of IRP Stakeholder Engagement

| Number | Title | Page # |
|---------------|-----------------------|---------------|
| Table 1 | Stakeholder Workshops | 2 |