

NORTHWESTERN ENERGY
2018 ELECTRICITY RESOURCE PROCUREMENT PLAN
STRAWMAN ¹

CHAPTER 1. EXECUTIVE SUMMARY

1. Load Service Requirements
 - a. Peaking Capacity (*Planning Reserve Margin*)
 - b. Dispatchable Capacity (*hourly*)
 - c. Fast-Response Capacity (*intra-hour*)
2. Regional Market Transformation
3. Portfolio Additions and Customer Impacts
 - a. Base case portfolio
 - b. Indicative portfolios
 - c. Customer Impacts of portfolio additions
4. Action Plan

CHAPTER 2. RESOURCE PLANNING PROCESS AND HISTORY

1. Montana Resource Planning Requirements
2. NorthWestern Resource Planning
 - a. 2018 Planning Process
 - b. 2018 Plan Assumptions
3. Regional Resource Planning
 - a. NWPPC 7th Power Plan
 - b. Regional Resource Adequacy Advisory Committee
 - c. Other Regional Resource Plans

CHAPTER 3. LOAD SERVICE REQUIREMENTS

1. Energy Forecast
 - a. Overview and Background
 - b. Methodology
2. Peak Demand Forecast
 - a. Winter
 - b. Summer
 - c. Coincidence with Pacific NW
3. Variable Energy Resources Integration Study
 - a. Background
 - b. Flexible Capacity Need
 - c. Flexible Capacity Need with Additional Renewables
4. Future Capacity Needs
 - a. Peaking capacity

¹ As of February 22, 2018

- b. Dispatchable capacity
- c. Fast-response capacity

CHAPTER 4. EXISTING RESOURCES

- 1. Existing Resource Portfolio
 - a. Existing Resources
 - b. Energy Production By Resource
 - c. Capacity by Resource
 - i. Nameplate capacity
 - ii. Peaking Capacity
 - iii. Dispatchable capacity
 - iv. Fast-response capacity

CHAPTER 5. REGIONAL MARKET TRANSFORMATION

- 1. Energy Imbalance Market
 - a. E3 Cost/Benefit Analysis
 - b. Current Activities
 - i. Day ahead imbalance market
- 2. Reliability Coordinator
 - a. Background
 - b. Changes in RC Market
- 3. Regional Transmission Organizations
 - a. California Independent System Operator
 - b. Southwest Power Pool - Mountain West
 - c. Peak Reliability – PJM

CHAPTER 6. PORTFOLIO ADDITIONS STRATEGY

- 1. Resource Acquisition Strategy
 - a. Meet Load Service Requirements
 - i. Short term market operations
 - 1. Ancillary service RFP in summer of 2018
 - 2. Other short term PPAs
 - ii. Recovery of capital costs (15-year vs. 20 year)
 - iii. Process
 - 1. RFPs
 - 2. Opportunity resources
 - b. Regional Transmission Organization
 - i. Timing
 - ii. RTO Structure
 - 1. Proxy RTO structure
 - 2. Adequacy requirement
 - 3. VER capacity contribution
 - iii. Delayed RTO Entry

CHAPTER 7. RESOURCE OPTION DESCRIPTIONS

1. Generation Resource Options
 - a. Thermal Resources
 - i. Normal portfolio of thermal resources
 - b. Hydroelectric Resource Options
 - i. Hydroelectric Upgrades
 - c. Renewable Resources
 - i. Solar PV Resources
 - ii. Wind Resources
 - iii. Other Renewable Technologies
 - d. Geothermal
 - e. Energy Storage Options
2. Overview of Storage Technologies
 - a. Physical Storage Technologies
 - b. Battery Storage Technologies
3. Net Metering
 - a. Net Metering (NEM) study
4. Demand Side Resource Options
 - a. Energy Efficiency
 - b. Demand Response

CHAPTER 8. ENVIRONMENTAL

1. National Environmental
 - a. Current status
 - b. Changes from 2015 Plan
2. Regional Environmental
 - a. Impact of WECC Renewables Mandates
 - b. State Actions
 - c. State Environmental
3. Carbon

CHAPTER 9. PORTFOLIO ADDITIONS AND CUSTOMER IMPACTS

A. MODELING INPUTS

1. Fuel Price Forecasts
 - a. Natural Gas Price Forecast
 - b. Montana Basis differential
 - c. Colstrip Coal Price Forecast
2. Electricity Price Forecast
 - a. Market Price Volatility
 - b. Implied Market Heat Rates Over Time
3. Renewable Portfolio Standard
 - a. Overview and Background
 - b. Renewable Energy Credits

- c. Community Renewable Energy Projects

B. PORTFOLIO MODELING

1. Base Case Assumptions
 - a. Planning Horizon (15-year vs. 20 year)
 - b. Recovery of capital costs (15-year vs. 20 year)
 - c. RTO Entry (no)
 - d. Carbon costs
 - e. Other
2. Optimal Resource Expansion
 - a. Description of model
 - b. Assumptions
 - c. Analysis
3. Portfolios to Model
 - a. Base Case
 - i. Life cycle cost recovery of capital costs
 - ii. 15 year cost recovery of capital costs
 - b. RTO entry
 - c. Increased Wind
 - d. Increased Solar PV
 - e. Storage
 - i. Pumped Hydroelectric
 - ii. Liquid Air Energy Storage (LAES)
 - iii. Battery technologies
 - f. Carbon Cost
 - g. High Natural Gas Prices
 - h. Low Load Growth
 - i. High Load Growth
4. PowerSimm Modeling and Analysis
 - a. Modeling Overview
 - b. Optimal Expansion Analysis
 - c. Description of the PowerSimm Model
 - i. Objective function
 - d. Model Enhancements
 - i. Market Heat Rate Curves
 - ii. Daily Price Curve
 - iii. Market Price Volatility
 - e. Modeling Results
 - i. Net Present Value of Portfolio Costs
 - ii. Valuation of Risk
 - iii. Carbon Footprint
 - iv. Customer Impacts
5. Conclusions
 - a. Indicative portfolios

- b. Meet load resource requirements with RFPs
- c. Opportunity resources

CHAPTER 10. ACTION PLAN

1. Short Term Action Plan
2. Long Term Action Plan