Assessing Resource Need

IRP Stakeholders
Seattle City Light
January 16, 2014
Agenda

- Introduction
- Resource Adequacy
- How Much is Enough?
- Eye of the Beholder
- Measuring Need
- Conclusions
Resource Adequacy
Why is “Resource Adequacy” Important to Customers?

- Reliability of service
- Electric rate increases
- Environmental impacts
What is Resource Adequacy?

“The ability of the electric system to supply the aggregate electrical demand and energy requirements of the end-use customers at all times, taking into account scheduled and reasonably expected unscheduled outages of system elements.”

North American Electric Reliability Corporation (NERC)
How Much is Enough?

Peak Demand, Hydro Variability, Outage Risk, Economics, Market Supply
Commercial Customers Flatten the SCL Load Shape in Both Winter and Summer

Much of the Variability in Peak Load is From Residential Customers

Winter Peaking Can be in the Morning or Evening
Summer Peak Demand Days: 2008-2010

- Summer Peaks are Growing Faster than Winter Peaks
- Peaks Occur About 1:00 PM: Commercial Air-Conditioning

![Graph showing SCL Summer Peak Days 2008, 2009, 2010 with Scale exaggerated]
Columbia River Hydro Variability
January- July Natural Flows
SCL Hydro Variability and Typical Load Shape
Outages

Plant Availability

100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%

Boundary  Newhalem  Gorge  Diablo  Ross
Economics: Low Prices Make Carrying Unneeded Renewables Costly

Notes: Resource levelized costs from US Energy Information Administration. Power market levelized prices from Ventyx Spring 2011 Outlook. Levelized costs and power prices are used here only for illustrative purposes.
WECC “Building Block” Reserves:
1. Contingency Reserves;
2. Regulating Reserves;
3. Reserves for generation forced outages
4. Reserves for 1-in-10 weather events.

### Table 5 – Winter Results

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“In this updated assessment, the forum concludes that the likelihood of a shortfall in 2017 has increased to 6.6 percent. *This means that the region will have to acquire additional resources in order to maintain an adequate power supply...*”

- Northwest Resource Adequacy Assessment, 2013
  Northwest Power & Conservation Council
Eye of the Beholder
People May Think About Resource Decisions Very Differently

Markets
- coverage ratio
- capital budget
- rates
- VAR

Megawatts
- capacitor banks
- 3-phase
- N-1
- power factor

GHGs
- solar
- reds
- EIS
- decadal oscillation
- DG

Note: Hypothetical people for discussion purposes only
Challenging Trade-offs

Cost
- High Rates

Reliability
- No supply outages or brownouts

Unpredictable Finances

Risk

All Renewables

Environment

Note: Hypothetical people for discussion purposes only
Buy from the Short-Term Market Instead of Owning or Contracting Resources?

Yes, it’s nearly always cheaper and there’s much less long-term financial risk. The market has always been there for us when we needed it!

No, it’s not as reliable as owning a resource. It doesn’t meet NERC recommendations. The entire market is effected in cold or dry years!

No, the market has a lot of surplus energy from GHG emitting plants fueled by oil, coal, and natural gas. It would keep those plants operating even more!

Note: Hypothetical people for discussion purposes only
Measuring Need
How Others Measure Need

- RTOs, ISOs, and NERC Regions
  - 1 in 10 Loss of Load Expectation (LOLE)
    - PJM, MISO, NYISO, Quebec, MAPP, IESO, ERCOT
  - Capacity Margin
    - SPP (15%),
    - Manitoba (> 50% hydro) 12% for capacity and critical water for energy
- Each Control Area has its Own
  - WECC
How Others Measure Need (Cont.)

- Pacific Northwest Utilities
  - Critical Water
    - Tacoma Power, Snohomish PUD, Clark PUD
How We Measured Need: A Risk Analysis for Resources

- A Probabilistic Measure of the *Difference* (+,-) *Between Generation Capability and Load in December*, Before Any Corrective Actions are Taken
  - The analysis estimates potential need before any SCL seasonal reshaping, short-term transactions, or hydro flexibility

- Aurora is Used for Estimating Generation Capability Through the Years Considering:
  - Hydro conditions
  - Unplanned outages
  - Changes in long-term power supply contracts
  - Biological opinion impacts for the Columbia River
  - Planned rewinds and maintenance

- City Light Used a 1 in 10 Loss of Load Probability
An Overview of the Methodology

- Over 3,000 Supply and Demand Scenarios
  - Based upon detailed studies of historical hourly supply and demand conditions in winter

- Scenarios Rank Ordered by Resource Need
  - Majority of scenarios are surplus
  - The 99th, 95th, 90th, and 50th percentiles are identified
    - Deficits reduced for amount Power Management expects to augment supply ahead of need
      - Hydro flexibility, seasonal reshaping, and short-term market purchases
Risk Analysis

- Risk is applied to Supply and Demand Independently
  - **Supply Risk**: Volatility in Hydro (High & Low Water) and Forced Outages
  - **Demand Risk**: Volatility in Heating Demand November through February
Supply (Hydro) Volatility

- Hydro is About 90% of our Resource Portfolio
  - Water conditions have a major impact on SCL generation capability
- Hydro “Volatility” is Not Uniform Across All of Our Hydro Resources
  - Within a given year, the Skagit projects may have a high water month in December while Boundary may have a low water month in December
- “Time Series” and “Cross-Sectional” Correlations are Incorporated into the Probability Distribution Analysis
Demand Volatility

- Demand is Strongly Related to Temperature
  - Demand and hydro conditions have no correlation

- The Temperature for a Given Hour has Almost No Correlation with the Temperature of an Hour in Another Month
  - Northwest weather variability and seasonal changes

- Historical Demand Variation (AVG, SD, and CV) for December and January are Incorporated in the Probability Distribution Analysis
Developing Risk Metrics: Simulation of Objective Function

Resource Adequacy Function:
A Normal Distribution was assigned to both Hydro and Demand inputs in the following objective function

\[ R.A. = F(D_{\text{DEC}}, D_{\text{JAN}}, \text{SKAGIT}_{\text{DEC}}, \text{SKAGIT}_{\text{JAN}}, BN_{\text{DEC}}, BN_{\text{JAN}}, \text{SLICE}_{\text{DEC}}, \text{SLICE}_{\text{JAN}}) \]

R.A. = Resource Adequacy
D = Demand
BN = Boundary
Skagit = Gorge + Diablo + Ross
Slice Product = SCL Share of BPA’s system

The simulation method that was used in this process is: Latin Hypercube Simulation
Risk Analysis of Supply and Demand

Risk Analysis of Supply and Demand (MW)

MW

D2
D0
D1

S2
S0
S1

Risk Area

Time (Hourly, 20 years)
Estimating Risk for Resources

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<th>MO(DEC)-Hrly NetDeficit</th>
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Net Deficit Sorted

- Obsv-1
- Obsv-2

99th Percentile
95th Percentile
90th Percentile
85th Percentile
80th Percentile
75th Percentile
50th Percentile
25th Percentile

Resource Adequacy Computational Algorithm
Winter Season One-Hour Resources to Reach 95% and 90% Confidence Levels

Notes: After up to 300 MW of hydro flexibility, seasonal reshaping, and short-term market purchases. Analysis is an estimate based upon long-term forecasts of hourly loads, resources, and generation capabilities.
Questions or Comments?

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