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*."

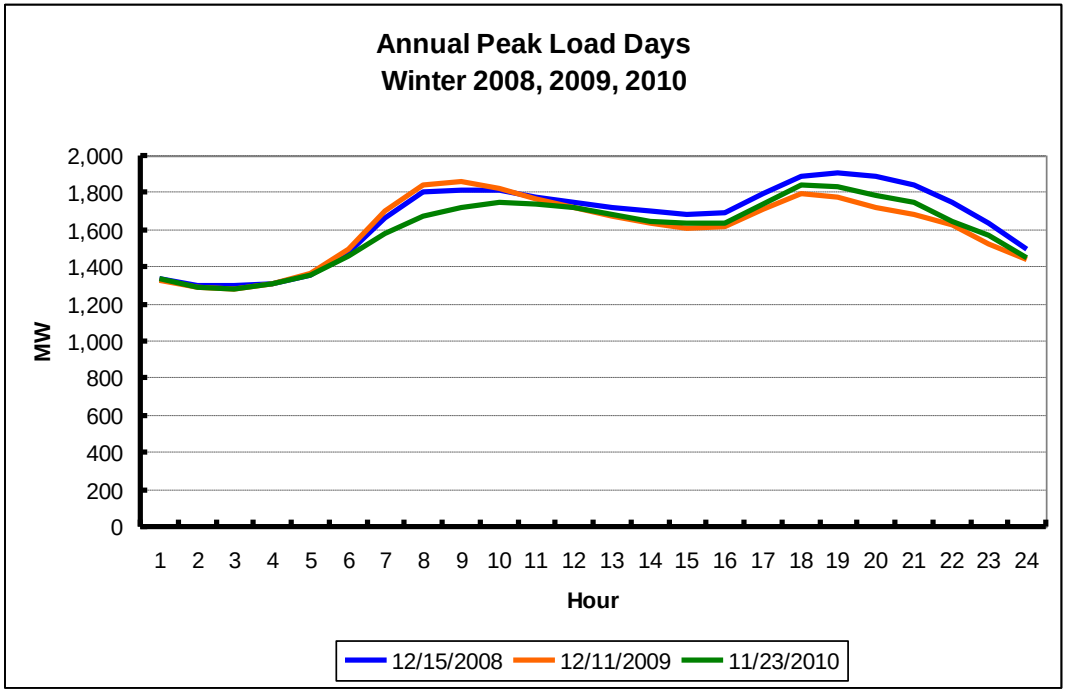
North American Electric Reliability Corporation (NERC)

How Much is Enough?

Peak Demand, Hydro Variability, Outage Risk, Economics, Market Supply

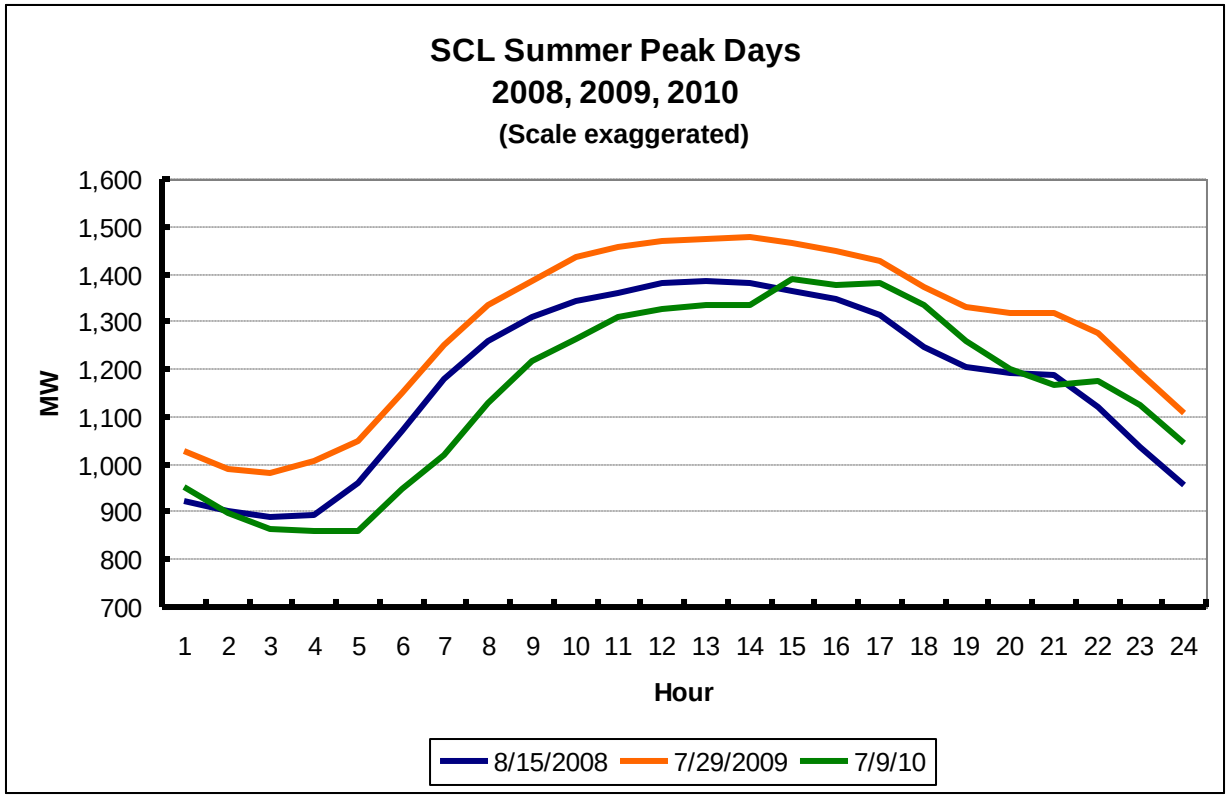
Annual Peak Demand Days: Winters of 2008-2010

- 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

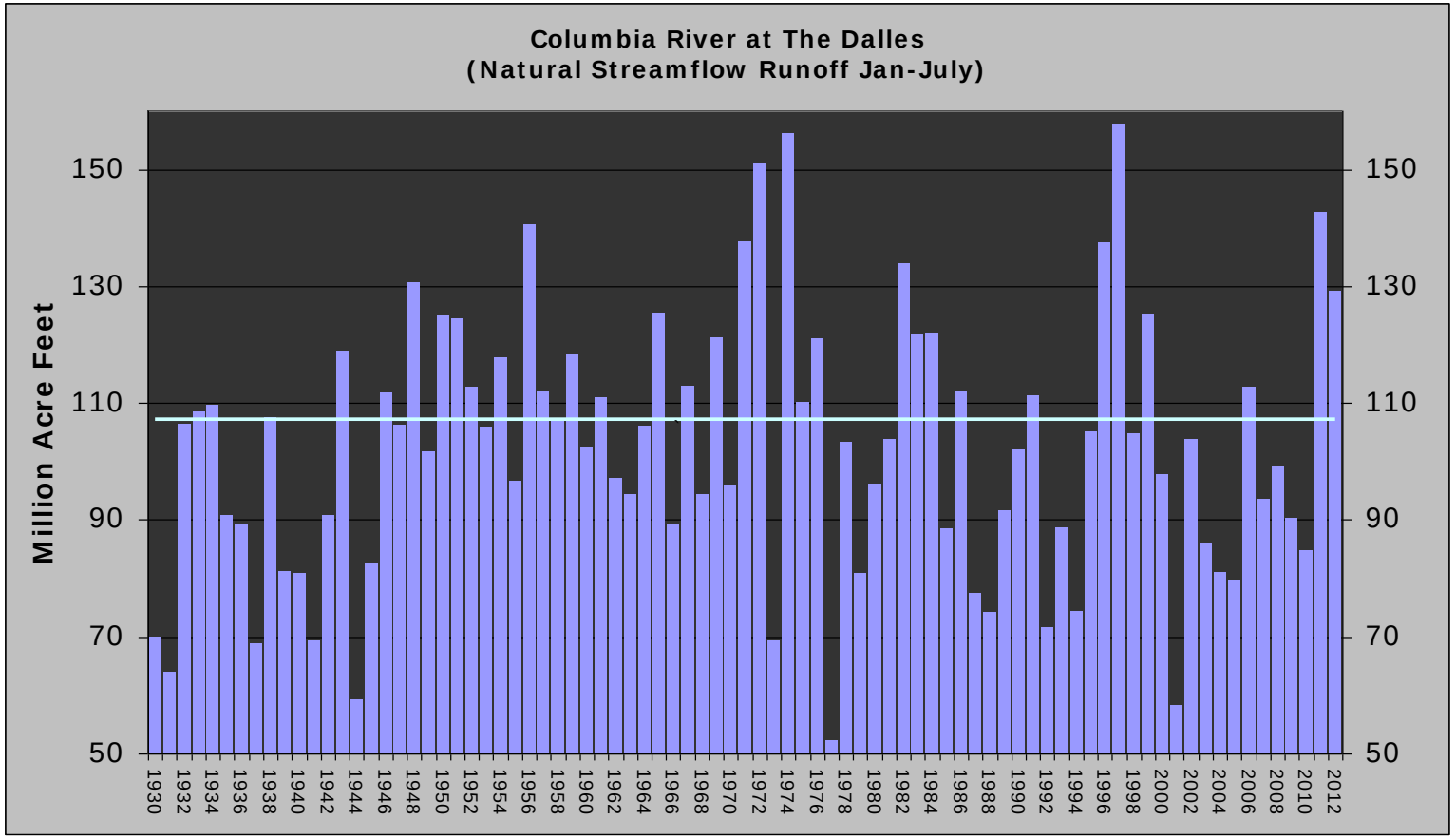


Summer Peak Demand Days: 2008-2010

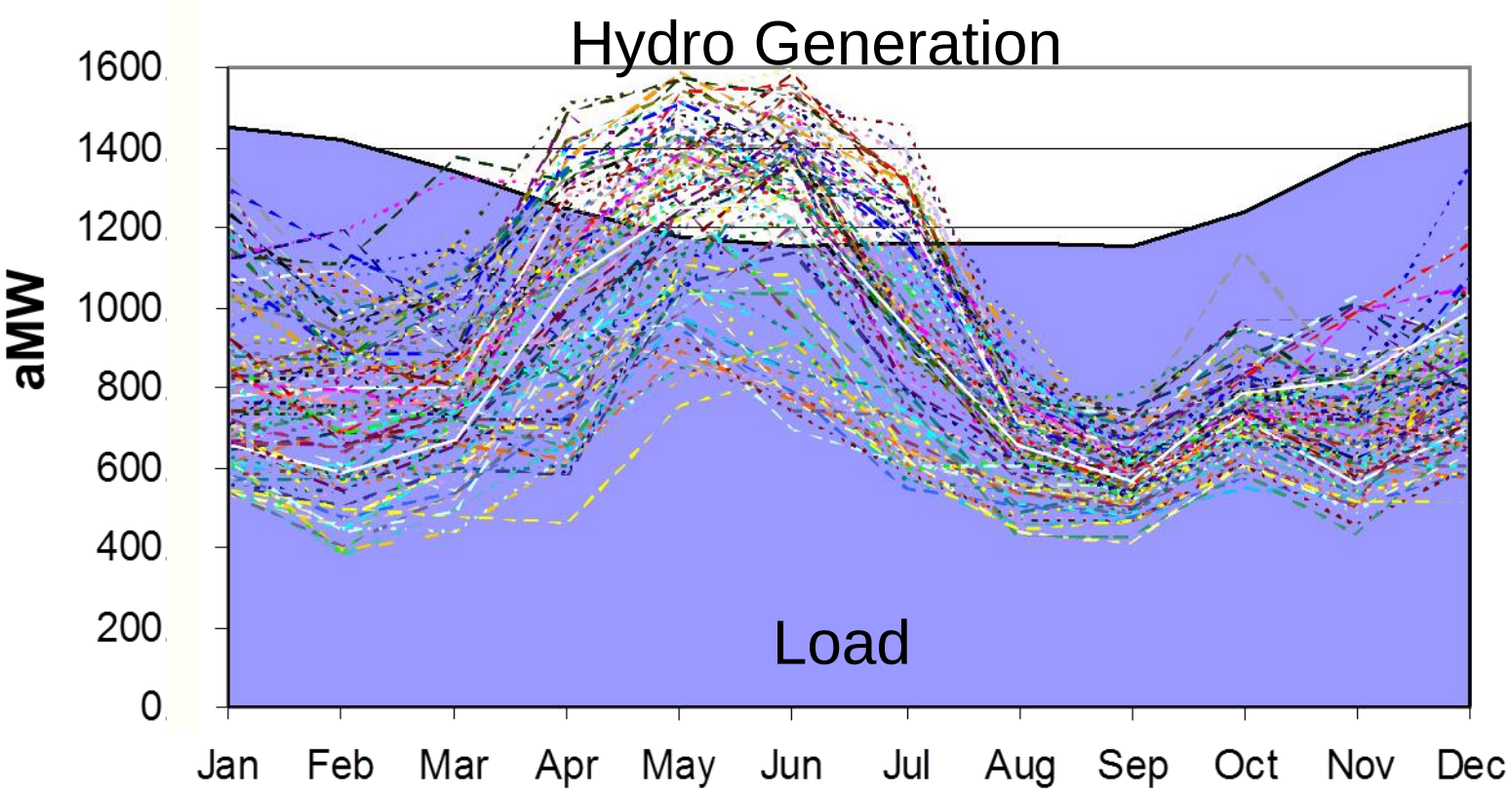
- Summer Peaks are Growing Faster than Winter Peaks
- Peaks Occur About 1:00 PM: Commercial Air-Conditioning



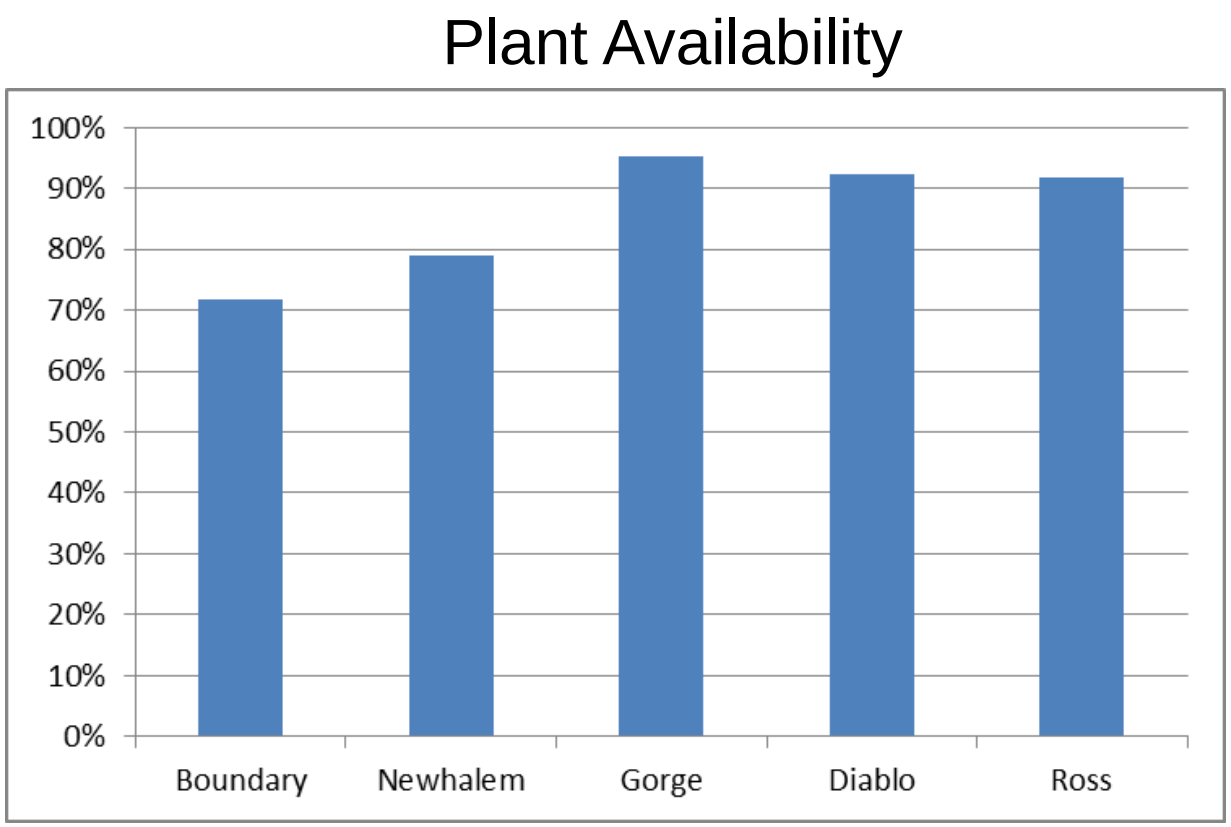
Columbia River Hydro Variability January- July Natural Flows



SCL Hydro Variability and Typical Load Shape

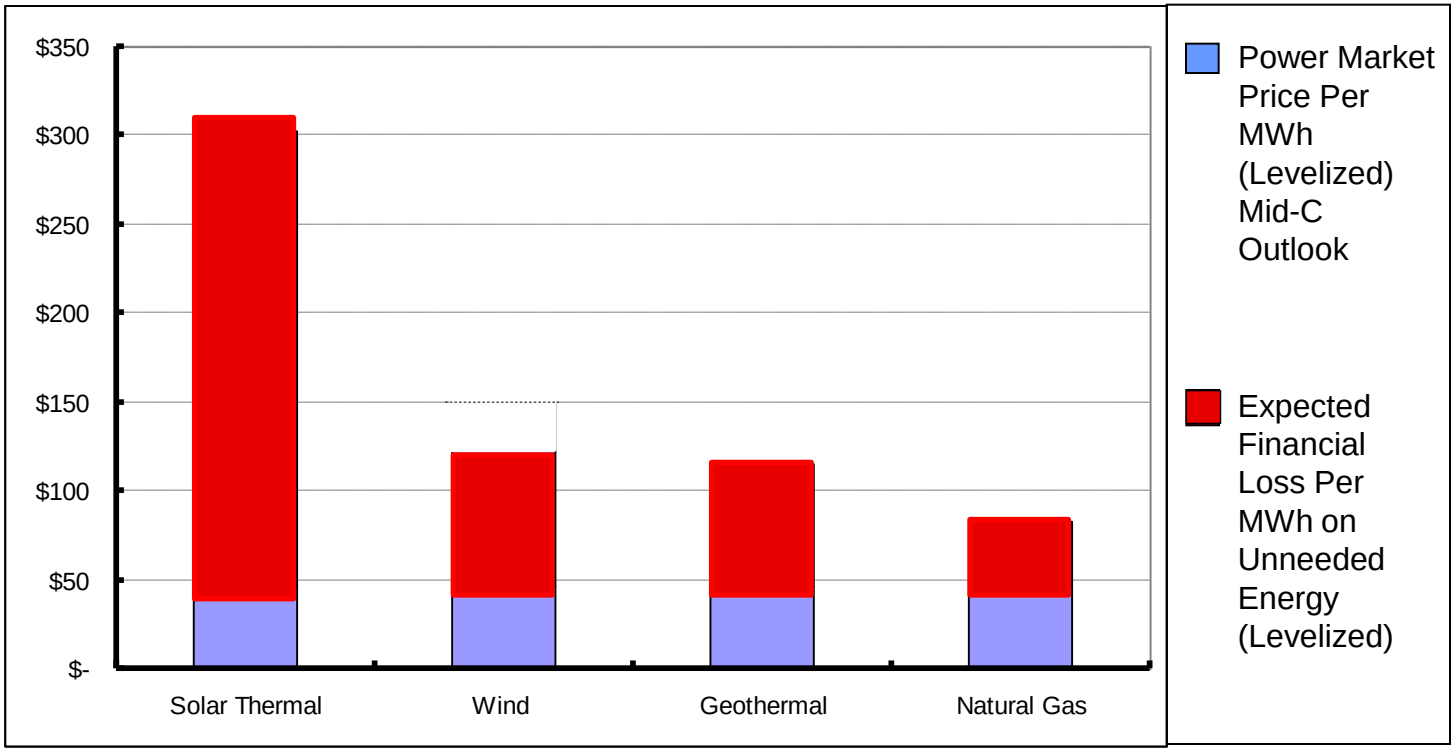


Outages


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

Buying Resources and Selling Into the Short Term Power Market



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.

Market Supply: WECC Winter Extreme Temperature Assessment – No Worries

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

Planning Reserve Margin		Winter									
Subregion	Resources	Building Block Target	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Canada	Existing/Class 1	13.9%	**11.5%**	14.4%	**12.2%**	**7.6%**	**3.3%**	**0.9%**	**1.9%**	**-0.1%**	**-0.7%**	**-0.9%**
	Existing/Class 1/Class 2		17.9%	21.4%	24.9%	23.8%	20.9%	19.5%	19.1%	17.6%	16.7%	16.3%
	Existing/Class 1/Class 2/Class 3		18.1%	26.0%	25.3%	25.9%	22.5%	19.5%	19.1%	17.6%	16.7%	16.3%
	Existing/Class 1/Class 2/Class 3/Class 4		20.2%	29.6%	30.5%	33.2%	36.6%	33.7%	35.0%	35.9%	34.7%	34.1%
Northwest US	Existing/Class 1	19.2%	33.5%	32.4%	30.5%	29.9%	29.3%	26.1%	23.7%	23.1%	21.4%	19.3%
	Existing/Class 1/Class 2		32.0%	34.4%	32.9%	33.4%	32.8%	30.6%	29.1%	27.8%	26.1%	23.9%
	Existing/Class 1/Class 2/Class 3		33.9%	34.5%	32.9%	33.4%	33.5%	31.4%	29.9%	28.2%	26.4%	24.3%
	Existing/Class 1/Class 2/Class 3/Class 4		34.0%	34.5%	32.9%	33.5%	33.6%	33.7%	32.2%	30.4%	28.7%	26.5%

Market Supply: NW Resource Adequacy Forum – More than 1 in 20 Risk

- "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

The Financial Analyst

Markets
coverage ratio
capital budget
rates
VAR

Megawatts
capacitor banks
3-phase
N-1
power factor

The Environmentalist

GHGs
redds
EIS
solar
DG
decadal oscillation

Note: Hypothetical people for discussion purposes only

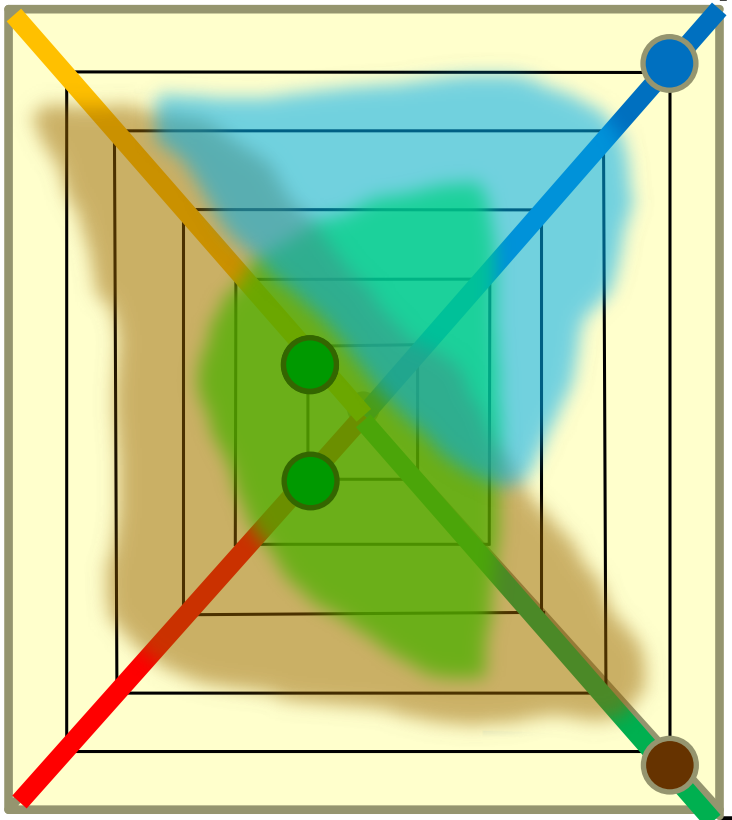
Challenging Trade-offs

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?

The Financial Analyst

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!

The Environmentalist

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:**

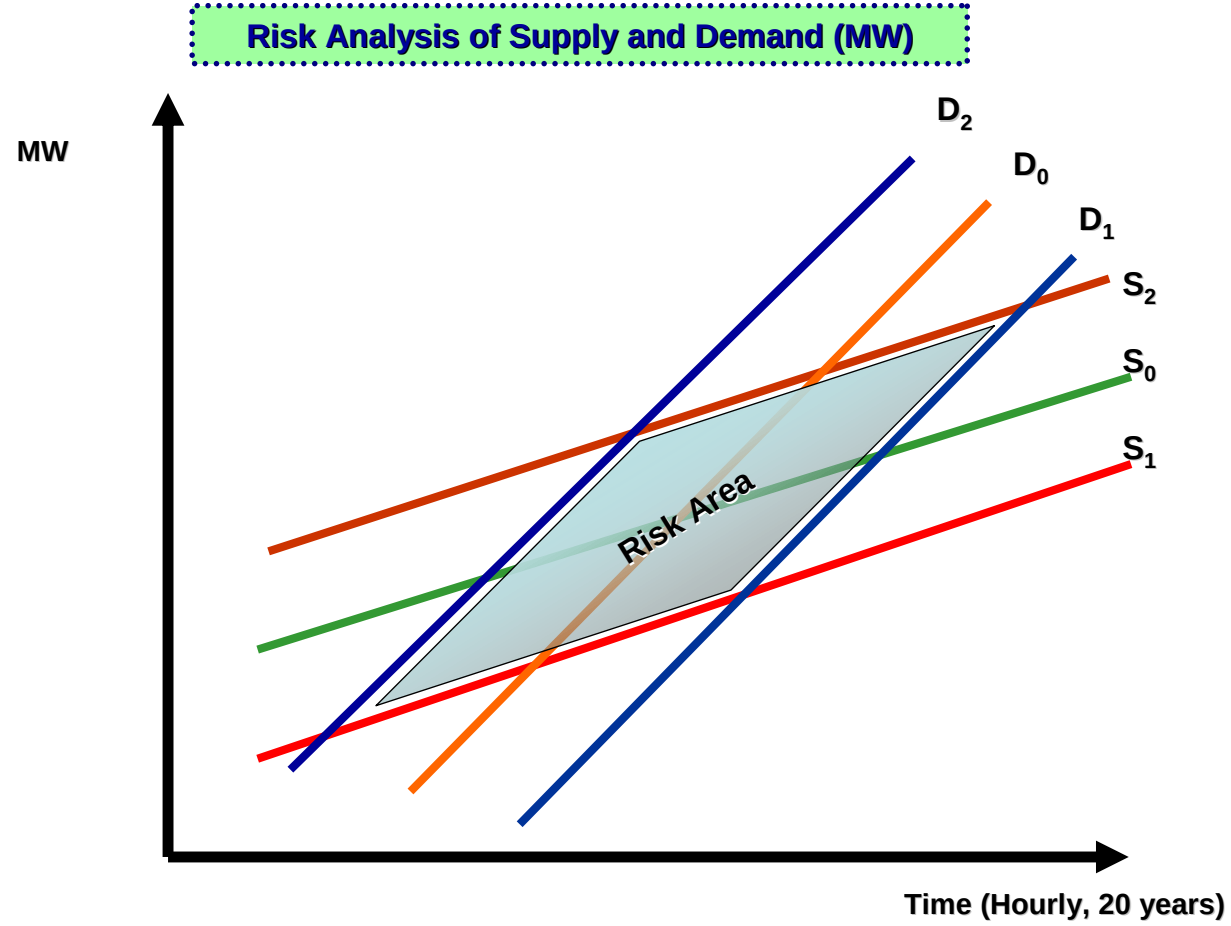
  A Normal Distribution was assigned to both Hydro and Demand inputs in the following objective function

$$R.A. = F(D_{DEC}, D_{JAN}, SKAGIT_{DEC}, SKAGIT_{JAN}, BN_{DEC,} BN_{JAN,} SLICE_{DEC}, SLICE_{JAN})$$

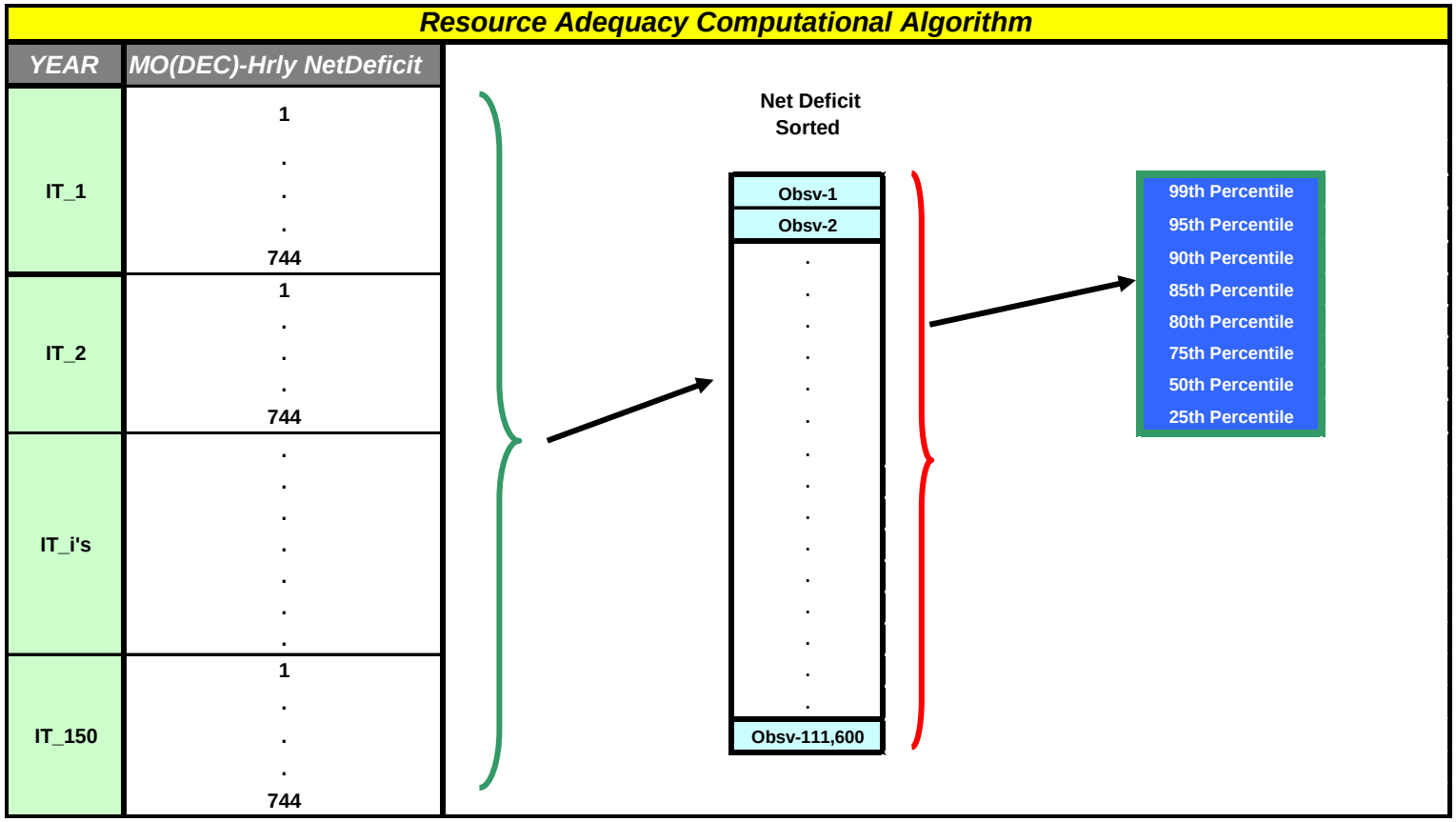
R.A. = Resource Adequacy
D = Demand
BN = Boundary
Skagit = Gorge + Diablo + Ross
Slice Product = SCL Share of BPA's system

The simulation method that was used in this process is: Latin Hypercube Simulation

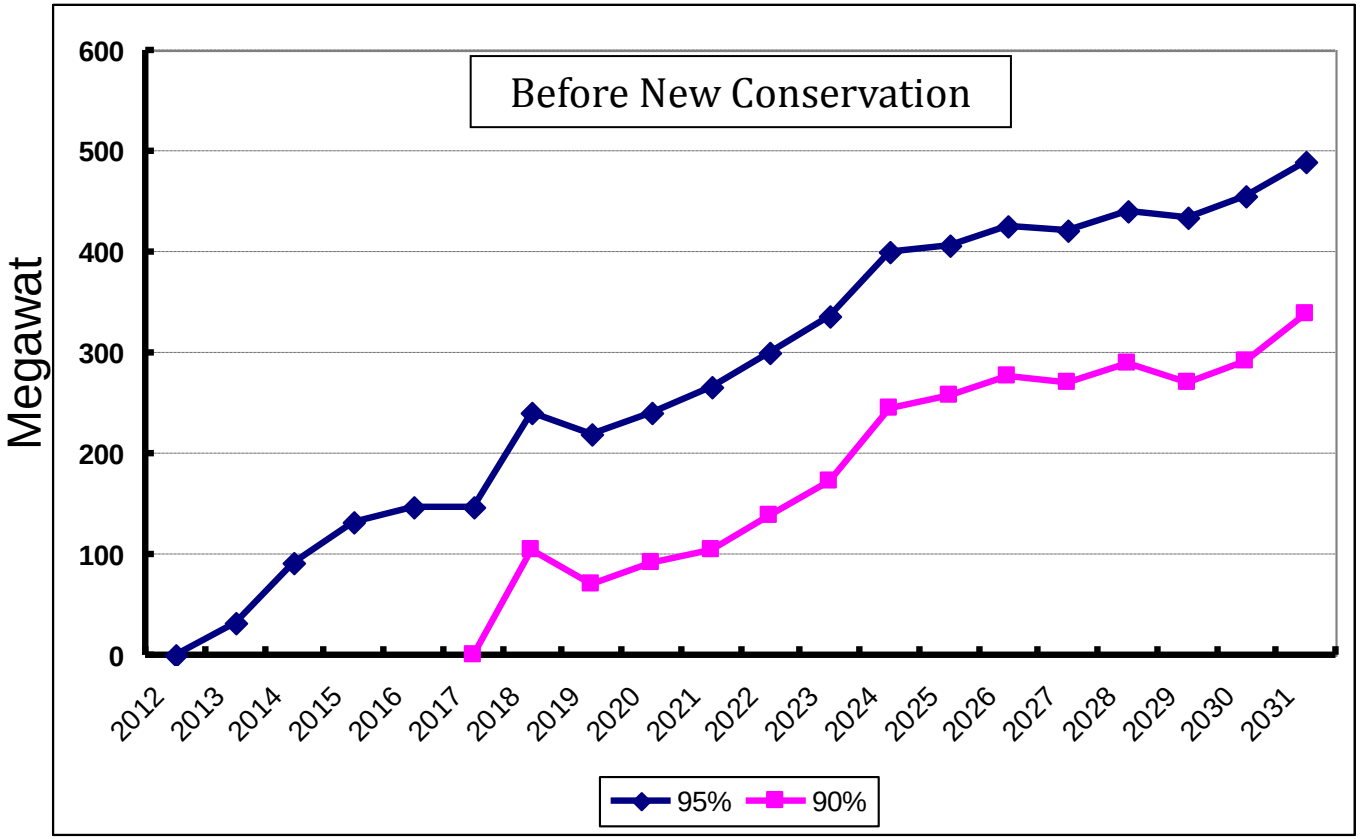
Risk Analysis of Supply and Demand



Estimating Risk for Resources



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?

IRP Website Address:
http://www.seattle.gov/light/news/issues/irp/
E-Mail: SCL.IRP@Seattle.gov

David Clement
(206) 684-3564, Dave.Clement@Seattle.gov