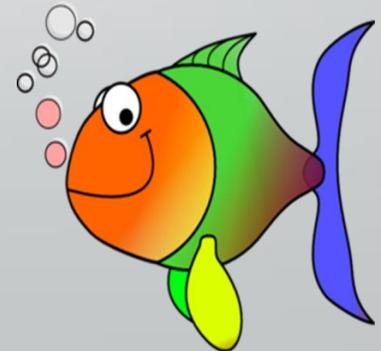


Small Fish in a Big Pond

(Why We Benchmark Our Electric
Generation Resources)

Eugene Water & Electric Board

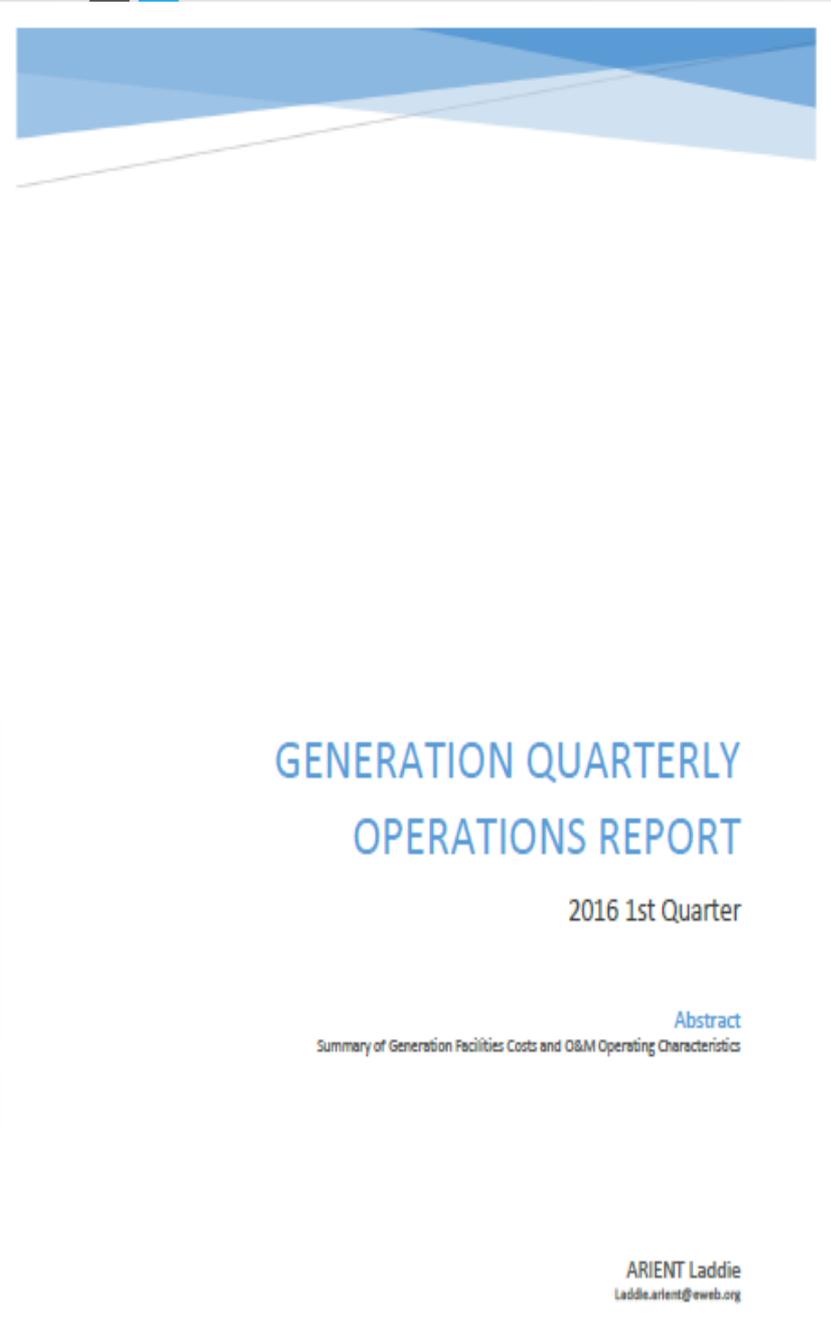


A little bit about us:

- We have 189 MW of hydro capacity in five plants / ten units.
- We have 29 MW of wind capacity at two wind farms.
- We have 61 MW of capacity from two co-gen facilities.
- Generation Engineering has 11 employees.
- Generation Operations has 5 MAPT employees & 14 operators.
- Our (former) GM said: "I am a fan of real benchmarking."

So what do we measure?

- Performance data: availability (AF), capacity (CF), forced outages (FOF), critical maintenance (CPM), output (MW-hrs)
- Cost data: Operational expenses (operations, maintenance, administration), Capital expenses/investment, budget adherence
- Human performance: staffing, OT, safety (LTAs, reportables).
- Condition assessment: HydroAMP (tier1/tier 2)



GENERATION QUARTERLY OPERATIONS REPORT

2016 1st Quarter

Abstract

Summary of Generation Facilities Costs and O&M Operating Characteristics

ARIENT Laddie
laddie.orient@eweb.org

We produce a quarterly report that presents operations data for all generation resources, including:

- Status of critical PMs
- Status of capital work
- Cost data
- Performance data
- Outage summaries

EWEB Hydro Generation

MARCH 2016

First Quarter KPI Report

Unit Short Name	Year	Availability Factor	Gross Capacity Factor	Forced Outage Factor	Gross Output Factor
LBU1 (8.4 MW)	2016	100.00	83.13	0.00	83.13
	2015	67.34	46.63	32.66	69.25
	2014	100.00	72.95	0.00	77.58
LBU2 (7.5 MW)	2016	100.00	93.75	0.00	93.75
	2015	67.36	61.47	32.64	91.25
	2014	100.00	86.52	0.00	91.98
WVU (8 MW)	2016	99.75	79.84	0.25	80.04
	2015	100.00	82.14	0.00	82.14
	2014	100.00	59.21	0.00	81.74
CSU1 (52.25 MW)	2016	100.00	37.72	0.00	71.14
	2015	99.94	33.12	0.05	68.00
	2014	97.18	25.91	2.82	61.04
CSU2 (52.25 MW)	2016	100	26.94	0.00	51.62
	2015	99.68	20.74	0.04	58.41
	2014	91.08	38.22	8.80	59.47
TBU (9.98 MW)	2016	99.90	71.89	0.00	71.96
	2015	100.00	61.33	0.00	61.76
	2014	99.34	74.18	0.66	74.67
TOTAL MCKENZIE HYDRO	2016	99.94	44.72	0.04	69.26
	2015	89.05	36.17	10.90	68.26
	2014	97.93	42.29	2.05	67.60

LB-WV Costs –

Table 1: LB Cost Comparison through end of current quarter

Note: Cost sections are currently populated with 2015 annual report data. Reports are in development that will allow us to collect this data more easily on a quarterly basis.

	Quartile	Value	Benchmark Value (Peer Group 0-30MW)
O1 + O2 (000\$/Unit)	4	\$358	>\$99
O1 + O2 (\$/kW)	4	\$46	>\$38.38
O1 + O2 + M1 + I1PWR (\$/kW)	3	\$73.89	\$47.38-\$79.84
M1 + I1PWR (\$/kW)	3	\$27.89	\$23.81-\$51.84

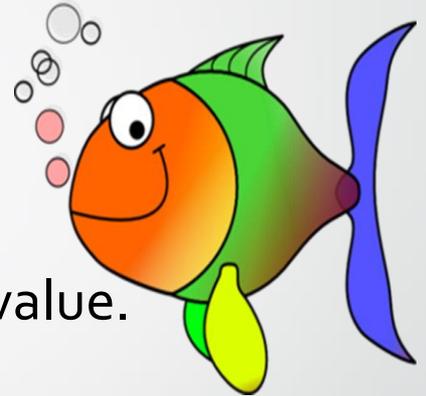
Table 2: WV Cost Comparison through end of current quarter

	Quartile	Value	Benchmark Value (Peer Group 0-30MW)
O1 + O2 (000\$/Unit)	4	\$483	>\$99
O1 + O2 (\$/kW)	4	\$51.84	>\$38.38
O1 + O2 + M1 + I1PWR (\$/kW)	3	\$66.75	\$47.38-\$79.84
M1 + I1PWR (\$/kW)	2	14.51	\$8.61-\$23.81

How do we use the information?

- Internal and external reporting: budget and KPIs
- Capital planning (5 yr / 10 yr CIP)
- Schedule and outage planning
- Benchmarking with other utilities through EUCG:
 - Staffing levels and safety metrics
 - Environmental and social costs
 - Operations – availability, outages, output
 - Costs - \$/kw, \$/MW-hr

Why is this important to EWEB?



- It provides metrics to assess performance and value.
- It provides data to justify decisions.
- It identifies problem areas or hot spots to focus attention.
- Current market pressures are driving additional scrutiny.
- Supports a team approach to improving performance.
- Why EUCG? It provides us a peer group with which to benchmark, evaluate, problem solve, and learn from.

Benchmarking Applications

Dan T. Davis, PE

O&M Program Manager

US Army Corps of Engineers --
Northwestern Division

Portland, Oregon

May 17, 2016



US Army Corps of Engineers
BUILDING STRONG®

Benchmarking of Hydropower in NWD

- EUCG
 - ▶ All Corps plants are benchmarked
 - ▶ USBR became involved recently
 - ▶ Self-service database and analysis
 - ▶ Oak Ridge National Laboratories advancing the efforts of the Hydropower Analysis Center (HAC) on modeling of data sets
 - ▶ Annual reporting under development
- Navigant until FY 2014
 - ▶ Just Pacific Northwest plants and sister agency (USBR) were included
 - ▶ Turnkey service and annual report
- Independent efforts by HAC using USACE accounting principles
 - ▶ Focused on the PNW
 - ▶ O versus M as defined in our regulations
 - ▶ Investment categories expense versus capital
 - ▶ Compare and contrast with Performance Data (e.g., NERC GADS)



Benchmarking of Hydropower in NWD (continued)

- Performance Data must be included with cost information to get a complete picture
 - ▶ Run-to-ruin is very cost effective and benchmarks well, for a short time.
- Long term trends can be more valuable than where you benchmark
 - ▶ Validates ISO 9000 principles of continuous improvement
 - ▶ Relative information when comparing against yourself removes the uncertainties with other peoples data
 - ▶ Comparing your trends against others can be illuminating
 - ▶ Particularly useful in the USACE because of the size of the data set (75 plants)
- Design characteristics and geography are more significant than plant management
 - ▶ Well-designed and well-sited plants will always benchmark ahead of excellently-managed, poorly-designed plants.
 - ▶ Contrast best and worst performer in our system
 - Big versus small
 - Kaplan versus Francis
 - Remote operation versus continuously manned control room



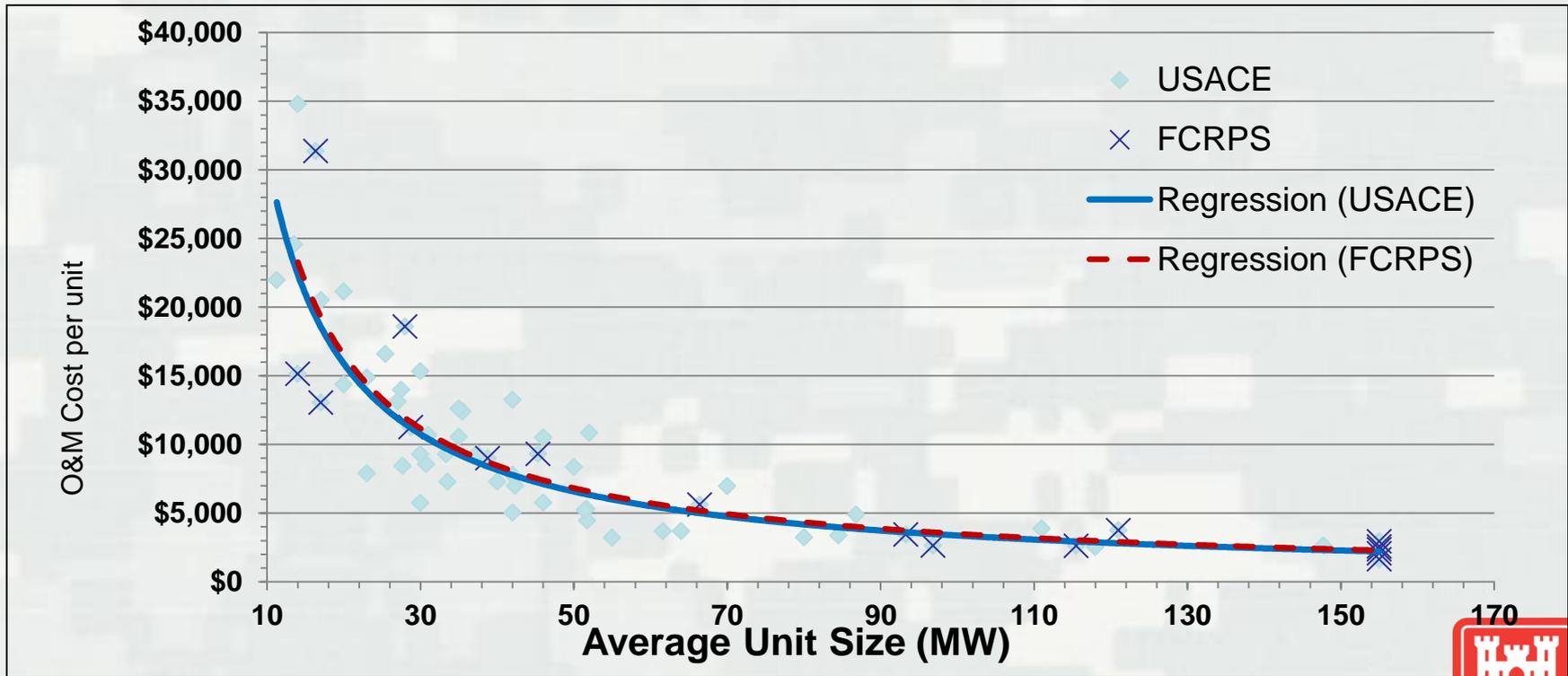
Observations

- Different data visualizations and combined metrics can help focus analysis on different aspects of benchmarking
 - ▶ O+M+A gives a holistic picture of plant efficiency
 - ▶ Cost shifting from O to M and vice-versa
 - Tornado diagrams
 - Radar Displays
- Comparison of systems or watersheds, not plants, is often valuable
 - ▶ Capital re-investment is not useful at a plant level because it fluctuates wildly depending on the projects
 - ▶ In our system, re-Investment levels are low for a system of our size and age
- Benchmarking can be a blunt instrument, but multi-year trends hone the results



More Observations

- “Peer Group” concept was flawed and replaced with a multivariate regression with all plants
 - ▶ Shoulder effect – plants near the end of a peer group are often the best or worst performers



Benefits of EUCG

- Do-it-Yourself data set to answer many questions and compare many parts of your organization
- Low cost for access
 - ▶ Mostly internal costs for sorting and uploading data
- Collaboration with industry partners and POCs in many organizations
- Other individual surveys and studies used to examine your organization
 - ▶ Manpower studies
 - ▶ Safety studies



Questions and comments?



®

US Army Corps of Engineers
BUILDING STRONG®



EUCG BENCHMARKING

Using Data to Support Strategic Goals

Michelle Vargo | May 17, 2016



a picture
is worth
1,000
words





CITY LIGHT

OUR VISION

To set the standard—to deliver the best customer service experience of any utility in the nation.

OUR MISSION

Seattle City Light is dedicated to exceeding our customers' expectations in producing and delivering environmentally responsible, safe, low-cost and reliable power.

OUR VALUES

Excellence, Accountability, Trust and Stewardship.



SEATTLE CITY LIGHT



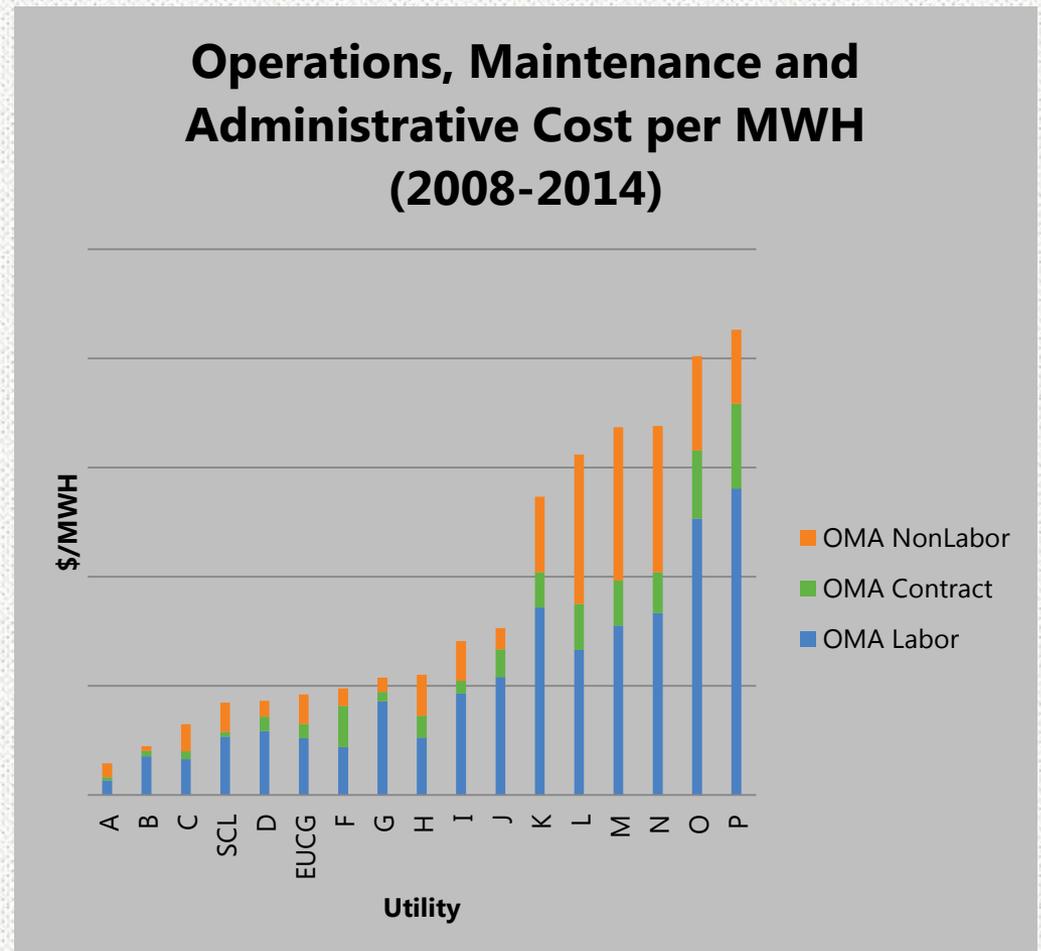
- **Public: Municipally-Owned utility**
- **Incorporated 1902**
- **131 Sq. mi. service area**
- **776,336 Population served**
- **1835 Employees**
- **7 Hydroelectric Plants**
- **15 Major Substations**
- **1810 MW Generation Capacity**
- **656 Transmission Circuit Miles**
- **2,313 Distribution Circuit Miles**
- **317 Network Distribution Circuit Miles**
- **Net-Zero Greenhouse emissions since 2005**

STRATEGIC INITIATIVE COMMITMENT

- Power Production Strategic Initiatives 2010-2016
 - Reduce O&M and CIP Budget by \$1,560,600/year
 - 6.3% O&M reduction; 16.1% O&M-labor reduction
 - Efficiency Gains of \$45,000 per year
 - Predictable & Sustainable 4.3% rate increase
- EUCG Data Used to Support
 - Baseline Budget and Staffing Needs
 - Exceedance of Organizational Goals

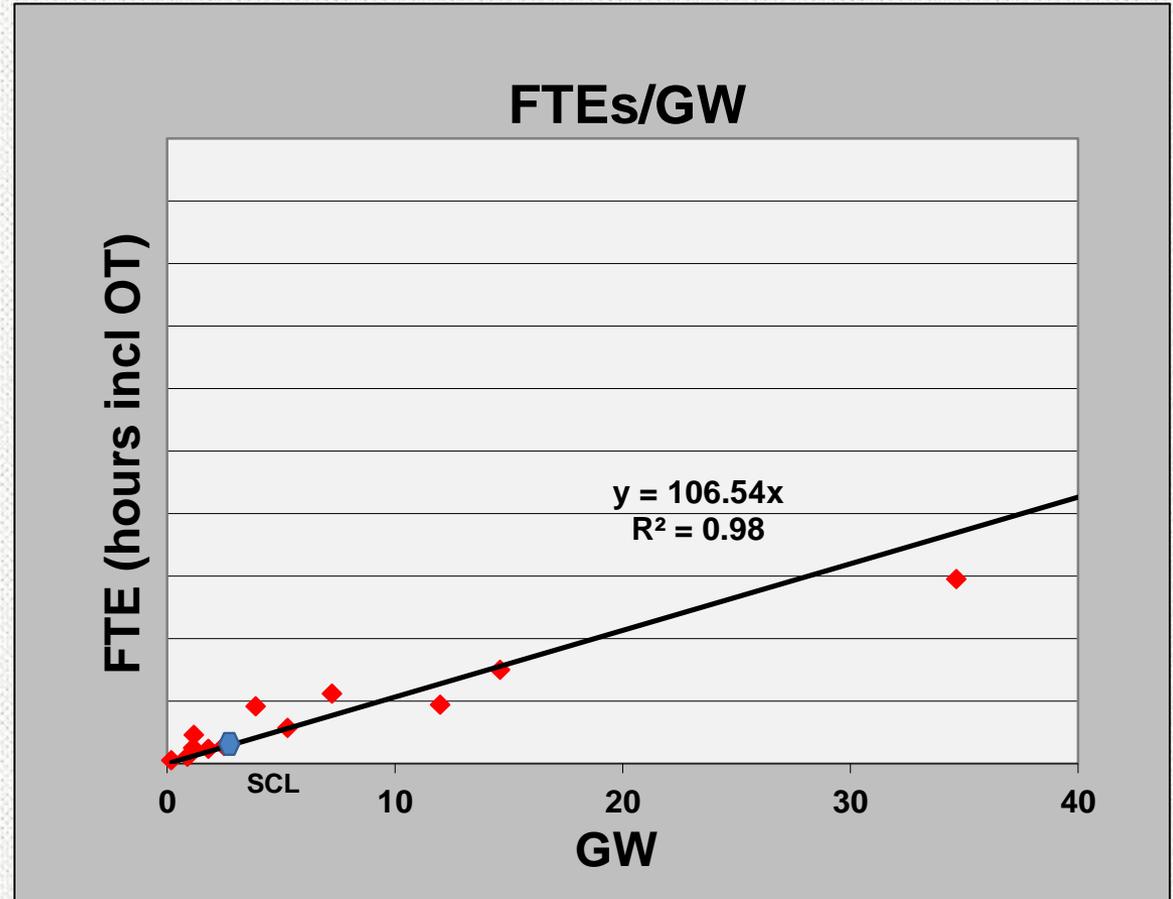
OMA COST PER MWH

- Hydro-Related Costs/MWH (excluding capital, regulatory, and environmental):
 - Spending is less than EUCG average → SCL among industry leaders
 - OMA Labor > EUCG average
 - OMA Contract Labor < EUCG average
- Achieved efficiency gains through:
 - Maximizing unit performance
 - Optimizing maintenance schedule



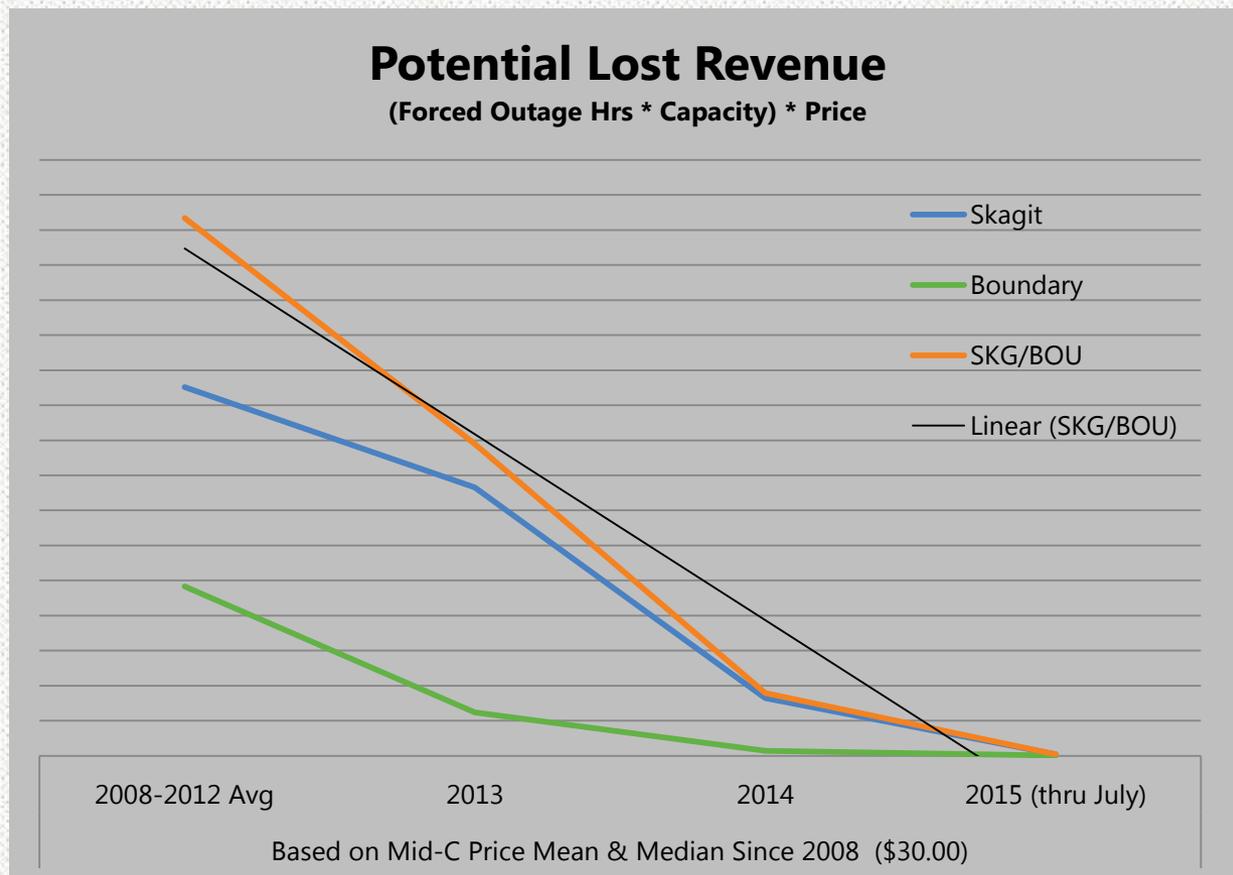
FTE'S PER GW

- Average from EUCG Hydropower Committee participants
- SCL on average line and hours include OT:
 - adding FTE's justified to meet current productivity
 - Current FTE's overworked
- Division is lean; leader among small utilities
- Depicts economies of scale



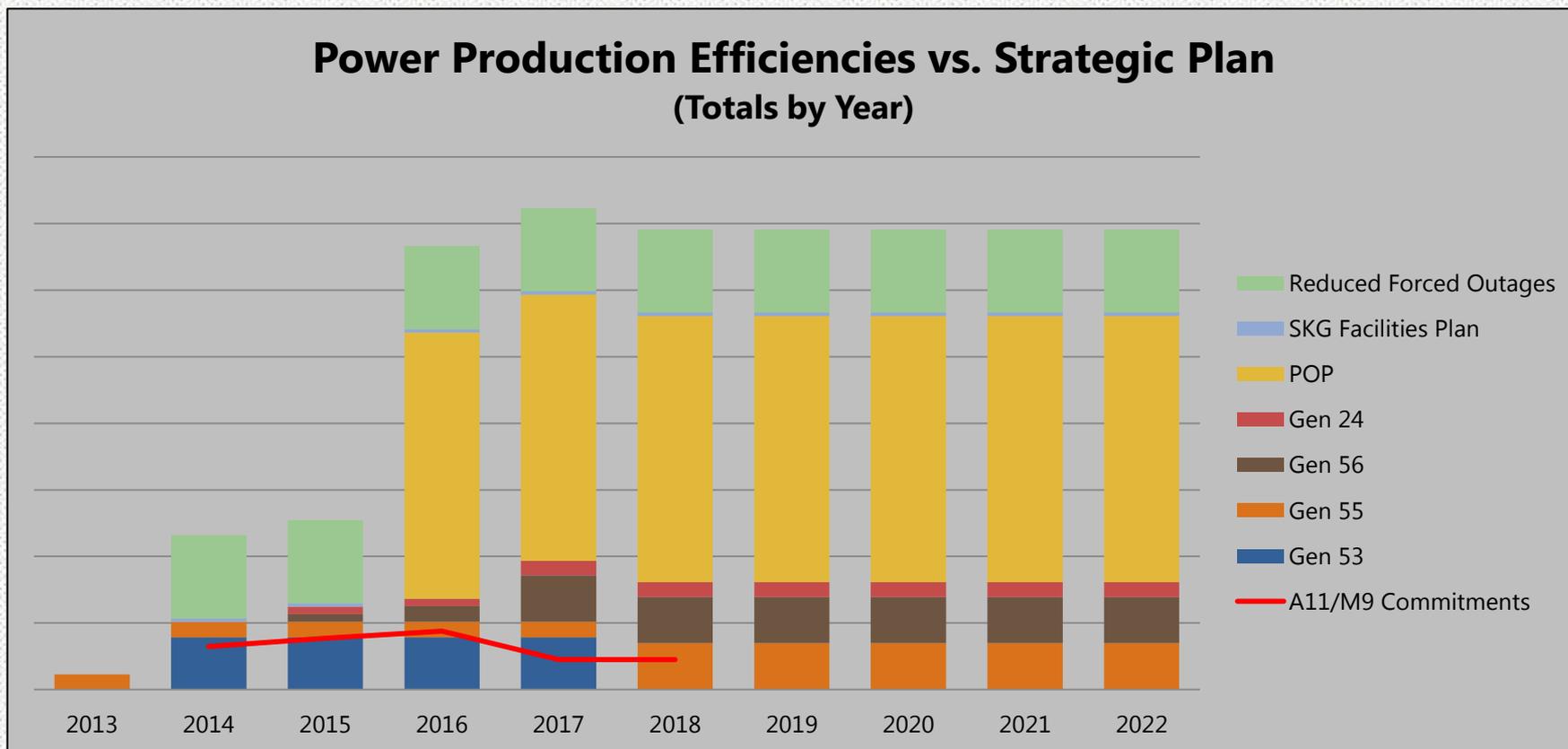
LOST REVENUE OVER TIME

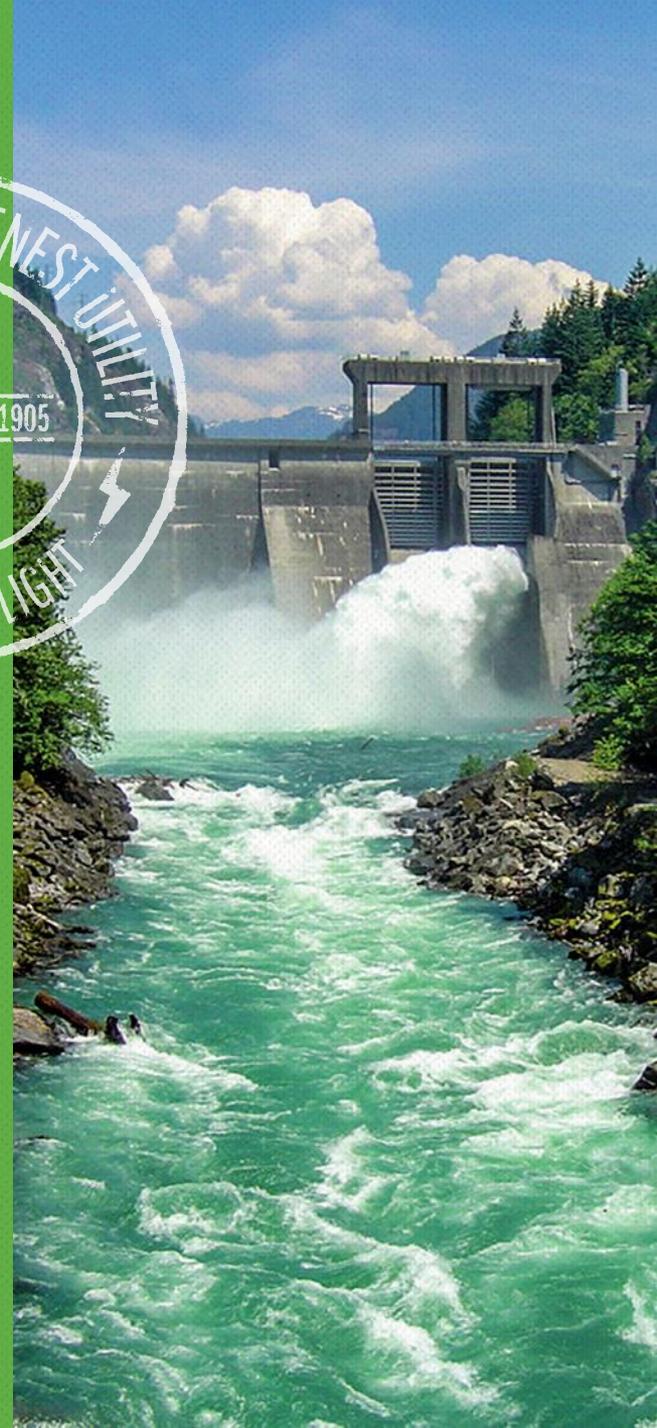
- Consistent reduction in forced outage hours
- Improved reliability:
 - Unit Rewinds/Upgrades
 - 10 scheduled 2010-2022
 - Maintenance Practices
 - HydroAmp
 - Coordination/Scheduling with Power Marketing



EFFICIENCY GAINS OVER TIME

- Exceeding efficiency gains: Capital investments, scheduling, maintenance program, facilities plan







Benchmarking at BPA

Matt Dau
Hydro O&M Program Manager
Bonneville Power Administration

Northwest Hydro Forum
Eugene, OR
May 17, 2016

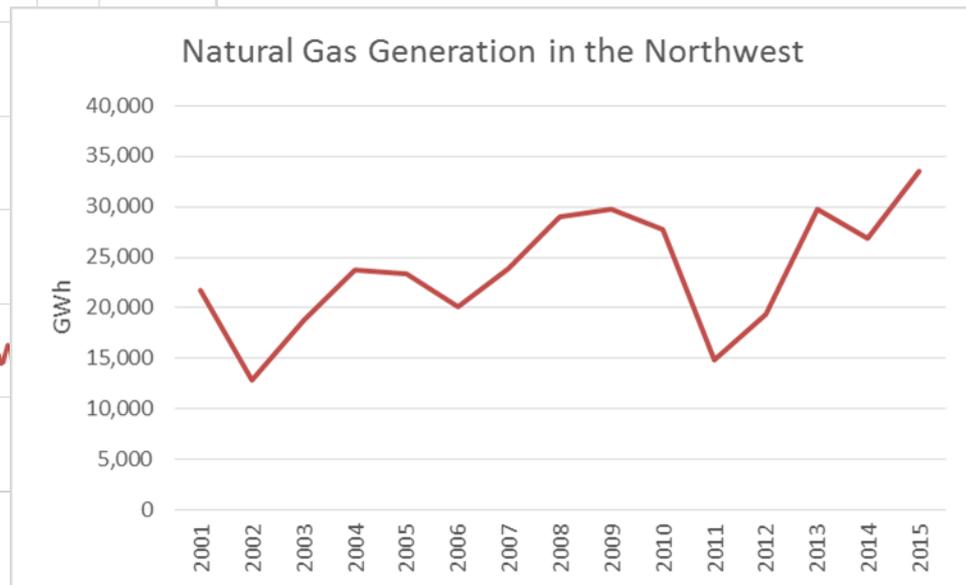
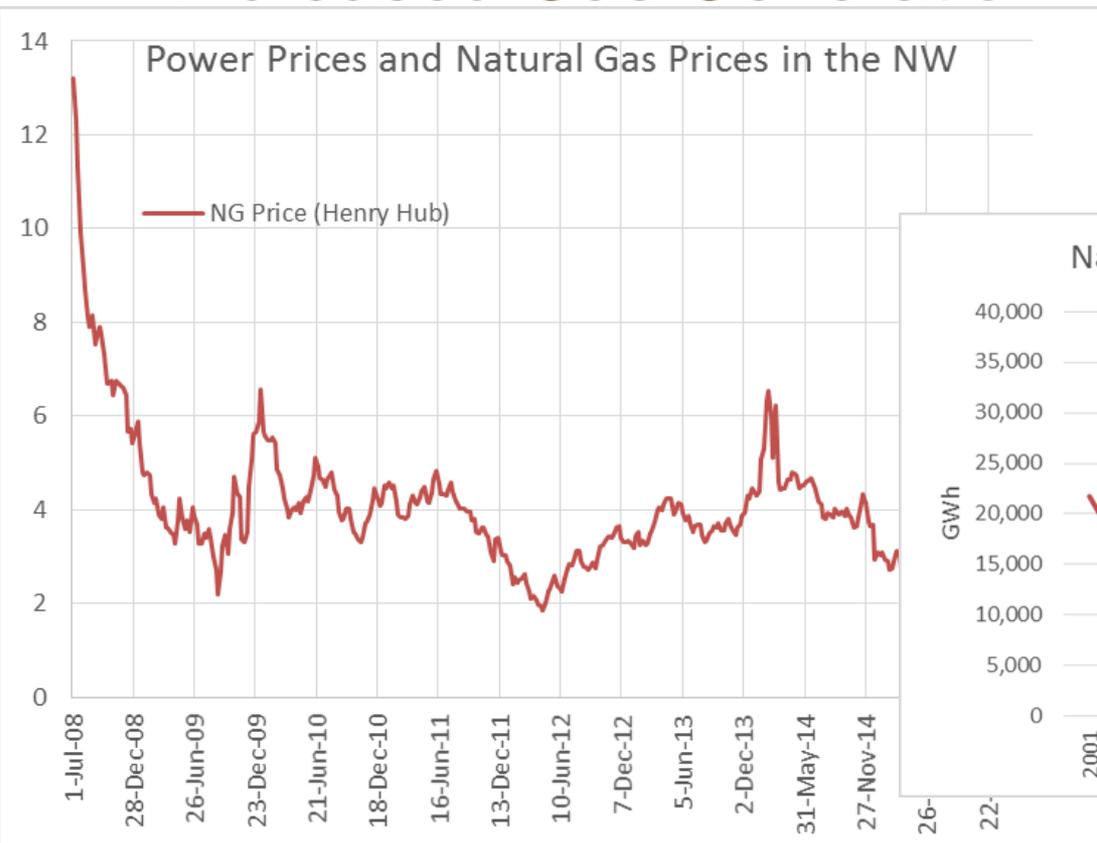


Overview

- What are you measuring?
- Not a performance management tool
- Large-scale utility- or corporate-level trends
- Raises just as many questions as it answers

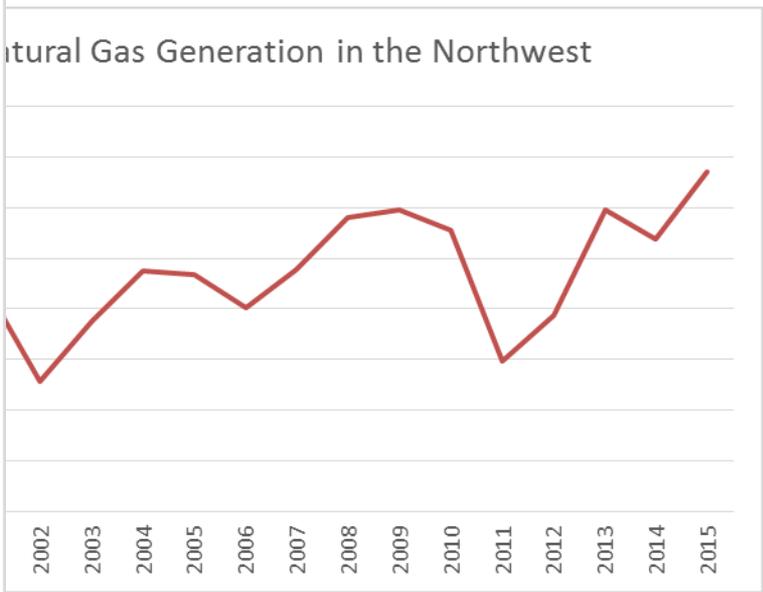
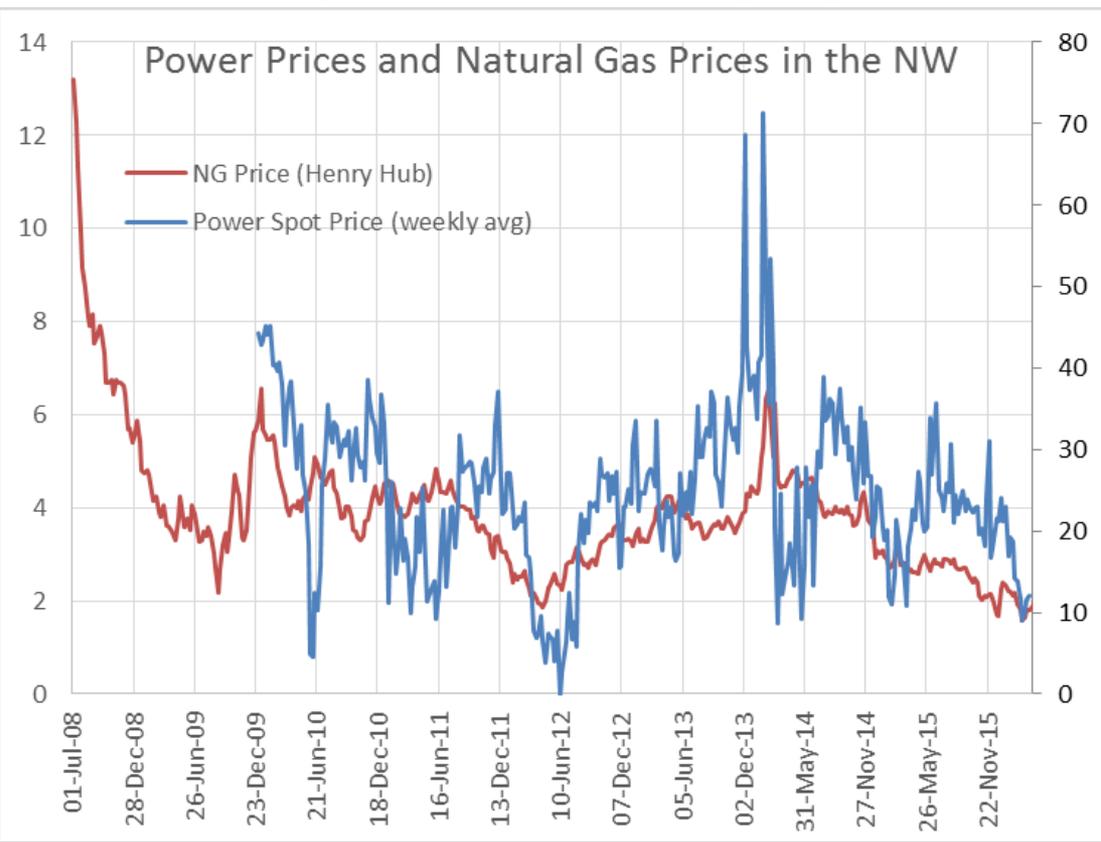
Market context

- Cheap Natural Gas
- Increased Gas Generation



Market context

- Wholesale power prices, while influenced by many factors, largely follow natural gas prices

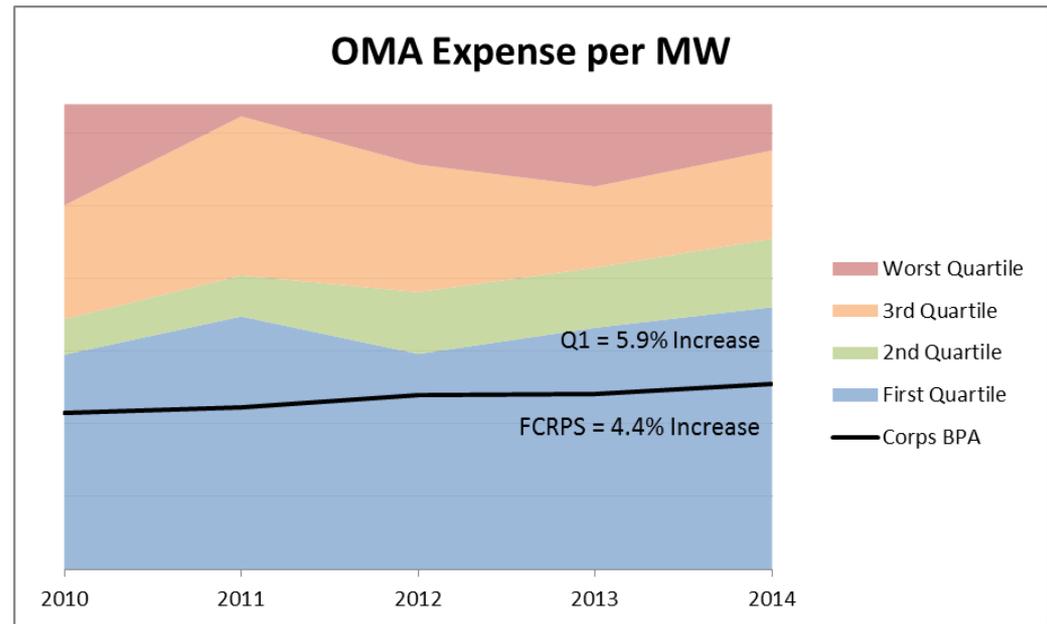


Source: EIA

Program Justification

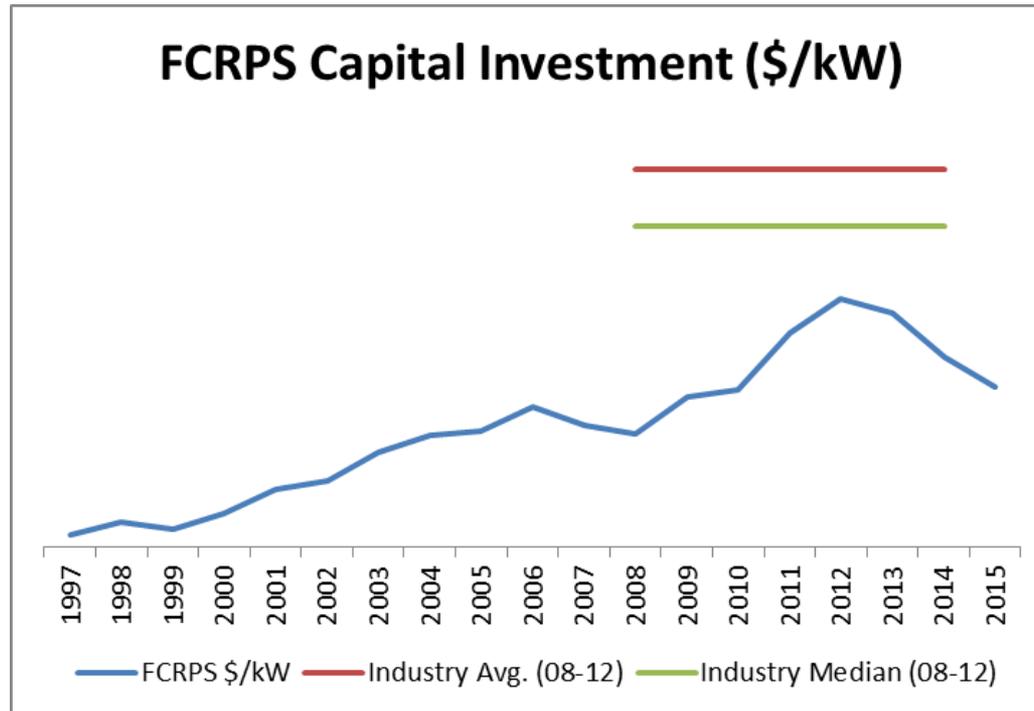
- When we ask for increases to hydro O&M expense or capital programs, benchmarking can help make the case that our trends are within industry norms
- EUCG data provides the granularity to dive deeper, e.g. non-routine maintenance

Utility	Non-Routine Expense Rank (out of 16)	Powerhouse Maintenance Ranking (out of 16)	Capital Ranking (out of 16)
A	1 st	10 th	11 th
B	2 nd	2 nd	8 th
C	3 rd	9 th	3 rd
D	4 th	16 th	15 th
E	5 th	1 st	2 nd
FCRPS	6 th	4 th	5 th
F	7 th	6 th	9 th



Program Justification

- Although our capital investment has increased in the last 15 years, benchmarking shows it is still well below the hydro industry as a whole



EUCG Benefits

- How do you trust other utilities' cost and performance data?
 - EUCG instituted a 3-day peer review meeting to go over submitted data to ensure accuracy and completion
- Lessons Learned / Cost Drivers
 - Automation/remoting
 - Staffing strategies
 - Outage Planning
 - Performance Management
 - Maintenance Strategies
 - Capital Investment Strategies

Discussion Items

- What do others do?
- Are others getting pressure to prove competitiveness?
- What are the challenges?
- How does industry data inform your asset management and investment programs?
- Are there opportunities to do NW-specific benchmarking?