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Integrated Resource Plan 2009

Third Stakeholder Presentation & Discussion

December 10, 2008

PGE

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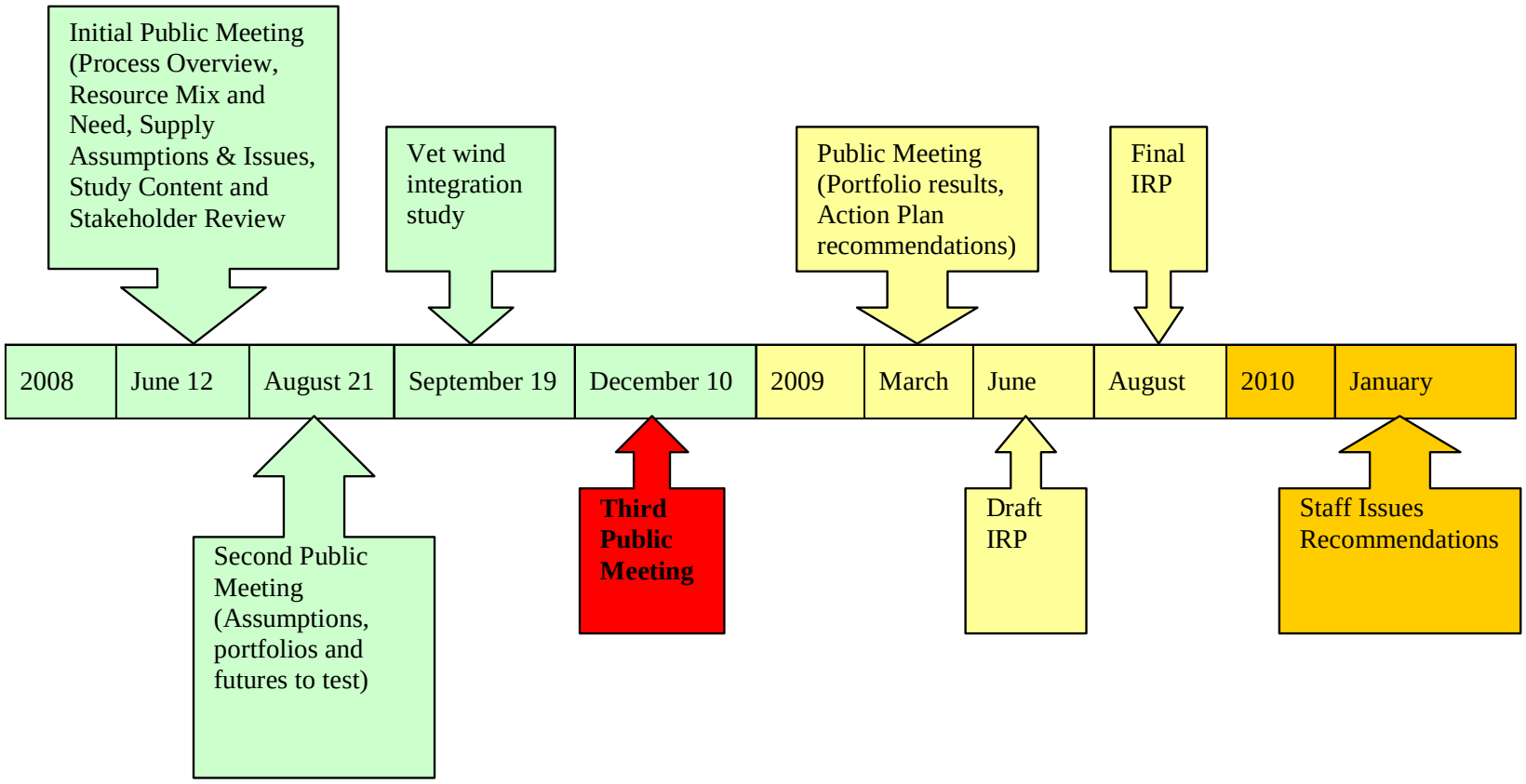
IRP Timeline



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Today's Topics

- *Demand Side Topics*
  - Energy Efficiency Resource Assessment – Energy Trust of Oregon
  - Demand Response Technical Assessment – Brattle Group
  - Demand Response RFP
  - Load Forecast Update
- *Supply Updates*
  - Boardman DEQ Emission Control Proposal
  - Renewable Supply RFP
  - Wind Self-Integration Cost Study
- *Draft Fuel Forecasts and CO2 Cost Outlook*
- *Resources*
  - Benchmark Resource Descriptions
  - Draft Generic Generation Revenue Requirements
- *Planning*
  - Planning Metrics
  - Portfolios/Futures
- *Parking Lot Issues from August 21 Meeting*

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Demand Response Peaking Capacity RFP

- *RFP issued August 18, 2008*
- *Posted at www.portlandgeneralrfp.com*
- *50 MW (or greater) of peaking capacity*
- *Contract for dispatchable Peaking capacity*
  - 10-minute notice
  - 1-hour increments
  - 2 seasons per year
    - *1 winter morning option*
    - *1 winter afternoon option*
    - *1 summer afternoon option*
  - Max 50 hours per option per year
  - Starting December 2009

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Demand Response Peaking Capacity RFP

- *Multiple proposals received from six bidders October 29, 2008*
- *Proposals under evaluation for short list by mid-December 2008*
- *Measures proposed direct load control in all markets*

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Load Forecast Update

- *Load forecast updated in September '08*
- *Near-term (5-year) annual load growth reduced from 1.9% to 1.7% due to weaker economic conditions (~45 MWa lower in 2009 and ~60 MWa lower by 2014)*
- *Long-term (30-year) annual load growth remains unchanged ~ 1.9% (~70 MWa lower in 2029) in base case*
- *Adjustments made for some economic factors based on the state's September '08 and Global Insight's August '08 economic forecasts, as well as recent updates for some large customers*
- *Forecast will be updated again in March to incorporate US and global recessionary impacts.*

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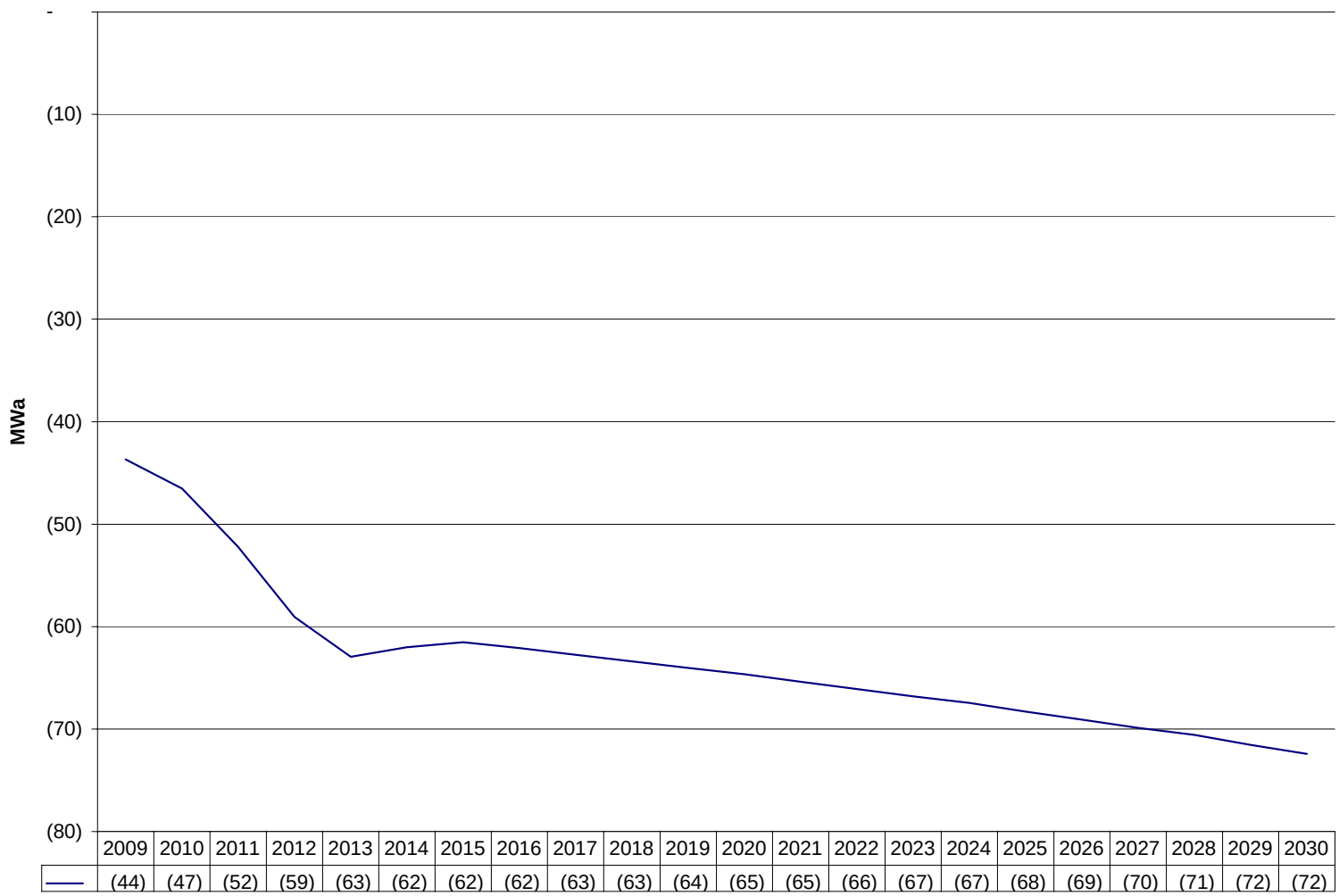
Load Forecast Update
Forecast Change October vs. July
(Annual MWa)



	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
—	(44)	(47)	(52)	(59)	(63)	(62)	(62)	(62)	(63)	(63)	(64)	(65)	(65)	(66)	(67)	(67)	(68)	(69)	(70)	(71)	(72)	(72)

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Boardman DEQ Emission Control Proposal

- *PGE still evaluating*
- *Concerns with Proposal*
  - Selective Catalytic Reduction (SCR) would have minimal impact on visibility and could cost over $250 million (2017 dollars) in addition to the cost for BART controls.
  - Requires immediate decision to address all future emissions controls.
- *Flexibility is Important*
  - Need to consider future carbon legislation costs, fuel availability/costs and alternative control technologies
  - Effect on costs and reliability should be evaluated through IRP process.

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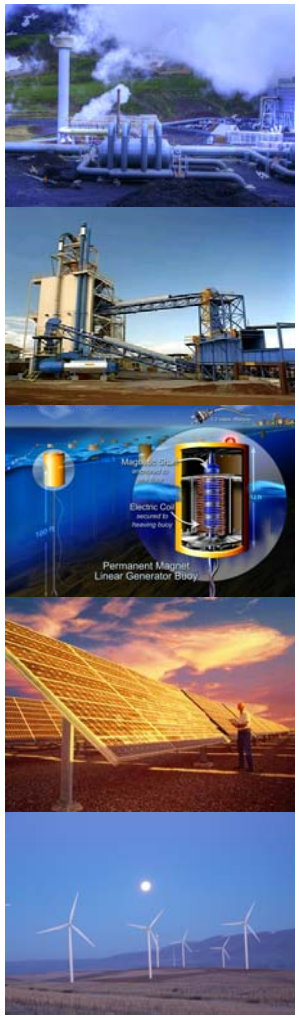
Renewables RFP Update

- *Final Short List*
  - –Bidders notified of status on November 13th by Independent Evaluator
  - –12 bids remaining (9 separate bidders and projects), totaling about 255 MWa (97% wind).
  - –Real levelized delivered prices in 2008$ range from approximately $85 to $110/MWh, including PGE's cost of integration.
- *The Independent Evaluator is expected to issue a draft report by mid-December.*
- *Negotiation phase has commenced and is expected to be completed in 2009.*
  - –Executions of definitive agreements dependant upon results of negotiations.
- *Major challenges included transmission and counter-party credit quality.*



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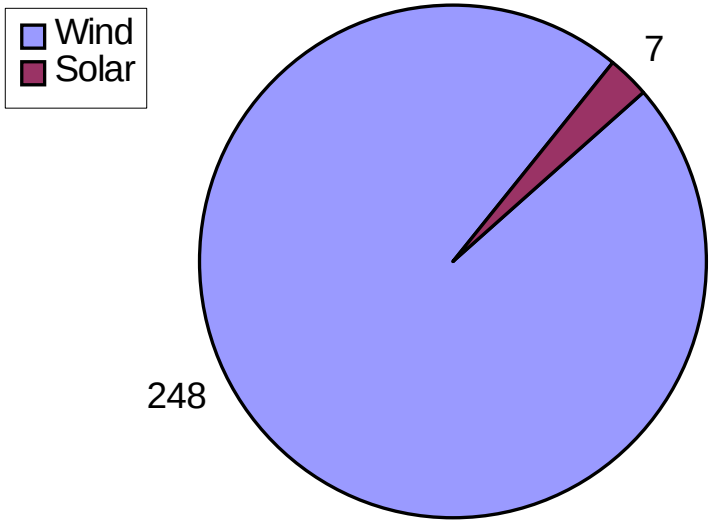
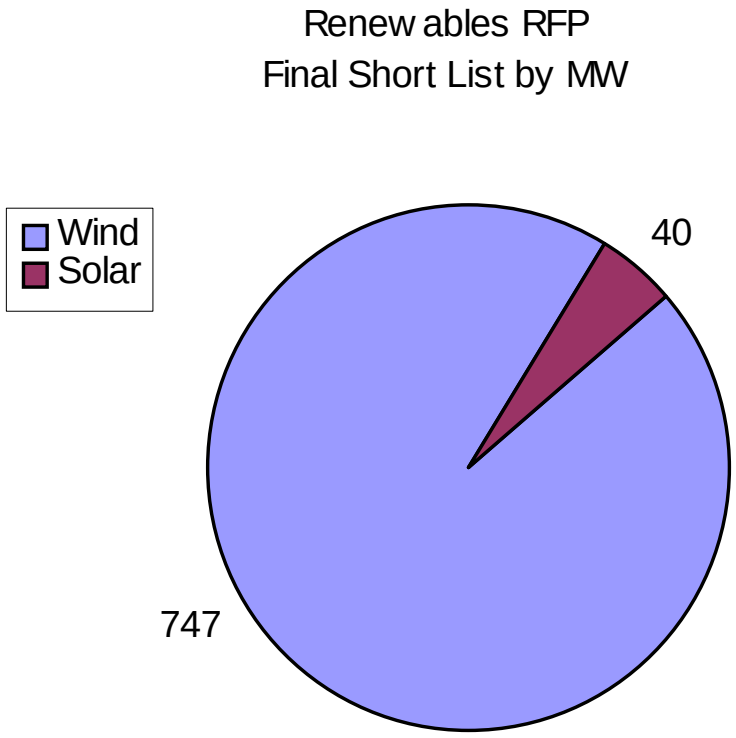
Renewables RFP Update

Final Short List





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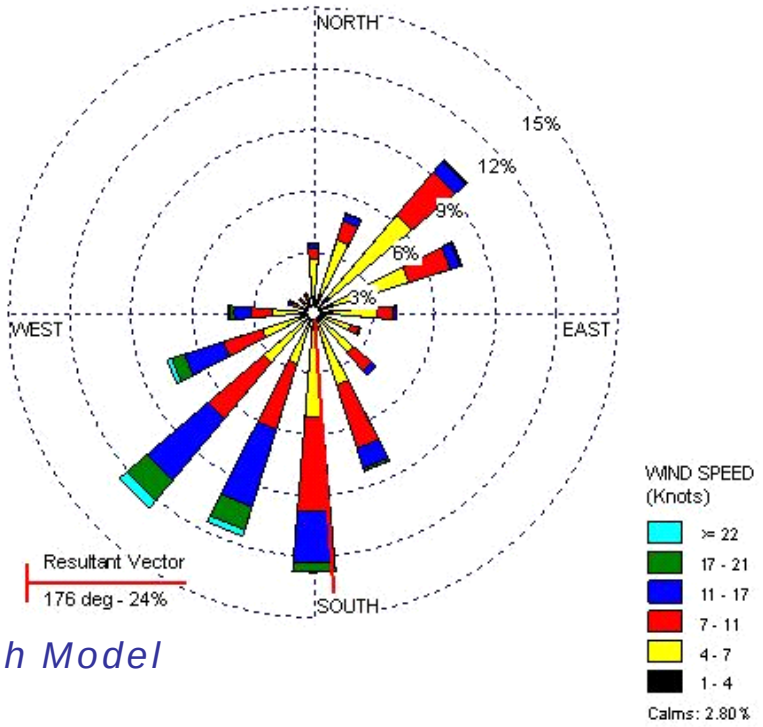
Wind Self-Integration Cost Study Update

- *Feb 2007 - PGE Contracts with Enernex to perform Wind Integration Study (WIS)*
- *Aug 2007 - Enernex Provides In-hour Balancing Cost based on Mid-C Dispatch Model (Monet)*
- *Nov 2007 - PGE determines additional granularity needed for effective WIS*
  - Original Model Limited to Real Time only
  - Acquires Excel add-on "What's Best" for developing Preschedule to Real Time Hourly Dispatch Model
- *June 2008 - PGE Assembles Technical Review Committee*
  - AWEA, UWIG, RNP, NREL



- *Aug 2008 - PGE Completes Hourly Dispatch Model*
- *Sept 2008 - PGE Produces Phase I Integration Cost*

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Wind Self-Integration Cost Study Update

- *2005 Hydro and Wind conditions*
- *2014 base year forecasts for load, hydro contracts, PIRA gas price and market electric power price (Aurora) by hour*
- *1100 MW of nameplate wind capacity by 2014; "High Diversity" (5 Geographic Zones)*
- *PGE's existing thermal system -- no additional flexible resource assumed*
- *Pre-schedule Bid-Ask spread of $0.50/MWh flat; ±$0.25/MWh from Market Price*
- *Real-Time Bid-Ask spread of 20% of Market Price; average spread of $14.30/MWh; ±$7.15/MWh*
- *Integration costs estimated to be $13.00/MWh in 2014$ to reach 2015 RPS compliance*

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Draft Fuel Forecasts

Delivered Powder River Basin Coal

- *Commodity:*
  - Forecast is based on PGE's contract rates through 2011 and on an average of EIA Annual Energy Outlook 2008 and PIRA October 2008 forecasts beginning 2012.

- *Transportation*
  - Based on PGE's forecasted transportation, including possible surcharges.

- *Real levelized prices are derived from 2009 – 2020 and are in 2008$*

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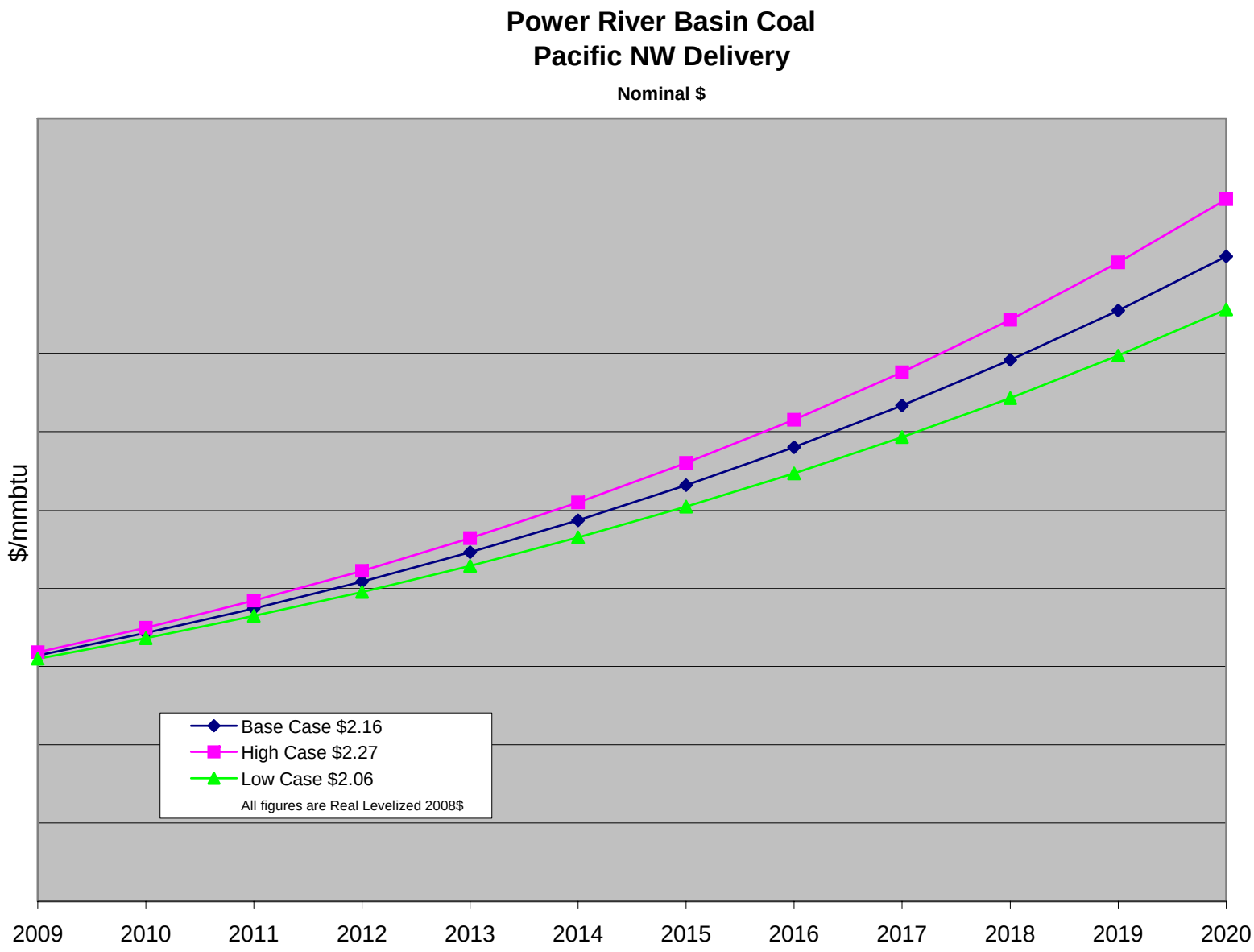
Draft Fuel Forecasts



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Draft Fuel Forecasts

Natural Gas Outlook

Natural Gas Supply Assessment, Navigant Consulting, July 2008 & PIRA

- *Domestic outlook for natural gas production over the next decade has improved sharply over last IRP: "Technology has allowed access to and economic production of a vastly greater resource base."*
- *New resources are "unconventional": domestic shale and tight sands deposits which are economic to extract at about $8 / mmbtu ($2008).*
- *Supply from such deposits expected to increase from < 5 Bcf per day to > 25 Bcf per day - equal to half of current domestic production (excluding Alaska).*
- *While short-term price volatility will still exist, forecast is for longer-term stable prices.*
- *Assumes ongoing renewables growth and that transportation sector does not make a significant move to use of natural gas.*
- *PIRA embeds a modest carbon tax in their prices from 2012 - 2020.*
- *PIRA asserts that the link between CO2 tax levels and natural gas prices is quite weak.*

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Draft Fuel Forecasts

Natural Gas Forecast Components

- *Reference, high and low cases based on October 2008 PIRA forecast for Henry Hub with basis adders for Sumas and AECO through 2020.*
- *Chart curve represents an average of Sumas and AECO nominal commodity prices.*
- *November 8, 2008 trading curve through 2011.*
- *Interpolation through 2013.*
- *PIRA forecast beginning 2014.*
- *Real levelized prices are derived from 2009 – 2020 and are in 2008$*

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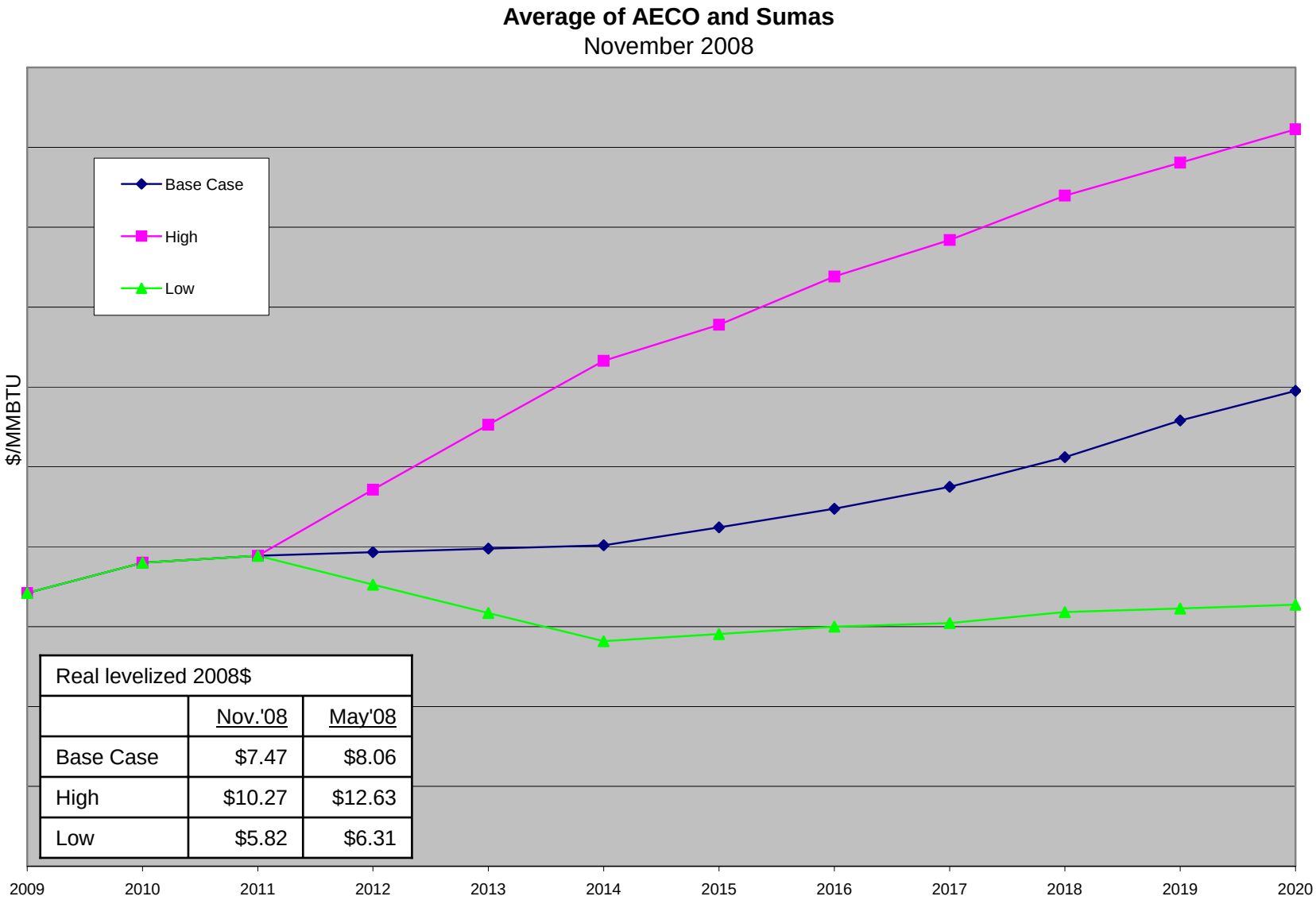
Draft Fuel Forecasts

Natural Gas Price Forecast



Real levelized 2008$		
	Nov.'08	May'08
Base Case	$7.47	$8.06
High	$10.27	$12.63
Low	$5.82	$6.31

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CO2 Cost Outlook

Findings of McKinsey & Co.

- *Reducing U.S. Greenhouse Gas Emissions: How Much at What Cost, Dec. 2007. This study is significant because it takes a careful look at abatement options, the estimated amount available for each option, and their estimated cost.*
- *Performed survey of ~ 50 abatement activities, with estimated supply and cost curves for each activity.*
- *About 18 abatement activities, dominated by EE yield net benefits.*
- *Marginal cost to achieve legislative goal of 4.5 gigatons per year is $50 / ton ($2005), average cost is much less.*
- *McKinsey estimates that coal CO2 sequestration, when mature, will cost around $50 / ton. Hence, McKinsey used $50 / ton as a soft cost cap.*
- *Carbon capture and storage (CCS) on existing coal plants provides 11% of the total abatement potential.*
- *Utility options (other than EE) are among the more expensive - other abatement activities can first be undertaken at lower cost.*

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CO2 Cost Outlook

EPRI WECC Analysis

- *Collaborative EPRI Analysis of CO2 Policy Impacts on Western Power Markets, May 2008*
- *PGE was a sponsor, along with SCE, APS, Tuscon Electric Power, Salt River Project, PacifiCorp, Puget, a PUD and a municipality.*
- *The study estimates that utility reduction of CO2 emissions takes place at between $50 and $60 per ton (at current natural gas prices).*
- *Much lower carbon taxes are sufficient to discourage new coal plant construction.*
- *The study assumes significant additions of renewables, nuclear, and CCS.*
- *Higher retail electric prices are inevitable.*

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CO2 Cost Outlook

Brattle Group

- *New Approaches to Electricity Supply Planning, The Brattle Group, Jan. 2006*
- *"Policies analyzed suggest $10-$50 per ton of CO2 would be necessary to stabilize CO2 emissions below current levels."*
- *"Extreme uncertainty (of CO2 timing and trajectory) makes analysis of the "best" option very conditional."*
- *"Probabilities or timing of CO2 = $0/ton, $20/ton, $50/ton, etc. are not knowable at this time."*
- *"Some critical risks may not be resolved for ten or more years. Planning based on least-cost 40-year PVRR feels like 'driving beyond the headlights'."*
- *Brattle suggests choosing a technology that may not be "best" on average, but is more robust across extreme scenarios.*
- *"Current planning problem is not just a noisier version of prior (supply) planning. Multiple possible equilibria, determined as much by policy events as economic trends."*

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CO2 Cost Outlook

PGE Observations

- *Prior approach of assuming federal legislation with most inertia has become more complex:*
  - Multiple federal proposals exist, perhaps with no clear frontrunner
  - Most versions employ a cap and trade without a price cap
- *More certainty with a democratic Congress and President is offset by the effects of the recession.*
- *Current expectations are for cap and trade legislation to begin between 2013 and 2015.*
- *There is minimal new coal development given the current regulatory environment.*
- *More time and effort is needed for sequestration and algae recycling technologies to develop and mature.*

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CO2 Cost Outlook

PGE Observations (continued)

- *Aligning PGE's baseline CO2 forecast to the costs embedded in PIRA would give forecast consistency among CO2, natural gas, and coal prices.*
- *We have initiated a custom scenario with PIRA to examine the impacts of varying CO2 prices on natural gas and coal prices.*
- *Current PIRA CO2 prices are modest. We expect the February update to contain higher CO2 prices and we may be able to use that as a base case.*
- *PGE proposes using existing 3rd party CO2 price estimates for its scenario analysis. Specifically, PGE proposes using the 2nd highest and 2nd lowest credible forecast as "jaws".*
- *Should PTCs and ITCs be phased out upon start of a CO2 market?*
- *What suggestions do you have for establishing a baseline case for CO2 planning?*

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Benchmark Resources

- *Energy Resource*
  - Combined Cycle Combustion Turbine(s)
- *Capacity Resources*
  - Aero-derivative Combustion Turbines
  - Reciprocating Engine Gensets
- *PGE Synergies*
  - Existing locations
  - Existing infrastructure

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Benchmark Resources

Energy Resource F, G, H, Comparison

- *Efficiency*
  - F - 58%
  - G - 59%
  - H - 60%
- *Track Record*
  - F and G - well established
  - H - pilot currently in operation
- *Reliability*
  - F and G well established, generally above 95%
  - H to be determined
- *Generic Costs*
  - F and G installed costs approximately $1,400 - $1,500 per kw (1X1)
  - H to be determined (expected higher)
- *Schedule*
  - F and G – 2 years for permitting and development, 2 years for construction
  - H to be determined.

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Benchmark Resources

Capacity Resource (100-200 MW)

Attribute	GE LMS100 Combustion Turbine Generators (CTGs)	Reciprocating Engine Gensets (Recips)
Unit Size (MW)	100 MW each	4 - 16 MW each
Fuels	Natural Gas	Natural Gas/Distillate
Construction Period*	12-18 months	12-18 months
Installed Capital Cost (2008 $)	$1200/KW	$1100/KW
Heat Rate at Full Load (BTU/kWh, HHV)	8900-9100	8400-8800
Heat Rate at Min. Load (BTU/kWh, HHV)	10,300-10,500	9300-9800
Minimum Operating Load	~50 MW	2 - 8 MW
Fixed O&M per MW-Year ($ 000s)	TBD	TBD
Variable Non-Fuel O&M ($/MWh)	TBD	TBD
Annual Forced Outage Rate (%)	TBD	TBD
Starting Reliability (%)	TBD	TBD
Full Output from Cold Start	10 minutes	10 minutes
Warranty Period	12 months	12 months
Long Term Service Agreement?	Available	Available

* After permitting completion and contractor(s) given Notice to Proceed

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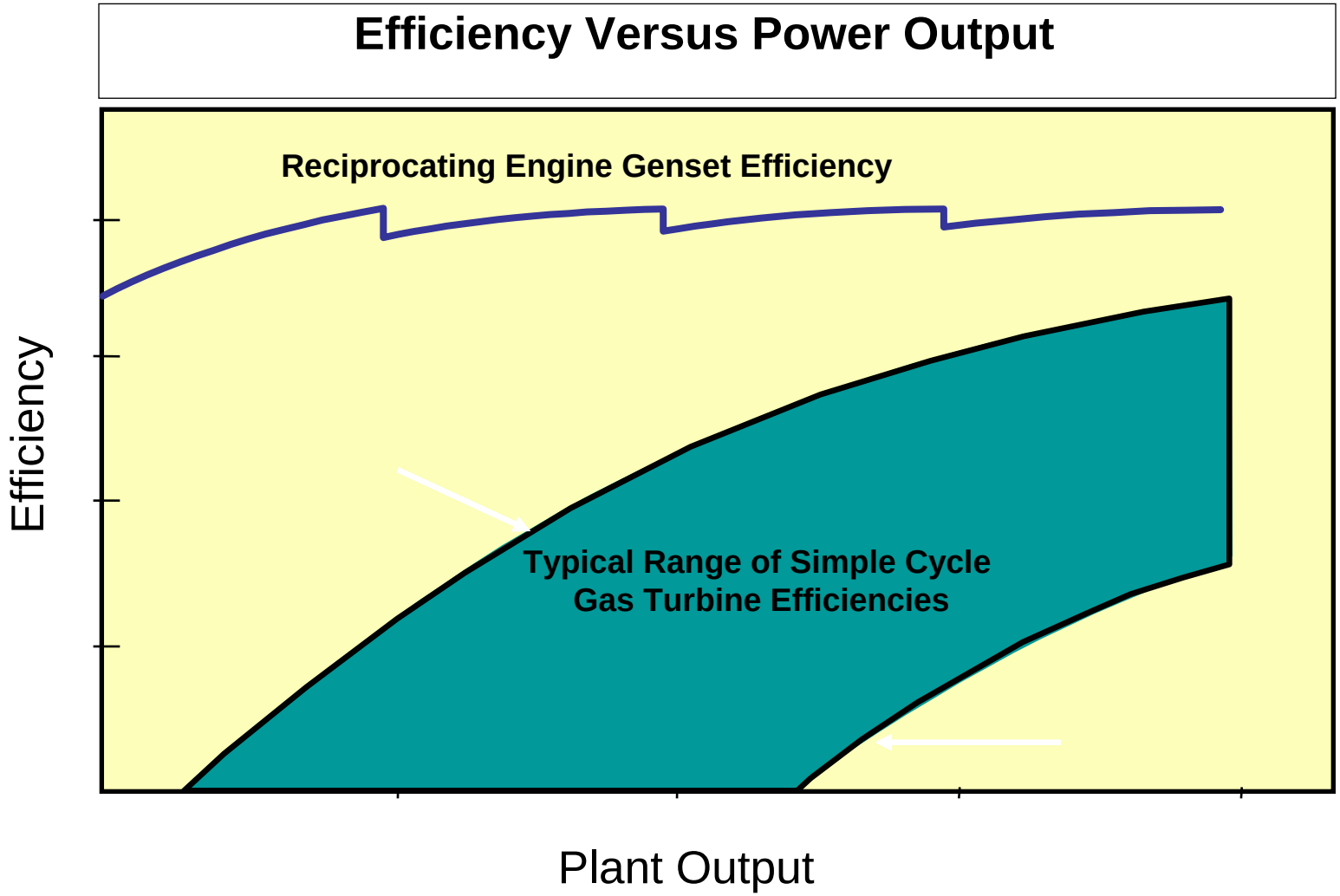
Efficiency Curves for Recip. Engine Gensets vs Combustion Turbines



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LMS100 Power Plant

Standard scope of supply (dry)

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Reciprocating Genset Power Plant

Standard scope of supply

Excel Energy Plains End Generating Station (Colorado)

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Draft Generic Revenue Requirements

Capital Cost by Technology
Cost Estimates from Industry Sources

	Typical Size MW	Availability Factor	Book Life	Earliest date Avail.	Preliminary 2009 IRP Best Estimate 2008$/kW		Comments
Super critical pulverized coal	850	85%	40	2016	$2,820		A conventional pulverized coal plant operating at higher pressures and temperatures, without CO2 storage and sequestration
IGCC (Sequestration ready)	569	86%	40	2016	$4,660		Integrated Gasified Combined Cycle, sequestration ready
Wind Farm	150	95%	25	2012	$2,240		Expected capacity factor 32%. Capacity value 5%.
Geothermal	30	86%	20	2011	$4,630		Capital costs and size highly dependent on location, fuel, etc.
Biomass	20	86%	20	2010	$3,325		Capital costs and size highly dependent on location, fuel, etc.
NG - High Efficiency	400	92%	30	2015	$1,400		Assumed capacity factor of 78%.
Solar	6	95%	20	2010	$5,000		Assumed capacity factor of 11%. Located in PGE's service territory.
Hydro-Kinetic - Wave	30	88%	25	2012	$3,575		Assumed capacity factor of 30%.

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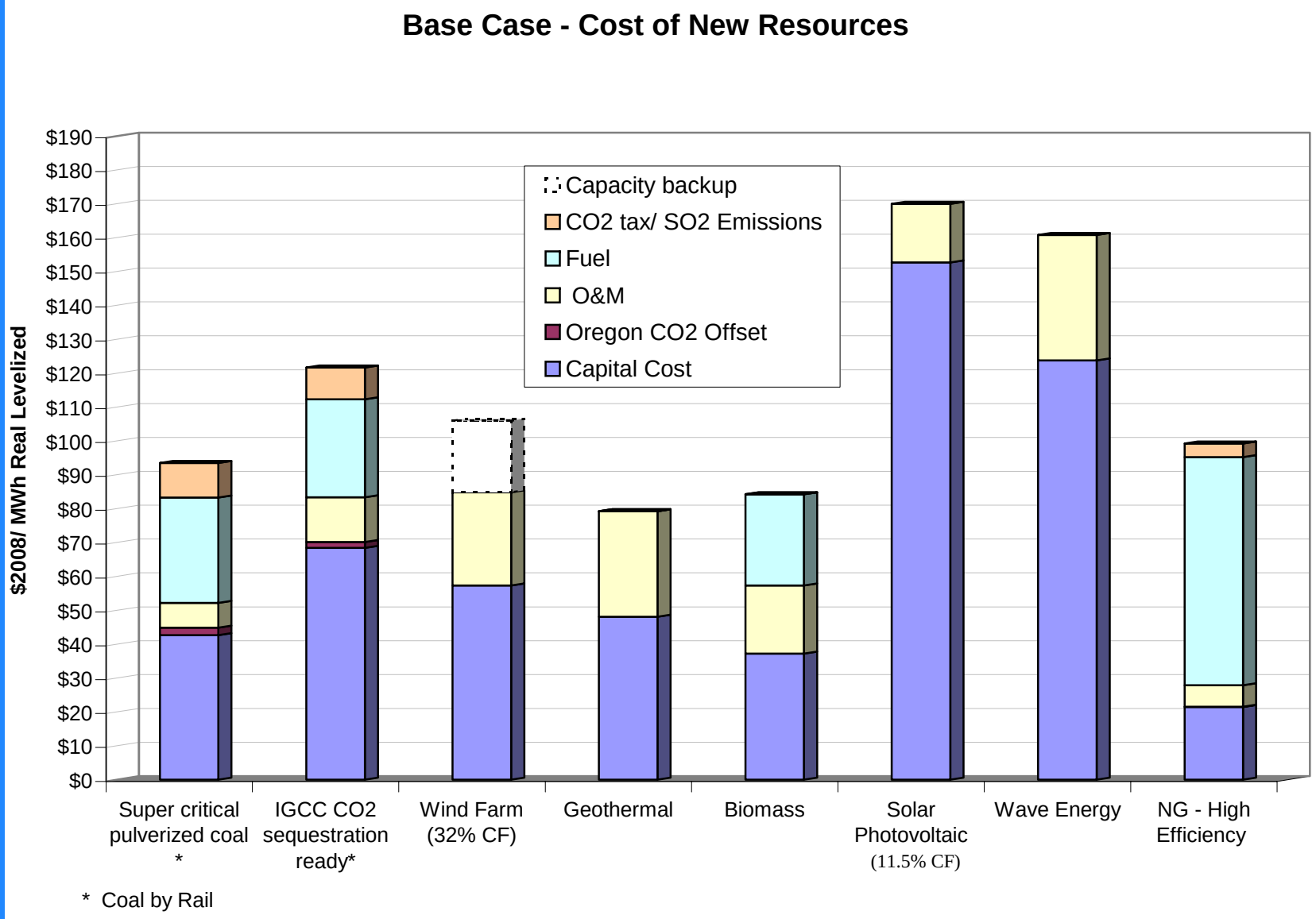
Draft Generic Revenue Requirements



* Coal by Rail

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Planning Metrics

Energy Planning Standard in the PNW

Utility	*Load*	*Hydro Conditions*
Avista	90% confidence interval load	Average
BPA	Annual average firm load	critical water: year 1937
Idaho Power	70th percentile average load	70th percentile
NWPCC	Annual average firm load	critical water: year 1937
PacifiCorp	Plans for peak load	Average
PGE	Annual Average 1-in-2 Load	Average
PUGET	Max of the monthly average loads (typically the December load)	Average

PGE current energy planning target is the least aggressive.

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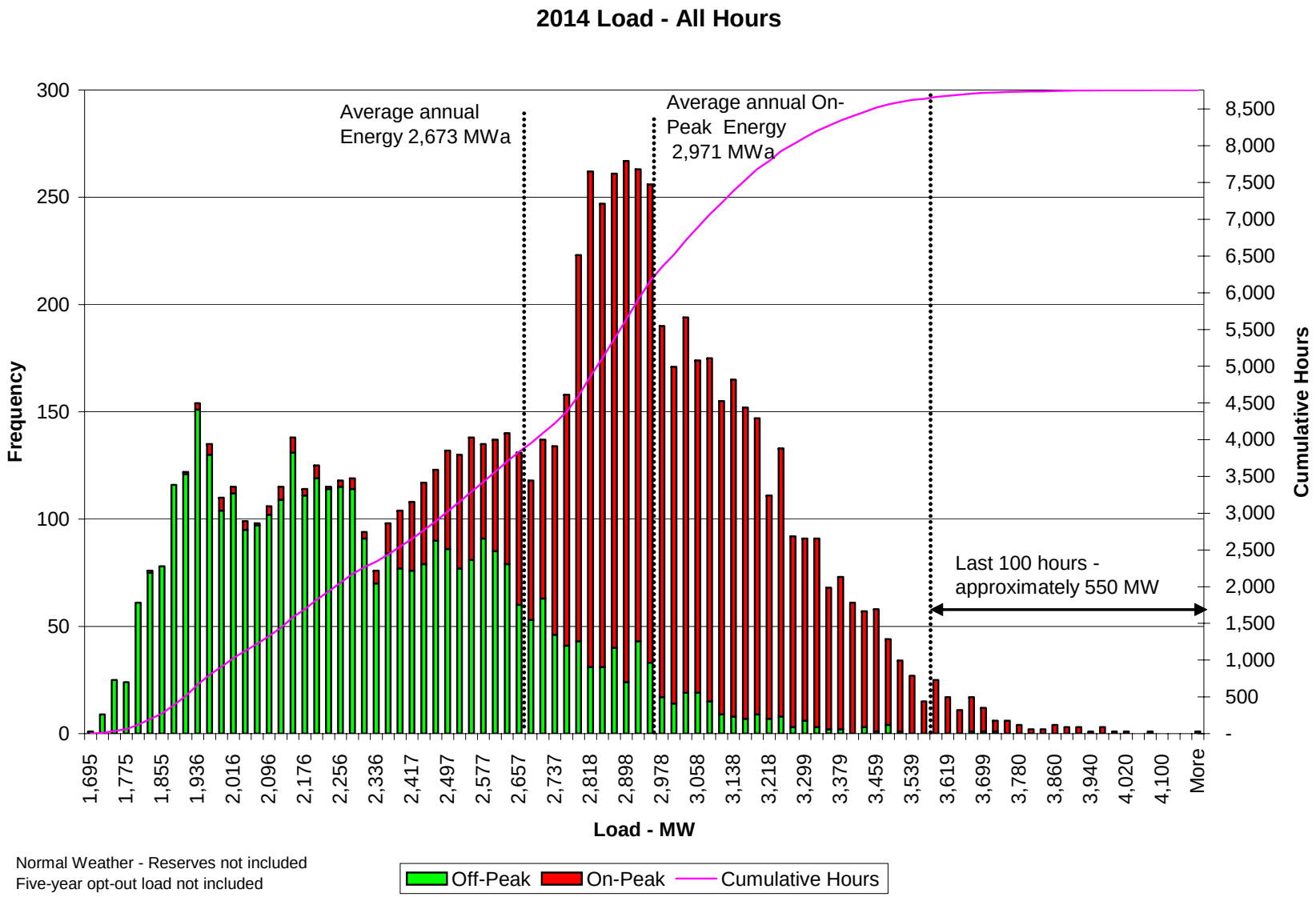
Planning Metrics



Normal Weather - Reserves not included
Five-year opt-out load not included

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Planning Metrics

- *Currently plan to annual average energy need*
  - Covers 45% of 2014 hours
- *Potential proposal is to plan to annual on-peak energy need*
- *For 2014 increase is around 300 MWa*
- *Covers additional 27% annually - 2,400 hours*
- *Similar result to Puget's "December average" planning metric*

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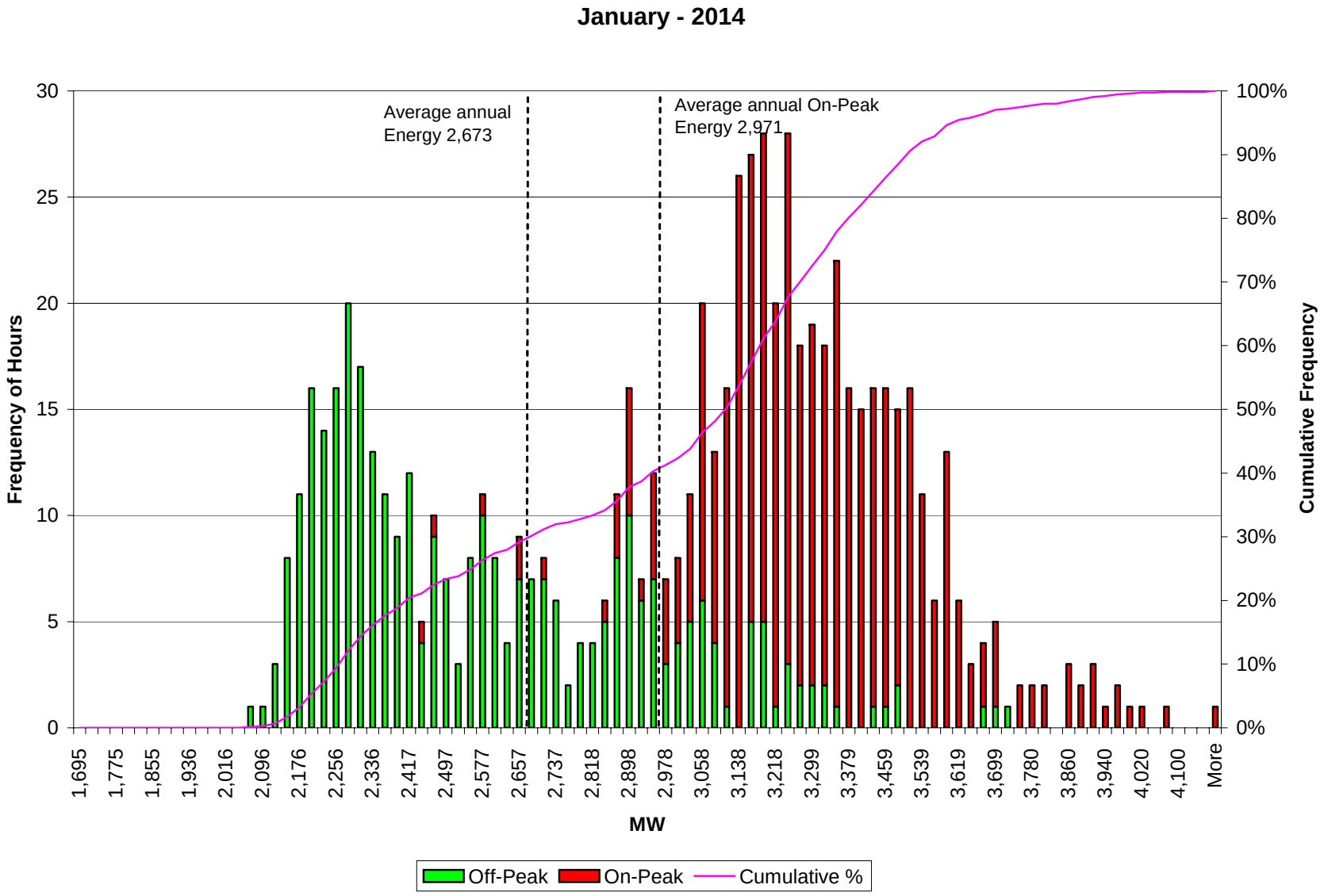
Planning Metrics

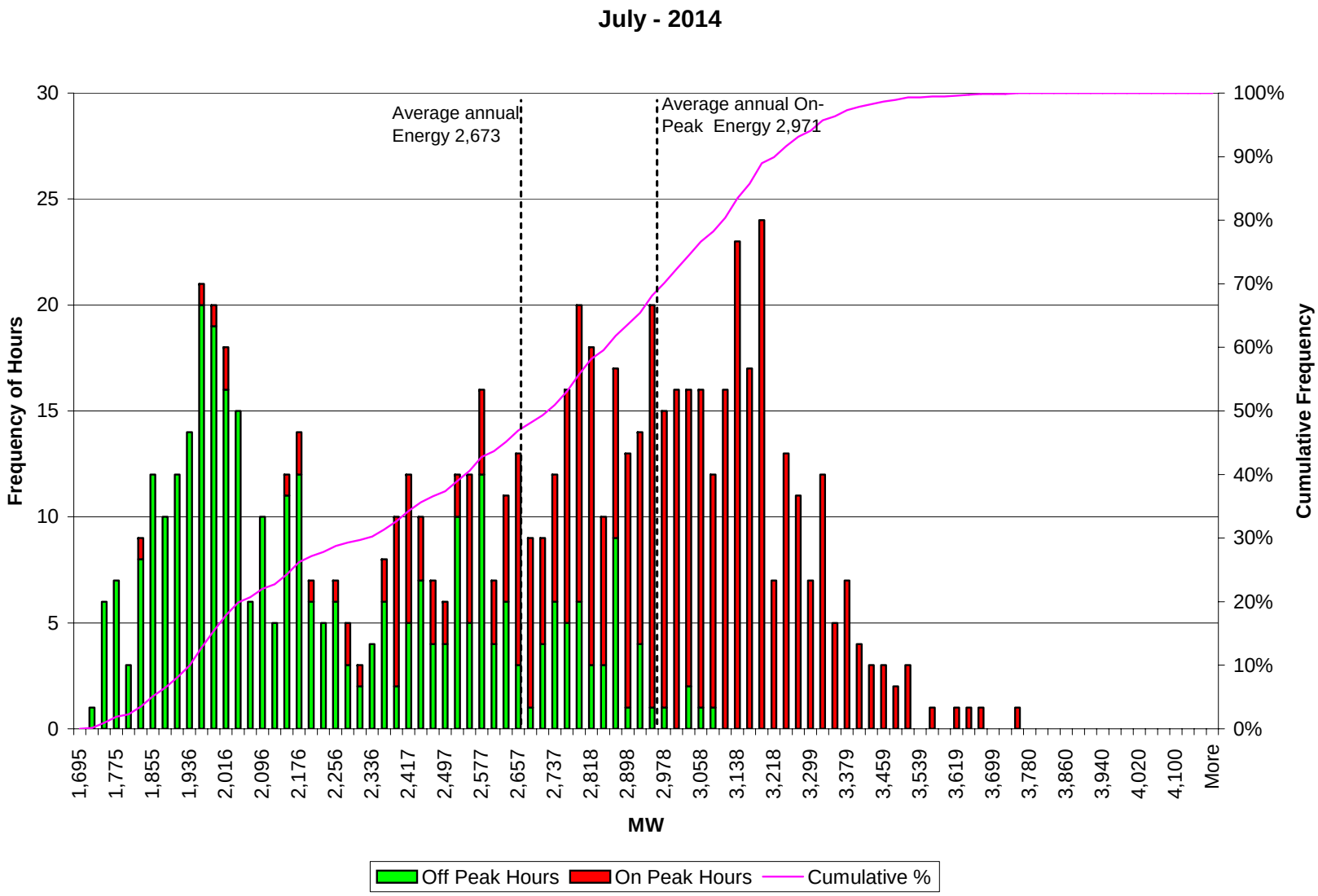
Peak Winter Month



Normal weather - does not include reserves

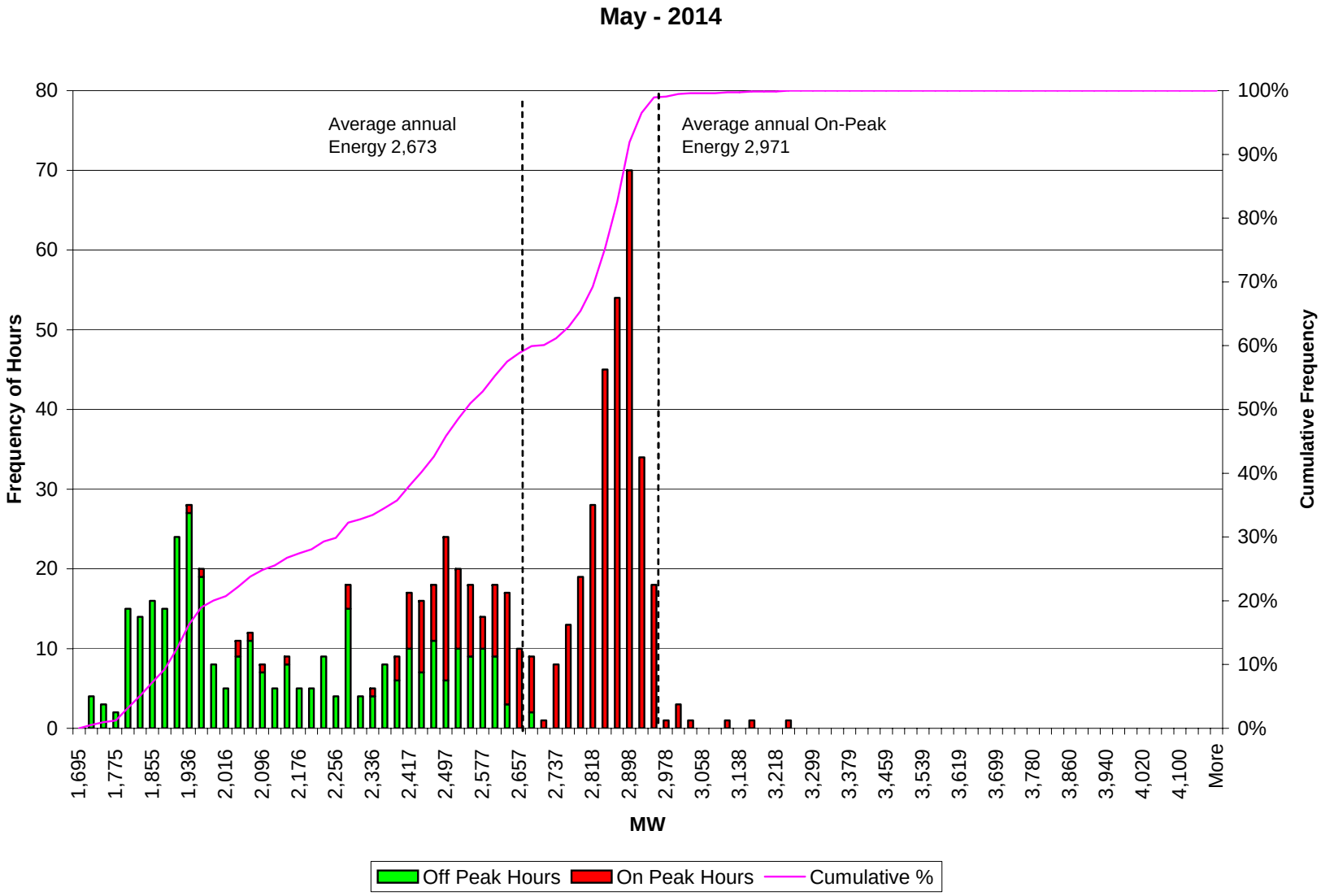
Planning Metrics

Peak Summer Month



Normal weather - does not include reserves

Planning Metrics
Shoulder Month



Normal weather - does not include reserves

Planning Metrics
On- vs. Off-Peak

	2014 Average Annual MWa (2,673)	2014 Average On-Peak MWa (2,971)	Total Hours
Total Hours Covered	3911	6300	8760
Percent	45%	72%	
On-peak hours Covered	637	2603	4912
Percent	13%	53%	

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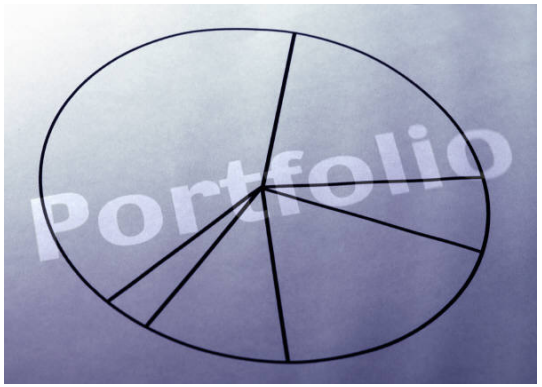
Portfolios

All proposed portfolios meet expected PGE load from 2010 to 2030

- Long-term resources (plants and contracts) are economically dispatched first.
- Spot wholesale electricity purchases fill the difference between load and generation/LT purchases.

Long-term resources are added thru 2030

- For modeling purposes additions are in 2012, 2017, and 2019.
- After 2019 we will add renewables to meet RPS.
- Any remaining load is met by spot purchases.



Targets for LT resources additions

- Annual Average Energy Load in 2012.
- Annual On-Peak Energy Load by 2017, 2019.

Capacity/peaking need

- Capacity resources (peakers) are added in 2012, 2017, 2019 to achieve equivalent capacity value across portfolios.
- A few portfolios will add incremental capacity resources to test costs and risks involved in being “energy long”.

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Portfolios Analysis

Draft Handouts Show our Trial Portfolios

- Bookends to test the impact of fuel/technologies choices to cost and risk
- Candidates for action plan:
  - Meet RPS requirements, then all Thermal;
  - Implement Governor's CO2 reduction goals;
  - Diversified Green portfolio with Gas backup;
  - Mid-term PPA Bridging strategy.

Cost Performance Metric

- Total Revenue Requirement for the overall portfolio (existing resources + LT additions + spot purchases) including:
  - Fixed costs over the plant lifecycle
  - Variable costs from 2010-2030

Risk Performance Metrics

- Scenario Risk: maximum cost increase across scenarios;
- Probability of worst outcome;
- CO2 intensity;
- Stochastic risk: TailVar90 of NPVRR;
- Etc. (see Chapter 11 of the 2007 IRP).

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Futures

PGE expects to evaluate against each trial portfolio:

- Potential carbon regulation in accordance with Guideline 8
  - Certain break-evens, such as the carbon tax price at which a coal plant is on par with a natural gas alternative on a per kWh basis.
- High and low gas price future
- High CO2 tax with high fuel prices
- High capital cost;
- High and low load growth (for PGE and WECC)
- High and low wholesale electricity prices (perfect storm and technology break-thru)
- High Plug In Electric Hybrid Vehicle (PHEV) penetration (we are currently evaluating how/if to model this quantitatively)
- Suggestions?

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Parking Lot Issues

- *Solar Availability*
- *Load Resource Balance – Economic vs Physical*
- *Federal Funds for Local Hydrokinetic Research*

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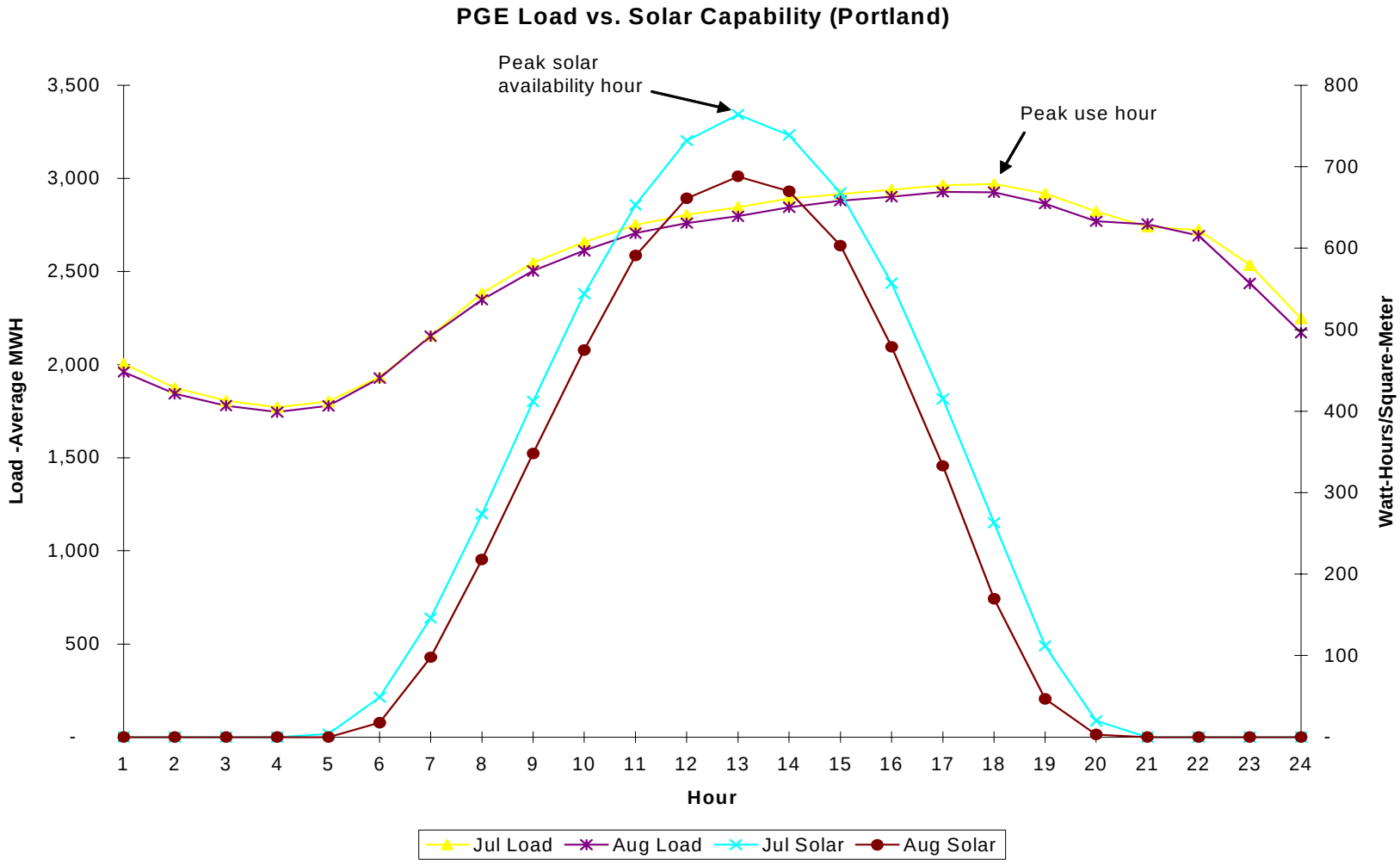
Solar Availability - Summer



Source: University of Oregon Solar Radiation Monitoring Lab

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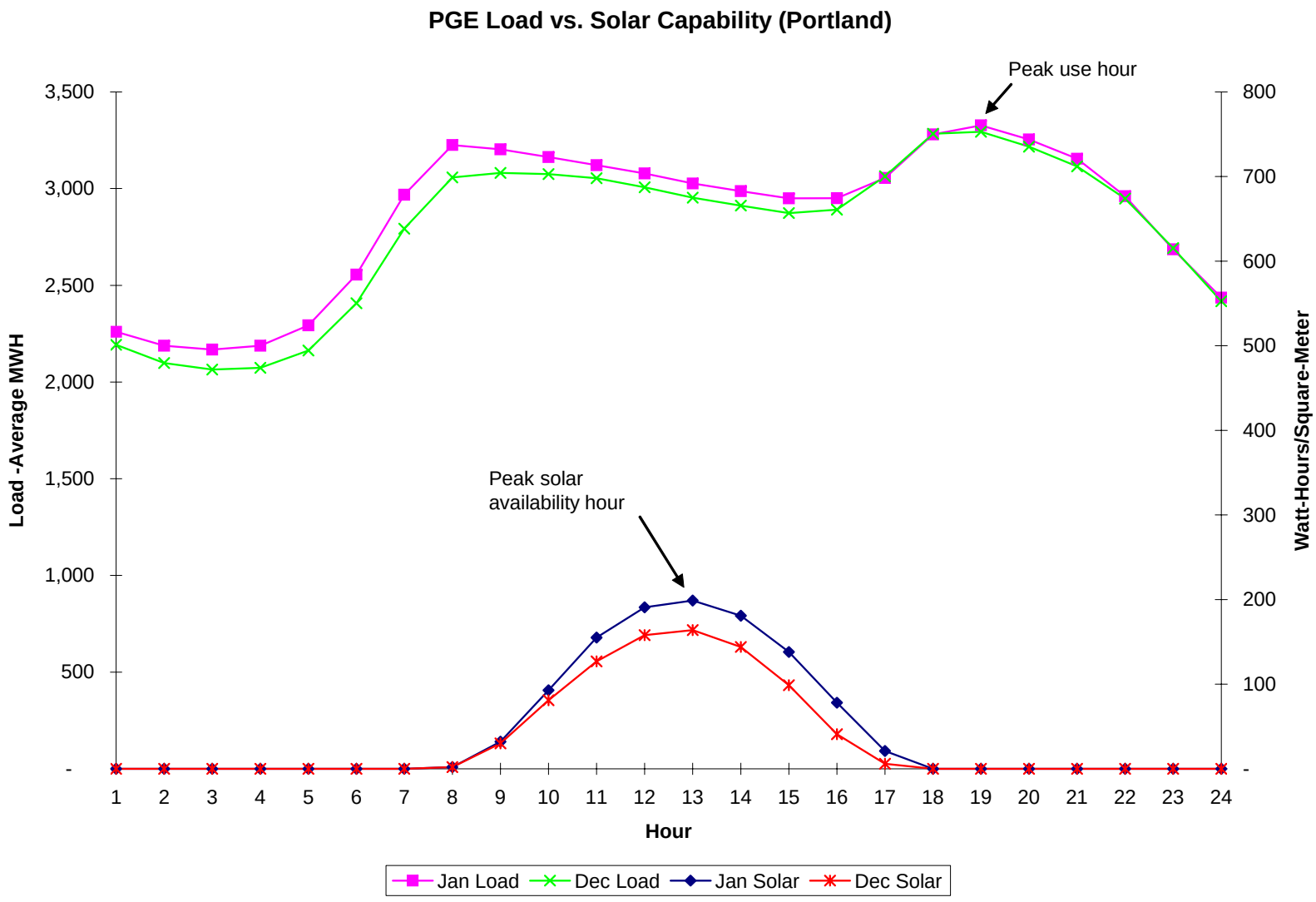
Solar Availability - Winter



Source: University of Oregon Solar Radiation Monitoring Lab

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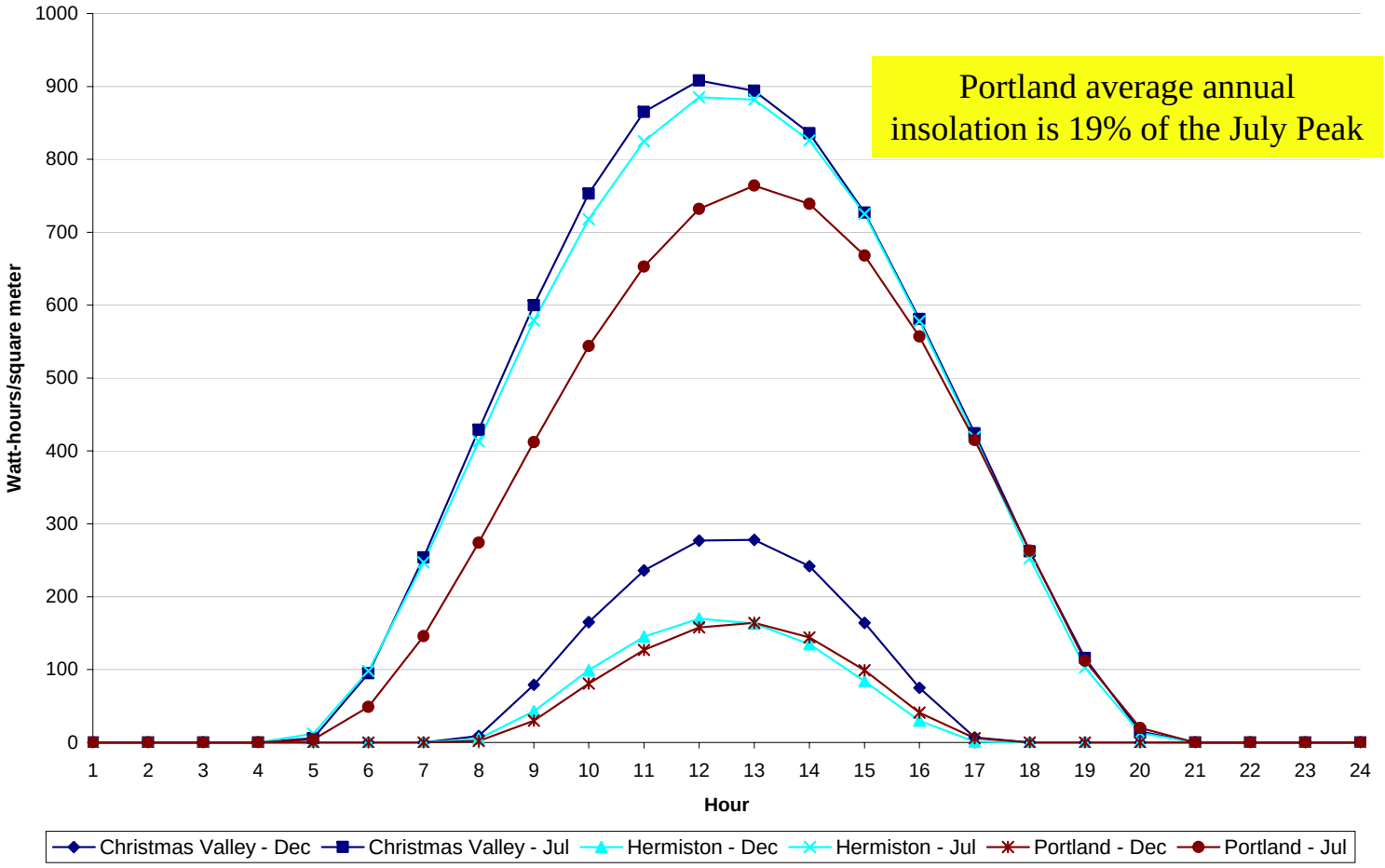
Solar Availability



Source: University of Oregon Solar Radiation Monitoring Lab

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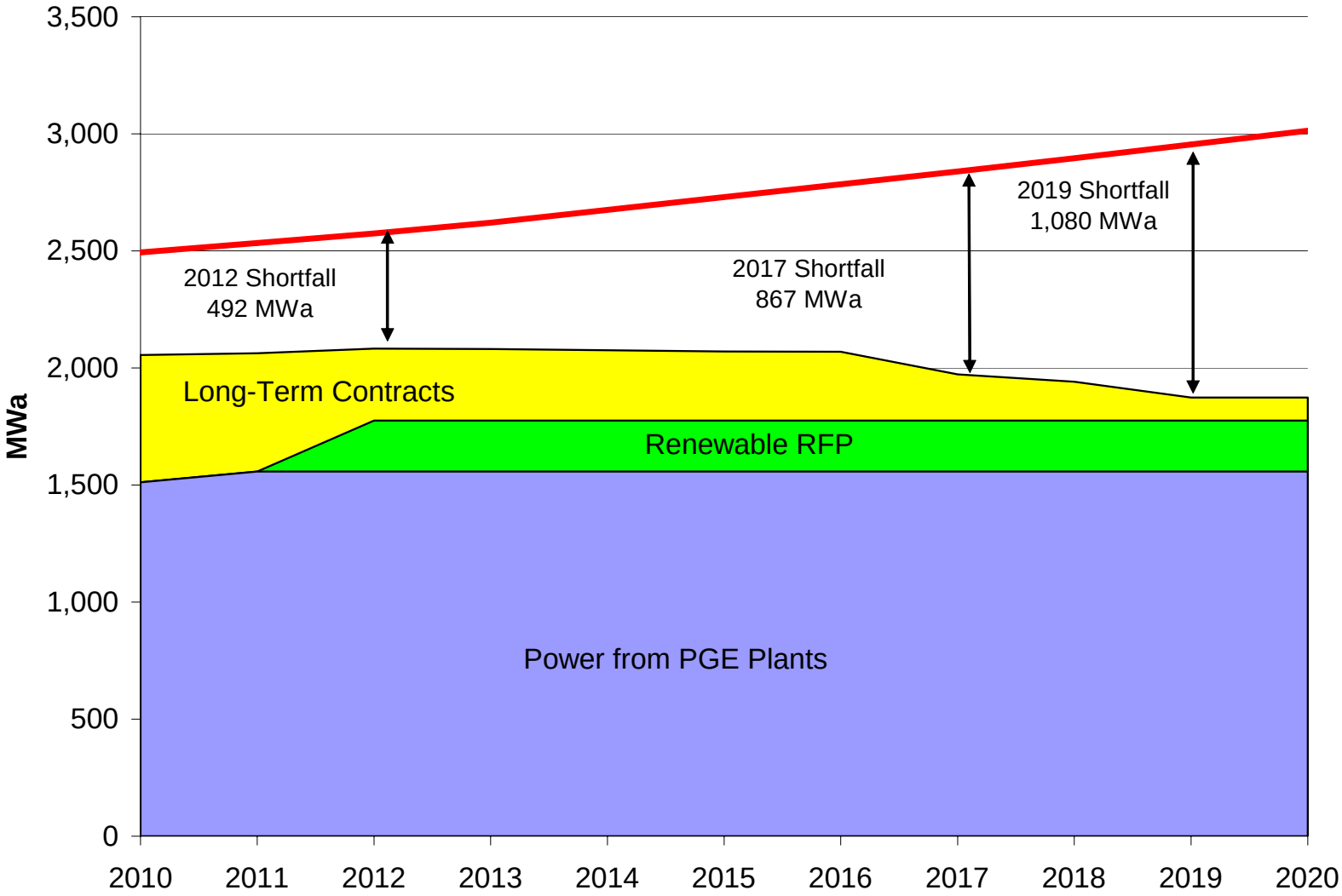
Load Resource Balance revised October '08 Economic View

Future *Energy* Needs 2010 to 2020 @ Normal Hydro based on average annual energy



Assumptions:

- Load forecast does not include 30 MWa of non-cost of service.
- Normal hydro and thermal operating conditions.
- Economic dispatch of Beaver operating units.

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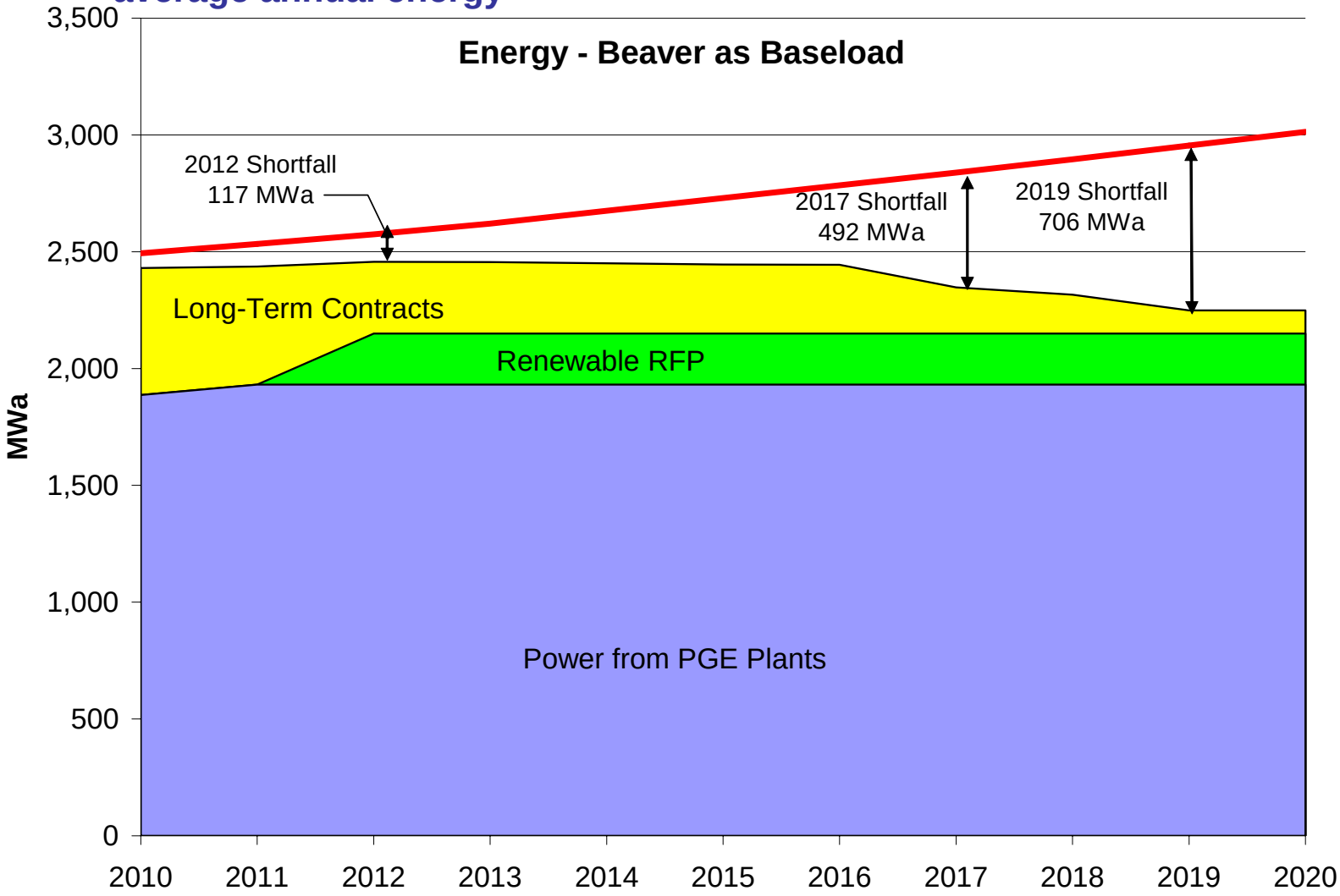
Load Resource Balance revised October '08 Physical View

Future *Energy* Needs 2010 to 2020 @ Normal Hydro based on average annual energy



Assumptions:

- Load forecast does not include 30 MWa of non-cost of service.
- Normal hydro and thermal operating conditions.

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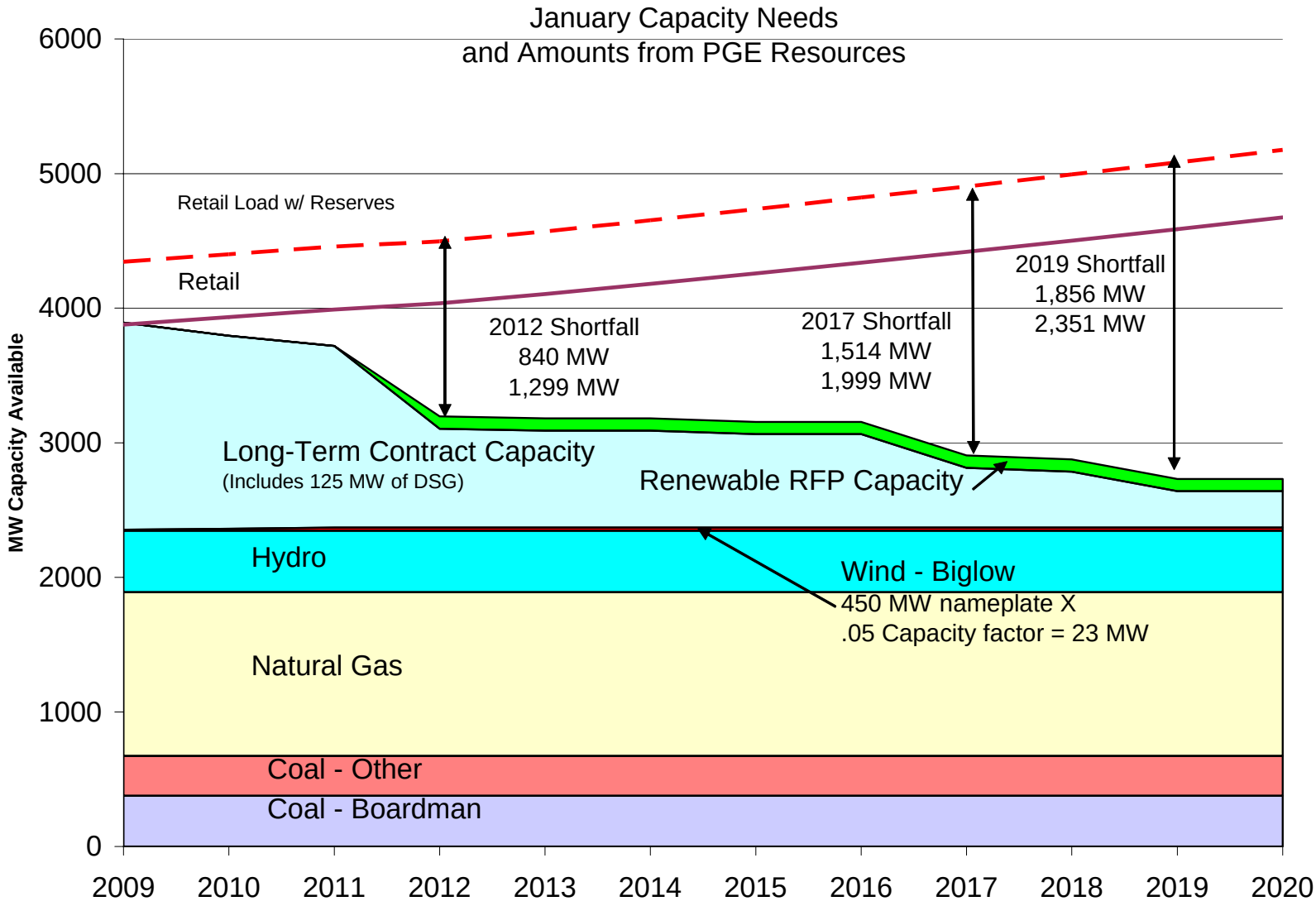
Load Resource Balance revised October '08

Future *Peaking Capacity* Needs 2010 to 2020



Assumptions:

- Load forecast does not include 32 MW of non-cost of service.
- Normal hydro and thermal operating conditions.

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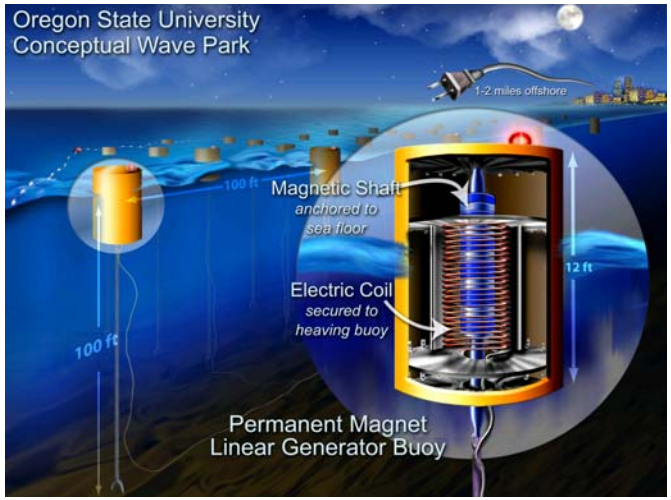
Local Hydrokinetic Research

- *Oregon State University's National Wave Energy Research Center*
  - U.S. DOE funding
  - $6.25 million – five years



- *Makah Bay Project – Washington*
  - Multiple public and private parties involved
  - 4 buoys – 1 MW

- *Reedsport Oregon Project*
  - Developed by Ocean Park Technologies
  - Initially 2 MW – full scale of 50 MW
  - BPA funding first portion of project at $100,000
  - Central Lincoln County PUD supports and will purchase power

- *Lincoln County Wave Park Project*
  - Multiple wave plants – depths of 1-70 meters
  - Off coast of Lincoln County
  - Interconnect with BPA and Central Lincoln County PUD

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Please call with questions, concerns, or any follow up.

Thank You!

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