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April 26, 2010

## MEMORANDUM

**TO:** Council Members

**FROM:** Terry Morlan

**SUBJECT:** Presentation by Portland General Electric on Proposed Plans for Boardman Coal Plant

Facing expensive environmental upgrades and the risk of carbon regulations, PGE has proposed a plan to phase out the Boardman coal-fired power plant. Jim Lobdell, PGE Vice President for Power Operations and Resource Planning, will discuss their proposed plans for the Boardman coal plant. In addition, he will summarize their experiments with sequestering carbon dioxide in algae and using the dried algae as biomass fuel.

The Sixth Power Plan included a coal plant retirement scenario in which about half of the coal-fired energy in the region was retired in order to reduce carbon dioxide emissions to meet current policy targets in Washington and Oregon, WCI, or proposed federal legislation. In that scenario, the energy capability of coal-fired generation is reduced by 2,700 average megawatts between 2012 and 2019. Retiring the Boardman plant would reduce regional coal-fired energy capability by 500 average megawatts, although 25 percent of Boardman energy is committed out of the region. Negotiations are underway in Washington State to displace the generation at the Centralia coal-fired power plant. If those negotiation were to succeed, coal-fired energy capability would decrease by a further 1,220 average megawatts.

I have attached short papers from PGE on the Boardman proposal and the algae carbon sequestration experiment.

Attachments



## PGE pilot project demonstrates algae's potential to reduce carbon emissions

Portland General Electric is committed to meeting Oregon's growing energy needs in a reliable, cost-effective and increasingly sustainable way. As part of that focus, PGE is actively investigating ways to reduce carbon dioxide (CO<sub>2</sub>) emissions from electricity generation. This is an important step in addressing greenhouse gases that contribute to global climate change.

PGE recently concluded a successful small-scale pilot project using algae to capture and consume CO<sub>2</sub> emissions from our coal-fired plant in Boardman, Oregon. PGE is among the first utilities to undertake a dedicated investigation into using algae to reduce CO<sub>2</sub> emissions.

Algae require sun, water, nutrients and CO<sub>2</sub> to grow. The Boardman site is an ideal site for conducting algae research, due to its relatively large amount of sunlight, water, CO<sub>2</sub> emissions and land mass.

### Research findings

In this study, PGE and its partners demonstrated that algae did consume carbon dioxide from the Boardman plant. Algae that were fed CO<sub>2</sub> emissions grew significantly faster than algae that were exposed only to air.

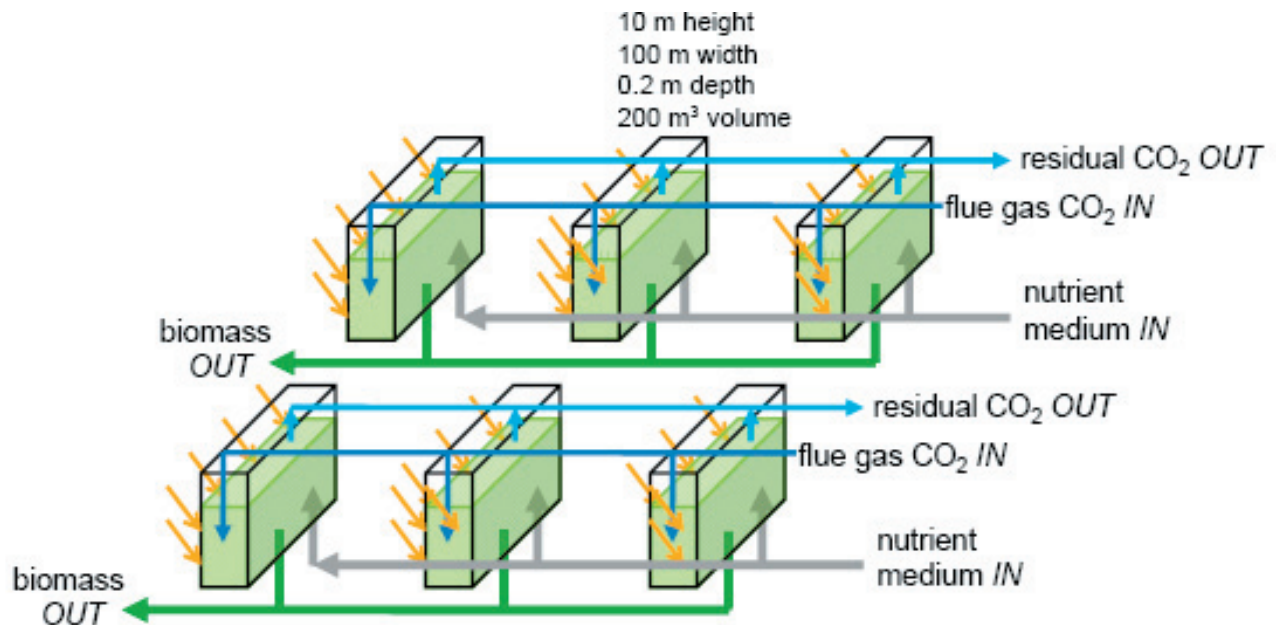


For the study, PGE diverted gas produced during power generation, including CO<sub>2</sub>, to an outgoing pipe in the side of the exhaust stack. After traveling through a cooling bath, an above-ground piping system delivered the gas to three of six large tubs, where the CO<sub>2</sub> was absorbed by the algae. The other three tubs were exposed only to air. Algae also were skimmed from the water for harvesting into biomass.

### What's next?

The PGE pilot project demonstrated that algae will consume carbon dioxide emissions in horizontal, open-air tubs. It would take vast amounts of land, however, to produce enough algae to consume substantial emissions from the plant. Our scientists and engineers suspect that a closed-air, vertical system fed by carbon dioxide would grow even more algae, using less land mass.

That's why PGE, in partnership with Oregon State University, proposes to conduct further research using closed-system, vertical bioreactors. In the process, we also hope to find a method for measuring the amount of nitrous oxide consumed by algae. In addition, PGE proposes to study which of the available naturally occurring algae strains are best suited to the CO<sub>2</sub> capture process. Currently, PGE is helping fund research at Oregon State University to investigate different strains of algae that could be used as part of this project.



*Conceptual design of proposed photo bioreactor at PGE's Boardman Plant.*

## Why algae?

Harvesting algae holds significant promise for addressing the nation's energy and agriculture needs. In addition to consuming carbon dioxide that contributes to global warming, algae produce two important byproducts: biofuel and biomass. Biofuel made from algae oil can be used to power automobiles and jets, thereby reducing our dependence on foreign oil. Biomass can be used as fertilizer and livestock feed, freeing up other crops for human consumption.

Unlike other biofuel sources like corn, wheat and sugar beets, algae can be grown almost anywhere — in fresh water, saltwater, even wastewater — and in areas that don't support agriculture. And because algae grow very quickly, it delivers a yield of biofuel per acre unmatched by other alternatives — 1,000 times greater, in some cases.

## About the Boardman plant

PGE owns 65 percent of the 585-megawatt coal-fired Boardman Power Plant in northeastern Oregon. It is the workhorse of PGE's generating resources, dependably and cost effectively providing about 15 percent of our total generating capacity. It assures our customers a diverse power generation mix and enables PGE to avoid dependence on any one type of fuel.

In addition to conducting research into carbon capture, PGE is developing an aggressive action plan to cut permitted haze-causing emissions and mercury emissions from the plant. The effort is part of our shared, regional and statewide commitment to improve visibility in wilderness areas and national parks.



### Portland General Electric

April 2010

#### Overview

Ever since it went online in 1980, the Boardman Generating Plant and the 110 employees who operate it have provided Portland General Electric customers with a reliable, low-cost source of electricity. Located east of the Cascades in Oregon's Morrow County, Boardman is the workhorse of PGE's generation resources, providing about 15 percent of the electricity our customers use. The 585-megawatt coal-fired plant is also one of our lowest-cost resources, generating electricity at one-third to one-half the price we would pay on the wholesale market — which helps us keep customer prices affordable.

As PGE looks to meet the rapid growth in demand for electricity in Oregon, it's clear that Boardman can continue to provide strong value for our customers. Yet new environmental rules call for installing expensive pollution controls to regulate haze-causing emissions. In the Integrated Resource Plan we filed with the Oregon Public Utility Commission in November — our plan which describes the best mix of resources available to generate the electricity our customers need — we considered the costs and benefits of the two viable options available under current Oregon environmental regulation:

1. Close Boardman in 2014. This is an expensive and risky option for our customers. It threatens reliability, in part because replacement generation could not be built in time. It also would force PGE to purchase power on the market, which can be very expensive.
2. Invest \$520 million to \$560 million in extensive pollution controls on the Boardman Plant, which would allow us to operate the plant through 2040. Our analysis concluded that even with these increased costs, this option is better for our customers, when we balance risk and cost, as compared to closing the plant in 2014.

But new analysis indicates that an alternative plan — closing Boardman in 2020 or switching to an alternate fuel — would provide the optimum benefits for our region. It would result in significant cost savings to customers and major environmental improvements, while allowing for a smooth transition to an alternate resource. With so many potential benefits to our customers, PGE is working with stakeholders and regulators to determine whether we can make this option a reality.

PGE on April 2 submitted a proposal to the Oregon Department of Environmental Quality, asking for rule revisions that would allow us to meet environmental rules related to haze-causing emissions by closing the Boardman plant in 2020. We also expect to file an addendum to our Integrated Resource Plan in April, requesting acknowledgement of a 2020 closure date contingent on DEQ approval of revised rules.

The 2020 plan saves customers about \$600 million over the next decade, compared to a 2014 shutdown. Three factors make the 2014 option more expensive: The cost of accelerating capital investment in a replacement resource; the higher cost of replacement electricity; and the cost of depreciating the remaining investment in Boardman at such an accelerated pace.

Under the 2020 plan, PGE would install pollution controls in 2011 that would cut mercury emissions by 90 percent and haze-causing emissions of nitrogen oxides by

**What would be the cost savings to customers under the 2020 alternate plan?**

**What are the environmental benefits of the 2020 plan?**

about 50 percent. In addition, PGE would switch to a lower-sulfur coal that would reduce sulfur dioxide emissions 50 percent by 2014. The actual level of haze-causing emissions produced would be less than if we implemented additional environmental controls and operated the plant through 2040, the plan already approved by the Environmental Quality Commission. In addition, the 2020 plan ends carbon emissions from the plant 20 years earlier than planned.

That's important, because carbon emissions have been linked to greenhouse gas and global climate change, and currently no technology has been developed that effectively addresses carbon emissions from generating plants, conventional automobiles or the many other sources of carbon.

**Are there other benefits to the 2020 plan?**

Yes. PGE would be able to maintain a reliable source of electricity while working to establish replacement resources. In addition, future technology may make alternative fuels more viable and cost effective. By keeping Boardman operating through 2020, we may be able to take advantage of technological advances and continue operating the plant using low-emission alternative fuels.

We also care deeply about the impact of our decisions on our employees and the economic vitality of the Boardman-area community. A decade of additional time allows us to work with Boardman community leaders and our employees to pursue replacement jobs by building new generating resources.

**What will be needed to make the 2020 alternative possible?**

If PGE obtains the support needed from our stakeholders, we will submit to the OPUC an addendum to our Integrated Resource Plan. This addendum will include a proposal to operate Boardman through 2020, contingent on 1) obtaining approval from the Oregon Department of Environmental Quality for a new plan for reducing regional haze; 2) resolution of existing legal challenges over past and current operating standards at the plant; and 3) resolution of issues concerning pending federal air regulations. PGE is reaching out to key stakeholders for help in resolving these contingencies.

**Would a 2014 shutdown be a better option?**

A 2014 shutdown is more costly and risky for customers and could severely hamper our system reliability. A 2014 closure would result in additional costs of about \$600 million being passed on to customers during the next 11 years. Additionally, it takes many years to develop plans and receive proper approvals to build new generation resources. It is unlikely that we would be able to have another plant built and operating that quickly, which means PGE customers would be exposed to the wholesale electricity market to fill the gap. That could spell higher prices for customers. Such a rapid closure would also impact the economic vitality of the Boardman community and our employees who work at the Boardman Plant.

**Does the 2020 plan include additional pollution controls on the Boardman Plant?**

Yes. PGE plans to install pollution controls in 2011 that would cut mercury emissions by 90 percent and haze-causing nitrogen oxides (NO<sub>x</sub>) emissions by about 50 percent. These controls cost about \$40.5 million. In addition, PGE would switch to a lower-sulfur coal that would reduce sulfur dioxide emissions 50 percent by 2014.

If the alternative plan is approved, PGE would not install scrubbers to reduce sulfur dioxide (SO<sub>2</sub>) emissions or a selective catalytic reduction (SCR) system to further reduce NO<sub>x</sub> emissions, but those emissions would be eliminated entirely with the plant shutdown in 2020. The cost of installing these controls would be about \$470 million.

**If 2020 isn't viable, what course will PGE pursue for its Boardman Plant?**

Because the plant would be shut down 20 years earlier than planned, haze-causing emissions from Boardman would be less than if we installed all the proposed new controls and operated the plant through 2040.

While this alternative plan is our preferred option, if we are not able to resolve contingencies, we will continue to seek approval for installation of emissions controls and continued operation of the plant through 2040 — the next best option available to our customers under the current rules.

**What type of generating resource will be used to replace Boardman?**

Our Boardman Plant is a baseload plant. That means it cost-effectively generates electricity 24 hours a day, with minimal interruptions for annual maintenance or repairs. Currently, the only viable replacement for a baseload plant like Boardman is likely to be a high-efficiency natural gas plant, similar to our Port Westward and Coyote Springs plants. The strategy for how best to replace Boardman will be taken up in a subsequent resource plan.

**Why not replace Boardman with renewable resources like wind or solar power?**

PGE's resource plan already calls for adding another 122 average megawatts of new renewables to PGE's diverse mix of resources by 2015, helping to ensure the utility meets the state's renewable power requirements on or ahead of schedule. An additional 122 average megawatts would produce about the same amount of power as another wind farm the size of our Biglow Canyon Wind Farm. But as valuable as renewable power projects like this are to PGE's diverse resource mix, they cannot take the place of a baseload plant like Boardman because they are "intermittent" resources. That means they cannot be depended on to generate electricity without interruption, because the sun doesn't always shine and the wind doesn't always blow.

**How does Boardman compare to other coal plants?**

PGE has operated Boardman since it went online in 1980, under regulation by the Oregon Department of Environmental Quality (DEQ) and in strict compliance with state and federal law. The plant consistently performs more cleanly than its operating permit requires, with air emissions that are generally lower than its permit would allow. It's also important to put Boardman into national context:

- While electricity generation accounts for 40 percent of carbon emissions nationwide, here in Oregon, the Boardman Plant contributes only about 7 percent of the state's carbon dioxide emissions (43.5 MMT per year).
- As a nation, we generate 6,000 million metric tons of CO<sub>2</sub> annually, with transportation and electricity generation accounting for more than two-thirds of that. Oregon ranks among the 10 states with the lowest carbon emissions.
- While Boardman is Oregon's only coal plant, it represents one of 1,325 coal fired generating units nationwide.
- About 50 percent of the electricity generated in the U.S. is from coal-fired plants.

**Aren't other utilities shutting coal plants now?**

Yes, but those plants generally are older than Boardman, and /or do not serve as baseload resources for those utilities. In fact, some utilities are building new coal plants.

**Why weren't more stringent environmental controls required at Boardman previously?**

Development of the Boardman Plant was already underway in 1974 when Congress passed new regulations under the Clean Air Act. In response to an inquiry by PGE, the Environmental Protection Agency ruled that the plant was not subject to the new regulations. Nonetheless, under an agreement with the Oregon DEQ, PGE agreed to fully comply with the provisions of the new 1974 EPA regulations, including an

**What is PGE's overall environmental record?**

agreement to use low-sulfur coal to fuel the plant, and meeting air quality emission standards applicable under the 1974 regulations. A number of subsequent regulations have been imposed on new generating plants, which have not applied to plants like Boardman because they were built prior to the regulations.

PGE has a strong record as an environmental leader. As we work to secure Oregon's energy future, PGE is committed to finding sustainable and affordable options to fill the gap and meet our customers' electricity needs.

- **Policy leadership:** We supported the development of a Renewable Energy Standard adopted by the Oregon Legislature in 2007, which mandates that Oregon's largest utilities acquire 25 percent of their electricity from new renewable energy sources change and call for a national policy to reduce greenhouse gases.
- **Energy efficiency:** Our resource plan relies on energy efficiency to meet nearly half of our customers' growing demand for electricity through 2020. PGE works closely with the Energy Trust of Oregon to help all our customers — business and residential — save money and help the environment by using less electricity.
- **Rapid development of renewable resources:** PGE is working hard to meet the state's Renewable Energy Standard, including investing more than \$1 billion in our Biglow Canyon Wind Farm. Our new IRP seeks to add an additional 122 average megawatts of renewable power by 2015 and 168 more average megawatts by 2020. We also are helping lead efforts in Oregon to establish a market for solar power. Last year, PGE ranked eighth in the nation — and fourth in the West — for total solar power generation, according to the Solar Electric Power Association.
- **Renewable power sales:** For the fourth year in a row, our residential customers helped make PGE the No. 1 utility in the nation in sales of renewable power, according to the U.S. Department of Energy's National Renewable Energy Laboratory. PGE residential customers purchase more than 530 million kilowatt hours of renewable energy annually.
- **Fish protection:** PGE's 2007 removal of its Bull Run Hydro Project restored fish runs to the upper regions of the Sandy River for the first time since 1912. We recently completed construction of the state-of-the-art fish passage system at our Pelton Round Butte hydro project on the Deschutes River. These are just two of rivers where our hydro facilities are located.
- **Promoting a green economy:** PGE has been a leader in attracting green industries to the area and in promoting Oregon as the ideal testing ground for electric vehicles.

In summary, while the 2020 plan faces several obstacles, we believe it is worth pursuing because it offers the greatest benefit for our customers. It allows us to eliminate coal at the plant by 2020 at a cost savings of about \$600 million over the next decade, compared to closing the plant in 2014. It results in fewer haze-causing emissions and eliminates all coal-based carbon generation in Oregon two decades earlier than the 2040 plan. It allows PGE a decade to plan and build replacement generation resources, ensuring that the reliability of our electric system isn't compromised. This timeline also allows us to work with Boardman community leaders and our Boardman employees to identify replacement jobs.

We look forward to working with stakeholders to make this plan a reality.

# Boardman Update



Northwest Power & Conservation Council

May 12, 2010





# PGE's dynamic operating area

4,000-square-mile operating area

818,000 customers

43% of Oregonians depend on PGE for electricity

Area represents the state's economic engine, accounting for 70% of the state's GDP

52 cities served

25,600 circuit miles of T&D lines

1,975 MW of generation

Summer peak load of 3,950 MW (2009)

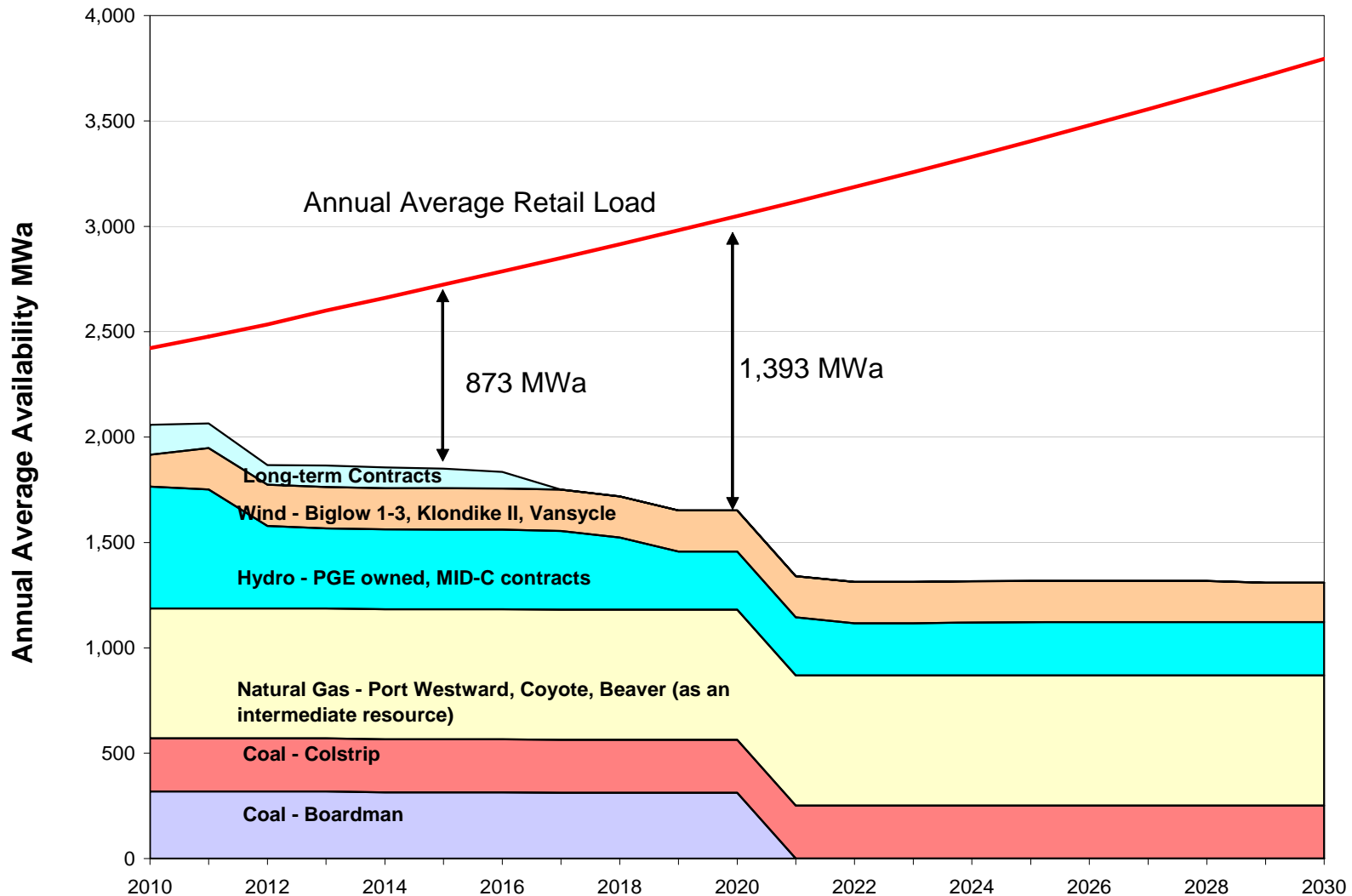
Winter peak load of 4,073 MW (1998)

Annual demand of 2,266 MWa (weather adjusted)



# PGE Resource Needs – Energy

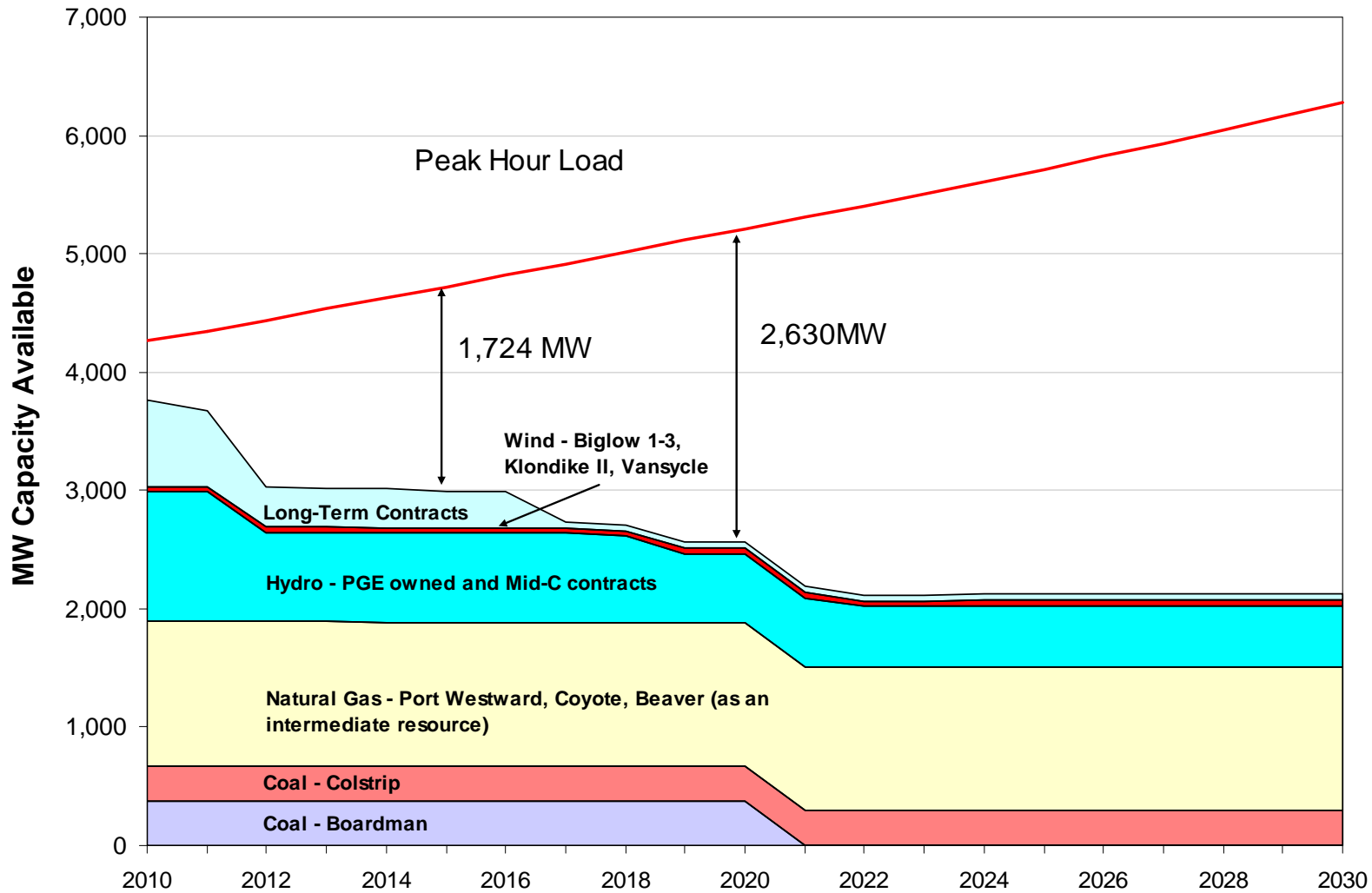
## Load-Resource Balance 2010-2030



- 1.9% Load Growth
- Load before EE actions
- Load excludes 5-yr Opt-Outs under SB1149
- Expiration of 450 MWa in contracts
- Boardman operation through 2020

# PGE Resource Needs – Winter Capacity

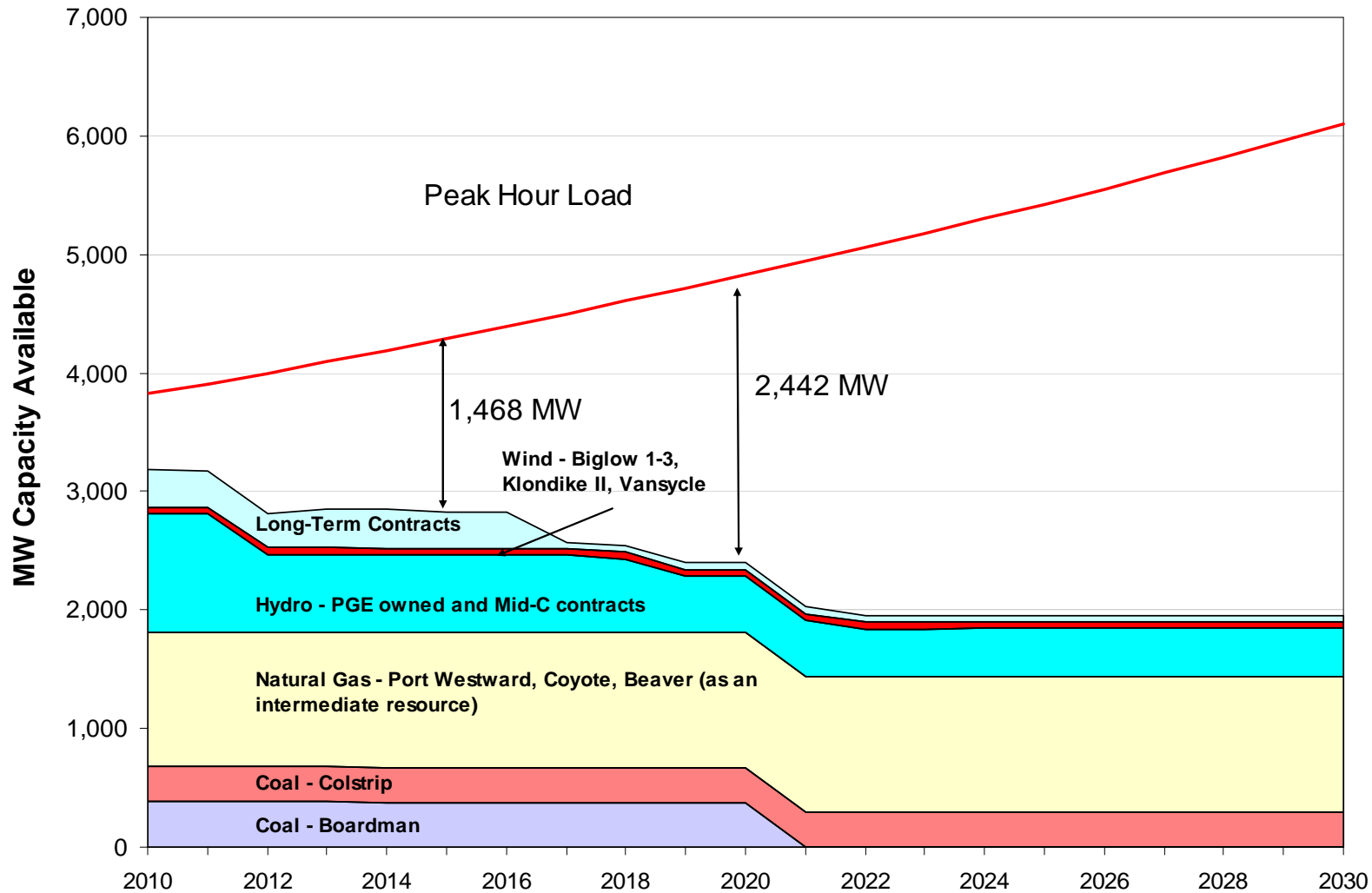
## Load-Resource Balance 2010-2030



- 1.7% increase in peak hour load
- Includes operating & planning reserves
- Load before EE actions

# PGE Resource Needs – Summer Capacity

## Load-Resource Balance 2010-2030



- 2.2% increase in peak hour load
- Includes operating & planning reserves
- Load before EE actions

# IRP Objective

The primary goal of the IRP is the selection of a portfolio of resources with the best combination of expected costs and associated risks and uncertainties for the utility and its customers.

## The IRP Process:

PGE files an Integrated Resource Plan (IRP) periodically with the Public Utility Commission of Oregon (OPUC). Through the IRP process the company is able to discuss with stakeholders and regulators the results of its research, analysis and findings with respect to anticipated future resource requirements and alternatives for serving our customers' electricity needs.

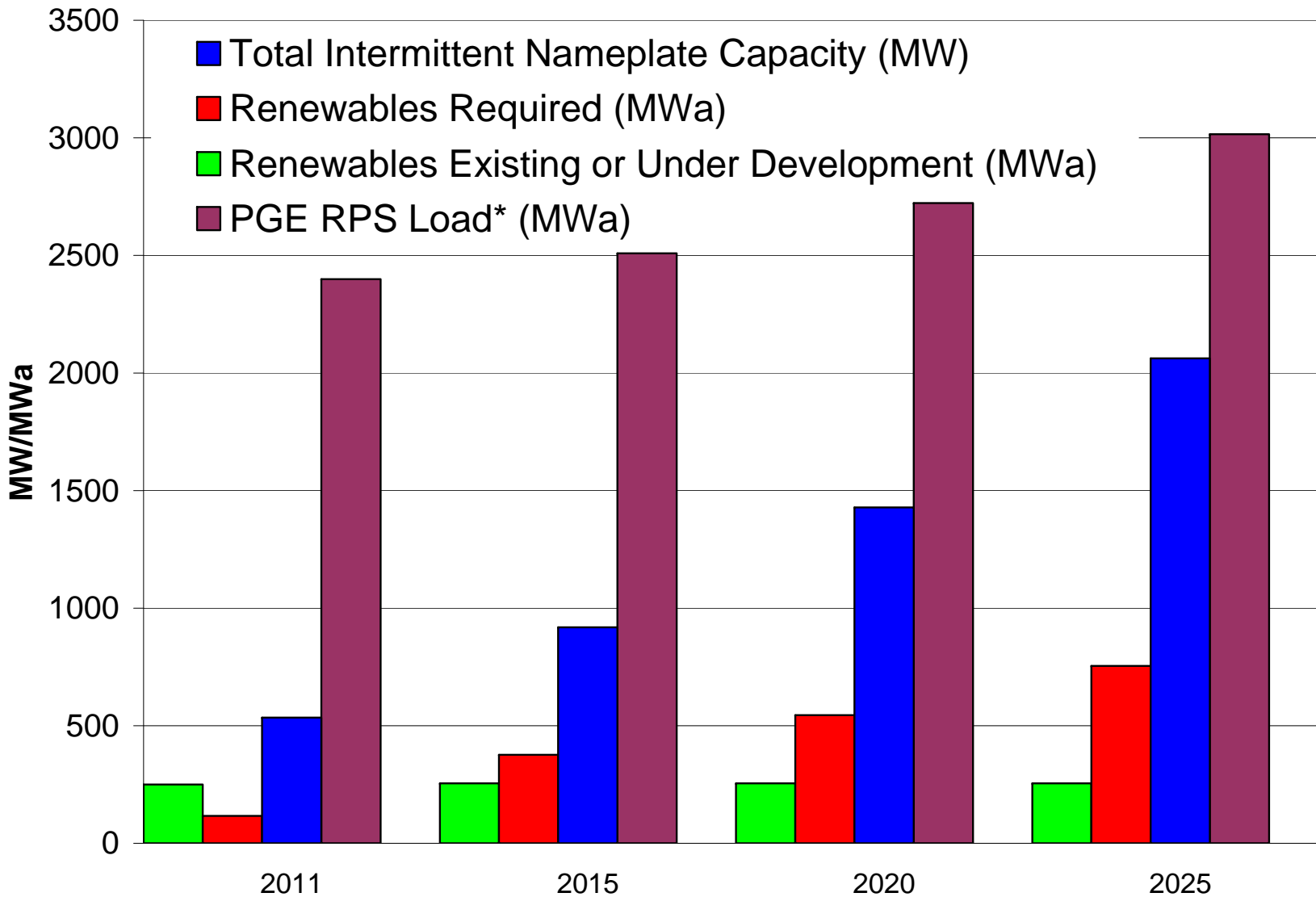


# Key IRP Modeling Assumptions

- Plan for PGE's system load net of 5-yr opt out
- Resource targets based on average hydro conditions
- Fuel forecast based on PIRA Energy Group (natural gas & coal)
- Energy Efficiency forecast from ETO
- CO<sub>2</sub> cost based on proposed legislation
- Western Electricity Coordinating Council (WECC) utilities meet RPS targets
- PGE meets OR RPS requirements with physical resources
- Reliability constraints imposed across WECC (peak load + reserves)
- Generic resource costs

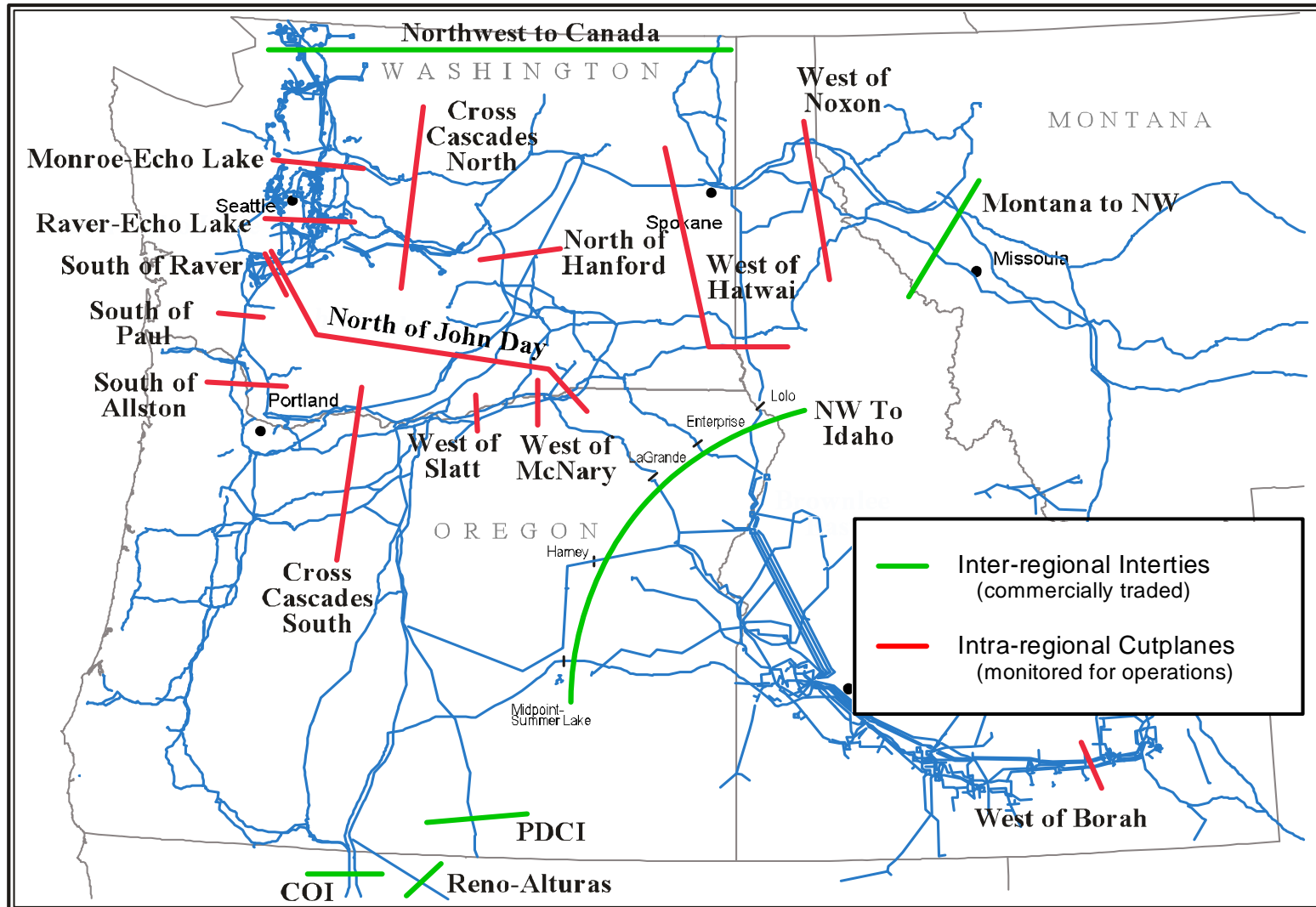


# PGE RPS Resource Need



- We will need 500 MWa of new renewables by 2025 to meet OR RPS.
- Incremental RPS need, combined with current generation translates to a total of almost 2,100 MW of nameplate capacity of intermittent resources (at 33% capacity factor).

# NW Constrained Paths



- Available transmission service has been a limiting factor in gaining access to additional resources

Source: [www.transmission.bpa.gov/PlanProj/transmission\\_projects/.../maps.PDF](http://www.transmission.bpa.gov/PlanProj/transmission_projects/.../maps.PDF)



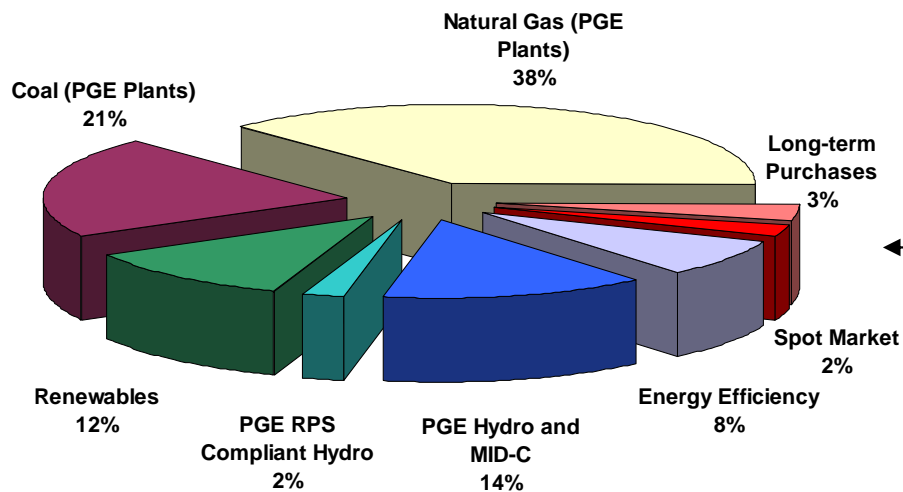
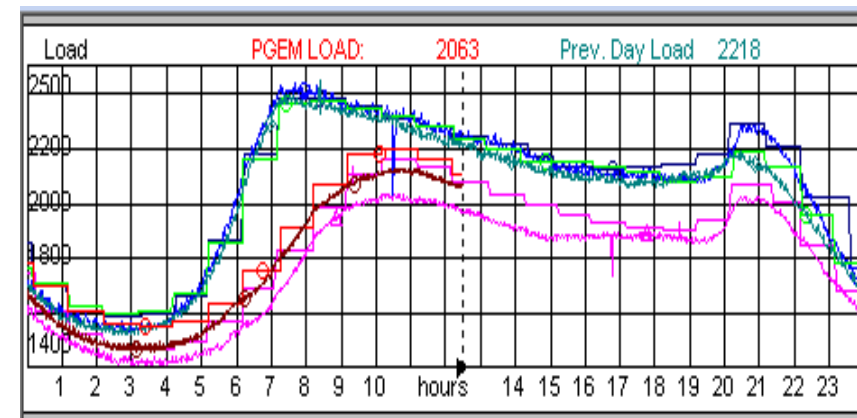
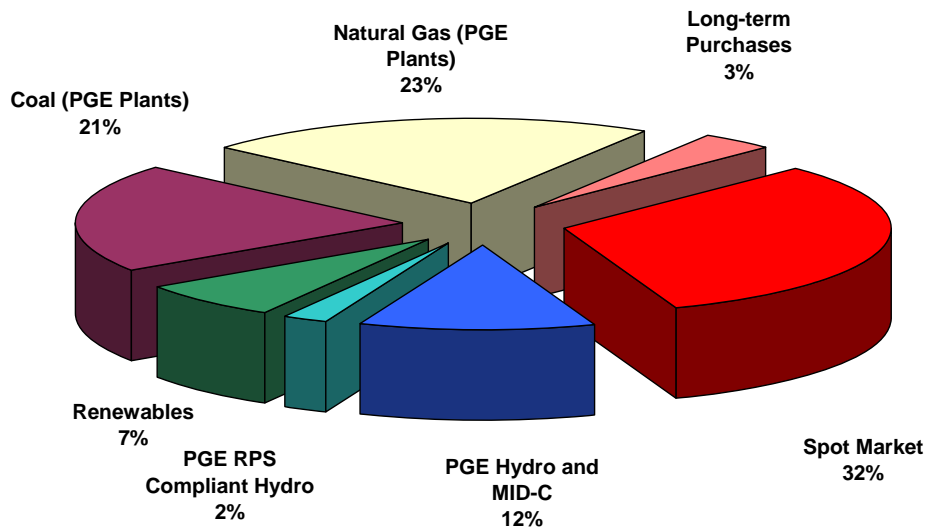
# Proposed Action Plan

## Key Proposed Resource Actions:

- Acquire 122 MWa of Renewable Portfolio Standard (RPS) compliant renewables
  - Meets 2015 Oregon RPS compliance
- 214 MWa of EE by 2015
- 300-500 MW high-efficiency combined cycle gas plant
- Up to 200 MW of flexible gas capacity resources
- Natural Gas Fueling
  - Acquire pipeline and storage capacity to meet future gas fueling requirements
- Cascade Crossing Transmission Line
  - 500 kV double-circuit transmission facility from Boardman area to southern end of PGE's system
- Other Actions: Contract renewals, DSG expansion (67 MW), DR acquisitions (60 MW)
- Pursue Boardman 2020 closure plan
  - Install Emission Control Upgrades to meet requirements of proposed RH BART II petition
  - Include 2040 contingent plan if 2020 plan not achievable



# PGE 2015 Energy Resource Mix



# Boardman Generating Station

Plant Capacity: 585 MW

Location: Approximately 13 miles southwest of Boardman in Morrow County, Oregon

Owners:

- Portland General Electric (65%) – Operator
- Idaho Power Company (10%)
- Power Resources Cooperative (10%)
- Bank of America (15%)

Fuel: Low sulfur sub-bituminous coal

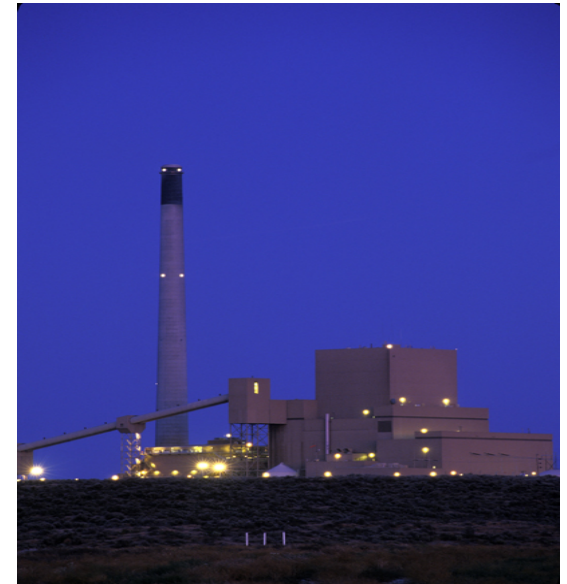
Commercial operation: August 1980 (Site certificate March 1975)

Approximately 110 full-time employees, 30 contractors, 225 seasonal maintenance positions

Consistently performs more cleanly than operating permit requires

Approximately 15% of PGE's power comes from Boardman at prices one-third to one-half market prices

Supply Portfolio: Fuel diversity, low marginal cost, baseload and dispatchable



DAN AGUAYO/THE OREGONIAN

# DEQ / EPA - Regional Haze Program

## Federal Program

- Regional Haze Rule adopted July 1999
- Objective: Return visibility to natural background level by 2064
- Haze is commonly caused by: motor vehicles, power plants, industrial/manufacturing processes, outdoor burning and natural sources such as wildfires and wind blown dust
- States must submit and periodically update implementation plans

## Oregon's Regional Haze Plan

- Identifies pollutants and sources causing haze
- Describes current visibility conditions for national parks/wilderness
- Contains 10-year projection of visibility (first planning period) and compares to 2018 Milestone
- Explains how Oregon is showing "Reasonable Progress" in improving haze
- Contains a long-term strategy
- Describes DEQ BART Review & DEQ proposal for the Boardman coal fired power plant

BART "Best Available Retrofit Technology"

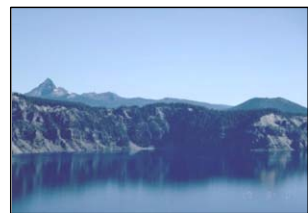
Applies to:

- Major sources > 250 tons per year of any haze pollutant
- Construction commenced 1962-1977
- 26 source categories, including Electric Generating Units & industrial boilers, kraft pulp mills, and refineries

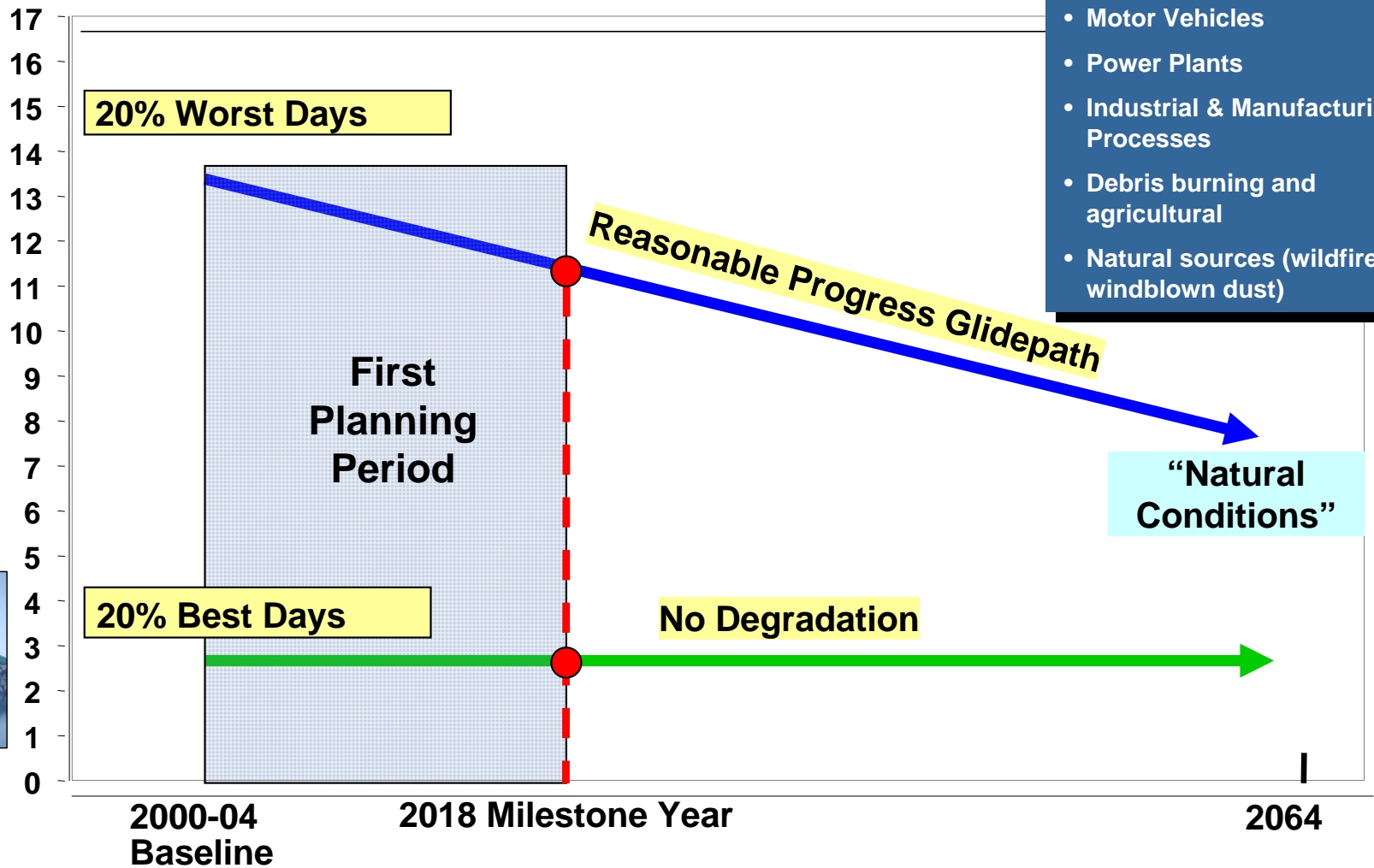
BART is determined on case-by-case basis

# Objective of Regional Haze Plan

## Class I Area

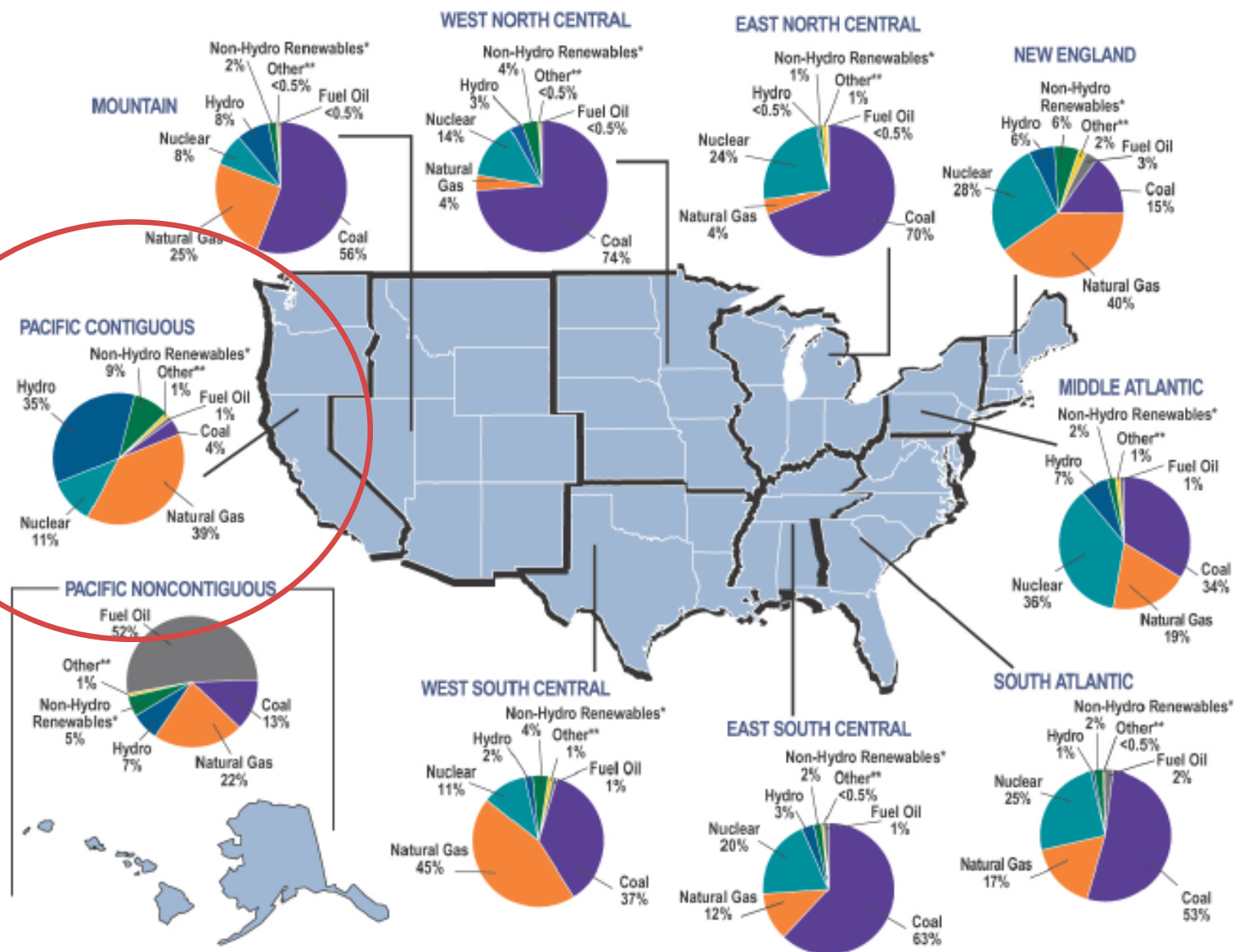


Deciview - dv



- Regional Haze sources are both urban and rural, such as:
- Motor Vehicles
  - Power Plants
  - Industrial & Manufacturing Processes
  - Debris burning and agricultural
  - Natural sources (wildfire, windblown dust)

# Regional Supply Portfolio Composition



\*Includes generation by agricultural waste, landfill gas recovery, municipal solid waste, wood, geothermal, non-wood waste, wind, and solar.

\*\* Includes generation by tires, batteries, chemicals, hydrogen, pitch, purchased steam, sulfur, and miscellaneous technologies.

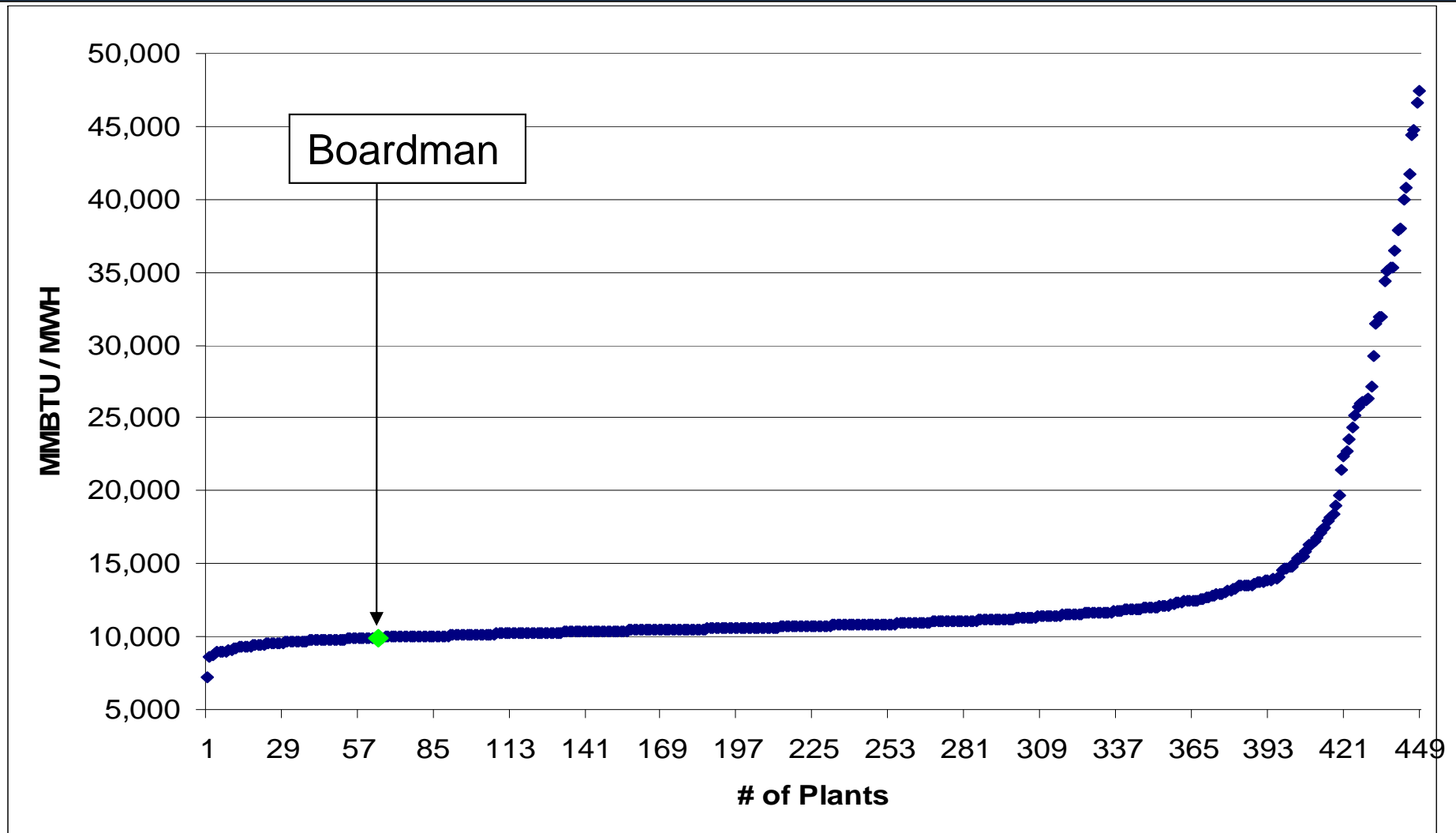
Sum of components may not add to 100% due to independent rounding.

Source: U.S. Department of Energy, Energy Information Administration, Power Plant Operations Report (EIA-923); 2008 preliminary generation data.

January 2010

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# US Coal Fleet Heat Rate\*



Source: 2000-2007 Average, SNL Financial Database

\*Chart shows overall efficiency at 449 of the 533 U.S. coal plant sites where heat rate data is available. Some plant sites operate multiple coal-generating units. There are over 1,325 coal-fired units operating in the U.S.; Boardman operates a single unit.

# Boardman: Recent Regulatory History

- Jan. 2006:** PGE volunteers Boardman to submit data for DEQ regional haze study
- Nov. 2007:** PGE proposes BART – Best Available Control Technology – for Boardman
- Nov. 2008:** DEQ issues proposed regional haze rule requiring BART controls
- Dec. 2008:** PGE recommends “decision point” plan with off-ramps in 2020 and 2029, reflecting uncertainty of future carbon costs
- June 2009:** DEQ adopts regional haze rule. Rejects decision point plan but allows possibility of future rule revision
- 

## **DEQ -- Best Available Retrofit Technology (BART) Requirement:**

- |   |                                |
|---|--------------------------------|
| ▪NO <sub>x</sub> (Low NO <sub>x</sub> Burner & Over Fire Air) | 0.23 lb/mmBtu by July 1, 2011  |
| ▪SO <sub>2</sub> (Semi-Dry Scrubber)                          | 0.12 lb/mmBtu by July 1, 2014  |
| ▪PM (Bag House)   | 0.012 lb/mmBtu by July 1, 2014 |

## **DEQ -- Reasonable Progress (RP) Requirement:**

- |  |                               |
|--|-------------------------------|
| ▪NO <sub>x</sub> (Selective Catalytic Reduction) | 0.07 lb/mmBtu by July 1, 2017 |
|--|-------------------------------|

**DEQ’s regional haze rule effectively left PGE with two options: Close the plant in 2014, or install controls and operate thru 2040+**



# Boardman: Recent Regulatory History

- Sept. 2009:** Despite DEQ rule limitations, stakeholders ask PGE to consider 2020 closure in Integrated Resource Plan
- Nov. 2009:** PGE submits IRP to OPUC, incorporates required BART controls with 2040 operating plan as best option actionable under current rules
- Sept. 2009 - Jan. 2010:** PGE conducts additional cost and risk analysis of Boardman operating scenarios
- Jan. 2010:** PGE announces intent to cease Boardman operations 20 years early
- April 2010:** PGE submits “BART II” proposal to DEQ, files IRP Addendum with OPUC to incorporate 2020 plan

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## **PGE Proposal -- Best Available Retrofit Technology (BART II) :**

- NO<sub>x</sub> (Low NO<sub>x</sub> Burner & Over Fire Air) 0.23 lb/mmBtu by July 1, 2011
- SO<sub>2</sub> Sulfur restriction #1 (Pre combustion controls – Coal) 0.96 lb/mmBtu in 2011
- SO<sub>2</sub> Sulfur restriction #2 (Pre combustion controls – Coal) 0.60 lb/mmBtu in 2014
- Particulate Matter (PM) No change in current PM emissions
- Cease operation of the Boardman Plant boiler by December 31, 2020

Under a separate DEQ rule PGE will be reducing mercury (Hg) at Boardman by 90% by 2012

# Comparison of Existing vs. Proposed BART II Rule

Controls	Constituent	2009		BART I			Proposed BART II Revision		
		Emissions*	Permit Levels*	Emissions*	Cost**	Schedule	Emissions*	Cost**	Schedule
Low NOx Burners / OverFire Air	NOx	0.41	0.70	0.23	\$32.8 Million	Jul-11	0.23	\$32.8 Million	Jul-11
Dry Scrubber with Fabric Filter	SO <sub>2</sub>	0.70	1.20	0.12	\$289 Million	Jul-14	Shut Down @ end of 2020		
	PM	0.04***	0.04	0.012	(Incl. in above)	Jul-14			
Reduced Sulfur Coal Restriction 1	SO <sub>2</sub>						0.96	Increased O&M	Dec-11
Reduced Sulfur Coal Restriction 2	SO <sub>2</sub>						0.60	Increased O&M	Jul-14
Selective Catalytic Reduction (SCR)	NOx			0.07	\$180 Million	Jul-17	Shut Down @ end of 2020		
Mercury Controls	Hg			90%	\$7.7 Million	Jul-12	90%	\$7.7 Million	Jul-12
Aggregate Emissions (tons)				256,815			231,224		
Totals					\$509.5 Million			\$40.5 Million	

\* Lbs/Mmbtu

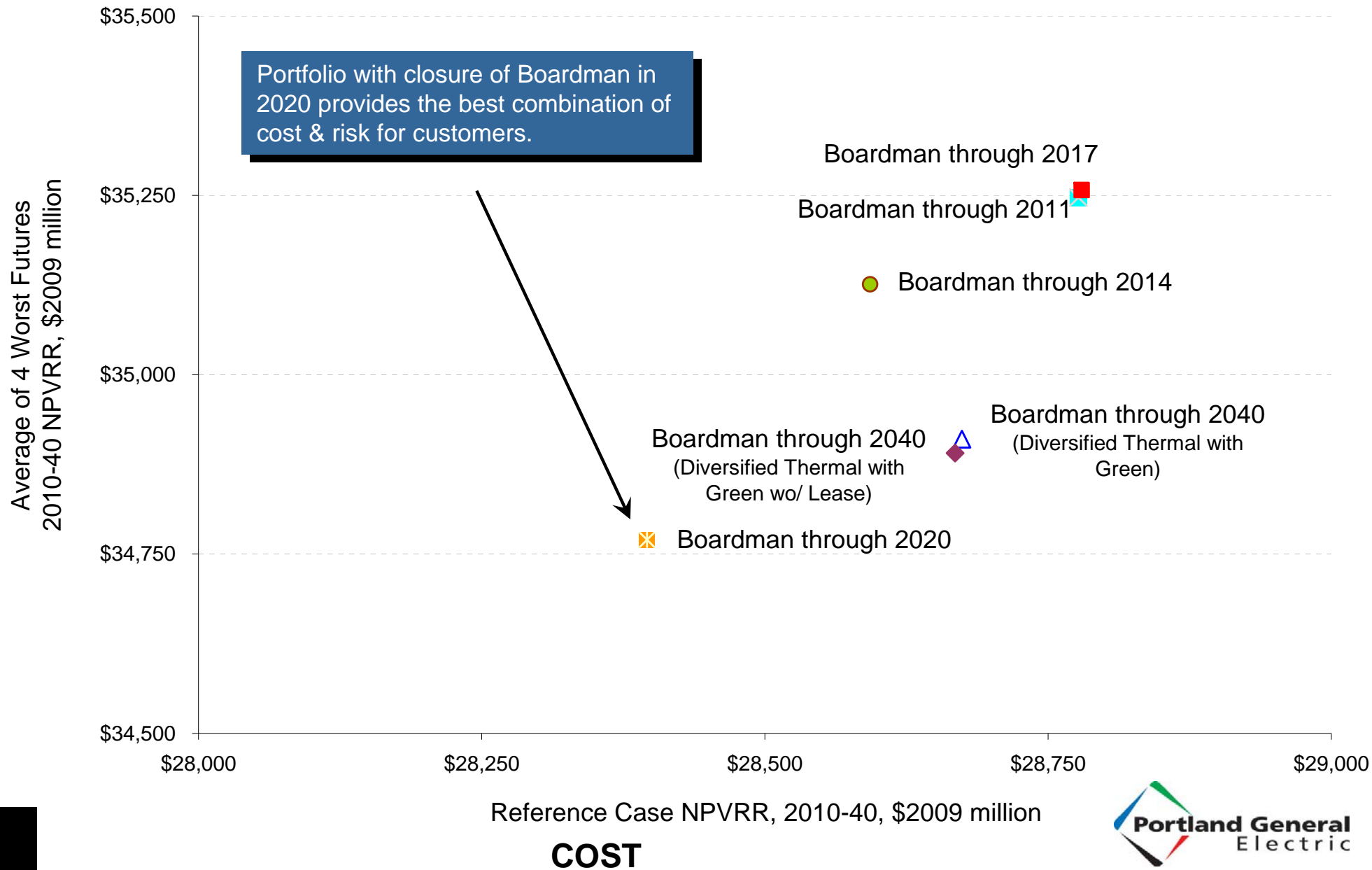
\*\*Costs are nominal Capital dollars and do not include AFDC and property taxes

\*\*\*Correction from filed IRP Addendum

- Proposed BART II schedule
  - Petition submitted to DEQ – April 2010
  - EQC ruling targeted by end of 2010
  - Order Low-NOx Burner/OFA equipment Q1 2010
  - Order sorbent injection equipment for mercury controls Q2 2010
  
- Bart I would require ordering equipment for Scrubber in Q1 2011

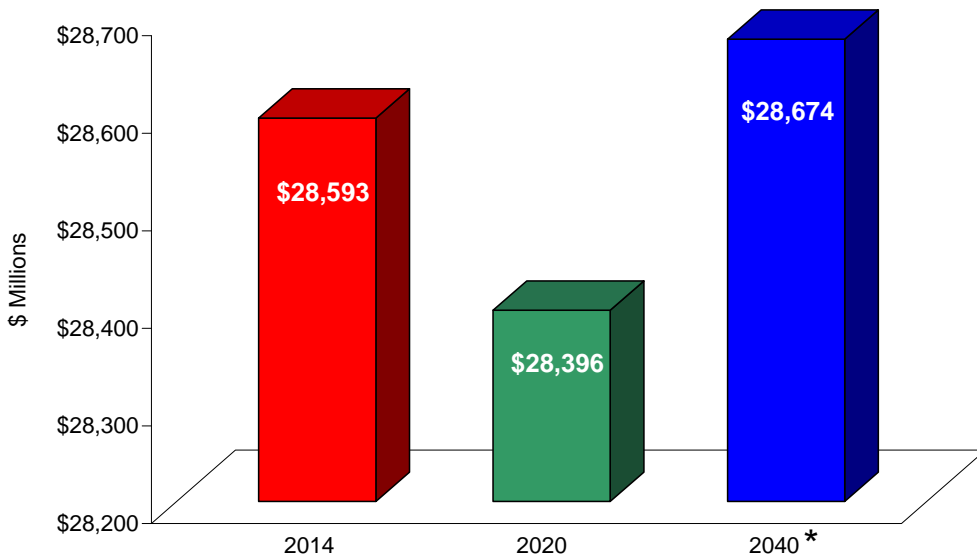
# Portfolio Cost vs. Risk: Boardman Highlight

RISK



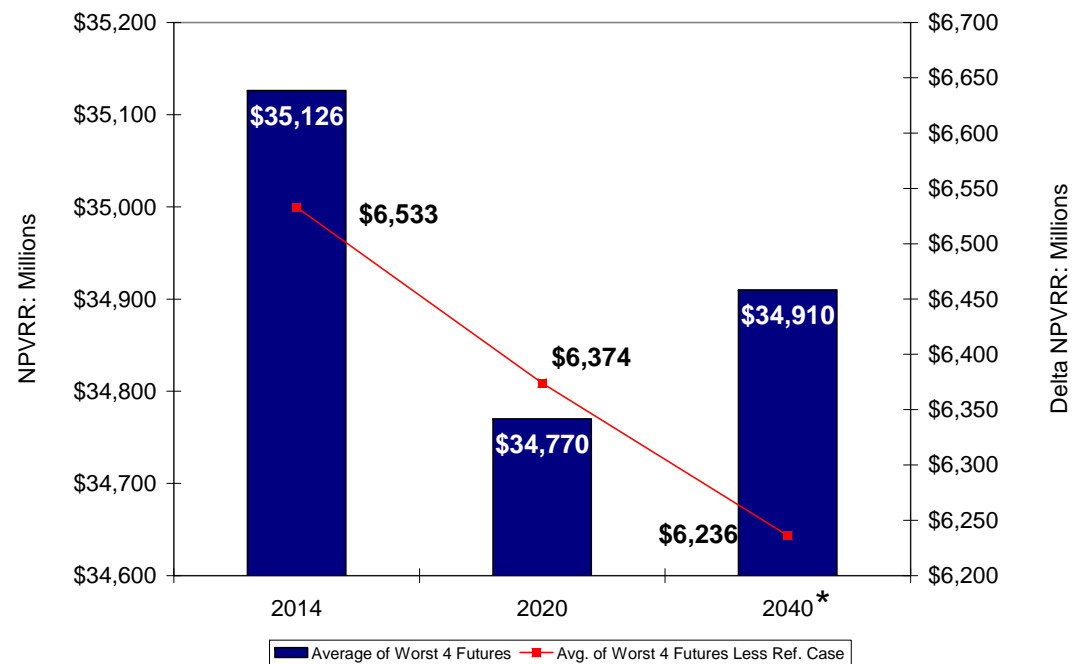
# NPVRR (2009\$) – Reference Case Cost & Deterministic Risk

## Boardman Portfolios



Boardman 2020 portfolio provides lower cost for customers by \$197 MM NPV as compared to 2014 Boardman option.

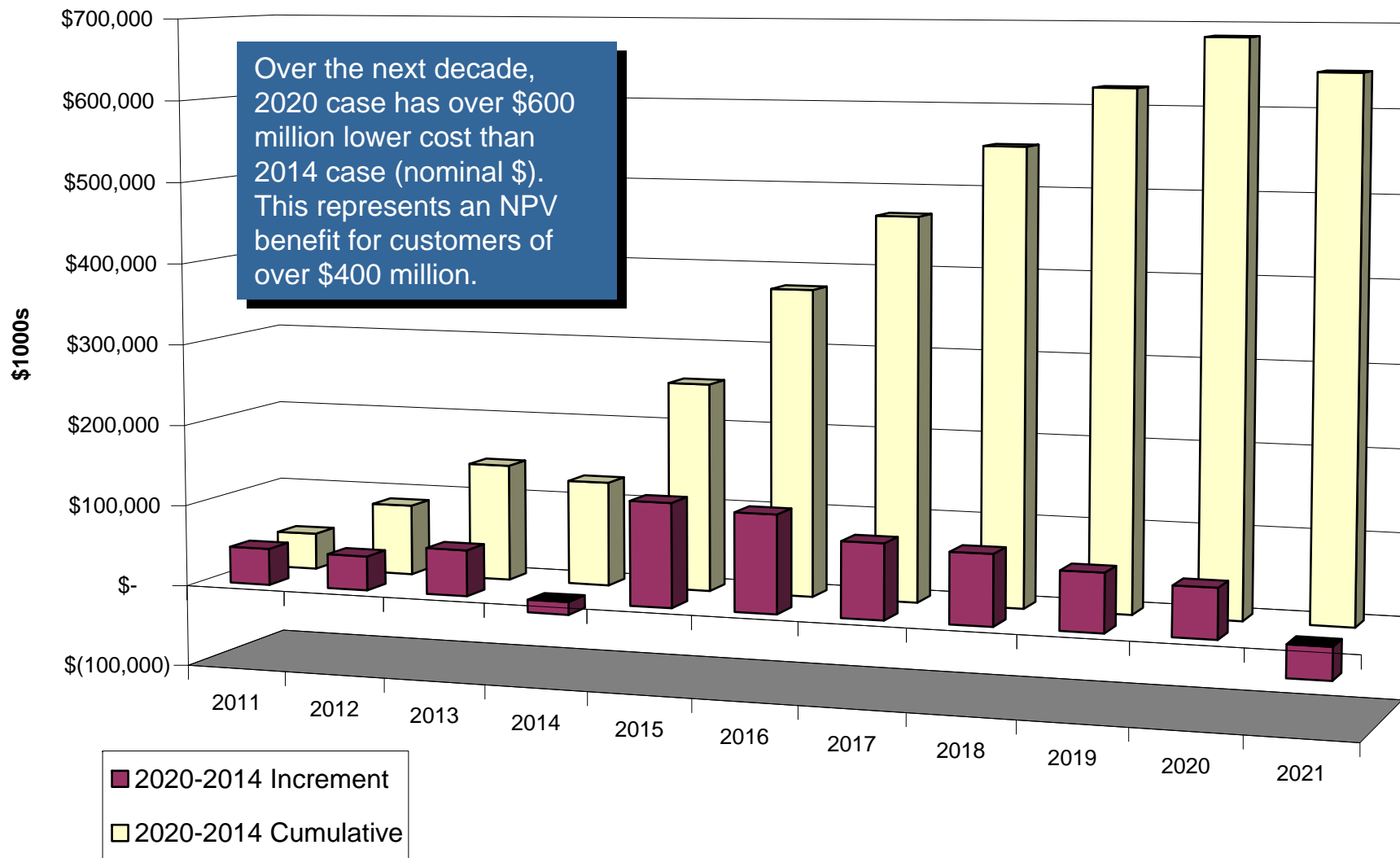
Both 2020 and 2040 closure cases perform well under deterministic risk measures. 2014 case is riskier according to both measures.



NPVRR = Net present value of revenue requirement  
 \* 2040 is Diversified Thermal with Green Portfolio

# Cost Impacts to 2021

## Boardman 2014 vs. 2020 Closure



# Summary Comparison: Boardman Cases 2014, 2020 and 2040

Summary	2014 vs. 2020*	2014 vs. 2040*	2040 vs. 2020*
<b>Cost &amp; Risk Metrics (\$2009 millions)</b>			
NPVRR - Reference Case Costs	\$197	(\$81)	\$278
Deterministic Risk - Avg. of Worst 4 Futures	\$356	\$216	\$140
Deterministic Risk - Avg. of Worst 4 Futures Less Reference Case	\$159	\$297	(\$138)
<b>Revenue Requirements 2011 - 2021 (millions)</b>			
Nominal Change	\$645	\$324	\$321
NPV Change (\$2009)	\$421	\$233	\$187
<b>Rate Impacts 2011 - 2021**</b>			
First Year Impacts	2.6%	3.3%	-0.6%
Average Rate Impacts	3.2%	1.6%	1.5%

\* Delta of first comparison year less second comparison year

\*\* Based on current revenue requirement with 1.9% load growth

#### NOTES:

Positive number indicates higher cost  
Numbers based on PGE share of the plant



## **Challenges to a Boardman 2020 closure:**

- DEQ adoption of BART II Rulemaking Petition
- Resolution of issues related to potential National Emission Standards for Hazardous Air Pollutants (NESHAP) Maximum Achievable Control Technology (MACT) requirements
- Resolution of pending Sierra Club litigation
- IRP Acknowledgement

# 2040 Boardman Alternate Plan

**If the 2020 Plan for Boardman is not achievable, a 2040 Boardman alternative based on the Diversified Thermal with Green portfolio is the next best option for PGE and our customers.**

- Under this alternate Action Plan, PGE will install all emissions controls required under the current Oregon Regional Haze and Oregon Utility Mercury rules and operate Boardman through 2040
  - Cost of all emissions controls is approximately \$510 MM (nominal capital, excluding AFDC and capitalized property taxes)
- The 2040 alternate Action Plan also provides a good balance between cost and risk, while ensuring our ability to reliably serve our customers energy needs
- The 2040 alternate Action Plan is only modestly higher in cost than a 2014 closure case, but performs considerably better on a cost-risk basis
- If the 2020 preferred plan is not achievable, the 2040 alternate Action Plan is the only other available option that meets emissions control regulations and provides certainty of supply for PGE customers



# Boardman 2020: Most Sustainable Option for Customers

## Best outcome for customers and state

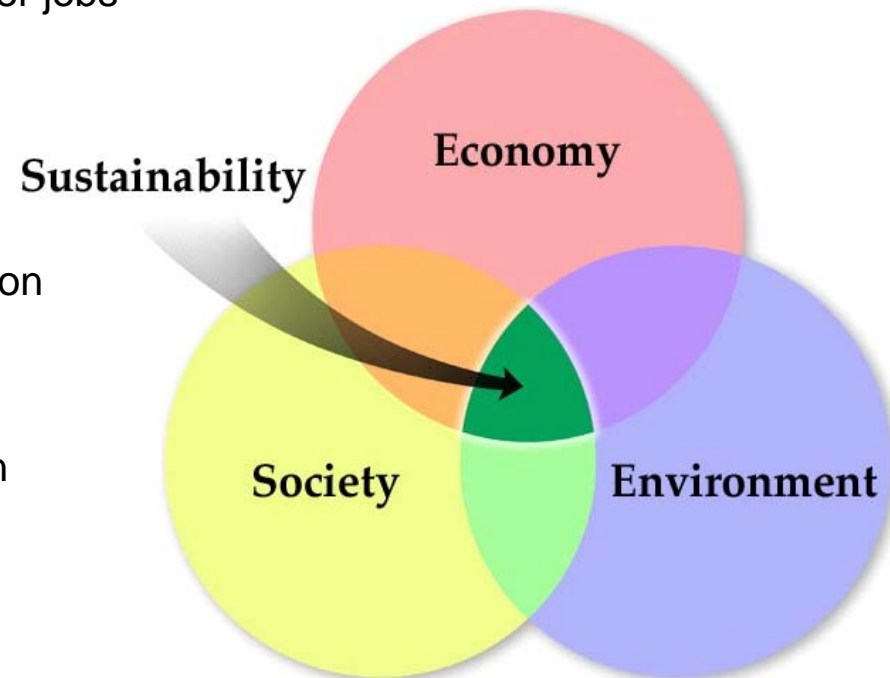
- Saves customers about \$600 million over the next 11 years, compared to 2014 shutdown
- Gives PGE time to build or buy cost-effective, reliable replacement resources
- Allows time for workers at the plant to transition to other jobs

## Meets or exceeds environmental goals

- Cuts mercury by 90 percent
- Cuts nitrogen oxides by 50 percent
- Haze-causing emissions would be less than 2040 option
- Lower sulfur coal would reduce allowed sulfur dioxide emissions 50 percent by 2014
- Ends Boardman carbon emissions from coal at least 20 years earlier than planned (net 60% carbon reduction if replaced by gas)

## Sets an important national precedent

- Eliminates use of coal at a relatively young baseload plant, 20 years ahead of schedule





Q & A