

Bruce A. Measure
Chair
Montana

Rhonda Whiting
Montana

W. Bill Booth
Idaho

James A. Yost
Idaho



Dick Wallace
Vice-Chair
Washington

Tom Karier
Washington

Bill Bradbury
Oregon

Joan M. Dukes
Oregon

January 26, 2011

MEMORANDUM

TO: Council Members

FROM: Terry Morlan

SUBJECT: Presentation by Portland General Electric

Portland General Electric (PGE) will brief the Council on its integrated resource plan and the agreement to close the Boardman coal-fired generation plant by 2020.

The discussion of PGE's integrated resource plan is another in a series of agenda items examining utilities' resource plans and issues they are facing. It is useful for the Council to see what utilities are thinking and how their planning conclusions and strategies compare to the Council's plan for the region.

The Boardman plant closure is very significant not only from a regional perspective, but from a national perspective as well. It is the first instance of early closure of a coal-fired generation plant for environmental reasons. Risk of carbon policy figured in PGE's thinking on the cost and risk of the Boardman plant. Replacement of the plant's capability is a challenge for PGE, which is already resource-short and therefore in a different position from the region as a whole as viewed in the Council's power plan.

We have attached a summary of the Boardman plan from the PGE website for additional background.

q:\tm\council mtgs\2011\feb11(c-)pge presentation cm.docx



[Contact Us](#) [Careers](#) [Investors](#)

Search PGE

Go

[Sign In](#)

[Residential](#) [Business](#) [Renewables & Efficiency](#) [Safety & Outages](#) [Economic Development](#) [Community & Environment](#) [Our Company](#)

Our Company

Boardman Plant Air Emissions



[PGE at a Glance](#)

[Corporate Information](#)

[Generation & Transmission](#)

[Awards & Recognition](#)

[Careers](#)

[News & Issues](#)

[News Room](#)

[Current Issues](#)

[Boardman Plant Air Emissions](#)

[Climate Change & PGE](#)

[Determining Energy Prices](#)

[Help for Tough Times](#)

[Oregon's Energy Future](#)

[PGE Energy Strategy](#)

[Plug-in Charging Stations](#)

[Smart Meters](#)

[Investor Relations](#)

[Community & Environment](#)

[Contact Us](#)

New plan approved

The Oregon Environmental Quality Commission has approved new rules for the Boardman Power Plant under which the plant will implement emission control retrofits over the next ten years and cease coal-fired operations by the end of 2020.

Good balance of costs and benefits

“These are tough new rules that put Oregon at the forefront of national efforts to reduce emissions from coal-fired power generation,” said Jim Piro, PGE president and CEO. “We’ve worked hard with a broad coalition of Oregon citizens and organizations to gain public support and regulatory approval for an environmentally responsible, workable, cost-effective emissions control strategy and timeline for the Boardman Plant. Implementing these rules won’t be easy or inexpensive, but it strikes a good balance of costs and benefits for our state and our customers.”

The new controls are expected to reduce NO_x emissions by about 50 percent and permitted levels of SO₂ emissions by 75 percent. A separate set of rules also requires controls to reduce the plant’s mercury emissions by 90 percent. All coal-related emissions from the Boardman facility will be reduced to zero with the end of coal-fired operations in 2020. The combined capital cost of the required controls is currently estimated at about \$60 million.

The new rules were recommended by staff at the Oregon Department of Environmental Quality, following an extensive public process with two formal comment periods and seven public

Could biomass be in Boardman's future?



Now that its plan to stop using coal at the Boardman Plant in 2020 has been approved, PGE is

investigating whether the plant could continue to serve our customers with a different fuel — replacing coal with a carbon-neutral renewable resource.

With the help of Oregon State University and Washington State University Extension Services, PGE is researching the potential for giant cane (*Arundo donax*) as a replacement biofuel. The cane could be produced near the plant, resulting in minimal transport cost. When put through a torrefaction (charring) process and pulverized, giant cane produces a fuel source with properties very similar to coal — but without the high carbon impact.

Research is in its early stages,

hearings. The agency also convened a fiscal advisory committee last summer to review the economic impact of various control options. The new rules will be implemented with the following measures:

Installation of new low-NO_x burners and modified overfire air ports in July 2011 to comply with Best Available Retrofit Technology (BART) standards for oxides of nitrogen.

Installation of a dry sorbent injection system in July 2014 to comply with BART standards for sulfur dioxide.

Pilot studies for the DSI system to verify that set SO₂ limits for 2014 and 2018 are achievable.

Repeal of DEQ's 2009 BART rule, which would have allowed continued operation of the Boardman Plant through at least 2040 with installation of a much more expensive suite of emissions controls.

Permanent cessation of coal-fired operation no later than Dec. 31, 2020.

DEQ will now incorporate the EQC decision into its state implementation plan for regional haze, which will be forwarded to the federal Environmental Protection Agency for approval.

Next steps

As operator and majority owner of the plant, PGE will proceed with acquisition and installation of the necessary controls, beginning with the low-NO_x burners and mercury controls in July 2011. The company will also engage stakeholders in a comprehensive analysis of potential options to replace the power from the Boardman Plant — or convert the existing plant to a different fuel — as part of its next integrated resource planning cycle.

Background on process

Adoption of the new rules completes a process that began when PGE volunteered in 2006 to have the Boardman Plant to be the first Oregon facility evaluated under BART guidelines. The utility then submitted an initial analysis and control plan to DEQ in 2007. After DEQ adopted its first BART rule in 2009, PGE incorporated the rule's emissions control requirements into the company's long-term resource plan, but also responded to stakeholder requests for further analysis of an alternative strategy based on a 2020 timeline.

In January 2010, PGE announced that it would pursue a 2020 alternative and then in April submitted an initial 2020 plan to DEQ. The company also modified its integrated resource plan as

and to move forward would require new permits, additional emission controls, and consideration as part of a larger Integrated Resource Plan process. But, if research results are promising, a converted Boardman Plant would bring new life — and new job opportunities — to a relatively young facility. It would also create one of the largest biomass power plants in the nation — a reliable baseload resource providing low-cost, carbon-neutral renewable power for decades to come.

For more details, see our [fact sheet](#) (PDF) on assessing the potential to use giant cane to fuel the Boardman Plant.

Algae shows potential for reducing carbon emissions



PGE has concluded a successful small-scale pilot project using algae to capture

and consume carbon dioxide emissions from the Boardman Plant. We are among the first utilities to undertake a dedicated investigation into using algae to reduce carbon dioxide emissions. The process involves capturing CO₂ and feeding it to algae, which are being grown adjacent to the plant. During photosynthesis, the algae ingest CO₂ and release oxygen into the air, retaining oil and other byproducts. The oil can be "squeezed" out of the algae and used to produce clean-burning biodiesel. The remaining biomass has the potential to produce ethanol and proteins for livestock feed.

CSWeb Version: 5.0.0
Server: WP2WTC

submitted to the Oregon Public Utility Commission. PGE then updated and strengthened the 2020 plan in August and October, incorporating new technologies and further tightening proposed emissions and operational restrictions to address concerns of regulators and stakeholders.

The OPUC acknowledged the revised 2020 plan in November, noting that earlier closure dates would not allow enough time for the company to secure reliable replacement power.

Newspaper editorials

Below are local newspaper editorials about the Boardman 2020 plan:

[A sane plan for Boardman's closure](#),
The Oregonian, 12/4/10

[Boardman plan strikes right balance](#),
Community Newspapers, 12/2/10

[PGE floats sensible Boardman plan](#),
Portland Business Journal, 9/27/10

About the Boardman Plant

The Boardman Power Plant is a 585-megawatt coal-fired electricity generating plant in northeastern Oregon. It is one of PGE's most cost-effective sources of power, producing electricity at a variable cost of about one-third to one-half the wholesale market price. Boardman provides about 15 percent of the power PGE delivers to its customers, making it a key resource in meeting Oregonians' current and future energy needs.

PGE, in partnership with Oregon State University, will be conducting further research on algae, investigating how different algae strains that could be used for this reducing carbon emissions. [View our fact sheet](#) (PDF) to learn more.

2009 Integrated Resource Plan



**Northwest Power and
Conservation Council**

February 9, 2011



PGE – Integrated Resource Planning (IRP)

Integrated Resource Plan 2009



Portland General Electric

OPUC mandates that “energy utilities engage in integrated resource planning and to file an IRP every two years. OPUC reviews the filed plans to determine whether they adhere to IRP guidelines and either “acknowledge” them, or return to the utility with Comments.”

Guidelines impose that the IRP is:

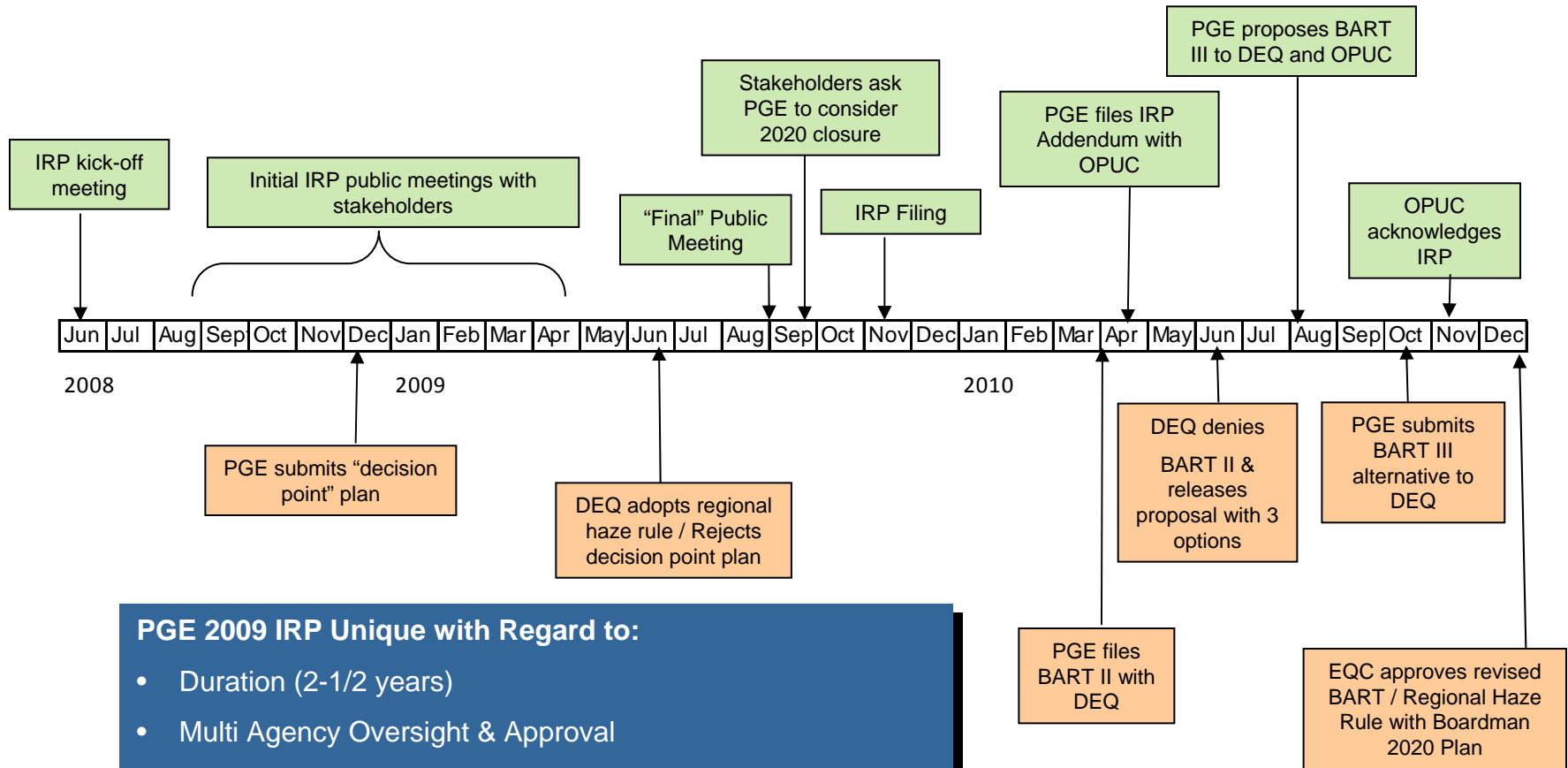
- A public process;
- A thorough assessment of energy and capacity needs for the next 20 years;
- Detailed analysis of cost and risks of long-term procurement strategies.

Goal: identify a resource procurement plan (Action Plan) and issue an RFP to identify and select the best available resources.

Balancing Multiple Objectives & Interests



IRP – Timeline and Milestones

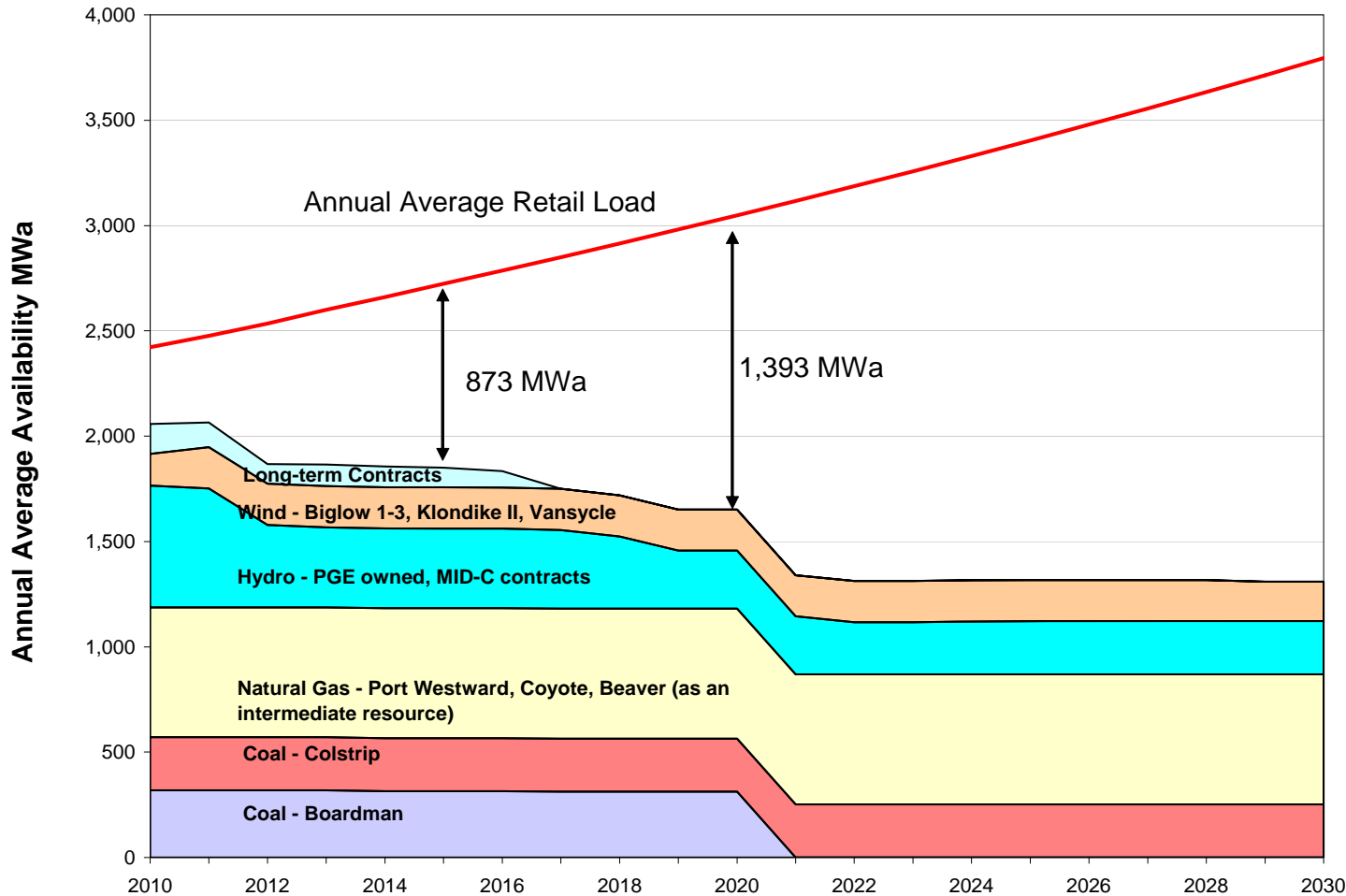


PGE 2009 IRP Unique with Regard to:

- Duration (2-1/2 years)
- Multi Agency Oversight & Approval
- Complexity of Issues
- Public Dialogue / Review
- Stakeholder Involvement
- Media Coverage / General Public Interest
- Impact to Future PGE Portfolio and Oregon Energy Supply

PGE Resource Needs – Energy

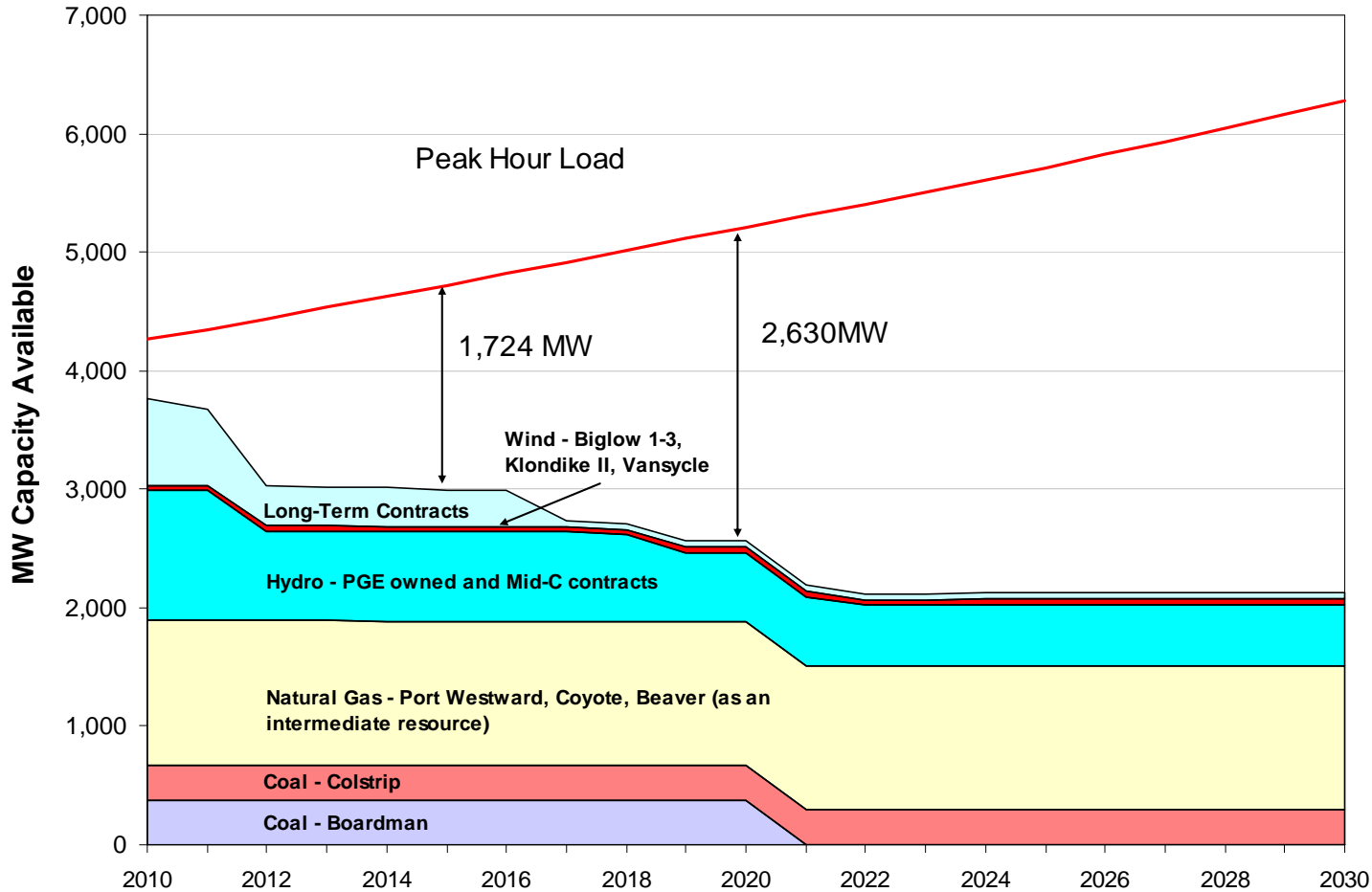
Load-Resource Balance 2010-2030



- 1.9% annual load growth
- Load before EE actions
- Load excludes 5-yr Opt-Outs under SB1149
- Expiration of 450 MWh in contracts
- Boardman coal operation through 2020
- Hydro is a decreasing share of our portfolio

PGE Resource Needs – Winter Capacity

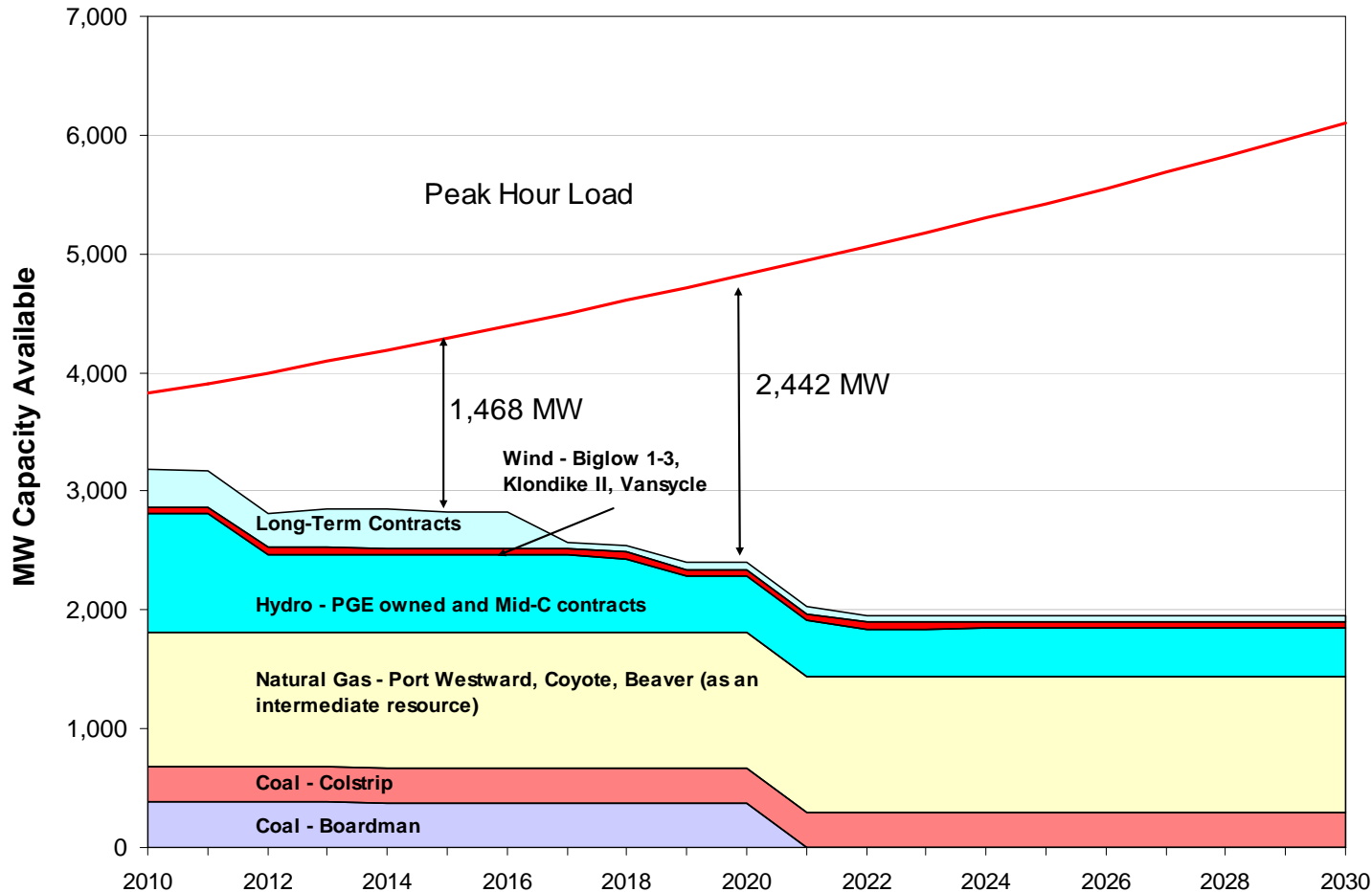
Load-Resource Balance 2010-2030



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

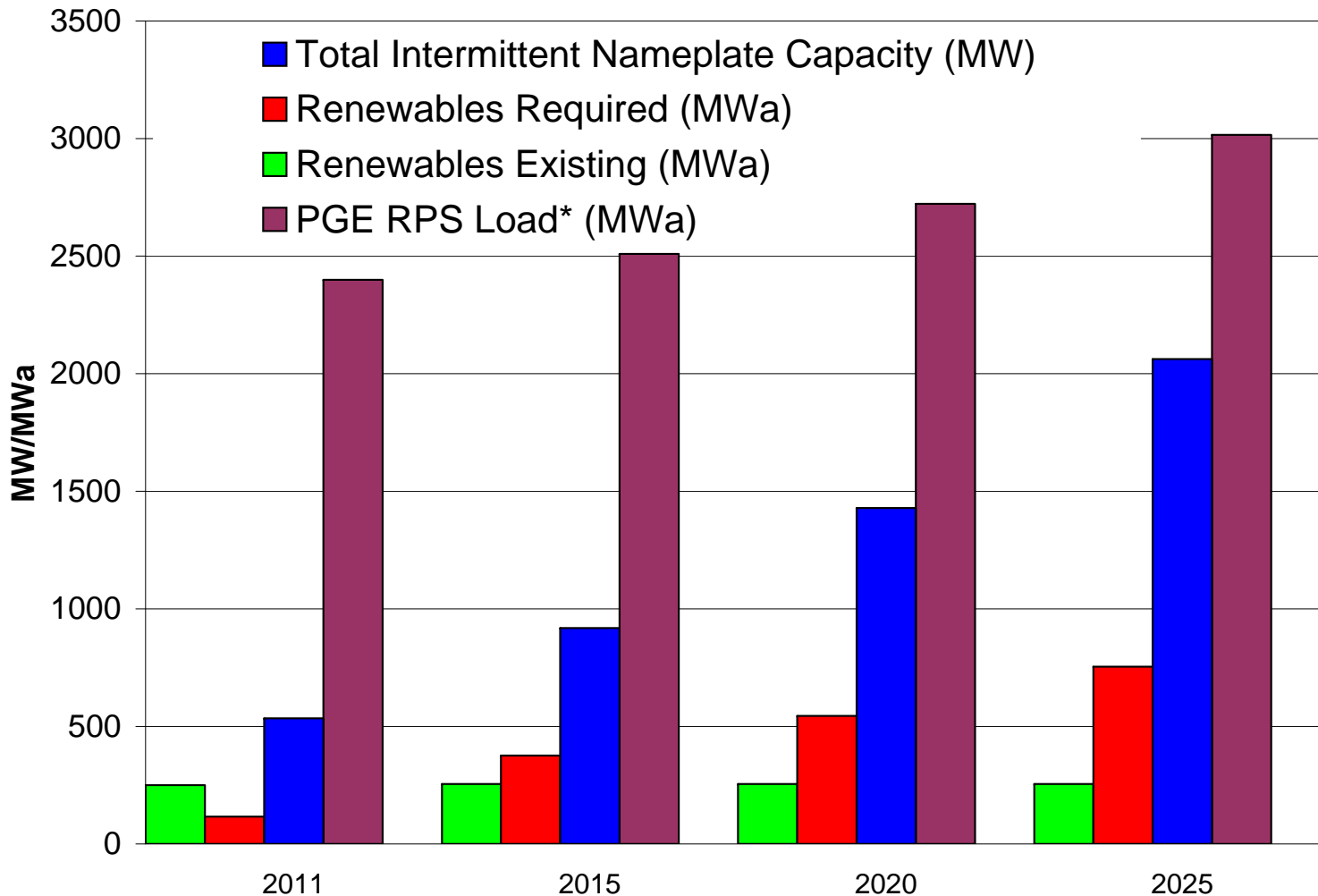
PGE Resource Needs – Summer Capacity

Load-Resource Balance 2010-2030



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

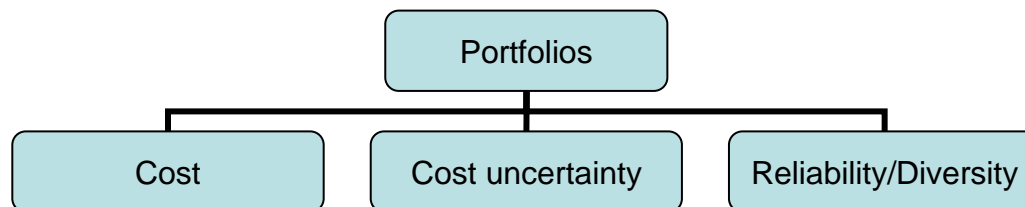
PGE RPS Resource Need



- PGE will need 500 MWa of new renewables by 2025 to meet OR RPS.
- Incremental RPS need + current renewables = almost 2,100 MW nameplate capacity of variable generation resources by 2025 (at 33% capacity factor).

*RPS load is PGE load forecast less EE and projected 5-year opt-out load

IRP Modeling Approach: Portfolio Analysis



Candidate Portfolios (18 alternate strategies)

- Considered all commercially viable generation technologies (e.g. gas, wind, coal, solar, biomass, nuclear, geothermal, wave)
- Incremental resource additions included “pure plays” and more diverse mixes
- Imposed: physical RPS compliance, max Demand Side (EE, DSG, DG)

Cost

Cost to customers from 2010 to 2040 (given reference case assumptions for gas, load, hydro, etc.)

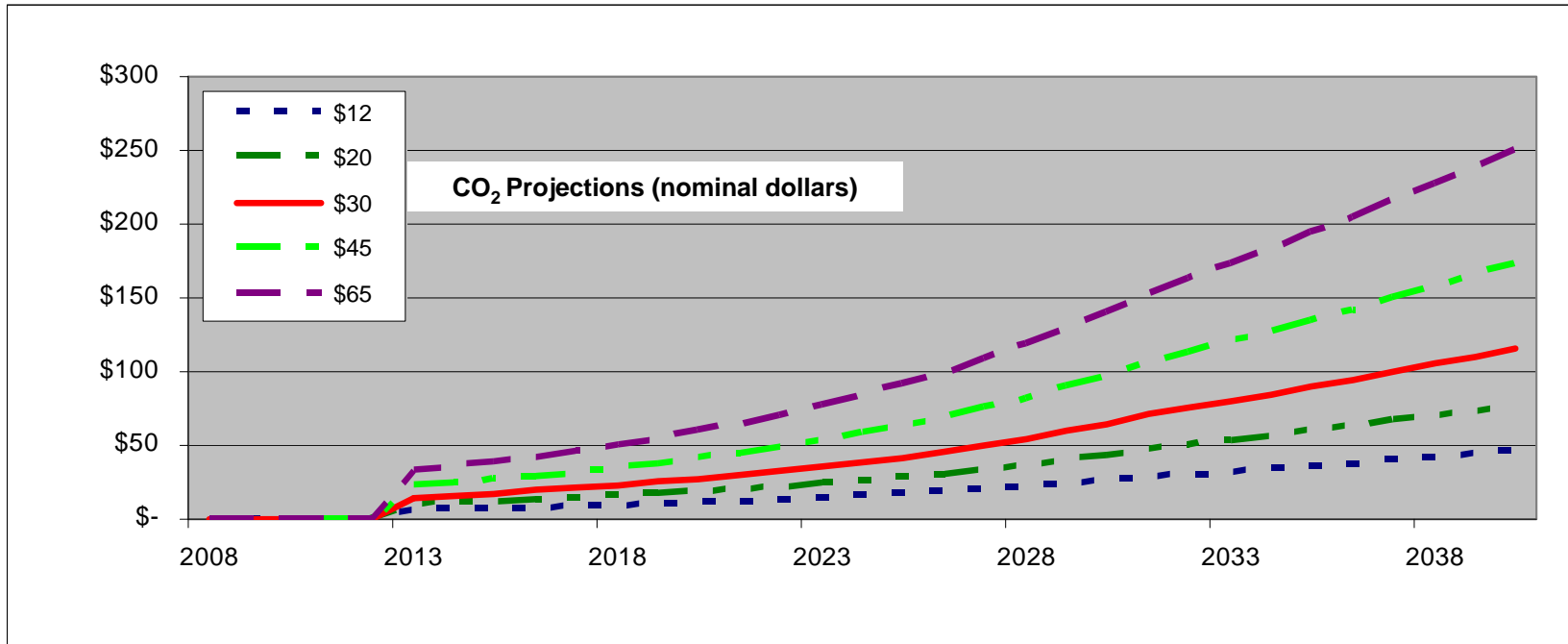
Cost Uncertainty

- a. Scenario analysis to simulate fundamental shifts in key price drivers (e.g., gas prices, electricity prices, PTC).
- b. Stochastic analysis to simulate variability of certain model assumptions.

Reliability

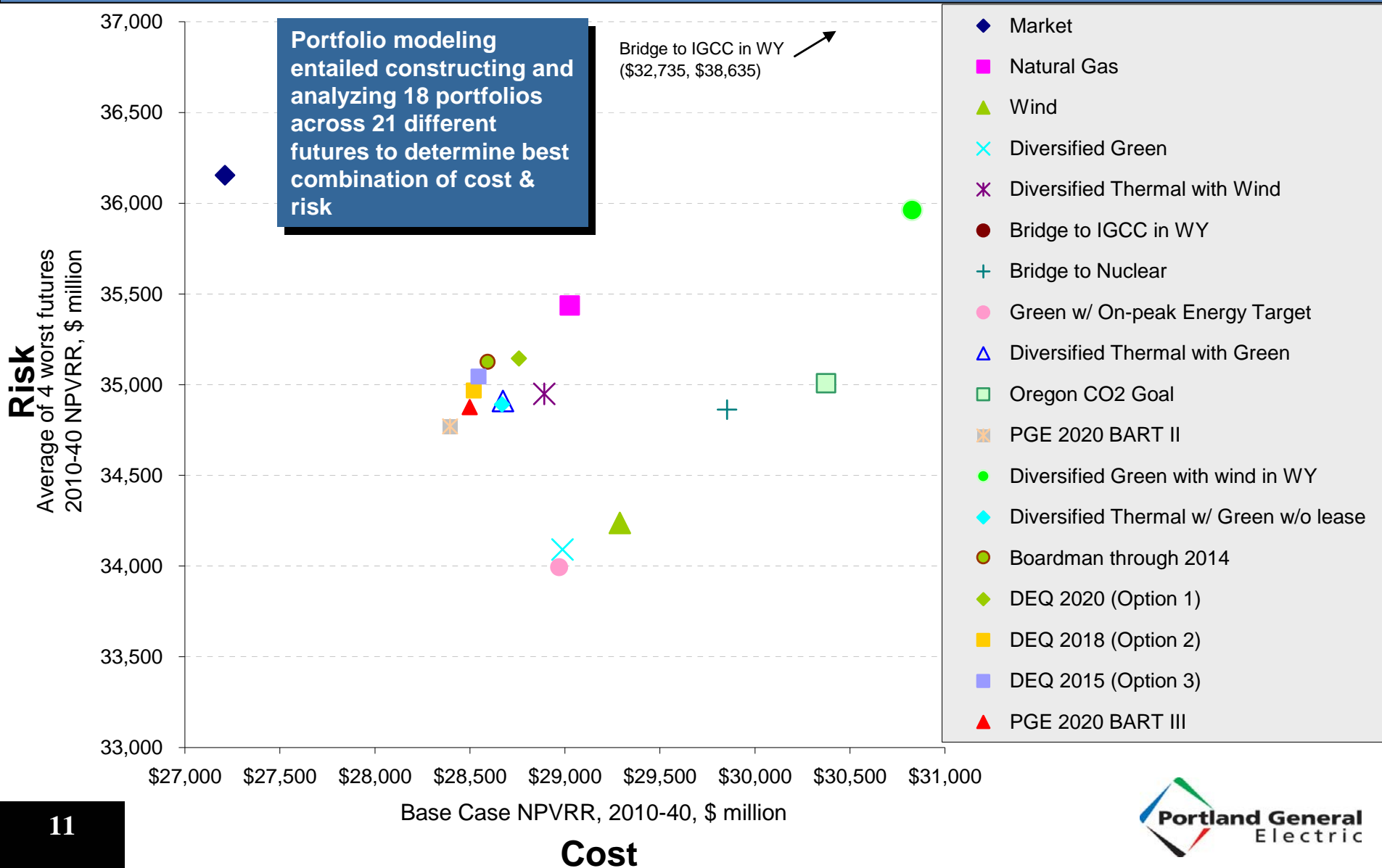
- a. Loss of load
- b. Technology and Fuel diversity.

CO₂ Price Futures



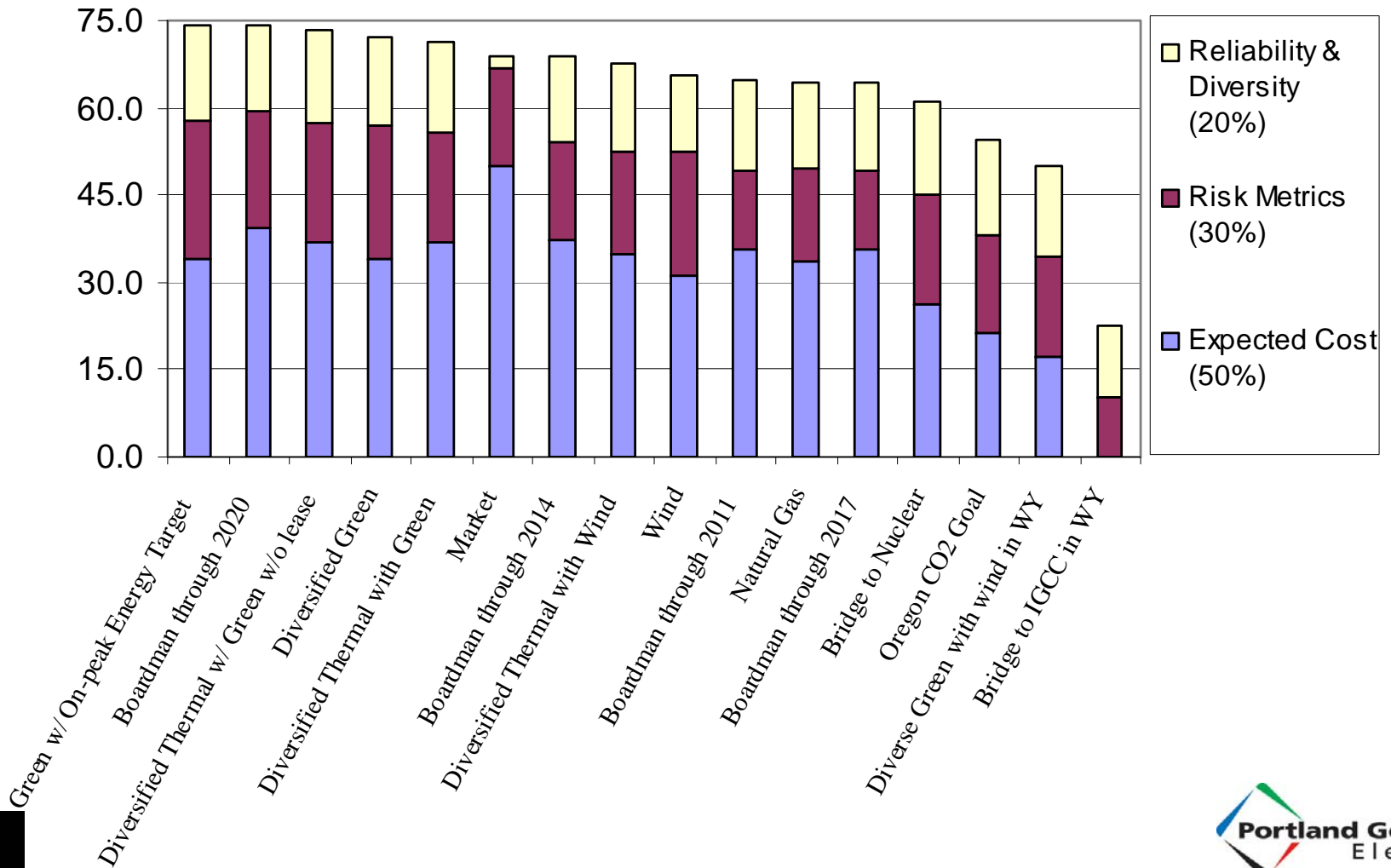
- Assessment of proposed carbon regulation made in 2008
- Used EIA/EPA leading studies (Lieberman, Bingaman, Waxman)
- Estimated a CO₂ reference case cost of \$30/ton
- Start year: 2013
- Developed alternative cost futures (higher & lower than reference case)
- Also evaluated 2012 and 2014 start year

Portfolio Cost & Risk Trade-off



Portfolio Scoring Grid

Weighted Scores & Ranked Results



Acknowledged Action Plan

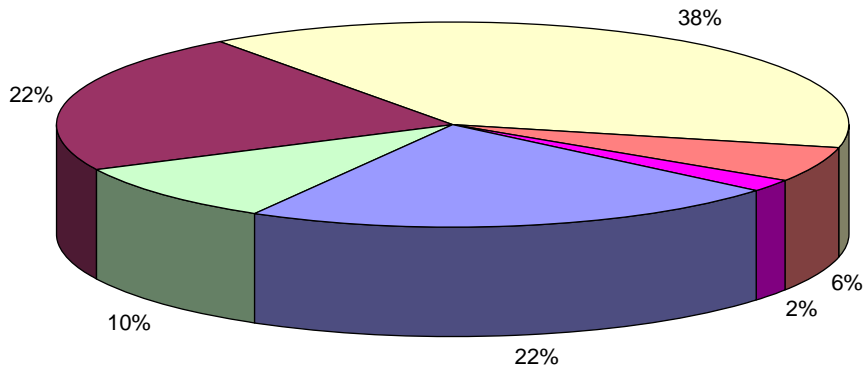
Key Elements of PGE Action Plan:

- Acquire 122 MWa of Oregon RPS compliant renewables
- 214 MWa of EE by 2015
- 300-500 MW high-efficiency combined cycle gas generation
- Up to 200 MW of flexible gas capacity resources
- Acquire additional natural gas pipeline and storage capacity
- Cascade Crossing Transmission Line
- Other Actions: Contract renewals, DSG expansion, DR acquisitions
- Boardman 2020 plan
 - Install Upgrades to meet requirements of Dec 2010 EQC rule
 - Cease coal-fired operations by end of 2020

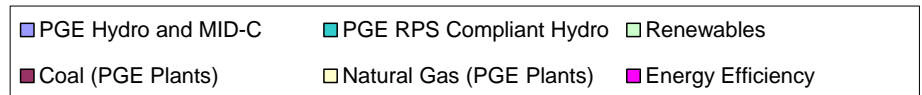
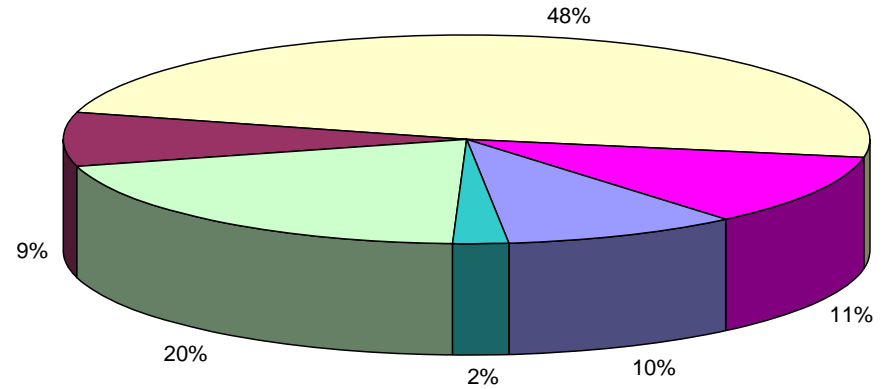


PGE Resource Mix – Pre and Post Action Plan

Current Energy Mix



2021 Projected Energy Mix



Cascade Crossing – Project Overview

PGE proposes to construct approximately 210 miles of new 500 kV electric transmission capacity to provide increased transmission transfer capability

Path : Boardman, Oregon to Salem, Oregon

Target capacity:

- Double Circuit Proposal – 2200 MW
- Single Circuit Option – 1500 MW

Anticipated generation interconnection:

- Coyote Springs
- Boardman (Boardman replacement post-2020)
- New thermal generation
- Renewables
- Third party interconnection requests



Right of Way (ROW) parallels PGE's existing Boardman-Slatt 500 kV line and Round Butte-Bethel 230 kV line, and existing BPA lines

Commercial operation target - 2015

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%)

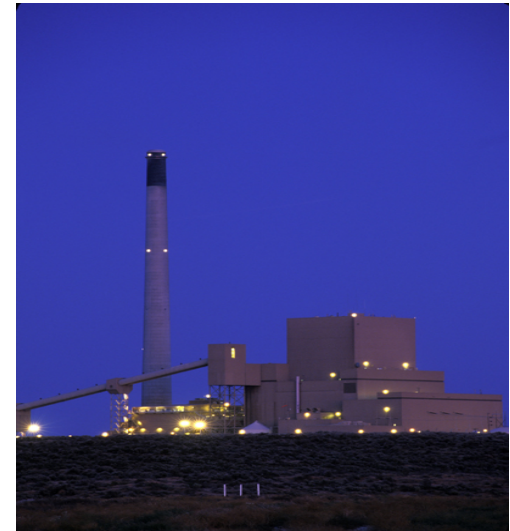
Fuel: Low sulfur sub-bituminous coal

Commercial operation: August 1980 (Site certificate March 1975)

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

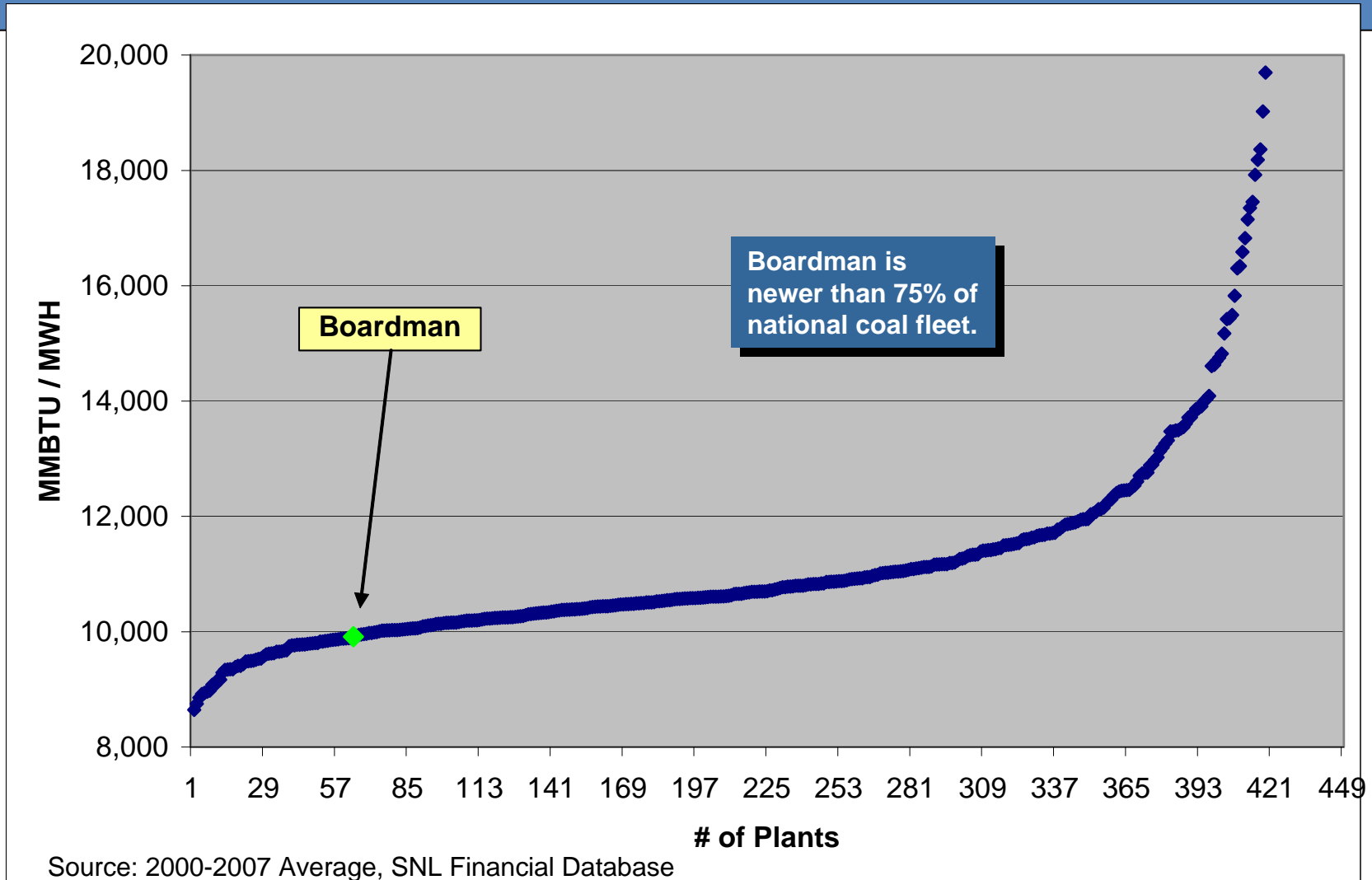
Approximately 15% of PGE's power comes from Boardman at prices one-third to one-half market prices

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



DAN AGUAYO/THE OREGONIAN

US Coal Fleet Heat Rate*



*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 1,325 coal-fired units operating in the U.S.; Boardman operates a single unit.

DEQ / EPA - Regional Haze Program

Federal Program

- Regional Haze Rule adopted July 1999
- Objective: Return visibility to natural background level by 2064
- 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 & Emissions Control Plan for Boardman

Regulated Haze Emissions

Applicable to Boardman RH BART:

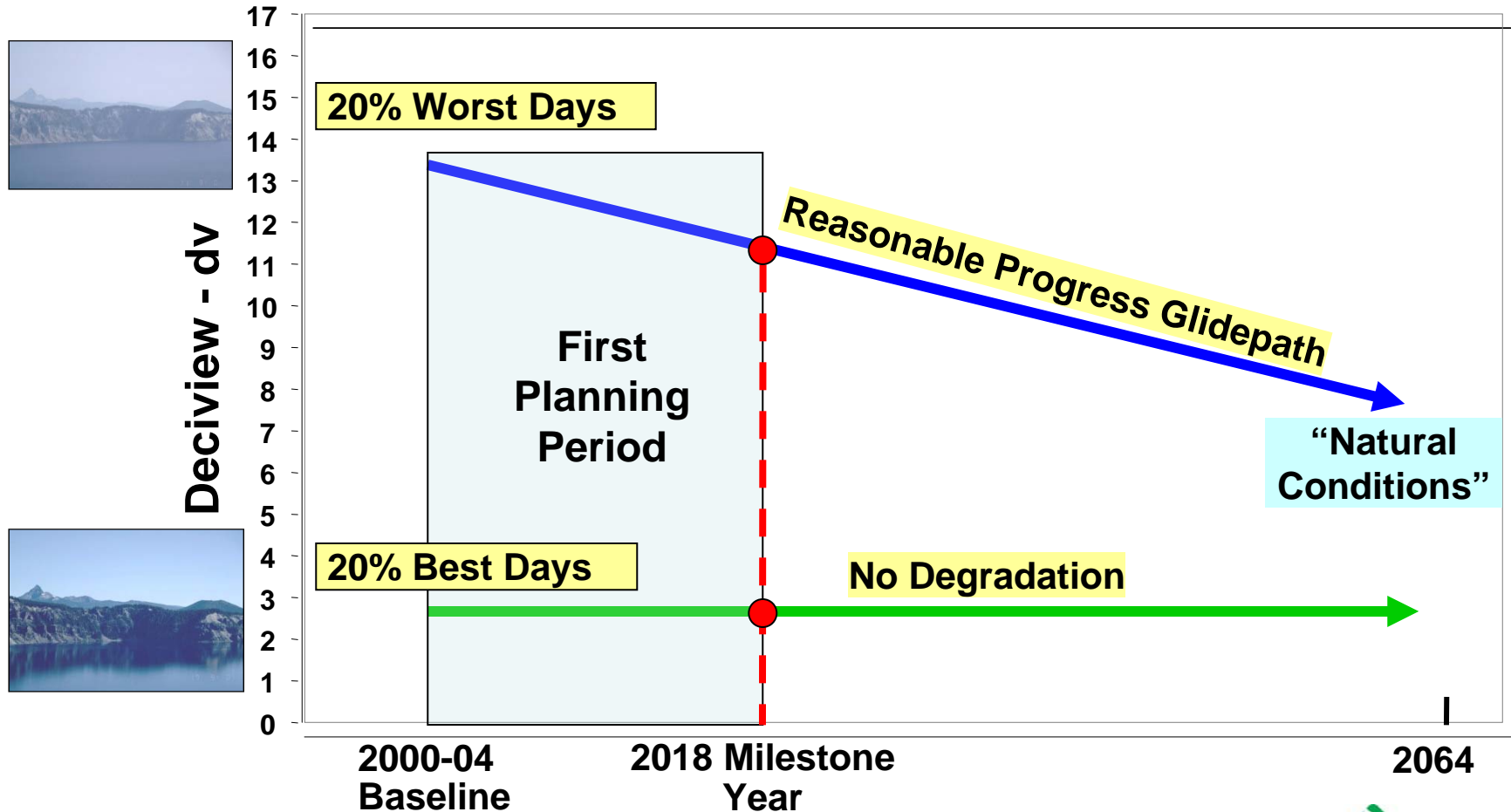
- **Ammonium Sulfate:** SO_2 + ammonia, from combustion of fuels containing sulfur
- **Ammonium Nitrate:** NO_x + ammonia, from high temperature combustion processes
- **Particulate Matter (PM):** Includes fine and coarse particles in the air. PM_{10} and $\text{PM}_{2.5}$ are particles measured at less than 10 microns and less than 2.5 microns

Not applicable to Boardman RH BART:

- **Organic and Elemental Carbon:** mostly combustion due to fire (wildfire + forest, agricultural, other controlled burning, and woodstoves)
- **Fine Soil:** dust from dirt roads, farmland, bare ground, dust storms

Objective of Regional Haze Plan

Class I Area



BART BASICS

- BART is “Best Available Retrofit Technology”
- BART 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



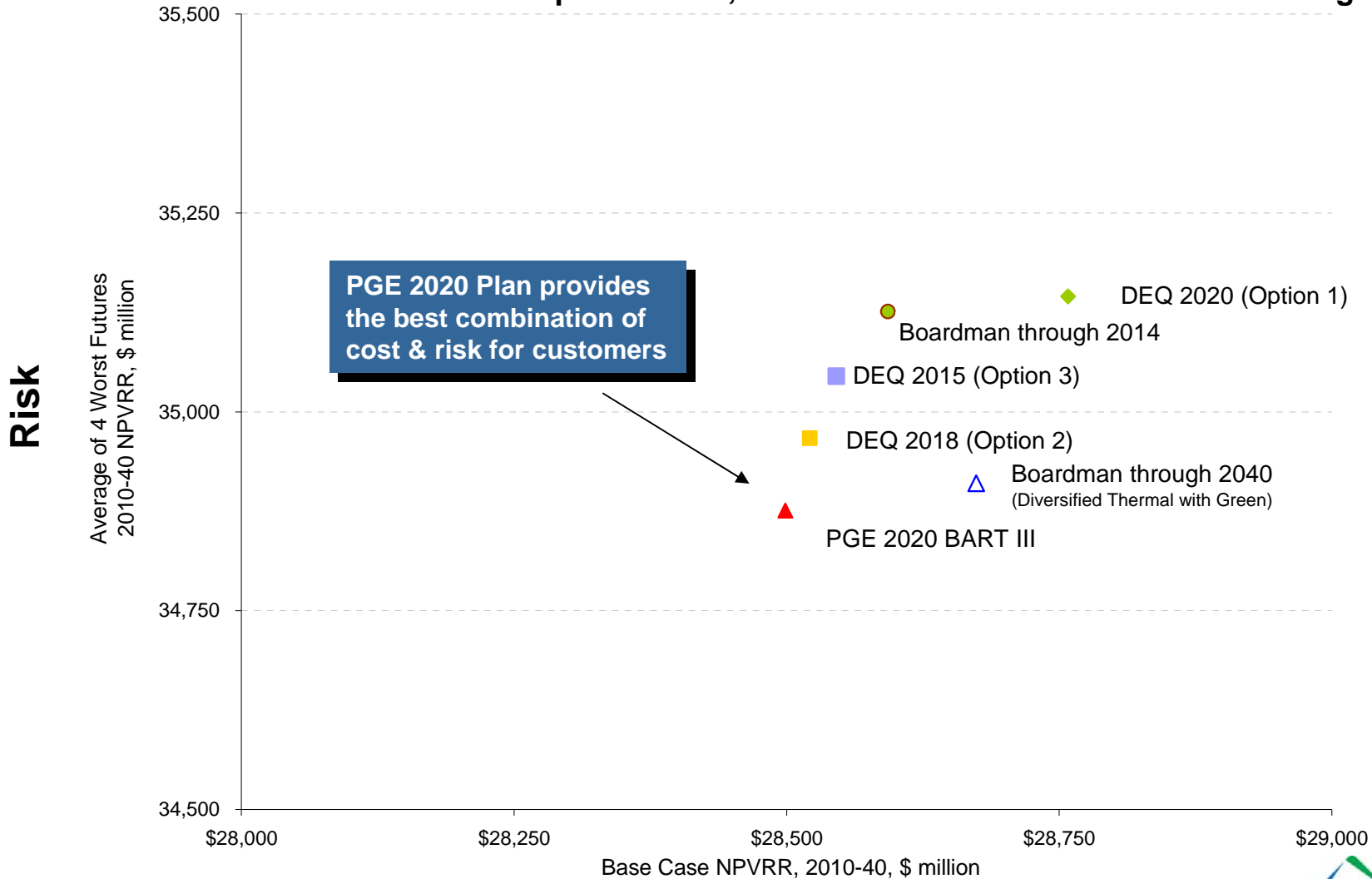
Boardman Alternatives

Boardman Plant Options					
Controls & Cost Summary (\$ in Millions, Based on 100% of Boardman)	DEQ 2015 (DEQ Opt. 3)	DEQ 2018 (DEQ Opt. 2)	PGE 2020 BART III (Final)	DEQ 2020 (DEQ Opt. 1)	DEQ 2040 BART I
Low NOx Burners / OFA	X	X	X	X	X
Mercury Control	X	X	X	X	X
Lower-sulfur Coal					
DSI via SBC + Lower-sulfur Coal		X	X		
Semi-Dry FGD (Scrubber with Fabric Filter)				X	X
SNCR		X		X	
SCR					X
Coal Operations Cease (end of year)	2015	2018	2020	2020	2040
Nominal Capital Cost	\$ 41	\$ 75	\$ 63	\$ 343	\$ 511
Inc. O&M per Year (Mostly Variable)	\$ 7	\$ 24	\$ 21	\$ 16	\$ 16

* Dates for IRP analysis purposes are at year-end.

Cost-Risk Analysis: Boardman Alternatives Highlight

Horizontal axis shows expected cost; vertical axis shows risk of adverse change in cost.



Approved Boardman 2020 Plan

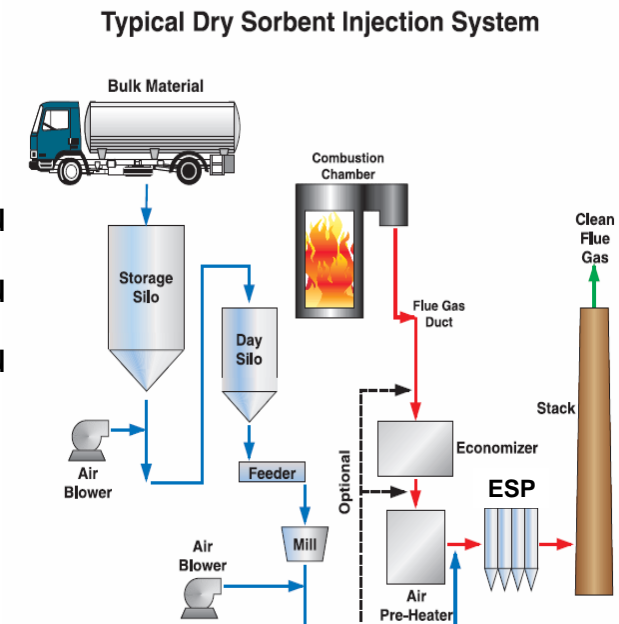
- Boardman BART / Regional Haze Plan Approved by OPUC and EQC

- Controls and emission levels:

	<u>Control</u>	<u>Date</u>	<u>Emission</u>
NO _x	LNB/MOFA	July 2011	.23 lb/mmBtu
SO ₂	Post combustion ctrl.	July 2014	.40 lb/mmBtu
SO ₂	Post combustion ctrl2.	July 2018	.30 lb/mmBtu

- PM - No change from current emissions
- Cease Coal-fired Operations by end of 2020

Under a separate, previously approved DEQ rule, PGE will reduce mercury (Hg) by 90% by 2012



PGE's 2009 IRP Action Plan – Balanced & Responsible

- ✓ Creates the highest value for customers by balancing expected cost and associated risks and uncertainties
- ✓ Preserves power supply diversity while transitioning to a lower environmental footprint
- ✓ Opens up access to new resources and regions to improve and maintain system reliability
- ✓ Captures opportunities to reduce energy needs through energy efficiency and demand response
- ✓ Strikes a fair and reasonable balance between regulatory requirements
- ✓ Invests in new renewable resources and emission reductions to achieve RPS legislation and state environmental objectives
- ✓ Minimizes the impact on residents of the state by leveraging existing assets and rights
- ✓ Recognizes the impacts on employees and communities
- ✓ Sets national precedents for environmental stewardship
- ✓ Positions Oregon for a more sustainable energy future



Next Steps – IRP Action Plan Implementation

- Issue New Resource RFPs
 - Flexible Capacity
 - Baseload Gas
 - RPS Renewables
- Include “Benchmark” Utility Owned projects to consider alongside Market Alternatives
- Engage OPUC Staff and Independent Evaluator to provide third-party review of RFP process and resource evaluation
- Continue development and evaluation of Cascade Crossing Transmission
- Begin Implementation of Boardman 2020 Plan
 - Install Low NOx Burners and Initiate DSI testing

