Integrated Resource Plan

2016

Commission Workshop 1

Monday, July 6, 2015

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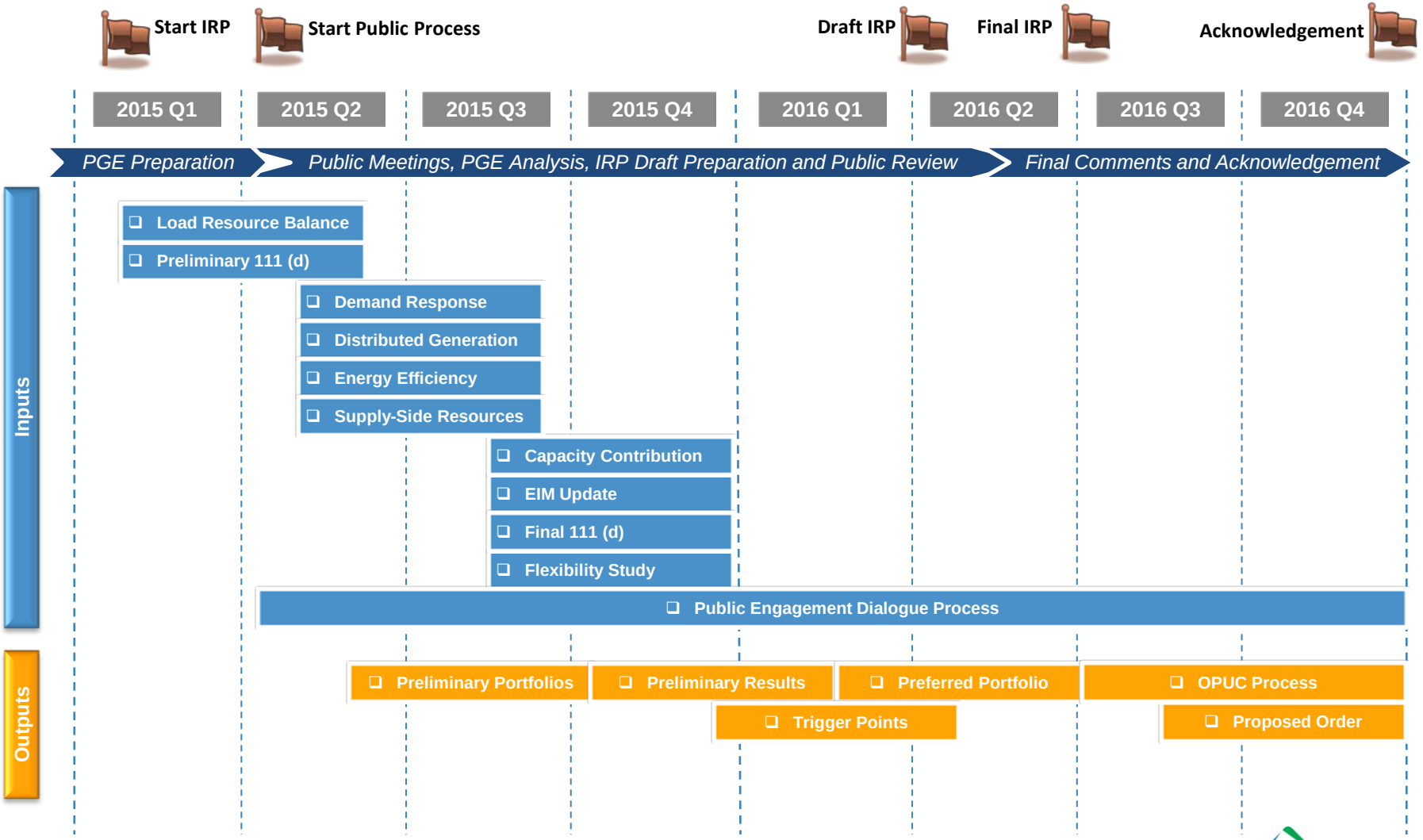
2016 IRP Timeline

July 6, 2015 Slide 2



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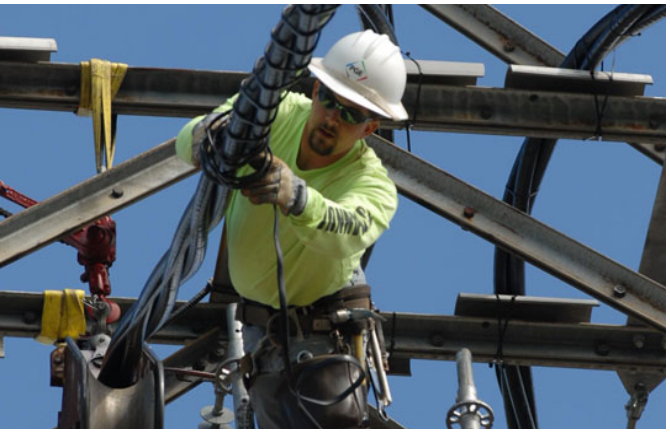

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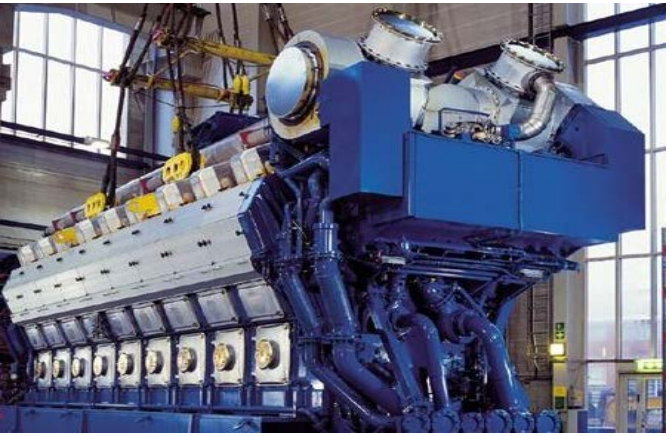
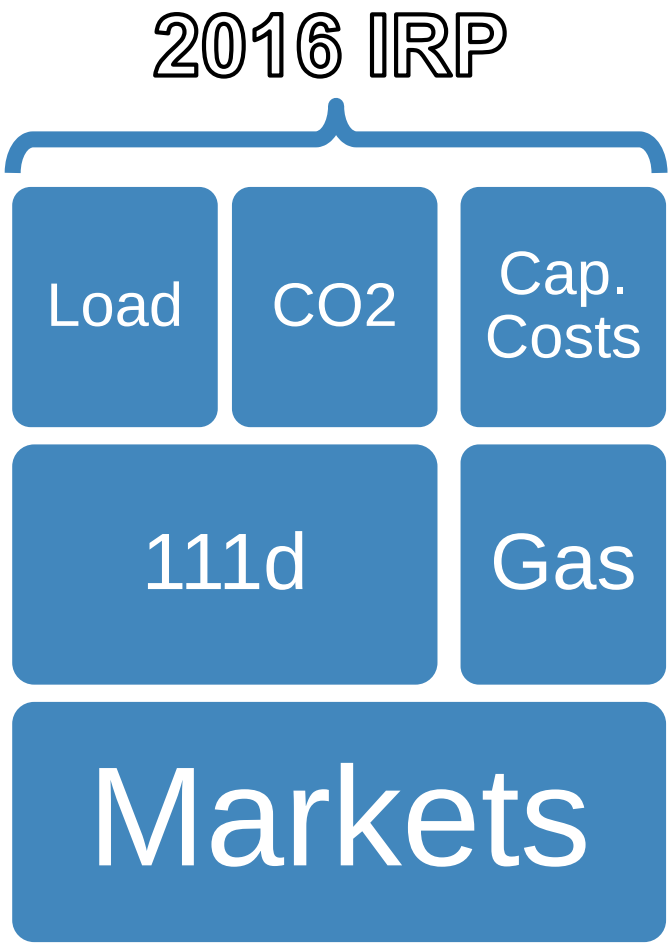
Clean Power Plan – 111(d) Modeling



111(d): IRP Objective

- To identify a portfolio strategy that performs well under a broad range of policy and economic futures.
  - To do this well, PGE must appreciate how the Clean Air Act § 111(d) will affect wholesale power markets
  - But, focusing narrowly on 111(d) compliance may endanger the identification of the best portfolio strategy.



111(d): Rule Uncertainty

- PGE has timed its IRP analysis to mitigate rule uncertainty
- Model 111(d) as written Sep '15
- PGE anticipates final rule will provide additional certainty on:
  - The stringency of the final goal
  - The nature of the interim goal
  - Renewable ownership issues
  - NW hydro allocation concerns

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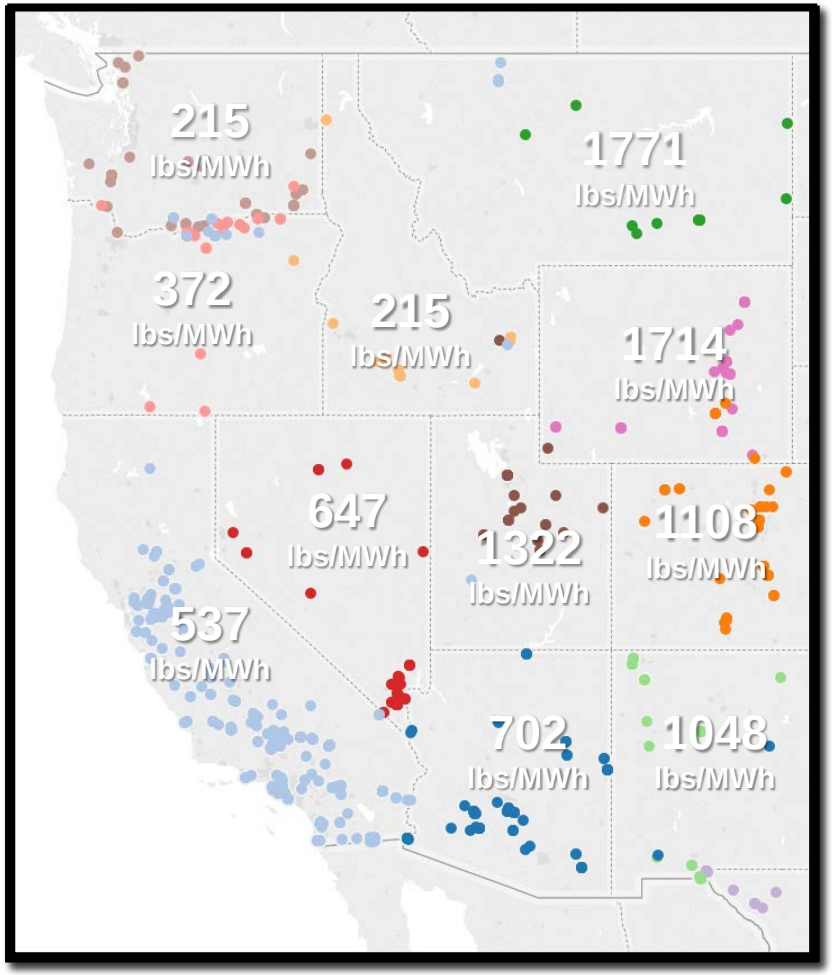
111(d): Modeling Approach

1. Identify eligible units
2. Assign units to state groups
3. Apply a new constraint to the appropriate group



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111(d): Scenario Uncertainty

- **Scope of Constraint:**
  - State or Regional Plan?
- **Standard:**
  - Rate or Mass based standard?
- **EE Expectations:**
  - Available at EPA identified levels?
- **Heat Rate Improvements:**
  - Available at EPA identified levels?
- **New Resource Constraints:**
  - New resources constrained?

Scenario Uncertainty

- Regional vs State
- EE Availability
- Rate vs Mass
- 111(b) vs 111(d)

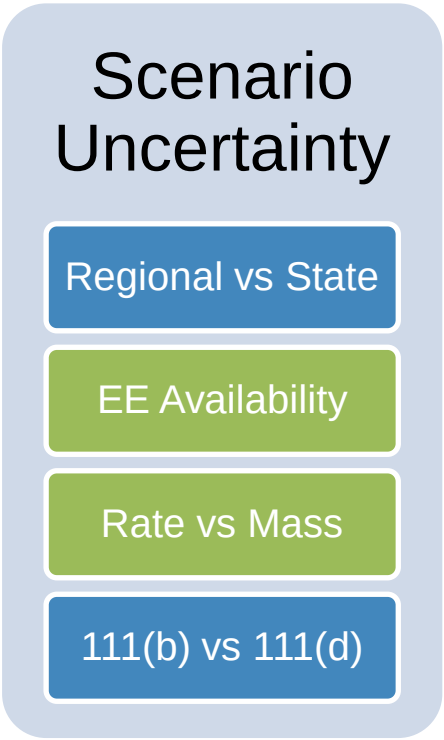
111(d): Case Studies

- PGE performed a review of the assumptions and results of national 111(d) analyses.

- Key Takeaways:

  1) Energy efficiency availability both in Oregon and regionally will affect the rule's cost of compliance.

  2) Rate based vs mass based standards will affect compliance costs, especially for states with coal retirements.



111(d): Scenario Analysis

- Four 111(d) Scenarios
  - Cost Eff EE: Regional load forecasts adjusted by EE programs proportional to ETO cost effective energy efficiency level.
    - Rate & Mass Standards
  - Expanded EE: Regional load forecasts adjusted EE programs proportional to ETO all achievable energy efficiency level.
    - Rate & Mass Standards

	COST EFF EE	EXPANDED EE
RATE	A: State Rate Based Implementation Plan with Cost Effective EE	B: State Rate Based Implementation Plan with All Achievable EE
MASS	C: State Mass Based Implementation Plan with Cost Effective EE	D: State Mass Based Implementation Plan with All Achievable EE

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111(d): Interaction With Additional Policy

- Existing policy modeled as written in law.
- Future policy risk accounted for through CO2 price scenarios
  - Despite diversity of mechanisms, environmental policy in the utility sector is generally designed to limit greenhouse gas emissions.
  - Employing effective cost of carbon price as a proxy allows a broad array of future policy outcomes to be captured in fewer scenarios.

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111(d): Interaction With Additional Policy

- In an effort to sample the broad range of possible future environmental policies:
  - 2016 IRP will model scenarios where 111(d) is left final, replaced, or repealed while layered with…
  - High, medium, low, and zero CO2 future prices
- An appropriate number of environmental policy futures allows 2016 IRP to measure portfolio risk of uncertain environmental policy.

Eight Environmental Policy Futures Tested in 2013 IRP, Table 9-5

↓ Futures	Risk Drivers→	Fuel Prices	CO_2
1 Reference Case			
Fuel/CO_2			
2 High Gas		X	
3 Low Gas		X	
31 Very High Gas		X	
4 High Coal		X	
5 Low Coal		X	
12 No Carbon Tax			X
13 Synapse low CO2			X
14 Synapse High CO2			X
30 CO2 trigger			X
33 16 dollars CO2 in 2023			X
34 High Capital Cost Wind and Solar/No CO2			X
25 High Gas and CO2		X	X
26 Low Gas and No CO2		X	X

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111(d): Proposed Framework For Policy Futures

Policy Class	Climate Policy Scenario	111(d)		CO2 Price					111(b)	Existing Policy
		As Finalized	Repealed Replaced	None	Low	Mid	High	Trigger		
111(d) Scenario Analysis	CPP-A	X		X?	X?				X	X
	CPP-B	X		X?	X?				X	X
	CPP-C	X		X?	X?				X	X
	CPP-D	X		X?	X?				X	X
Policy Interaction Analysis	CPP-A+ Low	X		X?	X?				X	X
	CPP-A+ Mid	X				X			X	X
	CPP-A+ High	X					X		X	X
	CPP-A+ Trig	X						X	X	X
Policy Replacement Analysis	No CO2		X	X					X	X
	Low CO2		X		X				X	X
	Med CO2		X			X			X	X
	High CO2		X				X		X	X
	Trigger CO2		X					X	X	X

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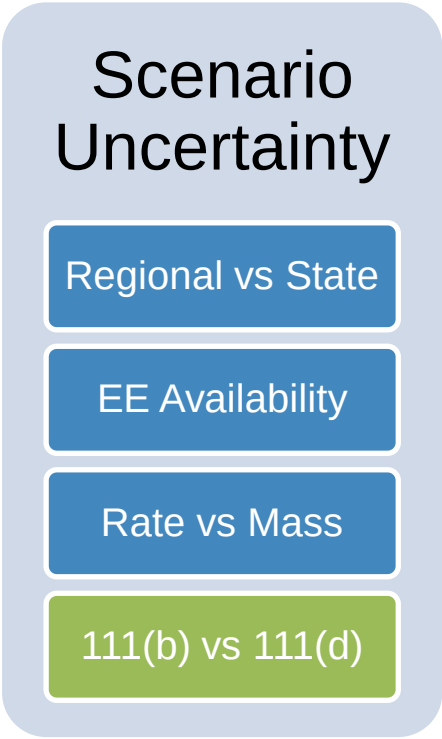
111(d): New Resource Constraints

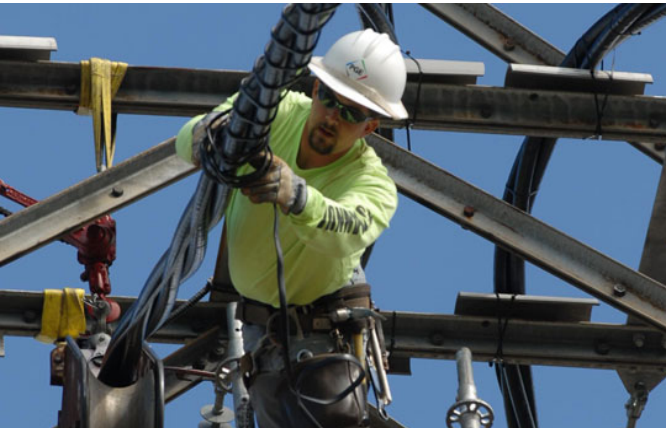
- Consistent with the proposed rule, PGE's analysis will not apply 111(d) constraints to new fossil fuel resources.
- Rather
  - Incremental CO2 price futures will be studied.
  - PGE will study some portfolios with no additional CCCTs.
  - 111(b) will continue to screen resources with high carbon intensities.



111(d): Recap & Discussion

- Thirteen proposed environmental policy futures used to evaluate a broad range of policy outcomes.
  - 111(d) scenario analysis used to prepare for unknown state implementation of the final rule.
  - CO2 pricing used as a proxy for future state and federal environmental policy changes.

- Feedback received from stakeholders:
  - ODOE – reasonable range of CO2 prices; use a mid or high CO2 price for core scenario modeling; consider modeling new resources under 111(d).
  - RNW – reasonable range of CO2 prices; keep an open mind to a regional 111(d) compliance plan should one develop during 2016 IRP study cycle.



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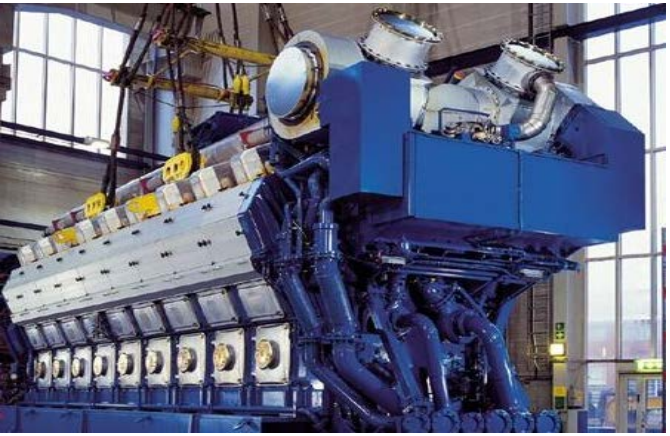
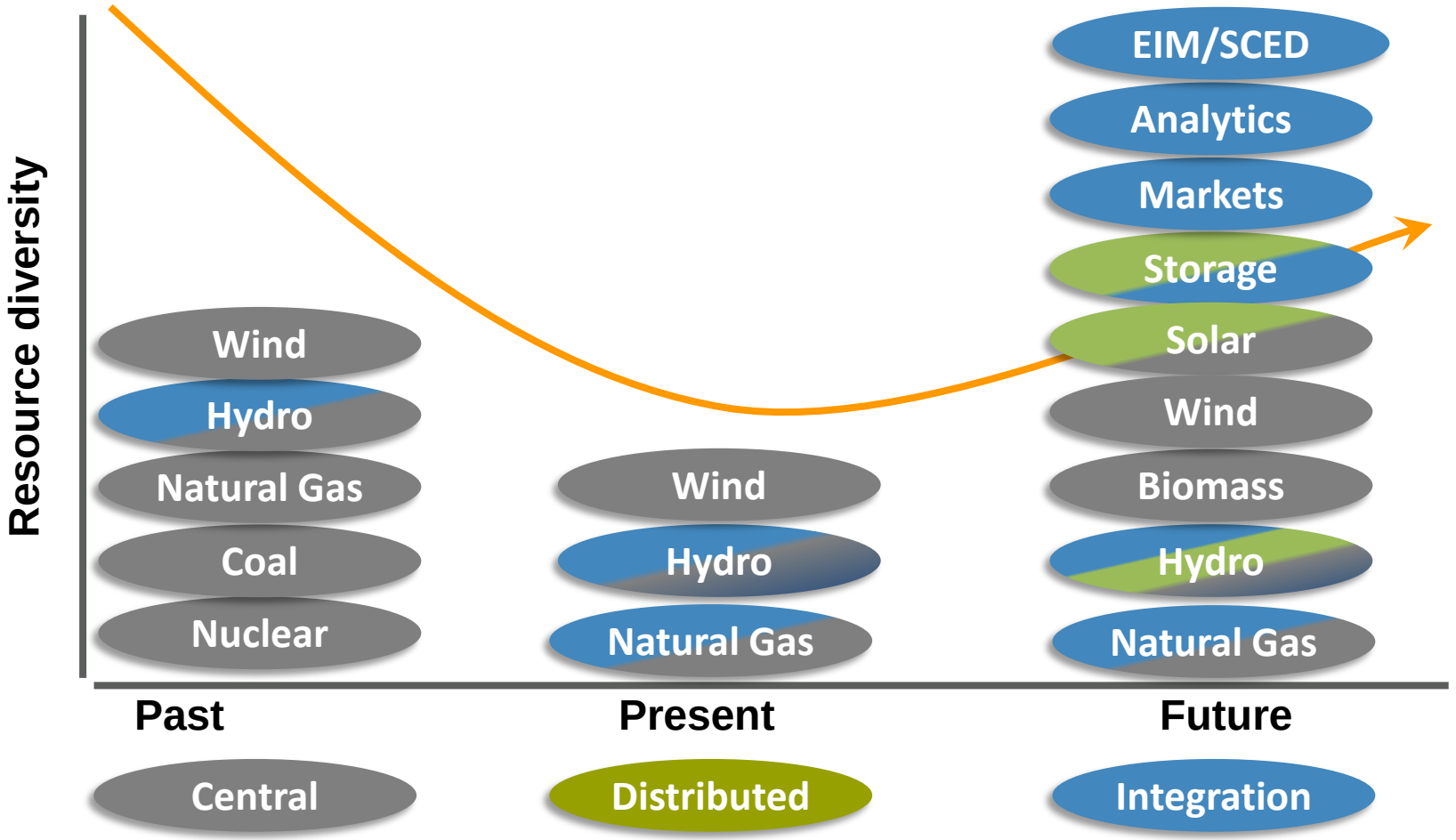
EIM Comparative Study



EIM: Reliability and Resource Needs

- **Technology is enabling integration of renewable and distributed generation to boost resource diversity and support energy supply reliability**



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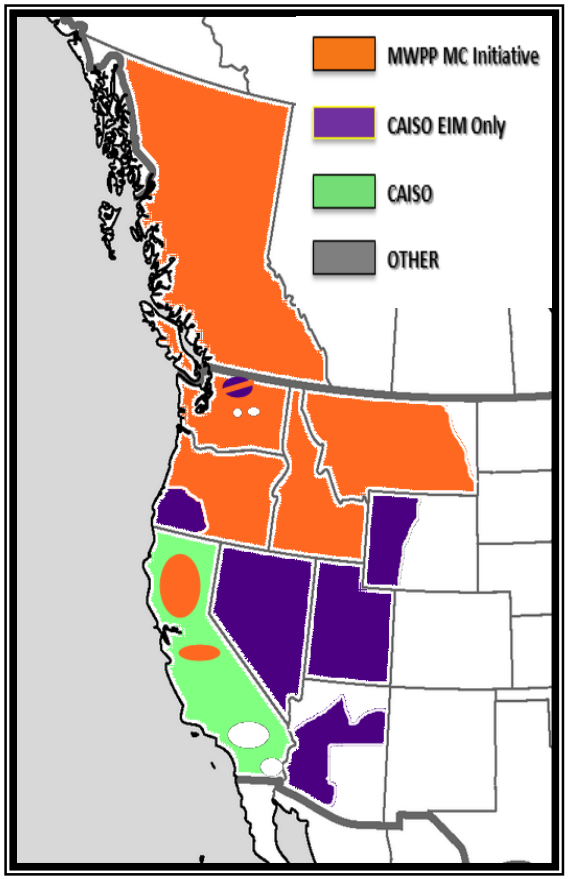
EIM: CAISO-EIM and NWPP - SCED

Address operational and commercial challenges affecting regional power system:

- Manage transmission constraints, impacts of variable energy resources
- Access regional balancing diversity

Respect unique attributes of footprint, including:

- Extensive coordinated hydro-thermal systems
- Multiple transmission providers, overlapping systems
- Tightly correlated variable energy resources
- Significant presence of non-jurisdictional entities



Note: "EIM" is intended to represent both the NWPP MC Market Initiatives and the CAISO EIM.

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EIM: Comparative Study's Role in PGE Initiatives

Power Supply and Generation: 2014-2017 Initiatives

Power Operations

- Dynamic Dispatch Program
- 15 Minute Scheduling
- BPA 15 Minute Wind Integration
- Outage Management Reporting System
- Market Interfaces

Generation Plants

- Improved Cycling Capabilities and AGC Implemented
- Revenue Quality Metering
- Balancing Capabilities of PW2
- Reliability Centered Maintenance
- Performance and Reliability Monitoring

Market Participation

- Co-Chairing NWPP MC Initiative
- Participant in CAISO Stakeholder Process
- **NWPP vs. CAISO Cost Benefit Analysis**

EIM: Committees and Utility Partners

EIM Comparative Study with E3

Utility/Market Operator Partners

Modeling Team

Clint Kalich	Avista
Scott Kinney	Avista
Jared Ellsworth	Idaho Power
Ron Schellberg	Idaho Power
Casey Johnston	Northwestern Energy
Ray Bush	Northwestern Energy
Bruce McAllister	PacifiCorp
Jim Price	CAISO

Advisory Committee **EIMSAC**

John Crider	OPUC
Cameron Yourkowski	Renewables Northwest
Bob Jenks	CUB
Scott Downey	Peak Reliability
Michael Goggin	American Wind Energy Assoc.
Maury Galbraith	Western Interstate Electric Board
Mark Rothleder	California ISO
Carl Monroe	Southwest Power Pool
Scott Kinney	Avista Corp.
Jim Shetler	BANC (Balancing Authority of Northern California)
Rachel Dibble	BPA
Tess Park	Idaho Power Company
Joe Lawlor	PG&E
Steve Beuning	Xcel Energy

Technical Review Committee **TRC**

Michael Milligan	National Renewable Energy Laboratory (NREL)
Brendan Kirby	Consultant to NREL
Bart McManus	Bonneville Power Administration
John Ollis	Northwest Power and Conservation Council
Ron Shelburg	Idaho Power Company
Ted Brekken	Oregon State University
Eduardo Cotilla-Sanchez	Oregon State University

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EIM: Past Studies Comparison

	Modeling Tool	Test Year	Real-Time Optimization	Focus of Analysis			Components of Benefits			
				Market Creation	Join CAISO EIM	Join NWPP SCED	Interregional	Flex reserve (Diversity)	Intra regional	Renewable curtailment
PacifiCorp / California ISO	Grid View	2017	Hourly	✓			✓	✓	✓	✓
NVEnergy					✓		✓	✓		✓
Puget Sound Energy	Plexos	2020	10-minutes Dispatch		✓		✓	✓		
aps					✓		✓	✓		
Northwest PowerPool				✓			✓	✓		
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PGE's study focus is quantifying the benefits of joining either CAISO or NWPP market.

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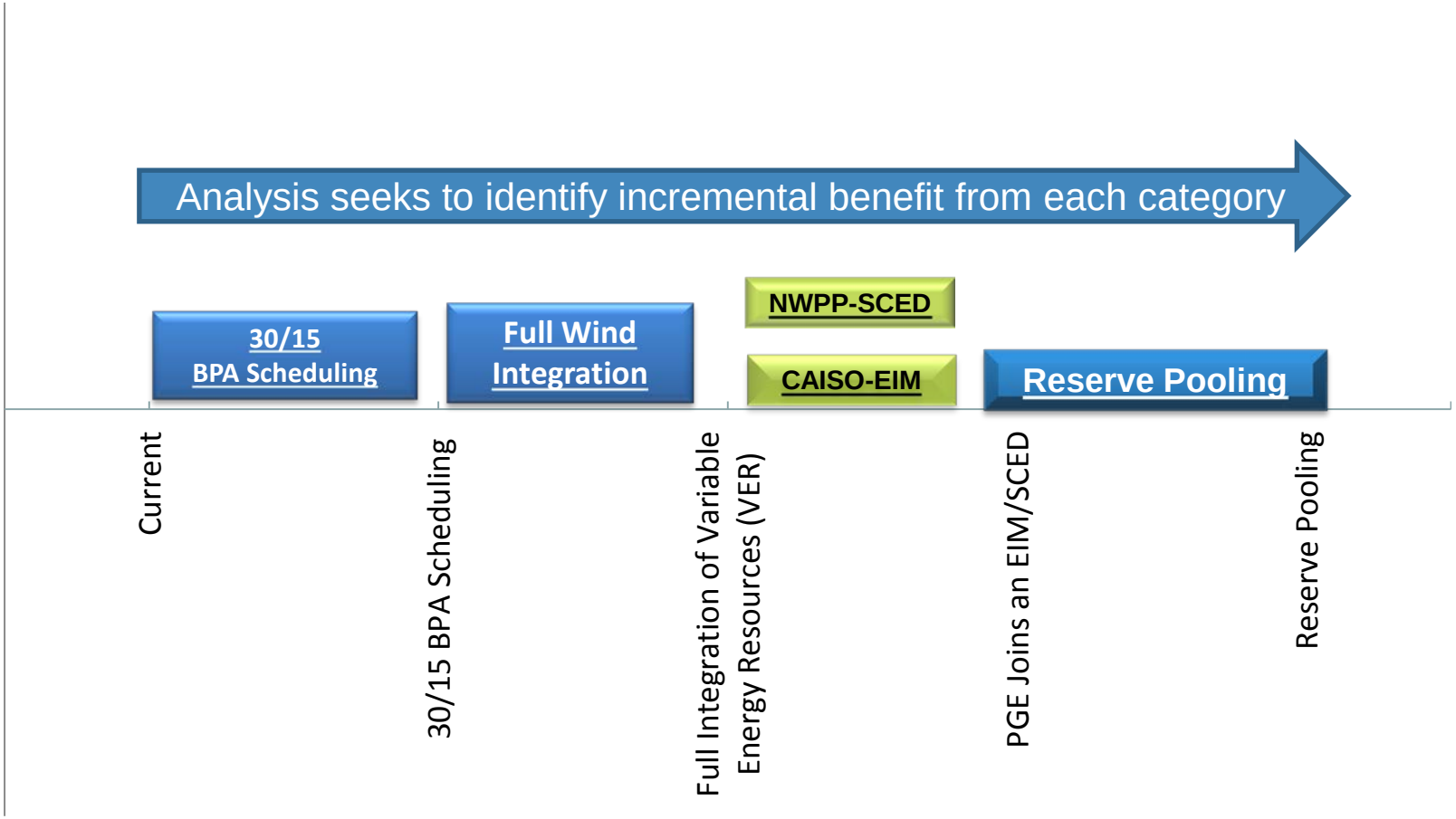
EIM: PGE's Stages of Benefits



To isolate the benefit(s) of joining a market, we need to structure the study in stages.

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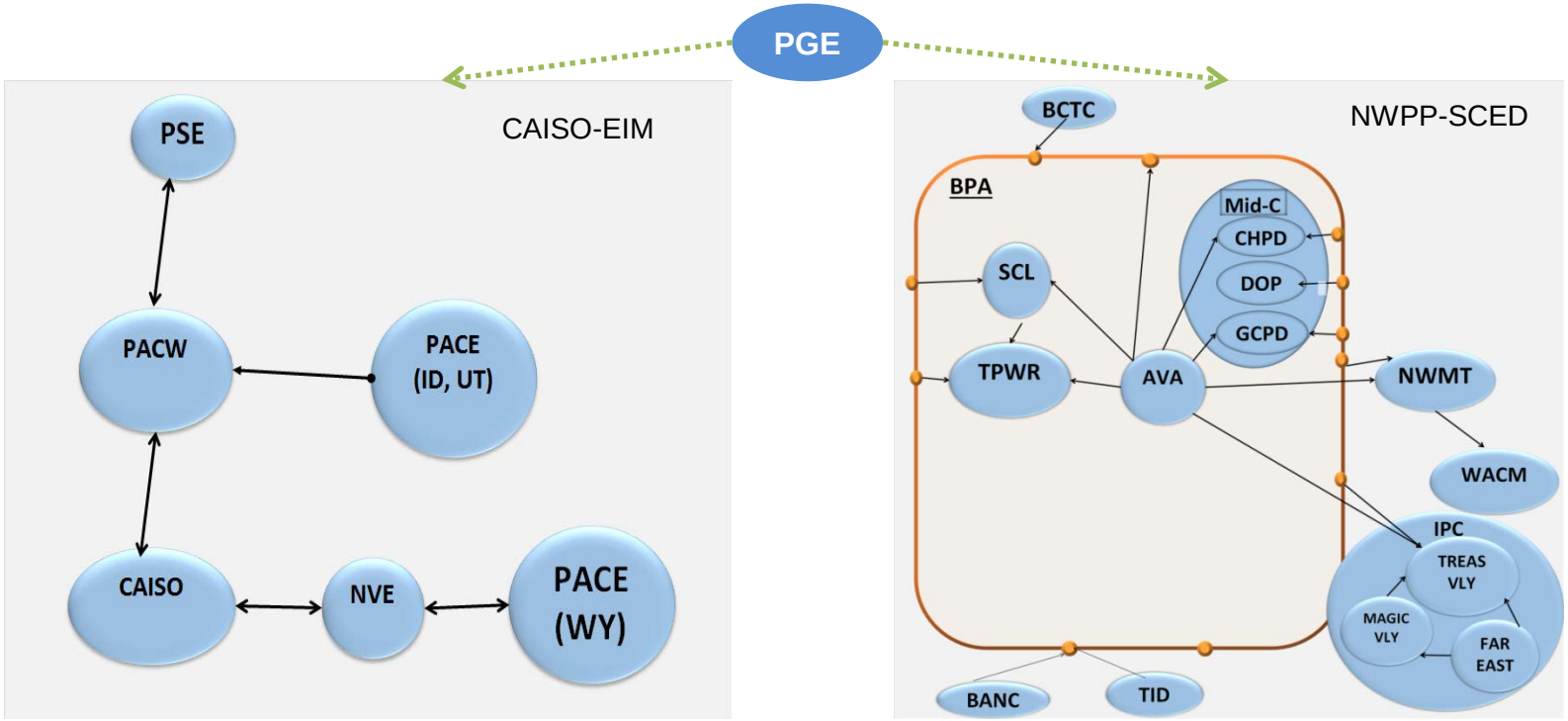
EIM: Modeling Assumptions

	Current	CAISO-EIM	NWPP-SCED
Full Wind Integration	PGE integrates Wind	PGE integrates Wind	PGE integrates Wind
Market	Day-Ahead Hour-Ahead	Day-Ahead Hour-Ahead	Day-Ahead Hour-Ahead
Sub-Hourly	10 minute re-dispatch	10 minute re-dispatch	10 minute re-dispatch
Available Dispatch	PGE's footprint	CAISO-EIM footprint	NWPP-SCED footprint
Reserves Diversity Benefit	Without Regional Reserve Pooling	Without Regional Reserve Pooling	Without Regional Reserve Pooling

Key difference in the analysis of a sub-hourly market is the footprint.

EIM: Differences in Study Footprints



The benefit for PGE is calculated by looking at costs before and after being part CAISO-EIM or NWPP-SCED

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EIM: Quantitative Diversity Benefits

	Current	CAISO-EIM	NWPP-SCED
Full Wind Integration	PGE integrates Wind	PGE integrates Wind	PGE integrates Wind
Market	Day-Ahead Hour-Ahead	Day-Ahead Hour-Ahead	Day-Ahead Hour-Ahead
Sub-Hourly	10 minute re-dispatch	10 minute re-dispatch	10 minute re-dispatch
Available Dispatch	PGE's footprint	CAISO-EIM footprint	NWPP-SCED footprint
Reserves Diversity Benefit	Without Regional Reserve Pooling	With Regional Reserves Pooling for the CAISO-EIM Footprint	With Regional Reserves Pooling for the NWPP-SCED Footprint

PGE assessing the potential benefit of pooling "Load Following" and "Forecast Error" reserve requirement amongst CAISO-EIM or NWPP-SCED participants.

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EIM: Comparative Analysis Activities

Action Item		Jan-Dec
Jan – Mar:	Coordinate with peer utilities on Base Case assumptions, gather & review generation and transmission data for the footprints. Review identified scenarios with TRC and EIMSAC	✓
Jan – Jun:	Assess PGE's internal costs to enter an EIM	Conducting RFPs w/Vendors
Mar – Jul:	Assess the external costs to join the NWPP or CAISO EIM	In Progress
Apr– Jul:	Present model assumptions, inputs and methodology to TRC and Advisory Committee Execute Base Case model runs and vet results with peer utilities	In Progress
May – Jul:	Facilitate workshops to present assumptions, inputs, and base case	In Progress
Jun– Jul:	Conduct model runs to capture the value for all of identified scenarios.	In Progress
Aug – Sep:	Validate results with the TRC and Advisory Committee and develop the final report	
Sep - Oct:	Present final results to PGE leadership team	
4th Quarter	Present results at Commission workshop	

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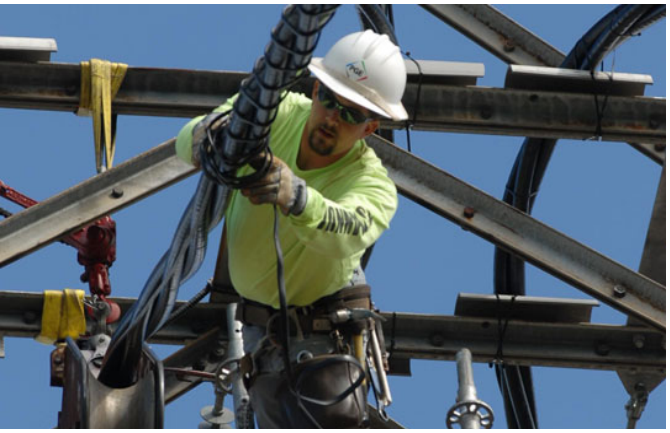

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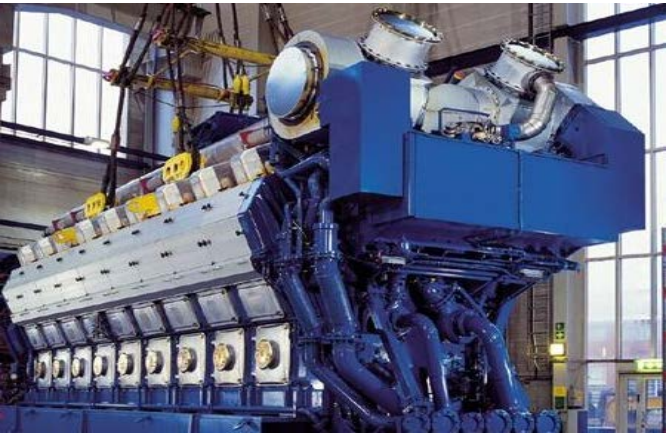
Clean Power Plan – Appendix Slides



111(d): What is it?

- Rulemaking issued by the EPA that is designed to substantially reduce CO2 emissions from the nation's existing fleet of power plants.

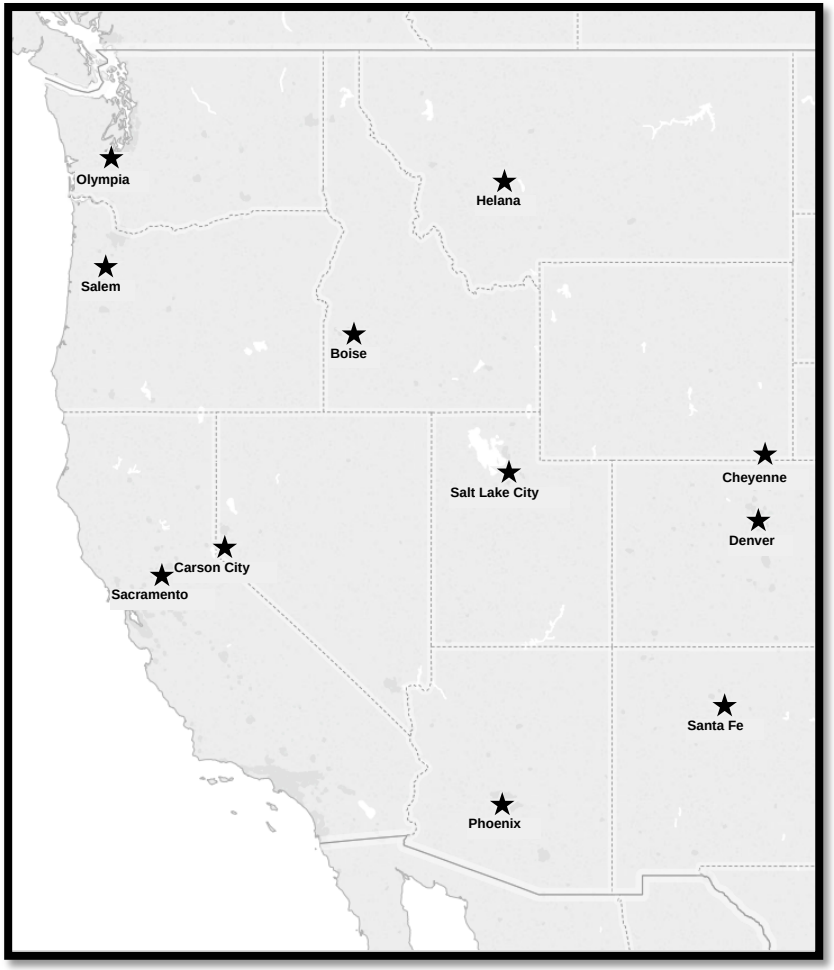
"I am following the direction of the Supreme Court, that they've given me three times, to say that carbon has to be addressed as a pollutant under the Clean Air Act."

-EPA Administrator Gina McCarthy

111(d): Compliance

- Under the proposed rule, states will require that eligible units meet EPA identified CO2 emission goals.
  - The goals differ dramatically between states.
  - The goals apply only to units within the state.

    Regional compliance is optional.
  - States have discretion to require compliance with an carbon intensity (rate based) or a carbon cap (mass based) standard.
  - States have discretion to include new CO2 emitting resources within the standard.



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111(d): Case Studies

- National Clean Power Plan simulation studies have relied upon mixed assumptions
- Case studies included:
  - SNL Financial
  - Rhodium Group
  - Energy Ventures Analysis
  - PJM

	SNL	Rhg	EVA	PJM	PGE
State	-	-	+	+	+
Regional	+	+	-	+	-
Rate	-	+	-	+	+
Mass	+	-	+	+	+
EE Availability	+	+/-	-	+/-	+/-
Heat Rate Improvement	-	-	-	-	-
New resource constraints	+	-	-	+/-	-

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111(d): Building Block Treatment

Building Block Treatment

EPA Proposed Rule	PGE's Proposed Analysis
All steam units' heat rates improved 6%	Unit heat rates unadjusted
CCCTs redispatched to 70% capacity factor	Model determines CCCT dispatch
2x new renewables nationally by 2029	RPS floor with no limit on new renewables
2.5x EE nationally by 2029	'Cost effective' EE and 'all achievable' EE scenarios