

Integrated Resource Planning

Technical Meeting

July 11, 2018



Meeting Logistics



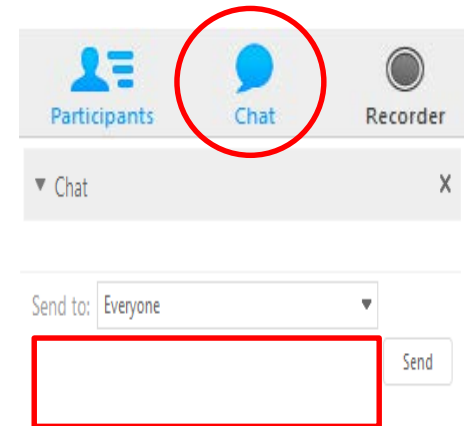
Local Participants:

- Each of you should have received guest Wi-fi access information via email
- Sign-in sheets

Virtual Participants:

- Ask questions via 'chat' feature
- Meeting will stay open during breaks, but will be muted
- Electronic version of presentation:
portlandgeneral.com/irp

>> *Integrated Resource Planning*



Today's Topics

- ❑ Welcome
- ❑ Safety Moment
- ❑ Market Capacity Study Update
- ❑ Distributed Energy & Flexible Load Study
- ❑ Flexibility Analysis Scope
- ❑ WECC Wide High Renewables Buildout
- ❑ Wrap-Up



Safety Moment

- Safe Boating Tips -

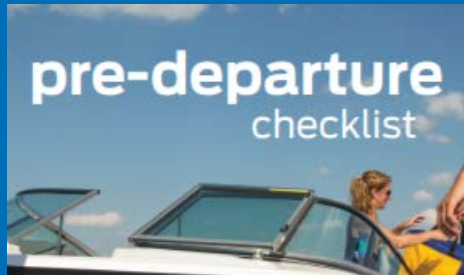


1. Be Weather-Wise
2. Follow a Pre-Departure Checklist
3. Use Common Sense
4. Designate an Assistant Skipper
5. Develop a Float Plan
6. Make Proper Use of Lifejackets
7. Avoid Alcohol
8. Learn to Swim
9. Take a Boating Course
10. Consider a Free Vessel Safety Check

Source: Discover Boating

Safety Moment

- Safe Boating Tips -

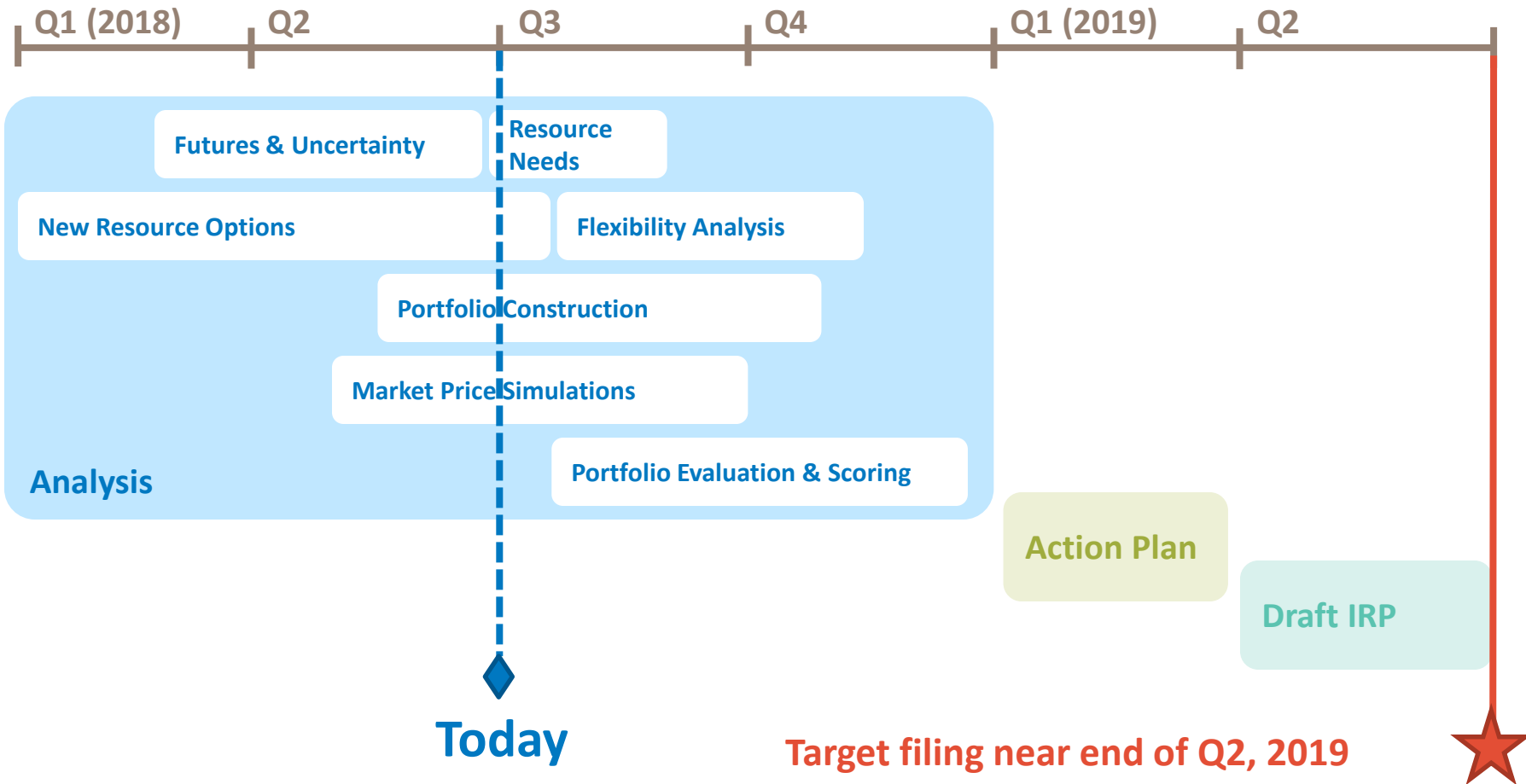


- ✓ Personal Flotation Devices
- ✓ Sound Producing Devices
- ✓ Lights & Shapes
- ✓ Distress Signals
- ✓ Tools & Spares
- ✓ Fuel & Oil
- ✓ Bilges
- ✓ Fire Extinguishers



2019 IRP Schedule

Progress continues on analysis to support the 2019 IRP



Market Capacity Study Update

Kate von Reis Baron



Market Capacity Study

Status Update



**Study
Presentation:
Early Fall 2018**

- Order No. 17-386 directs PGE to conduct a study of market capacity to inform the next IRP
- PGE hired Energy & Environmental Economics, Inc. (E3) to conduct the market capacity study
- Study is currently underway, aiming to complete analysis by late summer
- E3 will present to stakeholders at a Roundtable or technical meeting in early fall

Market Capacity Study

Scope

- Review of Pacific Northwest resource adequacy analyses and forecasts of future changes to loads and resources
 - Power Council, BPA, PNUCC, utility IRPs, and others
- Development of a PNW capacity load resource balance through 2030 informed by review
 - Account for regional import capabilities and seasonality
- Analysis of potential constraints that affect availability of excess regional capacity to meet PGE loads

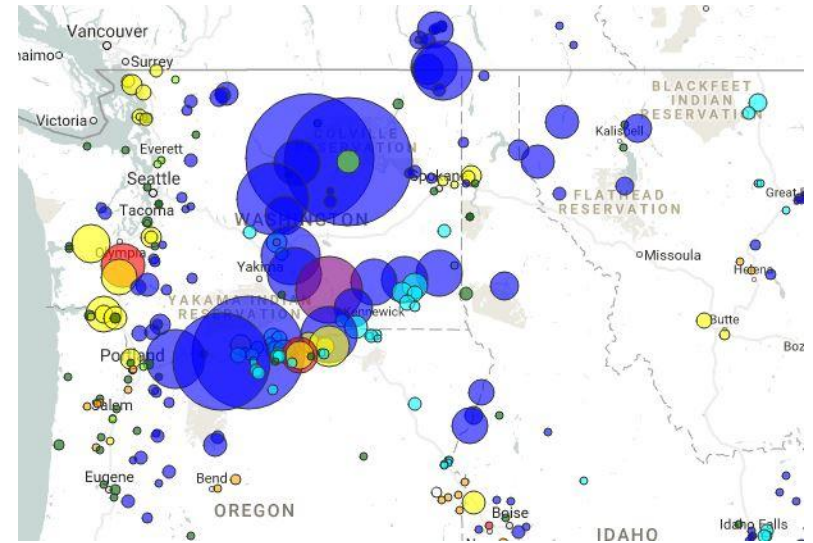


Image Source: NWPPC

- Provide reasonable assumptions of market capacity available to meet reliability needs to inform PGE's integrated resource planning

DER Scope & Overview

Shauna Jensen

Distributed Energy and Flexible Load Study




Flexibility Analysis Scope

Nora Xu



Flexibility Modeling Tools: Resource Optimization Model (ROM)

- What is ROM?
 - Mixed integer programming optimal commitment and dispatch model
 - Multi-stage 

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graph LR; A[Day-ahead stage] ==> B[Hour-ahead stage]; B ==> C[Real-time stage];
```
 - Includes generator representations, fuel constraints, market availability, regulation and load following reserve requirements
- What resources can be represented in ROM?
 - Current PGE generation portfolio
 - Potential new additions (thermal, storage, renewables)
- ROM does not model capital costs, revenue requirement modeling, loss of load expectation

ROM, haven't we met before?



- ROM was developed in 2007 for the 2009 IRP to estimate variable wind integration costs and subsequently used for analysis in:
 - 2013 IRP
 - 2016 IRP
 - General Rate Case/Annual Update Tariff proceedings
 - Internal economic analysis
- Most recently reviewed by an external technical review committee (TRC) and public stakeholder meetings during the 2016 IRP process
- ROM is under continuous development and improvement

Flexibility Analysis Components

An enabling set of studies that explore how to assess flexibility needs, value and costs

Flexibility Adequacy

This component studies how flexibility adequacy could be defined, and seeks to model flexibility adequacy with production cost models and develop initial methodologies to evaluate how different resources affect it.

Variable Energy Resource (VER) Integration Costs

This component continues to estimate costs of self-integrating additional VERs into the system.

Flexibility Value

This component studies how much we value flexibility from different resources, such as energy storage, flexible loads, gas-based generators.

Flexibility Adequacy in the 2016 IRP

Study Methodology

- Study with consulting firm Energy & Environmental Economics(E3)
- Used the REFLEX model, a three-stage mixed integer programming model for optimal commitment and dispatch
 - Includes regulation and load following reserve requirements
 - Synthetically generates combinations of load and renewable shapes for larger set of system conditions
 - Scenarios combined renewable portfolios and new thermal resource additions

2016 IRP Table 5.5

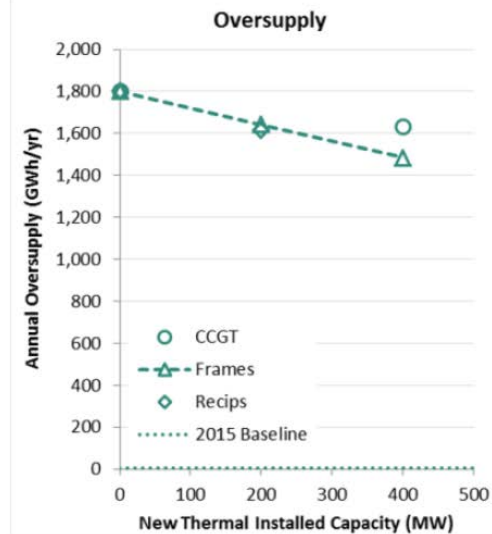
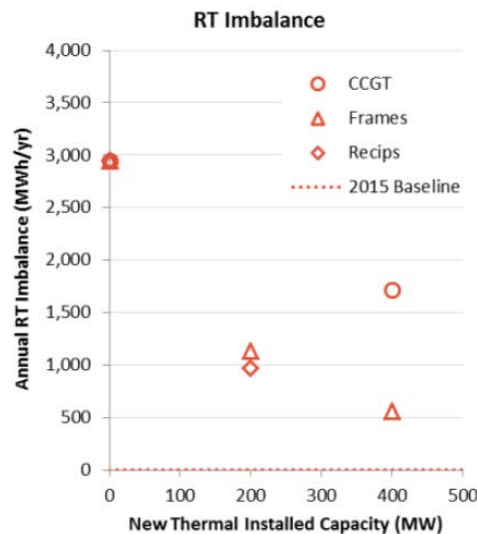
Renewable Portfolio	No New Thermal	CCCT	Frame CTs		Reciprocating Engines			
		400 MW	200 MW	400 MW	100 MW	200 MW	300 MW	400 MW
Portfolio A (25% RPS – Gorge Wind)	X	X	X	X	X	X	X	X
Portfolio B (25% RPS – Gorge Wind + Solar)	X		X	X				
Portfolio C (25% RPS – Gorge Wind + MT Wind)	X	X	X	X	X	X	X	X
50% RPS (double Portfolio B)	X	X	X	X		X		

Flexibility Adequacy in the 2016 IRP

Study Conclusions

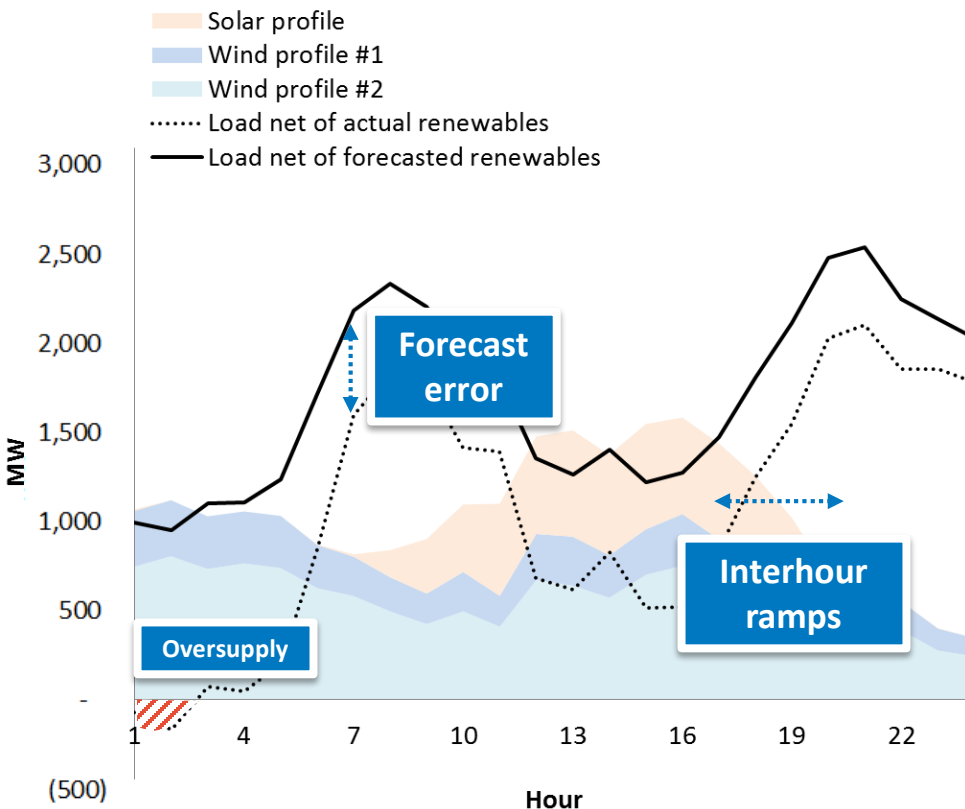
- Midterm flexibility challenges are moderate, but increase with renewable penetration increases
- Resource additions mitigate upward flexibility challenges
 - At 25% RPS, upward flexibility challenges mostly mitigated with 400 MW of additional dispatchable resources
 - At 50% RPS, there is potential for large amounts of renewable curtailment without integration solutions.

2016 IRP FIGURE 5-21: Expected RT Imbalance and oversupply for 50% portfolio with thermal resource additions



Flexibility Adequacy in the 2019 IRP

Illustrative Daily Dispatch with Increased Renewables

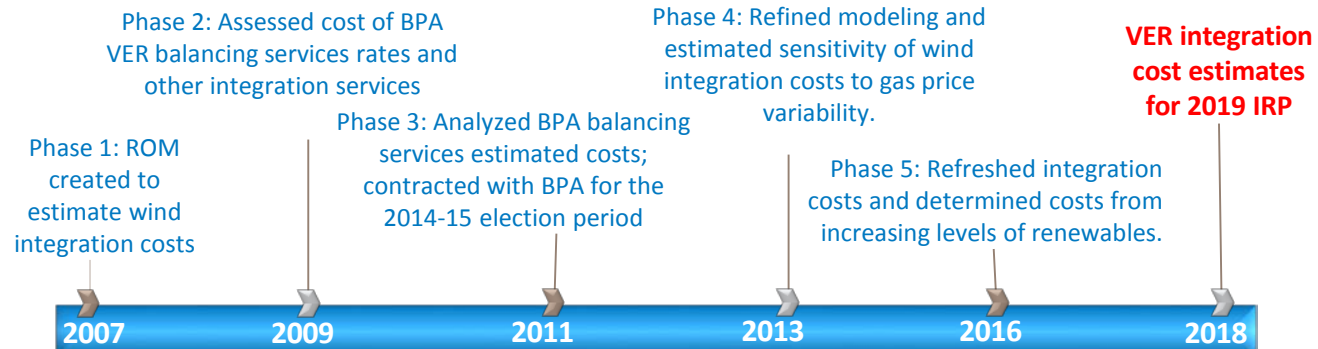


- Study scope:
 - Define metrics for flexibility adequacy
 - Model how different resources affect flexibility adequacy under several potential renewable portfolio futures
- Study will use the ROM model; PGE will have assistance from a consultant on a contract basis for ROM analysis
- Draft study timeline:
 - Study kicks off in mid-July
 - Completion goal by December 2018
 - Updated timelines will be provided

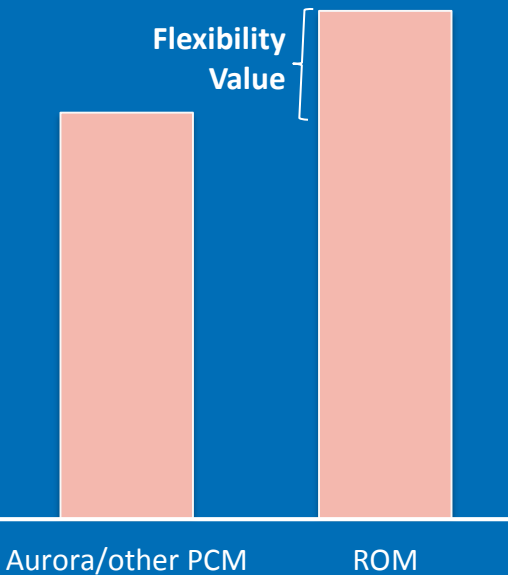
VER Integration Costs

- In previous IRPs and other work, there was analysis of wind integration costs
- In the 2019 IRP, we will estimate wind and solar integration costs

VER integration cost analysis using ROM



Flexibility Value



- System flexibility is needed to accommodate forecast errors, subhourly variability and to integrate VERs
- Given potential portfolios (and levels of renewables), what is the flexibility value of different types of resources?
- Proposed resources for flexibility value assessment
 - Short-medium duration storage
 - Long duration storage
 - Flexible loads
 - Thermal resources (CC, CT, reciprocating IC)
 - Any other suggestions?

WECC-Wide High Renewables Buildout

Shauna Jensen

WECC-Wide High Renewables Buildout



Wrap up

Elaine Hart

