Integrated Resource Plan

2016

OPUC Meeting

April 21, 2016

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Welcome: Today's Topics

- Clean Power Plan (CPP) Update
- Resource Portfolios Update

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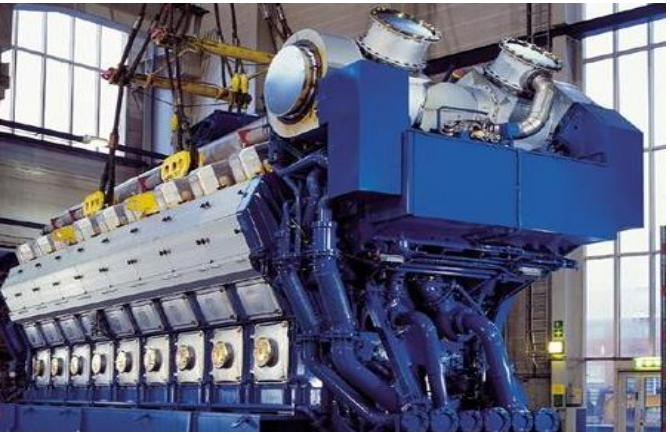
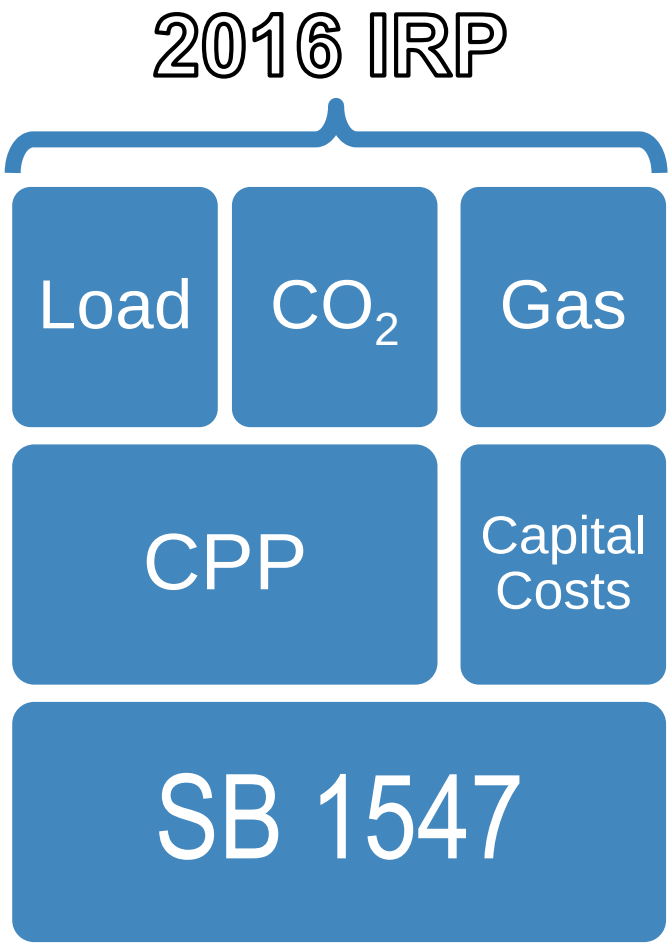
Clean Power Plan (CPP) Update



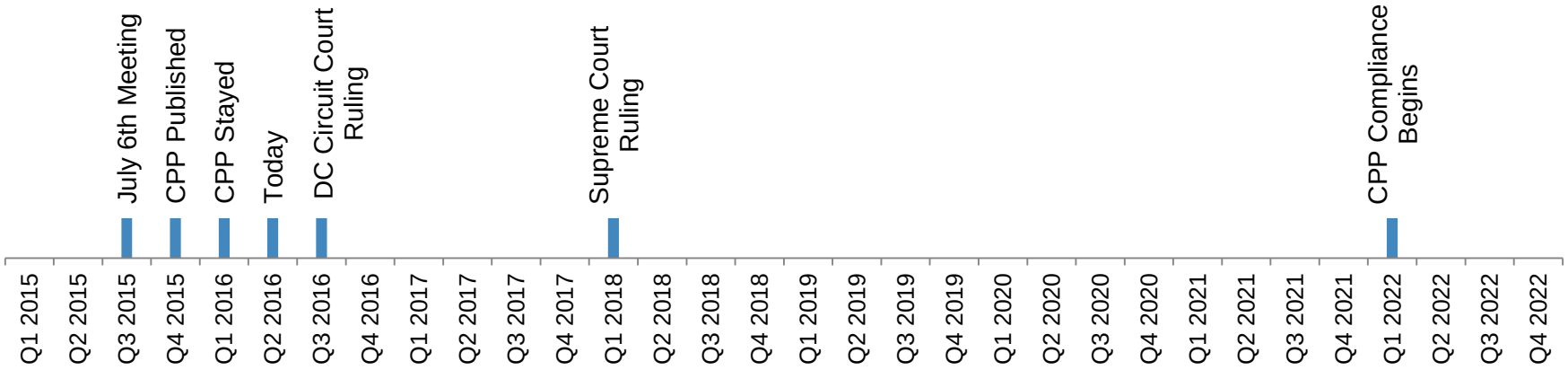
CPP: IRP Objective

- To identify a portfolio strategy that performs well under a broad range of policy and economic futures
  - PGE will incorporate the effects of the Clean Power Plan on wholesale power markets
  - CPP is one of many factors studied within IRP



CPP: Developments Since July 6th 2015

- Fall 2015 – EPA issues final rule
  - October 23, 2015 – Published in Federal Register
  - EPA revision responsive to PGE concerns
- February 9, 2016 – Supreme Court issues stay
  - Fall 2016 – DC Circuit Court ruling expected
  - Winter 2017/2018 – Supreme Court ruling expected
  - OR DEQ to continue collaborative plan design process



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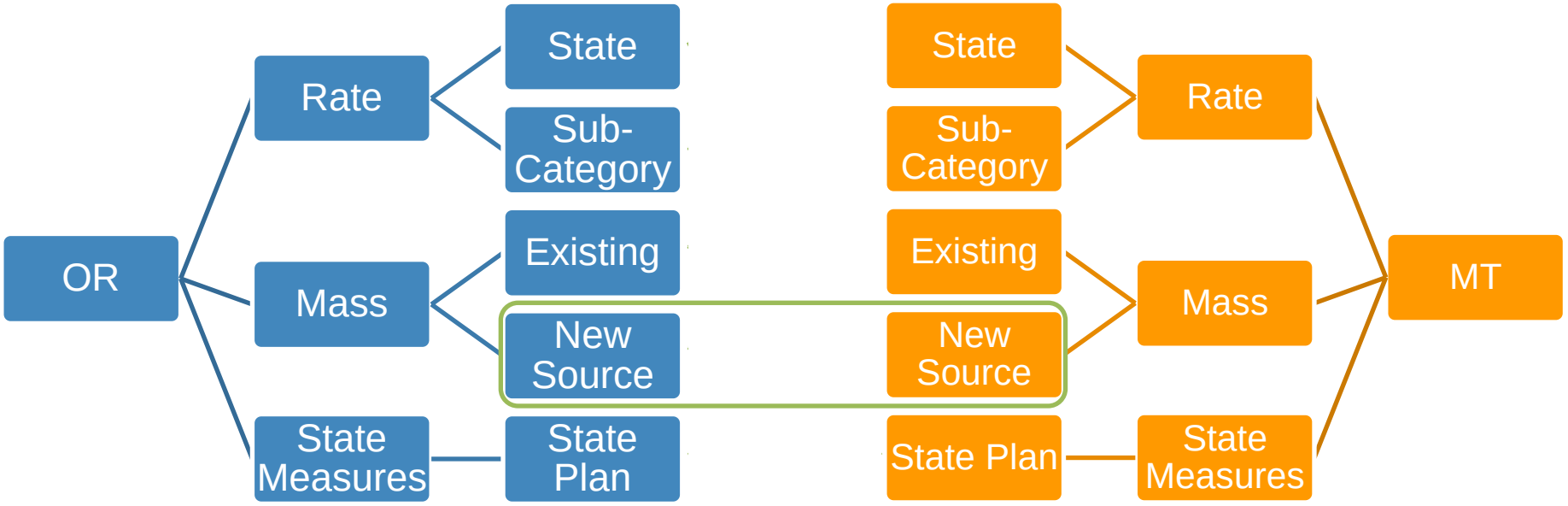
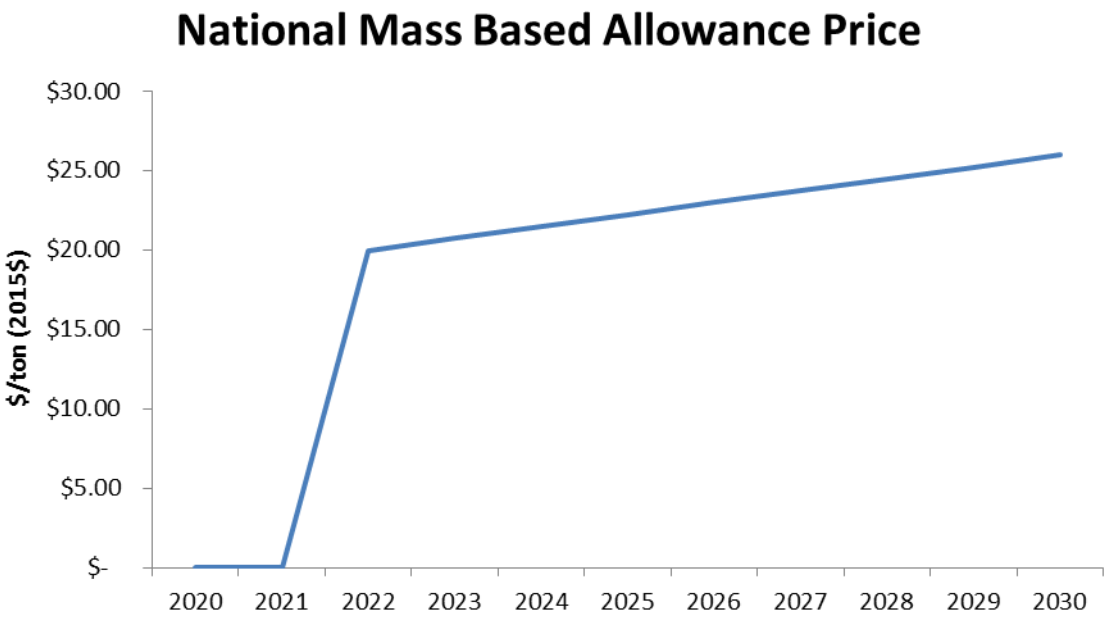
CPP: Implementation

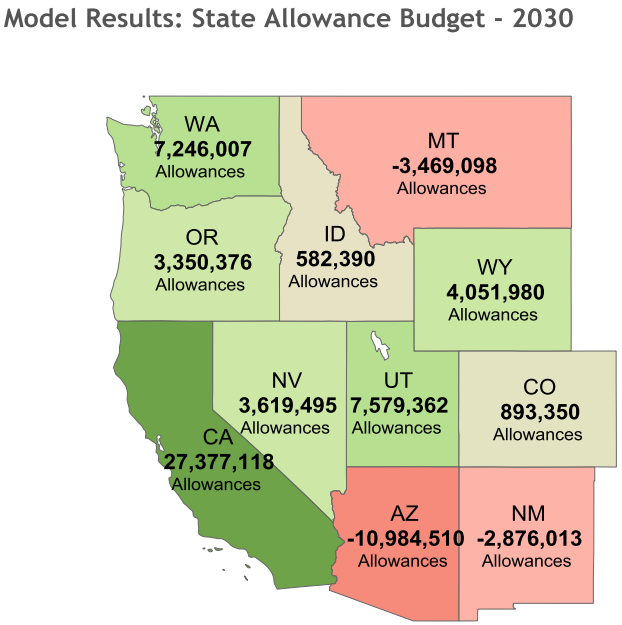
- Uncertainty remains regarding CPP implementation plans
  - 2016 IRP models
    1) trading ready mass based ‘new source complement’ plans
    2) rate based sub-category specific sensitivities
  - PGE supports a sub-category specific rate based plan



CPP Modeling – Mass

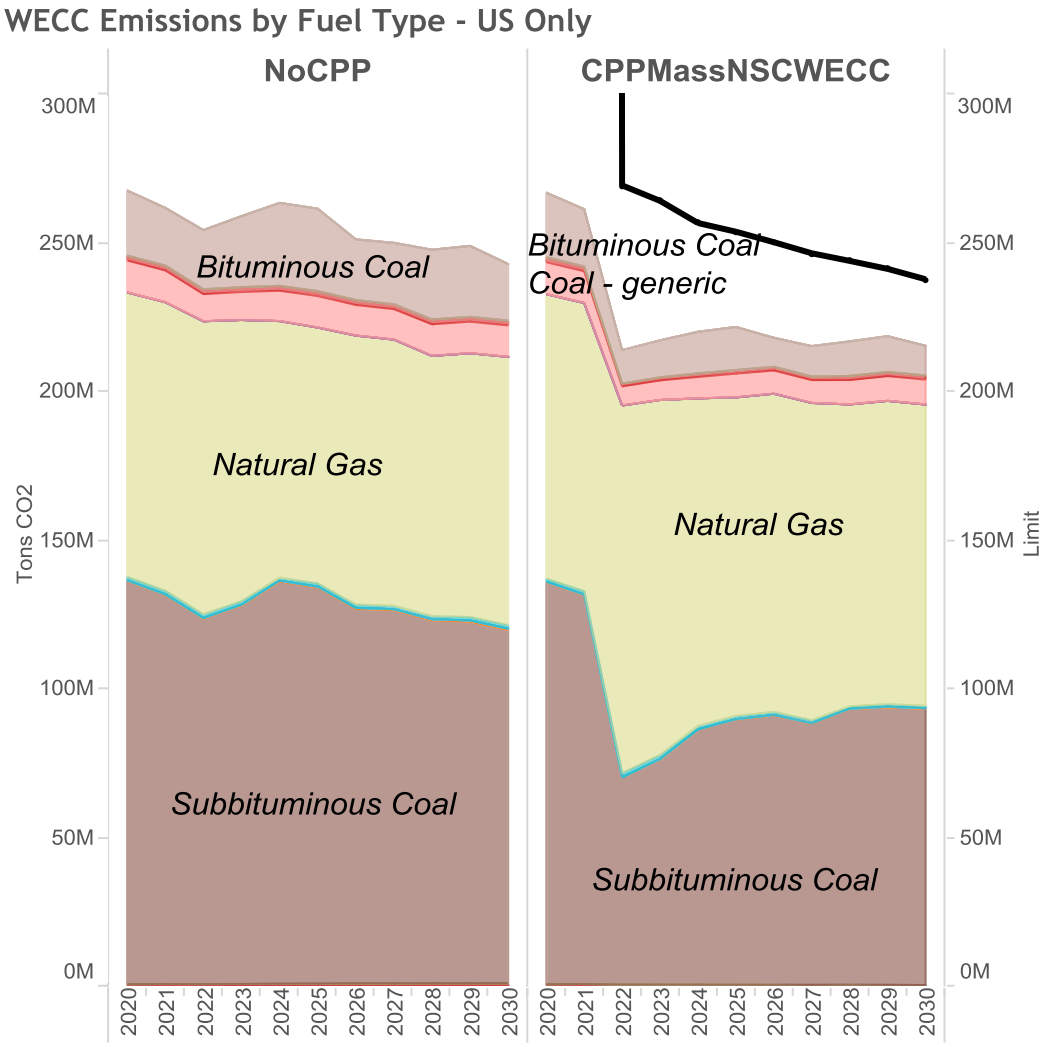
- 2016 IRP assumes mass based allowances can be traded interstate
  - Total WECC-wide emissions constrained by aggregate WECC limit
  - Mass based allowance price associated with national trading price
  - Eligible units must purchase allowances at national trading price
- Results indicate that the WECC will be a net exporter of mass based allowances



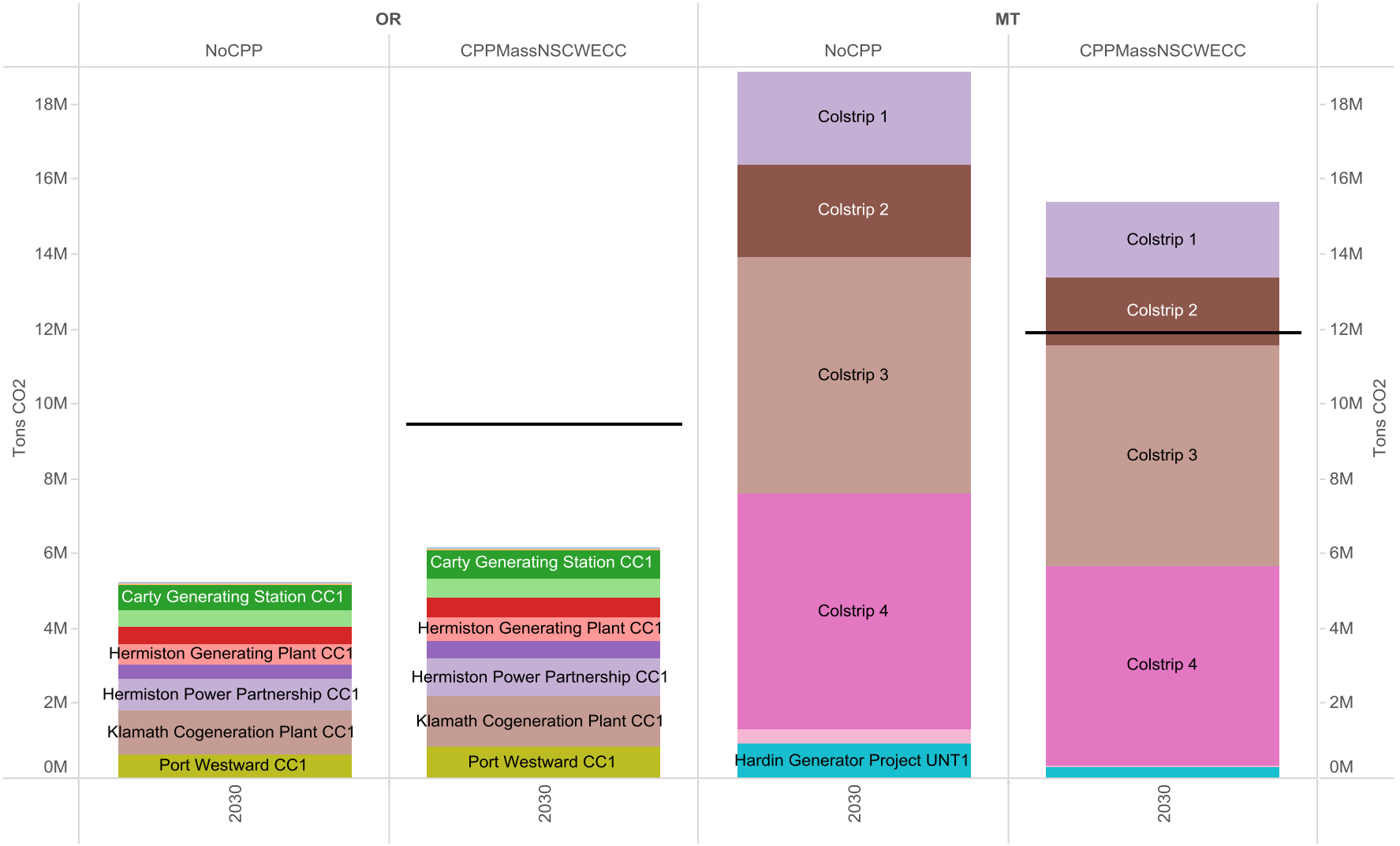


CPP Modeling – Mass WECC

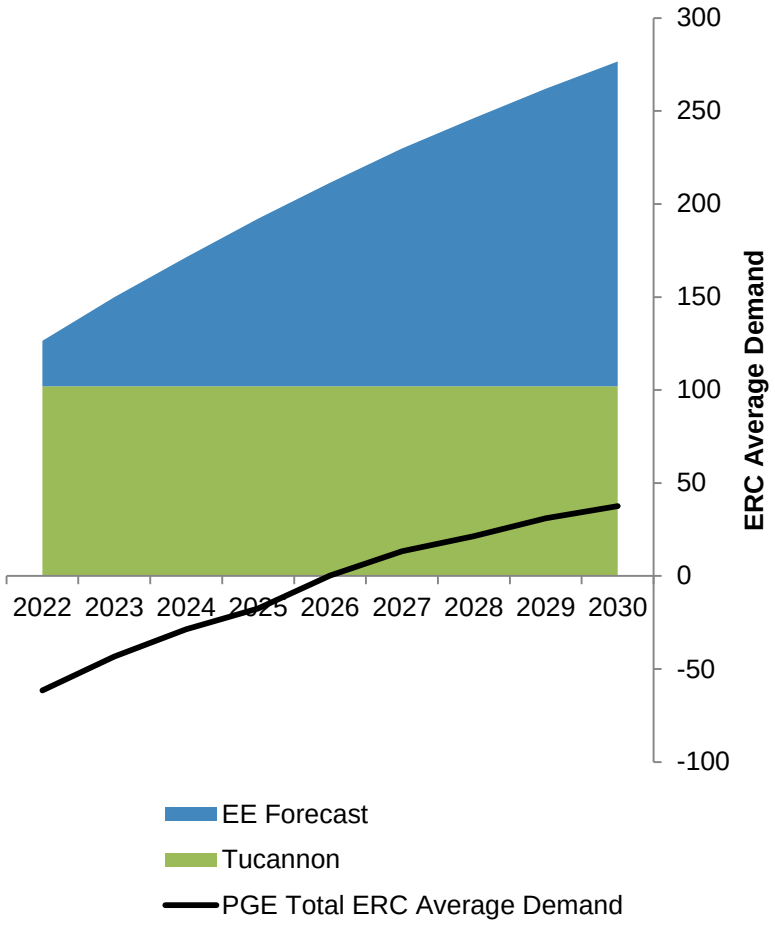
- Clean Power Plan contributes to expected emission declines
  - Emissions fall in Zero CO_2 Price due to elevating RPS standards in WECC
  - CPP drives emissions down further through the pricing of allowances
  - Coal to gas switching observed across WECC



CPP Modeling – Mass Oregon & Montana



CPP Modeling – Rate Oregon



- Rate based sensitivity:
  - Oregon participates in sub category specific rate based plan
  - Remainder of WECC participates in mass based implementations
- After the ceasing of coal-firing at Boardman, PGE's emission rate credit demand is significantly lower than supply
- A rate based implementation plan allows for zero incremental CPP compliance costs for PGE customers

ERC: Emission Rate Credit

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CPP Modeling – Summary

- Mass based
  - PGE is well positioned to comply with the CPP
  - Costs to customers are driven by:
    1. The national clearing price for allowances
    2. Oregon's method for allocating allowances
  - Additional natural gas resources can be sited in Oregon without exhausting available allowance supply
- Rate Based
  - PGE's actions related to Boardman, new renewable resources, and cost effective energy efficiency enable CPP compliance with no additional actions
  - No incremental compliance costs
  - Additional resources, both thermal and renewable, are neither limited nor benefited by rate based plan

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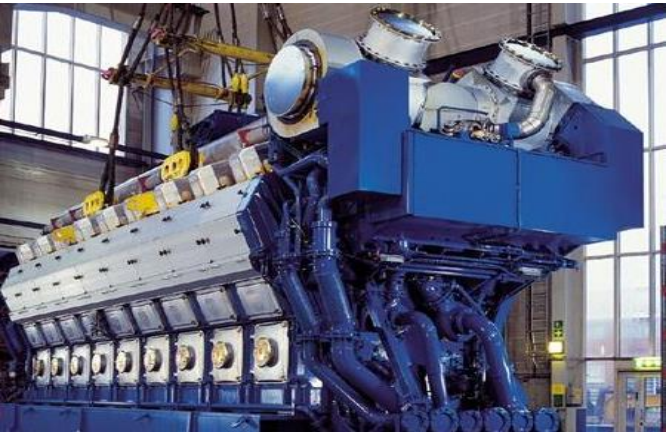
Resource Portfolios Update



PGE Resource Portfolios: Objectives

- To identify a portfolio strategy that performs well under a broad range of policy and economic futures.
  - Include known and commercially viable resource alternatives
  - Evaluate resource combinations
    - Resource technology and fuel types
    - Portfolio effects
  - Evaluate resource timing
    - Time value
    - Tax incentives
    - Technological maturity
    - Rate impact

PGE Resource Portfolios: Components

Common Assumptions

- SB 1547:
  - RPS obligations
  - Colstrip serving Oregon customers
- ETO energy efficiency deployment
- Demand response
- Short-term/mid-term market procurement
- Conservation voltage reduction
- Dispatchable standby generation

Available Resources

- Spot market open position
- Flexible combined-cycle combustion turbine
- Wind and Solar PV
- Biomass and Geothermal
- Simple-cycle combustion turbine
- Energy storage
- Additional (“non-cost effective”) energy efficiency

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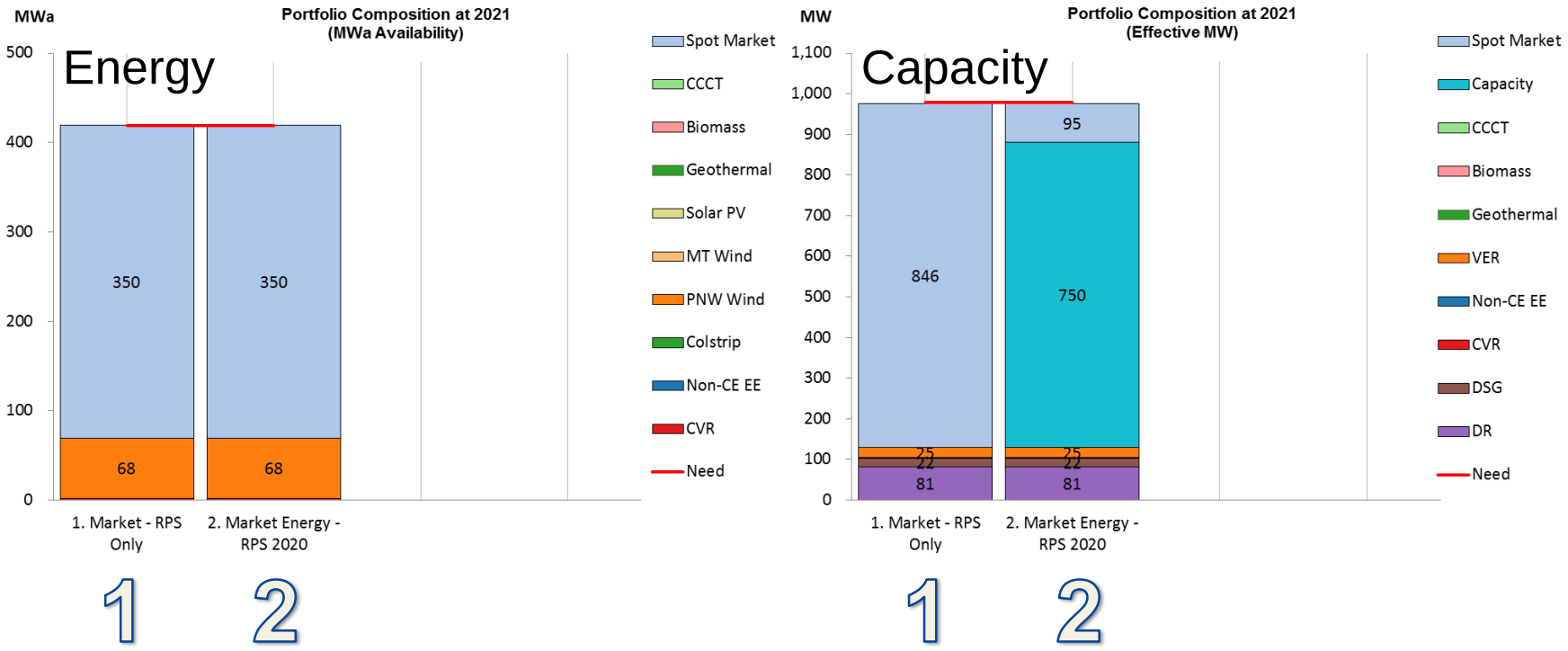
PGE Resource Portfolios: Design

- Spot Market vs. Resource (Portfolios 1 and 2)
  - Cost and reliability of market reliance
- CCCT vs. Wind (Portfolios 3 through 5)
  - Renewable resource economics relative to natural gas-fired
- PNW Wind vs. Diverse Wind (Portfolios 4 through 7)
  - Renewable resource locational diversification
- Wind vs. Baseload renewables (Portfolios 6 through 9)
  - Renewable resource capacity and variability
- Wind vs. Wind + Solar PV (Portfolios 6, 7, 10, and 11)
  - Renewable resource technological diversification
- Base vs. additional EE (Portfolios 13 and 14)
  - Portfolio cost / benefit of additional (“non-cost effective”) energy efficiency

PGE Resource Portfolios: Spot Market vs. Resource



- Cost and reliability of market reliance

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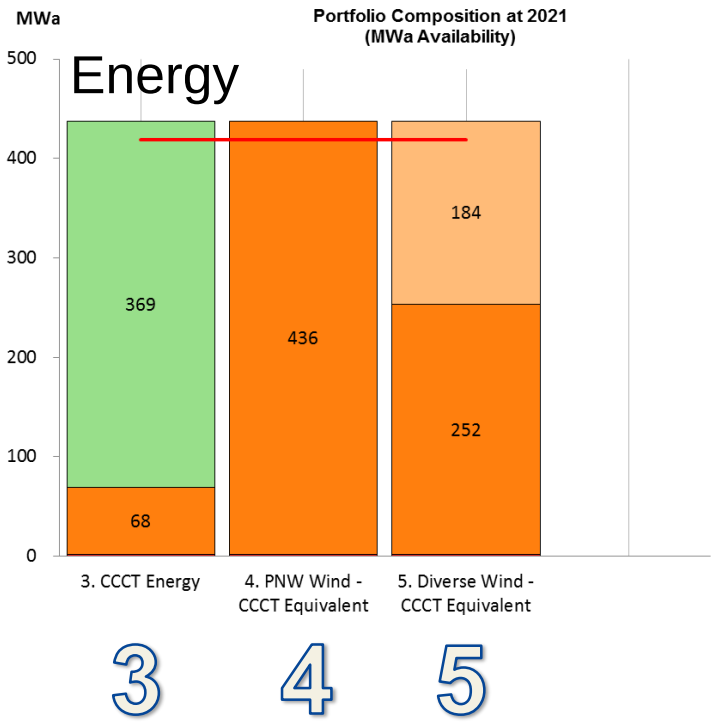
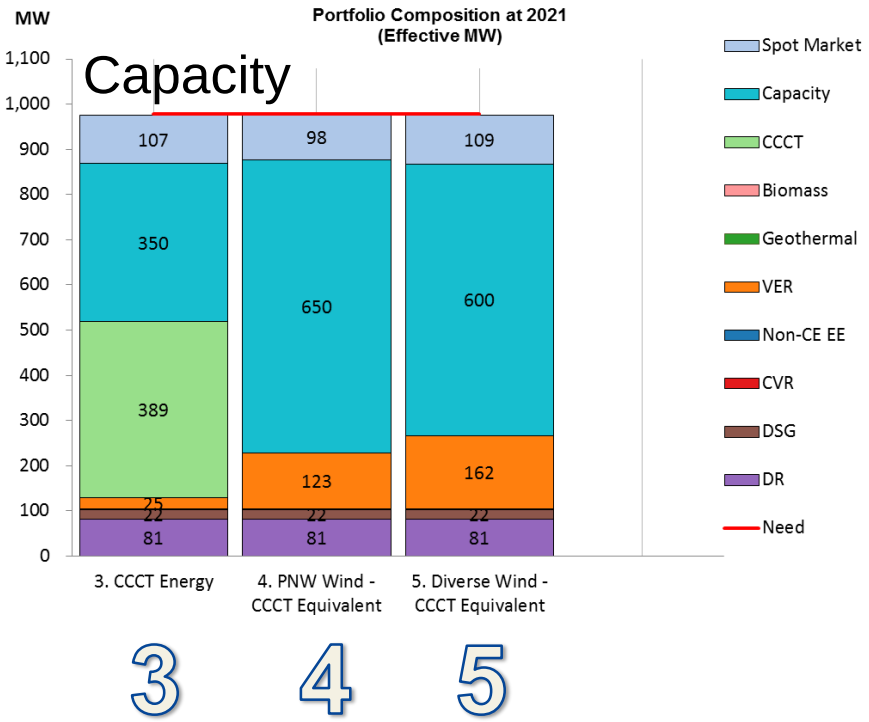
PGE Resource Portfolios: CCCT vs. Wind





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- Renewable resource economics relative to natural gas-fired

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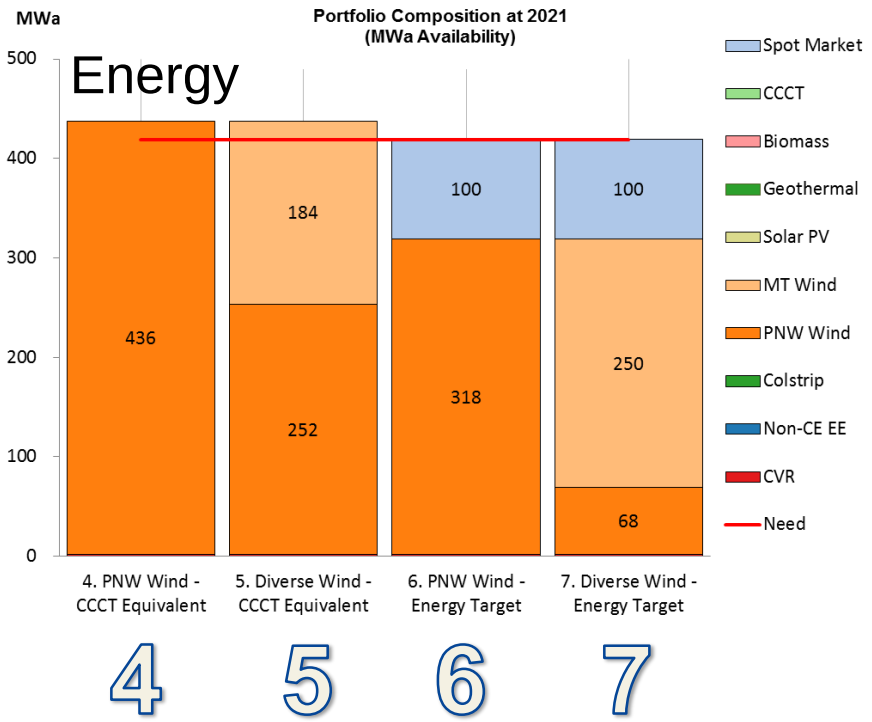
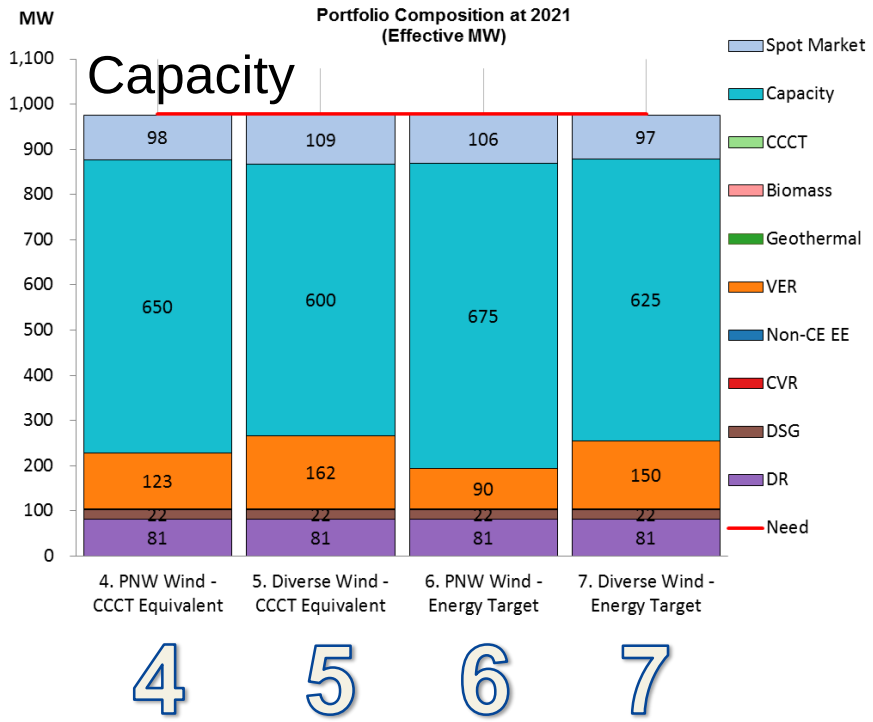
PGE Resource Portfolios: PNW Wind vs. Diverse Wind





- Renewable resource locational diversification

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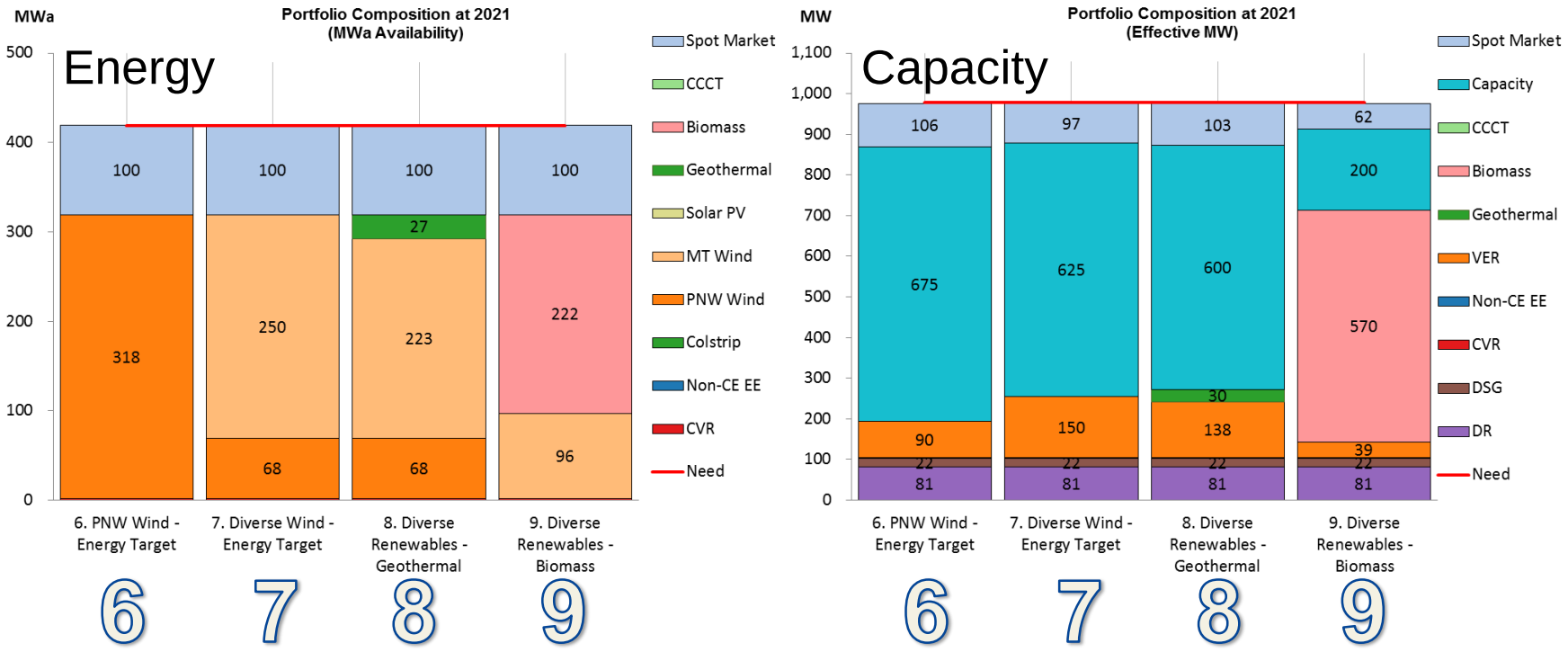
PGE Resource Portfolios: Wind vs. Baseload renewables



- Renewable resource capacity and variability

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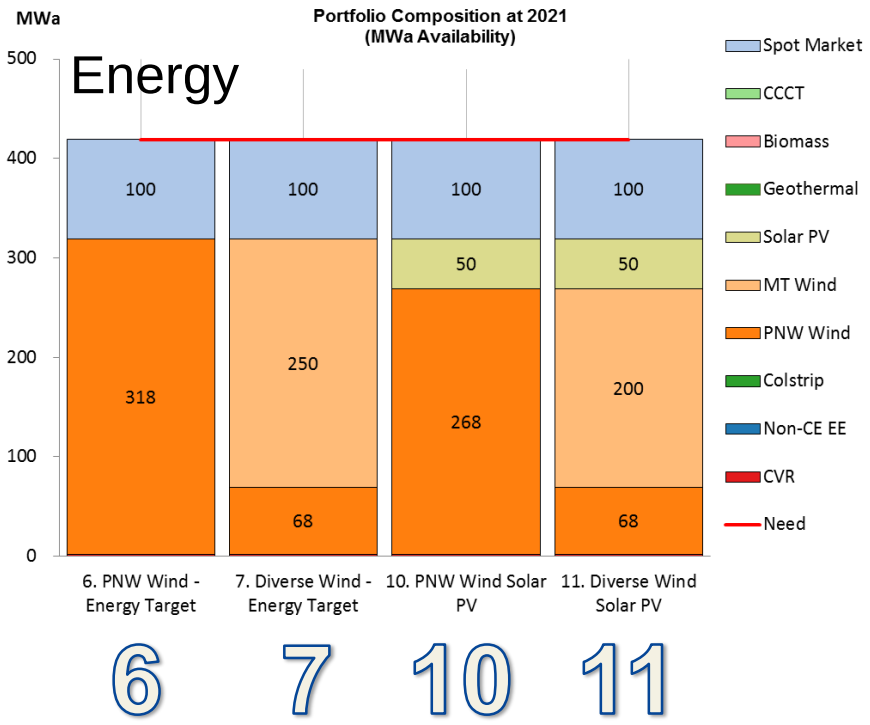
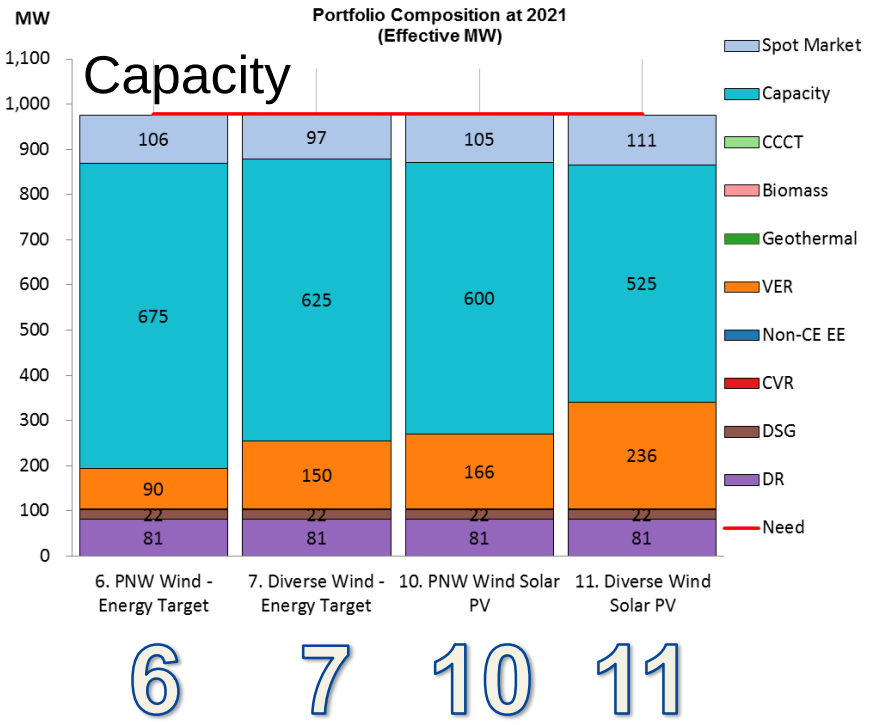
PGE Resource Portfolios: Wind vs. Wind + Solar PV





- Renewable resource technological diversification

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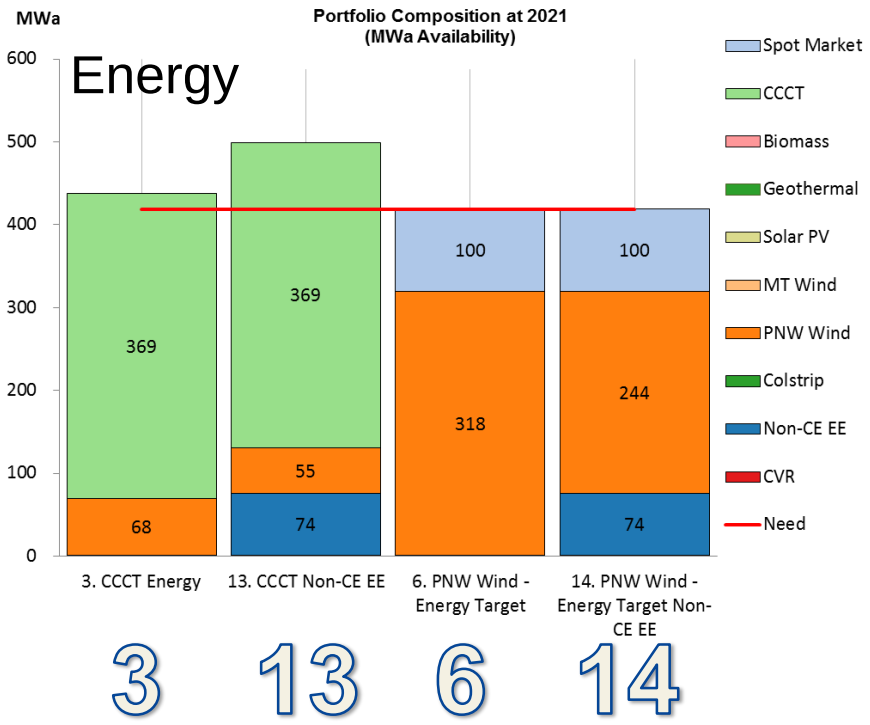
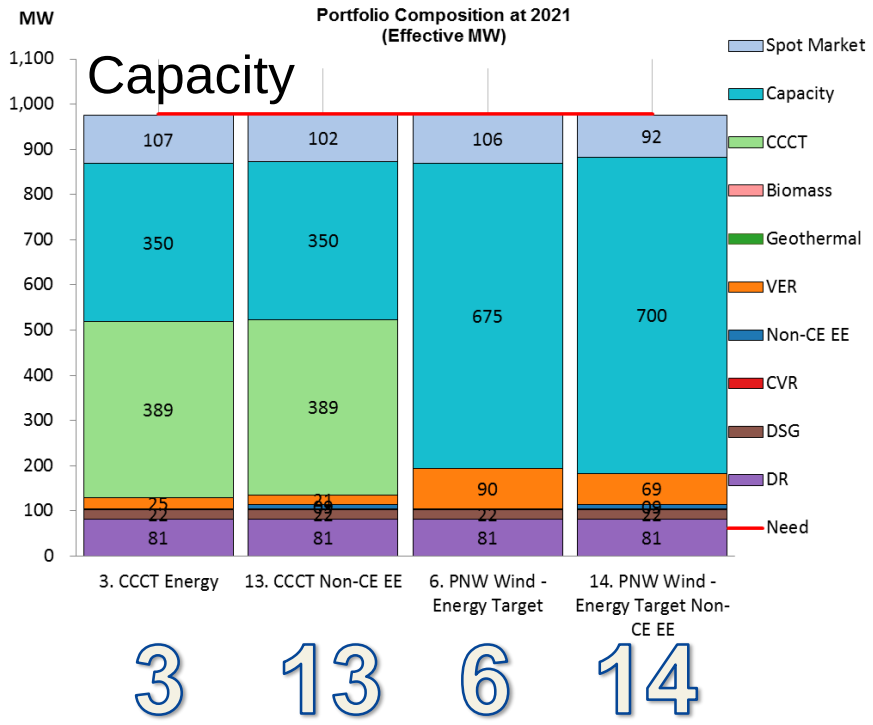
PGE Resource Portfolios: Base EE vs. additional EE





- Portfolio cost / benefit of additional (“non-cost effective”) energy efficiency

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