IRP Modeling Advisory Group Webinar

Californian Floating Offshore Wind: NREL's 2020 Resource and Cost Report

August 27, 2020

Outline

- Introduction (1pm – 1.10pm Pacific Standard Time)
- NREL's 2020 CA Floating Offshore Wind Resource and Cost Report (1.10pm – 2.25pm including Q&A)
- Update on Capacity Expansion Modeling using RESOLVE (2.25pm – 2.40pm including Q&A)
- Update on Production Cost Modeling using SERVM (2.40pm – 2.55pm including Q&A)
- Conclusion (2.55pm – 3pm)

Modeling Advisory Group (MAG) Background

- The MAG provides an **open forum** for informal technical discussion and vetting of data sources, assumptions, and modeling activities undertaken by CPUC staff to support the IRP proceeding (R.16-02-007 / R.20-05-003)
- **Participation** in the MAG is open to the public, subject to the terms of the charter, and communication of events and materials is through the IRP proceeding service list
- Feedback received during and following MAG webinars **inform** staff work products that are later introduced into the formal record of the IRP proceeding

Purpose and Scope of Webinar

- Purpose:
  - Inform stakeholders about draft results of National Renewable Energy Laboratory's (NREL) 2020 analysis of offshore wind, available for use in Integrated Resource Planning (IRP)
  - Provide opportunity for stakeholder feedback
- Scope:
  - Floating offshore wind in California
  - Potential use cases of NREL's results in IRP
  - RESOLVE and SERVM modeling of offshore wind
- Out of scope:
  - IRP Proceeding including, but not limited to:
    - Order Instituting Rulemaking Scoping Memo
    - Preferred System Plan
      - LSE plan development
      - LSE plan aggregation

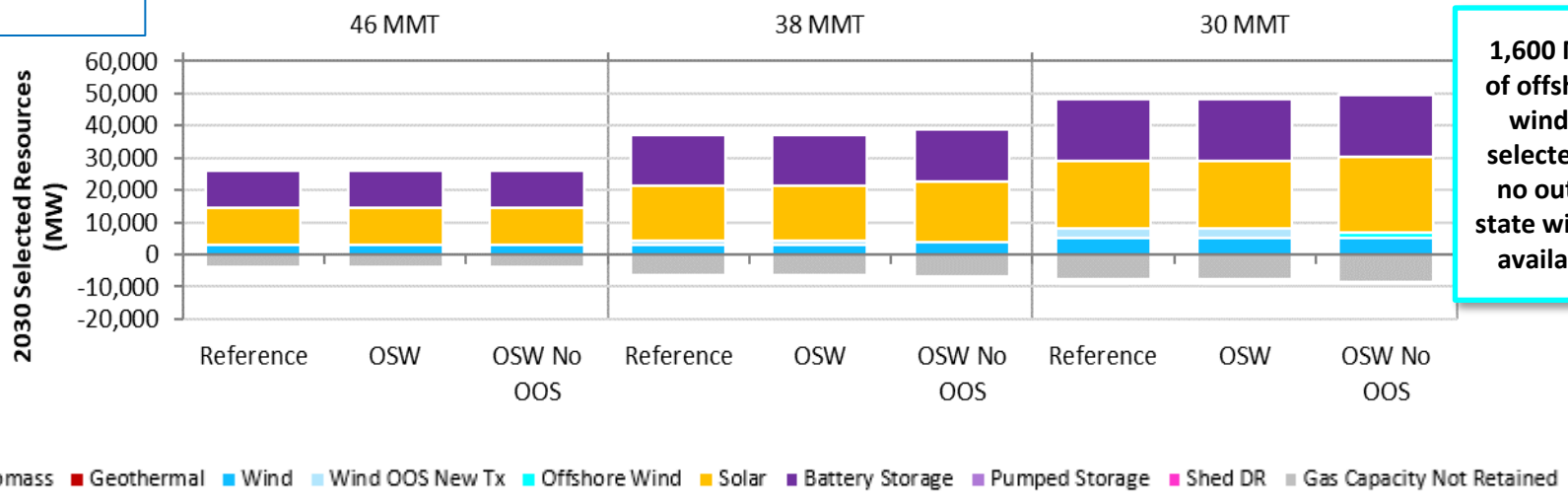
IRP context

- Offshore wind was modeled in California's IRP for the first time as part of 2019-2020 Reference System Portfolio sensitivity analysis
- Key data sources were University of California Berkeley's study (resource potential and generation profile) and NREL's 2018 Annual Technology Baseline (costs)[1]
- More certainty about assumptions needed for offshore wind to be a default resource type in IRP modeling

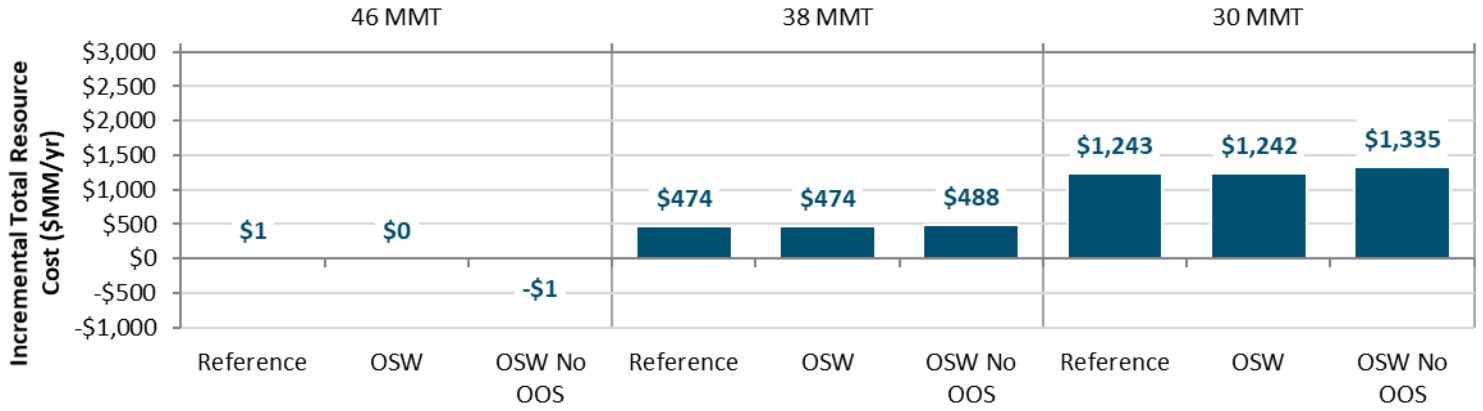
1. Refer 2019-20 IRP Inputs and Assumptions for further information
ftp://ftp.cpuc.ca.gov/energy/modeling/Inputs%20%20Assumptions%202019-2020%20CPUC%20IRP%202020-02-27.pdf

Slide 103, [2019-2020 Proposed RSP, November 6, 2019]

Offshore Wind Sensitivities



1,600 MW of offshore wind is selected if no out of state wind is available



Costs for the "OSW no OOS" cases reflect the net cost of deploying additional offshore wind and *not* deploying out of state wind on new transmission. The 30 MMT OSW no OOS sensitivity reduces incremental TRC by ~$25MM/yr relative to the "No OOS" sensitivity (earlier slide).

IRP context

- Bureau of Ocean Energy Management (BOEM) has engaged NREL to report on California floating offshore wind – specifically cost and resource profile
- IRP use cases:
  - Inputs and Assumptions update for 2022 Reference System Plan (RSP)
  - Inform 2020 Procurement Track analysis
    - Inform sensitivity cases to run as part of staff's analysis of long-lead time and large-scale resources, as flagged in D.20-03-028 (Decision adopting 2019-2020 RSP) and the Order Instituting Rulemaking Preliminary Scoping Memo

Questions and Feedback

- We invite questions and feedback at the end of each section

- Please “raise your hand” in the Participants view within Webex
- Webex host will unmute your microphone and you can proceed to ask your question
- Please “lower your hand” afterwards

- For those with phone access only:
  - Please email your question to IRPDataRequest@cpuc.ca.gov and we will read it out at the end of the webinar

  OR
  - Dial *3 to “raise your hand”. Once you have raised your hand, you'll hear the prompt, "You have raised your hand to ask a question. Please wait to speak until the host calls on you.“
  - Webex host will unmute your microphone and you can proceed to ask your question
  - Dial *3 to “lower your hand”

Collaboration between CPUC, BOEM and NREL

- CPUC staff acknowledge the collaboration with BOEM and NREL staff, including:
  - BOEM
    - Necy Sumait
    - Sara Guiltinan
    - Jean Thurston-Keller
  - NREL
    - Walt Musial
    - Philipp Beiter
    - Patrick Duffy
    - Aubryn Cooperman
    - Matt Shields

BOEM
Bureau of Ocean Energy Management

https://www.boem.gov/

NREL
Transforming ENERGY

https://www.nrel.gov/

NREL'S 2020 CA FLOATING OFFSHORE WIND RESOURCE AND COST REPORT

(REFER TO SEPARATE PRESENTATION)

OFFSHORE WIND IN IRP CAPACITY EXPANSION MODELING USING RESOLVE

Developing Offshore Wind Data for RESOLVE

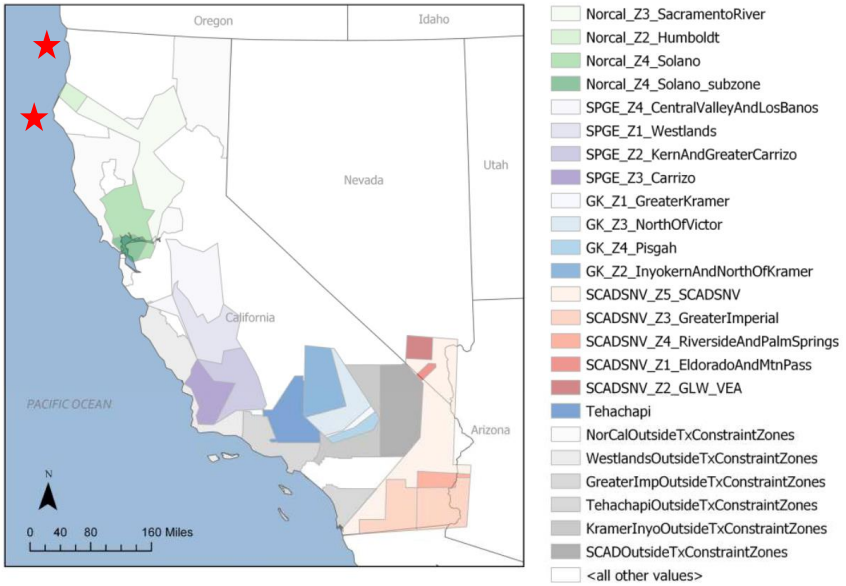
- Three key elements of the data from NREL are used in the RESOLVE modeling
  - Resource Costs: Capital costs, O&M costs, and financing assumptions are used to calculate the all-in fixed cost of each resource
    - This calculation is done using a publicly available proforma model that is part of the RESOLVE model package that is used for all the candidate resources modeled[1]
  - Resource Potential: Used to determine the capacity limit for each resource.
    - This is directly input into the RESOLVE user interface
    - This is unchanged from the 2019-2020 IRP modeling
  - Hourly generation profile: Used to model the dispatch behavior of the resource
    - The raw hourly generation profile data from NREL is collected for the 37 RESOLVE sample days and processed so that the profile shape remains the same but the capacity factor is representative of the annual average over the three historical years from which the 37 days were selected

1. Latest RESOLVE model release (3/23/2020) is available here: https://www.cpuc.ca.gov/General.aspx?id=6442464143

RESOLVE Transmission Assumptions for Offshore Wind

- For RESOLVE modeling additional information is needed on the transmission zone associated with each resource
  - Each resource is assigned to CAISO transmission deliverability zones
  - CAISO does not currently have transmission deliverability zones that coincide with the Cape Mendocino and Del Norte resource areas
    - Represented by the red stars in the image on the right

CAISO TX Deliverability Zones



Transmission zone assumptions contained in [IRP Inputs and Assumptions]

RESOLVE Transmission Assumptions for Offshore Wind

- For RESOLVE modeling additional data is needed on:
  - Available bulk transmission capacity required to deliver the resource to load
    - These values are readily available from the CAISO whitepaper
  - Data on cost of upgrades beyond this available capacity are also needed
    - Data for Northern California resources is limited
    - Potential sources may include:
      - Schatz Energy Research Center Study
      - WECC Transmission Cost Tool

CAISO TX Deliverability Zones Capability and Upgrade Costs

	Transmission capability estimates to support CPUC's IRP process								
	Estimated FCDS Capability (MW)				Incremental Upgrade Cost Estimate ($million)				Estimated EODS Capability** (MW)
	A		B				C		D
Transmission zones and sub-zones	Existing System	Minor Upgrades	Major Upgrade #1	Major Upgrade #2	Existing System	Minor Upgrades	Major Upgrade #1	Major Upgrade #2	Existing System
Northern CA	**2,000**		**2,000**				**$ 285**		**3,900**
- Round mountain	500								2,100
- Humboldt	-								100
- Sacramento River	2,000								4,600
- Solano	600		2,000				$ 322		1,300
Southern PG&E	**1,100**		**1,000**				**$ 55**		**TBD**
- Westlands	1,100		1,000				$ 55		TBD
- Kern and Greater Carrizo	1,000		1,500				$ 241		TBD
- Carrizo	400		700				$ 53		400
- Central Valley North & Los Banos	1,000		1,000				$ 274		TBD
Tehachapi	**4,300**	**1,000**				**$ 100**			**5,100**
Greater Kramer (North of Lugo)	600		400				**$ 146**		**600**
- North of Victor	300		400				$ 485		300
- Inyokern and North of Kramer	100		400				$ 485		100
- Pisgah	400		400				$ 261		400
Southern CA Desert and Southern NV	**3,000**		**2,800**				**$ 2,156**		**9,600**
- Eldorado/Mtn Pass (230 kV)	250		1,400				$ 76		2,400
- Southern NV (GLW-VEA)	700		1,400				$ 150		700
- Greater Imperial*	1,200		1,400				$ 2,334		3,100
- Riverside East & Palm Springs	2,950		1,500				$ 2,156		5,500

Transmission deliverability zones upgrade costs inputs are based on the [CAISO transmission whitepaper]

OFFSHORE WIND IN IRP PRODUCTION COST MODELING USING SERVM

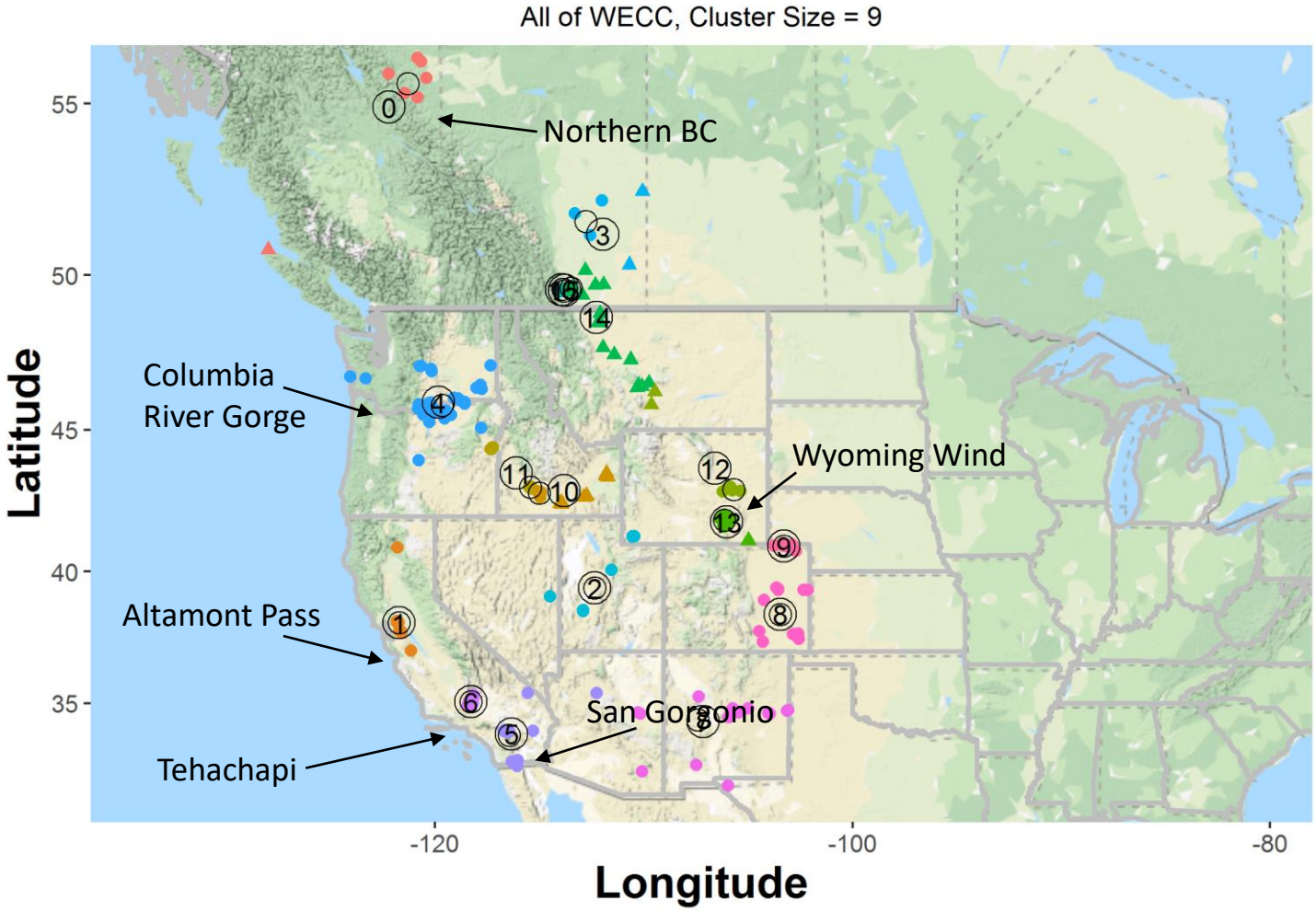
MERRA2 Wind Database

- CPUC Production Cost Modeling currently relies on MERRA2 database to inform its stochastic wind model
  - 1998 – 2017 hourly across Western US (continental) and Offshore
  - Will be replaced with Weather Researching and Forecasting Model (WRF) when that product is available
- MERRA2 is a reanalysis product
  - Based on numerical weather model
  - Informed by historical observations
  - WRF is newer product with higher spatial resolution and accuracy
- For land-based wind resources, clusters are formed around all wind resources, and wind profiles developed around them
  - Storing wind profiles at clusters reduces the number of wind profiles
- Offshore sites defined by NREL draft report

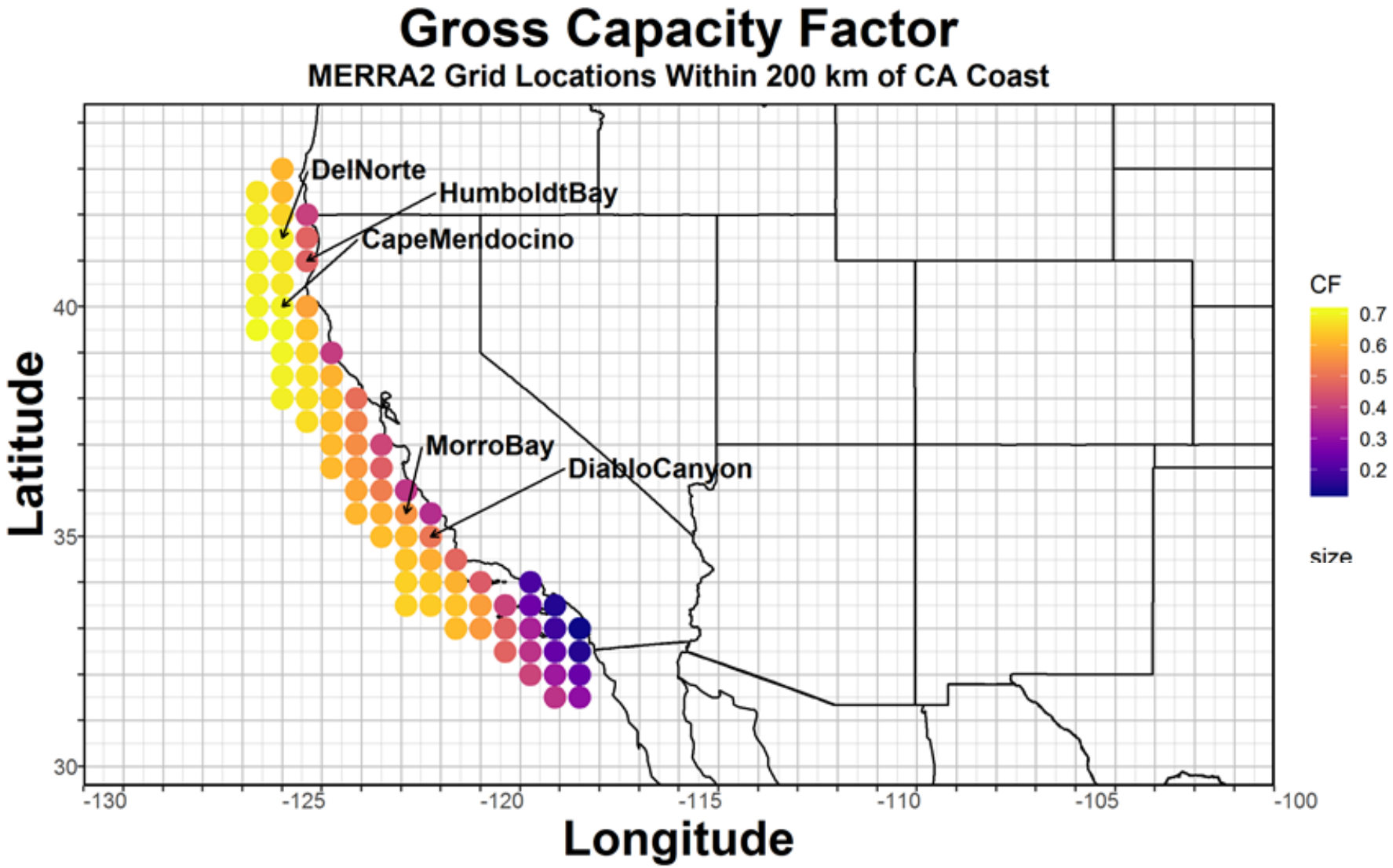
NASA Global Modeling and Assimilation Office (GMAO) https://gmao.gsfc.nasa.gov/reanalysis/MERRA-2/

Weather Research and Forecasting Model https://www.mmm.ucar.edu/weather-research-and-forecasting-model

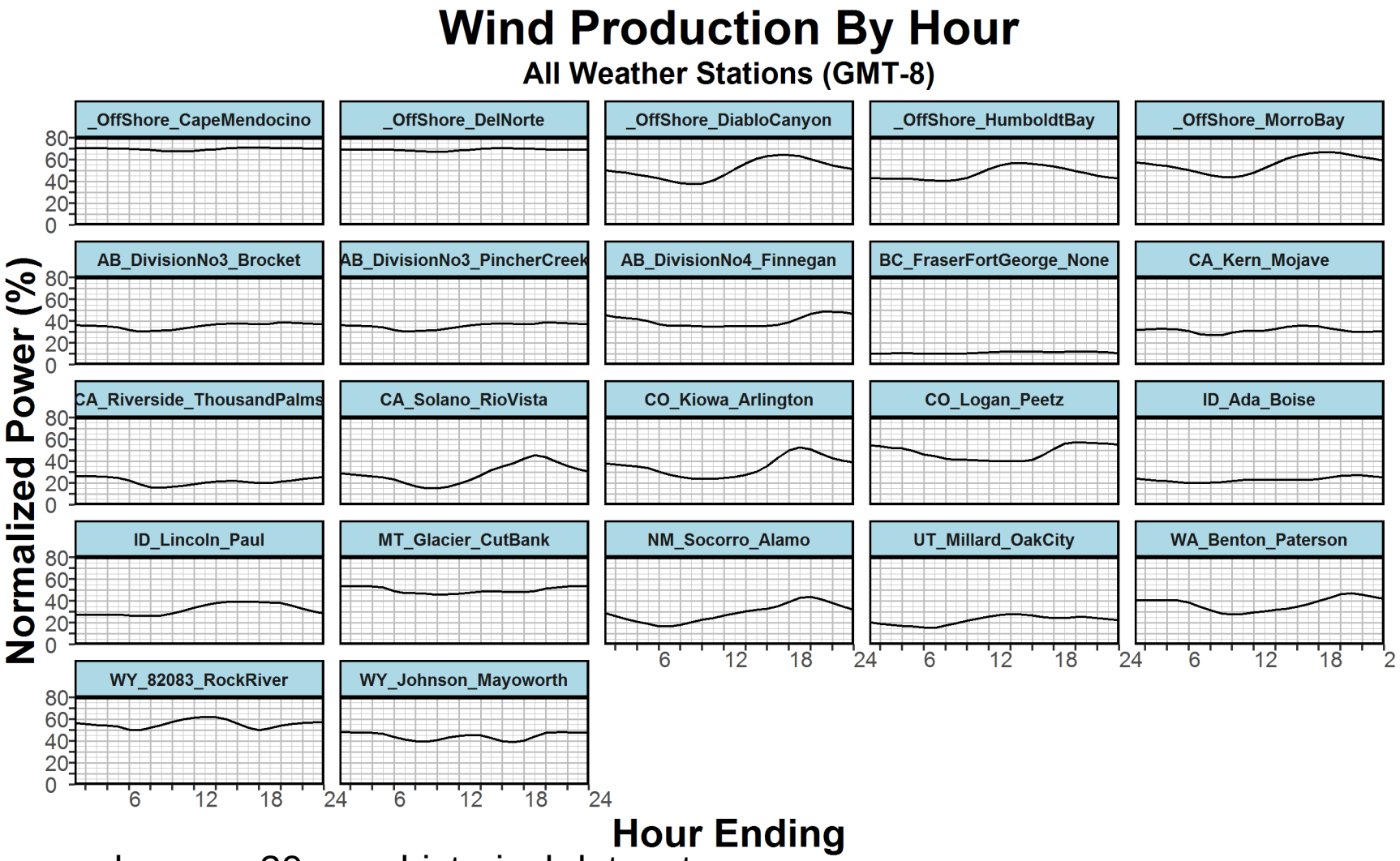
Onshore Wind Resources



- Each point represents a single wind resource in CPUC PCM
- Each circle represents a cluster of resources
- Offshore wind locations not represented here



- MERRA2 20 year hourly model (1998 – 2017)
  - based on approximately 50 km grid
- Uses power function (m/s to % nameplate) calibrated using CAISO data
- 5 NREL locations indicated



- Averaged across 20 year historical dataset
- Normalized power is % of Nameplate
- 5 NREL Offshore locations: Top Row

Comparing Gross Capacity Factor

	Gross Capacity Factors (%)				
	Site 1 - Morro Bay	Site 2 - Diablo Canyon	Site 3 - Humboldt Bay	Site 4 - Cape Mendocino	Site 5 - Del Norte
WRF, 2019	55.28	54.6	59.32	61.59	61.05
MERRA, 1998 - 2017	55.93	50.79	47.00	69.64	68.84

- Reasonable agreement
- MERRA2 significantly higher for Sites 4-5
- Differences may come from:
  - Different underlying wind speeds
  - Differences in power function (converts m/s to % power) as well as calibration

WRF result is taken from NREL Draft Report Table 12. Gross Capacity Factors, Losses, and Net Capacity Factors for California Study Areas

CPUC Wind Model

- We will be replacing with WRF as soon as it becomes available
  - In order to work with CPUC Production Cost Model it requires WRF hourly across WECC footprint as well as offshore
- In the meantime CPUC model is able to examine resources located at NREL offshore points using MERRA2
- Reasonable agreement with NREL draft report for offshore sites

CONCLUSION

Conclusion

- Next steps
  - Peer review of NREL's draft report
  - Publication of NREL's report
  - Continued preparation of IRP capacity expansion modeling (RESOLVE) and production cost modeling (SERVM) to utilize NREL's results
- With stakeholder feedback, potential for offshore wind to be a default candidate resource in IRP modeling

Further information

- Thank you for your participation. If you have any questions following the webinar please contact:
  - Neil Raffan: 415.703.2013 Neil.Raffan@cpuc.ca.gov
  - Karolina Maslanka: 415.703.1355 Karolina.Maslanka@cpuc.ca.gov
  - David Miller: 415.703.1146 David.Miller@cpuc.ca.gov

Important links:

IRP Events and Materials