



California Offshore Wind Energy: A Personal Vision

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**BOEM Offshore Renewable Energy
Workshop**
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Acknowledgements

- Contributors
 - Aubryn Cooperman
 - Henry Shiu
- Funding
 - California Energy Commission

Outline

- Introduction
- California Energy Future
- California Offshore Wind Power Forum 2013
- Final Observations - California Offshore Wind Power



Source: Mayda

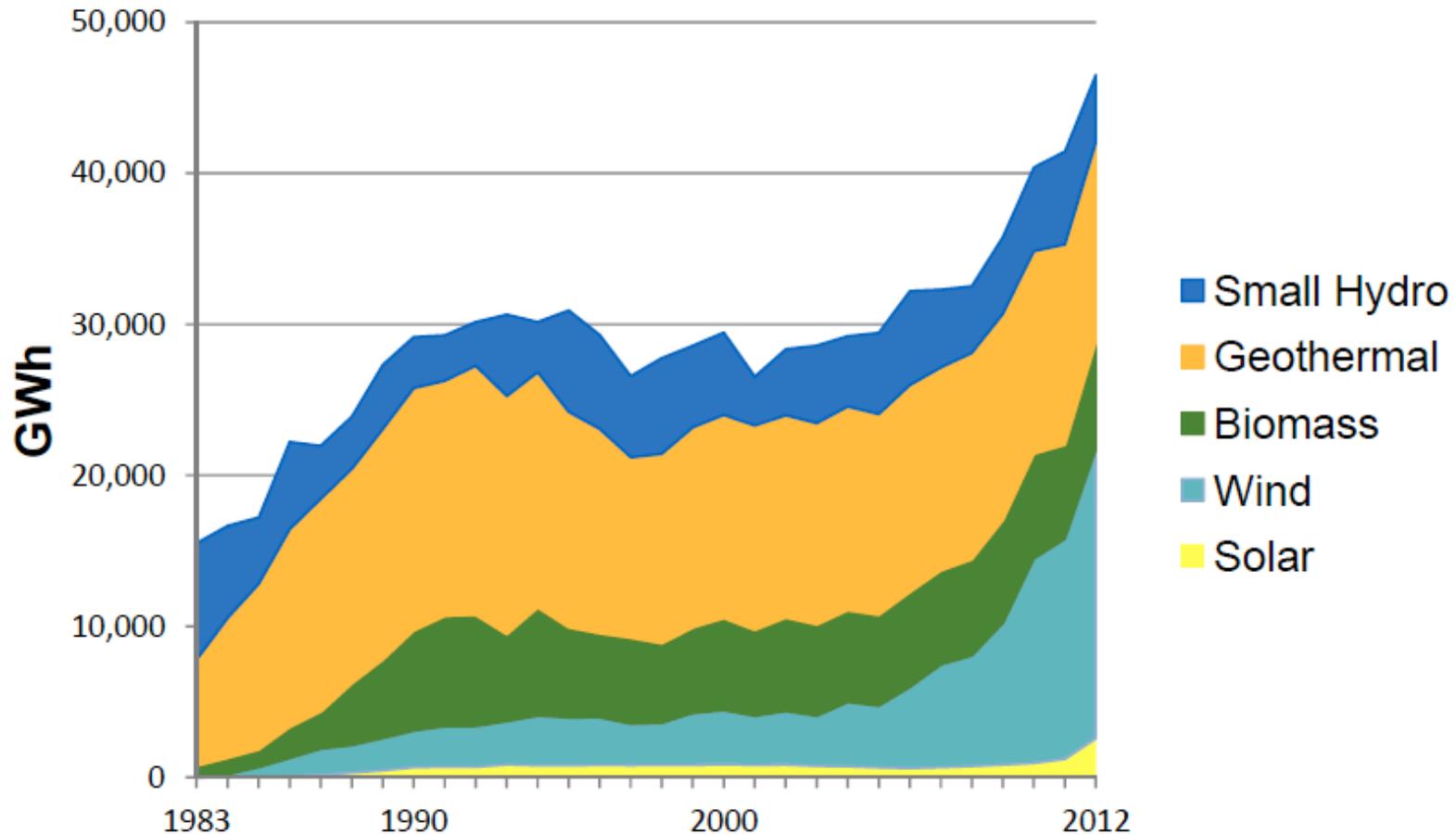
California Energy Future

- Renewables Portfolio Standard - 33% by 2020
- Once-Through-Cooling Restrictions
- San Onofre Nuclear Generation Station (SONGS) Replacement
- AB-32 GHG Initiative
- 50% RPS?

2020 33% RPS

- California has an aggressive Renewables Portfolio Standard (RPS). This standard requires all utilities to adopt the following RPS targets:
 - An average of 20% of retail sales from renewables in 2011-2013.
 - 25% by the end of 2016.
 - 33% by the end of 2020.
 - No less than 33% per year after 2020.
- In 2012, California served about 22% of retail electricity sales from facilities using renewable energy sources such as wind, solar, geothermal, biomass, and small hydroelectric.
- The CEC estimates that this electricity was generated from about 12,300 MW of wholesale generation and 1,600 MW of self-generation.
- CA operating renewable energy capacity grew from 14,100 MW in 2012 to 17,400 MW in 2013.
- On track to meet or exceed 33% RPS by 2020
 - + rooftop PV - 5%
 - + large hydro - 13%

CA Renewable Generation Trend 1983-2012



- *Not counting large hydro*
- *In-state and out-of-state*
- *Total CA electric generation in 2012 was 302 GWh*

CA Renewable Resource Type

December 31, 2013

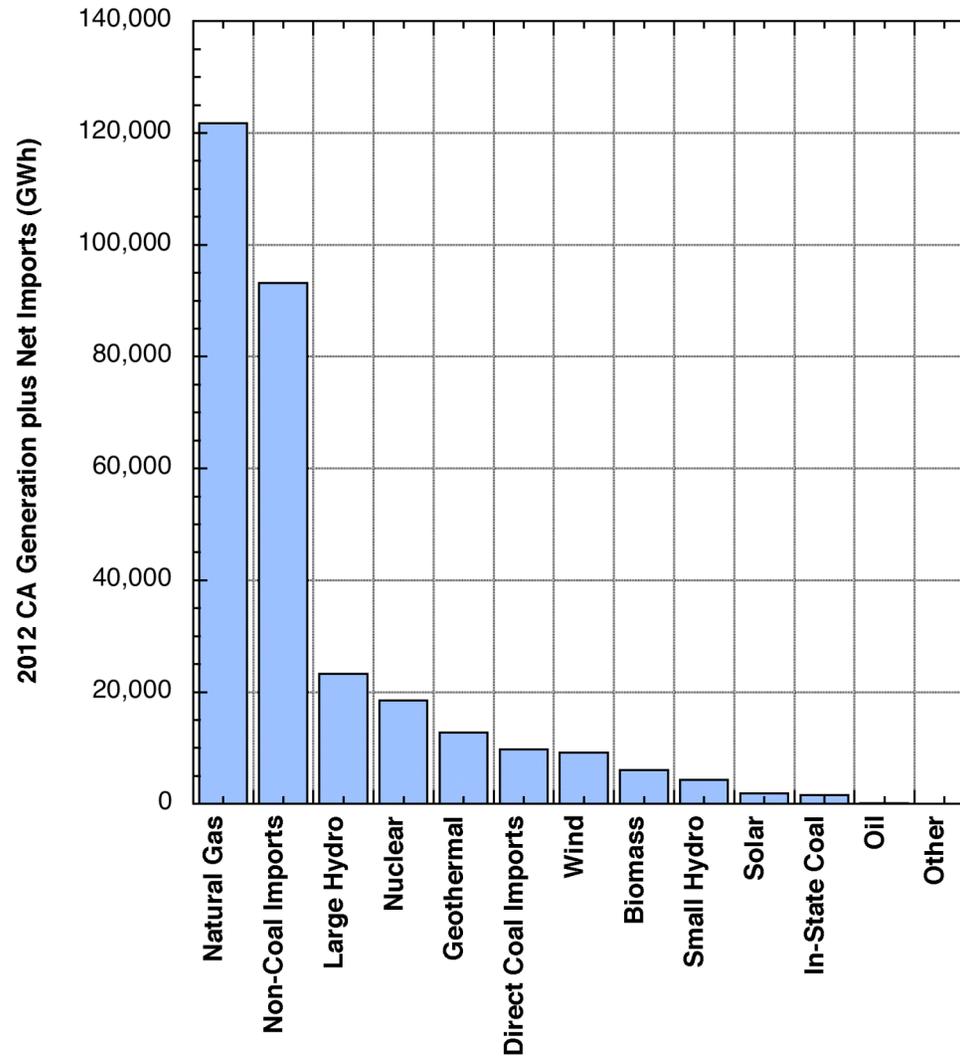
Renewable Capacity	Biomass (MW)	Geothermal (MW)	Small Hydro (MW)	Solar PV (MW)	Solar Thermal MW	Wind (MW)	Total Renewable (MW)
California	1,100	2,700	1,600	2,700	900*	5,700	14,700
Out-of-State	-	100	-	400		300	800
Grand Total	1,100	2,800	1,600	3,000	900	6,000	15,500

Source: California Energy Commission based on Quarterly Fuel and Energy Report, source [8], CPUC RPS contract database [D1], and POU S-2 and S-5 Forms for 2013 [D2].

* Includes 370 MW from Ivanpah Solar Units 1 through 3, even though they technically did not start selling power under their PPA until the first few weeks of January 2014.

Note: Totals may not sum due to rounding. Additional information about the data is provided in the notes for Table 2.

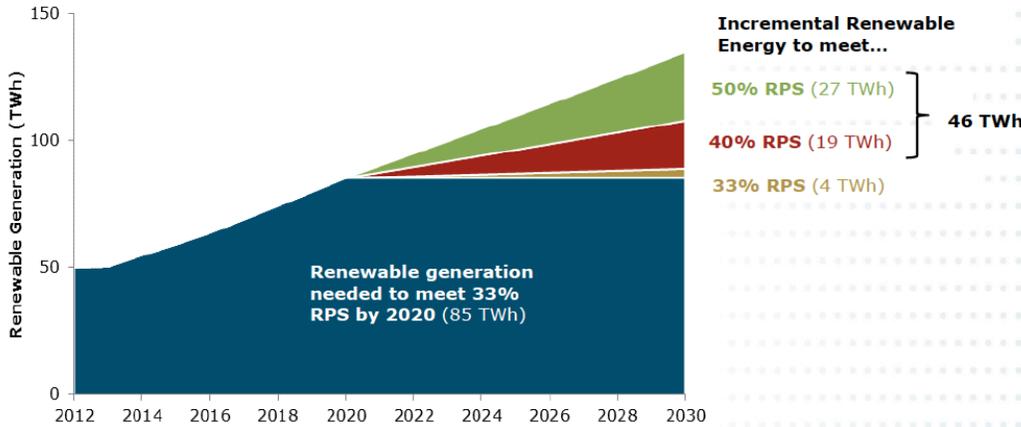
California Electric Energy Generation Mix, 2012



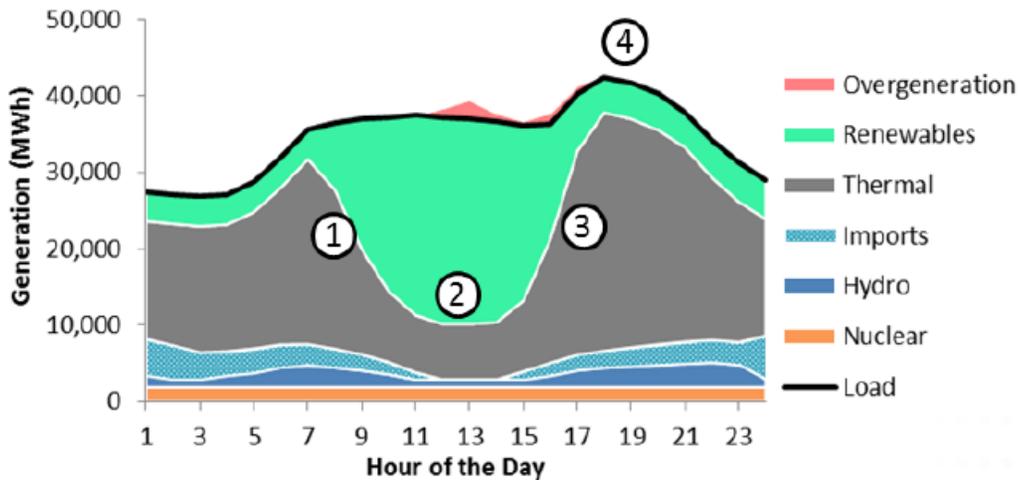
50% RPS Provides New Challenges

- California does not yet have operating experience with 33% renewables
- No other country or state appears to have achieved an equivalent RPS above 33%:
 - Germany: 22% renewables in 2012
 - 7.4% wind, 4.5% solar
 - Spain: 24% renewables in 2012
 - 18% wind, 4% solar
 - Denmark: 30% wind in 2012
 - Assisted by interconnections to Germany and Norway
- Norway, New Zealand, British Columbia achieve higher renewable penetrations with large hydro which does not count towards RPS in California

50% RPS Integration Challenges



1. Downward ramping capability
Thermal plants to serve load at night ramped down to deal with influx of solar after sunrise
2. Minimum generation flexibility
Thermal resources must have lower minimum generation levels to minimize overgeneration
3. Upward ramping capability
Thermal resources must have quick start up and ramp up capabilities to deal with sundown loss in solar and peak load
4. Peaking capability
System must be capable to meet reliably peak loads
5. Sub-hourly flexibility
System flexibility needed to meet sub-hourly ramping



50% RPS Study Conclusions & Recommendations

- 50% RPS does not face major technical hurdles
- May lead to overgeneration conditions during daylight hours
- May lead to higher electricity rates
- Solutions to mitigate operational challenges and reduce cost:
 - Increase regional coordination - sharing of flexible resources across WECC territory
 - Develop diverse portfolio of renewable resources
 - Implement long-term, sustainable solutions to address overgeneration
 - Implement distributed generation solutions

California Offshore Wind Power Forum 2013

June 11 & 12, 2013

University of California - Davis

Davis, California

The University of California, Davis and the California Energy Commission hosted a two day symposium to explore the future of offshore wind power off the coast of California. The Forum featured four panels of expert speakers discussing regulatory, environmental, technical, and economic challenges and opportunities. Drawing upon experience from overseas, other states, and other industries, they looked at how California can effectively and responsibly proceed to harness the abundant winds off its shores.

The proceedings of the Forum, including presentations are available at:
<http://cwec.ucdavis.edu/presentation/california-offshore-wind-power-forum/>

California Offshore Wind Power Forum - Program

Tuesday, 11 June 2013

8:00 a.m.	Registration and Continental Breakfast
8:30 a.m.	KEYNOTE Joan Barminski, <i>Bureau of Ocean Energy Management</i>
9:30 a.m.	Regulatory Issues for Offshore Wind Power MODERATOR: David Hochschild, Commissioner, California Energy Commission Holly Wyer, <i>California State Lands Commission</i> William Toman, <i>Pacific Marine Renewables</i> Aviv Goldsmith, <i>Fishermen's Energy</i> David White, <i>National Marine Fisheries Service, NOAA</i> Matthew Armsby, <i>Resources Law Group</i>
12:30 p.m.	Lunch
1:30 p.m.	Offshore Wind Power and the California Coastal Environment MODERATOR: David Stoms, California Energy Commission Andrea Copping, <i>Pacific Northwest National Laboratory</i> David Pereksta, <i>Bureau of Ocean Energy Management</i> Scott Terrill, <i>H.T. Harvey & Associates</i> Melinda Dorin Bradbury, <i>Independent Consultant</i>
5:00 p.m.	RECEPTION Provided by the Warren and Leta Giedt Endowment

California Offshore Wind Power Forum - Program

Wednesday, 12 June 2013

8:00 a.m.	Continental Breakfast
8:30 a.m.	KEYNOTE Huub den Rooijen, <i>The Crown Estate (via video conference)</i>
9:30 a.m.	Offshore Wind Energy Technologies for the California Coast MODERATOR: John Hingtgen, California Energy Commission Leslie Rosenfeld, <i>Central and Northern California Ocean Observing System</i> Walt Musial, <i>National Renewable Energy Laboratory</i> Kevin Banister, <i>Principle Power, Inc.</i> Jay Edgar, <i>PelaStar, The Glosten Associates</i> Mirko Previsic, <i>Re Vision Consulting, LLC</i>
12:30 p.m.	Lunch
1:30 p.m.	Economic Outlook and Infrastructure Needs MODERATOR: Michael Sokol, California Energy Commission Andy Wickless, <i>Navigant Consulting</i> Chris Elkinton, <i>GL Garrad Hassan</i> Christopher Morris, <i>Massachusetts Clean Energy Center</i> Jim Lanard, <i>Offshore Wind Development Coalition</i>

California Offshore Wind Power Forum Takeaways - General

- Internationally, offshore wind power is growing fast with roughly 5 GW capacity installed, almost all in shallow water.
- The Department of Energy (DOE) and Department of Interior's National Offshore Wind Strategy includes the following goals:
 - 10 GW deployed by 2020 at \$0.10 per kWh
 - 54 GW deployed by 2030 at \$0.07 per kWh
- First commercial projects in the United States are moving forward on the East Coast. Cape Wind is approaching construction.
- California contains a sizable offshore wind resource which could provide 661 TWh annually.

California Offshore Wind Power Forum

Takeaways - Regulatory Issues

- California's regulatory process is complex and lengthy, involving numerous federal, state, and local agencies and a wide array of stakeholders.
- The Bureau of Ocean Energy Management (BOEM), a federal agency, is the lead for offshore leasing in federal waters (in general, more than three nmi beyond shore).
- At the state level, a number of agencies would be involved including the State Lands Commission, the Ocean Protection Council, and Fish and Wildlife.
- As part of their "Smart from the Start" initiative, BOEM facilitates working with state and local agencies by establishing interagency state task forces.
 - Twelve state task forces have been established so far, including Oregon and Hawaii, but not California.
 - To establish a task force, the state governor's office must initiate contact with BOEM.
 - Experience from past efforts with marine protected areas in California can be applied to marine spatial planning today.
- Regulatory and permitting lessons and best practices can be gleaned from Europe and the East Coast.

California Offshore Wind Power Forum

Takeaways - Technology Issues

- California's deep waters will require floating platforms for wind turbines. This technology is still in the prototype stage.
- Floating platforms have converged upon three primary configurations.
- Two full-scale wind turbines have been deployed on floating platforms. A number of reduced-scale floating turbines have also been demonstrated.
- Principle Power has received DOE funding toward development of a floating wind power demonstration project off the Oregon coast.

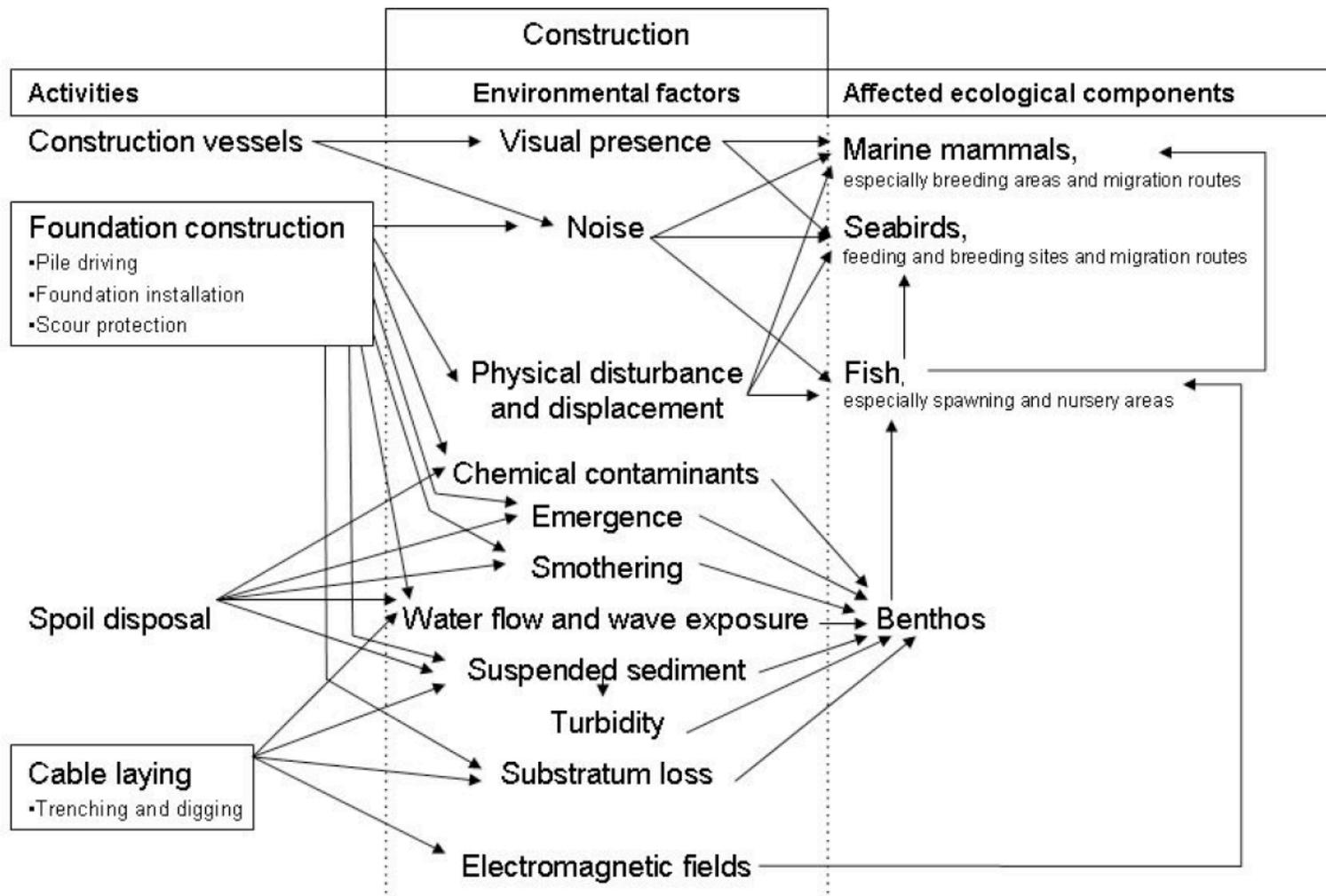
California Offshore Wind Power Forum

Takeaways - Environmental Issues

- Environmental baseline data is needed for potential offshore wind energy development areas, including information on coastal processes, birds, fish, marine mammals, noise, and electromagnetic fields.
- Pacific Northwest National Laboratory maintains TETHYS, a database of potential environmental impacts from offshore wind development.
- Studies are ongoing to address information gaps; many opportunities for collaboration.
- California can leverage experience from the state's earlier efforts with assessing wave energy.

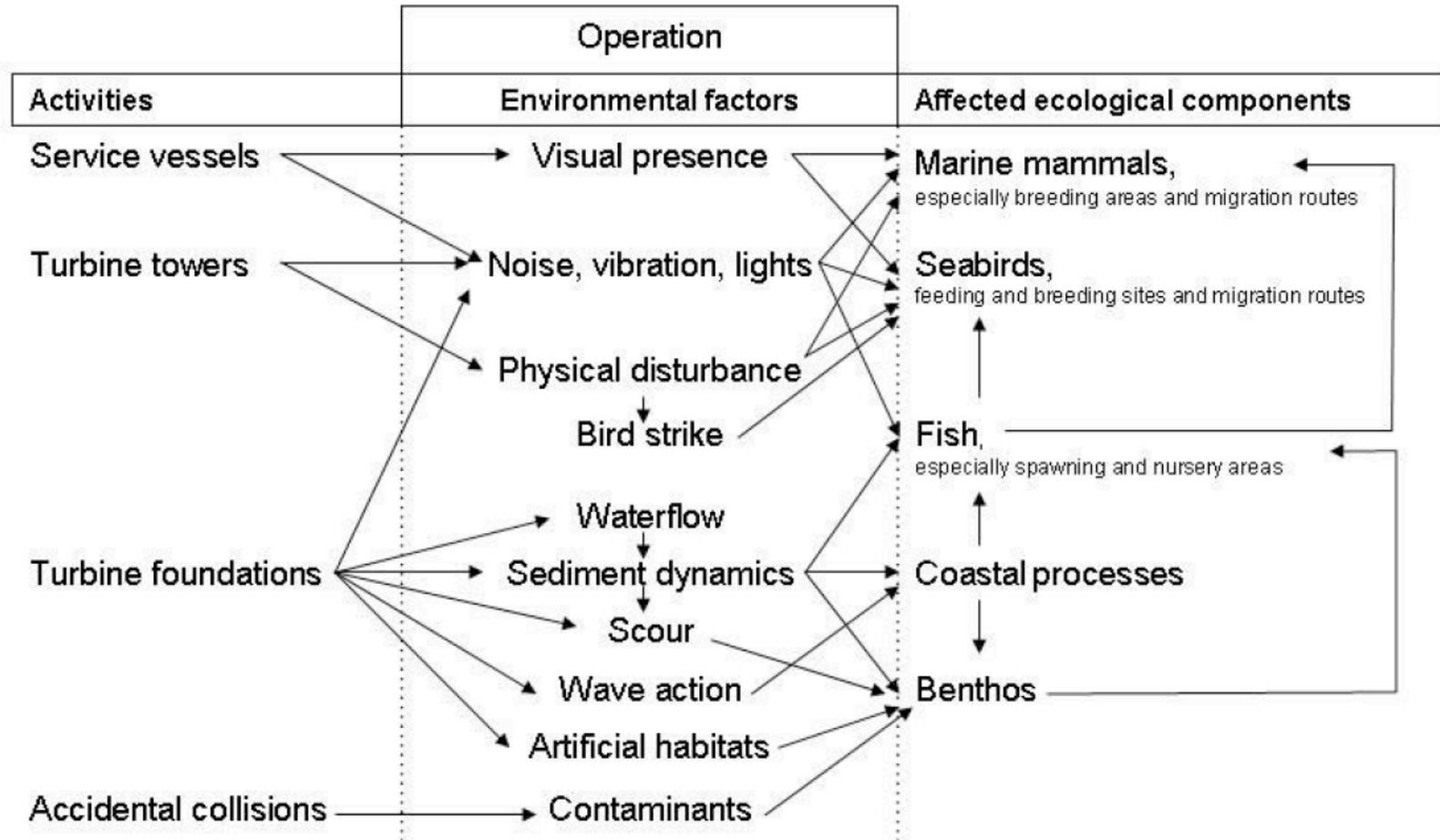
Environmental Impacts: Construction

Van der Wal et al., WindSpeed, 2009



Environmental Impacts: Operation

Van der Wal et al., WindSpeed, 2009



Marine Development Parties in CA

Selected agencies

- Bureau of Ocean Energy Management
- California Governor's Office
- California Energy Commission
- California Public Utilities Commission
- California Fish and Wildlife
- U.S. Fish and Wildlife
- National Oceanic and Atmospheric Administration
 - National Marine Fisheries Services
 - National Marine Sanctuaries
 - Office of Ocean and Coastal Resource Management
- California State Lands Commission
- California State Parks
- National Park Service
- U.S. Defense Department
 - Army
 - Navy
 - Air Force
 - Coast Guard
- Ocean Protection Council
- California Coastal Commission
- Federal Energy Regulatory Commission
- County agencies

Final Observations - California Offshore Wind Power

- Great Opportunity
 - Bountiful energy resource
 - Near load centers
 - Benefits from extensive onshore technical and regulatory experience
 - Leverage experience from other industries
 - Oil and gas industry
- Great Challenge
 - Young industry
 - Costs are currently high
 - Lack of established infrastructure
 - Coastal facilities
 - Ships
 - Cost challenges
 - Larger turbines
 - Deep water /floating platforms
 - Maintenance
 - New environmental considerations
 - Complex regulatory process with limited experience

Final Observations - California Offshore Wind Power

- Future of California offshore wind power depends on:
 - California's Renewables Portfolio Standard > 2020 - 50%?
 - Willingness of industry to deal with many regulatory hurdles facing offshore renewable power development in California
 - Cost of offshore renewable energy compared to land-based renewables; particularly solar PV

Thank You!

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