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Marine Renewable Energy: How can we have our orcas and low carbon energy?

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Northwest Straits Commission
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Bellingham WA



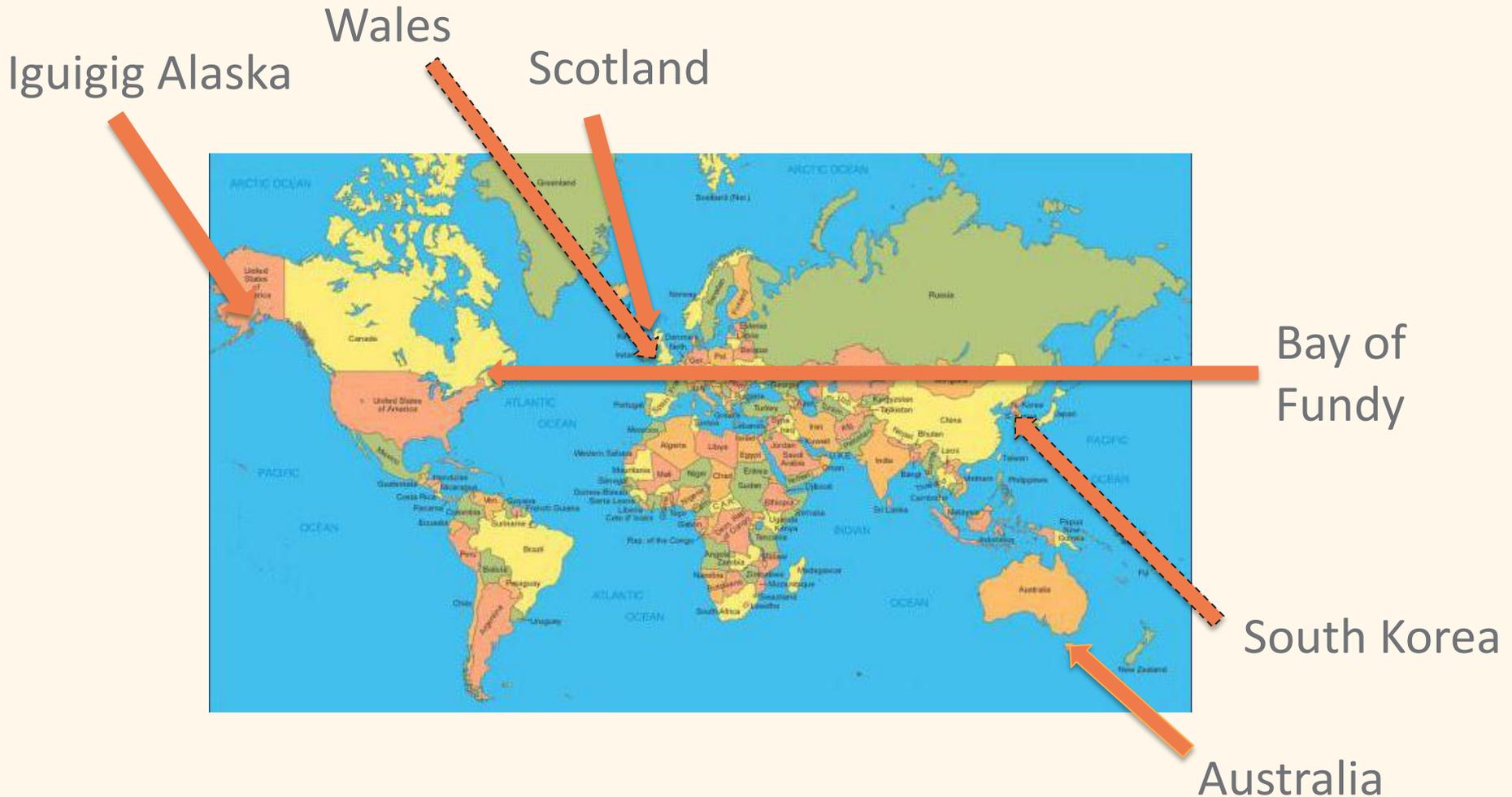
Today.....

- ▶ What can we learn from other parts of the world?
- ▶ What progress have been made of getting devices in the water?
- ▶ How have we progressed on understanding environmental effects?
- ▶ Can we safely deploy and operate small numbers of wave, tidal, offshore wind devices?
- ▶ What about larger commercial arrays?





Tidal and Riverine Testing and Development



Wave Energy Testing and Development





Offshore Wind Development

Rhode Island

All over Europe,
esp. UK, Denmark,
Germany

China

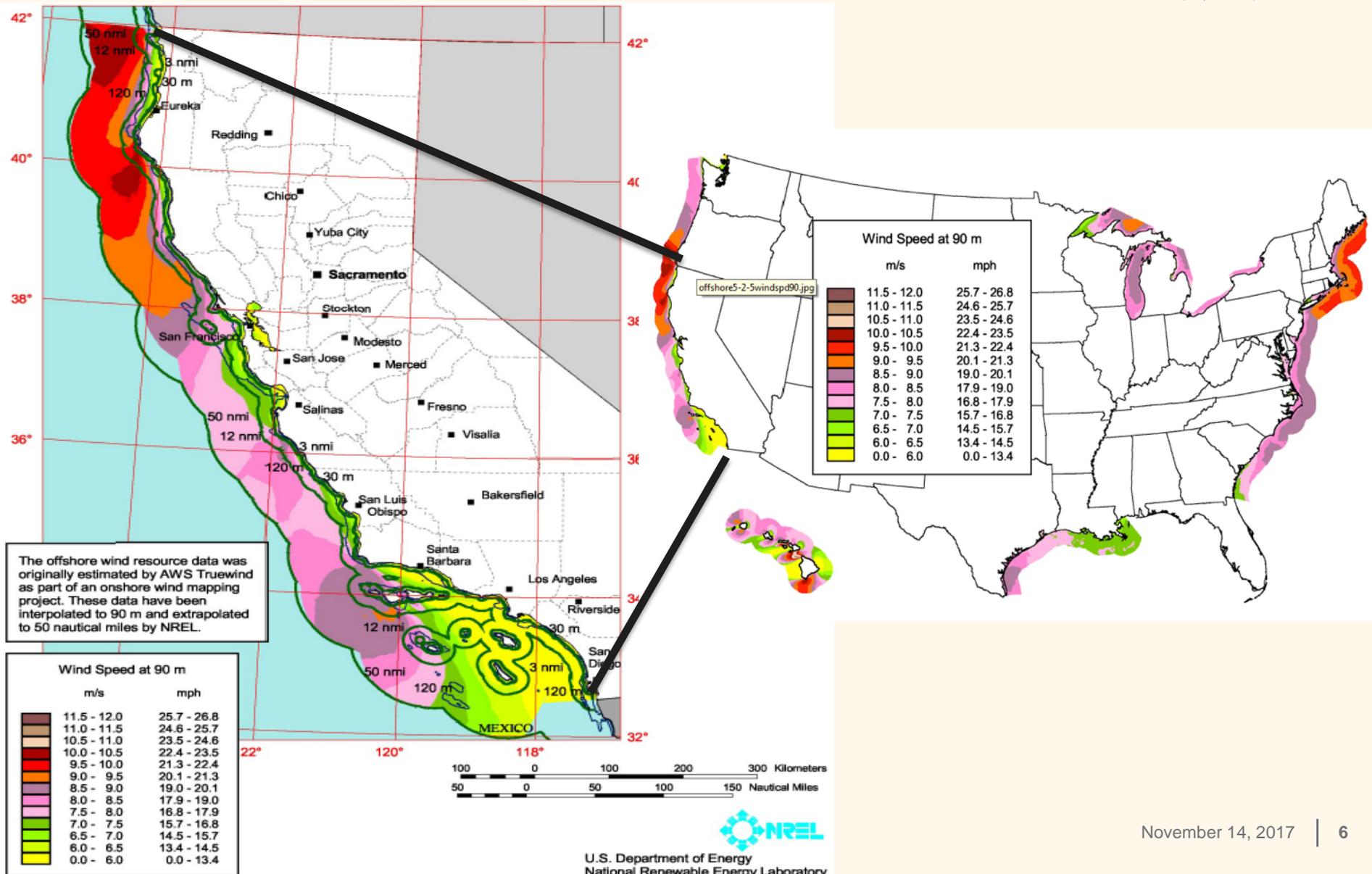


Offshore Wind Resources on the West Coast



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What have we learned (MRE and OSW)?

- ▶ Very challenging environment to test, deploy, maintain, recover devices.
- ▶ Very expensive to develop technologies, work at sea.
- ▶ Small scale tests (tanks and sheltered water) have helped, but it is not enough.
- ▶ Supply chain does not exist.
- ▶ Permitting still a real challenge, due to:
 - Novelty of technologies;
 - Uncertainty of potential environmental effects; and
 - Suspicion of social and economic risks (and also benefits).



Environmental Effects – what do we know?

- ▶ Information gathered from laboratory, modeling, and field studies
- ▶ Still little data from monitoring around deployed full scale devices
- ▶ Knowledge pieced together from different parts of the world
- ▶ Collection of that information (metadata) on *Tethys*
- ▶ Comprehensive look in 2016 (SoS)
- ▶ More recent literature review shows little change in current understanding of risks

The screenshot shows the Tethys website interface. At the top, there is a navigation bar with links for 'ABOUT', 'TETHYS CONTENT', 'CONNECTIONS', 'BROADCASTS', and 'HELP'. A search bar is located on the right. Below the navigation bar is a large banner image of orcas with the text 'The Annex IV 2016 State of the Science report is available here.' Below the banner, there is a description of Tethys as a knowledge management system. The main content area is divided into four tiles: 'Marine Energy' (Generating electricity from the sea), 'Wind Energy' (Generating electricity from wind on land and at sea), 'Annex IV' (Addressing environmental effects of marine energy internationally), and 'WREN' (Resolving conflicts between wind and wildlife internationally). To the right of these tiles is a 'NEW USER' button and a 'KNOWLEDGE BASE' section. At the bottom, there is a contact form and social media icons.

<https://tethys.pnnl.gov>



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2016 Annex IV State of the Science Report

ENVIRONMENTAL EFFECTS OF MARINE ENERGY DEVELOPMENT AROUND THE WORLD

<http://tethys.pnnl.gov/publications/state-of-the-science-2016>



Collision with Tidal Turbines

- ▶ Animals considered to be at potential risk include:
 - marine mammals
 - fish
 - diving seabirds
- ▶ Lack of observations
- ▶ Observation technologies not well developed, difficult to operate
- ▶ Quantitatively estimate number of animals in area of turbines, understand capability to sense and evade devices
- ▶ We look at individual animals; need to extrapolate to populations.



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PUBLIC REVIEW DRAFT

3.0 Collision Risk for Animals around Tidal Turbines



The potential for marine animals to collide with the moving parts of tidal devices, particularly the rotors of horizontal-axis tidal-stream turbines, is a primary concern for consenting/permitting and licensing of tidal developments. The importance of this issue, associated definitions, and the need to understand collision risk in general, and for mammals, fish, and seabirds, in particular, are discussed in the following sections.

Chapter authors: G. Zydlewski, G. Staines, C. Spirling, E. Masden, J. Wood

3-1 IMPORTANCE OF THE ISSUE

Animal interactions with tidal turbines is an active area of research because many questions remain today and ecological consequences are still mostly implied by expert opinion (Brusch et al. 2015). Most recently, applications of risk frameworks and collision risk modeling (Barnes-Gower and Hutchinson 2014; Hammar et al. 2015) has greatly informed research directions including the need to assess risk to populations with respect to environmental change associated with climate (Brusch et al. 2015).

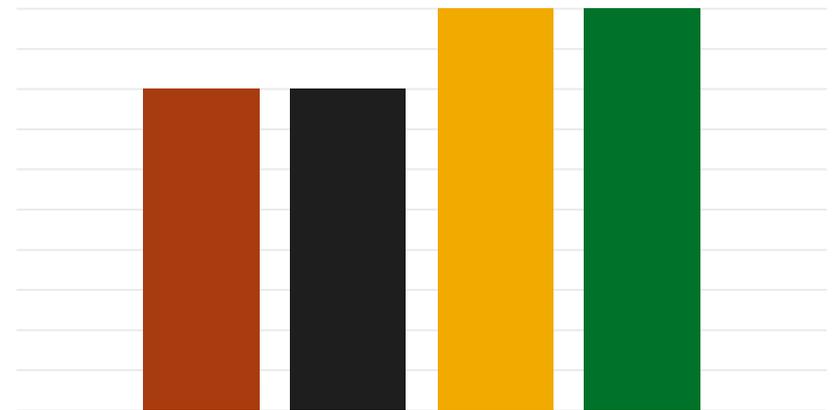


PUBLIC REVIEW DRAFT





Collision Risk (tidal) - Dashboard



- Increased sharing of existing information
- Improved modeling of interaction
- Monitoring data needed to verify findings
- New research needed

Copping, A.; Kramer, S.; Sather, N.; Nelson, P. (2017) Pacific Region Marine Renewables Environmental Regulatory Workshop Report.



Other Environmental Topics

- ▶ Offshore wind
 - Collision risk
- ▶ Wave and Tidal:
 - Effects of underwater sound from wave and tidal devices on marine animals
 - Effects of EMF on animals
 - Changes in benthic habitat, reefing of fish around devices
 - Changes in physical changes (WQ, ecosystem changes)
 - Marine Spatial Planning
 - Case studies of permitted projects: lesson learned
 - Path forward for getting through permitting



Social and Economic Challenges and Benefits

- ▶ To move towards commercial scale MRE development, we need:
 - Infrastructure for transport, deployment, maintenance, maybe manufacturer
 - But also for worker housing, schools, road improvements, worker training

- ▶ Risks include competition with existing uses, especially:
 - Fishing (commercial and recreational)
 - Shipping and shipping lanes
 - Conservation areas
 - Security and safety (DoD and USCG)
 - Recreational boating
 - Aesthetics – viewsheds, etc.

- ▶ Benefits are jobs!



Likely three causes (and solutions):

1. Lack of awareness of what is known
 - Need strong outreach and engagement program
2. Concerns about applying information from one location or jurisdiction to another
 - Data Transferability and Collection Consistency (2018 Annex IV thrust)
3. Need for new research
 - Coordinated strategic research studies

If you would like to know more:



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- ▶ Visit *Tethys* (<https://tethys.pnnl.gov>)
- ▶ Sign up for webinars, Tethys Blasts (every 2 weeks)
- ▶ Annex IV is international collaboration of 12 nations (Canada, China, Denmark, Ireland, Japan, Norway, Portugal, South Africa, Spain, Sweden, UK, US).
- ▶ Annex IV has sponsored:
 - quarterly webinars,
 - expert forums,
 - workshops on:
 - collision risk,
 - management measures for wave and tidal development,
 - information needs for social and economic benefits and risks.
- ▶ All archived on *Tethys*



November 14, 2017

Thank you!

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I would like to thank my very talented research team at PNNL, Aquatera Limited, the Annex IV and OES representatives, DOE's Water Power Technologies Office, the many marine energy developers and researchers around the world.



Energy Efficiency &
Renewable Energy

