

Tidal Power in Alaska

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FAIRBANKS

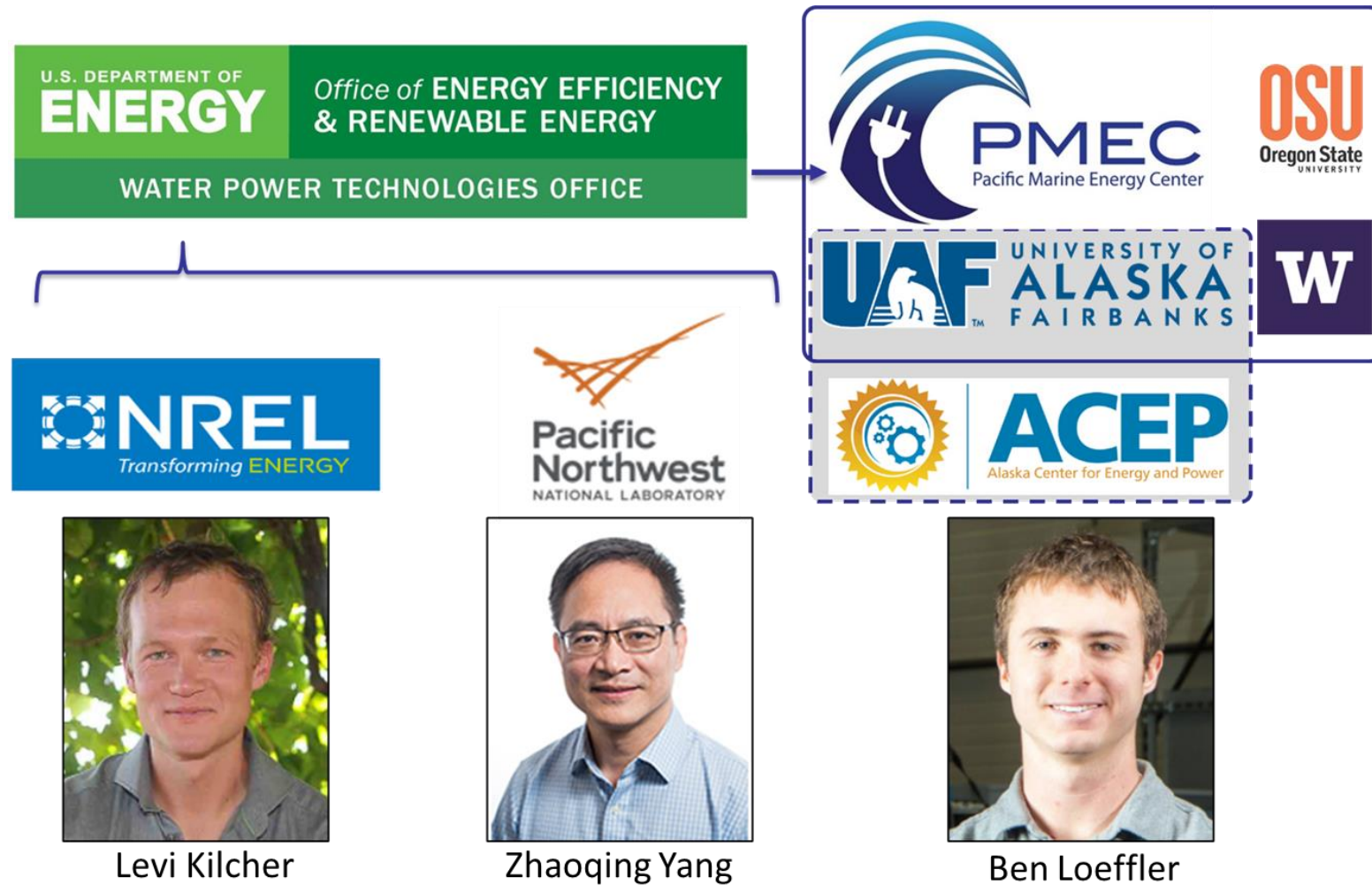
Oregon State
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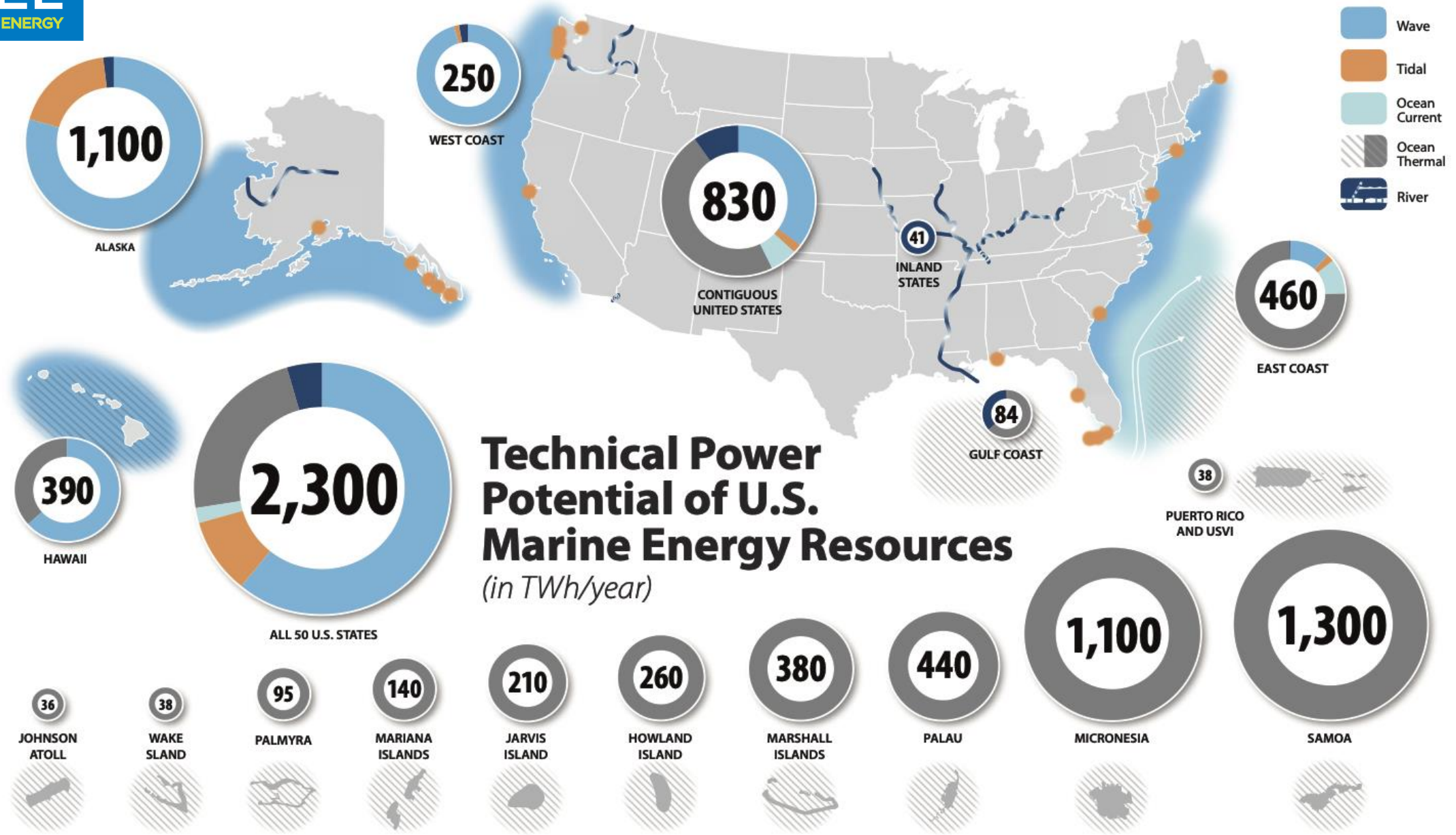
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Outline

- Alaska Marine Energy Overview
- Cook Inlet Tidal Focus
- Tidal technology overview
- NREL and PNNL Work
- ACEP/UAF Work (PMEC)
- Cook Inlet Tidal Energy Working Group
- Activities/opportunities

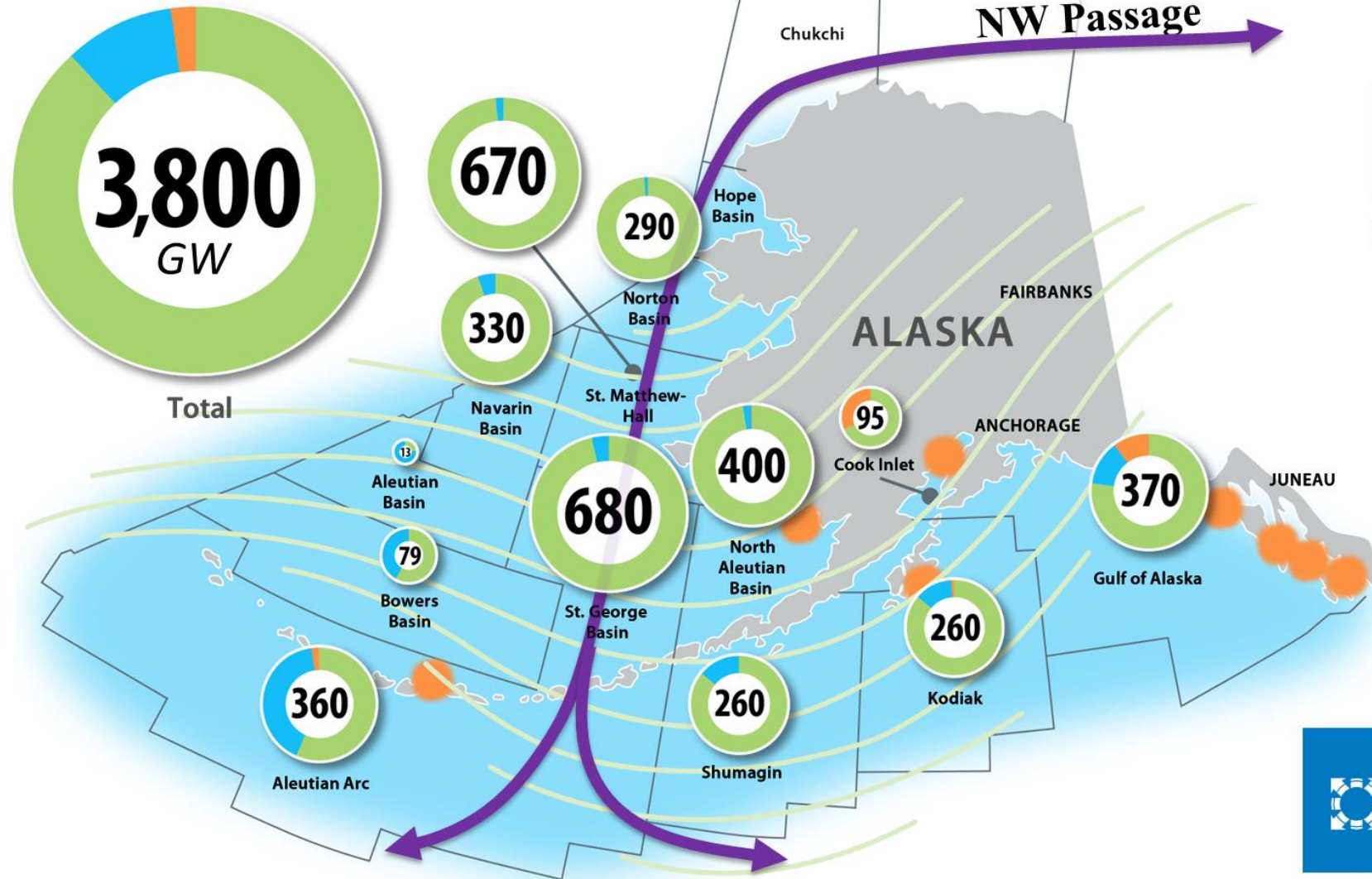
Tidal Space – DOE Research Efforts Intro





Technical Power Potential of Alaska Marine Energy Resources

(in GW)



BOEM
BUREAU OF OCEAN ENERGY MANAGEMENT

NREL
Transforming ENERGY

Cook Inlet Tidal Energy

- 18 GW Resource: ~30x Railbelt load
- Infrastructure – platforms, shoreside
- ‘Blue Economy’ expected to double to \$3T by 2030
- What will Alaska’s role be?

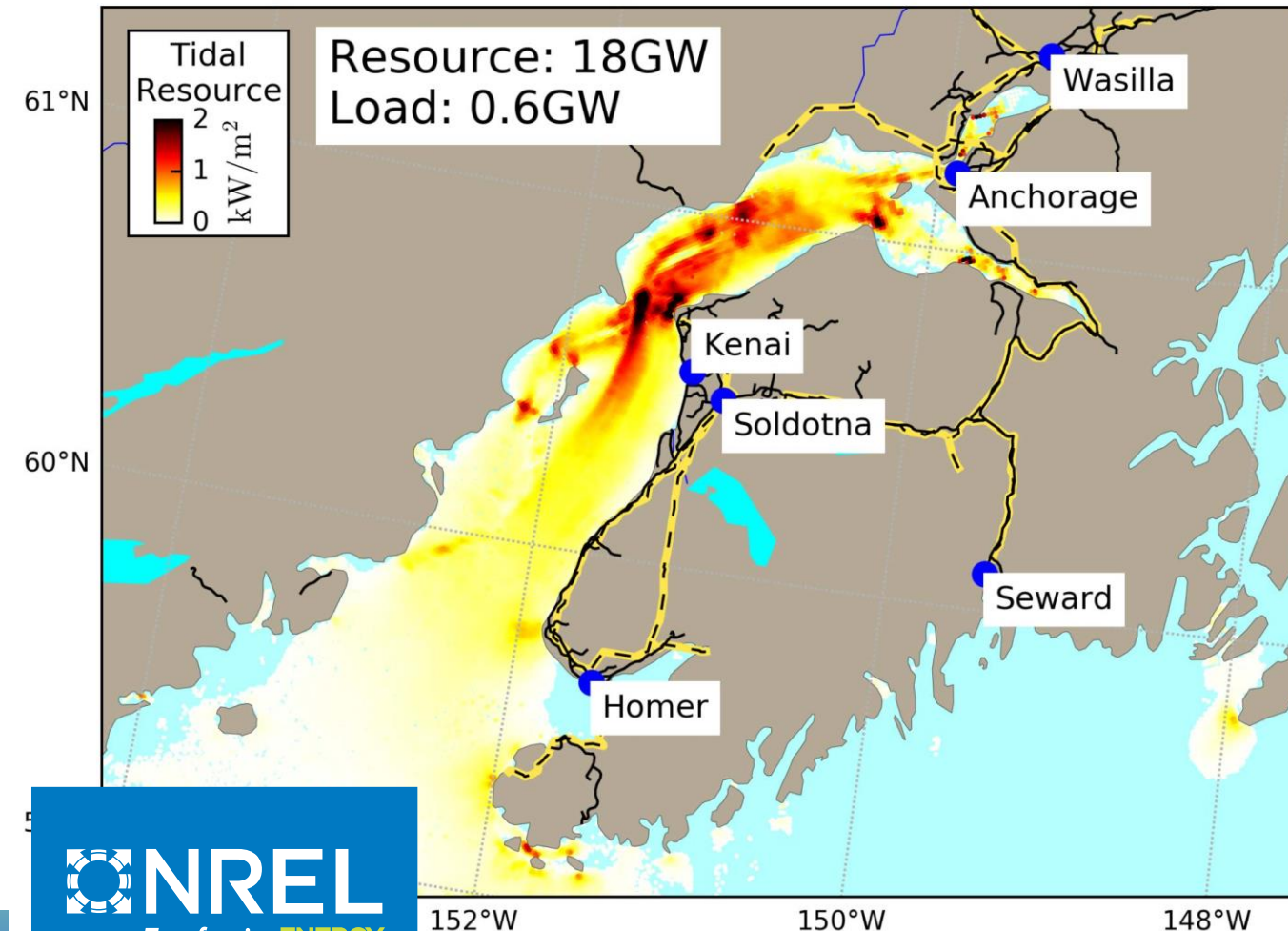
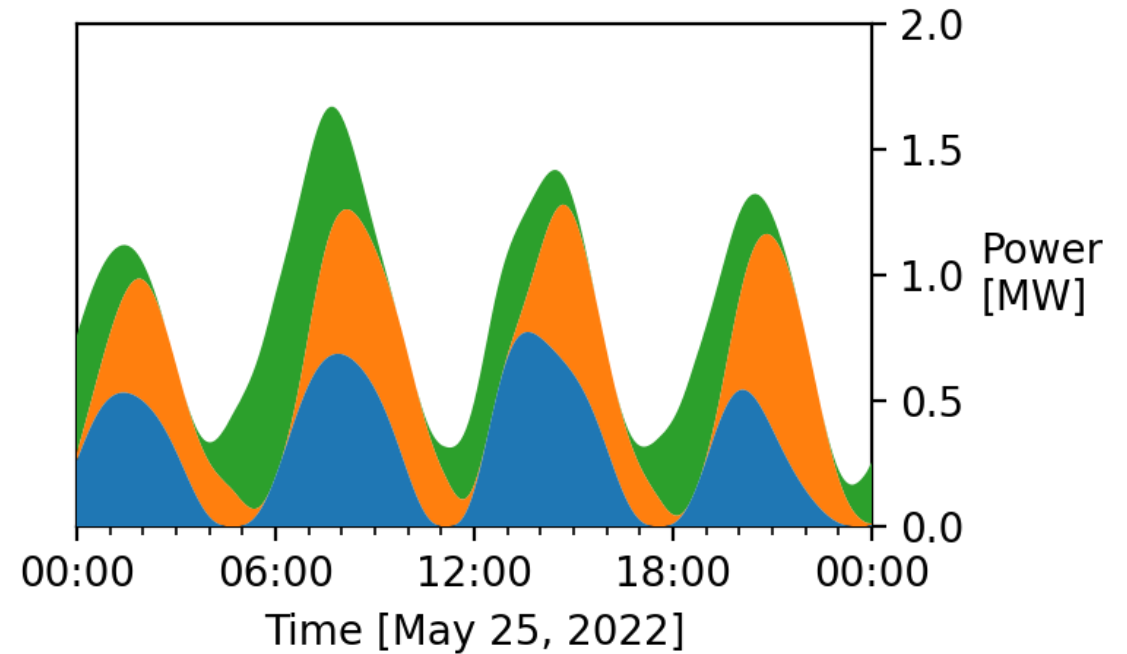
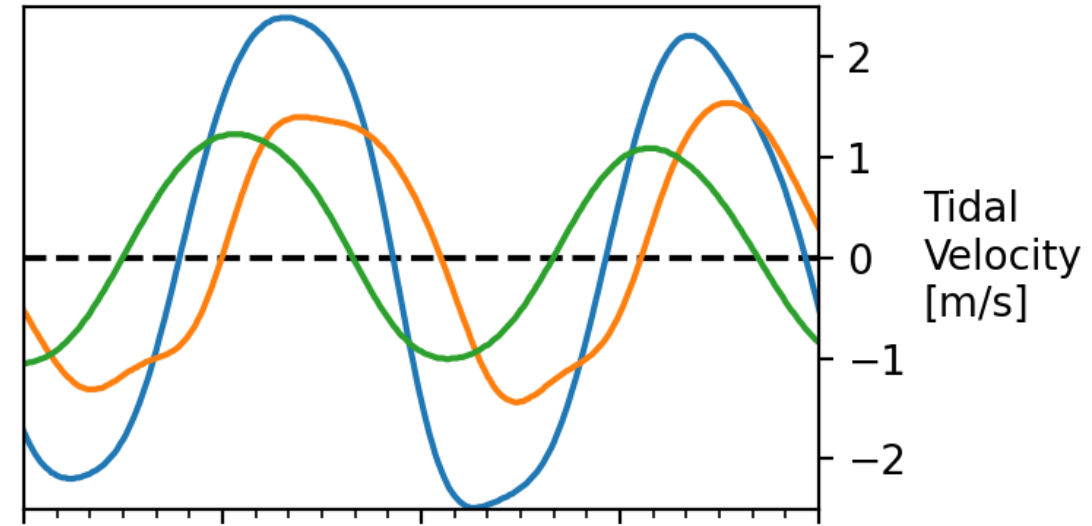
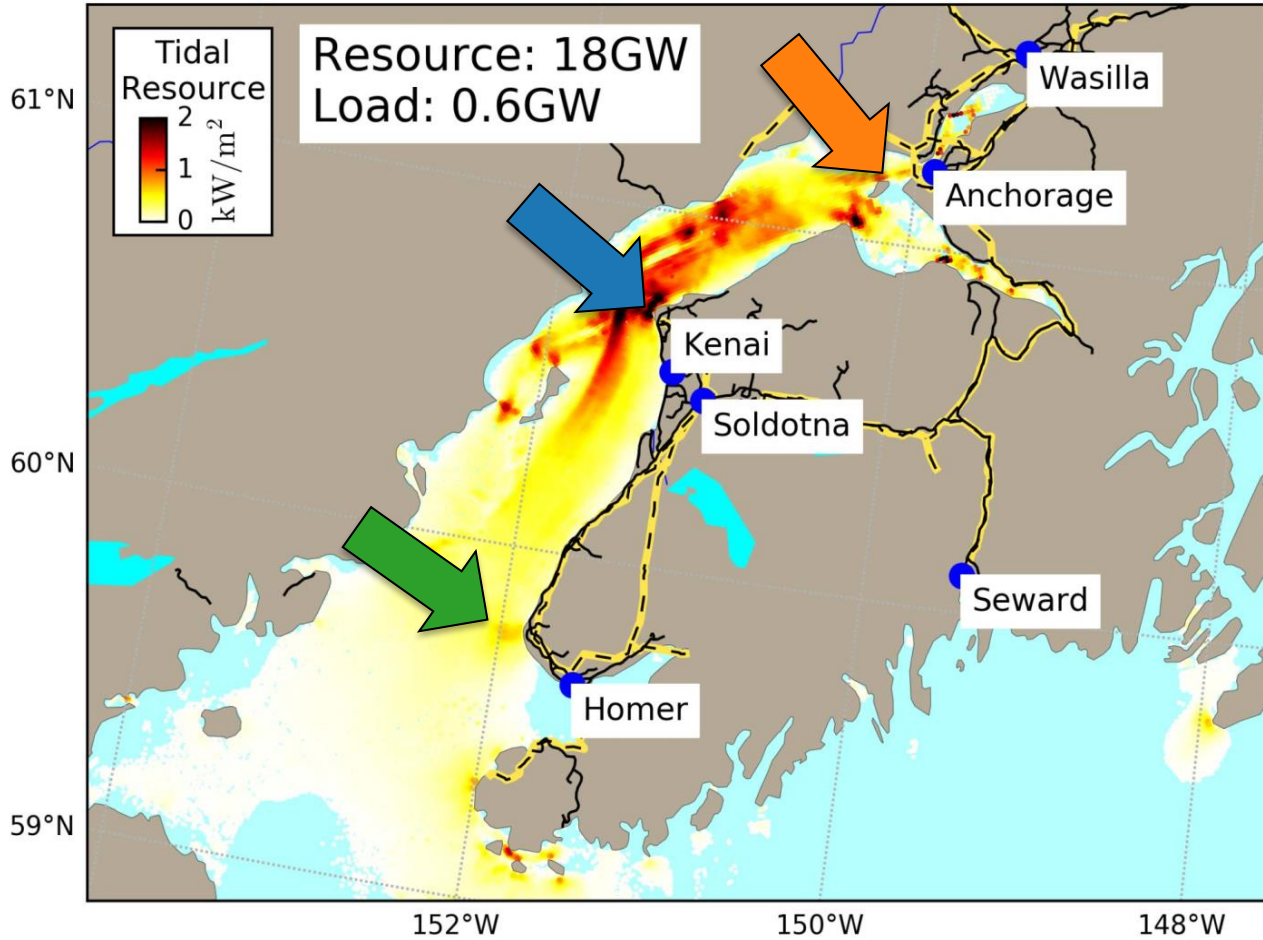
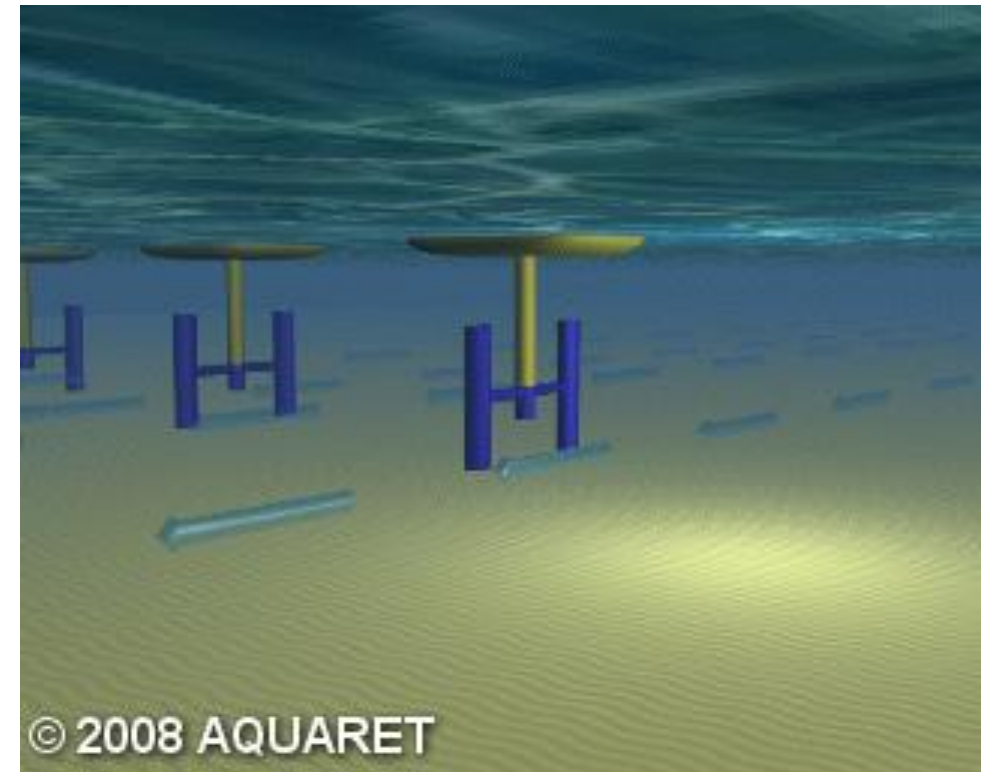
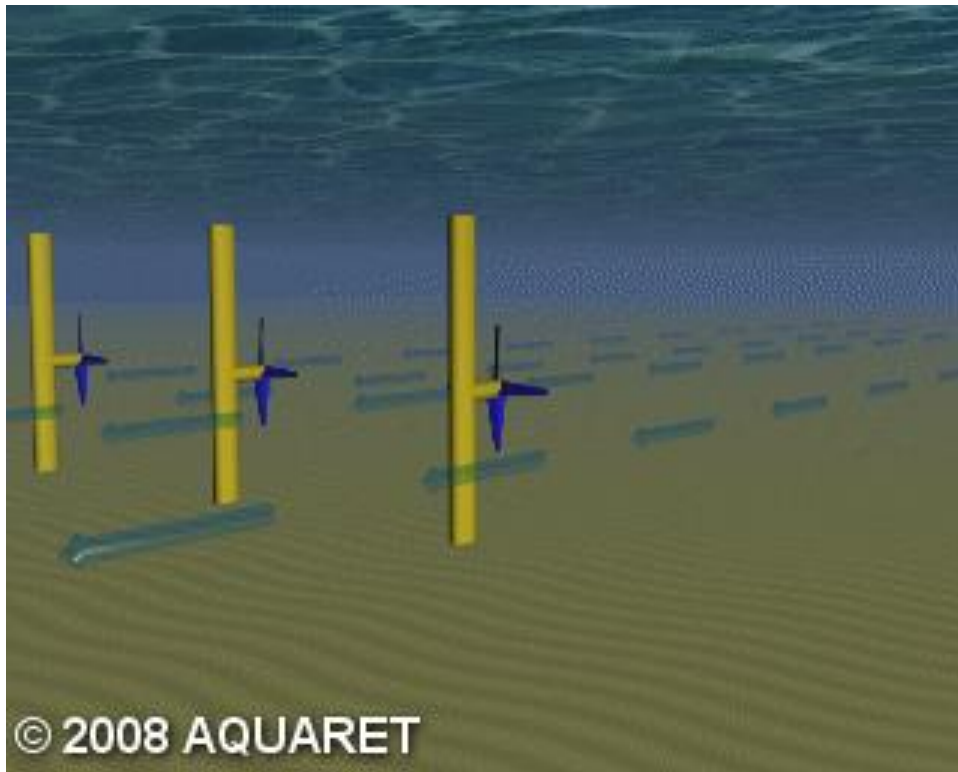


Photo by Bureau of Safety and Environmental Enforcement

Tidal Energy is Predictable



Current Energy Converter Types (Tidal or Riverine)



Tidal Energy Technology

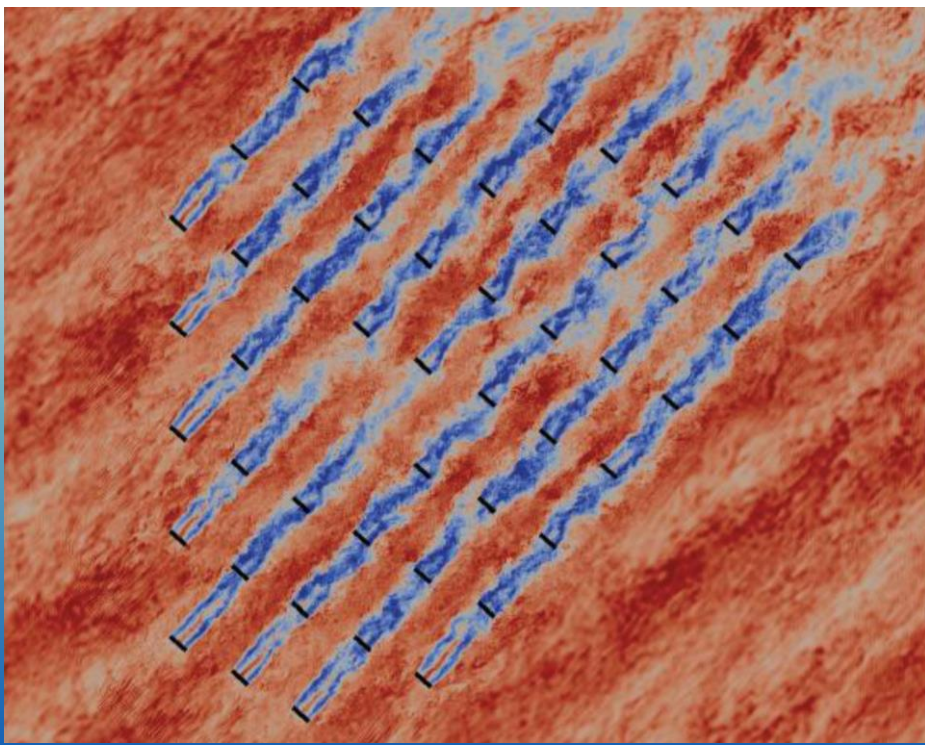
- Utility MW-scale technology convergence on axial flow
- MW-scale demonstration projects in EU: e.g. Meygen - Scotland, 8 MW in 2017
- Many kW-scale demonstration projects in the US and around the world
- Commercial pilot projects needed to prove viability of technologies

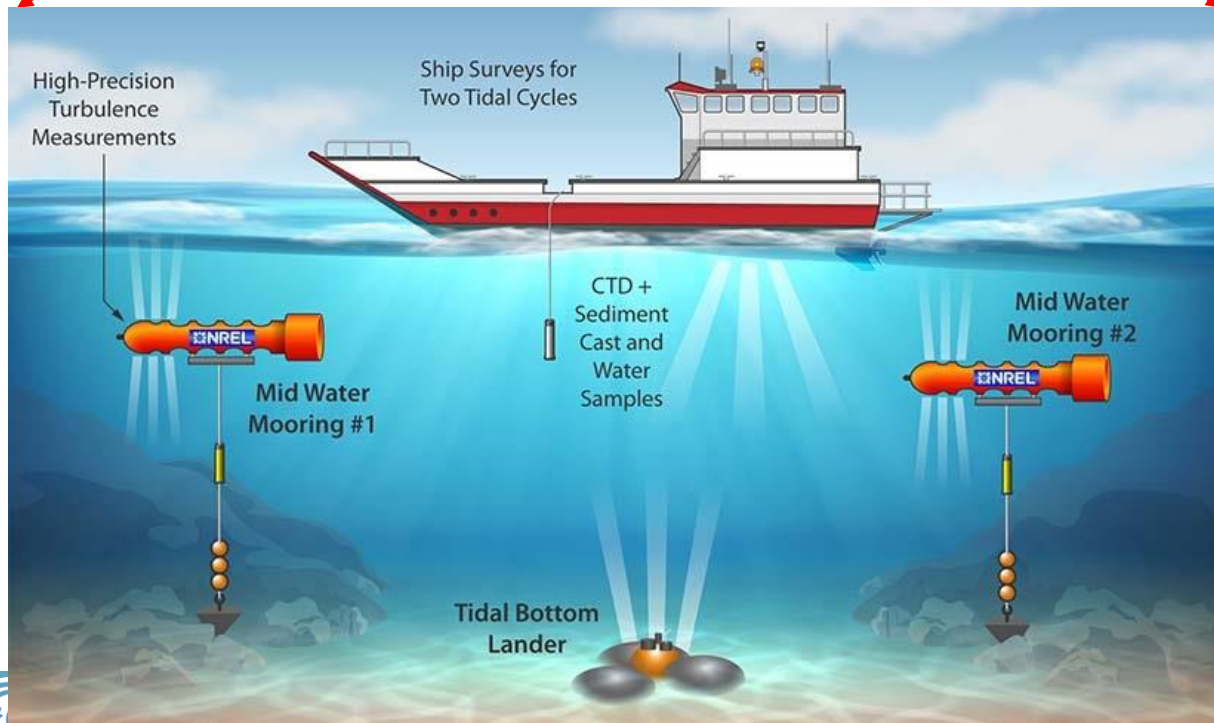
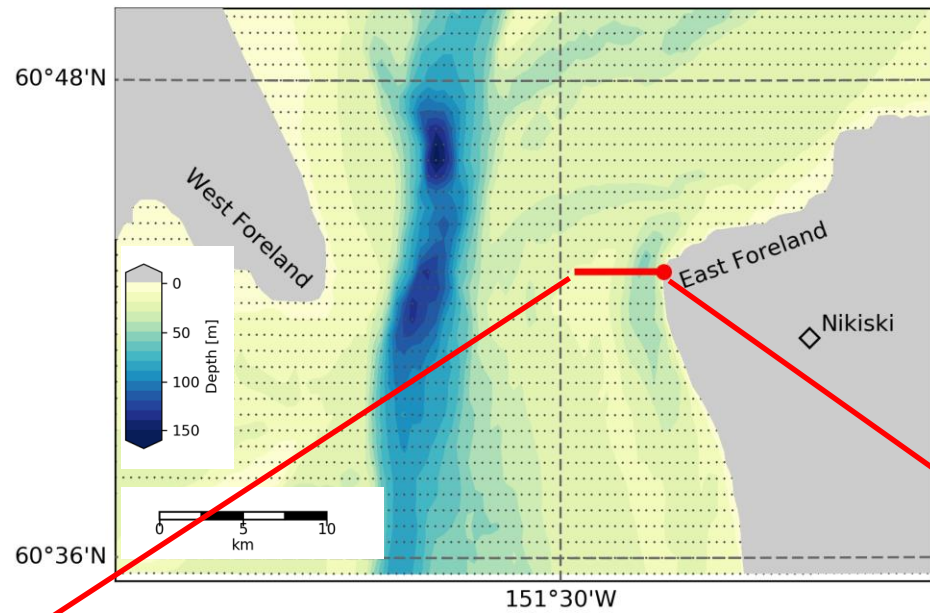




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U.S. DEPARTMENT OF
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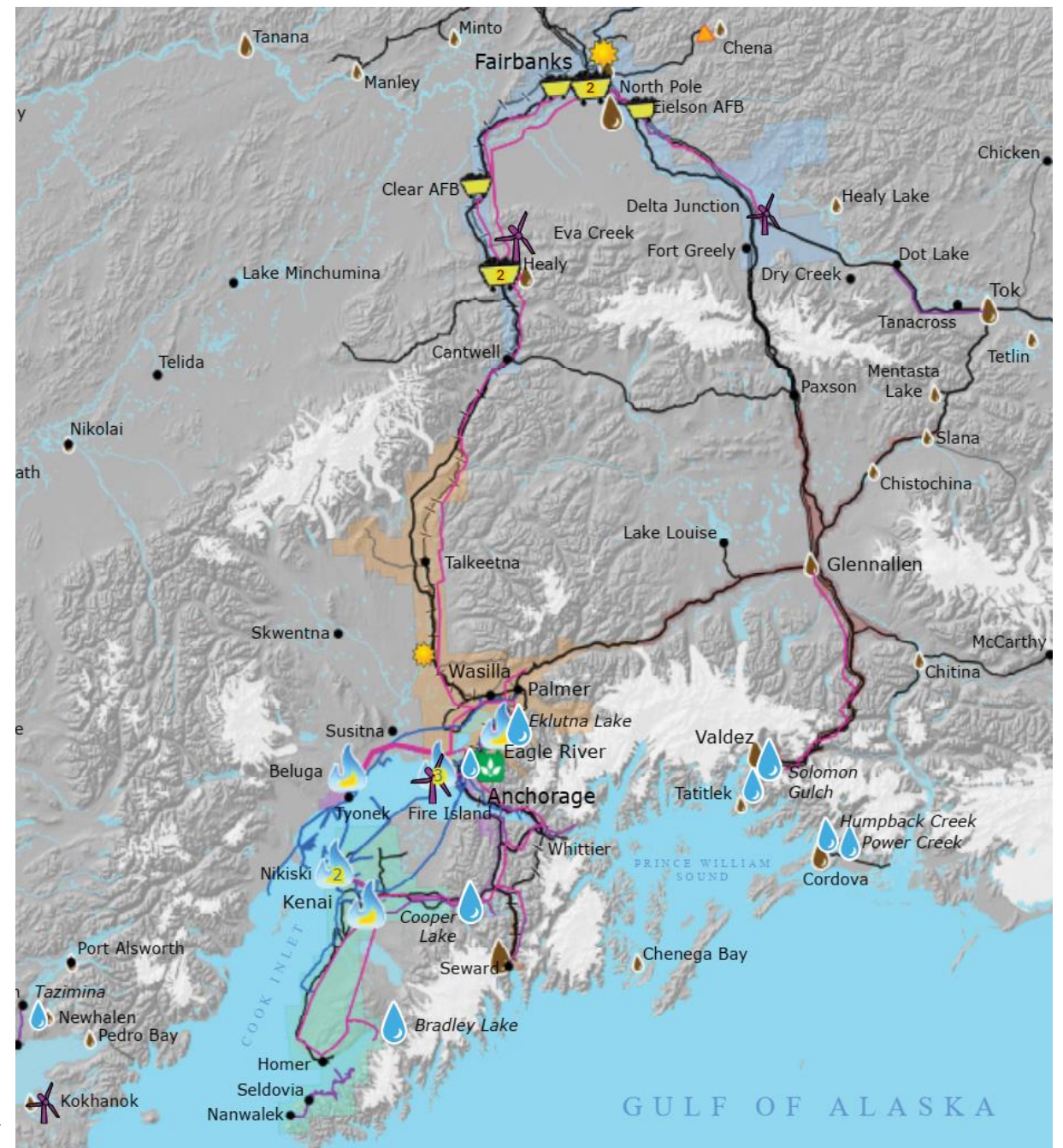
Energy Efficiency &
Renewable Energy

NREL
Transforming **ENERGY**

Alaska “Railbelt”

- Homer to Fairbanks
- 70% of AK population
- ~600MW average load
 - **42% natural gas**
 - 28% hydro
 - 27% coal & petroleum
 - 3% renewables
- Space heating
 - Fuel Oil
 - Wood
 - Natural Gas
 - ASHP (coastal)

<https://alaskarenewableenergy.org/initiatives/renewable-energy-atlas/>



Cook Inlet Tidal Energy - Context

Motivations

- Declining gas reserves
- Immense and predictable tidal resource
 - Tech reaching MW scale
 - FERC permits being issued
- RPS scenarios
 - “it’s time for Alaskans to consider where we want to be 20 years from now”
- Global interest in Hydrogen, carbon-free fuels



Cook Inlet Tidal Energy - Context

- Alternatives
 - North Slope Gas Pipeline
 - LNG import terminal
 - Traditional Hydroelectric
 - Advanced Nuclear
- Factors
 - Economics
 - Integration and Storage
 - Environmental Impact

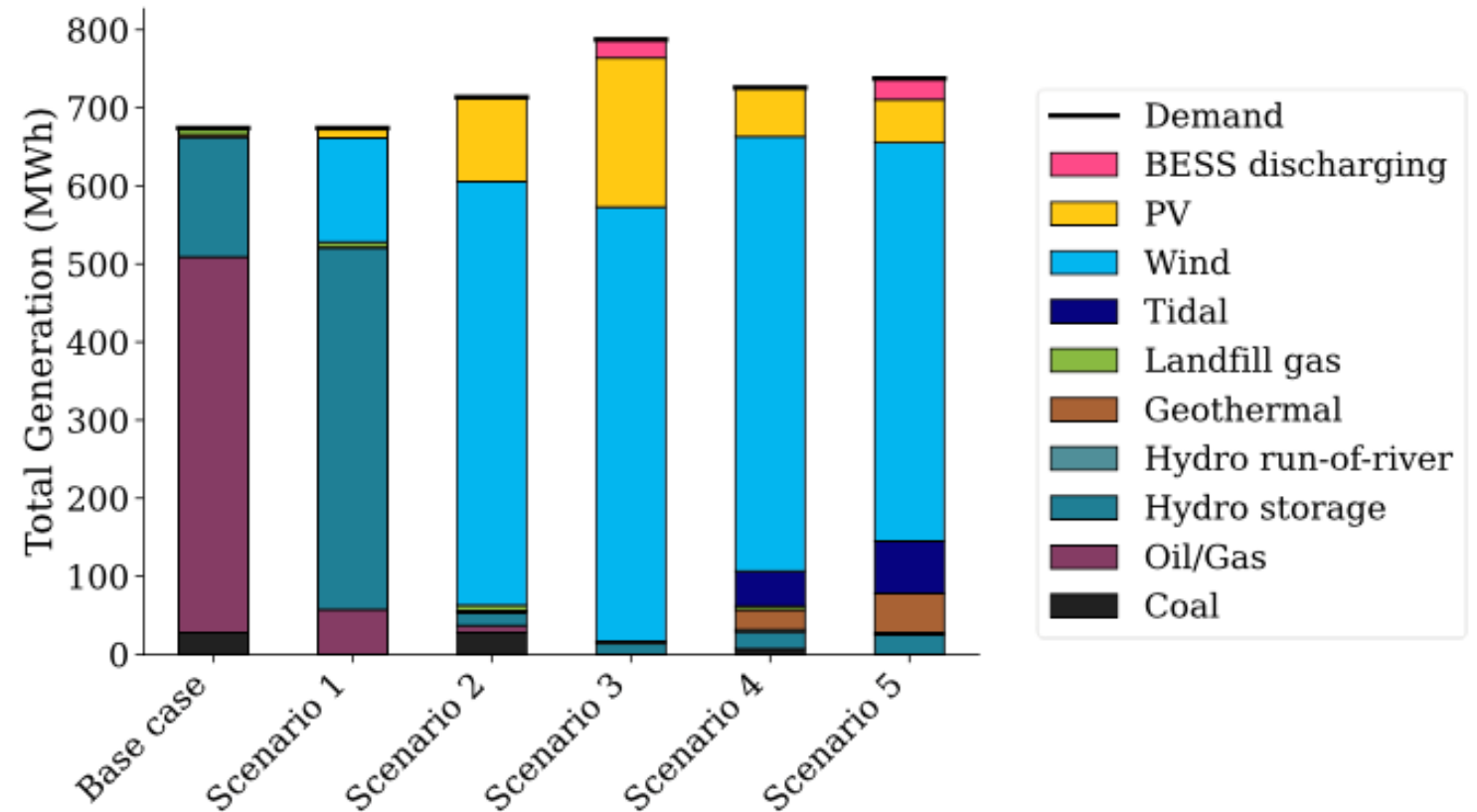


Renewable Portfolio Standard Assessment for Alaska's Railbelt

Multiple pathways to
achieving an 80% RPS

Balancing supply and
demand under major outage
conditions with appropriate
system engineering

**UAF working with OSU on
Grid Integration Modeling**



<https://www.nrel.gov/docs/fy22osti/81698.pdf>

Tidal Energy Progression

1. Tidal R&D, platform power
2. Tidal to electric utilities (RPS)
3. Tidal to synthetic fuels (export market)
 1. “Hydrogen Hub”
 2. Ammonia, Methanol, etc to export markets and rural Alaska
 3. AK heating and transportation
4. Tidal, synthetic fuels and carbon sequestration
 1. Natural gas export, CO2 import
 2. Synthetic fuel decarb and sequester



Renewable Portfolio Standard Assessment for Alaska's Railbelt

Paul Denholm, Marty Schwarz, Elise DeGeorge,
Sherry Stout, and Nathan Wiltse

NREL is a national laboratory of the U.S. Department of Energy
Office of Energy Efficiency & Renewable Energy
Operated by the Alliance for Sustainable Energy, LLC

This report is available at no cost from the National Renewable Energy
Laboratory (NREL) at www.nrel.gov/publications.

Contract No. DE-AC36-08GO28308

Technical Report
NREL/TP-5700-81698
February 2022

Cook Inlet Tidal - Roadmap Development

Topic Area	Date	Presenters	Participants
Working Group Intro	December 5	Levi Kilcher, NREL	30
Data Needs & Gaps	January 23	Katie Petersen, NREL	31
Permitting & Regulatory	February 13	Julianna Potter, Aleut Jonathan Colby, Streamwise	45
Global Tidal Energy Projects	March 27	Jonathan Colby, Streamwise	29
Tidal Array Modeling	April 12	Zhaoqing Yang, PNNL	18
Project Costs & Economics	May 18	Elena Baca, NREL	28

Participants include tidal tech developers, tidal project developers, electric utilities, user groups, state and federal regulatory agencies, university researchers, national lab researchers

Data Needs & Gaps - Feedback

WORKING GROUP HIGHLIGHT

Multiple development phases require different kinds of data and level of resolution. Key data needs now are for pre-demonstration phase

Resource data:

- Still need to validate data
- Have most of the resource data for pre-demo phase

Site data:

- Data gaps are bathy/sediment/ice/seafloor
- Private data on bathy, seafloor comp may exist

Environmental data:

- Salmon & belugas – major concerns; check with recreational & subsistence fishers too
- Review FERC dockets for enviro assessments

Socioeconomic data:

- Social license data thru lit review
- Funding for sustained stakeholder engagement?

Workforce development & engagement:

- NREL workforce dev program, engage with SeaGrant fellows
- Classroom outreach w/ STEM educators

Device design & performance:

- Would it be possible to have a generic testing facility? Single site presents some challenges wrt timing & suitability to different types of tech.

Economics:

- Cost of integration should be included.
- 2nd Phase Renewable Portfolio Standard for the Railbelt is underway.

Key Regulatory Agencies

FEDERAL

Lead Agency dependent on scope and location

FERC

- Federal Power Act
- Energy Policy Act

USACE

- Rivers and Harbors Act Section 10
- Clean Water Act Section 404

BOEM

- OCS Lands Act
- Energy Policy Act

EPA

- Clean Water Act
- APDES/NPDES

FAA

- Determination of No Hazard to Air Navigation

NMFS

- Endangered Species Act
- Marine Mammal Protection Act
- Magnuson-Stevens Act

USCBP

- Jones Act (Merchant Marine Act of 1920)

USCG

- Notice to Mariners
- Movement Regulations
- Private Aids to Navigation

USFWS

- ESA
- MMPA
- Fish and Wildlife Coordination Act
- Migratory Bird Treaty Act

STATE

ADNR, DMLW/DOG

- Land Use Authorization
- Right of Way/Easement
- Tidelands Lease

ADEC, DOW

- Clean Water Act
- Section 401 Cert.
- APDES/NPDES
- Domestic wastewater / Drinking water

ADNR, SHPO

- National Historic Preservation Act Section 106

ADFG

- Title 16, Fish Habitat
- Public Safety
- Title 5, Special Area Permit

LOCAL

Native Corp.

- Land Use Authorization
- Letter of Non-Objection

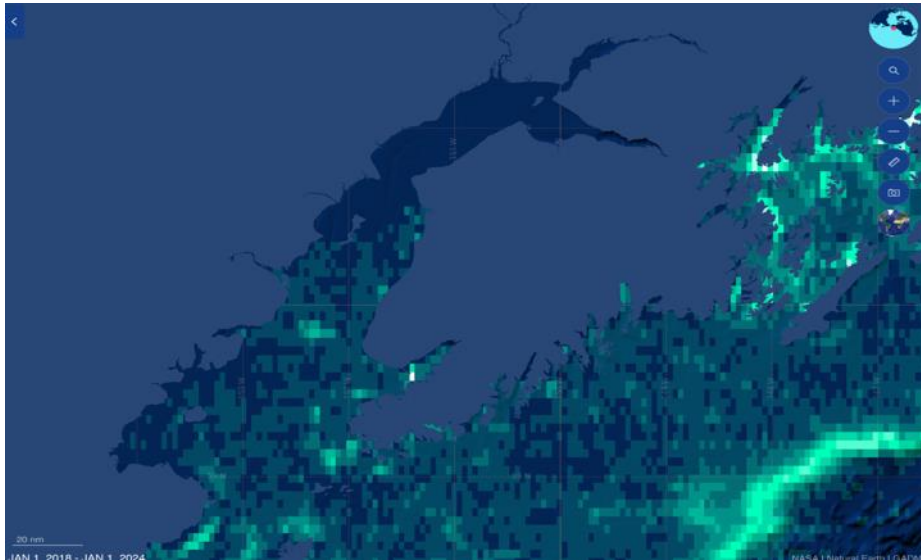
KPB/KRC

- Multi-Agency Permit
- Floodplain Permit
- Vegetation Management

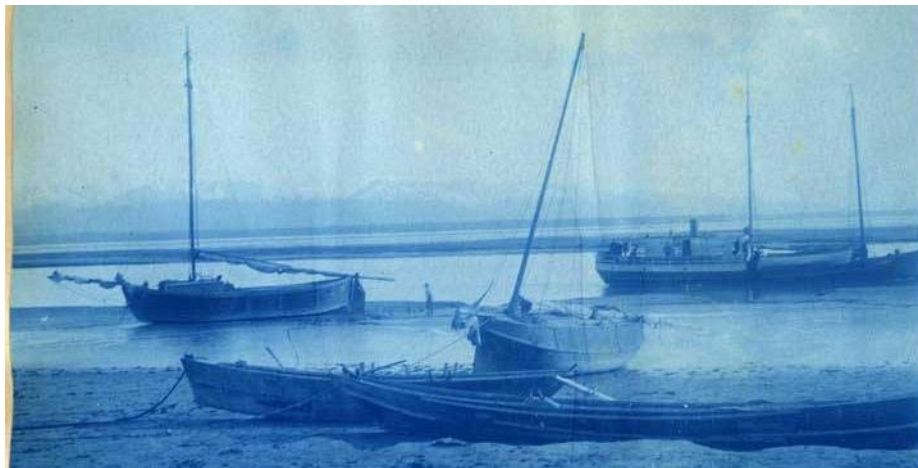
- Pre-Application Meetings are critical
- Engage with agencies early and often

Group Discussion:

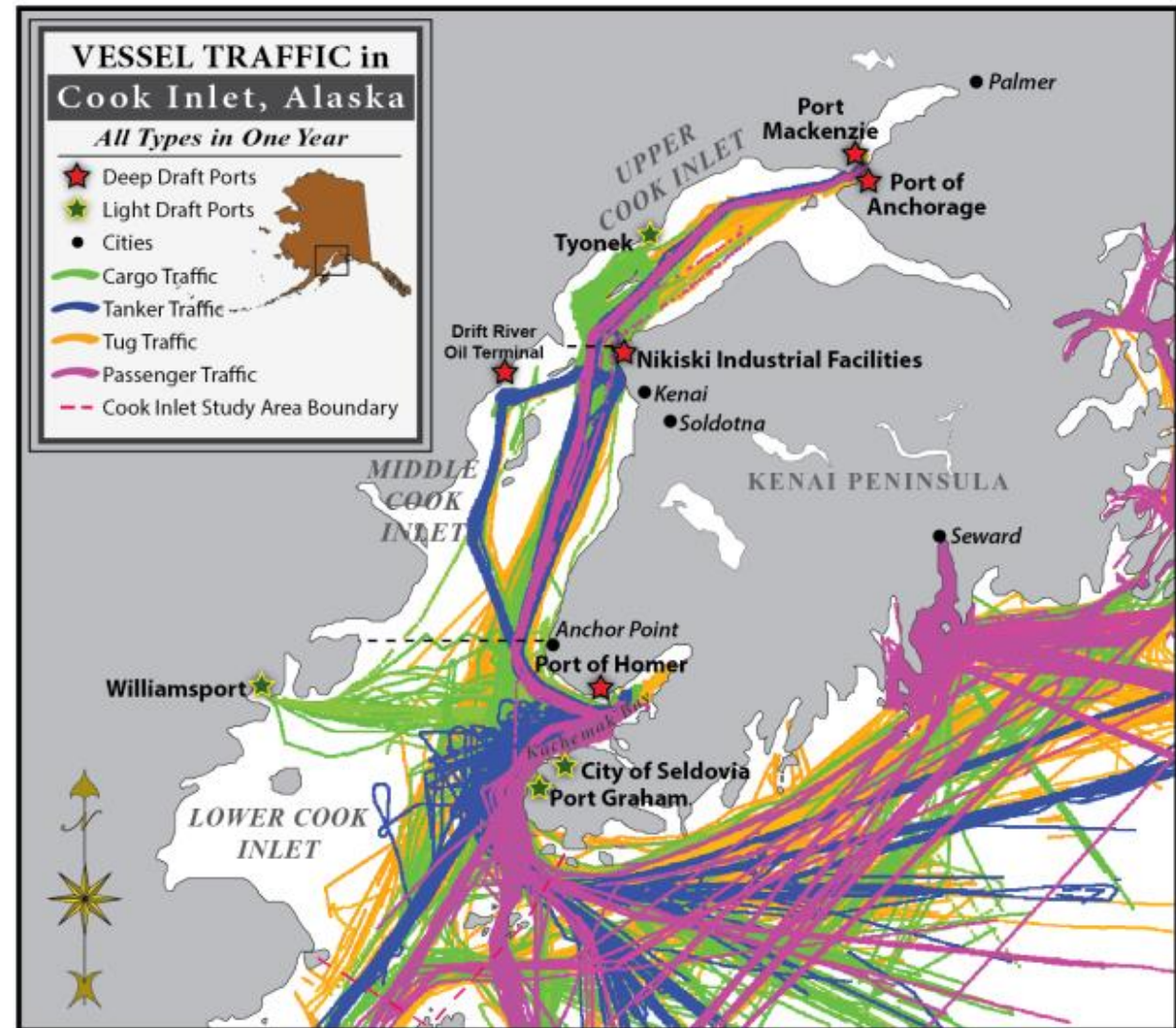
- 1) What other Agencies should be included?
→ PLEASE PROVIDE THESE IN THE CHAT.
- 2) What strategies have been successful in your experience?



Global Fishing Watch



Boats on Cook Inlet, 1898 – Alaska Digital Archives



Cape International, 2012

Marine Mammal Protection Act (MMPA)

- 13 species in middle Cook Inlet

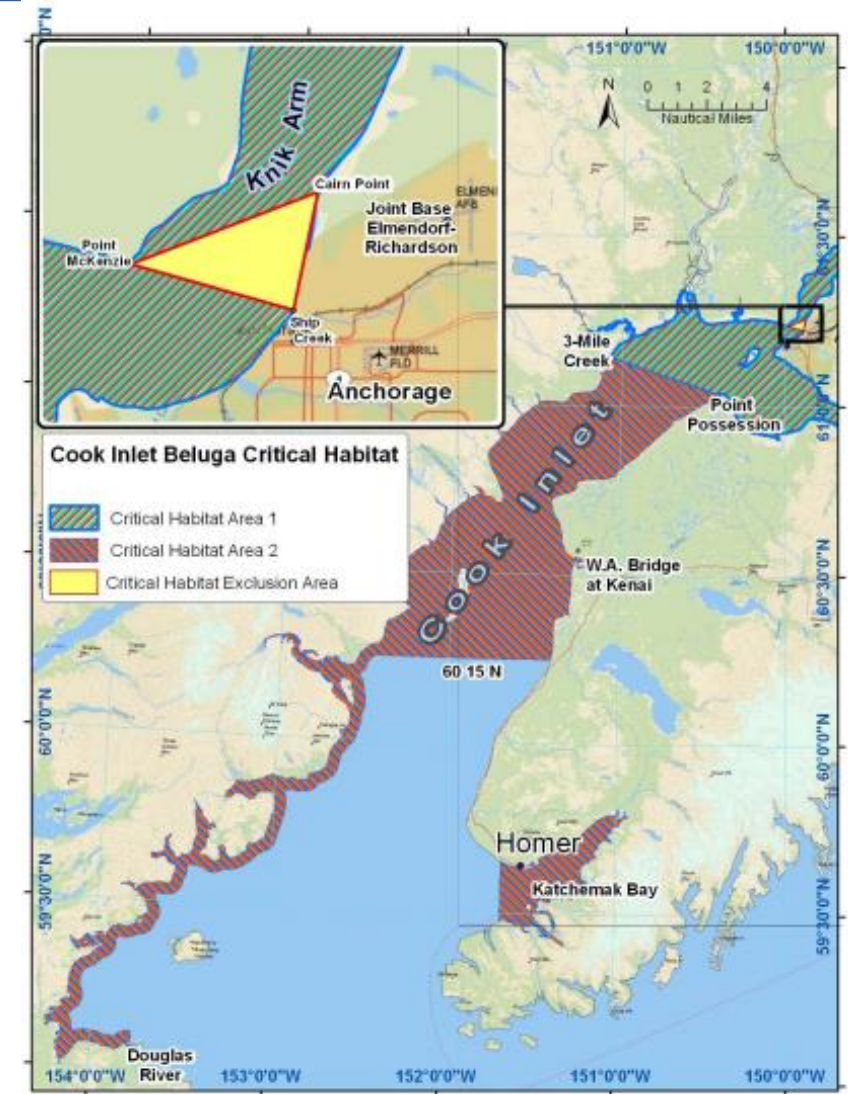
Endangered Species Act (ESA)

- 5 species in Cook Inlet
- Cook Inlet DPS Beluga Whales are the most endangered population in the U.S.
- Population estimates of Beluga Whales in Cook Inlet have declined since the 1970s



Marine Mammals	Injury (Level A) Threshold		Disturbance (Level B) Threshold	
	Impulsive	Non-Impulsive	Impulsive	Non-Impulsive
Low-Frequency (LF) Cetaceans	219 dB L _{pk} 183 dB SEL	199 dB SEL	160 dB rms	120 dB rms
Mid-Frequency (MF) Cetaceans	230 dB L _{pk} 185 dB SEL	198 dB SEL	160 dB rms	120 dB rms
High-Frequency (HF) Cetaceans	202 dB L _{pk} 155 dB SEL	173 dB SEL	160 dB rms	120 dB rms
Phocid Pinnipeds	218 dB L _{pk} 185 dB SEL	201 dB SEL	160 dB rms	120 dB rms
Otariid Pinnipeds	232 dB L _{pk} 203 dB SEL	219 dB SEL	160 dB rms	120 dB rms

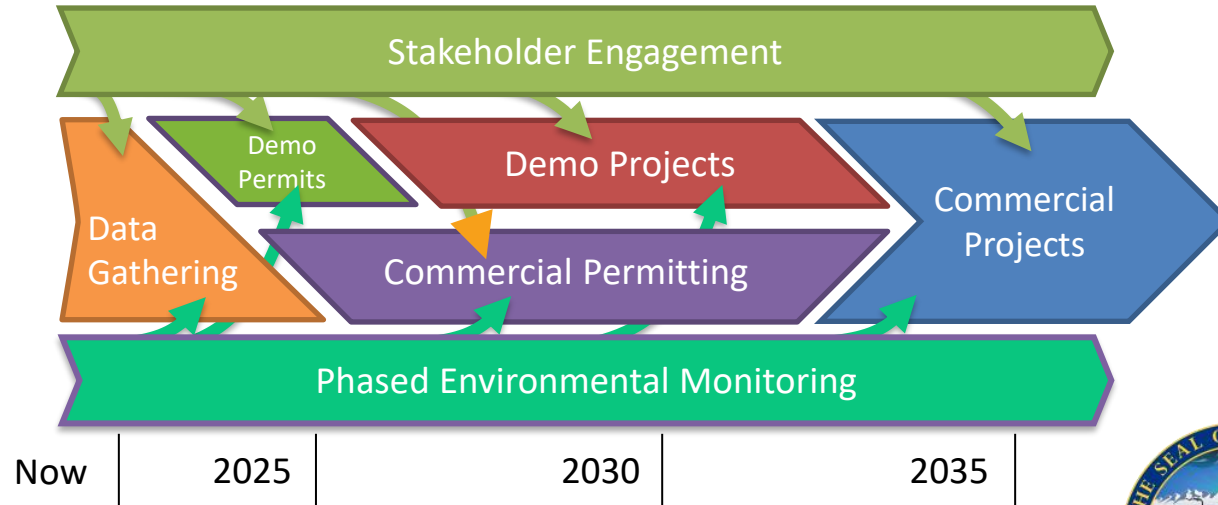
NOAA Technical Guidance, 2018



NOAA Fisheries Website

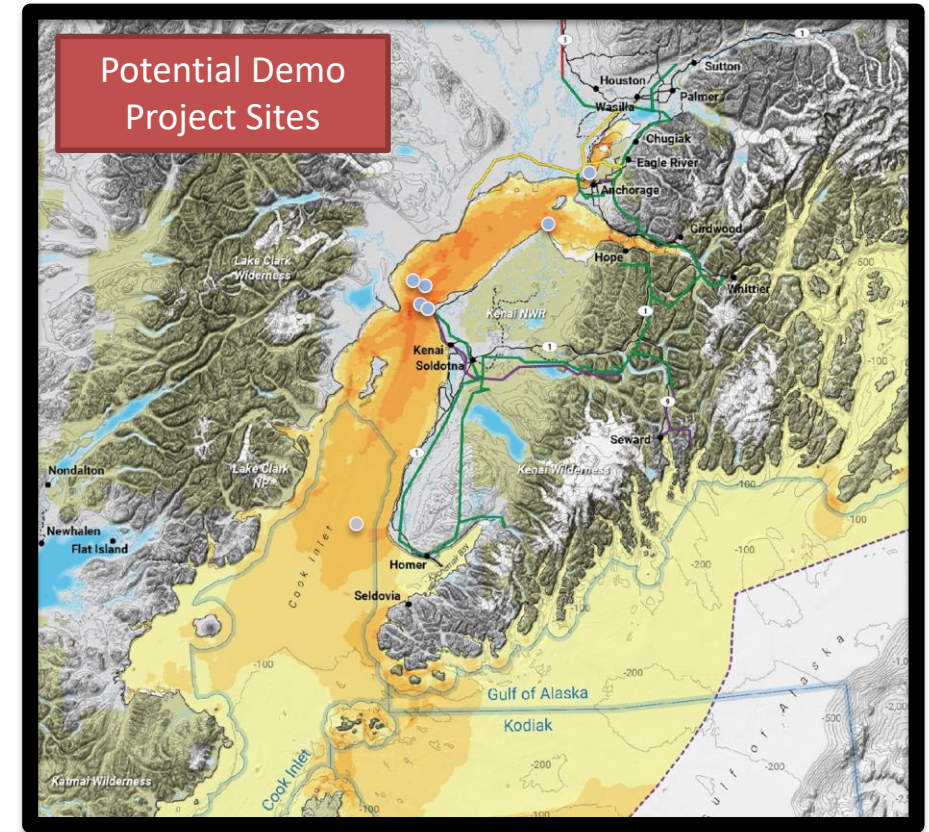
Cook Inlet Tidal Energy Roadmap

100MW by 2035



Demonstration projects are critical to proving technology, reducing cost, environmental monitoring, scaling up, and technology down-select.

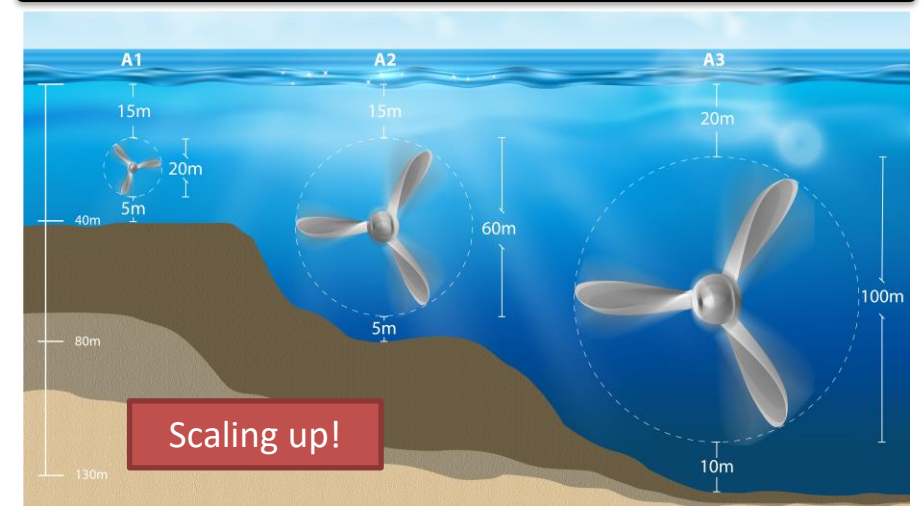
Research & development is critical to meeting these objectives and making informed decisions.



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Alaska Center for Energy and Power



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Policy & Permitting Recommendations

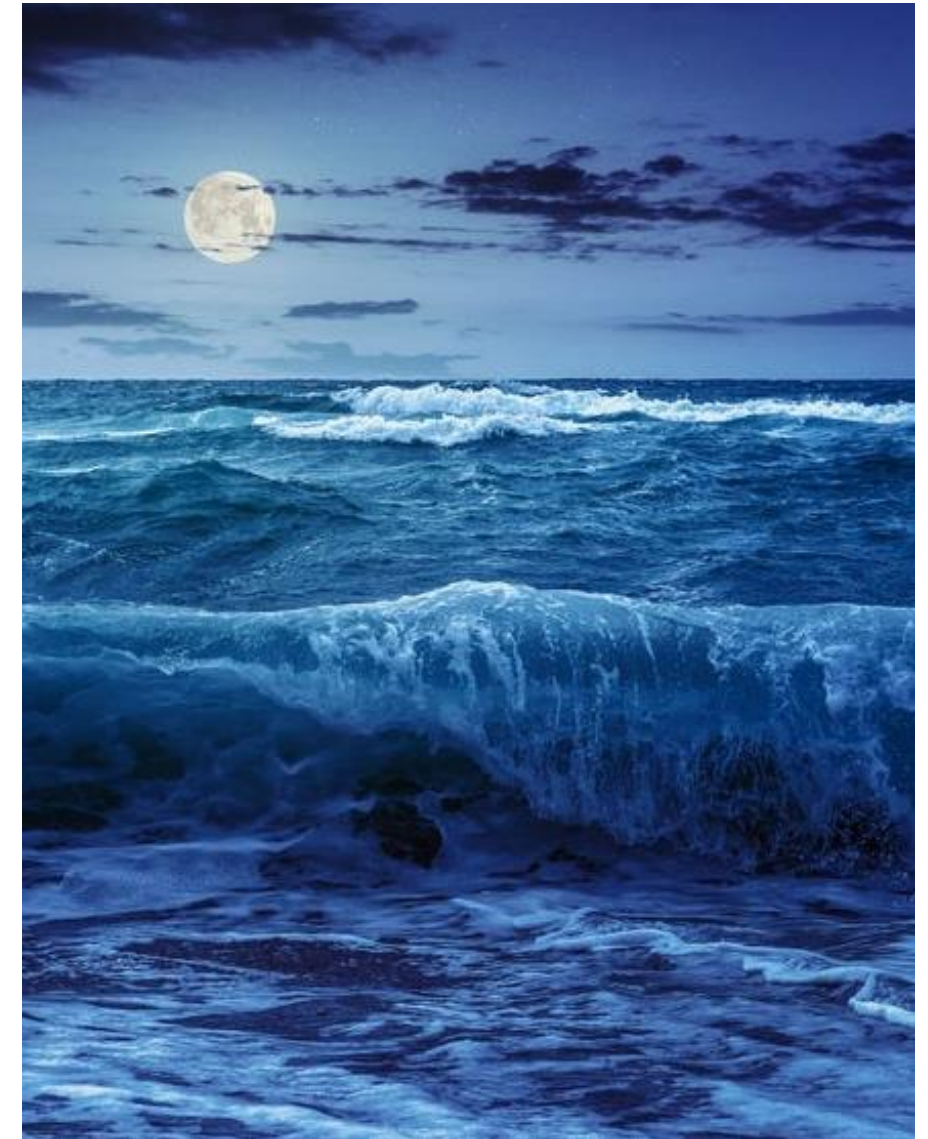
- Identify and Fill Regulatory Data Gaps
- Support Adaptive Management Approaches
- R&D Investment
 - Direct technology development
 - Skilled workforce development

\$35M for Tidal and Current Energy Systems

DOE's WPTO - \$35M funding from the Bipartisan Infrastructure Law

FOA Objectives and Goals

- Goal – 1-5MW pre-commercial tidal demonstration site
 - Build upon state clean energy strategies with local partners.
 - Attract competitive tidal and current energy developers for technology site integration.
 - Improve tidal and current energy research and development.
 - Build site infrastructure and supply chains with increased participation at the state level, including local agency, tribal, and university research involvement.
 - Establish a working business model covering site development to commercial scale.
- Multiple proposals included Cook Inlet
- Award decisions expected this November



Summary

- Resource is immense and predictable (storage requirements reduced)
- Alaska waters are challenging
- Technology is pre-commercial
- Environmental impacts not fully understood
- Variety of potential offtakes (electricity, hydrogen, ammonia, etc)

Alaska MHK History

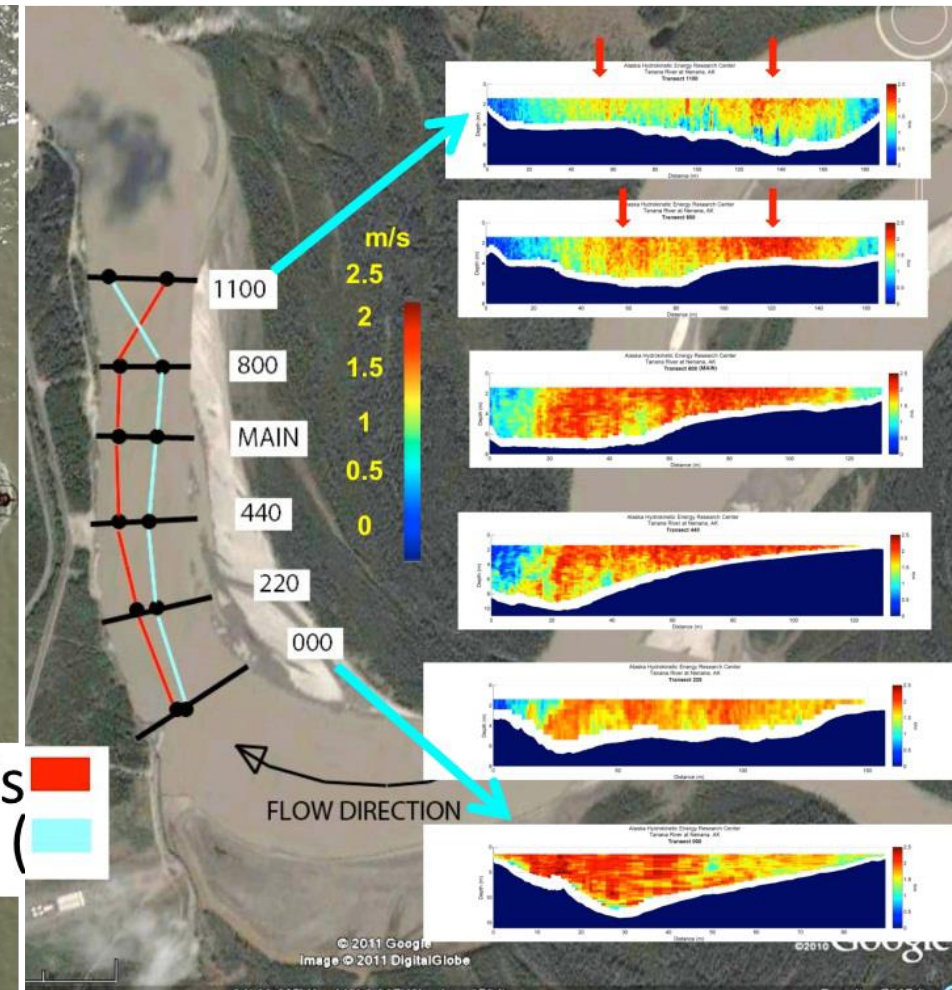
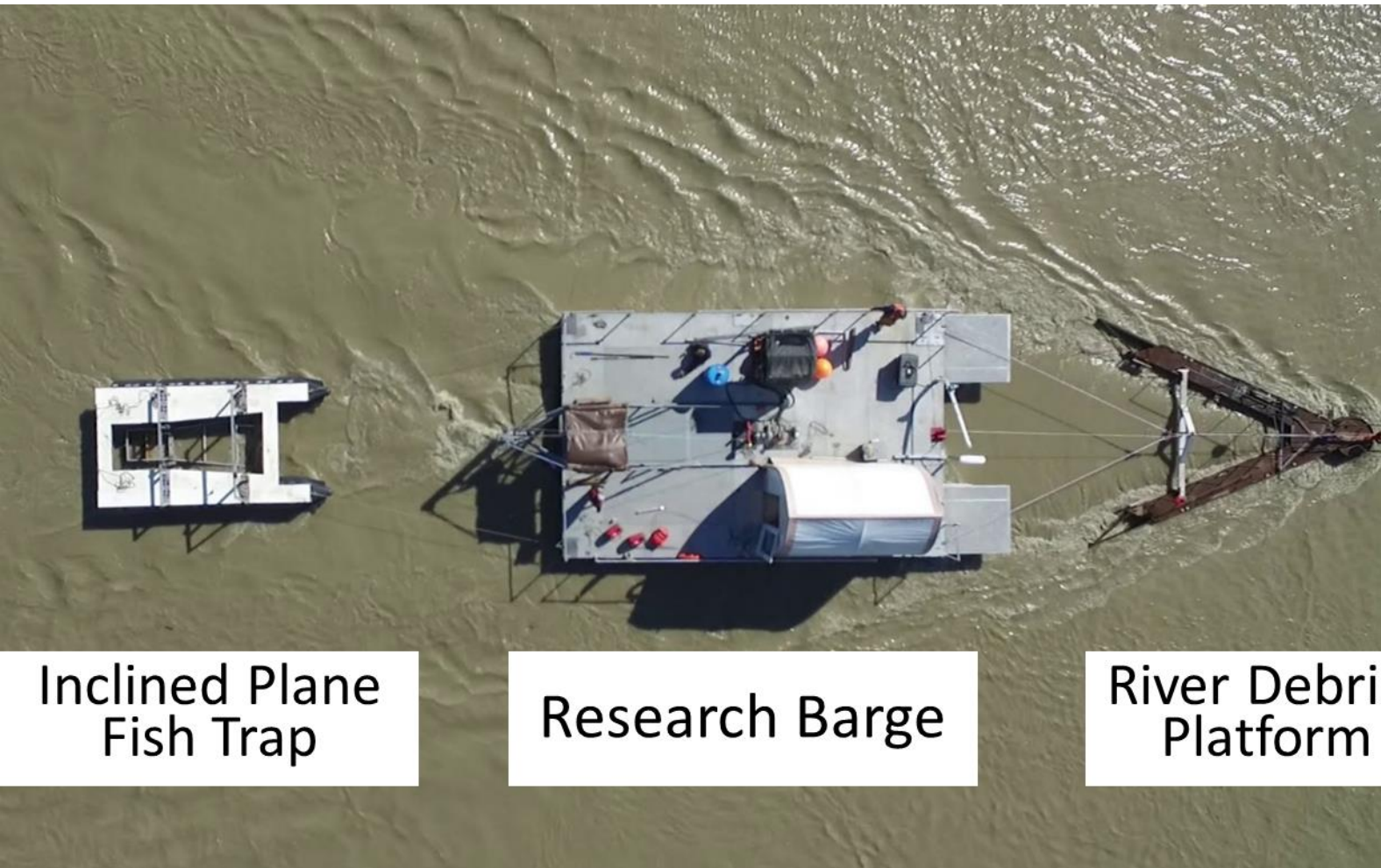


Debris accumulation on surface turbine. Ruby, AK 2013



ORPC RivGen, prior to submersion. Igiugig, AK 2020

Tanana River Test Site



Data Collection

- Simrad EK60 Split Beam Sonar
- Reson 7125 Multibeam Sonar
- Trimble GPS
- ADCP and ADV – 3D velocity
- Campbell Scientific Dataloggers
 - CR1000
 - CR6
- DC voltage and current transducers
- Load Cells



Hydrokinetic Experience



Hydrokinetic Experience



Alaska Energy Leadership

- State Level
 - Office of Energy Innovation
 - Alaska Energy Security Task Force
 - Alaska Energy Independence Fund (proposed)
 - Alaska Sustainable Energy Conference
- Federal Level
 - DOE Arctic Energy Office
 - National Lab Research Programs focused on Arctic
 - DOE Water Power Technologies Office
 - R&D in Alaska
 - National Marine Energy Centers

Alaska Energy Infrastructure

- 730,000 residents
- Railbelt Grid
- Remote Microgrids



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p on the Railbelt,
near Anchorage,
and 1.9 MW at

of installed power
the Railbelt. AEA
currently studying the
of power generation
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completed a total of
a Ketchikan, Kodiak,
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hydro facilities
Juneau and Prince

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a little over 3,000
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N D S

ARCTIC OCEAN

