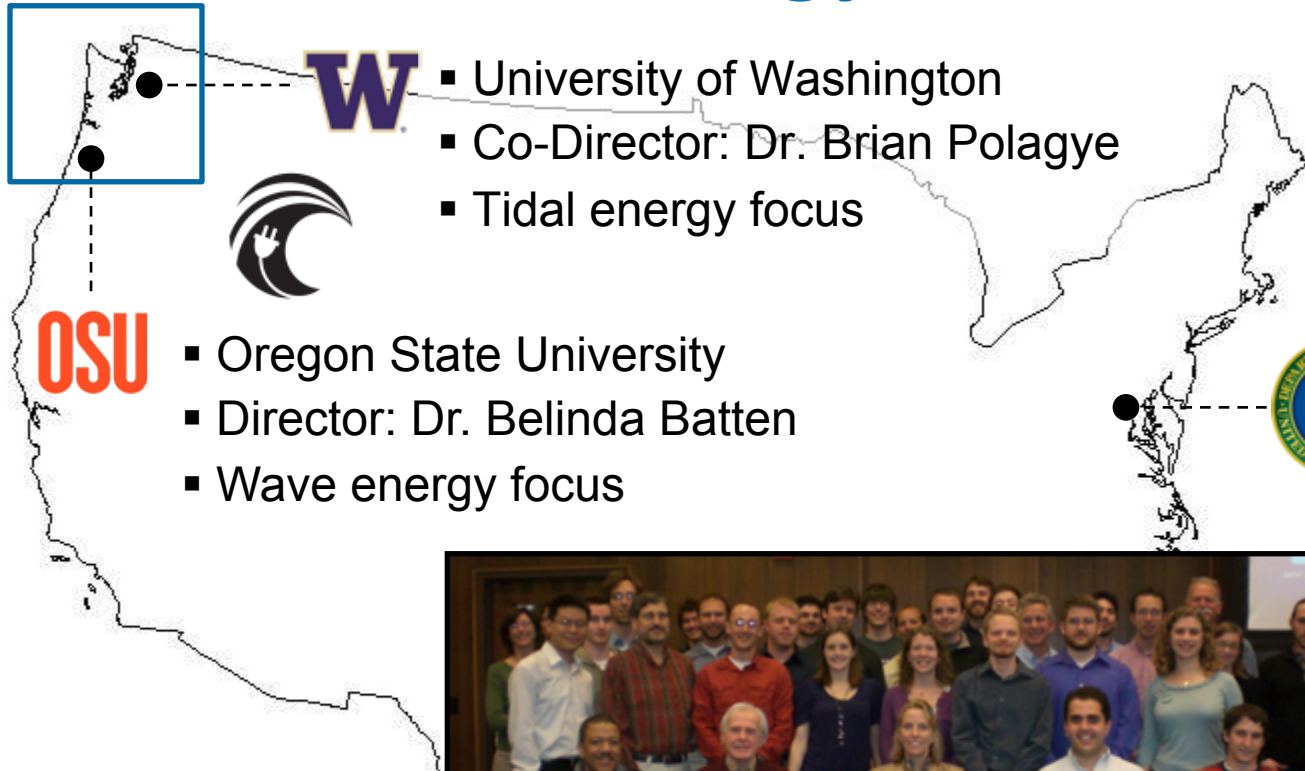


# Northwest National Marine Renewable Energy Center



- University of Washington
- Co-Director: Dr. Brian Polagye
- Tidal energy focus



- Oregon State University
- Director: Dr. Belinda Batten
- Wave energy focus



U.S. DEPARTMENT OF ENERGY  
**ENERGY**



*NNMREC Faculty and Students - May 2011 Meeting*



# US Marine Energy Research Centers

Northwest National Marine  
Renewable Energy Center  
(NNMREC)



Southeast National Marine  
Renewable Energy Center  
(SNMREC)



Hawaii National Marine  
Renewable Energy Center  
(HINMREC)



# Research Areas

*“Develop a full range of capabilities to facilitate the responsible development of marine renewable energy...”*

## Technical

*Testing / Demonstration*

*Wave Forecasting*

*Survivability / Reliability*

*Advanced Materials*

*Device / Array Optimization*

## Environmental

*Sediment Transport*

*Marine Mammals*

*Benthic Ecosystems*

*EMF and Acoustics*

*Site Characterization*

## Socio-economic

*Fisheries / Crabbing*

*Outreach / Engagement*

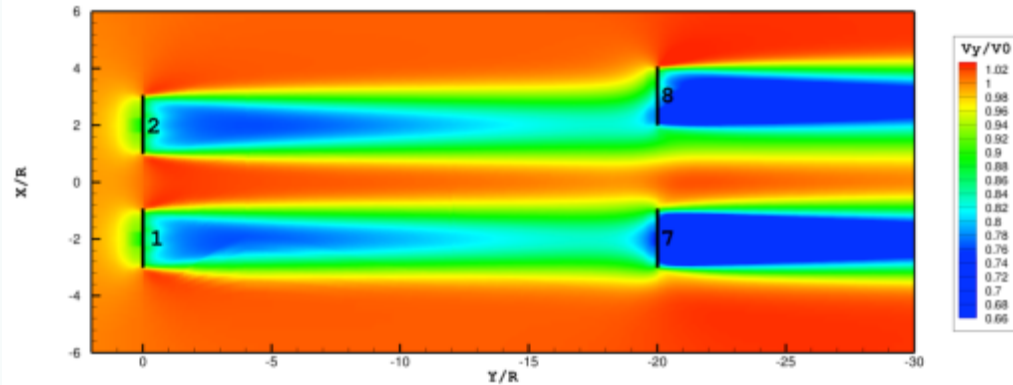
*Existing Ocean Users*

*Local / Oregon Economy*

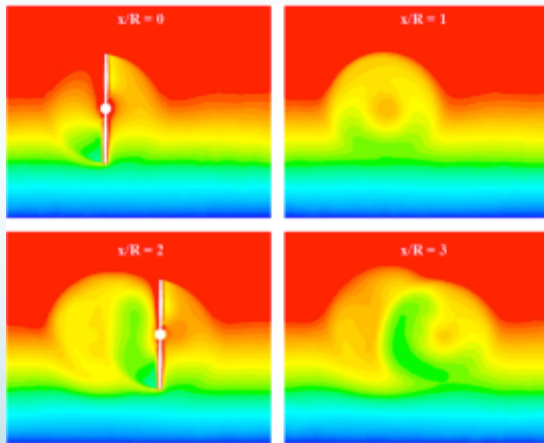


# Turbine and Array Optimization

Normalized Streamwise Velocity Contour of 1,2,7 and 8 Combination



Wake Interaction in Arrays

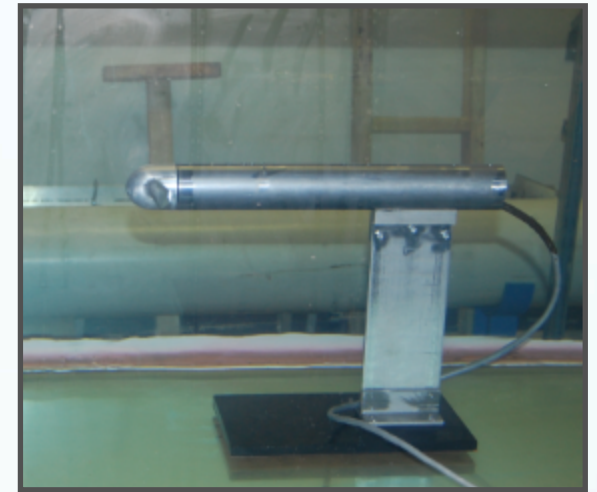


Individual Turbine Performance

Numerical Modeling

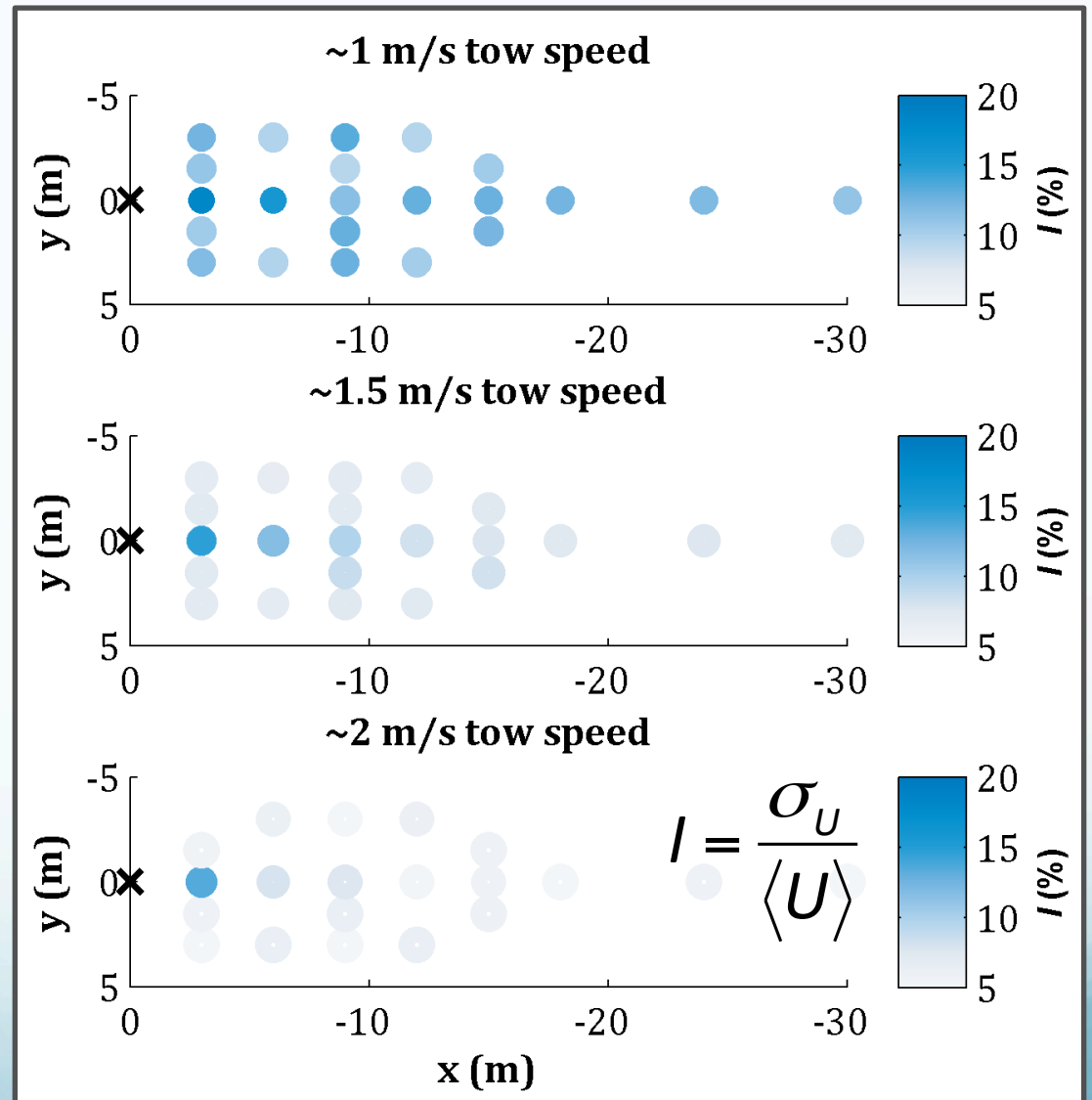
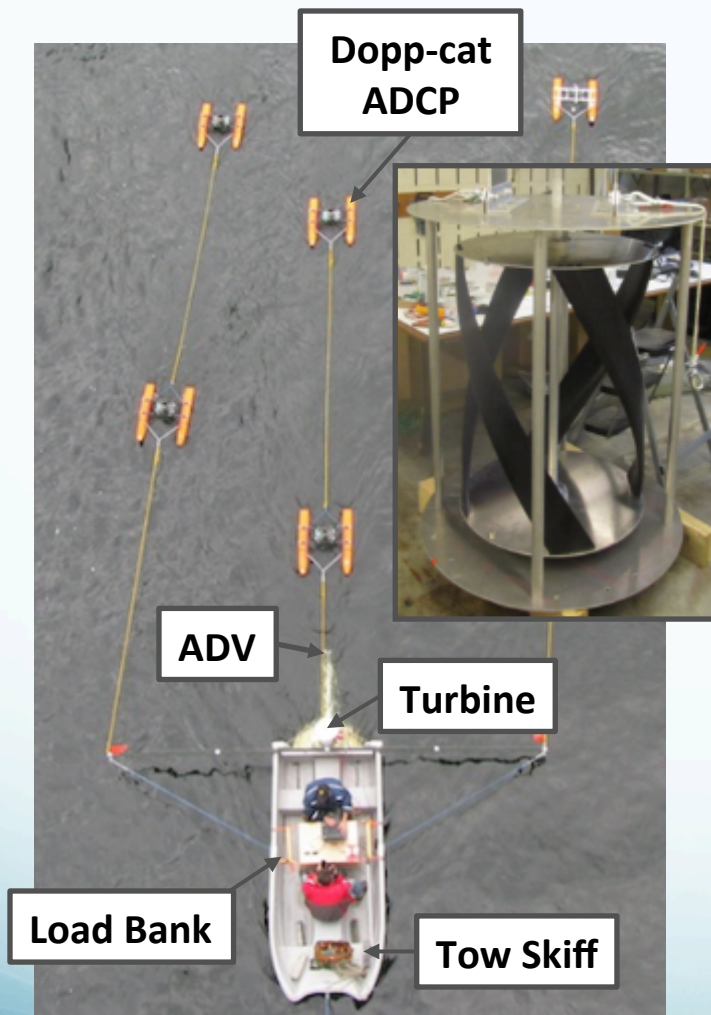


Field and Laboratory Measurements



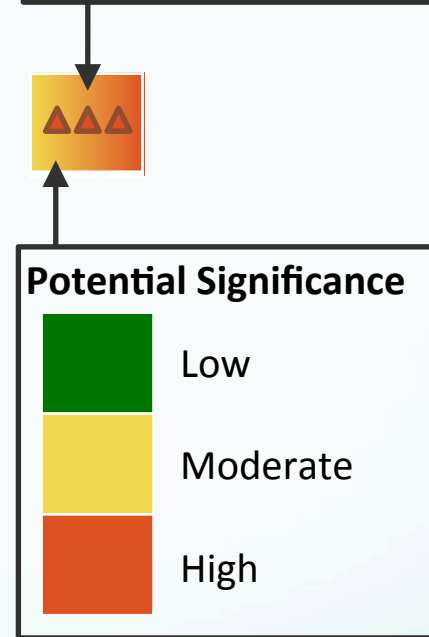
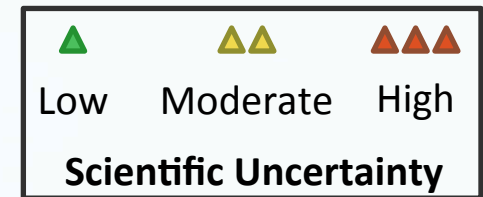
Flume Testing

# Field Wake Studies



# Addressing Environmental Uncertainties

	Device presence: Static effects	Device presence: Dynamic effects	Chemical effects	Acoustic effects	Electromagnetic effects	Energy removal	Cumulative effects
Physical environment: Near-field	▲▲▲	▲▲	▲▲▲	▲	▲	▲▲▲	▲▲▲
Physical environment: Far-field	▲▲	▲▲	▲	▲	▲	▲▲▲	▲▲▲
Habitat	▲▲	▲▲▲	▲▲	▲	▲▲	▲▲▲	▲▲▲
Invertebrates	▲▲	▲▲	▲▲	▲▲▲	▲▲▲	▲▲▲	▲▲▲
Fish: Migratory	▲▲	▲▲▲	▲▲	▲▲▲	▲▲▲	▲▲▲	▲▲▲
Fish: Resident	▲▲	▲▲▲	▲▲	▲▲▲	▲▲▲	▲▲▲	▲▲▲
Marine mammals	▲▲▲	▲▲▲	▲▲	▲▲▲	▲	▲	▲▲▲
Seabirds	▲▲	▲▲▲	▲▲	▲	▲	▲	▲▲▲
Ecosystem interactions	▲▲	▲▲	▲▲	▲▲	▲▲▲	▲▲▲	▲▲▲



Polagye, B., B. Van Cleve, A. Copping, and K. Kirkendall (eds), (2011) Environmental effects of tidal energy development.



# Example: Sound and Marine Mammals



*Example: Admiralty Inlet Tidal Demonstration  
Marine Mammal studies*

Initial Study Area  
and Objectives

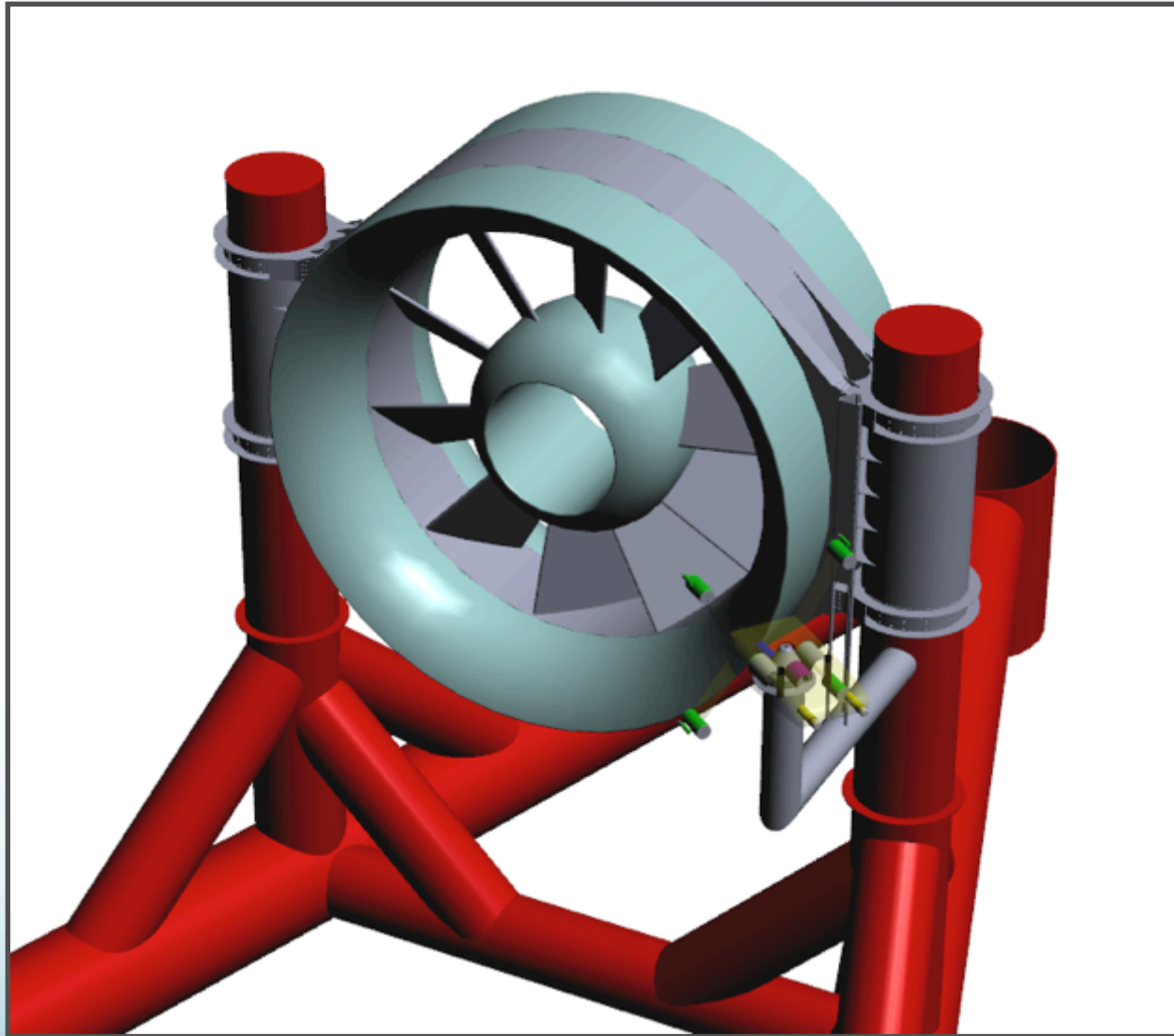


- Bassett et al., 2012 – Vessel Noise
- Bassett et al., 2013 – Sediment Noise
- Scottish Association for Marine Sciences measurement campaign
- Polagye, B., C. Bassett, M. Holt, J. Wood, and S. Barr, “A framework for detection of tidal turbine sound: A pre-installation case study for Admiralty Inlet, Puget Sound, Washington (USA)”



Revised Study Area  
and Objectives

# Example: Environmental Infrastructure

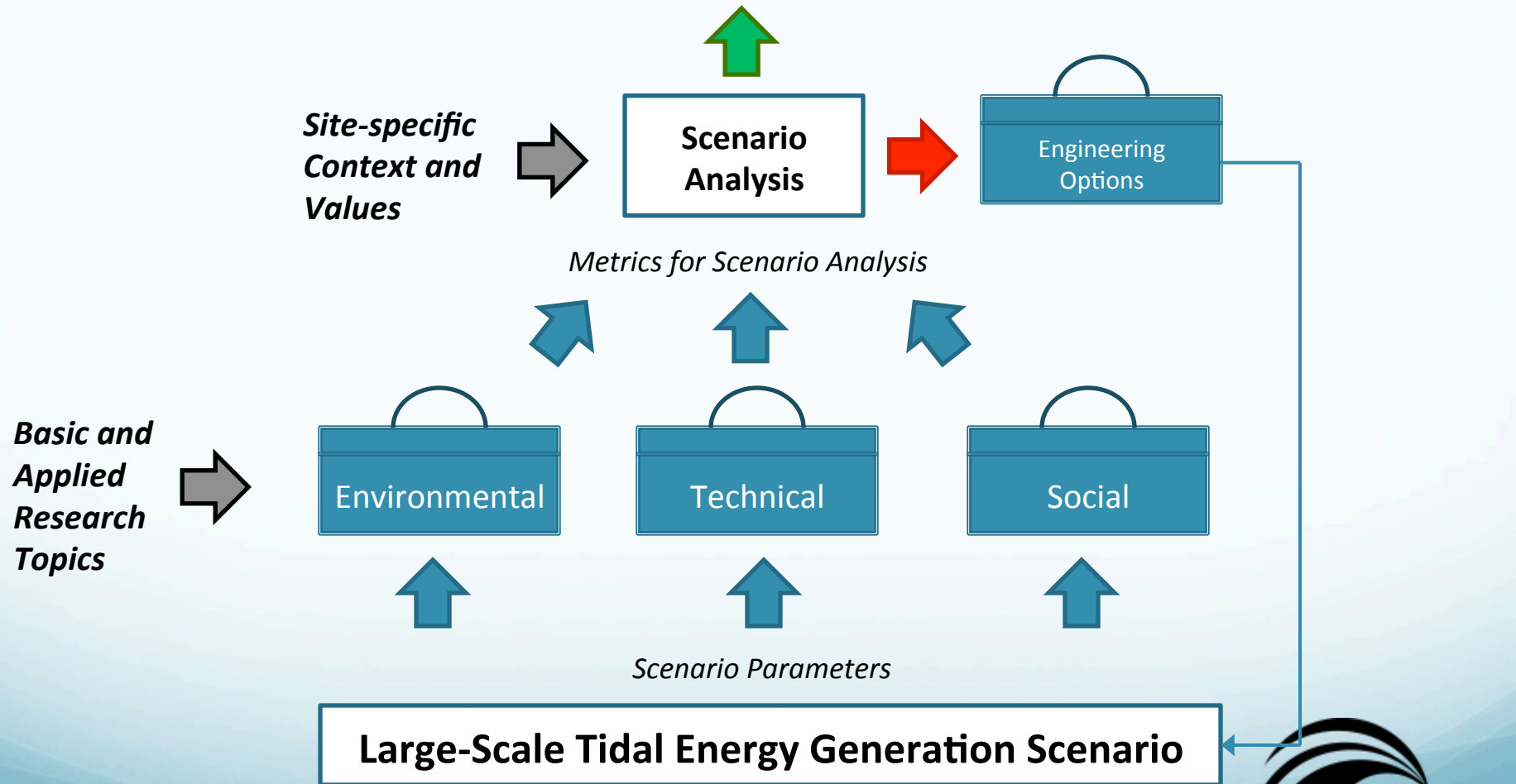


*Monitoring Environmental Effects at Pilot Scale Projects*



# Sustainable Technology Refinement

## Sustainable Large-Scale Tidal Energy Generation Scenario?



NSF Award  
1230426



# What is the Future of Tidal Current Energy?

## Pessimists

- Environmental and social costs outweigh the benefits of renewable power
- Resource may not be able to satisfy all human needs
- Oceans are already too crowded by existing uses

## Optimists

- Important source of renewable power
- Astounding progress in the past five years
- UK roadmap calls for 2 GW of wave and tidal to come online by 2020
- US roadmap calls for 20-30 GW of wave and tidal to come online by 2030



# Thank You

- **For further information on activities at UW:**
  - Brian Polagye, co-Director, University of Washington
  - [bpolagye@uw.edu](mailto:bpolagye@uw.edu)
  - <http://depts.washington.edu/nnmrec>
- **For further information on activities at OSU:**
  - Belinda Batten, Director, Oregon State University
  - [Belinda.Batten@oregonstate.edu](mailto:Belinda.Batten@oregonstate.edu)
  - <http://nnmrec.oregonstate.edu>



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