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Results-Driven Research for Alaska

February 12th, 2012

Gwen Holdmann, Director

Jeremy Kasper, Research Professor

Alaska Center for Energy and Power

UAF UNIVERSITY OF ALASKA FAIRBANKS

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ACEP Mission: Develop and disseminate practical, cost-effective, and innovative energy solutions for Alaska and beyond

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Who we are:

- Organized 6 years ago under the Institute of Northern Engineering as 'Gateway' to Energy Research for UA
- Based at UAF with a satellite office in Anchorage
- 20 dedicated staff (mostly engineers)
- 35 affiliated faculty and 50 students
- Base funding of $750k through the UA budget

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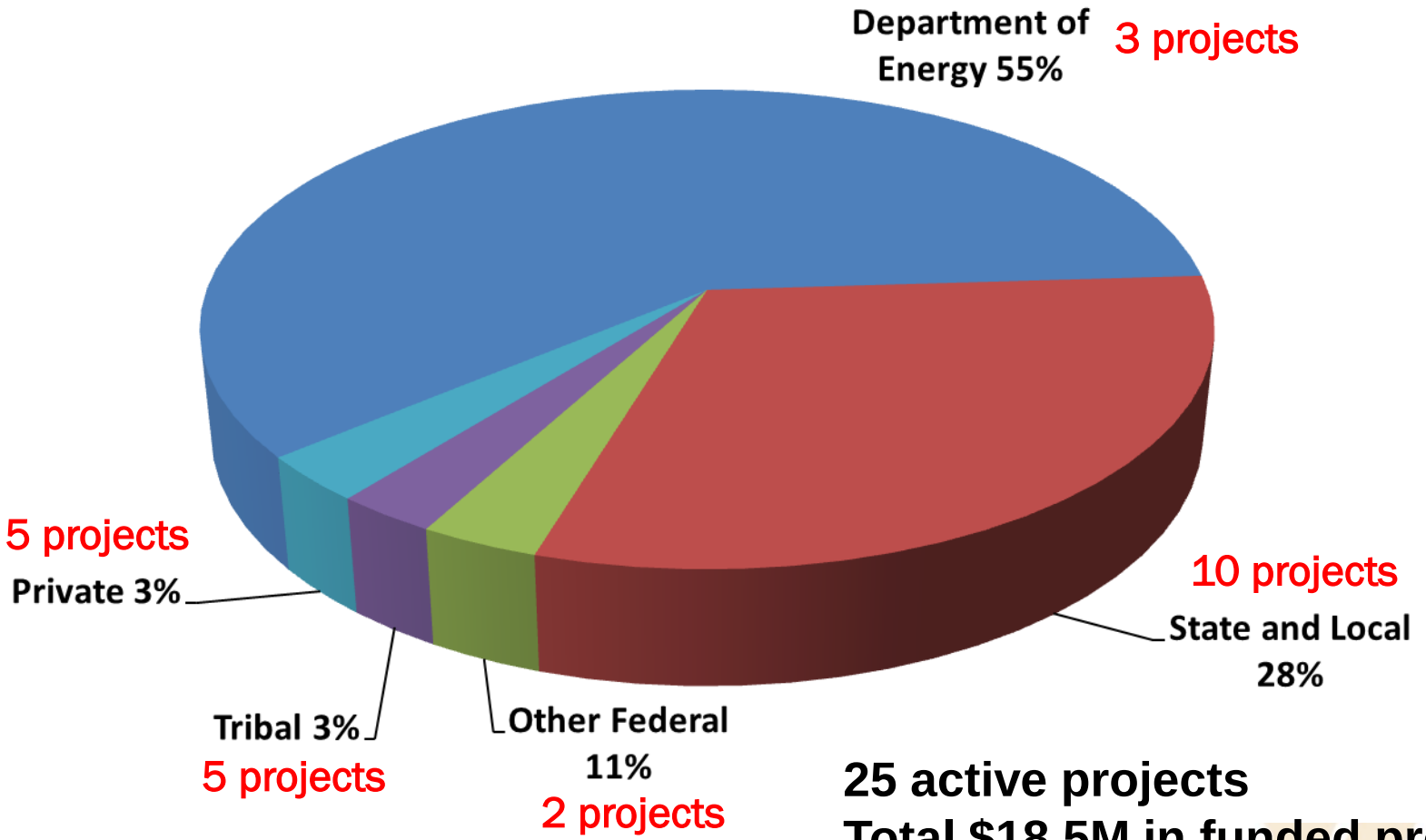
ACEP Funding Sources



25 active projects

Total $18.5M in funded projects

* some are multi-year
* does not include $750k in base funding

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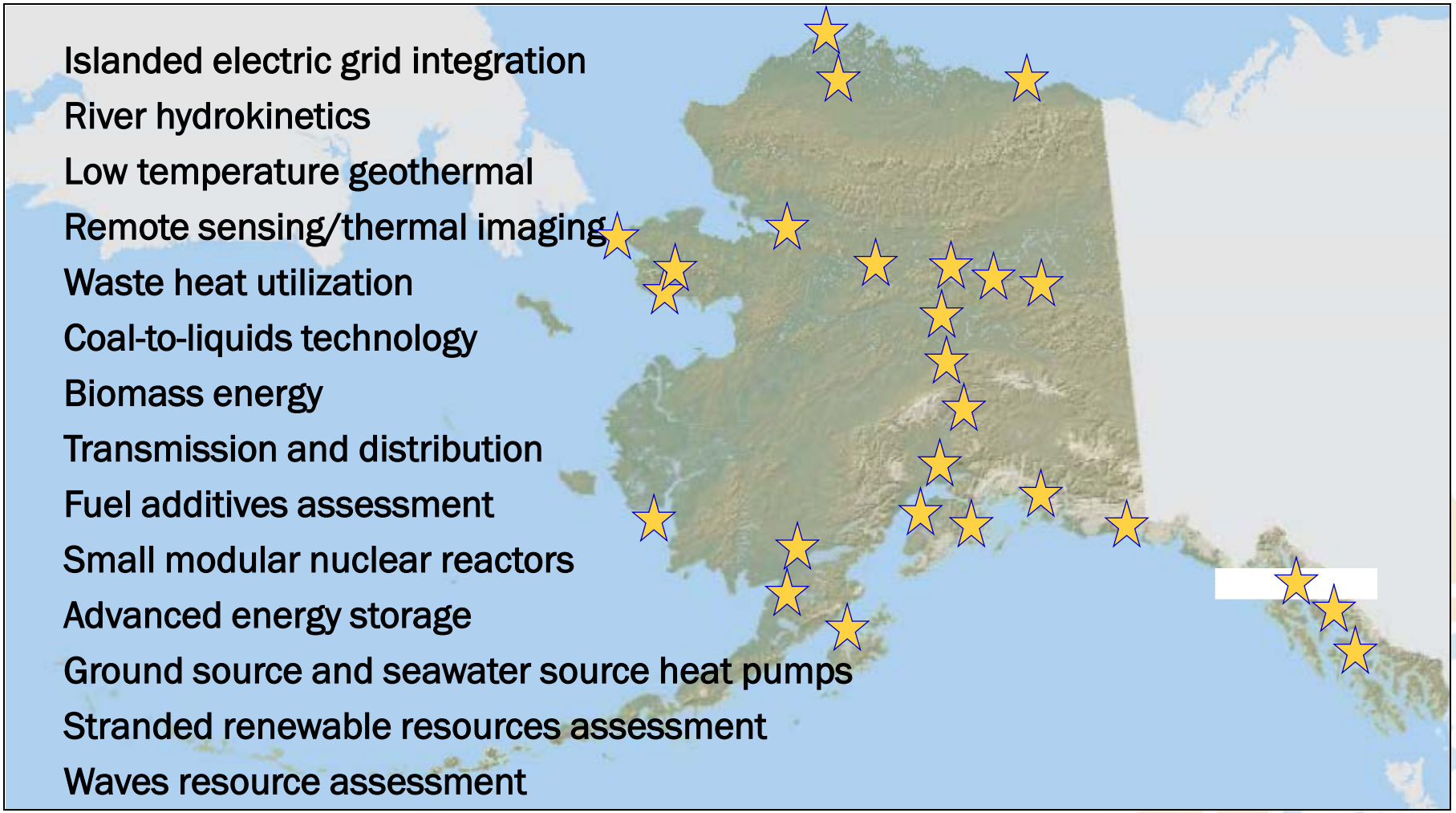
ACEP Projects are Statewide



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VISION: Alaska leading the way in innovative production, distribution, and management of energy

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What does this mean?

- We are maximizing production of our oil and gas resources
- We are developing local resources wherever practical
- We are using innovative financing mechanisms to incentivize private sector investment in Alaskan project
- Diesel-off is common place in our rural communities
- Experience gained by solving Alaska's energy challenges is exported (knowledge-based economy)

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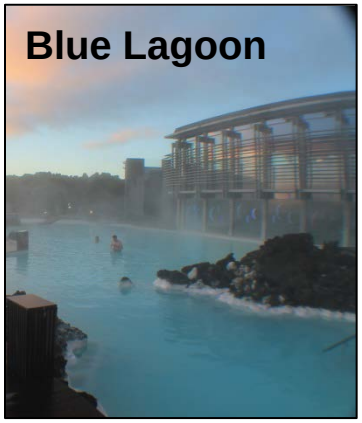
Iceland – World leader in geothermal energy



Creating opportunities at home & abroad

- Over 80 companies involved in geothermal industry (exploration, development)
- Provides free education to students from countries with undeveloped geothermal potential
- Pipeline for business opportunities for Icelandic businesses in emerging markets
- High quality jobs, energy sector significant contributor to GDP

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Supporting Statewide Economic Development: *Alaska's comparative advantages*

- High contribution renewables
- Difficult to extract/transport fossil fuels
- Value added processing
- Niche technologies (low temp geothermal, hydrokinetics)

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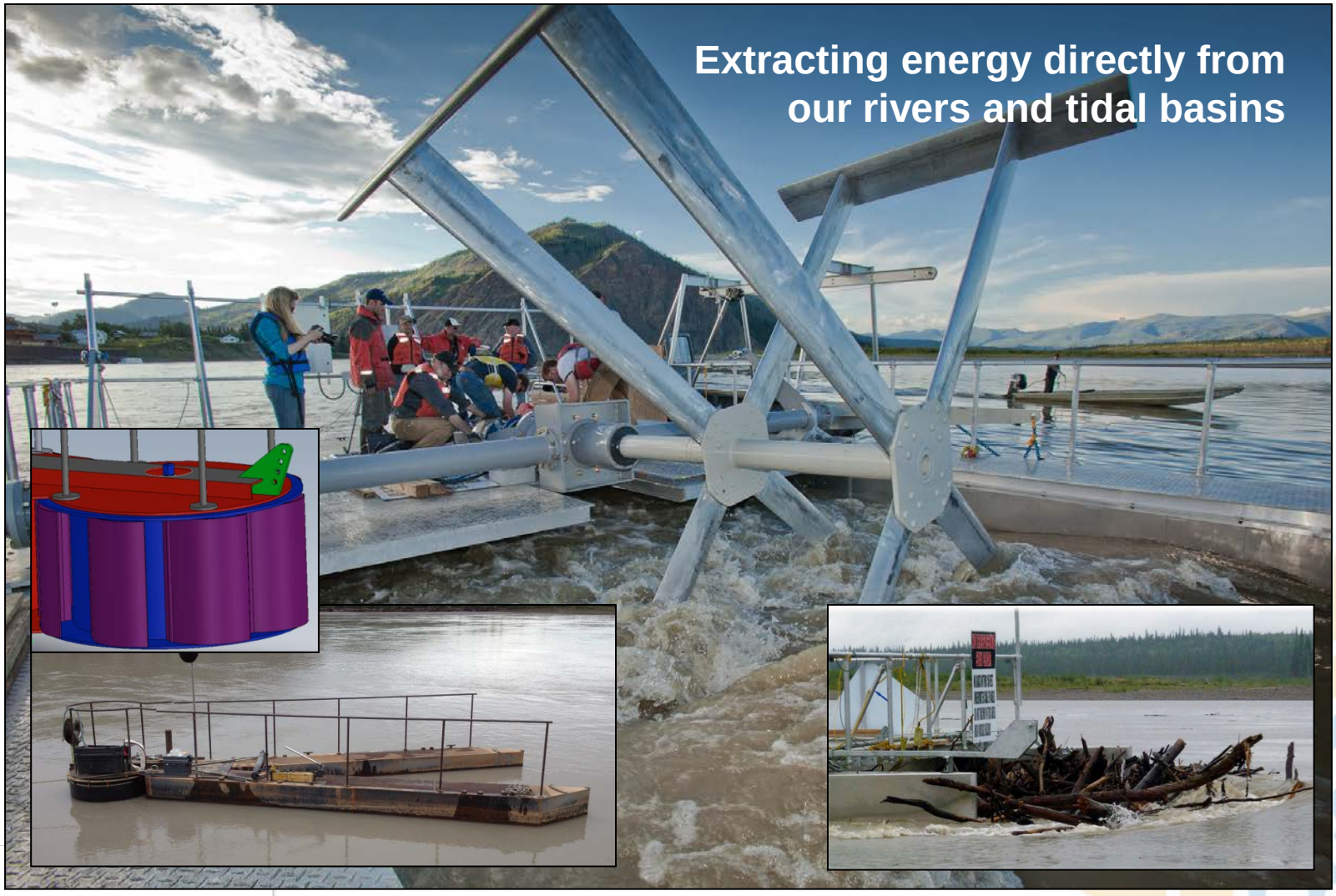
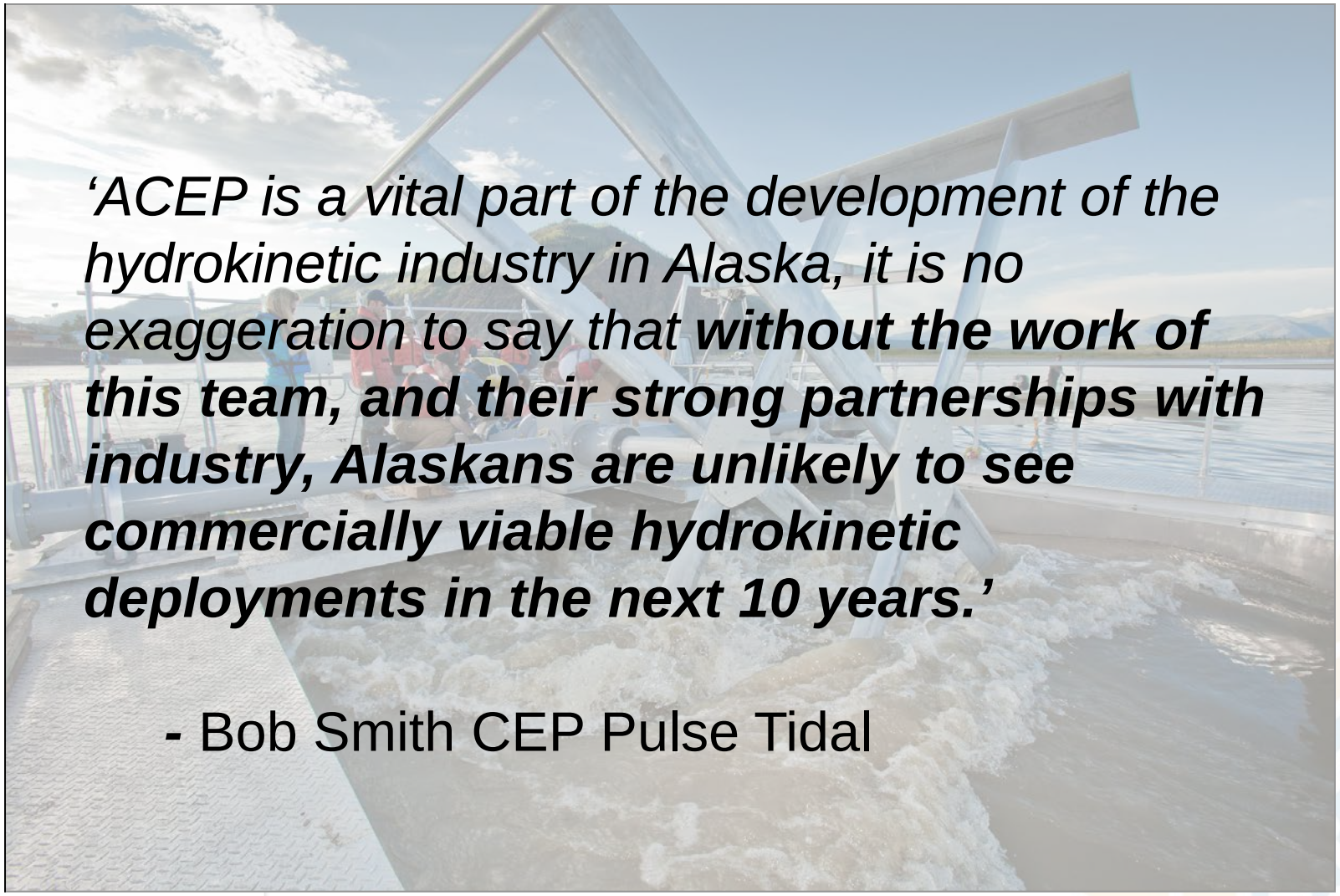
Niche Technologies - Hydrokinetics



Niche Technologies - Hydrokinetics



'ACEP is a vital part of the development of the hydrokinetic industry in Alaska, it is no exaggeration to say that ***without the work of this team, and their strong partnerships with industry, Alaskans are unlikely to see commercially viable hydrokinetic deployments in the next 10 years.'***

- Bob Smith CEP Pulse Tidal

Niche Technologies - Hydrokinetics

*'As a developer, I can speak directly to **ACEP's highly relevant and critical research** to support our industry. (Over the past couple of years) I have watched this organization **systematically identify barriers to deployment of these devices, then conduct research to see if those barriers can be mitigated**.'*

- Doug Johnson, ORPC

Hydrokinetic Energy in Alaska

Alaska Hydrokinetic Energy Research Center

(organized under ACEP)

J. Kasper, J. B. Johnson, P. Duvoy, J. Schmid, A. Seitz, H. Toniolo

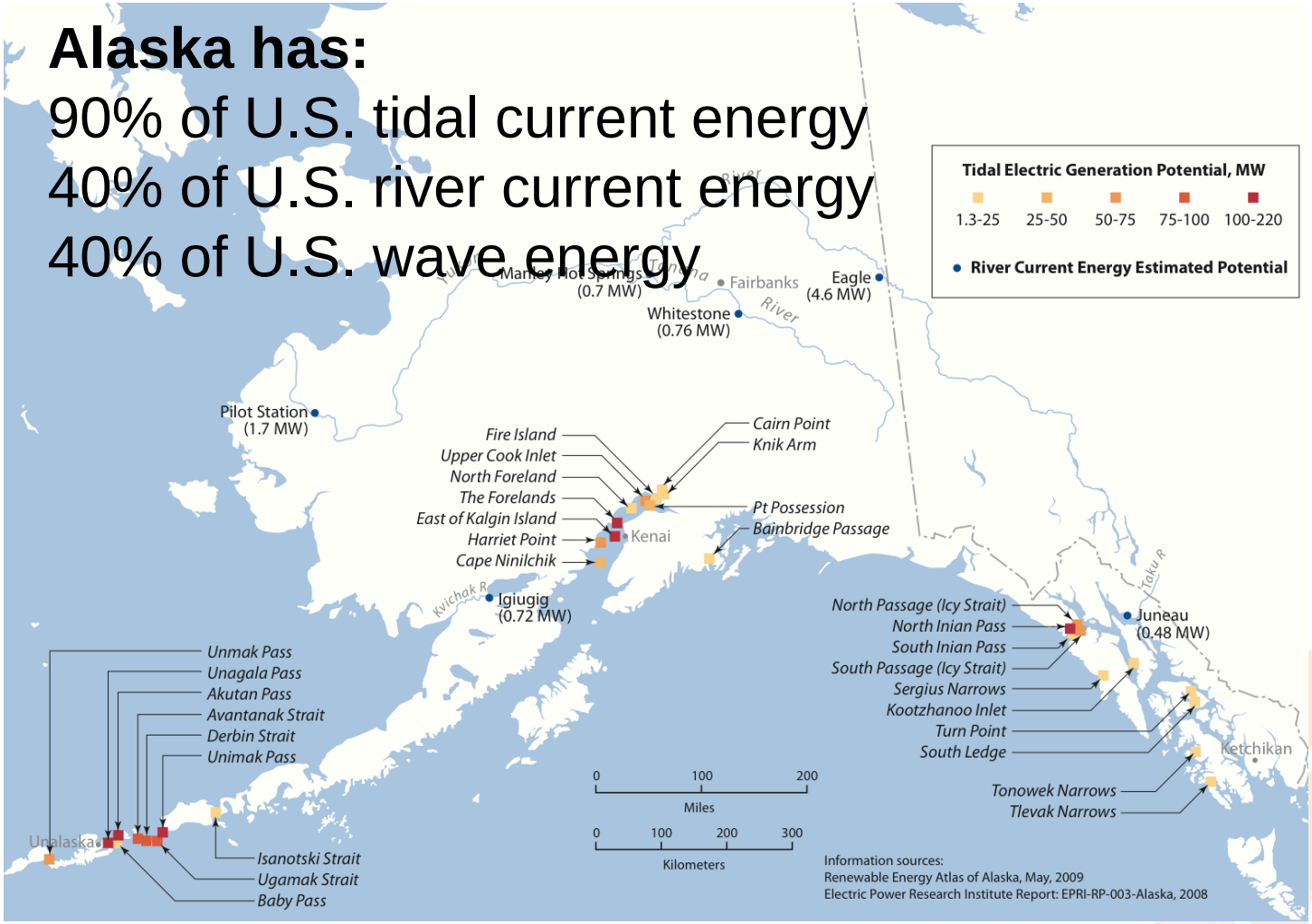
Opportunities

Alaska has:

90% of U.S. tidal current energy

40% of U.S. river current energy

40% of U.S. wave energy



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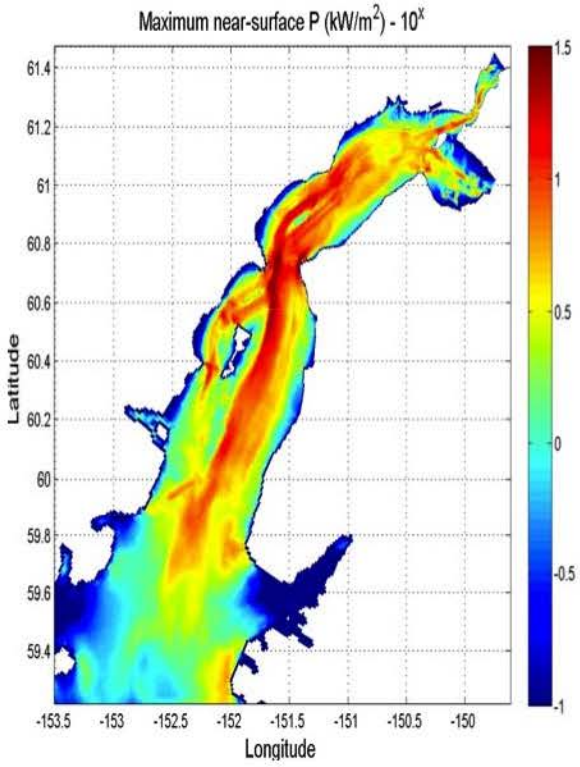
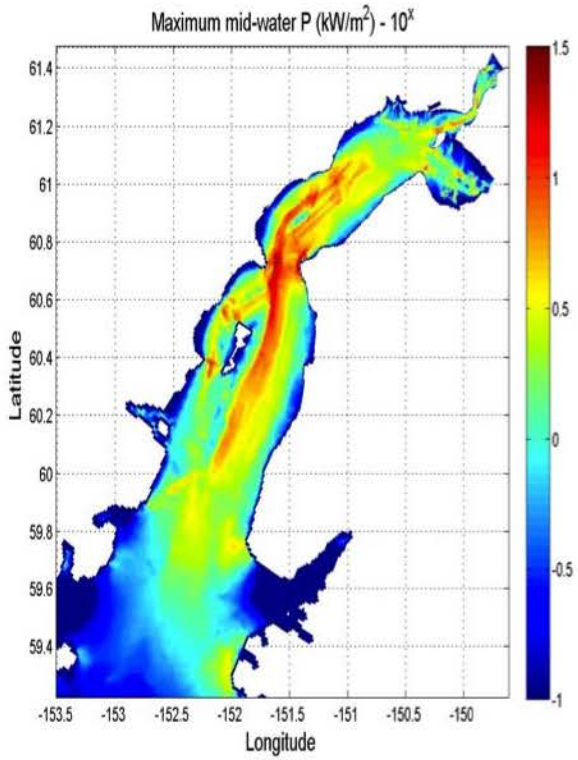
Cook Inlet – Tidal Power Potential for the Railbelt

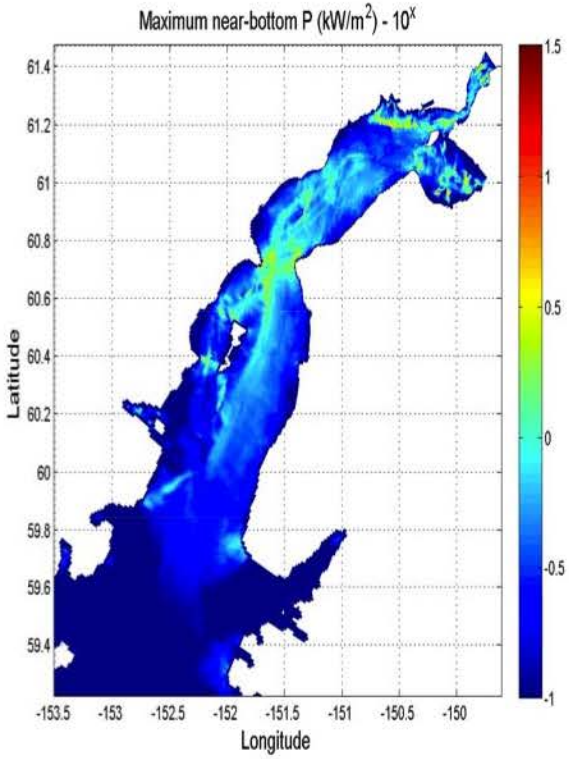
NOAA and AEA project to assess Cook Inlet tidal energy



Near Surface



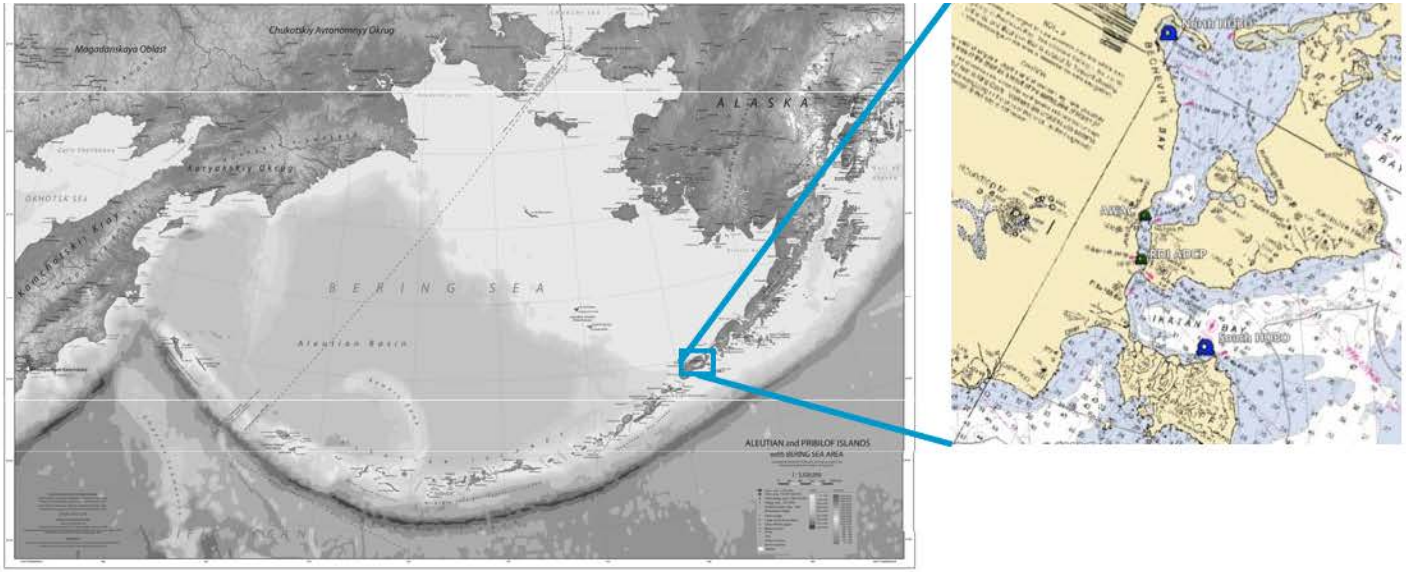
Mid water



Near bottom

Isolated Grid Opportunities – False Pass

The Aleutian Pribilof Islands Association (APIA) contracted ORPC to complete a tidal and ocean current resource assessment. APICDA, Benthic GeoScience, NREL and TerraSond helped to complete the survey.



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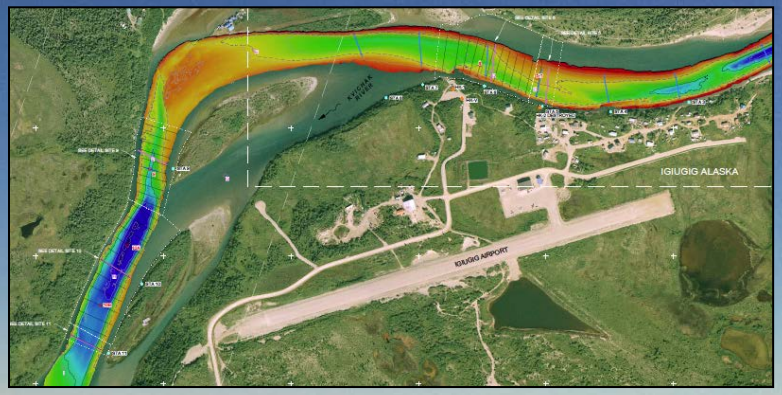
Images from ORPC website

In-River Hydrokinetics – Igiugig (Kvichak River)

- At mouth of Lake Illiamna
- Relatively little debris and ice
- Good resource identified
- Potential for 2 turbine technologies to be demonstrated in 2014



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Resolute Marine Energy

Clean Water From Ocean Waves

Yakutat Wave Energy Project

February 2014

Engineer of the Year "Sustainable development", Usine Nouvelle 2012
Global Hot 100 Award, World Summit on Innovation and Entrepreneurship 2012
Winner, MassChallenge 2011
Runner up, Global Ideas Competitions 2011
Winner, Startup Open (Global Entrepreneurship Week) 2010
World Top 100 Marine Technology Company 2009 & 2010

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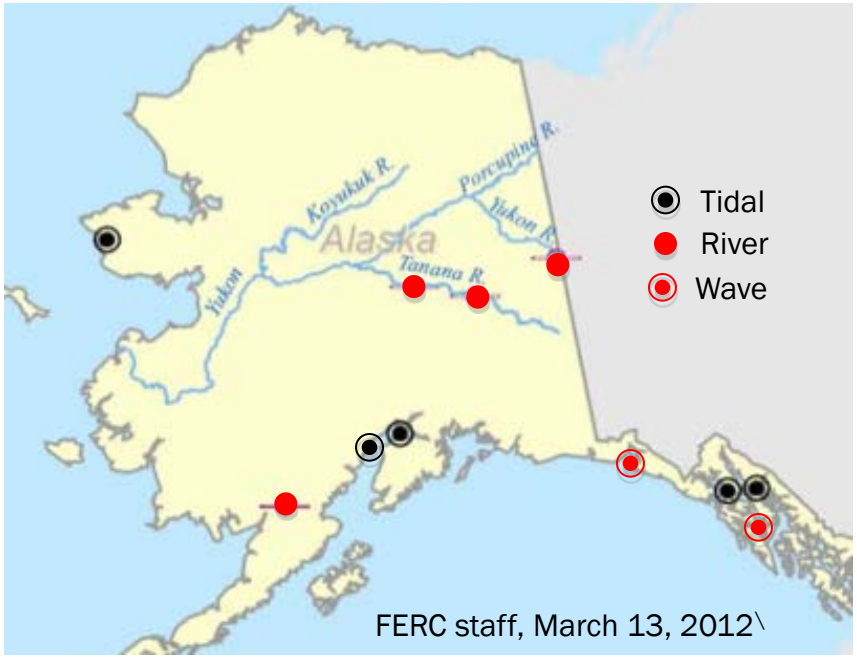
Opportunities



Issued and pending preliminary FERC permits

Economics of hydrokinetic power production at selected Alaskan locations (2010 dollars)		
Location	Est. renewable cost/kWh	Est. current Cost/kWh
Igiugig (River)	$0.68	$0.73
Eagle (River)	$0.68	$0.47
Whitestone (River)	$0.19	$0.14
Knik Arm (Tidal)	$0.11	$0.14
Yakutat (wave)	$0.28	$0.31

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Open Questions

- Hydrokinetic energy technologies are “pre-commercial”

VERDANT POWER

RITE Demo Project
Six Bottom Mounted Units

- 12/2006 to 8/2009
- Pre-commercial Units (Gen4)
  - Power to Two Customers
    - Gristedes
    - R.I. Motorgate
- Generator Units (5)
  - 60+ MWh Energy Produced
  - 7,000+ Operational Hours
  - Excellent Water-Wire Efficiency (~35%)
  - High Capacity Factor (~30%)
- Dynamometer Unit (1)

3

ORPC’s Cobscook Bay Installation

- Environmental concerns (fisheries and marine mammals)
- Economic questions – can these devices reduce energy costs for Alaskans
- High Hazards to operation in Alaska in debris, ice, shipping and both suspended and bed load sediment

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AHERC's approach

- Systematically identify challenges to adaptation of hydrokinetic energy (e.g. debris)
- Form industry partnerships
- Identify and test solutions to these challenges
- Assemble a multidisciplinary team to address these challenges

- J. Johnson (AHERC Director, Geophysicist)
- J. Kasper (AHERC Ass. Director, Physical Oceanographer)
- P. Duvoy (ACEP Res. Eng., Hydrologist)
- J. Schmid (ACEP Res. Eng.)
- A. Seitz (UAF-SFOS, Fish Biologist)
- A. Scott (ACEP, Economist)
- M. Mueller Stoffels (ACEP, Power systems Integration)
- A. Kulchitsky (UAF-INE, Computer Scientist)

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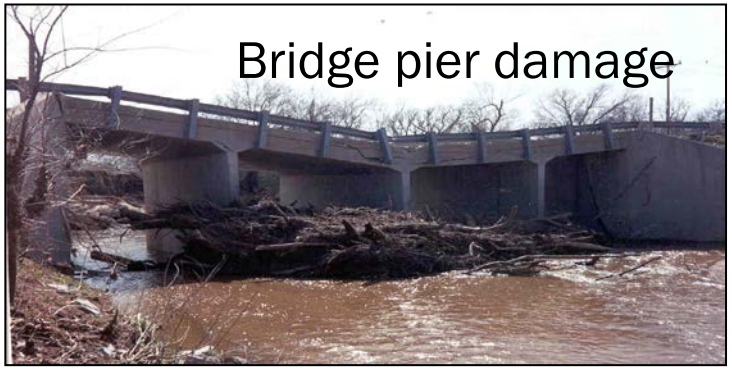
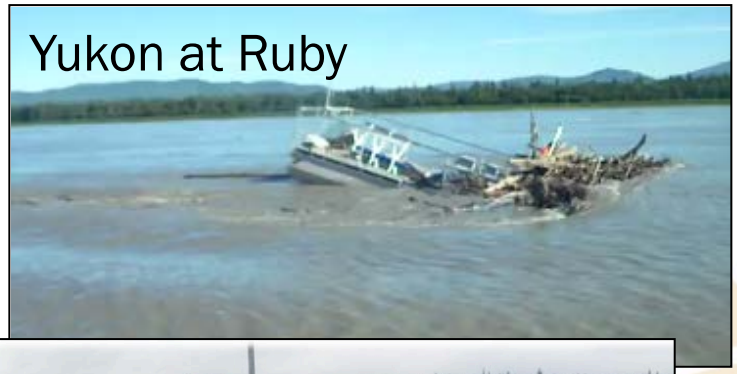
Debris Challenges

Debris accumulation damages infrastructure, disrupts operations, and creates maintenance and safety issues.

Examples:

- Ruby 5 kW turbine demonstration
- Eagle 25 kW AP&T Demonstration
- Fort Simpson 25 kW New Energy demonstration





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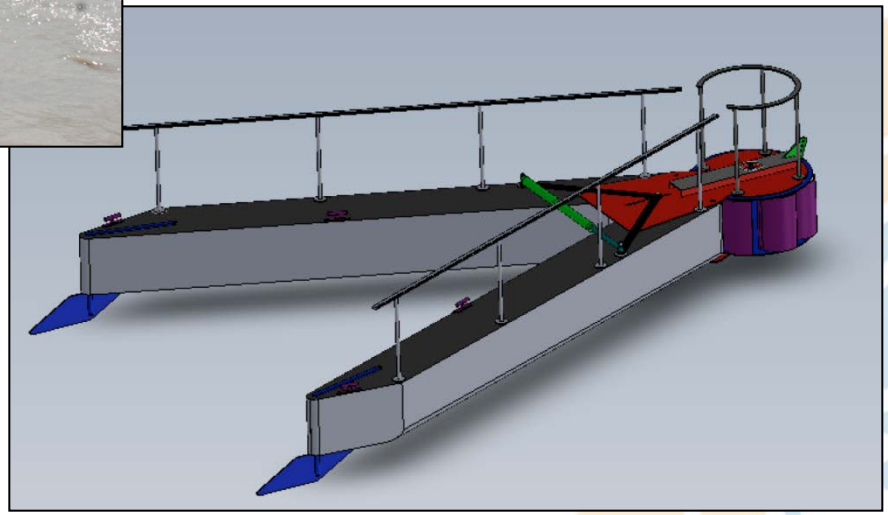
AHERC research focused on enabling technologies



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Debris Video (Debris Diversion)

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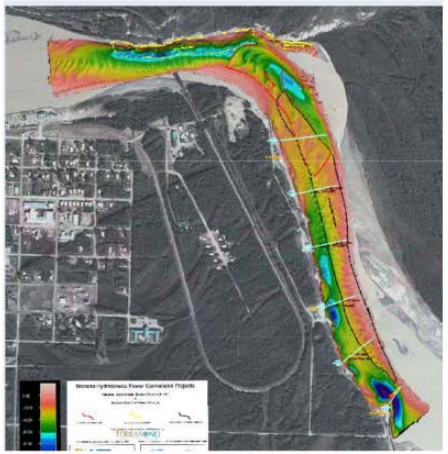
Oceana Hydrokinetic Device Evaluation Project

- Oceana device testing taking place at AHERC's Tanana River Test Site in 2014 and 2015
- UAA performing hydro-sedimentological monitoring
- Modifications to barge and preparation for testing are underway
- Subsurface debris diversion device under development



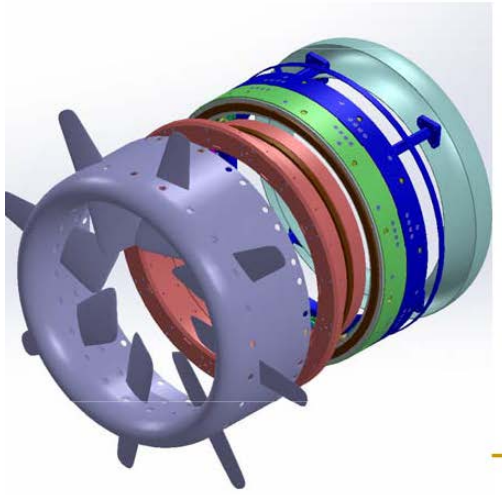


Image courtesy of Oceana

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Conclusions

- Favorable economics and highly leveraged state government support are fostering an emerging hydrokinetic knowledge economy in Alaska (e.g. ORPC, Benthic Geoscience, Inc., UAF, UAA)
- This knowledge is enabling: UAF-ACEP's debris diversion technology allowed
  - Oceana Energy to bring its technology in Alaska
  - ORPC to pursue projects in S. America
  - UAF is pursuing long term deployment of 5kW New Energy Turbine (economic analysis)
- Outside entities are engaging Alaska based entities for their expertise
  - AHERC researchers are becoming internationally recognized for their work (e.g. J. Johnson and J. Kasper are currently the 2 subject matter experts for the International Standards committee on run-of-river hydrokinetic energy resource assessment
  - Resolute Marine has engaged ORPC's Alaska project manager to consult on the Yakutat wave energy project
- UAF and UAA are actively engaged in training engineers to work in this field
- Companies are actively seeking out Alaska test facilities and opportunities
  - (examples: Boschma Research Inc., Oceana, Real New Energy, Vortex Hydro, Pulse Tidal, Resolute Marine Energy)

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Acknowledgements

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