The Alaska Hydrokinetic Energy Research Center
Alaska Center for Energy and Power
University of Alaska Fairbanks

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http://acep.uaf.edu/programs/alaska-hydrokinetic-energy-research-center.aspx

Photo by Todd Paris, UAF

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ACEP Projects are Statewide

Islanded electric grid integration
River hydrokinetics
Low temperature geothermal
Remote sensing/thermal imaging
Waste heat utilization
Coal-to-liquids technology
Biomass energy
Transmission and distribution
Fuel additives assessment
Small modular nuclear reactors
Advanced energy storage
Ground source and seawater source heat pumps
Stranded renewable resources assessment
Waves resource assessment
25 active projects
Total $18.5M in funded projects
* some are multi-year
* does not include $750k in base funding
Supporting Alaskan Economic Development

- Alaska is at the forefront of adopting new energy technologies
  - Difficult to extract/transport fossil fuels
  - State support
- Knowledge gained is exportable to other developing economies
- Niche emerging technologies such as hydrokinetics are economically competitive in Alaska
Niche Technologies - Hydrokinetics

Extracting energy directly from our rivers, tidal and wave basins
‘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
Alaska has:
90% of U.S. tidal current energy
40% of U.S. river current energy
40% of U.S. wave energy
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.
In-River Hydrokinetics – Igiugig (Kvichak River)

- At mouth of Lake Illiamna
- Relatively little debris and ice
- Good resource identified
- 2 turbine technologies demonstrated in 2014
Turbine Test at the Tanana River Test Site

Turbine Test Platform and RDDP

Oceana Turbine Testing
Permitted Site for Hydrokinetic Research and Testing in Natural Alaskan River Conditions

- Complete site characterization
  - Hydrodynamic measurement & modeling
    - Discharge, velocity, sediment, turbulence
  - Endemic fish species
  - Debris (size, type, frequency, location)

- Technology development and testing
  - Debris modeling and mitigation
  - River energy converter testing
    - Fish interaction monitoring
  - Infrastructure anchoring, deployment and operations in remote communities with islanded grids

Power density

- Low to Medium Power Density
  - Increased Turbulence
- Best Location to Capture Hydrokinetic Energy
  - High Power Density
  - Increased KE
  - Low TKE
  - TKE/KE = 2%* At transect 1100
- Reduced Power Density
  - Reduced KE
  - High TKE
  - TKE/KE = 30%
- High Power Density
  - High KE
  - High TKE
  - TKE/KE = 15%

Possible Location to Capture Hydrokinetic Energy
- Medium Power Density
- Reduced Turbulence

July 2010
(Q = 1,784 m³/s)

(Modified from Duvoy and Toniolo, 2012)
Mobile Monitoring and Assessments Capabilities: Yakutat Wave Energy Resource Assessment
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AHERC’s approach

Systematically identify challenges to adaptation of hydrokinetic energy (e.g., debris, grid integration)

Form industry partnerships

Assemble a multidisciplinary team to address these challenges

- J. Kasper (AHERC Director, Physical Oceanographer)
- J. Johnson (Senior Advisor, Geophysicist)
- P. Duvoy (ACEP Res. Eng.)
- N. Konefal (ACEP Res. Eng.)
- J. Schmid (ACEP Res. Eng.)
- A. Seitz (UAF-SFOS, Fisheries Oceanographer)
- A. Scott (ACEP, Economist)
- M. Mueller Stoffels (ACEP, Power systems Integration)
- A. Kulchitsky (UAF-INE, Computer Scientist)

Identify and test solutions to challenges

Provide information/solutions to communities, industry professionals, and educate students

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Debris Mitigation

Interaction Characterization

Mitigation Technology

Technology Testing

Debris Mitigation
Debris Mitigation Technology Testing and Modeling

RDDP debris diversion test

RDDP/debris interaction

Time: 0.000s
Mid-channel Fisheries Sampling

- **Frame Trawl**
  - Top of water column
  - Middle of water column
  - Bottom of water column
Mid-channel Fisheries Sampling

- Inclined Plane Trap
- Top of water column
Information from pre-deployment studies

• First documented mid-channel sampling in large glacially influenced Alaskan Rivers
• Abundance and species composition of catches depends on river, and timing and location of sampling
• Some primarily captured in margins
  - Longnose sucker
  - Arctic grayling
  - Whitefish spp.
  - Chum salmon
  - Lake chub
  - Burbot
  - Inconnu
  - Slimy sculpin
  - Northern pike
  - Lamprey
• Some primarily captured in the middle of the channel
  - Chinook/coho salmon
  - Chum salmon