GRID MODERNIZATION INITIATIVE
PEER REVIEW

E. IAN BARING-GOULD

April 18-20
Sheraton Pentagon City – Arlington, VA
**Project Description**

Develop and implement a pathway of technical and economic assessment leading to a 50% imported energy displacement in remote, islanded Alaskan community microgrids. First time a consortia of DOE Labs and Alaska organizations have undertaken this in a holistic way.

**Value Proposition**

- Alaskan and islanded communities have some of the most costly and least reliable energy in the U.S.
- Public sector funds decreasing but limited private investment models
- Potential huge worldwide market & learning potential

**Project Objectives**

- Develop pathways to reduce total imported fuel usage by 50% while lowering costs and improving reliability
- Using two pilot communities and existing analytical tools, articulate the use of this pathway to act as models, hopefully leading to actual projects.
- Develop data source and share information on the pathway that can be used by other stakeholders across Alaska and the Arctic.
### Alaska Microgrid Partnership

#### Project Team

<table>
<thead>
<tr>
<th>DOE National Labs:</th>
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<tbody>
<tr>
<td><strong>NREL</strong>: Ian Baring-Gould (PI), Scott Haase, Tony Jimenez. Task 1, 2, 3 leads. Project coordination, community assessment, design specifications, and modeling.</td>
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<tr>
<td><strong>LBNL</strong>: Peter Larsen (+1). Task 6 lead. Community assessment and web interface development.</td>
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<td><strong>PNNL</strong>: Trevor Hardy. Task 5 lead. Economic analysis.</td>
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<tr>
<td><strong>SNL</strong>: David Rosewater, John Eddy. Task 4 lead. Project modeling, equipment testing oversight and design specifications.</td>
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#### Alaska-based Partners:

**Renewable Energy Alaska Project:** Alaska coordination, community readiness, community and corporate engagement

**Alaska Center for Energy & Power:** Diesel control and operational testing, design specifications, and web interface development

**Intelligent Energy Systems:** Design specification, pilot community engagement, and equipment testing.

**Institute of Social & Economic Research:** Data collection support; web interface development

**External Technical Review Committee**

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#### PROJECT FUNDING

<table>
<thead>
<tr>
<th>Lab</th>
<th>FY16 $</th>
<th>FY17 $</th>
<th>FY18 $</th>
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<tbody>
<tr>
<td>NREL</td>
<td>$352,255</td>
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<td>LBNL</td>
<td>$77,400</td>
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<td>PNNL</td>
<td>$70,900</td>
<td>$81,930</td>
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<tr>
<td>SNL</td>
<td>$69,275</td>
<td>$36,920</td>
<td>$0</td>
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Alaska Microgrid Partnership
Relationship to Grid Modernization MYPP

MYPP Vision:
*The future grid will ... seamlessly integrating conventional and renewable sources, storage ... deliver ... Reliable ... sustainable, and affordable electricity to consumers.*

Topical Areas:
- **5.1.4:** Identify and classify data sources, define templates, and develop databases for new grid technologies
- **5.1.5:** Develop valuation methods and mathematical models for new energy technologies
- **5.1.8:** Develop methodologies and tools to produce simple-to-use desktop computer models
  - Task 7.1.4: As requested, DOE will provide technical support to analyze impacts of grid modernization on tribal entities
- **7.3.1:** Develop an analytical framework and tools for valuing potential benefits, costs, and impacts of distributed energy resources
- **7.3.2:** Develop and implement informational activity targeted at regulators, policy makers, consumers and utilities on valuation of DER technologies:
# Alaska Microgrid Partnership Approach

## Key Tasks:
- Project management and coordination (Task 1)
- Develop and collect community capacity metrics and data (Task 2)
- Conduct and complete community system analyses (Task 3)
- Microgrid hardware assessment (Task 4)
- Business and financing case analyses (Task 5)
- Knowledge-sharing portal to attract interest from public/private sector developers (Task 6)

## Key Issues:
- **High cost and low integration of sustainable energy solutions** for isolated communities
- **Lack of a streamlined, holistic approach** to conducting economic studies for microgrid projects
- Development of a pathway and supporting documentation to **allow additional communities or organizations to implement similar projects**
- Develop **case studies** based on **actual pilot projects**
- **Make the whole process available** on a web platform, so community-level data can be openly-shared

## Pathway for Holistic Community Microgrid Development

<table>
<thead>
<tr>
<th>Phase</th>
<th>Key Steps</th>
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</thead>
<tbody>
<tr>
<td><strong>Assess</strong></td>
<td>• Determine community readiness (capacity)</td>
</tr>
<tr>
<td><strong>Conduct</strong></td>
<td>• Conduct needs assessments (EE, RE, buildings, transportation)</td>
</tr>
<tr>
<td><strong>Analyze</strong></td>
<td>• Analyze opportunities using existing analytical tools</td>
</tr>
<tr>
<td><strong>Consider</strong></td>
<td>• Determine what new technologies may be appropriate and which options should be considered</td>
</tr>
<tr>
<td><strong>Design</strong></td>
<td>• Design projects and systems to meet project objectives</td>
</tr>
<tr>
<td><strong>Finance</strong></td>
<td>• Determine the mix of private and public funds necessary to implement design</td>
</tr>
<tr>
<td><strong>Share</strong></td>
<td>• Share information to attract project developers and Financing (private and public)</td>
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**Design and Planning Tools**

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[Image of design and planning tools]

**4/5/17**
## Milestone (FY16-FY17) | Status | Due Date
--- | --- | ---
Identify pilot communities | COMPLETE (Chefornak & Shugnak) | 8/1/2016
Early assessment of the identified pilot communities | COMPLETE, analysis complete with report development underway | 10/1/2016
Design Framework for Standardized Systems (DRAFT) | IN PROGRESS, Initial draft under review by the project team | 1/1/2017
Technical paper describing results of diesel testing (DRAFT) | IN PROGRESS, test plan under development, building off of current testing on a similar project (10% complete) | 4/1/2017
Technical paper with assessment of storage options (DRAFT) | IN PROGRESS, several storage options in operation and Alaska focused storage assessment complete (50%) | 4/1/2017
Review draft of generic business case analysis | IN PROGRESS, several existing pro-forma style assessments collected and being analyzed (10%) | 7/1/2017
Final technical and business case studies for two pilot communities | IN PROGRESS, economic model developed, technical studies under analysis | 10/1/2017
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Accomplishments to Date

Early Insights:

• Critical to engage across the portfolio of energy consumption (electrical, thermal & transportation)

• Two pilot communities show that a 50% reduction in imported fuel use is possible if considering both electricity and heat

• Fuel reductions from transportation sector have been harder to tease out

Stakeholder Engagement:

• Formulation of the Technical Review Committee and Financiers’ Roundtable

• Project has been discussed at several domestic and international conferences

• Project partner (Chris Rose) provided testimony to U.S. Senate E&NR Committee AMP project
Near-term Accomplishments:

• Community readiness indicators developed to assess human, financial, and technical capacity to undertake energy infrastructure projects
  • Applied to Power Africa Beyond the Grid and ACEP teaching programs
• Screening of techno-economic modeling tools (DER-CAM, REopt, Microgrid Design Tool, HOMER, etc.)
• Design framework for system design

Long-term Accomplishments (planned):

• Develop and implement a technical and financial pathway for remote communities to develop reliable, inexpensive, and sustainable energy infrastructure
• Upgrade the Alaska Energy Gateway to communicate community-level financial, technical, and human capacity to undertake energy infrastructure projects
<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Response from AMP Team</th>
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<tbody>
<tr>
<td>Engage with other microgrid projects – specifically New Orleans, LA and Knoxville, KY.</td>
<td><em>Initial discussions have taken place and information has been exchanged. The nature of the Alaska Microgrid Project (isolated systems and focused on the development of an implementation process) make direct linkages difficult.</em></td>
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<pre><code>                                                                                     | *Results of the different projects are being shared.*                                                                                                   |
</code></pre>
Project Collaboration:

- **1.3.04 Industrial Microgrid Analysis and Design for Energy Security and Resiliency** – microgrid analysis
- **1.3.05 DER Siting and Optimization Tool for California** – Der Cam included in screening assessment, improvements will support more detailed assessment
- **1.3.11 Grid Analysis and Design for Energy and Infrastructure Resiliency for New Orleans** – microgrid analysis

Communications:

Outputs from the AMP are influencing discussions across Alaska and beyond...

- Rural Alaska Energy Conference
- Alaska Power Association
- University of Alaska Fairbanks Arctic Remote Energy Networks Academy program
- International development programs: International Renewable Energy Agency, Power Africa
Alaska Microgrid Partnership
Next Steps and Future Plans

Near-Term Plans:
• Complete techno-economic modeling for two pilot communities (April 2017)
• Conduct business case analysis for the two pilot communities to identify viable financing models (July 2017)
• Develop template to allow application of the modeling and business-case approach to other communities (September 2017)
• Identify additional communities interested in implementing the pathway (September 2017)
• Establish the Alaska Energy Gateway 2.0 by expanding the existing Alaska Energy Data Gateway (September 2017)

Follow-on Work (pending additional support):
• Support two pilot communities in their pursuit of developing real energy infrastructure projects
• Collaborate with Harvard University students to integrate transportation sector assessments into the analysis process
• Implement the pathway produced from this project in additional communities
• Incentivize communities to upload additional financial, human, and technical capacity information into the Alaska Energy Gateway 2.0

Mid-term impact:
• Communities have been very conservative and piecemeal, only low imported energy saving systems have been applied in rural Alaska
• Approximately 20 (out of 200) communities could implement this process in the near-term
Questions?

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Significant Challenges in Rural Alaska:

- Approximately 200 remote Alaska communities rely on expensive, imported fuel for electricity, heat, and transportation.
- Electric power in these communities is some of the most expensive (up to 10x the national average cost) and least reliable in the United States.
- There is great potential for renewable energy, energy efficiency, and advanced technology solutions.
- The existing renewable energy retrofits (~40 communities) are mostly low- and medium-contribution systems. Although difficult, technical challenges related to high-contribution renewable energy systems can be solved.
- All projects to date have relied on federal and state grant funding, which is not viable going forward.
- After examining existing projects, no single model pathway has emerged to help other communities address dependence on imported fuels.
- The potential worldwide market and impact are huge:
  - 400 diesel microgrids in Canada, 70 in Greenland, more than 1,000 in Indonesia
  - IEA estimates that more than 700 million people currently without electricity access could be most cost-effectively served by mini-grids or microgrids.
Project Participants and Roles:

**NREL**: Project management, conduct techno-economic modeling for one community

**LBNL**: Community readiness assessment; Develop Alaska Energy Data Gateway 2.0

**SNL**: Conduct techno-economic modeling for one community

**PNNL**: Develop business case analysis for the financing of the opportunities identified in the techno-economic modeling

**REAP (Renewable Energy Alaska Project)**: Coordinate Alaska-based partners, represent project at Alaska-based forums, support collection of community data

**ACEP (Alaska Center for Energy & Power)**: Conduct hardware-in-the-loop laboratory testing of diesel generators operating with energy storage; Develop and host Alaska Energy Data Gateway 2.0

**IES (Intelligent Energy Systems)**: Conduct cost and performance assessment of microgrid storage technology options

**ISER (Institute of Social & Economic Research)**: Develop & host Alaska Energy Data Gateway 2.0

Technical Review Panel Members:

Rob Bensin
Eric Hansen
Dave Messier
Sonny Adams
Brian Hirsch
Bill Stamm
Tom Wolfe
Givey Kochanowski
Michael Johnson
Cady Lister
Josh Craft
Roderick Philip
Connie Fredenberg
Steve Colt
Brent Petrie
John Lyons
Robert Sheldon

Bering Straits Development Corporation
Alaska Native Tribal Health Consortium
Tanana Chiefs Conference
NANA
Deerstone Consulting
Alaska Village Electric Cooperative (AVEC)
Denali Commission
Office of Indian Energy, DOE
Department of Interior
Alaska Energy Authority
Alaska Energy Authority
Channinik Wind Group
Consultant
Alaska Pacific University
AVEC (retired)
TDX Power
Venture North Group