GRID MODERNIZATION INITIATIVE
U.S. Department of Energy

GRID MODERNIZATION INITIATIVE PEER REVIEW

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April 18-20

Sheraton Pentagon City – Arlington, VA

Alaska Microgrid Partnership
High Level Summary

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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.


Photo Credit: Riley Allen

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.

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Project Team

PROJECT FUNDING			
Lab	FY16 $	FY17$	FY18 $
NREL	$352,255	$182,280	$0
LBNL	$77,400	$129,040	$0
PNNL	$70,900	$81,930	$0
SNL	$69,275	$36,920	$0

DOE National Labs:

NREL: Ian Baring-Gould (PI), Scott Haase, Tony Jimenez. Task 1,2, 3 leads. Project coordination, community assessment, design speck, and modeling.

LBNL: Peter Larsen (+1). Task 6 lead. Community assessment and web interface development.

PNNL: Trevor Hardy. Task 5 lead. Economic analysis.

SNL: David Rosewater, John Eddy. Task 4 lead. Project modeling, equipment testing oversight and design specifications.

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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Relationship to Grid Modernization MYPP

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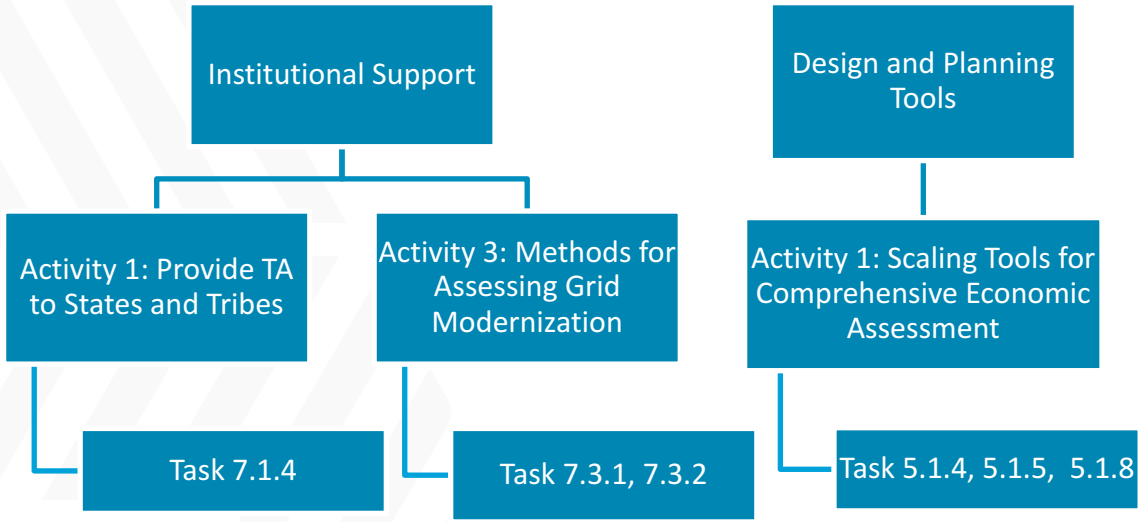
MYPP Vision:

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 *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:

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Approach

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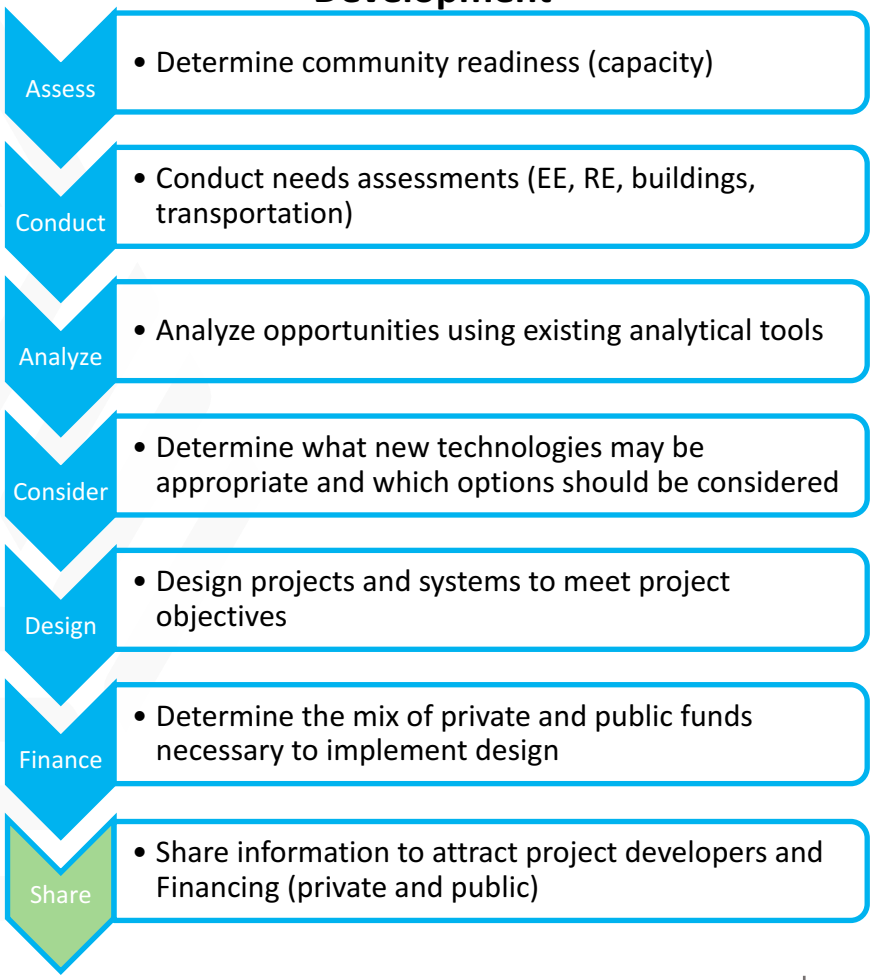
Key Tasks:

- ✓ 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



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Key Project Milestones

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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

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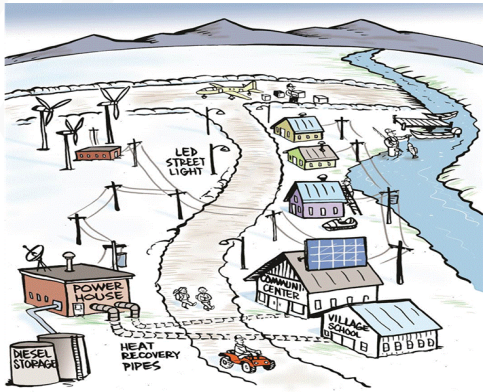
Early Insights:

- 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

Analysis must address total community loads, "Typical" remote Alaska homes provide opportunity Photo credit: Peter Larsen (LBNL)



A community energy system using high amounts of local energy sources is possible. Photo Credit: LBNL/RAP (2016)

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Accomplishments to Date

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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

Two of three wind turbines over the bulk fuel tanks of the Kasigluk Power Station, a vision of what could be possible in the future. *Photo by Ian Baring-Gould, NREL 16097*

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

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Response to December 2016 Program Review

Recommendation	Response from AMP Team
Engage with other microgrid projects – specifically New Orleans, LA and Knoxville, KY.	*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.* *Results of the different projects are being shared.*

Rural Alaska "Power House"
Photo credit: Peter Larsen (LBNL)

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Project Integration and Collaboration

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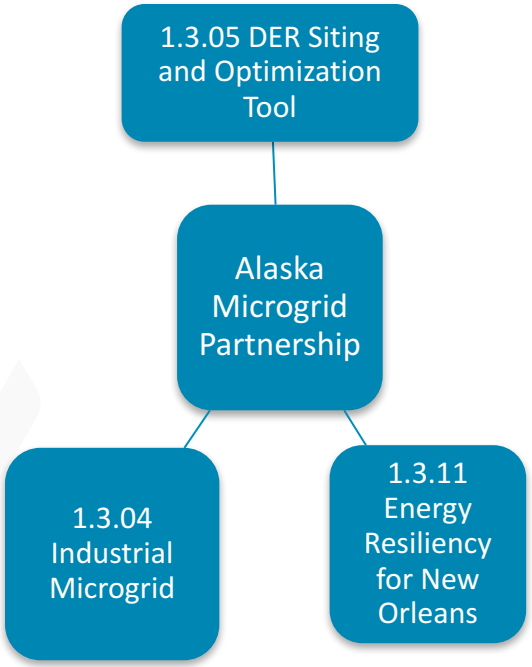
Project Collaboration:

- **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

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Next Steps and Future Plans

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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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Backup Slides

Backup Slide #1: AMP
Typical Rural Alaska Community

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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.


Riley Allen (RAP)


Alaska “Power House”
Photo credit: Peter Larsen (LBN

Backup Slide #2: AMP
Project Partner - Details

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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	Bering Straits Development Corporation
Eric Hansen	Alaska Native Tribal Health Consortium
Dave Messier	Tanana Chiefs Conference
Sonny Adams	NANA
Brian Hirsch	Deerstone Consulting
Bill Stamm	Alaska Village Electric Cooperative (AVEC)
Tom Wolfe	Denali Commission
Givey Kochanowski	Office of Indian Energy, DOE
Michael Johnson	Department of Interior
Cady Lister	Alaska Energy Authority
Josh Craft	Alaska Energy Authority
Roderick Philip	Channinik Wind Group
Connie Fredenberg	Consultant
Steve Colt	Alaska Pacific University
Brent Petrie	AVEC (retired)
John Lyons	TDX Power
Robert Sheldon	Venture North Group