NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Supported by the U.S. Department of Energy

Status of the Wind-Diesel Market

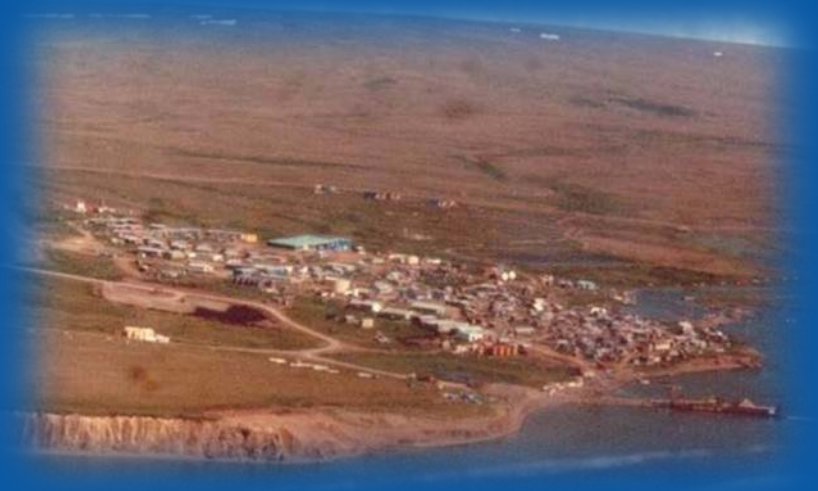

Photo credit: Northern Power Systems

E. Ian Baring-Gould

February 27, 2014

Distributed Wind Energy Association's (DWEA)

2014 Distributed Wind Conference

Washington, D.C.

NREL/PR-5000-61553

Range of Power Systems

Renewable power systems can cover a wide range of needs, including:

- **Dedicated use:** Power used at point source without regulation, such as water pumping and ice making
- **Small or simple systems:** Power systems for small communities, individual buildings, and dispersed energy needs
- **Community power systems:** Power provided to large communities and isolated loads
- **Integrated systems:** Large islanded systems integrating conventional and large-scale renewable generation.

The Wind-Diesel Market Remains Elusive

Progress is being made.

- There is a great need and many potential markets.
- A growing number of project examples are resulting in a general acceptance of the technology as a solution.
- The market is still limited, leading to continued market challenges.
- There are expanded capabilities but limited research and development.
- There is no clear path forward to “unlock” the industry.

Communities on the Verge of an Energy Crisis

Oil spikes & high costs have led many nations, states, and organizations to examine options to reduce dependence on diesel fuel for power generation.

- Remote Alaskan villages
  - As much as $1/kWh (10 x U.S. average)
  - As much as $12/gallon for diesel fuel
- Nations that comprise the Small Island Developing States (SIDS) and Alliance of Small Island States (AOSIS)
  - Power costs approaching $0.50/kWh
  - Typically 100% dependent on diesel, with small-scale solar or wind power
- Thousands of small, remote, off-grid communities
- Thousands of larger island communities
- More than 1.2 billion people in the world have no access to electricity (more than 85% in rural areas).

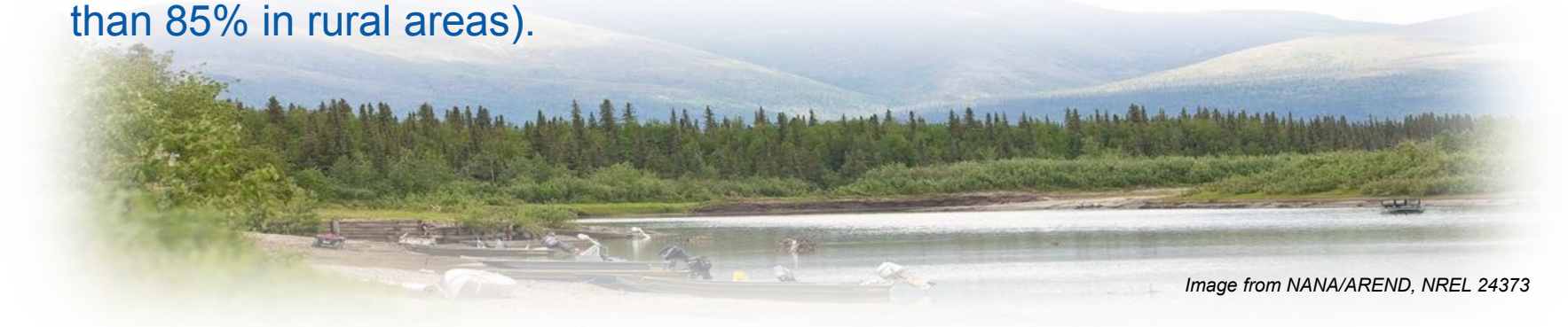

Image from NANA/AREND, NREL 24373

The Market Has Recently Advanced

~26 projects operating or under construction in Alaska

- Primarily low to medium contribution
- Some high-contribution projects being developed and implemented
- Larger turbines being installed in many larger communities
- Generally good turbine availability.

Operating projects in almost every region of the world, with technology that is pushing the market

- St. Paul, Alaska: High contribution for more than 20 years
- Chaninik Wind Group, southwest Alaska: Dispersed smart heating loads
- Ross Island, Antarctica: Advanced turbine and flywheel control
- King Island,Tasmania: High contribution using storage and smart grid
- Aruba, Galapagos, & others: Demonstrating large turbine deployment
- Banner Peak Wind Farm, Nome, Alaska: PPA-based isolated wind contract model
- Kodiak Island, Alaska: Wind-hydro facility with battery storage
- Coral Bay, western Australia: Wind, flywheel, and low-load diesel
- REMEA: Wind-diesel system with hydrogen storage
- Oahu, Hawaii: High contribution on large islanded grids.

Current Approach and Continued Challenges

- Tailored, unique solutions for each community
- Customized engineering, equipment, controls, and construction with little uniformity or commonality among systems
- Projects based mostly on grant or research funding
- Little precedent for streamlined project financing, component cost reduction, procurement, construction, and operation and maintenance
- Limited funding for technology development (outside of project funding)
- Even less funding for follow-up, evaluation, impact assessment, and technology improvement
- Limited common terminology or general agreement on even basic terms
- No common understanding of accurate performance metrics
- No standards or other internationally “accepted” design criteria – hard to find expanded institutional support
- No coordinated outreach, targeted industry or users group, or expanded communications network
- Systems are underperforming as compared to the modeling
- A virtual glass ceiling for high-contribution power systems.

Step-by-Step Improvements

- There is continued technology development, but it hasn't resulted in industry "game changers."
- Expansion of telecom and military use have increased reliability but have not really improved the price point for community power.
- The decreasing cost for wind technology and power converters has improved system economics and reliability but not up-front costs.
- Increased access to renewable resource information is very helpful.
- Smart grid concepts have a great deal of promise but little organized implementation.
- Expanded testing infrastructure is available to support system development.
- The DOI, DOD, and the Department of State are increasingly interested in research projects.

Top left: Photo by Lee Jay Fingersh, NREL 29583. Bottom left: Photo by Ian Baring-Gould, NREL 29581

Paths Forward

We know that there are many isolated and islanded communities.

We know that the viability of remote and islanded communities depends on affordable energy supplies that wind can help provide.

We know that many governments, utilities, and organizations are interested…

… but the steps required to move the market forward are still unclear.

Photo by Ian Baring-Gould, NREL 16096

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Photo from TDX power, NREL 13634

E. Ian Baring-Gould

Technology Deployment Manager

National Wind Technology Center

303-384-7021

Ian.baring-gould@nrel.gov