Standardizing Mini-grid Modeling, Feasibility, & Financial Analyses

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Mini-grids Workshop:
Technological Advances; Regulatory Framework and Quality Assurance
Dakar, Senegal
November 13 – 14, 2018
The Future of Power

Solar and Storage are both inherently distributed

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Growing Microgrid Market

The microgrid market will reach nearly $20 billion in annual revenue by 2020, according to Navigant Research.

Microgrid Projects by Geographic Area:
- Western Europe: 23,965
- North America: 25,917
- East Asia: 9,008
- Latin America: 9,448
- Mideast: 7,429
- Oceania: 5,434
- South Asia: 7,340
- Eastern Europe: 5,690

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Grid Extension

- Good option for large, nearby loads
- Bad option for small, distant loads

- Fix these problems before taking on new customers
  - Poor grid reliability
  - Poor grid financial condition
  - High grid losses, including “non-technical” losses

- Modern mini-grids can provide high quality, 24 hour power

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Technology Evolution

What used to be
- Early wind-based systems
- Lead batteries
- Unreliable inverters
- No monitoring
- Grant projects without community engagement

What works
- Inexpensive solar
- Hybrid technologies
- More & better storage choices
- Reliable electronics
- Remote monitoring
- Real commercial approach

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Microgrid Markets

• General Markets
  • Grid-Connected
    • Demand & TOU management
    • Resilience in developed countries
    • Reliability in developing countries

• Off-Grid
  • Energy Access
  • Island & isolated utilities

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Microgrid Value Propositions

- Forward Operating Bases
- Military Bases
- Backup for Unreliable Grids
- Energy Access
- Energy Cost Savings
- Demand Mgmt.
- Telecomm
- Islands
- Mines
- Campuses
- Ecotourism
- RE & EV Integration
- Emergency Services & Critical Infrastructure

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HOMER’s Evolution

• 1992 – Earth Summit in Rio
  • NREL creates Village Power Program
  • HOMER as research tool for small, off grid systems
• 1998 – HOMER available to the public
• 2001 – HOMER 2 for larger island systems, CHP, DG
• 2009 – HOMER Energy spin-offs from NREL
• 2014 – HOMER Pro released
• 2017 – HOMER APIs released
• 2018 – HOMER Grid released

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Too Many Choices

- Solar
- Wind
- Hydro
- Geothermal
- Ocean Energy
- Fuel Cells
- Micro-turbines
- Micro-grids
- Demand Response
- Load Management
- Electric Vehicles
- Smart grids
- New Storage Techs.

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What is best?

• It depends on:
  • Resources
  • Loads
  • Equipment prices
  • Equipment performance

• A confused mind says “No!”

• HOMER fits the pieces together

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How the HOMER software works

Project Inputs
- Load Profile
- Site-Specific Resources
- System Components

Analysis
- Simulation
- Optimization
- Sensitivity Analysis

Results
- Economic & Engineering
  - Financials
  - System Sizing
  - Performance Details

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Communication

Renewable Advocates

Power Engineers

Utility Operators

HOMER Model

Financiers

HOMER bridges different worlds

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Global Data

- HOMER users access
  - Resource data
  - Load data
  - Tariff data
- We collect project data
  - 50,000 projects under development
  - 2 million files
- Market Insight Reports
- Quarterly review for Partners

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What is Different about Microgrids?

• Hybrid renewable mini-grids
  • More complex, but smaller
• Need streamlined development
• Soft costs are the challenge
  • Make up a larger proportion of total capital costs
  • Hardest to finance
  • Everything prior to procurement
    • Marketing
    • Customer engagement
    • Engineering design
  • Permitting
  • Finance
• Quality Assurance standards are the answer

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Innovation in the Power Industry

- Smart, Clean Microgrids
- Smart Super Grid
- Hybrid Renewable Power Systems
  - Remote Diesels
  - Backup Diesels
  - Island Power Systems
- Major Utilities
  - Security obstacles
  - Regulatory obstacles

Smaller Systems
- Liquid fuels from oil
- High renewable penetrations

Large Utilities

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Standards

• Advantages of standardization
  • Reduce costs and risk

• Challenges of standardization
  • Utility industry is changing
    • Technological improvements
    • Innovation
    • Problems with existing grids
  • Is the central grid really going to come?

• Diverse applications

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Conclusion

• The Future is Distributed
• The Sun Shines Everywhere
• Learn from diverse global applications

• Regulatory obstacles abound
• Hybrid mini-grids can supply high quality, reliable power

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