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Standardizing Mini-grid Modeling, Feasibility, & Financial Analyses

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CEO, HOMER Energy

Mini-grids Workshop:

Technological Advances; Regulatory Framework and Quality Assurance

Dakar, Senegal

November 13 – 14, 2018

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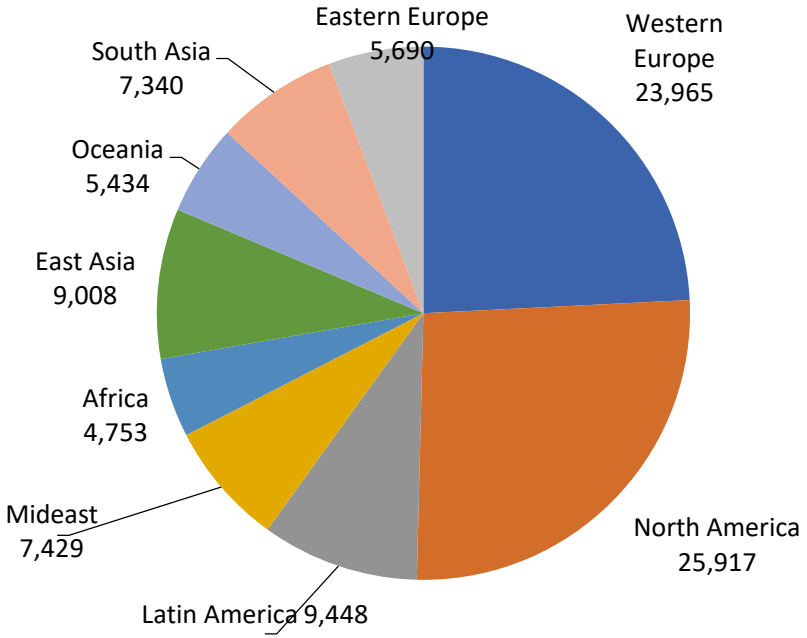
The Future of Power

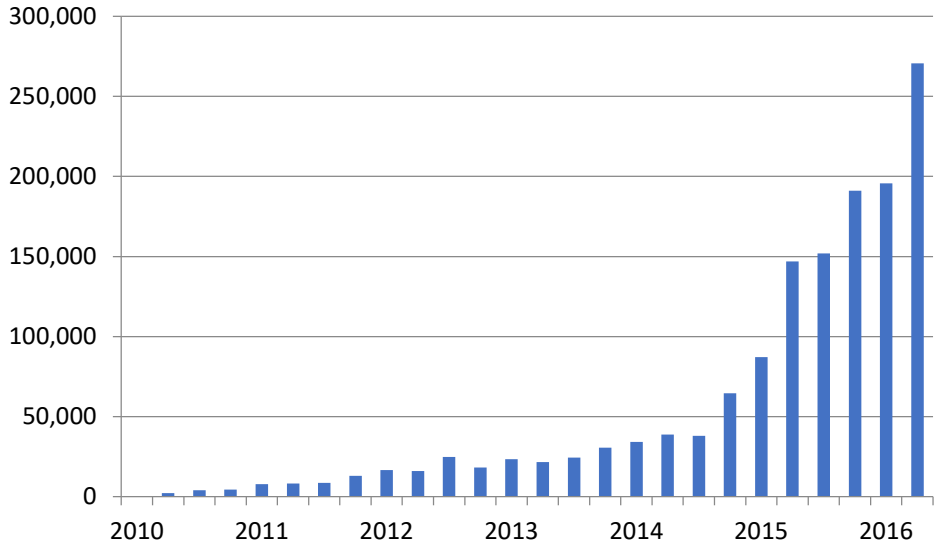
Solar and Storage are both inherently distributed

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



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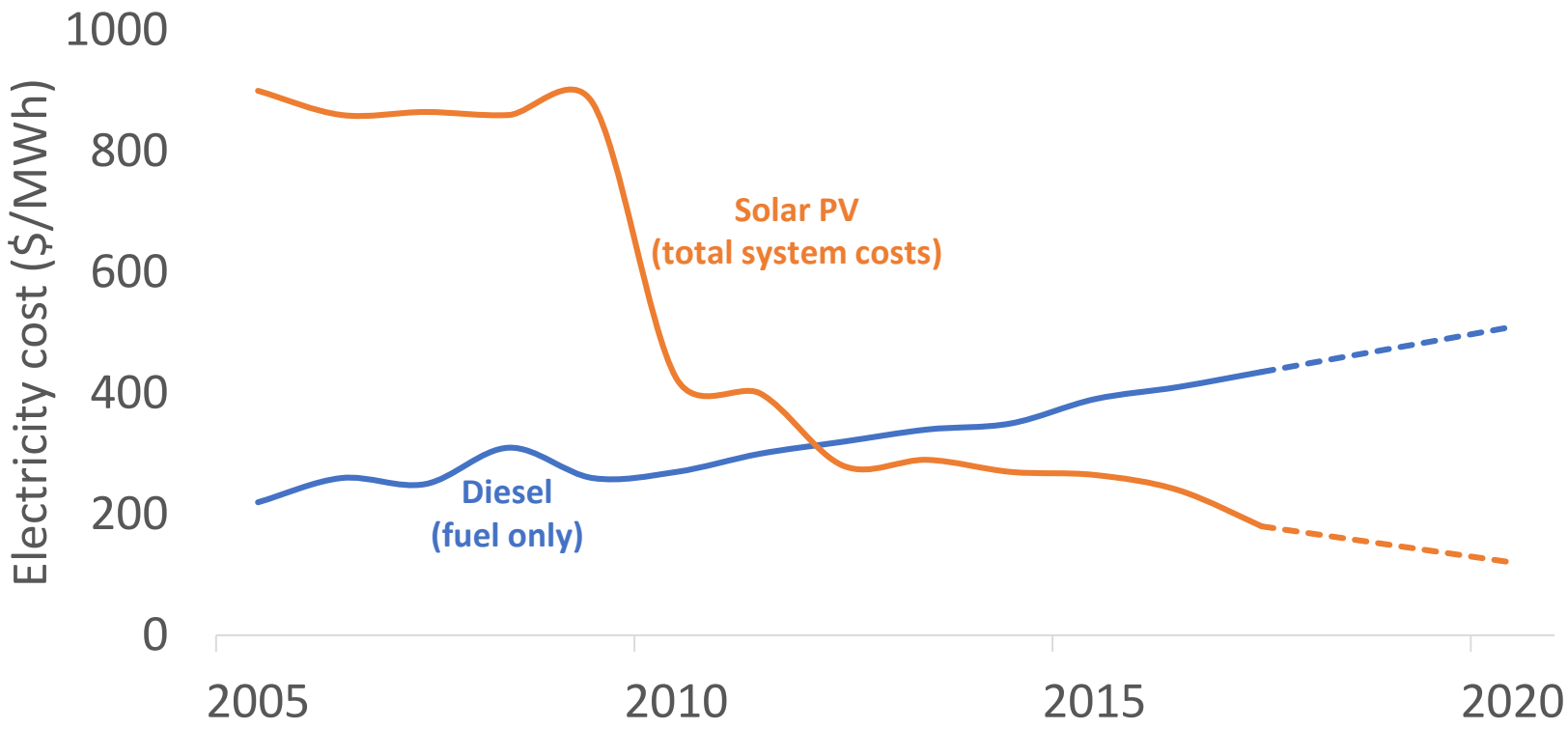
Unsubsidized Economics



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Grid Extension

- Good option for 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

Microgrid Markets

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

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

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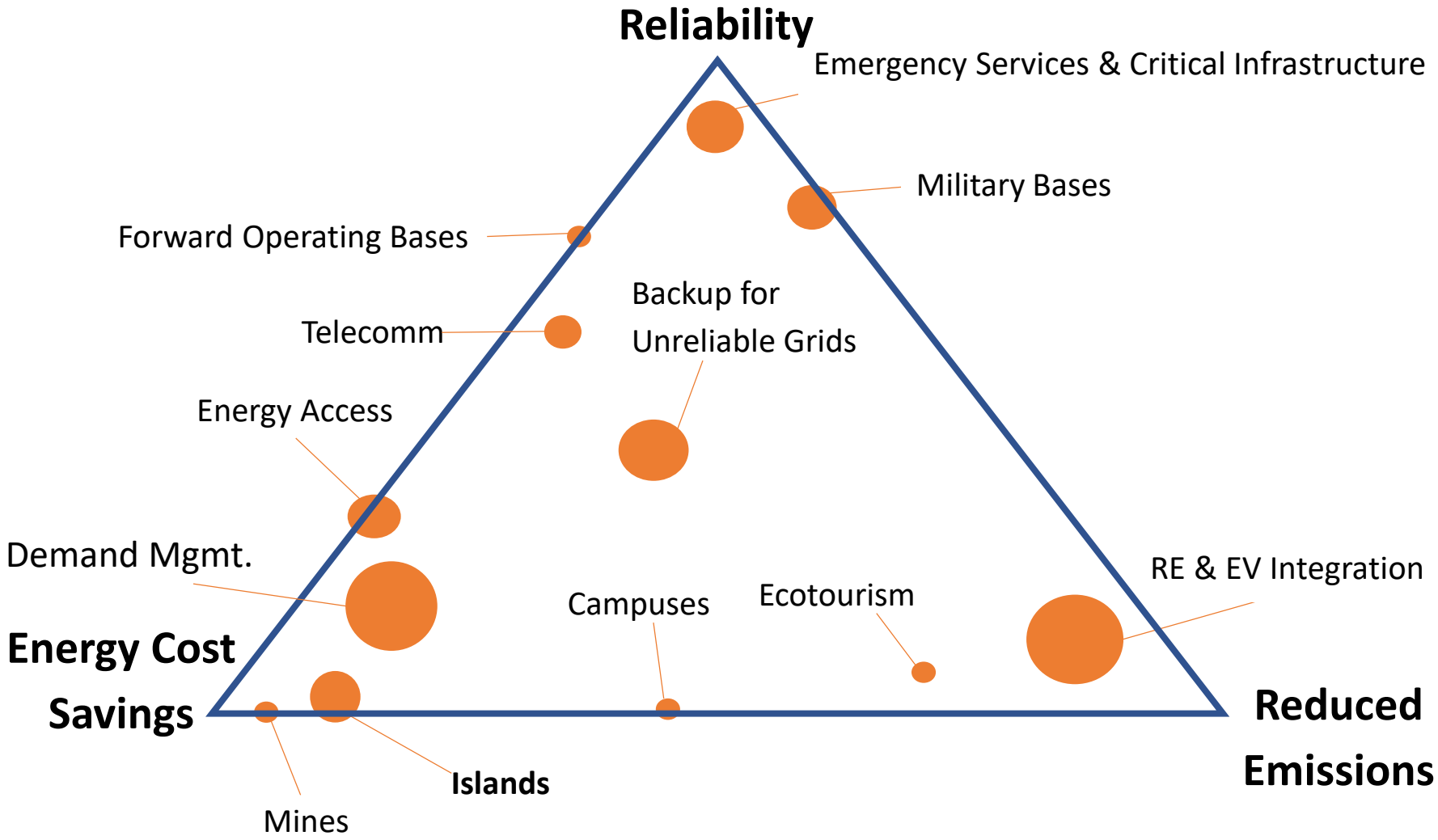
Microgrid Value Propositions



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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

Ocean Energy

Fuel Cells

Wind

Hydro

Micro-turbines

Geothermal

Micro-grids

Biomass

Demand Response

New Storage Techs.

Load Management

Electric Vehicles

Smart grids

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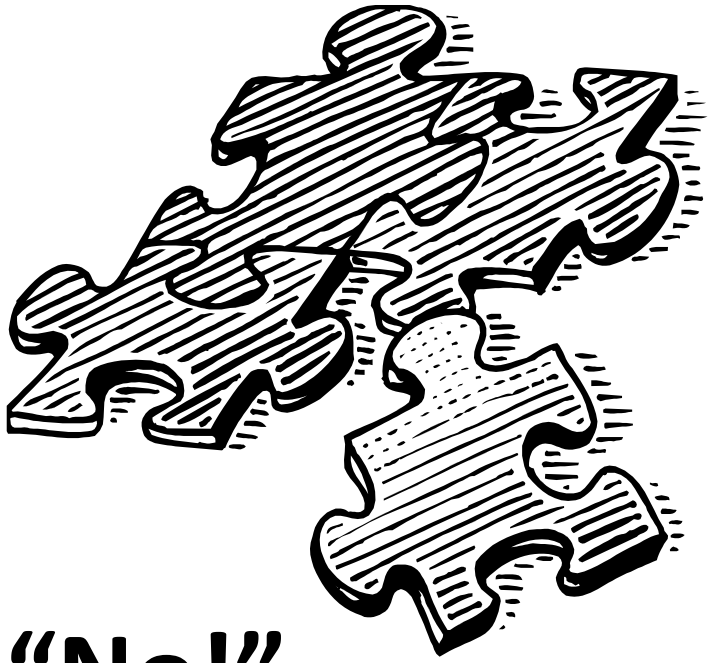
What is best?

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



- **A confused mind says "No!"**
- **HOMER fits the pieces together**

How the HOMER software works

Project Inputs

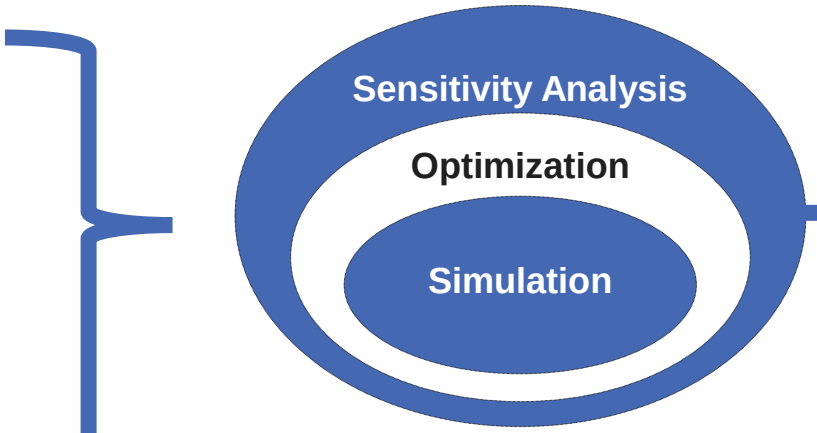
Load Profile

Site-Specific Resources

System Components

Analysis

HOMER Pro / HOMER Grid



Results

Economic & Engineering

Financials

System Sizing

Performance Details

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HOMER Solutions Framework

Market Access

- Conferences and Webinars
- Microgrid News
- Industry Partner Program
- Network Component Library

Software Solutions

- HOMER Pro
- HOMER Grid
- HOMER QuickStart
- HOMER QuickGrid
- HOMER SaaS API
- HOMER Controller API

Services

- Consulting
- Training
- Support

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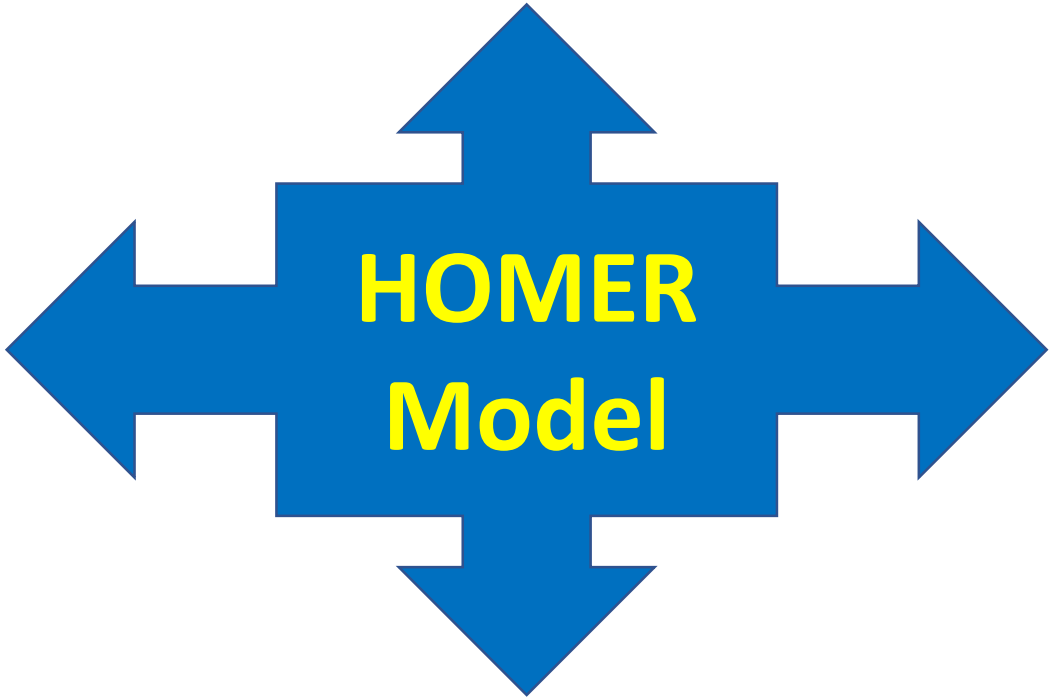
Communication

Renewable Advocates

Power Engineers



Financiers

Utility Operators

HOMER bridges different worlds

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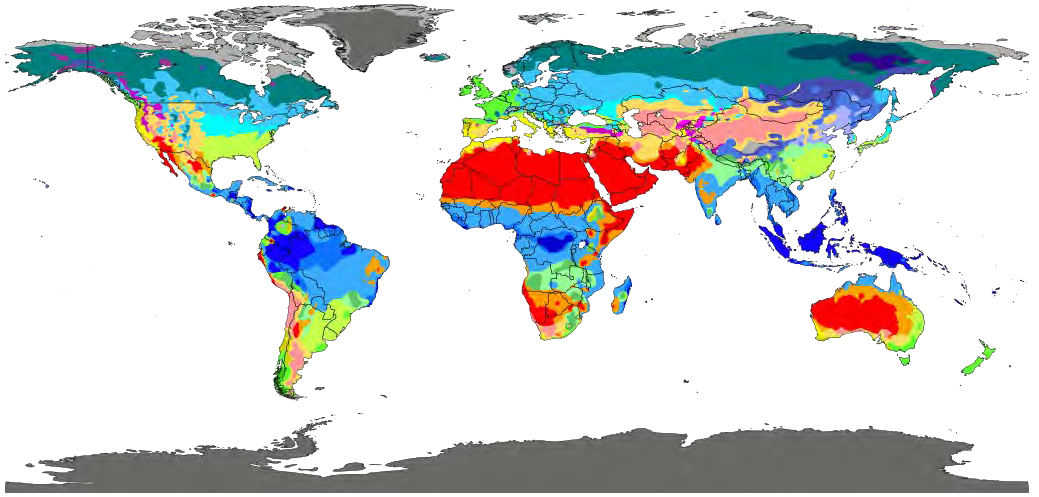
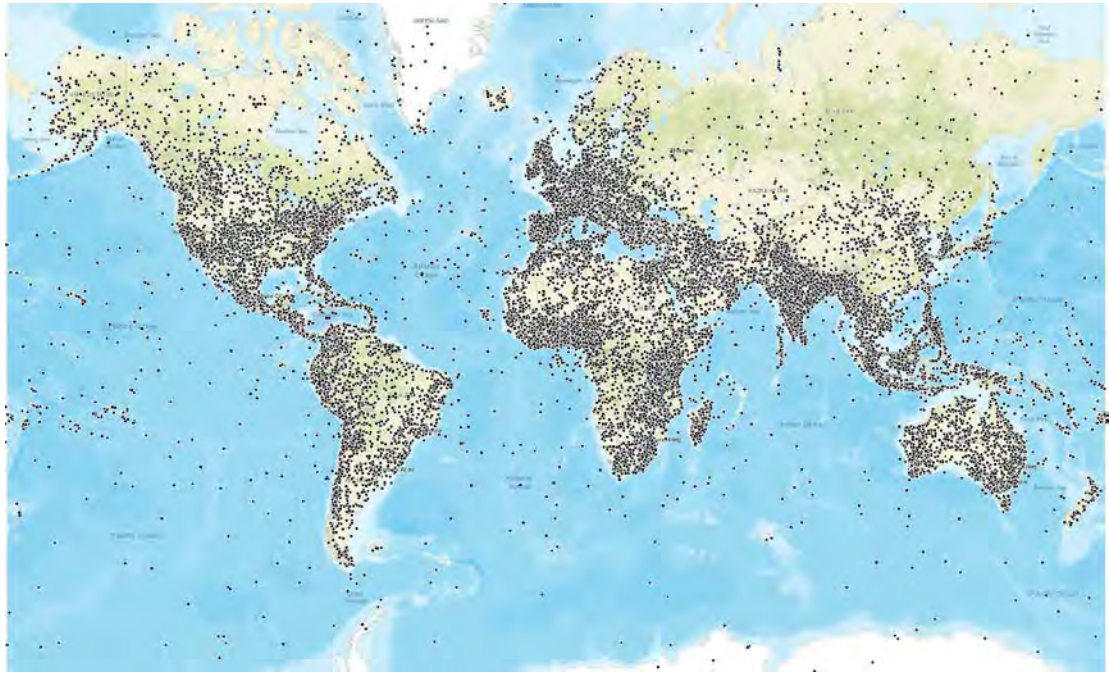
Global Data

- 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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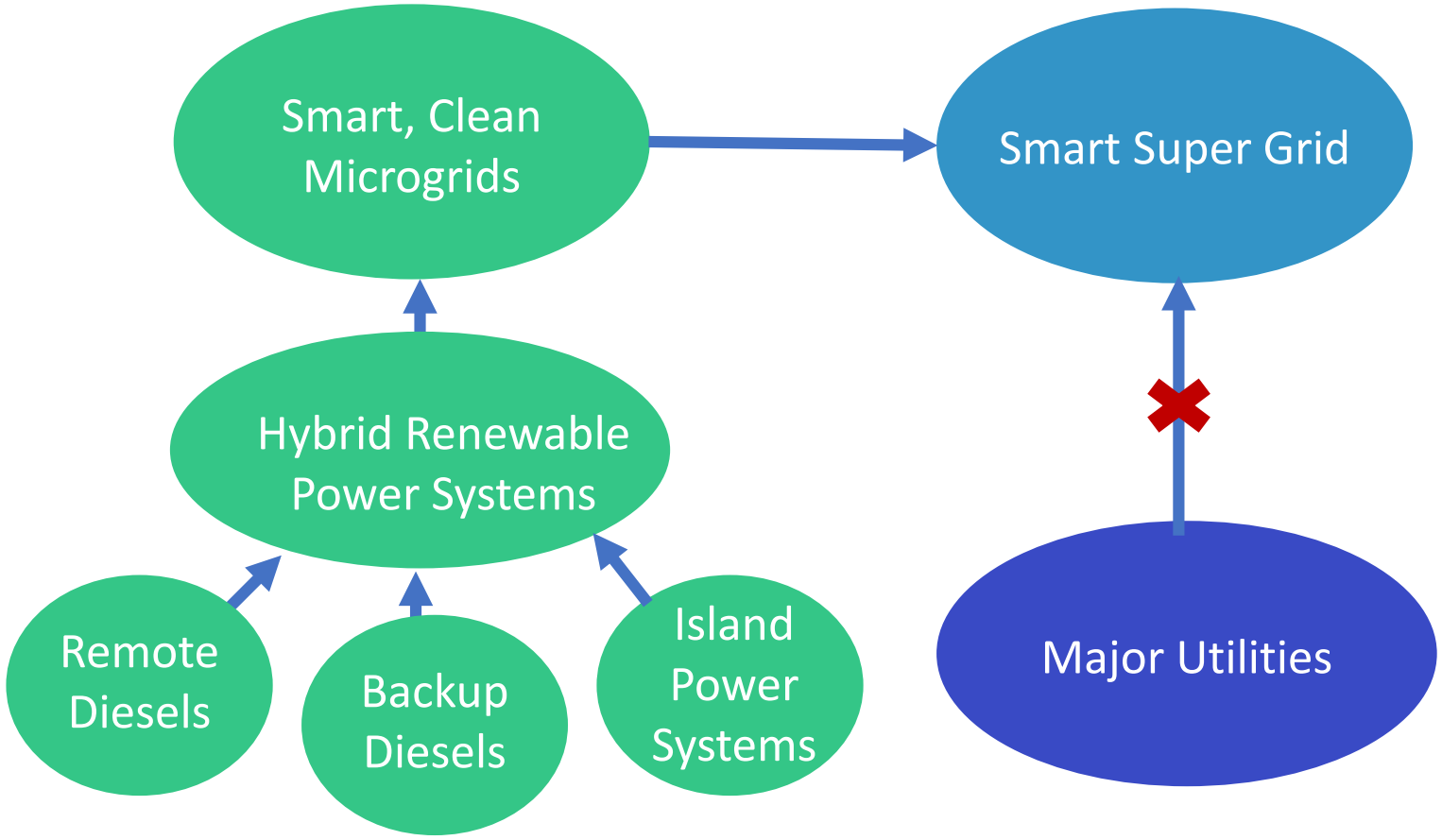
Innovation in the Power Industry



Smaller Systems

- Liquid fuels from oil
- High renewable penetrations

Large Utilities

- Security obstacles
- Regulatory obstacles

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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

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