Deriving Insights from the HOMER Software About Mini-grid Options for Energy Access

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Who is HOMER?

- NREL: 1992-2008
- Original developers now at HOMER Energy
- 160,000 users in 193 countries

http://www.homerenergy.com
Too Many Choices

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

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HOMER

- Industry standard for hybrid micro-grids
  - Conventional resources
  - Renewable resources
  - Storage
  - Load Management

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HOMER Analysis Layers

Design the most cost effective system by analyzing thousands of systems in minutes

Sensitivity Analysis -
Evaluates uncertain inputs: prices, weather, loads, ....

Optimization - LCOE, reliability, max. renewables, & resiliency

Simulation - Time varying loads & resources require chronological analysis for entire year

**Engineering and economics work side by side to arrive at an ANSWER!**

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HOMER as a Communication Tool

HOMER bridges different worlds

Renewable Advocates
Power Engineers
Diesel Mechanics
Financiers

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New in HOMER Pro

- Optimizer
- Getting Started Wizard
- Unreliable Grid
- Advanced Battery
- Multi-year
- API’s
- Load Profiles

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Sustainable Tariffs

• Affordable
  – Consumers
  – Producers
  – Government

• Equitable
  – Subsidy goes to poor

• Efficient
  – Incentive to use efficient appliances

• Capital subsidies to reduce operating cost

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Capital / Operating Cost Tradeoff

Trade-off Graph
2% Real Interest Rate on Replacement Fund

Capital Cost vs. Annual Operating Costs

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Two-part Tariff

Monthly Cost

- Wealthy households don’t get more of the subsidy
- Limited fiscal burden
- Maintain incentive for energy efficiency
- Full cost recovery for increased load
  - Pays for system expansion

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Other Tariff Concepts

- Productive uses based on solar
- Evening household use based on diesel
- Night-time use based on battery wear
- Waterpumping based on excess energy

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Renewable Penetration: Definition

- 8 definitions
  - Based on capacity or energy
  - Instantaneous versus average
  - Allocation of excess energy
- Factor of 10 difference

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Taxonomy of System Designs

• Low penetration
  – RE variability comparable to load variability

• Medium penetration
  – Curtail renewables to protect diesels

• High penetration (large systems)
  – Re-dispatch diesels for O&M & greater fuel savings

• Very high penetration
  – Run diesel-off except during low resource periods
  – Requires grid-forming inverter
100% renewables without diesel backup

- **Advantages:**
  - No fuel supply issues
  - Vastly reduced maintenance

- **Disadvantages:**
  - Unmet load
  - Battery management

- Applicable for very small systems

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Capacity Shortage without backup

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HOMER Energy’s Services

HOMER® Software: Global standard for microgrid design

Education, Training, & Capacity Building

Consulting: Model reviews and strategic planning

Market Access: Connecting suppliers with projects

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Conclusions

• No “one-size-fits-all” solution
• Make load growth pay for itself
• Base tariffs on incremental cost
• Small systems based on batteries
• Large systems based more on diesel
• 30 day free trial

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