HOMER ENERGY

Optimizing Clean Power Everywhere

REINVENTING THE NATIONAL POWER GRID ONE MICROGRID AT A TIME

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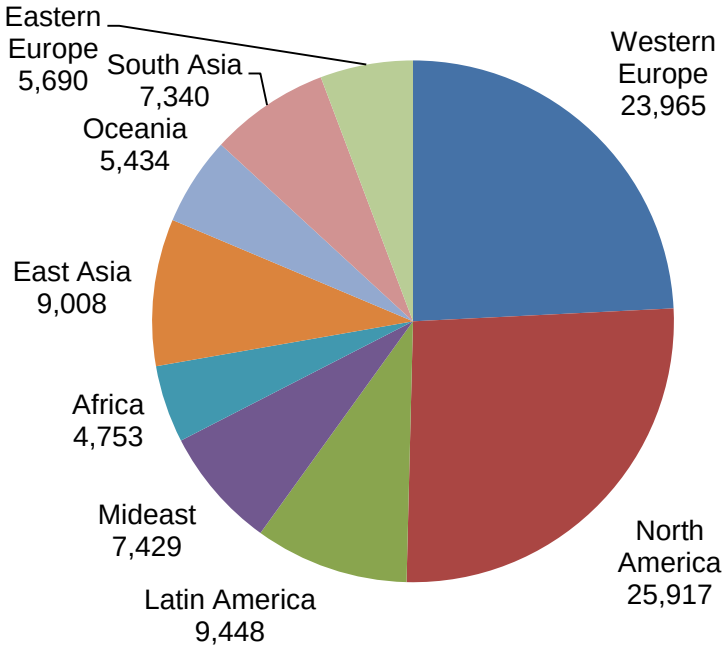
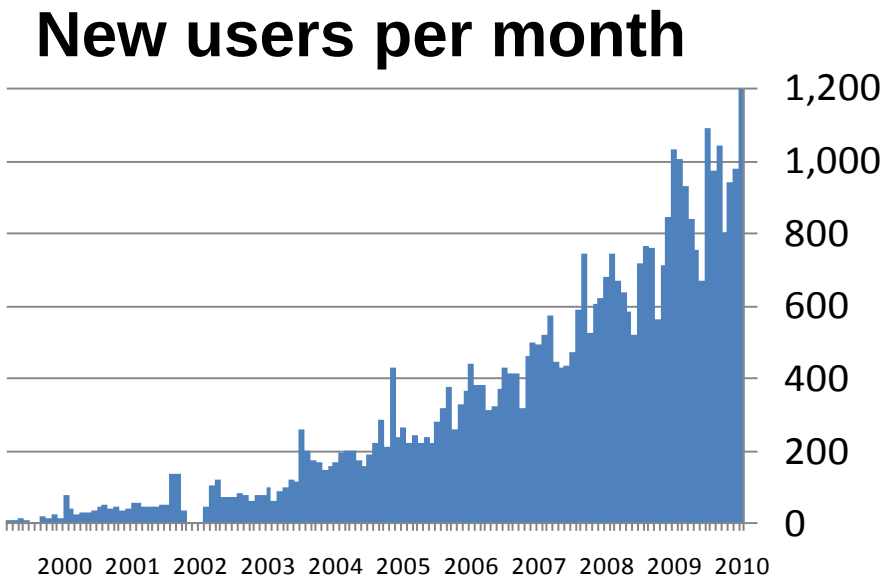
Who is HOMER?

- NREL: 1992-2008
- Original developers now at HOMER Energy
- 5 years of continuous, self-funded growth
- 107,000 users in 193 countries





The Future of Power

Clean, distributed power with hybrid renewables and smart micro-grids

How do we get there?

What's Wrong with Status Quo

Utilities Feeling Rooftop Solar Heat Start Fighting Back

Double threat: US grid vulnerable on two fronts

- **Texas comes close to rolling blackouts:**

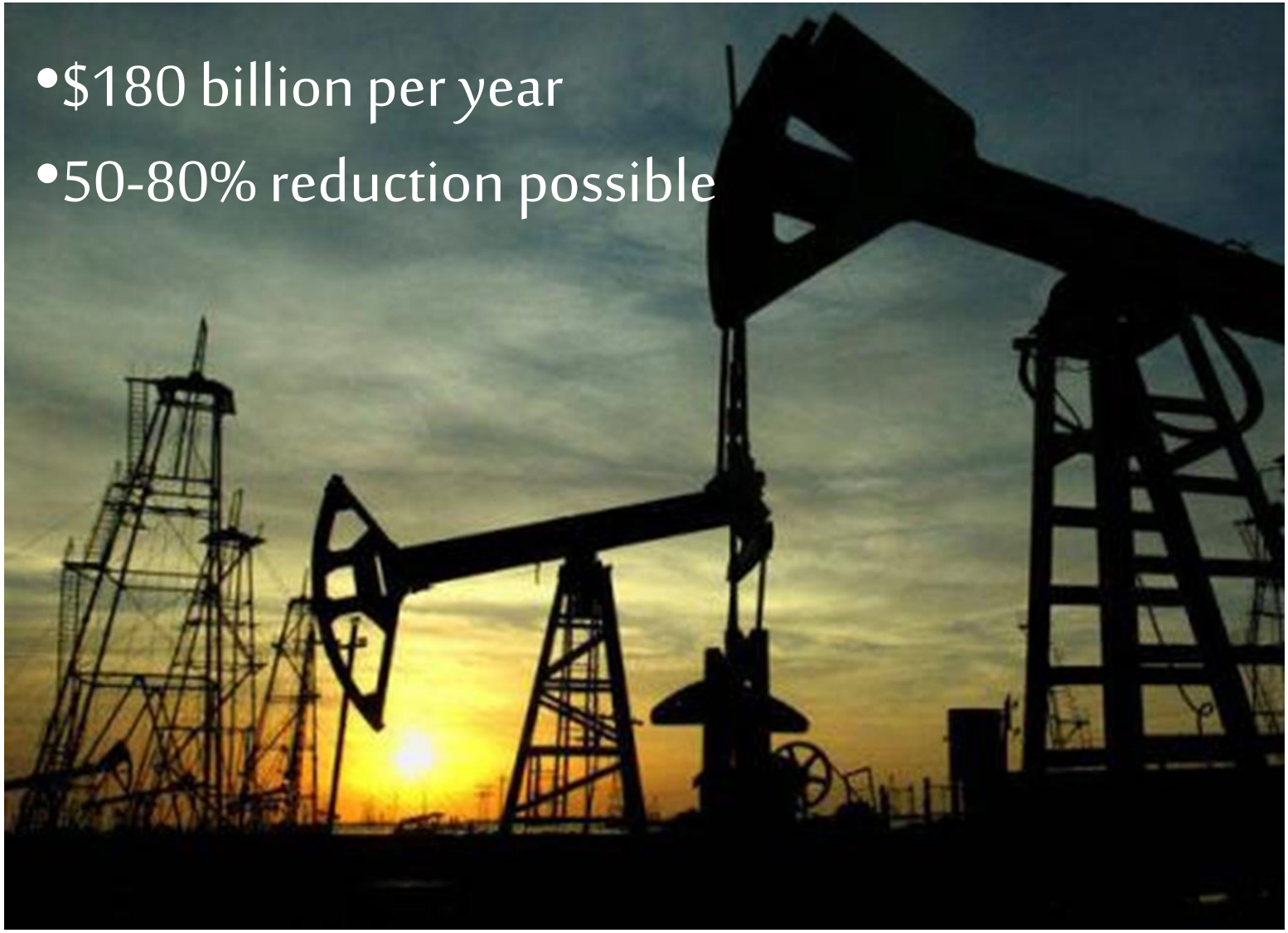
Electrical Grid Is Called Vulnerable to Power Shutdown

Balancing the Grid

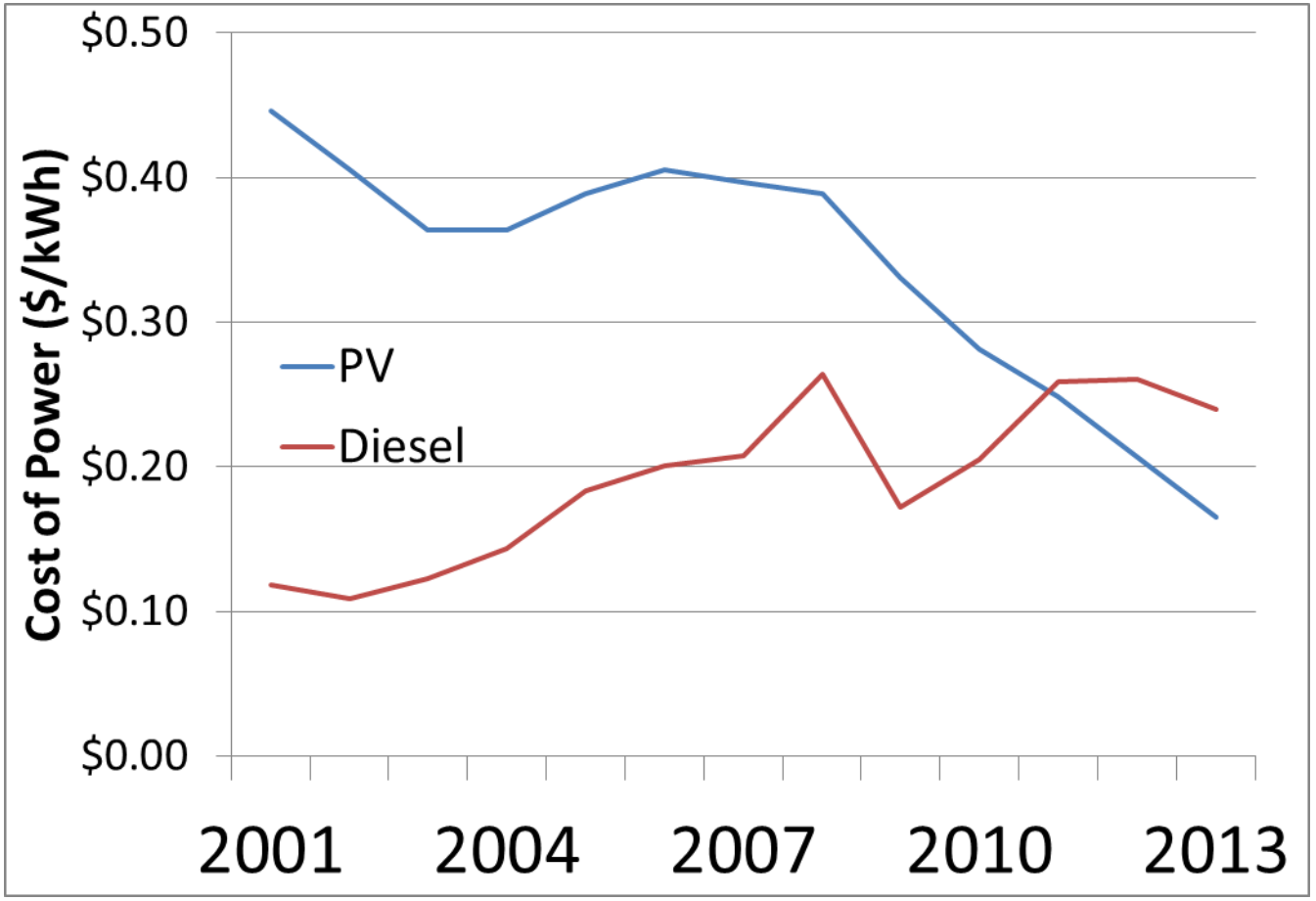
Renewables Evolution

- Entering a new era
- Where are the real economics?
- How do you create high penetrations?
  - Hint: do it in stages

5M barrels oil/day burned for electricity



Unsubsidized Economics



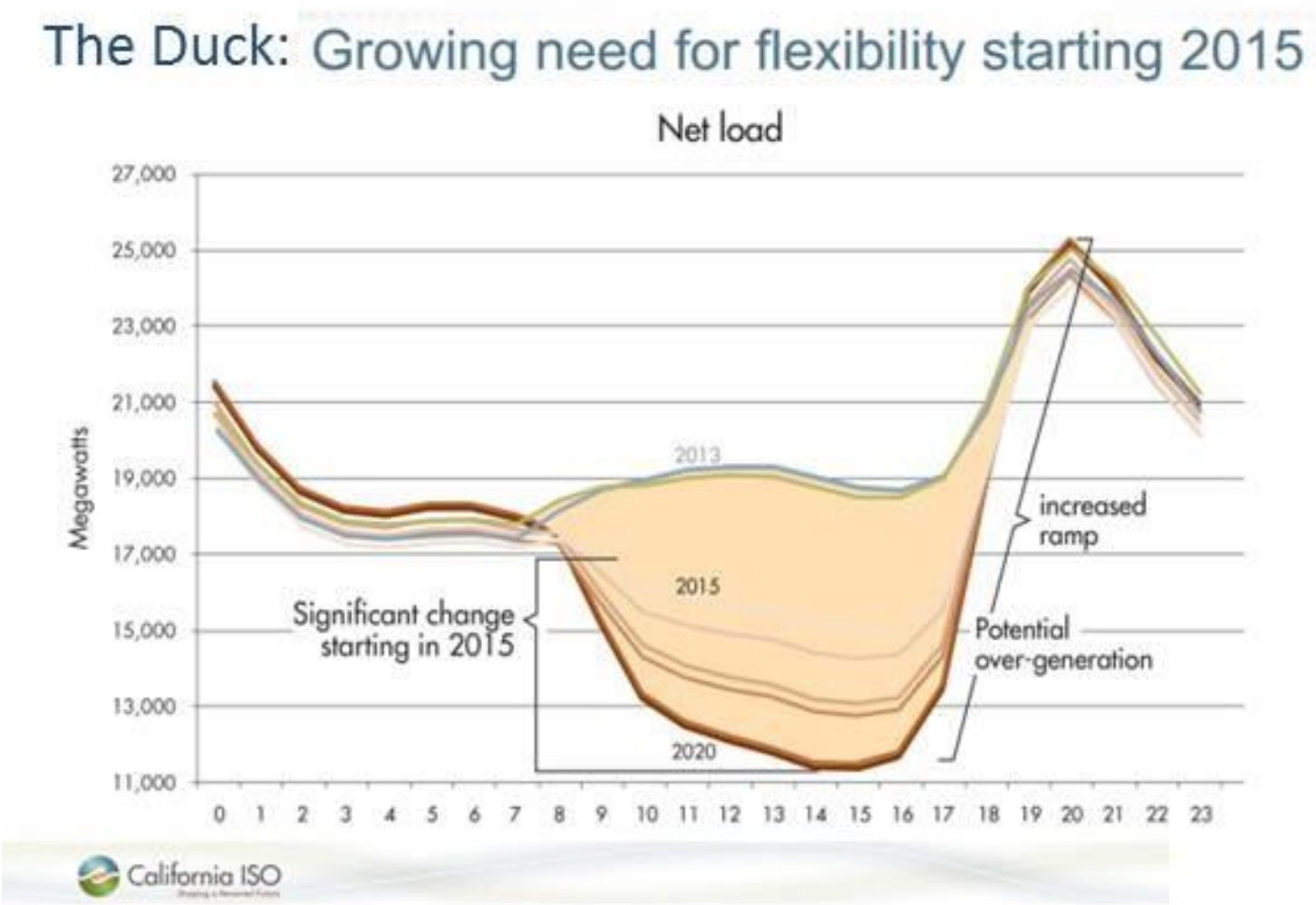
The Coming Train Wreck

http://homerenergy.com/events/economics-of-grid-defection-webinar.html

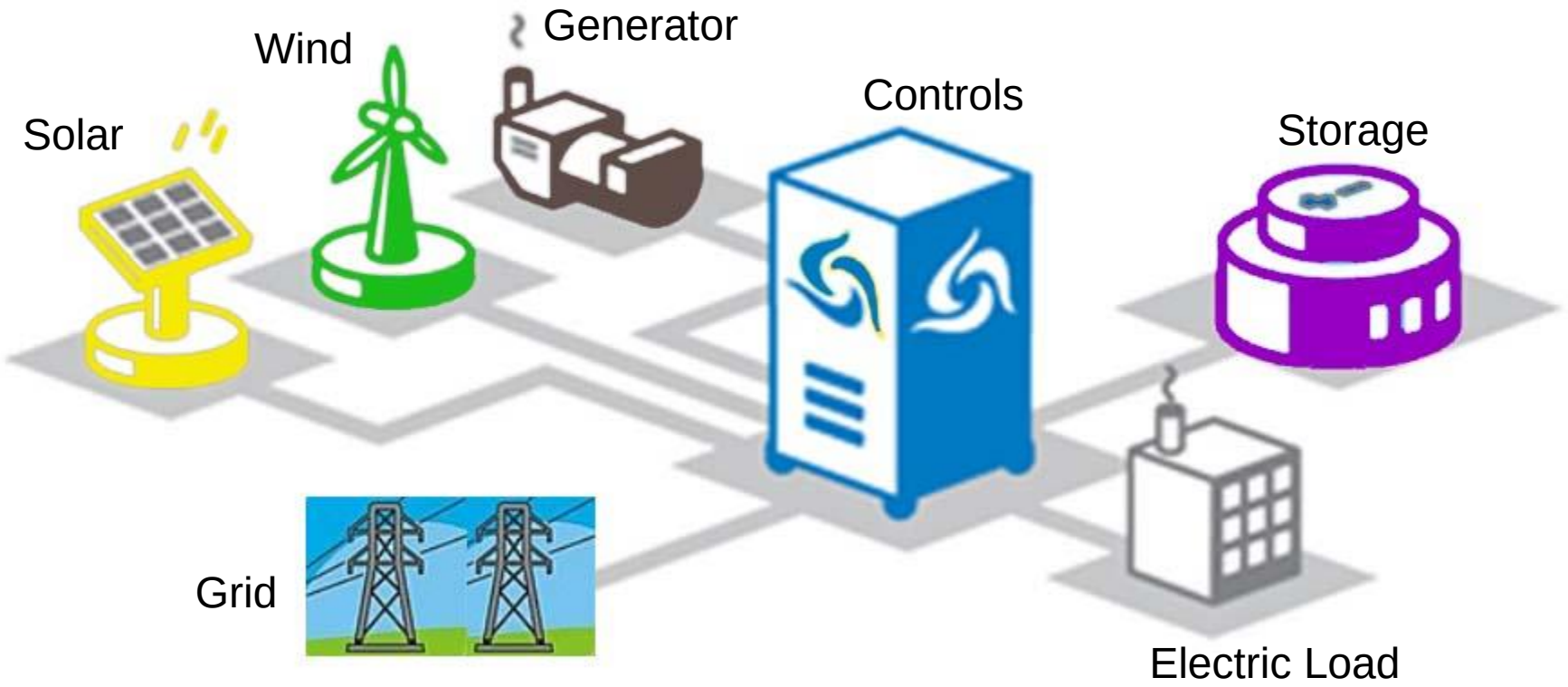
Everybody's been crying "Wolf".

The Coming Utility Finance "Death Spiral"

The Technical Problem



Hybrid Renewable Microgrids



Provided by ZBB Energy Inc.

Smart, clean micro-grids

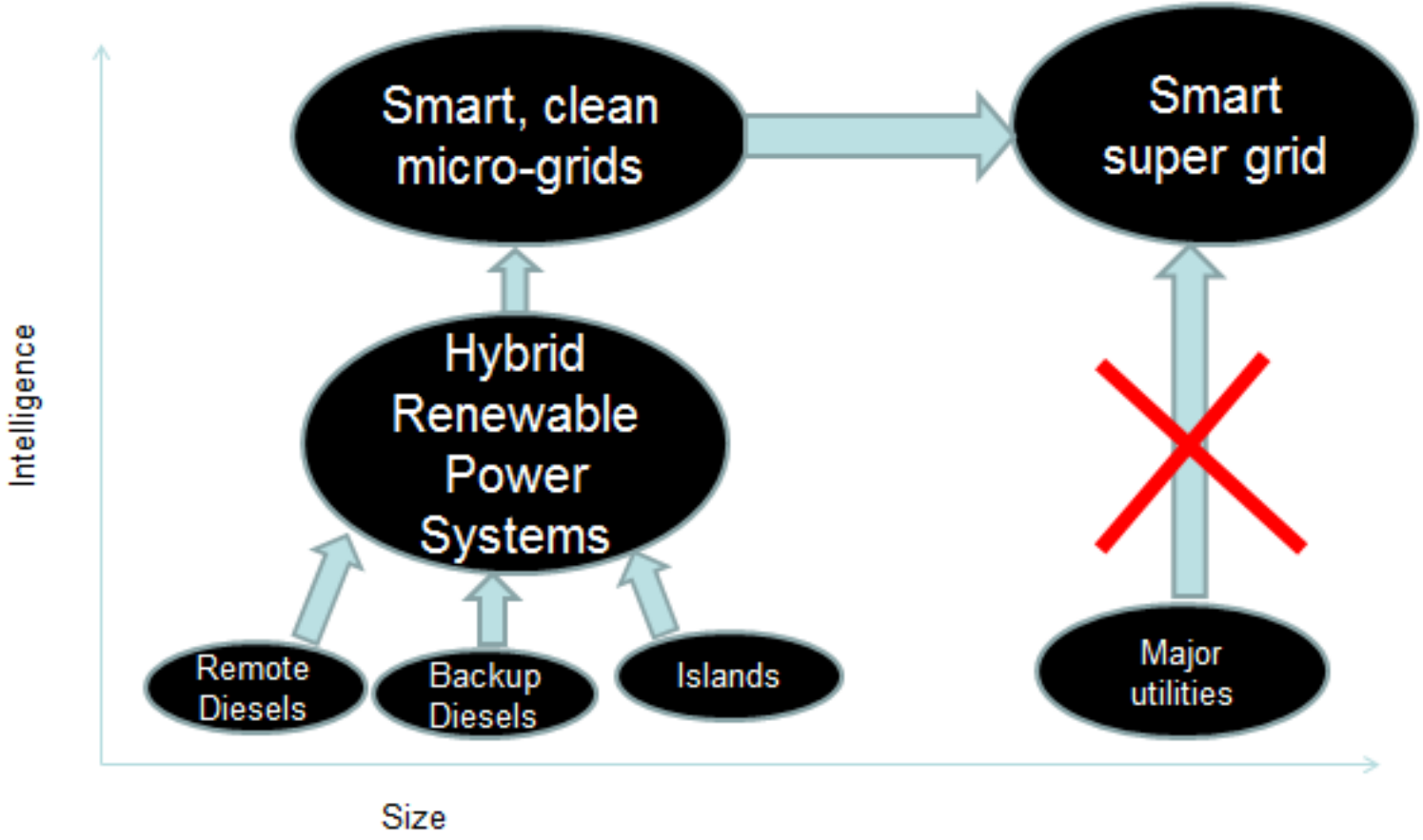
- Capable of operating on their own
- Empowering consumers
- Customized levels of:
  - Reliability
  - Renewables
  - Storage and load management

Microgrid Market Will Reach Nearly $20 Billion in Annual Revenue by 2020, Forecasts Navigant Research

Storage and Load Management

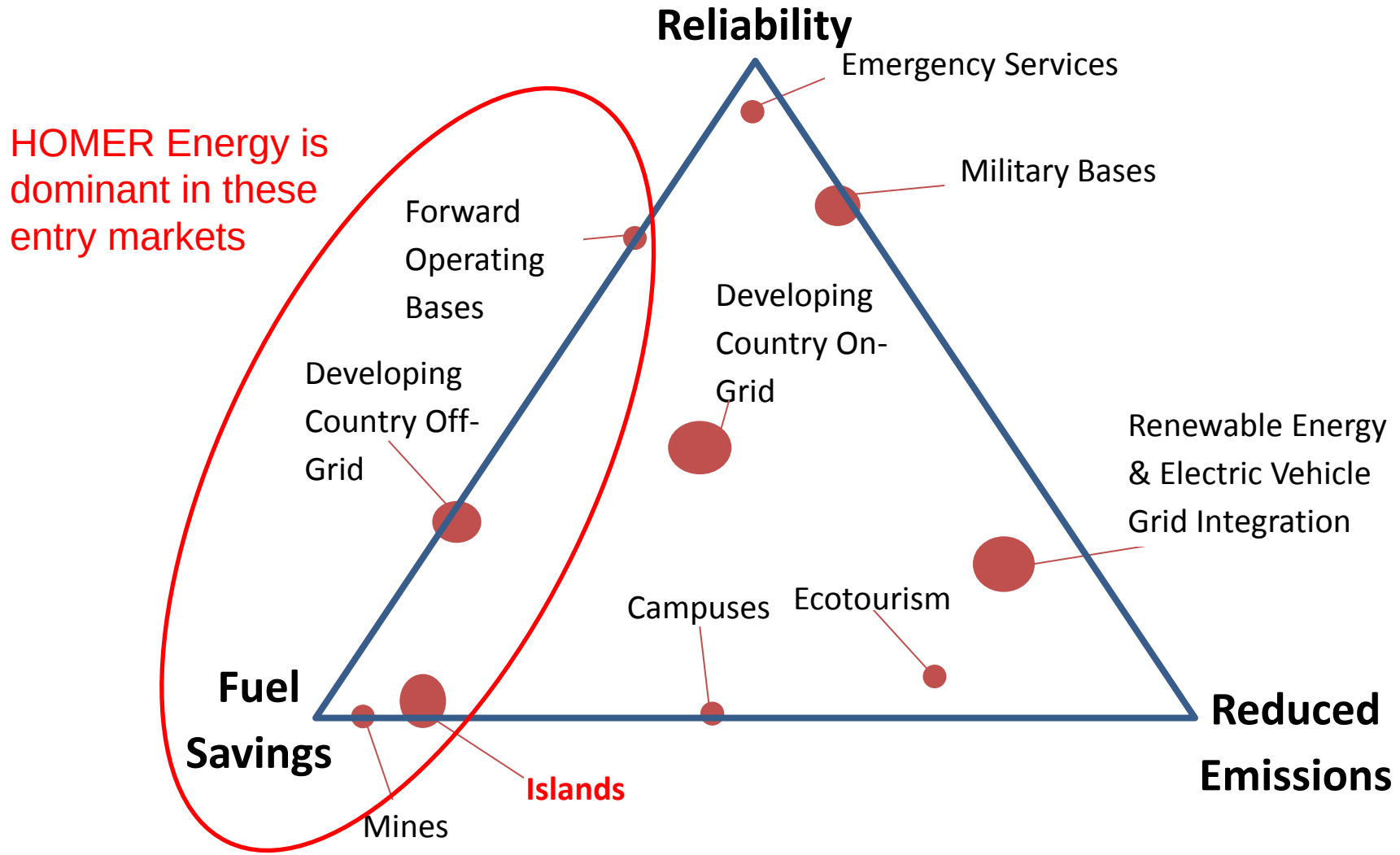
- Storage technologies are improving
- Value of storage is higher when distributed
  - Reliability
  - Voltage stability
- Load management is mostly IT
- Who controls your energy use?

Clean Power Evolution

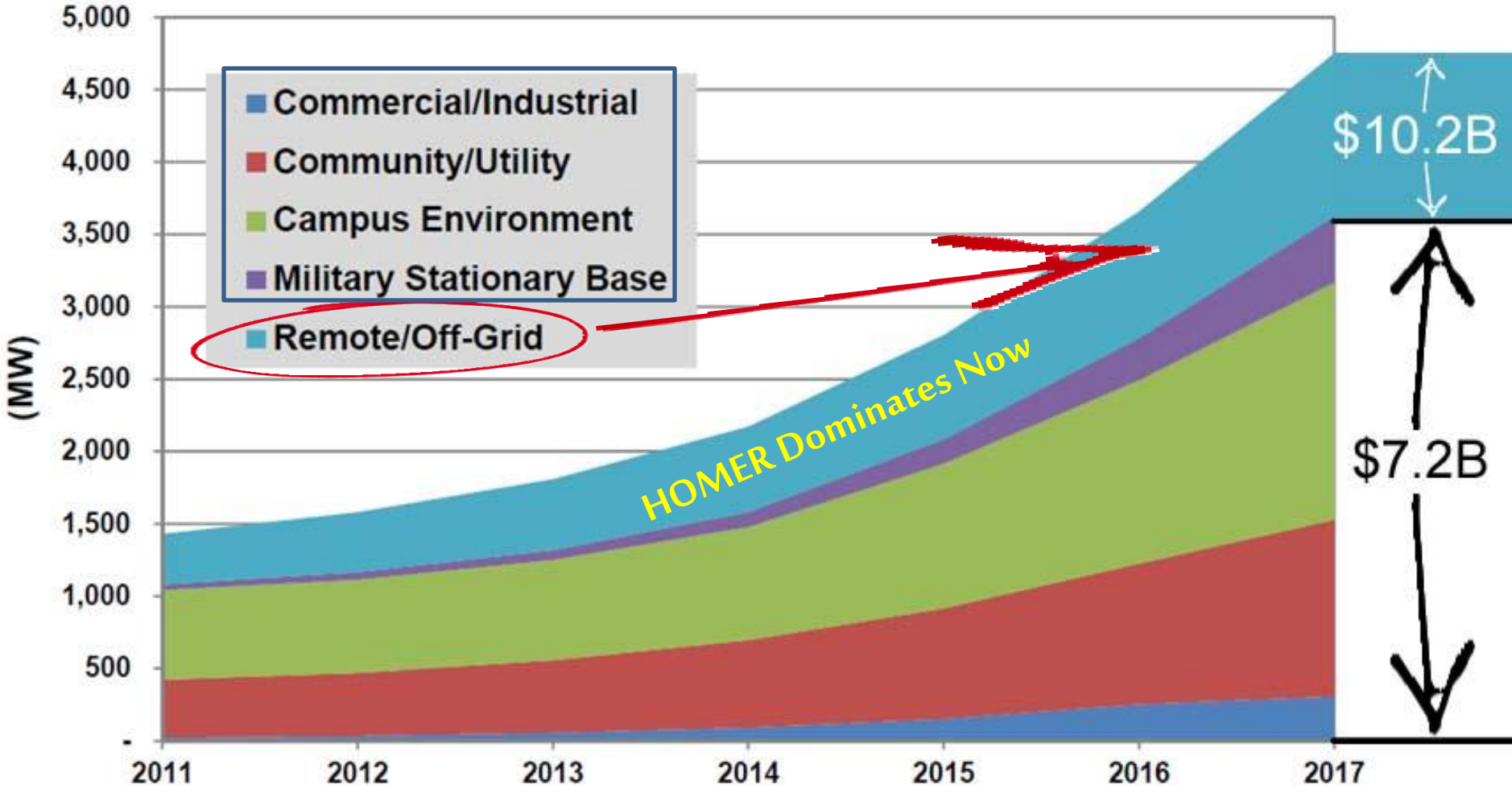


- Smaller systems
  - Liquid fuels from oil
  - High renewable penetrations
- Large utilities
  - Security obstacles
  - Regulatory obstacles

Microgrid Value Proposition



Global Microgrid Capacity by Market Segment



(Source: Pike Research)

Too Many Choices

Solar

Wind

Hydro

Geothermal

Biomass

New Storage Techs.

Electric Vehicles

Smart grids

Load Management

Demand Response

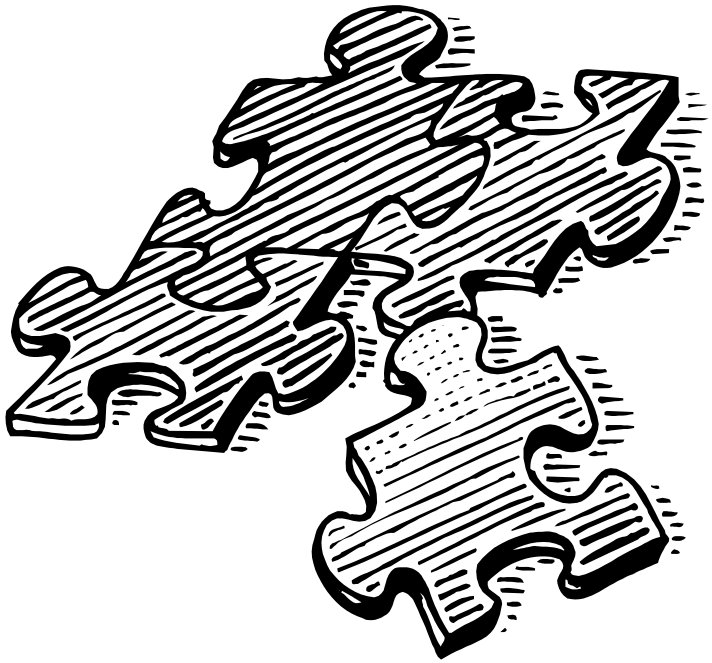
Micro-grids

Micro-turbines

Fuel Cells

What is best?

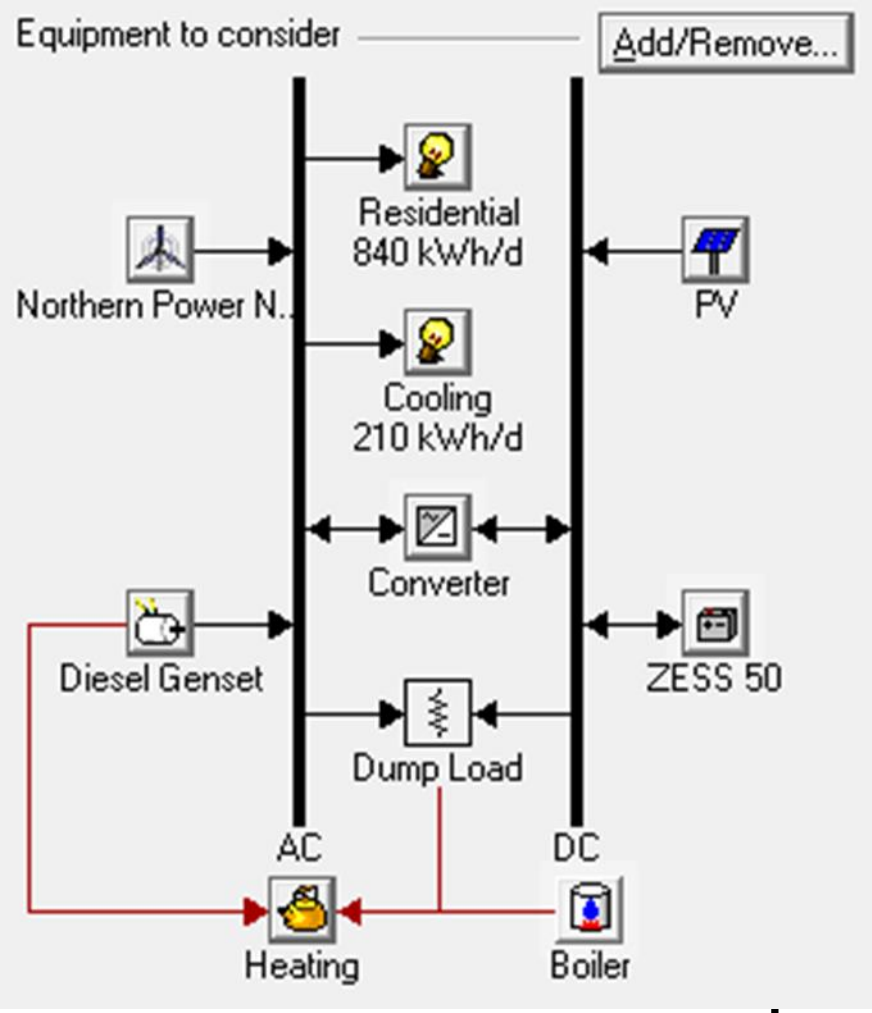
- It depends on:
  - Resources
  - Loads
  - Equipment prices
  - Equipment performance



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

HOMER

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



San Juanico, Mexico

Remote fishing community of 400 people with tourism

Power System

- 17 kW PV
- 70 kW wind
- 80 kW diesel generator
- 100 kW power converter/controller

Advanced monitoring system

Kotzebue, Alaska

- 11 MW diesel station in Northwestern Alaska
- 4 MW peak load
- 10 Entegrity 65 kW wind turbines and 1 NW 100, 100kW wind turbine
- Installing more wind

Selawik, Alaska

- Small Community in northern Alaska
- Installation of 4 Entegrity 65 kW wind turbines and dump loads

AVEC, Entegrity, Sustainable Automation

Toksook Bay, Alaska

- Small community in western Alaska
- Installation of 3 NW100kW turbines and dump loads
- Installed winter of 2006

AVEC, NPS

Coyaique, Chile

- Large regional distribution system
- 3x 660 kW wind turbines
- 4.6 MW of mixed hydro
- 16.9 MW of diesel

- Manually operated through local control center
- Currently runs as a wind/hydro facility

San Clemente Island, California

- U.S. Navy island off San Diego
- Diesel powered grid
- 900 kW avg, 1,400 kW peak
- Four diesel generators
- 3 NEG-Micon 225 kW turbines
- $97,000 fuel savings

Ascension Island

- U.S. Air Force installation in the Atlantic ocean.
- Four NEG-Micon 225 kW turbines.
- Operating since 1996
- Average penetration 14-24%
- Expansion in 2005
- 2 MICON 900 kW turbines
- 650,000 gal/yr fuel saved

High Penetration

- System runs at times without diesels
  - Typically requires storage
  - St. Paul, Alaska has no storage but enormous dump load
  - Wales, Alaska has 15 minutes of storage

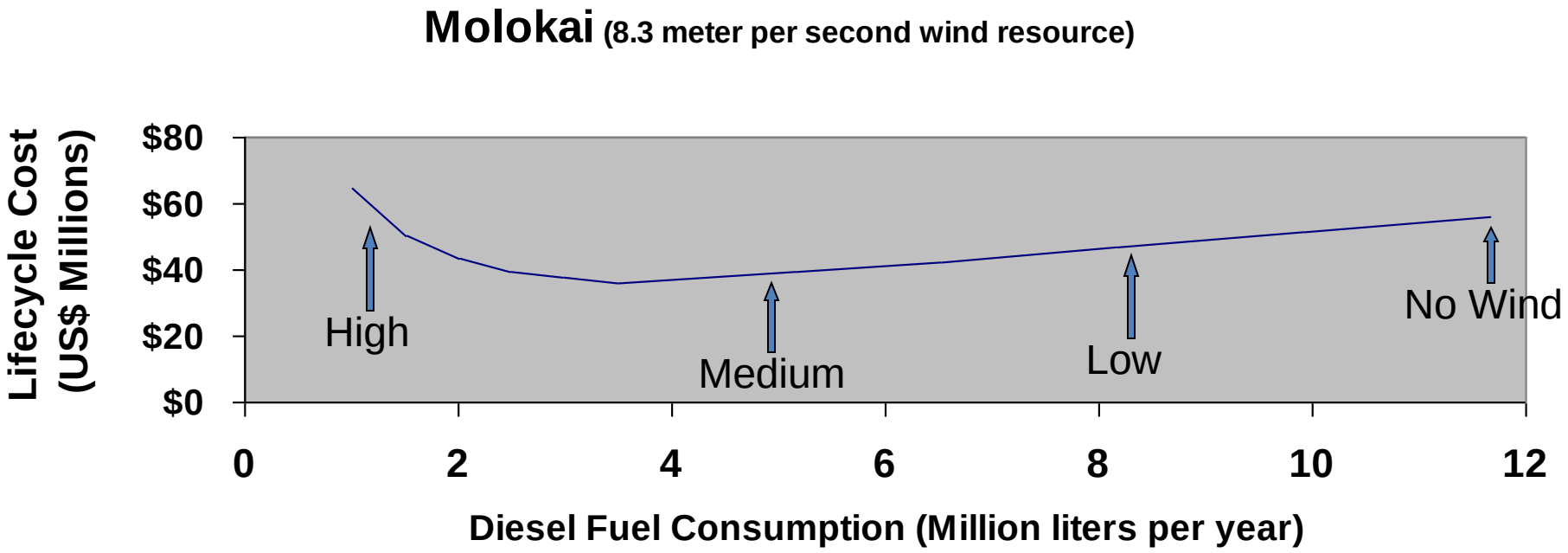
St. Paul, Alaska

- Island in the Bering Sea
- System runs without diesels
- Peak load of 160kW
- Cost of Power, ± $0.21/kWh
- Dump load used for heating

Wales, Alaska

- Remote community on the Bering Strait
- 80kW average load
- 2 Entegrity15/50 wind turbines
- Short term battery storage with rotary converter
- Resistive loads used for heating and hot water
- Operation with all diesels turned off

Penetration Analysis from HOMER



Conclusion

- Distributed power has major advantages:
  - Reliability
  - Environmental
  - Economic
- The utility industry is overdue for major change
- Transition in stages
- We live in interesting times