HOMER ® Optimization Model for Wind-Diesel

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Clean Power Everywhere

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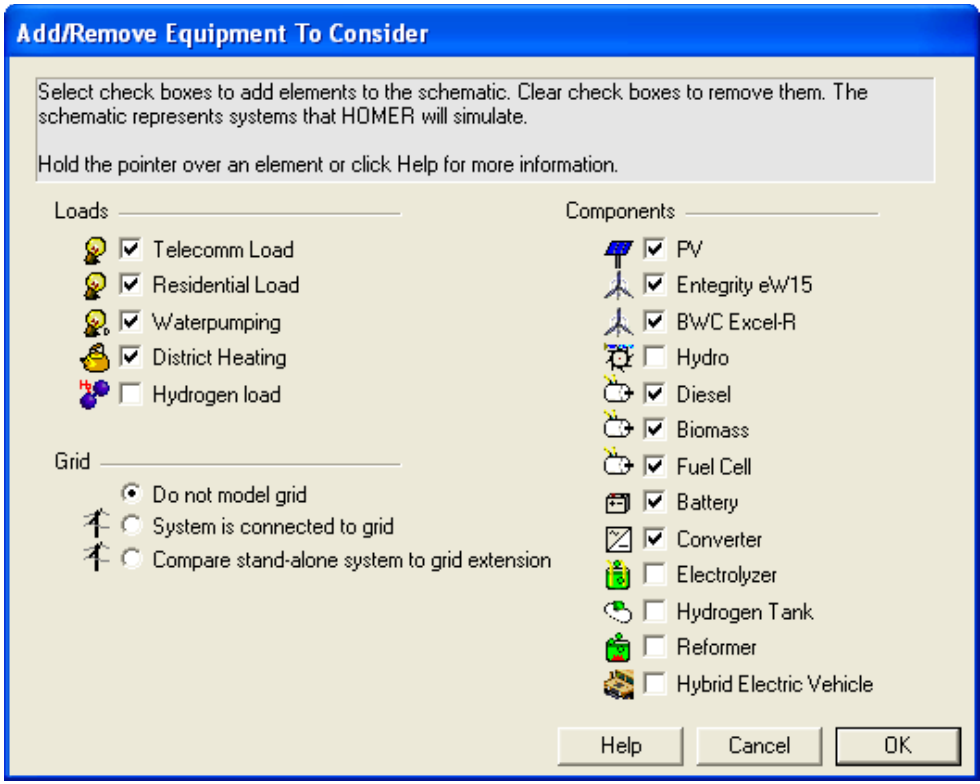
Outline

- What is HOMER ®
  - History
- What's Coming?
  - New company
  - New Versions
    - Software as a service
    - Specialized Wind-diesel version
  - On-line Community
    - Vote on new features

Fundamental HOMER® Question

- Which technologies are most cost-effective?
  - Micropower
  - Renewables; PV, Wind, Bio, Hydro
  - Fossil
  - Cogeneration
  - Hybrids
- It depends on application
  - Resources
  - Loads
  - Equipment prices
  - Equipment performance

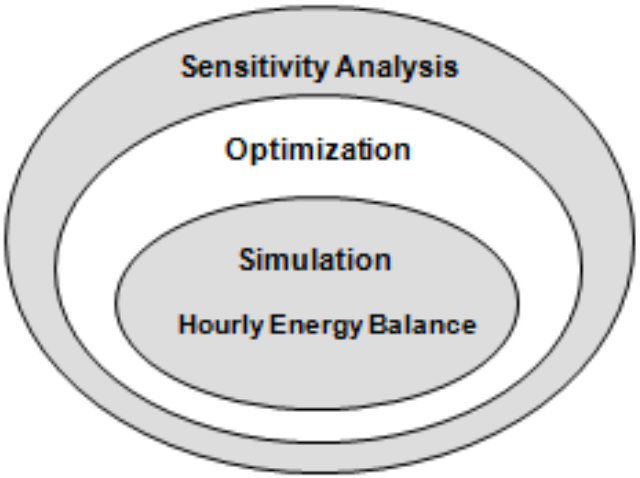


- A confused Mind Says No!

HOMER® is Flexible

- Estimated inputs for general analysis
- Detailed inputs for system design

- 8760 hour simulations
- Optimization
- Sensitivity Analysis

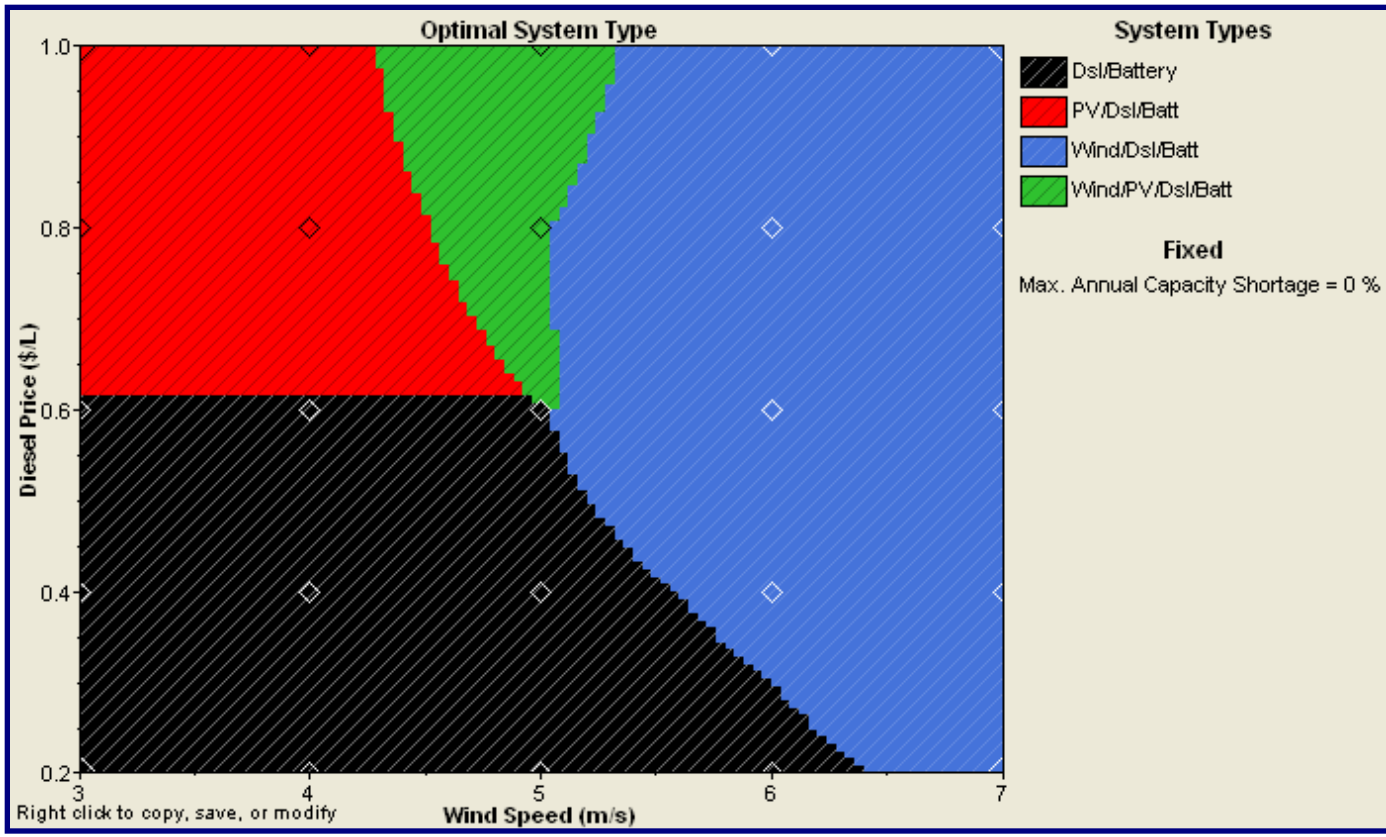


Answers from HOMER ®

- Optimal System Design
- Cost Breakdowns and Comparisons
- Operational Analysis
- Resource Analysis
- Technology Development Targets
- Policy Analysis

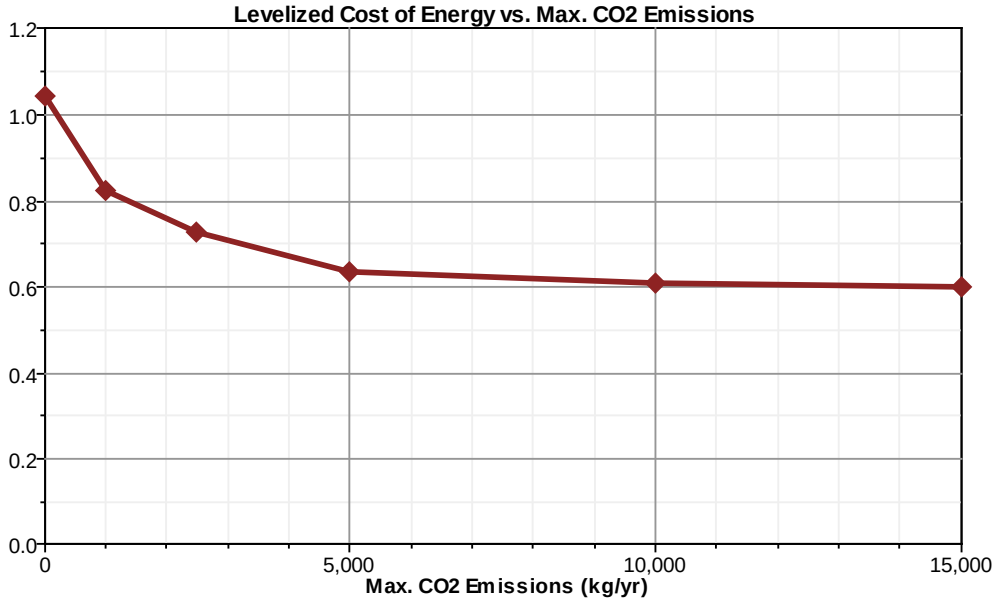
Optimal System Design

- What kind of system is best under which conditions?



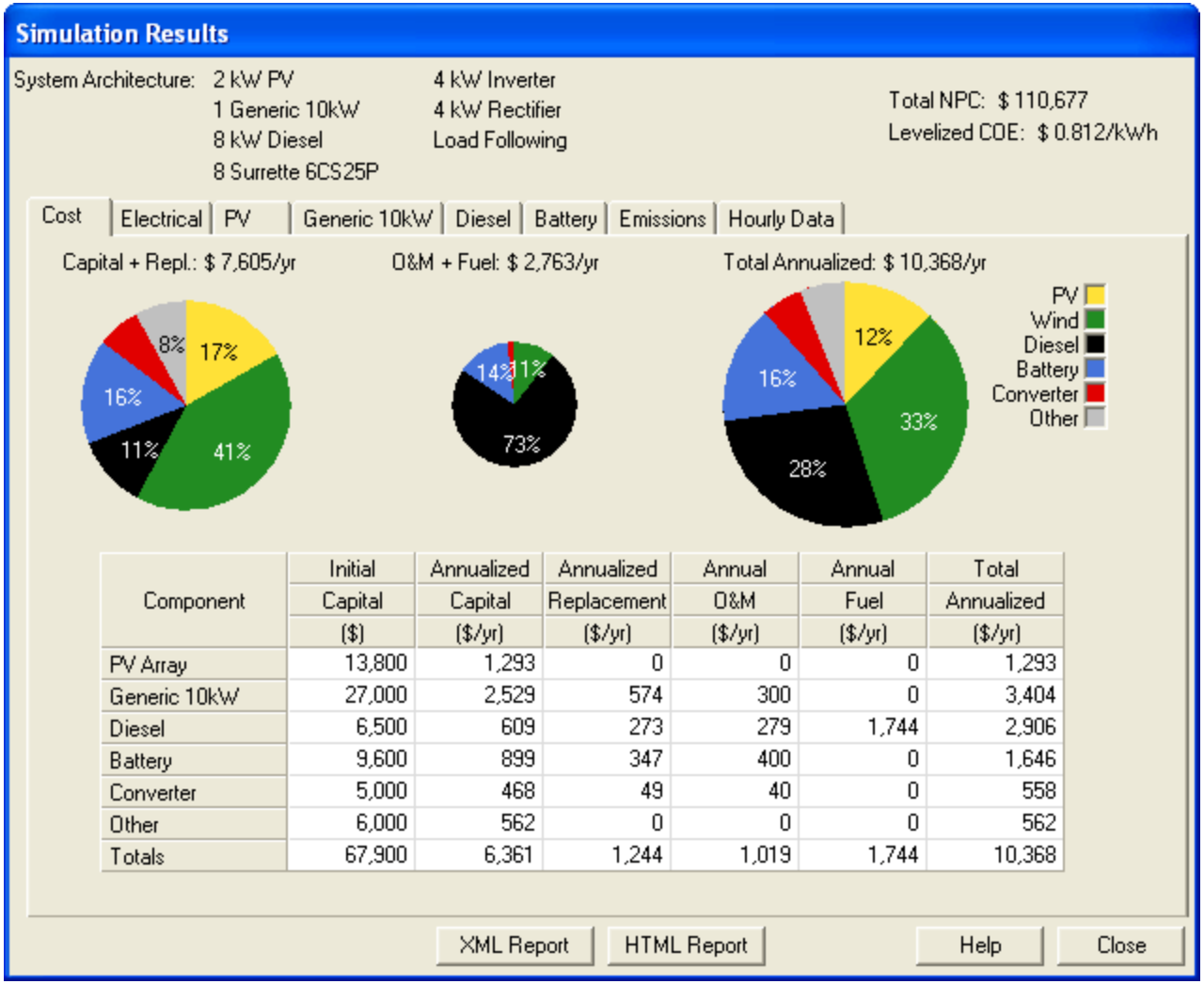
Combining sensitivity and optimization identifies design thresholds.
e.g. minimum fuel price for cost-effective PV

Policy Analysis



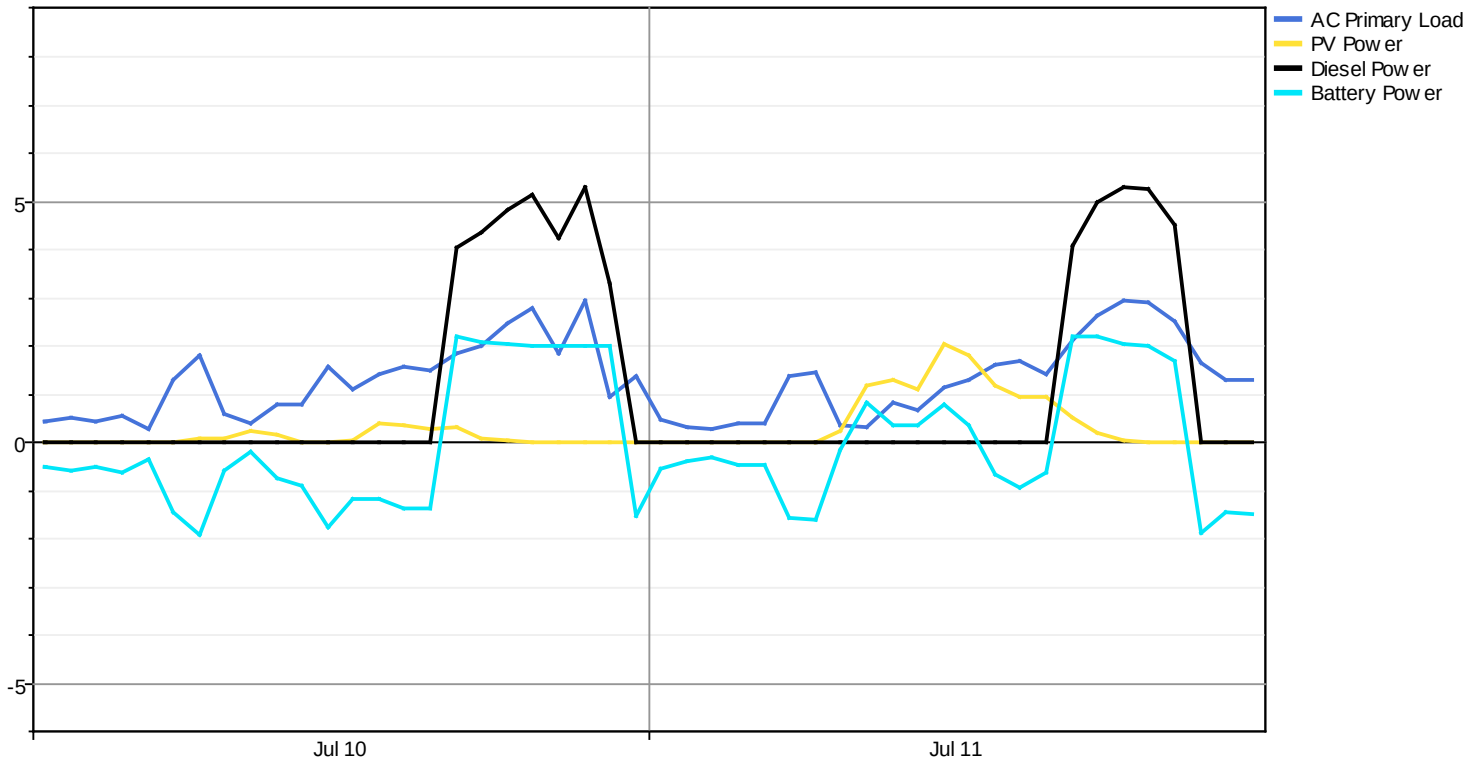
- Cost of emission constraints

Cost Breakdowns and Comparisons



Component	Initial Capital ($)	Annualized Capital ($/yr)	Annualized Replacement ($/yr)	Annual O&M ($/yr)	Annual Fuel ($/yr)	Total Annualized ($/yr)
PV Array	13,800	1,293	0	0	0	1,293
Generic 10kW	27,000	2,529	574	300	0	3,404
Diesel	6,500	609	273	279	1,744	2,906
Battery	9,600	899	347	400	0	1,646
Converter	5,000	468	49	40	0	558
Other	6,000	562	0	0	0	562
Totals	67,900	6,361	1,244	1,019	1,744	10,368

Operational Analysis

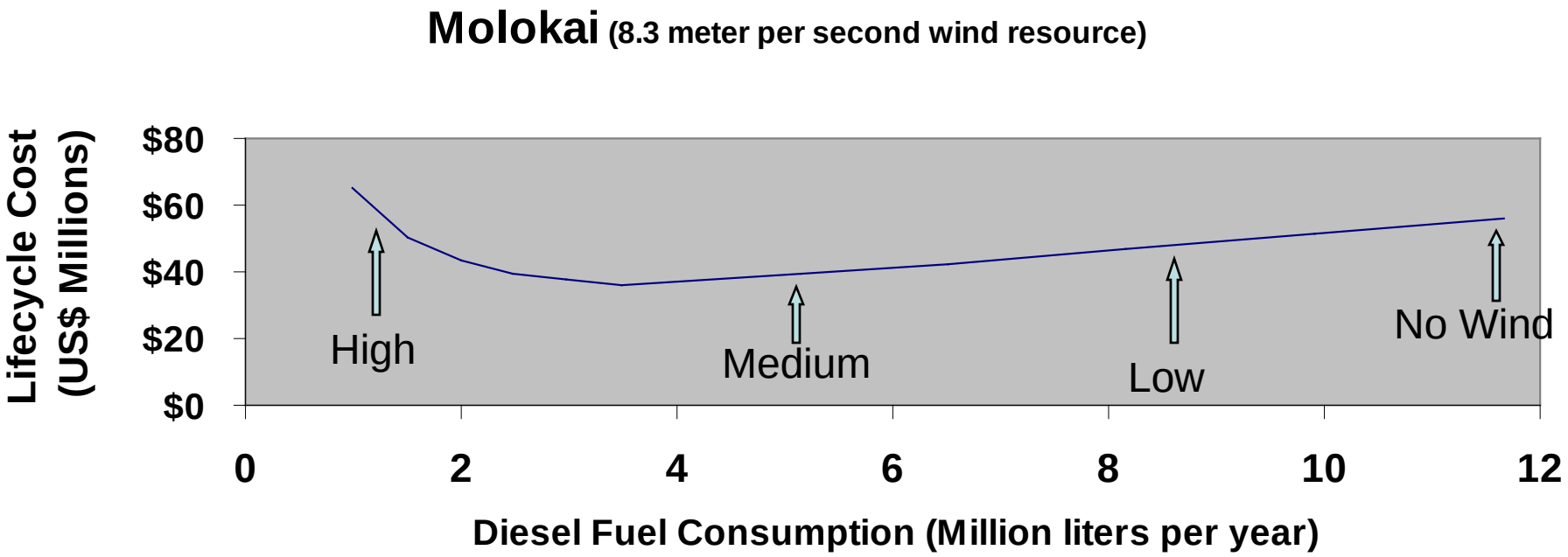


- When is backup power needed?

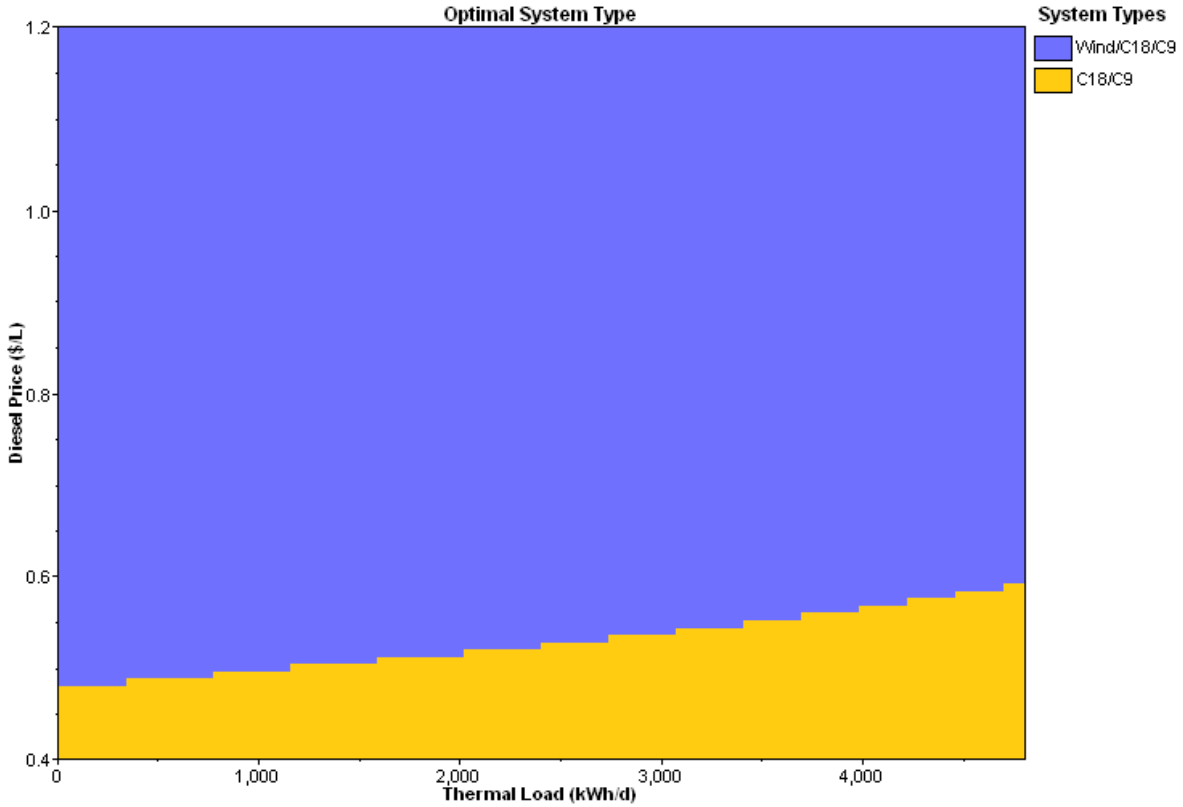
Integration Issues

- Resource variability
- Operating reserves
- Minimum load issues
- Controllable loads
  - Water desalination, pumping, and heating
  - Ice making
  - Plug-in vehicles
- Impact of these factors depends on system architecture and penetration level

Penetration Analysis



Wind-Diesel Cogeneration



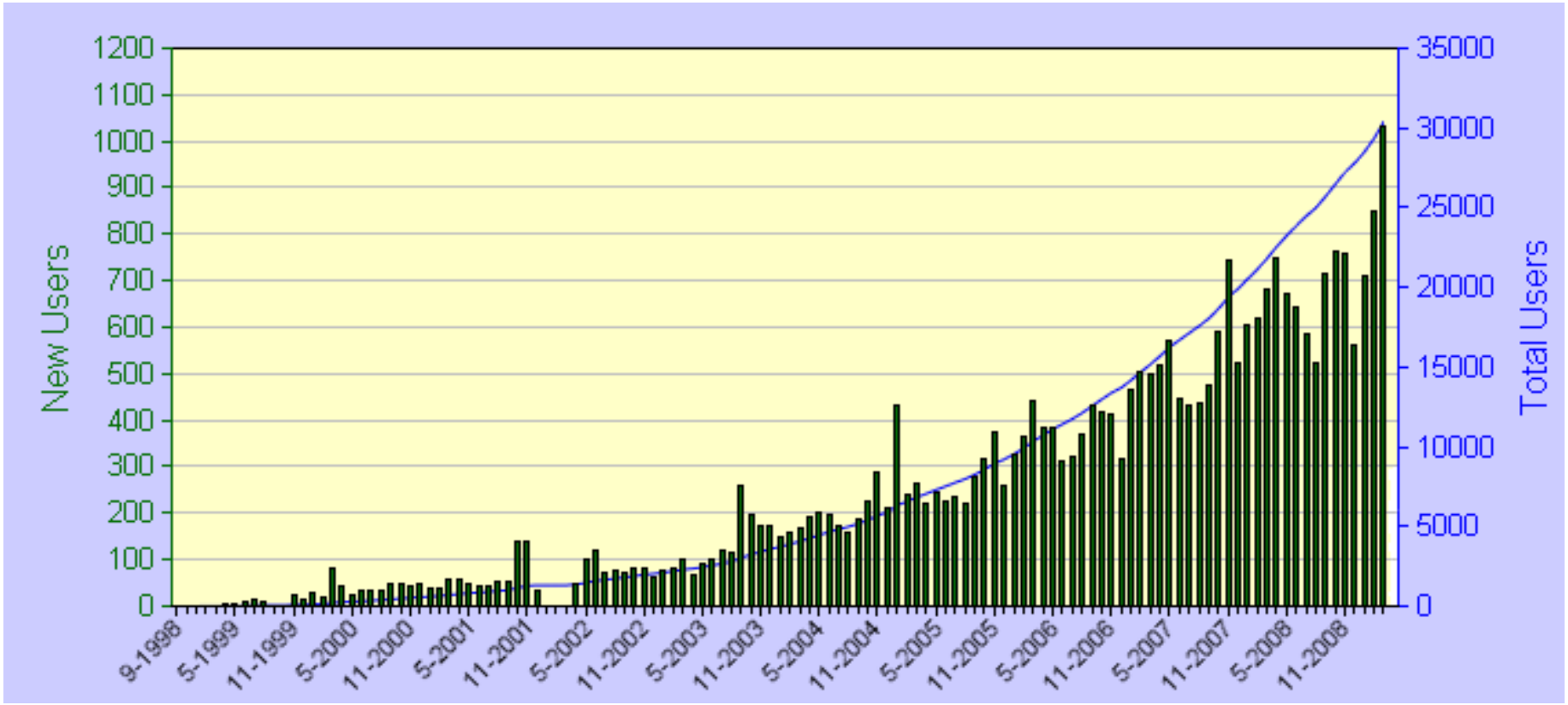
What is the minimum fuel price for wind-diesel to be cost-effective?

Does it depend on the size of the thermal load?

History

- 1993 Village Power
  - Internal NREL use
- 1998 Version 1.0
  - Publicly available Windows application
- 2001 Version 2.0
  - Grid-connected systems, multiple diesels, cogen, hydrogen, emissions
- 2007 Version 2.68beta
  - flow batteries, real time prices
  - 32,000 users in 191 countries
- 2009 Commercialization license

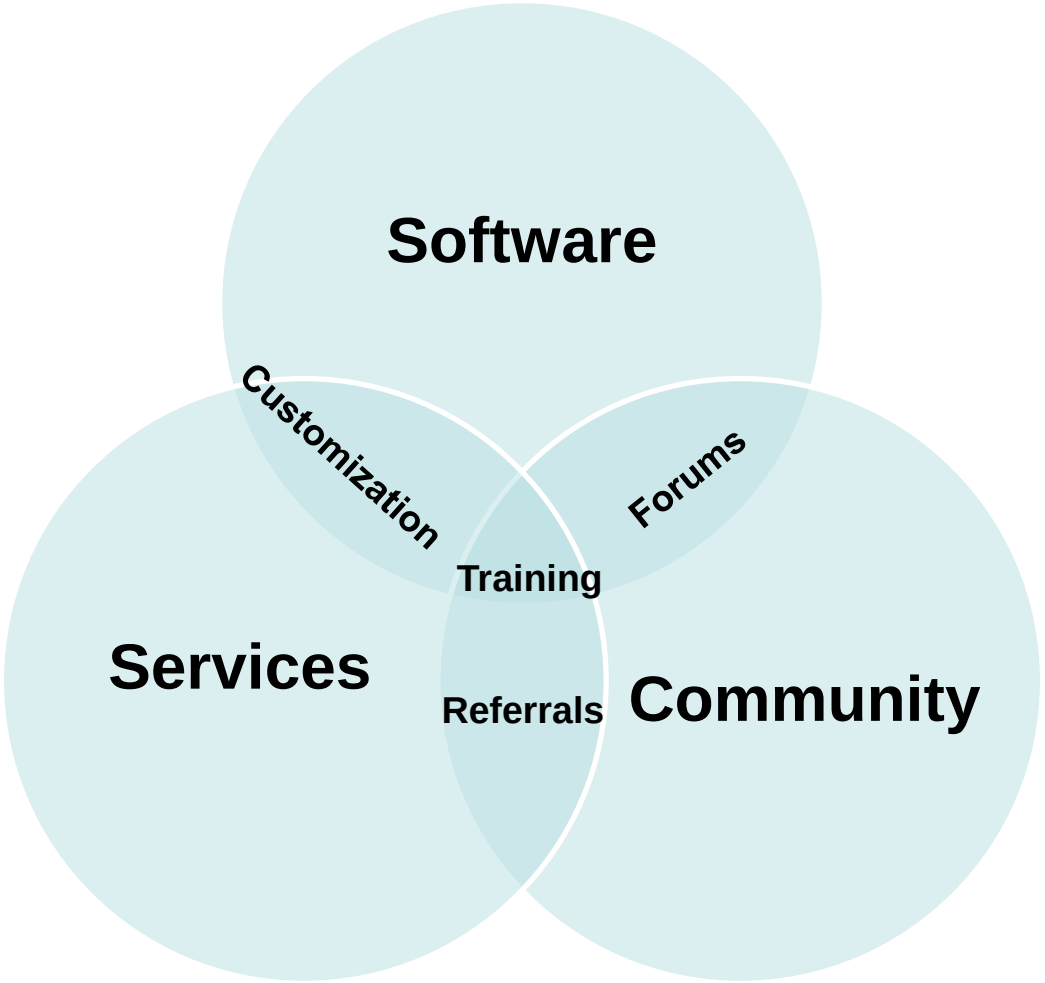
User Growth - 1998 to 2009



HOMER® Energy LLC

- Vision
  - Global, cost-competitive distributed energy based on high penetration renewables and hybrid power systems.
- Mission
  - Provide software, services, and a community to make the distributed energy grow and thrive.

Business Model



On-line Community

- Discussion groups
- FAQs
- Updated databases
  - User-generated content
- User input on new features
- Discussion groups
  - HOMER ® topics
  - General topics
- Information hub for industry and users
  - Case studies
  - News & announcements

Upgrade Modules

- Reliability module
- Detailed technology-specfiic modules
  - PV, Wind, Biomass, Hydro, Hydrogen
- Larger systems with multiple generators [such as islands]
  - Wind-diesel
- Plug-in Vehicles
- Load Management
  - Waterpumping and other deferrable loads
- Cogeneration and other thermal loads
- Finance module
- Decision analysis
- Custom programming

Wind-Diesel Version

- Diesel upgrades
  - O&M
    - Major & minor overhauls
  - Start-stop cycles
  - Ramp rates
  - 1 minute time steps
- Flywheels
- Wind upgrades
  - Availability
- Thermal modeling
  - Storage
  - Dump load as decision variable
- Region-specific database
  - Resources, loads, equipment

Your Participation

- Give feedback on HOMER ® software
  - Free download at www.nrel.gov/homer
  - Coming soon to: www.homerenergy.com
- Suggest new features
- Publicize case studies
- Participate in HOMER ® Community
- peter@homerenergy.com