



**PNWER Annual Summit
Energy Solutions
Portland, OR
July 24, 2017**

**John Glassmire
Director of Energy Engineering**

Clean Power Everywhere

Agenda

- Distributed Energy: Opportunities & Challenges
- About HOMER Energy
- Overview of HOMER Energy Solutions
 - Microgrid Analysis and Design
 - Marketing and Promotion
 - Capability Boosters
- Sample HOMER Results: Options for Small, Remote Alaskan Communities

Distributed Energy: Opportunities & Challenges

The Realities of Distributed Energy

45% of utility executives surveyed say traditional electricity distribution system is no longer fit-for-purpose*

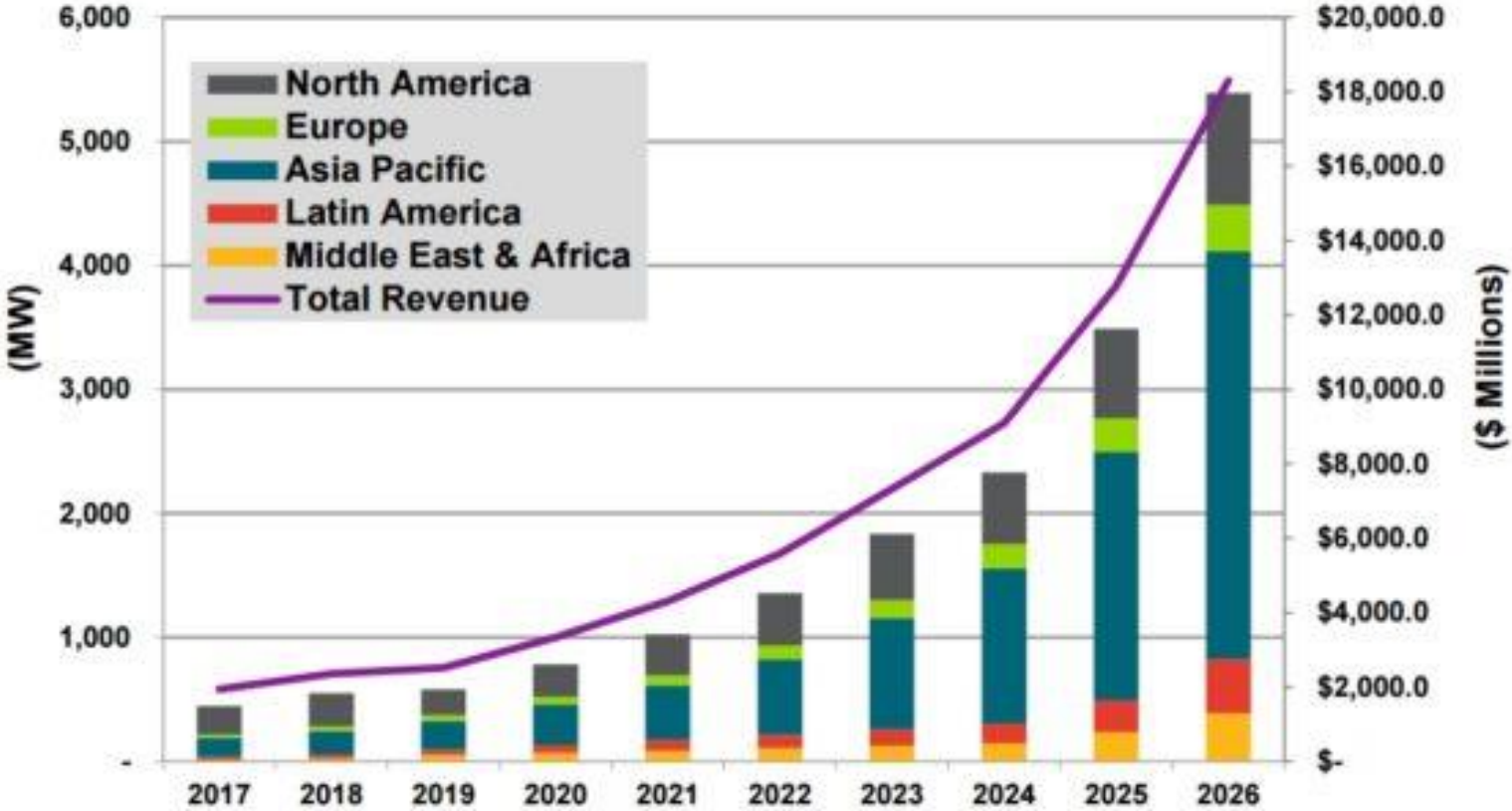
- Traditional power grid presents risks
 - Complex, aging system
 - Vulnerable to increasingly severe storms
 - Rising costs from increased complexity
- Energy sources are becoming more diversified
 - Changing consumer habits
 - Impacts of environmental regulations
- Microgrids have significant market potential
- Remote areas, like in Alaska, pioneering renewable Distributed Energy
 - HOMER has decades of experience in this market



*Accenture Digitally Enabled Grid research program, 2016

Microgrid Opportunities

Total C&I Microgrid Capacity and Implementation Spending by Region, World Markets: 2017-2026

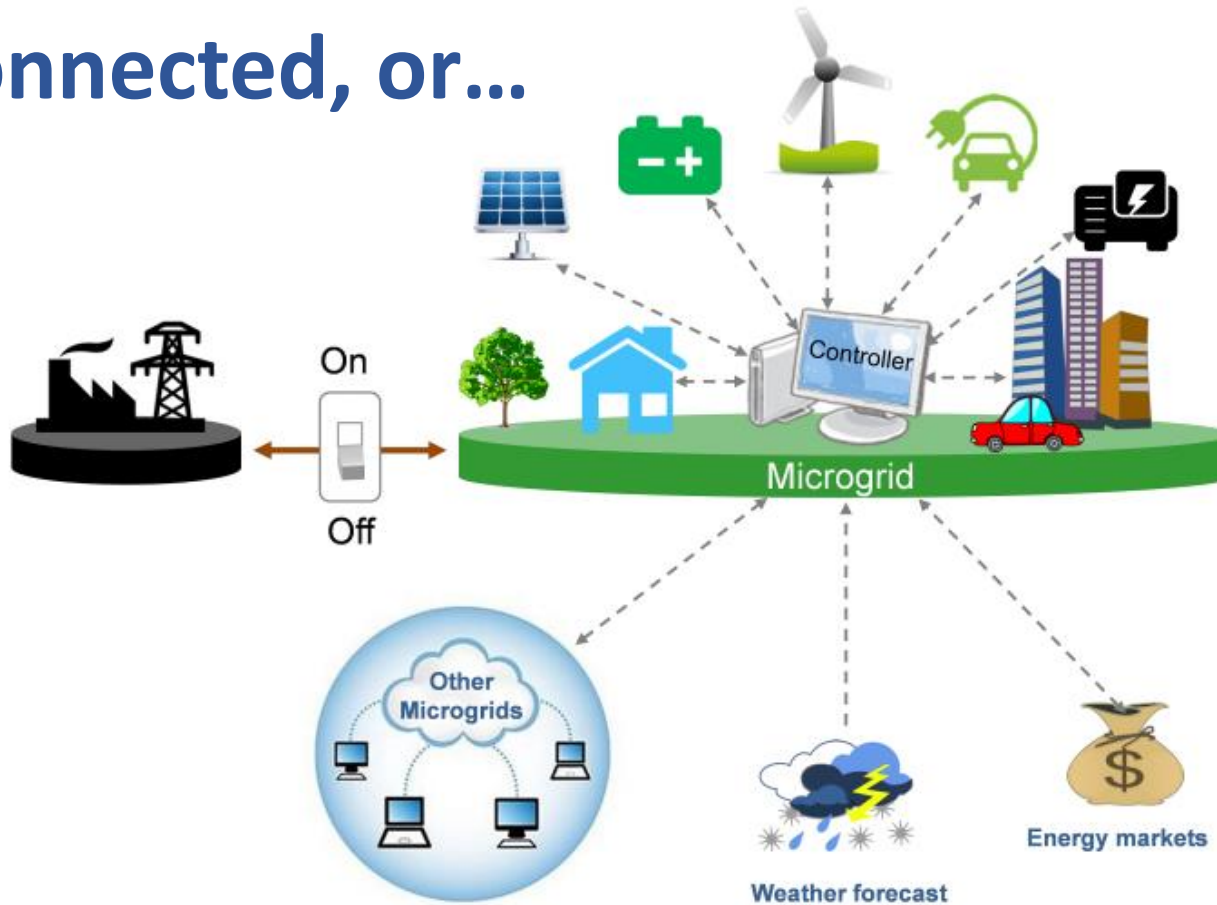


Source: Navigant Research



What is a Microgrid?

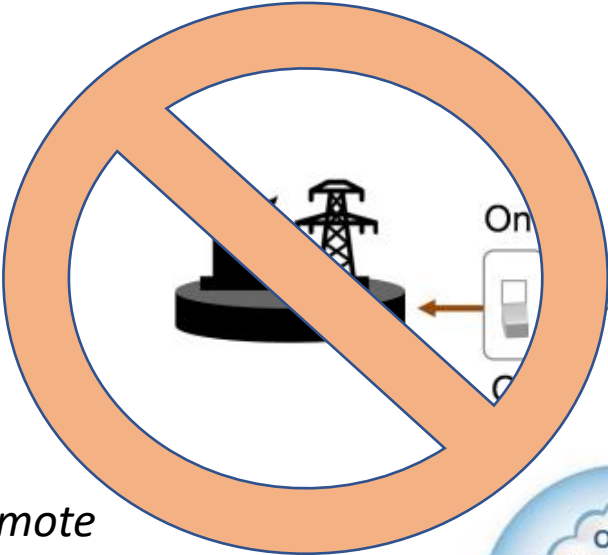
Grid-connected, or...



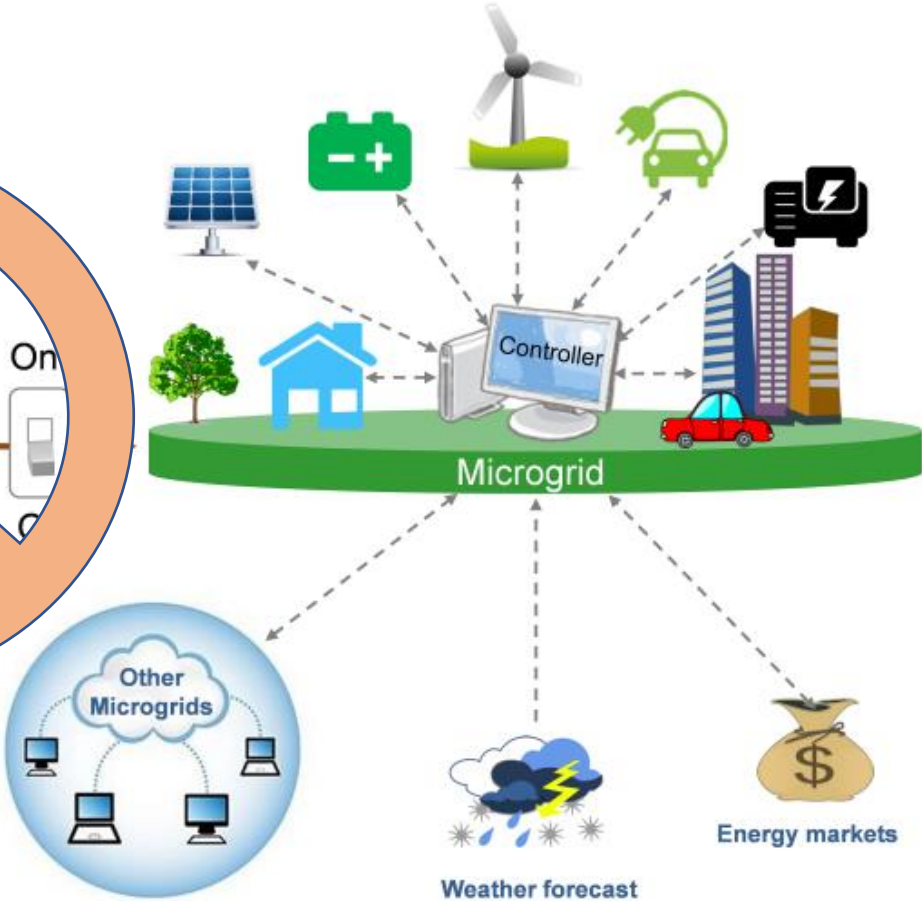
Copyright Berkeley Lab

What is a Microgrid?

...off-grid



Remote microgrids always run independently



Copyright Berkeley Lab

Microgrid Markets and Applications

- **Grid-Connected** – Grid-interconnection impacts the operation, stability, availability, and economic impacts of a microgrid.
- **Resilience** – Microgrids can provide the ability to deliver reliable, affordable, and clean electricity to consumers where they want it, when they want it, how they want it.
- **Energy Access** – Small areas with no incumbent infrastructure provide an opportunity to build energy systems that use today's technologies, business models, and community participation to deliver clean, affordable, reliable electricity.
- **Islands** – Microgrids serve the needs of consumers require cheaper, cleaner energy, in more remote location (200+ communities around Alaska)

Microgrid Challenges



Microgrid Design

- What is the best business case / proposal we can put forth?
- What is the optimal mix of components for the application?
- If it's not feasible today, when will it be?



Industry Analysis

- How do I learn more about the microgrid industry?
- How do we attract leads?
- How do we know which leads to follow up on?
- How do we educate our potential customers?
- Which markets are the best opportunities for us to focus on?
- Where are the best opportunities around the world?



Capability Boosters

- How do we become system design experts?
- How do we win projects?

How do you achieve your
fullest potential in this industry?

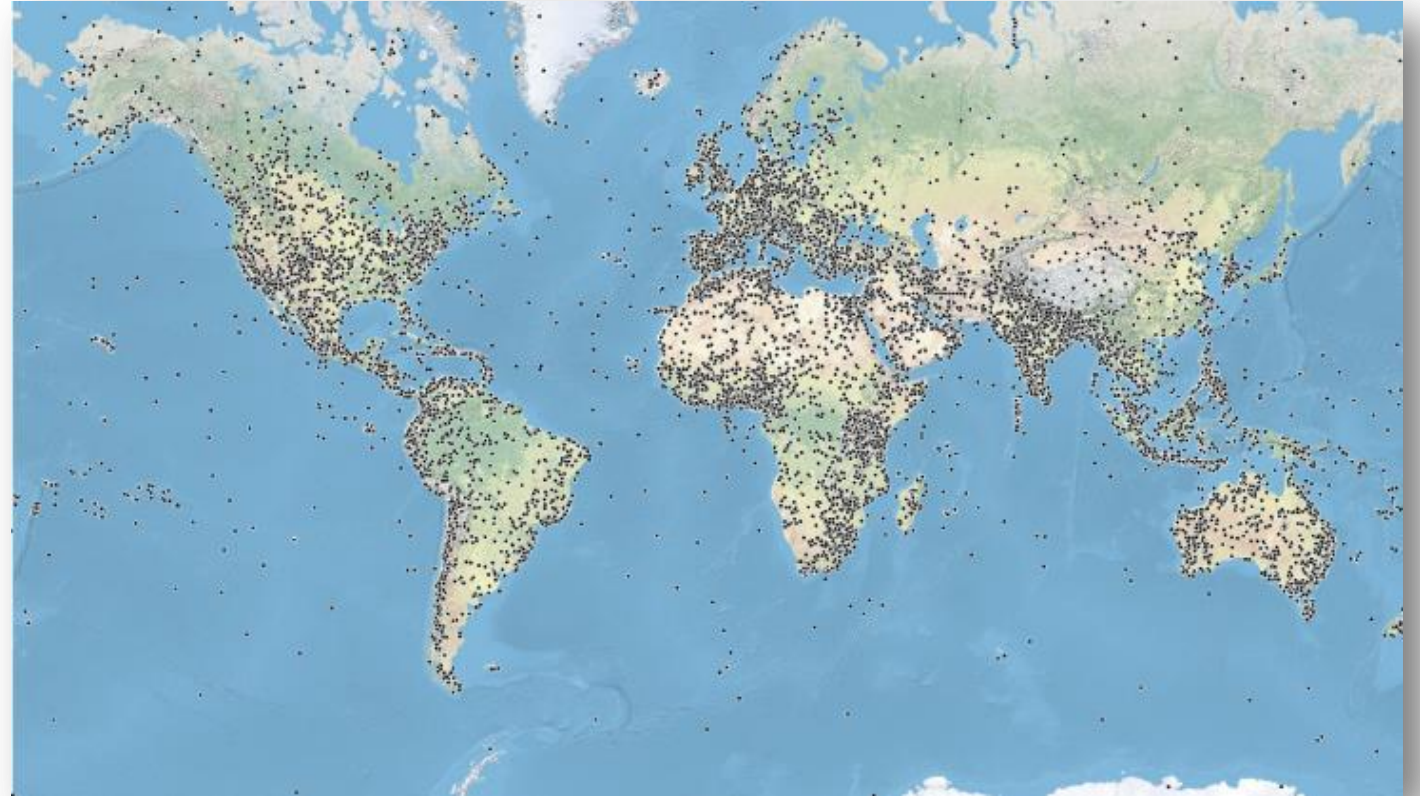
HOMER can help.

About HOMER Energy



HOMER Energy

- Privately held LLC based in Boulder, Colorado USA with 24 employees
- The **trusted global standard** in economic design analysis
- Created at **National Renewable Energy Lab (NREL)** in 1992; privatized in 2009
- **All 35+ of the rural AK communities that integrated renewables have used HOMER** to plan their microgrids
- Over 36,000 microgrids (both on- and off- grid) modeled in **193 countries...** and Mars



Over 36,000 microgrids modeled in HOMER Pro

Sampling of HOMER Customers

Developers



Component Suppliers



Education



Engineering Firms



Government & Financial Institutions



Utilities



HOMER Energy Solutions



Microgrid Analysis and Design

Microgrid Simulation & Optimization

Economic Analysis

Advanced Applications



Targeted Industry Marketing & Promotion

Lead Generation & Qualification

Market Pulse

Solution Promotion & Education



Capability Boosters

Consulting

Training

Premium Support

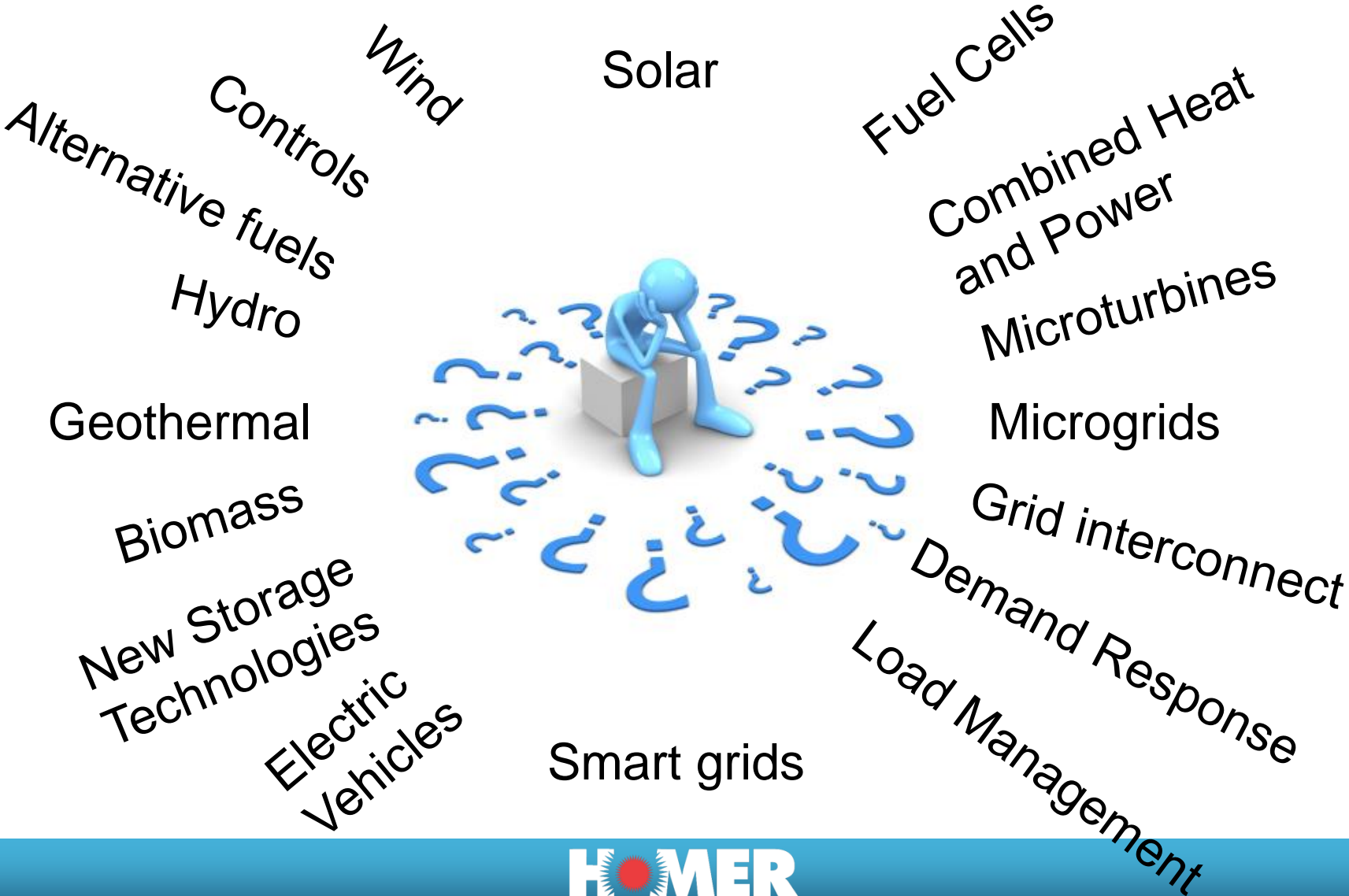
Microgrid Analysis & Design

Microgrid Analysis and Design: HOMER[®] Pro

- Hybrid Optimization of Multiple Energy Resources
- Designed to simplify the complex process of designing lowest cost of energy microgrid and DER systems
 - Enables modeling of nearly any system design
 - Simulates the design with real-life resources, load data, and components
 - Finds the best solution to deliver the lowest cost solution
- Technology agnostic platform provides accurate, unbiased results



Many choices for microgrids



What is best?

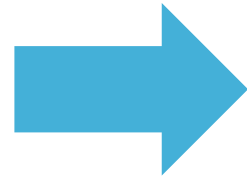
HOMER Project Inputs



Load Profile

Site-Specific Resources

System Components



HOMER fits the pieces together

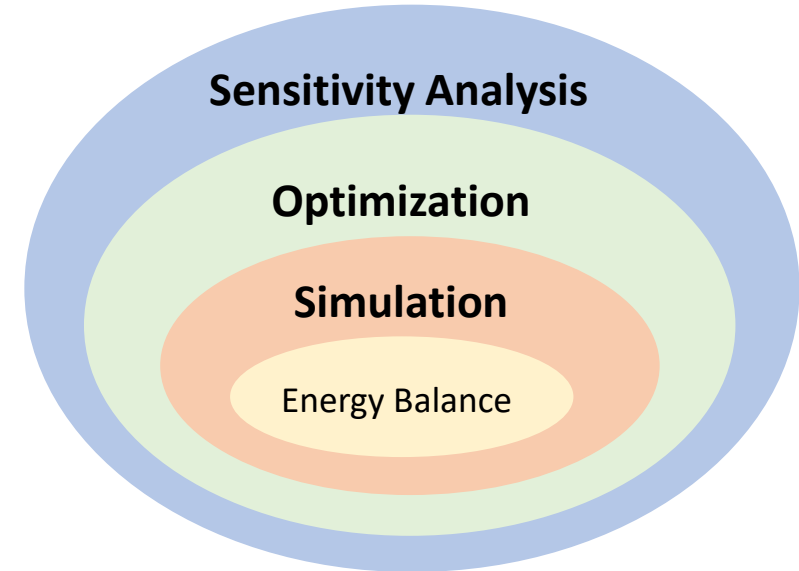


Benefits of Using HOMER[®] Pro

- Save thousands on proposal development by determining early stage project feasibility
- Ensure least-cost design by building out the basic design of a microgrid or DER
- Minimize project risk by considering all options
- Compare competitive components in various simulated environments
- Identify price points at which different technologies become competitive

The Power of HOMER[®] Pro

- Three powerful tools in one
- Engineering and economics work side by side
- Simplifies the design process
- Makes it easy to compare thousands of possibilities in a single run
- Can be customized to meet your specific needs



What People Say About HOMER[®] Pro

We recommend HOMER to everyone. There is nothing else out there that does what it does.

Anders Pedersen
World Bank

We spent a lot of money developing our own model, but threw it away because everyone kept asking for our HOMER results.

Bruce Levy, CEO
TDX Power

The best hourly assessment tool for hybrid renewable electric generation systems in the world – bar none.

Dr. Jan F. Kreider
Building Systems Program
University of Colorado

HOMER is a beautiful thing... it does most everything you could want it to, and it actually presents results in an intuitive/understandable manner.

Jonathan Murphy
Aerospace Systems Design Laboratory,
Georgia Tech

We are amazed at both the thoroughness of the software and the design complexity it allows us to relatively quickly evaluate. To our knowledge, there is no other software on the market that matches HOMER for the purpose of designing renewable energy systems.

Lisa Michael
Renewable Energy Systems

Marketing & Promotion

SaaS API: Your App Powered by HOMER

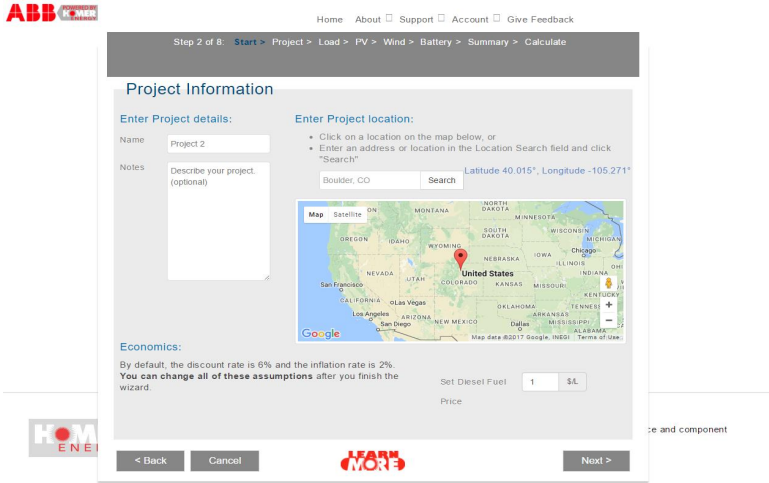
Show how your solution produces ROI/Payback in a realistic, unbiased simulation
Build your lead generation web app on top of HOMER's SaaS API

The screenshot displays the HOMER Energy SaaS API web interface. At the top left is the ABB logo with the text 'POWERED BY HOMER ENERGY'. The navigation bar includes 'Home', 'About', 'Support', 'Account', and 'Give Feedback'. A breadcrumb trail shows 'Step 2 of 8: Start > Project > Load > PV > Wind > Battery > Summary > Calculate'. The main section is titled 'Project Information' and is divided into two columns. The left column, 'Enter Project details:', contains a 'Name' field with 'Project 2' and a 'Notes' field with the placeholder 'Describe your project. (optional)'. The right column, 'Enter Project location:', includes a list of instructions: 'Click on a location on the map below, or Enter an address or location in the Location Search field and click "Search"'. Below this is a search input with 'Boulder, CO' and a 'Search' button. A map of the United States shows a red pin over Colorado, with coordinates 'Latitude 40.015°, Longitude -105.271°' displayed. Below the map is an 'Economics:' section with a note: 'By default, the discount rate is 6% and the inflation rate is 2%. You can change all of these assumptions after you finish the wizard.' To the right of this note is a 'Set Diesel Fuel' input with '1' and '\$/L'. At the bottom, there are '< Back', 'Cancel', 'LEARN MORE', and 'Next >' buttons. A small 'HOMER ENERGY' logo is in the bottom left corner, and the text 'se and component' is partially visible in the bottom right corner.

Potential to generate thousands of leads per month with your web app, built on HOMER SaaS API

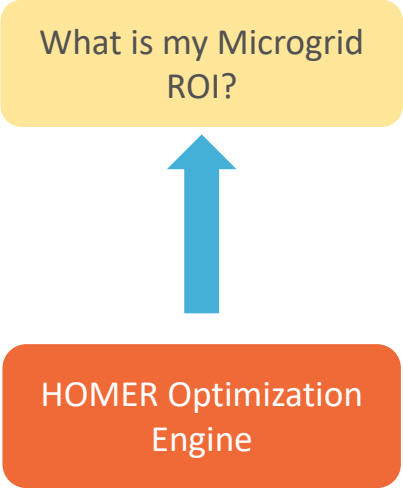
SaaS API: Your App Powered by HOMER

White-labeled or Custom App

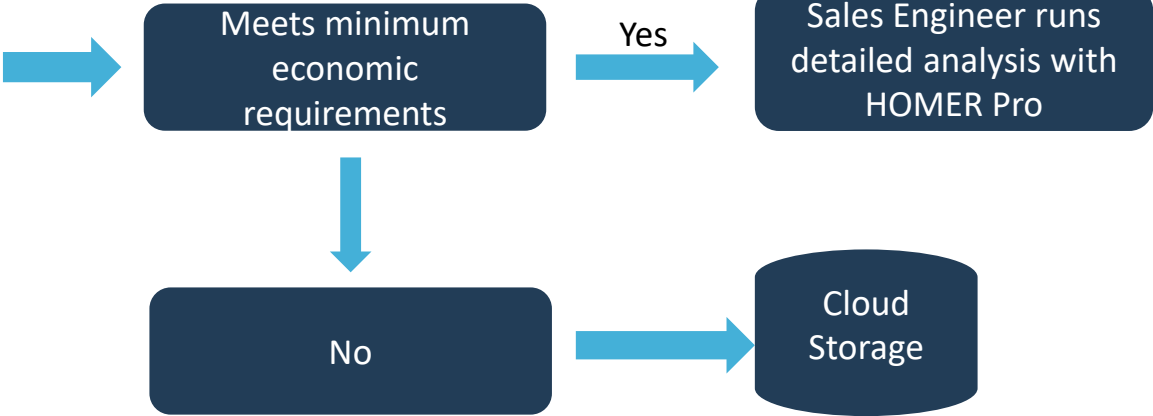


Prospective Customer

- Capture Prospect Data Name/Contact/Project /Financing/etc.
- Educate on your solutions



Sales Engineering

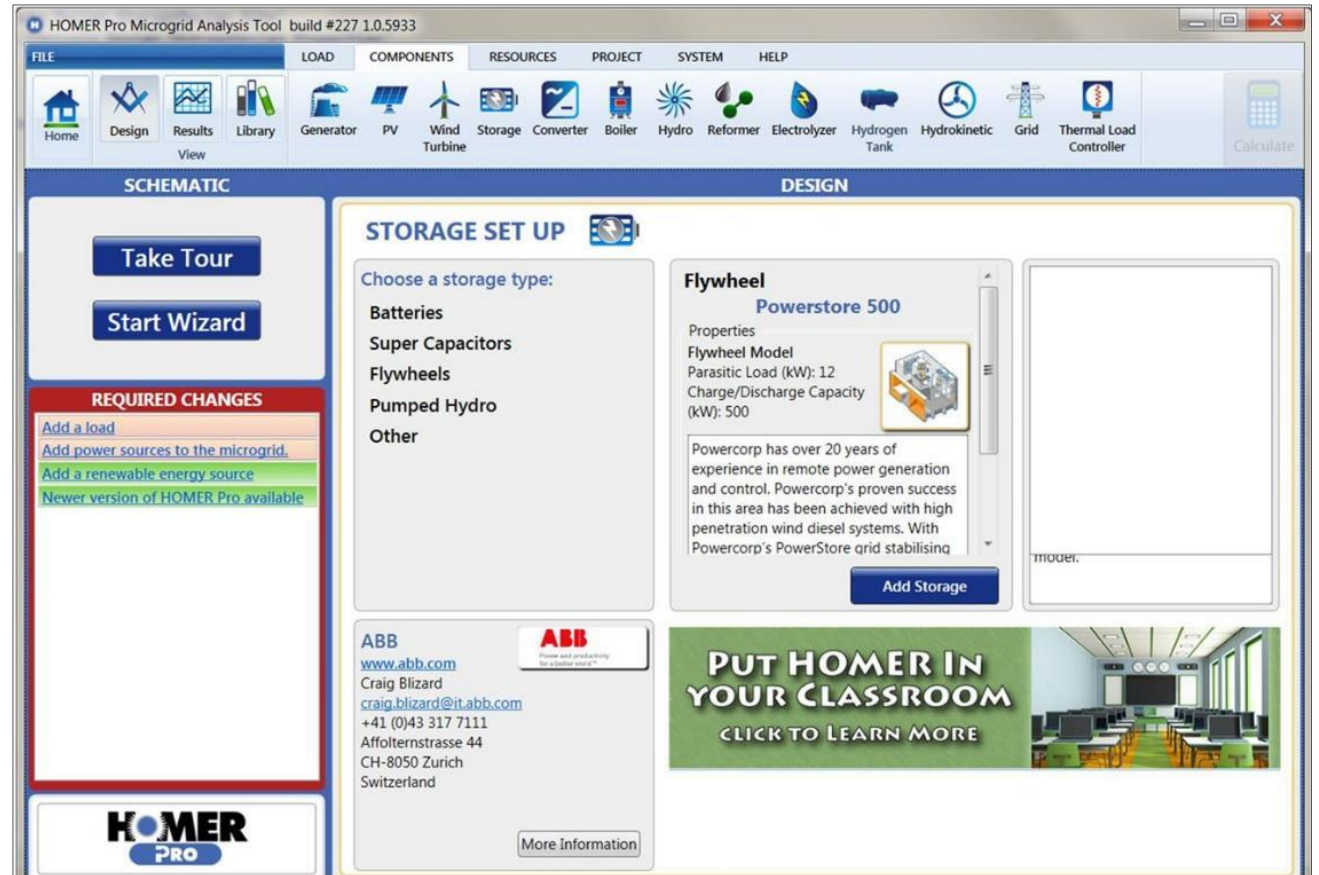


Unqualified leads stored until component and project costs drop enough to qualify

Component Partner Program

Detailed component information presented to potential customers early in design process

- HOMER Pro has the largest collection of microgrid equipment
- Component Partners Gain Premium visibility within HOMER Pro's Component Library
- Connecting suppliers with customers
 - Company contact details and additional info
 - Component image and notes
 - Three components in "Quick Pick" drop-down menu
 - Unlimited components in complete catalog



Annual Conference



HOMER International
MICROGRID

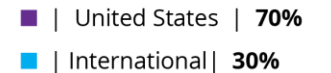
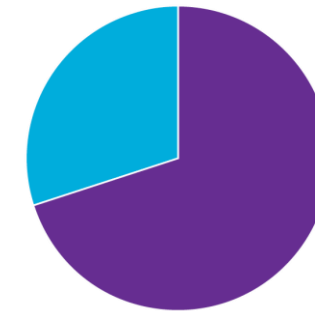
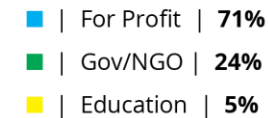
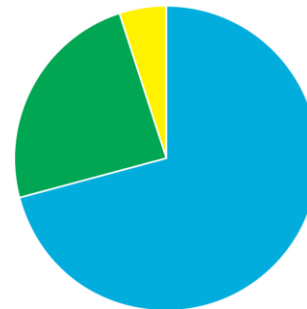
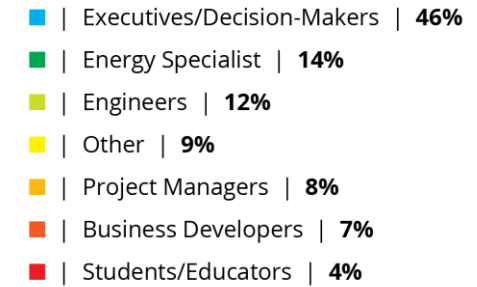
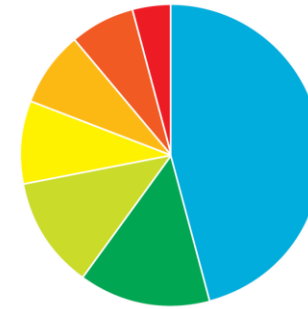
5th Annual HOMER International Microgrid Conference

September 18 – 20, 2017
Denver, Colorado USA

Annual Conference

This year's conference is expected to draw over 200 microgrid owners, developers, suppliers, financiers, and policy makers from around the world.

- The majority of attendees are executives or decisions-makers within their organizations.
- Over 70% of our attendees are affiliated with for-profit organizations, with almost 24% coming from government or non-profit organizations.
- In 2016, almost 1/3 of conference attendees came from outside the United States.



Capability Boosters

Consulting

- HOMER's staff have deep experience with the design and market dynamics of the microgrid/DER segments
- Services include co-authoring of case studies and other analyses
- Typically used for:
 - Mini-trainings on any feature within HOMER Pro
 - File verification for quality assurance
 - Microgrid design questions
 - Or... give us the data, and we will create your HOMER file



Training



- Train front-line sales engineers to use HOMER Pro to qualify incoming leads.
- Train inside engineers to use HOMER Pro to conduct competitive analysis of other products.
- Train engineers to use HOMER to establish the primary microgrid design.

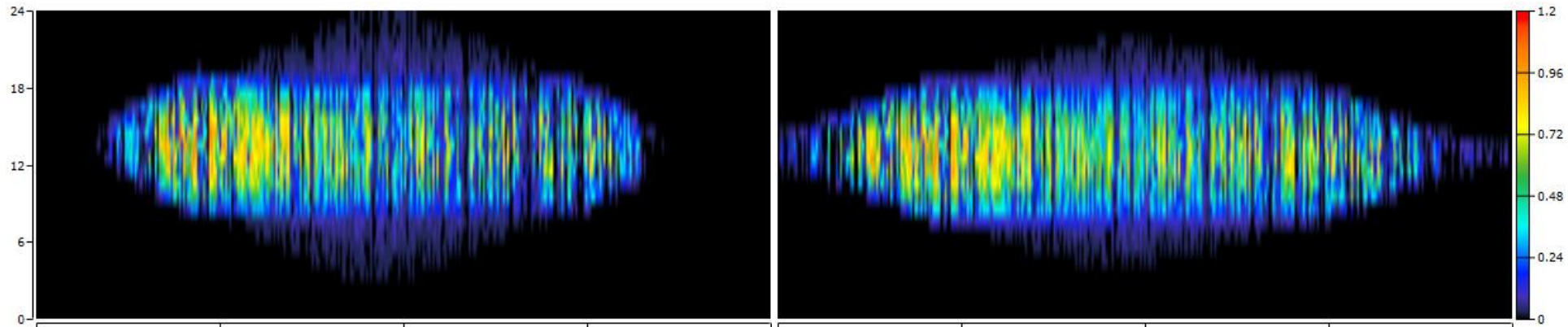
Sample HOMER Results: Small, Remote Alaskan Village

Small, remote Alaskan Community

- Based on Minto, Alaska
- Assumed Load
 - Modified AK Load
 - 137 kW Peak
 - 55% load factor
- Did not model thermal
 - Would be interesting, but limited time
- Can be generalized to other small villages
 - However, HOMER runs quickly, so you can quickly customize for other communities

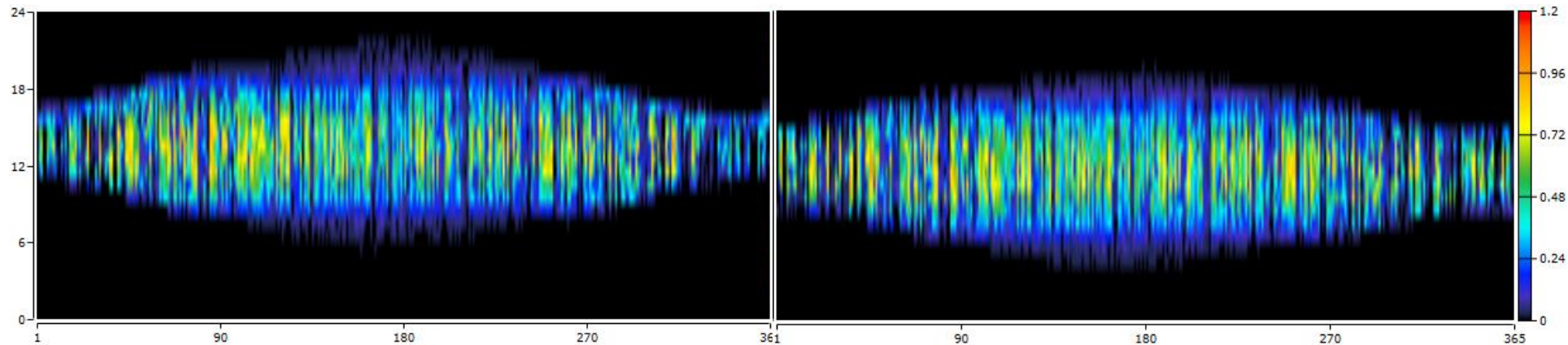


Quickly download solar resource anywhere



North Alaska (Barrow)
2.15 kWh/m²/day

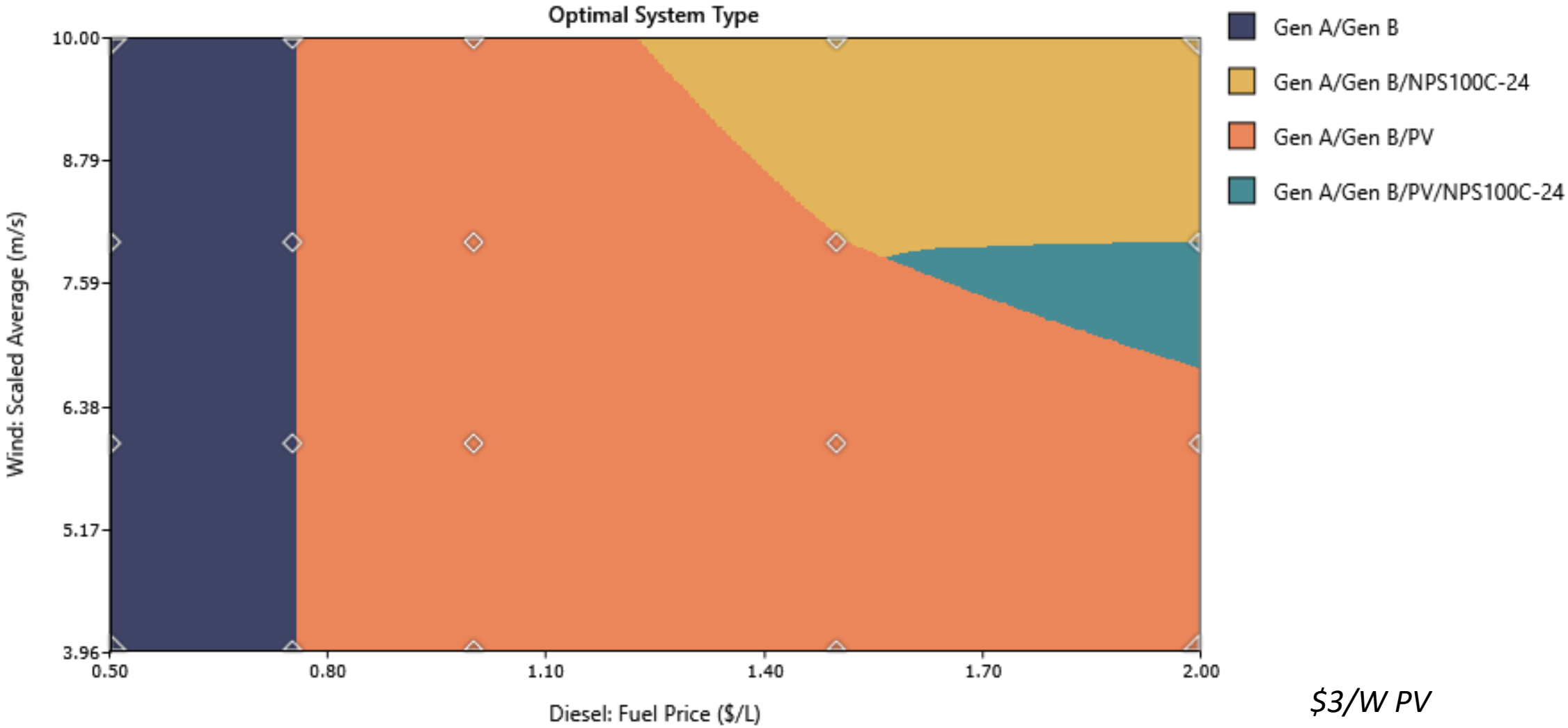
Central Alaska (Minto)
2.58 kWh/m²/day



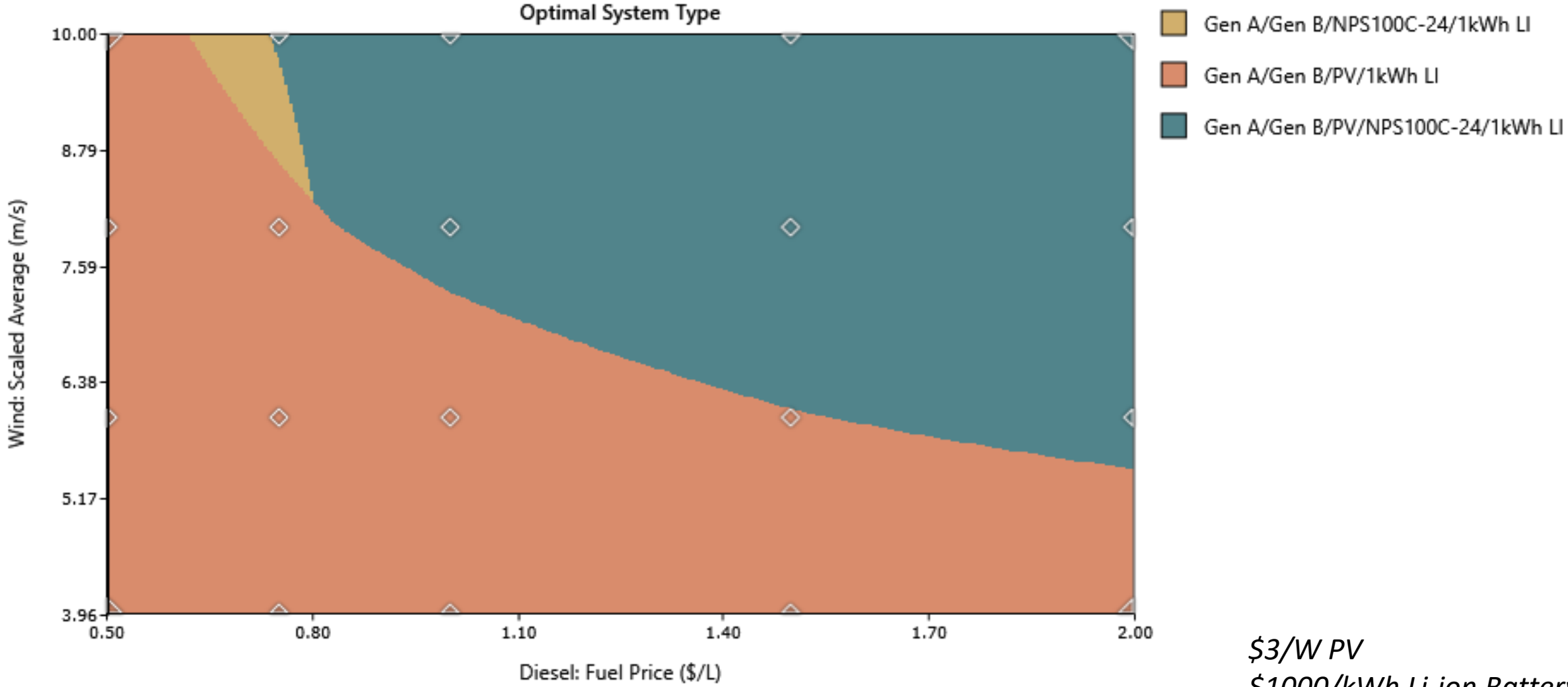
West Alaska (Dillingham)
2.67 kWh/m²/day

South Alaska (Ketchikan)
2.87 kWh/m²/day

Compare Options: Wind and solar

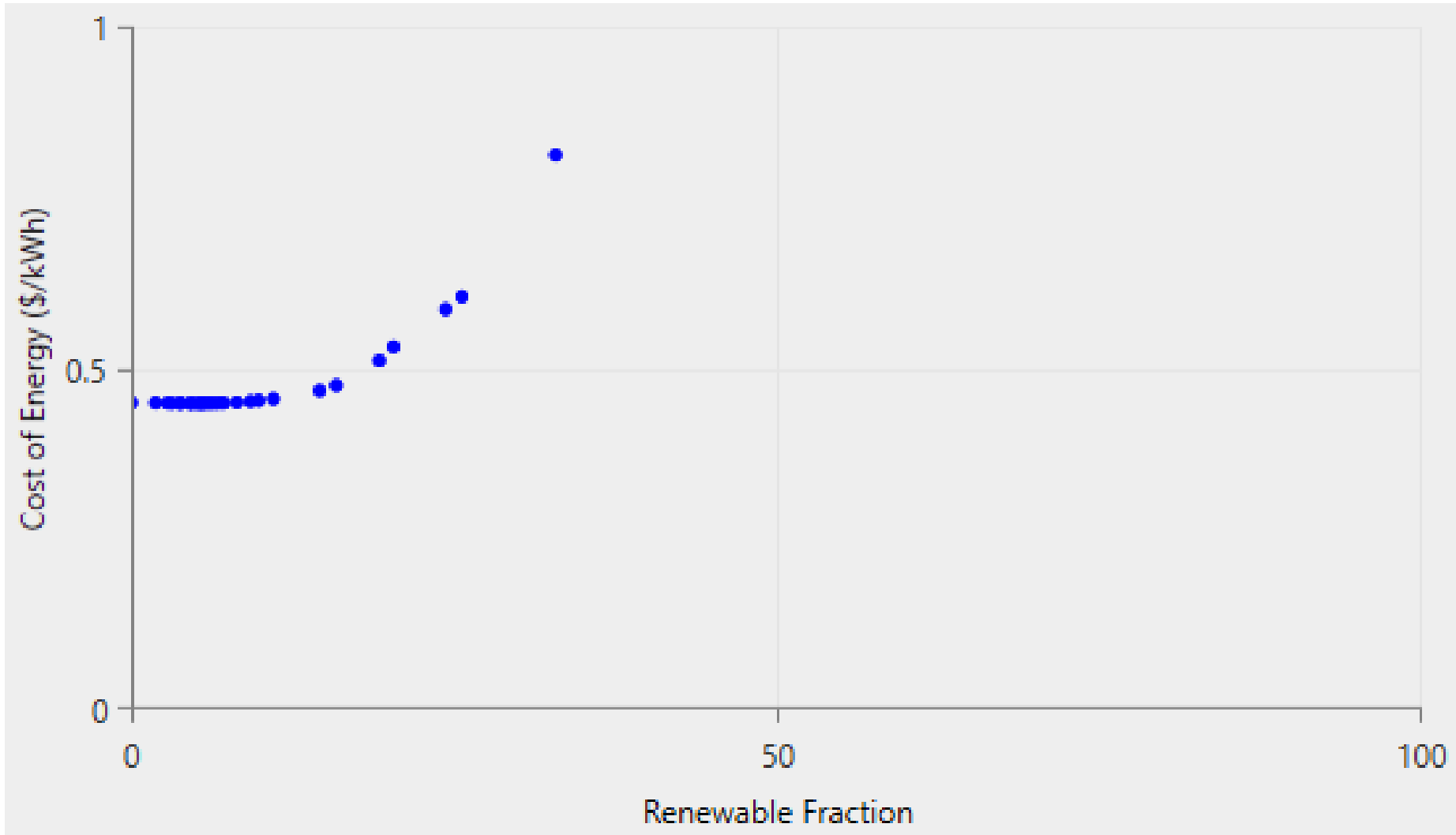


Compare Options: Wind/Solar with Batteries



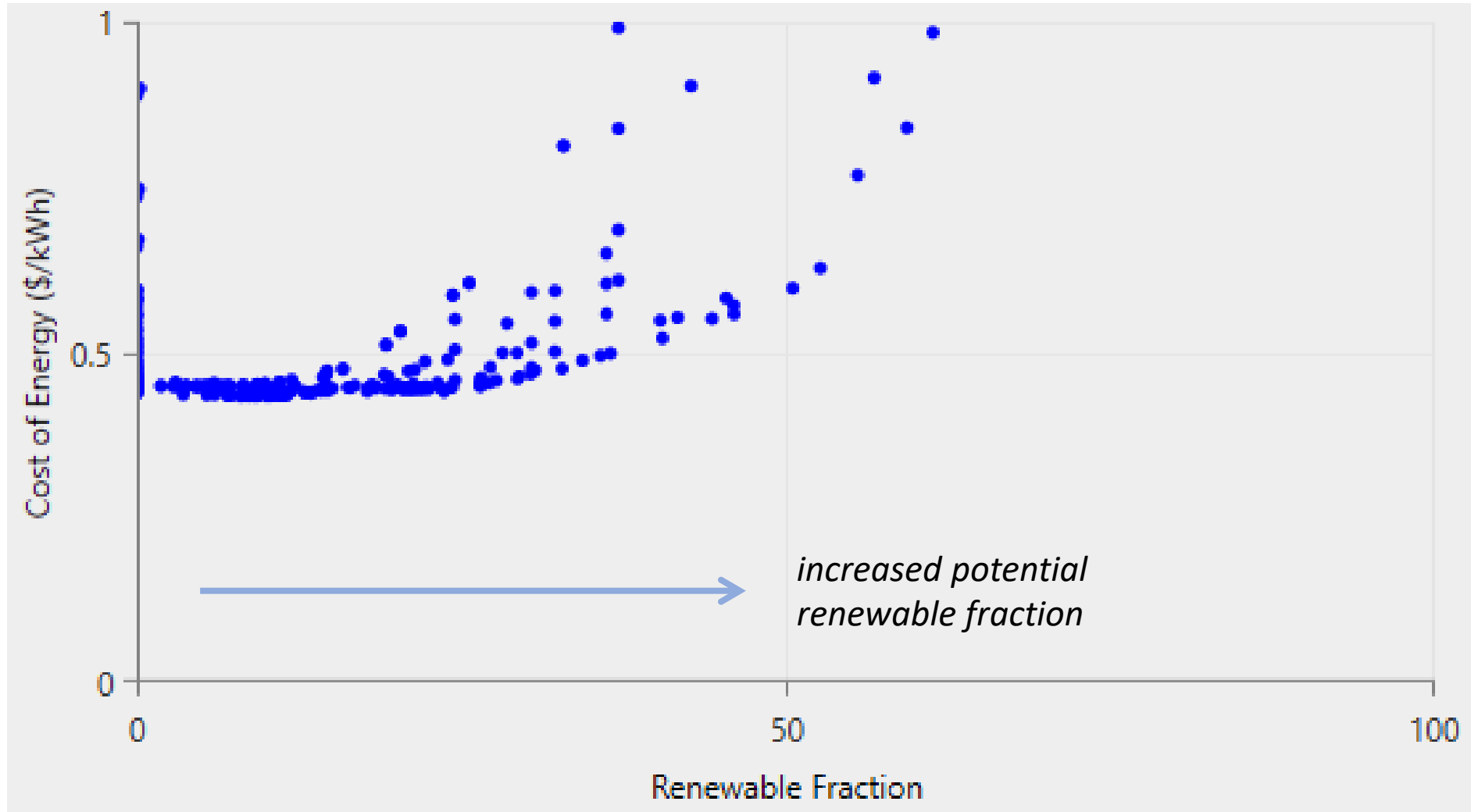
\$3/W PV
\$1000/kWh Li-ion Battery

Achieving renewable goals (no battery)



\$3/W PV
\$3.80/gal diesel

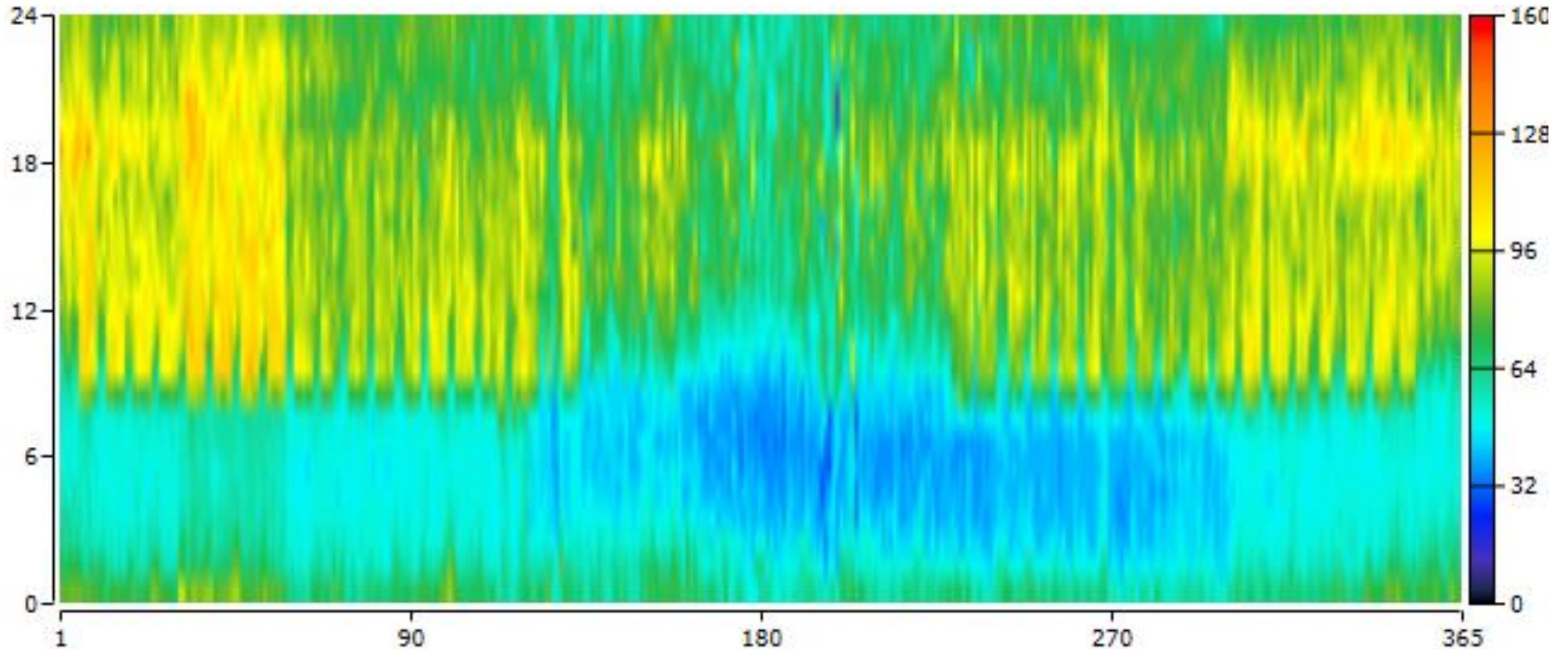
Achieving renewable goals (with battery)



\$3/W PV
\$3.80/gal diesel
\$1000/kWh Li-ion battery

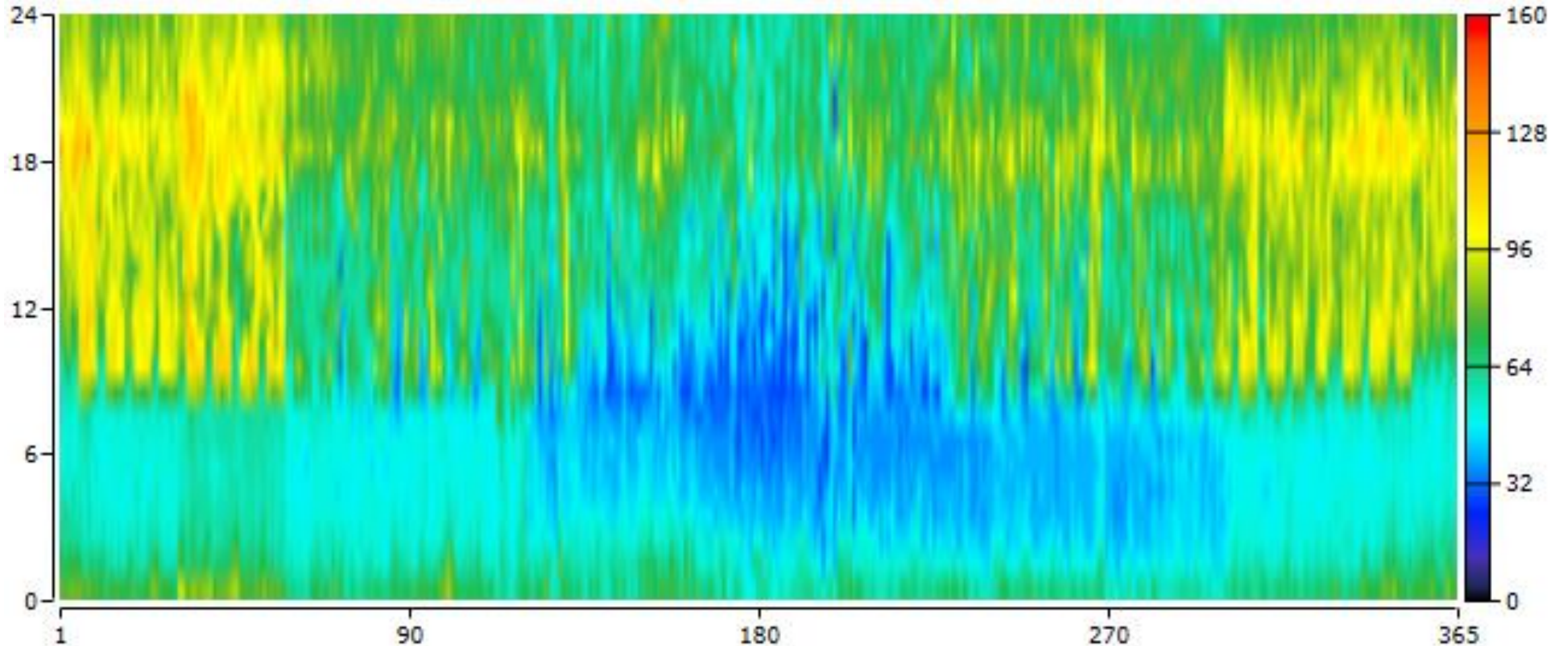
Operational impacts on diesel generator

Diesel production with diesel-only generation



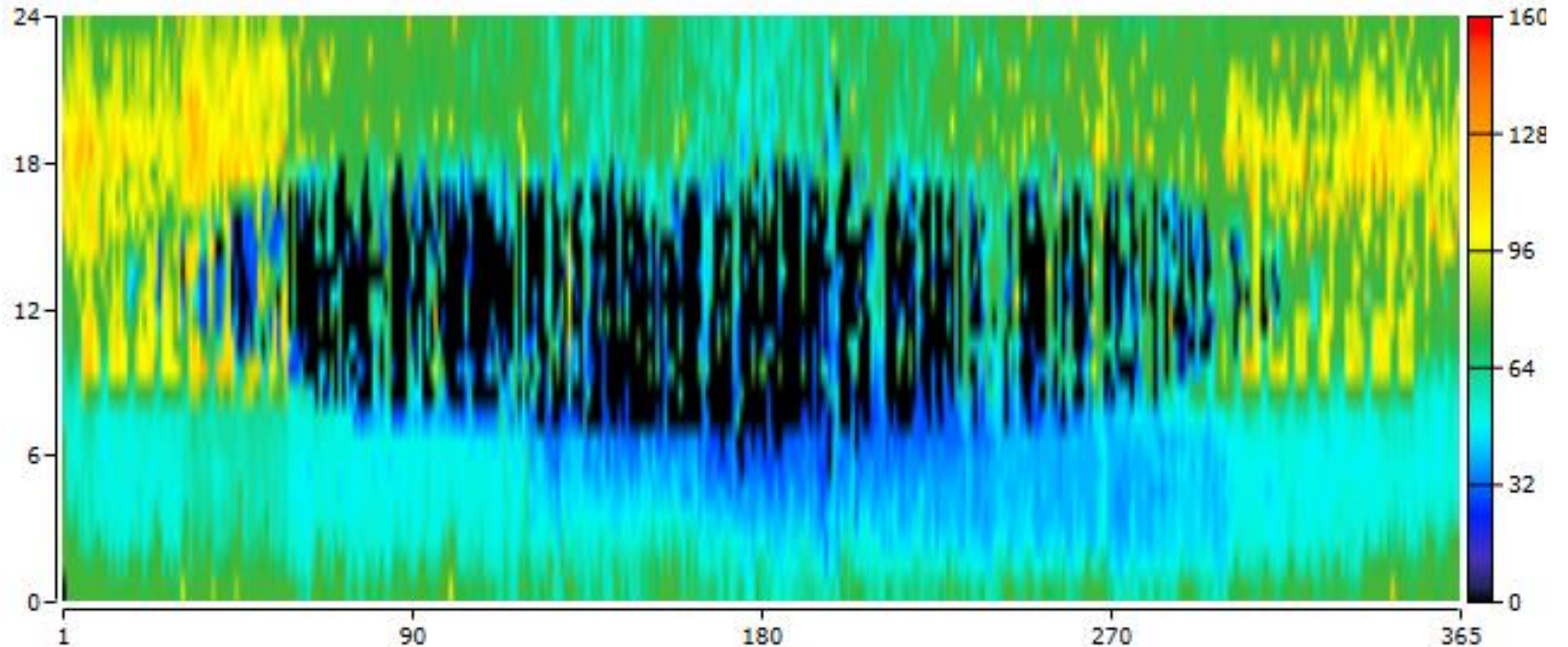
Operational impacts on diesel generator

Diesel production with 40 kW PV



Operational impacts on diesel generator

Diesel production with 150 kW PV, 130 kWh battery



Summary

HOMER Energy Solutions



**Microgrid
Analysis and
Design**



**Targeted
Industry
Marketing and
Promotion**



**Capability
Boosters**

Thank You

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