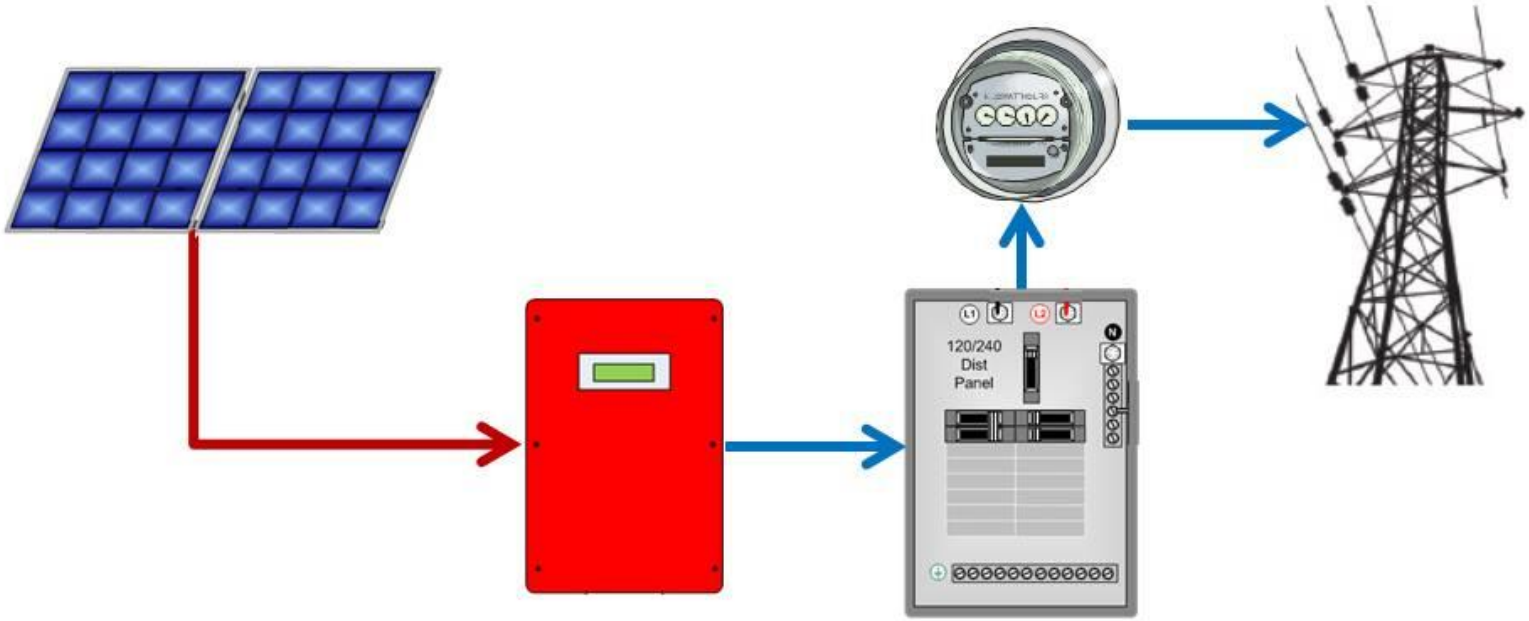
Alpha Technologies Inc.
&
OutBack Power

Energy Storage and Power Electronics in Residential and Small Commercial Systems

InterSolar Munich, Germany

June 11, 2015 15:00 to 15:30

Typical Grid Tie Inverter Connections



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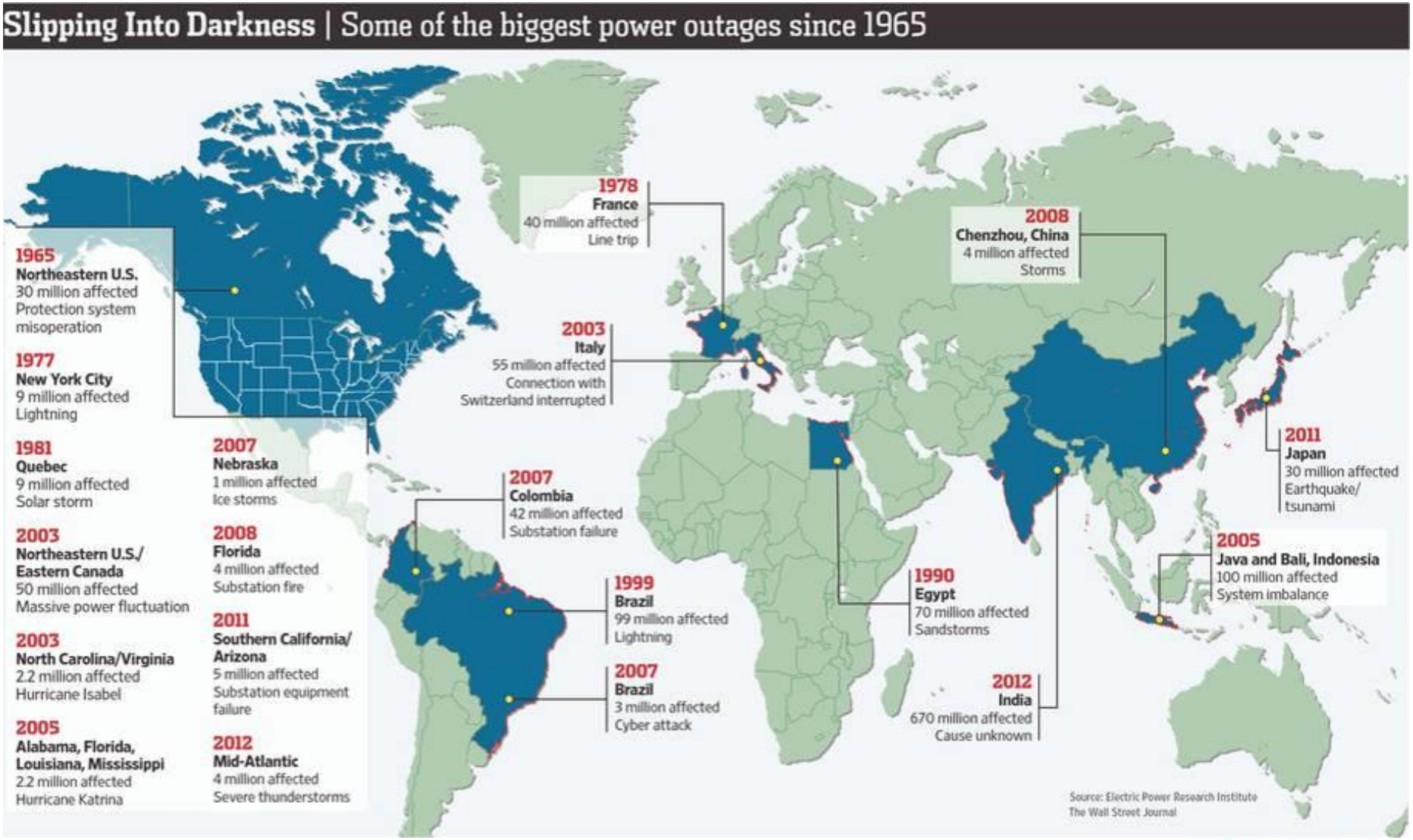
Life-altering outages



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What's the motivation to have backup power installated?

- Grid failure and instability
- Annual occurrence of the 100 year storm
- Climate change and other fear factors

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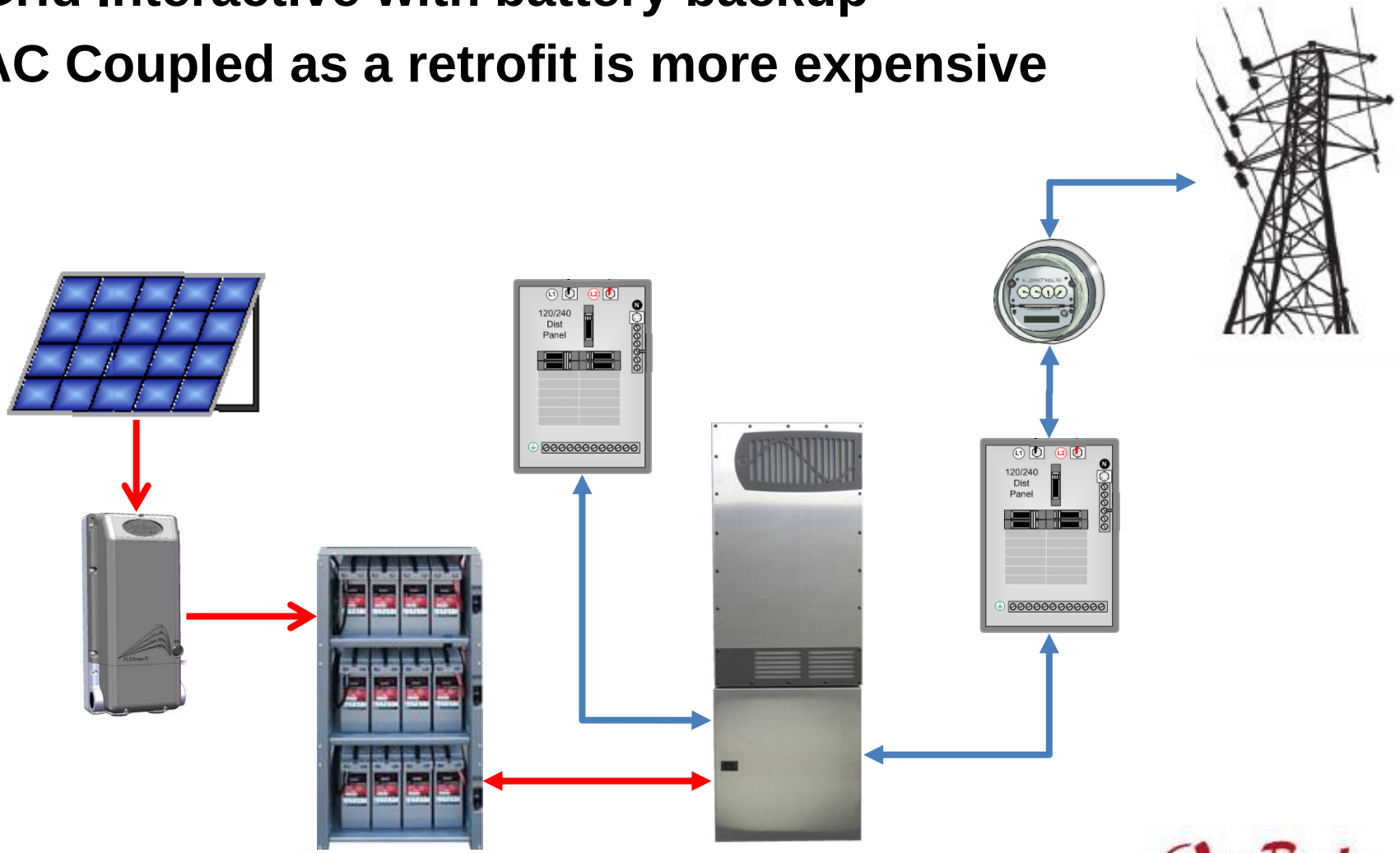
Grid Hybrid System

- **Grid Interactive with battery backup**
- **AC Coupled as a retrofit is more expensive**



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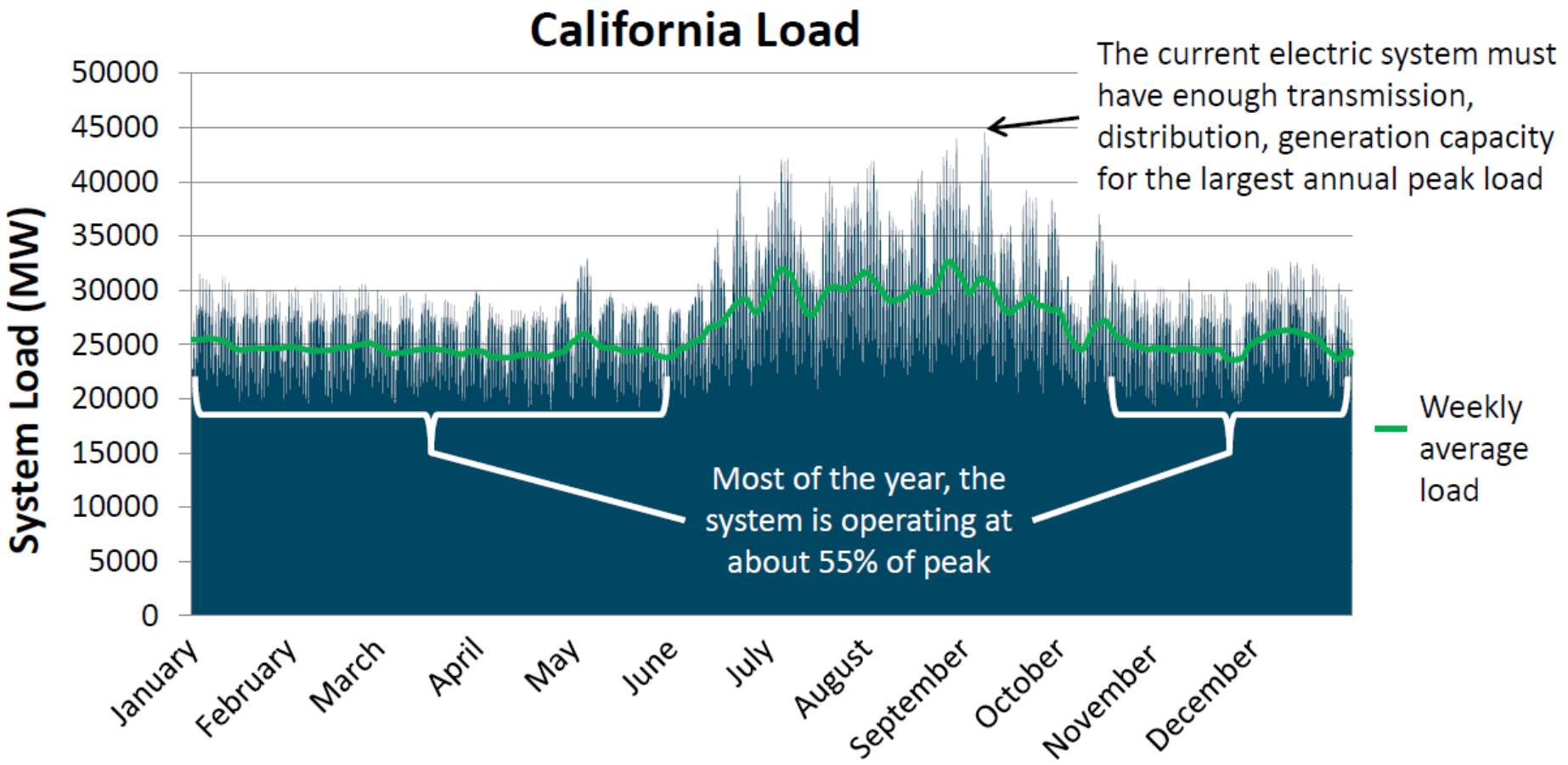
Disruptive Technology

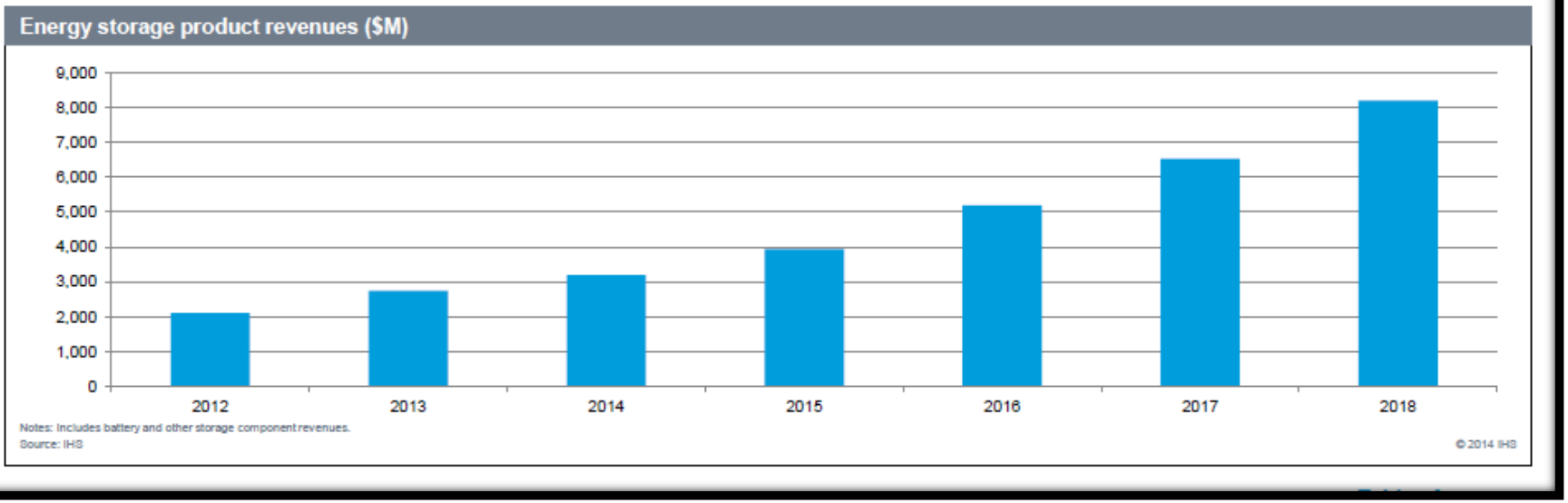
10. Artificial intelligence
9. Biometrics
8. Flexible displays
7. Sensors
6. Advanced user interfaces
5. Graphene
4. Energy storage and advanced battery technologies
3. 3-D printing
2. Cloud computing and big data
1. The Internet of everything

Why Energy Storage?

California's Electric System Is Not Being Efficiently Utilized



Global Energy Storage Revenue ($) Projections



PV energy storage revenues are forecast to rise from $3.2 billion in 2014 to $8.2 billion in 2018.

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Intelligent CPP / DR

- Subscriber removes load from the grid in response to utility signal
  - Simple **Drop** / **Use** commands
  - Loads continue to operate, powered by energy storage
  - Storage can be recharged after peak demand period passes
- Based on positive reinforcement structure
  - Take it independent
  - Keep it running
  - Do it yourself
- Net impact to the grid is identical to traditional Demand Response
  - Key differentiator is the quality of life to those downstream

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Premiere Application

Net-Zero Ranch in Southern California;

- **20 OutBack Radians in 160KW configuration at the center of a power complex including PV, wind, three utilities, and 11 ton battery bank**

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EV Charging Integration

- Integrating intermittent peak demand loads into the grid will become increasingly important
- EV charging is one example
- One Tesla fast charge bay can draw the equivalent of an entire home, one station the equivalent of a subdivision

Premiere Application

Pinnacles National Monument, California

OutBack-powered off-grid visitors' center in the National Park

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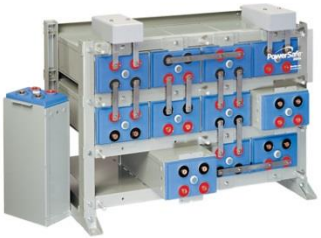
alpha™ Energy

Outback Energy Storage Solutions

EnergyCell RE
Top
Terminal

EnergyCell RE
Front
Terminal

EnergyCell GH
Front
Terminal



EnergyCell RE
High
Capacity

AlphaBat HP
Front
Terminal

Integrated
Battery Rack

Outback
Battery Enclosure

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Masters of the Off-Grid.™ First Choice for the New Grid.

EnergyCell Storage Overview

Standard → Premium → Premium-HC

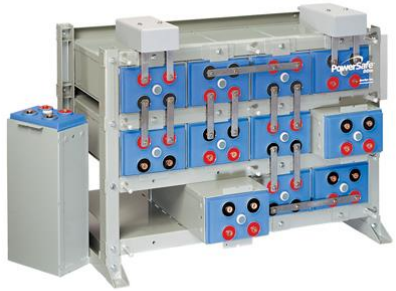
Low Energy Storage
34-212Ah

- Off grid or grid tied smaller residential with minimal backup requirements
- Light load commercial applications (remote traffic or security solutions)

Medium Energy Storage
200-600Ah

- Off-grid residential with medium to large backup requirements
- Medium load commercial applications (small radio tower, small office building)
- GH-Grid-Tied AC Coupling for residential and commercial applications
- GH-Minimal cycling grid-tied battery backup

High Energy Storage
800Ah-2700Ah



- Large backup requirements for off-grid or grid hybrid installations

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Battery Chemistry Comparison

Battery Type	Optimal Application	General Maintenance	Best Practices for Safety	Cycling Ability	Costs
Flooded Lead Acid	Off-grid, medium to high capacity	Electrolyte refreshing required by automatic or manual watering systems Equalization cycle can be periodically required	Hazardous Installed vertically only with basic racking solution Must be in well-ventilated space	High cycle life	Low initial cost of ownership Higher maintenance and accessory costs
VRLA Lead Acid	Grid-interactive, off-grid, UPS and backup power, emergency vehicles,	Maintenance-Free Superior shelf life Electrolyte does not need to be replaced Does not require equalization	Usually rated non-spillable for transportation. Sealed VRLA requires very minor ventilation with 99% recombination efficiency	High to moderate cycle life	Low initial cost of ownership with reduced maintenance and accessory costs
Lithium-ion	Hybrid EV's or high ambient temperature with high cycle required	Maintenance-Free	Must be used with an onboard battery management system to prevent over-charge / over-discharge / thermal runaway	Superior cycling ability	Very high initial cost of ownership. Dependent on application

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Integrated Battery Rack (IBR)

- Front Terminal Configuration
  - Complete, fully assembled solution, with interconnects, cabling, overcurrent protection and disconnects
  - Overcurrent protection and plexi-shielding on each battery string for safety
  - 2 and 3 tier options available
  - Easy to order and install

- Ideal installation examples
  - Compatible with both RE and GH front terminal batteries
  - Grid-tied battery backup with long float life (residential and commercial)

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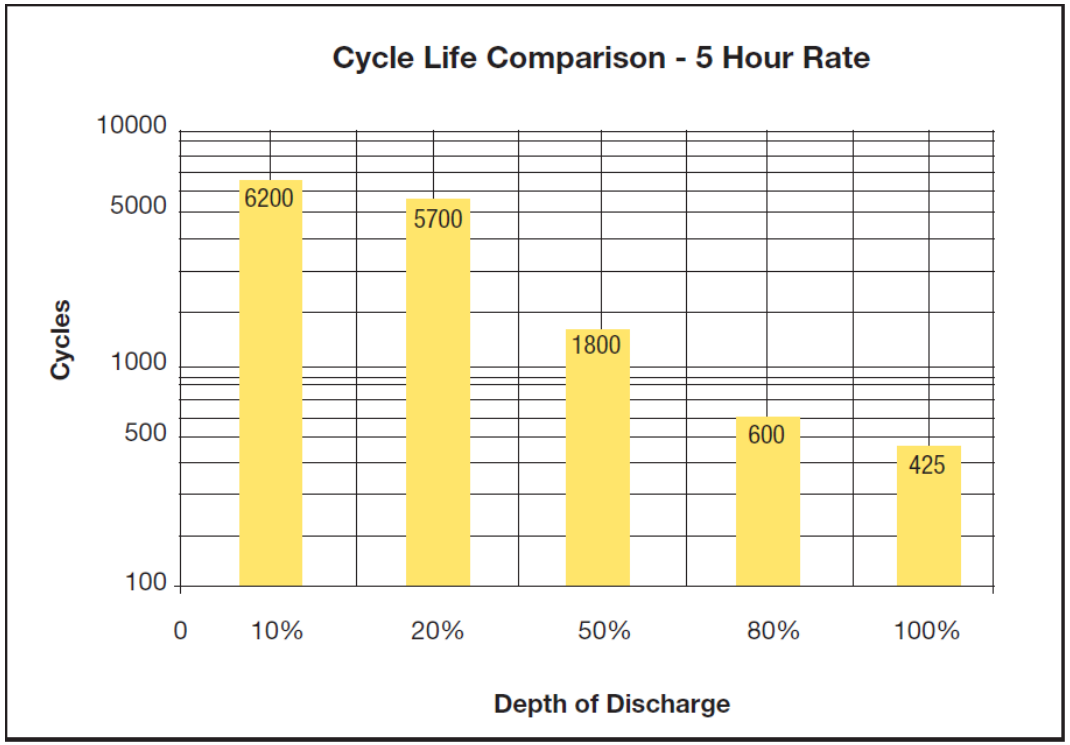
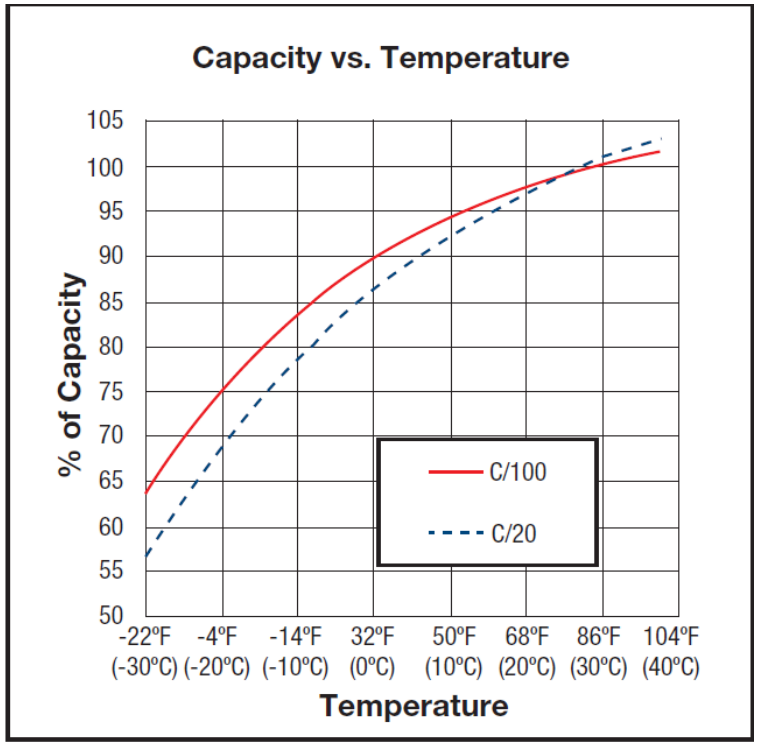
Alpha Front Terminal 170 & 200RE





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EnergyCell RE High Capacity

- 100% “out of box” initial battery capacity
- High Cycle Life – 1800 cycles @ 50% DOD
- High module configuration available
- Top termination standard on most models
- Clear flame retardant safety covers
- Inter-unit connectors and terminal plates
- 24V and 48V options standard

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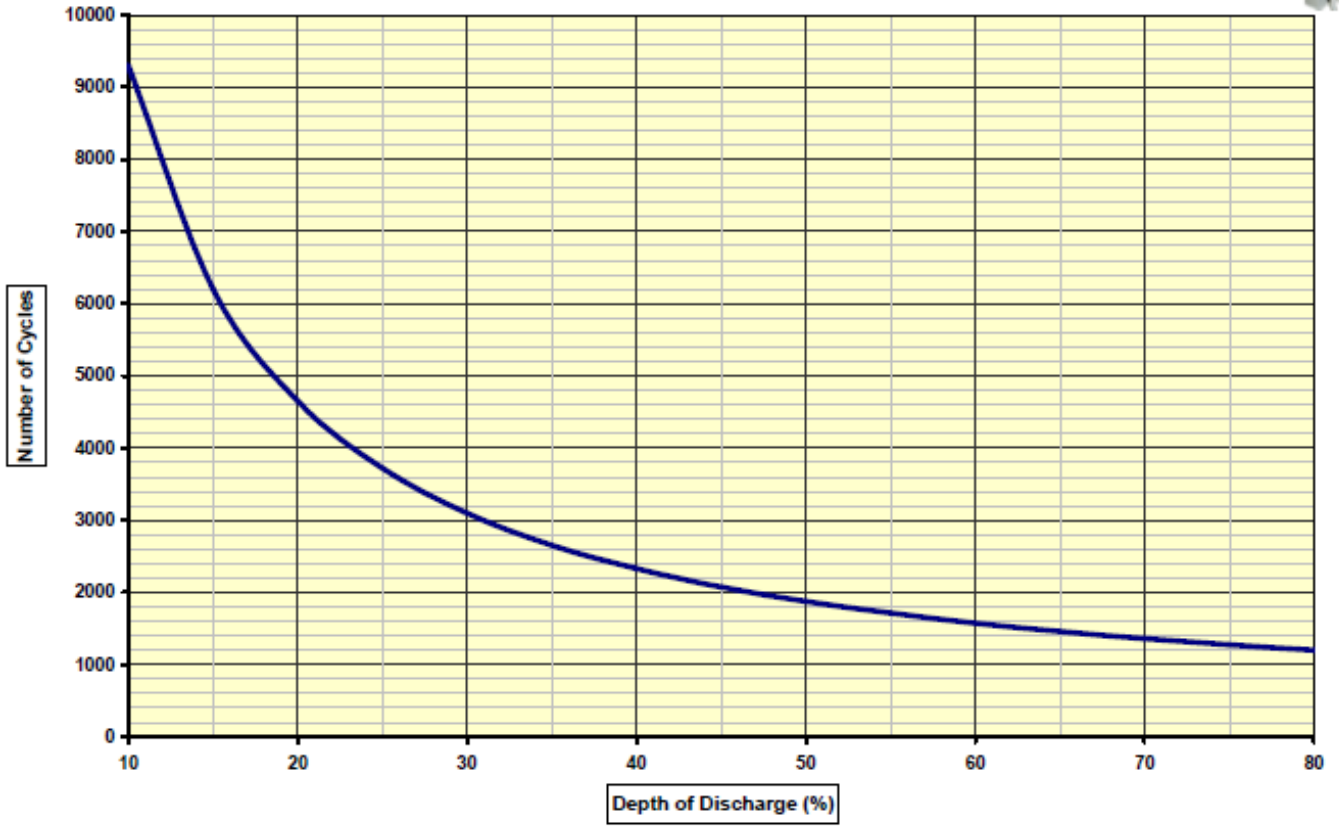
PowerSafe DDm Cycle Life

Number of Cycles versus Depth of Discharge at 25°C



Established by: Jeff Rissmiller
Approved by: Rob Brile

Engineering Group
EnerSys | Reserve Power

Ref: AE1206281
Date: 28 June 2012

EnergyCell Application Example – Off-Grid

Bahamas, small commercial installation, OFF GRID

- **Outback 5 – Radian Total 40 KW inverters**
- **5400 Ahrs- 260 Kwhrs**

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FLEXmax Controllers

- Advanced continuous Maximum Power Point Tracking (MPPT)
- Increase PV harvest by up to 30%
- Universal – supports battery voltages from 12 to 60Vdc
- Fully OutBack Network integrated and programmable
- Programmable auxiliary control output
- Built-in 128 days of data logging
- Standard 5 year warranty

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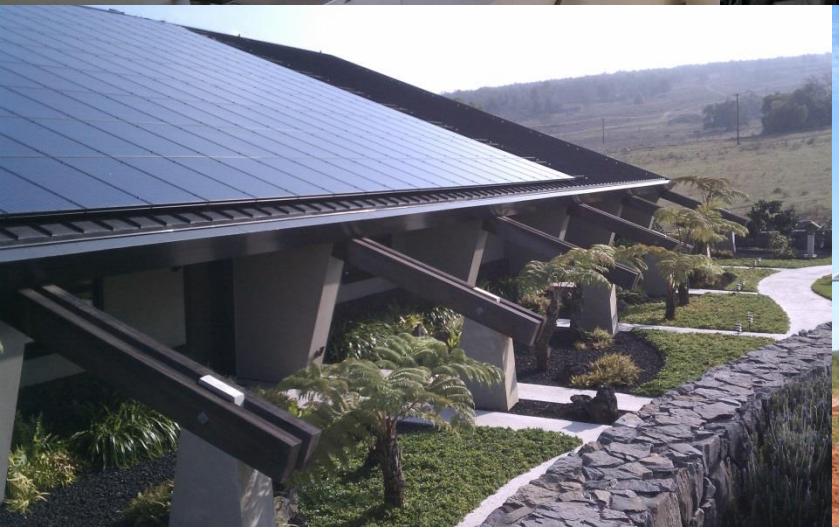

Case Study: First Net-Zero Building in India

OutBack Grid/Hybrid Power System Installation

Overview

Malankara Plantations Limited, founded in 1910, is an active plantation company operating in a historical business complex. The office power consumption consists of 18 tons of air conditioning, followed by water pumps, three packing machines, IT/networking and lighting. It was connected to a private power grid owned by the local maharaja, but the complex experienced frequent blackouts due to power shortages on the electrical grid. With rising energy costs and increased availability of government subsidies, management turned to TeamSustain to install solar panels on the existing roof while preserving the historical integrity of the structure. The 27kW system consists of nine OutBack GVX inverters, seven FLEXmax Charge Controllers and two MATE3 communication devices. The new system ensures uninterrupted power, offers an energy cost savings payback of less than five years and has made the structure the **first Net-Zero building in India.**

System Specifications

Location: Malankara Tea Plantation, Kottayam, India

System Power: 27kW Grid/Hybrid System

System Components: (9) GVX 3048 Inverter/Chargers, (7) FLEXmax 80 Charge Controllers and (2) MATE3 System Display Controllers

Power Source: PV Array and Backup Battery Bank

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We chose OutBack products for the Malankara Tea Plantation because of their reputation for reliability in a tropical climate with extreme temperatures. OutBack's rugged systems deliver uninterrupted power and cut diesel emissions for air conditioning and other major energy loads. Despite regular power cuts in the surrounding grid, the Malankara Tea Plantation stays online with clean, solar backup power and maintains historic heritage status with this creative solution."

George Mathew
Vice President, TeamSustain
TeamSustain is an OutBack Power Distributor

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Premium Sealed Lead Acid Storage Solutions

Alpha OPzV - Solar

Valve Regulated Lead Acid Batteries

- Safe
- Versatile Positioning
- Virtually Maintenance Free
- > 15 year operational life
- Deep discharge performance
- Extreme Temperature compatible
- Vibration resistant
- Non-hazardous shipping
- Minimal gassing

OPzV valve regulated lead-acid batteries

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Alpha OPzV - Premium Solar Lead Acid Storage Solutions

CHARGING

Float Voltage

- Standby use 2.25V/cell

Boost Recharge

- Maximum voltage of 2.35 to 2.40V/cell with a maximum current of 0.25 C10(A)

OPERATIONAL DATA

Operation Life

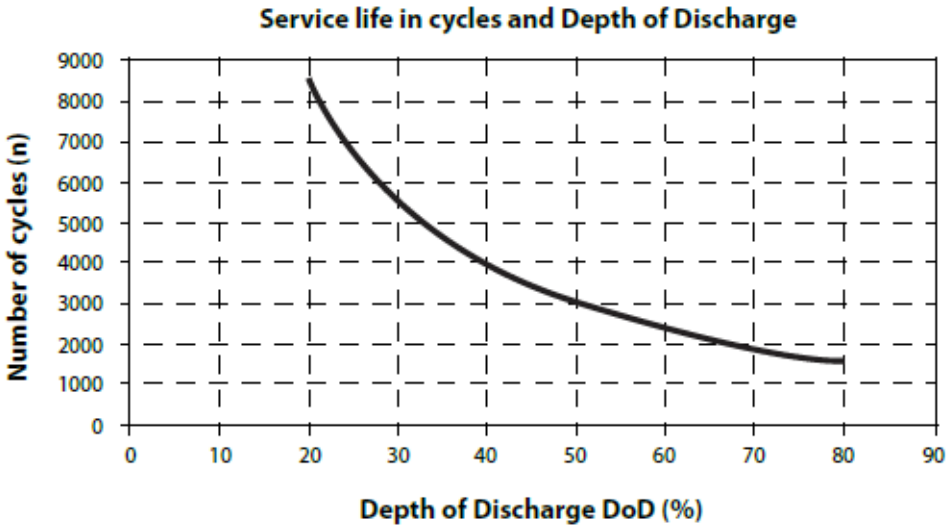
- More than 15 years IEC 896-1 Cycles
- 1200

Self Discharge

- Approx. 2% per month at 20°C / -4°F

Tests According

- IEC 896-1, EN 60896-1, EN 61427



Alpha & OutBack Li-ion Solutions

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Alpha Li-ion - Ultra Premium Storage Solutions

System Components:

1. **OutBack Radian Series** INVERTER/CHARGER
2. **OutBack FLEXmax Series** CHARGE CONTROLLER
3. **OutBack MATE3** SYSTEM DISPLAY AND COMMUNICATIONS
4. **Corvus Energy Storage** LITHIUM ION BATTERY

System Features:

- Very high power density of 10.4kWh of useable energy (80% DOD) with two Corvus li-ion batteries
- Compact, maintenance-free Corvus li-ion batteries are rated for 7,500 cycles to 80% DOD and come standard with a 5-year full replacement warranty
- Temperature range of -40 to 60°C; requires no cooling system, making it ideal for hot climates
- OutBack Power Radian Series is a premium, fully flexible, grid-interactive/off-grid inverter/charger
- System includes the proven OutBack Power FLEXmax Series charge controllers for solid performance and reliability
- OutBack Power MATE3 provides the ability to monitor and program the system

PVUPS LION

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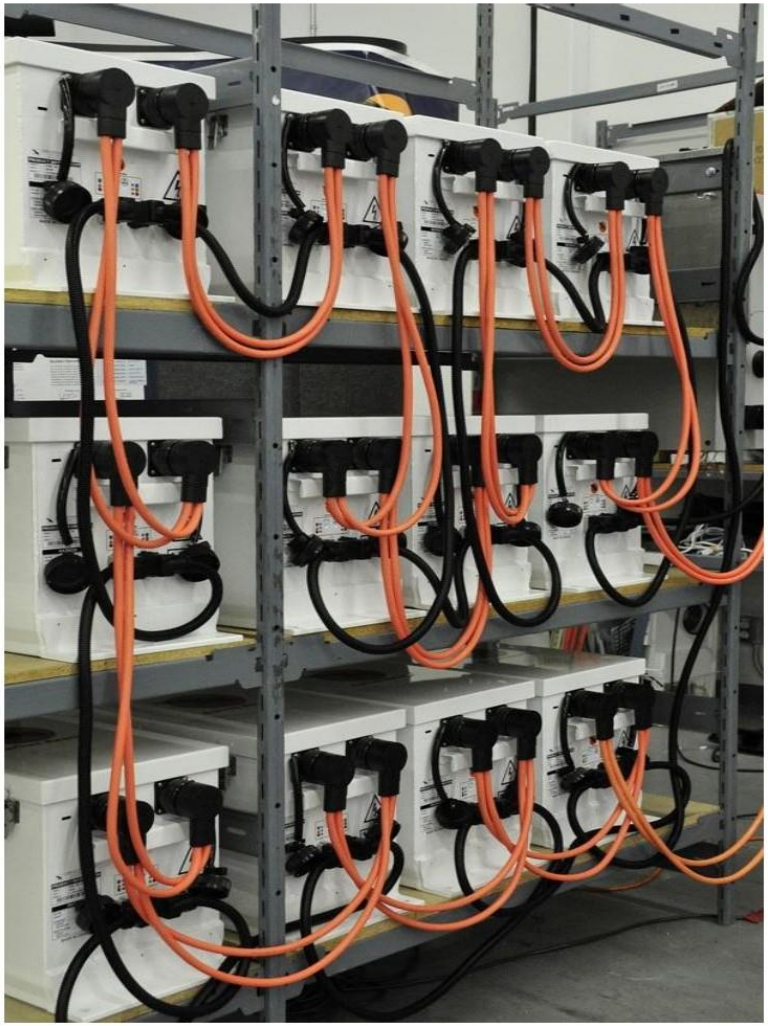
LION Battery



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Demo Site at: http://www.outbackpower.com

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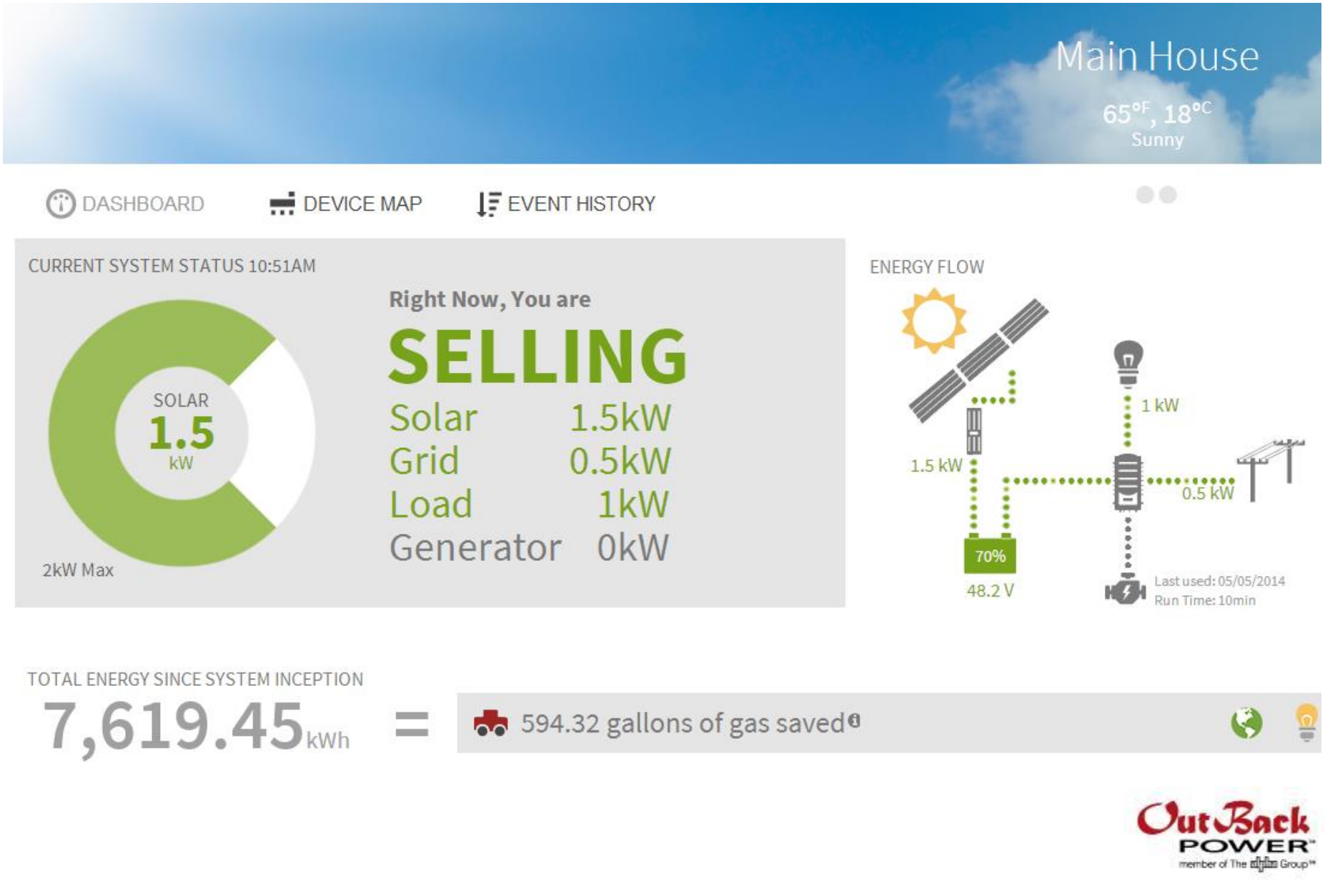
Demo – Screen Shots



Questions

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(360) 618 - 4363

Additional Info available at:
www.outbackpower.com