BUILDING A WORLD OF DIFFERENCE

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MICROGRID OPTIMIZATION AND LESSONS LEARNED

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BLACK & VEATCH
Building a world of difference.®

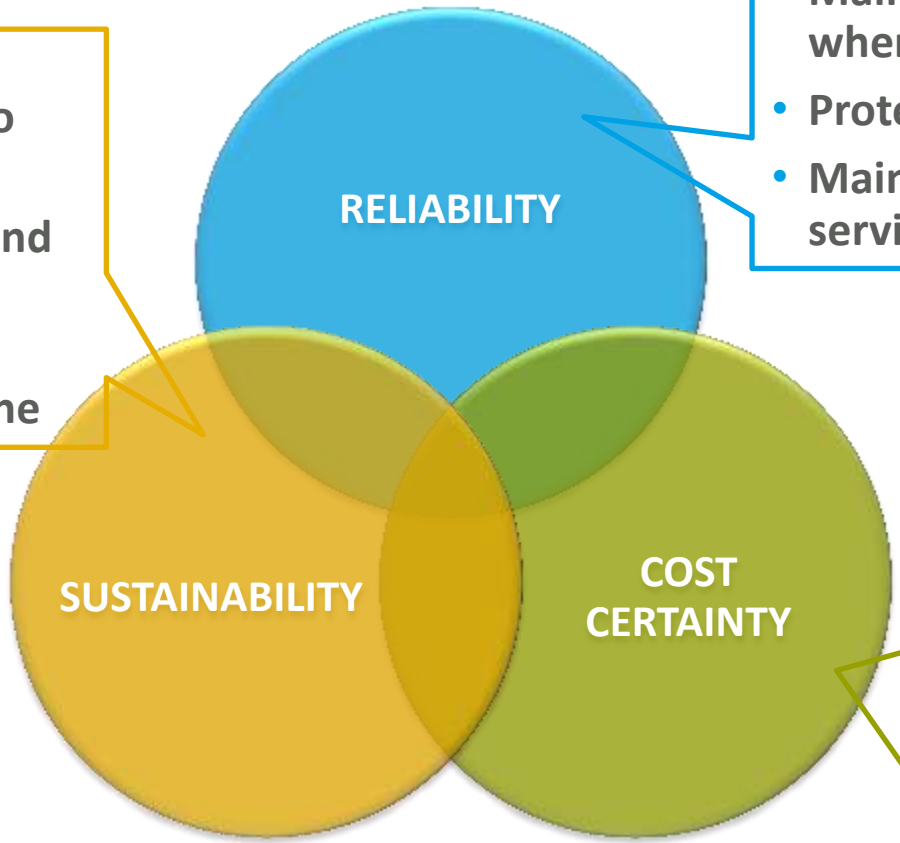
CHANGE IS HAPPENING AND THE PACE IS ACCELERATING

2005	2015
Coal new build	New coal “dead” in U.S.
64 MW solar PV	1,200 MW solar PV
Flip-phone	iPhone 6s
“Apps” didn’t exist	85+ billion app downloads
Buy software	Software as a service
Personal computers	The cloud

Business is changing and different approaches will be needed

DRIVERS FOR MICROGRIDS

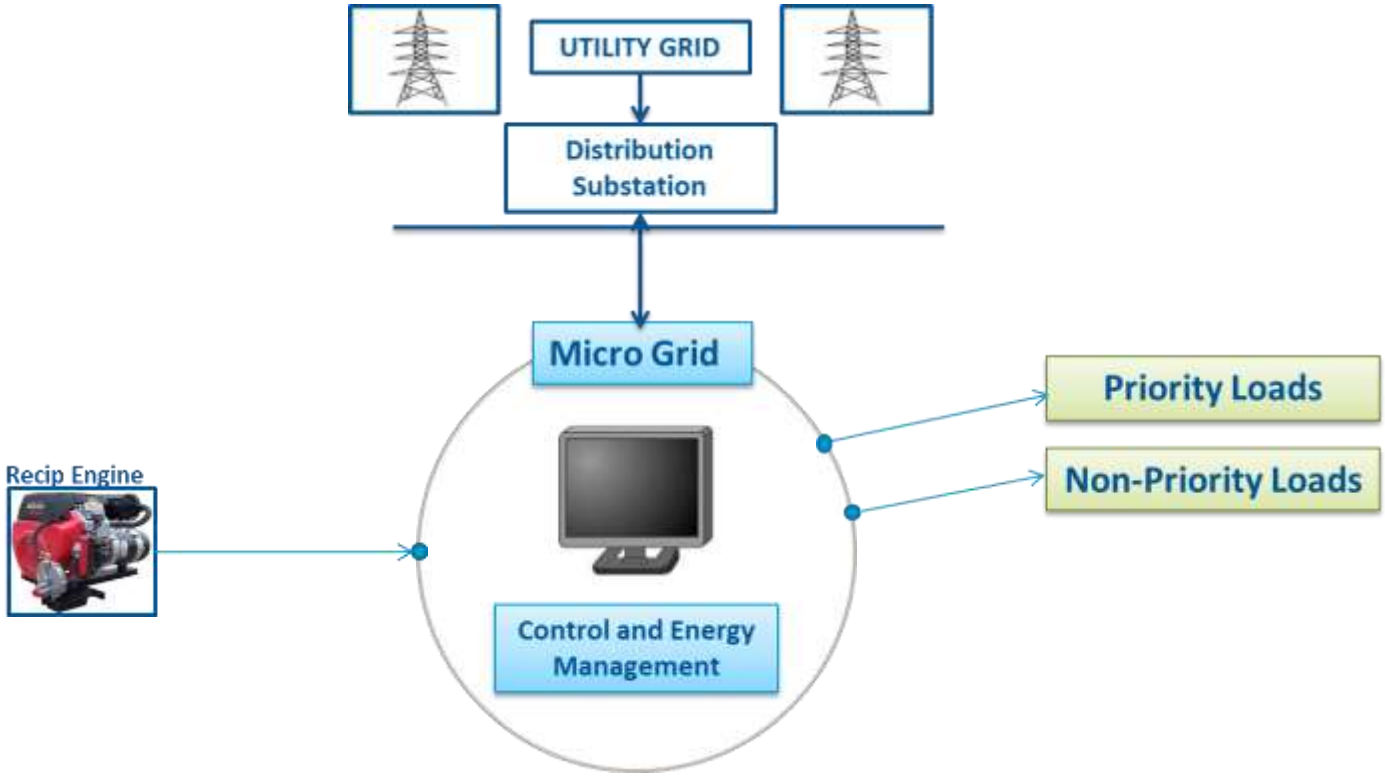
- Corporate commitments to sustainability
- Customer demand for greater renewables
- Triple bottom line



- Maintain critical operations when grid is down
- Protect mission critical assets
- Maintenance of community services

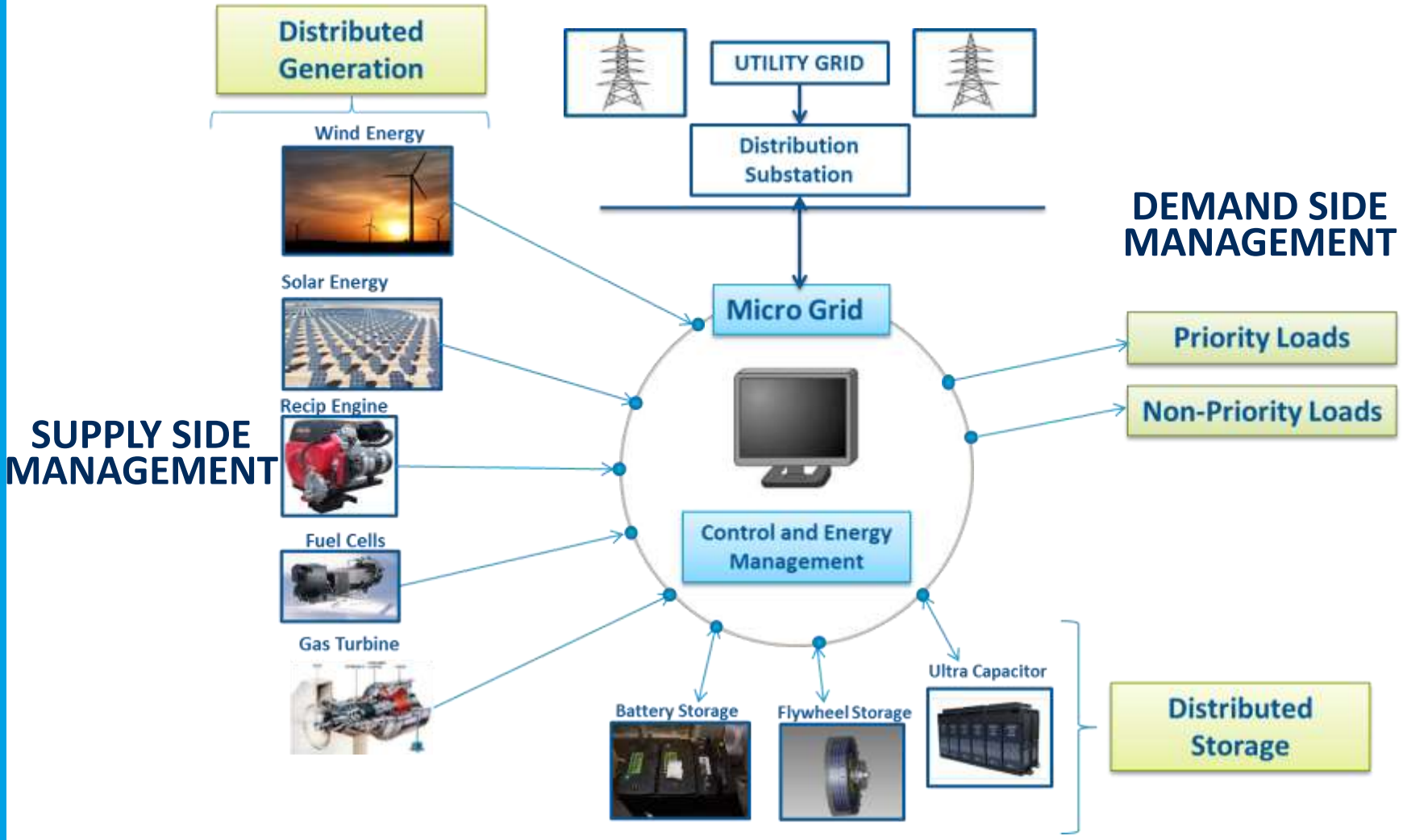
- Cost competitive industries seeking competitive advantages
- Hedge against future rate increases
- Lower cost generation for remote locations

YESTERDAY'S MICROGRID PROJECT



Established solutions of yesterday's microgrids

TODAY'S MICROGRID PROJECT



Optimizing multiple technologies requires complex engineering and control systems

BLACK & VEATCH MICROGRID

Demonstration of microgrid technologies

WHQ MICROGRID

KCP&L
Utility Grid

50kW Solar PV

Electric Vehicle
Charging

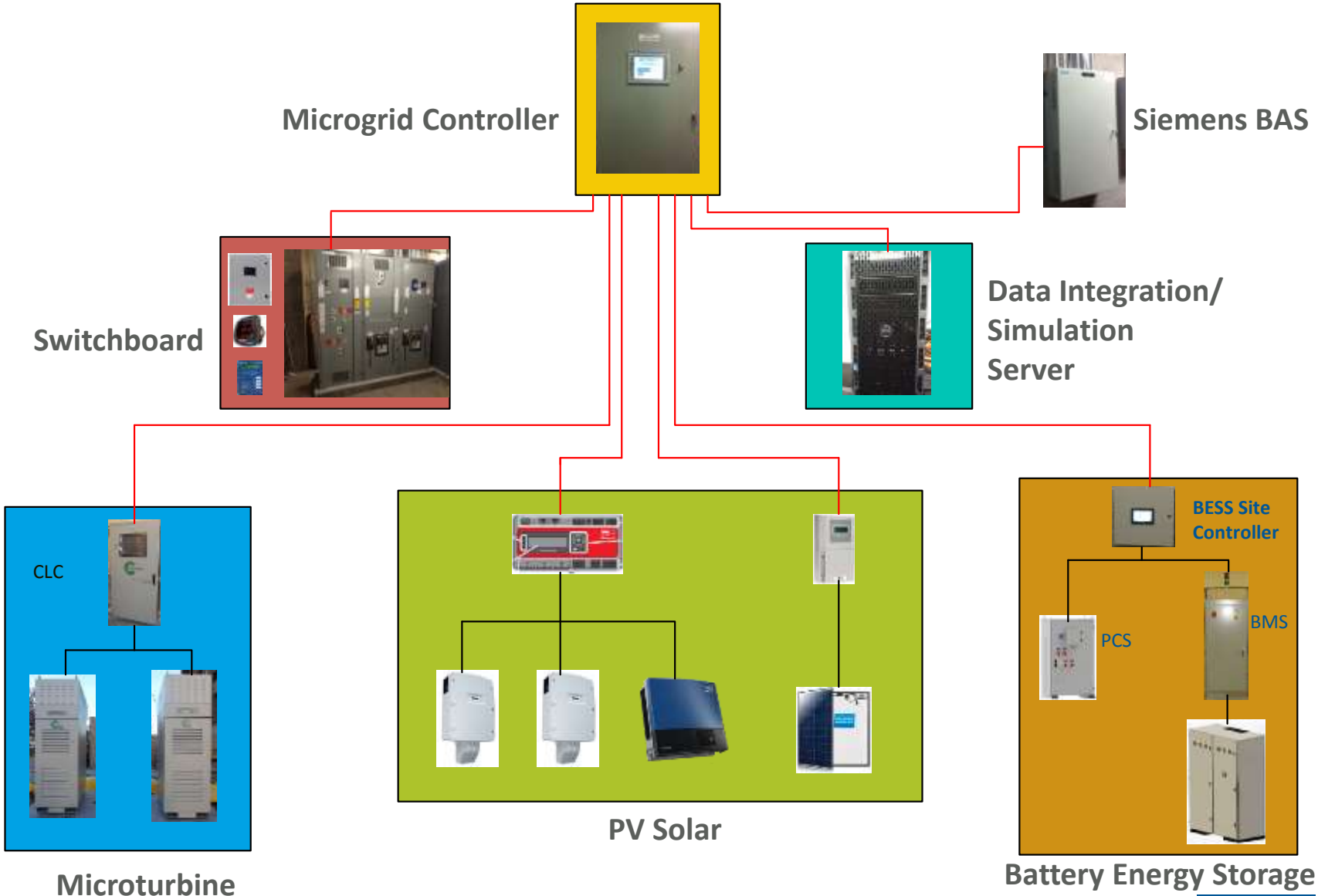
Control and Energy
Management
System

2X65 kW
Microturbines

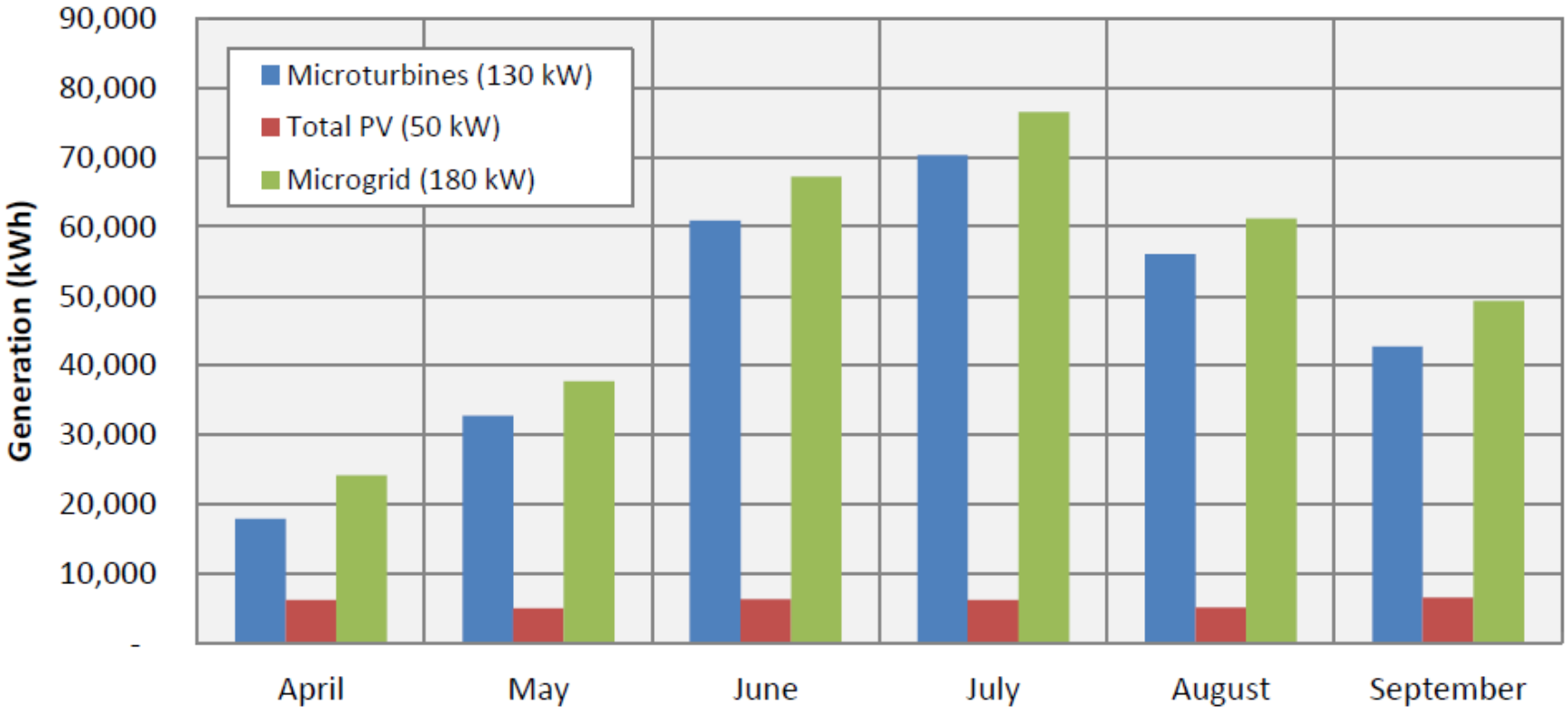
Electric Loads

100 kWh Battery
Energy Storage System

MICROGRID CONTROL SYSTEM



MICROGRID PERFORMANCE – FIRST SIX MONTHS



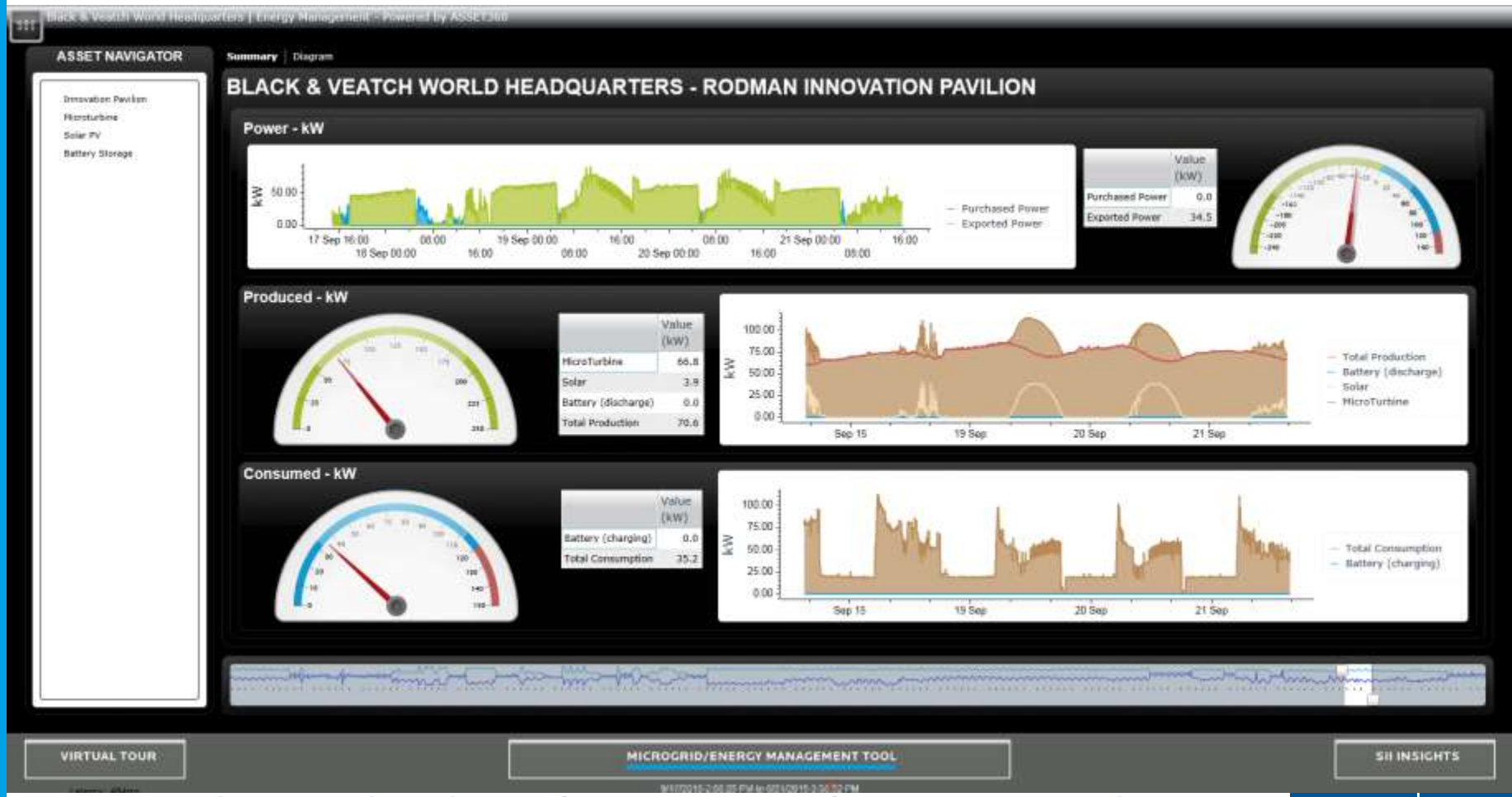
316,184 kWh generated over the first six months

FUNCTIONALITY DEMONSTRATED

- Bumpless transfer between island and parallel operation
- Scheduled start / stop
- Solar generation firming
- Peak shaving
- Remote monitoring and diagnostics

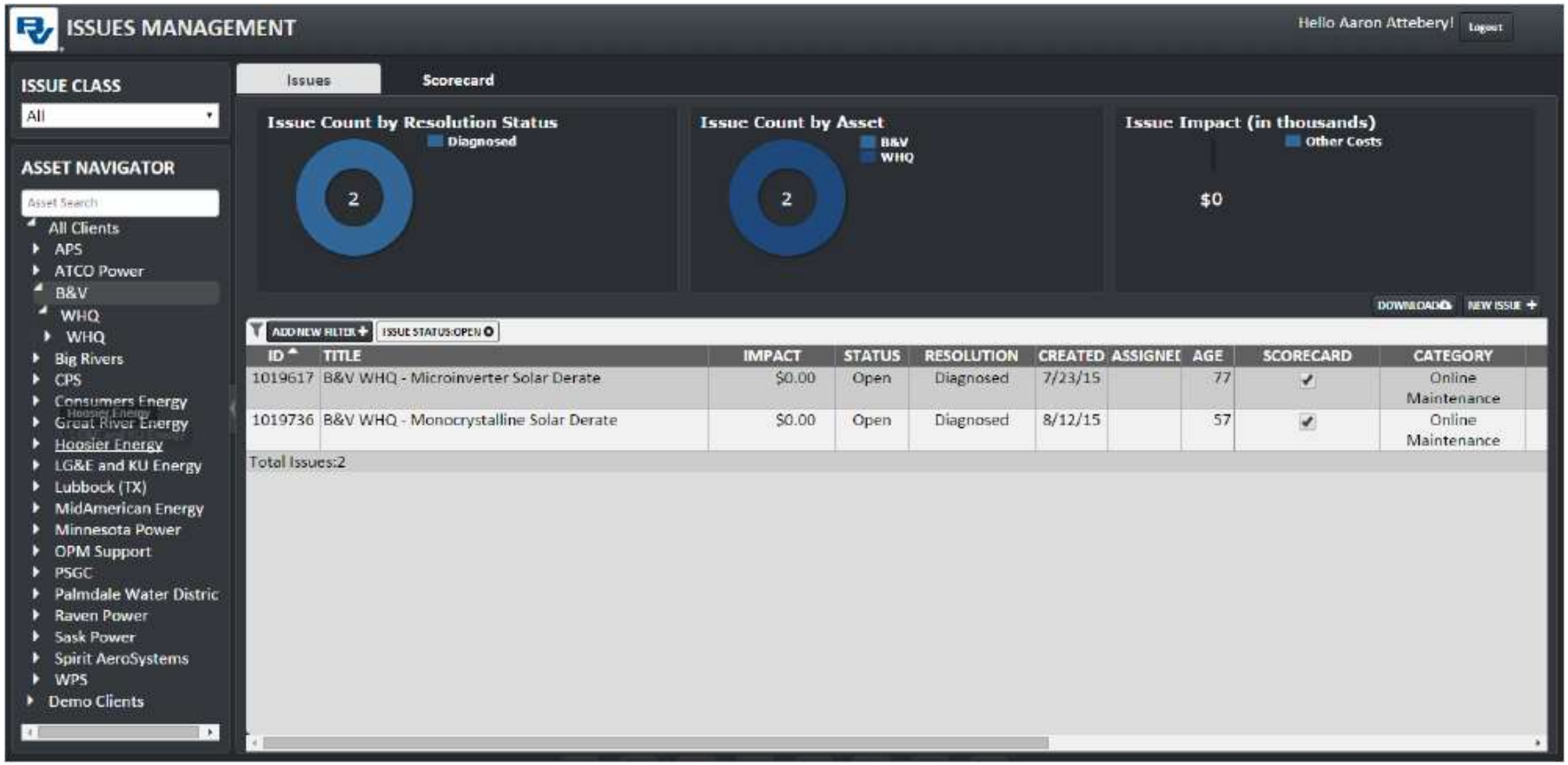
Functionality demonstrated to support reliable remote microgrids and grid connected microgrids

MICROGRID DASHBOARD



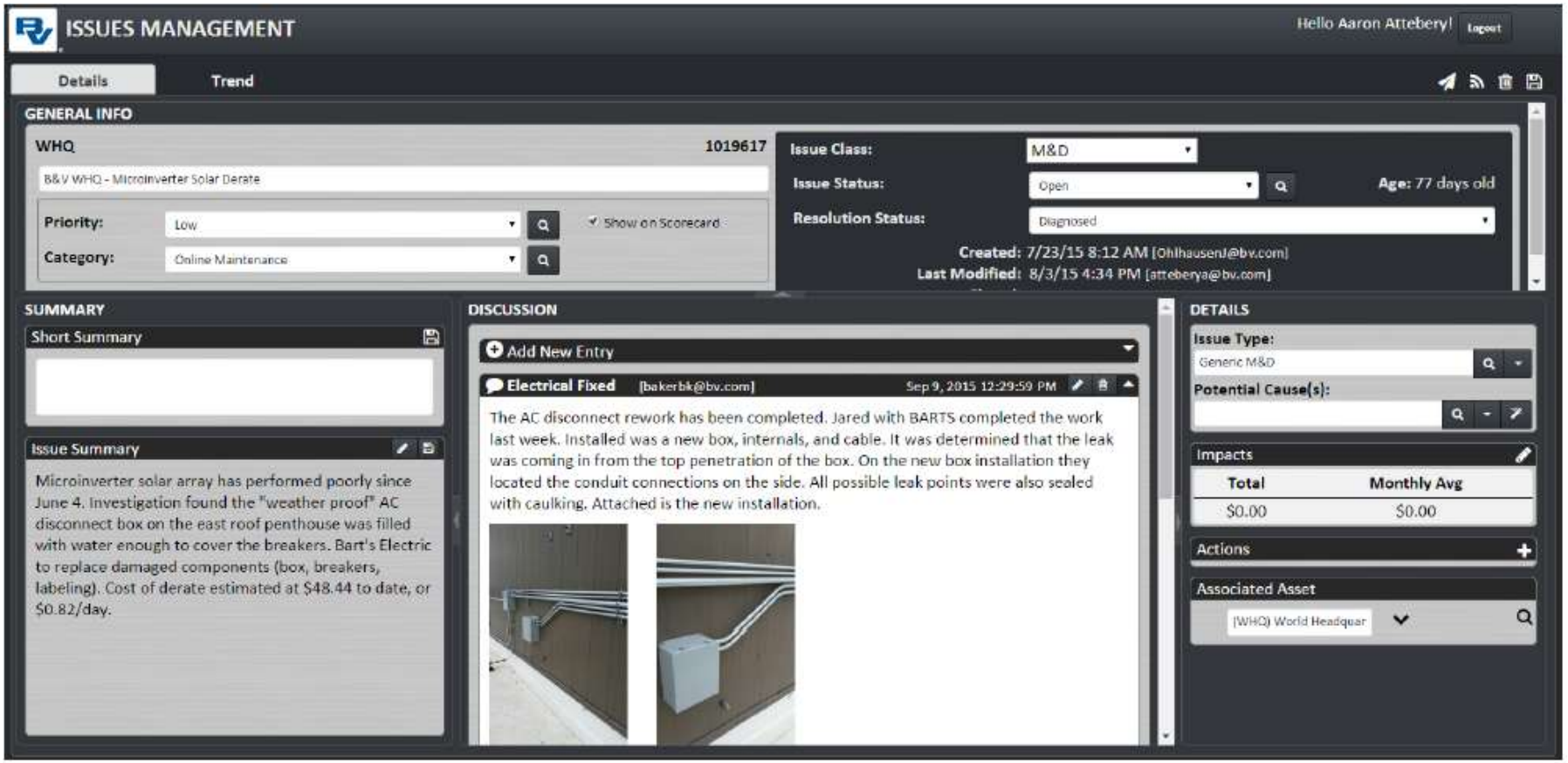
Real time display of system performance and facility benefits

REMOTE ISSUES MANAGEMENT AND MAINTENANCE MANAGEMENT



Asset360 used to identify and diagnose performance issues

ISSUE TRACKING AND MANAGEMENT



Deviation in solar generation from expected value enabled diagnosis of root cause

LESSONS LEARNED

- Well Defined Design Basis
- Focus Early on Controls
- Ensure Vendors Understand Custom Requirements
- Focus on Integration
- Fully Understand Building Integration

Effective microgrid solutions must consider the full lifecycle of the facility

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Together

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