

BUILDING A WORLD OF DIFFERENCE

MICROGRID OPTIMIZATION AND LESSONS LEARNED

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Distributed Generation

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CHANGE IS HAPPENING AND THE PACE IS ACCELERATING

2005



- Coal new build
- 64 MW solar PV
- Flip-phone
- “Apps” didn’t exist
- Buy software
- Personal computers

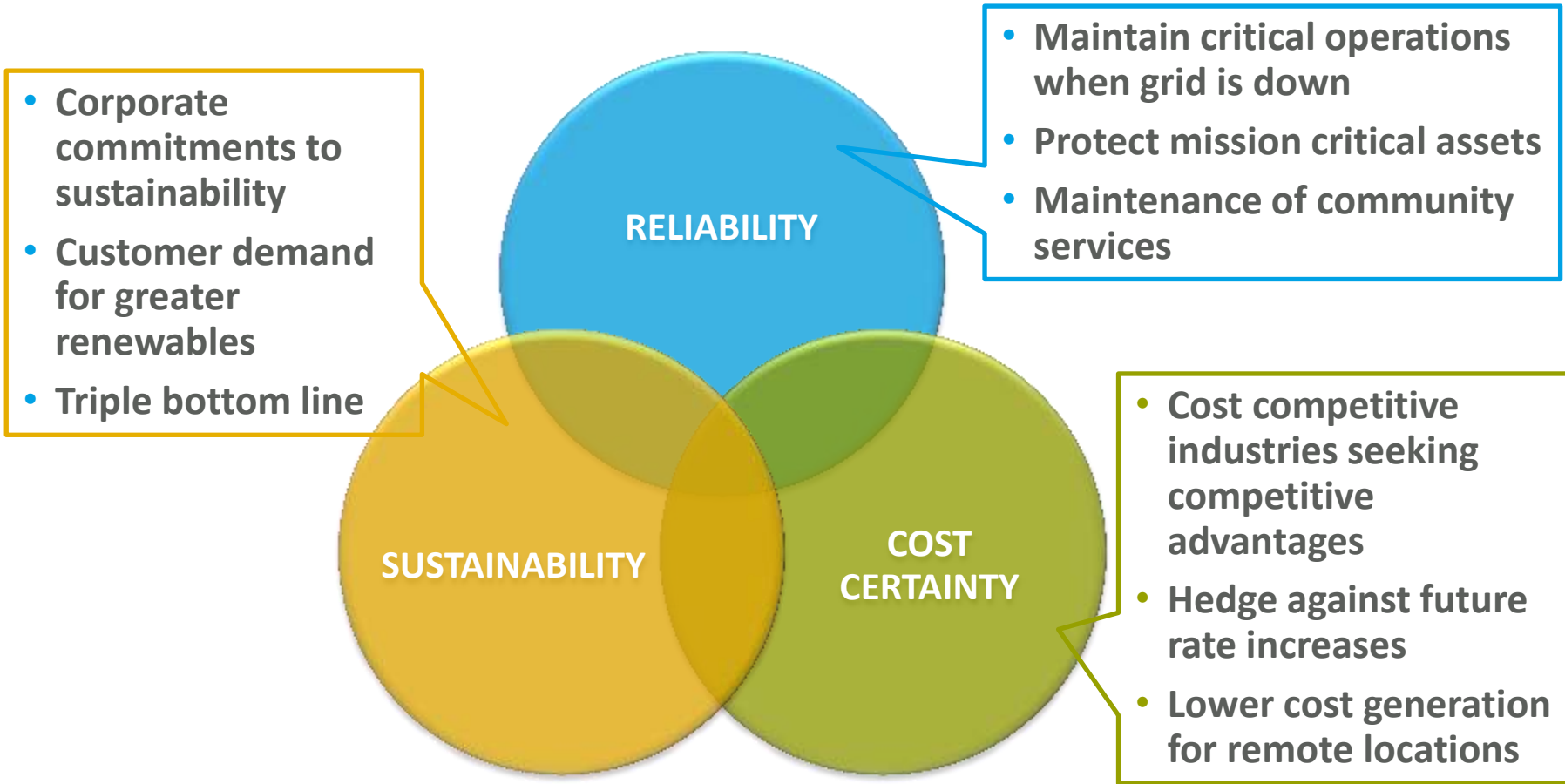
2015



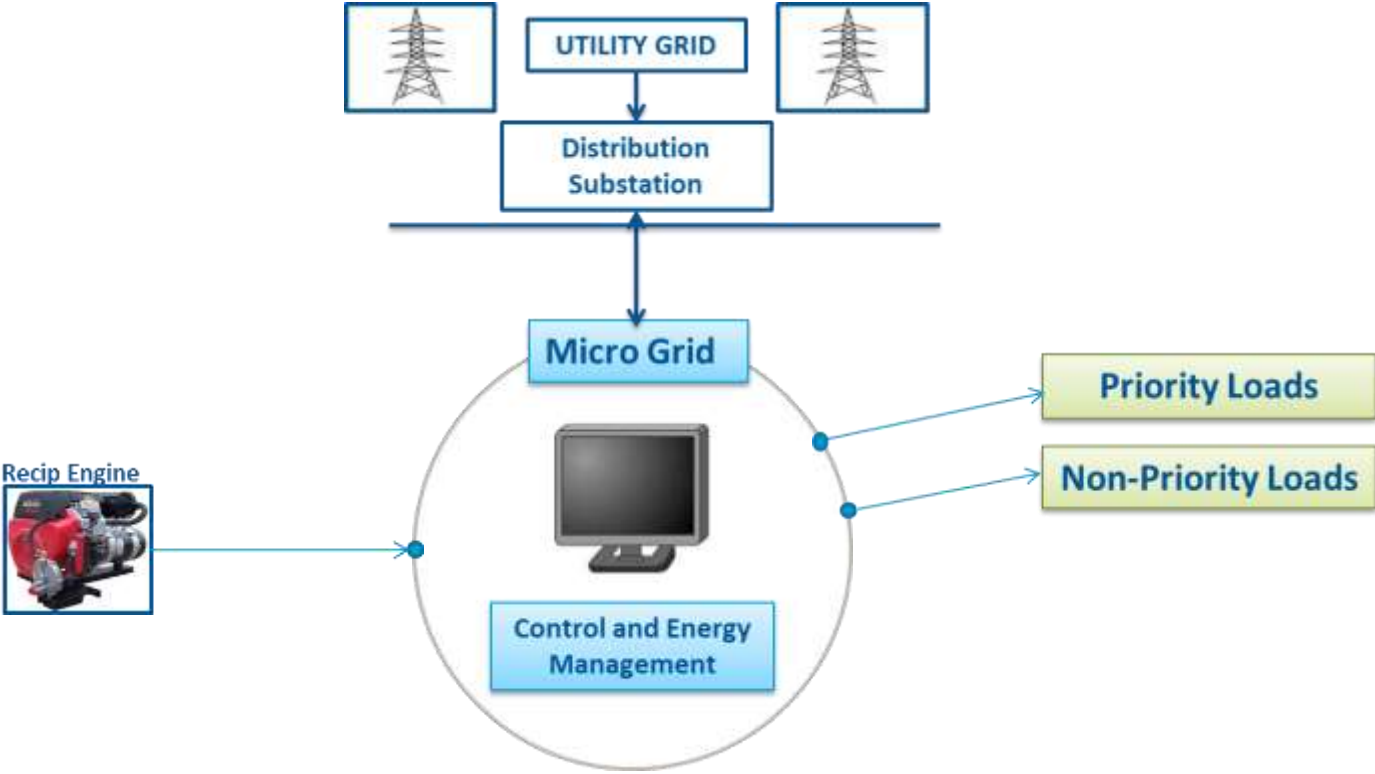
- New coal “dead” in U.S.
- 1,200 MW solar PV
- iPhone 6s
- 85+ billion app downloads
- Software as a service
- The cloud

Business is changing and different approaches will be needed

DRIVERS FOR MICROGRIDS



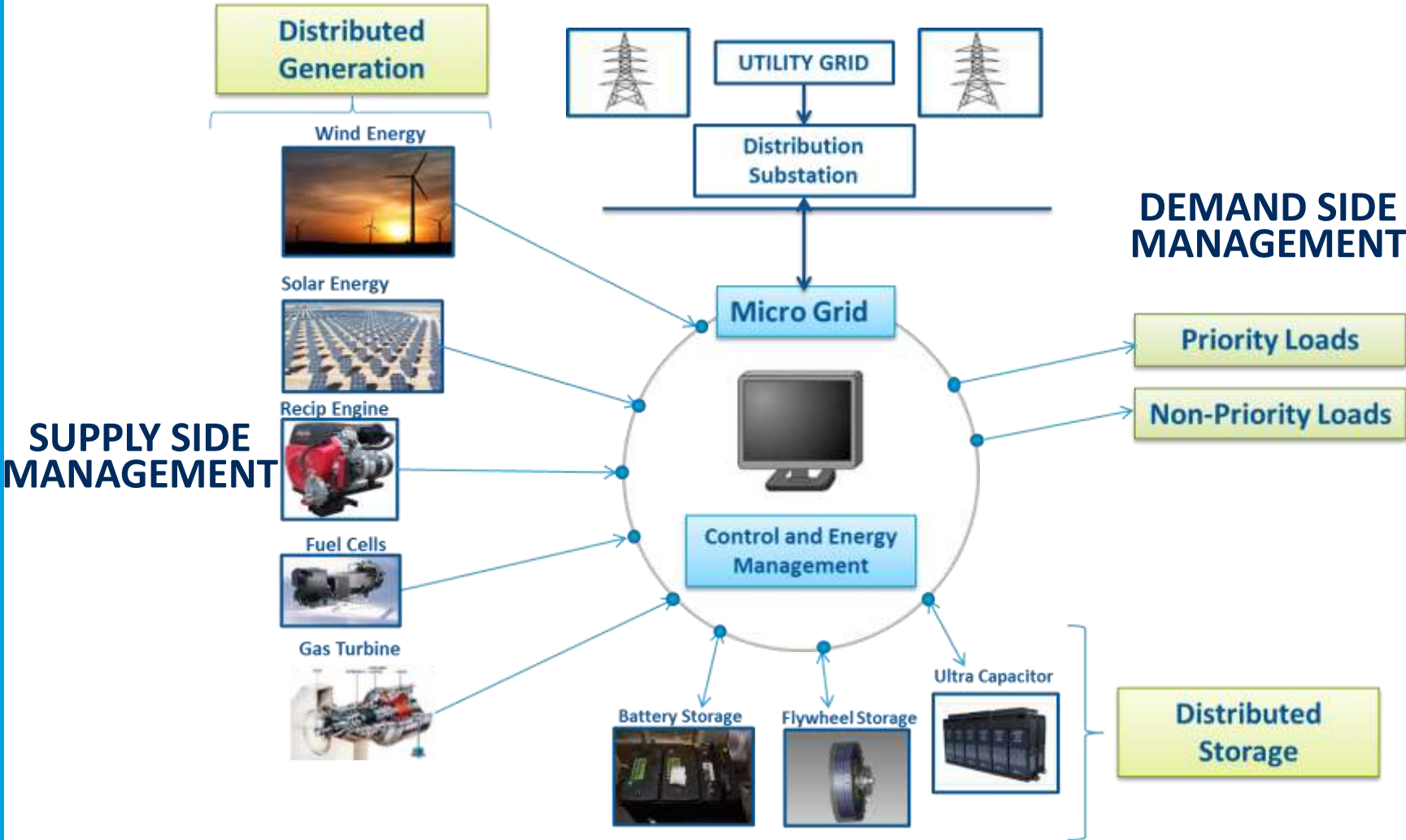
YESTERDAY'S MICROGRID PROJECT



Established solutions of yesterday's microgrids



TODAY'S MICROGRID PROJECT



Optimizing multiple technologies requires complex engineering and control systems

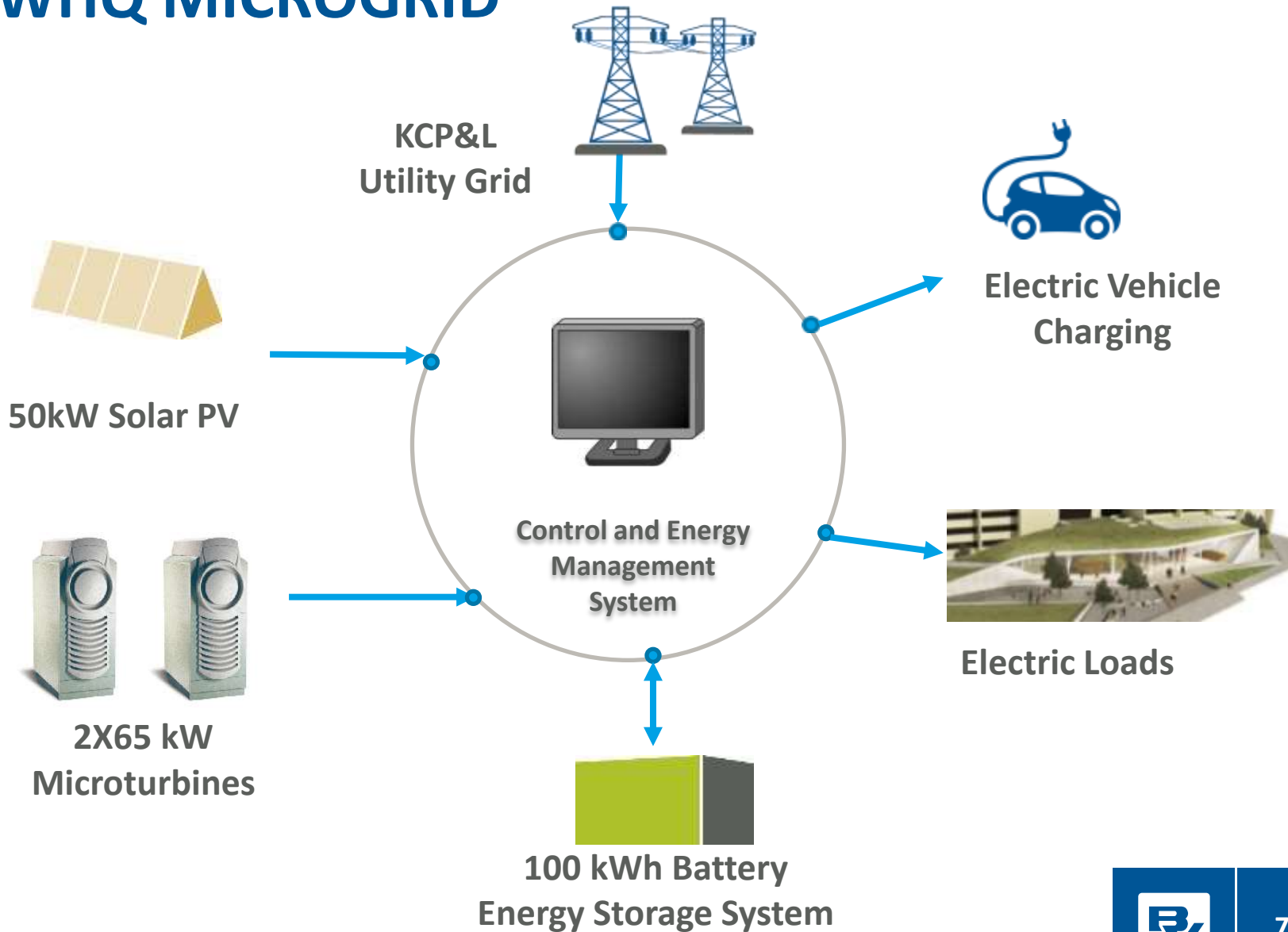


BLACK & VEATCH MICROGRID

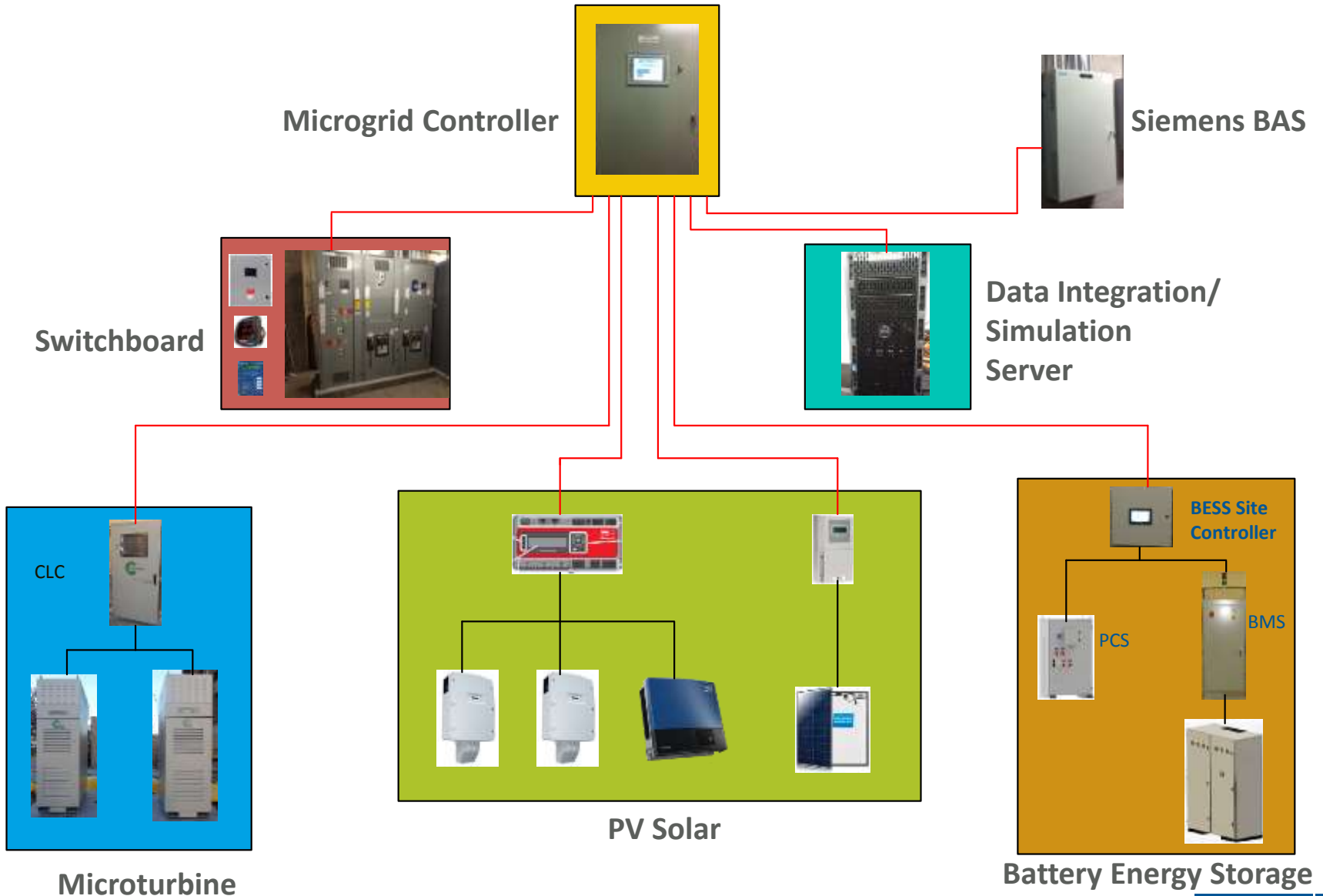


Demonstration of microgrid technologies

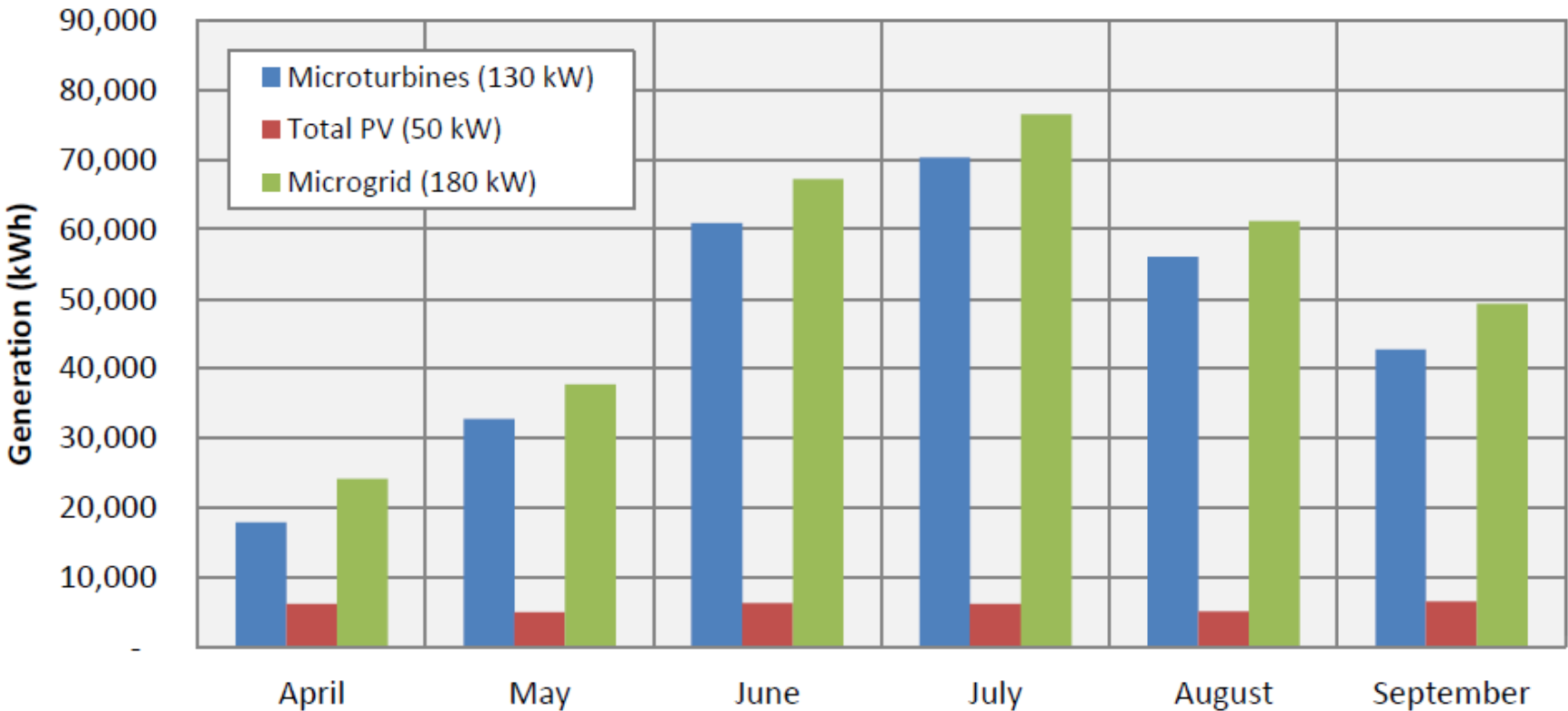
WHQ MICROGRID



MICROGRID CONTROL SYSTEM



MICROGRID PERFORMANCE – FIRST SIX MONTHS



316,184 kWh generated over the first six months





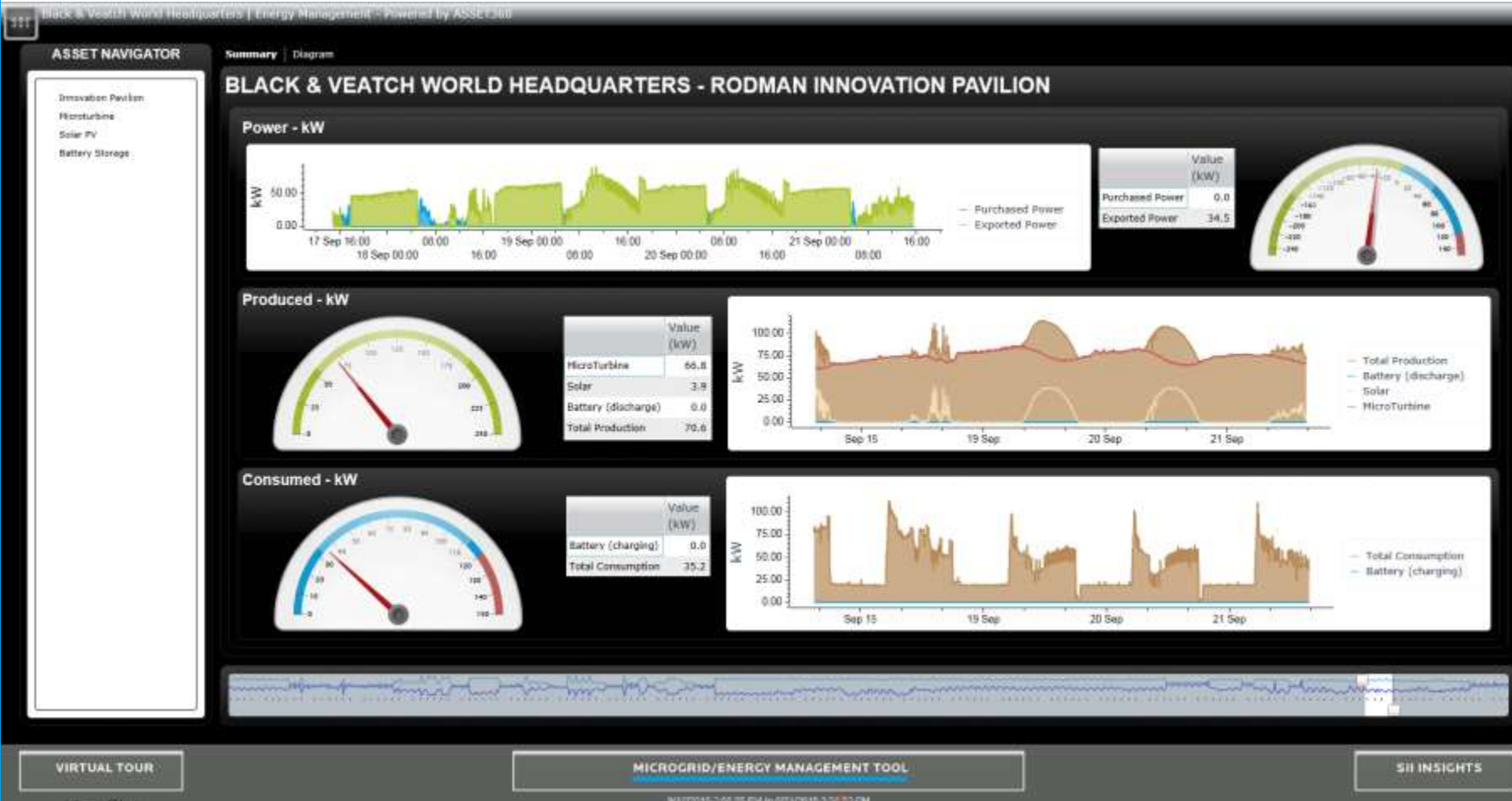
FUNCTIONALITY DEMONSTRATED

- 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

The screenshot displays the 'ISSUES MANAGEMENT' interface. On the left is an 'ASSET NAVIGATOR' with a tree view of clients. The main area shows a 'Scorecard' with three charts: 'Issue Count by Resolution Status' (2 Diagnosed), 'Issue Count by Asset' (2 B&V, 0 WHQ), and 'Issue Impact (in thousands)' (\$0). Below the charts is a table of issues.

ID	TITLE	IMPACT	STATUS	RESOLUTION	CREATED	ASSIGNED	AGE	SCORECARD	CATEGORY
1019617	B&V WHQ - Microinverter Solar Derate	\$0.00	Open	Diagnosed	7/23/15		77	✓	Online Maintenance
1019736	B&V WHQ - Monocrystalline Solar Derate	\$0.00	Open	Diagnosed	8/12/15		57	✓	Online Maintenance

Total Issues: 2

Asset360 used to identify and diagnose performance issues

ISSUE TRACKING AND MANAGEMENT

The screenshot displays a software interface for 'ISSUES MANAGEMENT'. The top right corner shows the user 'Hello Aaron Attebery!' and a 'Logout' button. The interface is divided into several sections:

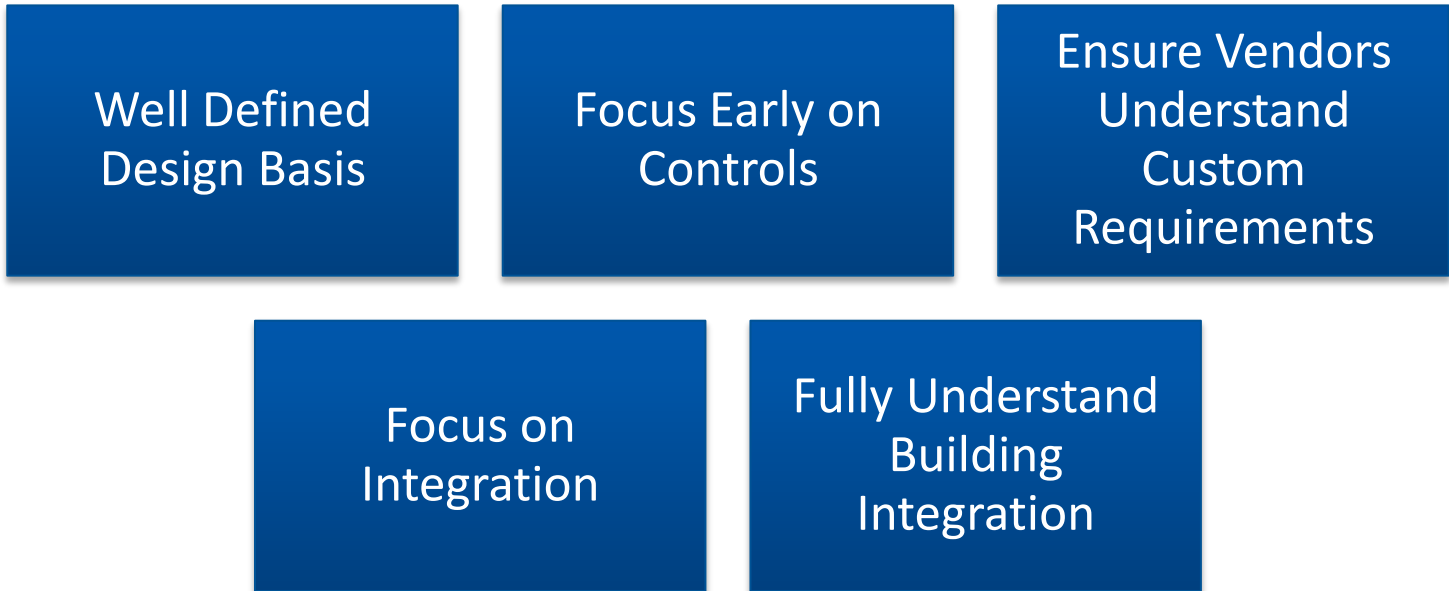
- GENERAL INFO:** Shows 'WHQ' as 'B&V WHQ - Microinverter Solar Derate' with ID '1019617'. The 'Issue Class' is 'M&D', 'Issue Status' is 'Open', and 'Resolution Status' is 'Diagnosed'. The issue is 'Age: 77 days old'. It was 'Created: 7/23/15 8:12 AM [OhlhausenJ@bv.com]' and 'Last Modified: 8/3/15 4:34 PM [atteberya@bv.com]'. The 'Priority' is 'Low' and the 'Category' is 'Online Maintenance'.
- SUMMARY:** Contains a 'Short Summary' field and an 'Issue Summary' section. The issue summary states: 'Microinverter solar array has performed poorly since June 4. Investigation found the "weather proof" AC disconnect box on the east roof penthouse was filled with water enough to cover the breakers. Bart's Electric to replace damaged components (box, breakers, labeling). Cost of derate estimated at \$48.44 to date, or \$0.82/day.'
- DISCUSSION:** Features an 'Add New Entry' button and a discussion entry titled 'Electrical Fixed' by '[bakerbk@bv.com]' on 'Sep 9, 2015 12:29:59 PM'. The text reads: 'The AC disconnect rework has been completed. Jared with BARTS completed the work last week. Installed was a new box, internals, and cable. It was determined that the leak was coming in from the top penetration of the box. On the new box installation they located the conduit connections on the side. All possible leak points were also sealed with caulking. Attached is the new installation.' Two photographs show the new electrical installation on a roof.
- DETAILS:** Includes 'Issue Type' (Generic M&D), 'Potential Cause(s)', an 'Impacts' table, 'Actions', and 'Associated Asset' (WHQ) World Headquar).

Impacts	
Total	Monthly Avg
\$0.00	\$0.00

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



LESSONS LEARNED



Effective microgrid solutions must consider the full lifecycle of the facility



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Together



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