Getting to (near) Zero:

Greening Hospital Power, Improving System Reliability, Preserving Safety and Effectiveness through Renewable Energy Microgrids

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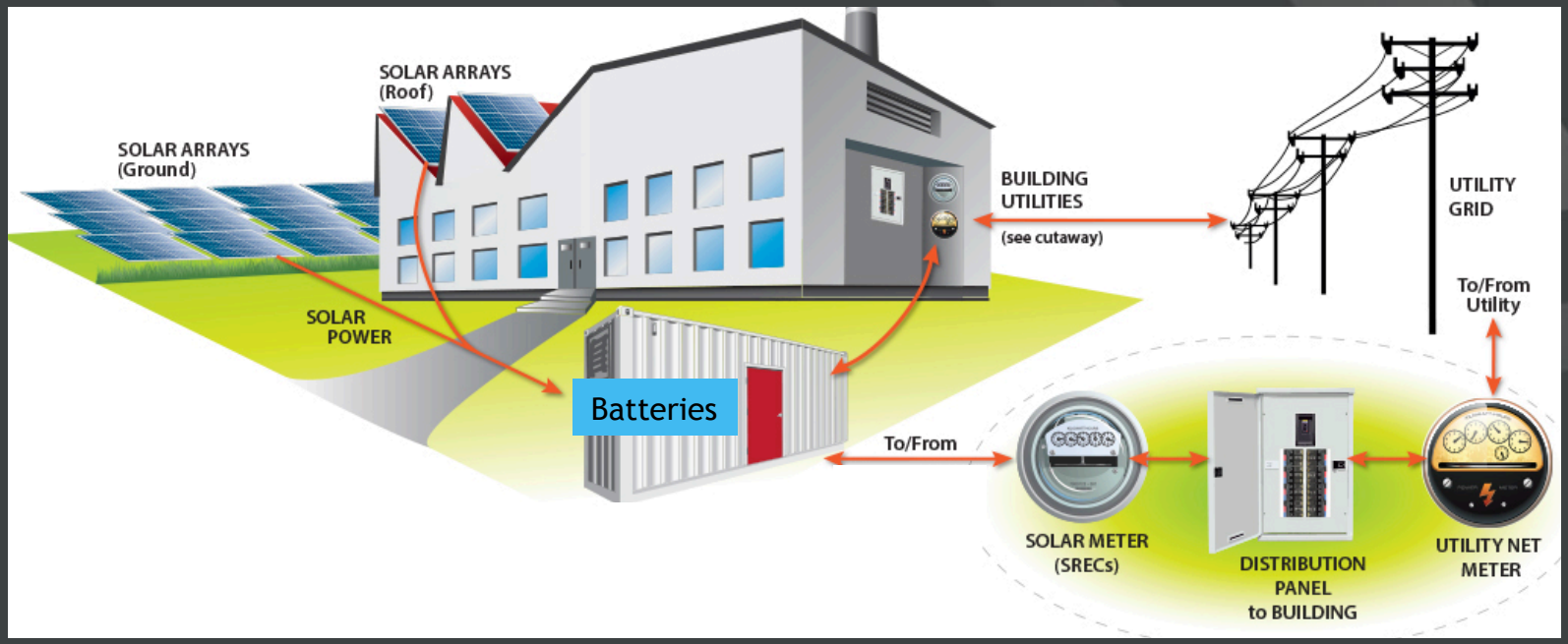
OPTIMIZING THE ENERGY ECOSYSTEM

Definitions and Significance

- <u>Hospitals are intensive users of Power (kW) and Energy (kWh) in the service of health</u>



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Why Micro Grids and Why Micro Grids in Hospitals

- Prepare health-care facilities for the Governors Challenge for CA to be Net-zero by 2030
- Prepare facilities for demand response and time of use energy pricing
- Hospitals are intensive users of power
- The way energy is delivered and generated is rapidly changing

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Nexus:
Law, Policy, Funding and Microgrids

- **California law and policy**
  - **AB 32** (Global Warming Solutions Act: http://www.arb.ca.gov/cc/ab32/ab32.htm;
    - California Health and Safety Code §§ 38500 et. seq.
  - **AB 785** (Building Efficiency): http://www.energy.ca.gov/ab758/;
    - Applicable Law: California Public Resources Code § 25943, California Public Utilities Code §§ 381.2 and 385.2
  - **Governor's Clean Energy Jobs Plan** (2011): http://gov.ca.gov/docs/Clean_Energy_Plan.pdf
  - **California Building Code: Title 24** **Healthcare facilities targeted for 2027 or Earlier**

- **OSHPD:**
  - **Mission Statement: 1) Finance Emerging Needs; 2) Ensure Safe Facilities**

- **CPUC:**
  - **50% of current commercial buildings and ALL new construction must be ZERO NET ENERGY by 2030- 40 buildings statewide already retrofitted**
  - **Final Decision:** http://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/167664.PDF.
  - **Strategic objectives S14, S14.2, S14.3**
  - **Microgrid Governance:** *Microgrids: A Regulatory Perspective*, CPUC Policy and Planning Division (April 2014;

    http://www.cpuc.ca.gov/NR/rdonlyres/01ECA296-5E7F-4C23-8570-1EFF2DC0F278/0/PPDMicrogridPaper414.pdf

- **CEC/EPIC**
  - **"Demonstrate secure, reliable microgrids…to build resilient, low-carbon facilities and communities."** www.energy.ca.gov/contracts/index.html
  - **Decrease GHG production, build renewable energy systems, and decrease use of fossil fuels through ARB and subsidiaries such as BAAQMD, SCAQMD**

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GOALS

- Augment Hospital Power Options
  - LARGE UPS
  - Power quality regulation
  - Opportunity to maintain "Blinkless" facility operation
  - Decrease need for "E Power"
  - Preserve operation of Grid-tied distributed generation (Cogen, Solar, etc…)
- Maintain Power "Hierarchy"
  - Serve primacy of critical loads
  - "No Touch" on backup power systems
- Meet State Imperatives for Green Power and Sustainability
  - Introduce renewables on much larger scale to healthcare
  - Act as a reserve of power for system-wide crises [what if diesel unavailable?]
- Lower costs of healthcare system operations
  - 45% of hospitals had NEGATIVE operating margins in 2007
  - California has one of the lowest ratios of beds to population in the Country

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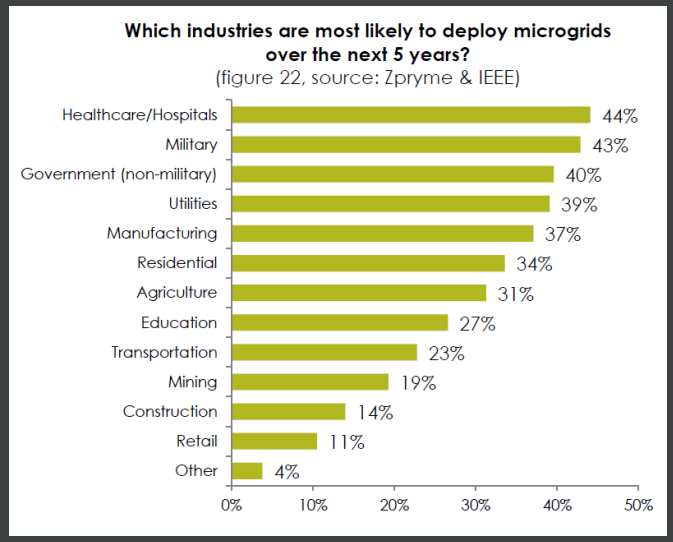


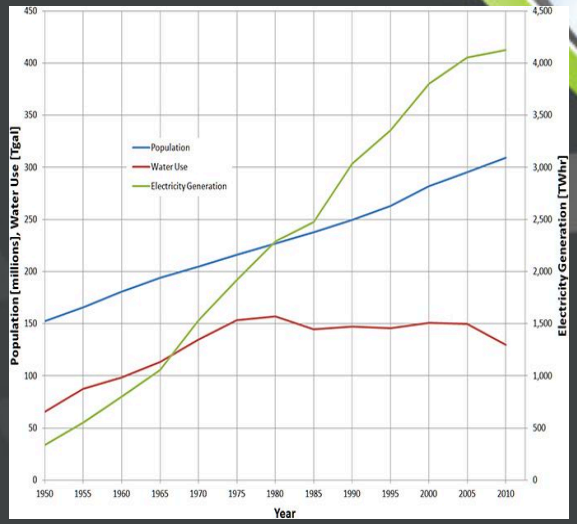
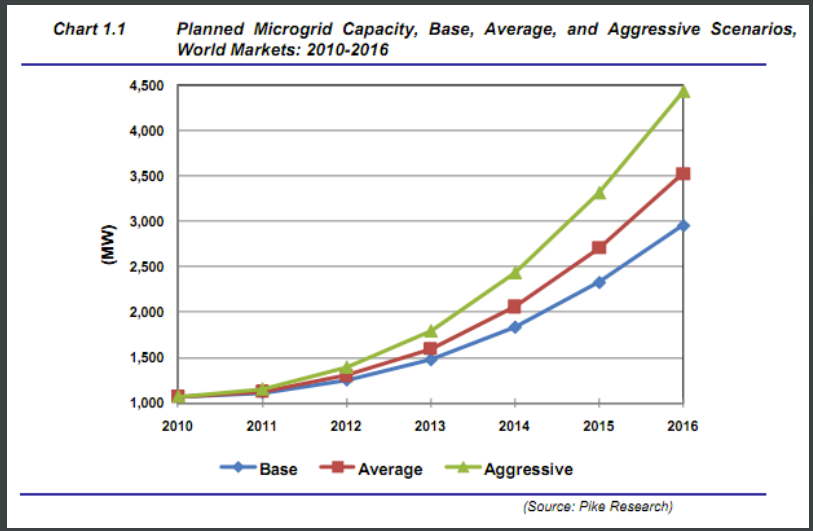


Figure 1. US population, water use, and electricity generation from 1950 to 2010 data show that the increase in electric-grid utilization has far outpaced population growth as virtually all sectors of society have adopted ever-greater numbers of electronic devices. (Sources: Census Bureau, US Dept of Commerce; US Geological Survey; Energy Information Administration, US Dept of Energy)



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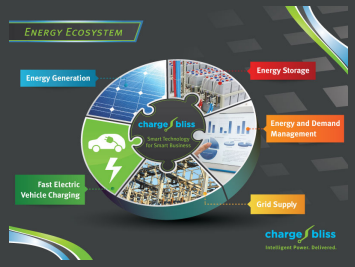
Principles:

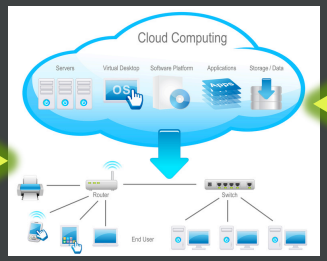
1. Charge Bliss Controller monitors and administers discretionary load items
2. OSI/PI Server iterative analytics with NREL, builds microgrid controller
3. Clean energy made, stored, distributed to optimize entire "ecosystem"



Hospital

Photovoltaic

PI Server



NREL

OSIsoft.
Infrastructure

PCS

Batteries

Technological Advances for Healthcare Centers

CURRENT

- Building management algorithms limited
  - Lack of coordination between device families can lead to stacking
  - No demand response capability
- CoGen cannot operate when Grid goes down (Grid-tied)
  - Lose significant generation- must use backup GenSet
- Cannot determine timing, quality, efficiency, and overall profile of individual and collective loads

MICROGRID

- ***Automated, reliable system optimization***
  - Same tolerances, but improved efficiency
  - Automated Demand Response (ADR)
- ***CoGen operation support***
- ***Monitor nearly unlimited number of devices and circuits*** to understand system functions, detect or predict diminished performance, and increase efficiency

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Granular Building System Data

Charge Bliss P3000tm can track/report or modulate building system operation based upon operational priorities

- **Life and Safety**: NO TOUCH; report 20+ power variables
- **Conditionally discretionary**: Report power variables AND limit/time shift discretionary systems
- **Fully discretionary**: Prioritized control with full monitoring and reporting
- ***DETECT AND ADDRESS POWER AND DEVICE VARIATION TO AVERT RATHER THAN REACT TO PROBLEMS***

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CHALLENGES

- **DEFINING SUPPLEMENTAL POWER**
  - Additional source of energy (kWh) and power (kW)
  - Power quality maintenance? Voltage, frequency, etc…
    - "Blinkless" operation?
  - Demand response?
- **POINT(S) OF INTERCONNECTION**
  - Location with respect to ATS?
  - Support non-critical systems only? Indirect support of critical systems?
- **NEW VERSUS ADDITIONAL SAFETY SYSTEMS [CODE]**
  - Monitoring
  - Controls
  - Parameters?

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The Technology Suppliers Perspective

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GE Energy Storage

Power Industry Ready Energy Storage for Renewable Operators

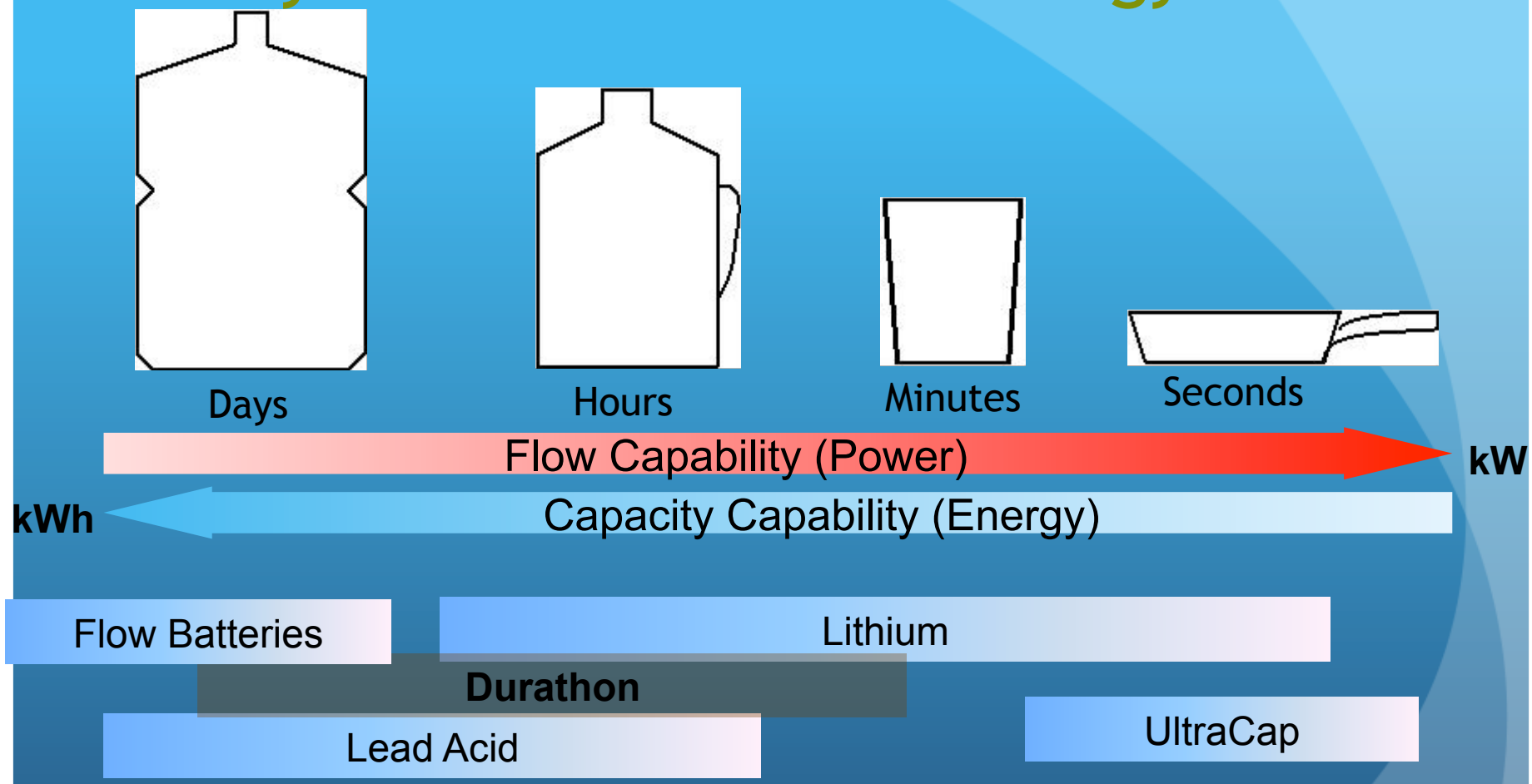
California Office of Statewide Healthcare Planning and Development

May 20, 2015
Scott Barnett
Global Sales Leader

GE Energy Storage

- Division of GE Renewable Power within GE Power and Water
- HQ in Schenectady New York –Sales and Service worldwide
- Active in energy storage for 10+ years
- Durathon (Na-Ni-Cl) product line established in 2010
- Expansion to non-GE DC block system integration in 2014

Battery Basics - Power & Energy

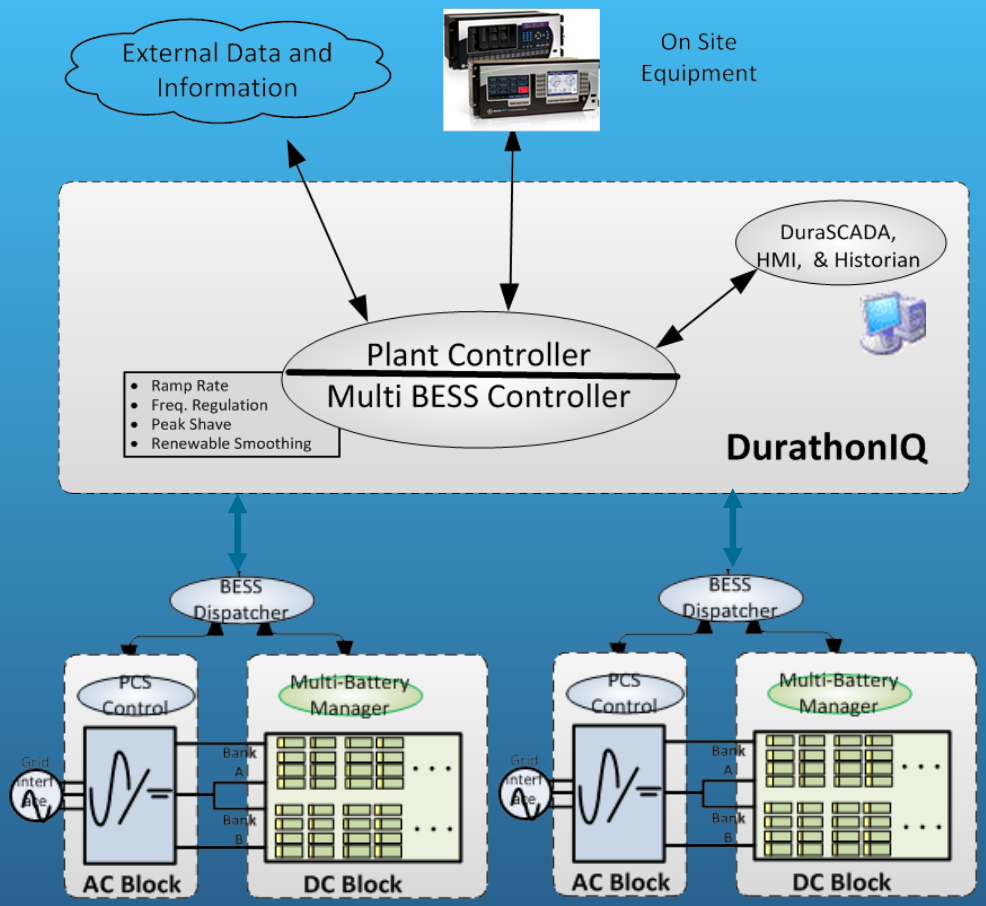


Batteries store energy for use at a time of need or economic advantage.
Every battery technology has its own attributes of energy and power.

Full AC System Supplier

An Storage Plant is comprised of 3 Primary Elements

- **Controls** – GE is a world leader in control systems for grid connected systems with years of experience in Wind, Thermal and Hydro
- **AC Hardware** – GE has a proud history of supplying AC hardware including inverter, transformer and med voltage equipment to global utility customers
- **DC Block** – As a battery manufacturer we have deep technical understanding of cell design, thermal mgt and other key battery design elements



Quoted over 2GW to 11 customers for recent CA RFP's

Total AC System Solutions

Durathon IQ Controls

Power Conversion

- Plant level controls
- SCADA
- Remote Operating Center
- Outdoor rated
- Standard communications (OPC, Ethernet, Modbus TCP/IP, ODBC, Analog/Digital

Brilliance Inverter

Power Conversion

- 1,000 kVac Power
- 480 Vac +/- 10%
- 1215 Aac Line Current
- 50 or 60 Hz
- 0.99 or great power factor
- NEMA 3R, outdoor enclosure
- 98.7% peak/ 98.3% wt. Eff.

Prolec Transformer

PROLEC

- 1250 KVA Type ONAN ANSI Three Phase Padmounted Transformer
- 40+ years of domain experience
- Installed base of 13,000+ units
- Installed in more than 35 countries around the world
- Located in Monterrey, Mexico

GE – Full System Provider

Hardware

Battery

GE Brilliance inverters

Battery agnostic : right performance, cost-effective Leverage Asian Li capacity

GE inverters: best in class

Software

Software: optimization of battery CTQs to grid requirements

Mark VI platform: seamless integration w/ installed base

Upgrades

Upgrades: upgrade installed base to thermal & wind hybrids

Finance

Finance: leverage GE project finance experience

Customers

DUKE ENERGY. NEXTera ENERGY RESOURCES Invenergy CALPINE SOUTHERN COMPANY

Market Channels : Partner with GE key customers utility, IPP, developer customer base

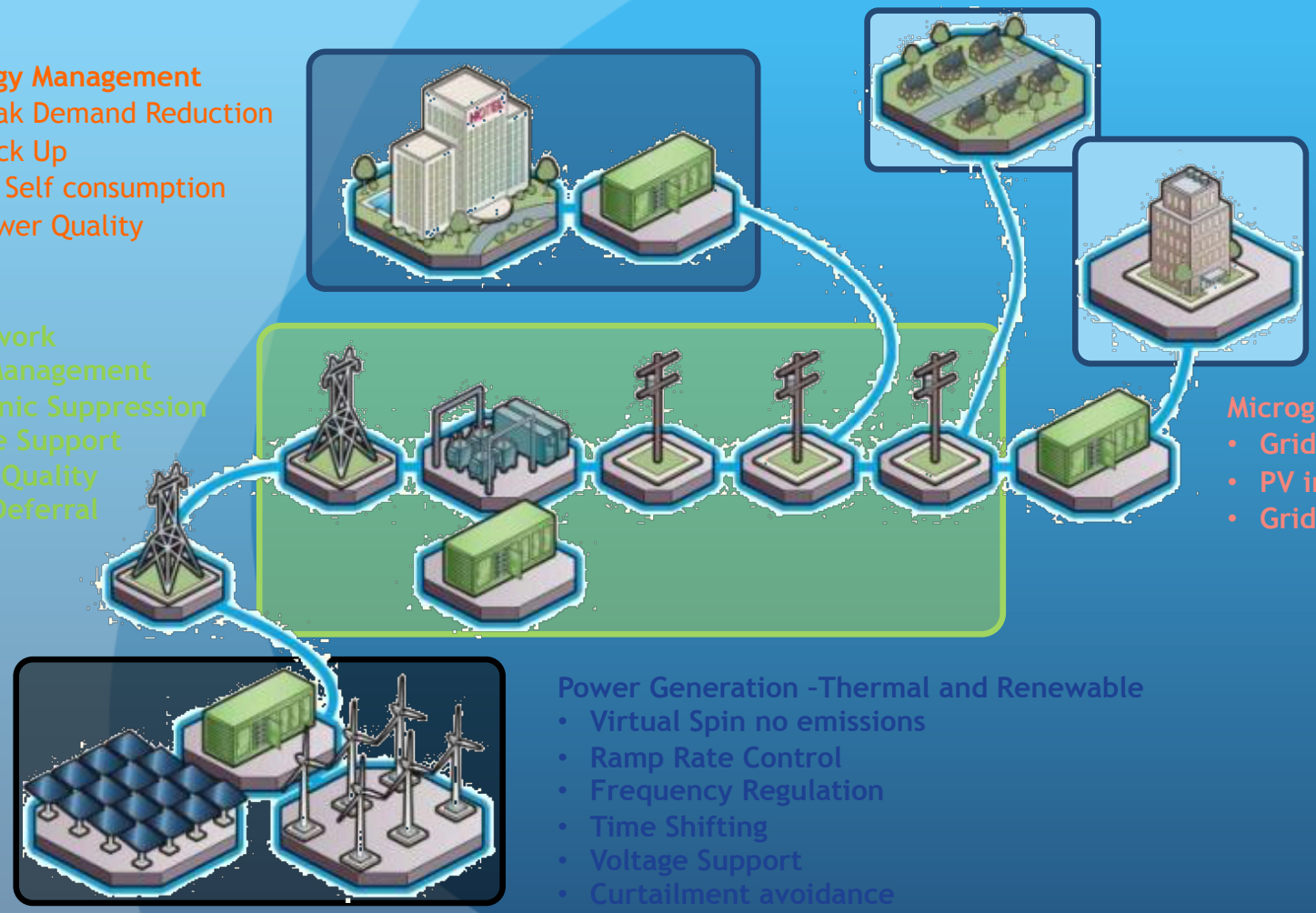
Focused on solving customers energy storage challenges

Focusing on 4 Grid Segments

Providing key applications combined with power and energy performance

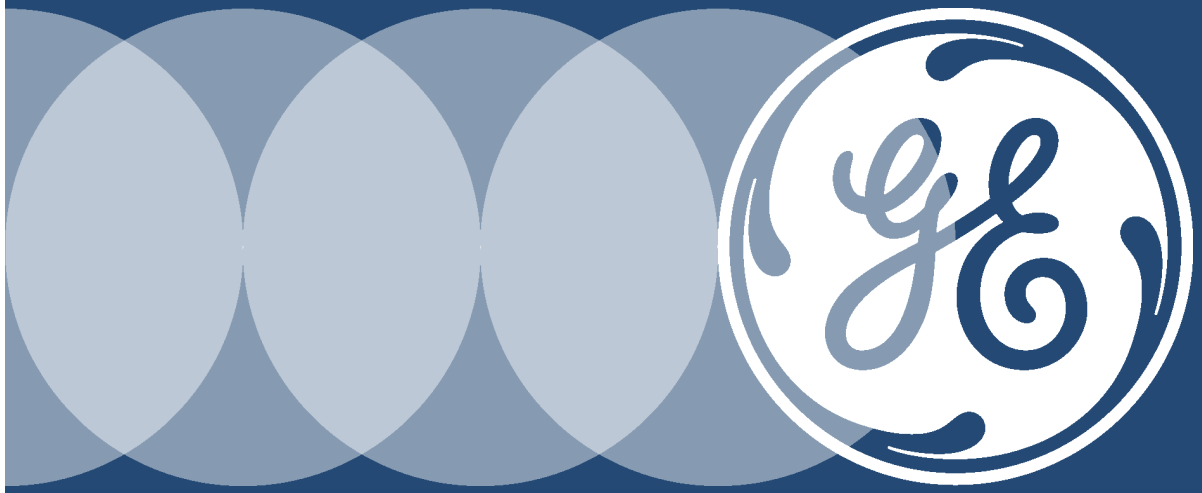
Energy Management
- Peak Demand Reduction
- Back Up
- PV Self consumption
- Power Quality

T&D Network
- Load Management
- Harmonic Suppression
- Voltage Support
- Power Quality
- Asset Deferral



Microgrid
- Grid Management
- PV integration
- Grid optimization

Power Generation –Thermal and Renewable
- Virtual Spin no emissions
- Ramp Rate Control
- Frequency Regulation
- Time Shifting
- Voltage Support
- Curtailment avoidance



The Hospital Designers, Builders and Operators Perspective

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That’s great, but this is a Hospital?

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CHALLENGES & OPPORTUNTIES

- **Seismic Compliance**
- Active components will require an OSP per OSHPD PIN 55 and CBC 1705A.12.4.1

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CHALLENGES

- **Utility Interconnection**
  - System will have to meet Utility Interconnection/PG&E Rule 21 for interconnection requirements
  - Need to implement while minimizing impact on the facility

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CHALLENGES

- <u>Need to Maintain Two Sources of Power</u>

- **The Micro Grid will Supplement the Emergency Power Systems, not replace it**

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CHALLENGES

- <u>This is very new to us</u>

- To meet the 2030 challenge HBSB will be seen as leaders in the adoption of the technology
  - Adopt Microgrids
  - Increase production and use of renewable energy

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OPPORTUNITIES

- The Micro Grid add resilience to the existing emergency system
- Additional benefits gained by having a the Micro Grid controller integration
  - Improve reliability
  - Better (more efficient) building operations
  - Improve staff and patient comfort
  - Enhance equipment life- identify performance declines, service needs earlier
  - Reduce Green House Gas Production form power generation
  - Minimize Generator Runtime and associate particulate production

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NEXT STEPS

- *This is start of a KEY dialogue*
  - Continue to work on a regular basis with the HBSB technology committee
- Broaden the discussion and engage greater Healthcare community
  - Facility Owners and Operators
  - Building Codes Officials and other State Agencies – CEC, PUC, CAISO etc
  - Building, Construction Industry
    - Contractors, developers,
  - Equipment Suppliers
  - Utilities
  - Engineers
  - Architects
  - Building Controls
- Integration of control and monitoring systems
- Reduce Green House Gas Production and the associated health risk

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Summary

- Microgrids are here and are being deployed at healthcare institutions across the country (Harvard, University of Florida, UCI)
- California law, policy, and directives require increasing use of renewable energy as well as contributing to overall Electrical System reliability, safety, and resiliency
- Hospitals are major consumers of energy and are exceptional candidates to adopt renewable microgrids
  - Urgent need to mitigate cost
  - Important to reduce "carbon footprint
- Controller systems may increase Hospital safety and effectiveness:
  - "Positive control" of systems allows adaptation to rapid changes in circumstance
  - Granular reporting of system functions allows deeper understanding of real world life-cycle of equipment in Hospitals, earlier recognition of dysfunction, improved preventative maintenance
  - Supplemental power creates greater resiliency in the event of power shortages (diesel shortage)
- Coordination of agencies (OSHPD, CEC, CPUC, ISOs) is needed to achieve expeditious development of:
  - Standards and Policy
  - Design and Execution

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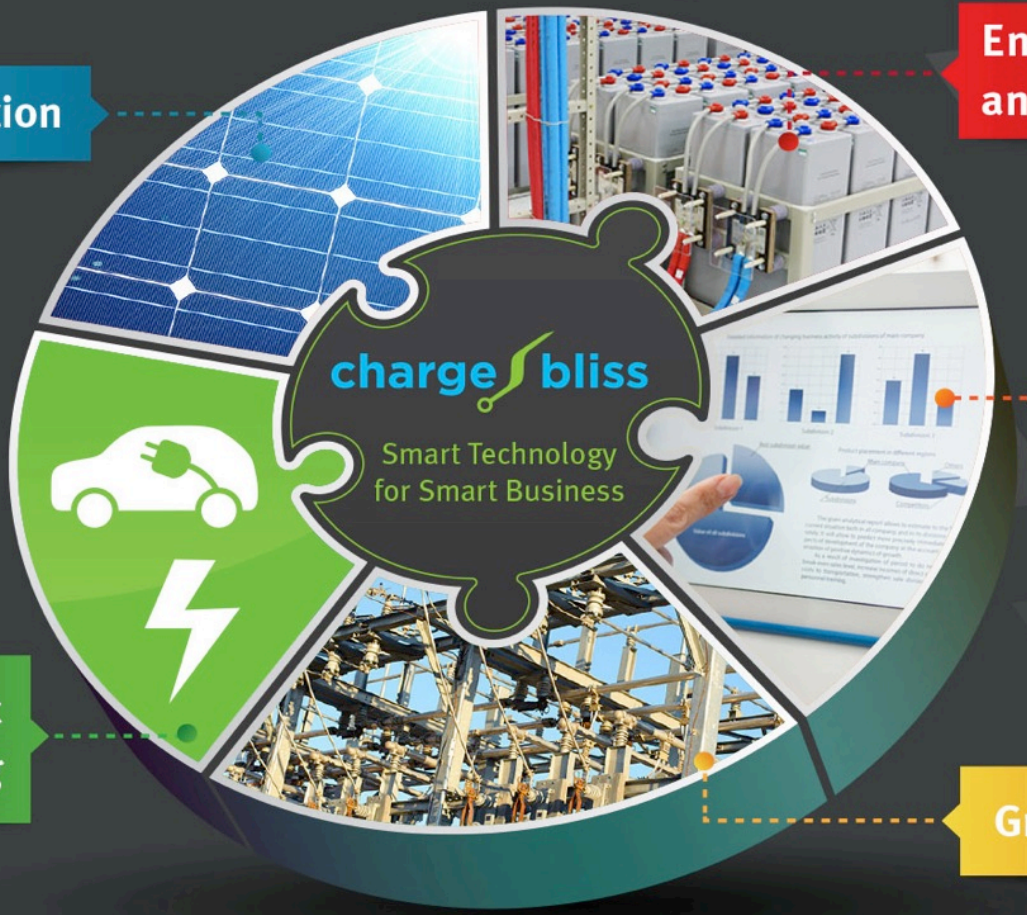
ENERGY ECOSYSTEM

THANK YOU



Energy Generation

Energy Storage and Redeployment

Energy and Demand Management

Grid Supply

Fast Electric Vehicle Charging

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