Energy Storage Technology Advancement Partnership (ESTAP) Webinar

Oregon's New Energy Storage Project for Resiliency and Cost Savings

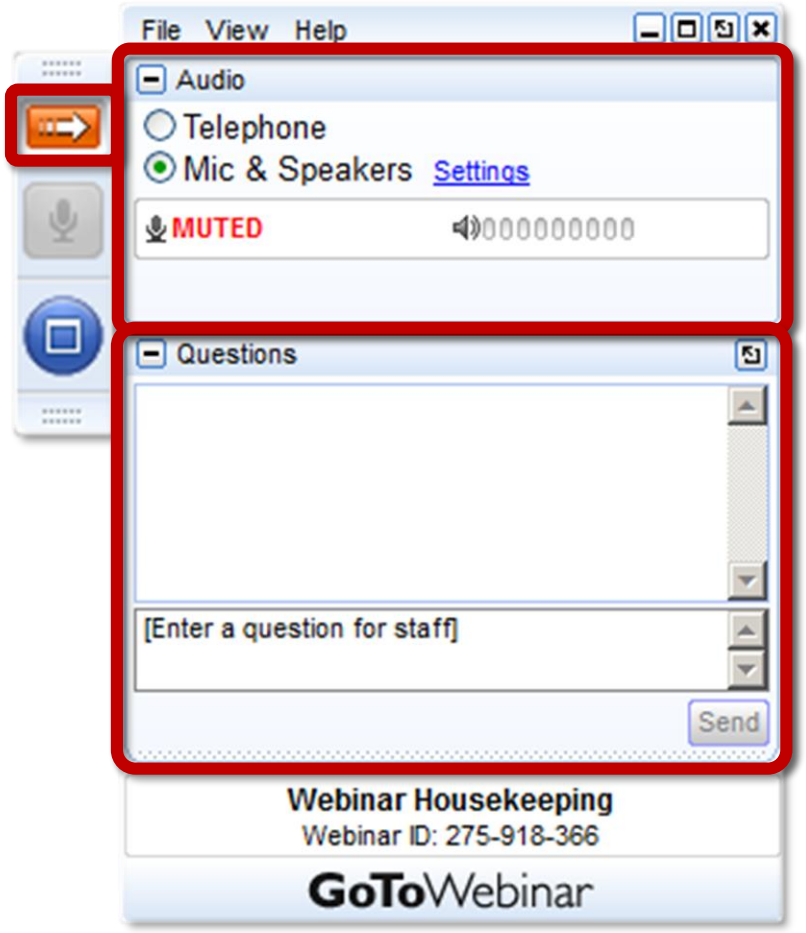
December 18, 2018

U.S. DEPARTMENT OF ENERGY

Sandia National Laboratories

CleanEnergy States Alliance

Housekeeping



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- Choose Mic & Speakers to use VoIP
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Use the orange arrow to open and close your control panel

Submit questions and comments via the Questions panel

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Clean Energy States Alliance

ALASKA ENERGY AUTHORITY

STATE OF CALIFORNIA ENERGY COMMISSION

DEPARTMENT OF ENERGY & ENVIRONMENT

EnergyTrust of Oregon

IOWA economic development

MASSACHUSETTS CLEAN ENERGY CENTER

IPA ILLINOIS POWER AGENCY

NEW MEXICO emnrd Energy, Minerals and Natural Resources Department

OEI Wisconsin Office of Energy Innovation

NEW YORK STATE OF OPPORTUNITY. NYSERDA

BPU New Jersey's cleanenergy njcleanenergy.com program™

CONNECTICUT GREEN BANK SM

New Hampshire PUBLIC UTILITIES COMMISSION

Maryland Energy Administration

STATE OF WASHINGTON Department of Commerce Innovation is in our nature.

MI Energy Michigan Agency for Energy Michigan Energy Office

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COMMERCE DEPARTMENT

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SMUD™ Powering forward. Together.

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DOER Massachusetts Department of Energy Resources

STATE OF RHODE ISLAND OFFICE OF ENERGY RESOURCES

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Illinois Department of Commerce & Economic Opportunity

Office of the People's Counsel District of Columbia Advocating, Protecting and Educating DC Consumers

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

Smart Electric Power Alliance

ACEP Alaska Center for Energy and Power

www.cesa.org

Energy Storage Technology Advancement Partnership (ESTAP) (bit.ly/ESTAP)

ESTAP is supported by the U.S. Department of Energy Office of Electricity and Sandia National Laboratories, and is managed by CESA.

ESTAP Key Activities:

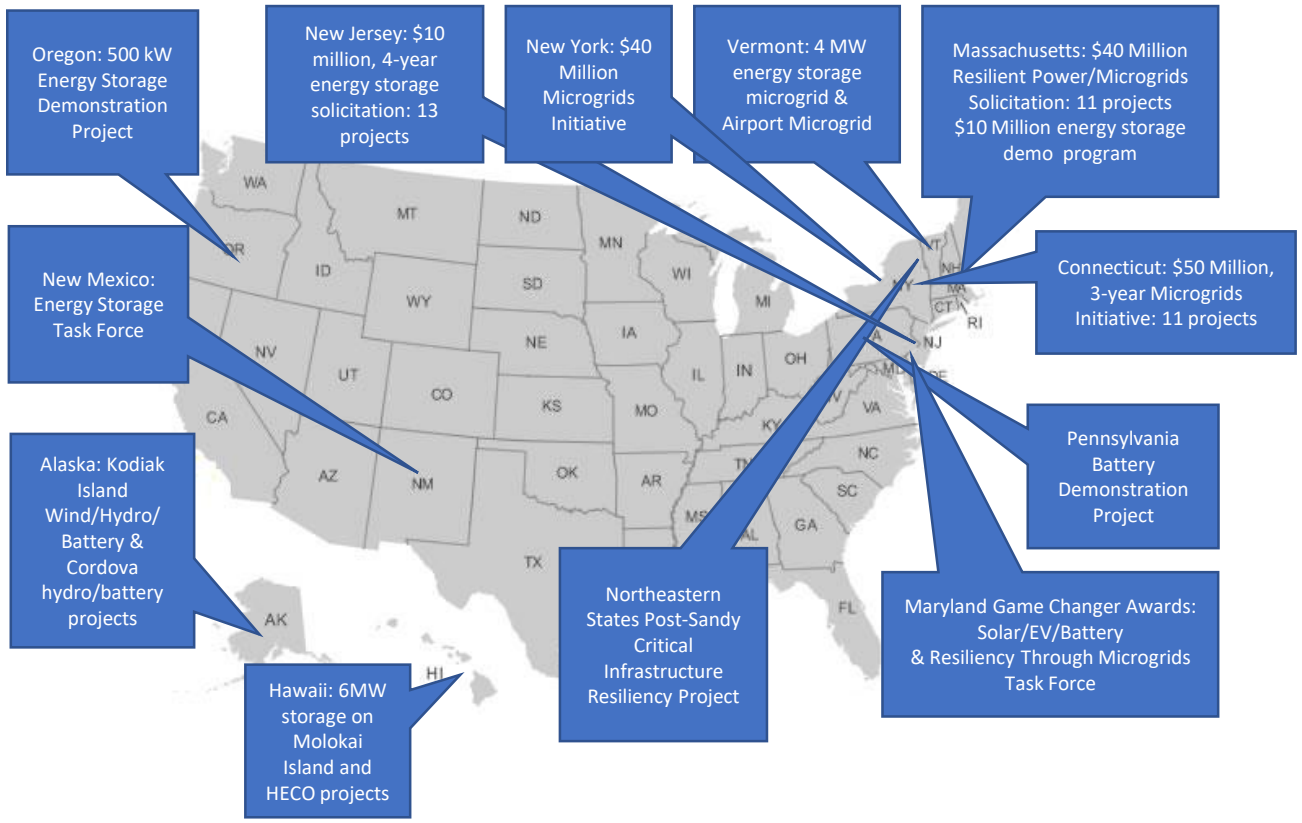
1. Disseminate information to stakeholders

   - ESTAP listserv >5,000 members
   - Webinars, conferences, information updates, surveys.

2. Facilitate public/private partnerships to support joint federal/state energy storage demonstration project deployment

3. Support state energy storage efforts with technical, policy and program assistance

ESTAP Project Locations:



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Webinar Speakers

- **Dr. Imre Gyuk**, U.S. Department of Energy Office of Electricity
- **Robert Del Mar**, Oregon Department of Energy
- **Matt Ibaraki**, Eugene Water and Electric Board (EWEB)
- **Phil Fischer**, NEC Energy Solutions
- **Alex Headley**, Sandia National Laboratories
- **Dan Borneo**, Sandia National Laboratories
- **Todd Olinsky-Paul**, Clean Energy States Alliance (moderator)

Oregon Department of **ENERGY**

Summary of Battery Storage Workshops

Rob Del Mar
December, 2018



OREGON DEPARTMENT OF ENERGY

SOLAR PLUS

USDOE Solar Energy Strategies Grant

SOLAR PLUS NORTHWEST

SNOHOMISH COUNTY PUD PUBLIC UTILITY DISTRICT NO. 1

EWEB

PGE

Sandia National Laboratories

OREGON DEPARTMENT OF ENERGY

PSE PUGET SOUND ENERGY

Pacific Northwest NATIONAL LABORATORY

Solar Plus…

- Community
- Resource Value
- Low Income
- Resiliency

EUGENE WATER AND ELECTRIC BOARD

"GRID EDGE" BATTERY STORAGE DEMONSTRATION
Resilience AT Eugene Water and Electric Board

EWEB

Sandia National Laboratories
Exceptional service in the national interest

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PUGET SOUND ENERGY

"GLACIER" BATTERY STORAGE PROJECT
Puget Sound Energy, Glacier, WA

- Glacier battery storage project
- Primus flow battery
- Behind the meter residential
- Behind the meter commercial
- Front of meter residential

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PSE PUGET SOUND ENERGY

PORTLAND GENERAL ELECTRIC

Community Resiliency

- 5 megawatt (MW) / 1.25 megawatt-hour Salem Smart Power Center
- Future procurements under Oregon storage capacity mandate

Project Name	Total Capacity (MW)	Total Energy (MWh)	Cost Cap (millions)
Baldock Mid-feeder	2	4	$2.5
Coffee Creek Substation	17 – 20	68 – 80	$30.1
Generation Kick Start	4 – 6	16 – 24	$5.3
Microgrid Pilot	4 – 12	16 – 45	$2.0
Residential Storage Pilot	1.2 – 2.3	3 – 6	$1.5
Controls Integration	N/A	N/A	$2.8
Portfolio Aggregate	**28 – 42***	**110 – 160**	**$44.2**

* Total portfolio aggregate will not exceed 38.7 MW (one percent of PGE's 2014 peak load), per HB 2193, Section (2)(a).

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Portland General Electric

NATIONAL LABS

Battery Storage ABCs

- Technology Overview
- Pricing Trends
- Technology Advancements
- Commissioning, Safety and Deployment
- Contracting Considerations

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Pacific Northwest NATIONAL LABORATORY
Proudly Operated by Battelle Since 1965

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Oregon Department of **ENERGY**

Rob Del Mar
Robert.delmar@Oregon.gov
503-302-7027

Thank You!



OREGON DEPARTMENT OF ENERGY

Grid Edge Demonstration Project

ODOE – Solar-Plus Technical Workshop 11-2018

Project Partners

1. EWEB
2. Sandia National Laboratories
3. ODOE
4. CESA
5. WorleyParsons
6. NEC
7. Eugene School District 4J

Special Thanks
Funding from US DOE, Dr. Imre Gyuk Energy Storage Program Manager

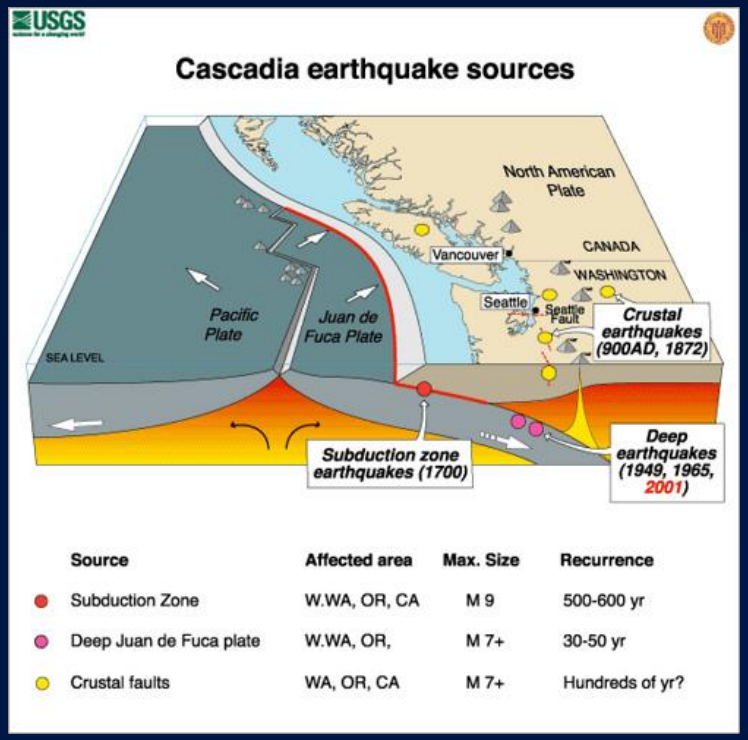
Grant Scope

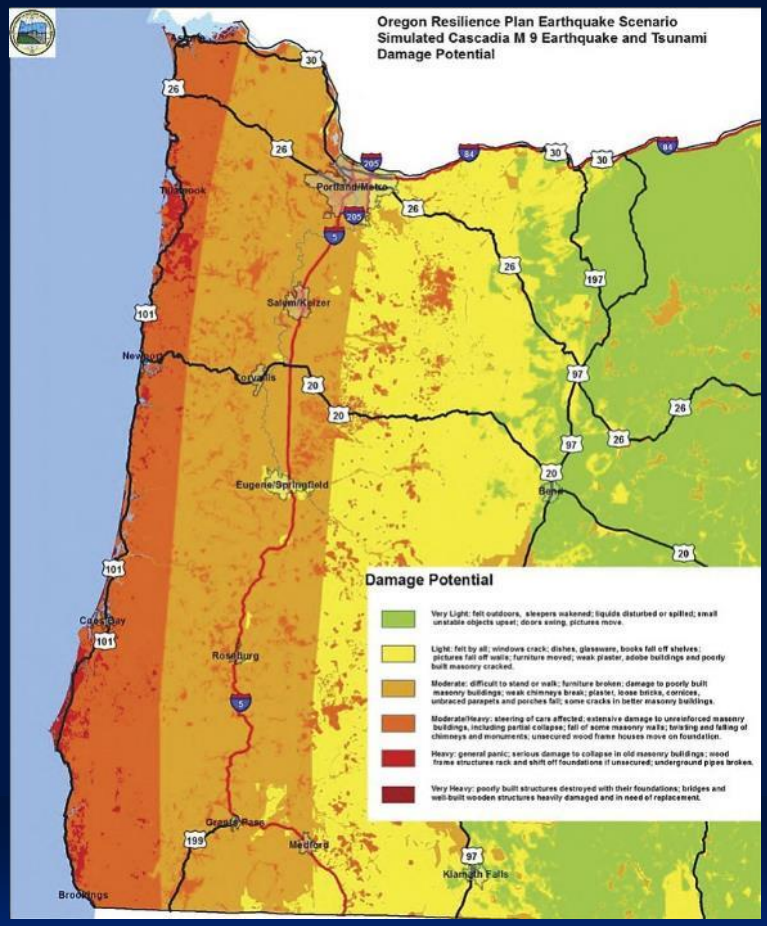
- Install a 500kW/1000kWh energy storage system
- Run for at least one year
- Verify promised services
- Customer and utility facing services (use cases)
- Conduct an optimization study

EWEB

EWEB Resiliency

- Why? Cascadia Subduction Zone Earthquake





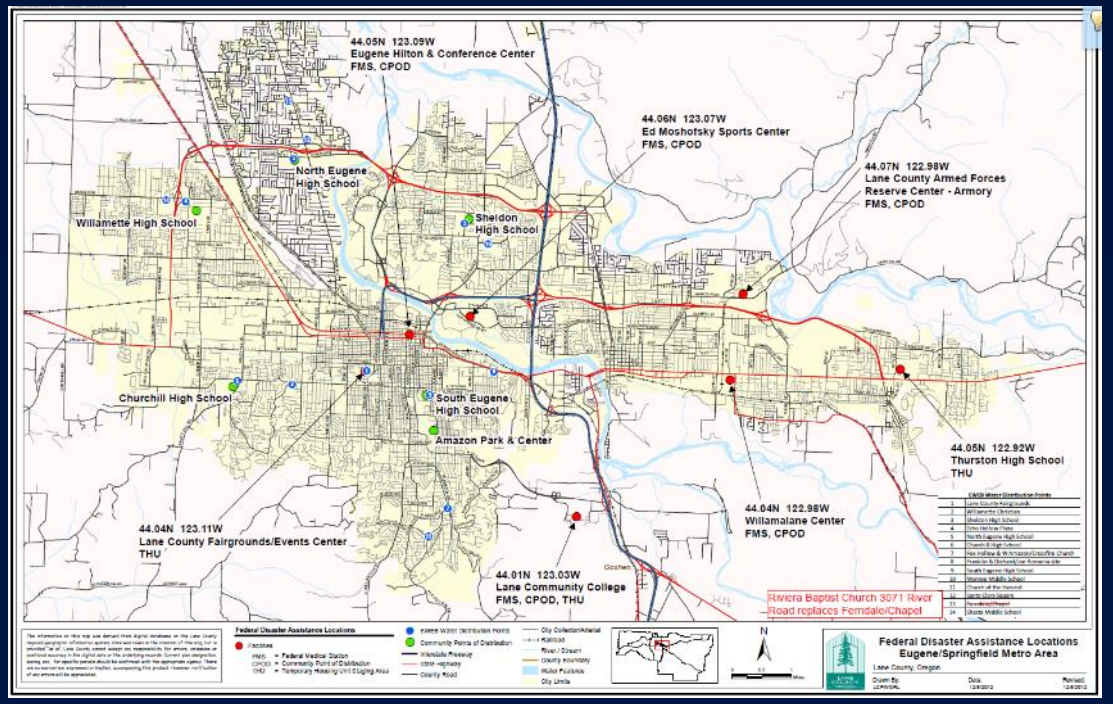
EWEB

EWEB Resiliency

Disaster Recovery (Long and short term)

Distributed Sites

Local water supply and potential staging area



EWEB

BESS Usage

How does EWEB intend to use the BESS?

1. Resiliency

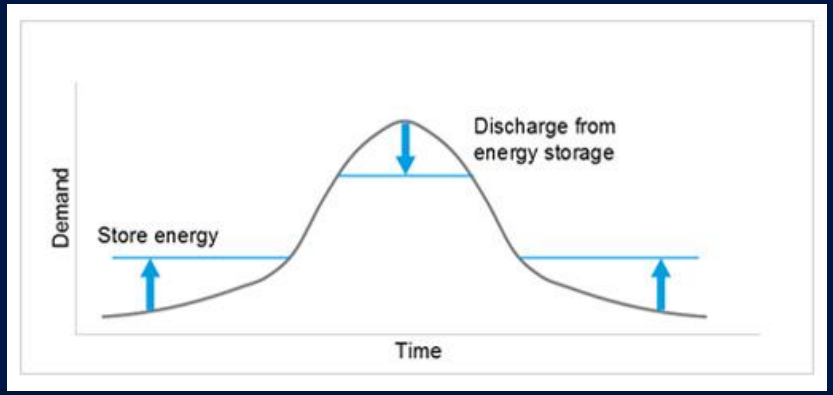
- Customer outage resiliency (short outages)
- Disaster resiliency
  - Community gathering site
  - Water distribution site
  - Staging area
- Aggregated generation (future)

EWEB

BESS Usage

How does EWEB intend to use the BESS?

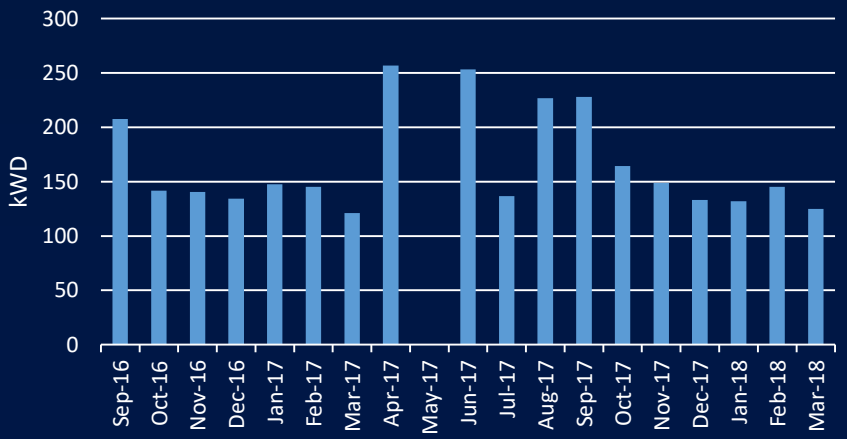
2. Research
   - Help National Labs with PNW economic analysis (use cases)
   - Develop EWEB interconnection standards for energy storage
3. Economics
   - Customer demand bill reduction
   - Utility BPA bill reduction



EWEB

Project Site

- Howard Elementary
  - Grades K-5
  - 411 students
  - Building area = 88,000 ft^2
  - 500 kVA 12.47kV/480V XF



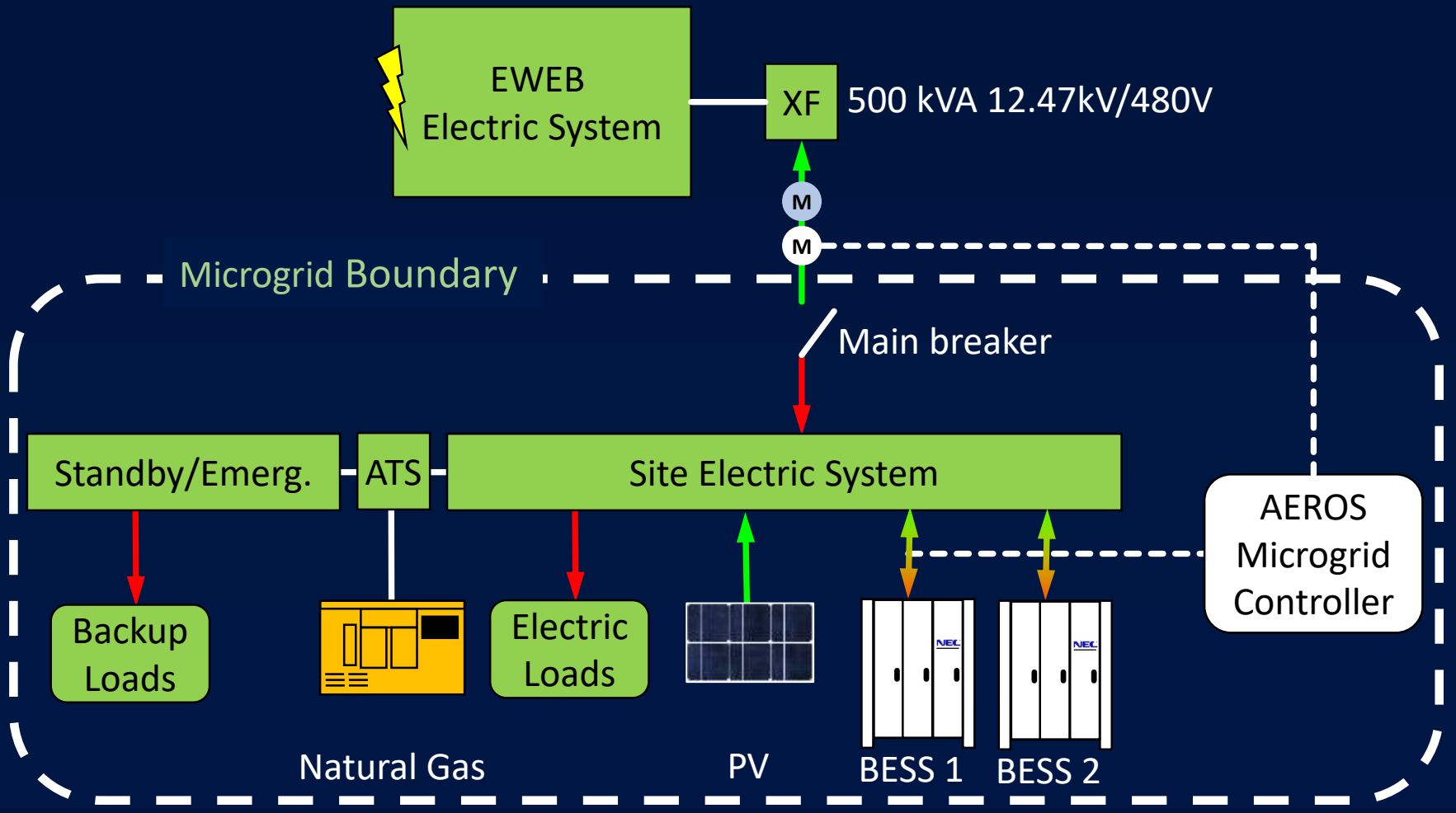
Howard Monthly Peak Demand

Originally built 1949

Re-built 2016

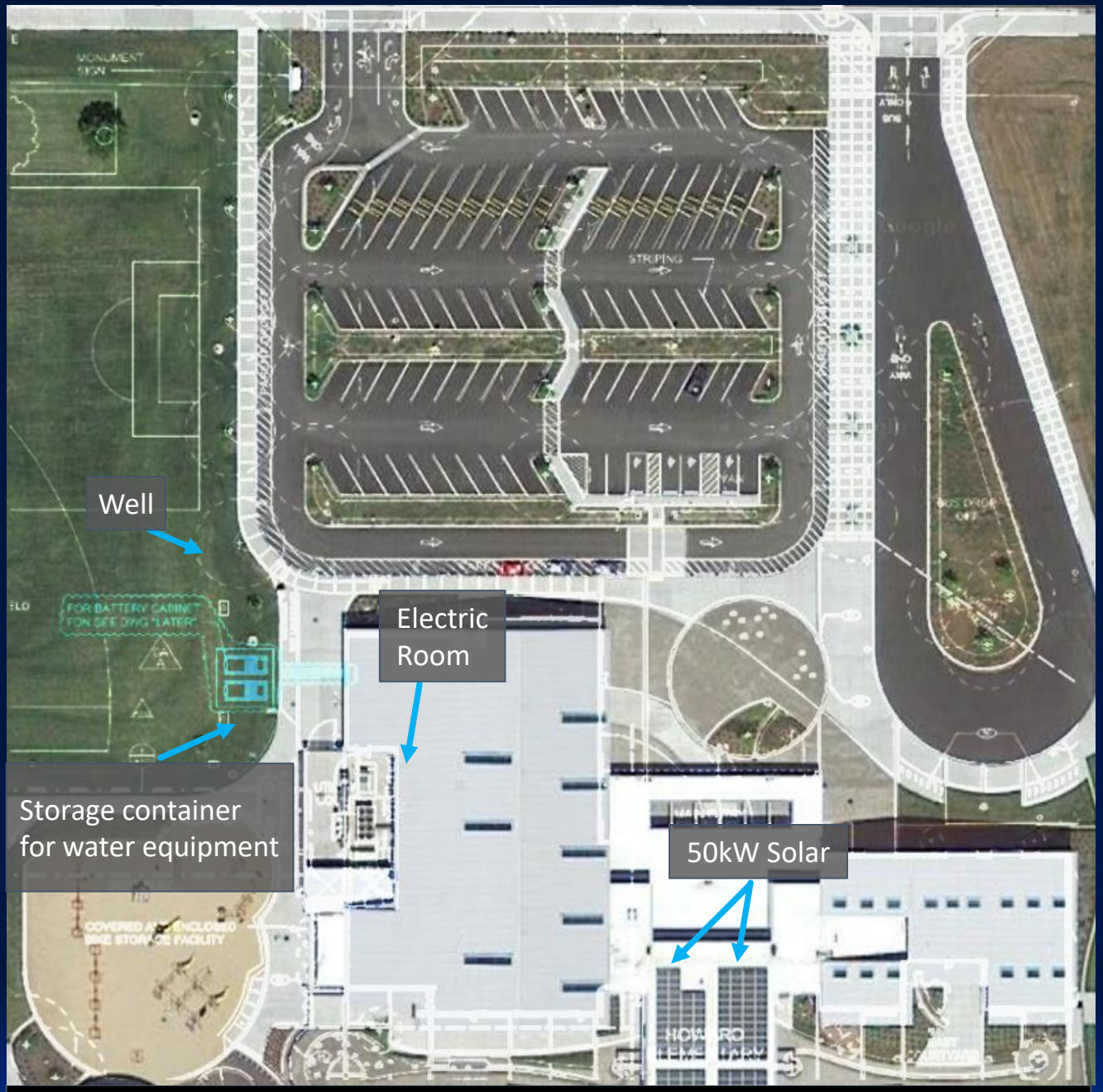
EWEB

Howard Elementary Microgrid



EWEB

Howard Elementary – Bird’s Eye



Howard Elementary – Bird's Eye

BESS Specs

WSTECH BATD0280-ES-1-480-1

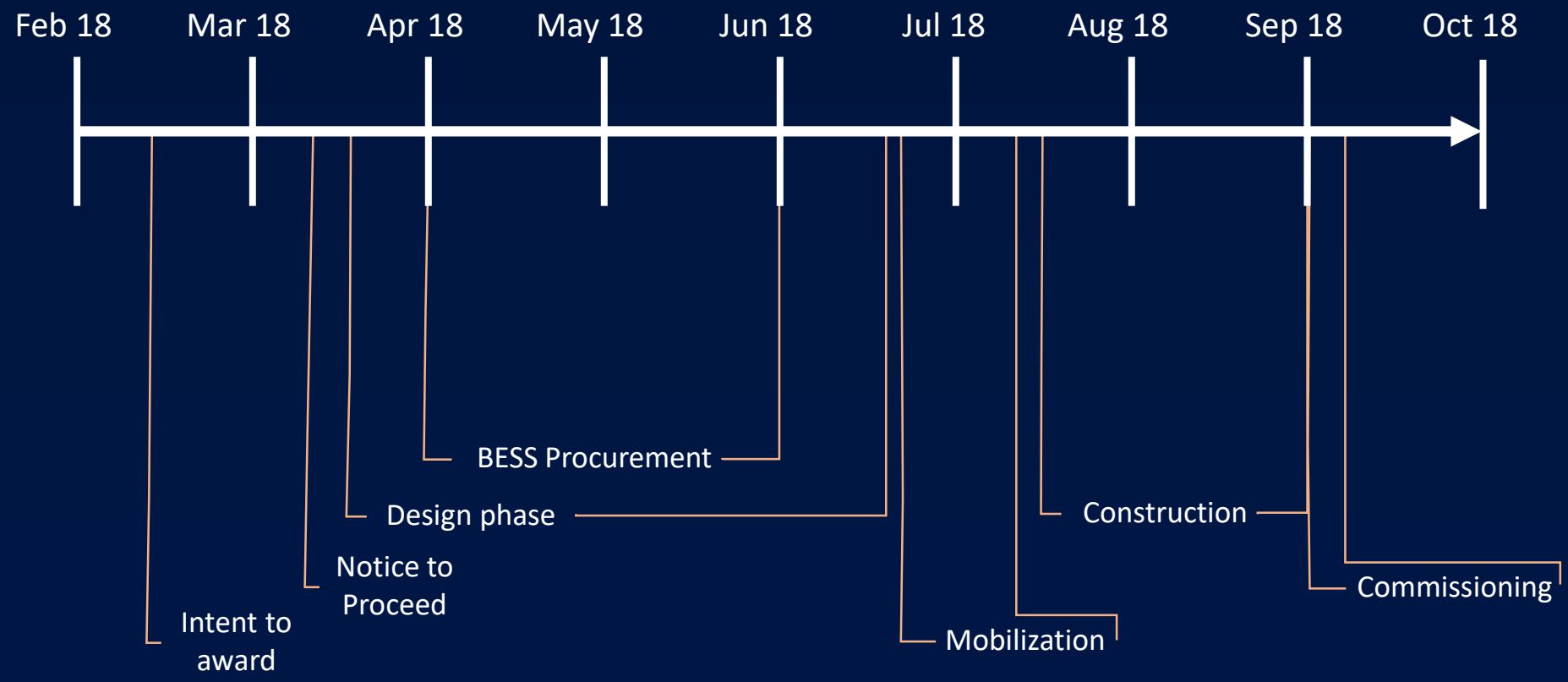
- 280kVA x 2
- 480Y/277V
- 337A max current output
- Efficiency 92-96% dep. on output

NEC DSS

- 280kW/510kWh x 2
- 6 bays
  - 85kWh per bay @ 720VDC
  - 14 batteries per bay @ 51.4V
- C/4 Continuous, 1C once/12hr
- NOVEC 1230 Agent
- Built-in AEROS Controller

EWEB

Timeline


Feb 18
Mar 18
Apr 18
May 18
Jun 18
Jul 18
Aug 18
Sep 18
Oct 18
Intent to award
Notice to Proceed
Design phase
BESS Procurement
Mobilization
Construction
Commissioning

Construction Photos

Excavation for pad

Construction Photos

Main BESS pad poured – 12” thick

Construction Photos

Crane picking BESS and Inverters

DSS Weight = 17,371 # ea

Inverter Weight = 4,409 # ea

Construction Photos

150’ well drilled – Pump to be installed and wired Q4 2018

10HP pump and 80-100 GPM

Construction Photos

Finished install with fencing

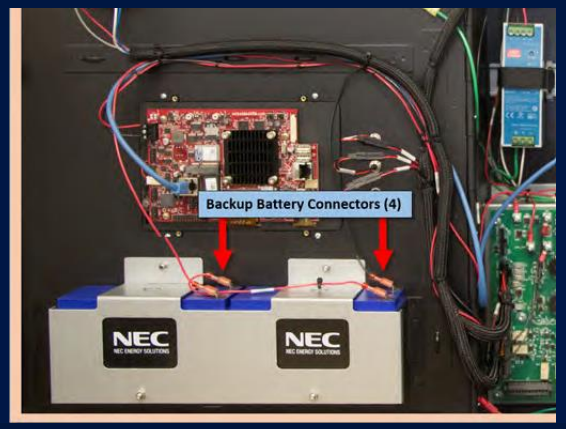
Challenges

1. Complexities of utility-owned projects behind customer meter
   - Metering
   - Use case selection
   - Backup reserves %

EWEB

Challenges

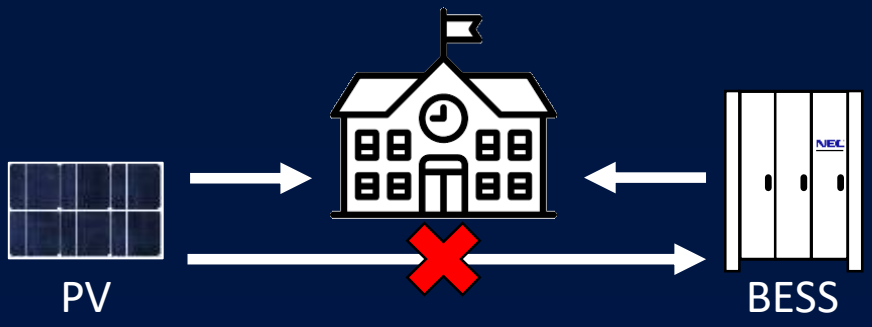
2. Delayed start/Not self-starting
   - UPS units run out quickly
   - Requires UPSs to power controller, fire suppression, and inverter



EWEB

Challenges

3. Unable to charge with solar while islanding
   - Site controller addition required
   - PV inverter upgrade
4. BESS trip-off if PV > Load



EWEB

Lessons Learned

1. Consolidate battery and inverter
2. Beef-up specifications around:
    1. Ability to charge the battery with solar when solar output is greater than load
    2. Ideally have the battery able to hibernate and then blackstart without an excessively sized UPS system
3. If possible, select utility owned sites
4. Keep an eye on the C&I space for microgrid controllers

EWEB

End

EWEB

NEC ENERGY SOLUTIONS

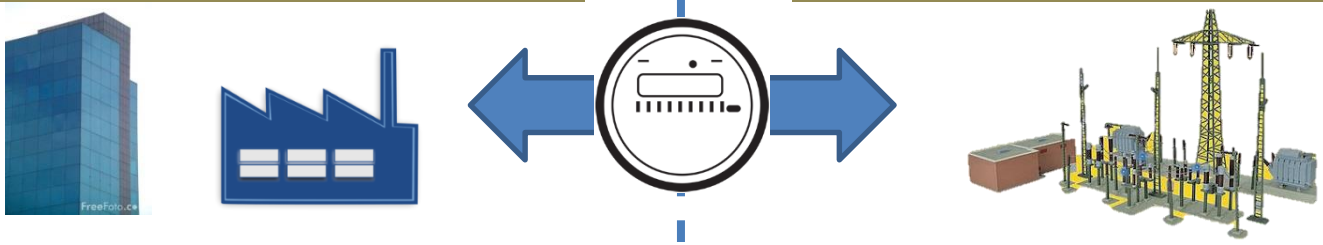
Distributed Storage Solution (DSS®)

Phil Fischer
pfischer@neces.com

Empowering New Energy Services at the Grid Edge

NEC ENERGY SOLUTIONS

Host premises | **Distribution Utilities**



Softening the real-time link between the grid and 'prosumers' promises new energy services for both enterprises and utilities

- Energy **Cost Optimization**
  - Demand charge reduction
  - Simpler demand response
  - TOU rate management
- Energy **Resiliency**
  - PV integration and back-up power enablement
  - Power quality assurance

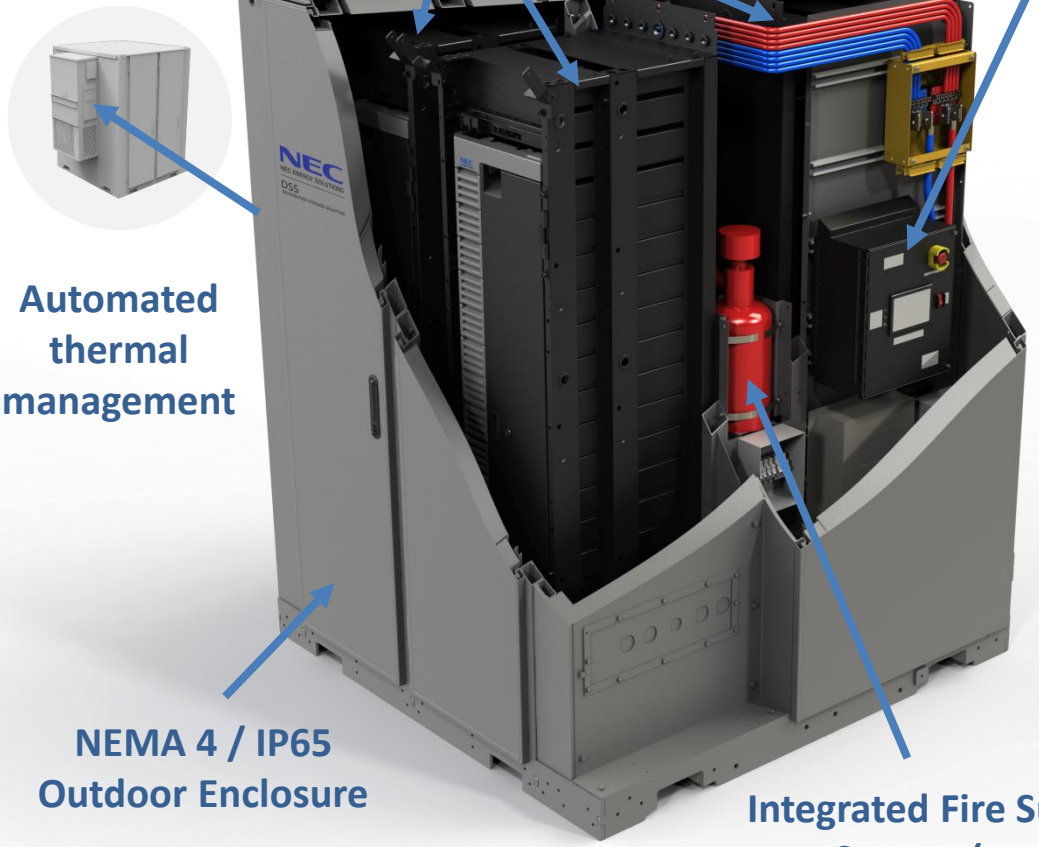
- Distributed **Asset Control**
  - Dispatch-ability of C&I load and distributed generation
- **Efficient utilization**
  - Local congestion relief at substations and feeders
  - Voltage/VAR support
  - Ancillary services

DSS® Integrated System Design

NEC ENERGY SOLUTIONS

2, 4, or 6 battery bays, supporting 1 to 6 energy storage racks

AEROS® controls with integrated touch-screen HMI



Automated thermal management

NEMA 4 / IP65 Outdoor Enclosure

Integrated Fire Suppression System (optional)

Separate PCS (100 & 280 kW)
(integral transformer)

Full certification and compliances assures safety and lowers deployment risk
(UL 9540, UL 1741 (SA), NFPA 70/ 70E, etc.)

EWEB site installation, performed by WorleyParsons

Maximizing Cost Savings with Optimal Energy Storage Dispatch

PRESENTED BY

Alexander Headley, Tu Nguyen

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Introduction

Battery and PV system installed at Howard Elementary in Eugene, OR

- Predominantly for backup power and resiliency

Battery specifications

- 500 kW 2-hour Li-ion battery
- 85% round-trip efficiency
- State of charge between 10% and 95%

Barring an outage, want to look at how the battery can add value

- Reducing customer electricity charges
- Potential value to EWEB

Behind-the-Meter Demand Charge Reduction

Monthly summary of 2017 bills, load, and PV generation from 25kW DC PV

Hourly load estimates

- EWEB provided simulated data (eQUEST 3.65) based on the building

Hourly PV generation modeled using PVWatts Calculator

- 50 kW DC
- 94% inverter efficiency

Demand and energy charge inputs given by EWEB

- No time of use pricing differences
- $7.43 per kW for peak monthly demand
- Net-metered at 0.06236 $/kWh

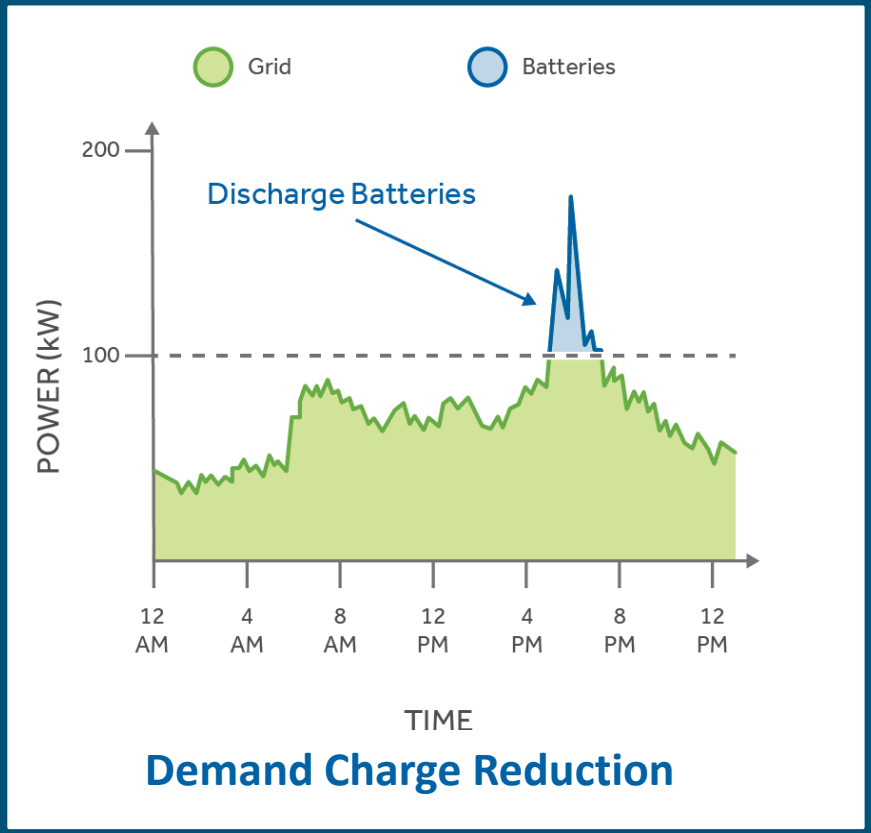


Image Credit - *Aquion Energy*

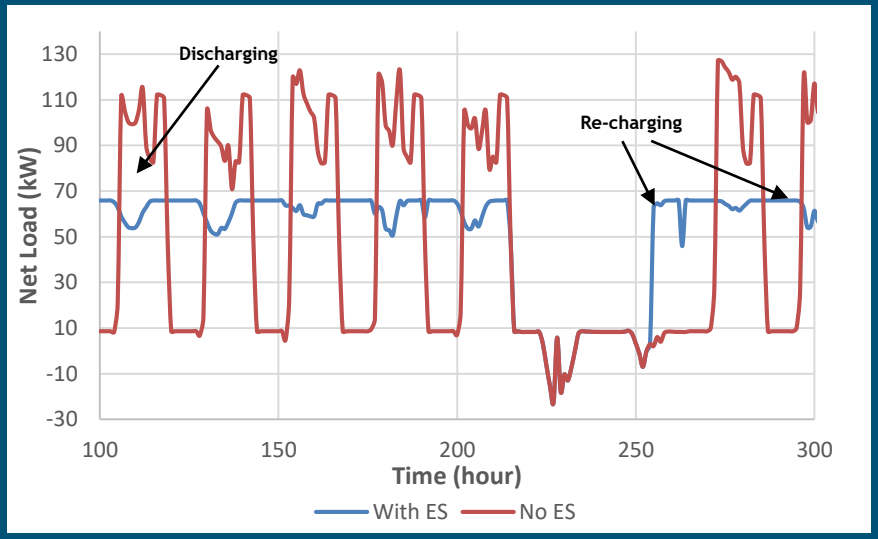
Optimal Battery Dispatch for Peak Demand Reduction

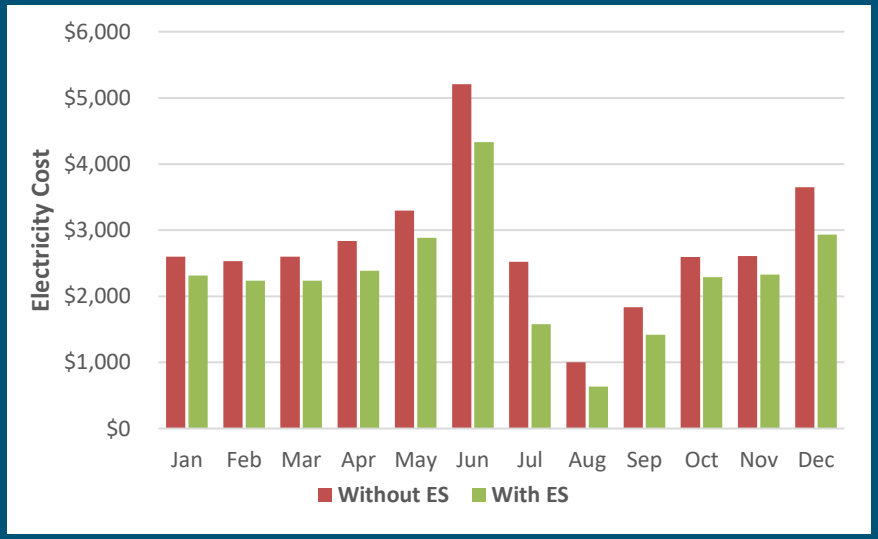
Scaled demand and PV generation to match monthly summary data
- Scaling factor to match total energy

Minimize electricity bill subject to:
- Battery state-of-charge model
- Demand simulation
- PV generation

Optimized battery dispatch schedule using Python/PYOMO
- Open source tools

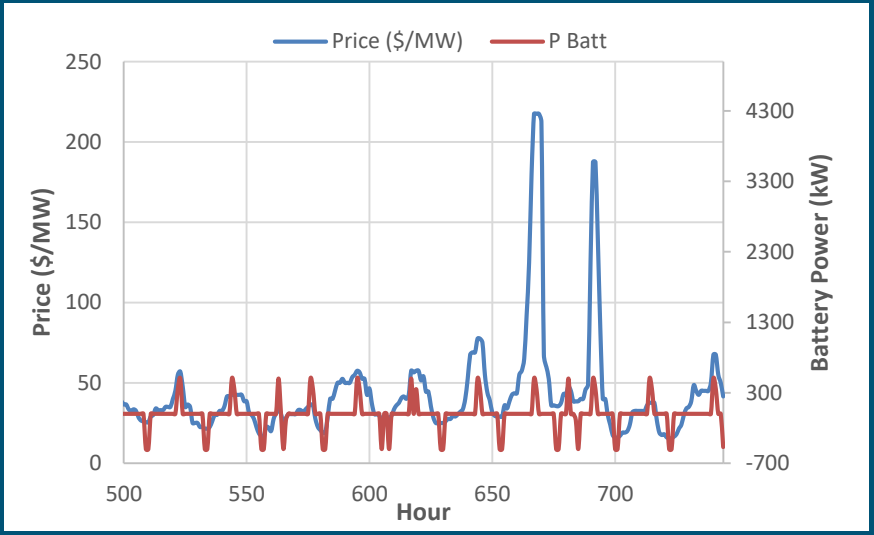
Approximately $6,000 annual savings
- Saving 18% of the annual cost

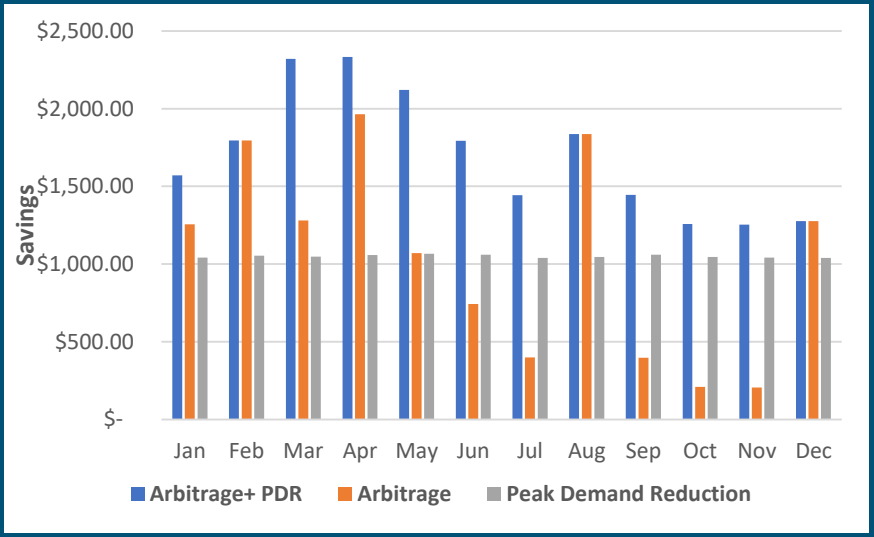




EWEB – Optimal Dispatch for Arbitrage and Demand Reduction

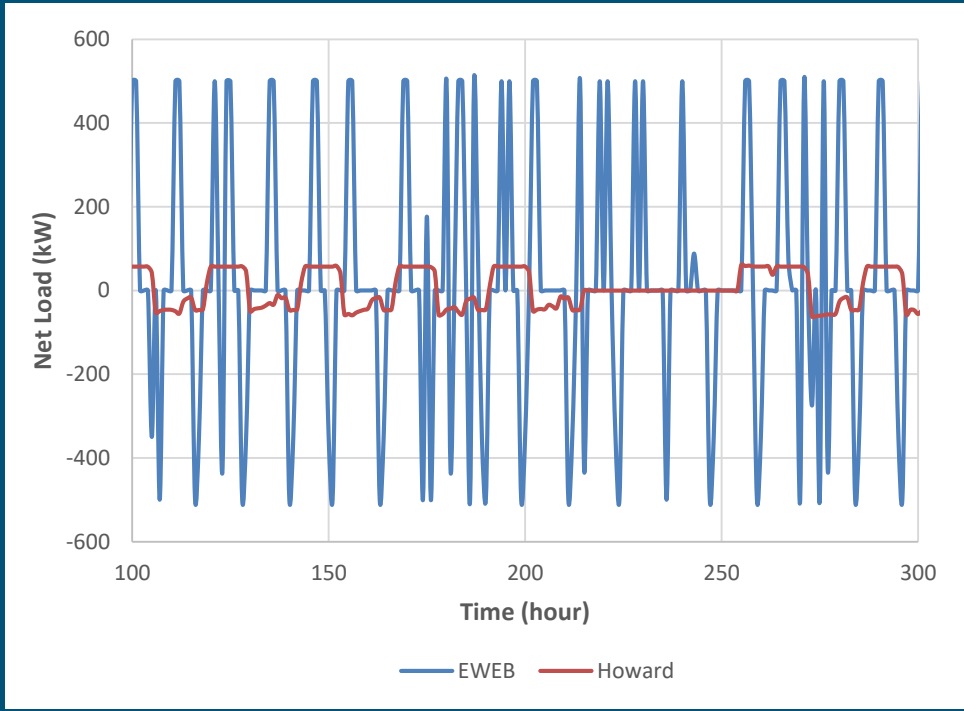
- EWEB supplied BPA and demand data
- Energy arbitrage
  - BPA hourly pricing fluctuations
- Coincident peak demand charge reduction
  - Minimize load during monthly BPA peak hour
  - $2.10/kW
- Optimization assumes perfect forecast
- Maximum value obtained with full power charge/discharge with price fluctuations
  - Likely bad for battery health
  - Very different from BTM schedule
- Approximately $20,000 annual savings



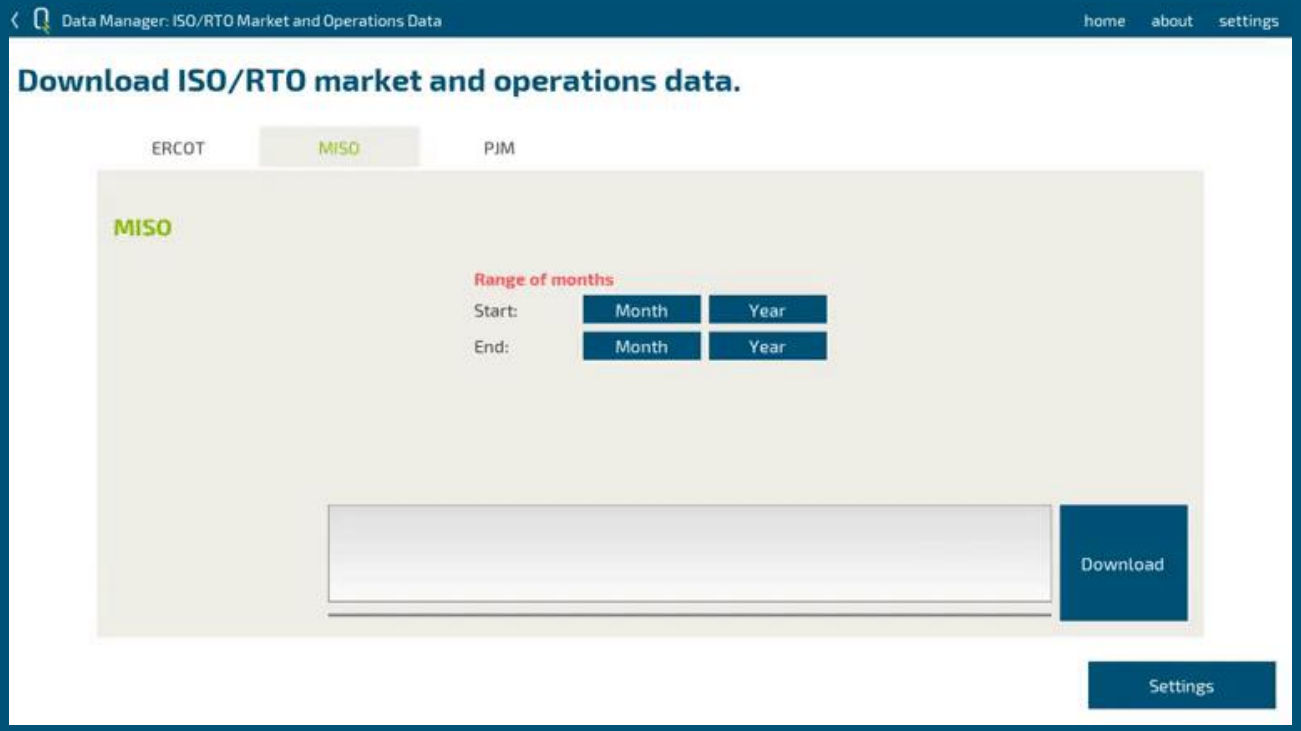


Summary and Potential Future Work

- Battery scheduling to minimize costs
  - ~$6,000/year savings BTM
  - ~$20,000/year savings EWEB
- Dispatch to optimize for BTM and EWEB costs
  - Discharge schedules are not compatible
  - Optimal for one may worsen the other
- Investigate other potential value streams for EWEB
  - Demand Response
  - Power Quality Support (Volt-VAR)
  - Transmission Congestion Relief
- Optimal EWEB dispatch considering battery life



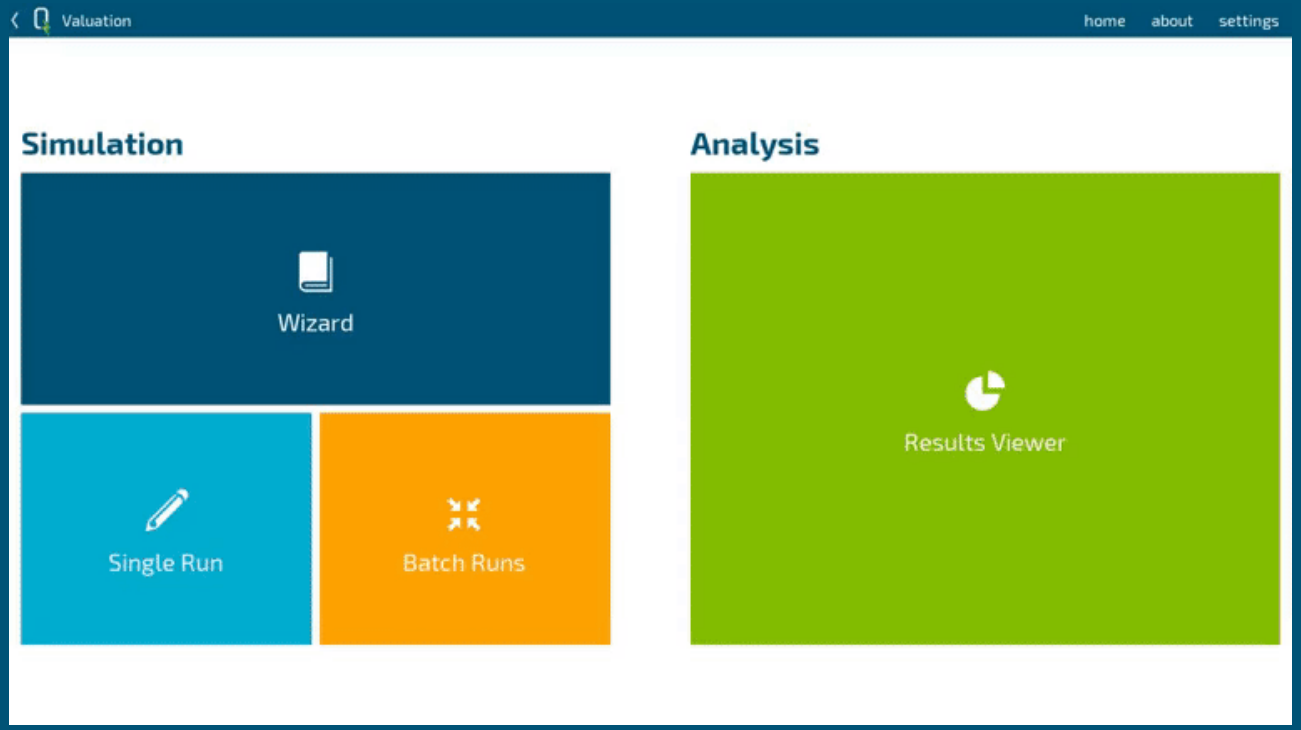
QuESt Valuation Wizard



QuESt energy storage valuation developed by Sandia National Laboratories

- Open source Python code
- Market area pricing data download manager
- Calculates potential revenue from ES system depending on market area, grid services being provided, and ES system parameters
- Available for download: github.com/rconcep/snl-quest

QuESt Valuation Wizard



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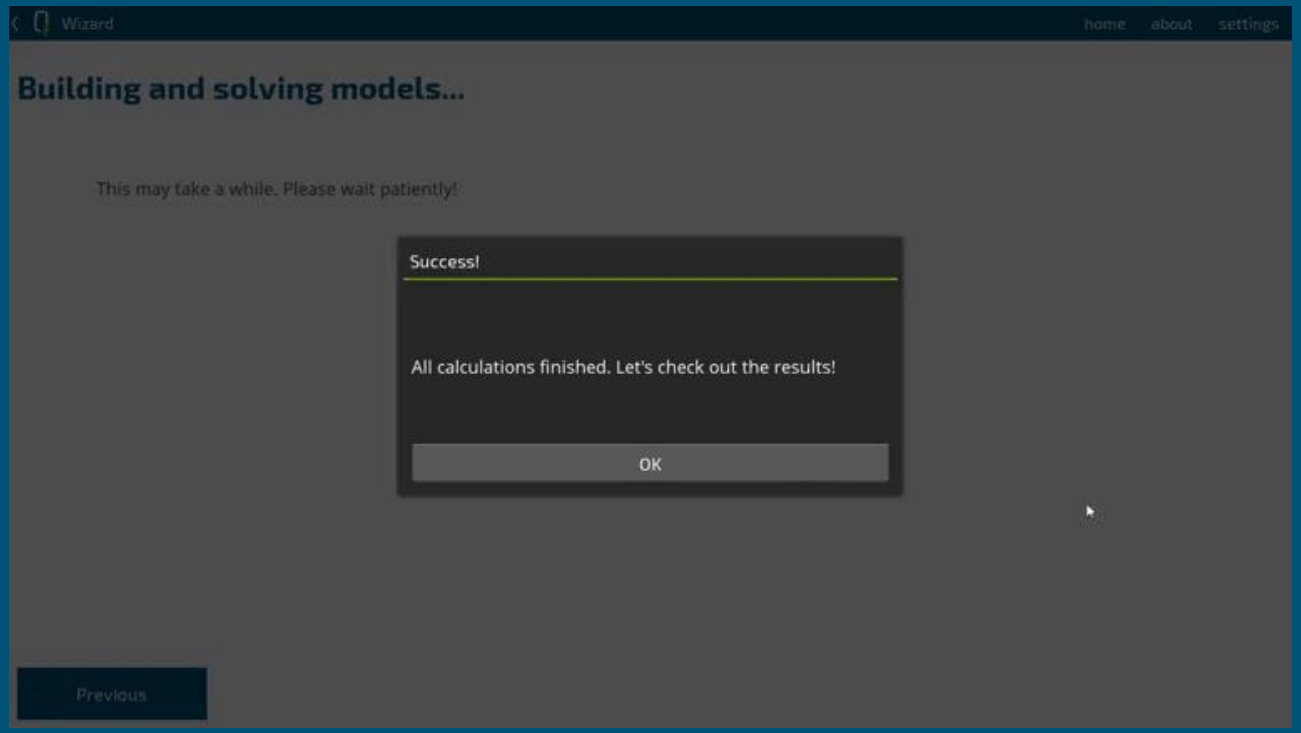

Additional functionality planned for future releases

- Behind-the-meter valuation
- Additional market areas and market products
- Technology selection assistant
- System cost estimator

Acknowledgements

The authors would like to acknowledge the support and guidance from Dr. Imre Gyuk, the program manager for the U.S. Department of Energy Office of Electricity Energy Storage program.

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Quest

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