Replacing Diesel in an Alaskan Community: Cordova’s New Battery Energy Storage System

May 7, 2020
Housekeeping

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The Energy Storage Technology Advancement Partnership (ESTAP) is a US DOE-OE funded federal/state partnership project conducted under contract with Sandia National Laboratories.

ESTAP Key Activities:

1. Disseminate information to stakeholders
   - ESTAP listserv >3,000 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
Thank You:

Dr. Imre Gyuk  
Director, Energy Storage Research,  
U.S. Department of Energy

Dan Borneo  
Engineering Project/Program Lead,  
Sandia National Laboratory
Webinar Speakers

• **Dr. Imre Gyuk**, Director, Energy Storage Research, U.S. Department of Energy
• **Clay Koplin**, CEO, Cordova Electric Cooperative, and Mayor of Cordova, Alaska
• **Scott Newlun**, Manager of Generation and Distribution, Cordova Electric Cooperative
• **Nathan Cain**, Power Production Foreman, Cordova Electric Cooperative
• **Dan Borneo**, Engineering Project/Program Lead, Sandia National Laboratory
• **Todd Olinsky-Paul**, Project Director, Clean Energy States Alliance
• **Val Stori**, Project Director, Clean Energy States Alliance (moderator)
This webinar was presented by the DOE-OE Energy Storage Technology Advancement Partnership (ESTAP)

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ESTAP Website: https://cesa.org/projects/energy-storage-technology-advancement-partnership/

ESTAP Webinar Archive: https://www.cesa.org/projects/energy-storage-technology-advancement-partnership/webinars/
Upcoming Webinars

100% Clean Energy States and the 100% Clean Energy Collaborative
Monday, May 11, 3-4pm ET

Decarbonizing Electricity: The Critical Role of Firm Low-Carbon Resources
Friday, May 15, 2-3pm ET

Solar for All: The District of Columbia’s Innovative Strategy for Low-to Moderate-Income Solar
Wednesday, May 27, 2-3pm ET

Replacing New York City’s Dirty Peaker Power Plants with Renewables and Battery Storage
Thursday, May 28, 1-2:30pm ET

Read more and register at: www.cesa.org/webinars
Grid Scale Energy Storage, for Resilience, Stability, and a Greener Grid

IMRE GYUK, DIRECTOR, ENERGY STORAGE RESEARCH, DOE-OE
Sterling, MA: Microgrid/Storage Project

DOE-OE Collaboration with Sterling Municipal Light Department.

Ribbon Cutting: October 2016
Commissioning: December 2016
Reducing Monthly and Yearly Peaks:

April 2019: 1 million Avoided Cost!

Visitors: Germany, Switzerland, Denmark, Sweden, England, Ireland, Australia, Japan, Malaysia, Taiwan, Brazil, Chile, .... Thailand
Cordova, Alaska – Pop. 2,239
Copper River Salmon
World’s Finest Salmon!
Cordova Electric Cooperative Collaboration with DOE-OE

Total Generating Capacity:
6MW + 1.25MW Hydro; 2x 1MW Diesel
0.5MW Deflected as Spinning Reserve
Hydro: $0.06/kW; Diesel: $0.60/kW

Clay Koplin, CEO
1 MW / 1 hr Li-ion Storage by SAFT

On ancient Eyak Land

Commissioned June 7, 2019

- Frequency Regulation – Replace Diesel
- Load following – Make Hydro Dispatchable
- Emergency Supply – Resilience
- Diesel Arbitrage, Preheating dormant Diesels
National Scope - Local Relevance!

• ABQ Public Schools: demonstrate economic & resilience benefits of ES available to public schools. 13 high schools, 140 campuses.

• Project with Picuris Pueblo, NM to install storage in combination with solar for “Energy Independence”.

• Iowa: Develop 6-8 hour backup for existing/planned renewables

• 3 projects involving Rural Co-ops and Military Reservations.

• Levelock Village, AK. Tech assistance for ES microgrid

• Puerto Rico: 5 town consortium to form Central Mountain micro-grid powered by 250MW solar and hydro with 75 MW storage backup
Energy Storage should be in the Toolbox of every Utility!
BESS Application in a Microgrid - Cordova Electric Cooperative

Energy Storage Technology Advancement Partnership (ESTAP)
DOE-OE-ES / Sandia / CESA / CEC Webinar
May 07, 2020
Cordova Electrical Grid

Humpback Creek Hydroelectric Plant
1250kW (2 x 500 kW + 1 x 250 kW)
17,000 foot UG and submarine transmission line

Power Creek Hydroelectric
6278kW (2 x 3124 kW)
25 kV transmission ties to Eyak Substation, Inflatable dam

City of Cordova
1,566 customers, 18MW
One Substation
78mi UG distribution lines

Battery Energy Storage System
1 MW, 1MWh
ABB/SAFT at Eyak Substation

Orca Power Plant
10.8 MW Diesel
Control Center, CEC
CEC Controls System Frequency by Deflecting up to 750kW of water, a waste of energy (orange), and there is excess in summer (green), and not enough in winter (black/diesel).
CEC Use Case for BESS Storage: A Bridge Across the Valley of Death; Hydro vs. Diesel Generation

Power Creek Run of River Hydro Intake
A US Department of Energy Sponsored Microgrid Battery Energy Storage Application

(Dr. Imre Gyuk, Director of Energy Storage Research, Office of Electricity)

PARTNERS: US DEPT OF ENERGY-SANDIA-NRECA-ACEP-CEC-CESA; SAFT/ABB PACKAGE

Office of ELECTRICITY
Battery Energy Storage – Vendor Choice

SAFT-ABB PACKAGE
RIBBON CUTTING
June 7, 2019
TIMELINES

- 2007 – CEC System Loads Exceed Hydro Capacity and diesel peaking creates a “valley of death”
- 2012 – CEC partners with ACEP and recognizes the benefits of energy storage to CEC Grid
- 2015-16 ACEP Approaches Dr. Gyuk with CEC use case/opportunity and rich CEC data set
- 2016 Dr. Gyuk initiates phase 1 modelling of CEC energy storage via Sandia Laboratories
- 2017 Modelling and analysis indicates a right-sized, right-located Lithium Ion solution for CEC
- 2018 Dr. Gyuk sponsors phase 2 specification and procurement of BESS
- October 2018 CEC BESS Ordered
- May 2019 BESS arrives on site
- June 2019 BESS Installed
- July 2019 BESS Operational
- November 2019 Fully integrated and automated, saves $10,000 over 2-day Thanksgiving Holiday
- November CEC achieves 94% hydro crushing all previous records
- December 2019 CEC achieves 86% hydro crushing all previous records
- April 2020 CEC goes 100% hydro 3 weeks early and starts automated electric boiler heating
- Today: CEC is 100% hydro and heating diesel generators with excess hydro due to BESS
CEC BESS – Preliminary Valuation

- Precise quantitative measures are complex
- CEC Preliminary analysis indicates that at $3.00/gallon, fuel is only half the savings – diesel runtime variable costs are significant
- CEC automated measurement of “valley of death” hours where the BESS balances the grid to keep diesels off
- Year to date “valley of death” is 105 hours for 2020
- CEC estimates a cost savings of $500/hour or $52,500 YTD 2020
- This does not include boiler fuel or other savings
- We just started full battery operations 2 weeks ago

### Battery kWh Metering

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<th>Current Values</th>
<th>End of Hour</th>
<th>End of Day</th>
<th>End of Month</th>
<th>End of Year</th>
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<tr>
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<td>Acc Value</td>
<td>Hr to Date</td>
<td>Day to Date</td>
<td>Month to Date</td>
<td>Year to Date</td>
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### Battery Savings

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<th>End of Year</th>
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<tr>
<td>Battery</td>
<td>1052015</td>
<td>0</td>
<td>2010</td>
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Preliminary CEC BESS Financials
Early Takeaways

- “Likely” scenario was 35,000 gallons fuel savings, trending toward 70,000
- “Likely” Battery life was 15 years – the CEC use case gets the highest value from grid balancing which requires little capacity – trending toward 30-year life
- Diesel non-fuel variable costs are significant: lube oil, rebuild hours, regular and emergency maintenance on a per-hour basis are very high from CEC historical records, whereas hydro maintenance and run time hours are an order of magnitude lower
- Data capture and analysis have been delayed by technical and logistical (COVID-19) challenges – a pending site visit will complete this task as travel restrictions ease, paving the way for Sandia to quantify economic and operational measures
- PNNL is working with Alaska Center for Energy and Power and CEC to continue to optimize economic value streams as emergency hospital generation, etc.
### Funding and Technical Partners

**DOE OE - ES**

<table>
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<th>Partner</th>
<th>Funding</th>
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<td>CEC</td>
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<td>SANDIA (Not Including Modeling)</td>
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<td>PNNL</td>
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<td><strong>Total Project Funding</strong></td>
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- **Project Champion:** Imre Gyuk, DOE/OE/Energy Storage
- **Technical Partners:** Department of Energy, Sandia Labs, PNNL, CEC, Alaska Center for Energy and Power, NRECA, SAFT, ABB, Electric Power Systems and now CESA advocacy/technical transfer
Here is What We Learned About BESS...

• Calendar aging capacity loss of 1.5% per year, our chemistry is estimated at 0.5%
• Capacity loss is kWh; kW remains near constant, round trip DC efficiency drops slightly
• Deep cycling causes rapid loss of life, shallow cycling extends life and total kWh throughput by a factor of 100; from 5GWh to 500GWh (or more) in our case.
• Frequency controls (small charges/discharges) can occur while bulk charging/discharging
• Removal, recycling, replacing a full battery set can cost 60% of initial package cost.
• Delivery times are fairly short, < 12 mo. From award to receipt
• Factory warranties and required annual maintenance are expensive
• Control algorithms are complex!
• Integration into a microgrid is costly and complex
• Improvements can be expected through careful monitoring and iterative optimizations
• CEC is Smashing Previous Hydro Records – 95% Hydro in November, 84% in December
Questions?