EBC Energy Resources Webinar

Electrification – Is the Grid Ready?

Thank you to our Sponsors!
Welcome

Marc Bergeron
Chair, EBC Energy Resources Committee
Principal, Epsilon Associates, Inc.

Environmental Business Council of New England
Energy Environment Economy
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Program Chairs

Richard Brooks
Co-Founder and Lead Software Engineer
Reliable Energy Analytics LLC

Tom Rooney
Vice President, Advanced Energy Services
TRC

Kevin Sullivan
Vice President
Fuss & O’Neill, Inc.
Introduction

Tom Rooney

Vice President, Advanced Energy Services
TRC
Transformation to Resilient: The Massport Experience

Peter DeBruin

Climate Mitigation & Resiliency Program Manager
Massachusetts Port Authority (Massport)
TRANSFORMATION TO RESILIENT: THE MASSPORT EXPERIENCE

Peter DeBruin
Climate Mitigation & Resiliency Program Manager,
Capital Programs & Environmental Affairs
Logan Airport

2,400 Acres
4 Terminals
6 Runways
700 Underwater Acres

15 Miles of Taxiways

Aviation
- Logan Airport
- Hanscom Field
- Worcester Airport

Maritime
- Conley Terminal
- Flynn Cruiseport Boston
- Seafood Landlord
- Boston Autoport

Real Estate
- South Boston
- East Boston
- Charlestown

Capital Improvements
- Consultants
- Engineers
- Construction

On Airport Impacts
- FBO's
- Aircraft Maintenance

Visitor Impacts
- Hotel Stay
- Dining
- Entertainment

Economic Impact of Massport Facilities:
- $16.7 B
- $21.9 B

2012/13
2017/18

Direct Jobs Supported:
- +23%

2012/13
2017/18

87,000
107,000
Massport’s continuing efforts to address climate change include mitigation and adaptation strategies.

**Mitigation**
Addressing the **causes** of climate change:
- GHG emissions from fossil fuel use,
- energy usage, waste
- GHG emissions reduction measures
- Sustainable design & construction guidelines
- Sustainability management plan

**Adaptation**
Addressing the **impacts** of climate change:
- Hardening existing critical assets
- Resiliency standards for new projects
- Flood operation plans and tools
MASSPORT SUSTAINABILITY GOALS AND OBJECTIVES

Logan international airport’s sustainability management plan (2015) established key metrics for all sustainability goals

**ENERGY AND GREENHOUSE GAS (GHG) EMISSIONS**
Reduce energy intensity and greenhouse gas emissions while increasing a portion of energy generated from renewable sources

**WATER CONSERVATION**
Conserve regional water resources through reduced potable water consumption

**MATERIALS, WASTE MANAGEMENT, AND RECYCLING**
Reduce waste generation, increase the recycling rate, and utilize environmentally sound materials

**COMMUNITY, EMPLOYEE, AND PASSENGER WELL-BEING**
Promote economically prosperous, equitable, and healthy communities and passenger and employee well-being

**NOISE ABATEMENT**
Minimize noise impacts from Massport’s operations

**AIR QUALITY IMPROVEMENT**
Decrease emissions of air quality criteria pollutants from Massport sources

**GROUND ACCESS AND CONNECTIVITY**
Provide superior ground access through alternative and HOV travel modes

**WATER QUALITY/STORMWATER**
Protect water quality and minimize pollutant discharges

**NATURAL RESOURCES**
Protect and restore natural resources

**RESILIENCY**
- Improve resiliency for overall infrastructure and operations.
- Restore operations during and after disruptive events in a safe and economically viable time frame.
- Create robust feedback loops that allow new solutions as conditions change.
- Inform operations and policy, and implement design/build decisions, through the application of sound scientific research principles that consider threats, vulnerabilities, and cost-benefit calculations.
- Become a knowledge-sharing exemplar of a forward-thinking, resilient port authority.
- Work with key influencers and decision makers to strengthen the understanding of the human, national and economic security implications of extreme weather, changing climate, and man-made threats to Massport’s facilities and the region.
Massport is collaborating to address climate change impacts including rising sea levels, increased intensity and impact of severe weather

- Neighborhood Planning
  - Climate Ready East Boston
  - Climate Ready South Boston
  - Climate Ready Charlestown
  - Non-profits

- Climate Resilient Design Standards & Guidelines

- Greater Boston Research Advisory Group
  - Extreme drought, precipitation, flooding

- Regional Planning
  - Coastal flood risk assessment
  - Critical infrastructure preparedness
ENVISIONING A TRIP TO THE AIRPORT

There are many implications and opportunities for “electrification” when considering the activity of going on a flight.

Logan had achieved (pre-Covid) 30% of passengers using High Occupancy Vehicles.

- Drop off/Pick up
- Passenger cars/ Parking
- “Uber”
- Taxi/ Limo

- Logan Express
- Water Shuttle
- Subway
ON-AIRPORT CONSIDERATIONS FOR ELECTRIFICATION

The airport includes complex interconnected and independent systems, processes and operators to provide the necessary equipment, infrastructure and services to facilitate a flight.

- **PARKING**
  - On-Airport Shuttle
  - Consolidated Rental Car Shuttle
  - Hybrid-Diesel Buses
  - Priority to HOV at the Curb
  - CNG Buses

- **SUPPORT FACILITIES**
  - Support Facilities
  - Control Heating/Cooling Plant
  - Gas Boiler Instead of Oil Co-generation of Electricity

- **TRANSPORTATION**
  - Retrofit Light to LED
  - Automated Payment System
  - Guaranteed Space Program
  - Electric Charging Station

- **AIRPORT**
  - State-of-the art Design
  - Natural Light
  - LED Lighting & Management System
  - Monitored Climate Control System and Temperature Setting
  - Recycling Programs
  - Renewable Energy - Solar Panel
  - Solar Heating Elements
  - Efficient Passenger Processing
  - Water Saving Devices

- **CONSTRUCTION**
  - Recycling
  - Locally-Made Materials
  - Renewable Resources
  - Ultra Low Sulfur Diesel Fuel
  - Air Filtration Device on Construction
Conducting the flight is another level of opportunity, and potentially the most challenging yet also the most impactful.
U.S. Airports Environmental Impact Categories

There are many different aspects of operations that could benefit from electrification
Authority-wide greenhouse gas emission scopes indicate the depth and complexity of challenges in addressing all electrification opportunities.

**Scopes 1 & 2: Massport Controlled**
- Airport, Cruise, & Container Terminals
- Logan Airport Central Heating Plant
- Fire Training Facilities
- Massport Fleet Vehicles & Equipment
- Parking Garages
- Support Buildings
- Cargo Handling Equipment
- Emergency Generators
- Snow Melters
- Purchased Electricity

**Scope 3: Massport Influenced**
- Aircraft
- Tenant Fleet Vehicles & Ground Service Equipment
- Passenger & Employee Transportation
- Cargo Vessels
- Harbor Craft
- Cruise Liners
- Hangars
Greenhouse Gas Emission Scopes Across All Massport

Massport controlled emissions account for 16.4% of total emissions across all scopes in 2019

Notes: Scope 1 emissions are from sources that are owned or controlled by Massport (i.e., ground support vehicles, Massport shuttles, on-airport traffic, and stationary sources), Scope 2 emissions are from electrical consumption (both Massport and tenant), which are generated off-Airport at power generating plants, and Scope 3 emissions are from aircraft, ground service equipment (GSE) including auxiliary power units, and ground transportation to and from the Airport.
Logan Airport – Airside Electric Ground Support Equipment & Charging

Ground support equipment is a larger category of emissions reduction opportunity

• Installation of charging stations to support the continued conversion of gasoline and diesel powered GSE with all-electric equipment

• Partnering with GSE owners to secure grant funding for equipment replacement.

• Logan Airport tenants currently operate ~ 200 eGSE

• Existing Charging Ports
  • 9 (Level 2)
  • 279 (Level 3)
AUTHORITY-WIDE – LANDSIDE CHARGING

Existing EV charging infrastructure includes all parking areas and Ride-for-Hire, taxi and staging locations

- Existing Charging Ports
  - 123 Charging Ports

(Level 2 stations are the primary inventory with Level 3 only available in RideApp, Taxi and Logan Gas Station locations)
Previous renewable energy efforts at Massport on-site were almost exclusively solar PV arrays

<table>
<thead>
<tr>
<th>Location</th>
<th>Size</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LOGAN AIRPORT</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Terminal A</td>
<td>1,248 panels</td>
<td>300 kW</td>
</tr>
<tr>
<td>Terminal A Satellite</td>
<td>418 panels</td>
<td>93 kW</td>
</tr>
<tr>
<td>Terminal B Garage</td>
<td>1,024 panels on 32 ‘trees’</td>
<td>200 kW</td>
</tr>
<tr>
<td>Terminal C Canopy</td>
<td>10,000 SF panel array</td>
<td>174 kW</td>
</tr>
<tr>
<td>Green Bus Depot</td>
<td>208 panels</td>
<td>50 kW</td>
</tr>
<tr>
<td>Rental Car Center</td>
<td>616 panels on 22 ‘trees’</td>
<td>121 kW</td>
</tr>
<tr>
<td>Economy Garage</td>
<td>396 panels on 18 ‘trees’</td>
<td>81 kW</td>
</tr>
<tr>
<td><strong>HANSCOM FIELD</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Civil Air Terminal</td>
<td>222 panels</td>
<td>51 kW</td>
</tr>
</tbody>
</table>
EVOLVING ELECTRIC AIRCRAFT MARKET

The advancement of regional electric aircraft, and electric vertical takeoff and landing aircraft design, may dramatically alter aviation and the discussion on electrification.
THANK YOU

Peter DeBruin
Climate Mitigation & Resiliency Program Manager
Capital Programs & Environmental Affairs
Massachusetts Port Authority
PDeBruin@massport.com
RIPTA Battery Electric Buses – Lessons Learned and Opportunities for Growth

Greg Nordin

Chief of Strategic Advancement
Rhode Island Public Transit Authority
Today’s Presentation

I. ZEV Pilot Program Basics
II. What We’re Learning
III. Impacts
IV. Next Steps
Roots of the ZEV Pilot Program

- 2010: Hybrid Buses and Trolleys Procured
- 2015: Lead by Example E.O.
- 2017: VW Settlement
- 2018: RIPTA/DEM Sign MOU
- 2019: BEB Pilot Buses Enter Revenue Service - Late September

- 2014: Resilient Rhode Island Act Enacted
- 2016: Rhode Island Greenhouse Gas Reduction Plan Adopted
- 2018: RIPTA submits and awarded LoNo I
- 2018: BEB Pilot Buses Leased
- 2019: Vehicle Compliance
Phase I. Demonstration
  • Testing Vehicle Performance, Energy Usage, and Infrastructure Requirements

Phase II. Broader Adoption
  • Introduce Fully Battery-Electric Service on the R-Line

Phase III. Sustainable and Resilient Deployment
  • Begin Electrification of Newport-based Services
  • Completion of Fleet and Facilities Action Plan to guide Full Deployment System-wide
• RIPTA leased three 40’ Proterra Catalyst E2 buses in Fall 2018.

• Entered service in September 2019 following extensive vehicle compliance and operational review.

• All 3 are charged overnight by depot chargers installed at 265 Melrose Street.

• Equipped with 440 kWh batteries.

• Vehicle performance testing has evolved over time.
• To ensure increased deployment success, R-Line blocks were restructured to match average electric bus range of +/- 70 miles.

• Despite redirection in pilot, electric bus performance trends match peer experience through remainder of 2020 and into 2021.

• During summer and fall, staff undertake energy and vehicle modeling on the R-Line blocks operated by the electric buses and validate the criticality of on-route charging for successful deployment.

• Pilot buses showed month-over-month improvement in performance during spring/summer, but some issues persist.
ZEV Phase II: Expansion

• 14 40-foot New Flyer Xcelesor XE40 buses.

• Scheduled for delivery in Fall 2022. Alignment with infrastructure is paramount.

• Will operate exclusively on the R-Line. Every 1 in 5 RIPTA passenger trips zero-emissions.

• On-route charging will occur at Broad/Montgomery.
  • Construction bid has been awarded, anticipated to begin this Spring.
ZEV Phase III: Aquidneck

- Funded by FTA, RIPTA, and the State of Rhode Island.
- Procurement of up to 40 battery-electric buses.
- Facility improvements and charging equipment at Newport Gateway Center, RIPTA Middletown Garage, and planned URI Regional Mobility Hub.
- Funding for technical assistance associated with long term operational resiliency.
- $1.5M Battery Storage Demonstration funded by OER.
- Sen. Reed has secured $4M for the project through a THUD earmark.
What We’re Learning
Vehicle and Energy Costs
Infrastructure/Energy Requirements
Range
Weather/Temperature
Resiliency and Redundancy
Operations
Technology
Vehicle Price and Scalability

Standard diesel bus

40% increase in cost

Avg. 2:1 scalability

Battery electric bus
Federal Funding

Low/No Emissions Vehicle Program (FFY 16-21)

<table>
<thead>
<tr>
<th>Year</th>
<th>Available ($m)</th>
<th>Requested ($m)</th>
<th>Awarded ($m)</th>
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<tr>
<td>FFY 16</td>
<td>$500.00</td>
<td>$3.5 million</td>
<td>$1.5 million</td>
</tr>
<tr>
<td>FFY 17</td>
<td>$600.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FFY 18</td>
<td>$700.00</td>
<td>$5.07 million</td>
<td>$5.07 million</td>
</tr>
<tr>
<td>FFY 19</td>
<td>$800.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FFY 20</td>
<td>$900.00</td>
<td>$13.44 million</td>
<td>$5.15 million</td>
</tr>
<tr>
<td>FFY 21</td>
<td>$1000.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
• RIPTA is a commercial utility ratepayer. We do **not** have a special rate.

• Electricity usage estimated to increase by a third above current levels upon operation of Phase II.

• RIPTA and National Grid are working on securing a short-term discount on demand charges to the extent possible under the existing rate case.

• More electric buses = increase in electricity usage = increased electricity costs = increased OpEx
14 battery electric buses = 1.2 MW = +/- 1000 houses
Multiple Charging Options / Rapidly Evolving Technology:

- Depot (slow) charging
- Pantograph (fast) charging
- Wireless/induction (fast) charging
• Bus manufacturers claim their vehicles can run between 200-300 miles/day (under ideal conditions).
  • Major divergence between ideal and real-life operation.

• 50% of RIPTA’s service is above 140 miles/day.

• Due to unique service profile, we have higher than average service blocks than compared to our peers.

• If we were to transition the fleet using existing service design, there would be an increase in OpEx and CapEx

• Charging strategy is key to offsetting range limitations on some routes.
Weather/Temperature Impacts

• Research by the Zero Emission Bus Resource Alliance (ZEBRA) finds that below 40 or above 90°F, state of charge and effective range decline by 30%. RIPTA’s own experience validates this finding.

• Use of heating and cooling during respective seasons increase energy consumption on HVAC and reduce available energy for propulsion.

• On very cold winter mornings, buses of any propulsion type need to be pre-heated to ensure key systems are safe and operable. Immediately running a BEB with a cold battery results in short duration of service.

• RIPTA has seen higher than average kWh/mi energy consumption on very cold and very hot days. This translates to higher electricity costs.
Resiliency and Redundancy

• Fleet transition requires contingency planning for continuity of service.
  • Imperative that infrastructure projects by RIDOT and municipalities align with fleet transition in the future.
• Ever-worsening conditions caused by climate change suggest that research into resilient infrastructure and redundancy measures is advisable.
• Potential areas to explore include:
  • Renewable energy solutions
  • Battery storage technology
  • Micro grid technology
• RIPTA’s Newport Electrification Project incorporates a battery storage demonstration in partnership with the Office of Energy Resources.
Impacts on Transportation Operations

• Driver Training:
  • Use of on-route charging equipment
  • Regenerative breaking and acceleration
  • Cognizance of battery state-of-charge
• Maintenance Training and Processes
• Vehicle Storage and Staging
• Impacts of Range on Scheduling and Vehicle Requirements
• Different Approach to Procurement
Next Steps
• Integrate fleet electrification & Transit Master Plan implementation
• Continue to strengthen partnerships with DEM, OER, National Grid, City of Providence, and others
• Leverage federal infrastructure investment
Next Steps: Action Plan

ZEV Implementation

TMP Implementation

Fleet & Facilities Action Plan
Next Steps: TMP/ZEV Fleet Action Plan

- Improve existing services
- Expand service to new areas
- Develop High Capacity Transit
- Improve access to transit
- Make service easier to use

Adopted December 2020
Next Steps: Leverage Federal Funding
• This is a Brave New World.

• ZEV technology is evolving... we need to move forward strategically.

• A 100% zero-emissions RIPTA fleet requires a long term sustained investment.

• Improving transit service will produce faster and greater reductions in GHGs overall, while also bringing greater health and equity benefits.
Thank You!

ZEV Program Contacts:

Zachary Agush  
Capital Planner  
zagush@ripta.com

Sarah Ingle  
Director of Long Range Planning  
ingle@ripta.com

Greg Nordin  
Chief of Strategic Advancement  
gnordin@ripta.com
Municipal Light Plants – How Public Power is Approaching Decarbonization Targets

Noel Chambers

Director of Energy Efficiency and Electrification

Energy New England
Municipal Light Plants - How Public Power is Approaching Decarbonization Targets

Noel Chambers
Jan 25th, 2022
Who is ENE

We are a municipal light plant cooperative established under Chapter 164, Section 47C of the Massachusetts General Laws.

• Our ownership is made up of light departments in Braintree, Concord, Hingham, Reading, Taunton and Wellesley, Massachusetts.

Power Supply

• >1100 MW of power supply
• >550 MW of generation
• Manage in excess of 1 Billion kWh in wholesale power transactions and 100-150 million kWh in retail transactions annually
• Manage up to 250,000 therms of natural gas and 5,000 barrels of oil daily

Conservation

• Residential, Commercial, and Electric Vehicle education and support

Clients we Serve
MA Legislative Actions

• Massachusetts Senate Bill S.9 from the 192\textsuperscript{nd} General Court (signed March 2021)
  – “An Act Creating a Next-Generation Roadmap for Massachusetts for Climate Policy”
  – Establishes first-time GHG emissions standard for MLPs to purchase non-emitting electricity at the following levels
    • 50% by 2030
    • 75% by 2040
    • 100% by 2050
How is ENE getting our clients there

- Nationwide first, agreement for Public Power inclusion in awarded Vineyard Wind bid

- Operate and dispatch batteries and other spinning resources as necessary

- Constant engagement with solar developers to acquire large tranches of generation capacity for PPA agreements
Navigating the energy economy.

- Demand Response
- Energy Efficiency
- Electrification
- Renewables
Navigating the energy economy.

Electrification

- Heat Pumps
- Hot Water Heat Pumps
- Electric Lawn Equipment
- Fleet Electrification
- Personal Vehicle Electrification
Navigating the energy economy.

Energy Efficiency

- Residential and Commercial energy audits
- Load reduction though all cost-effective strategies
- Targeted marketing
- Leveraging IOU programs
- Financing / Loans
Demand Response

- Off Peak EV charging programs

- Battery (Electric or Thermal) dispatch

- Thermostats

- Generators
DOER and MLPs had partnered to offer $1.20 / Watt rebates to MLP customers.

Some MLP continued program self funding at either $0.60 or $1.20 / Watt.
Thank You EBC

Questions or inquiries please contact:

Noel Chambers
Director, Energy Efficiency and Electrification
nchambers@ene.org
(508) 698-1233

linkedin.com/in/noelmchambers
ISO New England’s Long-Range Heating and Transportation Electrification Forecasts

Victoria Rojo
Senior Data Scientist
ISO New England

Environmental Business Council of New England
Energy Environment Economy
ISO New England’s Long-Range Heating and Transportation Electrification Forecasts

Victoria Rojo
SENIOR DATA SCIENTIST
ISO NEW ENGLAND
ISO New England’s *Mission and Vision*

**Mission:** *What we do*

Through collaboration and innovation, ISO New England plans the transmission system, administers the region’s wholesale markets, and operates the power system to ensure reliable and competitively priced wholesale electricity.

**Vision:** *Where we’re going*

To harness the power of competition and advanced technologies to reliably plan and operate the grid as the region transitions to clean energy.

*The ISO’s new Vision for the future represents our long-term intent and guides the formulation of our Strategic Goals.*
ISO New England (ISO) Has More Than Two Decades of Experience Overseeing the Region’s Restructured Electric Power System

- **Regulated** by the Federal Energy Regulatory Commission
- **Reliability Coordinator** for New England under the North American Electric Reliability Corporation
- **Independent** of companies in the marketplace and **neutral** on technology
ISO New England Performs Three Critical Roles to Ensure Reliable Electricity at Competitive Prices

**Grid Operation**
Coordinate and direct the flow of electricity over the region’s high-voltage transmission system

**Market Administration**
Design, run, and oversee the markets where wholesale electricity is bought and sold

**Power System Planning**
Study, analyze, and plan to make sure New England's electricity needs will be met over the next 10 years
The ISO’s Long-Range Forecast is Integral for Reliability

• The annual forecast looks 10-years into the future to:
  – **Determine** the region’s resource adequacy requirements to meet expected demand
  – **Evaluate** the reliability and economic performance of the electric power system under various conditions

• The forecast focuses on annual **summer** and **winter peaks** and overall **annual energy consumption** in each of the six New England states

• The ISO began including **forecasted impacts** of heating and transportation electrification on state and regional electric energy and demand in the 2020 annual report of Capacity, Energy, Loads, and Transmission (CELT)

• The ISO’s system planning processes are conducted through public meetings of the **Planning Advisory Committee**
  – Detailed discussions on the development of the long-term load forecast take place through meetings of the **Load Forecast Committee**
State Policies are Driving Electrification in New England

• Electrification of the heating and transportation sectors is expected to play a **pivotal role** in meeting state GHG-reduction mandates and goals
  – State-funded energy efficiency (EE) and other utility programs are increasingly promoting electrification to support **holistic goals** focused on **total energy savings across all sectors**

• The ISO’s electrification forecasts have advanced significantly in the past few years
  – We expect to **continue to refine our methodologies** as policy drivers and state initiatives are further developed and **additional data** become available
States Are Targeting Increases in Renewable and Clean Energy and Deep Reductions in CO₂ Emissions

<table>
<thead>
<tr>
<th>Goal</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>≥80% by 2050</td>
<td>Five states mandate greenhouse gas reductions economy wide: MA, CT, ME, RI, and VT (mostly below 1990 levels)</td>
</tr>
<tr>
<td>Net-Zero by 2050</td>
<td>MA statewide GHG emissions limit</td>
</tr>
<tr>
<td>80% by 2050</td>
<td>MA clean energy standard</td>
</tr>
<tr>
<td>90% by 2050</td>
<td>VT renewable energy requirement</td>
</tr>
<tr>
<td>100% by 2050</td>
<td>ME renewable energy requirement</td>
</tr>
<tr>
<td>Carbon-Neutral by 2045</td>
<td>ME emissions goal</td>
</tr>
<tr>
<td>100% by 2040</td>
<td>CT zero-carbon electricity goal</td>
</tr>
<tr>
<td>100% by 2030</td>
<td>RI renewable energy goal</td>
</tr>
</tbody>
</table>
Draft 2022 Transportation Electrification Forecast

• There are about **11.7 million** personal light-duty vehicles, and **800,000 fleet*** vehicles in New England

• The forecast focuses on the **summer** and **winter impacts** of several categories
  – Light-duty personal vehicles
  – Light-duty fleet vehicles
  – Medium-duty delivery trucks
  – School and transit buses

• Electric vehicle adoption forecasts are developed **in collaboration with states**
  – Reflect laws, policies, goals, reports, presentations, and announcements

• Daily charging patterns stem from analysis of real-world charging data for each vehicle type

---

<table>
<thead>
<tr>
<th>Year</th>
<th>Light-Duty Personal</th>
<th>Light-Duty Fleet</th>
<th>Medium-Duty Delivery</th>
<th>School Buses</th>
<th>Transit Buses</th>
</tr>
</thead>
<tbody>
<tr>
<td>2022</td>
<td>35,435</td>
<td>713</td>
<td>48</td>
<td>51</td>
<td>10</td>
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<tr>
<td>2023</td>
<td>49,837</td>
<td>1,071</td>
<td>69</td>
<td>84</td>
<td>15</td>
</tr>
<tr>
<td>2024</td>
<td>84,442</td>
<td>1,897</td>
<td>94</td>
<td>130</td>
<td>22</td>
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<tr>
<td>2025</td>
<td>113,754</td>
<td>2,549</td>
<td>133</td>
<td>186</td>
<td>27</td>
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<tr>
<td>2026</td>
<td>140,954</td>
<td>3,784</td>
<td>174</td>
<td>259</td>
<td>35</td>
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<tr>
<td>2027</td>
<td>167,868</td>
<td>5,162</td>
<td>231</td>
<td>374</td>
<td>48</td>
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<tr>
<td>2028</td>
<td>193,140</td>
<td>6,411</td>
<td>301</td>
<td>515</td>
<td>67</td>
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<tr>
<td>2029</td>
<td>220,953</td>
<td>7,885</td>
<td>368</td>
<td>674</td>
<td>82</td>
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<tr>
<td>2030</td>
<td>248,280</td>
<td>9,520</td>
<td>439</td>
<td>864</td>
<td>101</td>
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<tr>
<td>2031</td>
<td>267,134</td>
<td>11,214</td>
<td>499</td>
<td>1,012</td>
<td>115</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,521,796</strong></td>
<td><strong>50,206</strong></td>
<td><strong>2,355</strong></td>
<td><strong>4,150</strong></td>
<td><strong>521</strong></td>
</tr>
</tbody>
</table>

* Total refers only to the fleet vehicle types currently included in the ISO’s forecast: light-duty fleet, medium-duty delivery, school buses, and transit buses.
Draft 2022 Heating Electrification Forecast

- There are approximately **6 million** households in New England
  - Approximately 75% of the region’s residential heating uses fossil fuels as a primary input
- Forecast focuses on the winter (October-April) impacts of residential air-source heat pumps (ASHPs)
  - Future forecasts will likely include additional heating electrification technologies
- ASHP adoption forecasts are developed in collaboration with the states
- Weather-dependent electric consumption patterns are developed for both full and partial heating applications

### ASHP Adoption Forecast (Annual Growth)

<table>
<thead>
<tr>
<th>Year</th>
<th>Households with New Installs</th>
<th>% Partial</th>
<th>% Full</th>
</tr>
</thead>
<tbody>
<tr>
<td>2022</td>
<td>57,557</td>
<td>80%</td>
<td>20%</td>
</tr>
<tr>
<td>2023</td>
<td>63,100</td>
<td>78%</td>
<td>22%</td>
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<td>2024</td>
<td>80,557</td>
<td>75%</td>
<td>25%</td>
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<td>2025</td>
<td>98,202</td>
<td>73%</td>
<td>27%</td>
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<tr>
<td>2026</td>
<td>114,586</td>
<td>69%</td>
<td>31%</td>
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<tr>
<td>2027</td>
<td>129,562</td>
<td>65%</td>
<td>35%</td>
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<tr>
<td>2028</td>
<td>145,322</td>
<td>62%</td>
<td>38%</td>
</tr>
<tr>
<td>2029</td>
<td>158,529</td>
<td>58%</td>
<td>42%</td>
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<tr>
<td>2030</td>
<td>168,337</td>
<td>55%</td>
<td>45%</td>
</tr>
<tr>
<td>2031</td>
<td>177,778</td>
<td>51%</td>
<td>49%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,193,530</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Draft 2022 Electrification Forecasts

- Electric consumption of ASHPs increases as the weather gets colder
  - Coefficient of performance drops off as weather becomes colder

- Electric consumption of electric vehicles increases as you move away from the optimal operating temperature of ~70°F
  - Battery thermal management systems
  - Cabin space conditioning
  - Increase in consumption is more prominent in cold weather than in warm weather

- In New England by 2031, the ISO forecasts that there will be:

  ~ 1.2 million house-holds with air-source heat pumps
  ~ 1.6 million electric vehicles
ISO New England is a Summer-Peaking System

New England shifted from a winter-peaking system to a summer-peaking system in the early 1990s, largely because of the growth of air conditioning and a decline in electric heating.

- Peak demand on a normal summer day has typically ranged from 17,500 MW to 22,000 MW.
- Summer demand usually peaks on the hottest and most humid days and averaged roughly 25,600 MW since 2000.
- Region’s all-time summer peak demand was 28,130 MW on August 2, 2006.

The region could shift back to a winter-peaking system with the electrification of heating and transportation demand.

- Region’s all-time winter peak demand was 22,818 MW on January 15, 2004.
Questions

Victoria Rojo
Senior Data Scientist
ISO New England
vrojo@iso-ne.com
Port Electrification Ecosystem: Impact of Electrifying Freight Supply Chains

Rick Fioravanti

Director, Transportation Electrification
Quanta Technology
Port Electrification Ecosystem: Impact of Electrifying Freight Supply Chains

EBC Energy Resources Webinar
Electrification – Is the Grid Ready?
Integrating Electrification of Freight/Cargo Supply Chains at Ports

The Challenge:

- Heavy-duty vehicle charging (150kW+) is growing and adding to Utility Load
  - Most states focus on light-duty vehicle impacts and may be tracking this area closely enough
- Evidence in parts of the country that infrastructure upgrades will be needed
  - California’s AB 2127 Study in May 2021 highlights issue
- It is key for Public Utility Service Commissions to recognize the potential upgrades needs and understand the load impacts - non-wire alternative approaches may not be able to singularly mitigate issues created by electrification

A Solution:

- Quantification on the impact is the first step – utilities are just beginning to focus analysis on the actual sites
- Solutions are challenging – likely will need a combination of infrastructure upgrades and use of DER (non-wire alternatives)
- Tools are available that can help utilities present and quantify these impacts

Utilities are faced with challenges regarding impact of heavy-duty vehicle charging at airport and seaport eco-systems
Analysis of Freight Movement Has Typically Focused on Single Distribution Centers

- Most understanding of freight electrification focuses on single sites, such as a distribution center
- Flat roof space on these facilities sets the stage for use of DER (solar + storage in this case) to mitigate EV load issues
  - EVSE adds load (kW/kWh) to a facility, DER can mitigate those increases
  - DER may be able to provide dual purposes, mitigating the load at the facility itself but also mitigating the load on the feeders that are supporting the distribution center
- Tools, such as the Quanta Technology Value of DER, show the benefits and how utilities can incentivize the installations
Focus on Freight Movement at Cargo Ports – Electrification Hubs

- The Distribution Center Analysis focused on one building and the impact of electrifying that building
  - What happens when the building is part of a cluster of facilities?
  - What happens when the cluster of facilities is part of a value chain?
  - This is the potential when examining cargo ports and the movement of freight

- Market segment, due to State mandates and potential corporate initiatives, may be moving faster than consensus is anticipating
  - Shipping companies realize that the consistent, short-haul trucking and delivery to support the freight movement supply chain is perfect for electrification and see potential to save money
  - Freight movement is simultaneously being identified as a heavy pollution contributor; it is not just decarbonization driving the transition, but health / smog improvements as well
  - Major cargo/freight increases are occurring at all Cargo Airports
  - Smaller facilities and developers are bumping into inter-connection cost, delays, barrier to electrification at some facilities – again making the grid a potential barrier to the transition
Example: A Utility Use Case with Quanta Approach

- Initial quantification to assess this electrification as an “Eco-system” focused on airports and shipping ports
  - Rockville Airport, Chicago Area
  - Ontario Airport and San Bernadino Airport, California
  - Port of Long Beach, CA

- When focusing on Port of Long Beach, CA, analysis shows how far supporting infrastructure extends outside the actual port location
  - In this case, an area 8-10 miles away from the port was examined
    - Logistic centers are located outside of the port because there isn’t any room at the facility itself
  - Shipping Ports also have the added dimension of shore power / electrification along with trucking centers and distribution centers
But Examination of the key Areas Confirms Concerns

*Transportation Center*

*Retail Store Location*

*Casino*
Building up incremental approaches to assess feeder, substation, and transmission solutions!

### How NWA Solutions is Compared to Traditional Upgrade

<table>
<thead>
<tr>
<th><strong>Assumption:</strong></th>
<th>The maximum allowable capacity per node is: PV kW: 500 kW, BESS kW: 500 kW, BESS kWh: 4000 kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Optimal location:</strong></td>
<td>4 Locations are selected Locations further from the feeder head</td>
</tr>
<tr>
<td><strong>Optimal technology:</strong></td>
<td>PV + BESS</td>
</tr>
<tr>
<td><strong>Optimal size:</strong></td>
<td>2 X [500 kW/3100 kWh] BESS 1 X [500 kW/2500 kWh] BESS; 1 X [150 kW/350 kWh] BESS; 1 X 150 kW PV; 1 X 20 kW PV</td>
</tr>
<tr>
<td><strong>Budget:</strong></td>
<td>Total CapEx for DER solution: $4.3 M  Total expected annual OpEx: $101K</td>
</tr>
<tr>
<td><strong>Financial Parameters:</strong></td>
<td>Cost of Debt, ROR, ROE, Taxes, Debt/Equity Ratios</td>
</tr>
<tr>
<td><strong>Conventional Costs:</strong></td>
<td>Capital Cost (Utility or Quanta Technology Estimate, O&amp;M, Project Life</td>
</tr>
<tr>
<td><strong>Deferral Project:</strong></td>
<td>Capital cost, O&amp;M, Deferral period, NWA book life and tax life</td>
</tr>
</tbody>
</table>

### BCA:
- Cumulative benefit: $ -3.65M
- Net present value of benefit: $ -1.9M

Negative benefits: Deferral project is not cost effective
Additional Challenges When Examining Port Eco-Systems

- When shore power is included in the analysis, these eco-systems are revealing loads in the 60+ MW range. Some of the larger ports are showing potential loads in the 100+ MW range.
- These loads may not only overwhelm the ability of DER to mitigate the loads, but may also overwhelm feeder and substation upgrades – leading to transmission solutions.

Quanta is starting to examine specific ports to quantify the loads that are likely to be seen at ports across the U.S.

- Using Quanta tools to assess cost benefits of multiple approaches to transmission, substation, or feeder solutions to support electrification.
- Conducting Shore Power Assessments on key ports – Florida is the initial focus.
- Linking the initiative to potential opportunities in the Infrastructure Bill to electrify this freight supply chain.
Additional Challenges When Examining Port Eco-Systems

• Description of First Port: Blount Island Port – Jacksonville, FL
  • Blount Island provides a unique opportunity to examine the three issues listed
    • Shore Power
    • Truck Electrification
    • Distribution Centers
  • Additionally, Island services as HQ for Department of Defense activity with Marine Corps operations. Jacksonville is also home to both a Navy Base and Naval Air Base as well.

• Phase 1: Estimating Impact at Site 1 - Blount Island Terminal Facility, Jacksonville, FL
  • Estimating the impact of Shore Power:
  • Estimating Load from Electrifying Trucking Activity
  • Estimating the Load from Electrifying Blount Port Activity
  • Model the estimated electrification impact on electricity grid and identify potential BESS mitigation solutions

• Team is examining East Coast for 2nd Port to Assess
Thank you!

Richard Fioravanti
RFioravanti@Quanta-Technology.com
Quanta Technology, LLC
4020 Westchase Blvd., Suite 300
Raleigh, NC 27607

(919) 334-3000
quanta-technology.com
info@quanta-technology.com

Facebook.com/quanta-technology-LLC
@QuantaTech
Linkedin.com/company/quanta-technology
Moderated Discussion

Brenda Enos
Moderator
Director of Transportation Electrification, TRC