Pilot Heavy-Duty Electric Vehicle (EV) Demonstration for Municipal Solid Waste Collection

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Organization:	Municipality of Anchorage Solid Waste Services (SWS)
Presentation Date:	June 22, 2022
Project ID:	TI139

Overview

Timeline

- Start: October 1, 2020
- End: December 31, 2023
- 29% Complete

Budget

- Total project funding:
  - DOE share: $695,182
  - Cost share: $1,288,909
- Total project expended:
  - DOE share: $16,395.99
  - Cost share: $567,826.32

Barriers Addressed

- Cold climate performance of medium and heavy-duty electric vehicles
- Battery integration to shave peak demand charges
- EV workforce development

Partners

- Alaska Energy Authority
- Alaska Center for Energy and Power
- eCamion, Inc.

Project Objectives

Objectives

- Acquire and integrate two 520 electric garbage trucks and a 220 electric box truck
- Install battery-tied EV Servicing Equipment (EVSE); program for optimized charging times for both heavy duty EVs
- Collect and analyze data from integrated software
- Provide project data to local and statewide fleet managers
- Compare performance to manufacturer claims and document in quarterly reports
- Offer private demonstrations, test drive opportunities, and reporting of lessons learned, best practices, and case studies to fleets in Anchorage and beyond

VTO TI Goals

- Improve fuel diversity
- Increase local resiliency
- Reduce greenhouse gas emissions

Impact

- Demonstrate cold climate performance of medium and heavy duty electric vehicles
- Integrate battery for peak shaving
- Future proof new construction for EV integration

Any proposed future work is subject to change based on funding levels

Project Approach

Initiate pilot deployment

- Extensive research and discussions to identify the most appropriate technology and vendors, considering our remote location, cold climate, and operational needs
- Acquire and install equipment
- Begin equipment integration
- Prepare for data collection and analysis

Monitor pilot deployment

- Performance assessment of EVs and EVSE with a focus on cold climate operation
- Assess battery supported EVSE performance and applicability
- Offer project data and demos to local and statewide fleet managers
- Compare fuel use of EVs to diesel vehicles; calculate savings and carbon reduction

Continued equipment maintenance

- Continued fleet outreach
- Create performance assessment summary
- Calculate and share carbon and fuel use of EVs and EVSE

Go/No-Go decision points

Equipment received and tested

Duty cycle and minimum uptime requirements met

Final Report Developed and Distributed

Project Approach: Milestones

Budget Period 1

Milestone	Type	Description
All equipment received	Technical	The recipient takes delivery of both heavy-duty EVs and EVSE
EVSE installed	Technical	Battery-tied EVSE has been installed and tested. Final programming has been completed to optimize charging times for both heavy-duty EVs.
Equipment Operation Initiated	Technical	Charging of heavy-duty EVs with battery-tied EVSE successful. Waste collection and cart delivery begins using heavy-duty EVs
Data Collection and Analysis Implemented	Technical	Data collection from heavy-duty EVs and EVSE begins using installed equipment and integrated software. Analysis begins and quarterly reporting begins.
Equipment received and tested	Go/No Go	All equipment has been received and has been confirmed to perform to specification.

Budget Period 2

Milestone	Type	Description
Performance Assessment of EVs and EVSE Continued	Technical	Coordinate the collection and analysis of data and produce quarterly analysis reports
Fleet Outreach	Technical	Provide project data to local and statewide fleet managers.
Fleets provided with personal demos	Technical	No less than five fleet managers provided with personal demonstrations of the equipment
Analysis Reports Prepared	Technical	Compare performance to manufacturer claims and document in quarterly reports
Duty cycle and minimum uptime requirements met	Go/No Go	The EVSE and heavy-duty EVSE meet all duty cycle requirements and achieve a minimum 90% uptime rating

Budget Period 3

Milestone	Type	Description
Performance Assessment of EVs and EVSE Continued	Technical	Coordinate the collection and analysis of data and produce quarterly analysis reports
Fleet Outreach Continued	Technical	Provide project data to local and statewide fleet managers.
Fleets provided with personal demos	Technical	No less than five fleet managers will be provided with personal demonstrations of the equipment
Final Report Developed and Distributed	Technical	A final report will be compiled for the project with in-depth written analysis and summarizing lessons learned from this project.

Any proposed future work is subject to change based on funding levels

Project Accomplishments and Progress

The hood interior of the 220 electric vehicle box truck

Residents looking at the SWS Peterbilt 220e box truck at the Anchorage Electric Vehicle Car Show, August 2021. Photo: Tim Leach

Task 1: Initiate Pilot Deployment	**Completion:**
• Acquire and install equipment	Partial
• Begin equipment integration	Partial
• Prepare for data collection and analysis	Complete
Task 2: Monitor Pilot Deployment	
• Performance assessment of EVs and EVSE	Partial
• Quarterly assessment and reporting	Ongoing
• Offer project data and demos to local and statewide fleet managers	Partial
• Equipment Maintenance	Ongoing
• Compare fuel use of EVs to diesel vehicles; calculate savings and carbon reduction	Incomplete

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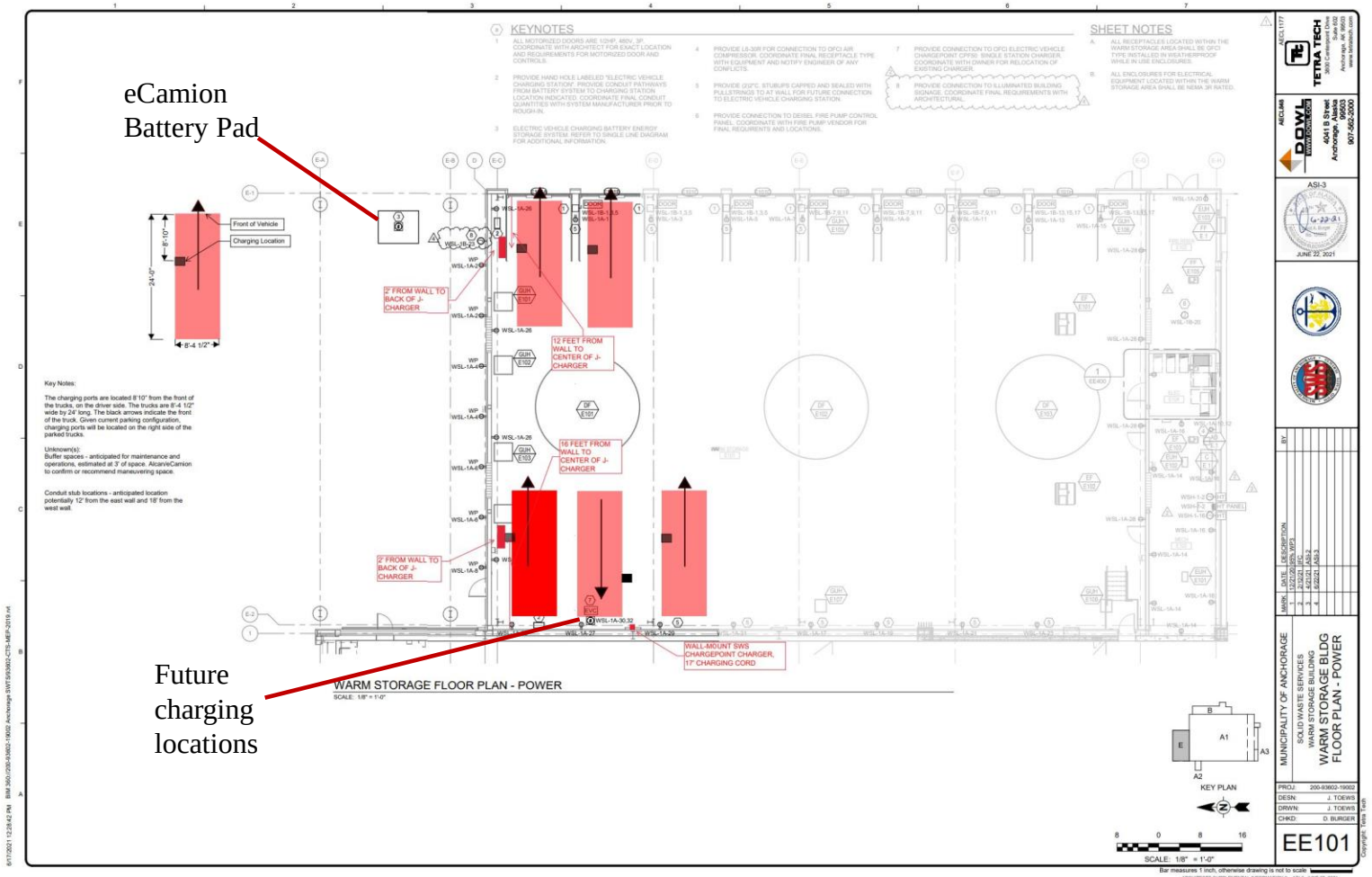
Project Accomplishments and Progress

<u>Additional Accomplishment</u> Future Proofing for EV trucks in new Transfer Station:

SWS laid conduit pathways to five bays from the eCamion battery and to seven bays from the electrical room**.**

Cost savings from not moving the eCamion battery from the existing transfer station to the new transfer station.

SWS New Central Transfer Station Warm Storage Floor Plan



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Collaboration and Coordination Among Project Team

Project Sponsor	Prime Recipient / Project Manager	Special Recognition
US DOE	Solid Waste Services	Peterbilt, Inc.

Deployment Partners

ACEP Alaska Center for Energy and Power

Analyze and share performance of the EVSE and trucks

ALASKA ENERGY AUTHORITY

$25,000 contribution toward battery and technical support

ecamion

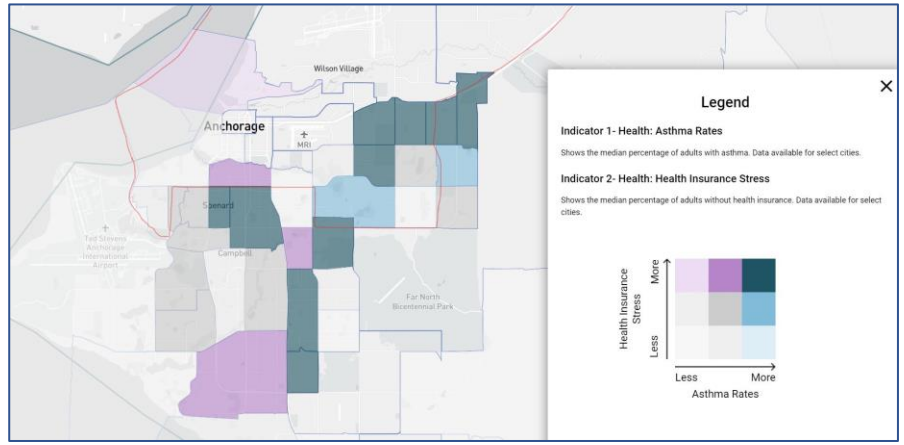
Technology and mechanical design support

Any proposed future work is subject to change based on funding levels

Contribution to Energy Equity and Environmental Justice

SWS's service territory includes areas with the highest asthma rates and health insurance stress, including much of Mountain View along the highway to the Landfill. Electric garbage trucks will reduce pollution along this corridor. A successful pilot could support the broader adoption of electric heavy-duty vehicles. The DOE grant allows SWS to complete this pilot project without a cost increase to the ratepayers.

This project will last for years beyond the period of performance. If the heavy-duty trucks and battery operate well, it is likely that more will be integrated into the SWS fleet.



Greenlink Equity Map showing health indices and SWS service territory

2022 Remainder:

- Acquire and integrate the eCamion battery and two 520 electric garbage trucks
- Monitor and maintain trucks and equipment, paying particular attention to winter operation

2023:

- Performance assessment of EVs and EVSE with a focus on cold climate operation
- Offer project data and demos to local and statewide fleet managers
- Compare fuel use of EVs to diesel vehicles; calculate savings and carbon reduction
- Develop and share performance assessment summary

Any proposed future work is subject to change based on funding levels

Summary

Barriers

- Cold climate performance of medium and heavy-duty electric vehicles.
- Lack of maintenance training.
- Battery integration to shave peak demand charges.
- The 520e has had multiple manufacturing delays due to supply chain issues and border and factory closures. SWS expects to integrate the vehicles well before the end of 2022.
- The 220e box truck has had inconsistent use due to programming issues and concerns over two-wheel drive in the winter, making data analyses challenging.

Relevance

- Heavy-duty electric trucks are gaining recognition globally but can be challenging in a cold climate. With a start-and-stop duty cycle, garbage trucks are particularly well suited to take advantage of the unique characteristics of an electric motor. As the northern-most major city in the US, Anchorage is an ideal location to demonstrate their applicability. One incident of a rapid reduction in battery occurred on a -10°F day. This has not occurred again.
- Spiking Fuel Costs: Diesel cost $2.85/gallon in 2020 and is currently $4.16 (discounted rate), creating an additional estimated $3,500 fuel savings per year.
- Estimated Maintenance Savings: All work is currently under warranty, so does not yet apply to savings.

Accomplishments

- Future proofing the new transfer station for electric vehicles.

Any proposed future work is subject to change based on funding levels

Technical Backup Slides

EV Garbage Truck Details

	520e Automated Side Loader	220e Box Truck
Manufacturer	Peterbilt, Inc., Meritor, Inc., LaBrie, Inc.	Peterbilt, Inc., Dana, Inc.
Gross Vehicle Weight Rating	67,500 pounds	26,000 pounds
Class	8	6
Battery Type	Liquid-cooled CATL LFP	Liquid-cooled CATL LFP
Battery Size	Up to 424 kWh	141 kWh
Approximate Range	90 miles	100 miles
Daily Maximum Range	50 miles	40 miles
DCFC charging capability	150kW	150kW

Battery-tied Direct Current Fast Charger (DCFC)

eCamion specializes in battery-tied fast charging deployments in cold-weather conditions. eCamion's unique architecture integrates Energy Storage System with a DCFC.

The eCamion unit will slowly charge during the day and will be able to fast charge the garbage trucks without spiking demand use and costs. This will enable and support the high levels of power required to charge the heavy-duty EVs, while minimizing the impact to the local grid. This system will reduce the demand charges that might otherwise be incurred if the pilot was to select a traditional DC charger without an energy storage system.

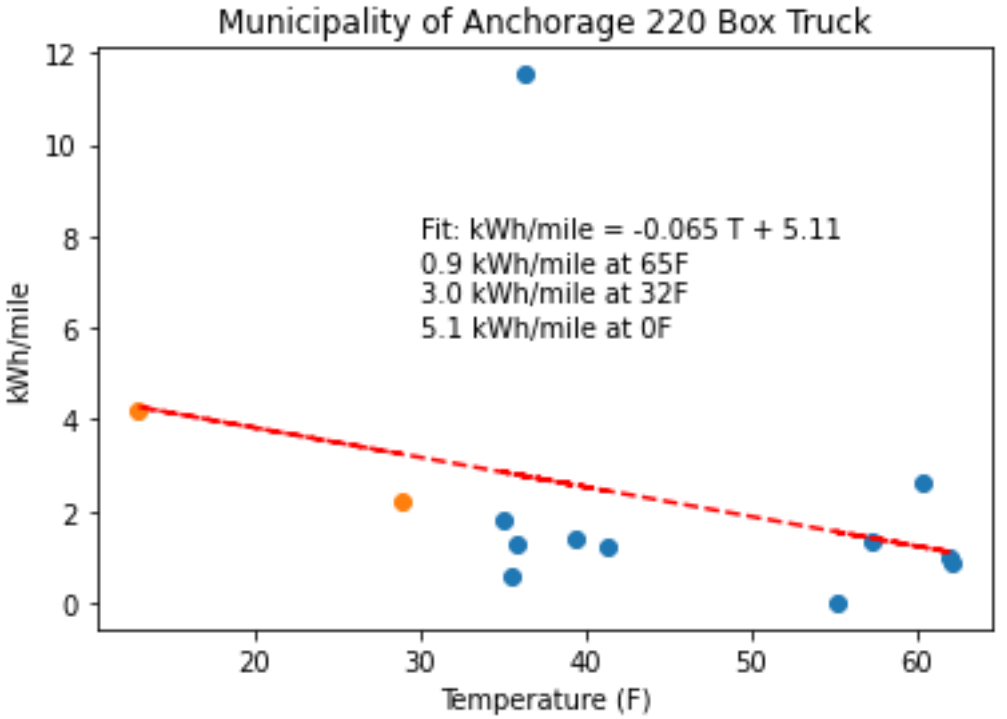
220e Box Truck Analysis

Using the best fit of the data, the box truck shows an energy use (kWh) per mile increasing with decreasing temperature, as expected.

Modeling using this data shows that this truck, if driven 5200 miles per year, would use approximately 13,700 kWh. At $0.11/kWh, this would cost **$1,507** to charge, and emissions from electricity generation would be approximately **6,850 kg CO2eq.**

(Assuming the charger uses ~7kW, this could also add $1848 in demand charges to the yearly cost of charging, if charging was coincident with existing peaks. This is unlikely to be true with overnight charging, and could be managed.)

An equivalent fuel truck with year-round average fuel efficiency of 7 mpg (this may be generous) and fuel prices of $4/gallon would cost **$2,970** to fuel, and would emit approx. **7,570 kg CO2eq**



Plot of the energy use per mile of the 220e vs ambient temperature, with a linear fit (Red). Temperature data for Merrill Field, Anchorage from www.NOAA.gov. Charging data used to find energy use downloaded from Chargepoint MOA account. Trip data used to find miles traveled from Dana (Blue), and from MOA hand readings (Orange). The blue point above 10kWh/mile is likely an anomaly due to the assumption that each recharge was to a fully charged state.