



# AAPA 2020 ENVIRONMENTAL IMPROVEMENT AWARDS APPLICATION

Port Authority of New York and New Jersey |  
Yard Tractor Electrification Study

June 30, 2020

Port Department | Environmental Initiatives Group

## **SUMMARY OF PROJECT**

The Yard Tractor Electrification Study was conducted by the National Renewable Energy Laboratory (NREL) in conjunction with the Port Authority of New York and New Jersey (PANYNJ) and three marine terminal operator tenants. The purpose of this study was to minimize the environmental impact of port operations through partnering with tenants to evaluate the feasibility of yard tractor electrification. Through the analysis of real-world data, tenants are confidently informed with an unbiased view of today's vehicle technology and are also able to make data-driven decisions based on their own fleet operations.

Over the course of three months, NREL collected information through the installation of onboard data logging devices onto 36 yard tractors at three terminals, recording 21,219 miles of operation and over 26 million seconds of data. NREL developed modelling scenarios to evaluate use patterns of yard tractors at each terminal and charging capability. The scenarios evaluated viability of electric yard tractors with minimal changes to existing operations as well as what operational and technological changes would be needed to achieve full electrification. The final report provides characterization of yard tractor usage at each terminal, evaluates the feasibility for fleet electrification, and identifies performance requirements for battery electric yard tractors to operate within the terminals with little to no operational impact. The study also evaluated terminal charging infrastructure requirements to achieve full electrification. In addition to identifying potential charging locations, the study calculated anticipated monthly energy consumption and developed demand peak charging estimates if all vehicles were charged simultaneously. It included recommendations for the costs and benefits of adoption of newly available technologies. To estimate expected emissions reduction, the study considers both reduced emissions from the equipment in addition to the emissions difference in use of fuel and electricity.

Overall, yard tractors were observed to be good candidates for electrifications because the tractors operate at slow speeds and consume minimal energy while stopped. However, the study also found that substantial and likely prohibitive needs in increases in battery size and charge rates would be required for

some tenants to electrify their fleet with limited operational changes. The report concluded that of the three participating tenants, one could fully electrify its fleet under existing battery electric technology with minimal impact to operations. As of early 2020, this tenant has applied and will receive funding to electrify its yard tractor fleet and is moving forward with the transition to electrification and significant port landside emissions reduction.

## **GOALS AND OBJECTIVES**

The objective of this project was to minimize the environmental impact of port operations through equipment electrification. Working toward this objective empowered participating tenants to make data-driven decisions when seeking to adopt new technologies. The study also provided an avenue for the Port Authority to better understand the maturity of available technology and its ability to meet operational needs. All of the information collected will inform future agency policy development.

## **DISCUSSION**

### **BACKGROUND**

The PANYNJ Environmental Initiatives Group manages multiple incentive programs to minimize the environmental impact of port-related activities, primarily through opportunities to reduce air emissions. The group also coordinates with tenants to apply for funding opportunities to encourage integration of equipment or vehicles that lead to emissions reduction at and around port facilities. As global pressure on ports and port-related activities continues to mount for increasing emission reductions, private operators are forced to balance risk between ongoing operations and integrating new technologies.

Conceptually, many port tenants are interested in pursuing electrification for equipment in their fleets that exist on the market. However, hesitation to be first adopters is a shared concern among tenants because of the level of uncertainty associated with new technologies and potential impact to operations. The tight timelines of the nature of port operations makes it imperative that all equipment work smoothly.

Therefore, operators prefer to see equipment tested widely before integrating it into their own operations.

Identifying necessary charging infrastructure and optimal locations for the supporting infrastructure serves as an additional barrier for fleet adoption.

Based on the observed qualitative information, the Environmental Initiatives Group chose to pursue a new strategy to catalyze future electrification. This resulted in the Yard Tractor Electrification Study; the PANYNJ fully funded the study, hired NREL as an objective third party and technical expert, and offered the study for up to three tenants to participate free of charge. The commitment from each tenant was to allow NREL to install data loggers onto a sample of yard tractors from their fleet, and to allow that data to be analyzed for fleet electrification.

A key component of the strategy was that an objective third party collect and analyze data to evaluate feasibility of electrification. The PANYNJ considers this approach a critical aspect of the strategy to support tenant-led initiatives for emissions reductions. By providing tenants with information that acknowledges where existing technology may be lacking and specifically what innovations to look out for, tenants can move forward with electrification with a higher degree of certainty of cost benefits and supporting infrastructure needs. The study concluded that one tenant was found able to electrify its yard tractor fleet based on existing technology with minimal to no impact to operations. Equipped with data of their own operations, this tenant is now pursuing fleet electrification for its yard tractors.

## **OBJECTIVES AND METHODOLOGY**

The over-arching aim of this study was to reduce the environmental impact of port operations through catalyzing yard tractor fleet electrification for port tenants. The methodology to achieve this objective was collecting operational data and analyzing operational needs with respect to available technology and expected future advancements. By empowering tenants to better understand the landscape of questions and variables involved with fleet electrification, they can confidently make decisions that meet their bottom line, align with their business case, and have no short or medium-term detrimental impact to their operations.

The methodology of the study included identifying a sample of yard tractors. NREL installed data loggers on each yard tractor and collected GPS data for roughly 30 days. NREL subsequently conducted an analysis that developed two modeling scenarios. The first scenario examined battery electric yard tractor viability with minimal changes to existing operations. Assumptions in the first scenario included assumptions that tractors charge when they are stopped for 50 minutes or longer and have a usable battery size of 220 kilowatt hours (kWh) and can charge at 70 kilowatts (kW). The second scenario evaluated what operational, charging infrastructure and changes in battery electric yard tractor technology would be necessary to achieve full electrification.

Subsets of these scenarios included evaluating daily average engine break energy and percent of energy used while idling, terminal-specific flywheel energy and fraction of energy spent at idle, detailed charging hotspot location analysis at each terminal, as well as a logarithmic distribution of stop duration.

Additional details regarding the insights and findings can be found in the attached report.

## **HOW THE PROJECT FULFILLS THE AWARD CRITERIA**

The Port Department is in close communication with community groups and other stakeholders seeking emissions reductions in and around port facilities. The Port Department conceived of the idea to fund a study to catalyze the movement toward electrification of equipment and vehicles where possible. The outcomes of this study will directly improve air quality in and around port facilities.

The idea to fund this study was developed completely independently by the port as a new strategy to continue increasing emissions reduction efforts. We sought out an objective third party to conduct the analysis and made the opportunity available to tenants free of charge. We believe that by partnering with tenants and making this opportunity available to them at no cost, we are continuing to cultivate a long-term relationship of trust. By offering this study, we acknowledge that private operators are under immense pressure to make major upfront capital investments in areas where uncertainty exists regarding operational impacts to their businesses. We hope that by financially supporting the study, our tenants see

that we are willing to meet them at the table to evaluate how we collectively carve a pathway toward lower emissions operations at port facilities.

This project was developed as an innovative idea outside of other ongoing incentive programs managed by the Port Authority. Due to funding constraints and limitations in the regulatory authority of the Port Authority, we devised a creative alternative avenue to move the conversation of fleet electrification forward.

The project results are apparent in two ways. First, the tenant whose fleet was found to be eligible for full electrification with minimal change to operations is currently pursuing funding to electrify its fleet. The study provided the degree of certainty required for the tenant to pursue this course. Secondly, based on positive feedback received from tenant participants, the PANYNJ has recently initiated a similar study with other tenants focusing on evaluating the feasibility of electrification of drayage truck fleets.

The cost effectiveness of the project is evident. With a financial investment from PANYNJ that is roughly one third the cost of an electric yard tractor, one tenant is now investing in replacing a fleet of diesel yard tractors with electric yard tractors. Two other tenants are now better equipped with similar decision-making capabilities as technology continues to evolve.

The transferability of insights of this report and to the port industry is evident in multiple ways. PANYNJ better understands the opportunities and limitations with available technologies for yard tractors, which will inform the development of future incentive programs and other agency policies. Additionally, NREL has wide-ranging relationships with equipment and vehicle manufacturers across the industry. They can use insights learned from this study and share them with manufacturers to improve future innovations in equipment and vehicle technologies.