



CARGO-HANDLING EQUIPMENT

PROJECT BACKGROUND

Cargo-Handling Equipment (CHE) is nonroad equipment for transporting cargo around terminals, including to and from marine vessels, railcars, and on-road vehicles. The CHE at the NorthWest Seaport Alliance (NWSA) harbors includes terminal tractors, top handlers, side handlers, reachstackers, rubber-tired gantry cranes (RTGs), straddle carriers, and forklifts. CHE, especially older equipment, can release high levels of air pollution. The NWSA harbors are located within and border neighborhoods identified as having the highest risk of environmental health disparities. While zero-emissions CHE remains largely in the demonstration stage, particularly for larger and heavier-duty equipment, there are significant public health opportunities from reducing diesel consumption in CHE.

PROJECT DESCRIPTION

Collaborations with NWSA's tenants, who own most of the CHE at the port, are a central strategy to increasing use of zero and near-zero CHE but require additional funding sources. The NWSA Demonstration Projects are planned to be split between Seattle and Tacoma, with equipment lifetime ranging from 12 years for a terminal tractor to 30 years for a new hybrid RTG. The equipment replacement targets early retirement of older equipment that has higher air pollution associated with diesel consumption than does newer equipment.

At the Seattle Harbor, the targeted equipment includes 10 battery electric terminal tractors and charging infrastructure, 2 RTG retrofits, and 4 new hybrid RTGs. The new capital costs are around \$11 million dollars. At the Tacoma Harbor, targeted CHE upgrades include Port of Tacoma and NWSA owned and operated straddle carriers, which have not been broadly demonstrated but present a unique and impactful opportunity for NWSA. In addition to 2 electric straddle carriers, the Tacoma project seeks to support 2 electric top handlers and 10 electric terminal tractors. The new capital costs are around \$15 million dollars.

CASE STUDY RESULTS

Timeframe

Tacoma **15 years**

Seattle **30 years**

Public Health Benefits

Tacoma

\$180 / tCO₂e emitted

Seattle

\$77 / tCO₂e emitted

Cumulative Avoided Emissions

Tacoma

10 thousand tCO₂e

Seattle

25 thousand tCO₂e

Cumulative Public Health and Climate Benefits, NPV

Tacoma **\$1.7 million**

Seattle **\$2.0 million**

Total Costs, NPV

Tacoma **\$6.7 million**

Seattle **-\$3.3 million**

Abatement Cost, NPV

Tacoma **\$920 / tCO₂e**

Seattle **-\$210 / tCO₂e**

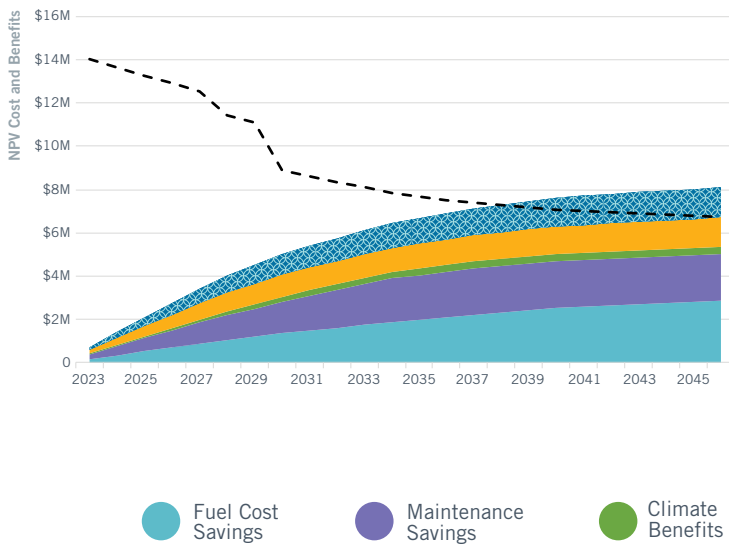
Potential CFS Credits, NPV

Tacoma **\$1.4 million**

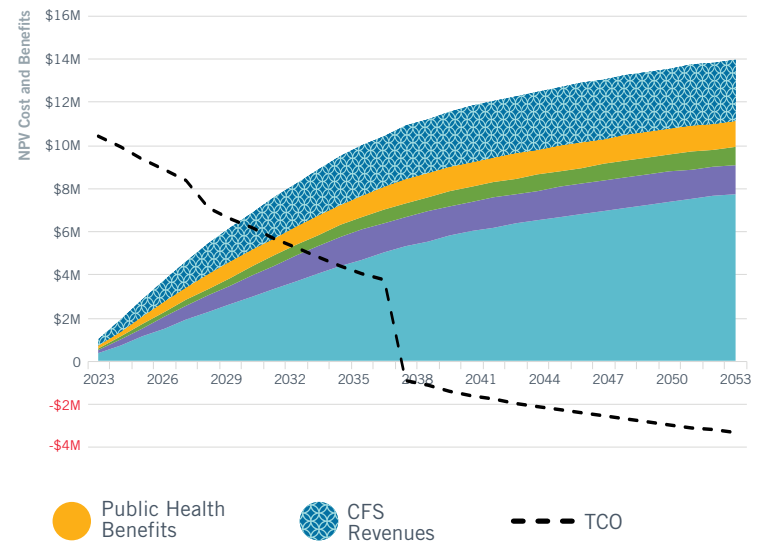
Seattle **\$2.8 million**

NET COSTS, SAVINGS, AND VALUE OF BENEFITS OVER THE PROJECT LIFETIME

Tacoma Equipment



Seattle Equipment



DISCUSSION

These potential demonstration projects in Tacoma and Seattle are evaluated as two separate projects. Isolating the equipment by type indicates that retrofit RTGs and new hybrid RTGs offer the largest and most cost-effective return on investment, followed by terminal tractors, then top handlers, with straddle carriers being the least cost-effective. However, the more expensive GHG mitigations from the non-RTG pieces of equipment also have some greater upside in terms of public health benefits. The economics of these projects will likely improve over time as the technologies mature and the upfront costs come down.

The greatest air quality opportunity is in the short-term, and depending on the relative prioritization of this outcome, a compelling case can be made for why these projects are worth prioritizing despite higher abatement cost for their GHG reduction potential. Early demonstration projects can help drive future costs down through providing a market signal to equipment-manufacturers that zero-emission technologies are desired, demonstrating the technologies through deployment, and providing critical lessons learned for future deployments. This could have multiplier effects that our case studies do not attempt to evaluate.

POTENTIAL SCALE AND IMPACT

Across NWSA's operations at the Tacoma and Seattle harbors, there are 347 terminal tractors, 79 straddle carriers, 103 top handlers, and 22 RTGs. The collective potential of transitioning them to zero and near-zero emissions equipment using our current model assumptions for each type of equipment indicates upfront capital costs of over \$600 million and abatement costs of \$800 per tCO₂e avoided. Net total costs are around \$500 million after 7 years, and \$300 million after 15 years. With a much larger inventory, the emissions reductions potential (510,000 tCO₂e), public health benefits (\$56 million), and potential CFS credits (\$65 million) are much greater than in the demonstration project alone. These total benefits will be limited by replacing newer, more efficient, and lower polluting equipment. At the same time, incremental costs are expected to decrease as technology matures, meaning the costs are likely to be lower.