Clean & Prosperous Washington

Low Carbon Prosperity Institute

FERRY SYSTEM ELECTRIFICATION

PROJECT BACKGROUND

Washington State Ferries (WSF) is the largest ferry system in the US and one of the highest-ridership ferry systems in the world, consuming over 18 million gallons of diesel per year and emitting the most carbon pollution within the state's transportation fleet. Diesel engines for ferry boats are pollution-intensive sources of toxic criteria in proximity diverse population centers, including many communities at highest risk for environmental health disparities, and therefore maintains a strong nexus with environmental justice.

PROJECT DESCRIPTION

This case study examines a full transition from diesel-powered to plug-in hybrid electric ferries along four central Puget Sound routes: Seattle-Bainbridge, Seattle-Bremerton, Edmonds-Kingston, and Clinton-Mukilteo. It includes retrofit conversions of the 3 largest vessels in the fleet and new construction of 8 ferries, totaling 11 plug-in capable ferries. The electrification plan also calls for 5 ferry terminal shore power infrastructure projects: Seattle, Bainbridge, Bremerton, Kingston, and Mukilteo. Combined, the four routes considered in this case study consume nearly 13 million gallons of diesel annually, equal to 29,000 new Ford F-150 Turbo-Diesel Trucks traveling 10,000 miles per year.

A new ferry has a 60 year anticipated lifetime. The air pollution-health damages associated with fuel use ranges from $161 for each metric ton of diesel greenhouse gas (GHG) emissions for new ferry builds to $341 for each metric ton of diesel GHG emissions for conversion of existing Jumbo Mark II class ferries to electric hybrid. The public health damages multiplier is lower for the new ferry builds due to displacing cleaner, Tier 4 engines, while the retrofit ferries displace fuel consumption in older, Tier 1 engines.

CASE STUDY RESULTS

Timeframe
75 years

Public Health Benefits
$280 / tCO_2e emitted

Cumulative Avoided Emissions
4.4 million tCO_2e

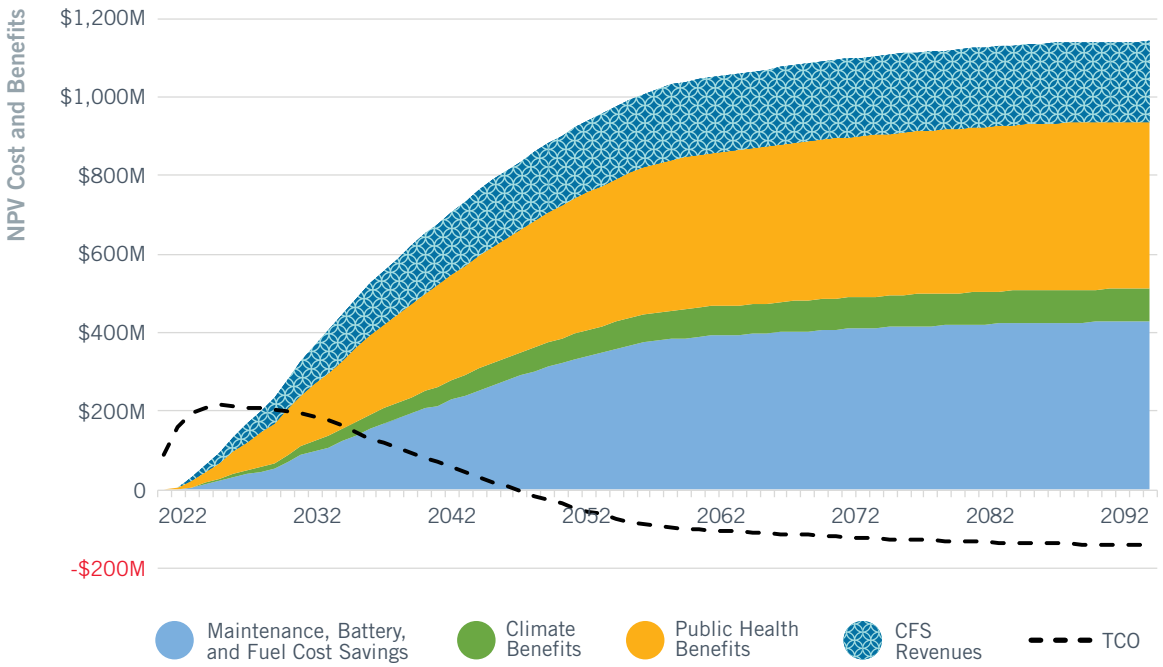
Cumulative Public Health and Climate Benefits, NPV
$510 million

Total Costs, NPV
-$140 million

Abatement Cost, NPV
-$90 / tCO_2e

Potential CFS Credits, NPV
$205 million

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



DISCUSSION

This analysis aligns with previous findings that Washington State Ferries create significantly more public health damages than most other transportation fuels, and indicates that the public health and climate benefits alone are very likely to significantly outweigh the upfront costs even before fuel cost savings are included.[1] Net benefits outweigh the system costs even under pessimistic cost assumptions. Shore power availability is essential, reducing fuel consumption by around 5 times more than vessel efficiency alone, and delays in providing shore power should be avoided.

This ferry system plan may be uniquely positioned for maximum return on investment because ferries operate fixed, multi-daily, and repeatable routes. Therefore, batteries are utilized to their full capacity and capability throughout the year. The fuel savings unlocked as a ratio of the overall battery capacity, therefore, are much greater than most, if not all, on-road applications.

POTENTIAL SCALE AND IMPACT

These four routes represent the majority of the fuel consumption across the WSF system. Additional benefits and cost-savings from the longer-term but planned electrification of the West Seattle-Vashon-Southworth and Anacortes-San Juan Island routes are also anticipated, but are not modeled in this case study.

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[1] *Building Back Better: Investing in a Resilient Recovery for Washington State* projected $334 in public health benefits for each tCO_2e avoided in fuel consumption by the existing ferry fleet, several times higher than the existing on-road diesel or gasoline impacts per gallon of fuel. In this research, we account for newer ferry engines as a point of comparison for new builds, such that the public health benefits are somewhat lower, at an average of $\$280/tCO_2e$.