GREATER VICTORIA HARBOUR AUTHORITY

SHIP EMISSION MITIGATION TECHNOLOGY ASSESSMENT AND BUSINESS CASE

THE NEED FOR CRUISE SHIP EMISSIONS MITIGATION

Victoria is an essential Canadian cruise port-of-call for vessels operating in the coastal waters of southeast Alaska and British Columbia. In 2019, 256 cruise ships carrying 709,000 passengers arrived at Greater Victoria Harbour Authority's (GVHA) Ogden Point Facilities. Following an anticipated normalization of cruise travel and leisure to the region post COVID-19, passenger levels are anticipated to approach one million guests by 2030.

Cruise operations contribute an estimated $130 million in economic impact to the region annually. However, there are adverse environmental and quality of life issues that come with welcoming cruise vessels to Victoria's shores. Greenhouse gas (GHG) emissions generated by cruise vessels while in port and moving to and from Victoria is one such impact.

Estimates of Carbon (CO_2), Sulfur Oxides (SO_X), and Nitrogen Oxides (NO_X) indicate emissions from Victoria bound cruise vessels have and will continue to rise as vessels and passenger levels increase. While cruise lines are making headway on technologies and practices to help reduce their emissions, meaningful reductions will take decades to implement industry wide.

It is possible to make gains over the short term. Vessels run their engines while in port to generate power. These "hotelling" activities contribute an estimated 71% of total cruise ship emissions associated with Victoria operations. Through investment in emissions mitigation systems such as shoreside power, cruise ships could plug into the local grid and shut off their engines. For Victoria and communities deriving power from renewable energy sources such as hydropower, connecting to the local power grid has the net benefit of reducing carbon emissions.

SOURCE OF CRUISE SHIP EMISSIONS IN VICTORIA (2018)

Hotelling **71%**

Manoeuvring/ Transiting **29%**

CRUISE SHIP CALLS IN VICTORIA FOR 2019 & 2030 *(Estimated)*

2019 Calls **256**

2030 Calls **317**

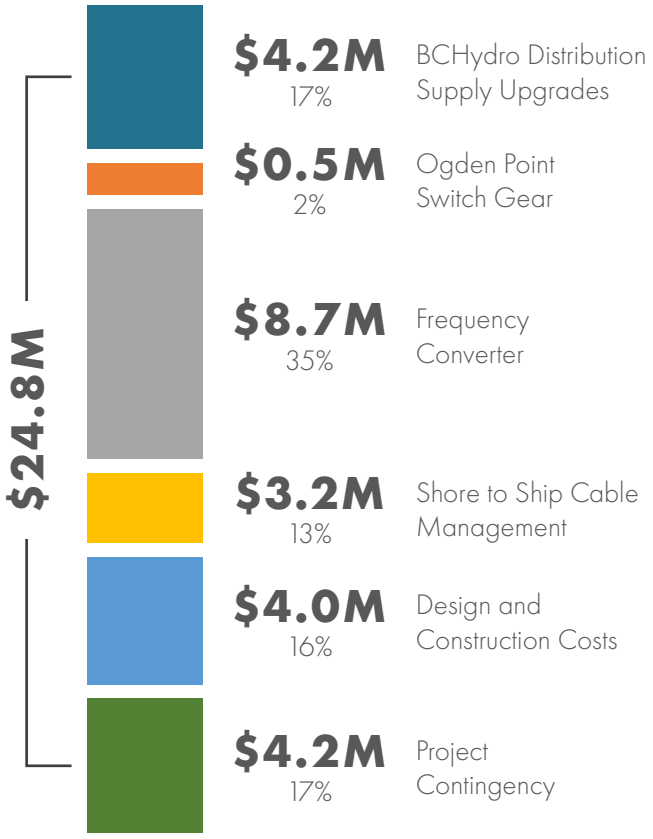
INVESTIGATION OF TECHNOLOGIES

In 2020, GVHA launched an investigation into the viability of investing in shoreside emissions mitigation technologies. Entitled *Ship Emission Mitigation Technology and Business Case*, the study sought answers to two broad questions. First, in which technologies should GVHA invest? Second, how should a preferred technological approach be funded.? Work was prepared over nine months by consultant Moffatt & Nichol with support from Synergy Enterprises.

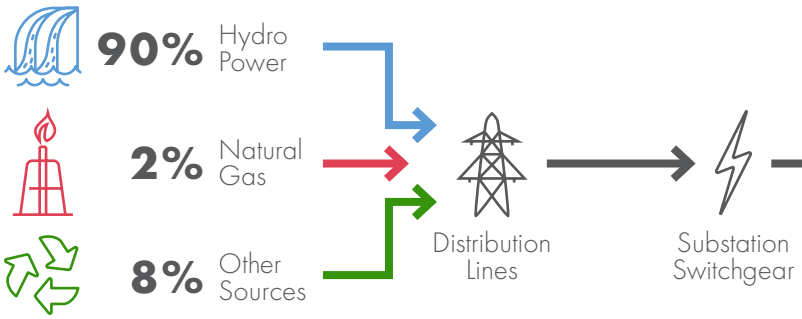
To address the first question, Moffatt & Nichol reviewed several different emissions mitigation approaches. Each approach was assessed against an assortment of screening criteria—total cost, longevity, emissions reduction, level of support infrastructure, cruise line acceptance, community perception, and others. From the initial screening process, a shortlist of technology candidates was prepared and reviewed in greater detail. Shortlisted technologies included: conventional shore power systems; advanced shore power approaches with variable frequency conversion and modular grid storage; and, approaches that utilized alternative fuels, such as liquefied natural gas (LNG).

After weighing pros and cons with each approach, implementation of either a conventional shore power system or one with the added modularity of frequency conversion was determined as most advantageous to GVHA. The conventional approach is time tested and found at several West Coast ports (e.g., Vancouver, Seattle and Juneau) and other global locations. The addition of frequency conversion allows a conventional shore power system to offer more precise and stable ship voltage control in a minimum project footprint. This approach also provides flexibility to expand the system to other GVHA berths and other applications at Ogden Point. Detailed costing of both approaches ranged between $23.3 (conventional) to $24.8 million (frequency conversion) for a system that would support two berths at Ogden Point's Pier B and an estimated 75% of total GVHA cruise traffic.

CAPITAL COST ESTIMATE 2-BERTH SHORE POWER SYSTEM



HOW IT WORKS - FREQUENCY CONVERTER SHORE POWER SYSTEM



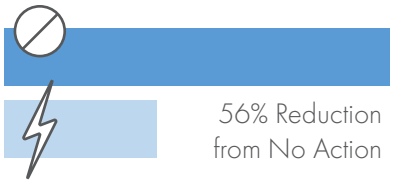
THE BENEFITS OF IMPLEMENTING SHORESIDE POWER

Using the preferred technology approach coupled with forecasts of cruise vessel utilization of the system over the next 20 years, an estimate of GHG reductions was prepared. Work was assembled by Synergy Enterprises using standard and best modelling practices.

By implementing a shoreside power system at two berths, the estimated average annual reduction of carbon emissions is between 6,450 and 7,300 tonnes of CO_2. This equates to a total savings of 131,700 tonnes of CO_2 through 2040 over a no action scenario. Sulfur Oxides (SOx) and Nitrogen Oxides (NOx) emissions would similarly reduce. These reductions would be in addition to gains made by cruise lines as they work to meet a global pledge of reducing the rate of carbon emissions across the fleet by 40% by 2030.

Beyond the measured reductions above, use of a shoreside power system by a majority of visiting cruise ships would reduce emissions impacts and improve air quality to nearby residential areas. Ambient noise impacts associated with running vessel engines would also diminish.

CO_2 EMISSIONS *(Tonnes)*

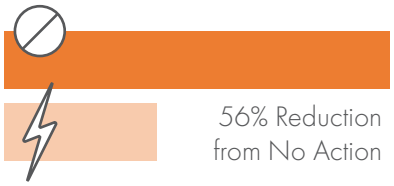


236,448

56% Reduction from No Action

104,747

SOx EMISSIONS *(Kg)*

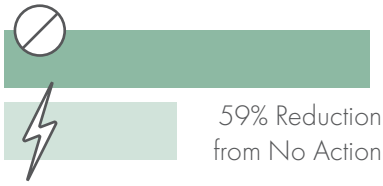


149,930

56% Reduction from No Action

65,288

NOx EMISSIONS *(Kg)*

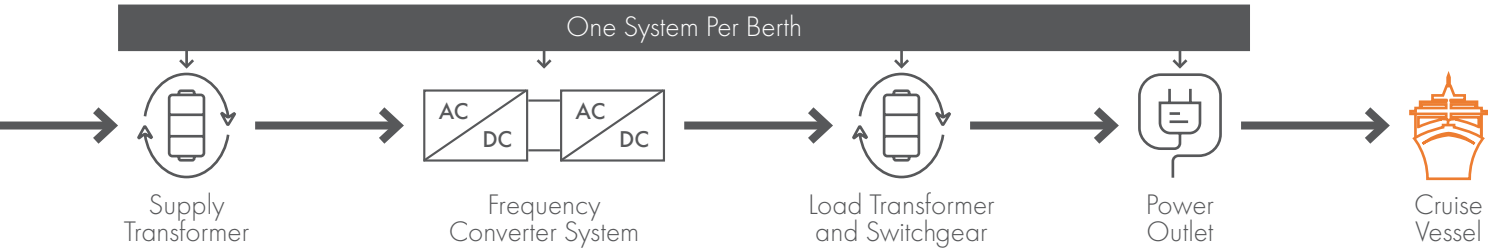


1,935,560

59% Reduction from No Action

799,658

No Action ⊘
With Shore Power (2 Berths) ϟ



FUNDING DESIRED OUTCOMES

The business case for funding preferred shore power systems is challenging. Recovery of capital expenditures of $23.3 to $24.8 million through use of only user fees would create a per call charge of between $10,000 and $11,500 per vessel call. Allowing for utility rates associated with power consumption and additional labor connection fees, the per vessel call rate would approach $20,000, a level considered unsustainable in the region in comparison to peer shore power providing ports.

Public sector grants and subsidy programs, such as the Shore Power Technology for Ports Program (SPTP) which can fund up to 50% of marine shore power capital expenditure costs, move the needle toward a more sustainable project funding model. A typical vessel call under this capital expenditure scenario would equate to an estimated $13,315 per call, inclusive of electricity charges levied by BC Hydro.

The cruise industry's recovery post COVID-19 is expected but not without risk. The GVHA is also under financial strain as it is reliant on port charges from the industry to fund operations. Both circumstances create risks to fully committing to funding a $23.3 to $24.8 million capital expenditure project.

In conclusion, a workable emissions mitigation technological approach that provides quantifiable benefits and flexibility for expansion in the future is available but financially difficult to sustain without significant government financial support. The recommendation is to advance shore power infrastructure investment over the near term if public subsidy of a minimum of 50% (but preferably greater) can be secured along with commitments by cruise lines to a larger than regionally observed shore power related fee per call.

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