

Portland IMT Reefer Container Yard Modernization – Benefit-Cost Analysis for the Maine Port Authority PIDP 2023

A BCA provides estimates of the benefits that are expected to accrue from a project over a specific period and compares them to the anticipated costs of the project. Estimated benefits are based on the projected impacts of the project on both users and non-users of the facility, valued in monetary terms.

Based on the 2023 version of the US DOT Guidance, this analysis uses the following methodology and principles:

- Establishing existing and future conditions under “Build” and “No-Build” scenarios.
- Measuring benefits in dollar terms, whenever possible, and expressing benefits and costs in a common unit of measurement. All dollar terms are presented in 2021 prices.
- Using USDOT guidance for the valuation reductions in Co2 emissions, while relying on industry best practice for the valuation of other effects
- Discounting future benefits and costs with the real discount rates recommended by USDOT of 7 percent generally and 3 percent for benefits related to carbon dioxide emissions/
- Conducting a sensitivity analysis to assess the impacts of changes in key estimating assumptions.
- Setting appraisal period to 25 years from first year of construction

The BCA measures benefits against costs throughout a period of analysis beginning at the start of project development and including 20 - 50 years of operations.

Portland IMT Reefer Yard Modernization

Brief Description

The Port of Portland has seen unprecedented growth in containerized cargo import and export. This growth is attributed to Icelandic shipping company Eimskip, which began liner service to the IMT in 2013. As shown in Table 1-2 in the main report, Portland IMT Container Throughput grew by c. 21% year on year.

The project seeks to increase storage capacity for refrigerated containers (reefers), which is a core tenant of Eimskip’s business and of great interest to the MPA, which sees the IMT facility as not just a benefit to the state, but a regional cold-chain logistics hub. Currently, the terminal can support up to 136 refrigerator containers. In the next five years, Eimskip projects that they will need storage for at least 420 reefers to support their operations.

Summary of benefits

Benefit	NPV 2021 \$
Cost avoided of trucks no being rerouted	18,989,644
Cost avoided of vessels not being rerouted	6,774,185
Increased wharfage fees	668,647
Avoided external Highways Use Costs	1,950,096
Avoided Co2 emissions	6,059,456
Residual value	1,604,154

Construction Costs

Jacobs' estimators worked with MPA to estimate construction costs for this project, these are detailed below:

Table 1 - Project Schedule and Costs

VARIABLE	UNIT	VALUE
CONSTRUCTION START	Year	2023
CONSTRUCTION END	Year	2026
PROJECT OPENING	Year	2026
TOTAL CAPITAL COSTS	\$M	17.8

Operations and maintenance costs

Based on MPA rates and charges, all operational costs are covered by the users and therefore are considered to have no net impact on the appraisal.

Base Case and "No Build" Scenario

Based on the current trajectory of container demand throughput in the port (8% growth per year), demand is expected to exceed capacity by 2025. In the Build scenario it is assumed that capacity will increase to 414,960 container per year allowing demand to continue to grow by 8% per year. For the No Build scenario, it was assumed that container demand will be constrained to the capacity of 109,200 containers per year from 2025, and the latent container demand would be lost or rerouted.

	NO BUILD		BUILD		CONTAINERS AT RISK
	Capacity	Demands	Capacity	Demand	
2023	109,200	94,370	109,200	94,370	-
2024	109,200	99,535	109,200	99,535	-
2025	109,200	109,200	109,200	107,498	-
2026	109,200	109,200	262,080	116,097	444
2027	109,200	109,200	414,960	125,385	1,041
2028	109,200	109,200	414,960	135,416	1,686
2029	109,200	109,200	414,960	146,249	2,382
2030	109,200	109,200	414,960	157,949	3,135
2031	109,200	109,200	414,960	170,585	3,947
2032	109,200	109,200	414,960	184,232	4,825
2033	109,200	109,200	414,960	198,970	5,773
2034	109,200	109,200	414,960	214,888	6,796
2035	109,200	109,200	414,960	232,079	7,902
2036	109,200	109,200	414,960	250,645	9,095
2037	109,200	109,200	414,960	270,697	10,385
2038	109,200	109,200	414,960	292,353	11,777
2039	109,201	109,200	414,960	315,741	13,281
2040	109,202	109,200	414,960	341,000	14,906
2041	109,203	109,200	414,960	368,280	16,660
2042	109,204	109,200	414,960	397,743	18,554
2043	109,205	109,200	414,960	397,743	18,554
2044	109,206	109,200	414,960	397,743	18,554
2045	109,207	109,200	414,960	397,743	18,554

2046	109,208	109,200	414,960	397,743	18,554
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Project Benefits

The Portland IMT Reefer Yard Modernization will generate several benefits:

Avoided cost of Reefers being rerouted or not shipped due to capacity constraint:

We assume that in a “No Build” scenario, 60% of the displaced demand will be rerouted to Portland, incurring additional costs for additional vessel calls at Boston and trucking costs between Boston and Portland. This is based on Eimskip data that 60% of the reefers (containers) traffic remains within 30 miles of the port after being unloaded. Of the remaining 40%, it is assumed that half of it would be lost (not shipped), and the remaining 20% will be shipped in a way that would not generate any net increase in costs (as a conservative assumptions).

The shipping route to the port of Port of Portland is the most efficient for Eimskip - the main shipping company to use the port – due to its proximity to the market. If the Portland port will reach capacity, Eimskip is likely to reroute the excess reefers traffic to a different port, the closest one being Boston.

1. **Increased Vessel cost** - It is assumed that one additional vessel call to Boston per week would be required in order to accommodate the containers that need to be routed to Boston instead of Portland. A deviation to the port of Boston would increase vessel operating time by c. 14 hours per call. For a full year (assuming two weeks of no operations) this equates to 738 hours of additional vessel time, and c. 1,538 MT of fuel (and associated Co2 emissions). Based on daily operational cost of c. \$40,000, this results in an additional cost of \$858,958 each year.¹ It should be noted, we have assumed conservatively that a diversion of a single 3,000 TEU container will be sufficient to carry any amount of diverted containers traffic.
2. **Increased Trucking fuel costs** – It is assumed that the diverted containers will have to be trucked from Boston to Portland, covering a distance of 112 miles per container, or 224 miles round trip per truck, assuming one container per truck. We assumed truck fuel consumption values of 7.5 miles per gallon in 2023, increasing in future years.
3. **Reduced Co2 emissions** – additional vessel and truck miles will generate significant Co2 emissions in the No Build scenario. To estimate the value of this benefit we used Co2 emission rates for trucks and vessels and the carbon values from the latest US DOT BCA Guidance from Jan 2023.
4. **External Highways Use Costs** – Additional truck miles will also generate negative highways use costs that would be avoided in the “Build” scenario. External highways costs considered in this project are congestion, noise and safety. These are estimated using the latest US DOT BCA Guidance from Jan 2023.
5. **Lost trade** – We estimated the benefit from avoiding 20% of reefers traffic not being shipped, and the associated loss to the Ports, and US economy in terms of reduced economic activity, by multiplying the number of potential lost reefers by the port’s Wharfage fees of \$55 per container.

Residual value:

¹ This analysis assumes of 3,000 TEU vessels at 70% utilisation. Vessel costs data source: <https://transportgeography.org/contents/chapter3/transport-costs/operating-costs-containerships/>

The project is estimated to have a 50-year service life. Assuming straight-line depreciation, the installed equipment will still retain 56% percent of its original value at the end of the 25-year analysis period. Undiscounted residual value is approximately \$9.9 million. Discounted at 7 percent from the close of the project analysis period, the residual value is \$1.6 million. The residual value is included in the numerator of the BCR per U.S. DOT Guidance.

Summary of discounted costs and benefits

	TRUCKS NO BEING REROUTED	VESSEL NOT BEING REROUTED	INCREASED WHARFAGE FEES	EXTERNAL HIGHWAYS USE COSTS	CO2 EMISSIONS REDUCTION	RESIDUAL VALUES	DISCOUNTED COSTS
2023	0	0	0	0	0	0	4,843,367
2024	0	0	0	0	0	0	4,526,512
2025	0	0	0	0	0	0	4,230,385
2026	252,621	572,360	7,629	22,249	252,532	0	0
2027	366,618	534,916	11,548	33,680	254,600	0	0
2028	466,279	499,922	15,252	44,483	256,748	0	0
2029	566,836	467,216	18,756	54,702	258,972	0	0
2030	658,006	436,651	22,073	64,374	265,368	0	0
2031	744,639	408,085	25,215	73,538	267,767	0	0
2032	824,576	381,388	28,194	82,227	270,314	0	0
2033	899,306	356,437	31,022	90,474	273,061	0	0
2034	967,560	333,119	33,708	98,309	276,042	0	0
2035	1,036,631	311,326	36,263	105,760	279,292	0	0
2036	1,096,061	290,959	38,695	112,853	286,818	0	0
2037	1,156,601	271,924	41,013	119,613	290,686	0	0
2038	1,213,294	254,135	43,224	126,063	294,923	0	0
2039	1,265,465	237,509	45,337	132,224	299,558	0	0
2040	1,176,942	221,971	42,371	123,574	294,001	0	0
2041	1,099,025	207,450	39,599	115,490	292,302	0	0
2042	1,022,283	193,878	37,008	107,934	286,874	0	0
2043	954,347	181,195	34,587	100,873	281,556	0	0
2044	885,874	169,341	32,325	94,274	276,341	0	0
2045	826,057	158,262	30,210	88,106	271,208	0	0
2046	781,978	147,909	28,233	82,342	269,350	0	0
2047	728,644	138,232	26,386	76,956	261,142	1,604,154	0
TOTAL	18,989,644	6,774,185	668,647	1,950,096	6,059,456	1,604,154	13,600,264

Sensitivity Analysis

In the central scenario for this analysis, we assumed a growth rate of 8%. This is considered a reasonable assumption given that overall container traffic in the port grew by 18% per year in the past 5 years. However, to further ensure the robustness of the analysis we also estimated the benefits using a 6% and 4% growth rates.

Table 2 - sensitivity analysis

GROWTH RATE	8%	6%	4%
BENEFITS PV (2021 \$)	36,046,182	27,602,382	20,871,253
COSTS PV (2021 \$)	13,600,264	13,600,264	13,600,264
BCR	2.65	2.03	1.53
NPV (2021 \$)	22,445,918	14,002,118	7,270,990

Summary of analysis assumption

Input	Value	Source
Discount rate	7%	US DOT BCA Guidance
Discount rate (Co2 benefits)	3%	US DOT BCA Guidance
Discount year	2021	US DOT BCA Guidance
Dollar year	2021	US DOT BCA Guidance
Analysis period	25	US DOT BCA Guidance
Project Opening Year	2026	Client data
Analysis period begins	2023	Client data
Analysis period ends	2047	
Reefers traffic background growth (central case)	8%	Based on 10 years trend
Value of Person-Hour (Truck Driver)	23.23	US Bureau of Labor Statistics
Truck miles per gallon (2021)	7.3	US Energy Information Administration
Truck Diesel Costs (Commercial Trucks) - \$ per litre in 2022	\$5.10	US Energy Information Administration
Co2 emissions (Truck) - KG per litre	2.24	US Environmental Protection Agency
Co2 emissions (Vessel) - Metric tone per Metric Ton Fuel	3.15	Marine Benchmark Maritime CO2 Emissions 2020-11
Co2 values 2022	\$56	US DOT BCA Guidance
Wharfage fees per container	\$55	Client data
% traffic with final destination close to Portland	60%	Client data
Increased time per vessel to divert to Boston (hours)	14.8	Map Based Estiamte
Vessel calls per year at Boston	50	Assumption
Vessel costs per hour	\$1163.75	The Geography of Transport Systems