All Brands on Deck

Furniture, Fashion, Retail & Technology Companies
Must Act Now to Abandon Dirty Ships

LG
LOWE'S
SAMSUNG
IKEA
DELL
amazon
TARGET
THE HOME DEPOT
WILLIAM
Walmart

SHIP IT ZERO

Acknowledgments

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In 2021, news media shone a rare spotlight on international shipping, a sector that is largely out-of-mind and out-of-sight for everyday citizens. The media reported extensively on ship backlogs at ports leading to supply chain disruptions[1] as import capacity at U.S., Chinese and other ports could not keep pace with a historic pandemic-era shift to online commerce, or "e-commerce."

Less seen in headlines were the sky-rocketing climate and public health impacts of fossil-fueled cargo shipping, exacerbated to new levels in 2021 by COVID-19-related supply chain disruptions and related port congestion.

The global shipping industry is a lifeline industry for oil and fossil gas.

Buoyed by reliance on the cheapest, most deadly fossil fuels on the planet, international shipping companies and the corporations that rely on them make billions while treating our oceans, health and climate as externalities. For far too long, they've gotten away with it.

This study provides retrospective analysis on port and ship pollution in the U.S. in 2021, during which the U.S. and world experienced COVID-19-related supply chain crises. It analyzes the climate and air pollution created by many of America's favorite brands as a result of their reliance on fossil-fueled shipping companies to import their products into the U.S.

Specifically, this report analyzed the ocean import emissions of:

01. **Walmart**
02. **Target**
03. **The Home Depot**
04. **LG**
05. **Lowe's**
06. **Ashley Furniture**
07. **Amazon**
08. **Samsung**
09. **Costco**
10. **Nike**
11. **IKEA**
12. **Williams Sonoma**
13. **Dell**
14. **VF Corporation**
15. **Adidas**
16. **HP**
17. **Living Spaces**
18. **H&M**

Using the latest advancements in publicly available data and novel methods, this study estimates that just 18 retail, furniture, technology and fashion companies were responsible for 3.5 million metric tons of climate-warming greenhouse gas emissions as a result of importing their goods into the United States in 2021—equivalent to the climate emissions of 400,000 U.S. homes.

These retail, furniture, technology and fashion companies pummeled U.S. port communities with smog-forming, nitrogen oxide (NOx) emissions. These pollutants create asthma, cancer and other life-threatening conditions in U.S. port-adjacent and coastal communities where residents are disproportionately Black, Indigenous and Brown working class people.[2]

Ports and shipping companies might argue that 2021 was an extraordinary year of booming business, and that they would not expect similar levels of pollution as demand slows. But long-term evidence is not on their side. The international shipping industry is growing at a breakneck pace due to both increasing global trade demands and COVID-19-related shifts in consumer behavior that led to the meteoric rise in e-commerce.

Even before the COVID-19 pandemic, maritime trade volumes were predicted[3] to triple by 2050 with emissions accounting for 17% of global greenhouse emissions.[4] In 2021, the world's shipping giants made more revenue than the Big Five tech giants —Facebook, Alphabet, Amazon, Apple

and Microsoft—combined. **There are more cargo ships on order in the "global pipeline" than at any time since the 1990s,[5] creating an unprecedented, but short-lived, window of opportunity to shift to greener shipping technology.** Many global ports, including the Port of Long Beach in California, are actively applying for funding to expand their ports to make room for ever-larger cargo ships. This includes new dredging of coastlands to make space for these massive vessels packed with more imported goods.

Fortunately, the technology exists to power ships without fossil fuels.

This report brings light to the pollution impacts of America's favorite retail brands and largest ocean importers, and their reliance on fossil-fueled cargo ships to move their products across the seas. We are calling on the retail, furniture and home improvement, technology and fashion industries, and major corporate leaders within them, to end port pollution, abandon dirty ships and put 100% zero-emission ocean shipping at the helm this decade, no later than 2030.

We hope this report compels the world's largest furniture, fashion, retail and technology companies to abandon dirty ships for good and get on deck for zero-emission shipping by 2030.

Main Findings

2021 Ocean Import Emissions of America's Favorite Brands

This report analyzes the ocean shipping import emissions of many of the nation's largest retail, furniture and home improvement, fashion and technology companies. These findings likely represent an underestimation compared to real emissions due to our conservative methodology. Using latest advancements in publicly available data and novel methods, this study estimates that just 18 retail, furniture, technology and fashion companies were responsible for 3.5 million metric tons of climate-warming greenhouse gas emissions as a result of importing their goods into the United States in 2021 — equivalent to the emissions from roughly 750,000 passenger cars or the energy needed to power 440,000 U.S. homes.

These retail, furniture, technology and fashion companies pummeled U.S. port communities with smog-forming, nitrogen oxide (NOx) emissions. These pollutants create asthma, cancer and other life-threatening conditions in U.S. port-adjacent and coastal communities where residents are disproportionately Black, Indigenous and Brown working class people.

Top 2021 U.S. Ocean Import Polluters	Climate Pollution (metric tons)				Air Pollution (metric tons)				
	TEUs*	CO_2	CH_4	N_2O	SO_x	NO_x	$PM_{2.5}$	PM_{10}	BC
Walmart	850,630	788,019	14.9	45.3	11,877.6	21,161.0	1,719.3	1,868.8	60.7
Target	648,922	543,634	10.4	31.4	8,163.7	14,026.7	1,188.3	1,291.7	43.7
The Home Depot	495,255	419,839	8.0	24.2	6,328.3	10,536.1	920.1	1,000.1	33.3
LG	345,974	309,464	5.9	17.9	4,576.1	8,319.0	668.0	726.1	23.7
Lowe's	300,464	288,817	5.5	16.7	4,326.7	7,369.4	628.8	683.5	23.0
Ashley Furniture	303,469	240,414	4.6	13.9	3,602.2	6,172.5	524.1	569.6	19.5
Amazon	241,252	223,248	4.3	12.9	3,346.1	5,847.6	485.4	527.6	17.1
Samsung	321,760	216,810	4.2	12.5	3,166.1	5,670.8	462.7	502.9	17.3
Costco	160,497	145,143	2.8	8.4	2,141.6	3,545.2	311.4	338.5	11.5
Nike	136,276	87,000	1.7	5.0	1,297.2	2,224.9	189.3	205.7	7.0
IKEA	148,878	82,323	1.6	4.8	1,136.9	2,191.3	166.6	181.1	6.3
Williams Sonoma	98,353	68,614	1.3	4.0	1,026.0	1,799.2	148.9	161.9	5.3
Dell	59,410	49,787	1.0	2.9	747.8	1,323.5	107.8	117.2	3.5
VF Corporation	42,332	28,313	0.5	1.6	406.7	749.9	59.2	64.3	2.2
Adidas	33,639	25,055	0.5	1.4	377.4	663.5	55.0	59.8	2.0
HP	21,531	19,771	0.4	1.1	292.0	517.4	42.4	46.1	1.5
Living Spaces	26,079	15,882	0.3	0.9	240.1	402.4	34.9	37.9	1.3
H&M	15,300	9,994	0.2	0.6	150.2	270.5	21.8	23.7	0.8
Totals	4,250,018	3,562,127	68	206	53,203	92,791	7,734	8,407	280

Retail   Furniture   Fashion   Technology

* Twenty-foot Equivalent Units, the size of a typical shipping container

Top 2021 Ocean Import Methane and NOx Polluters	Methane (metric tons) CH$_4$	Nitrogen Oxides (metric tons) NOx
Walmart	14.9	21,161.0
TARGET	10.4	14,026.7
THE HOME DEPOT	8.0	10,536.1
LG	5.9	8,319.0
Lowe's	5.5	7,369.4
Ashley Furniture	4.6	6,172.5
Amazon	4.3	5,847.6
Samsung	4.2	5,670.8
Costco	2.8	3,545.2
Nike	1.7	2,224.9
IKEA	1.6	2,191.3
Williams Sonoma	1.3	1,799.2
Dell	1.0	1,323.5
VF Corporation	0.5	749.9
Adidas	0.5	663.5
HP	0.4	517.4
Living Spaces	0.3	402.4
H&M	0.2	270.50
Totals	68	92,791

| Retail | Furniture | Fashion | Technology |

Walmart, Target and The Home Depot produced the majority of climate and air pollution of all companies analyzed through their ocean import practices in 2021.

Whether we analyzed for smog-forming nitrogen oxide (NOx) emissions, cancer-causing particulate matter (PM), or climate-warming carbon dioxide (CO2), Walmart, Target and The Home Depot topped the charts as the nation's largest ocean import polluters in 2021.

Walmart was the top ocean import polluter to the United States in 2021, responsible for 788,000 metric tons of carbon dioxide and 14.9 metric tons of the climate super-pollutant methane. Its ocean import pollution was heavily concentrated in Houston, Texas.

Walmart's share represents 22.1% of all CO2 emissions generated across the 18 companies considered. It was also the Number. 1 emitter of methane in this analysis, with 15 metric tons emitted for its imports in 2021. Methane is a greenhouse gas that is 86 times more potent than CO2 on a 20-year timeframe. Methane is also a precursor to ground-level ozone, which negatively impacts local air quality and public health.

Walmart played the greatest role in Houston port pollution, responsible for 208,200 metric tons of carbon dioxide emissions, 3,200 metric tons of sulfur

oxide emissions, 5,800 metric tons of nitrogen oxide emissions, and 460 metric tons of particulate matter emissions on voyages made to the Port of Houston in 2021. According to the University of Texas School of Public Health, children living within 2 miles of the Houston Ship Channel (predominantly Latinx neighborhoods) have a 56% greater chance[7] of contracting leukemia than children living greater than 10 miles from the channel.

Target had the second highest maritime carbon and methane emissions of all companies studied, producing 544,000 metric tons of carbon dioxide and 10 metric tons of methane in 2021. Target is the No. 1 ocean import emitter in U.S. West Coast ports, as well as at the Port of Savannah, Georgia.

Target had the greatest share of climate and air pollution at the Ports of Los Angeles, Long Beach, Seattle and Savannah, contributing to human rights and environmental racism crises at these ports. In 2021, cargo ship congestion in Los Angeles and Long Beach saw a record-breaking 100+ ships offshore awaiting berths, causing an increase in lung-damaging particulate matter emissions equivalent to emissions from 100,000 big rig trucks per day,[8] according to the California Air Resources Board.

In Savannah, 67% of people living within two miles of the Port are people of color,[9] according to the U.S. Environmental Protection Agency. Our analysis suggests

Company-by-Company Highlights

that Target's 2021 imports to the Port of Savannah produced 1,800 metric tons of sulfur oxide emissions, 2,900 metric tons of nitrogen oxide emissions, and 260 metric tons of particulate matter 2.5 emissions, contributing to ongoing environmental inequities in Savannah's port-adjacent communities. Abandoning dirty ships is critical for Target to maintain its commitments to environmental justice, equity and being a credibly good neighbor to all of its consumers.

The Home Depot was the largest ocean import climate polluter in the furniture and home improvement sector, and the third largest import climate polluter in 2021 across all companies. The Home Depot's ocean shipping was responsible for nearly 420,000 metric tons of carbon emissions and 8 metric tons of methane in 2021. The Home Depot's import pollution is particularly significant at the Port of Newark, New Jersey.

In 2021, The Home Depot was responsible for 88,000 metric tons of carbon dioxide emissions on voyages to the Port of Newark, in addition to the highest levels of air pollution among companies studied: 1,400 metric tons of sulfur oxide, 2,300 metric tons of nitrogen oxide, and 200 metric tons of particulate matter 2.5 emissions. Overall, The Home Depot was responsible for 24.6% of the carbon dioxide emissions at the Port of Newark among the 18 retail, furniture, technology

and fashion companies studied. One in four Newark children suffer from respiratory asthma[10] leading to high rates of school absenteeism, and cancer risk from air quality is highest closest to the port.[11]

LG Group and Samsung were the top import polluters among technology companies. These companies accounted for 309,000 and 217,000 metric tons of carbon dioxide emissions and 5.9 and 4.2 metric tons of methane on voyages to the United States in 2021 respectively.

In 2021, LG was a top carbon dioxide polluter in Los Angeles (88,000 metric tons), Long Beach (53,000 metric tons), Newark (48,000 metric tons) and Savannah (47,000 metric tons). Meanwhile, Samsung played a disproportionate role in carbon dioxide emissions in Long Beach (47,000 metric tons), Los Angeles (40,000 metric tons), Newark (34,000 metric tons) and Savannah (30,000 metric tons).

LG and Samsung are the largest technology polluters.

LG
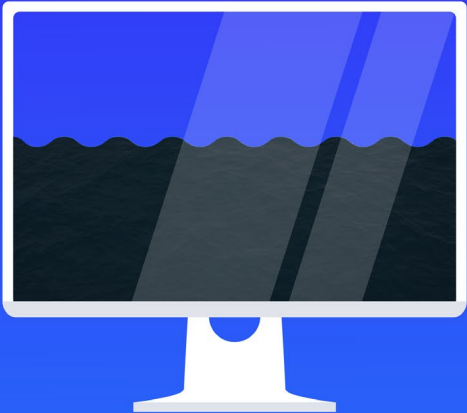
309,000
metric tons of CO2 from ocean shipping in 2021
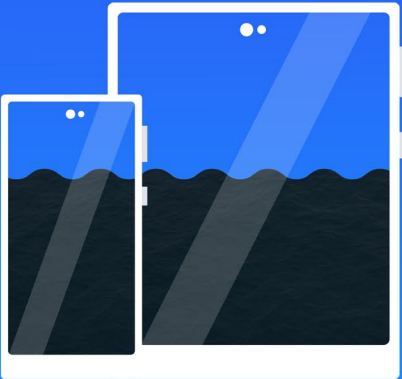
SAMSUNG

217,000
metric tons of CO2 from ocean shipping in 2021

Tech was the 3rd largest ocean shipping emitter of CO2 in 2021

Did you know?

Nike and VF Corporation—parent company to popular outdoor brands like The North Face and Vans— are the top ocean polluters in the fashion industry.

Nike was the top ocean import polluter of all the fashion companies analyzed, responsible for 87,000 metric tons of carbon dioxide emissions in 2021.

Nike's principal port for bringing goods into the United States is Los Angeles, where, in 2021, it generated 48,000 metric tons of carbon dioxide, 710 metric tons of sulfur oxide, 1,200 metric tons of nitrogen oxide, and 100 metric tons of particulate matter 2.5 emissions. Therefore, compared to its industry peers, Nike has played a disproportionate role in escalating a longstanding public health crisis in Black and Brown working-class port-adjacent neighborhoods in the Los Angeles airshed.

Walmart, Target and The Home Depot were the worst ocean import polluters in 2021

Whether we analyzed for smog-forming nitrogen oxide (NOx) emissions, cancer-causing particulate matter (PM), or climate-warming carbon dioxide (CO2), Walmart, Target and The Home Depot topped the charts as the nation's largest ocean import polluters in 2021.

Home Depot produced in 2021

427,028 metric tons of GHG's

18,818 metric tons of air pollutants

Target produced in 2021

552,943 metric tons of GHG's

24,714 metric tons of air pollutants

Walmart produced in 2021

801,450 metric tons of GHG's

36,688 metric tons of air pollutants

Port-by-Port Analysis

This analysis conducted five case studies of major U.S. port hubs to better understand the specific impacts of companies' ship pollution on local air quality and the potential adverse health impacts for port neighbors.

Key findings

The Ports of Los Angeles and Long Beach were estimated to handle the largest share of company cargo imports investigated by the Ship it Zero campaign, with over 40% of imports by TEU and 35.5% of total carbon emissions found in this study.

The Port of Savannah handled the second largest share of imports, at 13.3%, followed closely by Seattle at 13.1%. New York and Newark together handled 9.6% of container traffic analyzed, representing 10.5% of cargo CO_2 generation in this study. Houston handled the least cargo from retailers considered in the study (6.6%), however those cargoes were the most carbon intensive with 1.1 metric tons of CO_2 generated for each container shipped.

The Ports of Seattle, Tacoma and the Northwest Seaport Alliance were estimated to handle some of the cleanest, least carbon intensive cargoes with an average of 732 kg of CO_2 produced per TEU. This suggests that these PNW ports are well positioned to lead the U.S. in developing credible, high ambition green shipping corridors.

Imports were generally dominated by a small group of companies—Target, Walmart and The Home Depot—together responsible for 66.4% of containers

and 70.1% of CO_2 generation at the Port of Seattle. Seattle saw the least carbon intensive fashion imports (477 kg), close to 50% less than the average for all retailers considered. Target remains a large importer to the Port of Seattle, yet had the most carbon intensive imports of the retailers considered (838 kg CO_2 per container), generating 152 kt CO_2 (37.4%) throughout 2021. This suggests Target has the most climate credentials to gain from working with the Port of Seattle to end ship and port pollution.

The Ports of Houston had the worst carbon intensity per container of all ports analyzed in 2021.

Walmart played the greatest role of all companies studied in Houston's port pollution, responsible for 208,200 tons of carbon dioxide emissions, 3,200 tons of sulfur oxide emissions, 5,800 tons of nitrogen oxide emissions, and 460 tons of particulate matter emissions on voyages made to the Port of Houston in 2021.

The Port of Savannah was estimated to handle the most retailer containers on the East Coast.

Responsible for 15.7% total CO_2 generation, Savannah had the second highest carbon intensity per container of any port throughout 2021 (989 kg CO_2), second only to Houston. The imports of furniture and technology retailers generated more

CO_2 per container than of any of the port cases considered, 1,060 kg and 1,030 kg respectively. Target constituted the highest polluting importer into the Port of Savannah, with its cargoes responsible for 117 kt CO_2 (20.8%) throughout 2021. The three leading importers together generated 342 kt CO_2 (61.1%) from their cargoes.

Furniture and Home Improvement Companies are Polluting U.S. Port Communities

Ashley HOMESTORE

LIVING SPACES

WILLIAMS-SONOMA

THE HOME DEPOT

LOWE'S

San Pedro Port Hub — Long Beach

	Climate Pollution (metric tons)			Air Pollution (metric tons)				
	TEUs*	CO_2	CH_4	SOx	NOx	$PM_{2.5}$	PM_{10}	BC
Amazon	64,403	54,207	1.03	808.66	1,393.13	117.16	127.34	4.20
Costco	12,659	10,764	0.21	157.32	266.18	22.93	24.92	0.92
IKEA	18,630	8,757	0.16	130.54	217.64	18.87	20.51	0.71
Target	141,226	82,237	1.55	1,227.24	2,117.41	178.29	193.79	6.52
Walmart	40,450	27,663	0.53	420.07	728.73	61.18	66.50	2.24
Ashley Furniture	86,969	78,810	1.50	1,181.73	2,038.03	172.12	187.09	6.34
The Home Depot	58,078	46,889	0.92	712.24	1,156.34	104.33	113.40	3.86
Living Spaces	15,032	8,246	0.15	125.79	204.95	18.17	19.75	0.66
Lowe's	50,510	3,3091	0.62	483.38	835.48	70.61	76.75	2.70
Williams Sonoma	19,524	12,385	0.24	188.96	317.53	27.46	29.84	0.99
Adidas	3,200	1,833	0.03	27.25	46.12	3.96	4.31	0.15
H&M	1,808	1,259	0.02	18.84	33.42	2.74	2.98	0.10
Nike	26,965	16,612	0.31	250.98	430.10	36.36	39.52	1.33
VF Corporation	8,168	5,245	0.10	80.49	132.34	11.62	12.63	0.42
Dell	13,693	14,392	0.36	221.56	396.61	31.79	34.56	0.90
HP	3,487	2,900	0.05	42.46	74.14	6.18	6.72	0.23
LG	81,151	53,249	1.00	750.87	1,374.03	109.92	119.47	4.14
Samsung	72,607	47,345	0.93	684.90	1,184.95	99.69	108.36	3.85
Totals	718,561	505,882	10	7,513	12,947	1,093	1,188	40

San Pedro Port Hub — Los Angeles

	Climate Pollution (metric tons)			Air Pollution (metric tons)				
	TEUs*	CO_2	CH_4	SOx	NOx	$PM_{2.5}$	PM_{10}	BC
Amazon	124,745	114,315	2.14	1,714.02	3,035.09	248.53	270.14	8.52
Costco	34,798	26,304	0.49	388.92	614.50	56.34	61.24	2.04
IKEA	10,276	6,464	0.12	95.55	164.32	13.88	15.09	0.51
Target	150,970	128,757	2.42	1,945.77	3,314.83	281.85	306.36	10.37
Walmart	100,289	77,592	1.49	1,158.66	2,061.29	168.91	183.60	6.19
Ashley Furniture	79,660	48,188	0.91	713.04	1195.11	103.70	112.72	3.84
The Home Depot	120,525	71,728	1.38	1,069.44	1,768.43	156.27	169.86	5.66
Living Spaces	9,455	6,204	0.12	92.86	158.90	13.63	14.81	0.51
Lowe's	55,135	47,872	0.91	708.11	1,237.91	103.35	112.34	3.87
Williams Sonoma	22,892	14,169	0.27	211.47	365.24	30.68	33.35	1.13
Adidas	9,411	4,975	0.09	74.20	124.87	10.83	11.77	0.41
H&M	2,826	1,831	0.03	27.47	50.87	3.98	4.32	0.13
Nike	79,238	47,602	0.91	713.09	1,195.00	104.19	113.24	3.86
VF Corporation	8,821	5,587	0.11	83.77	142.63	12.21	13.27	0.45
Dell	19,315	16,383	0.31	247.25	451.82	36.00	39.13	1.16
HP	13,023	10,668	0.20	160.88	288.21	23.35	25.38	0.79
LG	90,917	88,097	1.69	1,270.73	2,330.38	186.54	202.76	6.74
Samsung	61,011	40,439	0.79	588.48	1,042.14	86.75	94.30	3.28
Totals	993,307	757,175	14	11,264	19,542	1,641	1,784	59

Retail | Furniture | Fashion | Technology

* Twenty-foot Equivalent Units, the size of a typical shipping container

Port of New York	Climate Pollution (metric tons)			Air Pollution (metric tons)				
	TEUs*	CO_2	CH_4	SOx	NOx	$PM_{2.5}$	PM_{10}	BC
Amazon	2,411	2,269	0.04	35.53	56.82	5.15	5.59	0.18
Costco	1,136	921	0.02	12.84	24.06	1.86	2.02	0.07
IKEA	3,013	1,795	0.03	26.58	49.33	3.84	4.17	0.13
Target	276	170	0.00	2.78	4.20	0.39	0.43	0.01
Walmart	4,925	2,831	0.05	44.26	78.07	6.37	6.92	0.22
Ashley Furniture	298	214	0.00	3.38	5.55	0.49	0.53	0.02
The Home Depot	1,895	2,067	0.04	32.41	54.10	4.67	5.08	0.16
Living Spaces								
Lowe's	381	182	0.00	2.45	4.71	0.36	0.39	0.01
Williams Sonoma	583	345	0.01	5.26	9.22	0.76	0.83	0.03
Adidas	147	129	0.00	1.94	3.37	0.28	0.31	0.01
H&M	1,053	482	0.01	7.53	13.60	1.09	1.18	0.04
Nike	1,406	1,697	0.03	27.00	46.39	3.87	4.21	0.13
VF Corporation	398	229	0.00	3.64	5.97	0.52	0.57	0.02
Dell	1,198	903	0.02	13.31	23.88	1.92	2.09	0.07
HP	2	1	0.00	0.01	0.02	0.00	0.00	0.00
LG	84	70	0.00	1.10	1.79	0.16	0.17	0.01
Samsung	1,315	806	0.02	12.15	21.27	1.79	1.95	0.06
Totals	20,521	15,112	.29	232	402	34	36	1.16

Port of Newark	Climate Pollution (metric tons)			Air Pollution (metric tons)				
	TEUs*	CO_2	CH_4	SOx	NOx	$PM_{2.5}$	PM_{10}	BC
Amazon	11,900	12,877	0.24	200.51	339.71	28.94	31.46	0.99
Costco	16,939	18,473	0.35	283.15	460.06	40.75	44.29	1.44
IKEA	18,270	10,299	0.20	146.44	279.81	21.26	23.10	0.77
Target	2,020	1,778	0.03	28.17	50.64	4.05	4.40	0.13
Walmart	24,335	19,995	0.38	301.09	542.77	43.54	47.33	1.52
Ashley Furniture	41,236	37,420	0.70	584.45	957.20	83.87	91.17	2.91
The Home Depot	79,075	88,044	1.68	1,371.48	2,264.54	198.40	215.65	6.92
Living Spaces	24	23	0.00	0.37	0.63	0.05	0.06	0.00
Lowe's	37,586	41,540	0.79	642.20	1,088.76	92.75	100.81	3.20
Williams Sonoma	31,728	23,835	0.45	367.78	633.23	53.14	57.76	1.80
Adidas	5,205	4,989	0.09	76.31	136.82	11.05	12.01	0.39
H&M	7,189	4,982	0.09	77.22	135.21	11.16	12.13	0.39
Nike	5,163	4,547	0.09	68.70	124.44	9.96	10.83	0.35
VF Corporation	4,869	4,058	0.08	62.90	107.46	9.06	9.85	0.31
Dell	5,181	3,202	0.06	48.55	82.37	7.02	7.63	0.25
HP	491	485	0.01	7.44	10.18	1.07	1.16	0.03
LG	51,184	47,992	0.91	749.67	1,315.89	108.66	118.11	3.56
Samsung	45,107	33,851	0.64	514.02	906.90	74.33	80.79	2.58
Totals	387,502	358,389	7	5,530	9,437	799	869	28

| Retail | Furniture | Fashion | Technology

* Twenty-foot Equivalent Units, the size of a typical shipping container

Port of Savannah	Climate Pollution (metric tons)			Air Pollution (metric tons)				
	TEUs*	CO_2	CH_4	SOx	NOx	$PM_{2.5}$	PM_{10}	BC
Amazon	7,204	8,140	0.15	124.78	207.71	17.97	19.53	0.62
Costco	8,836	9,050	0.17	134.62	218.76	19.46	21.15	0.68
IKEA	16,430	10,008	0.19	137.13	260.56	20.09	21.83	0.75
Target	106,621	116,642	2.17	1,779.54	2,926.34	256.45	278.75	8.59
Walmart	135,838	114,874	2.15	1,698.75	2,885.44	245.83	267.21	8.58
Ashley Furniture	6,538	5,841	0.11	84.26	152.30	12.29	13.35	0.46
The Home Depot	105,602	110,978	2.11	1,664.64	2,727.30	241.34	262.32	8.59
Living Spaces								
Lowe's	69,999	82,199	1.54	1,241.66	2,069.77	179.30	194.89	6.27
Williams Sonoma	13,933	8,891	0.17	125.00	227.62	18.22	19.81	0.67
Adidas	1,751	1,136	0.02	16.04	29.17	2.35	2.56	0.09
H&M	243	80	0.00	1.05	2.14	0.15	0.17	0.01
Nike	10,569	7,040	0.13	100.18	178.92	14.56	15.83	0.57
VF Corporation	1,769	1,534	0.03	22.17	40.31	3.23	3.51	0.12
Dell	6,230	5,990	0.11	90.31	137.01	13.00	14.13	0.43
HP	168	200	0.00	2.92	4.10	0.42	0.46	0.01
LG	41,471	47,495	0.89	726.00	1,298.26	104.89	114.01	3.50
Samsung	33,362	30,216	0.57	452.58	797.98	65.47	71.16	2.29
Totals	566,566	560,315	11	8,402	14,164	1,215	1,320	42

Port of Houston	Climate Pollution (metric tons)			Air Pollution (metric tons)				
	TEUs*	CO_2	CH_4	SOx	NOx	$PM_{2.5}$	PM_{10}	BC
Amazon	2,642	4,268	0.08	66.00	117.84	9.55	10.38	0.33
Costco	5,908	7,490	0.14	113.55	204.57	16.41	17.83	0.60
IKEA	12,446	8,483	0.16	120.41	234.81	17.50	19.02	0.63
Target	82	67	0.00	0.69	1.93	0.10	0.11	0.00
Walmart	172,790	208,189	3.86	3,213.95	5,847.31	462.29	502.49	15.49
Ashley Furniture	2,128	2,172	0.04	34.12	58.57	4.90	5.32	0.17
The Home Depot	23,623	20,578	0.38	324.38	556.68	46.54	50.59	1.62
Living Spaces	706	921	0.02	14.33	25.43	2.07	2.25	0.07
Lowe's	5,892	6,297	0.12	96.80	173.00	13.99	15.20	0.51
Williams Sonoma	2,458	2,643	0.05	35.73	73.62	5.27	5.73	0.20
Adidas	1,687	2,116	0.04	32.54	59.00	4.68	5.09	0.16
H&M	103	122	0.00	1.88	3.38	0.27	0.29	0.01
Nike	1,631	1,380	0.03	18.75	38.44	2.75	2.99	0.10
VF Corporation	6,023	5,259	0.10	70.02	146.36	10.23	11.12	0.37
Dell	3,287	1,789	0.03	25.29	48.62	3.68	4.00	0.14
HP	161	226	0.00	3.40	6.11	0.49	0.53	0.02
LG	21,391	25,007	0.48	388.73	694.96	56.29	61.18	2.00
Samsung	17,443	10,602	0.20	162.46	298.37	23.43	25.47	0.80
Totals	280,400	307,611	6	4,723	8,589	680	740	23

| Retail | Furniture | Fashion | Technology |

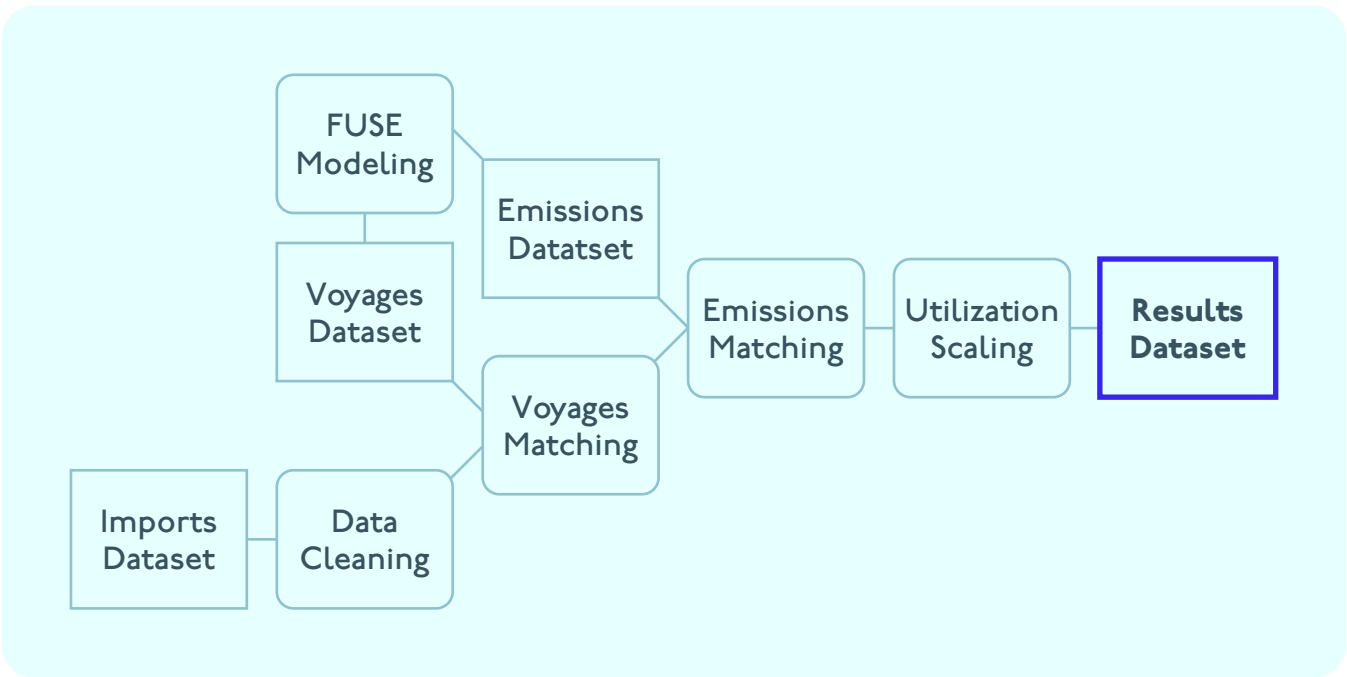* Twenty-foot Equivalent Units, the size of a typical shipping container

Figure 1 Schematic of Methodological Approach

Import Validation

Stand.earth Research Group provided shipping consignments for 18 of the largest importers into the U.S., using U.S. vessel manifest data for imports from Jan. 1, 2021 to Dec. 31, 2021. Data was collected for each of the companies by querying for shipments from each company and all of its subsidiaries, including carriers. Information on subsidiaries was gathered through various public sources including company websites, SEC filings and shipping databases.[12] Additionally, records were included where the company in question is the shipper, the consignee, the notifying party or the brand of goods. The TEUs found in the query were then scaled to the TEUs reported in the Journal of Commerce (JOC) Top 100 Importers for 2021. Scaling TEUs requires taking the

TEUs from the queries and scaling them up to the reported imports from the JOC list. Where a company was not listed in the JOC Top 100, other means of scaling or verifying the TEUs were employed. If it was not possible to scale or verify the TEUs, the company was excluded from the study.[13]

A few companies, most notably Amazon and LG, owned a subsidiary carrier company that ships more than just the companies' products. These couriers were also included in the TEU query. Amazon Global Logistics and its wholly-owned subsidiary Beijing Century Joyo Courier Service Co. began in 2017 shipping from southern China to ports in California. From there, the shipping containers were trucked to fulfillment centers in

Research Methods

This study once again deployed the research methods we first developed in 2021 to bring public transparency to otherwise proprietary pollution data on the global shipping industry. The Ship It Zero coalition commissioned this research from Stand.earth Research Group (SRG) and UMAS.

California and Indiana under the name of the Chinese freight forwarder.[13] LG owns LX Pantos, a Korea-headquartered global logistics enterprise established in 1977. The rationale for included carriers is to calculate emissions across each company's total shipping operations, which becomes an important factor for companies such as Amazon, who ship far more goods related to their business than just the ones that they consign.

Linking Imports with Emissions

Voyages associated with each cargo manifest have been identified and, using results from the proprietary fuel consumption estimation (FUSE) model employed in the 4th International Maritime Organization (IMO) Greenhouse Gas Study (Faber et al., 2020),[15] emissions associated with each manifest have been calculated. The FUSE model is underpinned by an extensive and well-maintained database of Automatic Identification Systems (AIS) vessel data tracking the movement, speed and draught of vessels with high spatial resolution and validated with real-world data from thousands of vessels.

Two data cleaning steps were then performed to ensure appropriate fields for IMO vessel numbers and ports of loading. A total of 1.1 million consignment records were considered in the dataset representing more than 2.4 million containers (and later scaled to 4.7 million)

carried on 1,658 unique vessels. Where IMO numbers were not initially present in the dataset, their value has been infilled using the vessel's name. This step preserves more than 167,000 records that would otherwise have been discarded and results in the removal of 10,533 records.

Fuel use statistics and emissions were then evaluated at hourly aggregation for each vessel contained in the study as part of the FUSE model, owned and managed by UMAS. Considering the voyages associated with each manifest, FUSE data has been windowed and summed to capture the emissions associated with the vessel over the time frame that the cargo is loaded. Finally, emission statistics are allocated to individual retailers based on the estimated proportion of their cargo over the total cargo capacity of that vessel. Repeating the same process for each cargo manifest, emission statistics are then aggregated to generate annual emission estimates by retailer and port.

Matching Process

While transporting cargo, ships may stop at several ports on their journey from source to destination. Reflected in raw AIS data, such stops can be identified using defined criteria, thereby enabling a vessel's continuous movement to be broken down into unique voyage legs. Through the identification of voyages that best match the initial and final conditions of each manifest, a robust reflection of both the geographical history of the cargo and the

static and dynamic characteristics of the carrier vessel is produced.

Limitations

We expect the emissions numbers presented in this study to be lower than real life emissions, as our methodology has limitations. Limitations include: (a) the rigorous quality assurance standards we use to match departure voyages, which means we have not included many likely company voyages or charters that we could not verify; (b) the inability to verifiably measure or assign emissions responsibility for "backhaul emissions," i.e., when cargo ships return back to loading ports, often empty or only partially full in order to quickly refill customer demands; and (c) assumptions we chose to make for vessel utilization employed in the emission allocation process, which results in a likely undercounting. These limitations could therefore change the ranking of emitters in this and future studies.
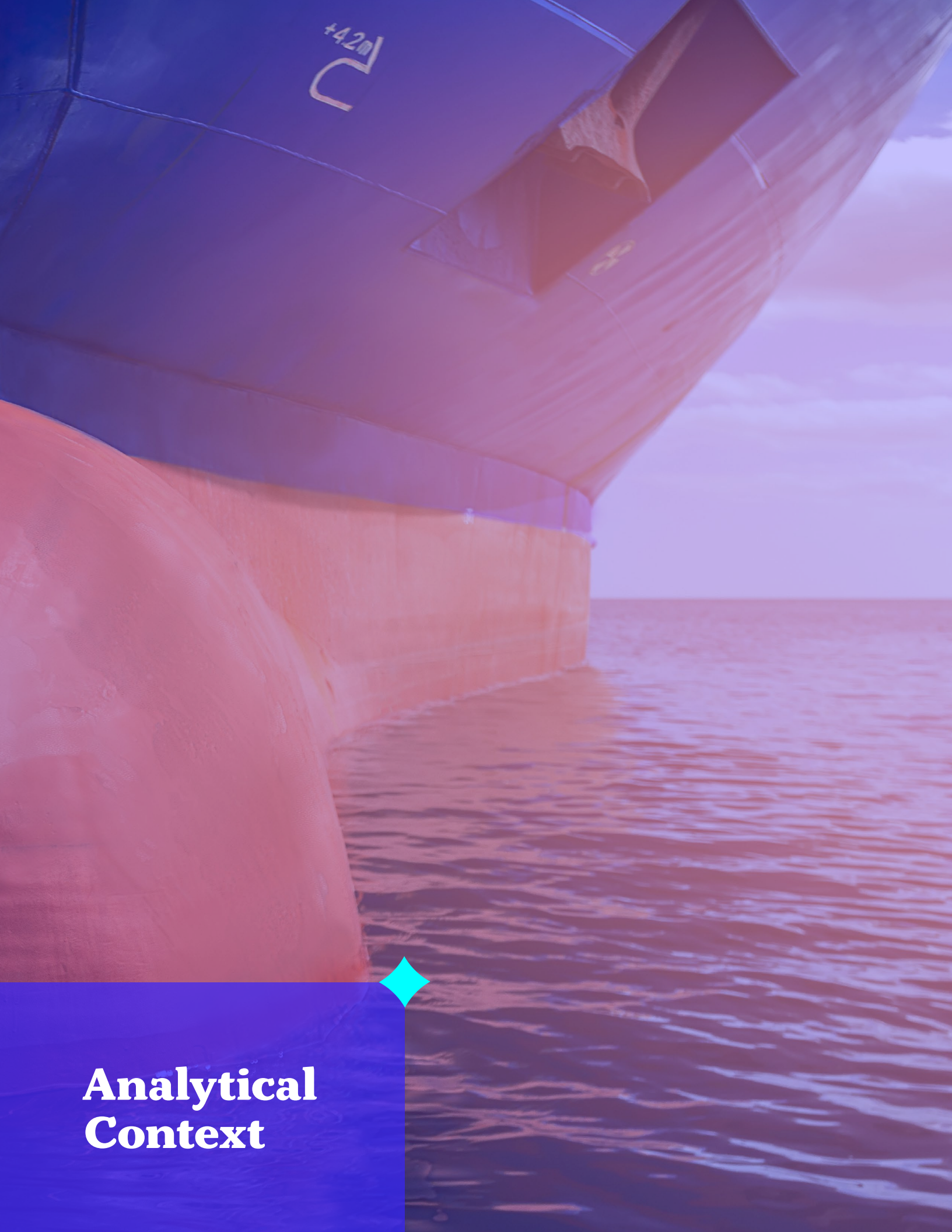
Investments in zero-carbon container shipping are growing, but are not yet aligned with 1.5 degrees C pathway

Initial voluntary, long-range zero-by-2040 commitments for shipping from Amazon, IKEA, Unilever, Michelin, Patagonia, REI and most recently Target have helped spur initial investments in carbon neutral, zero-carbon, and zero-emission capable shipping. While this is progress, it is not sufficient. For shipping to be 1.5C aligned, greenhouse gas emissions must halve by 2030 and be eliminated entirely by 2040. The S-Curve 2030 diffusion target for achieving this goal requires at least 200 GHG-free cargo ships on the water by 2030. The industry is just 25% on the way to that goal, and even this 25% remains feedstock dependent.

Zero-Emission Capable Containerships in Development

Company	Vessel Total	Propulsion	Date on Water
Maersk	19	Dual-fuel engines, green methanol capable	2023-2025
CMA-CGM	8	Dual-fuel engines, green methanol capable	2024
HMM	8	Dual-fuel engines, green methanol capable	2024
COSCO	12	Dual-fuel engines, green methanol capable	2025
NEOLINE	1	Wind power and sails	est. 2025
Total	48		

Figure 2 Total number of containerships on order globally to be powered by scalable, zero-carbon and zero-emission capable fuels, according to DNV data as of January 2023. Ship it Zero so far views e-methanol, wind, and battery containerships to be "scalable, zero-carbon, and zero-emission capable." Ship it Zero does not view bio-methanol as a viable solution for zero-emission shipping.

Analytical Context

Maersk Routes for Green Methanol

Virginia
Rotterdam
Spain
Egypt
Singapore

Figure 3 Maersk has formed partnerships across the globe to secure green methanol (e-methanol and bio-methanol) bunkering at critical transshipment ports. Among the partnerships are Spain's commitment to produce 2 million tons of green fuels per year and partnerships with six companies to source at least 730,000 tons of green methanol per year by the end of 2025. Maersk anticipates 6 million tons/year of green methanol demand by 2030 to fuel its carbon-neutral fleet.[17]

Maersk's green methanol corridor build-out shows that low- and zero-emission shipping is possible

In the last year, shipping giant Maersk signed Memorandums of Understanding to refuel its green methanol-powered ships at critical transshipment ports around the world. This procurement and development shows that the combination of corporate commitments, policy incentives and infrastructure can accelerate the transition to replace fossil fuel ship refueling stations (bunkering) with non-fossil and ultimately zero-emission energy.[16]

Say No to LNG

Without 1.5C-aligned greenhouse gas emission standards in place for the global shipping industry at the United Nations or in major shipping nations, shipping companies are racing to lock in fossil fuel contracts while they still can. This means that many shipping companies are ordering new, gas-powered containerships to lock in multi-decade reliance on LNG in shipping.

LNG is the fossil fuel industry's greenwashed solution for shipping decarbonization. While it emits less carbon dioxide and certain air pollutants than traditional heavy fuel oil, LNG is a fossil fuel that emits methane, a greenhouse gas **up to** 86 times more **potent** in climate warming effect than carbon dioxide on a shorter timescale.[18] The Ship it Zero campaign urges all companies committed to reject LNG as a bridge fuel in the shipping industry's transition— including all those in the coZEV Initiative—to act on these commitments and demand that their products be moved onto credible, well-to-wake, zero-emission newbuilds instead.

Recommendations and Key Takeaways

For Companies and Sectors

1

The Home Depot, Walmart and Target must do more to protect U.S. port communities and end their reliance on fossil-fueled shipping.

Walmart and The Home Depot have made no public commitments to fossil-free ocean transport in their climate or ESG plans, yet produced the highest levels of carbon dioxide, methane and carcinogenic particulate matter pollution of all companies studied. Walmart and The Home Depot have enormous market power to help end the era of fossil-fueled shipping and must wield it. While Target has made an initial commitment to zero-emission shipping by 2040, we have seen no material progress on this announcement.

2

All brands must make more near-term, year-over-year commitments to abandon dirty, fossil-fueled ships this decade. We urge all brands in this study to get on deck for zero-emission shipping and:

◆ Commit to 100% zero-emission shipping by 2030 — not 2040 — and set year-over-year emissions reduction targets.

◆ Sign up to the new Science Based Targets Initiative (SBTI) for maritime shipping and disclose their performance and progress on that pathway each year.

◆ Ask carriers to demonstrate immediate and year-over-year emissions reductions during contract negotiations. Any ship on the water today could be retrofitted with wind-assist propulsion or other emissions reducing technologies; public health and the climate cannot wait for an entirely new generation of vessels.

◆ Move business away from carriers that do not offer you zero-emission solutions.

3

All brands must say no to LNG in ocean shipping.

This shipping industry is on the cusp of locking in decades of climate-warming methane emissions. Hundreds of LNG-fueled ships are in the global orderbook waiting to be built. Brands in this study have the power to stop this from happening, by making clear public commitments and communications to shipping carriers that they will not move their products on a new generation of LNG-fueled ships.

4

Amazon, as the leader of the e-commerce movement and fastest growing ocean shipping polluter in the United States, must go further in its ocean shipping commitments.

While Amazon sits in the Top 10 of our 2021 import emissions rankings, we estimate that its emissions will continue to grow this decade without greater action. Ship It Zero Coalition calls on Amazon to increase the ambition of its ocean climate leadership by committing to 100% zero-emission ocean shipping by 2030 with interim year-over-year emissions reductions targets. Finally, Amazon should use its power to lead a Zero-Emission Maritime Fuels Buyers Alliance to help pool aggregated demand for zero-emission cargo ships and fuels at the world's major ports, as alluded to at COP27.

For Ports and Policymakers

1

The Ports of Los Angeles and Long Beach have a unique responsibility to end ship pollution and should lead the United States toward achieving 100% zero-emission shipping by 2040.

We urge the San Pedro Ports to lead on clean shipping in 2023 by working with the California Air Resources Board to develop new emissions regulations for ocean-going vessels, supporting the U.S. Congress to advance and pass the Clean Shipping Act and ending all new fossil fuel expansion at their ports, including liquefied natural gas (LNG).

2

The Ports of Houston, Texas; Newark, New Jersey; and Savannah, Georgia must step up to protect U.S. port communities and end ship pollution.

California is the only U.S. state with mandatory low- or zero-emission standards for ships at berth or in-transit. Port Authorities in Houston, Newark and Savannah should work with their major retail import partners to accelerate zero-emission shipping and bring overdue health relief to port-adjacent communities.

3

The Northwest Seaport Alliance and policymakers across Washington State can create model zero-emission, fossil-free cargo shipping corridors, port terminals and trade routes.

The Northwest Seaport Alliance should build on its leadership of managing highly carbon efficient imports by helping create the nation's first truly fossil-free green shipping cargo corridors across the Pacific. The Northwest Seaport Alliance should consider adding other port partners to its current green shipping corridor collaboration with Busan, South Korea and should expressly make any final corridor arrangement fossil-free, including saying no to LNG.

4

State and national policymakers must pass mandatory zero-emission greenhouse gas and air pollution standards to drive ship decarbonization.

Voluntary commitments to ship it zero by 2040 from Amazon, IKEA, Unilever, Target, Michelin and others have driven billions of dollars into the development of a zero-carbon vessel market, spurring the announcement of nearly 50 carbon neutral or zero-carbon cargo ships. Later this year, the United Nations' International Maritime Organization is expected to pass a revised, more ambitious global decarbonization target for the industry. It is time for state and national policymakers to step in with mandatory policy tools that—like they've done for cars and trucks—mark the death knell for fossil-fueled shipping, and make sure zero-carbon commitments become zero-emission realities.

Annex I | **Additional Technical Information**

TEU Scaling and Data Cleaning

Table 1 presents the TEUs that were found to be associated with the imports of each retailer. Only TEUs which could be successfully linked with emission data were taken forward, and these totals are also presented.

Company	Total TEUs Found	Usable TEUs
Walmart	930,000	850,630
Target	775,000	648,922
The Home Depot	590,000	495,255
LG Group	360,627	345,974
Lowes	340,000	300,464
Ashleys Furniture	348,672	303,469
Amazon	266,243	241,252
Samsung	342,179	321,760
Costco	171,684	160,497
Nike	150,000	136,276
Ikea	168,803	148,878
Williams Sonoma	106,884	98,353
Dell	65,520	59,410
VF Corporation	46,066	42,332
Adidas	37,131	33,639
HP	24,908	21,531
Living Spaces	30,135	26,079
H&M	19,138	15,300

Table 1   Total TEUs found associated with the imports of each retailer in 2021 compared with the final useable TEUs taken forward for emissions analysis

Validation

Various studies have recently been published containing analyses of carbon efficiency for containerized transportation. The fourth IMO Greenhouse Gas Study includes emission intensities describing 2018 containerized import volumes and are presented in Table 2, demonstrating the reductions in carbon intensity that can be observed as vessel TEU capacity increases. Although moderate variation between carbon intensities can be observed in Table 2, there is reasonable alignment between the two, which provides confidence that the novel manifest-emission matching method described above is providing valid results.

TEUs	2021 Study	IMO IV*
Vessel Size	g CO2 per TEUnm	g CO2 per TEUnm
0–999	218	247
1000–1999	192	188
2000–2999	157	139
3000–4999	128	120
5000–7999	115	114
8000–11999	92	94
12000–14499	70	76
14500–19999	35	57
20000+	37	55

Table 2   Carbon Dioxide Emissions per TEUnm (TEU nautical miles) Traveled for Containerships of Various Sizes, Calculated as Part of the Recent 2021 U.S. Retailer Emissions Study and the IMO GHG IV Study (Faber et al, 2020) using 2018 data

Annex II | **List of Methanol Powered Ships According to DNV data as of January 2023**

Delivery Year	Project Type	Main Ship Type	Ship Name	Area of Operation	Class	Technology
2023	Newbuild	Container Ships	TBN	Europe	ABS	Methanol Fueled
2024	Newbuild	Container Ships	TBN I	Europe	DNV	Methanol Fueled
2024	Newbuild	Container Ships	TBN I	Global	ABS	Methanol Fueled
2024	Newbuild	Container Ships	TBN I	Global	DNV	Methanol Fueled
2024	Newbuild	Container Ships	TBN I0	Global	ABS	Methanol Fueled
2024	Newbuild	Container Ships	TBN II	Global	ABS	Methanol Fueled
2024	Newbuild	Container Ships	TBN I2	Global	ABS	Methanol Fueled
2024	Newbuild	Container Ships	TBN 2	Europe	DNV	Methanol Fueled
2024	Newbuild	Container Ships	TBN 2	Global	ABS	Methanol Fueled
2024	Newbuild	Container Ships	TBN 2	Global	DNV	Methanol Fueled
2024	Newbuild	Container Ships	TBN 3	Global	ABS	Methanol Fueled
2024	Newbuild	Container Ships	TBN 3	Global	DNV	Methanol Fueled
2024	Newbuild	Container Ships	TBN 4	Global	ABS	Methanol Fueled
2024	Newbuild	Container Ships	TBN 4	Global	DNV	Methanol Fueled
2024	Newbuild	Container Ships	TBN 5	Global	ABS	Methanol Fueled
2024	Newbuild	Container Ships	TBN 5	Global	DNV	Methanol Fueled
2024	Newbuild	Container Ships	TBN 6	Global	ABS	Methanol Fueled
2024	Newbuild	Container Ships	TBN 6	Global	DNV	Methanol Fueled
2024	Newbuild	Container Ships	TBN 7	Global	ABS	Methanol Fueled
2024	Newbuild	Container Ships	TBN 7	Global	DNV	Methanol Fueled
2024	Newbuild	Container Ships	TBN 8	Global	ABS	Methanol Fueled
2024	Newbuild	Container Ships	TBN 8	Global	DNV	Methanol Fueled
2024	Newbuild	Container Ships	TBN 9	Global	ABS	Methanol Fueled

Delivery Year	Project Type	Main Ship Type	Ship Name	Area of Operation	Class	Technology
2025	Newbuild	Container Ships	TBN 1	Global	BV	Methanol Fueled
2025	Newbuild	Container Ships	TBN 13	Global	ABS	Methanol Fueled
2025	Newbuild	Container Ships	TBN 14	Global	ABS	Methanol Fueled
2025	Newbuild	Container Ships	TBN 15	Global	ABS	Methanol Fueled
2025	Newbuild	Container Ships	TBN 16	Global	ABS	Methanol Fueled
2025	Newbuild	Container Ships	TBN 17	Global	ABS	Methanol Fueled
2025	Newbuild	Container Ships	TBN 18	Global	ABS	Methanol Fueled
2025	Newbuild	Container Ships	TBN 2	Global	BV	Methanol Fueled
2025	Newbuild	Container Ships	TBN 3	Global	BV	Methanol Fueled
2025	Newbuild	Container Ships	TBN 4	Global	BV	Methanol Fueled
2025	Newbuild	Container Ships	TBN 5	Global	BV	Methanol Fueled
2025	Newbuild	Container Ships	TBN 6	Global	BV	Methanol Fueled
2026	Newbuild	Container Ships	TBN 1	Global	ABS	Methanol Fueled
2026	Newbuild	Container Ships	TBN 2	Global	ABS	Methanol Fueled
2027	Newbuild	Container Ships	TBN 10	Global	ABS/CCS	Methanol Fueled
2027	Newbuild	Container Ships	TBN 3	Global	DNV	Methanol Fueled
2027	Newbuild	Container Ships	TBN 4	Global	DNV	Methanol Fueled
2027	Newbuild	Container Ships	TBN 5	Global	LR	Methanol Fueled
2027	Newbuild	Container Ships	TBN 8	Global	CCS	Methanol Fueled
2027	Newbuild	Container Ships	TBN 9	Global	CCS	Methanol Fueled
2028	Newbuild	Container Ships	TBN 11	Global	ABS/CCS	Methanol Fueled
2028	Newbuild	Container Ships	TBN 12	Global	ABS/CCS	Methanol Fueled
2028	Newbuild	Container Ships	TBN 6	Global	LR	Methanol Fueled
2028	Newbuild	Container Ships	TBN 7	Global	ABS/CCS	Methanol Fueled

Footnotes

1 'The shipping crisis is getting worse. Here's what that means for holiday shopping,' CNN, Aug. 23rd, 2021. https://www.cnn.com/2021/08/23/business/global-supply-chains-christmas-shipping/index.html

2 'Cleaner fuels for ships provide public health benefits with climate tradeoffs,' Sofiev et al., Nat Commun 9, 406, 2018. https://www.nature.com/articles/s41467-017-02774-9

3 Ocean shipping and shipbuilding,' OECD, Accessed Feb. 2nd, 2023. https://www.oecd.org/ocean/topics/ocean-shipping/#:~:text=The%20main%20transport%20mode%20for,can%20create%20economic%20value%20added.

4 'Shipping emissions 17% of global CO2, making it the elephant in the climate negotiations room,' Transport & Environment, Nov. 23rd, 2015. https://www.transportenvironment.org/discover/shipping-emissions-17-global-co2-making-it-elephant-climate-negotiations-room/

5 'Containership orderbook closes in on all-time highs,' Splash247.com, March 2nd, 2022. https://splash247.com/containership-orderbook-closes-in-on-all-time-highs/

6 'Shady Routes: How Big Retail and their Carriers Pollute along Key Ocean Shipping Corridors,' Ship It Zero, Nov. 2021. https://shipitzero.org/wp-content/uploads/2021/11/FINAL-Ship-it-Zero-Campaign-Report.pdf

7 'Study: Children near Ship Channel face more risk,' The Houston Chronicle, Jan. 19th, 2007. https://www.chron.com/news/houston-texas/article/Study-Children-near-Ship-Channel-face-more-risk-1583566.php

8 'Emissions Impact of Ships Anchored at Ports of Los Angeles and Long Beach,' California Air Resources Board, Nov. 9th, 2021. https://ww2.arb.ca.gov/sites/default/files/2021-11/SPBP_Congestion_Anchorage_Emissions_Final.pdf

9 'Environmental Justice Primer for Ports: Impacts of Port Operations and Goods Movement,' Environmental Protection Agency, Accessed Feb. 2nd, 2023. https://www.epa.gov/community-port-collaboration/environmental-justice-primer-ports-impacts-port-operations-and-goods

10 'N.J. officials seeking a solution to Port Newark pollution,' NJ.com, July 18th, 2014. https://www.nj.com/business/2014/07/seeking_a_solution_to_port_pollution.html

11 'Ports are the new power plants — at least in terms of pollution,' The Washington Post, Nov. 24th, 2015. https://www.washingtonpost.com/news/wonk/wp/2015/11/24/ports-are-the-new-power-plants-at-least-in-terms-of-pollution/

12 'Amazon.com, Inc. List of Significant Subsidiaries,' U.S. Securities and Exchange Commission, Accessed Feb. 2nd, 2023. https://www.sec.gov/Archives/edgar/data/1018724/000119312513028520/d445434dex211.htm ; 'Brands,' VF Corporation, Accessed March 30th, 2022. https://www.vfc.com/brands ; 'Affiliated companies,' LG Corporation, Accessed March 28th, 2022. https://www.lgcorp.com/about/companies

13 3 companies were excluded in this way, from a total list of 21 companies.

14 'Amazon.com, Inc. List of Significant Subsidiaries,' U.S. Securities and Exchange Commission, Accessed Feb. 2nd, 2023. https://www.sec.gov/Archives/edgar/data/1018724/000119312513028520/d445434dex211.htm ; 'Amazon pushing hard into ocean shipping, making it easier for Chinese goods to get to you,' USA Today, Jan. 18th, 2018. https://www.usatoday.com/story/money/2019/01/18/amazon-pushing-hard-into-ocean-shipping-china-u-s/2589422002/

15 Faber, J., Hanayama, S., Zhang, S., Pereda, P., Comer, B., Hauerhof, E., ... Yuan, H. (2020). Fourth IMO greenhouse gas study. International Maritime Organization. https://www.imo.org/en/OurWork/Environment/Pages/Fourth-IMO-Greenhouse-Gas-Study-2020.aspx

16 https://www.porttechnology.org/news/maersk-signs-partnership-to-establish-first-green-e-methanol-plant-in-southeast-asia/

17 https://www.porttechnology.org/news/maersk-signs-partnership-to-establish-first-green-e-methanol-plant-in-southeast-asia/

18 'Comparing the Future Demand for, Supply of, and Life-Cycle Emissions from Bio, Synthetic, and Fossil Marine Fuels in the European Union,' International Council on Clean Transportation, September 22nd, 2022. https://theicct.org/publication/lng-marine-fuel-sep22/

Glossary of Terms

Term	Definition
BC	Black Carbon
CO_2	Carbon Dioxide
CH_4	Methane
GHG	Greenhouse Gas
N_2O	Nitrous Oxide
NOx	Nitrogen Oxide
$PM_{2.5}$	Particulate Matter 25
PM_{10}	Particulate Matter 100
SOx	Sulfur Oxide
TEUs	Twenty-foot Equivalent Units, the size of a typical shipping container