

PRACTICAL PATHWAYS FOR PORT DECARBONIZATION AND ENVIRONMENTAL JUSTICE

Guidance for U.S. Ports and their Partners



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Environmental Defense Fund is dedicated to protecting the environmental rights of all people, including the right to clean air, clean water, healthy food and flourishing ecosystems. Guided by science, we work to create practical solutions that win lasting political, economic and social support because they are nonpartisan, cost-effective and fair.

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Practical Pathways for Port Decarbonization and Environmental Justice is a guide for ports in the United States to set, plan, implement and achieve their decarbonization goals.

This report is written for ports—specifically port authorities and terminal operators—as the primary audience and for port stakeholders and partners as a secondary audience. We hope that U.S. ports can use this guide to develop actionable transition plans towards net zero greenhouse gas (GHG) emissions and that organizations and communities that engage with ports can use this guide to work together to achieve greater ambition in decarbonization and environmental justice planning in and near ports.

Reviewing the Table of Contents, “Introduction” frames the purpose of the report. The “Landscape Scan” summarizes the progress for ports decarbonizing in the United States today and raises many of the challenges ports face in achieving decarbonization. “The Opportunity” makes the case that ports have a unique and essential role in decarbonization that will unlock benefits for themselves, their communities and the freight industry. “Practical Pathways” lays out the “Framework” for ports to decarbonize that responds to the challenges ports face and the “Action Dashboard” provides a checklist of dozens of detailed, specific, practical actions that port actors can take to achieve decarbonization and environmental justice.

INTRODUCTION



U.S. ports need a transparent pathway to net zero-emissions to increase their decarbonization ambition, while encouraging accountability, especially to port-adjacent environmental justice (EJ) communities. Some ports in the U.S. have recently created net zero or carbon-neutral goals, but in the absence of a policy framework outlining how these goals should be made and with no requirement for community accountability or consistent reporting metrics, there is uncertainty about how or if ports will achieve the goals they have set. Furthermore, most ports that have set decarbonization plans focus on a narrow boundary of directly controlled GHG emissions or rely on purchasing carbon offsets to achieve their goals, rather than targeting more impactful initiatives that directly reduce emissions and span across their broader zone of influence over port users. For ports who have not yet set goals, their lack of commitment creates unnecessary uncertainty as to whether they will generate meaningful reductions in GHGs and impacts to port-adjacent communities from their operations.

Recent federal investments from the Bipartisan Infrastructure Law (BIL) and the Inflation Reduction Act (IRA) represent an unprecedented opportunity for U.S. ports to access funding to upgrade their infrastructure to accelerate their zero-emission transition. Since the federal government Justice40 (J40) initiative ensures that 40% of project benefits be targeted towards historically disadvantaged EJ communities, there is momentum to use these funds to ameliorate the disproportionate impacts of climate change and air pollution from port operations on low income, communities of color. It is essential that the transition to more sustainable energy systems and infrastructure happens in a way that significantly benefits EJ communities and the federal funding available for U.S. ports enables this transition.

Developed for U.S. ports, *Practical Pathways for Port Decarbonization and Environmental Justice* promotes U.S. port programming changes and investments on and off terminals, that support zero-GHG supply chains, zero-GHG transportation, zero-GHG energy systems and environmental justice. This guide will identify high-potential entry points, including federal infrastructure funding opportunities, to bring ports across the U.S. towards zero-GHG emission best practices and ensure that EJ communities are equitably protected from impacts resulting from port operations and port users. It will also help increase U.S. ports' competitiveness for government funding and expand investment and business opportunities by creating alignment with the net zero-GHG reduction goals published by major beneficial cargo owners (BCOs).¹

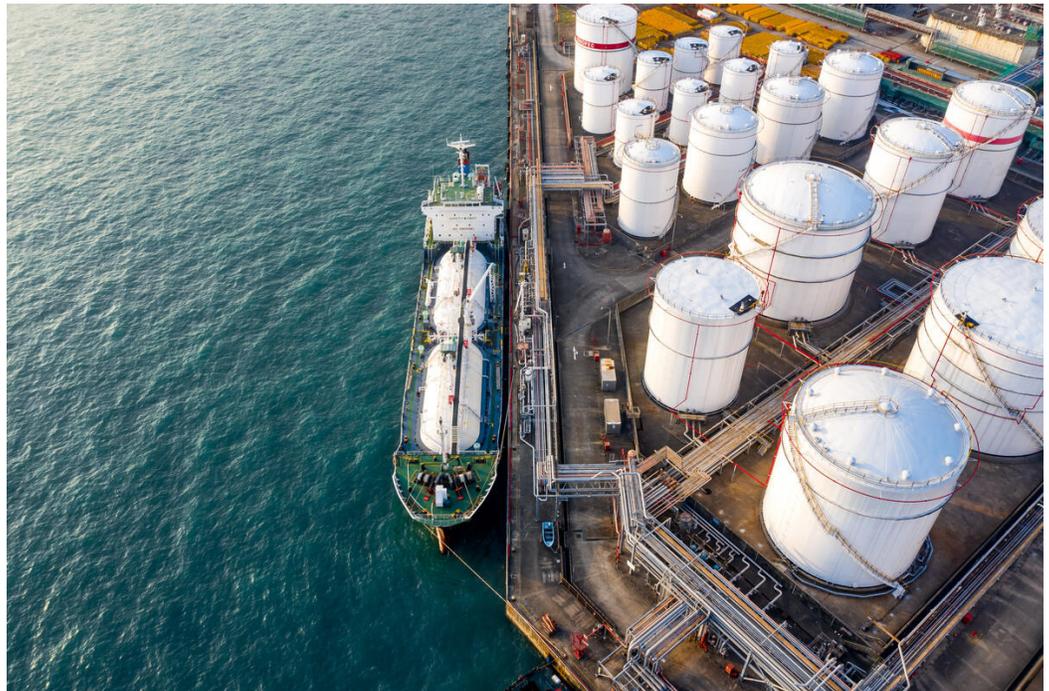
Acknowledging the diversity of ports in scale, function and governance, this guide:

1. Provides a **landscape scan** on current U.S. progress for port decarbonization and EJ;
2. Introduces the **key drivers** for why ports can and should lead climate action;
3. Lays out a **comprehensive framework for decarbonization**; and
4. Provides a list of actions, metrics and key outcomes across each action-area for ports to measure their progress on net zero goals with **environmental justice opportunity** call outs.

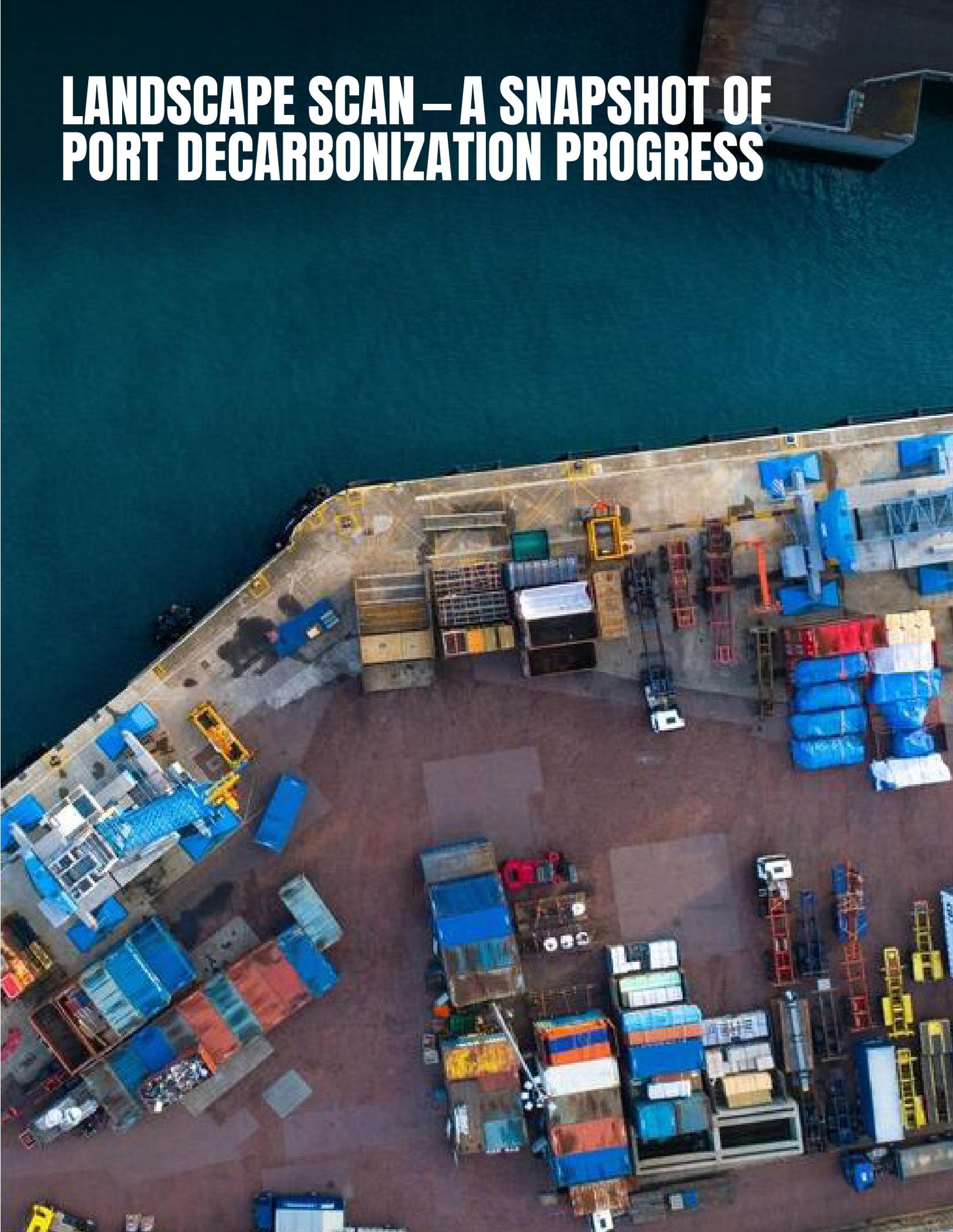
1 In this report, we use multiple terms to refer to decarbonization targets and goals, including "net zero," "zero-/low emissions," "zero-GHG emissions," "zero-/low-carbon," and "decarbonized." We recognize that these terms have different and nuanced meanings and that those differences are critically important. We note here that we will predominantly use the terms "net zero-GHG," "net zero-GHG emissions" and "net zero-carbon," to describe a state in which an entity has reduced their direct and indirect GHG emissions dramatically and has neutralized residual remaining GHG emissions via permanent carbon removal and storage. We use the term "decarbonization" to describe those reductions or cuts in absolute direct and indirect GHG emissions. Note that while we may use the terms "net zero" or "near-zero," we draw a distinction between reducing GHG emissions and investing in permanent carbon removal technology, versus relying upon purchasing carbon offsets to achieve "net zero" or "carbon neutral" goals. Finally, we also note that we endeavor to refer to "GHG emissions" specifically as distinct from other air pollutant emissions that may be tracked and reported by ports, since air quality is not the primary focus of this report. There are co-benefits between decarbonization and reduction in air pollution and we expect that as ports decarbonize there will be meaningful reductions in air pollution exposures for ports and port-adjacent communities.

This guide makes the case that U.S. ports can and should make genuine commitments to center decarbonization in their organization strategies, including their *zones of control* and *zones of influence* (capital, operational, user and system impact areas); develop comprehensive decarbonization plans, aligning actions with science-based targets and other drivers for net zero by 2050; take action to align port development and decarbonization by managing emissions associated with construction and by developing port facilities that enable the energy transition and decarbonize port operations and port user's activities by energy demand-side and energy supply-side initiatives; and importantly, integrate environmental justice considerations into every aspect of the above actions, to enable broader community co-benefits and ensure a social license to operate and grow.

We envision U.S. ports using this guide are able to develop an actionable transition plan to launch major initiatives putting them on the path to net zero-GHG emissions. This guide will also support engagement with ports across the U.S. to facilitate greater ambition in their decarbonization and environmental justice planning, with the goal of getting more ports to commit to net zero-GHG goals and for those ports with existing goals to increase their ambitions.



LANDSCAPE SCAN – A SNAPSHOT OF PORT DECARBONIZATION PROGRESS



STATUS QUO – GREEN SHOOTS BUT MUCH PROGRESS TO BE MADE

We conducted a landscape scan to explore the status of U.S. port decarbonization with an environmental justice focus. The landscape scan investigated 20 ports across the U.S. that represented a wide range of locations, types, operations, capacities, policy contexts and degree of progress on decarbonization. Those working in ports often use a phrase “when you’ve seen one port — you’ve seen one port!” Any appraisal of U.S. port decarbonization efforts must embrace the tremendous diversity of ports and how this influences their decarbonization and environmental justice journey.

Note that this landscape scan and framework is concentrated on marine ports, with their connections to ocean-based and land-based transportation links (and the zone of influence ports have on them).

Inconsistent scopes and goals for decarbonization

Many ports are developing decarbonization strategies and planning for action, but the scope, detail and evidence-base of such planning is highly variable. Most of the ports evaluated in the landscape scan have public decarbonization strategies, programs and goals, including strategies that cover investment access as well as a whole system focus on decarbonization. These strategies range widely in formality, level of detail and public transparency — from well-documented and comprehensive plans among a few leading ports, to more limited public statements or summary presentations from other ports.

U.S. ports with well-developed goals and plans tend to have already progressed those plans with short-term projects and have set interim goals to encourage decarbonization and have made plans to continue to apply for a variety of state and federal grants to support their projects. Outside of a few leading ports, progress to date on decarbonization actions is often limited to specific near-term projects and to operational emissions associated with directly owned port infrastructure. There is often a lack of a cohesive approach between different port actors — for example, between port authorities, port owners and terminal operators. Many existing port decarbonization plans focus on a narrow boundary of GHG emissions (Scope 1 and 2) or “carbon neutrality” with a reliance on purchasing carbon offsets, rather than targeting more impactful initiatives that span across the port’s zone of influence. Many ports recognize the role of broader user GHG emissions or “Scope 3” emissions, but it does not appear that there are any published U.S. port Scope 3 materiality assessments at the time of this writing.

Many large U.S. ports publish an emissions inventory to track the progress of their air emissions reduction programs and these typically include some GHG emissions, such as carbon dioxide, methane and carbon monoxide directly emitted by port infrastructure and equipment. Ports typically distinguish between the emissions under their direct control (Scope 1 and 2) and those that are not (Scope 3) which are frequently the large majority of the emissions. For example, the Port of New York and New Jersey’s (PANYNJ) *Net Zero Roadmap*, which aims to achieve net zero for *all* GHG emissions by 2050, acknowledges that, “Approximately 96% of total emissions are outside of our direct control (Scope 3).”² The transparency shown by PANYNJ in articulating the contributions and source apportionment clearly allows for meaningful planning and engagement as it implements its plan. However, in most cases, port decarbonization efforts are focused on the small portion of emissions within the ports’ direct control. For example, the Port of Virginia has a “carbon neutral by 2040” goal that targets reductions in Scope 1 and 2 emissions through a clean power

purchase agreement and efforts to decrease fuel use through operational efficiencies, expanded use of electric cargo handling equipment (CHE) and other measures.³ While a laudable first step, the goal is limited to Scope 1 and 2 emissions and ignores the much larger emissions from, for example, drayage truck operations and ocean-going vessels (OGVs).

The following table summarizes the status of port GHG inventories and decarbonization goals among the 20 ports evaluated in the landscape scan.

TABLE 1
Twenty ports evaluated in the landscape scan

Port	GHG emissions inventory	Emissions scopes included	Net zero-GHG or similar goal	Goals
NW Seaports Alliance (Port of Seattle + Tacoma)	Yes	1, 2, 3	Yes	Net zero by 2050
Port of Virginia	Yes	1, 2	Yes	Carbon neutral by 2040
Port of Houston	Yes	3	Yes	Carbon neutral by 2050
Los Angeles	Yes	3	Yes	Net zero by 2030
Long Beach	Yes	3	Yes	Net zero by 2030
San Diego	Yes	3	No	100% of cargo handling equipment and cargo trucks calling to port being ZE by 2030
Charleston	No	N/A	No	None
New York/New Jersey	Yes	1, 2, 3	Yes	Net zero by 2050
Baltimore	Yes	1, 2, 3	Yes	Net zero by 2045 as aligned with SB 528
Savannah	Yes	1, 2, 3	No	None
Port of South Louisiana	No	N/A	No	None
South Carolina Ports	Yes	1, 2	No	None
Oakland	Yes	1, 2, 3	Yes	50% reductions by 2030
Corpus Christi	Yes	1, 2, 3	No	7.5% annual reductions in GHG emissions per cargo ton handled
Baton Rouge	No	N/A	No	None
Miami	No	N/A	No	Awarded \$16 million to develop a Net Zero Program to “convert the entire cargo movement chain to a carbon neutral operation.” (in development)
Port Everglades	Yes	1, 2, 3	No	None
New Orleans	No	N/A	No	None
Honolulu	No	N/A	No	Goal to provide shore-side power by 2045
Memphis	No	N/A	No	None

Need for meaningful inclusion of environmental justice priorities

The landscape scan also sought to understand how environmental justice challenges experienced by port-adjacent communities are characterized and whether ports are making meaningful progress on incorporating environmental justice into their decarbonization plan. The assessment found that while some consistent topics like air pollution are reported, **there is no cohesive framework that ports are using to connect environmental justice threats to decarbonization actions.** Many ports appear to recognize environmental justice challenges that arise from port activities and operations in public statements, as well as the potential co-benefits that accrue by aligning environmental justice and decarbonization agendas. Further, while some ports and port stakeholders are actively incorporating environmental justice in their decarbonization planning and projects, recognition and action varies significantly from location to location largely driven by the presence of environmental justice community pressure to lean into these topics.

A few examples show the steps that ports and adjacent communities are taking to jointly advance environmental justice and sustainability initiatives. At the Port of Seattle, the Port Community Action Team (PCAT) is comprised of residents from nearby port communities that strive to remedy the current and historical impacts of port operations on its neighbors and the environment. The Environmental Protection Agency (EPA) has facilitated discussions between the Port of Seattle and PCAT to identify the challenges confronting the community and identify priority projects for the port. These conversations amplified the voices of local community members and catalyzed mutually beneficial actions and programs. In Long Beach and Los Angeles, the Trade Health and Environment (THE) Impact Project, a collaborative of academic and community partners, formed in 2001 to “elevate health equity as a central concern in goods management decisions.”⁴ Still in existence today, THE Impact Project advocates by centering voices of frontline communities to accelerate the transition to a zero-emission freight system, improving quality of life for port-adjacent communities and expanding green job opportunities in the region. THE Impact Project regularly engages with the Ports of Long Beach and Los Angeles to ensure their decarbonization efforts integrate EJ community priorities.



Key challenges

One of the reasons for the varied progress towards decarbonization is that U.S. ports face systemic challenges to meaningfully address decarbonization. The table below summarizes the key challenges ports must consider to maximize the opportunity ahead. The landscape scan and prior team engagements with ports have informed and shaped these identified challenges. The decarbonization framework and actions in the *Practical Pathways* sections provide ports with the tools to face these challenges.



Challenge 1 Current action isn't embracing the full influence of ports

Port action is often focused on decarbonization of infrastructure and operations within the direct control of ports. Action in the broader zone of user and community and industry influence, where impacts are often far greater and where potential benefits are significant, is lacking. Ports are often not planning their future development to align with the low-carbon sustainable economy of the future.



Challenge 2 Diverse governance structures for ports are hampering integrated efforts

The diverse nature of port governance—with sometimes separate port owners (landlords), port statutory bodies (authorities) and terminal operators—means that many decarbonization efforts are piecemeal or contain significant gaps. This varied governance structure is hindering collaboration, accountability and impact.



Challenge 3 Uncertainty is hindering planning

There is significant uncertainty in the optimal solutions for decarbonization and how they integrate with existing port operations. The low technical, commercial and regulatory maturity of some solutions presents risks to adoption. A changing and variable regulatory and financial landscape only increases this uncertainty. While the climate transition risks associated with delayed decarbonization are arguably more significant, such transition risks are often not formally recognized in current decision-making.



Challenge 4 Action isn't connected to climate goals

Ports' decarbonization strategy and action planning is often disconnected from science-based climate goals. While ports sometimes quantify the impact of decarbonization initiatives, they rarely assess the cumulative impact of decarbonization programs nor compare those impacts to the near- and long-term GHG reduction goals required. There are isolated examples of ports having accredited Science-Based Targets (SBTs), but these are sometimes limited in scope. Varying industry goals, norms and guidance around GHG emissions quantification makes this more difficult and inconsistent.



Challenge 5 Environmental justice needs are not always prioritized

Despite the critical environmental justice benefits resulting from port decarbonization, it is often overlooked or only briefly mentioned in both planning and implementation. Meaningful community engagement and building social license in neighboring communities can significantly enhance the alignment of port development projects with local needs and enable co-benefits.



Challenge 6 Ports lack funding for impactful action

Many financial resources are insufficient to meet the urgency and scale needed to decarbonize port operations and infrastructure. This lack of funding hampers ports' ability to implement effective measures that could significantly reduce their carbon footprint and benefit adjacent communities. While unprecedented federal funding for ports decarbonization exists in the BIL and IRA, ports need support to access this funding and ensure it is meaningfully aligned with decarbonization and environmental justice goals.

THE OPPORTUNITY – WHY PORTS SHOULD LEAD CLIMATE ACTION



There are many opportunities for ports to take a leadership role in climate action to accelerate mitigation and environmental justice priorities within and outside port boundaries. These opportunities include the following:

1. Ports can become critical energy hubs, spur the just and equitable energy transition across the nation and globe and expand workforce development opportunities as they align their functions with a future sustainable, low-carbon energy economy.
2. Ports can use their influence to lead transformational climate action both within and beyond their borders to accelerate their transition to zero-emission technologies, to mitigate transition risks, to decrease environmental justice impacts and prepare for the future.
3. Ports can become more competitive for BIL/IRA grant funding, build trust and gain the social license to operate and grow when they expand their decarbonization action planning to include meaningful engagement with port-adjacent communities and center planning around J40 goals.
4. Ports can unlock opportunities for funding and partnership by supporting their land-side and water-side users in their decarbonization journeys, boosting their competitive position and enabling new development and innovation.

Ports are critical transport and energy hubs

Our nation's ports are critical hubs — for transport, energy, industry and jobs. U.S. ports handle 41% (over \$1.8 trillion) of the nation's international trade by value.^{5, 6} This trade of goods supports 18% of 2020 GDP, enhancing our prosperity.⁷ Our ports also support domestic transport of both people and goods, connecting communities and supporting our economy. Acting as intersections between the land and sea, ports can become catalysts for cross-sectoral decarbonization, ranging from maritime to energy.



Many U.S. cities were historically developed around ports, making ports deeply intertwined with communities. Ports provide career opportunities, enable supply of essential goods and often connect people with the waterfront. Ports are also often gateways for leisure and tourism — connecting societies domestically and internationally and with the natural environment. However, the activities of ports and their users, on land and sea, need to be managed carefully to reduce the adverse environmental impacts effects on local communities of pollution, traffic or inequitable economic development to name a few examples. Furthermore, U.S. ports are often custodians of nature — regulating activities and managing operations to protect sensitive coastal areas and provide resilience against climate shocks and stressors. The global biodiversity crisis places an additional emphasis on ports to enhance and protect the environment.

Many port businesses, especially in the Gulf of Mexico, are dependent on a fossil fuel-based economy, as large quantities of the goods ports transport are fossil fuels and added-value services undertaken within port boundaries include the storage and processing of fossil fuels, including offshore oil and gas exploration. Port users, such as ocean-going vessels and drayage trucks, predominantly use fossil fuels and vessels often rely on ports to provide those fuels. A fossil fuel economy has supported the economic development of ports and their communities, but as the U.S. and its trade partners decarbonize, change is inevitable in the U.S. energy economy and ports must be prepared to respond to these changes. In a decarbonized future, cargo owners will use low-carbon freight alternatives, passengers will prioritize low-carbon routes and investors will support low-carbon transport hubs — and ports must proactively prepare or risk being left behind. Examples of ports demonstrating their leadership as energy hubs may include offshore wind development, solar micro-grid projects and fuel bunkering of alternative fuels such as renewable hydrogen. Some recent examples include the Port of Galveston, which recently received \$1 million to pilot a solar power-driven shore power project for cruise ships docking at the port.⁸ The Port of Long Beach has a project concept to develop offshore wind to enhance the availability of renewable energy for their use in their zero-emission transition.⁹ And the Port of Seattle has developed four micro-grid solar projects to provide renewable energy and facilitate the decarbonization of their buildings and operations.¹⁰

Recent investments of over \$7 billion by the Department of Energy (DOE) in clean hydrogen hubs demonstrate a commitment by the U.S. government to shift the energy economy.¹¹ Of the seven hub projects selected in this investment, three are directly connected to ports. Clearly, the energy transition can present huge opportunities for ports through new energy infrastructure development, bunkering for alternative fuels and other business opportunities. Also, DOE's Office and Equity and Justice, has laid out its framing for a just and equitable energy transition. This includes shifting away from fossil fuels to meet global climate goals, while simultaneously lifting those communities up who have historically borne the burden of the impacts of the energy system through health effects from exposure to air pollution and the myriad climate change impacts frontline communities experience first and worst. This equitable transition calls upon all stakeholders to include environmental justice communities in the workforce development and economic opportunities of this clean energy transition.¹²

There will be demonstrable improvements to port-adjacent community's health as ports and their users transition from diesel to zero-GHG emission.¹³ Ports, utilities, port users and communities must take a coordinated, ecosystems approach to planning for the grid needs in this transition, which will become especially important as shipowners and operators expand their use of shore power. Ports play a critical role in coordinating with all stakeholders, especially utility providers, to ensure that the electricity needs to aid this transition are met. One emerging resource for this coordination is a port electrification

handbook that the Pacific Northwest National Laboratory is developing to help ports lead this energy transition.¹⁴

Globally, ports have started to publicly showcase their climate commitments through Memorandums of Understanding (MOUs) to develop green shipping corridors — zero-GHG emission shipping routes between two ports. The movement has been guided by global ambition at the United Nations Framework Convention on Climate Change (UNFCCC) COP 26 in Glasgow, where some countries, including the U.S., signed onto the Clydebank Declaration for green shipping corridors.¹⁵ The U.S. federal government has recognized that green shipping corridors have the power to significantly contribute to the decarbonization of the maritime shipping industry, by spurring early and rapid adoption of fuels and technologies that deliver low- and zero-emissions.¹⁶ The U.S. envisions green shipping corridors with the ambition to achieve zero-GHG emissions across all aspects of the corridor in support for sector-wide decarbonization no later than 2050 and there are initiatives and tools that have been developed globally to address the environmental, social and economic impacts of these. For example, EDF together with Lloyd's Register and Arup released a “Sustainable First Mover Initiative Indicator Tool” and the UN Global Compact’s “Tides of Change: Framework for developing just and inclusive maritime green corridors” both of which provide port and shipping stakeholders with the tools to deliver green shipping corridors that deliver wider environmental and social co-benefits.^{17, 18}

Collectively, these examples demonstrate ways that U.S. ports are expanding their decarbonization efforts beyond their boundaries.

Ports can be key energy hubs for the United States, spurring the just and equitable energy transition across the nation and globe and expanding workforce development opportunities as they align their functions with a future sustainable, low-carbon energy economy.

Ports can lead transformational climate action beyond their borders

Increasing GHGs from human activities are causing huge shifts to the global climate, resulting in higher-than-average temperatures year after year.¹⁹ These shifts to global temperatures cause greater frequency of extreme weather events, impacting nature and people and the ecosystems surrounding both.²⁰ The climate crisis motivates a two-fold transformation of ports — the need for rapid **mitigation via decarbonization** aligned with climate goals and the need for **adaptation to a changing climate**, enhancing the resilience of ports and systems they connect. Ports must shift their planning to consider the wider systems within which they operate, incorporating both the known risks of the past and the projected the risks of the future as they build infrastructure and manage their operations within their spheres of control and influence. While not the focus of this report, resilience efforts are essential to keeping the supply chain moving and to protect port assets and the systems they connect. For more guidance on achieving port resilience, the report *Port Resilience: Framework for Action* by Resilience Rising and Arup provides a line of sight for resilience from a policy level through implementation at a port asset level, including 10 goals that can transform port performance.²¹

Ports directly impact GHG emissions in two ways. First, through their development, such as during new construction, maintenance and decommissioning of port assets, often involving the use of carbon-intensive materials and processes. Second, through their operations, including the operation of buildings, cargo-handling equipment and other energy-intensive activities in the control of ports mostly powered by fossil fuels. Beyond the assets they build and operate, ports can have significant influence for broader GHG emissions mitigation by facilitating decarbonization of their users — including ocean-going vessels, trucks and rail. A comprehensive lifecycle view of port GHG emissions recognizes

that every stage of port action — from initial capital planning and sourcing all the way to decommissioning and disposal of equipment and materials — influences GHG emissions and therefore presents an opportunity for decarbonization.

There are many drivers for action on port emissions, but few more compelling than the policies and regulations driving innovation. Ports typically operate as a system of mobile sources, each regulated by a myriad of local, state and/or federal rules and laws. Some U.S. ports exist in a more stringently regulated environment, accelerating their transition to zero-emission technology, while other ports do not. For example, the State of California has been a leader in the policy and regulatory space affecting U.S. ports. Among many actions, in 2007 the California Air Resources Board (CARB) passed an “At-berth” regulation broadly phasing in a requirement of ocean-going vessels to “plug in” when at-berth to minimize port-adjacent community exposure to harmful air pollutants from these vessels.²² Despite opposition to the regulation, the EPA approved CARB’s request for authorization to continue with the phase-in of the program, approved in late 2023. This is one example of how state-level action is transforming and speeding innovation at U.S. ports.

Nationally, the U.S. government is applying pressure on ports by raising its climate ambition through its National Climate Task Force which aims to achieve a net zero-emissions economy by 2050.²³ Additionally, as the EPA continues rulemaking to strengthen the National Ambient Air Quality Standards (NAAQS), ports in non-attainment regions will be under increasing pressure to participate in regional efforts to decrease emissions from their operations.²⁴

Delaying action will present significant transition risk to those ports not planning for this inevitable future, by increasing costs associated with GHG mitigation and affecting ports’ competitiveness, public image and financial position.²⁵ In the absence of policies and regulations forcing this transition, ports can take immediate action on priority decarbonization actions in the short-term while planning for continued action as new policies emerge and decarbonization technologies mature. A port that decarbonizes its own infrastructure and operations but remains embedded in a fossil fuel dependent supply chain will be subject to many of the transition risks mentioned so ports must lean into the sphere of influence beyond their own boundaries for risk management. Although enabling and prompting port users to act is challenging, the potential for emissions reductions from users is huge — typically many times the potential of directly owned or managed port infrastructure. Furthermore, in many cases, the environmental justice impacts from ports are felt most severely by the off-port impacts of port users, including rail and drayage. Action in this space requires ports to facilitate collaboration, holistic planning and leadership — fundamental ingredients to make a successful port of the future. In their position linking different types of port users and other stakeholders such as utilities and local governments, ports can play a pivotal and necessary facilitation and enabling role towards coordinated decarbonization — we argue that no other organization in this space can enable this collaboration in the way that port leadership can.

Ports can lead transformational climate action both within and beyond their borders to accelerate their transition to zero-emission technologies, regardless of the policy and regulatory environment, to mitigate transition risks, decrease environmental justice impacts and prepare for the future.

Environmental justice and Justice40

Port infrastructure and operations are major contributors to global GHG emissions and other air and water pollutants, contributing to poor public health outcomes for the communities that live and work nearby.²⁶ Exposure to these hazards, such as particulate matter, heavy metals and toxic air pollutants, is frequently compounded by social and economic factors that render port communities especially vulnerable to adverse health outcomes. People of color and low-income communities are disproportionately impacted by pollution and its resulting health impacts.²⁷ Environmental justice is the “fair treatment and meaningful involvement of all people regardless of race, color, national origin or income with respect to the development, implementation and enforcement of environmental laws, regulations and policies.”²⁸ Port-related emissions are an EJ issue and while the U.S. is experiencing unprecedented growth at its ports, creating more emissions from the diesel trucks, ships, trains and cargo equipment required to move goods throughout the country, this deepens the harmful impact to local communities’ health and well-being.²⁹

We are amidst a once-in-a-generation opportunity for port investment as BIL and IRA have created new opportunities to fund the intersection of decarbonization and environmental justice and together will provide approximately \$20 billion in grant funding for ports between 2022-2026.³⁰ This brings a unique opportunity for U.S. ports to not only decrease pollution in port communities and improve public health, but also to re-center and elevate the voices of community members in collaboratively advancing environmental justice goals. This can occur in tandem with ports improving the “safety, efficiency and reliability” of their operations, as required by many of the Department of Transportation (DOT) grant programs funded by BIL.

The appetite for aligning decarbonization and environmental justice goals is present. In our landscape scan of 20 U.S. ports, nearly all ports defined decarbonization goals and nearly half of them addressed environmental justice topics in their sustainability planning. Furthermore, many ports are conducting research and outreach to better understand how port activity impacts neighboring communities through the lens of environmental justice considerations. While there are clear leaders and laggards in this space, as ports explore opportunities for innovation in their infrastructure and operations, their work will create potential for new strategies to collaborate with community members for a just and inclusive transition.³¹

Ports will be more competitive for BIL/IRA grant funding, will build trust and will gain the social license to operate and grow when they expand their decarbonization action planning to include meaningful engagement with port-adjacent communities on issues of environmental justice and center their planning around J40 goals.

Environmental justice is the “fair treatment and meaningful involvement of all people regardless of race, color, national origin or income with respect to the development, implementation and enforcement of environmental laws, regulations and policies.” (See Glossary for definitions.)

Business case for ports to decarbonize

Ports are comprised of clusters of companies and economic activities and thus, pressure towards ports to address Environmental, Social and Governance (ESG) disclosure and reporting is applied from multiple directions, including regulation, investors and users such as beneficial cargo owners. By developing robust emissions profiles, setting targeted net zero aligned strategies and mitigating climate risk, ports can prepare and adequately support their user's and investor's ESG-related strategies and avoid running afoul of future regulations, investor pressures or industry needs.

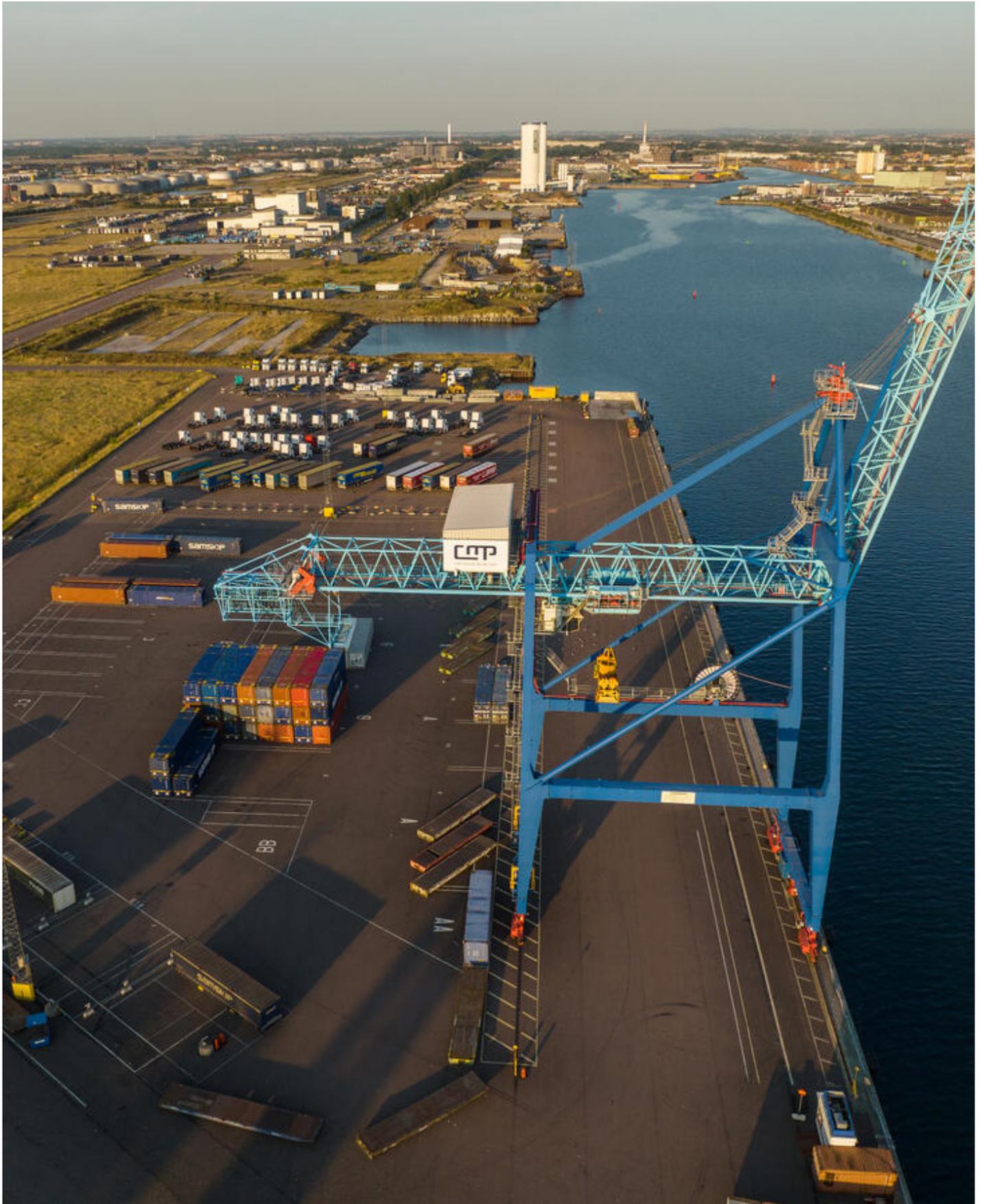
Corporate and financial institutions are adapting their climate strategies in response to stringent climate policies at a global, federal and regional level. As major players in the bond markets to finance large infrastructure projects, ports must pay attention to these changes. The demand for ESG reporting, disclosure and climate target setting is growing due to increased scrutiny from shareholders and bond investors who are including climate physical risks (e.g., resilience) and mitigation elements in the evaluation of their portfolios. Widespread recognition of climate change and a rising interest in ESG investing from both institutions and individuals has led to a push for standardization of policies and practices. The Securities and Exchange Commission (SEC) is likely to enact standardized disclosure regulations for publicly traded companies in the U.S. later in 2024 and the International Sustainability Standards Board (ISSB) has issued a global baseline to ensure companies provide sustainability-related information alongside financial statements, requiring companies to have plans to disclose physical and transition risks as well as their potential impact as they strive to reducing emissions.^{32, 33}

Updated global and federal climate regulation has led port users, such as beneficial cargo owners, to publicly commit to limiting global warming to 1.5°C through net zero by 2050-aligned strategies, as aligned with the Paris Agreement. Therefore, ports must increase their climate impact and ambition to keep up with the ongoing energy transition, respond to company commitments to decarbonized supply chains and meet the U.S. government's climate ambition.

Voluntary sector specific initiatives, such as Cargo Owners for Zero Emission Vessels (CoZEV), have set a maritime shipping decarbonization target of zero by 2040.³⁴ These initiatives are also key drivers for ports to adopt climate action strategies and phased net zero plans to facilitate a zero-emission supply chain. By contributing to a zero-emission supply chain, ports can be competitive in drawing customers with their own decarbonization goals and attract more businesses seeking low-carbon solutions.

First mover shipping companies, such as shipping major Maersk, are also playing a key role in driving corporate climate action through their own commitments to decarbonize. Maersk has committed to decarbonize their container terminals to a 70% reduction in total emissions by the year 2030 (Maersk) and net zero by the year 2040.³⁵ This is the port industry's most ambitious GHG emission target and whether guided by regulatory or financial pressure, first mover action will have a significant impact on the speed with which ports are responding with net zero strategies.

Port leadership can unlock significant funding and investments by supporting their users in their decarbonization journey, thus boosting their competitive position and unlocking new development opportunities.



DECARBONIZATION ACTIONS AND ENVIRONMENTAL JUSTICE OUTCOMES

EJ Outcome: Less air and water pollution from decarbonized ships and vessels, improving the aquatic ecosystem and livelihoods of nearby communities that depend on fishing and aquatic farming.

Action: Procurement for efficient and low-carbon equipment like ship-to-shore cranes.

Action: Facilities that support a circular economy, like reusing and recycling low-carbon goods and materials.

Action: Support for zero-emission freight projects, like charging infrastructure for electric trucking.

EJ Outcome: Less air pollution from decarbonized trucks and ships, creating better air quality for nearby communities.

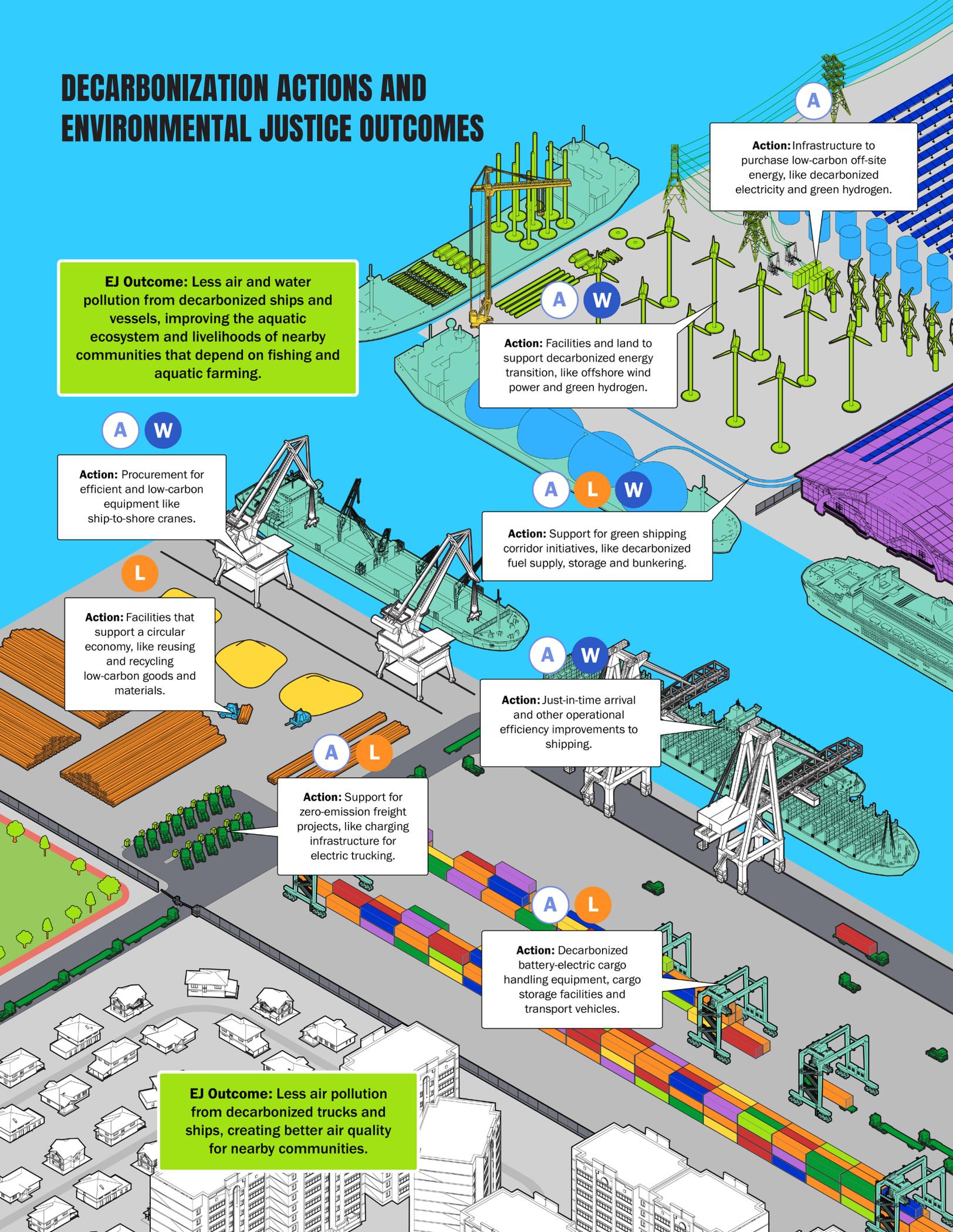
Action: Facilities and land to support decarbonized energy transition, like offshore wind power and green hydrogen.

Action: Support for green shipping corridor initiatives, like decarbonized fuel supply, storage and bunkering.

Action: Just-in-time arrival and other operational efficiency improvements to shipping.

Action: Decarbonized battery-electric cargo handling equipment, cargo storage facilities and transport vehicles.

Action: Infrastructure to purchase low-carbon off-site energy, like decarbonized electricity and green hydrogen.



Environmental Justice Links

- A** Air
- L** Land
- W** Water

EJ Outcome: Well-paying, safe, green jobs that support a new energy economy.

Action: On-site port solar and other renewable power generation.

A

Action: Support for decarbonized passenger transit, like electric trains.

A L

Action: Support for decarbonized passenger transit, like charging infrastructure for electric buses.

A L W

EJ Outcome: Co-development of projects with nearby communities, improving road safety and increasing access to green space.

EJ Outcome: Increased access to affordable decarbonized public mass transit modes near ports.

Action: Efficient and decarbonized port buildings.

L

Action: Decarbonized harbor vessels using battery-electric or green hydrogen.

W

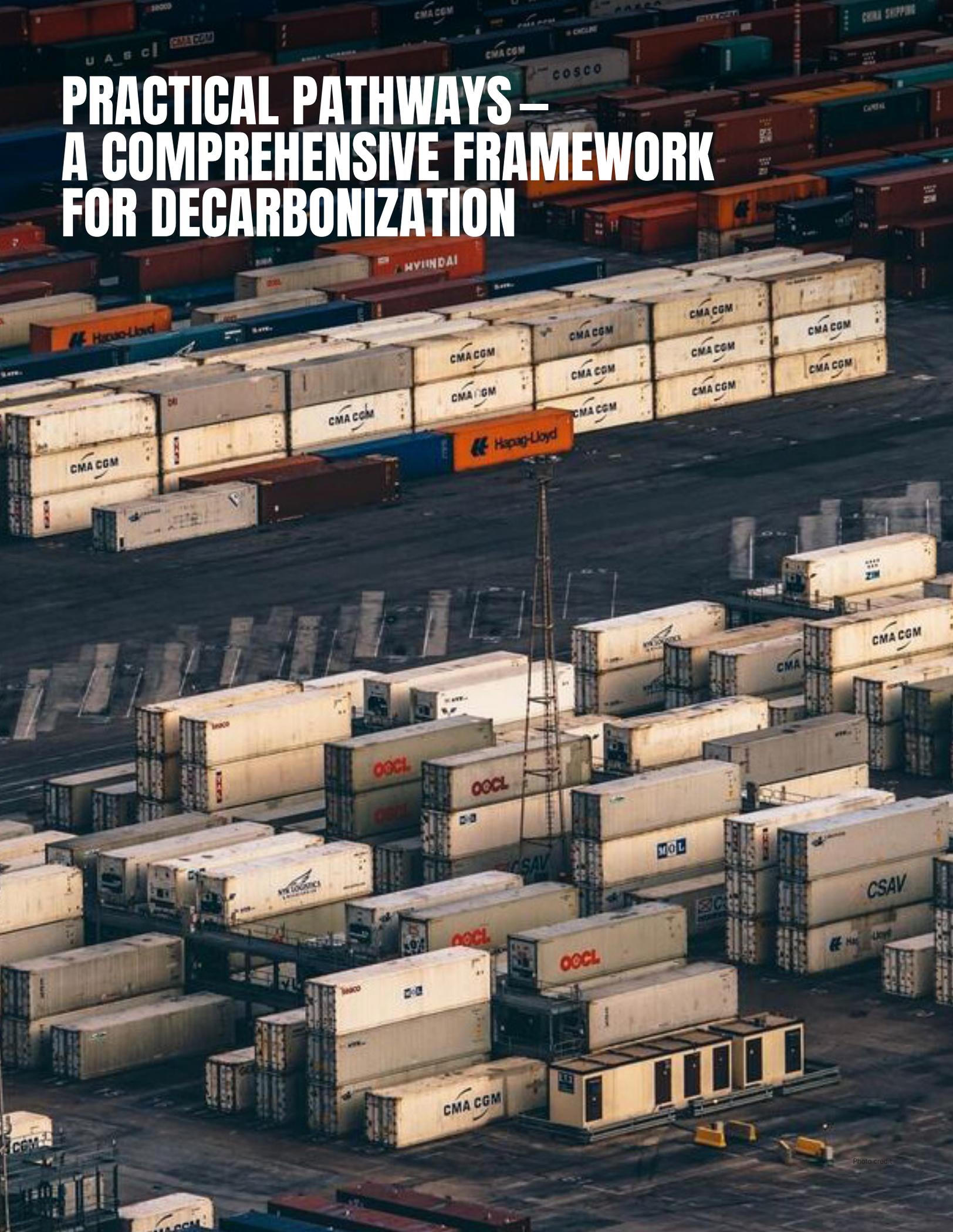
Action: Decarbonized shore power for vessels at berth.

W

Action: Low-carbon dredging works that reduce capital carbon impacts.

A W

PRACTICAL PATHWAYS – A COMPREHENSIVE FRAMEWORK FOR DECARBONIZATION



HOW THIS GUIDE TACKLES THE IDENTIFIED CHALLENGES

This section describes how U.S. ports can tackle the identified challenges to fully embrace the opportunities that climate action presents and to manage the risks inherent to delayed or piecemeal action. The topics covered in this section are summarized in the table below.

Challenge	How this guide helps ports
 <p>1. Current climate action isn't embracing the full influence of ports.</p>	<p>We describe a comprehensive view of the actions ports can take on decarbonization, spanning their control and influence.</p>
 <p>2. Fragmented governance of ports is hampering integrated efforts.</p>	<p>We identify actions for three different port roles—port landlord, port authority and port terminal operator—while linking those actions to common outcomes. This recognizes the specific actions for each role and gives different organizations sight of others' actions, all focused on a shared goal and outcome.</p>
 <p>3. Uncertainty is hindering planning.</p>	<p>We describe a staged approach for decarbonization planning through uncertainty, covering strategy, planning and actions in three different areas. The actions include more mature solutions that can be deployed in the near term and less mature interventions that require studies and pilots for later implementation.</p>
 <p>4. Action isn't connected to climate goals.</p>	<p>We describe how actions can be aligned with climate goals specific to the port's local context. We set out an approach to action planning that works backwards from emission reduction targets so that port actors can be confident in their climate leadership and the effectiveness of their interventions. We also describe how this links to organizational reporting aligned with the Greenhouse Gas Protocol.</p>
 <p>5. Environmental justice needs are not always prioritized.</p>	<p>We outline an EJ framework that ties decarbonization actions to specific opportunities to advance environmental justice. The framework also provides a common vocabulary of EJ opportunities as they relate to port actors. By understanding the synergies between decarbonization and EJ opportunities, port actors can better prioritize projects that align with both social and environmental goals. EJ opportunities are included in the actions section of the report, where applicable.</p>
 <p>6. Ports lack funding for impactful action.</p>	<p>We link actions to new funding opportunities under BIL/IRA that ports can leverage to fund decarbonization. We detail multiple programs and discuss which opportunities can fit both planning and construction projects.</p>

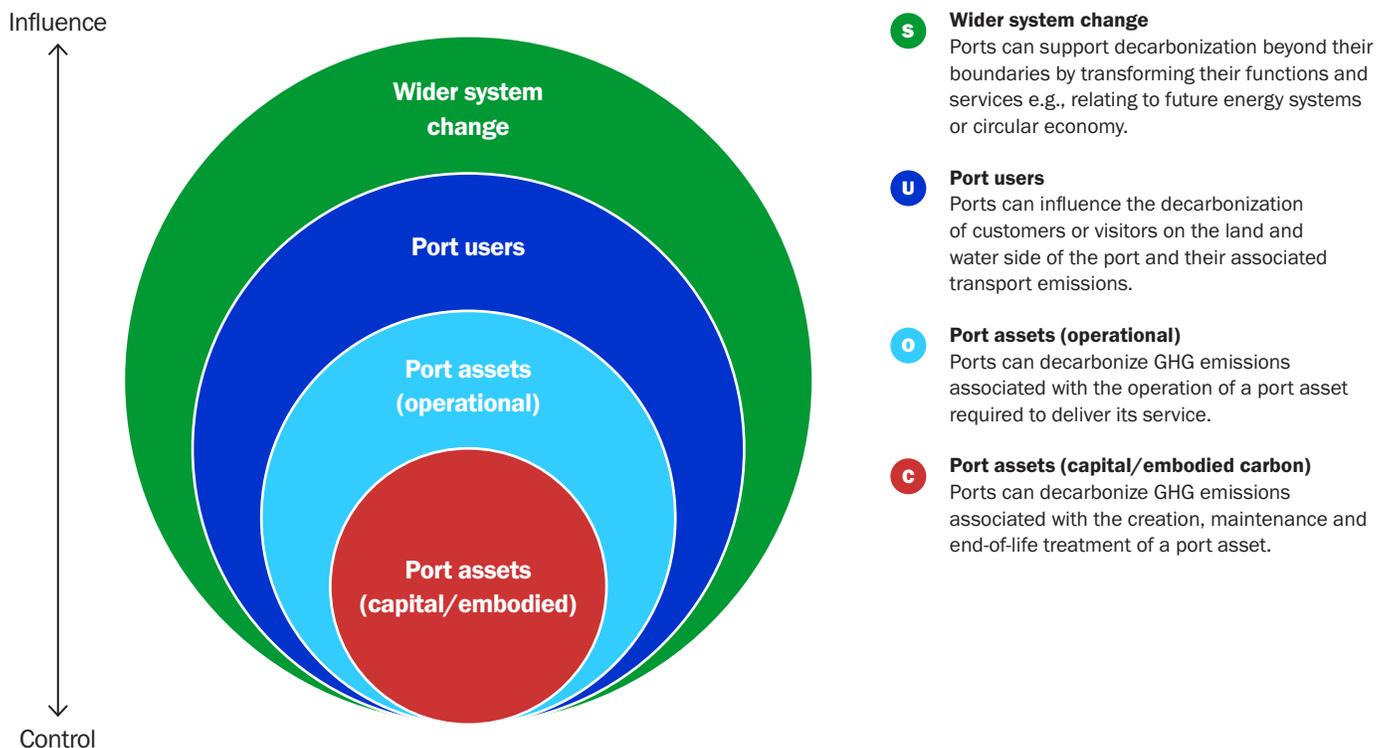


Response to challenge #1: A comprehensive view of actions

The *Practical Pathways* guide takes a comprehensive view of action that will manage ports' climate risks and capitalize on ports' climate opportunities. It includes action on port assets and operations and also on port users. This framing recognizes that ports cannot directly control emissions from ships, trucks and rail, but they can support and encourage their transition to zero-GHG emissions, unlocking benefits for ports and their adjacent communities. Importantly, port business models are directly tied to the GHG emissions of port users — without action, as port profits increase so too do user GHG emissions. This framing also explores the new functions that ports can deliver in a low-GHG, circular and resilient economy.

The actions described later in this report link port outcomes to four impact areas, shown below. This impact framing captures more than the typical Scope 1/2/3 framing that has historically not been well-aligned to ports. There are many drivers for ports to act in this expanded zone of influence to accelerate mitigation and EJ priorities. In their central position among many port stakeholders and users, ports and port leadership have relational influence that enable them to convene stakeholders and facilitate broader action among port users for wider system change — no other stakeholder in this space has the same convening and facilitating ability.

FIGURE 1
Areas of impact



Response to challenge #2: Describing actions for different port roles



The *Practical Pathways* action framework brings together a system-view of outcomes (changes required at the port) and organizational actions (how each stakeholder can support this change, recognizing their jurisdiction). Focusing on three primary organizational roles, it sets out the actions required by each party, linked to a common outcome.

We have shaped the actions around the three primary port roles described below. We acknowledge that governance and roles vary at each port; this framework allows the actions to be grouped together to suit a particular port's governance model.

Role	Headline action areas
 <p>Port Landlord The owner and developer of port land. Often also the body that develops main port infrastructure and navigation. May be a public or private body. Has a strategic planning role.</p>	<ul style="list-style-type: none">• Incentivize action on decarbonization by port/terminal operators.• Shape port master plans that are centered on decarbonization.• Lead decarbonization plans that bring together a holistic view of port impact areas.• Implement actions that support decarbonization of port development projects.• Invest in and/or lease land for new facilities to support decarbonization of port operations, port users and new port facilities that support the energy transition.
 <p>Port Authority The organization typically responsible for overall port governance. Authority sets the planning framework and enforces national and port—specific rules and regulations, linking to environmental, security and safety issues. They often provide services to ensure safe navigation.</p>	<ul style="list-style-type: none">• Shape port regulatory and policy environment to support and incentivize decarbonization across the impact areas.• Shape or contribute to port master plans that are centered on decarbonization.• Contribute to navigation-focused elements of port decarbonization plans.• Implement actions that support decarbonization of navigation activities.
 <p>Port/Terminal Operator The organization who leases a part of the port for operations including cargo handling, logistics, navigation, passenger transport, bunkering and retail. Sometimes this is done directly by the landlord, as owner-operator; or with multiple third-party operators with individual terminals.</p>	<ul style="list-style-type: none">• Work with port equipment suppliers to accelerate the implementation of effective zero-carbon products.• Develop terminal decarbonization plans and contribute to wider port decarbonization plans.• Invest in new port infrastructure and equipment to support decarbonization of port operations and port users.• Participate in green shipping corridor partnerships to explore the possibilities for zero-GHG fuel supply for shipping.



Response to challenge #3: Planning through uncertainty

The world is full of change and uncertainty that impacts ports' planning — climate change, societal attitudes, consumer demands, policies, funding opportunities and technologies. Decarbonization actions by ports involves embracing new technologies. These can be enabling technologies, such as expanded use of renewable energy (wind, solar); shore power technology; the use of digital platforms to understand and manage emissions; or new on-the-ground technologies that unlock more efficient and low-carbon energy use, such as zero-GHG emission cargo handling equipment. In some cases, these technologies are immature, the most advantageous option is unclear or the technology required by users (for example, vessels) is unclear.

Furthermore, drivers for climate action — linked to regulation, finance, stakeholders or customers — are changing rapidly and will continue to change over time and space. And, while the climate transition risks associated with delayed decarbonization are arguably more significant than the risks associated with uncertainty, such transition risks are not often formally recognized or quantified in current organizational decision-making. These transition risks can include but are not limited to litigation risk from noncompliance with future regulations, loss of revenue due to shifts in supply and demand; negative public reputation; or write-offs from early retirement of inefficient assets.

To be effective and mitigate future risks, ports must take an integrated approach to decarbonization planning, rather than planning at an asset-by-asset or user-by-user basis. To acknowledge this context, the action dashboard included in this report discusses actions linked to threetime horizons. These time horizons are broadly linked to port planning and implementation timelines, as well as natural progressions of specific actions (e.g., planning occurring prior to implementation). However, we recognize that such timelines will vary for individual ports depending on their size, structure, leadership ambition and capacity.

The action tracker includes:

1. **Short-term (one to two year horizon) and medium-term (five year horizon) actions focused on strategy and planning.** These involve port authorities and landlords creating dynamic plans that can be updated over time as the context changes.
2. **Medium-term (five year horizon) actions linked to more mature solutions.** These focus on port operations but also some port user initiatives.
3. **Medium-term (five year horizon) actions around both piloting less mature solutions and planning for rapid uptake of these solutions in the long term.** These are mostly focused on transport users on land and sea, many of which are “hard to decarbonize” sectors.
4. **Long-term (five to 25-year horizon) actions linked to the rapid decarbonization of port users.** These focus on the evolution of ports to hubs for a low-carbon, resilient and sustainable economy.

Short Term
1 to 2 year horizon

Medium Term
1 to 5 year horizon

Long Term
5 to 25 year horizon

Response to challenge #4: Aligning action with climate goals



Creating a clear decarbonization goal with medium- and long-term net zero target dates provides a clear pathway against which ports can plan and deliver actions. By aligning targets with relevant local, state, federal and international climate ambitions, as well as considering the existing decarbonization strategies of all stakeholders and port users, ports can unlock investment and federal funding, contribute to transparency in climate mitigation tracking and reporting progress, cultivate stakeholder support and promote collective action. Ports can then assess, plan and implement a range of interventions to support achieving decarbonization targets.

Each port will need to review its own local context when identifying driving policies and ambitions, but certain policies and climate drivers will be relevant to all. These include, but are not limited to, the Cargo Handling Equipment Regulation, Clean Air Act, Corporate Average Fuel Economy Standard, the International Maritime Organization (IMO) 2023 GHG Strategy, the Paris Agreement and regulations from the U.S. Environmental Protection Agency for port-related sources (e.g., heavy-duty trucks, ocean-going vessels, rail), among others.³⁶

Since ports play a key role in enabling port user's climate commitments, ports can guide their decarbonization strategies based on available and reliable third-party resources such as and not limited to, the Greenhouse Gas Protocol (GHGP), the Science Based Target Initiative (SBTi), Green Marine and others. These corporate standards and guidance tools enable industry to create sustainability strategies that promote accountability in emission reporting. This *Practical Pathways* guide aims to enable ports to contribute to their user's sustainability strategies and set decarbonization targets that are aligned with federal and global climate policy.

U.S. Climate Policy

The U.S. does not have federal policy that explicitly regulates port GHG emissions; however, federal policy does regulate ports' general environmental impacts. Policies include the Clean Air Act (which regulates emissions from diesel engines, marine vessel loading operations and vehicle emissions, among others), the Clean Water Act (which regulates discharge of pollutants into navigable waters), the National Environmental Policy Act (which requires analysis of environmental impacts for federal construction projects) and the Corporate Average Fuel Economy (CAFE) standard that regulates how far vehicles must travel on a gallon of fuel with the goal to increase the fuel economy of cars and light trucks.³⁷

The federal government also provides supportive programs for ports, primarily through the EPA Ports Initiative which provides funding, technical resources and coordination for ports to support a broader goal of U.S. port leadership in clean and efficient transportation. This combination of policy with supportive programs ensures that ports meet clear mandates to limit adverse environmental impacts and aspire to higher environmental action.

Ports planning for a zero-emission future need to align with numerous land-side and water-side policies. A summary of some such policies follows:

Policy type	Name	Description and implication
Ocean-side (International and Domestic)	IMO GHG Strategy	The IMO has agreed to a clear decarbonization pathway for shipping, with a long-term net zero target and interim checkpoints. Ships on international voyages will be subject to increasingly stringent regulations put in place to achieve these goals.
	SBTi Maritime Sectoral Pathway	The SBTi has developed sector-specific emission trajectory for shipping that is aligned with a 1.5°C Paris Agreement goal. This trajectory is globally recognized including by governments, cargo owners and investors.
	U.S. Federal Environmental Policy/ U.S. EPA	The U.S. Federal Clean Water Act regulates discharge of pollutants and water quality in the navigable waters of the United States. It's managed partially via the National Pollutant Discharge Elimination System (NPDES) which is a permit program that regulates point sources that discharge pollutants. While this doesn't regulate GHG emissions directly, it does regulate stormwater, wastewater and vessel discharges which indirectly supports cleaner fuels and electrification.
Land-side (City, State, Federal)	City, County and State Climate Action Plans	Climate Action Plans published at different levels of local government set out decarbonization and GHG emissions targets and detailed actions to achieve them. The specifics and level of ambition of the plans relevant to each port will vary depending on its location. Typically, these plans do not include binding regulations on ports emissions, but broader regional goals related to decarbonization or air or water pollution.
	U.S. Federal Environmental Policy/ U.S. EPA	<p>The U.S. Clean Air Act (CAA) regulates air quality standards. For ports, these standards cover six criteria air pollutants and emissions from diesel engines, marine vessel loading operations, paint coatings and emissions from vehicles and other types of port equipment. The Clean Air Act has the statutory authority to regulate greenhouse gases that contribute to climate change, which it regulates directly for some stationary emitters, which does not include ports. However, regulation of the criteria pollutants indirectly supports decarbonization by (1) supporting renewable and cleaner fuels and electrification to reduce overall air pollutant emissions and (2) by limiting the greenhouse effect of some of the criteria pollutants (like particulate matter).</p> <p>Some policies have established ongoing funding or technical support programs for ports that can unlock funding opportunities. One example is the EPA Clean Ports Program, established through the IRA. Another example is the Diesel Emissions Reduction Act (DERA) which established an ongoing program through which the EPA issues "clean diesel" grants for eligible heavy-duty vehicles, marine engines, cargo handling equipment and numerous other types of equipment when older engines are replaced or retrofitted to reduce diesel emissions.</p> <p>A few states have authority beyond the EPA regulations related to limiting port emissions. For example, in California, the EPA has provided authorization for the state to regulate the manufacture of new vehicles and equipment including port mobile cargo handling equipment and shore power equipment.</p>
	Zero-Emission Vehicle Regulations	<p>Some federal and local policies and programs set mandates or goals to reduce road vehicle emissions, which indirectly impact port decarbonization through fleet users and support for vehicle charging infrastructure.</p> <p>At the federal level, the U.S. EPA and DOT set a second round of standards ("Phase 2") in 2016 that regulate the fuel efficiency and carbon emissions of medium- and heavy-duty vehicles (MD/HD) to cut carbon pollution. At the time of this writing in 2023, EPA has proposed a new Phase 3 rule to strengthen the carbon emission standards for HD vehicles.</p> <p>In California, the California Air Resources Board (CARB) Advanced Clean Fleets (ACF) requires certain vehicle fleets to transition to zero-emission vehicles (ZEV) and sets requirements for manufacture of ZEV trucks starting in 2036. The complementary CARB Advanced Clean Trucks regulation sets manufacturers ZEV sales requirements and reporting requirements for large entities and fleets. In New York State, a 2020 MOU seeks to accelerate the market for electric MD/HD vehicles, with goals of 30% sales ZEV by 2030 and 100% sales by 2050.</p>

Global climate policy

Ports' key role as international hubs makes them responsible players in global climate policies and voluntary sectoral commitments. While global climate policies have yet to explicitly target ports, increasing sectoral policy on port users and voluntary commitments by ports, governments and port users will directly impact ports and their ability to respond. By setting goal-based decarbonization targets, ports can prepare climate action plans in alignment with global climate goals.

The UN's Intergovernmental Panel on Climate Change UN IPCC has indicated that crossing the 1.5 °C climate threshold risks unleashing far more severe climate change impacts, including more frequent and severe droughts, heatwaves and rainfall. To limit global warming to 1.5 °C, GHG emissions must peak before 2025 at the latest and decline 43% by 2030.³⁸ The Paris Agreement, a legally binding international treaty on climate change, has set an overarching goal to hold "the increase in the global average temperature to well below 2 °C above pre-industrial levels" and pursue efforts "to limit the temperature increase to 1.5 °C above pre-industrial levels."³⁹ Through the Paris Agreement, countries are to communicate their national climate action plans, known as nationally determined contributions (NDCs) and communicate the actions taken to reduce their GHG emissions as well as ensure alignment to the Paris Agreement temperature goal. Global pressure for countries to be accountable for their climate action has influenced global sectoral policy commitments as well as private sector voluntary commitments.

The UN has sector specific agencies that regulate GHG emissions for the transport sector. For example, the International Maritime Organization (IMO), the United Nations agency with responsible for the safety and security of shipping and the prevention of marine and atmospheric pollution by ships, regulates the shipping sector. The IMO recognizes the need for technological innovation to decarbonize shipping and as of 2023 has agreed on a strategy with targets, guiding principles and potential measures to reduce GHG emissions from international shipping. The strategy aims to achieve "net zero" emissions from international shipping by or around, the year 2050, with the following interim goals:

1. Reduce annual GHG emissions by at least 20%, striving for 30%, by 2030, compared to 2008.
2. Reduce annual GHG emissions by at least 70%, striving for 80%, by 2040, compared to 2008.

The phased emissions reduction pathways that have been proposed by the IMO has signaled to industry that the maritime energy transition is necessary for the sector to meet the proposed decarbonization targets. While these targets are maritime specific, they have implications for ports and their ability to facilitate the maritime sector's climate goals.

Voluntary sectoral commitments

In addition to global climate policy, voluntary and mandatory governmental climate commitments are being used as levers to stimulate the demand for low- and zero-emission fuels and technologies that are needed to meet regional, federal or global climate goals.

For drayage trucks, for the technology to scale sufficiently global zero-emission, heavy-duty truck production must hit economies of scale by 2035 to align with the Paris Agreement goals. Grid readiness for charging fleet at depots and long-distance public charging must be scaled up in the same timeframe in order to enable demonstrable decreases in emissions from HDV. In February 2023 the Biden-Harris administration announced funding for "Zero-Emission Medium- and Heavy-Duty Freight Corridors" through the DOE.⁴⁰ At the time of

writing, the DOE has awarded \$7.4 million to seven projects to develop medium- and heavy-duty electric vehicle (EV) charging and hydrogen corridor infrastructure plans and to reduce emissions from freight corridors and other facilities, like ports.

In the maritime space, voluntary climate commitments include the UNFCCC COP26's Clydebank Declaration, where signatory countries, including the U.S., have declared their ambition and intent to support the creation of green shipping corridors.⁴¹ The U.S. envisions green shipping corridors as "maritime routes that showcase low- and zero-emission lifecycle fuels and technologies with the ambition to achieve zero-GHG emissions across all aspects of the corridor in support of sector-wide decarbonization no later than 2050."⁴²

As government and industry showcase voluntary climate commitments through freight and shipping corridor initiatives, ports must be enablers through climate action plans that are aligned to these climate commitments and goals.

Corporate climate action and third-party resources

Global and federal policies, international financial report standards and voluntary climate commitments have stimulated the socially conscious finance community to set Environmental, Social and Governance (ESG) standards for private sector company behavior.⁴³ Through ESG commitment and reporting, companies are demonstrating public commitments to sustainability, ensuring their products and services contribute to sustainable development and climate goals through sustainability reporting.

Most recently the International Sustainability Standards Board (ISSB) issued its first International Financial Reporting Standards (IFRS) Sustainability Disclosure Standards, IFRS S1 and IFRS S2. The Standards are meant to inform investment decisions by improving a company's sustainability disclosure, ensuring companies provide sustainability-related information alongside financial statements. As this is a global standard for climate-related financial disclosure, companies — some of which are port users — will have increased pressure to develop a robust transition plan in alignment to these Standards. This increased pressure from the finance community on port users will soon, directly or indirectly, impact ports.

Third party resources such as the Carbon Disclosure Project (CDP), SBTi, the GHGP and others, are guiding the private sector to align their climate commitments to science-based targets and deliver on social responsibility.^{44, 45} Ports are not yet considered an audience of scope for some of these third-party standards and resources given their complexity. However, given the unique position ports play as hubs for energy system and trade, ports are recognized as crucial enablers of private sector sustainability through their relationship with port users.

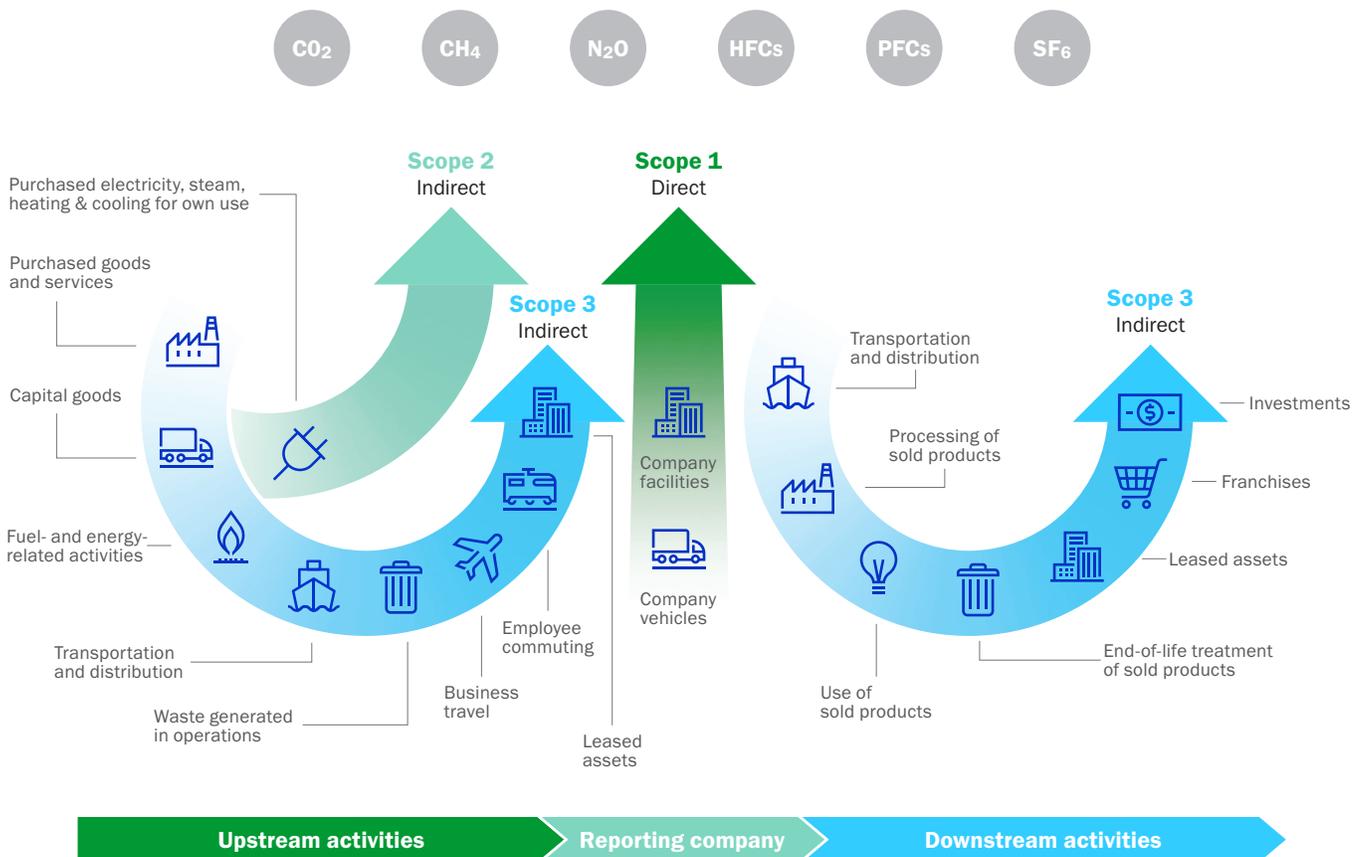
Globally, there are recognized decarbonization resources such as the GHGP and SBTi that provide standards and tools to help companies, cities and governments track progress toward climate goals. The GHGP offers a Corporate Accounting and Reporting Standard that provides guidance for organizations preparing a GHG emissions inventory. SBTi, on the other hand, serves as a third-party resource providing companies and organizations a defined path to reduce emissions in line with the Paris Agreement climate goals.⁴⁶

Greenhouse Gas Protocol (GHGP)

The GHGP provides a widely adopted corporate accounting standard for GHG emissions, categorizing them into three scopes as illustrated in the figure below.⁴⁷ While this provides a useful framework for corporate-level carbon accounting and decarbonization action for companies and other organizations, it does not always promote a holistic approach to decarbonization for hubs like ports.

As described previously, ports are governed by a range of organizations, with organizational roles (and thus Scope, 1, 2 and 3 emissions) differing between ports. Furthermore, the vast majority of ports' decarbonization impact is in the form of indirect influence rather than direct control of these organizations. As such, using the GHGP as a starting point for port decarbonization planning has the effect of narrowing the view of the influence of each organization, even when considering all indirect value chain emissions (Scope 3).

FIGURE 2
Overview of GHGP scopes and emissions across the value chain



Science Based Targets Initiative (SBTi)

SBTi is a global body enabling businesses and financial institutions to set ambitious emissions reduction targets in line with climate science. SBTi is focused on accelerating companies globally to halve emissions before the year 2030 and achieve net zero-emission by the year 2050. SBTi provides guidance for companies, across sectors, to plan for a low-carbon future by providing a clearly defined pathway to reduce GHG emissions in line with the goals of the Paris Agreement to limit global warming to a 1.5 °C above pre-industrial levels and is consistent with the UN body in assessing the science related to climate change (IPCC).⁴⁸

To support target-setting process, the SBTi has developed guidance material that includes the SBTi Corporate Net Zero Standard supporting corporates in setting net zero targets and the Corporate Net Zero Standard Criteria which includes the criteria to which a company's net zero targets must conform with to be validated by the SBTi.

Limited guidance for ports

There is limited guidance available for port organizations to approach Scope 3 emissions and some approaches to date are inconsistent. While the GHGP offers a corporate accounting and reporting standard that provides guidance for organizations preparing a GHG emissions inventory and SBTi serves as a third-party resource providing companies and organizations a defined path to reduce emissions in line with the Paris Agreement climate goals, neither are port specific nor do they lend themselves to assisting ports in addressing Scope 3 emissions or emissions from port users.

The SBTi guidance does include individual sectoral guidance for land transport and sea transport that can be used as an example for how port users are guiding their net zero action plans.⁴⁹ At the moment the few U.S. ports that have committed to the SBTi have set emissions reduction paths for Scopes 1 and 2. Further guidance is needed on how to report a port's Scope 3 emissions.

As such, this *Practical Pathways* document takes a comprehensive approach to exploring port decarbonization actions based on systems view rather than starting with an organizational GHGP framing. The decarbonization actions and framework in this report follow this approach which aligns GHG emissions and decarbonization across impact areas of port capital/embodied assets, port operational assets, port users and wider system change. Utilizing this approach and the guidance of third-party resources, ports can construct short- and long-term climate action plans that align to their user's climate targets.

The actions described in this guide will make significant contributions to GHGP scopes and categories as outlined in the following table. The links between these impact areas and decarbonization actions are explored in further detail in the actions table.

Practical Pathways impact area

Organizational reporting (Scope 1, 2 and 3) considerations

<p>C Port assets (capital/embodied)</p>	<p>Action in this area will reduce organizational Scope 1 emissions if the capital works are undertaken in-house by the port organization. If capital works are undertaken by third parties (contractors) or involve purchased products (as is likely), this will reduce Scope 3 organizational emissions, under Category 1 (purchased goods and services) or Category 2 (capital goods).</p> <p>It is not common for ports to account and action plan for capital/embodied carbon when using a GHGP framing. Action in this space will help ports retain a social license for port development projects as decarbonization pressure grows.</p>
<p>O Port assets (operational)</p>	<p>Action in this area can reduce Scope 1 and 2 emissions for the organizations who own (or lease-in) port assets. It will also reduce Scope 3 emissions for organizations who lease-out assets—such as port landlords—under the GHGP Scope 3 Category 13 (Downstream Leased Assets) (GHGP Scope 3 Calculation Guidance).</p> <p>It is more common for ports to account and action plan for operational emissions, but only those they own and operate, rather than those they lease-out. However, by acting across their whole value chain, port landlords can best manage climate risks and capitalize on climate opportunities.</p>
<p>U Port users (user emissions)</p>	<p>Action in this area can reduce Scope 3 emissions, which are almost always (by a significant margin) the most significant of a port organization’s value chain.</p> <p>It should be noted that there is a lack of formal guidance or consistent approach on how port organizations treat user emissions. GHGP Scope 3 Category 9 (Downstream Transportation and Distribution) is sometimes referenced or Scope 3 Category 11 (use of Sold Products).</p> <p>A port that has decarbonized its own operations and assets but that is still facilitating fossil fuel-based supply chains will not adequately manage climate transition risk or capitalize on climate opportunities. Action in this area—in collaboration with others—is essential to ports’ future success.</p>
<p>S Wider system change</p>	<p>Action in this area is not about reducing port organization’s existing Scope 1, 2 or 3 emissions, but supporting the whole societal move to net zero-GHG emissions. As such, actions in this area (for example, supporting development of an offshore wind logistics base) could potentially increase port organizational emissions but have a much greater benefit for wider societal decarbonization.</p> <p>This impact area is focused on ports delivering functions that are aligned with our future low-carbon sustainable economy. They are essential to future-proofing ports as businesses.</p>



Response to challenge #5: Advancing environmental justice

Port-adjacent communities are exposed to higher levels of harmful pollutants from port operations and this pollution is directly linked to elevated rates of chronic health conditions, hospitalizations and premature mortality as compared to other communities. Port communities also tend to include historically marginalized populations including people of color, lower-income and less formally educated populations — meaning that these already disadvantaged populations bear the disproportionate burden of these pollutants. One assessment indicates that approximately 40% of zip codes within a 25-mile radius of California’s major ports are classified as "disadvantaged" communities, characterized by high unemployment, low income and low levels of educational attainment.⁵⁰ A separate study of 50 American ports reveals that individuals residing within two miles of port infrastructure are more likely to be minority, lower-income and less formally educated compared to those in neighborhoods further away.⁵¹

The proximity of these communities to ports is typically a consequence of long-standing urban planning and investment practices, particularly redlining, which have resulted in generational and historical inequitable impacts.⁵² The persistent and often intentional underinvestment in infrastructure and the exclusion of communities adjacent to ports from such investment and development exacerbate the challenges faced by these communities. The following section outlines the specific, physical environmental justice burdens afflicting port-adjacent communities categorized into three primary domains: air, water and land. The following examples draw on the most consistent language and taxonomy identified through the review and recognize the interconnected, systemic challenges outlined above.

Air

The movement of goods through fossil fuel-dependent ocean-going vessels and trucks causes increased particulate matter (PM 2.5), GHG emissions, smog and other toxic air pollutants in adjacent communities and along the truck or locomotive routes emanating from the marine terminals.⁵³ This poor air quality causes disproportionate adverse health outcomes. Prolonged exposure to these air pollutants can cause or exacerbate a myriad of adverse health effects including asthma, cancer and premature mortality.⁵⁴ In response, many ports are looking for ways to better track and mitigate their emissions to control air pollution more effectively. For example, the Port of Houston (PHA) has been tracking air quality improvements for PHA and non-PHA sources through the development of Goods Movement Emission Inventories (GMEI). Between 2013 and 2019 the port has seen reductions across all reported air emissions for activity associated with PHA terminals. While the scope of their carbon neutral goal is not inclusive of user emissions, the GMEI provides important benchmarking to develop broader targets and goals.⁵⁵

Some ports and community groups are jointly researching the public health impacts of living and working by ports to better understand impacts and opportunities for improvement. For example, the Duwamish Valley, a community that experiences health impacts related to the Port of Seattle’s operations, completed a Cumulative Health Impact Analysis in 2013. They found that the neighborhoods surrounding the Port of Seattle had an eight-year shorter life expectancy and 50% chance higher rate of heart disease than the Seattle average.⁵⁶

Water

Port operations can significantly degrade water quality, posing risks to both aquatic ecosystems and the communities that depend on them. Wastewater from ships, leakage of toxic substances from vessels and stormwater runoff all contaminate water. Fossil fuel-based ships, trucks and equipment can all produce contaminants that can discharge directly or runoff into the water. Contaminated water not only endangers aquatic ecosystems, but also threatens the communities that rely on them for food and livelihoods and directly harms people exposed to contaminated water via recreation or work.⁵⁷

Land

Operations at ports, including the use of equipment like straddler carriers and forklifts, generate flashing lights and substantial noise. This light and noise pollution, along with vibrations from port activities, have detrimental effects on both the workforce and the surrounding community. Such pollution can lead to health issues such as hearing loss, hypertension and sleep disorders for adjacent communities and can negatively affect worker productivity.⁵⁸

Infrastructure and transportation channels created to service ports also cause congestion, traffic and road safety issues. In many locations, due to the redlining, ports and adjacent roads have become physical barriers dividing neighborhoods from important local resources such as grocery stores, health services, pharmacies, retail centers, transit and recreation spaces.⁵⁹

While ports play a critical role in supplying jobs in their community, these jobs can present risks and hazards that must be mitigated. For example, there have been reported accidents of chemical explosions or leakages that have severely harmed or killed employees at ports.⁶⁰

Addressing challenges with communities

In response to these challenges, ports, communities and community groups across the U.S. are beginning to take significant steps to advance environmental justice across these three domains.

A key strategy in this endeavor is air quality monitoring, which has proven instrumental in understanding the impacts of air pollution at numerous ports. Collaborations with local communities and governmental agencies are also fostering positive change and co-creation. For example, the City of Seattle completed a bike and pedestrian access and mobility impact analysis to understand port impacts on these modes of transport.⁶¹ The Port of San Diego has partnered with San Diego State University's Center for Energy and Environmental Justice to conduct research on environmental justice issues, including a study on the port's transition from diesel to electric cranes.^{62,63}

Parallel to these efforts, numerous community organizations have formed to lead environmental justice initiatives in their port communities. By partnering with these community groups, ports have the potential to gain a deeper understanding of community needs and project priorities and further enhance their ability to implement effective strategies that advance both decarbonization and environmental justice goals. Some alliances include The Moving Forward Network (National), Duwamish Valley Communities (Seattle), Harbor Community Benefit Fund (LA/Long Beach), Healthy Port Communities Coalition (Houston), Coalition for Healthy Ports (NY/NJ), West Oakland Environmental Indicators Project (Oakland) and Low Country Alliance for Model Communities (Charleston).



Response to challenge #6: New funding opportunities

Funding has recently been allocated to the EPA and the Department of Transportation (DOT) to expand or create new programs to facilitate enhancing the safety and reliability of the supply chain. With the Biden White House’s *Justice40 Initiative*, which aims to ensure that 40% of the benefits of federal programs accrue to historically disadvantaged communities, EPA and DOT programs also prioritize *climate change and sustainability, equity, workforce development, job quality and wealth creation* in the evaluation of grant applications submitted by U.S. ports and other stakeholders.⁶⁴ These investments both “de-risk” ports leaning into new technologies or approaches to their operations, but also provide incentives for ports to incorporate environmental justice elements and engagement with port-adjacent communities to their project planning.

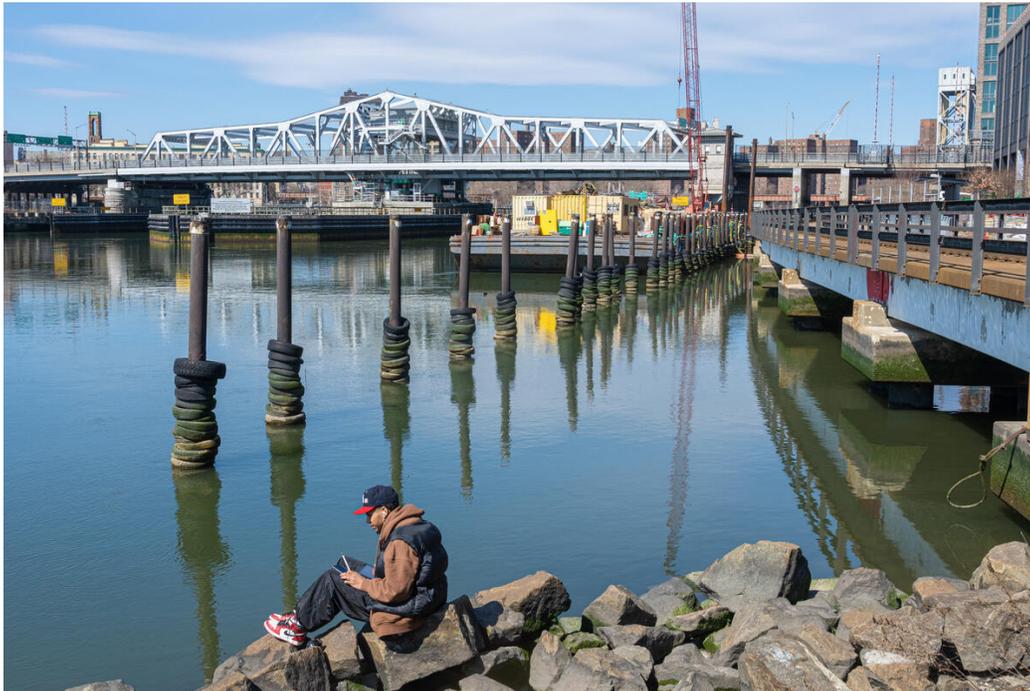
The EPA Clean Ports Program serves as an important mechanism for distributing IRA funding and highlights priorities and opportunities for ports. Established under the IRA, this \$3 billion grant program focuses on port decarbonization, environmental justice and resiliency. It covers all stages of the decarbonization process, from planning — such as developing climate action plans — to installation of zero-emission technologies. Furthermore, the program encourages stakeholder collaboration, especially with low-income and disadvantaged communities.⁶⁵

Other federal funding opportunities span various sectors that intersect with ports and often center environmental justice and community engagement. These include:

Program	Agency	Summary	Funding available
Port Infrastructure Development Program (PIDP)	Maritime Administration (MARAD)	Covers all stages of port development activities that improve safety, efficiency and reliability.	\$450 million allocated in FY 2024
Rebuilding American Infrastructure with Sustainability and Equity (RAISE)	U.S. DOT	Aims to rebuild America’s transportation and port infrastructure with a focus on sustainability and equity.	\$1.5 billion allocated in 2024
Multimodal Projects Discretionary Grant (MPDG)	U.S. DOT	Reduce emissions of road, rail, freight and marine highway corridor transportation modes.	~\$5.5 billion for FY 2023 and FY 2024
Reduction of Truck Emissions at Port Facilities (RTEPF)	Federal Highway Administration (FHWA)	Funds port operation efficiency improvements that reduce truck idling.	\$160 million for FY 2022 and FY 2023. Currently closed
Diesel Emissions Reduction Act (DERA)	U.S. Environmental Protection Agency (EPA)	Provides funding in the form of grants and rebates for projects that reduce trucking diesel emissions and improve air quality.	\$115 million allocated under FY 2022 and FY 2023. Awards anticipated in Spring, 2024

Both the EPA and DOT have worked to provide resources for U.S. ports seeking to expand their decarbonization and environmental justice ambitions. The EPA Ports Initiative provides a technical resources for conducting GMEIs, evaluating the use of shore power technologies and for operational improvements with emissions benefits. The Ports Initiative also provides Community-Ports Collaboration Toolkit and other resources for ports new to these engagements.⁶⁶ DOT has incorporated J40 elements into its strategic plan, including key performance indicators to consistently evaluate how J40 is being integrated into its programming. DOT's J40 staff has developed new guidance for community engagement practices, *Promising Practices for Meaningful Public Involvement in Transportation Decision-Making*, helpful for ports interested in meaningfully engaging with adjacent communities their planning and programs.⁶⁷

For U.S. Ports to be successful in obtaining BIL or IRA funds, they should engage early to assess the needs of the adjacent community and understand their unique characteristics when both applying for and implementing projects through these opportunities. This involves facilitating partnerships, conducting community outreach and evaluating needs in terms of both physical and community resilience. Some resources to help with establishing an initial understanding of surrounding communities and their potential needs include the White House's Climate and Economic Justice Screening Tool (CEJST), EPA's EJScreen, DOT's Equitable Transportation Community (ETC) Explorer the Opportunity Zones Interactive Map and FEMA's Risk MAP.^{68, 69, 70, 71} Additionally, DOE has developed an interagency website including a list of the federal funding opportunities for low- to zero-emission technologies for ports. More resources are available on the following page.⁷²



Building on existing guidance

There is a growing body of guidance, tools and other resources to support port decarbonization. This *Practical Pathways* guide looks at site stakeholder-specific actions within a comprehensive framework but does not provide detailed information around the implementation of actions. As such, this guide complements studies that are specific to key action areas. We highlight additional resources below as particularly complementary to this study.

Report name	Description	Area of action
Carbon Footprinting for Ports Guidance Document	An introduction to “carbon foot printing” and resource guide for ports wanting to develop or improve their GHG emissions inventories/baselines.	• Cross-cutting
AIVP—Good Practice Database (energy transition and circular economy)	Database containing over 150 best practice documents based on real, concrete solutions which contribute to achieving the 10 goals defined in the AIVP Agenda 2030 for sustainable port cities.	• Cross-cutting
UNGC Practical Guidance for Ports	Practical guidance for six themes: Ocean Health and Productivity, Governance and Engagement, Data and Transparency, Climate Resilience, Just Energy Transition and Finance.	• Cross-cutting
EPA: Ports Initiative Resources	Database of resources for improving environmental performance and increasing economic prosperity of ports.	• Cross-cutting
EPA Ports EJ Primer	Helps port decision-makers better understand the needs of near-port communities, how they can help address these needs and build productive community relationships during planning activities and operations.	• Cross-cutting
EPA GMEI Guidance	Describes how to develop port-related and goods movement emissions inventories.	• Cross-cutting
EPA Shorepower Technology Assessment	Characterizes the technical and operational aspects of shore power systems and shows an approach for comparing shore power and vessel emissions while at berth.	• Port assets • Port users
EPA Technical Resources for Ports	A summary page of various port resources including strategies, guidance and assessments.	• Cross-cutting
EDF: Clean Air Guide for Ports and Terminals	A guide describing frameworks (divided into measurement practices, planning initiatives and engagement strategies) used to establish the groundwork for individual sector strategies.	• Port assets
EDF: The Green Freight Handbook	A handbook assisting companies in developing strategies to reduce GHG emissions and overall costs linked to freight transportation.	• Port users
EDF + Maersk Mc-Kinney Moller Center—Maritime Makeover for Investors	A review of maritime shipping progress towards decarbonization, key factors in the sector’s energy transition and recommendations for specific commitments that investors should ask of providers and users of maritime shipping services on the path to zero-emissions by 2050.	• Cross-cutting
Powering Net Zero Ports: The Case for Electrified Container Handling	Provides industry stakeholders with a clear roadmap for electrifying container handling equipment within two to eight years, based on conclusive research.	• Port assets
Decarbonizing the Maritime Shipping Industry: Starter Guide to Reducing GHG Emissions	A toolkit providing a suite of strategies and approaches to reduce GHG emissions from maritime shipping, aiming to help government agency decision-makers.	• Port users

Report name	Description	Area of action
Green Marine: Performance Indicators	Performance indicators developed to protect specific habitat and/or species in a region or to address maritime operations.	<ul style="list-style-type: none"> • Port assets • Port Users
A Practical Guide to Decarbonizing Ports: Catalogue of Innovative Solutions	Outlines several practical and innovative solutions to include in port decarbonization strategies and highlights promising initiatives already being undertaken by European ports.	<ul style="list-style-type: none"> • Port assets • Port Users
The Potential of Ports in Developing Sustainable First Mover Initiatives	Introduces the concept of Sustainable First Mover Initiatives (SFMI) and presents an identification tool for most suitable port locations.	<ul style="list-style-type: none"> • Port Users
MI: Action Plan for the Zero-emission Shipping Mission	An action plan outlining the actions needed with timescales and required stakeholder participation to reach mission goals.	<ul style="list-style-type: none"> • Port Users
WPCAP Port Readiness Level for Alternative Fuels for Ships	A communications toolkit to ensure stakeholder alignment for maritime decarbonization, providing transparency about the capacity and appetite of ports to be “alternative fuel ready.”	<ul style="list-style-type: none"> • Port Users
Ports Playbook for Zero-emission Shipping	Nine-point playbook challenging ports to act on bold commitments, progressive policies and demonstrable progress.	<ul style="list-style-type: none"> • Cross-cutting
IAPH World Ports Sustainability Program	Program is aimed at enhancing and coordinating future sustainability efforts of ports worldwide and fostering international cooperation with partners in the supply chain.	<ul style="list-style-type: none"> • Cross-cutting
IAPH Environmental Ship Index (ESI)	Industry standard tool and incentive scheme that measures the environmental footprint of merchant vessels so that ports can serve as incentive providers to reward vessels demonstrating improvements in emission performance.	<ul style="list-style-type: none"> • Port users
UNEPFI Best Practices for Port Sustainable Finance	Review of some leading examples of best practice in social and environmental sustainability across the port sector to support financing.	<ul style="list-style-type: none"> • Port assets
PNNL Port Electrification Handbook	Reference to aid maritime ports nationwide in their clean energy transition. (To be published 2024)	<ul style="list-style-type: none"> • Port assets
Resilience Rising & Arup: Port Resilience Framework for Action	Report that provides a line of sight for resilience from a policy level through to implementation at a port asset level, including setting 10 goals to transform port performance and resilience.	<ul style="list-style-type: none"> • Cross-cutting

PRACTICAL PATHWAYS – ACTION DASHBOARD



This guide presents an EJ framework and action dashboard that bring together the approaches described above in a usable “checklist” of actions and outcomes. The action dashboard describes action in five categories:

1. Decarbonization strategy
2. Decarbonization planning
3. Decarbonization actions: port development
4. Energy demand-side decarbonization actions
5. Energy supply-side decarbonization actions

Actions are differentiated for the three primary port roles (authorities, landlords and operators) but linked to common ideal future outcomes. For each set of actions, the dashboard also includes linkages to environmental justice impacts and case studies of such actions to illustrate real world applications. Together, these actions bring about change across the four impact areas, so that ports can make the most of the opportunities ahead.



CATEGORY 1: DECARBONIZATION STRATEGY

Comprehensive action, that best prepares port actors for managing future risks and embracing future opportunities, starts with *strategy*. These actions on strategy will pave the way for the plans and actions that follow and will send a clear message within and outside organizations.

Port outcome	Impact area	Port actions
Short term (one to two years)		
Port actors align in prioritizing the need for decarbonization at a strategic level, making this clear to internal and external stakeholders.	C O U S	<p>Landlords, Authorities and Operators: Update organizational strategy to highlight the need for and commitment to, decarbonization, covering capital, operational, user and system impact areas. Recognize action falls within both the control and influence of your organization—highlight value of action in both. Describe decarbonization goals as part of wider organizational strategy, providing a "north star" for action planning.</p> <p>EJ opportunity: Engage early and often with local partners* in the planning, development and implementation of the net zero goal and associated decarbonization projects and programs, including efforts to secure federal grants. Refer to the EPA Ports Initiative which has resources to assist ports in understanding how to engage meaningfully and provides case studies of collaboration.</p> <p>*Local partners are residents living nearby/impacted by port operations and/or community groups and organizations representing residents.</p>
Port actors collaborate, nationally and globally, to accelerate action.	C O U S	<p>Landlords, Authorities and Operators: Collaborate with other port actors nationally and globally to share emerging best-practice, as appropriate in a competitive environment.</p> <p>EJ opportunity: Engage early and often with local partners in the planning, development and implementation of the net zero goal and associated decarbonization projects and programs, including efforts to secure federal grants. Rely on existing regional coalitions and engagement processes. Co-create solutions and programs by working with EJ partners through the process from the beginning.</p>
Port actors incentivize decarbonization across their value chain.	C O U S	<p>Landlords: Influence or stipulate action on decarbonization by port operators—across impact areas—via concession agreements. Ensure procurement of concessions creates competition around decarbonization performance.</p> <p>Authorities: Influence or stipulate action on decarbonization by port landlord and port/terminal operators e.g., via port policy/regulation or via "green port fees" linked to action on capital, operational or user carbon emissions.</p> <p>Operators: Incentivize provision of capital and operational carbon performance information (e.g., Environmental Performance Declarations [EPDs]) and reduced capital and operational emission products (e.g., cargo handling equipment) from suppliers e.g., via collaboration agreements that prioritize decarbonization.</p> <p>EJ opportunity: Create programs to promote minority and women-owned businesses eligibility for port contracts. Prioritize businesses that hire locally from the community.</p>

Port outcome

Impact area

Port actions

Short term (one to two years)

Port actors lead or participate in feasibility studies to explore the potential and strategy for first mover action on Green Shipping Corridors.



Landlords and Authorities: Explore potential of green shipping corridors partnerships to drive first mover action on shipping decarbonization. Port landlords/authorities can facilitate and convene green shipping corridor partnerships, recognizing interfaces with both land and sea transport and with energy systems. It is important to acknowledge that not all ports can be first movers for shipping decarbonization and each port’s role will vary significantly. As such feasibility studies are key to take an evidence-based approach to strategy.

Operators: Liquid bulk terminal operators may have a direct role in participating in feasibility studies and strategy development for green shipping corridor partnerships because of their role as the key operators who will supply fuels to ships.

EJ opportunity: Engage early and often with local partners regarding inclusion of low-carbon fuel production and bunkering in green shipping corridors, as some EJ groups oppose the build-out of industrial infrastructure required to facilitate the use of these fuels (e.g., hydrogen, methanol and ammonia and the use of CCUS). For hydrogen, some EJ groups see a place for renewable hydrogen, so long as equity principals are adhered to California Environmental Justice Alliance, 2023.⁷³ Working in collaboration with environmental justice communities can yield integration of EJ principles with decarbonization strategies for these hard to abate sectors. Provide technical assistance and resources to ensure EJ community participation in the process and decision-making. Co-create solutions and programs by working with EJ partners through the process from the beginning.

Ports explore the changes that decarbonization presents to the port and its functions, highlighting both challenges and opportunities.



Landlords, Authorities and Operators: Conduct studies to explore how port functions (traded goods, passenger transport and other value-added functions) may be affected by decarbonization. This will include for example, how declining use of fossil fuels affects traded goods, how low-carbon transport trends affects passenger numbers and how the energy transition may require new port facilities, such as for construction of offshore wind.

EJ opportunity: Collaborate with EJ partners on strategies and approaches to evaluate the path for decarbonization. Refer to the EPA Ports Initiative for some resources on building community-port collaboration.

Medium term (one to five years)

Ports embrace organizational change to facilitate implementation of decarbonization actions.



Landlord, Authorities and Operators: Build capacity and processes to implement decarbonization strategy, noting that the human-side of delivery is essential to success.

EJ opportunity: Incorporating a meaningful community engagement structure between ports staff and port-adjacent communities is integral to building trust and co-creating decarbonization solutions for the wider port system. Ensure that port staff are trained to understand how to engage meaningfully with local communities, what EJ principles are and how to co-create decarbonization policies and programs. Outreach to train and hire locally from EJ communities for port positions.

Ports integrate climate change into master plans, providing a strategic and spatial framework for port planning.



Landlord and Authorities: Shape or update the port master plan to center decarbonization. This should consider how the function of the port should change in a decarbonized world and how spatial planning needs to respond to decarbonization needs across the impact areas. The plan will need to be agile to accommodate future uncertainty, for example, by using a scenario-based approach.

Operators: Feed into the updates of port master plans.

EJ opportunity: Engage intentionally with local community, building a process and timeline that works for them. Integrate decarbonization planning with EJ communities’ priorities. Formalize public engagement processes around master plan development and include listening sessions and consultation with port-adjacent communities.

Early leadership example: Decarbonization strategy with EJ

The Port of Long Beach (POLB) published a Port Master Plan (2022) that integrates environmental sustainability, climate change adaptation and environmental justice goals in the strategy of their future port.⁷⁴ The port is using the San Pedro Bay Ports' Clean Air Action Plan (CAAP) and the Port's Green Port Policy to further support their Port Master Plan. New land use designations include a new Environmental Protection designation for environmental restoration and protection and a new Renewable Energy Resources for power generation from renewable sources and energy storage. These new designations will support the port's goal for improvements to air quality, water quality and decarbonization initiatives. Efforts to reduce the impact of port operations on the environment and public health include reducing the speed of vessels in the harbor, installing shore power and assisting terminal operations to transition to cleaner cargo. The port engaging with community organization groups and local Native tribes in the planning and development of the port. The port is meeting with neighborhood groups that are most impacted by port projects to provide outreach on port development and encourage greater participation in decision-making. Separately, the port seeking consultation with local tribes in the beginning of the planning and development of new port projects. The port prioritizing engagement to identify regional cultural resources within the Harbor District and consider any concerns from the community. Finally, to better understand environmental justice challenges, the port completed a Community Impact Study (2016) and used these results to strategically direct Community Grants to the neighborhoods that are most affected by port operations.

Connected actions

Port actors align in prioritizing the need for decarbonization at a strategic level, making this clear to internal and external stakeholders. Ports integrate climate change into master plans, providing a strategic and spatial framework for port planning.

The Northwest Ports Clean Air Strategy is the first international strategy of its kind in the port community.⁷⁵ It is a collaborative effort between the Port of Seattle, Port of Tacoma, Northwest Seaport Alliance and Vancouver Fraser Port Authority in British Columbia to reduce air and GHG emissions from shipping and port operations. The strategy not only works across ports but also agencies, such as the U.S. EPA and Environment Canada, to decarbonize their systems and policies. First adopted in 2008 and renewed in 2020, the strategy has goals to phase out GHG and other air pollution emissions from seaport-related activities by 2050. Since 2013, diesel particulate matter (DPM) has been reduced by 75%, however, total GHG emissions across the ports have increased by almost 5% due primarily to growth in cargo movement. The 2020 strategy focuses on reducing emissions from ocean-going vessels, cargo-handling equipment, trucks, harbor vessels, rail and port administration and tenant facilities.

Connected actions

Port actors collaborate, nationally and globally, to accelerate action. Port actors align in prioritizing the need for decarbonization at a strategic level, making this clear to internal and external stakeholders. Port actors lead or participate in feasibility studies to explore the potential and strategy for first-mover action on Green Shipping Corridors.

The Port of San Diego's Maritime Clean Air Strategy connects community co-benefits to carbon reduction and clean air strategies.⁷⁶ For example, the port has set an objective to reduce emissions from cargo handling equipment by approximately 90% for nitrogen (NOx), 80% for diesel particulate matter (DPM) and 50% for carbon dioxide equivalent (CO₂e) below 2019 levels by 2025. They have tied the objective to goals of improving health, creating jobs and reducing ambient noise reduction.

Connected actions

Port actors align in prioritizing the need for decarbonization at a strategic level, making this clear to internal and external stakeholders.

CATEGORY 2: DECARBONIZATION PLANNING

Decarbonization planning will allow ports to prioritize action based on what is easiest, most affordable and aligned with their goals. These insights can shape future investment strategy, supported by credible measurement and reporting that ensures ports can operate within a carbon-focused regulatory and investment environment.

Port outcome	Impact area	Port actions
Short term (one to two years)		
Ports have comprehensive GHG baseline emission that cover capital, operational and user impact areas.		<p>Establish a comprehensive baseline GHG emission inventory.</p> <p>Landlords: Include capital and operational emissions associated with owned or leased-in assets as well as emissions associated with leased-out assets (e.g., those leased to port operators). Also include emissions from users (e.g., ships, trucks, passenger vehicles) linked to the facilities using an appropriate boundary. Leased-out asset emissions and user emissions may be reported separately to recognize that they are within the actor’s zone of influence rather than their control.</p> <p>Authorities and Operators: Include capital and operational emissions associated with owned or leased-in assets. Also include users linked to same assets — likely reported separately — considering emissions on land and sea using an appropriate boundary. Also include emissions from users (e.g., ships, trucks, rail) linked to the facilities using an appropriate boundary. User emissions may be reported separately to recognize that they are within the actor’s zone of influence rather than in their control.</p> <p>EJ opportunity: Completing annual Goods Movement Emissions Inventories (GMEI) to track port emissions reduction progress and with clear, public-facing baselines provides port-adjacent communities with clarity on where targeted action is needed and builds public trust. Conduct regular public information sessions on GMEIs and expand collaboration with EJ communities to establish a baseline culture of cooperation and collaboration.</p>
Ports have BAU emission pathways to plan actions against.		<p>Landlord, Authorities and Operators: Building on the emissions baseline, develop a “Business as Usual” (BAU) emissions pathway, considering potential future port growth. Use to understand the emission ‘hot spots’ that require prioritization for action. For the most material emissions sources, these may benefit from being broken down to a more granular level to aid action planning.</p> <p>EJ opportunity: Providing publicly available information to assist in targeting action for decarbonization builds public trust. Build capacity for community partners to understand and engage in the information, including by providing sessions in commonly understood language with appropriate multi-lingual translation.</p>
Ports have, between their actors, decarbonization targets, ideally that are science-based.		<p>Landlord, Authorities and Operators: Set decarbonization targets, covering all emissions within the baseline. Align targets with relevant local, national and international climate goals, policy and drivers. Targets should ideally be science-based.</p> <p>Ensure that decarbonization efforts are prioritized over offsetting. Include a near-term (five to 10 year) and long-term target (by 2050) with interim milestones as required. Avoid “carbon neutral” goals that suggest offsetting as a primary focus.</p> <p>EJ opportunity: The use of offsets in decarbonization planning that ensures that emissions exposures persist in disadvantaged communities does not protect port-adjacent communities. Providing publicly available, science-based targets that prioritize near-term action to achieve relief for EJ communities currently burdened by port operations, builds public trust.</p>

Port outcome

Impact area

Port actions

Short term (one to two years)

Ports have, between their actors, comprehensive decarbonization plans that cover capital, operational and user emissions, spanning the control and influence spectrum.



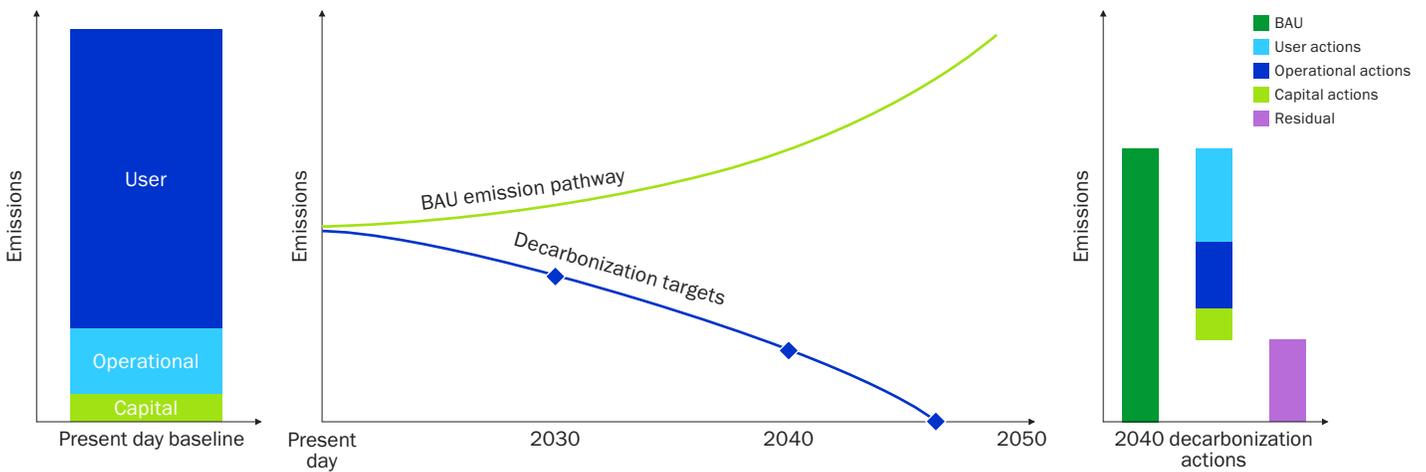
Landlord, Authorities and Operators: Create a decarbonization plan, defining actions that close the gap between the BAU pathway and the port decarbonization targets.

There may be separate plans for emissions within the actor’s control compared to their influence. Some actions, particularly those in the medium- and longer term, will be uncertain and immature, but the plans can be developed further over time. Consider actions explored in the categories 3, 4 and 5.

EJ opportunity: Decarbonization planning with clear commitments for community investment and engagement and with plans for future safe green jobs, including retraining and upskilling, builds public trust and highlight opportunities for improvement and action. GHG emission accounting can go hand-in-hand with general air quality monitoring and reporting; and plans to reduce GHG emissions can indirectly improve air quality, public health and public safety. Outreach should be targeted to local communities to ensure that benefits are targeted to those burdened first and worst.

FIGURE 3

Target aligned decarbonization planning



Early leadership example: Decarbonization planning

The Port of San Diego developed a Maritime Clean Air Strategy (MCAS) (2021) based on the results from their 2019 emissions inventory. The MCAS 2019 Emissions Inventory measures the levels of carbon, particulate matter, GHGs and other air pollutant sources at the port. The emissions inventory covers operational and user emissions (reported under Scope 1 and Scope 3) including emissions from ocean-going vessels, harbor craft, cargo handling equipment, freight train and heavy-duty trucks. Results from the inventory guided the goals and strategies for their MCAS.⁷⁷ Examples of long-term actions that are planned based on the results of the emissions inventory include using lower-emitting engines or alternative fuels because tugboat-related Diesel Particulate Matter (DPM) emissions would be reduced by half, as well as electrifying cargo handling equipment. Benefits of these actions include improved air quality, enhanced public health, reduced noise pollution and increased number of jobs.

The Port of Seattle annually conducts a GHG emissions inventory that covers port controlled and indirect emissions (reported under Scopes 1 and 2).⁷⁸ Calculation of emissions the port has influence over but not direct control (reported under Scope 3) is conducted by their partner Puget Sound Maritime Air Emissions Inventory. The port uses these emission inventories to develop strategies to meet and track progress against, their carbon emission goals which includes 2030, 2040 and 2050 targets. As of 2022, the port has been able to cut their Scope 1 and 2 emissions by 41% since 2005 by building energy efficiency improvements and decreasing gasoline use due to increased support for virtual work and efficient vehicles. While the port's Maritime GHG Inventory is not yet verified by a third-party program, the port has stated an intention to seek verification for future maritime inventories.

The Port of Everglades was the first seaport in the country to voluntarily partner with the EPA to study air emissions at the seaport.⁷⁹ In 2017, the port completed the 2015 Baseline Air emissions Inventory which measures emissions from ocean-going vessels, harbor vessels, cargo handling equipment, on-road vehicles and rail operations. The results from this inventory are now being used to strategically reduce carbon emissions and provide better public health and environmental benefits for the community.

Connected actions

Ports have comprehensive GHG baselines that cover capital, operational and user impact areas.

Connected actions

Ports have comprehensive GHG baselines that cover capital, operational and user impact areas; Ports have BAU emission pathways to plan actions against; Ports have decarbonization targets that ideally are science-based. Ports have comprehensive decarbonization plans.

Connected actions

Ports have comprehensive GHG baselines that cover capital, operational and user impact areas.

CATEGORY 3: DECARBONIZATION ACTIONS: PORT DEVELOPMENT

Port expansion and modification presents opportunities for decarbonization, either in managing emissions associated with construction or in developing port facilities that support the energy transition.

Port outcome	Impact area	Port actions
Medium term (five years)		
Ports deliver capital carbon reductions through port development projects.		<p>Landlords: Ensure port development and maintenance projects include decarbonization goals for capital/embodied carbon. Work with designers and constructors to deliver goals via design efficiency, material optimization or innovative construction techniques. Ensure that projects specify and install material alternatives with lower embodied carbon than traditional materials, especially for steel and concrete.</p> <p>Authorities: Ensure navigation development projects (including dredging works) and other capital projects include decarbonization goals. Deliver goals via e.g., innovative dredging technologies, low-carbon dredging equipment or reducing need for dredging.</p> <p>Operators: Ensure terminal development and maintenance projects include decarbonization goals for capital/embodied carbon. Work with designers and constructors to deliver goals via design efficiency, material optimization or innovative construction techniques.</p> <p>EJ opportunity: Where expansion of port operations are considered, engage early and often with local partners to ensure that expansion does not further exacerbate EJ community impacts. Provide technical assistance and resources to ensure EJ community participation in the process and decision-making. Co-create solutions and programs by working with EJ partners through the process from the beginning. Port development actions can positively impact EJ outcomes when installation of new emission reduction infrastructure can offer new, safe and green jobs and directly improve air and water quality and reduce pollution discharges. If done thoughtfully in coordination with communities, investments in port infrastructure can be aligned with investments and improvements in adjacent developments, offering opportunities for direct community investment according to community priorities.</p>
Ports deliver capital carbon reductions through good procurement.		<p>Landlords: Purchase goods and equipment with reduced capital carbon footprint, by integrating decarbonization into procurement and through engagement with suppliers.</p> <p>Authorities: Goods and equipment purchased by the port authority (including new harbor vessels) are reduced in capital carbon vs.. the baseline, based on a new procurement strategy and engagement with suppliers.</p> <p>Operators: Goods and equipment purchased by the port operator also has a reduced GHG footprint vs.. the baseline — for example, via effective procurement of carbon-intensive port equipment, such as ship-to-shore cranes.</p> <p>EJ opportunity: Ports can support local economic opportunities in the green sector, catalyzing green businesses and jobs through its procurement choices.</p>

Port outcome

Impact area

Port actions

Medium term (five years)

Ports pilot and commercially develop new functions and associated infrastructure to support the energy transition.



Landlords: Invest in or lease land for new facilities to support the energy transition, including fixed and floating offshore wind facilities, other maritime renewable support facilities and import/export terminals for low-carbon fuels.

Authorities: Enable, through regulatory, convening or other roles, new facilities to support the energy transition, including fixed and floating offshore wind facilities, other maritime renewable support facilities and import/export terminals for low-carbon fuels.

Operators: Invest in new facilities to support the energy transition, including fixed and floating offshore wind facilities, other maritime renewable support facilities and import/export terminals for low-carbon fuels.

EJ opportunity: Engage early and often with local partners regarding the expansion of low-carbon fuels production and bunkering at or near ports, as some EJ groups oppose the build-out of industrial infrastructure required to facilitate the use of these fuels (e.g., hydrogen, methanol and ammonia and the use of CCUS). For hydrogen, some EJ groups oppose the use of hydrogen and others see a place for renewable hydrogen, so long as equity principals are adhered to.⁸⁰ Working in collaboration with EJ communities can yield integration of EJ principles with decarbonization strategies for hard to abate sectors.

Ports pilot and commercially develop new functions and associated infrastructure to support a sustainable low-carbon economy.



Landlords: Invest in or lease land for new facilities to support a circular economy.

Authorities and Operators: Authorities to enable (through regulatory or convening role) and operators to invest in new facilities to support a circular economy.

Both: These facilities can intervene in goods moving through the port, via maintenance, reuse, refurbishment, remanufacture, recycling and composting, encouraging products and materials to be kept in circulation.

EJ opportunity: Ports can support local economic opportunities in the green sector, catalyzing green businesses and jobs through its procurement choices.



Early leadership example: Port development

Connected actions

Ports are delivering capital carbon reductions through port development projects. Ports are delivering capital carbon reductions through good procurement. Ports are piloting and commercially developing new functions and associated infrastructure to support a sustainable low-carbon economy.

Connected actions

Ports are piloting and commercially developing new functions and associated infrastructure to support the energy transition.

The Port Authority of New York New Jersey (PANYNJ) first developed a Clean Construction program in 2020 in support of its broader sustainability goals, with goals including specification for low-carbon concrete, waste matching for construction debris to reduce landfill waste and reduce truck trips and emissions and requirements for environmental product declarations (EPDs) from contractors.⁸¹ In 2023 PANYNJ further updated its sustainable concrete specifications for all future construction projects and has collaborated with local universities to test recycled materials in concrete mixes and implement these new mixes in pilot projects.⁸²

In 2022, the Port of Virginia was awarded a PIDP grant for the creation of a wind turbine generator staging area and storage for offshore wind projects at the Portsmouth Marine Terminal. The once container terminal is being repurposed to handle the heavy weight and construction of offshore wind turbines. It is expected to support the construction of 176 offshore wind turbines on a lease site 27 miles off the coast of Virginia Beach. This decarbonization project is intended to support the offshore wind energy supply chain for the U.S. and is planned to bring hundreds of high-quality green jobs to the local community.^{83, 84}



CATEGORY 4: ENERGY DEMAND-SIDE DECARBONIZATION ACTIONS

To reduce emissions from port operations and port users requires demand-side interventions which need to encompass both energy efficiency (reducing need for carbon-intensive energy) and deployment of new infrastructure and equipment that can use low-carbon forms of energy. Note that demand-side decarbonization refers to efforts on the “usage” side of the meter or pipe, referring to energy consumed by port owners and users.

Port outcome	Impact area	Port actions
Medium term (five years)		
Ports use digital tools and technologies to support implementation of decarbonization plans.		<p>Landlords: Develop digital platforms to collect data and bring together decarbonization implementation across the port complex. For example, a port landlord may collect and benchmark energy use by tenants across the port complex and incentivize energy efficiency improvements or usage during off-peak periods.</p> <p>Authorities: Use digital tools to enhance the operational efficiency of port authority operations. For example, automated survey vessels could be operated with reduced deployment time vs. manned vessels.</p> <p>Operators: Deploy technologies to aid decarbonization of terminal operations. For example, this could involve the use of remote sensing to monitor energy usage across the terminal or in-terminal emissions from storage and cargo handling equipment.</p> <p>EJ opportunity: Providing publicly available information to assist in targeting action for decarbonization builds public trust.</p>
Ports continue to improve energy efficiency.		<p>Deploy energy efficiency measures.</p> <p>Landlords: For example, retrofitting port buildings to decrease their heating and cooling energy needs.</p> <p>Authorities: For example, operational measures for pilot and harbor vessels.</p> <p>Operators: For example, operational planning for cargo handling equipment.</p> <p>EJ opportunity: Ports demonstrating emissions reductions through their own energy use builds public trust.</p>
Ports decarbonize cargo handling equipment, cargo storage facilities, transport vehicles and harbor vessels.		<p>Landlords: Monitor and enforce concession agreement mechanisms to encourage operational carbon emissions reductions.</p> <p>Authorities: Support permitting for the safe use of new cargo handling, port transport and vessel technologies, where relevant. Work with equipment suppliers to deploy low-carbon port vessels for example, using battery-electric or green hydrogen-fueled products. Create clear electrification plans that link supply- and demand-side requirements.</p> <p>Operators: Work with equipment suppliers to deploy low-carbon solutions for cargo handling equipment, cargo storage facilities, port transport vehicles and port vessels for example, using battery-electric or green hydrogen-fueled products.</p> <p>EJ opportunity: Ports should accelerate the retirement of dirty and old equipment for zero-emission equipment, rather than wait until it is through its “useful life” to accelerate the emissions reductions opportunities from this sector. Further, providing publicly available, regularly updated information about the existing fleet of equipment used by ports and their users provides transparency in decarbonization planning.</p>

Port outcome

Impact area

Port actions

Medium term (five years)

Ports decarbonize and electrify port buildings.



Landlords, Authorities and Operators: Retrofit existing buildings and design new buildings to be zero-carbon for example, low-carbon HVAC systems and local renewables. Create clear electrification plans that link supply- and demand-side requirements.

EJ opportunity: Ports demonstrating emissions reductions through their own operations builds public trust.

Ports support shipping energy efficiency initiatives.



Landlords, Authorities and Operators: Support initiatives such as just-in-time arrival that improve operational efficiency of shipping.

Authorities: Provide green port tariffs for vessels meeting Environmental Ship Index (ESI) benchmarks.

EJ opportunity: Ports demonstrating emissions reductions through their broader operations builds public trust.

Early leadership example: Energy demand-side actions

Georgia Port Authority (GPA) has implemented several electrification initiatives at the Port of Savannah. GPA electrified both its ship-to-shore cranes (cranes used to unload cargo from ships) and their rubber-tired gantry (RTG) cranes (cranes that move shipping containers around the port). The port authority also installed more than 100 electric “refrigerated container racks.” These electric options are reducing carbon emissions at ports.⁸⁵

Building off ambitious planning efforts, the Port of San Diego is moving forward with transitioning to zero-emission (ZE) heavy-duty cargo trucks as outlined in their Maritime Clean Air Strategy (MCAS).⁸⁶ The program aims for 100% of heavy-duty trucks entering and exiting the port’s cargo terminal to be zero-emission by 2030. The port is the first in the region to develop a comprehensive plan for ZE truck infrastructure. Notably, the program directly links environmental justice goals such as reducing air pollution to the intended outcomes of the project and reports continued community engagement efforts throughout implementation.

The Port of Miami recently received \$16 million from a Rebuilding American Infrastructure with Sustainability and Equity (RAISE) grant for its NetZero program. The program plans to be the nation’s first end-to-end net zero-carbon emission supply chain. Projects include the installation of LED lights at port buildings, the reconstruction of the stormwater drainage system to account for sea level rise and gate improvements and technology upgrades.⁸⁷ The port has stated an intent for this program to support environmental justice communities through the electrification of the supply chain, by creating green jobs and by supplying jobs and workforce training to a historically underserved area.⁸⁸

As of 2021, the Port Milwaukee StewardSHIP initiative offers domestic and foreign vessels dockage discounts for vessels that have implemented emissions reductions and other environmental improvements against credible certification programs. This initiative provides flexibility for applicants — permitting certification under a range of international programs such as the ESI, Clean Ship Index and Green Marine programs — while mandating minimum levels of performance across categories covering GHG emissions and underwater noise.⁸⁹

Connected actions

Ports decarbonize cargo handling equipment, cargo storage facilities, transport vehicles and harbor vessels. Ports decarbonize and electrify port buildings.

Connected actions

Ports decarbonize cargo handling equipment, cargo storage facilities, transport vehicles and harbor vessels.

Connected actions

Ports continue to improve energy efficiency, Ports decarbonize and electrify port buildings.

Connected actions

Ports support shipping energy efficiency initiatives.



CATEGORY 5: ENERGY SUPPLY-SIDE DECARBONIZATION ACTIONS

A key role for ports to enable decarbonization of port operations and port users is around supply of energy — both electrical energy and low-carbon fuels. There are both planning and implementation actions required in the medium-term to pave the way for impactful action into the long term. Note that supply-side decarbonization refers to efforts on the “production” or “supply” side of the meter or pipe, referring to energy produced by utilities and other suppliers or producers.

Port outcome	Impact area	Port actions
Medium term (five years)		
Ports deploy renewable energy generated, stored and distributed on-site.	C O U S	<p>Landlords and Operators: Develop or facilitate on-site renewable energy generation, storage and distribution facilities. Create clear electrification plans that link supply- and demand-side requirements.</p> <p>Authorities: Support permitting for the safe use of on-site energy solutions, where relevant.</p> <p>EJ opportunity: Where the expanded availability and use of renewable energy can benefit port-adjacent communities, especially during extreme weather events, presents an opportunity for continued collaboration between ports and local communities.</p>
Ports use off-site renewable or low-carbon energy supply.	C O U S	<p>Landlords and Operators: Develop or facilitate the supply of renewable and/or low-carbon energy to the port complex. Work with energy partners, utilities and each other to enable supply aligned with demand to allow decarbonization in line with targets.</p> <p>Authorities: Support permitting for the safe supply of renewable energy, where relevant.</p> <p>EJ opportunity: Expand renewable energy capacity for off-site port users, including drayage trucks servicing ports through the installation of charging stations to support mitigating off-port impacts on port-adjacent communities.</p>
Ports provide shore power for vessels to run from low-carbon electrical power when at berth.	C O U S	<p>Landlords: Develop infrastructure to support provision of shore power to vessels or lease land for development by others. Integrate development of infrastructure with wider port electrification plans.</p> <p>Authorities: Provide green port tariffs for vessels using shore power systems.</p> <p>EJ opportunity: Ports play an important role in ensuring a coordinated, ecosystems approach to planning for grid needs as shipowners and operators expand their use of shore power. Coordinating with all stakeholders, especially utility providers, to ensure that electricity needs to aid this transition are met. Ensure consultation and meaningful engagement with port-adjacent communities occurs as these projects move forward.</p>

Port outcome

Impact area

Port actions

Medium term (five years)

Ports are prepared to support the rapid decarbonization of shipping, land-based passenger transport and land-based goods transport from 2030 or before.



Landlords: Understand potential infrastructure and operational interventions at the port, informing port master planning, leasing opportunities or direct investments. Recognize the revenue opportunities that could be unlocked. Consider leasing agreements for bunker operators based on fuel sustainability considerations.

Authority: Explore the potential regulatory, operational and safety implications of land-based passenger transport and land-based goods transport on the land-side of the port as decarbonized, active and mass transit modes proliferate. Explore the potential regulatory, operational and safety implications of mass uptake of zero-emission fuel bunkering and explore potential revenue opportunities linked to transport of fuels to bunkering hubs or from fuel production hubs.

Operators: Explore fuel supply, storage and bunkering opportunities as demand potentially rapidly scales in the 2030s. Take scenario-based approach to potential demand evolution, exploring commercial supply demands. Explore terminal facilities required to enable decarbonized, active and mass transit modes associated with terminal activities (e.g., passenger vessels) and enable decarbonized freight transport systems on land.

EJ opportunity: Engage early and often with local partners regarding the expansion of low-carbon fuels production and bunkering at or near ports, as some EJ groups oppose the build-out of industrial infrastructure required to facilitate the use of these fuels (e.g., hydrogen, methanol and ammonia and the use of CCUS). For hydrogen, some EJ groups oppose the use of hydrogen and others see a place for renewable hydrogen, so long as equity principals are adhered to.⁹⁰ Working in collaboration with environmental justice communities can yield integration of EJ principles with decarbonization strategies for hard to abate sectors.

Ports are involved in green shipping corridor partnerships that are implementing pilot actions to catalyze the supply and use of scalable zero- or near zero-GHG fuels. In some circumstances, ports are developing commercial fuel supply projects.



Landlords and Authorities: Participate in green shipping corridor initiatives during implementation phase.

Landlords: Lease land for development of green shipping corridor actions, such as fuel storage and bunkering infrastructure. Where circumstances allow (e.g., local policy drivers in place), lease land for commercial fuel supply projects. Ensure that port infrastructure development to support zero-carbon shipping is aligned with wider port development plans.

Authorities: Support regulatory development and compliance for new fuel supply, storage and bunkering systems. Provide green port tariffs for vessels using zero-carbon bunkering systems.

Operators: Develop terminal infrastructure to support zero-carbon fuel supply, storage and bunkering. Consider adaptation of existing fuel terminal infrastructure where feasible.

EJ opportunity: Engage early and often with local partners regarding inclusion of low-carbon fuels production and bunkering in green shipping corridors, as some EJ groups oppose the build-out of industrial infrastructure required to facilitate the use of these fuels (e.g., hydrogen, methanol and ammonia and the use of CCUS). For hydrogen, some EJ groups oppose the use of hydrogen and others see a place for renewable hydrogen, so long as equity principals are adhered to.⁹¹ Working in collaboration with environmental justice communities can yield integration of EJ principles with decarbonization strategies for hard to abate sectors. Co-create solutions and programs by working with EJ partners through the process from the beginning. Provide technical assistance and resources to ensure EJ community participation in the process and decision-making.

Ports are involved in demonstration projects for zero-emission freight transport on land. Ports also enable decarbonization of freight supply chains by enabling modal shift.



Landlords: Lease land for the development of zero-emission freight demonstration projects or modal shift initiatives, ensuring port infrastructure development is aligned with wider port development plans.

Authorities: Support regulatory development and compliance for zero-emission freight demonstration projects or modal shift initiatives.

Operators: Develop land for zero-emission freight demonstration projects or modal shift initiatives.

EJ opportunity: Expand zero-emission freight demonstration projects to include protecting EJ communities from the off-port impacts of operations through the use of truck re-routing or buffers, anti-idling campaigns, noise reduction efforts and other initiatives. Co-create solutions and programs by working with EJ partners through the process from the beginning.

Port outcome	Impact area	Port actions
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Medium term (five years)

Ports are involved in demonstration projects for zero-emission passenger transport on land, with a focus on active and public transport and provision of low-carbon energy/fuels to vehicles.



Landlords: Lease land for the development of zero-emission passenger transport demonstration projects, ensuring port infrastructure development is aligned with wider port development plans.

Authorities: Support regulatory development and compliance to zero-emission passenger transport demonstration projects, e.g., for cruise and ferry terminals.

Operators: Develop land for zero-emission passenger transport demonstration projects, e.g., for cruise and ferry terminals.

EJ opportunity: Expand zero-emission passenger transport demonstration projects to include protecting EJ communities from the off-port impacts of operations through the use of truck re-routing or buffers, anti-idling campaigns, noise reduction efforts and other initiatives. Co-create solutions and programs by working with EJ partners through the process from the beginning.

Long term (25-30 years)

Ports support the rapid decarbonization of freight transport, with a focus on smart logistics as well as provision of low-carbon energy/fuels to vehicles.



Landlords and Operators: Support deployment and scale-up of decarbonized freight transport systems, either directly or through leased activities, via port infrastructure and operations. Understand how innovations in technologies (e.g., automated travel) may drive changes to freight transport in the future.

Authorities: Support safe and effective decarbonized freight transport systems via ports.

Operators: Support deployment and scale-up of decarbonized freight transport systems via port infrastructure and operations. Understand how innovations in technologies (e.g., automated travel) may drive changes to freight transport in the future.

EJ opportunity: Co-create solutions and programs by inviting EJ partners into the process from the beginning.

Ports support the rapid decarbonization of land-based passenger and staff transport, with a focus on active and public transport and energy supply for electric vehicles.



Landlords: Support deployment and scale-up of decarbonized, active and mass transport systems, either directly or through leases. Understand how innovations in technologies (e.g., automated travel) may drive changes to passenger transport in the future.

Authorities: Support safe and effective decarbonized, active and mass transport systems via ports.

Operators: Support deployment and scale-up of decarbonized, active and mass transport systems via port infrastructure and systems. Understand how innovations in technologies (e.g., automated travel) may drive changes to freight transport in the future.

EJ opportunity: Co-create solutions and programs by inviting EJ partners into the process from the beginning.

Early leadership example: Energy supply-side actions

The Port of Long Beach has conducted several projects over the past few years to add dockside power hookups and improve electrical infrastructure to enable shore power for ships.⁹² Increased shore power helps to reduce the emissions associated with ships running diesel engines while at berth, by allowing ships to use grid electricity which typically has lower emissions. This work has been driven by the CARB At-Berth regulation which sets requirements for various ships to run on shore-side electricity while at berth at ports in California. While the local utility Southern California Edison provides electricity and billing, POLB funded the infrastructure upgrades to enable this increased electrification. Other ports in California including Los Angeles, San Diego, Oakland, San Francisco and Hueneme — and their operators — have also invested in shore power in recent years in response to the same regulatory and market drivers.

The Ports of Los Angeles and Hueneme are implementing a zero-emission goods movement demonstration project that includes two hydrogen fueling stations combined with hydrogen fuel cell Class 8 trucks, electric yard trucks and cranes and battery-electric forklifts. This “Shore to Store” project, which is ongoing as of 2023, is in partnership with numerous trucking, energy and port operator partners — highlighting the importance and opportunity associated with ports’ broader influence in enabling a decarbonized energy economy.⁹³

Connected actions

Ports provide shore power for vessels to run from low-carbon electrical power when at berth.

Connected actions

Ports are involved in demonstration projects for zero-emission freight transport on land and enable decarbonization of freight supply chains by enabling modal shift. Ports support the rapid decarbonization of freight transport, with a focus on smart logistics as well as provision of low-carbon energy/fuels to vehicles.

GLOSSARY

Bipartisan Infrastructure Law (BIL): Provides additional funding to advance equitable public transportation planning and operations.

Business as Usual (BAU) Scenario: A scenario for future patterns of activity which assumes that there will be no significant change in people’s attitudes and priorities or no major changes in technology, economics or policies, so that normal circumstances can be expected to continue unchanged.

Cargo Handling Equipment: Encompasses equipment that move cargo around a port such as forklifts and cranes.

Circular Economy: A circular economy keeps materials and products in circulation for as long as possible. It uses a systems-focused approach and involves industrial processes and economic activities that are restorative or regenerative by design, enables resources used in such processes and activities to maintain their highest value for as long as possible and aims for the elimination of waste through the superior design of materials, products and systems (including business models). A circular economy reduces material use, redesigns materials and products to be less resource-intensive and recaptures “waste” as a resource to manufacture new materials and products.

Clean Air Act: A law that defines EPA’s responsibilities for protecting and improving the nation’s air quality and the stratospheric ozone layer.

Clean Water Act: An EPA law that establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters.

Decarbonize: To reduce the levels of GHG emissions out of a facility, process or organization.

Diesel Emissions Reduction Act (DERA): Provides federal funding in the form of grants and rebates and encourages collaboration with low-income and disadvantaged communities.

Embodied/Capital Carbon: The GHG emissions associated with upstream — extraction, production, transport and manufacturing — stages of a product’s life.

Environmental Justice (EJ): The fair treatment and meaningful involvement of all people regardless of race, color, national origin or income, with respect to the development, implementation and enforcement of environmental laws, regulations and policies.

Environmental Performance Declarations (EPDs): Provides information about a product’s impact on the environment, such as global warming potential, smog creation, ozone depletion and water pollution.

EPA's Ports Initiative: Works in collaboration with the port industry, communities and all levels of government to improve environmental performance and increase economic prosperity.

Federal Emergency Management Agency (FEMA): The federal agency responsible for leading the nation's efforts to prepare for, protect and mitigate against, respond to and recover from the impacts of natural disasters and man-made incidents or terrorist events.

Federal Highway Administration (FHWA): Provides stewardship over the construction, maintenance and preservation of the nation's highways, bridges and tunnels.

Green Shipping Corridors: A shipping route on which zero-carbon emissions ships and other emissions reduction programs are deployed and emissions reductions are measured and enabled through public and private actions and policies.

Greenhouse Gas Protocol (GHGP): Provides a widely adopted corporate accounting standard for GHG emissions, categorizing them into three "scopes."

Greenhouse Gas (GHG) Emissions: Gases that trap heat in the atmosphere including carbon dioxide (CO₂), methane (CH₄), Nitrous oxide (N₂O) and fluorinated gases.

Inflation Reduction Act (IRA) of 2022: A historic down payment on deficit reduction to fight inflation, invest in domestic energy production and manufacturing and reduce carbon emissions by roughly 40% by 2030.

Institute for Sustainable Infrastructure: Help communities around the world build sustainable, resilient and equitable civil infrastructure.

Intergovernmental Panel on Climate Change (IPCC): The United Nations body which assesses the science related to climate change.

International Maritime Organization (IMO): The United Nations specialized agency with responsibility for the safety and security of shipping and the prevention of marine and atmospheric pollution by ships.

Justice 40 Initiative (J40): Directs 40% of the overall benefits of certain federal investments — including investments in clean energy and energy efficiency; clean transit; affordable and sustainable housing; training and workforce development; the remediation and reduction of legacy pollution; and the development of clean water infrastructure — to flow to disadvantaged communities (DACs).

Low-carbon energy: Refers to materials or energy sources that provide thermal or electrical energy with fewer GHG emissions than fossil fuels. Low-carbon energy does produce non-zero-GHG emissions.

Multimodal Projects Discretionary Grant (MPDG): Provides federal financial assistance to highway and bridge, intercity passenger rail, railway-highway grade and separation, wildlife crossing, public transportation, marine highway and freight and multimodal projects.

National Environmental Policy Acts (NEPA): Requires federal agencies to assess the environmental effects of their proposed actions prior to making decisions.

Net Zero: Consuming only as much energy as produced, achieving a sustainable balance between water availability and demand and eliminating waste sent to landfill. In the context of GHG emissions, net zero describes a state in which an entity has reduced their direct and indirect GHG emissions dramatically and has neutralized residual remaining GHG emissions via permanent carbon removal and storage.

Nitrogen Oxides (NO_x): A family of gases that are poisonous and highly reactive. These gases form when fuel is burned at high temperatures.

Ocean-going Vessels (OGV): Move cargo and people into and out of a port and typically travel long distances between foreign or domestic ports.

Offsets: Represent a quantity of GHG emissions reductions that occur as a result of a discrete project. The emissions reduction from that project can be sold to enable the purchaser/owner to claim those GHG reductions as their own.

Office of Secretary of Transportation (OST): Formulates national transportation policy; prepares needed transportation legislation; helps negotiate and implement international transportation agreements; assures the fitness of U.S. airlines; and enforces airline consumer protection regulations.

Particulate Matter (PM_{2.5}): Fine inhalable particles, with diameters that are generally 2.5 micrometers and smaller.

Port Infrastructure Development Program (PIDP): A discretionary grant program administered by the Maritime Administration. Funds for the PIDP are awarded on a competitive basis to projects that improve the safety, efficiency or reliability of the movement of goods into, out of, around or within a port.

Science Based Targets Initiative (SBTi): Utilizes a sectoral decarbonization approach to set maritime GHG emissions targets that are consistent with the IPCC's goal of limiting global temperature rise to 1.5°C and therefore is a globally recognized "north star" for climate action.

Rebuilding American Infrastructure with Sustainability and Equity (RAISE): The program aims to rebuild America's infrastructure with a focus on sustainability and equity.

Scope 1 Emissions: Direct GHG emissions that occur from sources that are controlled or owned by an organization.

Scope 2 Emissions: Indirect GHG emissions associated with the purchase of electricity, steam, heat or cooling.

Scope 3 Emissions: The result of activities from assets not owned or controlled by the reporting organization, but that the organization indirectly affects in its value chain.

Shore power: The process of providing electrical power from the shore to a vessel at berth, thereby allowing the auxiliary engines to be turned off.

Transition Risk: Risk associated with the pace and extent at which an organization manages and adapts to the internal and external pace of change to reduce GHG emissions and transition to renewable energy.

Twenty-foot Equivalent Unit (TEU): Defined as the approximate unit of measure of a shipping container.

U.S. Department of Transportation (DOT): Responsible for planning and coordinating federal transportation projects. It also sets safety regulations for all major modes of transportation.

U.S. Environmental Protection Agency (EPA): Protects people and the environment from significant health risks, sponsors and conducts research and develops and enforces environmental regulations.

World Resources Institute (WRI): A global research nonprofit working on six critical goals that the world must achieve this decade in order to secure a sustainable future: climate, energy, food, forests, water and sustainable cities.

Worldwide Fund for Nature (WWF): The leading organization in wildlife conservation and endangered species.

ENDNOTES

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