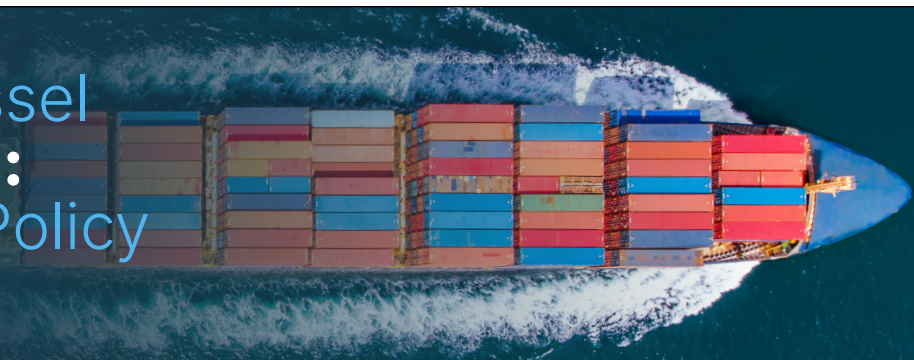


# Ocean-Going Vessel Decarbonization: Technology and Policy Assessments



## EXECUTIVE SUMMARY

May 21, 2024

For more than 130 years, ships have been a large source of air pollution and greenhouse gas emissions. The impact is especially harmful to coastal and port communities. For most of that time those impacts were unknown, or just accepted as the price to pay for benefits of transoceanic trade. And until recently there were limited alternatives.

While ships have become more efficient in fossil fuel consumption, those gains have been overwhelmed by massive expansion of sea-borne trade in past 30 years. Today, 50,000 large cargo ships, in continuous motion globally, move everything from sneakers to iron ore, and emit about 1 billion tons/year GHG emissions, along with huge amounts of toxic particulate matter, acid gases and metals. And port communities are paying the price – globally ~265,000 premature deaths were projected for 2020 (~0.5% of global mortality) attributable to global shipping-sourced emissions.<sup>1</sup>

It does not have to be that way. Recent policy changes show us a future in which the huge pollution and climate impact of shipping gradually comes to an end. Today, there is strong momentum for a transition to zero emission sea transport. European Union has moved to reduce GHG emission from ships calling at its ports. In 2023, an international negotiation adopted a target to largely eliminate greenhouse gases from ships, including a goal to reduce GHG emissions by 70% by 2040. Follow up negotiations are currently underway to adopt measures to achieve those targets; implementation will be carried out in part by national and state governments.

### There is reason to be optimistic.

- We have the technology. Hundreds of ocean-going ships, capable of operating on zero carbon liquid fuels, are being built today. Supply chains for zero carbon fuels are under construction in Europe, Asia, and North America.
- We have the financial resources. Vast revenues are produced by international shipping which can support a gradual transition to zero carbon seaborne trade.
- There is broad support for this transition among international, national, regional governments, and the shipping industry itself.
- There are multiple policy and technical pathways to deeply decarbonize ship operations.
- Work is underway to address technical barriers and challenges. Prices for low and zero emission ship fuels will come down with experience and economies of scale.
- Many of the needed technical and policy changes will also help decarbonize other sectors of the world economy.

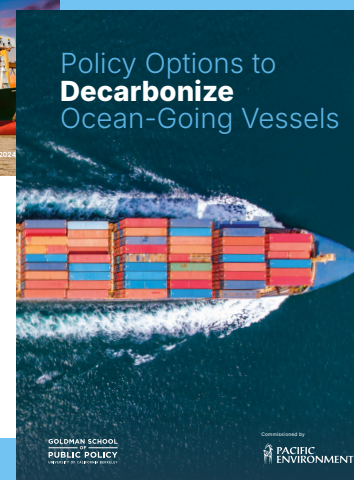
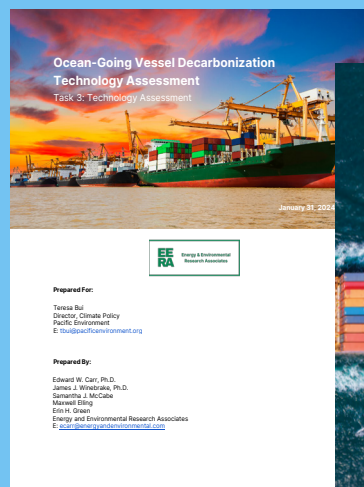
While the future is suddenly brighter, the path has hurdles and more work is needed to accelerate the journey. The climate and health imperatives are to reach zero emission shipping by 2040. IPCC's *AR6 Synthesis Report: Climate Change*, is the final warning to humanity on how to remain on a 1.5 degrees Celsius global warming trajectory and avoid catastrophic climate scenarios. As of May 2024, we have 7 months to meet the first goal of peaking global climate emissions before 2025.

<sup>1</sup> Health impact assessments of shipping and port-sourced air pollution on a global scale: A scoping literature review, <https://www.sciencedirect.com/science/article/pii/S001393512201787X>



**This set of reports seeks to inform stakeholders and policymakers on the potential to reduce GHGs and criteria pollutants from the maritime sector. These reports describe:**

1. decarbonization technologies for ships, including low and zero-emission fuels and propulsion, supplemental power systems and fuel bunkering infrastructure;
2. the policy landscape – what’s happening nationally and internationally; and,
3. recommended policy initiatives for state and federal agencies in the US.



US national and state governments will need to play a key role in decisions on clean fuel supply chains and infrastructure. California is uniquely influential. California was the first to require low sulfur fuel and emission controls for ships, action that later inspired international and national emission controls. It can play that catalytic role again by signaling intent regulate GHG emissions of ships, either: 1) to implement strong international controls, or 2) to complement and inspire other regional initiatives if international negotiations fail.

For example, California policy leadership could increase momentum toward strong regulation by the International Maritime Organization, which is currently debating measures to implement its 2023 zero carbon target for shipping emissions. In absence of strong IMO action, California action would complement and, in effect, extend the geographical impact of recent European Union policies.

California and other subnational governments can require zero carbon fuel in for ships operating in their coastal waters. They can create financial incentives for production and use of zero carbon fuels in ships through the Low Carbon Fuel Standard. They can invest in or incentivize zero carbon port infrastructure and fuel production. For example, there is currently no zero emission ship fuels produced on the West Coast of US. This fuel supply infrastructure is critical to success of voluntary and mandatory commitments to zero emission ship operations.

The US federal Government also has important opportunities to transition ships to zero emission fuels. Funding is available today for ports to adopt zero emission equipment, but relatively little funding is available to decarbonize the US Jones Act fleet or to produce zero emission liquid ship fuels. The US could also support electrification of ships operating on short voyages between US maritime and inland ports. Similarly, while the US does fund work to develop low-cost renewable hydrogen (RH2), it could also fund supply chains for green-methanol and -ammonia, which can be used on many existing ships and eventually in on-board fuel cells. The existing funding for RH2 is one important step, but more is needed to complete the supply chains for zero-emission liquid maritime fuels.

Federal agencies can also more actively support effective implementation measures in the current round of IMO negotiations. If IMO negotiations fall short, the US could establish a GHG fuel standard for ships calling at US ports and modify the Federal Renewable Fuel Standard to create market-based incentives for production of zero emission marine fuels.

**We do not suggest that a zero-carbon transition for shipping will be easy, but there are clear near-term technical and policy options to significantly reduce emissions from seaborne trade and lay the foundation for a fully decarbonized industry by 2040.**