

Measuring the Impact of the Blue Economy

A Triple-Bottom-Line Framework for Innovators | Summary Report | October 2026

Forty percent of the U.S. population lives in a coastal county, though these represent just 10 percent of our landmass. Coastal counties produce \$10 trillion in goods and services, employ 54.6 million people, and pay \$4 trillion in wages each year, much of which is tied to the blue economy, the activities and innovations focused on using ocean resources to support economic growth and improve livelihoods while preserving the health of coastal and marine ecosystems. The “triple-bottom-line” of environmental, economic, and social factors are interconnected and interdependent—the health of marine ecosystems affects the viability of ocean-based industries, and vice versa.

Maritime Blue is a blue economy innovation cluster organization that supports the development of new markets, startups, and workforce development within the blue economy application space.

Maritime Blue focuses on five strategic innovation areas across multiple sectors:

1. Sustainable Fishing and Seafood

The practices, policies, markets, and technologies that together ensure the long-term, just, and regenerative provisioning of food from the ocean.

2. Healthy Ocean Ecosystems

Ecosystems that are biologically diverse, ecologically functional, able to sustainably support subsistence and economic activity, and resilient to human pressures.

3. Digital Transformation

The adoption of digital tools and data-driven processes to modernize business models, improve operational efficiency, insights, and create new value streams.

4. Maritime Decarbonization

The transition of the maritime industry towards net zero emissions by 2050 through the broad adoption and deployment of low and zero emission vessels, supportive technologies, and infrastructure development.

5. Renewable Ocean Energy

Energy harnessed from oceanic sources in ways that are naturally replenished, such as wind, wave, thermal, and salinity gradients.



Across these strategic innovation areas and multiple blue economy subsectors, stakeholders include entrepreneurs, government (local, state, federal, Tribal), academia, nonprofit and community organizations, and investors. Their actions and investments create positive change in the world, yet recording the impacts of their activity on the environment, economy, and society across all sectors and participants is a considerable task.

The Blue Economy Impact Framework

Together, the blue economy and emerging ocean-based industries have the potential to support our resilience in the context of climate change, providing food security, storm protection, and biodiversity safeguards, while also addressing social equity. Monitoring and reporting the impacts of blue economy efforts can help to guide future investment, encourage the adoption of best practices, and trace the ripple effect of sustainable investments as they drive change within the local maritime industry and environment.

Maritime Blue and Earth Economics have created a conceptual Blue Economy Impact (BEI) Framework. The framework synthesizes seven triple-bottom-line (TBL) frameworks which were both relevant to Washington state and provided quantitative metrics.

From over 300 published key performance indicators (KPIs), Earth Economics identified 75 relevant KPIs into a usable, balanced framework relevant to Maritime Blue's current focus areas.

The KPIs provide unit-based measures for industry, business, technologies, human capital, and ecological systems. Additionally, the BEI reviewed over 50 innovations that are advancing the goals of Maritime Blue's five focus areas.

A technical report includes the full list of indicators and sub-indicators (e.g., individual fish species) with associated metrics, available upon request.

Maritime Blue, its partners, and other blue clusters can use the BEI Framework to measure, report, and compare the impact of blue economy activities and the impact of innovation in this area. Startups and other companies can also apply the framework to individual projects to understand and structure reporting and communication of their impacts to their stakeholders.

KEY TERMS

BEI Framework = Blue Economy Impact Framework

TBL = Triple-Bottom-Line

KPI = Key Performance Indicator

HOW TO USE THE FRAMEWORK

Measure, report and compare the impact of activities

Identify impact of innovation

Support reporting and communication with stakeholders



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MAPPING INNOVATION IMPACTS

Earth Economics reviewed frameworks assessing the impact of blue economies and compiled all metric-based KPIs designed to measure economic, environmental, and societal impacts. Seven frameworks were identified as especially relevant, comprehensive, and robust. These spanned a spectrum of priorities from infrastructure to marine habitat and also aligned with Maritime Blue’s current focus areas. Earth Economics excluded frameworks that fell outside of Washington Maritime Blue’s geographic scope and current focus areas (e.g., health priorities, recreation).

Table 1. Seven Frameworks Aggregated into the BEI Framework

	Smart Port Index (Molavi et al., 2020)	Maritime Economic Impacts (McKinley Research Group, 2023)	Digital and Marine Fishery Economies (Jiang et al., 2024)	Sustainable Marine Capture Fisheries (FAO, 1999)	Ocean Impact Navigator (Vincent et al., 2022)	Vital Signs Framework (Puget Sound Partnership, 2024)	Coastal MPAs (Cardoso et al., 2022)
1 Sustainable Fishing and Seafood		●	●	●	●	●	●
2 Healthy Ocean Ecosystems	●		●	●	●	●	●
3 Digital Transformation	●	●	●				
4 Maritime Decarbonization	●				●		●
5 Renewable Ocean Energy	●				●		

INDUSTRIAL FOCUS

SUSTAINABILITY

ECOSYSTEM FOCUS



ALIGNMENT WITH THE UN SUSTAINABLE DEVELOPMENT GOALS

The UN Sustainable Development Goals (SDGs) established targets for human, societal, and planetary well-being. Each KPI in the framework aligns with at least one SDG and provides a way to measure SDG outcomes. For instance, marine water temperature can impact marine ecosystem health and biodiversity (SDG 14).



2 ZERO HUNGER

- Sustainable agricultural productivity
- Improved nutrition
- Health outcomes



3 GOOD HEALTH AND WELL-BEING

- Better health
- Longevity



5 GENDER EQUALITY

- Increased economic participation
- Productivity from women
- Greater inclusion
- Equity



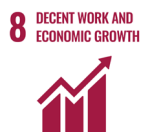
6 CLEAN WATER AND SANITATION

- Protection and sustainable management of water resources
- Social well-being



7 AFFORDABLE AND CLEAN ENERGY

- Reduced energy costs
- Economic opportunities in renewable energy
- Lower GHG emissions
- Reduced environmental impact



8 DECENT WORK AND ECONOMIC GROWTH

- Sustainable economic development
- Job creation
- Improved livelihoods



9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

- Enhanced productivity
- Economic growth
- Innovation in sustainable technologies
- (10) Reduced Inequalities
- More equitable distribution of wealth
- Greater social cohesion



11 SUSTAINABLE CITIES AND COMMUNITIES

- Efficient resource use
- Economic resilience
- Reduced environmental footprint



12 RESPONSIBLE CONSUMPTION AND PRODUCTION

- Cost savings
- Economic opportunities through efficiency
- Minimized waste
- Sustainable resource use



13 CLIMATE ACTION

- Mitigation of economic risks
- Reduction of GHG emissions
- Adaptation to climate change



14 LIFE BELOW WATER

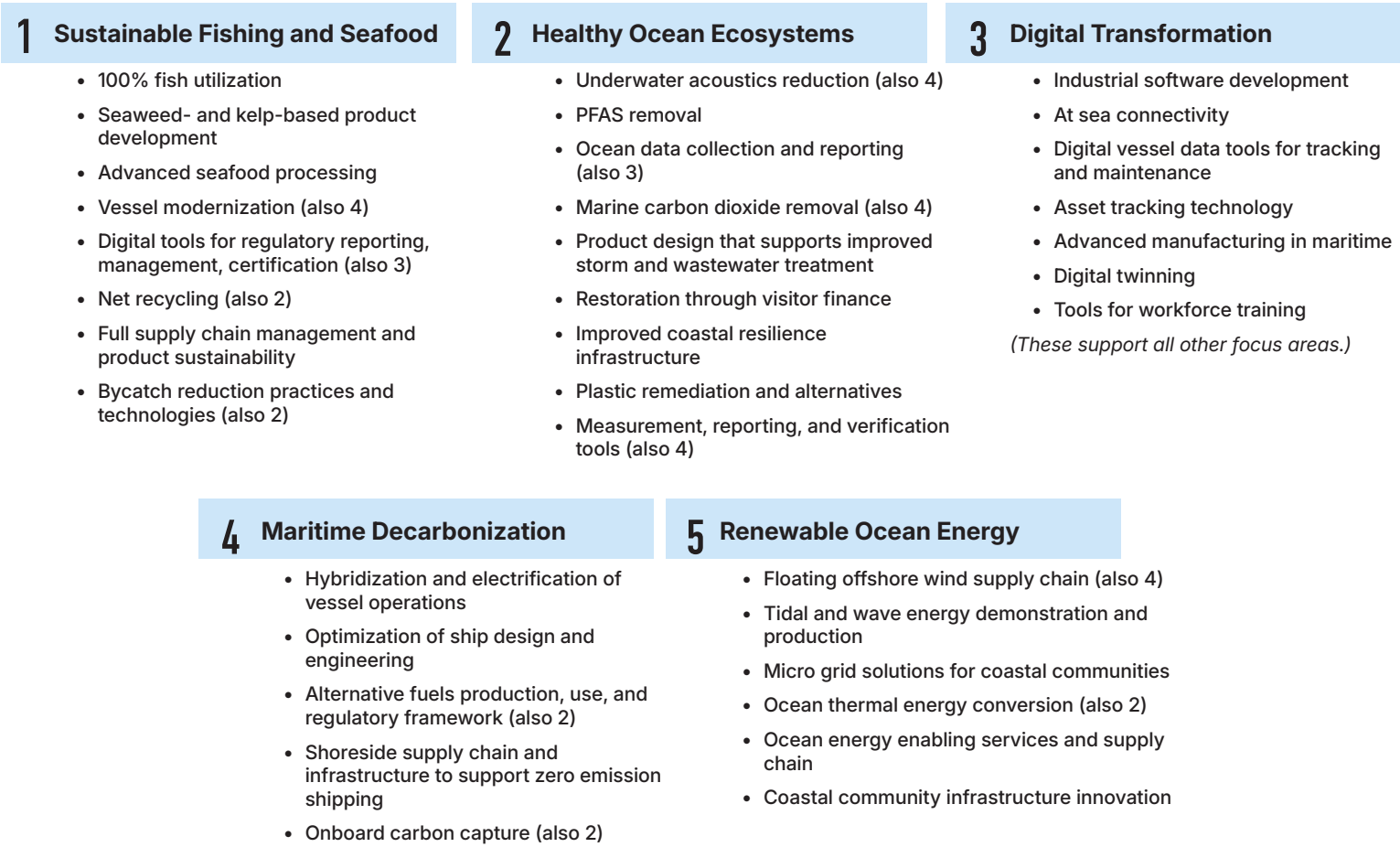
- Healthy marine ecosystems
- Biodiversity

IMPACTS OF A BLUE ECONOMY CLUSTER

Maritime Blue provides a rich environment for innovators, where triple-bottom-line analysis can be critical for understanding how sustainability goals are being met. Visualizing Maritime Blue innovations across all five focus areas highlights the complexity of understanding sustainability impacts (Figure 1). Each focus area has a distinct set of KPIs, impacting different sustainability areas.

As innovations multiply, they may complement each other, work in parallel, or present potential trade-offs against some sustainability goals. KPIs can guide stakeholders in identifying synergies, trade-offs, and gaps among economic, environmental, and social priorities, helping them to optimize outcomes. Local and regional priorities and concerns are critical to this process. For instance, electrification of hydrofoil ferries or green hydrogen may increase aggregate energy demand, which could affect greenhouse gas emissions and air pollution, depending on the final energy portfolio.

Figure 1. Blue Economy Innovations Across the Five Focus Areas



CONTEXTUALIZING KEY PERFORMANCE INDICATORS

Drawing boundaries: Creating an accessible framework relevant to all clusters is a challenge, given the scope and complexity of global blue economies. This review is the product of surveys and interviews, evaluation of multiple global and regional frameworks, working group collaboration, and real-world stress testing to consolidate and standardize approaches. The Blue Economy Impact Framework (BEI) includes diverse KPIs capable of capturing a broad range of activity, selecting quantitative metrics that are most relevant to Washington state contexts (e.g., local economy, marine environment). The broader KPI list has been retained to facilitate transferability to clusters in other maritime regions.

Setting measurable targets: As performance indicators, KPIs must necessarily identify criteria and targets. For example, the World Benchmarking Alliance developed a global methodology of criteria for governance, ecological, economic, and social indicators. In Washington, the Puget Sound Partnership has set regional goals for conserving local fish species: “by 2050, all Chinook Salmon populations increase and at least 50 percent of the populations reach their recovery goals.” The BEI provides context to assist in determining whether KPI values and trends are easily aligned with goals set by clusters or Maritime Blue members.

Data matters: Once users identify the KPIs most-relevant to their efforts, they must review available data (including public datasets) and their ability to collect the data required for each KPI. Data gaps should be addressed with research and data collection protocols. Users of the BEI must review how their chosen KPIs inform their TBL impacts and whether they neglect key factors. The BEI is intended as a starting point—users should consider the KPIs as a first “port of call,” but should add their own contextual data, as relevant.

Photon Marine deploys electric workboats at the Port of Friday Harbor.



Impacts of a Blue Economy Innovation

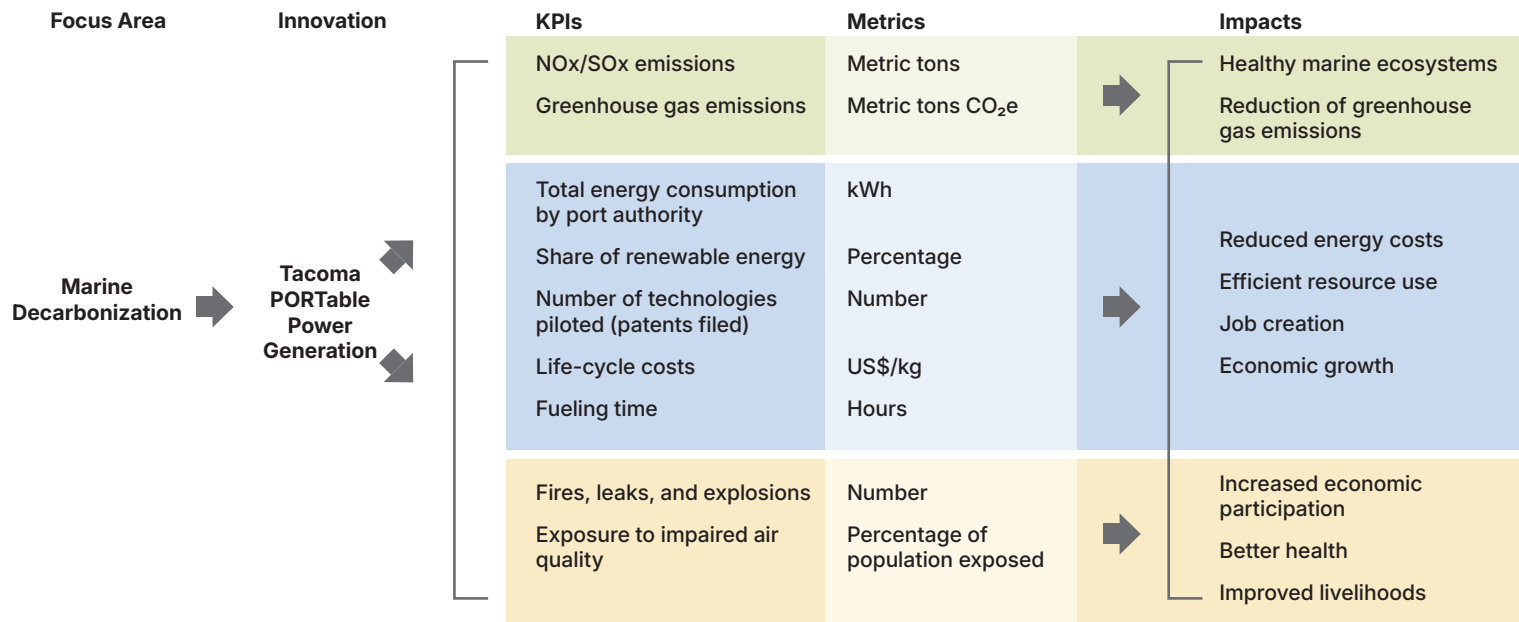
Case Study: Green Hydrogen

Maritime Blue members are advancing a broad portfolio of blue economy projects. This includes the Tacoma *PORTable Power Generation*, a Maritime Decarbonization project that seeks to shift a portion of the Port of Tacoma's fuel needs (largely electrical generation) from diesel generators to hydrogen formate, a liquid hydrogen carrier that is considered to be safer, cheaper, cleaner, and a more flexible source of stored energy. Portable hydrogen formate storage units would power various port infrastructures and operations.

Multiple KPIs can be applied to this project, highlighting its benefits relative to diesel or other energy sources. The following KPIs are likely relevant to an initial deployment of the technology:

- **Total energy consumption by port authority:** the energy potential of stored hydrogen formate and its impact on overall port energy portfolios
- **Lifecycle costs:** the total value chain costs (including production, distribution, and tax credits) as compared with other energy sources, including other means of hydrogen generation, distribution, and storage
- **Number of technologies piloted:** the number of patents generated by this pilot project
- **Energy from renewable sources:** the share of green electricity (primarily hydropower) used for hydrogen production
- **Fires and explosions:** reduced risk or safety incidents, compared with alternative energy sources such as gray-green compressed hydrogen, or gas-powered generators
- **Exposure to impaired air quality:** whether port workers and operators are exposed to lower pollutant loads
- **NOx/SOx emissions:** the degree to which transitioning to green hydrogen reduces emissions of these pollutants, relative to prior port operations
- **GHG emissions:** the degree to which transitioning to green hydrogen reduces emissions of climate-forcing substances (e.g., carbon dioxide, methane), relative to prior port operations

Figure 2. BEI Framework for Tacoma *PORTable Power Generation* at the Pilot Stage



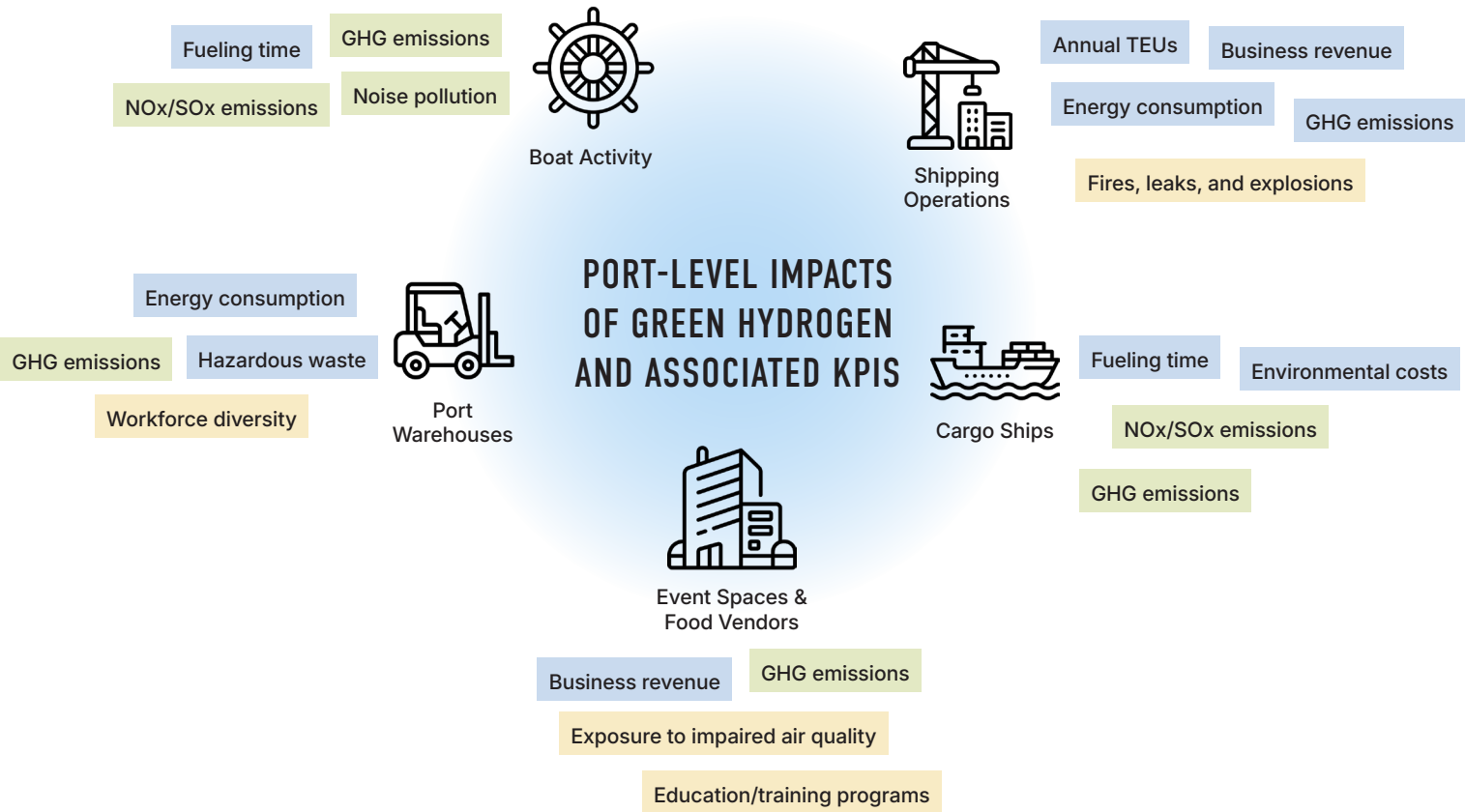
Should *Tacoma PORTable Power Generation* technologies be deployed at larger scales, they will likely influence other aspects of Port operations. Such impacts can be assessed with KPIs more relevant to commercial-scale applications. Figure 3 shows the potential for portable green hydrogen to support shipping and boat operations, manufacturing, community events, and food vendors.

As an example, the greenhouse gas emissions of shipping and manufacturing operations can be analyzed as they shift their operational energy needs to hydrogen. Other KPIs (e.g., education/training programs, business revenue) may emerge, should hydrogen be used to power conference spaces, or lead to lower operating costs.

While hydrogen technology is still evolving, these scenarios demonstrate the value of the BEI framework for analyzing the effects of blue economy innovations. It also improves our understanding of impacts as technologies shift from pilot phases to commercial deployment, as they affect individual technologies, operational sectors, and even entire ports.

Applying the BEI to blue economy innovations illustrates the strategic decisions necessary to delineate and understand sustainability impacts. Analyzing *Tacoma PORTable Power Generation* through a BEI lens can help other clusters understand the impact of investing in green hydrogen technologies. As Maritime Blue collects KPI data to monitor project progress, those data can be shared with other clusters, thus informing the wider blue economy investment journey.

Figure 3. Port-Wide Impacts of PORTable Power and Selected KPIs



Conclusion

The BEI Framework can help users to better understand the social, economic, and environmental impacts of blue economy innovations and their application in each project and sector.

As innovations proliferate, this tool can help to frame interactions across multiple TBL factors and help trace technology maturation and wider impacts on connected industries and sectors. The framework also offers a sound basis for initiating planning and decision-making around technological design, data collection needs, and stakeholder engagement.

As innovation clusters collect and generate data while deploying blue economy technologies, they have the opportunity to lead development of best practices in baselines, targets, and data collection. Data availability and the need to build knowledge across disciplines remain challenges, yet clusters can coordinate their resources to act as hubs for data collection, collaboration, and capacity-building in ways that are both faster and more efficient. Maritime Blue can apply the BEI to current and planned projects, mapping logical paths from initial proposals to their ultimate environmental, economic, and social impacts to fully capture the sustainability performance of each. Individual or collective project performance (by focus area or across the full Maritime Blue portfolio) could steer future investment and demonstrate the cumulative triple-bottom-line impacts of the broader cluster.

Though not done in the course of this development phase, this framework could be expanded and operationalized as an online or app-based decision-making tool, enabling stakeholders to identify their desired, planned, or implemented innovations and select desired impacts. Such a tool could then generate KPIs to help document how each innovation could impact sustainability goals.

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Thanks to all who supported this project: Devon Emily Thorsell and Joshua Berger at Maritime Blue, and Earth Economics' Board of Directors.

This report was prepared by Maritime Blue using Federal funds under award ED23OIE0G0139 from the Economic Development Administration, U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of the EDA or the U.S. Department of Commerce.

Earth Economics acknowledges that we operate on the lands of the Coast Salish peoples, specifically the ancestral homelands of the Puyallup Tribe of Indians, and the 1854 Medicine Creek Treaty.

