# Building the Blue Innovation Pipeline

Lessons Learned from the United States and Sweden

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Institute for Sustainable Development



Institute for Sustainable Development (ISD) 1199 North Fairfax Street Suite 600 Alexandria, Virginia 22314 www.isdus.org

1 (833) 473-2020 Info@lsdus.org

Lead Author and Editor: Stephen Jordan CEO, ISD

Managing Editor: Patrizia-Faith Pelingon Program Coordinator, ISD

**Contributing Editor:** Erin Endres Research Assistant, ISD

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# **Executive Summary**

While there are many exciting innovations taking place in the "blue" (water-based) economy, the findings of this study indicate that more investment in research and development (R&D) is economically justified. In fact, blue R&D is underfunded by at least 112% compared to worldwide benchmarks. Even if an additional \$30-50B (billion) in global funding for R&D reduced the future risks of water environments and increased the economic rewards of water-based industries by just 10%, this would still deliver \$183B worth of economic benefit and enhanced environmental protection.

The case for innovative blue approaches to water management is clear. From a risk management perspective:

• Water-based natural disasters and other environmental impacts caused

approximately \$509.62B in global economic losses in 2022.

- Water-related disasters break down as follows: extreme storms (49%), floods (36%), and droughts (15%). Since 2000, flood-related disasters have increased by 134% and drought-related disasters by 29%.
- Other costs conservatively exceed \$278B, including: ocean acidification (\$10B), ocean plastics pollution (\$8B), and poor sanitation and hygiene (\$260B).
- These, in turn, create cascade effects for industries such as agriculture, aquaculture, finance, fishing, housing, infrastructure, and insurance.

Likewise, from an opportunity creation perspective, a study of fifteen maritime industries with total revenues of approximately \$1.32T (trillion) as of 2022 illustrate three different types of market opportunities:

- 1. the reinvention of mature industries with low or declining growth rates like shipping, aquaculture, and fishing,
- the embedding of blue features and benefits into high-growth industries like marine tourism, offshore wind power, container shipping, desalination, and deep-sea mining (DSM), and
- 3. the development of emerging maritime industries like carbon capture, utilization, and storage (CCUS), maritime digitization, unmanned underwater drones, and biomimetics.

Current blue R&D, including for off-shore energy, is \$15.8B.

This amounts to 0.86% of 2022 total maritime revenues and environmental costs analyzed in this report combined. If this were increased to the global average of 2.5% for all R&D spending, this would represent a 300% increase on current global blue R&D budgets. If it were increased to leadership levels such as Sweden's of 3.5%, this would justify a 420% increase to \$64.0B. To be clear, R&D is not necessarily correlated to funding levels, but more funding creates more opportunities for breakthroughs to happen.

A global increase of \$30-50B in R&D would pay for itself, even if it only decreased water-related costs by 10% and increased markets by 10%. This level alone would lead to at least \$183B worth of enhanced hazard mitigation, reduced disaster recovery costs, improved maritime market growth, and new job creation.

> Both the United States (U.S.) and Sweden have developed significant water-based research and innovation clusters that help to explain the current state of blue environmental and economic progress. The U.S. has robust higher education programs across the states that border the Pacific, Atlantic, and Gulf Coast, as well as in the Great Lakes, Alaska, and Hawaii. These are supplemented by incubators and accelerators, specialized venture capital investors, and corporate business

development ecosystems. Sweden's academic anchors are in Gothenburg, Stockholm, Norrköping, and Malmö. In addition, Sweden has sixty-four science parks and incubators located all over the country and robust western and eastern innovation ecosystems.

Over 71% of all water-based research in the U.S. and in Sweden is funded by the private sector. Public sector support, including European Union (EU) support, accounts for 25% in Sweden and 21% in the U.S. Higher education and private foundations account for the difference. 42% of all basic research is funded by government agencies, either directly or indirectly. Most private sector funding is directed towards applied research and experimental development.

Based on these findings, the following recommendations can help to catalyze more blue innovation.

### Strengthen Research and Innovation Catalysts

- All sectors should develop catalytic tools to raise awareness about pressing research questions, both in terms of environmental challenges and market opportunities.
- Governments should create policy frameworks that incentivize private capital investment, innovation prizes, specialized journals, international conferences, education and workforce development programs, and other support systems for innovation pipelines.

- All sectors should consider developing catalytic incentives, such as the creation of prizes patterned after those like the Nobel Prize, competitions, hackathons, and so on.
- A blue innovation pipeline index should be developed that supports national:
  - needs identification and prioritization,
  - funding requirements versus budget,
  - basic research funding and productivity,
  - applied research,
  - experimental design,
  - entrepreneurship support and new business development, and
  - new product development.

# Support Basic Research

- Governments should benchmark their current blue innovation R&D budgets and increase support for basic research to 50%, 75%, or 100% of best-in-class R&D funding levels. These investments should be indexed to projected costs and compound annual growth rate (CAGR) forecasts.
- Governments should not pick winners and losers, but rather, encourage competitions, diverse approaches, and multiple innovation hubs to flourish.
- Support must grow for drones, sensors and other monitors, and digital tools that can expand data coverage to measure essential variables related to

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water dynamics and ocean processes across all sectors.

- Greater development is needed for new tracking and prediction capacities that support integrated and multi-hazard early warning systems, improved community preparedness, and greater awareness across all sectors.
- Efforts must advance towards building "digital twin" models of flooding, drought, and extreme storm conditions that leverage machine learning, artificial intelligence (AI), and the latest innovations in information technology that should be embraced across all sectors.

### Strengthen Applied Research, Experimental Design, and New Business Development, specifically:

• the relationship and alignment between identification and prioritization of blue

economy needs and public sector basic research investments,

- cross-sector and cross-industry dialogue, information-sharing, and network opportunities, and
- incubator and accelerator support systems and capabilities leveraging ports, industrial parks, research parks, and other facilities.
- After-action reviews and criticisms of existing approaches should by systematized across sectors. Catalysts for new ideas should be embraced in a spirit of promoting continuous improvement.
- "Failure" should be redefined as an important tool of the learning process, while "fast failure" that encourages pilots, prototypes, trials, and other initiatives that promote rapid learning should be embraced.

# Build Up Pipeline Support Capabilities, specifically:

- encourage the development of waterthemed educational materials for kindergarten through twelfth grade (K-12) curricula,
- support workforce development programs such as apprenticeships, community college and undergraduate programs, and advanced degree programming that includes financial support for students from lowerincome or otherwise disadvantaged or underserved backgrounds,
- encourage corporate R&D, venture funds, and "intrapreneur" (new business developers inside large companies) programs,
- facilitate business, academia, and public sector dialogues, showcases, and information-sharing opportunities, and
- encourage private capital formation and deployment for water R&D. ●





1199 North Fairfax Street, Suite 800 Alexandria, VA 22314 +1 (833) 473-2020 info@ISDUS.org