



ENVIRONMENT THE BLUE ECONOMY

The future of the oceans will take shape at the boundary between two catalysts:

the ongoing impacts of human activities and our growing ability to manage environmental systems. Even as some celebrate a possible new golden age of oceanography, others see the oceans as a battleground for new international disputes over efforts to alter the oceanic environment. At the heart of these disputes may be the rise of a new blue economy: even as a catastrophic collapse of ocean systems looms, we see in the oceans new potential for abundant renewable energy.



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OCEANIC COLLAPSE: ACTIONS AND CONSEQUENCES

We've long known that oceans are fragile, but the last few years have brought a harsher knowledge: the ocean environment is already close to catastrophic collapse. Overuse, pollution, and large-scale changes to ocean chemistry and temperature threaten the survival of many species and put at risk many ecosystem services that humans have come to depend on. The drivers are manifold: population growth and unsustainable development; international competition and instability; and above all, global warming.

The littoral "interface" zone—the coastline—is home to some of the greatest stresses. Nitrogen runoff from overuse of fertilizer in agriculture has sterilized large stretches of coastal waters. Oil spills remain a recurring problem. And the destruction of coastal mangroves and wetlands is eliminating a critical layer of protection from hurricane and tsunami impacts.

A more direct threat to human society comes from the rapid decline of fish populations. Already, key species such as blue fin tuna, swordfish, and salmon face near-total collapse. The causes? Ever more efficient fishing technologies as well as changes in ocean chemistry.

OCEAN MANAGEMENT: TRANSPARENT WATERS

At the same time, new tools could enable humans to make far more careful use of ocean resources. In fact, some consider this a new "golden age of oceanography," arising from a rapidly improving understanding of ocean biology and physics. This new oceanography has been driven by cutting-edge technologies such as underwater autonomous

vehicles, sophisticated models, and distributed sensor arrays. Such tools may even allow the intentional manipulation of ocean systems as a means of combating climate change.

OCEANIC ENGINEERING: CLIMATE AS CATALYST

Such manipulation is known as geo-engineering, and among its proponents are those who would solve climate change with costly and controversial plans, such as fertilizing the ocean with iron particles to encourage algal growth and thereby remove carbon dioxide from the atmosphere.

At the same time, the oceans may provide some of the most abundant and reliable sources of renewable non-carbon energy. Ocean power technologies, including both "hydrokinetic" and thermal conversion systems, could easily meet current and projected energy demands—and suffer from fewer intermittency and location problems than wind and solar systems.

The massive scale and complexity of oceanic geo-engineering enterprises raise many questions. They are, by definition, uncontrollable experiments. Yet the accelerating pace of climate disruption may make such proposals irresistible, while the demands for food and energy of a growing population will almost certainly focus speculation on this new blue economy.

It's clear that oceans present humans with engineering options on an unprecedented scale. It's also clear that the future of the oceans is the future of the planet—and ultimately, of human civilization itself.