



# One Ocean: The Climate Change Challenge

The ocean is our planet's most powerful climate regulator, covering 70% of Earth's surface and holding 97% of its water. Dr. Carolyn V. Currie's research highlights how this massive ecosystem balances global temperatures, absorbs heat, and serves as our largest carbon sink.

However, this vital system faces unprecedented threats from pollution—particularly untreated sewage and wastewater. With 80% of wastewater entering oceans untreated, marine ecosystems are rapidly degrading, compromising the ocean's ability to mitigate climate change.

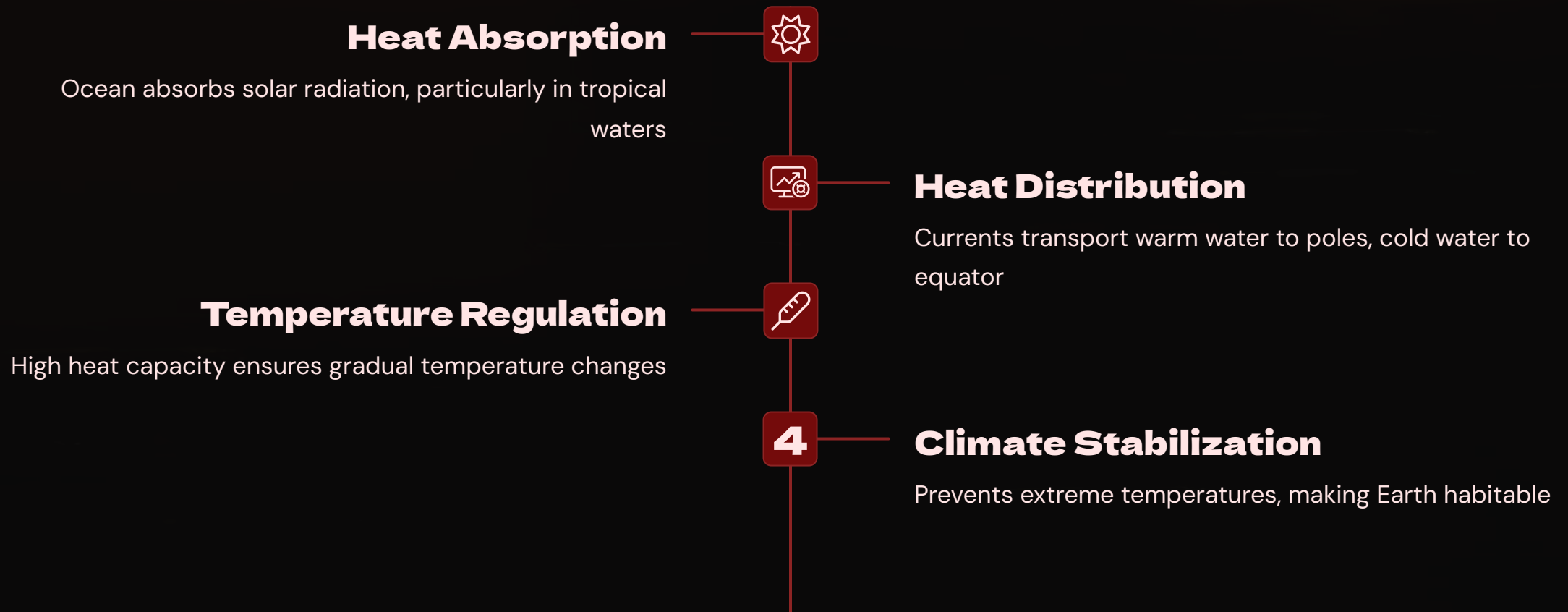
This presentation explores the ocean's critical roles in maintaining our planet's function and the urgent actions needed to preserve these capabilities for future generations.

# The Ocean as Earth's Thermostat

The ocean functions as our planet's global thermostat, absorbing 93% of global warming since the 1950s. This massive heat absorption and distribution system prevents extreme temperatures, making Earth habitable.

Ocean currents, driven by wind, temperature, salinity, and Earth's rotation, transport warm water from the equator to the poles and cold water back. The Atlantic Meridional Overturning Circulation (AMOC) is particularly crucial for moderating Europe's climate.

However, this vital function is under threat. Rising ocean temperatures are creating hypoxic zones with reduced oxygen levels, endangering marine ecosystems and disrupting the ocean's ability to regulate our climate.



# The Ocean as Carbon Sequestration Engine

The ocean serves as Earth's largest carbon sink, storing approximately 50 times more carbon than the atmosphere. This massive reservoir absorbs about 25% of anthropogenic CO<sub>2</sub> emissions, significantly slowing climate change.

Two primary mechanisms drive this carbon sequestration. The biological pump involves phytoplankton converting CO<sub>2</sub> into organic matter that sinks to the deep sea. The physical pump, powered by ocean circulation, transports dissolved CO<sub>2</sub> to the deep ocean, particularly in polar regions where cold water enhances CO<sub>2</sub> solubility.

## Atmospheric CO<sub>2</sub> Absorption

Ocean surface absorbs CO<sub>2</sub> from atmosphere

## Long-term Storage

Carbon remains sequestered for centuries



## Biological Conversion

Phytoplankton converts CO<sub>2</sub> to organic carbon

## Physical Transport

Ocean currents move carbon to deep waters

# The Ocean's Role in the Water Cycle

The ocean drives Earth's water cycle by supplying moisture for precipitation, sustaining terrestrial ecosystems and human agriculture. Nearly all rainfall on land originates from oceanic evaporation, with tropical regions receiving particularly high precipitation due to intense heat absorption.

This continuous cycle of evaporation, cloud formation, and precipitation maintains freshwater availability worldwide. The ocean effectively functions as a massive desalination plant, converting saltwater to freshwater through natural processes.



## Evaporation

Solar energy causes water to evaporate from ocean surface



## Condensation

Water vapor forms clouds as it rises and cools



## Precipitation

Rain and snow fall on land and ocean



## Return Flow

Water returns to ocean via rivers and groundwater

Ocean pollution and warming are disrupting these evaporation patterns, intensifying both droughts and floods globally. Preserving clean oceans is essential for maintaining stable precipitation patterns and freshwater security.

# Oxygen Production: The Ocean's Breath

The ocean produces over 50% of our planet's oxygen, primarily through phytoplankton photosynthesis. These microscopic marine plants convert carbon dioxide and sunlight into energy, releasing oxygen as a byproduct—making them as crucial as rainforests for our atmosphere.

Cold waters naturally hold more dissolved oxygen, while nutrient availability influences phytoplankton growth and productivity. This delicate balance sustains both marine and terrestrial life, including humans.

**50%+**

**Global Oxygen**

Percentage of Earth's oxygen produced by  
ocean

**70%**

**Marine Source**

Portion of oceanic oxygen from  
phytoplankton

**2%**

**Declining Rate**

Estimated annual decrease in ocean  
oxygen levels

Ocean warming and pollution are creating expanding hypoxic zones with dangerously low oxygen levels. These "dead zones" threaten marine ecosystems and could eventually impact global oxygen cycles, making ocean protection a matter of planetary respiratory health.

# Marine Biodiversity and Food Security

The ocean hosts extraordinary biodiversity, supporting millions of species and providing a primary food source for billions of people through fisheries and aquaculture. Coastal ecosystems like mangroves, coral reefs, and seagrasses serve as crucial nurseries for fish while storing significant amounts of carbon.

This marine biodiversity underpins global food security and economic livelihoods, particularly in developing nations where seafood provides essential protein and income for coastal communities.

## Fisheries Impact

Over 3 billion people rely on seafood as their primary source of protein, with marine fisheries supporting 260 million jobs worldwide.

## Ecosystem Services

Coastal habitats provide storm protection, prevent erosion, filter pollutants, and serve as carbon sinks worth trillions in economic value.

## Biodiversity Hotspots

Coral reefs cover less than 1% of the ocean floor but support 25% of all marine species, making them comparable to rainforests in biodiversity.

Pollution, overfishing, and acidification threaten these vital ecosystems, risking food scarcity and economic instability for communities worldwide. Protecting marine biodiversity is essential for sustainable food systems and coastal resilience.



# The Sewage Crisis: A Solvable Threat

Dr. Currie's research identifies sewage and wastewater as the most significant pollutants undermining the ocean's climate functions. With 80% of global wastewater entering oceans untreated, this pollution source demands immediate attention.

Just 25 watersheds are responsible for nearly half of all nitrogen and pathogen inputs to coastal areas. This concentrated pollution leads to eutrophication, harmful algal blooms, and expanding dead zones that devastate marine ecosystems.



## Eutrophication

Excess nutrients from sewage cause explosive algal growth, depleting oxygen when algae die and decompose.



## Dead Zones

Areas with oxygen levels too low to support marine life are expanding globally due to pollution and warming.



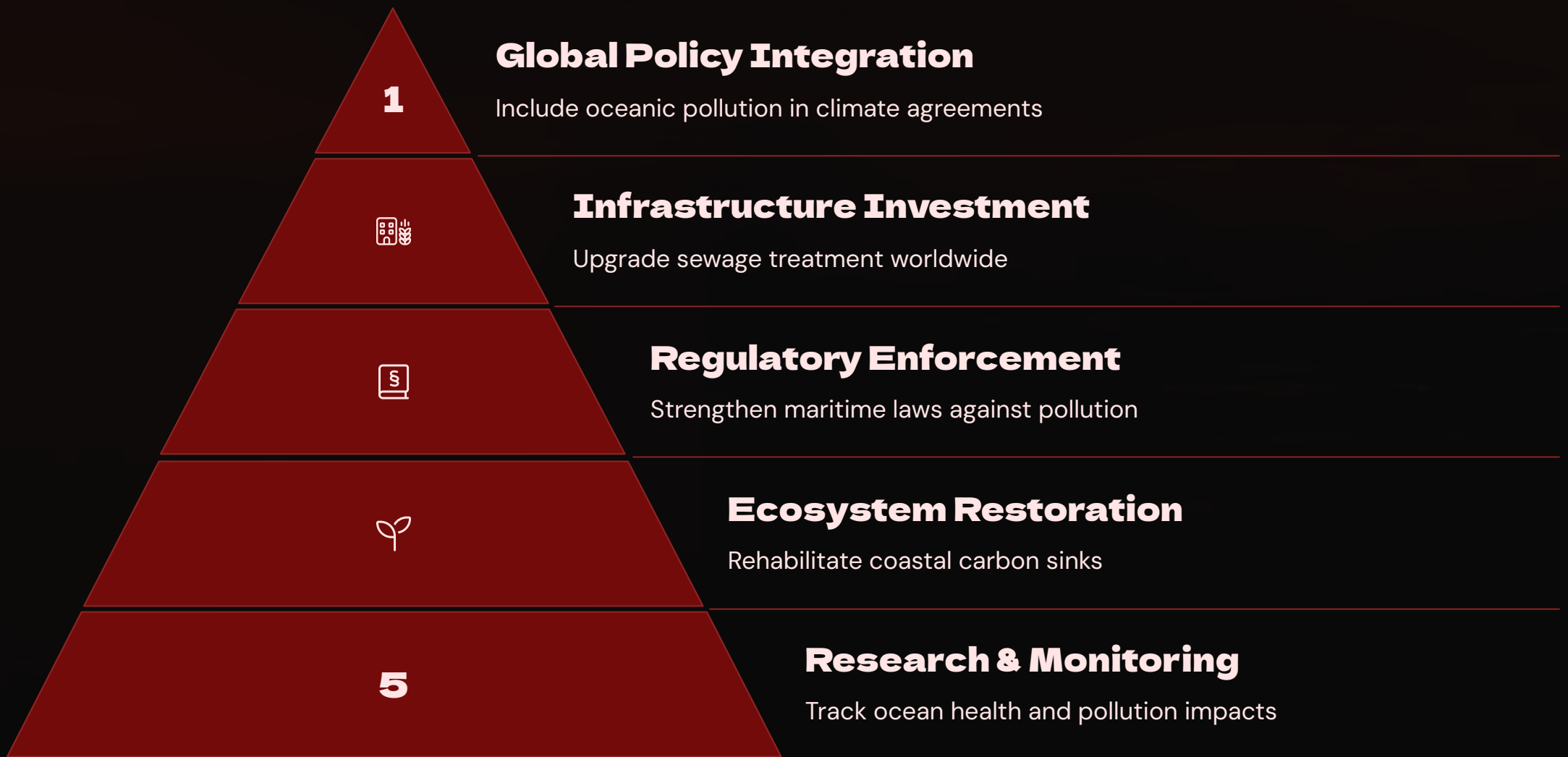
## Treatment Solutions

Modern wastewater infrastructure can effectively prevent marine pollution while recovering valuable resources.

Current international frameworks, including the 2023 UN High Seas Treaty, inadequately address sewage pollution. Shipping regulations even allow untreated sewage dumping beyond 12 nautical miles, exacerbating the problem.

# Action Plan: Saving Our Ocean Climate System

Addressing oceanic pollution, particularly sewage, offers a simpler and more cost-effective climate solution than focusing solely on greenhouse gas reductions. Dr. Currie's research shows this approach provides immediate benefits for climate mitigation and human wellbeing.



By preserving the ocean's five critical functions—climate regulation, carbon sequestration, oxygen production, water cycle maintenance, and biodiversity support—we protect our planet's life support system. The time for action is now, with sewage pollution representing the most addressable threat to ocean health.

Our one ocean connects all life on Earth. Its protection is not just an environmental imperative but a climate necessity that requires immediate global cooperation and investment.