

**Supplemental materials to accompany testimony of  
Ayana Elizabeth Johnson, Ph.D., Co-founder of Urban Ocean Lab,  
Before the U.S. House of Representatives Natural Resources Committee**



**Legislative Hearing on Ocean-Based Climate Solutions  
June 22, 2021**

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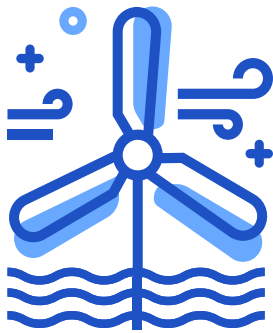
# ADVANCING OFFSHORE WIND ENERGY IN THE U.S.

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BY TERESA R. CHRISTOPHER, MEGAN DAVIS,  
JEAN FLEMMING, AND AYANA ELIZABETH JOHNSON<sup>1</sup>

## BACKGROUND



Globally, offshore wind development is flourishing. As costs decline, wind is becoming more competitive with traditional energy sources, and government and public support is increasing. The offshore wind energy market is expected to grow at 18.6% annually through 2024 and 8.2% through the end of the decade, with the

industry projected to generate about 234 gigawatts (GW) of power globally by 2030. In the U.S., seven east coast states alone have committed to sign contracts totaling over 30 GW of offshore wind by 2035, and President Biden has also established a national goal of 30 GW of production by 2030. However, there are currently only two operational offshore wind facilities: A 30 megawatt (MW) wind farm off the coast of Rhode Island that became operational in 2016 and a 12 MW wind farm (phase one of a potentially 2,640 MW project) off the coast of Virginia that became operational in June 2020. Around 30 additional proposed offshore wind projects are in various stages of development in U.S. waters. The Bureau of Ocean Energy Management (BOEM) has issued 16 active commercial wind energy leases, which, when operational, could power approximately 8 million homes. In May 2021, the Vineyard Wind project received final federal approval to begin construction, and it is expected to begin delivering clean energy to 400,000 Massachusetts homes in 2023.

There is massive potential for offshore wind as an energy source, and it could be a major component of a clean energy economy. Notably, offshore wind is stronger and more consistent than onshore wind. This is particularly significant because lack of reliability is often cited as one of the major barriers to expanding renewable energy. In the U.S., it is technically feasible that offshore wind could

provide over 2,000 GW of energy, two times the present generation of the entire U.S. electric grid. With 40% of Americans living in coastal counties, harnessing offshore wind energy would allow the U.S. to generate energy close to where demand is highest.

Additionally, offshore wind has the ability to create jobs and bolster the transition to a clean energy economy. BOEM has a number of lease areas that are expected to be auctioned in 2021 and 2022. If these areas are auctioned as commercial leases, offshore wind has the potential to support an average of 80,000 jobs per year in the United States through development, construction, and operation from 2025 to 2035—60% more jobs than the coal mining industry provided in 2019. Under current plans, this will include jobs in turbine manufacturing and supply chains, and in the construction, transportation, and port industries. Many wind energy jobs require highly skilled trades, including skills easily transferable from the oil and gas sector, helping to enable a just and economically sound energy transition. As the U.S. continues to recover from the major economic downturn instigated by the Covid-19 pandemic and deal with our climate crisis, offshore wind can be part of the solution.

## BARRIERS TO U.S. OFFSHORE WIND GROWTH

As offshore wind continues to grow, it can become a significant component of our energy mix and a key contributor to our clean energy economy. However, to-date, the U.S. offshore wind industry has been slow to develop due to a number of factors. Energy markets, cost competitiveness, protracted permitting processes, lack of science and data concerning cumulative impacts on wildlife and ecosystems, needing to conduct studies during specific times of year, interest group opposition, lawsuits, and

jurisdiction complications have all contributed to delays or barriers to expeditiously expanding offshore wind in U.S. waters. In order to harness this opportunity and achieve the targets the President has set forth, we need to address these barriers with pragmatic solutions and continue to advance policies that allow for the growth of the industry.

Here are the key barriers that have slowed the growth of the U.S. offshore wind industry.

### COMPLEX OFFSHORE GOVERNANCE AND REGULATORY REQUIREMENTS

Offshore areas often support multiple industries and fragile marine environments, all of which need to be considered and protected when proposing, developing, and constructing an offshore wind project. This requires involvement from multiple federal agencies with different authorities at various points of the process. It can result in lengthy permitting processes and a certain amount of risk and uncertainty for developers. Additionally, offshore site selection and acquisition usually involves a combination of federal, state, and local government jurisdictions.<sup>2</sup> Overlapping state and federal jurisdiction creates numerous complications, as offshore wind projects within state waters are still subject to a number of federal laws, and offshore wind projects in federal waters will still need to run transmission lines through state waters to connect to the onshore grid.

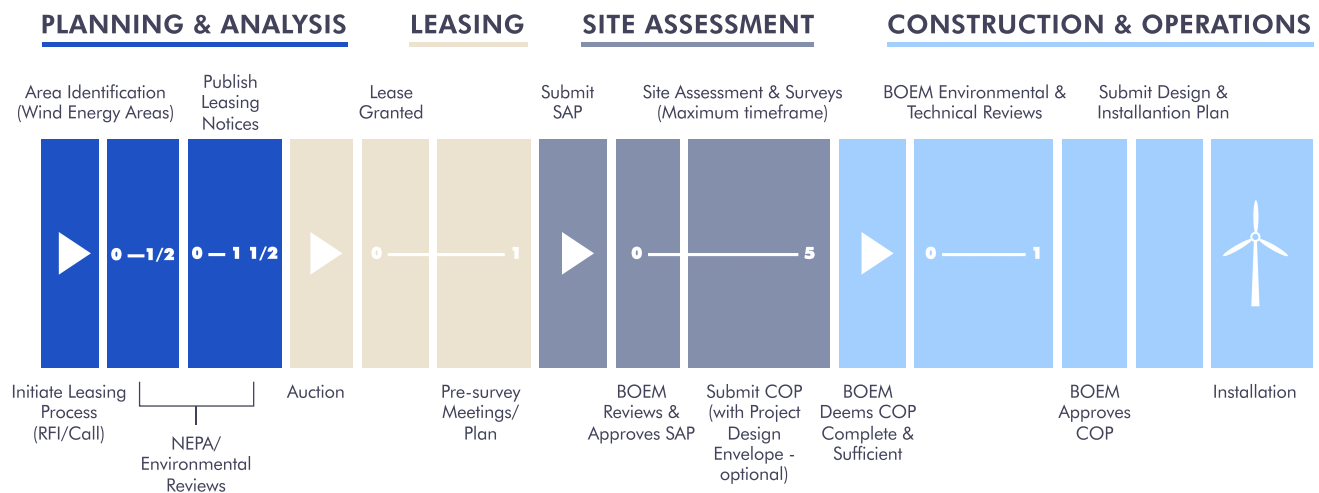
### INADEQUATE STAFFING AND RESOURCES

Lack of adequate staffing and resources at BOEM, the federal agency with primary responsibility for permitting offshore wind, has contributed to the protracted permitting review process. While BOEM has received some increases in their budget—including at the end of 2020—more funding is needed to meet the President’s goals. BOEM has already completed eight competitive lease sales, issued 16 active commercial leases, approved nine Site Assessment Plans, approved one general activity plan, and issued 10 instances of guidance on offshore wind programs.<sup>3</sup> However, without additional resources the agency will be limited by staff capacity as it seeks to implement additional lease sales, review Construction and Operation Plans (COPs), and conduct other technical and environmental analyses necessary for projects to move forward.

### INTEREST GROUP OPPOSITION

Interest groups that are common opponents of offshore wind construction include marine industries like fishing and shipping, as well as coastal homeowners. Commercial fishermen often oppose wind farms due to potential loss of use of commercial fishing areas, and shipping and other stakeholders have expressed concerns over navigation and safety. However, many of these concerns can be addressed upfront with coordinated planning and modification of turbine spacing. In the past, coastal homeowners and communities have opposed the construction of wind farms

## The Bureau Of Ocean Energy Management Offshore Wind Permitting Process Timeline (In Years) From Call To Operations



Source: Adapted from Bureau of Ocean Management (BOEM)

due to perceived aesthetic or siting concerns, bringing lawsuits or creating public opposition that mire projects in lengthy proceedings for years. However, with improved siting and design, and proposed wind farms sited further offshore, aesthetics are less of a concern, as wind farms are barely visible from the shore. In addition, recent polling by Data for Progress shows that 58% of voters support restricting the influence of coastal homeowners on wind permitting decisions.

## ECOLOGICAL IMPACTS AND LIMITED SCIENTIFIC DATA

Offshore wind development can have an impact on the marine environment, affecting birds, bats, and marine mammals, including the highly endangered North Atlantic Right Whale. While many of these negative impacts can be mitigated, it is important to first have a firm scientific understanding of what those impacts are. For example, whales are extremely sensitive to noise and the installation of offshore turbines via pile-driving can negatively impact them, as can ship strikes from support vessels. Similarly, wind farms sited in bird migration corridors or in productive scallop habitat can have impacts on wildlife and on fisheries. While site surveys and research help to determine the impact of individual wind projects, over 30 projects have been proposed along the eastern seaboard thus far and the collective impact that suite of projects could have on marine ecosystems and species is unknown. Concerns over the cumulative impacts to species and ecosystems must be considered. However, given the newness of the offshore wind industry, there has not yet been an analysis of its likely cumulative impacts due to a lack of research and data. For example, BOEM has delayed processing of COPs due to the need for supplemental environmental impact statements and reviews that account for multiple wind farms planned for the same area off of the coast of New England.

## LACK OF A WELL DESIGNED TRANSMISSION SYSTEM

One of the biggest challenges for the offshore wind industry is getting potential power to users. Understanding the potential impacts of a growing offshore wind energy on the onshore grid is critical for grid integration and for scaling the industry in the U.S. Existing connections to the onshore grid are limited, and as the system is developed it must account for how the additional power will affect system reliability and transmission congestion. Additionally, as wind turbines are built further offshore and grow in size, storage stations and grid architecture will become increasingly important to minimize grid losses and maintain system reliability. Potential solutions to these issues exist, such as a high-capacity transmission “backbone” or a “hub and spoke” model, where several

wind turbines are connected by a single high-capacity cable. Regardless of the type of technology used, building a well-designed offshore transmission system will be increasingly important as capacity is reached at the limited connection points onshore and as more wind farms are built.

The U.S. will require substantial investments in both its onshore and offshore transmission infrastructure to integrate the proposed and projected offshore wind projects. In Europe, planning transmission for scale and encouraging competition has been essential to the growth of the offshore wind industry. Although the Biden-Harris administration recently announced the availability of \$5 billion of transmission financing through the Department of Energy’s Loan Programs Office, there is currently no master offshore transmission plan in the U.S. to strategically develop this infrastructure. Limited regional planning has been done by the Regional Transmission Organizations (RTOs) and Independent System Operators (ISOs). The Federal Energy Regulatory Commission (FERC) has begun to discuss whether existing regional frameworks can accommodate the anticipated growth in offshore wind and consider possible changes or improvements to the current framework. Additionally, companies are investing in offshore transmission technology advancements that could have implications for offshore wind.

## TECHNOLOGICAL LIMITATIONS

Offshore wind technology is evolving globally, allowing wind farms to be built in deeper waters, at larger scales, and with the ability to harness more energy. As the technology around floating turbines develops, wind farms will be built further offshore, minimizing aesthetic concerns but potentially creating conflicts with other ocean users. Additional challenges include resilience to storms and resistance to corrosive salt water. The continental shelf is generally narrower on the west coast of the U.S., so installing offshore wind on the west coast at a significant scale will require floating turbines, which bring additional technology challenges related to substructure optimization, logistics, maintenance, and repairs.

## POLICY RECOMMENDATIONS

### LEGISLATIVE BRANCH

1. **Set an offshore wind goal at the federal level.** In the past, Congress has set goals for various energy types. For example, in 2005, the Energy Policy Act set a goal of authorizing more than 10,000 MW of renewable energy generation on public lands by 2015. Additionally, many states have already set target offshore wind goals. For example, New York has a

goal of 9,000 MW of offshore wind by 2035 and New Jersey has a goal of 7,500 MW by 2035. By establishing a national goal of at least 30 GW by 2030 as the Biden-Harris administration has done through executive action, Congress can monitor progress toward the goal and help ensure that offshore wind is a critical component of a clean energy agenda.

2. **Enact a Clean Electricity Standard (CES) to achieve 100% clean power by 2035.** Decarbonizing the electricity sector is the first step to fully decarbonizing our economy. A power sector-specific, technology-neutral clean energy standard will drive clean electrons to the grid, create necessary demand for a robust offshore wind industry, and continue to drive down the cost of renewable technologies. This new CES should call for 100% renewable and zero-emission energy in electricity generation by 2035, aligned with President Biden's stated goal—and consistent with language included in the CLEAN Future Act.
3. **Increase staffing and resources at BOEM to expedite review and approval processes.** Congress should allocate additional resources to BOEM specifically for staff to review permit applications and other technical reviews required during the permitting process, as well as for additional science and research to support environmental reviews. While some funding increases were authorized at the end of 2020 for FY2021, more resources will be needed to set forth the goals established by the President.
4. **Support research focused on regional and national strategies to accelerate and maximize the effectiveness, reliability, and sustainability of U.S. offshore wind deployment and operation** with partners from institutions of higher education, research institutions, national laboratories, the private sector, and state and local governments relevant to emerging commercial scale offshore wind deployment. While some investments have already been made, more are needed. For example, the National Offshore Wind R&D Consortium, partially funded by the Department of Energy, just announced 15 new projects totalling \$8 million in new investment. Additionally, the Consolidated Appropriations Act of 2021 authorized \$125 million for each of fiscal years 2021 through 2025 for a wind energy research and development (R&D) program, but appropriations will be needed to support the program.
5. **Ensure that the communities hosting new wind development receive a share of the benefits.** Congress should require all federal tax incentives for offshore wind to be conditioned on local hiring and strong labor standards, including requirements for prevailing wages, project labor agreements, best value contracting, and collective bargaining rights. Offshore wind presents an enormous opportunity to create jobs that generate wealth in the communities that host new development. For example, coalitions like Climate Jobs New York have successfully worked in partnership with New York State to ensure that a burgeoning offshore wind industry creates good union jobs.
6. **Create a skilled, unionized, local workforce for offshore wind through investment in workforce training programs.** Offshore wind projects rely on skilled labor and advanced manufacturing for construction, installation, operations, and maintenance. With job growth projected to grow by tens of thousands, there is a need to develop a domestic workforce. Offshore wind draws on workers from a wide range of often unionized trades, including logistics, construction, and the maritime industry. To help build a highly skilled, readily available workforce, Congress should invest in workforce training programs at the federal and state levels in partnership with the industry. In February 2021, Congress took an initial step toward supporting workforce training by passing the Offshore Wind Jobs and Opportunity Act. The new law authorizes the Department of the Interior to provide offshore wind career training grants to institutions of higher education or labor organizations, but appropriations will still be necessary to implement the program.
7. **Invest in manufacturing programs that create and enhance domestic supply chains for the offshore wind industry.** With seven East Coast states having already collectively committed to creating over 30 GW of power by 2035, there is an opportunity to create a domestic supply chain to support the industry. Both manufacturing and installation of offshore wind turbines could present an opportunity to domestic businesses in the supply chain totaling nearly \$70 billion. The Biden-Harris Administration has called on Congress to make significant supply chain investments in both the American Jobs Plan and in the proposed budget for Fiscal Year 2022. Investments should be transformational and focus on American-made components from turbine creation to deployment, innovations in new materials, as well as research and development.
8. **Establish a fund to support research and mitigate environmental impacts of offshore wind.** Congress should establish a fund in which a percentage of the bonuses, royalties, and other payments made to the Treasury for leasing and operation of offshore wind projects can be collected and used to pay for research and cumulative impact studies necessary for offshore wind projects to be approved. Such funds could also be

used to monitor, minimize and mitigate potential impacts to the marine environment and marine species. While some existing efforts support research and development of the offshore wind industry, such as the National Offshore Wind Research and Development Consortium, this would ensure sustainable, long-term funding for research and monitoring.

## EXECUTIVE BRANCH

### 1. **Prioritize offshore wind as part of a climate and clean energy agenda with near term actions and long term vision.**

The Administration has taken early steps to prioritize offshore wind by establishing a 30 GW by 2030 national goal through executive action until Congress acts, and the Departments of the Interior, Energy, Commerce, and Transportation have all committed to making that goal a reality. Funds for technology advancement, research debt financing, and port infrastructure to support the offshore wind industry have been proposed or made available through various programs. Additionally, BOEM has already announced new wind energy areas, advanced proposed projects, and committed to new lease sales and the completed review of at least 16 Construction and Operation Plans (COPs) by 2025. However, prioritizing federal investments through budgetary requests is also needed. Further, bold federal leadership that sets a vision for our ocean and accounts for multiple ocean users is necessary.

### 2. **Establish a White House-led interagency coordinating body on offshore wind, and direct relevant agencies to prioritize creating efficiencies and reducing barriers to offshore wind development and ability to scale the industry.**

While the President's plan to kickstart offshore wind advances key actions, we recommend the creation of a subcommittee of the White House National Climate Task Force to expedite deployment and enable the ability to scale offshore wind. Day-to-day leadership and focused implementation are essential to scale the industry quickly and achieve clean energy goals. We recommend the subcommittee be directed to:

- Create a plan, with input from relevant states and stakeholders, that articulates a coordinated, cohesive vision for offshore wind and details actions and timelines to address barriers;
- Recommend actions to minimize conflicts between offshore wind and other ocean users;
- Work with relevant states to ensure needs are understood and federal/state decisions are coordinated;
- Ensure BOEM, the National Oceanic and Atmospheric Association (NOAA), the Fish and

Wildlife Service (FWS), and other relevant agencies coordinate and prioritize environmental permitting needs and identify efficiencies;

- Work with the U.S. Department of Labor and the U.S. Department of Commerce to create a plan to expand domestic supply chains, manufacturing capability, and a skilled workforce to support the offshore wind industry taking into account existing efforts; and
- Ensure DOE, NOAA, and other relevant agencies prioritize research and development investments to support key industry barriers to scale.

Additionally, the subcommittee should enter into an agreement with FERC to coordinate on an offshore transmission master plan and any additional science and research needed to support transmission planning.

### 3. **FERC, in coordination with DOE, BOEM, other relevant Federal agencies, the States, and the RTOs/ISOs, should develop a cohesive, strategic offshore wind transmission master plan or regional master plans.**

Studies have assessed the transmission and grid integration needs for U.S. wind development, and regional ISOs have planning processes that can accommodate individual wind project connections to the onshore grid. Still, an overarching, comprehensive plan to address transmission, the unique qualities of the offshore environment, and long-term grid reliability is needed. Recent studies have shown that transparent, long-term, on and offshore grid planning removes barriers to entry, improves coordination, and lowers costs. The plan should be developed within one year, consider phased implementation, and account for the projected growth of the offshore wind industry, as well as address additional transmission needs of future larger, floating turbines in deeper waters.

### 4. **BOEM should review its offshore wind regulations and procedures to build efficiencies into the permitting process** in a manner that facilitates a sustainable offshore wind industry while minimizing environmental impacts. The Biden-Harris Administration's "Tackling the Climate Crisis at Home and Abroad" Executive Order has taken a first step in this area by directing the Secretary of the Interior to "review siting and permitting processes on public lands and in offshore waters to identify... [steps] to increase renewable energy production on those lands and in those waters, with the goal of doubling offshore wind by 2030 while ensuring robust protection for our lands, waters, and biodiversity and creating good jobs." Regulatory and procedural changes will be needed for BOEM to implement the recommendations that result from that review.

5. **Support scientific research needed for Cumulative Impact Studies.** Understanding cumulative impacts of offshore wind on species and the marine environment is critical. The Administration should request and Congress should appropriate additional resources for cumulative impact studies to be done for key species or in key regions to help expedite the review process for wind projects in those areas. This will be helpful for understanding and developing solutions to address fisheries impacts. The Administration is initiating some of these studies already through BOEM, NOAA, DOE, and the National Oceanographic Partnership Program. For example, NOAA's Northeast Sea Grant programs, in partnership with DOE, DOC, and NOAA's Northeast Fisheries Science Center, recently issued a request for research proposals "to support more than \$1 million in grant funding to improve understanding of offshore renewable energy for the benefit of a diversity of stakeholders, including fishing and coastal communities," but more research will be needed.
6. **Continue to invest in the regional integrated data and tools that allow for upfront planning and minimizing conflict.** The Northeast Regional Ocean Council and Mid-Atlantic Regional Council on the Ocean built fairly comprehensive databases that allow planners to look at existing uses including fishing, wildlife, habitat, and other conditions to engage key stakeholders and address some stakeholder conflicts upfront. The West Coast Ocean Alliance is engaged in that process now. As offshore wind expands, additional investment in these partnerships would help facilitate the siting and review process, and provide a forum for addressing conflicting uses. At the same time, public-private sector data-sharing agreements can provide essential information for upfront planning. NOAA's newly announced Memorandum of Agreement with offshore wind developer Ørsted to share ocean mapping and biological data in Ørsted-leased waters is a first-of-its-kind agreement between an offshore wind developer and NOAA that paves the way for future data-sharing agreements that the Administration should pursue.
7. **Focus existing manufacturing, workforce training, and skills programs on increasing the capability and capacity of the domestic workforce and supply chain for offshore wind.** Many of the components, subcomponents, and infrastructure for commercial-scale offshore wind projects in the U.S. are currently and will continue to be imported until a domestic supply chain and workforce is developed. Several states and the Biden-Harris administration have already taken steps to build this capacity. For example, North Carolina, Maryland, and Virginia announced a

regional partnership to position themselves as an economic hub for offshore wind supply chain companies, and states such as New Jersey are expanding their port infrastructure to service the industry. The Administration has also called for a \$100 billion investment in workforce development, a portion of which would be used for training programs in clean energy and manufacturing. While Congress should make these transformational investments to increase both capability and capacity, and some investments have been made by the National Offshore Wind Research and Development Consortium, the Administration should leverage and focus applicable existing programs in the Departments of Commerce, Labor, and Education, to help address skills and labor gaps and support development of supply chains. For example, the Economic Development Administration could direct resources from applicable grant programs to support workforce training and the National Institute for Standards and Technology's (NIST) through the Hollings Manufacturing Extension Partnership (MEP) Centers could help to build a skilled workforce for manufacturing. The Department of Labor can support workforce development and potentially create specialized certification for specific types of offshore wind jobs.

Offshore wind must be a significant part of our energy mix if the United States is going to meet our carbon reduction goals. The legislative and executive actions recommended in this document provide a pathway to rapidly scale offshore wind in the United States while protecting the environment and creating American jobs.

## ENDNOTES

1. Maggie Thomas, then political director of Evergreen Action, was co-author on the original August 2020 version of this memo. This update was completed in May 2021 with the assistance of Urban Ocean Lab's Project Manager, Michele Zemplenyi, and Research Fellow Daniela Schulman.
2. State jurisdiction over the seabed is defined by the Bureau of Ocean Energy Management as follows: "Texas and the Gulf coast of Florida are extended three marine leagues (nine nautical miles) seaward from the baseline from which the breadth of the territorial sea is measured. Louisiana is extended three U.S. nautical miles (U.S. nautical mile = 6080.2 feet) seaward of the baseline from which the breadth of the territorial sea is measured. All other States' seaward limits are extended three International Nautical Miles (International Nautical Miles = 6076.10333 feet) seaward of the baseline from which the breadth of the territorial sea is measured." Beyond that is considered federal waters, the exclusive economic zone.
3. These numbers were confirmed as up-to-date as of May 2021 via internal communications with the Department of the Interior.

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## *Observations* | Opinion

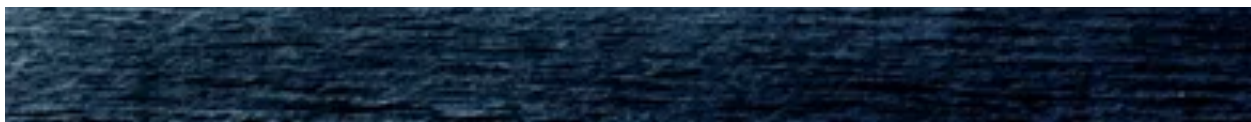
# To Save the Climate, Look to the Oceans

They can be a source of clean, renewable energy, sustainable food, and more

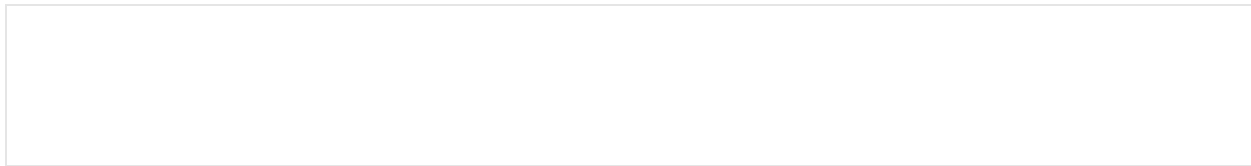
By Ayana Elizabeth Johnson on June 8, 2020







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Learning to swim, in a pool in the Florida Keys, was pure joy. I was five and reveled in blowing bubbles and doing cannonballs. A few years later, when I learned to swim in the ocean, the vibe was different, not purely playful. The mantra was: never turn your back on the ocean. Because, I was warned, you need to keep an eye on the waves, to avoid getting pummeled, or worse. I was taught to navigate undertows and rip currents, to respect the power of the sea.

As an adult, I re-learned this lesson of the ocean's dangerous power watching climate change-fueled hurricanes smash into coastlines, and reading the science of sea level rise. But while we might respect the sea's capacity to upend and rend lives and communities, what we have turned our backs on is its power to *heal*. This too we neglect at our peril. I don't mean the ocean's ability to heal us emotionally, although we should probably make better use of that in these wild times. The healing power we most need to harness is the ocean as a source of climate *solutions*.

This is a much needed flip of the script. We often focus on the ways in which the ocean puts up with endless waves of abuse — pollution from oil spills, agriculture, factories, plastics; seawater heating up and acidifying due to greenhouse gases, driving fish toward the poles and disintegrating coral reefs; coastal ecosystems being bulldozed to build resorts and shrimp farms; the plunder of overfishing causing fish populations to plummet; the deep sea on the brink of being mined, torn up (perhaps needlessly) for minerals.

That was perhaps as overwhelming for you to read as it was for me to write. For sure, we must keep our eyes on all that, and work to halt it. The ocean is in dire straits (and it's so hard to write about it without inadvertent puns). *But*, know that it also offers us a way

forward. It offers major opportunities to abandon fossil fuels, sequester tons of carbon, and create a sustainable food system. I'm talking about renewable offshore energy and algae biofuel, about coastal ecosystems and regenerative ocean farming. We are overdue for a reframe, from seeing the ocean as victim or threat, to appreciating it as hero.

## **Offshore Renewable Energy**

Around 40 percent of Americans live in coastal counties. Imagine if the homes and business along our coasts were powered by offshore wind and waves. This doesn't have to remain a dream. Offshore, the wind blows more strongly and consistently than it does over land, so floating turbines could mean more energy, generated more reliably—and produced near population centers. However, while there are quite a few in development, Block Island Wind Farm, a few miles off of Rhode Island, is currently the solitary offshore commercial wind farm operating in the U.S. Between protracted permitting processes, the need for data on environmental impacts and the fact that wealthy coastal property owners are fighting proposals near their homes, we are way behind the UK, Germany and other European countries at making use of this free, gusty resource.

Offshore wind can and should leap from providing essentially zero percent of our national energy to over 10 percent by 2050 if we are to achieve the needed rapid decarbonization of our electricity grid. And then there's the burgeoning technology for harnessing the energy of waves and currents, and even spreading solar panels across the sea surface. While we must take care with ocean ecosystems and species' migratory routes when we choose installation locations, we also need to move quickly.

## **Marine Ecosystems**

Not only can the ocean be a source of carbon-free energy, it can also sequester tons of carbon: so far, it has absorbed around 30 percent of the carbon dioxide we have emitted by burning fossil fuels. Lately, there has been a lot of discussion of planting trees, billions of them, with no mention of the fact that about half of global photosynthesis happens in the ocean. That land-centric myopia misses the carbon drawdown potential of wetlands and seagrasses, coral reefs and oyster reefs, kelp forests and mangrove forests.

In fact, wetlands can hold five times more carbon in their soils than a temperate or tropical forest! And even though New York and New Jersey have already lost 85 percent of coastal wetlands, what little remains reduced damages during Superstorm Sandy by \$625 million. Coastal ecosystems can often provide cheaper and more effective shoreline protection than sea walls, and “blue carbon” should not be overlooked. Protecting and restoring coastal ecosystems is a good investment.

## Algae Biofuel



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Biofuels produced on land—mostly ethanol from crops like corn and sugar—often rely on large amounts of water, fertilizers, and pesticides, and require so much fossil fuel to produce that they can barely be considered green. Not so with algae grown along our coasts, although much research and infrastructure development is needed in order to produce algae biofuel at scale. The federal Advanced Research Projects Agency—Energy (ARPA-E) Mariner program, which funds R&D, estimates that the U.S. could grow 500 million dry metric tons of macroalgae annually, which equates to about 10 percent of national transportation demand. Plus, seaweeds absorb tons of carbon dioxide as they grow—kelp can grow up to two feet in a single day, and turn sunlight into chemical energy more efficiently than land plants. Even though I know the science, to me, photosynthesis still seems like magic.

## Regenerative Ocean Farming

We also can, and arguably should, use algae to power our bodies and feed our livestock, not just provide energy for our machines. With over 90 percent of global fish stocks maximally exploited or overfished, we certainly can't rely on wild fish to feed the world as our population approaches eight billion. At the same time, industrial aquaculture has been largely unsustainable, often focused on carnivorous fish that require a lot of feed and infrastructure. However, there is huge potential for a regenerative renaissance in ocean farming, focused on seaweeds and filter-feeding shellfish (oysters, mussels, clams,

scallops), which live simply off sunlight and nutrients already in seawater.

This type of ocean farming can reduce local ocean acidification (photosynthesis!) and improve local water quality. Plus, seaweeds absorb excess nitrogen and phosphorus that runs off land from overuse of fertilizers for industrial agriculture, and can cause ocean dead zones. Bonus: These “sea vegetables” have high nutritional value, and when fed to cows can reduce their methane emissions by up to 67 percent.

As our economy struggles to recover from the coronavirus-triggered recession, it is also important to note that implementing these ocean-climate solutions can create many jobs. In the U.S., the “blue economy” supports around three million jobs and contributes \$285 billion annually to GDP, from tourism, shipping, fishing and construction. And that can continue to grow. In the next decade, installing offshore wind from Maryland to Maine could support over 36,000 full time jobs. As part of a green stimulus package, a Climate Conservation Corps could put people to work re-planting coastal ecosystems. Scaling regenerative ocean farming could create millions of direct and indirect jobs.

This is why we need a Blue New Deal in addition to a Green one. The Green New Deal resolution merely mentions the ocean once in passing. The ocean must go from afterthought to centerpiece if we are to address the climate crisis at the order of magnitude required.

So when you think of climate solutions, don’t just think of rooftop solar panels and electric cars. Don’t turn your back on the ocean. It positively brims with climate solutions.

*The views expressed are those of the author(s) and are not necessarily those of Scientific American.*

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## **ABOUT THE AUTHOR(S)**

Ayana Elizabeth Johnson, Ph.D., is a marine biologist, policy expert and Brooklyn native. She is founder of the consultancy Ocean Collectiv and the think tank Urban Ocean Lab. Find her on Twitter @ayanaeliza.



Marine biologist Ayana Elizabeth Johnson swimming in Jamaica's seagrass. | Photo courtesy of Jeremy McKane

## What I Know About the Ocean We Need Ocean Justice

By [Ayana Elizabeth Johnson \(/sierra/authors/ayana-elizabeth-johnson\)](/sierra/authors/ayana-elizabeth-johnson) | Dec 12 2020

**Here is what I know.** The ocean is not separate from us or our daily concerns. It is our nourishment, protection, livelihood, and the air we breathe. It is culture, joy, and freedom. All this is at risk, and we need ocean justice.

**Ocean conservation is about people—more specifically, it's about marginalized people.** Sometimes it seems we've been duped into thinking ocean conservation is just about fish, dolphins, whales, corals, and remote tropical islands. The well-being of communities of color and of poor and working-class folks is deeply affected as the ocean's health degrades. No different than on land, we are either excluded from accessing ocean resources or relegated to the most denuded and polluted places. Although we bear the greatest brunt of the impacts, we often had the least hand in causing them.

A healthy ocean is critical to food security, economies, cultures, and our own health. Right now, overfishing, pollution, coastal development, and climate change are jeopardizing all of that. In addressing these threats to ocean health, we must consider who benefits from ocean exploitation and from conservation, and who does not.

**We need ocean justice.** While the concept of environmental justice—defined by the US Environmental Protection Agency as “the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies”—may have finally permeated the zeitgeist, the concept seems to end at the shore.

Communities of color and poor communities remain most disastrously affected by pollution, overfishing, human rights abuses, loss of coastal ecosystems, storms strengthened by climate change, and sea-level rise. Tackling these challenges will require working at all levels, from micro-local to global, and building political power. We cannot afford to wait for governments and international bodies to lead. We—coastal communities who have the most at stake—must chart a path out of this mess mostly not our making.

**There are not, in fact, many fish in the sea.** Nearly 94 percent of fish populations are over (<http://www.fao.org/documents/card/en/c/ca9229en>)fished or fished to their maximum capacity (<http://www.fao.org/documents/card/en/c/ca9229en>). Biggie rapped about “remember when we had to eat sardines for dinner” as a sign of poverty. But that's actually what we should be eating: small, fecund fish rich in omega-3s, not top predators like tuna, whose numbers have plummeted by more than 50 percent (<https://www.pnas.org/content/108/51/20650>)t (bluefin by 97 percent (<https://www.wcpfc.int/node/31024>)) since we got a taste for them. Technologies developed for war—radar, sonar, helicopters, spotter planes—are used to seek and destroy the remaining fish. While some places are fished sustainably (<https://www.fisheries.noaa.gov/national/2017-report-congress-status-us-fisheries>), wild fish simply can't make babies fast enough to keep up with our plunder. Yet, around 3 billion people rely on seafood as a significant source of protein (<http://www.fao.org/documents/card/en/c/ca9229en>). The adage about teaching a man to fish doesn't work if there are no fish to catch.

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We must kill fewer fish. We must go from the 2 percent of the ocean that is currently protected to the 30 to 50 percent that scientists recommend (<https://mpatlas.org/>). Closing the high seas to fishing—the poorly managed two-thirds of the ocean that no one “owns,” and where fishing is often profitable only with massive subsidies (<https://advances.sciencemag.org/content/4/6/eaat2504.full>)—is a key step.

**Unsustainable, unregulated fishing is a human rights disaster.** Working conditions for fish workers are often perilous, and labor law violations and wage theft abound. In Africa and Asia, fish scarcity has spurred women traders to barter sex ([http://pubs.iclarm.net/resource\\_centre/WF\\_973.pdf](http://pubs.iclarm.net/resource_centre/WF_973.pdf)) to get priority to purchase fish—not sex for fish, but sex to get to the front of the line to buy fish. This has contributed to the spread of HIV. Meanwhile, large seafood companies are enslaving fishermen on Pacific tuna vessels, and if your shrimp was imported, it may have been peeled by slaves in Thailand (<https://www.theguardian.com/global-development/2015/dec/14/shrimp-sold-by-global-supermarkets-is-peeled-by-slave-labourers-in-thailand>).

Then there are the pirates. Overfishing by Asian corporations in the Gulf of Aden caused some Somali fishers to turn to piracy (<https://www.theguardian.com/world/2011/may/24/a-pioneer-of-somali-piracy>) since they could no longer make a living fishing, which (<https://www.theguardian.com/global-development/2012/sep/25/somalia-fishermen-struggle-pirate-infested-seas>) in turn makes it dangerous for the remaining fishermen to go out and fish (<https://www.theguardian.com/global-development/2012/sep/25/somalia-fishermen-struggle-pirate-infested-seas>). We must think beyond the science of sustainability and economics of the supply chain and consider the people upon whose work this industry is built.

**Emptied and polluted oceans hollow out cultures.** Overfishing happens in shallow areas first, and governments often sell off fishing rights to the highest, often foreign, bidder. This means coastal communities that have relied on seafood for centuries can no longer put fish on the table. Artisanal fishermen can't afford the gas and the bigger boats required to go farther from shore and don't have access to capital to join this race for fish. Degraded coastal ecosystems destroy not just economies but cultures. Water too dirty to swim in. Sand riddled with plastic. No teaching kids and grandkids to fish. No fish fry on the beach. No jambalaya, no crawfish boils.

We must acknowledge that some traditions don't scale, that some of the old ways can't be sustained with this many people and with such depleted ecosystems. We must also find ways to preserve invaluable cultural connections to the sea.

**We need to farm the ocean.** No, not industrial salmon farms that pollute the water and require tons of feed. For our food security and for sustainability, the future must include seaweed and shellfish farms dotting our coastlines. With “regenerative ocean farming,” (<https://www.greenwave.org/>) mussels grow on hanging ropes while oysters and clams grow in cages on the seafloor, and kelp grows on lines between it all. No fertilizer, freshwater, or feed required. Through photosynthesis and the formation of shells, ocean farms absorb tons of carbon, so can be a significant climate solution while also creating a habitat for a cornucopia of wild marine life (<https://www.yesmagazine.org/environment/2016/04/04/the-seas-will-save-us-how-an-army-of-ocean-farmers-is-starting-an-economic-revolution/>). A single acre of ocean can produce 25 tons of seaweed and 250,000 shellfish in five months. We must farm the ocean to health, not hunt it to death.

**The ocean stabilizes the climate, but that's ruining the ocean.** The ocean has absorbed 90 percent of the excess heat created by burning fossil fuels (<https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2012GL051106>). This comes at a cost. Warmer seawater evaporates more easily, leading to more devastatingly torrential rains with hurricanes. Fish and other species are making a one-way migration (<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0196127>) toward the poles to stay cool. Corals can't move, so they are frying in place.

The ocean has also absorbed around 30 percent of the excess carbon from the atmosphere (<https://research-information.bris.ac.uk/en/publications/carbon-and-other-biogeochemical-cycles>). This has changed the very chemistry of seawater, a phenomenon called ocean acidification. Humans have changed the pH of the entire ocean. It boggles the mind. This makes it harder for corals to form their skeletons and harder for shellfish to make shells. Lost with coral reefs will be food and income for around 500 million people (<https://portals.iucn.org/library/node/9361>), many in the Caribbean and Africa. We must break our addiction to fossil fuels, turning instead to offshore wind farms and harnessing wave energy.

**The sea level is rising and will continue to rise.** As the ice melts, the ocean swells. As the seawater warms, it expands. Global mean sea level has already risen about 20 centimeters (<https://www.ncei.noaa.gov/news/usgcrp-climate-science-special-report>) and could rise another meter by the end of the century (<https://www.nature.com/articles/nature17145?foxtrotcallback=true>). This will force mass exodus from the Marshall Islands (<https://www.sierraclub.org/sierra/2019-1-january-february/feature/atolls-arkansas-marshall-islands-marshallese>), the Maldives (<https://www.theguardian.com/environment/damian-carrington-blog/2013/sep/26/maldives-test-case-climate-change-action>), Kiribati, and other low-lying countries, creating many millions of “climate refugees.” Bangladesh produces only 0.3 percent of global carbon emissions, yet 18 million residents are expected to lose their homes by 2050 (<https://www.nytimes.com/2014/03/29/world/asia/facing-rising-seas-bangladesh-confronts-the-consequences-of-climate-change.html>).

New York's Rikers Island prison, already prone to flooding, has no evacuation plan, putting those incarcerated at great risk (<https://grist.org/justice/a-sinking-jail-the-environmental-disaster-that-is-rikers-island/>). Entire communities in coastal Louisiana and Staten Island, New York, have already had to relocate (<https://www.nytimes.com/2016/05/03/us/resetting-the-first-american-climate-refugees.html>). Likely next are Native Alaskan villages ([https://www.huffpost.com/entry/shishmaref-alaska-climate-change-relocation\\_n\\_6296516](https://www.huffpost.com/entry/shishmaref-alaska-climate-change-relocation_n_6296516)), Miami (<https://www.nytimes.com/2016/11/24/science/global-warming-coastal-real-estate.html>), and the Carolinas (including Princeville, the first town chartered by African Americans (<https://www.nytimes.com/2016/12/09/us/princeville-north-carolina-hurricane-matthew-floods-black-history.html>)).

Conservatively, 190 million people globally live in places below the projected high tide line for 2100, and 630 million live in places that will soon flood annually (<https://sealevel.climatecentral.org/research/papers/new-elevation-data-triple-estimates-of-global-vulnerability-to-sea-level-ri/>). We must find just ways to move communities out of harm's way, ways to say goodbye to some of the coastal places we treasure, ways to mourn that loss, ways to adapt. It is pure hubris to think we can hold back the ocean.

**Coastal ecosystems protect us. Literally.** There are deadly repercussions of destroying coastal ecosystems for development. In Southeast Asia, extensive swathes of coastal mangroves have been bulldozed for shrimp aquaculture. Then, in the 2004 tsunami, locations without mangroves were the most severely impacted ([https://ejfoundation.org/resources/downloads/tsunami\\_report.pdf.PdfCompressor-1022348.pdf](https://ejfoundation.org/resources/downloads/tsunami_report.pdf.PdfCompressor-1022348.pdf)),

because residents were left without natural protection from the deadly waves. Likewise in the Mississippi Delta. By the time Hurricane Katrina hit in 2005, southern Louisiana had already lost more than 4,900 square kilometers of wetlands, so there wasn't enough left to buffer the power of the storm (<https://ehp.niehs.nih.gov/doi/full/10.1289/ehp.114-a40>). Likewise, the archipelagic New York City, once surrounded by more than 40 square kilometers of wetlands and by oysters so abundant they were a navigational hazard, is now unprotected (<https://www.sciencedirect.com/science/article/abs/pii/S235248516301001>). Poor and working-class folks are still reeling from Hurricane Sandy, seven years later, which wasn't even hurricane-strength when it smashed into my hometown.

This story plays out again and again. These massive storms are becoming regular occurrences, becoming stronger and wetter, fueled by warmer waters, fueled by global warming. They are devastating Black, brown, poor, and working-class communities. Storms are also a chance to consider how we rebuild. The answer is not simply to construct walls to try to keep the ocean out—our barriers will never be as effective as nature. We must restore and replant.

**We have polluted the entire ocean.** Drilling for oil exacerbates the climate crisis, plus inevitably and incessantly leads to spills. Across the Mississippi River Delta, pollution from industrial plants triggers high rates of cancers (<https://pulitzercenter.org/reporting/cancer-alley-big-industry-big-problems>) in nearby communities of color. Chemicals from this “Cancer Alley” end up in the ocean. Rivers run to the sea. Those rivers take pesticides, antibiotics, synthetic fertilizer, and other toxins with them, harming wildlife, making seafood unsafe to eat, disrupting the balance of nutrients, and causing dead zones and blooms of toxic algae ([https://www.huffpost.com/entry/opinion-algal-blooms-health\\_n\\_5b802b9be4b0cd327dfc5b91](https://www.huffpost.com/entry/opinion-algal-blooms-health_n_5b802b9be4b0cd327dfc5b91)). Our poisonous, chemical-based industrial agriculture is ruining our health and the ocean. Hurricane Florence caused massive lagoons of excrement from factory-farmed pigs to overflow (<https://www.newyorker.com/news/dispatch/after-florence-manure-lagoons-breach-and-residents-brace-for-the-rising-filth>), with the putrid waste hitting poor and brown communities particularly hard before it wound its way to the sea. There are pesticides even in seawater and krill in Antarctica (<https://www.sciencedirect.com/science/article/abs/pii/S0967064595000860>). We must transition to regenerative agriculture (<https://www.drawdown.org/solutions/regenerative-annual-cropping>), which goes beyond organic and actually restores soil by planting cover crops and perennials, and by eliminating monocultures, tilling, and pesticides.

**Every year around 8 million metric tons of plastic enter the ocean** (<https://science.sciencemag.org/content/347/6223/768.full>). That's the equivalent of a garbage truck full of plastic being dumped into the ocean every single minute, every day of the year (<https://www.weforum.org/agenda/2016/10/every-minute-one-garbage-truck-of-plastic-is-dumped-into-our-oceans/>). There are 500 times more pieces of plastic in the ocean than there are stars in our galaxy (<https://news.un.org/en/story/2017/02/552052-turn-tide-plastic-urges-un-microplastics-sea-now-outnumber-stars-our-galaxy>). Once plastic is in the ocean, it is broken down into smaller pieces by the sun and salt. It becomes microplastic and gets incorporated into the food chain. There is plastic in the seafood we eat (<https://www.sciencedirect.com/science/article/abs/pii/S0269749114002425>), the sea salt on our tables (<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0194970>), our drinking water, and even beer. Even animals in the Mariana Trench, the deepest place in the ocean, have plastic in their guts (<https://royalsocietypublishing.org/doi/10.1098/rsos.180667>). By 2050, there may be more plastic in the ocean than fish (<https://www.weforum.org/agenda/2016/10/every-minute-one-garbage-truck-of-plastic-is-dumped-into-our-oceans/>).

We created a material that lasts forever, and then we throw it away, all day, every day. That doesn't make any sense. And of course, there is no “away.” Almost all the plastic that has ever been created is still with us (<https://blogs.scientificamerican.com/observations/we-need-to-kick-our-addiction-to-plastic/>). We must break our addiction to plastic, to a culture built around disposability. We must sit down and break bread together, look each other in the eye—and then wash the dishes.

**The ocean produces over half of the oxygen we breathe.** Perhaps you somehow find none of the above compelling. You hate seafood, and care neither for your fellow humans nor for nature's splendor. Perhaps, however, you would like to keep breathing. Phytoplankton, the base of the marine food web, produces over half the oxygen in the air (<https://science.sciencemag.org/content/281/5374/237.full>). Prochlorococcus is both the smallest and most abundant photosynthetic organism on Earth (<https://mmbr.asm.org/content/63/1/106>). Humans have managed to even mess with this—phytoplankton is declining by about 1 percent a year (<https://journalistsresource.org/studies/environment/ecology/global-phytoplankton-decline-over-the-past-century/>) due to warming waters with fewer nutrients. To continue respiring, we must address the climate crisis and protect the ocean.

**We need a healthy ocean for our own health.** And it's ocean, singular. It's all one thing, this 71 percent of the planet connected by currents and migrating animals. While people often discuss ocean health as all or nothing, as a dead ocean or a healthy one, there is a whole spectrum in between, from zero to one hundred. We must be honest with ourselves that with almost 8 billion people on the planet, one hundred is now out of our reach. But whether we land at 20 or at eight is within our control. So many lives, livelihoods, and cultures hang in that balance. So many Black lives, livelihoods, and cultures hang in that balance. Plus, the ocean is valuable for our mental health—being near it can literally keep us sane (<https://academic.oup.com/heapro/article/35/1/50/5252008>). The ocean will be fine without us; in fact, it would be much better off. However, the opposite is unequivocally untrue. We need the ocean.

**It's time to radically re-envision our relationship with the ocean.** The way forward will be imagined and created as we build community around solutions. We must shift public opinion, corporate practices, and political will toward sustainability. Our future could be less plastic, with less toxic pollution coming from land, and less extractive. Our future could be more oysters on the half shell, more seaweed salads, more mangrove forests, more wind turbines, more vibrant coastal cultures, more joy, more justice. That's what we should all be fighting for.

**Now you know what I know. Perhaps now you will see this is your fight too.**

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# The Concrete Jungle Has 578 Miles of Shoreline at Risk

New York City's safety and economy depend on the surrounding sea.

May 27, 2019

By Ayana Elizabeth Johnson  
Dr. Johnson, a Brooklyn native, is a marine biologist.

In New York City, it's often easy to think that ocean conservation is an issue for someplace else — tropical islands, coral reefs, the Gulf of Mexico, the Arctic.

But New York City is an archipelago, a reality that can be obscured by the concrete jungle. The five boroughs — four of them on islands — have 578 miles of shoreline. The Hudson River can get salty up to Poughkeepsie. And the East River is not really a river; it's a tidal strait that links New York Bay and the Long Island Sound and makes Long Island an island. So the city has much to gain from a better approach to managing the ocean, including storm protection, access to healthy seafood, coastal recreation and a thriving “blue economy” based on the sustainable use of the ocean's resources.

The point is, ocean conservation is an urban issue, and fortunately, there has been a growing movement in the city to protect its waters.

The Billion Oyster Project, for which I am a board member, is working to restore a billion oysters in New York Harbor by 2035 through reef construction to create habitat and improve water quality. The groups Riverkeeper and Surfrider Foundation NYC monitor the health of local waters and work for their protection. The Science and Resilience Institute at Jamaica Bay provides scientific advice to the city on wetland restoration and making neighborhoods resilient to floods and storms. The state has been installing “living breakwaters” conceived by Scape Landscape Architecture as part of a design competition to protect the shoreline from storm surges and create habitat for marine life. The group Gotham Whale conducts scientific monitoring and offers whale-watching tours. The Wildlife Conservation Society (a former consulting client of mine) is working through its Seascape program to restore populations of threatened aquatic species and protect near-shore and offshore habitats. And Mayor Bill de Blasio's Office of Resiliency and the One NYC initiative are working to prepare the city for the changing climate.

These efforts and others are inspiring, but they are not nearly enough given the magnitude of threats from climate change, pollution and habitat loss.

Many coastal cities simply are unprepared for rising seas. For New York City, which has already seen sea levels rise 18 inches since 1850, as measured by a tide gauge at the Battery, upper-end forecasts suggest the ocean could rise another six to nine feet by 2100. While Mr. de Blasio has recently proposed a plan to fortify Lower Manhattan, we must confront the fact that because of climate change, increasingly, homes and businesses in the city will need to be relocated out of harm's way. We need a policy for this kind of managed retreat.

Hurricane Sandy made it clear that it's foolish not to spend money now to ensure that the city's infrastructure and neighborhoods are resilient to storms and flooding that undoubtedly will occur again as climate change intensifies. As with so many other environmental issues, poor communities and communities of color will likely bear the brunt of these impacts unless we guard against them.

One way to do that is to turn to nature. The replanting, restoration and conservation of disappearing coastal wetlands, sand dunes and oyster reefs is crucial. Eighty-five percent of the coastal wetlands have been lost to development in the New York-New Jersey harbor estuary, and sand dunes on Long Island's South Shore are eroding at one to two feet a year. The oyster reefs — historically an important barrier to storm surges — were wiped out a century ago from overharvesting.

Intact coastal ecosystems can provide better and less expensive flood and storm protection than sea walls; what little wetlands remain in New York and New Jersey prevented \$625 million in damages during Hurricane Sandy, according to one study. That's why the United States Army Corps of Engineers should prioritize ecosystem restoration over building more sea walls. And Congress should fully fund the National Oceanic and Atmospheric Administration's Coastal and Estuarine Land Conservation Program, which provides matching funds to state and local governments to purchase threatened coastal lands or conservation easements. These would have climate benefits, too, because the soil of wetlands holds about five times as much carbon per acre as the soil of rain forests.

Coastal cities need support from the state and federal governments. For example, preventing raw sewage from entering New York City's waterways when it rains would require a multibillion-dollar investment in the wastewater and sewage treatment system. Also, the city is relying on the Federal Emergency Management Agency to update flood risk maps, and on Congress to overhaul the National Flood Insurance Program to better manage risk and discourage building and rebuilding along coastlines. And with 40 percent of the United States population living in coastal counties, the ocean should not be forgotten in the Green New Deal.

New York City arose and prospered around a remarkable natural harbor, a reason the state ranks third among coastal states in employment in the blue economy, supporting nearly 350,000 jobs in shipping, fishing and tourism, and fourth in its contribution to state gross domestic product, worth about \$26 billion annually.

The vast majority of these jobs and dollars are from tourism and recreation, which rely on healthy ecosystems and clean water. So do the seven species of whales that visit New York Harbor and all 338 marine species that live in the city's seascape, including sharks, sea turtles, seals and sea horses. The surfing culture that is thriving in the Rockaways and other recreational opportunities city residents pursue — swimming, kayaking, boating and fishing — depend on healthy, living ecosystems. And even more than affording us these key jobs and treasured leisure activities, being near the ocean helps to keep us sane.

Ocean conservation is critical to the future of New York City. Coastal cities can and should be leaders in climate and ocean policy. As we enter the summer season and ocean waters beckon, all New Yorkers would do well to remember that — as we make sure the lawmakers who represent us don't forget it either.

Ayana Elizabeth Johnson (@ayanaeliza) is a marine biologist, founder and chief executive of the consulting firm Ocean Collectiv and founder of the Urban Ocean Lab.

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