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CONTENTS

Offshore Wind for America: The promise and potential of clean energy off our coasts.....2
Bryn Huxley-Reicher and Hannah Read

In Too Deep: What we know, and don't know, about deep seabed mining.....13
World Wildlife Fund

Leaders Summit on Climate Summary of Proceedings.....18
The White House

News and Announcements.....23

Offshore Wind for America: The promise and potential of clean energy off our coasts

Bryn Huxley-Reicher and Hannah Read

Introduction

Building a world powered by 100% renewable energy will make us both healthier and safer. To get there, we need to make simultaneous use of every source of renewable energy because each has its unique advantages and complements the others.

For the United States, offshore wind energy is a largely untapped resource with many benefits – a key element of a future energy system powered by renewable energy.

Offshore wind energy is abundant. As is discussed in this report, the U.S. has the technical capacity to meet its 2019 electricity demand almost twice over with power from offshore wind. Even if we electrified homes and businesses, transportation and industry – replacing fossil fuel powered appliances, vehicles and machinery with electricity-powered alternatives – by 2050, offshore wind could theoretically meet nearly all of that electricity demand. While using the entirety of the U.S. offshore wind resource is unlikely, impractical and would have far too high an environmental impact, we will need to take advantage of the enormous benefits of offshore wind to transition to a 100% renewable energy system.

Offshore wind is also conveniently located near major sources of electricity demand. About 40% of the American population lives in counties on the coast of an ocean or Great Lake.[1] That means power generated by offshore wind does not have to travel far to get where it is needed, reducing the difficulty of transitioning to 100% renewable power.

And finally, offshore wind is reliable. Because wind on the water tends to be strong and consistent, offshore wind turbines can have very high capacity factors, meaning they turn wind into electricity consistently.[2] Offshore wind is also strongest – and therefore generates the most power – when we will need it after transitioning our buildings, vehicles and industry to run on electricity: during the winter months, when the East Coast will be heating buildings; and during the afternoon and evening, when electricity demand is at its peak.[3]

These characteristics – abundance, convenience and reliability – make offshore wind an integral piece of a 100% renewable energy system, complementing other sources of energy like solar and geothermal. It fits our needs and can help make us, and the climate, healthier. To take advantage of offshore wind's immense potential, however, policymakers need to act quickly to remove barriers to offshore wind development while ensuring and accelerating its growth.

Offshore Wind is Ready to Grow

Offshore wind is a large and growing source of energy around the world, and is poised for rapid growth in the U.S. The technology has improved dramatically, with larger turbines generating much more power and turbines successfully being put much farther from shore and in much deeper water. New announcements promise still better designs, opening up even more area for possible deployment of offshore wind turbines. This section explores the current state of offshore wind technology and its presence around the world.

Offshore wind is a global energy source

Offshore wind is widely used in Europe and China and is being adopted elsewhere in the world. Global offshore wind capacity topped 27 GW by early 2020, though the U.S. represents less than two-tenths of 1% of that.[4]

Globally, 6.1 GW of installed capacity was added in

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2019, almost 40% of it by China and almost all of the rest by Germany, Denmark, the United Kingdom and Belgium.[5] Those five countries are also those with the largest total installed offshore wind capacity, accounting for the vast majority of the world's offshore wind production.[6]

As of 2019, there were more than 5,500 offshore wind turbines powering the grid in 17 countries around the world.[7] That capacity is set to expand rapidly, with about 150 projects in 19 countries – including all over Asia, Oceania, Europe and the U.S. – in the pipeline.[8] According to the National Renewable Energy Laboratory's (NREL) *2019 Offshore Wind Technology Data Update,* that global pipeline represents more than 200 GW of capacity coming online in the near future.[9]

The rest of the world is setting big goals, too. The European Union, for instance, recently set a goal to expand its offshore wind capacity from 12 GW to 60 GW by 2030, and 300 GW by 2050.[10]

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The U.S. is currently far behind the leaders in offshore wind. But, with the projects in the pipeline and the upcoming growth in the domestic supply chain, the U.S. could soon become a major producer of offshore wind turbines and of power from offshore wind.

Offshore wind technology is good, and getting better

Offshore wind technology has advanced dramatically in recent decades, enabling offshore wind farms to produce more energy more efficiently than ever before.

Denmark's Vindeby, the first offshore wind farm in the world, installed in 1991, had 11 turbines, each with a capacity under half a megawatt (MW), and used onshore turbines placed on concrete foundations in shallow water.[11] In 2019, by contrast, the average capacity of installed offshore wind turbines around the world was over 6 MW, with the average capacity per turbine for projects coming online in 2025 anticipated to reach 11 MW worldwide – a roughly 20-fold improvement over the first generation of turbines.[12]

A big piece of the growth in capacity of offshore wind turbines has been the increase in height and rotor diameter. In 2010, the tip of a 3 MW turbine – the largest turbine commercially available that year – reached about 330 feet high, just a bit taller than the Statue of Liberty.[13] Just six years later, an 8 MW turbine had a tip height of almost 660 feet.[14] As the turbines increase in size, they are also able to capture more energy from the wind, and the average capacity factor of installed turbines – the percentage of their technical capacity for generating power that is actually realized – increased from 38% in 2010 to 43% in 2018.[15]

Two recently announced turbines – which are taller and have bigger rotors, have higher efficiency, and can generate more power – are promising to push the industry even further. Siemens Gamesa, the largest turbine supplier in the world, has announced a 15 MW turbine with a 730-foot diameter rotor, which will be available in 2024.[16] General Electric's Haliade-X turbine, the first prototype of which was installed in the Netherlands, promises capacity of between 12 MW and 14 MW capacity, an 850-foot height and 720-foot rotor diameter, and a 60%-64% capacity factor.[17]

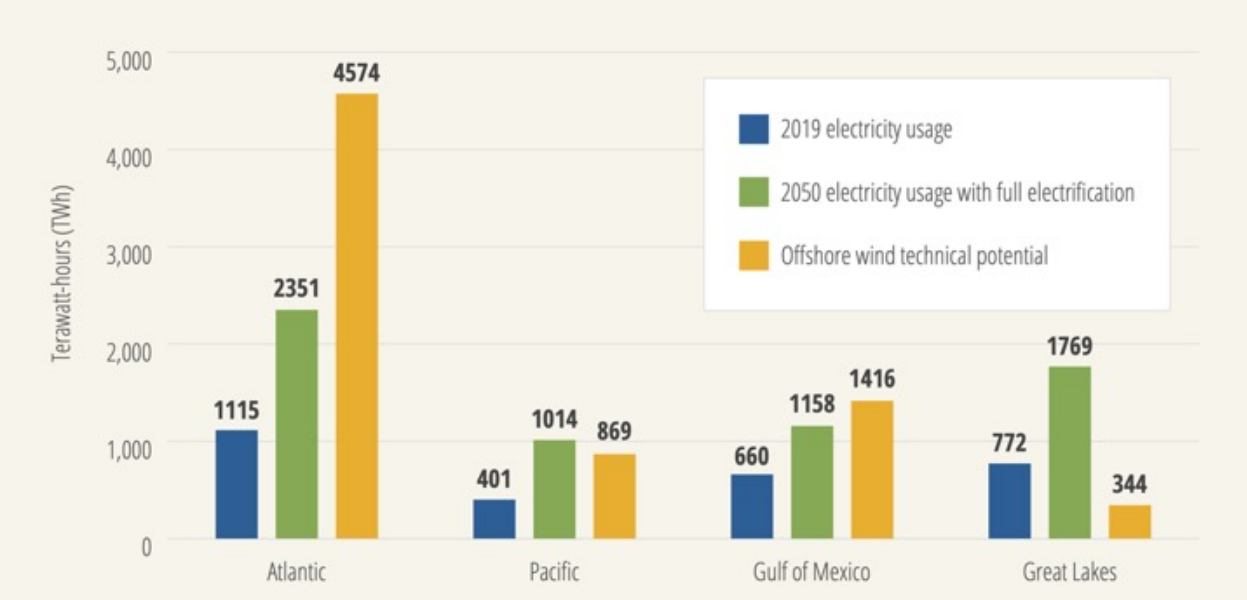
This new generation of turbines could be deployed in the U.S. to enormous effect: At full power, the Haliade-X turbine can generate enough power in under seven seconds to serve an average American home for a day.[18] And developers of U.S. projects are taking notice: Vineyard Wind recently announced that it will use Haliade-X turbines in the 800 MW wind farm planned off the coast of Martha's Vineyard in Massachusetts.[19]

Offshore wind projects are also moving farther from shore. While older projects were mostly within 31 miles of land, new projects being commissioned are more than 62 miles out, making use of better foundation technology and adapting lessons from the oil and gas industry.[20] Floating turbines are allowing projects even farther out and in deeper water. Some announced projects are as far as 93 miles from shore, and some installed floating turbines are in water almost 1,000 feet deep.[21] Developing floating technology is going to be crucial for offshore wind industry growth because most of the world's offshore wind resources are in deep water.[22]

There are already multiple international demonstration and commercial floating turbine projects deployed or in development in countries such as Scotland, Japan and Spain. Domestically, the University of Maine is developing a new, lower-cost floating hull for offshore wind turbines, and the state of Maine is looking to develop a floating turbine research array.[23]

U.S. offshore wind resources could power the country

As the U.S. looks to transition away from fossil fuels and towards renewable energy, offshore wind stands out as an abundant energy source and a powerful solution for delivering clean electricity to major population centers.[24] While Europe and Asia have large and fast-growing offshore wind industries, the U.S. has very little installed capacity, and no domestic supply chain. What the country does have, however, is enormous potential for offshore wind generation, and the beginnings of a large, reliable offshore generation sector in the Atlantic, Pacific, Gulf of Mexico and Great Lakes.



Regional offshore wind technical potential and electricity usage

There are 29 coastal and Great Lakes states with the potential for offshore wind generation, not counting Alaska.[25] According to NREL, those states have the technical potential to produce 7,200 terawatt-hours (TWh) of electricity annually. This is almost twice as much as the 3,800 TWh of electricity the entire nation used in 2019, and about 90% of the approximately 7,900 TWh the country might use in 2050 if we electrified as much of our energy use in buildings, transportation and industry as possible.

The trend of increasing capacity factors in current and future turbines means that technical potential for offshore wind could be even higher than the figures used in this report.

More specifically, 19 of the 29 states with offshore wind potential have the technical potential to produce more power in a year from offshore wind than they used in their entire economies in 2019. And 11 of them have the technical potential to produce more power than they would use in 2050, even if our country electrified buildings, transportation and industry as much as possible. But there are significant variations among regions and individual states in offshore wind potential, and in the opportunities and hurdles facing offshore wind development.

The future of U.S. offshore wind

Although the U.S. currently has only seven active offshore wind turbines in two locations – five at the first offshore wind farm in the U.S., the Block Island Wind Farm in Rhode Island, and two at the first wind farm in federal waters, the Coastal Virginia Offshore Wind pilot – there are many projects in development that could come online throughout the next decade.[26]

Today, in addition to the two operational offshore wind farms, the U.S. has 34 proposals for offshore wind development – including 27 projects in various stages of planning and development – with a combined total of about 26.1 GW of site capacity.[27] Most of the projects are along the East Coast, and the remainder are off of California and Hawaii.[28] Most of the projects are in the site control and permitting phases, which means the developer has signed a lease or in some way been given control of the site, and the planning for the project has begun but has not yet been fully approved.[29]

Even with the chaos of the COVID-19 pandemic, 2020 was a surprisingly good year for offshore wind. According to NREL, the amount of offshore wind capacity with a signed offtake agreement – meaning some entity had signed an agreement to purchase the power – had more than tripled from March 2019 to March 2020, to a total of almost 6.5 GW.[30] Other developments also pointed to future success of the industry. Vineyard Wind, which has been delayed repeatedly but is still scheduled to be one of the first U.S. projects to come online, recently restarted its permitting process. A Bureau of Ocean Energy Management (BOEM) report about Vineyard Wind – one of the many delays in the project's development – detailed manageable environmental impacts and many benefits from developing offshore wind.[31] The year also saw lower-than-expected prices for new offshore wind, signaling strong economics for new projects.[32] Additionally, Maryland, Virginia and North Carolina entered into an agreement to work together on offshore wind development, a formal recognition of the importance of regional cooperation.[33]

New projects are in the development process along the East Coast, from Maine to North Carolina.[34] On the West Coast, California is starting to plan for offshore wind to help the state reach 100% renewable energy.[35] Investment is beginning to flow as well: Siemens Gamesa – one of the largest turbine suppliers in the world – is considering a U.S. manufacturing facility and states and companies are putting money into offshore wind infrastructure and equipment.[36] New Jersey has announced that it will develop the New Jersey Wind Port for staging, assembly and manufacturing, and that two offshore wind companies have invested $250 million in a monopile manufacturing facility in the state.[37]

With planned projects set to go online in the next few years, prices continuing to drop, and a domestic supply chain emerging, the offshore wind industry has lots of potential, but federal policies and practices have slowed its growth.

Impediments to offshore wind slow its growth

There are two major impediments to the growth of offshore wind in the U.S. Both are federal practices that slow development and make the transition to 100% renewable energy harder.

Short-term and unpredictable tax credits: The U.S. currently has both a production tax credit (PTC) and an investment tax credit (ITC) for offshore wind.[38] In December 2020, congressional action extended the PTC at 60% of its per-kilowatt value for one year (until 2022), and created the ITC set at 30% of the cost of projects that begin construction before 2026.[39] These tax credits reduce the cost of offshore wind development and the power wind turbines produce, helping to jump-start deployment and grow the industry to the point where it is competitive without the credit.

However, Congress's pattern of extending tax credits for short periods of time, as opposed to making a consistent commitment to supporting offshore wind, makes it hard for developers to plan and commit to projects. As the Union of Concerned Scientists showed, this short-term cycle of tax credit extension and expiration, which has happened many times since the implementation of the renewable energy PTC in 1992, has led to a "boom-bust cycle" in which development slows significantly when the credits expire and then pick up when the credit is renewed.[40] Short-term extensions like those enacted in December 2020 – while necessary to prevent a drop-off of financial support for renewables – serve to introduce uncertain incentives for offshore wind, rather than allowing long-term and consistent growth.

Lack of action and delays by the Bureau of Ocean Energy Management (BOEM): BOEM has not leased a new area for offshore wind development since February 2019.[41] This means two years without new projects getting to start planning and design, despite plenty of interest.[42]

Additionally, the BOEM process for permitting and approval is very slow and is currently delaying U.S. offshore wind development. This is abundantly clear in the case of Vineyard Wind; the Massachusetts wind farm off of Martha's Vineyard that is set to be America's first major utility-scale operation.[43] Vineyard Wind has faced multiple delays in the federal permitting process – separate from the state and local processes that themselves are not smooth – which threatened to scuttle the entire project.[44] These repeated delays have forced the project's operational timeline back at least one year, and involved reviews of multiple proposed projects along the Atlantic coast all at once.[45]

President Joe Biden has signaled an interest in boosting U.S. offshore wind development, which could cause BOEM to speed up the processes for leasing, environmental impact studies and permitting.[46]

Conclusions and recommendations

The United States can take on some of its biggest environmental challenges by taking advantage of one the most underutilized energy resources in the country: offshore wind.

America has sufficient offshore wind potential to power nearly the entire country even after a nationwide transition away from fossil fuels to electricity. Moreover, much of that potential is close to the biggest population centers and largest sources of electricity demand in the U.S.

While deploying offshore wind in the U.S. to its full technical potential would both be impractical and have negative environmental impacts, even using a fraction of the abundant energy off our shores would add another source of clean and reliable energy to rapidly growing onshore wind and solar energy. Deploying offshore wind strategically also allows mitigation of environmental impacts and is a crucial step in the path to 100% renewable energy for the United States.

In recent years, offshore wind technology has improved dramatically, and prices have fallen far enough that new offshore wind developments are cost competitive with new fossil fuel power plants. Lazard, an asset management firm that forecasts energy prices, puts the unsubsidized levelized cost of energy for offshore wind lower than that of nuclear, coal and gas peaking power plants, and nearing competitiveness with gas combined

cycle plants.[47] The rate of deployment of offshore wind is growing rapidly across the globe, and the U.S. pipeline for projects shows states' ambition to make offshore wind a major piece of the energy economy.

But the development of offshore wind requires policies to ensure that deployment happens quickly, effectively and responsibly. To that end, policymakers in local, state and federal government should:

- **Provide market certainty for offshore wind.** Policymakers can enact "carve-outs," or minimum requirements for specific technologies in state renewable electricity standards, or they can require utilities to enter into power purchase agreements with offshore wind projects that meet certain standards. States can also set and increase their targets for offshore wind deployment, which should be strong and enforceable. Targets and renewable electricity standard minimums help to drive growth in the industry. To date, Connecticut, Maryland, Massachusetts, New Jersey, New York and Virginia have set targets for offshore wind development, totaling over 28 GW of capacity.[48] States that set targets or enact minimum requirements should devote the resources necessary to deploy capacity quickly, including by soliciting and responding to proposals for new projects.
- **Support domestic supply chain development.** States have begun to put infrastructure in place to create a domestic supply chain for offshore wind and to help the offshore wind industry grow and deploy. For instance, New York and New Jersey have both announced projects to build or upgrade ports to facilitate use by the offshore wind industry.[49] Encouraging companies to build factories in the U.S., as states are encouraging Siemens Gamesa to do, could also help grow the industry in the U.S.[50] Domestic construction of the vessels needed to build and repair turbines will be required under the Jones Act, and having a U.S. based fleet would speed up construction of new offshore wind farms.[51]
- **Set national standards to ensure the environmental integrity of offshore wind projects and to avoid, minimize and mitigate impacts to marine ecosystems and wildlife.** Although they can become new habitat for marine life, offshore wind turbines can also negatively impact birds and marine life both during construction and during operation.[52] Noise and habitat destruction from pile driving during construction, disruption to habitats or migration routes, and even direct collisions with turbines can all be harmful.[53] These impacts can threaten important struggling and endangered species, including the critically endangered North Atlantic Right Whale.[54] There are, however, best management practices that can reduce the impact of deployment, and can make sure offshore wind farms don't harm wildlife. State and federal agencies must work together to make sure offshore wind development happens in an environmentally responsible way, and proven methods and best practices should be mandated for all projects.[55] All projects should be required to incorporate a research and monitoring plan for mitigating environmental impacts and relevant agencies should develop an industry-wide impact assessment for the North Atlantic Right Whale, including required coordination and best practices to mitigate harm to the species.
- **Direct the Bureau of Ocean Energy Management and relevant state agencies to accelerate the offshore wind leasing and permitting process while ensuring transparency and environmental responsibility.** BOEM and state permitting authorities need to streamline and accelerate the permitting and review processes to allow new projects into the pipeline and to help deployment happen quickly and responsibly, while protecting local communities and ecosystems. BOEM also needs to coordinate with state and local permitting authorities where appropriate to further the same goals. In particular, BOEM should prioritize issuance of final Records of Decision for projects in the review process and Notices of Intent to Prepare an Environmental Impact Statement for those projects that already have contracts for their power. It should also begin auctioning new Wind Energy Areas as soon as possible. Finally, the transparency of the development process should include community engagement with relevant stakeholders, including the fishing industry, local communities and environmental advocates and experts.
- **Extend offshore wind tax credits.** Both the production tax credit and the investment tax credit for offshore wind should be extended for a long enough time period to encourage new projects to enter the pipeline and to allow the industry to grow and mature.

- **Plan for regional offshore wind development, including transmission infrastructure.** While states should set their own goals and requirements for offshore wind development, projects should be developed with a long-term plan for integration across state boundaries. The Federal Energy Regulatory Commission should require planning around these efforts. Regional partnerships, like that of Maryland, Virginia and North Carolina, can encourage this method of planning. Regional integration will help maximize economic potential and lower overall costs for offshore wind projects. Regional cooperation and planning are particularly important for the transmission infrastructure needed to integrate power from offshore wind farms into the wider power system.[56] A coordinated, planned approach can reduce transmission needs, costs, risks and environmental impacts while encouraging increased participation of offshore wind and transmission developers in the process.[57]
- **Support research and development of new offshore wind technologies,** including floating platforms, deeper water non-floating structures, taller turbines, larger rotors, more efficient designs, better transmission technology, better materials, turbine designs that can better withstand hurricanes and ice floes, and recycling procedures to reduce waste from end- of-life decommissioning of turbines.

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Editor's Note

While the U.S. is moving forward toward fulfilling its robust offshore wind potential, there are certain aspects of this technology that warrant additional research. This editor's note describes issues that should be examined and addressed in the planning and development of offshore wind, as well as recent policy updates on the issue.

The construction and maintenance of offshore wind turbines can have negative impacts on marine ecosystems. Many of these negative impacts are due to noise from the construction process, including pile driving foundations into the seabed and ships going back and forth to the construction site. Potential mitigating measures include creating "bubble curtains" to dampen noise during construction or using floating turbines (although these are typically constructed in deeper waters, where our understanding of marine ecosystems is generally less complete).

Another ecosystem impact of offshore wind is bird mortality from collisions with the spinning blades of turbines. Proper measures should be taken to minimize this impact as well. There is some evidence that larger turbines can reduce bird mortality. A 2020 study also found that painting one turbine blade black may increase visibility and help larger birds avoid the spinning blades. Proper siting and arrangement of turbines can also help avoid excessive bird fatality.

Like all new infrastructure, physical and cybersecurity should be a consideration, since reliance on offshore wind for energy security could make installations a target for attack.

These factors should be considered when planning offshore wind installations and efforts should be made to further study and minimize them.

Under the Trump administration, BOEM delayed permitting for offshore wind. They added requirements for "cumulative analysis" of impacts on fisheries late in the process, raising questions about the intent of these additional requirements. On March 29, 2021, the Biden administration confirmed a change in approach by announcing a set of new policies and initiatives in support of offshore wind development. These include advancing permitting processes, building port infrastructure, providing funding for research and development, and assessing the ecosystem impacts of offshore wind development.

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In Too Deep: What we know, and don't know, about deep seabed mining

World Wildlife Fund

A World Under Threat

The deep seabed is our planet's final frontier. Covering around half the Earth's surface, it's a largely unknown, uncharted world. But we're beginning to discover that it's a world teeming with life, and that it exerts a major influence on the whole ocean ecosystem and on our climate.

It's also rich in metals and minerals. Some argue that mining the deep seabed is our best bet for providing the cobalt, lithium, nickel and other minerals needed under a business-as-usual scenario to enable the massive growth in the number of electric vehicle batteries, solar panels and wind turbines over coming decades. Proponents also suggest that mining the deep seabed could avoid the negative environmental and social impacts of mining on land.

But the risks are great. Mining would have a destructive impact on deep-sea ecosystems and biodiversity, which could have a knock-on effect on fisheries, livelihoods and food security and compromise ocean carbon, metal and nutrient cycles. It also runs counter to the transition to a circular economy, undermining efforts to increase recycling and reduce the use of finite resources.

Ultimately, moving to a low-carbon future will require major structural changes in our economy and in our lifestyles – not a rush to exploit the resources of previously untouched areas of our planet.

This briefing presents the existing knowledge on the likely environmental and socioeconomic impacts of deep seabed mining in the context of global efforts to transition to a low-carbon circular economy. It draws on a detailed research study available **here**.

Do We Need More Metals?

Material demand is expected to increase significantly over the coming decades with the rapid growth in electric vehicles. One 2019 study, for instance, includes scenarios where demand for cobalt, lithium and nickel well exceeds current mining reserves by 2050 – in the case of cobalt by around 420%.[1] Other studies have made similar projections.

But these estimations are at the upper end of the range – the same studies say that mineral demand can in fact be kept within terrestrial limits. Demand reductions of as much as 60-90% for almost all minerals are possible with increased material efficiency and recycling.[2]

The models also don't take account of the rapid technological developments in material science, innovative business models or policy and lifestyle changes that could reduce demand. The electric vehicle sector in particular is young and rapidly evolving, with manufacturers regularly announcing innovations – from new solid-state battery technologies that could halve battery size to modular battery rental schemes that can optimize battery utilization.

What is on the Ocean Floor?

Much of the deep sea remains yet to be explored and scientifically understood – but we do know that, contrary to long-held beliefs, it's full of life.

Mining interest centers around three main marine mineral resources: polymetallic nodules, seafloor massive sulphides and cobalt-rich crusts, although exploiting the latter is currently not expected to be commercially profitable.[3] These metal-rich geologies provide habitat for a wide variety of microbial life and other larger lifeforms. In fact, the very minerals that mining companies wish to exploit are the foundation of deep-sea ecosystems.

In the absence of sunlight, deep-sea microorganisms use the energy from chemical reactions to absorb carbon and form organic compounds through a process called chemosynthesis.

This builds the bottom layer of the food chain for the wider marine ecosystem. It also has a significant influence on the ocean's ability to cycle nutrients, balance chemical concentrations, and absorb carbon dioxide from the atmosphere.

What is the Enviromental Impact of Ocean Mining?

Up to now, deep-sea ecosystems have experienced little disturbance from human activities. But we know they are likely to have low levels of resilience. Various characteristics reduce their capability to withstand and recover from disturbance: species are long-lived and slow to reach reproductive age, and fertility rates are low. Given the slow pace of deep-sea processes, destroyed habitats are unlikely to recover within human timescales.[4]

Next to direct destruction of ecosystems when minerals are mined, major damage and disturbance would likely arise from light, noise and sediment pollution. It's important not only to consider these risks at a project level but to look at their cumulative impact, since deep seabed mining would affect areas at continental scale. A single polymetallic nodule mining operation would pour millions of tonnes of sediment back into the water, releasing already accumulated metal particles and smothering the habitat of deep-sea organisms.

Likely Impacts of Deep Seabed Mining

- Loss of habitat and life-supporting substrates, killing fauna and flora
- Sediment plumes swirled up from mining, harming species and habitats
- Exposure of seabed life to toxic metals released during mining operations
- Harm to genetic links between different populations of deep-sea animals
- Habitat alteration and fragmentation through sediment, light and noise pollution
- Reduced primary production, affecting marine food webs
- Disruption of key processes affecting ecosystem functions
- Alteration of large-scale ocean cycles including carbon, nutrients and trace metals

While deep seabed mining as an industry has been valued at US$2-20 billion,[5] it threatens to disrupt a much wider ocean economy, valued at US$1.5-2.4 trillion annually.[6] Because marine ecosystems have no obvious physical boundaries, deep seabed mining cannot occur in isolation and its impacts would not be limited to the ocean floor. Disturbances can easily cross ecological and jurisdictional boundaries, leading to unexpected and unquantifiable consequences, even on land. Loss of primary production, for example, could affect global fisheries, threatening the main protein source of around 1 billion people and the livelihoods of around 200 million people, many in poor coastal communities.

Land-Based Mining has Negative Social and Environmental Impacts, so Wouldn't the Deep Seabed be a Better Alternative?

Some proponents speculate that deep seabed mining would have fewer negative impacts than land mining – which is associated with deforestation, pollution, human rights abuses and other environmental and social issues.

However, the extent to which deep seabed mining may replace land-based mining is highly uncertain. It's a nascent technology and lacks scientific proof for its supposed environmental advantages over land-based mining. A lack of historical experience and limited scientific understanding of deep-sea ecosystems make it impossible to fully compare the impacts of deep seabed mining against potentially avoided impacts on land.

Despite many historical problems, mining operations represent significant sources of employment and income for some of the poorest countries and communities on the planet.

Deep seabed mining, on the other hand, would be highly automated and dominated by only a few operators who have the required technology and capital.

How do Deep Seabed Mining Processes Work?

While different mineral deposits require different mining techniques, all destroy seabed habitats by physically removing sediments. Seafloor massive sulphides and cobalt-rich crusts require the use of cutting and drilling tools to break up and extract the minerals, while polymetallic nodules are sucked up by vacuum cleaner-like collection vehicles. The equipment is remotely operated, and the collected material is piped to a collection vessel on the water's surface. From there, the minerals are processed and transported to land, while the remaining sediments are released back into the water.

Operational similarities mean some project management standards from the offshore oil and gas industry could be adapted to deep seabed mining operations – but not all standards will be applicable. The same applies to environmental standards: while these draw on many years of research, this is mostly limited to the shallow waters of the continental shelf. Deep-sea environments below 3,000m pose different challenges, and there is little knowledge or experience of managing the impacts.

What are the Regulations Around Deep Seabed Mining?

Most of the deep seabed falls outside the jurisdiction of national governments. The United Nations Convention on the Law of the Sea (UNCLOS) designates the deep sea and its resources as the Common Heritage of Humankind.

Deep seabed mining operations in areas beyond national jurisdiction are regulated by the International Seabed Authority (ISA). This intergovernmental body is responsible for drafting standards and regulations on the management and funding of environmental monitoring and safeguarding. However, monitoring and oversight of offshore deep-sea operations is extremely costly: a single day of offshore research may cost up to US$80,000.[7]

The ISA is also tasked with establishing a benefit-sharing mechanism that will redistribute some of the financial profits from deep seabed mining to projects for the global good. While this may be well intentioned, having a single institution in charge of regulating deep seabed mining while also having an interest in its financial benefits presents a possible conflict of interest.

Governments face a similar conflict. Deep seabed mining operations need to be sponsored by a state that is a signatory to UNCLOS. These states will benefit from the success of the deep seabed mining operators they sponsor, but are also ultimately responsible for pursuing liabilities against them in case of misconduct or damages.

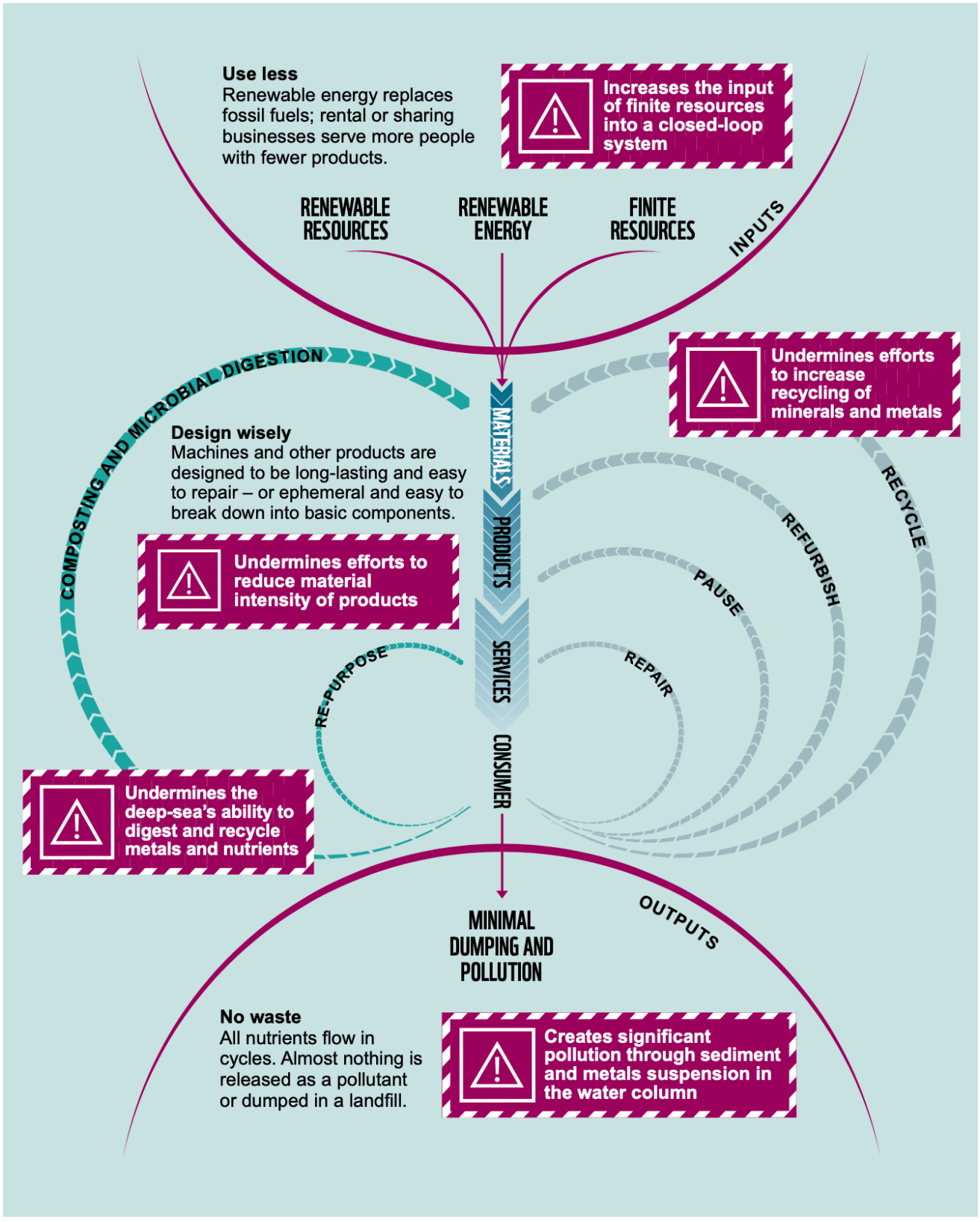
Why Can't We Just Recycle?

Most studies agree that recycling alone won't be enough to meet our rapidly rising metal demands. To avoid catastrophic climate change, we need to ramp up production of electric vehicles and renewable energy technologies over the next two decades – but the long lifetime of solar cells and electric vehicle batteries keeps the metals they contain in circulation for many years before they can be recycled.

Recycling also has high labour costs, which reduces its competitiveness against mining. Under current projections, producing copper through recycling in 2060 will still be around 15% more

Deep Seabed Mining Goes Against the Principles of a Closed Loop Economy by:

- Creating significant pollution and environmental destruction
- Exploiting finite resources that are essential to the functioning of deep-sea ecosystems
- Upsetting ocean carbon, metals and nutrients cycles
- Undermining efforts to increase recycling of minerals and metals
- Undermining efforts to reduce material intensity in design and production



Source: adaptations introduced into original illustration from Kunzig, R. 2020. Is a world without trash possible? National Geographic. www.nationalgeographic.com/ magazine/2020/03/how-a-circular-economy-could-save-the-world-feature.

expensive than through mining, and other recycled non-ferrous metals will be up to 25% more expensive.[8] Adding a new supply of minerals from deep seabed mining could dampen prices and undermine long-term incentives for producers and governments to scale up recycling efforts, especially in emerging economies. Profit-driven deep seabed mining companies will also face pressure to extract excessive quantities of minerals for many years to recoup their initial capital costs.

Ultimately, the aim must not be to feed enough material into the system to make recycling possible, but to reduce material demand at customer, design and production stages to levels where recycling can cope.

Deep Seabed Mining is an Environmental Disaster We Can Still Avoid

A transformational change in how we use ocean and planetary resources is required if the world is to achieve the goals and aspirations, set by the United Nations Agenda 2030, for a better future for all. We need to steer urgently towards a truly sustainable and circular Blue Economy. With this transformation in mind, WWF wants to see an immediate moratorium on deep seabed mining activities, unless and until:

- The environmental, social and economic risks are comprehensively understood.
- It is clearly demonstrated that deep seabed mining can be managed in a way that ensures the effective protection of the marine environment and prevents loss of biodiversity.
- Where relevant, there is a framework in place to respect the free, prior, informed consent of Indigenous peoples and to ensure consent from potentially affected communities.
- Alternative sources for the responsible production and use of the metals also found in the deep sea have been fully explored and applied, such as reduction of demand for primary metals, a transformation to a resource-efficient, closed-loop economy, and responsible terrestrial mining.
- Public consultation mechanisms have been established and there is broad and informed public support for deep seabed mining, which should fulfil the obligation to benefit humankind as a whole.
- Member States reform the structure and functioning of the International Seabed Authority to ensure a transparent, accountable, inclusive and environmentally responsible decision-making and regulatory process.

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Leaders Summit on Climate Summary of Proceedings

The White House

After fulfilling his promise to bring America back into the Paris Agreement, President Biden convened 40 world leaders in a virtual Leaders Summit on Climate on April 22 and 23, 2021 to rally the world in tackling the climate crisis and meeting the demands of science. The United States and other countries announced ambitious new climate targets ensuring that nations accounting for half of the world's economy have now committed to the emission reductions needed globally to keep the goal of limiting global warming to 1.5-degrees C within reach. Many leaders underscored the urgency of other major economies strengthening their ambition as well on the road to the United Nations Climate Change Conference (COP 26) in November 2021 in Glasgow.

The Summit, which was the largest virtual gathering of world leaders, convened the Major Economies Forum on Energy and Climate (the world's 17 largest economies and greenhouse gas emitters) and included the leaders of other countries especially vulnerable to climate impacts or charting innovative pathways to a net-zero economy. President Biden was joined at the Summit by Vice President Harris, members of the President's Cabinet, Special Presidential Envoy for Climate John Kerry, and National Climate Advisor Gina McCarthy, as well as senior representatives of other countries and leaders from business and civil society. The full agenda and list of participants is available at **https://www.state.gov/leaders-summit-on-climate/**.

With the science telling us that the world needs to significantly increase the scale and speed of climate action, President Biden considered it vital to host this Summit within his first 100 days in office to make clear that it is a top U.S. priority to combat the climate crisis at home and abroad.

Vice President Harris opened the Summit by emphasizing the intertwined imperatives of addressing the climate crisis, creating jobs, and protecting the most vulnerable communities. Her remarks set the stage for the launch of the Summit's five sessions, which were live-streamed: [**https://www.state.gov/leaders-summit-on-climate/**].

President Biden began Session 1 ("**Raising Our Climate Ambition**") by framing enhanced climate action as necessary both to address the crisis and to promote economic opportunity, including the creation of good-paying, union jobs. He told Summit participants that the United States will halve its greenhouse gas emissions within this decade, noting that countries that take decisive action now will reap the economic benefits of a clean energy future. To enshrine this commitment, the United States submitted a new "nationally determined contribution" (NDC) under the Paris Agreement setting an economy-wide emissions target of a 50-52% reduction below 2005 levels in 2030. Secretary of State Blinken conveyed a strong sense of urgency in tackling the climate crisis, noting that this is a critical year and a decisive decade to take action. He noted the U.S. resolve to work with other countries to engage in all avenues of cooperation to "save our planet."

Participants noted the need to work rapidly over the course of this decade to accelerate decarbonization

efforts and are taking a range of actions to that end. Announcements during this Session included, among others:

- Japan will cut emissions 46-50% below 2013 levels by 2030, with strong efforts toward achieving a 50% reduction, a significant acceleration from its existing 26% reduction goal.
- Canada will strengthen its NDC to a 40-45% reduction from 2005 levels by 2030, a significant increase over its previous target to reduce emissions 30% below 2005 levels by 2030.
- India reiterated its target of 450 GW of renewable energy by 2030 and announced the launch of the "U.S.-India 2030 Climate and Clean Energy Agenda 2030 Partnership" to mobilize finance and speed clean energy innovation and deployment this decade.
- Argentina will strengthen its NDC, deploy more renewables, reduce methane emissions, and end illegal deforestation.
- The United Kingdom will embed in law a 78% GHG reduction below 1990 levels by 2035.
- The European Union is putting into law a target of reducing net greenhouse gas emissions by at least 55% by 2030 and a net zero target by 2050.
- The Republic of Korea, which will host the 2021 P4G Seoul Summit in May, will terminate public overseas coal finance and strengthen its NDC this year to be consistent with its 2050 net zero goal.
- China indicated that it will join the Kigali Amendment, strengthen the control of non-CO2 greenhouse gases, strictly control coal-fired power generation projects, and phase down coal consumption.
- Brazil committed to achieve net zero by 2050, end illegal deforestation by 2030, and double funding for deforestation enforcement.
- South Africa announced that it intends to strengthen its NDC and shift its intended emissions peak year ten years earlier to 2025.
- Russia noted the importance of carbon capture and storage from all sources, as well as atmospheric carbon removals. It also highlighted the importance of methane and called for international collaboration to address this powerful greenhouse gas.

Session 2 ("**Investing in Climate Solutions**") addressed the urgent need to scale up climate finance, including both efforts to increase public finance for mitigation and adaptation in developing countries and efforts to catalyze trillions of dollars of private investment to support the transition to net zero emissions no later than 2050. President Biden stressed the importance of developed countries meeting the collective goal of mobilizing $100 billion per year in public and private finance to support developing countries. He also announced that the Administration intends to seek funding to double, by 2024, annual U.S. public climate finance to developing countries, compared to the average level of the second half of the Obama-Biden Administration (FY 2013-2016). This would include tripling public finance for adaptation by 2024. President Biden also called for an end to fossil fuel subsidies and announced that his Administration will undertake a series of steps to promote the measurement, disclosure, and mitigation of material climate risks to the financial system.

Treasury Secretary Yellen highlighted the role of multilateral development banks in supporting the transition. She also said that the Treasury Department will use all its tools and expertise to help support climate action. Special Envoy Kerry moderated a discussion among leaders from government, international organizations, and multilateral and private financial institutions. These leaders noted the importance of concessional finance to leverage much larger sums of private capital, as well as to provide finance to technologies, activities, and geographies where private capital is not flowing. They noted the urgent need to increase finance for adaptation and resilience in developing countries. The participants also recognized the need for governments to embrace key policies, including meaningful carbon pricing, enhanced disclosure of climate-related risks, and phasing out fossil fuel subsidies. Several of the private financial institutions expressed their support for coalitions such as the

Glasgow Financial Alliance for Net Zero and the Net Zero Banking Alliance. They also referred to recent commitments by U.S. banks to invest $4.16 trillion in climate solutions over the next ten years.

Session 3 elevated four specific topics for more focused consideration by government officials and, in some cases, a broader range of stakeholders.

- The discussion on **climate action at all levels**, hosted by U.S. EPA Administrator Regan and including participation from a wide range of governors, mayors, and indigenous leaders from around the world, illustrated the importance of marshalling a multi-level "all-of-society" approach to climate action. The Session showcased States, cities, and indigenous groups that are committed to an equitable vision for advancing bold climate ambition and building resilience on the ground. Participants discussed the critical importance of building just and inclusive societies and economies as they accelerate efforts to transform their communities in line with limiting warming to 1.5 degrees Celsius. Participants discussed not only the importance of leadership at all levels of society and government, but also the importance of collaboration between national and subnational governments to catalyze additional ambition.
- The discussion on **adaptation and resilience**, hosted by Secretary of Agriculture Vilsack and Secretary of Homeland Security Mayorkas, focused on innovative ways in which countries from a wide variety of regions are responding to climate change in the areas of water and coastal management, food security, and human impacts. On the theme of coastal and water management, panelists offered up innovative solutions to prepare for water-related climate challenges, such as locally-owned disaster insurance instruments, relocation, and the use of green and blue bonds to finance nature-based solutions. Focusing on food security and climate, participants highlighted the need for better technology to address a changing agricultural landscape as well as the importance of supporting small-scale farmers. On human health and security, the discussion centered on scaling up locally-led solutions to climate vulnerability, emphasizing that economic opportunities are key to keeping communities healthy and stable. The session emphasized that adaptation and mitigation go hand in hand.
- The discussion on **nature-based solutions**, hosted by Interior Secretary Haaland, addressed how achieving net zero by 2050 is not possible without natural climate solutions, such as stopping deforestation and the loss of wetlands and restoring marine and terrestrial ecosystems. She announced U.S. support of a proposal to protect the Southern Ocean through the three marine protected area proposals under the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR). All participants highlighted their support for protecting and conserving land and marine areas to sequester carbon and build climate resilience, and several made announcements. Seychelles is dedicating a chapter of its enhanced NDC to ocean-based solutions and is committing to protect at least 50% of its seagrass and mangrove ecosystems by 2025 and 100% by 2030, with support. Canada, for its part, is committing $4 billion in its new federal budget for land and ocean protection. In addition, Costa Rica underlined its co-leadership of the High-Ambition Coalition for Nature and People and the intention to have 30% of its ocean under protection by 2022; Peru highlighted that more than a fifth of its NDC measures are associated with nature-based solutions; Indonesia discussed its Presidential decree to permanently freeze new license for logging and peatland utilization, as well as its mangrove rehabilitation program; and Gabon noted that its intact and logged forests absorb four times more CO2 annually than its total emissions across all sectors. Representatives of the Global Alliance of Territorial Communities and of the Kharia Tribe of India highlighted the need to recognize the contributions and traditional knowledge of local and indigenous communities in ecosystem protection.
- The discussion on **climate security** was hosted by Defense Secretary Austin. His remarks were followed by remarks from both Director of National Intelligence Haines and U.S. Ambassador to the United Nations Thomas-Greenfield, who then moderated a panel discussion. Speakers included NATO Secretary General Stoltenberg, defense officials from Iraq, Japan, Kenya, Spain, and the UK, as well as the Philippines' finance minister. A common theme throughout the discussion was how climate impacts exacerbate security concerns and, as a result, affect military capabilities, heighten geopolitical competition, undermine stability, and

provoke regional conflicts. Participants further emphasized that their nations and regions are vulnerable to extreme weather events, including sea level rise, cyclones, typhoons, drought, and increasing temperatures. All of these intensify underlying political, social, and economic conditions, which in turn can lead to food insecurity and water scarcity, violent extremism, and mass population movement, with disproportionate effects on vulnerable populations, especially women. Defense officials noted that their ministries are increasingly called upon to respond to disasters, which taxes their resources, thus elevating the need for enhanced disaster preparedness and response. In looking at their own operations and readiness, they showcased current efforts to decrease their militaries' emissions, emphasizing how incorporating climate considerations into their operational planning can increase the agility of their forces. Additionally, they described the benefits of collaboration between defense ministries on shared climate risks. Participants highlighted the NATO climate security action plan and called on countries to incorporate climate considerations more broadly into multilateral fora, including UN peacekeeping missions. Perhaps most noteworthy, this was the first-ever U.S. Secretary of Defense convening of Secretaries of Defense focused on climate change.

Session 4 ("**Unleashing Climate Innovation**") explored the critical innovations needed to speed net-zero transitions around the world and highlighted the efforts of governments, the private sector, and civil society in bringing new and improved technologies to market. Energy Secretary Granholm and Commerce Secretary Raimondo emphasized the economic rewards from investing in innovation as multi-trillion dollar markets for clean technologies emerge in the coming decades and announced reinvigorated U.S. international leadership on innovation. The discussion underscored the urgent need for innovation: 45% of the emissions reductions needed for a swift net-zero transition must come from technologies that are not commercially available, according to the Executive Director of the International Energy Agency, and Bill Gates urged investment to drive down "green premium" prices of most zero-carbon technologies compared with fossil fuel alternatives. Several leading countries — Denmark, the United Arab Emirates, Israel, Kenya, Norway, and Singapore — described their approaches to investing in mitigation and adaptation technologies. These included clean fuels such as hydrogen, renewables such as offshore wind and geothermal energy, energy storage, clean desalination, carbon capture, advanced mobility, sustainable urban design, and monitoring technologies to verify emissions and stop deforestation. Leaders from the private sector, including from GE Renewables, Vattenfall, and X, as well as from the Rensselaer Polytechnic Institute, focused on training the diverse innovators of the future and investing in technologies for digitalized, electrified, decarbonized, and resilient energy systems. Special Envoy Kerry closed by emphasizing that raising our innovation ambition enables us to raise the world's climate ambition.

Several speakers made announcements during this Session: Denmark announced a technology mission under Mission Innovation to decarbonize the global shipping sector, in collaboration with the United States, and that it will build the world's first energy islands to produce clean fuels and supply power to Europe. The United Arab Emirates launched the Agriculture Innovation Mission for Climate in partnership with the United States, Australia, Brazil, Denmark, Israel, Singapore, and Uruguay. Bill Gates launched the Breakthrough Energy Catalyst to drive public, private, and philanthropic capital to scale up critical emerging technologies. Rensselaer Polytechnic Institute announced the Institute for Energy, the Built Environment, and Smart Systems to decarbonize urban systems. GE Renewable Energy announced that the GE Foundation is committing up to $100 million to increase the diversity of the next generation of engineers. And X, Alphabet's Moonshot Factory, announced a Moonshot for the electric grid.

President Biden began Session 5 ("**The Economic Opportunities of Climate Action**") by recognizing the opportunity that ambitious climate action presents to countries around the world to create good, high quality jobs. He noted that countries that prioritize policies that promote renewable energy deployment, electric vehicle manufacturing, methane abatement, and building retrofits, among other actions, would likely reap the rewards of job growth and economic prosperity in the years ahead. The U.S. Trade Representative, Ambassador Tai, Transportation Secretary Buttigieg, and National Climate Advisor McCarthy underscored that the climate agenda could be a race to the top for countries that are pursuing the most ambitious methods to tackle the crisis, noting the American Jobs Plan that President Biden has proposed.

Participants echoed this vision and elaborated their own projects and programs to maximize the economic benefits of their climate actions. Leaders of countries recognized that the economic recovery from the COVID-19 pandemic presents an opportunity for countries to build back better and invest in the industries of the future. Community, tribal, private sector, and labor leaders also weighed in on the opportunities that decarbonization provided. Panelists noted that climate action presents economic opportunities to all parts of society, from energy workers to vehicle manufacturers, from large businesses to small. In particular, there was general alignment among both country representatives and other participants that governments should promote equitable opportunities for workers and that labor unions can play a key role in promoting high quality employment opportunities for people around the world. To that end, Poland announced that they had just concluded negotiations with coal mine labor unions to ensure a just transition of workers as part of their coal-fired power phasedown. In response to the discussion, President Biden closed by emphasizing that climate action might represent the largest economic opportunity of this century and urging leaders to stay focused.

In between the five Sessions, several **other speakers** provided important perspectives. Youth speaker Xiye Bastida, declaring that climate justice is social justice, underlined that youth need to be a part of decision-making processes and called for a stop to fossil fuel subsidies and extraction. Current and future Conference of Parties Presidents Minister Carolina Schmidt (Chile) and MP Alok Sharma (UK) discussed the urgency of achieving net-zero emissions by 2050. Minister Schmidt noted that COP25 included, for the first time, a mandate to address the ocean-climate nexus, while MP Sharma noted that we must put the world on a path to achieve net-zero emissions by 2050 through long-term targets and aligned NDCs, as well as immediate action, such as phasing out coal. Pope Francis, who has been a climate leader for many years, underlined the need to "care for nature so that nature may care for us." Chair Mallory of the White House Council on Environmental Quality highlighted the Biden Administration's commitment to environmental justice and introduced Peggy Shepard, Co-Chair of the White House Environmental Justice Advisory Council; she underlined the need to build back better to lift up the communities struggling with climate impacts and environmental injustice. Michael Bloomberg, UN Special Envoy on Climate Ambition and Solutions, noted the key role of cities and businesses in tackling the climate crisis.

Alongside the Summit, Special Envoy Kerry hosted two **Ministerial Roundtables** to provide a broader group of countries an opportunity to contribute to the discussions. He heard from representatives of more than 60 countries from all over the world, reflecting a wide range of regions, geographic features, and national circumstances, and summarized their input for leaders on the second day of the Summit. Many Roundtable participants expressed concern about the inadequacy of global climate action to date and/or shared the unprecedented climate impacts they are experiencing. At the same time, participants enthusiastically reported on the significant, exciting efforts they are undertaking to confront the climate crisis, even while facing the global pandemic. Beyond many commitments to net zero emissions, enhanced NDCs, and innovative adaptation efforts, participants included a carbon-negative country, countries that have successfully decoupled economic growth from carbon emissions, leaders in carbon storage, countries with extensive forest cover, issuers of green bonds, and countries focusing on gender-responsive approaches and the participation of indigenous communities. It was notable that many of those passionately embracing climate solutions contribute far less than 1% of global emissions. The Roundtables contributed to the Summit's sense of urgency as countries rally around increased ambition on the road to Glasgow.

Roundtable participants represented: Afghanistan, Andorra, Angola, Armenia, Austria, Bahrain, Belgium, Cabo Verde, Cambodia, Croatia, Cyprus, Czech Republic, Ecuador, Estonia, Federated States of Micronesia, Finland, Georgia, Greece, Grenada, Guatemala, Guyana, Honduras, Hungary, Iceland, Jordan, Kazakhstan, Kosovo, Latvia, Libya, Lithuania, Luxembourg, Madagascar, Maldives, Mali, Malta, Mauritania, Monaco, Mongolia, Montenegro, Nepal, North Macedonia, Oman, Panama, Papua New Guinea, Paraguay, Republic of Congo, Romania, Senegal, Slovakia, Slovenia, Sri Lanka, St. Kitts and Nevis, Suriname, Sweden, Switzerland, Tanzania, The Bahamas, Turkmenistan, Ukraine, Uruguay, Uzbekistan, Vanuatu, and Zambia. A list of new climate-related initiatives announced by the United States at or around the Summit can be found in this **Fact Sheet**.

News and Announcements

Renewable Natural Resources Foundation

Now Accepting Nominations for RNRF's 2021 Awards Program

RNRF is now accepting nominations for its 2021 Awards Program.

The **Sustained Achievement Award** recognizes a long-term contribution and commitment to the protection and conservation of natural resources by an individual.

The **Outstanding Achievement Award** recognizes a project, publication, piece of legislation, or similar concrete accomplishment that occurred during the three years prior to nomination for the award.

The **Excellence in Journalism Award** honors and encourages excellence in print journalism about natural resources, recognizes work by an individual, group, or organization for both print and digital media.

Nominations will be accepted until June 1, 2021.

For more information on selection criteria, eligibility, and submission instructions, visit the **Call for 2021 Awards Nominations.**

For more information on RNRF's Awards Program and lists of past winners, visit RNRF's **Awards Program page.**

American Geophysical Union

Next Steps in the Growth of ESSOAr

Seven societies, including AGU, are joining together to further enable open science by officially participating in the governance and continued development of **ESSOAr.org**, the Earth and Space Open Archive. The societies—Association for the Sciences of Limnology and Oceanography, Ecological Society of America, Society of Environmental Toxicology and Chemistry, as well as three societies in the ACSESS coalition: American Society of Agronomy, Crop Science Society of America, the Soil Science Society of America—will join AGU on the Advisory Board to provide governance for ESSOAr, guide future development and help populate the Editorial Board that manages the content.

To read more, click **here**.

American Meteorological Society

AMS Signs Medical Society Consortium Letter on Climate and Health

On April 8, 2021, the American Meteorological Society joined a group of health and climate organizations in a letter of support for climate-conscious policies from the Biden administration. They highlighted the health benefits of climate action and urged the administration to “go big” for our climate, and for our health.

To read the full letter, click **here**.

American Society of Civil Engineers

Now is (finally) the time to future-proof our infrastructure

In today's Member Voices article, Constantine Samaras, Ph.D., A.M.ASCE, and Mikhail Chester, Ph.D., A.M.ASCE, look at the unique opportunity afforded by the upcoming infrastructure bill in Congress, presenting it as a chance to finally address the country's need for climate-resilient infrastructure.

Finally, it looks like Infrastructure Week is going to happen. Decades of disinvestment gave the country an infrastructure system that recently earned a "C-" on ASCE's Report Card for America's Infrastructure. And this is before climate change accelerates.

Extreme weather is becoming more frequent and more intense, and the world is barreling toward a more volatile climate with infrastructure designed for the past. With infrastructure widely expected to be prioritized in Congress soon, we need to recognize that every infrastructure bill is also a climate bill. It is critical that we make our infrastructure climate safe.

To read more, click **here**.

American Society of Landscape Architects Fund

ASLA Testifies Before Congress on Clean Infrastructure

Kevin Robert Perry, FASLA, Senior Landscape Architect, Toole Design, and Principal, Urban Rain Design, testified on behalf of ASLA to the U.S. House of Representatives Committee on Transportation and Infrastructure, Subcommittee on Water Resources and Environment. He spoke about the value of green infrastructure and the work that landscape architects are doing in this space, and expressed support for increasing congressional funding for green indrastructure programs.

To read his full testimony, click **here**.

Geological Society of America

Challenges and Solutions for a Changing Climate: New Directions for GSA

In his 2019 GSA Presidential Address, then-President Don Siegel called on members of GSA to take a leadership position in developing climate adaptation strategies. In response to this challenge, 17 GSA Scientific Divisions sponsored a Pardee Keynote Symposium at GSA2020 Connects Online entitled "Challenges and Solutions for a Changing Climate: New Directions for GSA." The goal of the session was to compel GSA members to think creatively, critically, and constructively about the role of geoscientists in addressing emerging climate disruption. We assembled a panel representing a range of expertise and diversity of perspectives to explore four main themes: assessment, mitigation, adaptation, and engagement. The presentations and discussions pushed for innovation around alternative approaches to adaptation and mitigation, utilizing diverse sources of data, and examining linkages among geological processes, as well as illustrating how effective collaborative engagement of all stakeholders is essential to meet the challenges that face us.

To read more, click **here**.

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