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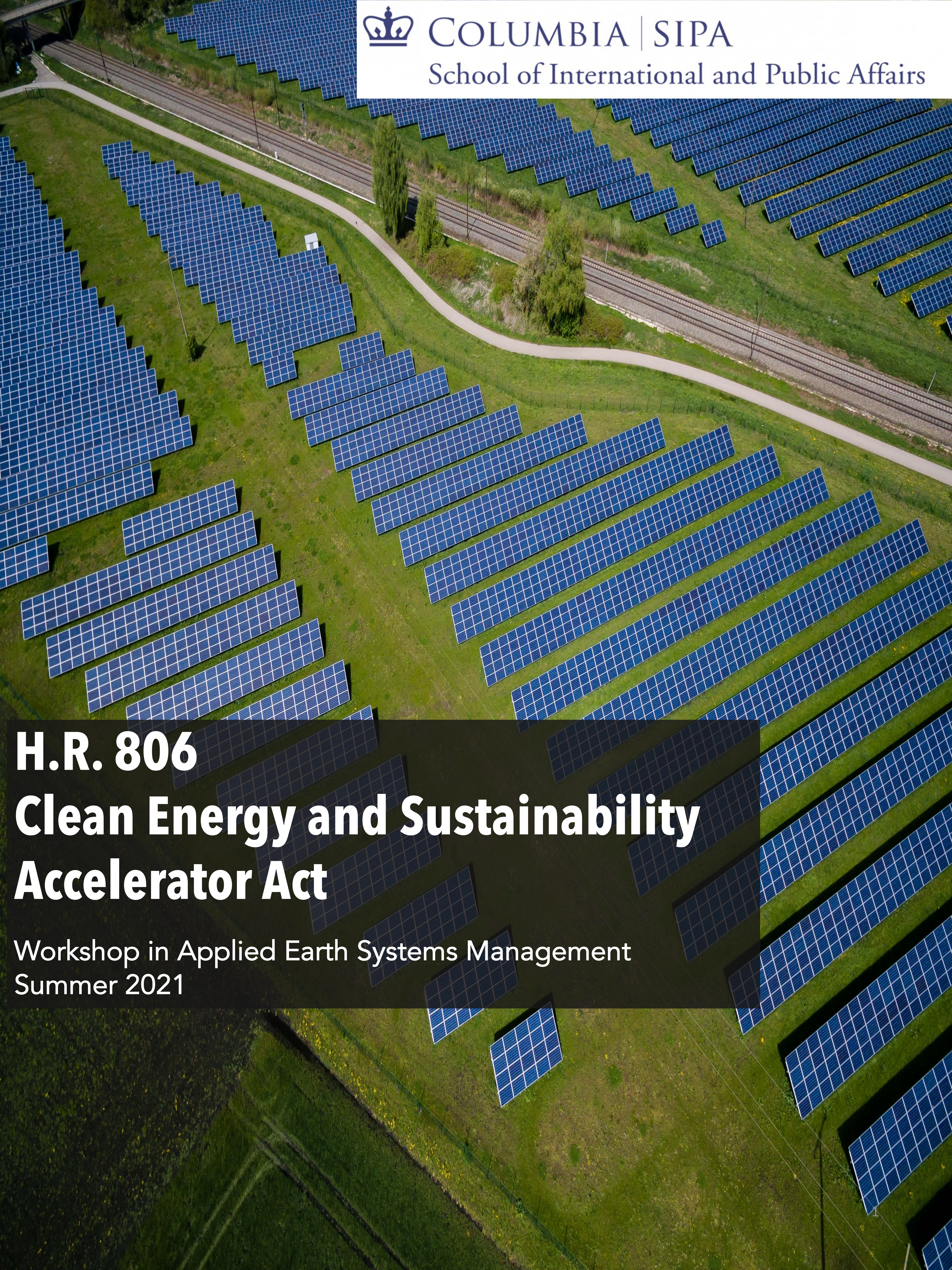

H.R. 806
Clean Energy and Sustainability Accelerator Act

Workshop in Applied Earth Systems Management
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COLUMBIA CLIMATE SCHOOL
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ACKNOWLEDGEMENTS

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

H.R. 806, cited as the "Clean Energy and Sustainability Accelerator Act," will establish a non-profit corporation to be known as the Clean Energy and Sustainability Accelerator. This organization is charged with reducing the emission of greenhouse gases and other dangerous pollutants by catalysing investment in emerging energy technologies and sustainable infrastructure. This report will outline the environmental and public health implications of emissions; the mechanisms through which the Accelerator can mitigate emissions; the technological, financial, and administrative challenges associated with the Accelerator's projects; the Accelerator's investment criteria and standards; and the metrics most useful in judging the Accelerator's success.

Accelerator initiatives will not only invest directly in low- and zero-emissions technologies and infrastructure, but also encourage private investment in projects with low potential for short-term profit but a strong link to equity and public wellbeing. This legislation was crafted to support climate-impacted and otherwise marginalized communities through a period of economic transition and mitigate the environmental harms which these communities are disproportionately likely to experience. The proposed Act also secures the rights and welfare of workers engaged in projects associated with the Accelerator.

H.R. 806 will be successful if the Accelerator's projects are deemed effective in reducing the quantity of emissions associated with U.S. energy generation to a greater extent than baseline projections. The Accelerator must measure and report its progress in stimulating renewable energy production and innovation, especially with regards to solar and wind energy projects. It must also demonstrate success in building cohesive energy systems with efficient storage, distribution, and use of energy. Developments in these areas must be regularly monitored and corroborated with key performance indicators to adequately evaluate the achievement of the Accelerator.

INTRODUCTION TO PROPOSED LEGISLATION

SUMMARY OF LEGISLATION

H.R. 806 aims to facilitate a transition of the U.S. economy toward a reliance on clean and enduring sources of energy through financial and policy support of renewable energy and sustainable infrastructure projects. This resolution was introduced to the House on February 4, 2021, by Rep. Debbie Dingell (D-MI) and subsequently referred to the House Committees on Energy and Commerce; Financial Services; Transportation and Infrastructure; and Agriculture. It has since been co-sponsored by twelve other Representatives and introduced to the Senate by Senators Edward Markey (D-MA) and Chris Van Hollen (D-MD). The Accelerator is designed to perform the following:

- Provide financing support for investments in the United States in low- and zero-emissions technologies and processes in order to rapidly accelerate market penetration.
- Catalyze and mobilize private capital through federal investment and support a more robust marketplace for clean technologies, while avoiding competition with private investment.
- Enable climate-impacted communities to benefit from and afford projects and investments that reduce emissions.
- Provide support for workers and communities impacted by the transition to a low-carbon economy.
- Support the creation of green banks within the United States where green banks do not exist.
- Cause the rapid transition to a clean energy economy without raising energy costs to end users and seeking to lower costs where possible.

KEY DEFINITIONS

- **The Accelerator** is the Clean Energy and Sustainability Accelerator established by H.R. 806.
- **Climate-Impacted Communities** include communities of color, communities likely to feel the negative effects of climate change or environmental pollution, distressed neighbourhoods, low-income communities, low-income households, Tribal communities, persistent poverty counties, or communities that are economically reliant on fossil fuel-based industries.
- **Energy Efficiency** is any project, technology, function, or measure that results in the reduction of energy use required to achieve the same level of service or output prior to the application of such project, technology, function, or measure, or substantially reduces greenhouse gas emissions relative to emissions that would have occurred prior to the application of such project, technology, function, or measure.
- A **green bank** is a dedicated public or non-profit specialized finance entity that– "(A) is designed to drive private capital into market gaps for low- and zero-emission goods and services; "(B) uses finance tools to mitigate climate change; "(C) does not take deposits; "(D) is funded by government, public, private, or charitable contributions; and "(E) invests or finances projects– "(i) alone; or "(ii) in conjunction with other investors.
- **Renewable energy generation** is electricity created by sources that are continually replenished by nature, such as the sun, wind, and water.
- A **greenhouse gas** is a gas that contributes to the greenhouse effect by absorbing infrared radiation.

ENVIRONMENTAL PROBLEM

To mitigate the adverse effects of climate change, the world must decarbonize by mid-century and reach net-negative emissions thereafter. Decarbonizing carbon intensive industries like the power sector is key. As governments and private entities commit to investing in climate change technology, it is imperative to have policy support which makes deployment of renewable energy more speedy and economically feasible.

The proposed clean energy and sustainability accelerator seeks to address the cost-effective reduction of emissions to mitigate the increase in global surface temperature and air pollution, and adverse human health and ecosystem health effects associated with it.

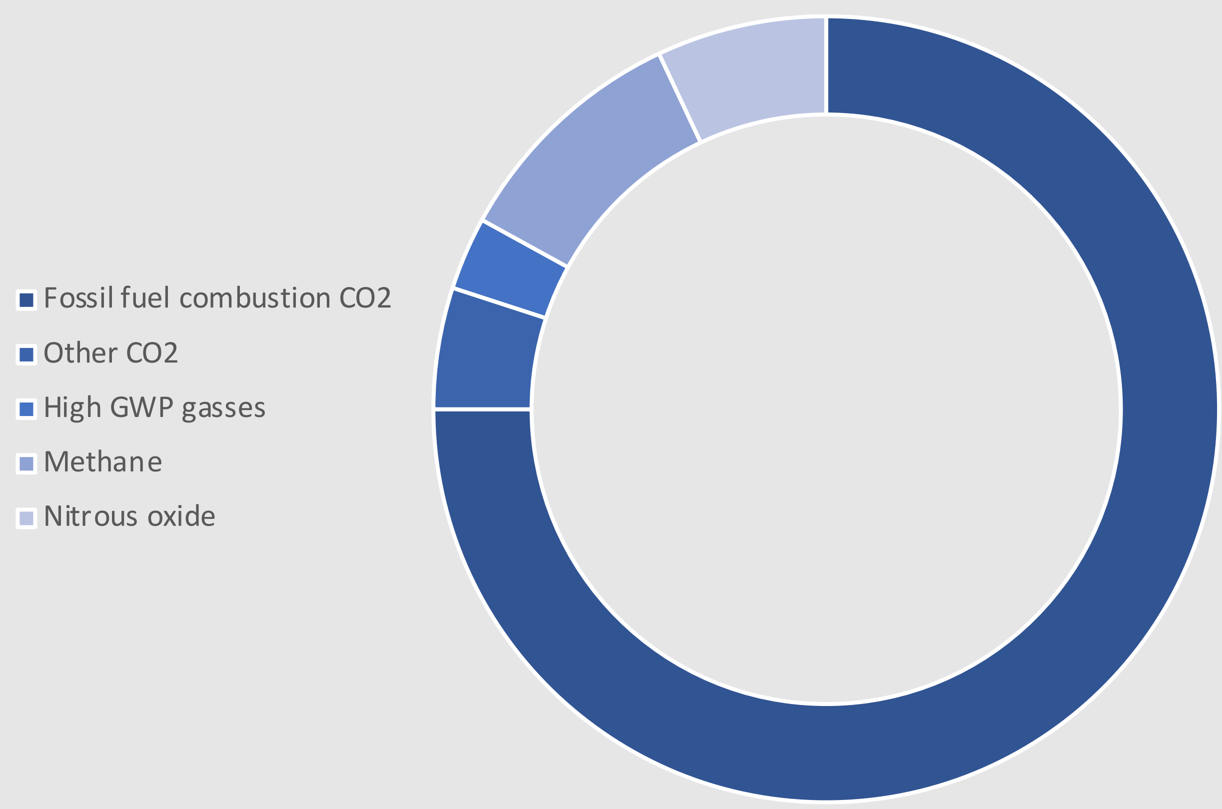
i. EMISSIONS

Emissions is defined as the release of gases and particles into the atmosphere through the extraction, processing, or consumption of fossil fuels. Emissions, especially of greenhouse gases, both warm the planet and degrade air quality[1]. According to the US Emissions Information Administration, fossil fuel combustion accounted for 74.1% of carbon dioxide (CO2) emissions in the United States.

ii. HOW EMISSIONS OCCUR

Fossil Fuels are formed from the buried remains of plants and animals that lived millions of years ago. Oil and gas are formed from organic matter deposited as sediments and then broken down and transformed over millions of years. The carbon content of these organisms under high pressure and heat gets converted into oil and coal deposits. In the process of combustion, these hydrocarbons burn to produce carbon dioxide (CO_2) and water (H_2O) and carbon monoxide (CO) which are more commonly known as greenhouse gasses. Additionally, the combustion of fossil fuels also releases gases like NO_x, SO_x (a group of highly reactive gases) which circulate in the atmosphere, creating smog and degrading the quality of air.

Figure 1 | Percentage of greenhouse gas emissions in the United States in 2019 (Source: EIA)



ENVIRONMENTAL PROBLEM

iii. GREENHOUSE GAS EMISSIONS AND GLOBAL WARMING

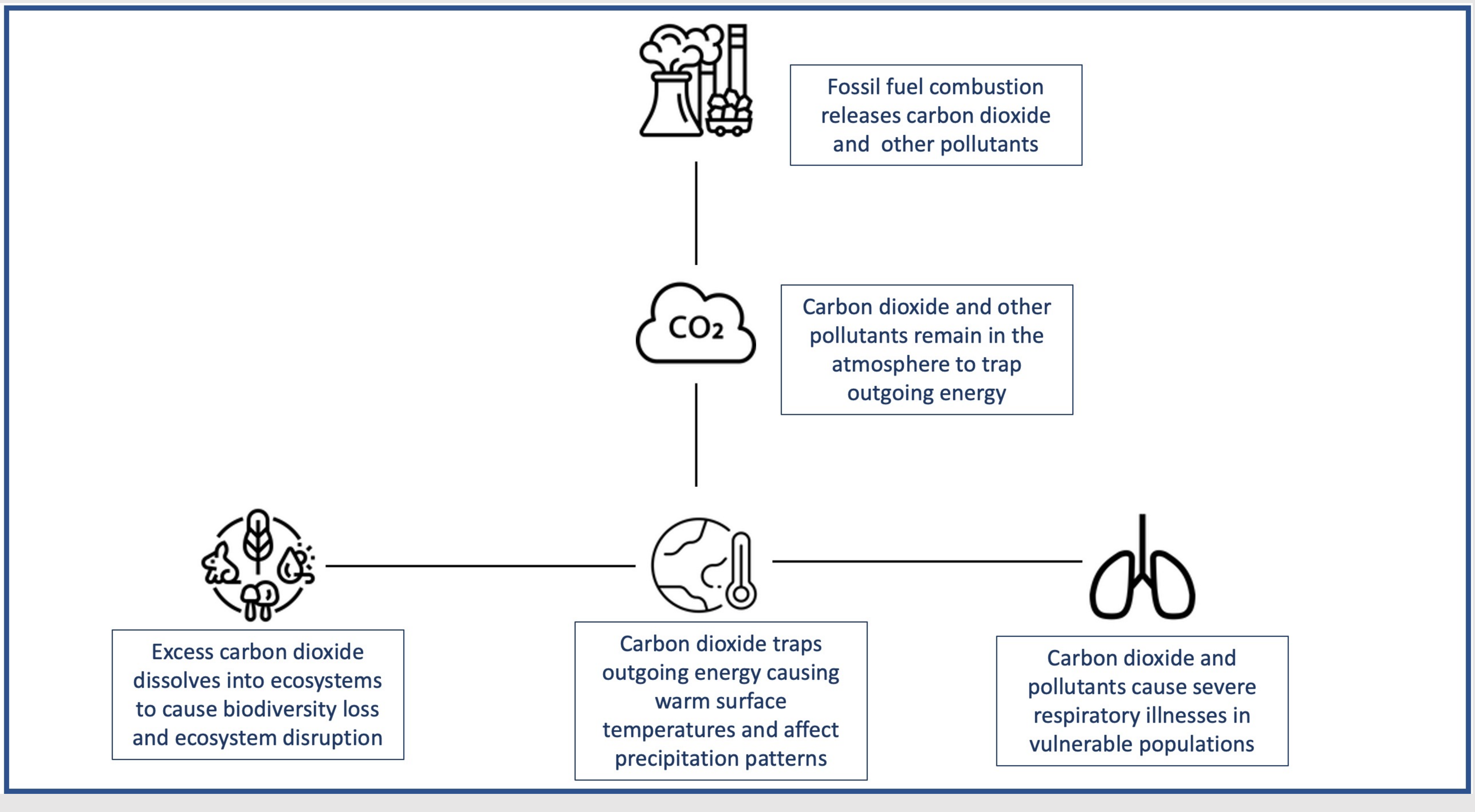
Earth has an energy budget which it maintains, where the energy entering the system in the form of incoming solar radiations is balanced with the energy leaving the earth's system in the form of longwave radiations reflecting back to space. When concentrations of greenhouse gasses like carbon dioxide increase in the atmosphere, the heat absorbing capacity of these gasses prevents energy from escaping from the earth's atmosphere back to space - leading to increased surface temperatures, which causes global warming[2]. Additionally, greenhouse gasses like carbon dioxide remain in the atmosphere for long periods of time, approximately years. While a proportion of these gasses are absorbed by the plants, oceans and get trapped in rocks and sediments, the amount being naturally removed from the atmosphere is less than the concentration being added through anthropogenic activities[3]. This trapping of heat by the greenhouse gases is warming the earth's surface and creating a greenhouse effect.

iv. GREENHOUSE GAS EMISSIONS AND GLOBAL WARMING

Greenhouse gas emissions are impacting the entire globe. For example, the United States is observing long-term changes in temperature and precipitation as a result of global warming. The extent of warming has varied across regions of the country, with the West and Alaska experiencing the greatest degree of warming[2]. Shifting precipitation patterns have also been observed. Coastal areas, including the West, Gulf, and Atlantic coasts are experiencing increased winter precipitation by up to 30%, while precipitation in the central part of the country (the Midwest and the Great Plains) has decreased by up to 20%[3]. As weather conditions intensify, agricultural productivity is at risk, and the sudden loss of livestock and crops may cause increased food prices or greater food insecurity.

Overall, the ecosystem that we depend upon and the environmental resources we value - water, air, soil, energy, agriculture ecosystems, wildlife - all will experience the effects of a changing planetary condition, impacting human welfare and health.

Figure 2 | Summary of fossil fuel combustion and associated ecosystem and health impacts



ENVIRONMENTAL PROBLEM

Ecosystem health impacts: Emissions directly and indirectly disrupt entire ecosystems, inducing mass extinction, threatening food sources, and reducing biodiversity. For example, atmospheric carbon dioxide dissolves in water and leads to ocean acidification, which inhibits the formation of shells and growth of crustaceans and other calcification-dependent animals. The degradation of ecosystems directly impacts the wellbeing of human populations, especially those who rely on ecosystem services.

Human health impacts: Emissions from fossil fuel production and combustion have been linked to declining health and wellbeing standards in humans. According to a 2021 study published in Environmental Research, areas with high concentrations of fossil fuel emissions experience greater instances of respiratory related illnesses and deaths[3] .Emissions specifically target the human respiratory system, to trigger chronic conditions like asthma and bronchitis. Excessive mucus malfunctions are also associated with high atmospheric sulfur dioxide concentrations. Studies have also indicated that the impacts of global warming as a result of greenhouse gas emissions are largely disproportionate**.** African American and low-income communities are disproportionately affected by air pollution in the United States[4]. For example, more than 6.7 million African Americans live in the 91 US counties with oil refineries.

v. THE ACCELERATOR AS A CLIMATE POLICY TOOL

Virtually every sector of the global economy, from manufacturing to agriculture to transportation to power production, contributes greenhouse gases to the atmosphere. Many industries essential to human health rely on the burning of fossil fuel, so each must transition to renewable sources if we are to avoid the worst effects of climate change. Considering the far-reaching nature of climate change, it is the government that can hold corporations and individuals accountable. In addition to enacting policies, treaties, regulations, and exercising taxes to decrease emissions, the government can also influence markets with its broad purchasing power and ability to finance or insure large, capital-intensive projects. All of these mechanisms must be utilized to curb global warming and air pollution.

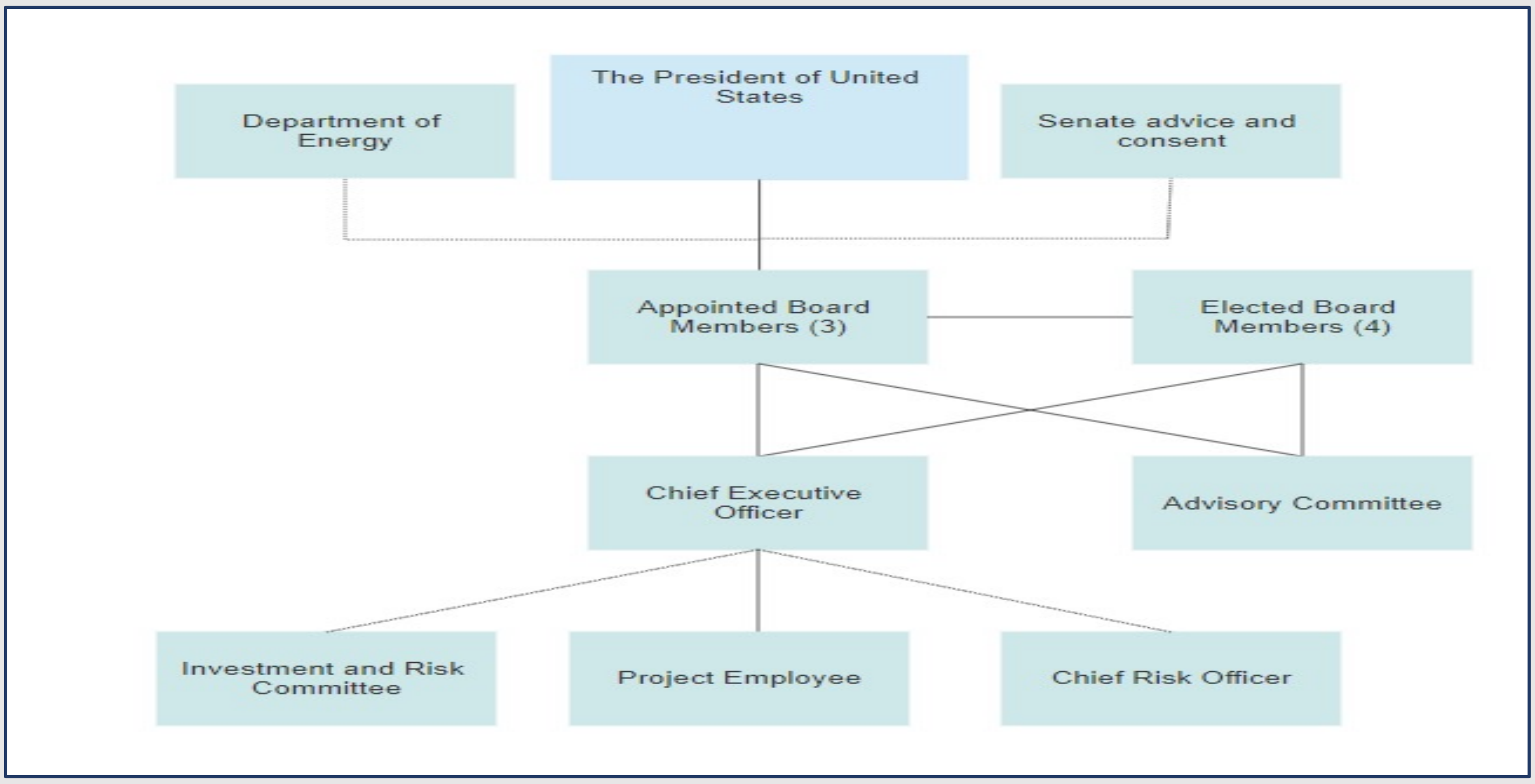
Given the current policies and incentive structure, corporations will not act on their own at a rate quick enough to keep warming under the 2°C mark - they are profiting off the emissions. H.R. 806 firmly puts the U.S. on the path toward climate leadership by bolstering investment in projects aimed at reducing emissions. The bill will work towards building a model where the government and private sector actors can work together to leverage investments in climate action, reduce emissions, and support environmental justice communities.

SOLUTIONS

i. ACCELERATOR INITIATIVES

The enactment of H.R. 806 shall authorize the appropriation of funds for use by the Accelerator. With Congressional and Presidential approval, the Secretary of Energy shall transfer $50 billion for the fiscal year in which the Accelerator is established and $10 billion annually for each of the five succeeding fiscal years. For the duration of its 30-year charter, the Accelerator shall operate under the direction of a Board of Directors, which is in turn mandated to establish advisory, investment, risk management, and audit committees to oversee and direct the activities of the Accelerator. The Accelerator will be required to report to the President and to the relevant committees of Congress on a quarterly and annual basis, and to conduct internal audits of the accounts of the Accelerator with the support of independent public accountants. Additionally, the Accelerator will be subject to external oversight by the Inspector General of the Department of Energy.

Figure 3 | Operation strategy of the Accelerator within the U.S. government



SOLUTIONS

H.R. 806 will directly increase federal investment in green technologies while taking action to facilitate a robust energy marketplace, indirectly encouraging private financing. The Accelerator shall also initiate a program that provides zero-interest loans to eligible organizations to acquire zero-emission vehicles or the infrastructure to support them and explore the creation of an accelerated clean energy program. Additionally, it will promote public education on the importance of lowering emissions to facilitate a robust market demand for clean technologies.

The Accelerator's finance and investment division will work with private investors to facilitate new investment in areas that do not already have green banks or large amounts of investment in low- and zero-emission products.

The Accelerator will incorporate a Start-Up Division to aid in the establishment of green banks in these areas. Green banks typically take the form of either a government-owned or quasi-public bank, with a fixed rate of government funding allocated as cash on hand to arrange and backstop lending agreements with private investors for projects and companies that are considered too risky for ordinary capital markets. The U.S. has no Green Banks at the federal level, but a handful in cities and states, including Washington D.C., Connecticut and New York. According to the Annual Green Bank Report 2020, Green banks mobilized $1.69 billion of total investment in clean energy projects with $442 million of green bank funds[5]. HR 806 is geared towards facilitating more investments in this way.

ii. SUSTAINABLE ENERGY TECHNOLOGIES

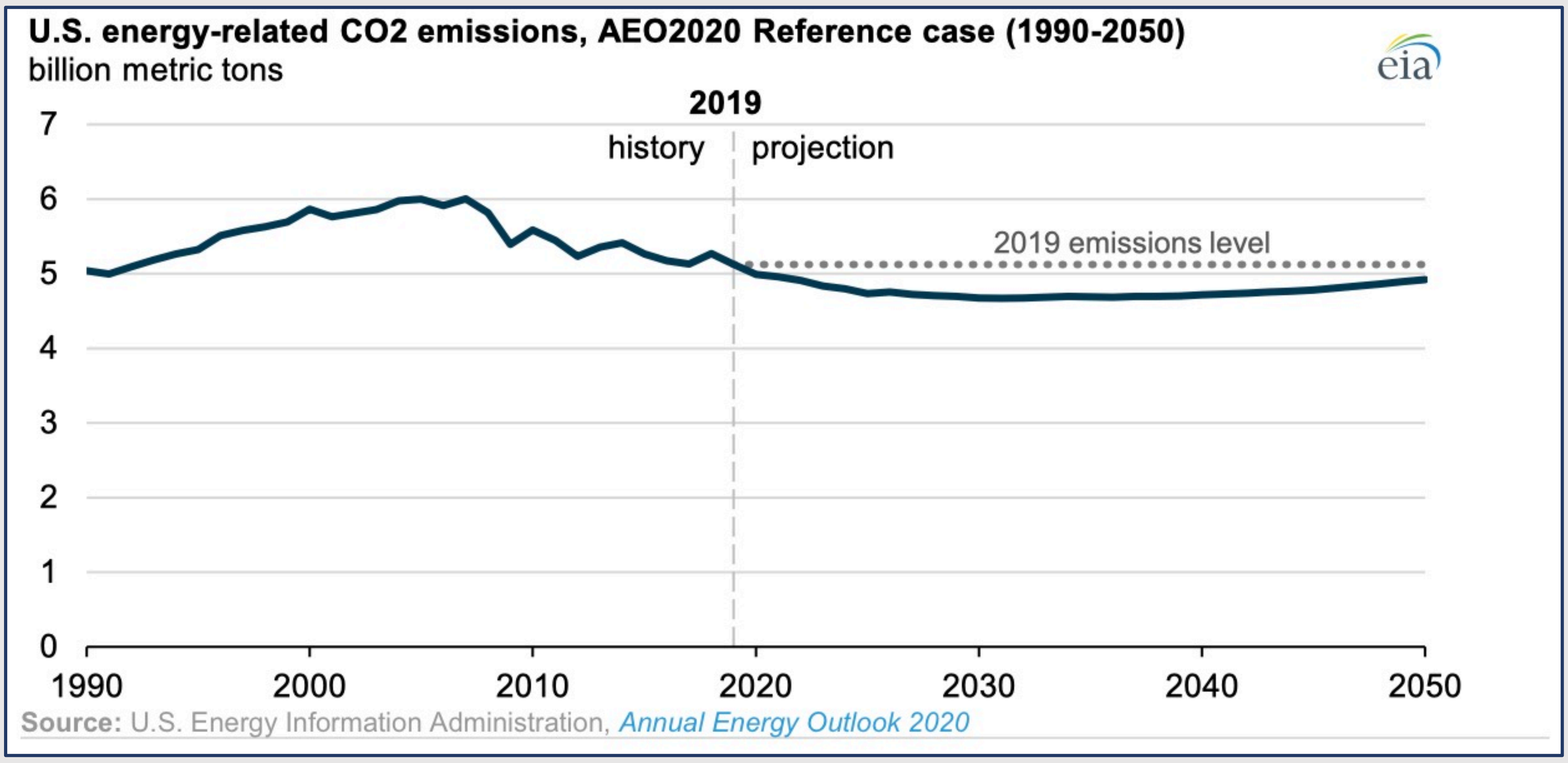
H.R. 806 seeks to address climate change by broadening and accelerating investment in sustainable sources of energy. Wind and solar are usually built by private actors via project finance agreements, in which third-party investors pay for all the labor and materials used in the construction process in exchange for a share of future cash flows. Because their production is very predictable based on weather patterns, and there are no variable fuel costs, it's relatively cheap for clean energy investors to borrow money for their projects. Solar and wind capacity in the U.S. are already growing consistently: While renewable energy accounted for 20% of electricity generation in 2020, with wind energy and hydropower plants respectively contributing 8.4% and 7.3% of all generation[6], its market share for 2021 is forecasted to be 21%[7]. This growth is projected to accelerate in the coming decades.

However, installed generation capacity must double from 2018 levels by 2050[8] in order to meet anticipated demand in a high-electrification world, and a green transition still faces significant obstacles. Each renewable source of energy comes with idiosyncratic technical challenges to implementation, and adoption is further impaired by a political setting deeply committed to the fossil fuel industry. These conditions require top-down action to rework the U.S. energy landscape.

SOLUTIONS

Renewable energy is generated with a heterogeneous range of technologies, and so understanding the science behind this technology is vital in effectively financing and implementing it. Solar energy requires sunlight's energy disrupting electrons in solar panels to create electricity. Semiconductors on top of solar panels absorb energy from sunlight that creates a vibration among the electrons. The vibration leads to electrons moving upwards leading to an imbalance in electron charges. The imbalance leads electron flow in one direction which creates an electric current or electricity. Consequently, sunlight intensity and semiconductor efficiency are fields that can be innovated. Wind energy involves the transformation of wind force through the rotation of blades and rotors into electricity. When wind flows through the blades, an air pressure difference causes the blades to rotate. The rotor connects to a generator either directly or through a series of gears which can speed up the rotation, and this translation of force creates electricity. The size and motor efficiency of blades are two technological factors that can be improved upon for greater efficiency. Another opportunity for the generation of clean and consistent carbon-free electricity, well suited to supplementing the natural fluctuations of solar and wind, is geothermal energy. However, geothermal relies on the Earth's natural heat, its deployment may also be geographically restricted to hotspots of intense geothermal activity. Given these differences, projects in each given region must be tailored to the renewable energy potential of that area.

Figure 4 | Graph depicting energy-related CO2 emissions for U.S. between 1990-2050 (EIA)



SOLUTIONS

iii. INTEGRATION TECHNOLOGIES

The emission of carbon dioxide is rising even as renewable energy production grows. These power sources produce energy at a zero marginal cost, but wind and solar radiation are variable and intermittent by nature and the underlying technology has limitations[9]. Even utilities which rely heavily on renewable energy purchase fossil fuel-based energy to maintain their minimum load of supply to consumers. A modern economy, and especially energy-intensive sectors, require an integrated energy system. Continued investment on energy storage and distribution infrastructure can ease the path to a greater reliance on renewable energy. However, the technologies capable of filling the gaps in U.S. decarbonization strategy have proven difficult to finance. They are frequently viewed as unproven by investors, and the country's decentralized power markets don't provide sufficient incentives.

Energy Storage

Energy storage is one key area of the U.S. energy system which the Accelerator is well-placed to address. For example, electricity in Hawaii is expensive due to the cost of importing fossil fuels from continental producers. To drive down energy costs, the state installed solar panels capable of producing 28 megawatts of electricity, and 18,304 lithium-ion batteries. The batteries charge during the day, ready to deploy energy when Hawaiians begin their days the following morning. However, with current battery technology, this system only provides reliable power for about 4 hours before fossil fuels must be used to power the grid. This system cuts about 3.7 million gallons of fossil fuel usage, but still needs to develop the technology to store enough energy to see out a full day[10].

The leading energy storage technology is the lithium-ion battery. This type of battery stores energy for devices including phones, computers, EVs, and an increasing portion of the electrical grid. However, while battery technology is improving every day, lithium-ion batteries remain expensive to scale and generally only last between 2-10 years before needing to be replaced, depending on usage frequency and how much power is required per usage[11]. When it comes to scale and potential for powering the grid, lithium-ion battery plants are generally only capable of supporting the grid for 4-6 hours without an infusion of energy from renewable sources. This may be sufficient for powering through day-to-day fluctuations in power generation from wind and solar due to variability in sunlight and wind in a given region, but it is not enough to supply power to the grid during a sustained outage lasting multiple days in emergency circumstances or otherwise. Energy storage can also be optimized through improvements in battery composition, electrolyte application, electrochemical capacitors, and flywheels.

Energy Distribution

In conjunction with battery innovation, the US must also develop an efficient system of mass energy distribution. Because renewable energy production is intrinsically variable and location-dependent, energy produced in great quantities in one area may not meet demand more broadly. And wherever renewable supply is inadequate, demand for fossil fuel burning grows. High voltage electrical wires should be installed to assist in balancing energy distribution from highly variable sources of energy production[12].

SOLUTIONS

High-voltage power lines are needed to bring solar and wind power from the rural regions where resources are most plentiful into the population centers where the most power is consumed.

However, fragmentation among decision makers and stakeholders, limited public acceptance, and significant financial barriers all pose challenges which delay implementation of needed transmission improvements. Private-sector transmission financing is very rare in renewables-heavy regions like Texas and the Midwest, as most of the profits in the electricity sector flow to plant owners that get paid per Megawatt-hour of power generated and distribution utilities that sell that power to end users[13]. An exception to this trend is the vertically integrated utilities of the Southeast, where capital expenditures are incentivized by state-level regulatory agencies that restrict competition and allow the resultant monopoly power providers to set their own rates based on the amount of infrastructure they build[14]. These states have not experienced the same constraints on renewable deployment, and efforts are already underway to identify regions where power line capacity is holding back solar and wind buildout. The promotion of green banks capable of lending to private transmission developers and negotiating grid maintenance fees for generators or customers could remove one of the primary barriers to adding more renewable energy.

The utilization of high voltage lines also calls focus to a broader issue: determining the correct balance in deployment of centralized and distributed energy grids. Centralized energy generally refers to large-scale power generators (or energy storage) connected to the transmission grid: coal or natural gas plants, wind farms, solar fields, and grid-scale battery stacks. Distributed energy consists of anything that generates, stores, or manages electricity on distribution grids: rooftop solar panels, ground-mounted "community solar" arrays, consumer batteries, electric vehicles, and building energy management software[15].

While centralized systems are typically more reliable and easily scaled, they are extremely prone to weather related events and in the case of solar energy, require a large amount of land to generate the necessary power[16]. Distributed grids are costly and face technical challenges, but carry environmental, safety, efficiency, and security benefits[17]. The question remains how central and distributed grids will play a role in the future of the US energy grid. There is no one size fits all solution, and further analysis of supply and demand profiles will be required in order to design optimal solutions at the local, regional, and national level.

One distributed path forward is with Distributed Energy Resources (DER). DERs are small and somewhat more expensive than their utility-scale power plant counterparts, but by breaking the grid down into community-level components, they are an extremely valuable tool for climate resiliency and climate justice. Accelerating DER deployment will allow grid operators to manage not only how much power is flowing to customers from centralized power plants, but also connect directly with residences to make sure that energy services are calibrated to customer needs. A green bank can help finance distributed resources both for individual homeowners and for entire communities in aggregate. This increase in access to capital will both allow disadvantaged communities to reap the benefits of clean electricity, both by selling excess energy back to the grid and establishing resilience against grid-wide disruptions like weather-related power outages. It will also reduce the energy supply burden on utility providers, which will make it easier to shut down expensive fossil plants[18].

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SOLUTIONS

iv. CARBON SEQUESTRATION TECHNOLOGIES

Carbon sequestration technologies trap carbon before it is released into the atmosphere and will be critical in decarbonizing the energy sector. Emerging technologies, including Carbon Capture and Storage (CCS), Biochar, and Direct Air Capture (DAC)[19] will allow existing natural gas plants to capture their emissions and bury them back underground, essentially turning natural gas into a renewable resource. A green accelerator can help these technologies climb the learning curve, which will cause costs to decline as developers, suppliers, and construction engineers learn the best methods to build projects cheaper and faster.

However, this technology, and especially DAC, is currently too expensive to capture at a relevant scale[20]. In 2011, it cost around $600 to capture a ton of carbon. By 2018, it cost around $94-$232 to capture the same amount. The World Resources Institute estimates there will need to be $150 million per year in the next decade and another $483 million per year in tax credits to allow DAC to put us on track to reduction goals[21].

Due to these high upfront costs, this area has not received consistent interest from investors. Post-combustion carbon capture requires a breakthrough in the ability to capture small amounts of carbon dioxide in large quantities of nitrogen. This may increase the cost of electricity for a new pulverized coal plant by up to 80 percent and result in a 20 to 30 percent decrease in efficiency due to parasitic energy requirements[22]. Pre-combustion carbon sequestration requires the oxidation of the burning source through high temperatures and pressures, creating a syngas that contains carbon dioxide. This has a cost of 60 dollars per ton but due to being a relatively new area, numerous potential innovations may lower costs[23].

Another issue is that these machines require huge quantities of energy, specifically heat and electricity, to function. In order to bring DAC to a national scale and capture billions of tons of CO_2 per year, it would require 10% of the U.S. current energy consumption. An additional issue is the lack of a negative emissions market. Companies that use DAC have no financial incentive to store the CO_2 they capture, and instead are using the CO_2 to make synthetic fuel. While DAC has a long way to go in reaching its potential, the Accelerator can influence market dynamics through capital investment.

SOLUTIONS

v. STANDARDS AND PRIORITIES

The central aim of the Accelerator will be the promotion of projects which reduce the emission of dangerous pollutants. In order to maximize the reduction of emissions for each dollar deployed, the Accelerator will incorporate a finance and investment division tasked with managing the financial activities of the Accelerator. Any project undertaken by the Accelerator must additionally be approved by both the audit and risk management committees, each composed of experts in associated fields, to prevent potential financial and environmental missteps.

In order to minimize partisan conflict, the first three members of the Accelerator's board of directors will be appointed by the President and confirmed with the advice and consent of the Senate. Of these three founding members, each is required to belong to a different political party or ideological background. These three appointed committee members will unanimously select the remaining four members.

While emissions can be restricted through a variety of means and unifying metrics for success are difficult to establish, the connective considerations for all investment are human wellbeing and ecological integrity. Therefore, the success of a project will be measured not only by absolute reductions in polluting activity, but by improvements to environmental and human health.

The investment activities of the Accelerator will also be guided by an explicit set of commitments to vulnerable communities. It will prioritize projects which promote equity, especially with regard to low-income communities and communities of color. The Accelerator will identify those communities most directly affected by climate change through examination of demographic and environmental data and ensure that 40 percent of its investment is directed towards projects in these communities.

H.R. 806 also addresses the rights and wellbeing of American workers engaged in associated projects. The Accelerator's advisory committee is required to include at least 2 members from the labor community to ensure adequate representation in project selection and management. The bill further mandates that laborers involved with projects directly financed by the Accelerator must be paid a reasonable wage that is comparable to similar projects in the region. H.R.806 includes a project labor agreement requirement for all financed projects with capital expenditures in excess of $99,999,999, which may incidentally bolster labor agreements in nearby projects.

In recognition of the fact that a transition towards a low emissions economy will necessarily undermine employment in traditional energy industries, the Accelerator will also provide material support to transition-impacted communities and ultimately aim to foster new employment associated with the low emissions energy sector.

MEASUREMENT OF SUCCESS

Measuring the success of implementation of renewable energy technologies such as solar and wind, microgrids, and renewable energy transmission is necessary to ensure the accelerator is maximizing emissions reductions for every dollar spent and that all investments are utilized judiciously. Key metrics to track the increase in renewable energy share of domestic power generation as a result of the Accelerator include the capacity generated by projects deployed and the amount of carbon emissions reduced.

i. SCIENTIFIC INDICATORS OF SUCCESS

The primary indicator of success for H.R. 806 is whether it can bolster the deployment of the technologies described above. As traditional energy systems are phased out, the U.S. is likely to experience an associated reduction in greenhouse gas emissions. In order to assess these efforts, solar energy, wind energy, high voltage transmission lines from source to settlements, and microgrids implementation have to be measured. While the scope of H.R. 806 is broad in terms of project types it will fund, tracking the implementation of vital technologies will determine its success. Total greenhouse gas emissions reductions must also be measured.

Solar and Wind Energy:

Solar energy has the highest potential to provide clean and reliable energy[24] and is already more economical than fossil fuels[25]. Solar power has exhibited a 42% average annual growth rate and since 2013, and has ranked in the top two kinds of energy in terms of capacity added to the U.S. electrical grid, total, over the last decade[26]. There is currently 100 gigawatts of solar capacity installed in the United States, enough to power 18.6 million homes[27]. Furthermore, there are economic benefits to solar energy. As of 2020, more than 230,000 Americans worked in the industry, and in 2019, the solar industry generated more than $25 billion of private investment in the economy[28]. The growth in solar is led by the decreasing costs associated with the PV system. Between 2010 and 2020, the price per watt has dropped from $5.79/watt to $1.25/watt[29]. The accelerator should continue to collect data on the amount of solar energy produced and the economic impact of the industry specific to the projects the accelerator funds.

Wind energy scaled most rapidly, thereby making it one of the most widely used, economical, and domestically generated renewable energy options. Its estimated cost is only $0.01-$0.02 per kilowatt hour, accounting for the production tax credit[30]. Though wind energy will be surpassed by solar energy production in 2040, wind will be a substantial portion of renewable energy generation until then[31]. In the last decade, wind energy generation has tripled in the Midwest, largely due to the decline in construction costs for wind farms and renewable portfolio standards. Renewable portfolio standards are state level policy incentives to increase the production of renewable generated electricity. While 12 states have yet to enact such standards, as the Accelerator takes on the initiative of investing in initial capital costs of renewables, more states in the South Atlantic region of the country can learn from the success of the Midwest. All the strides in generation translate to a variety of economic opportunities. The wind sector amounts to over 100,000 jobs with potential to grow to 600,000 by 2050[32]. Farmers can rent land on their agricultural operations to wind farms, which has the double benefit of reducing land cover change and adding revenue streams for farmers. Likewise, new projects in the wind sector account for $10 billion in annual investments[33].

MEASUREMENT OF SUCCESS

The Accelerator must measure the gigawatts of solar and wind capacity installed annually across regions in the U.S. where renewable energy generation can improve community resilience. Further, the costs per watt will be important to monitor and ensure the technology is becoming ever more affordable and efficient. Lastly, monitoring jobs created in the industry, jobs replaced from the coal sector and in coal-dependent communities, as well as the amount of private investment the accelerator inspires, will provide valuable insights into the Accelerator's impact. Year over year, these metrics can be cross referenced with Energy Information Administration's projections to understand whether the accelerator is causing a steeper increase in renewable energy projects, jobs, and investments.

Renewable energy transmission:

The Department of Energy, Office of Electricity, implemented a Transmission Reliability Program to develop technologies to create a resilient and secure electric grid, while still cutting electricity costs and ensuring the integration of renewable energy. One of the goals of the program is to increase renewable energy, storage capacity, and distributed energy resources aggregation[34]. Transmission planning and operations must also be aligned with future decarbonization planning and infrastructure[35]. Estimating costs associated with renewable energy transmission is difficult, as investments create system-wide impacts, so it is difficult to attribute specific investment to any particular generation. With that said, maximizing renewable energy generation while minimizing the distance between generation and load centers is a key priority[36]. In order to measure success as it relates to renewable energy transmission, the accelerator should look at costs associated with energy transmission as well as distance travelled between generation and load center.

Microgrids:

As DERs grow, the corresponding delivery infrastructures will become increasingly important. Microgrids strengthen the resilience and expand the coverage of the power grid, especially those with renewable energy supplies[37]. By establishing the networks and marketplaces for distributed energy generation and storage, microgrids reduce grid failures, enfranchise DER producers, increase energy efficiency, and mitigate power costs to users[38]. In an event of complete loss in one energy source, traditional providers are incentivized to prioritize privileged areas with timely maintenance and repairs over environmental justice communities. In such an event, microgrids can continuously supply electricity end-to-end[39]. As such, microgrids deployments and participation are potential indicators of renewable energy resilience and availability in underserved and rural areas. Possible metrics include the number of microgrid users connected to the grid (partially or fully), coverage area, energy outage frequency, and end-user power costs.

Greenhouse gas and particulate matter emissions:

In order to assure the increase in renewable energy, clean transportation, and low carbon agricultural and industrial practices are continually improving, greenhouse gas and particulate emissions should be measured. Greenhouse gas emissions are measured in megatons of carbon dioxide, or equivalents of carbon dioxide for other gases[40]. Particulate emissions are measured in both particle concentration and particle size[41]. The emissions for greenhouse gases and particulate matter should be measured by specific investment projects. There should be a particular focus on the difference between EIA projected emissions and actual emissions post-H.R. 806 implementation.

MEASUREMENT OF SUCCESS

ii. DATA COLLECTION CHALLENGES

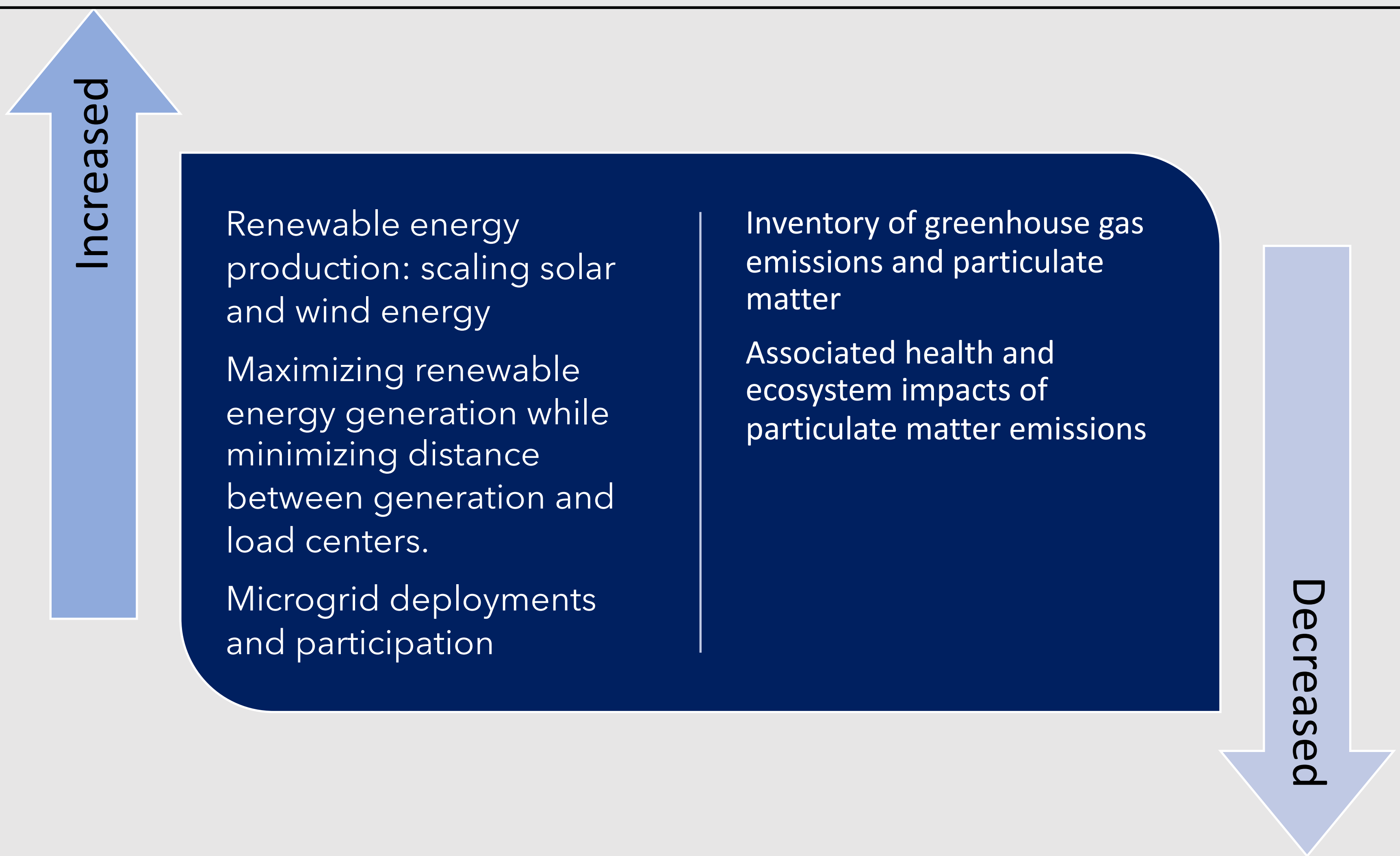
Political and Financial Incentives to Distort and Misreport:

Projects managers and technology providers have incentives to inflate the benefits of their products and services while underplaying the costs and risks. Data collection from green bank investment targets may face similar challenges to data collection from any private and public company. Private companies particularly do not have the rigorous filing requirements of public companies, and may delay or conceal crucial data required for H.R. 806 measurements. In addition to the bill's reliance on faithful reporting of its subjects, H.R. 806 is also dependent on the fidelity of reporting by its division members. Green Bank agents, for personal or political reasons, may delay or alter accurate information. Potential ways of surmounting these challenges include delineating report requirements prior to investment as well as intra-agency callpoints.

Scale and Complexity of Microgrids and the Corresponding Cost of Data Collection:

Unlike a centralized grid, whose fluxes are predictable based on temporal trend of demands, microgrids operate with many more parameters. Whereas centralized grids have unidirectional transmission from sources to users with standardized equipment, microgrids implement bidirectional power transmission with various standards due to the relatively young age of industry players and technologies. Furthermore, local and provincial regulations vary across regions, and can drastically influence the microgrid management system. As such, a nationwide measurement may prove difficult, as the data from regional grids must be standardized and compiled. Furthermore, during an energy shortage, individual power and storage providers may elect to isolate from the grid, potentially leaving other users without power. Different mandates exist for individual players' participation, so the reliability in EJ communities is also difficult to audit.

Figure 5 | Upscaling renewable energy and reducing emissions will define success



MEASUREMENT OF SUCCESS

Transportability of GHG and of Particulate Pollutants:

The exact measurement of these gases and pollutants are influenced by specific project goals, the project type, data availability, and staff capacity. Emissions are also easily transported across large geographic areas, making the measurement from specific projects difficult. Since the Accelerator is concerned with investment in a variety of green projects, assessing greenhouse gas emissions requires an array of different methods to estimate emissions reductions. While all projects will result in GHG and particulate matter reductions, they may aim to do so by different means. Each approach will require metrics for success that match the activity of the project and the values of the community. In the implementation phase, the Board of Directors must explicitly detail data collection standards to align priorities and processes to avoid discordant methodologies. Additionally, in the case of smaller projects with shorter institutional histories of sustainability initiatives, they may opt to take inventory of GHG and particulate matter emissions by using national statistics. While this may be the most efficient way for limited staff to meet key deadlines, accuracy is sacrificed[42].

CONCLUSION

The Clean Energy and Sustainability Accelerator Act represents an opportunity to propel the U.S. economy into a cleaner, more efficient, more stable energy future. The Accelerator will combat the emission of greenhouse gases and other dangerous chemical pollutants through the rapid deployment of mature energy technologies and the scaling of new energy technologies. By capitalizing on existing market trends towards low- and zero- emissions energy production and sustainable infrastructure development, the proposed Act will curb the effects of climate change.

The success of this legislation will be judged by an array of quantitative variables including the efficiency of financial investment, the rate of technological deployment, and the total reduction in emissions associated with Accelerator projects. The Accelerator will also be guided by an explicit commitment to the wellbeing of marginalized and climate-impacted communities: A significant portion of associated investment will be targeted towards projects bolstering the public health, economic prosperity, and climate resiliency of these communities.

The research presented in this report highlights the necessity of action with regard to emissions reductions, delineates the financial tools at the Accelerator’s disposal, and defines the technologies most vital in reshaping U.S. energy dynamics. With deliberate action, the Accelerator will build a green economy supported by an integrated and sustainable energy system.

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