

SAYING THE QUIET PART OUT



QUIET CLIMATE POLICY IN A POST-COVID WORLD

Dan Blaustein-Rejto | Kenton de Kirby | Caroline Grunewald

Zeke Hausfather | Jameson McBride | Ted Nordhaus | Erik Olson | Saloni Shah

Alex Smith | Alex Trembath | Seaver Wang

EXECUTIVE SUMMARY

Historically, the US government has accelerated decarbonization through strategic investments in technology and infrastructure. Decarbonization of the American economy has depended upon the increasing affordability and scalability of lower-carbon alternatives to incumbent technologies: nuclear power plants, shale gas unlocked by the fracking revolution, solar photovoltaic and onshore wind plants, lithium-ion batteries, and biotechnology and other innovations that have improved the productivity of American agriculture. These were all enabled by decades of sustained, technology-specific research, development, demonstration, and deployment efforts made by the federal and state governments.

This is the essence of “quiet climate policy.” In this report, as elsewhere, we have referred to climate policy as “quiet” if it swims with the tide of existing sociopolitical institutions and economic growth, if it uses technology and infrastructure as its main lever, and if it disrupts, rather than exploits, political partisanship. Quiet climate policy contrasts with the increasingly polarizing visions of climate action emphasized in dominant debates over US climate politics.

Like the popular, enduring policy regimes that have driven innovation in low-carbon technologies for decades, the policies and investments detailed in this report have the potential to drive real and disruptive technological transitions that build and lock in lower-carbon energy, transportation, and agricultural systems.

What makes this moment in American politics unique is the eagerness of the federal government — in the wake of the COVID-19 pandemic — to support the economy by committing potentially unprecedented resources towards science, RD&D, and infrastructure. These resources can, and should be put toward low-carbon technologies and systems across all sectors of the American economy.

The policy recommendations in this report are the summation of the Breakthrough Institute’s COVID-19 recovery and stimulus proposals released over the course of 2020. In late December 2020, Congress passed, and President Trump signed, the \$1.4 trillion fiscal 2021 appropriations bill — which earmarked substantial funding for clean energy R&D, advancing many of the goals, if not always the specifics, of Breakthrough’s recommendations. This bill’s passage during a moment of historic partisan conflict is a potent signal of the virtue of quiet climate policy — its potential to simultaneously reduce the political polarization of climate change and advance the most important means of addressing it. The recommendations in this report offer abundant opportunities for quiet climate policy in the coming years.

ENERGY

In responding to the economic and public health crises brought on by the COVID-19 pandemic, policymakers have a unique opportunity to reset the US economy in a manner that ensures the US workforce is at the forefront of the global transition to a low-carbon economy. Despite the polarized political climate, there are many bipartisan proposals for robust and broad federal investment in energy and related infrastructure. Altogether, the energy policies and initiatives included here amount to roughly \$200 billion in federal spending and could help support as many as 9 million American jobs.

Energy Innovation: A \$68 billion investment in energy innovation — in nuclear, geothermal, carbon removal, and energy storage — could create over 600,000 jobs.

Grid Modernization: The US electrical grid is a vital, expansive, and often overlooked piece of infrastructure. The current economic crisis presents an opportunity for the federal government to truly modernize the US grid, allowing it to support a larger share of renewable energy and enabling the electrification of other sectors. The creation of a “supergrid” would cost \$80 billion *and* create 1.5 million jobs.

Clean Energy Subsidy Reform: Tax credits for wind and solar have been effective in growing these nascent industries and reducing costs. The sunset of the wind and solar tax credits should be delayed to the end of calendar year 2022. After that, however, new tax credits for clean energy should be introduced for technologies that are at an earlier stage of development, such as geothermal, advanced nuclear, and offshore wind.

TRANSPORTATION

Transportation and transportation-related industries employ over 13.3 million people, accounting for 9.1% of American workforce, and represents one of the largest sources of emissions in the US. The federal government should make robust investments in transportation infrastructure, including electric vehicle (EV) charging stations and America’s ports and airports.

EV Charging Infrastructure: Despite the economic impact of the pandemic, EVs are expected to continue growing their share of the consumer vehicle market, but this growth is threatened by a lack of charging infrastructure. In the US, there is an anticipated need for 9.6 million EV chargers by 2030, with only 84,000 available as of July 2020. A federal investment of \$5 billion

in EV charging stations — for highways, workplaces, and urban and suburban streets — would support approximately 65,000 jobs in the near-term, while realizing valuable environmental and public health benefits, particularly in historically disadvantaged communities.

Support for Ports and Airports: The ongoing COVID-19 crisis is also hurting the US air travel and marine shipping sectors, which are already threatened by climate change and insufficient funding for needed infrastructure. Federal support for these sectors as part of economic recovery efforts offers synergistic opportunities to promote near-term economic activity and environmental improvements while modernizing America's international gateways for the challenges of the future. Total federal spending on ports and airport infrastructure of \$20.62 billion could generate 133,000 direct and indirect jobs.

AGRICULTURE

Rural areas are especially vulnerable to the COVID-19-induced economic crisis and will likely have the hardest time bouncing back. The federal government should consider significant investments in agricultural innovation, the struggling US dairy sector, and agricultural conservation and efficiency programs — all of which offer valuable climate co-benefits.

Agricultural Innovation: American agricultural innovation, which generates tens of thousands of jobs, is threatened by the economic downturn and longstanding public underinvestment in research and development. But research labs and companies developing novel crop varieties, fertilizers, livestock feeds, alternative proteins, and other technologies are also essential to mitigating climate change and ensuring American leadership in emerging industries. Government support for basic and applied research efforts and early-stage startups at risk of failure would accelerate innovation, protect existing jobs, and lead to new job growth.

- \$300 million for ongoing publicly funded R&D to cover COVID-related costs: 3,600+ jobs
- \$9.4 billion to cover the agricultural R&D facility maintenance backlog: 145,600+ jobs
- \$190 million for new interagency research initiatives: 3,700+ jobs
- \$400 million for mission-driven research at AGARDA: 4,900 jobs
- \$74 million to incentivize private sector R&D through FFAR and SBIR: 650+ jobs
- \$13.3 million for federal loan guarantees to emerging agricultural industries: 2,200+ jobs

Support for US Dairy: The US dairy industry is another crucial candidate for Green stimulus. It has struggled with falling demand and low and volatile prices for decades, and in 2019, the US lost around 9% of its dairy farms. Now, the COVID-19 pandemic has intensified the sector's economic hardships. To make US dairy farms economically and environmentally sustainable over the long term, the federal government should incentivize exports, create a supply management program, facilitate dairy farm diversification, and increase adoption of financially and environmentally beneficial manure management technology and practices.

Agricultural Conservation Programs: Investment in agriculture conservation and efficiency programs is another opportunity to immediately relieve economic hardship while making US farmers more productive, environmentally efficient, and internationally competitive. The Conservation Stewardship Program (CSP) and the Environmental Quality Incentives Program (EQIP) support producers and provide critical resources to address agricultural pollution and environmental impacts. But funding has fallen since 2018, leaving enough money for only about a quarter of applications. Doubling EQIP and maintaining CSP funding through 2023 — and creating a one-time farm machinery rebate system — would cost \$6.35 billion and create nearly 100,000 jobs.

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INTRODUCTION

Historically, the US government has accelerated decarbonization through strategic investments in technology and infrastructure. Decarbonization of the American economy has depended upon the increasing affordability and scalability of lower-carbon alternatives to incumbent technologies: nuclear power plants, shale gas unlocked by the fracking revolution, solar photovoltaic and onshore wind plants, lithium-ion batteries, and biotechnology and other innovations that have improved the productivity of American agriculture. These were all enabled by decades of sustained, technology-specific research, development, demonstration, and deployment efforts made by the federal and state governments.

This is the essence of “quiet climate policy.” In this report as elsewhere, we have referred to climate policy as “quiet” if it swims with the tide of existing sociopolitical institutions and economic growth, if it uses technology and infrastructure as its main lever, and if it disrupts, rather than exploits, political partisanship. Like the popular, enduring policy regimes that have driven innovation in low-carbon technologies for decades, the policies and investments detailed in this report have the potential to drive real and disruptive technological transitions that build and lock in lower-carbon energy, industrial, and agricultural systems.

Quiet climate policy contrasts with the increasingly polarizing visions of climate action emphasized in dominant debates over US climate politics. For a generation, advocates have proposed a variety of sweeping reforms designed to precipitate a steady decline in greenhouse emissions: the Kyoto Protocol and various intergovernmental treaties; a global carbon price, harmonized by border carbon tariff adjustments; the Waxman-Markey cap-and-trade legislation; the Obama Administration EPA’s Clean Power Plan; and, most recently, the Green New Deal.

Over time, these efforts placed more emphasis on the central role of technology and innovation in determining national and global climate outcomes. Yet they were all still largely predicated on top-down emissions control mechanisms. As the Biden administration begins, with the narrowest of Congressional majorities, it has become clear once again that sweeping efforts to build a low-carbon economy by fiat are unlikely to take hold. Rather, successful climate action will hinge primarily — as it always has — on quieter, behind-the-scenes investments that make low-carbon food, energy, and other industrial technologies affordable and scalable.

What makes this moment in American politics unique is the eagerness of the federal government to commit potentially unprecedented resources towards science, RD&D, and infrastructure.

In the wake of the COVID-19 pandemic, trillions of dollars may be available for relief, recovery, stimulus, and reinvestment in the American economy. These resources can and should be used to accelerate innovation, deployment, and infrastructural investment in low-carbon technologies and systems across all sectors of the American economy.

It is time, so to speak, to say the quiet part loud.

In this report we detail over \$250 billion in such investments, from America's electric grid to its ports and airports, from nascent charging infrastructure to innovative dairy and alternative protein technologies. The policy recommendations in this report are the summation of the Breakthrough Institute's COVID-19 recovery and stimulus proposals released over the course of 2020. In late December 2020, Congress passed, and President Trump signed, the \$1.4 trillion fiscal 2021 appropriations bill — which earmarked substantial funding for clean energy R&D, advancing many of the goals, if not always the specifics, of Breakthrough's recommendations. This bill's passage during a moment of historic partisan conflict is a potent signal of the virtue of quiet climate policy — its potential to simultaneously reduce the political polarization of climate change and advance the most important means of addressing it. The recommendations in this report offer abundant opportunities for quiet climate policy in the coming years.

In the power sector, policymakers have a unique opportunity to reset the US economy in a manner that ensures the US workforce is at the forefront of the global transition to a low-carbon economy, enhancing the international competitiveness of US firms and goods while also producing knock-on benefits for other American industries. Despite the polarized political climate, there are many bipartisan proposals for robust and broad federal investment in energy and related infrastructure, including nuclear, geothermal, carbon removal, energy storage, transmission expansion, and energy efficiency.

In the transportation sector, America's electric vehicle industry is proving resilient to the economic downturn, but a key bottleneck in its long-term growth is an egregious lack of charging infrastructure. Federal investment in EV charging stations — for highways, workplaces, and urban and suburban streets — would reduce air pollution, save lives, and lower carbon emissions. Unlike EVs, the pandemic has hit US ports and airports hard, and their ongoing lack of funding for infrastructure upgrades is made worse by the threat of climate change. Federal support for these sectors can promote near-term economic activity while modernizing America's international gateways.

Agricultural areas are especially vulnerable to the COVID-19-induced economic crisis and will likely have the hardest time bouncing back. The federal government should consider significant

investments in agricultural innovation, the struggling US dairy sector, and agricultural conservation and efficiency programs — all of which offer valuable climate co-benefits.

In a nation and a world where fossil fuels still meet the vast majority of energy and industrial demand, the technological obstacles to decarbonization remain high. Quiet climate policy offers the best long-term promise at lowering those obstacles by accelerating innovation in low-carbon technology, infrastructure, and practices. Federal policymakers and other stakeholders should recognize the potential of this moment, and the enduring virtue of climate action built on innovation, growth, and economic opportunity.



ENERGY

In responding to the economic and public health crises brought on by the COVID-19 pandemic, policymakers have a unique opportunity to reset the US economy in a manner that ensures the US workforce is at the forefront of the global transition to a low-carbon economy. Despite the polarized political climate, there are many bipartisan proposals for robust and broad federal investment in energy and related infrastructure. Altogether, the energy policies and initiatives included here amount to roughly \$200 billion in federal spending and could help support as many as 9 million American jobs.¹

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Clean Energy Subsidy Reform: Tax credits for wind and solar have been effective in growing these nascent industries and reducing costs. The sunset of the wind and solar tax credits should be delayed to the end of calendar year 2022. After that, however, new tax credits for clean energy should be introduced for technologies that are at an earlier stage of development, such as geothermal, advanced nuclear, and offshore wind.

ENERGY INNOVATION

Spend: \$68 billion

Job creation: 600,000+ jobs

In responding to the economic and public health crisis brought on by the COVID-19 pandemic, policymakers have a unique opportunity to reset the US economy in a manner that ensures the US workforce is at the forefront of the global transition to a low-carbon economy.

The United States has historically benefited from its position as a leader in high-technology industries, aided by robust federal support for basic science and applied research. Support for promising emerging technologies that will be key components of low-carbon economies around the world will enhance the international competitiveness of US firms and goods while also producing knock-on benefits for other American industries.

The US high-tech industry, which employed 14.5 million American workers in 2016, provides a disproportionately large benefit to the national economy.² The Bureau of Labor Statistics has tracked consistent additions of 200,000 jobs a year within the technology sector since 2010.³ The sector generates an estimated 6% of national GDP and a quarter of all US exports, with significant follow-on economic benefits that provide diverse employment opportunities, including for Americans without a college education.⁴

By investing in the energy technology sector, the federal government can drive job creation and economic growth, and also support the development of next-generation resources that will enable a more efficient, flexible, and reliable supply of energy throughout the country, insulating the US economy against climate risk and global market shocks. By pursuing a position as a world leader in fields such as grid-scale storage, carbon dioxide removal, advanced nuclear and geothermal power, the United States can position itself to export these technologies to countries around the world, building constructive relationships abroad and fostering development that can provide new markets for American goods and services.

Federal policymakers have developed a host of bipartisan bills that should be front and center in a future stimulus targeted at energy innovation. Bipartisan priorities include carbon removal, energy storage, and sources of clean energy generation such as nuclear and geothermal, which are critical for decarbonizing challenging sectors of the economy and have the potential to jumpstart job growth in the US. Each of these categories has its own set of bills introduced, and most priorities have been combined into the American Energy Innovation Act (AEIA, S.2657).

AEIA combines over 50 individual bills into a comprehensive innovation package, and CBO estimates that implementing those provisions would increase spending by more than \$5 billion over the 2020-2025 period.⁵ AEIA also incorporates the ARPA-E Reauthorization Act of 2019 (H.R.4091, S.2714),⁶ which would boost the spending authorization for the program to \$750 million by fiscal year 2024. ARPA-E is responsible for advancing high-potential energy technologies that are too risky for private sector investment.

In addition to passing new legislation, the federal government should allocate substantial funds to the Department of Energy's Loan Programs Office⁷ (LPO), which is a critical source of funding for the deployment of new and innovative technologies and large-scale energy infrastructure projects in the United States. Currently, LPO has more than \$40 billion in loans and loan guarantees available, and this level of investment could potentially support 580,000 jobs.⁸

NUCLEAR INNOVATION

Nuclear power is America's largest single source of zero-carbon energy. The US nuclear sector provides nearly half a million jobs and contributes an estimated \$60 billion to the US gross domestic product every year.⁹ Furthermore, the US leads the world in the development of advanced nuclear technologies, a potential economic and clean energy powerhouse of the future. There are more than 50 American and Canadian companies and labs working on advanced reactors, which have attracted over \$1.6 billion in private investment.¹⁰

Advanced nuclear innovation has wide-ranging benefits, including to other American high-tech industries by driving research in materials science, nuclear engineering, and additive manufacturing. Further, advanced nuclear technologies possess advantageous applications for national security, as evidenced by ongoing interest in advanced reactor procurement from our Armed Forces.¹¹ Given the size of potential markets for advanced nuclear abroad — the Department of Commerce estimates the international civil nuclear energy industry will be valued at \$740 billion over the next 10 years¹² — the development of an American competitive advantage in advanced nuclear would be a powerful long-term investment in the country's economic future.

The investment needed is significant. A recent Department of Energy (DOE) report estimated that \$10 billion in incentives would be needed to deploy 6 GW of small modular advanced reactor capacity by 2035.¹³ This level of investment could result in the creation of 42,000 jobs, including high-quality engineering and trades employment.¹⁴

Thankfully, nuclear innovation has been a rare source of bipartisan cooperation in recent years. There are many vetted, bipartisan nuclear innovation bills, many of which have been incorporated in AEIA. These bills include the Nuclear Energy Leadership Act (NELA) (H.R.3306, S.903),¹⁵ which provides for deployment of first-of-a-kind advanced reactor designs; the Nuclear Energy Research and Development Act (NERD) (H.R.6097),¹⁶ which strengthens DOE's nuclear R&D programs; the Nuclear Energy Renewal Act (NERA) (S. 2368),¹⁷ which supports the continued operation of America's existing nuclear plants; and the recently introduced American Nuclear Infrastructure Act (ANIA) (S.4897),¹⁸ which streamlines permitting, revitalizes the nuclear supply chain, and supports existing nuclear. These proposals could all receive significant spending and generate significant economic activity. For example, the Congressional Budget Office estimates that implementing NERA would result in spending of \$2.5 billion over the 2020-2024 period and \$4.2 billion after 2024.¹⁹

Furthermore, the nuclear production tax credit should be strengthened to promote the deployment of advanced nuclear reactors. Policymakers should design deployment subsidies to accelerate technological learning and cost reductions in the nuclear industry instead of making big bets on a few large one-off projects. To ensure that the nuclear PTC is directed towards smaller and more innovative reactor projects, a per-reactor cap of 300 MW should be instituted. In return, the 6000 MW total capacity cap should be removed. Providing support to many smaller projects rather than a few large ones should accelerate technological learning and cost reductions.²⁰

Given the long development cycles inherent to the nuclear industry, the advanced nuclear tax credit should be extended as long as possible, perhaps to 2030 or 2040. Long-term policy certainty and stability will encourage potential developers and financiers of advanced nuclear projects.

The current US fleet of nuclear power plants could also benefit from consistent maintenance and upgrades. The government should streamline and expedite license renewals of existing nuclear power plants, including the near-term subsequent license renewal (SLR) petitions at Peach Bottom, Surry, and North Anna stations.²¹ As of October 31, 2019, there were 58 commercially operating nuclear power plants with 96 nuclear reactors in 29 US states.²² In many communities, these power plants are the largest source of revenue and economic activity.

CARBON REMOVAL INNOVATION

Carbon removal technologies will be critical for decarbonizing challenging sectors of the economy, such as the industrial sector. These technologies can help capture carbon dioxide pollution from power plants and industrial processes, and transport them via CO₂ pipelines to permanent storage facilities. In addition to capturing carbon at the source, negative emissions technologies like direct air capture (DAC) can offset emissions sources we are unable to easily decarbonize, such as beef production and air travel. DAC can pull carbon dioxide from the atmosphere and concentrate it, which enables transport and storage. Carbon removal technologies have the potential to support existing industries while also creating new job opportunities. Investing in these technologies should be a priority for federal policymakers.

AEIA would authorize \$600 million for a carbon storage program aimed at the discovery of natural rock formations underground suitable for large-scale carbon sequestration. But the National Academies of Sciences, Engineering, and Medicine (NASEM) recommends far more than that: an \$8.1 to \$10.5 billion of investment over the next one to two decades,²³ which could support over 50,000 jobs in the field of carbon capture, transportation, and storage.²⁴ Relevant vetted, bipartisan legislation includes the Utilizing Significant Emissions with Innovative Technologies (USE IT) Act (H.R.1166, S.383),²⁵ the Fossil Energy Research and Development Act of 2019 (H.R.3607),²⁶ the Enhancing Fossil Fuel Energy Carbon Technology (EFFECT) Act (S.1201),²⁷ and the Launching Energy Advancement and Development through Innovations for Natural Gas (LEADING) Act (H.R.3828, S.1685).²⁸

Beyond market “push” policies to create lower-cost carbon removal technologies, there is a need for expanded market “pull” policies to encourage companies to capture and store carbon. The section 45Q tax credit for captured carbon should be extended through the end of 2030, and the tax credit should be made fully refundable for eligible projects that begin before the end of calendar year 2022.

GEOTHERMAL INNOVATION

Geothermal is a potentially abundant source of clean energy in the US, especially in the West. It is particularly valuable to grid operators because it provides clean power “firmly,” which helps to balance out the variability inherent in wind and solar generation. Geothermal has been underutilized due to high development costs, immature technology, and restricted available resources — currently making up less than 1% of US electricity generation. However, “enhanced”

and “advanced” geothermal, which applies recent innovations in drilling from the oil and gas sector, is feasible in a much broader range of geologic conditions.

The International Renewable Energy Agency (IRENA) estimates that in 2018, the geothermal industry supported 35,000 direct and indirect jobs in the United States.²⁹ But a 2019 DOE report found that geothermal power generation could increase more than 26-fold from today, which has the potential to multiply job opportunities in this field. AEIA authorizes \$165 million annually over five years to research, develop, and demonstrate next generation geothermal technologies, which could support over 3,500 jobs.³⁰ Within AEIA, relevant legislation includes the Advanced Geothermal Innovation Leadership (AGILE) Act of 2019 (S.2657).³¹

ENERGY STORAGE INNOVATION

Long-duration energy storage will enable grid operators to better compensate for the variable nature of wind and solar energy, especially in areas that have poor grid interconnection and lack adequate long-distance transmission. According to the Environmental Defense Fund, from 2015 to 2016, energy storage jobs increased 235% to reach 90,800 jobs, and by 2022, they are projected to increase by over 800%.³²

Relevant legislation includes the bipartisan Better Energy Storage Technology (BEST) Act, which supports grid-scale energy storage in the United States by authorizing \$270 million per year through 2024³³ and could support over 3,000 jobs.³⁴

ELECTRICAL GRID MODERNIZATION

Spend: \$80 billion

Job creation: 1.5 million jobs

Like the transportation system, the US electrical grid is also a vital, expansive, and often overlooked piece of infrastructure, comprising a network of generation sources and transmission and distribution lines that stretch thousands of miles. The current economic crisis presents an opportunity for the federal government to truly modernize the US grid, allowing it to support a larger share of renewable energy *and* enabling the electrification of other sectors.

A significant federal investment in long-distance electric transmission as part of the COVID-19 stimulus would quickly create a great many jobs across a wide geographic area and would magnify the benefit of further investment in clean energy development. A study funded by the DOE's Grid Modernization Initiative found that expansion of transmission capacity would have a clear economic benefit, saving at least \$2.50 for every \$1 spent.³⁵ A study by the Brattle Group found that every \$1 billion invested in transmission per year supports 13,000 full-time equivalent jobs.³⁶

A comprehensive overhaul of the grid would cost an estimated \$350 billion to \$500 billion,³⁷ highlighting the magnitude of the current challenge, but a 2018 study led by NREL demonstrated how the US could build itself a "supergrid" for around \$80 billion. A national transmission expansion would require federal investment and coordination, as it would reach across many state and local jurisdictions. A national supergrid connecting the Eastern, Western, and Texas Interconnections would reduce system costs and regional variability associated with high shares of variable renewables in the generation mix.³⁸

Congress has a variety of available mechanisms at its disposal to accelerate the development of transmission. These include:

- **Designating federal funding for transmission expansion in the Power Marketing Administrations (PMAs).** PMAs are federal agencies in the West and Southeast that transmit and sell power from federally-owned electric generators; their transmission lines already serve more than 40% of the country.³⁹ Past efforts to expand and modernize the PMAs have met criticism for risking higher rates.⁴⁰ However, designated funds from the federal government could enable the expansion of the PMAs while ensuring rate stability. Expanding transmission infrastructure in PMA territory would enable rapid clean energy expansion in rural states and faster decarbonization of the power supply for demand centers. State governments and utilities should support the development of PMA transmission, as many states and utilities have emissions reductions targets. Finally, an expansion of PMA transmission could help identify best practices for grid modernization, which could then be scaled up outside of the PMA territories.
- **Establishing a tax credit for the construction of regionally significant transmission projects.** Tax credits have been successful in incentivizing the development of new energy sources like wind and solar. However, there is currently no federal tax credit for transmission. While FERC guarantees a rate of return on capital for transmission investment, there are still regionally significant transmission projects that should receive an additional incentive to ensure their construction. These regionally significant projects

would help to alleviate grid congestion, create jobs, and stimulate further clean energy development. The Electric Power Infrastructure Improvement Act (S.3107) would establish this tax credit and should be included in the stimulus.⁴¹

- **Reforming and strengthening federal backstop siting authority for projects in transmission corridors.** Historically, siting and approval decisions about transmission projects were made by states. The Energy Policy Act of 2005 (EPAct) gave federal agencies, DOE and FERC, the authority to make siting decisions for transmission projects in key geographical regions if they have stalled in the state approval process. However, subsequent federal court decisions significantly restrained this authority. Congress should restore this mechanism by rewriting the federal backstop authority in accordance with the court decisions by restricting its scope further and requiring it to be used in concordance with regional transmission organizations.⁴²
- **Alleviating regulatory burdens on transmission projects.** Expanding transmission will help accelerate decarbonization, so Congress should except or expedite key transmission projects from environmental regulatory barriers — those with clear potential to enable clean energy deployment and drive emissions reductions. Relevant legislation includes the Interregional Transmission Planning Improvement Act of 2019 (H.R.5511, S.3109).

ENERGY EFFICIENCY

Spend: \$1.4 billion

Job creation: 28,000 jobs

The energy efficiency sector has been growing strongly in recent years, but the economic crisis threatens its viability. In 2019, energy efficiency companies added more jobs than any other part of the energy industry, more than 50,000 positions nationwide.⁴³ Each million-dollar investment in energy efficiency supports approximately 20 jobs.⁴⁴ More than 2 million Americans work for companies that provide energy efficiency services.⁴⁵ Energy efficiency is also widely viewed as one of the most cost-effective measures for reducing marginal emissions, as it often results in net savings for families and firms.

Federal spending is a key driver of the energy efficiency market, particularly through the DOE's Weatherization Loan Program, which received more than \$300 million in this fiscal year. The Weatherization Loan Program was a key component of the DOE's response to the 2008-9 financial crisis, and it directed funding specifically at low-income households and blue-collar workers who could benefit most from the investment. As part of the stimulus response, Congress should further strengthen robust funding for federal efficiency programs like the Weatherization Loan Program, via the Weatherization Enhancement and Local Energy Efficiency Investment and Accountability Act of 2019 (S. 983).⁴⁶ This bill will authorize the appropriation of \$350 million for those activities for each of the fiscal years 2020 through 2024.⁴⁷

CLEAN ENERGY SUBSIDY REFORM

Spend: \$55.5 billion

Job creation: 700,000 jobs

When Congress passed the 2009 stimulus, clean energy investments played a key role in putting Americans back to work.⁴⁸ These upfront investments helped strengthen the foundation of the US wind and solar industries, which in 2018 supported 356,000 jobs. Over the last decade, both sectors have demonstrated promising growth, with wind sector employment growing 8% from 2017 to 2018. Employment of solar panel installation technicians has been projected by the US Bureau of Labor Statistics to grow by 68% between 2018 and 2028. Despite strong growth in recent years, the current economic downturn threatens renewables' continued progress. Clean energy employment has already suffered, with nearly 500,000 clean energy jobs lost since the beginning of the pandemic.⁴⁹

Tax credits for wind and solar have been effective in growing these nascent industries. However, the current structure of the tax credits is ill-suited for an economic crisis. The downturn threatens tax credits because the tax credit mechanism relies on clean energy developers finding "tax equity partners" — generally large financial institutions with large tax liabilities — to take advantage of the credits and finance projects. In a recession, these tax equity markets dry up, which threatens the continued growth of wind and solar. The 2009 stimulus included a provision to make the wind and solar tax credits directly refundable as cash payments, known as the 1603 Program.⁵⁰ This program should be restored for a temporary period during the crisis: all federal tax credits should be made fully refundable for projects that begin before 2022.

Furthermore, many clean energy tax credits are currently set to expire, and some are already winding down. To maintain support for clean energy deployment during the pandemic recovery, the sunset of the wind and solar tax credits should be delayed to the end of calendar year. In 2019, a total of \$55.5 billion was spent in the sector, an increase of 28%.⁵¹ If \$55.5 billion were set aside for directly refundable cash payments, it could support over 700,000 jobs.⁵² As the wind and solar industries restabilize and become cost competitive with other sources of electricity generation, the Investment Tax Credit (ITC) and Production Tax Credit (PTC) for these technologies should sunset, freeing up additional federal funding for new and emerging clean energy technologies that need market support.

In the long term, new tax credits for clean energy should be introduced for technologies that are at an earlier stage of development. These subsidies are most effective when used as a temporary tool in technology innovation policy, not as standalone decarbonization policy.⁵³ Limited federal deployment resources — and the limited availability of tax equity — should be directed at earlier-stage technologies, including offshore wind, enhanced geothermal, advanced nuclear, and carbon removal.

Congress should fully extend the federal renewable production and investment tax credits until the end of 2022. After that, the ITC and PTC should be extended through 2030, but solar and onshore wind projects should no longer be eligible. (Geothermal, offshore wind, and other clean energy technologies would retain their eligibility.) Ideally the sunset of tax credits should be conditioned on the adoption of a technology-neutral deployment policy like a clean electricity standard. Congress should also consider further reforms to federal deployment policy, such as those proposed in the Energy Sector Innovation Credit Act of 2019 (HR. 5523) and the Clean Energy for America Act (S. 1288). That legislation would create deployment incentives that automatically ramp down as the technology gains a foothold in the market.⁵⁴



TRANSPORTATION

Transportation and transportation-related industries employ over 13.3 million people, accounting for 9.1% of American workforce,⁵⁵ and represents one of the largest sources of emissions in the US. The federal government should make robust investments in transportation infrastructure, including electric vehicle (EV) charging stations and America's ports and airports.

EV Charging Infrastructure: Despite the economic impact of the pandemic, EVs are expected to continue growing their share of the consumer vehicle market, but this growth is threatened by a lack of charging infrastructure. In the US, there is an anticipated need for 9.6 million EV chargers by 2030, with only 84,000 available as of July 2020. A federal investment of \$5 billion in EV charging stations — for highways, workplaces, and urban and suburban streets — would support approximately 65,000 jobs in the near-term, while realizing valuable environmental and public health benefits, particularly in historically disadvantaged communities.

Support for Ports and Airports: The ongoing COVID-19 crisis is also hurting the US air travel and marine shipping sectors, which are already threatened by climate change and insufficient funding for needed infrastructure. Federal support for these sectors as part of economic recovery efforts offers synergistic opportunities to promote near-term economic activity and environmental improvements while modernizing America's international gateways for the challenges of the future. Total federal spending on ports and airport infrastructure of \$20.62 billion could generate 133,000 direct and indirect jobs.

ELECTRIC VEHICLE INFRASTRUCTURE

Prior to COVID-19, America was showing early signs of a longer-term shift from fossil-fueled to electric-powered vehicles. Though they account for less than 1% of the current US vehicle market, EVs have grown at an average annual rate of nearly 30% in recent years, while battery and overall EV vehicle prices have fallen steeply.⁵⁶

Although the pandemic took a toll — with losses estimated in the hundreds of billions of dollars^{57,58} — recent EV sales still suggest the industry is on a trajectory of long-term growth. In fact, the pandemic has led some auto companies to accelerate their electrification efforts, using shutdowns to retool production lines and debut new EV models or even committing to full electrification.^{59,60}

However, a key bottleneck in industry growth is the lack of charging infrastructure. With many highways having no chargers at all, consumers face “range anxiety,” which reduces demand.^{61,62} The lack of EV infrastructure in urban and suburban areas is also limiting.⁶³ American homeowners are six times more likely than renters to own an EV due in part to charging availability.⁶⁴ Public street charging construction efforts have failed to address this need because of the litany of local code requirements and land-use conflicts with citizens’ groups over street space. Workplace charging also still greatly lags demand for EVs, and commercial interests do not have the incentives to pay for construction and maintenance of EV charging.

In total, there is an estimated need of 9.6 million charging ports to support the EV fleet by 2030, which is 120 times the number currently available.^{65,66} This infrastructure gap has become so significant that several major electric utilities have united with EV incumbents to specifically advocate for EV friendly policies in addition to many utilities’ calls for faster charging infrastructure development.⁶⁷

Congress has rightfully identified this infrastructure need but has been unable to pass substantial legislation to develop greater access to electric vehicle charging on America’s highways. America’s Transportation Infrastructure Act of 2019 (ATIA, S.2302) attempts to address the lack of demand by providing \$1 billion in grants over five years for EV infrastructure projects along predetermined highway corridors. The bill’s future is uncertain as infrastructure talks in Congress have been stifled. Even if resurrected and passed, it does not go far enough to address the rapidly growing need for EV infrastructure and the sizable policy gap.

Federal investment in EV infrastructure is a promising opportunity for Congress to support economic recovery while combating air pollution and climate change. Air pollution, to which cars are a major contributor, kills an estimated 90,000 Americans per year, disproportionately impacting the poor and communities of color,⁶⁸ and has been found to contribute to COVID-19 mortality as well.^{69,70} The transportation sector is also the largest source of greenhouse gas emissions in the US, at roughly 30% of total emissions, half of which come from passenger vehicles.

HIGHWAY EV INFRASTRUCTURE

Spend: \$2.6 billion

Job creation: 33,800 jobs

The federal government should pass legislation to build out EV charging infrastructure at highway rest stops, which would greatly extend the range EV owners could drive. However, commercial activity at new publicly-owned rest stops was limited by federal law in 1960 in order to protect small businesses in the days of the early interstate system.⁷¹ (Rest stops that predated the law, including many in the East Coast and Midwest, were legacies in and today contain both thriving businesses and EV charging stations.) Congress should lift the ban on commercial activity at rest stops, or alternatively, exempt EV infrastructure specifically from the ban.

By leveraging the extant rest stop infrastructure, the government can circumvent other bureaucratic steps required to conduct the necessary work of scoping, deciding upon, and acquiring land as well as coordinating with private entities to complete construction. These stops are operated and maintained by state governments and many are placed in areas without otherwise existing commercial or private activity to create a dependable network across the US.⁷² By building EV infrastructure at rest stops, a great deal of the location-related burden of infrastructure development is already taken care of, a barrier to public and private EV charging buildouts.⁷³

In addition to the \$1 billion in competitive grants, ATIA allocates to predetermined highway corridors and lifting the ban on EV infrastructure, Congress should allocate \$1.1 billion to expand construction of modern EV fast-charging infrastructure to all of the 2,000 rest stops across the United States. Additionally, Congress should allocate \$1.5 billion over five years to support the ongoing operation and maintenance costs of the infrastructure projects in conjunction with the states' transportation departments responsible for currently maintaining the rest stops.⁷⁴

URBAN, SUBURBAN, AND WORKPLACE EV INFRASTRUCTURE

Spend: \$1.33 billion

Job creation: 17,000 jobs

EV charging infrastructure construction and maintenance is most often charged to states, cities, counties, and towns. Congress should fund development of EV charging stations on public, residential, and workplace curbsides, streets, and parking lots, and it should do so in coordination with other local government entities in order to rapidly distribute funding and provide economic stimulus.

First, the alternative fuel vehicle refueling property tax credit, which expired in 2017, should be made permanent. This tax credit provided \$1,000 for charging equipment installed at a residence and up to \$30,000 for business installations of alternative fuel infrastructure. Making these tax credits permanent would cost approximately \$332 million between 2019 and 2027, which could support as many as 11,000 chargers on corporate property or 332,000 residential EV chargers.⁷⁵ This policy addresses both residential and commercial development of EV infrastructure, partially addressing the general need for EV chargers in essentially all settings and ensuring private projects also receive sustained federal support.

Second, in order to best coordinate action and provide federal stimulus, Congress should develop a new dedicated grant program for the construction of EV charging stations within the DOE's Clean Cities Program,⁷⁶ which is part of the Vehicle Technologies Office. Congress should provide a minimum of \$1 billion in grant funding to be administered over the next 5 years to this grant program. Clean Cities, which encompasses nearly 100 local coalitions and nearly 16,000 stakeholders, focuses on the deployment of cleaner fuels, advanced technology vehicles, and alternative refueling infrastructure and could be leveraged to distribute funding for EV charging station projects that address the growing need in urban and suburban areas.

By taking advantage of already existing programs, Congress could ensure the funding is released more quickly, providing near-term economic stimulus around the nation. This funding would support the construction of as many as 139,000 EV individual chargers nationwide on its own, but also could be leveraged with private and state funding to potentially create many more.⁷⁷

INNOVATION FUNDING AND GENERAL POLICY SUPPORT FOR EV INFRASTRUCTURE

Spend: \$1.06 billion

Job creation: 14,000 jobs

There are several ways Congress can support technological innovation and make EV charging infrastructure more affordable and better functioning, and to generally support EV infrastructure development for highway, urban, suburban, and workplace settings.

First, Congress should authorize robust R&D funding for innovative vehicle technology, including EVs and charging infrastructure, with specific emphasis on reducing the cost of fast charging. Direct current fast chargers (DCFC) use up to 500 volts of direct current to supply 80 miles of range within minutes, and extreme fast chargers (XFC) could fully charge an electric vehicle in under ten minutes, significantly improving convenience of charging EVs for customers and making EVs comparable to internal combustion engine vehicles. However, DOE has found that widespread DCFC and XFC use requires research into better and more affordable batteries and vehicle electrical components able to withstand much higher electrical loads.⁷⁸ Authorizing \$1 billion in DOE funding for research into electrification technology, to be administered over the next five years, will help address challenges of vehicle electrification and fund research in fast charging infrastructure necessary to unlock further vehicle electrification while also improving the EV ownership experience.

Second, Congress should increase annual funding of the Vehicle Technologies Office (VTO) within the DOE's office of Energy Efficiency and Renewable Energy. In January, the DOE announced up to \$133 million in new and innovative advanced vehicle technologies research.⁷⁹ Of this, up to \$36 million was set aside for technology integration — including demonstration projects for EV charging stations. We recommend an additional \$50 million specifically for new and innovative EV charging station demonstration projects.

Finally, Congress should pass the recently introduced Electric Vehicle Mobility Area Planning (EV MAP) Act. This bill allocates \$2 million in annual funding through 2026 “[t]o establish a grant program to map optimal locations for electric vehicle charging stations and the derived demand for electricity, and for other purposes.” Identifying ideal EV charging sites in cities and towns will assist both governments and private entities in prioritizing sites for EV infrastructure development for maximum impact. This in turn will stimulate efficient new construction and economic recovery while also making EV ownership and use more practical — simultaneously bolstering the EV sector and reducing emissions.

CLIMATE AND PUBLIC HEALTH CO-BENEFITS OF EV CHARGING INVESTMENT

Direct support of critical EV infrastructure will create substantial climate and pollution-related co-benefits. Today in America, even electric vehicles powered by the most carbon-intensive energy sources are cleaner than the typical vehicle on the road — producing the same carbon dioxide as an 88 mpg vehicle and no tailpipe air pollution.⁸⁰ While an EV charger does not reduce emissions on its own, it enables low-carbon and low-pollution EVs to play a larger role in the transportation sector.

By helping to reduce air pollution, EV infrastructure would save lives. Replacing all passenger vehicles on the road today with EVs would reduce total US emissions of carbon monoxide and nitrous oxide by roughly 30%. This would prevent an economic loss of nearly \$143 billion by avoiding 15,750 premature deaths,^{81,82} eroding the legacy of systemic environmental racism.

The climate benefits would also be considerable. Replacing all passenger vehicles on the road today with EVs would slash US annual transportation carbon emissions by a whopping 25%.

AIR AND MARINE TRANSPORTATION INFRASTRUCTURE

The COVID-19 outbreak has dealt heavy blows to US airports, ports, and their labor forces. The particularly severe impacts of the pandemic upon American air travel and its workers have made national headlines since the very onset of the crisis,⁸³ with thousands of airport employees and workers in supporting industries having lost jobs.⁸⁴ The pandemic has also subjected American maritime transportation to high unpredictability. Compared to 2019, cargo transiting US ports declined by 12% in February and 18% in March,⁸⁵ and while freight movement rebounded in mid-to-late 2020, the resurgence in the severity of COVID-19 nationwide could subject the industry to a second shock.⁸⁶

These sectors also face the looming threat of climate change, which will precipitate extreme weather and sea level rise. Over the 21st century, port facilities will be increasingly exposed to these threats,^{87,88} which can damage equipment and infrastructure, lower operational efficiency, and reduce the economic competitiveness of US ports.⁸⁹ This is likewise true of airports. Extreme weather can disrupt flight operations and damage runways, terminals, and other infrastructure. For instance, the flooding of all three major New York area airports during Hurricane Sandy⁹⁰

caused 20,000 canceled flights, \$2.2 billion dollars in total damages, and \$200 million dollars in lost airline revenue.⁹¹ And for airports in coastal cities, even modest sea level rise can threaten to flood runways, as twelve major US airports have a runway located less than 3.7 meters above mean sea level.⁹² The need for upgrades to guard against such impacts adds to already acute problems presented by America's increasingly outdated port and airport infrastructure and long backlogs of projects stalled by insufficient federal funding and policy support.

The threat facing these sectors is matched by their centrality to the US economy. Nationally, pre-pandemic, airports generated \$1.1 trillion in economic activity annually and supported nearly 10 million US jobs.⁹³ With roughly a quarter of American yearly imports and exports by value traveling as airborne cargo,⁹⁴ US air transportation also plays a vital role in commerce. Meanwhile, waterborne freight provides essential access to world markets, carrying 75% of internationally traded goods by weight,⁹⁵ by far the largest shares of any mode of freight transportation. Port activity supports almost 31 million US jobs and the port sector represents a total annual economic value of \$5.4 trillion.⁹⁶ Both sectors also anticipate considerable long-term growth. Global freight demand may triple by 2050⁹⁷ and global air passenger ridership could double by 2037, with the US market adding 481 million passengers.⁹⁸

Faced with the threats of the ongoing pandemic, climate change, and aging infrastructure, the aviation and marine shipping sectors represent strong candidates for bipartisan, federally-funded economic recovery efforts. Support for these sectors can reduce the economic fallout of the current crisis by driving job growth across diverse regions of the country in the near-term while also preparing our transportation networks for tomorrow's challenges.

PORT INFRASTRUCTURE AND HARBOR MAINTENANCE

Spend: \$9.37 billion, with \$9.3 billion from already-collected revenue

Job creation: 66,000 jobs⁹⁹

Reform of the Harbor Maintenance Tax (HMT) as implemented by the CARES Act (H.R. 748) represents a commendable initial step in combining economic stimulus with investment in port infrastructure. Lifting the Army Corps of Engineers spending limit on HMT revenue alleviates a key bottleneck, allowing important backlogged shipping channel modernization projects to proceed. Clearing more of the current backlog of \$20 billion dollars' worth¹⁰⁰ of existing, shovel-ready projects will produce much-needed near-term economic activity in American harbors. A logical next step would be the unlocking of the full \$9.3 billion¹⁰¹ currently accumulating

within the HMT trust fund, enabling this already-collected tax revenue to be fully utilized for harbor maintenance. Relevant legislation includes the Water Resources Development Act of 2020 (H.R. 7575)¹⁰² and the Moving Forward Act (H.R. 2).¹⁰³

However, the HMT represents just one of several potential instruments the federal government could leverage to encourage port infrastructure development. A substantial backlog of existing infrastructure projects (\$98 billion total worth¹⁰⁴) have been authorized by Congress through previous iterations of the Water Resources Development Act but lack the needed federal appropriations to proceed.¹⁰⁵ These authorized projects can fill important port infrastructure and climate resiliency needs. For instance, navigation projects to expand shipping channels will improve efficiency and safety for cargo vessels while also providing dredged material that can be utilized to improve coastal protection. Similarly, the US Department of Transportation's (USDOT) Maritime Administration (MARAD)'s Port Infrastructure Development Program (PIRD) was funded at \$293 million in FY2019, only to be lowered to \$225 million for FY2020. Making additional funds available for the PIRD at a level at least consistent with FY2019 support would also drive progress on key projects that US ports have already identified. To further promote resilience, MARAD could particularly encourage grant proposals that defend port infrastructure against storms, winds, and sea level rise, or that accommodate new infrastructure to support low-carbon fuels.

Ultimately, however, promoting climate-resilient port infrastructure will depend upon accurate evaluation of climate risks. A 2008 EPA white paper¹⁰⁶ discussing future climate impacts for US ports identified a strong need for detailed, local-level assessments of vulnerability — a need that has remained unmet to date. Previous studies of the Atlantic¹⁰⁷ and Gulf¹⁰⁸ coasts lack high-resolution projections that could allow US ports to confidently plan. Commissioning a nationwide study specifically focused on ports and waterways by the USDOT Center for Climate Change and Environmental Forecasting in collaboration with the National Oceanic and Atmospheric Administration (NOAA) would vastly improve the ability of ports nationwide — particularly smaller or rural facilities without the resources to independently commission studies — to evaluate adaptation needs.

AIRPORT INFRASTRUCTURE

Spend: \$1 billion

Job creation: 28,000 jobs¹⁰⁹

Unlike the marine transportation sector, airport infrastructure has not yet received any direct support in the federal response to COVID-19. Although the \$10 billion allocated in the CARES Act (H.R. 748) toward airport efforts to contain COVID-19 represented essential assistance that has temporarily safeguarded airport jobs, further potential to provide relief and long-term benefits for the airport sector remains untapped.

Currently, airport infrastructure improvement projects receive funding from two programs administered by the Federal Aviation Administration (FAA). The Airport Improvement Program (AIP) provides federal funds to support airside infrastructure, including runways, taxiways, land purchases, and similar investments. The Passenger Facility Charge (PFC) allows airports to collect up to \$4.50 per passenger — funds that can be used more flexibly to pay for airside projects, terminal and road improvements, and interest on airport bonds — another key element of airport financing.

Raising the PFC cap would greatly increase the financial ability of larger airports to make long-overdue infrastructure upgrades. With many of the most-traveled airports in the US facing acute long-term climate threats, improving their ability to adapt will strongly benefit the nation. The \$4.50 cap on PFCs has not been raised since 2000, with the consequence that airports' infrastructure costs have significantly outgrown their ability to support them with PFC income. Congress has demonstrated bipartisan support for policy to raise the federal cap on PFCs. Relevant legislation includes the Investing in America: Rebuilding America's Airport Infrastructure Act (H.R. 3791).¹¹⁰ Under this or similar legislation, airports could elect to raise PFCs beyond the \$4.50 limit, in exchange for returning and foregoing all AIP support. Consumer research further suggests that increases in the modest charge would have few to no effects on passengers' ticket purchasing decisions.¹¹¹

Legislation to revise the federal limit on PFCs has often been accompanied by proposals to correspondingly decrease AIP funding, but this could disadvantage small, non-hub, and non-primary commercial and general aviation airports that provide important local economic activity and essential services like firefighting, pilot training, and crop management.

Furthermore, annual AIP funding has consistently declined from \$3.7 billion in 2007 to \$3.35 billion today.¹¹² Given our airport network's aging infrastructure and a current environment in

which airports cannot obtain sufficient federal support to meet more than half of their infrastructure needs,¹¹³ provisions in H.R. 3791 and similar legislation that reduce AIP support would be counterproductive.

In fact, supplemental AIP funding represents a powerful lever to drive near-term job creation and economic growth while investing in the long-term future of US air travel. Approval of a one-time additional supplemental AIP fund of \$1 billion, with a minimum of \$500 million designated for priority consideration of small, non-hub, and non-primary airports would bring FY2020 federal AIP support (total: \$4.75 billion) to a level consistent with that funded in FY2007 (inflation-adjusted) while promoting crucial progress on the national backlog of airport infrastructure projects. The \$1 billion supplemental AIP fund would also benefit from requiring grant applications to incorporate detailed planning for energy efficiency and to ensure the resilience of upgraded infrastructure to climate impacts over this century.

Improving the resiliency of US air travel will also involve encouraging innovation in flight operations and services like weather prediction. Investing in research to improve the efficiency of domestic air traffic management and the accuracy of weather forecasting can increase the ability of the US air travel system to respond to disruptions and reduce inefficiencies. Relevant programs include the FAA's Aviation Research Grants Program and the FAA's Center of Excellence for the Partnership to Enhance General Aviation Safety, Accessibility, and Sustainability (PEGASAS).

JOINT POLICIES FOR PORT AND AIRPORT INFRASTRUCTURE

Spend: \$10.25 billion

Job creation: 19,000 jobs¹¹⁴

A number of policies can simultaneously benefit both the airport and marine freight sectors while offering societal benefits. For instance, because ports and airports disproportionately favor diesel-powered equipment,¹¹⁵ retrofitting or replacing such equipment drives economic stimulus while also generating climate and public health-related co-benefits.

The Climate Smart Ports Act, contained within Title V of the Moving Forward Act (H.R. 2),¹¹⁶ would provide \$1 billion in annual funding over ten years for ports to replace outdated diesel-burning equipment, install electric vehicle charging and clean energy infrastructure, and prevent harmful pollutants associated with berthed ships. This legislation would also allocate an additional \$50 million in annual funding for five years to port-related grants managed through the bipartisan Diesel Emissions Reduction Act (DERA), which has provided longstanding support for replacing older airport and port equipment.¹¹⁷

The positive economic and public health impacts of the DERA program make a strong case for the benefits of upgrading port equipment and mitigating port-associated air pollution via the Climate Smart Ports Act. DERA has long been recognized for its support of American businesses and domestic job creation, as cleaner engines, retooling, and alternative vehicles supported by DERA grants are typically provided from American manufacturers.¹¹⁸ DERA assistance carries important follow-on economic and environmental benefits, with the EPA estimating that every \$1 of funding generates \$2 in fuel savings and between \$11 to \$30 in improved public health.¹¹⁹ For these reasons, DERA grants have proven popular, with requests regularly exceeding availability by 7:1 for national grants and by 35:1 for DERA's rebate program.¹²⁰

Efficient and resilient port and airport operations also depend upon interconnections between ship, air, road, and rail infrastructure. Important mechanisms for multimodal transportation infrastructure development include the BUILD grant program and the Transportation Infrastructure Finance and Innovation Act (TIFIA) program. The latter mechanism is of particular importance, focusing upon larger-scale projects that some vulnerable American ports and airports may require to satisfactorily adapt to climate impacts. As TIFA awards are relatively large, they can create significant local economic activity over the multi-year lifespan of the infrastructure improvement project. TIFIA appropriations, set to expire after FY2020, have been extended for an additional year through FY2021.¹²¹ Longer-term extensions of federal support for these programs would further aid investment into robust transportation infrastructure.



AGRICULTURE

Rural areas are especially vulnerable to the COVID-19-induced economic crisis and will likely have the hardest time bouncing back. The federal government should consider significant investments in agricultural innovation, the struggling US dairy sector, and agricultural conservation and efficiency programs — all of which offer valuable climate co-benefits.

Agricultural Innovation: American agricultural innovation, which generates tens of thousands of jobs, is threatened by the economic downturn and longstanding public underinvestment in research and development. But research labs and companies developing novel crop varieties, fertilizers, livestock feeds, alternative proteins, and other technologies are also essential to mitigating climate change and ensuring American leadership in emerging industries. Government support for basic and applied research efforts and early-stage startups at risk of failure would accelerate innovation, protect existing jobs, and lead to new job growth.

- \$300 million for ongoing publicly funded R&D to cover COVID-related costs: 3,600+ jobs
- \$9.4 billion to cover the agricultural R&D facility maintenance backlog: 145,600+ jobs
- \$190 million for new interagency research initiatives: 3,700+ jobs
- \$400 million for mission-driven research at AGARDA: 4,900 jobs
- \$74 million to incentivize private sector R&D through FFAR and SBIR: 650+ jobs
- \$13.3 million for federal loan guarantees to emerging agricultural industries: 2,200+ jobs

Support for US Dairy: The US dairy industry is another crucial candidate for Green stimulus. It has struggled with falling demand and low and volatile prices for decades, and in 2019, the US lost around 9% of its dairy farms. Now, the COVID-19 pandemic has intensified the sector's economic hardships. To make US dairy farms economically and environmentally sustainable over the long term, the federal government should incentivize exports, create a supply management program, facilitate dairy farm diversification, and increase adoption of financially and environmentally beneficial manure management technology and practices.

Agricultural Conservation Programs: Investment in agriculture conservation and efficiency programs is another opportunity to immediately relieve economic hardship while making US farmers more productive, environmentally efficient, and internationally competitive. The Conservation Stewardship Program (CSP) and the Environmental Quality Incentives Program (EQIP) support producers and provide critical resources to address agricultural pollution and environmental impacts. But funding has fallen since 2018, leaving enough money for only about a quarter of applications. Doubling EQIP and maintaining CSP funding through 2023 — and creating a one-time farm machinery rebate system — would cost \$6.35 billion and create nearly 100,000 jobs, while reducing the environmental and climate impacts of agriculture.

AGRICULTURAL INNOVATION

Agricultural research and development (R&D) has improved the productivity, global competitiveness, and environmental sustainability of American farms. Since the 1960s, productivity advances have enabled farmers to reduce land use by 9% and cut the carbon footprint per pound of milk and chicken over 50%.¹²²

Unfortunately, COVID-19 threatens to worsen the ongoing decline in public agricultural R&D in the US. On average, annual funding grew 2% between 1970 and 1995, but has since fallen about 1% annually.¹²³ While privately funded R&D has grown enough to compensate for the decline in public funding, private R&D is not a substitute for public R&D — the private sector focuses on shorter-term, lower-risk R&D and on different topics than the public sector.^{124,125}

The pandemic now threatens private agricultural innovation as well. Some companies have laid off large shares of their employees,^{126,127} and many labs — ranging from those that develop microbe-based fertilizers to those breeding crops to sequester more carbon — have reduced staffing or shut down.¹²⁸ Shortages of research equipment that are also used for healthcare have further delayed research projects. In addition, many innovative companies have lost a key revenue source as food service outlets close or severely decrease sales.

Without a significant public intervention, existing racial disparities in federal R&D funding may also worsen. Research-performing Historically Black Colleges and Universities (HBCUs) account for approximately 6% of all US institutions conducting R&D, but receive 1% of all federal academic R&D support on average, with 88% of HBCUs reporting that their current research spaces are insufficient.^{129,130}

To ensure that promising research efforts, companies, and infant industries do not fail and that the benefits of research are shared equitably, it is critical to increase public R&D funding as well as incentives for private R&D investments.

ECONOMIC AND ENVIRONMENTAL IMPORTANCE OF AGRICULTURAL INNOVATION

Recent years have seen a boom in food and agricultural startups and research contributing to “sustainable intensification” — aiming to raise agricultural productivity while reducing environmental impacts. Particularly promising efforts have developed or seek to develop:

- Crops and livestock varieties that are higher yielding¹³¹ and more resilient to extreme weather.¹³²
- Crop varieties that sequester at least 50% more carbon in soils than current varieties.¹³³
- Microbial seed treatments and soil amendments that can increase yields on the order of 10%,¹³⁴ reduce fertilizer application rates,¹³⁵ and reduce both nitrate leaching and greenhouse gas emissions.¹³⁶
- Fertilizers made from clean energy¹³⁷ and fertilizer products that reduce fertilizer greenhouse gas emissions as much as 44%.¹³⁸
- Alternative proteins such as plant-based and cell-cultured meat that pose less zoonotic disease, antibiotic-resistant bacteria, animal welfare, pollution, and food safety risks than conventional meat products, while also reducing greenhouse gas emissions.¹³⁹
- Cattle feed supplements that could cut US beef and dairy methane emissions as much as 23% and 19%, respectively, while increasing animal yields.¹⁴⁰

Startups working on these and other production-focused technologies attracted over \$1.5 billion in investment in the US in 2019,^{141,142} contributing to the creation of tens of thousands of science and technology jobs related to agriculture and food.¹⁴³ Prior to the spread of COVID-19, the sector was anticipated to continue growing. The agricultural biotechnology market, for instance, was projected to grow about 7-11% annually in coming years,¹⁴⁴ while the precision farming industry was expected to nearly double in size.¹⁴⁵

However, unless R&D funding and support is expanded, labs may need to cancel research projects that could otherwise have given rise to innovative new technologies and companies. In addition, without expanding support for the private sector, including for R&D, companies may shut down and would-be entrepreneurs may not start new businesses. There are several ways the federal government should support agricultural R&D in order to continue rapid innovation and growth in areas with large financial and environmental potential.

PUBLIC RESEARCH CAPACITY EXPANSION

Spend: \$9.7 billion

Job creation: 145,600-146,700 jobs¹⁴⁶

Publicly funded extramural research efforts were hamstrung by stagnant funding levels and deteriorating facilities before the crisis. Without additional funding, COVID-related research delays and shutdowns are further undermining research.

Providing supplemental appropriations of at least \$300 million to USDA research agencies would enable grant and contract-funded researchers to cover current expenses and restart projects. Multi-month lab closures have led to delays and potential cost-overruns in projects with a fixed amount of funding. Supplemental funds should be used to extend grant and contract funding, covering additional personnel and lab costs. Funds should also provide emergency relief to core facilities to maintain base operations, particularly in regions expected to re-open more slowly.¹⁴⁷ This level of funding could support about 3,600-4,700 jobs in research and related roles. Many research efforts, such as those funded by AFRI's Plant and Livestock Production and Protection programs, are also key to enhancing agricultural productivity and environmental sustainability.

The federal government also has an opportunity to immediately appropriate \$9.4 billion to clear the maintenance backlog, including \$8.4 billion¹⁴⁸ for land grant and public university (LGU) agricultural facilities and \$1 billion¹⁴⁹ for Agriculture Research Service (ARS) facilities. These funds should be appropriated as one-time cash infusions earmarked solely as grants for maintenance and facility improvements. For the ARS backlog, Congress can appropriate funds directly to ARS. To fund the LGU backlog, Congress can fund a new competitive grant program at the National Institute of Food and Agriculture under the auspices of the Research Facilities Act, authorized by the 2018 Farm Bill, or through the proposed AG RESEARCH Act (S. 2479, H.R. 6474).^{150,151} Deferring maintenance will undermine research due to building failures, higher operating costs, and disenchantment of researchers, faculty, and students, thus threatening America's position as a world leader in agricultural production and innovation.^{152,153}

Immediately and completely funding the \$9.4 billion maintenance backlogs at land-grant institutions and ARS facilities would create around 142,000 jobs, often in rural and agricultural areas.¹⁵⁴ It would also contribute to productivity growth, enabling farmers to use less land, fertilizer, and fuel while also reducing emissions and sequestering more carbon in soils. For example, by doubling its current funding level, the US federal government could cut global emissions from cropland by 109 millions of metric tons of carbon dioxide equivalent per year (MMT CO₂e/year) by 2050, equivalent to cutting 40% of current emissions from US crop production.¹⁵⁵

NEW INTERAGENCY RESEARCH INITIATIVES

Spend: \$190 million

Job creation: 3,700-4,200 jobs

Developing new R&D initiatives focused on individual technologies would address long-standing research shortfalls, mitigate new COVID-related research slowdowns, and advance long-term sustainable intensification. New R&D efforts should target fields with long-standing research gaps that have been exacerbated recently, and that have high long-term economic and environmental potential.

Increased funding and coordination across several agencies are necessary to effectively fund research in many fields given the wide range of scientific disciplines involved. Many agencies — particularly USDA, DOE, and NSF — fund and conduct active research on sustainable intensification. Coordinated interagency efforts, as the successful National Nanotechnology Initiative has shown, could reduce redundancy, cut costs, and improve agency productivity, while targeting research capacity toward promising industries.¹⁵⁶ New initiatives could include, among others:

- **A \$50 million “Alternative Protein Initiative” to strengthen US leadership in the rapidly growing alternative protein industry that can mitigate environmental and public health impacts from livestock production.** Currently, there is little known public funding other than a \$3.55 million NSF grant to UC Davis for cellular agriculture research.¹⁵⁷ Greater public R&D investment would ensure that nascent US research efforts accelerate, that a large portion of industry job growth occurs in the US, and that farmers who grow crops used in new products benefit. The federal government is uniquely suited to fund pre-competitive, multidisciplinary R&D — and make it open-access unlike private R&D — which is key to the alternative protein sector overcoming its barriers to develop new products while lowering prices. If research efforts and consumer demand continue

growing, the market could grow nearly ten-fold by 2030,^{158,159} generating nearly 200,000 US jobs in food processing, agriculture, and research.^{160,161} Already, the plant-based food industry supports more than 60,000 higher-than-average paying jobs, providing \$3.6 billion in income each year, in at least 35 different states. Meanwhile, cellular agriculture has not even commercialized yet. If a \$50 million US effort had the same economic impact per dollar invested as a recent Canadian R&D effort is projected to have, it would create over 2,000 jobs alone and add nearly \$1.5 billion to the US economy over 10 years.¹⁶²

- **A \$50 million “Cow of the Future Initiative” to establish US leadership in the nascent industry of products that can increase livestock productivity and reduce GHG emissions.** Many of the technologies are still under research, receive little public or private funding, and now are receiving less private funding due to the economic downturn.¹⁶³ Congress has previously appropriated funding for one particular cattle feed supplement — it should dramatically expand funding to explore additional feed and other livestock mitigation technologies. In addition to ensuring this nascent industry survives and substantially expands in the long-term, a dedicated initiative would generate about 600-800 jobs in the near-term.¹⁶⁴
- **A “Soil Science Initiative” to improve agricultural nitrogen efficiency and increase potential of soil carbon sequestration practices.** Current federal funding for soil science remains modest and without clear priorities. In total, the US federal government funds around \$180 million of soil science R&D per year, equivalent to only 0.1% of total US federal R&D spending.¹⁶⁵ To revitalize US agriculture, the federal government should create a research initiative centered solely on soil science R&D, and fund it accordingly. This initiative could work to coordinate priorities across federal agencies and other stakeholders — such as the Tri-Societies, land-grant university research centers, federal laboratories, and producer networks — while funding and advancing R&D programs in-house. Such an initiative should include, but needn’t be limited to:
- **A \$40 million “Agricultural Nitrogen Initiative” to bring down the cost of new technologies that increase crop yields, reduce farmers’ fertilizer costs, and reduce nitrogen pollution.** Despite promising advances in and increasing demand for products that will help farmers cut fertilizer costs and more easily comply with environmental regulations, the fertilizer industry only spends about 0.2% of its \$20.5B revenue on R&D, orders of magnitude less than the seed industry’s 10-20%.¹⁶⁶ Existing federal research funding is minimal and potentially duplicative.¹⁶⁷ For example, NSF, DARPA, and USDA have

funded overlapping research on microbes that can deliver more nutrients to crops, and crops that fix their own nitrogen from the air, among other topics. Increasing annual federal R&D funding to \$40 million, approximately matching current industry spending, would support foundational research in emerging fields. Besides benefits to farmers and the environment, this would generate about 500-600 jobs in the near term¹⁶⁸ and help position the US as a leader in the specialty fertilizer market, which is expected to grow globally by 50% from \$23 billion in 2018 to over \$38 billion in 2026.¹⁶⁹

- **A \$50 million “Enhanced Root Systems Initiative” to enhance crop productivity and soil carbon sequestration.** New research efforts to enhance crop roots, if successful, could increase farmers’ soil quality and sequester hundreds of millions of tons CO₂e, enough to offset the majority of greenhouse gas emissions from US agriculture. A 2019 National Academies of Sciences, Engineering, and Medicine report estimated that \$40 to \$50 million in additional funding is needed annually for approximately 20 years. In addition to establishing the US as a leader in a potentially multi-billion industry, \$50 million in funding would generate about 600-800 jobs in the near-term.¹⁷⁰

MISSION-DRIVEN RESEARCH THROUGH AGARDA

Spend: \$50-400 million, part of or in addition to new interagency initiatives

Job creation: 600-6,300 jobs, part of or in addition to new interagency initiatives

In addition to, or as part of, any large-scale inter-agency R&D initiative, Congress should appropriate at least \$50M for the Agriculture Advanced Research and Development Authority (AGARDA). The 2018 Farm Bill established and authorized up to \$50 million for AGARDA to fund grants and collaborative research between private and public entities, with the goal of spurring long-term, high-risk R&D that the private sector is unlikely to undertake. However, Congress has not yet appropriated any funding for AGARDA.

The success of R&D efforts similar to AGARDA illustrate why a new agency is necessary. The Defense Advanced Research Projects Agency (DARPA) and the Advanced Research Projects Agency-Energy (ARPA-E), after which AGARDA is modeled, have been credited with laying the groundwork for the internet, GPS, systems for advanced nuclear reactors, and other innovative technologies. Like these agencies, AGARDA should be administered to be mission-driven — focused on achieving specific advances that require broader coordination and longer-term support than other agencies can support.¹⁷¹

AGARDA's targets for R&D could include, among others:

- Developing carbon-neutral beef and dairy production systems that achieve cost parity with conventional systems.
- Developing crops that sequester 50% more carbon in the soil.
- Halving the average amount of nitrogen lost through crop nutrient management.
- Achieving price parity between conventional meats and plant-based products developed to be similar in taste, texture, and other characteristics.

To offset the slowdown in research at universities and private labs due to COVID-19 and to stimulate creation of new companies and jobs, Congress should consider providing additional one-time funding on the order of \$400 million for AGARDA. In 2009, in the wake of the financial crisis, Congress appropriated one-time funding of \$400 million to ARPA-E, infusing new funds into the clean energy industry when private capital availability had declined.

Congress could take a similar approach today, but should consider one adjustment: retaining equity in companies that receive particularly large support for R&D. This not only would help the government recoup spending, but also ensure that the public benefits from companies' success.¹⁷²

While the payoff from agricultural research investments today is unpredictable, past experience suggests funding AGARDA would have outsized job-creation benefits. Government investment in mission-oriented innovation increases GDP approximately ten times more than non-R&D government spending, creating about \$9 in GDP per dollar spent.¹⁷³ Ultimately, funding of \$400 million would generate about 4,900-6,300 new jobs for researchers, support staff, suppliers of scientific equipment, and others — a short-term estimate not accounting for the long-run economic benefits from R&D investment.¹⁷⁴

PRIVATE SECTOR RESEARCH INCENTIVES

Spend: \$74 million

Job creation: 650-750 jobs

To further restore and stimulate R&D spending, Congress should also create stronger incentives for the private sector to invest in R&D. Private sector spending on agricultural input R&D typically exceeds public agricultural R&D spending, making it key to spurring innovation that in turn helps achieve many societal goals including agricultural decarbonization.¹⁷⁵

An effective way to incentivize greater private investment would be to authorize additional funding for the Foundation for Food and Agriculture Research (FFAR). FFAR, created in the 2014 Farm Bill, spurs development of public-private partnerships and consortia. By requiring at least a 1-to-1 match for all funding, FFAR leverages substantial non-federal funding — about 1.2 non-federal dollars for every 1 federal dollar — and ensures that R&D activities are commercially relevant.¹⁷⁶ Its funding has spurred the development of four new public-private consortia working on key long-term challenges such as livestock antibiotic use and has supported cutting-edge research demonstrating how to improve crop photosynthesis.¹⁷⁷ While FFAR was authorized \$185 million in the 2018 Farm Bill, many agricultural economists argue that the country should double agricultural R&D funding in general.¹⁷⁸ Doubling FFAR funding would raise its average annual funding from \$37 million to \$74 million, generating 450-600 jobs in the short-term, not including jobs created from increased private sector R&D funding.¹⁷⁹

In addition, doubling funding for food and agriculture companies through the National Food and Agriculture Initiative (NIFA) Small Business Innovation Research (SBIR) program, an increase of \$37 million, would spur innovation and market expansion for the small businesses most impacted by COVID-19. SBIR acts as the federal government's seed fund for technology-intensive companies, providing early-stage grants through NIFA and other R&D agencies to small businesses to conduct R&D that has high potential for commercialization.

SBIR is highly effective in spurring innovation. Across NIFA and the other agencies that provide SBIR grants, grantees file about 10 patents per day,¹⁸⁰ about 70% of projects likely would not have started without SBIR funding,¹⁸¹ and 40-70% of projects reach the market.¹⁸² The programs have a high ROI — upwards of \$19.50 in economic activity per \$1 invested.¹⁸³ There is good reason to increase program funding for all industries given the program's high oversubscription rate — only 17% of Phase I grants are funded for instance. But doubling agriculture-related SBIR funding alone could address the R&D financing gap for nearly 100 startups that might otherwise

shutter,¹⁸⁴ and protect or create about 200 jobs in the near-term.¹⁸⁵ Recently proposed legislation that would increase small business R&D includes the Small Business Innovation Voucher Act (S. 3289, H.R. 5348) and Innovation Centers Acceleration Act (S.4624).

FEDERAL LOAN GUARANTEES TO EMERGING INDUSTRIES

Spend: \$13.3 million

Job creation: 2,200-3,200 jobs

In emerging industries and fields, such as cellular agriculture, companies must create first-of-a-kind pilot and commercial production facilities. The high risk involved can make it difficult to acquire financing. To address this challenge and jumpstart nascent industries, USDA could develop a new loan guarantee program.

Federal loan guarantees help borrowers receive privately financed loans by having the government assume the risk of the borrower's debt obligation. They are particularly effective at increasing the amount of loans given to companies using new technologies, such as many cellular-agriculture startups, which lenders otherwise consider too risky to lend to.¹⁸⁶ By stimulating growth in nascent industries, loan guarantee programs can also have outsized economic impacts. Coming out of the financial crisis of 2008-2009, the DOE guaranteed \$15.7 billion in loans which bridged the financing gap for the first utility-scale solar PV projects, supported 250,000 jobs, attracted \$9.3 billion in private equity, and reduced the cost of renewable electricity generation by about 20%.^{187,188,189}

With a low level of funding, USDA could guarantee enough loans — on the order of \$200 million — to close the financing gap for promising agriculture and food companies aiming to expand. This level of loan could be guaranteed with just \$13.3 million in appropriations, assuming administrative costs and default rates are similar to those of USDA's rural energy loan guarantee program.¹⁹⁰ If guarantees were focused on food manufacturing, for example, the program would generate on the order of 2,200-3,200 jobs in the near-term.¹⁹¹

SUPPORT FOR US DAIRY

Even in the decades leading up to the COVID-19 pandemic, demand for dairy was falling¹⁹² and prices were volatile, often dropping below farmers' costs of production.¹⁹³ The pandemic has exacerbated these hardships. In the spring, farmers were forced to dump excess milk, and as of June, it appeared dairy farmers could face losses of \$8.2 billion.¹⁹⁴ Sales of some dairy products have rebounded, but in the third quarter of 2020, sales of fluid milk and dry skim milk products were down 179 million pounds (1.6%) and 44 million pounds (16.6%) compared to 2019 levels, respectively.¹⁹⁵ Dairy's environmental footprint, which exceeds that of most other foods and beverages,^{196,197} has also hurt the sector by inspiring shifts to plant-based alternatives.

The USDA has responded with four rounds of the Farmers to Families Food Box Program, pledging to purchase \$605 million worth of dairy products in the first and second rounds,^{198,199} and by sending direct aid to dairy farmers through the Coronavirus Food Assistance Program. While welcome, this aid will not make farmers whole or accomplish what decades of support have failed to do. Dairy farmers received \$22.2 billion in direct and indirect subsidies in 2015²⁰⁰ and over \$47 million worth of USDA cheese purchases between 2016 and 2019, and yet farms continued to close.²⁰¹ In 2019 alone, the US lost 3,281, or around 9%, of its dairy farms.²⁰²

Support programs and pandemic aid have prioritized short-term relief over long-term sustainability and have failed to improve dairy's outlook. The following proposals would improve dairy's economic and environmental sustainability, providing a financial life raft to farmers, saving and creating tens of thousands of jobs, minimizing long-term government spending, and cutting greenhouse gas emissions by millions of metric tons of carbon dioxide equivalent (MMT CO₂e).

SUPPLY MANAGEMENT AND EXPORT PROMOTION

Spend: \$2.6 million per year in addition to supply management program costs

Job creation: protect up to around 50,000 jobs per year²⁰³

Export promotion programs grow demand for US dairy products, and a supply management program would stabilize farmgate prices by calibrating production to demand. In the US, export promotion has long been an industry priority, and support for supply management is gaining momentum. In 2019, the Wisconsin Farm Bureau Federation voted to consider a program modeled after Canada's supply management system.²⁰⁴

Congress should consider two actions:

- **Increase MAP and FMD funding (\$2.6 million) to increase international demand:** The US Dairy Export Council, which conducts overseas market development, receives much of its funding from the USDA Foreign Agricultural Service's Market Access Program (MAP) and Foreign Market Development Program (FMD). A total increase of around \$2.6 million for the programs would allow MAP and FMD to increase their US Dairy Export Council contributions by 50%.^{205,206,207}
- **Establish a supply management program to reduce dairy overproduction:** Canada's supply management program sets production quotas for each province,²⁰⁸ allows farmers on provincial marketing boards to negotiate minimum farmgate prices with processors, and imposes high customs tariffs on imports above a certain level.²⁰⁹ As a stopgap while a robust supply management program like Canada's is being developed, the US could pay producers to temporarily reduce production.²¹⁰

The following principles would help supply management and export promotion programs achieve their objectives while also improving overall welfare: 1) use a sliding scale for production permit prices, and reserve a proportion of subsidized quotas for young and disadvantaged farmers; 2) support dairy cooperatives in establishing their own processing facilities, or create recourse and forgivable loan programs for processors²¹¹; 3) redirect funds from the Dairy Product Donation Program (DPDP), which funds government purchases of dairy products for donation to WIC and SNAP; and 4) share agricultural technologies, information, and research funding internationally.

SUPPORT FOR DAIRY FARM DIVERSIFICATION

Spend: around \$525.3 million²¹² in addition to debt forgiveness, debt consolidation, and equipment and cattle sale costs

Job creation: protect up to around 50,000 jobs per year²¹³

Diversification can improve farms' financial viability, and it's especially advantageous for small and mid-sized farms, which, while unable to capitalize on economies of scale, can benefit from economies of scope. Currently, many dairy farmers face financial and informational barriers to diversification.

Congress should consider a number of steps to incentivize new investments and provide technical assistance:

- **Create a dairy farmland protection program (up to \$433.5 million per year²¹⁴):** Funding for easements is scarce, and easements are often only available to farms whose land has high conservation value.²¹⁵ A national conservation easement program that specifically targets dairy farms could be modeled after New York State's Farmland Protection Implementation Grant, which awards easements to dairies that are diversifying their farm operations or otherwise taking steps to improve their financial sustainability. Including Option to Purchase at Agricultural Value (OPAV) restrictions would keep farmland affordable and accessible to new and disadvantaged farmers.
- **Reduce farmer debt²¹⁶:** Senator Gillibrand's Relief for America's Small Farmers Act could serve as a model for Farm Service Agency (FSA) loan forgiveness.^{217,218} Because commercial banks hold over 41% of farm sector debt,²¹⁹ the USDA should also consolidate credit card debt into no- or low-interest FSA loans, contingent upon the adoption of environmentally sustainable practices.
- **Provide grants (\$85.5 million per year²²⁰):** A national grant program for dairy farmers interested in diversifying their farm operations could be modeled after a similar grant program in North Carolina.^{221,222} Alternatively, Congress could direct the USDA to increase funding for the Value-Added Producer Grant Program and to dedicate a portion of that funding to diversifying dairy farms.
- **Create a dairy diversification taskforce (\$6.3 million per year):** Creating a dedicated CTA dairy diversification task force would improve the CTA's capacity to help all interested dairy farms. To finance the task force, Congress should authorize an increase of \$6.3 million, or less than 1%, in CTA funding.²²³

If stranded assets are barriers to diversification, the USDA could establish an equipment buy-back program and a cattle transport program, either establishing a public-private partnership with a livestock transport company or creating a cost-share program.

INCENTIVES FOR BETTER MANURE MANAGEMENT PRACTICES

Spend: \$240+ million annually, averaged over 10 years²²⁴ in addition to costs of R&D funding and clean fuel standards

Job creation: over a thousand temporary and permanent jobs created and saved each year²²⁵

Anaerobic digesters (ADs) convert manure into biogas and digested solids, providing environmental benefits and new sources of revenue. But while over 8,000 US dairy and swine farms could host ADs, there are fewer than 300 on-farm ADs in operation.²²⁶ Low adoption is largely due to high installation and maintenance costs and low natural gas and electricity prices.

Small and tenant farmers are better equipped to adopt alternative manure management practices, such as compost bedded pack barns (the use of composted manure as bedding) and solid separation (the removal of solids, which can be dried and used as compost or bedding, from liquid manure). As with ADs, cost is also a barrier to the adoption of alternative practices.

Congress should consider a number of actions to increase deployment and third-party ownership of anaerobic digesters and increase uptake of alternative manure management practices:

- **Reestablish an investment tax credit for anaerobic digesters (\$14.9 million²²⁷ annual average over 10 years):** Judging from the previous investment tax credit's (ITC) performance, Senators Brown and Roberts' proposed 30% ITC for biogas and nutrient recovery projects could help spur the development of about 35 ADs annually. The ITC would likely spur outside investment and third-party ownership, which has several advantages.²²⁸
- **Create a manure transport program (\$56.1 million per year²²⁹):** Digesters work best on farms with at least 500 cows, and manure transport can be prohibitively expensive.²³⁰ A national manure transport cost-share program would allow small farms to benefit by transporting manure to a nearby digester or participating in a centralized digester cluster. A program in Maryland provides grants covering up to 87.5% of manure transportation and handling costs, or up to \$18 per ton of manure transported.²³¹
- **Invest in AD and biogas R&D:** Insufficient technical and applied research and development is a key barrier to the growth of the biogas industry.²³² Congress should increase funding for AD and biogas R&D. In the long run, these investments will decrease AD and biogas costs²³³ and with them the need for financial incentives. R&D will also position farmers, businesses, and utilities to benefit in the event of stricter fuel standards in the future.

- **Assist states in creating clean fuel standards:** The federal government should award categorical grants to states adopting clean fuel standards that generate credits²³⁴ based on a fuel's carbon intensity or incentivize refineries to continue to decrease their fuel's carbon intensity in some other way.²³⁵ The grants would cover the development and administrative costs of the programs. California's Low Carbon Fuel Standard (LCFS) has incentivized third-party ownership and private investment in the renewable natural gas produced by ADs, and similar clean fuel programs are already being considered in Washington, Colorado, South Dakota, Minnesota, Iowa, and New York State.²³⁶
- **Establish a manure management grant program (\$169.1+ million per year²³⁷):** A program, modeled after California's Alternative Manure Management Program, would award grants for non-digester practices. Rep. Chellie Pingree's Agriculture Resilience Act proposes establishing a national program with \$1 billion in annual funding,²³⁸ but California's program could be scaled up with around \$170 million per year.
- **Increase R&D of alternative manure management practices:** Increased R&D investment would accelerate the development of new manure management innovations and improve the efficiency of existing ones. Over time, R&D investments would decrease the cost of alternative manure management, eventually reducing the need for grants.

ECONOMIC AND ENVIRONMENTAL CO-BENEFITS OF DAIRY SECTOR SUPPORT

The proposals outlined above carry considerable benefits for the economy and the environment, including:

- **Higher and stabilized prices:** Dairy export promotion programs generate over half of annual exports and generate profits for farmers, with benefit-cost-ratios ranging from around 8.5 to 30.1.²³⁹ Global markets, however, are susceptible to variability in demand and prices,²⁴⁰ and a price spike can lead to years of depressed prices if farmers respond by collectively adding too many cows to production.²⁴¹ Supply management would stabilize prices by limiting growth to levels that domestic and international demand can absorb, and it would ensure a fair farmgate price without substantially increasing retail prices. Canada's retail prices are somewhat higher than in the US but comparable to Australia and New Zealand, two major dairy producers.²⁴²

- **Additional revenue sources:** Farm diversification and manure management both provide farmers with additional income sources. Dairy farms can diversify with high-value crops and products like bees,²⁴³ hemp,²⁴⁴ wine grapes, and hazelnut, almond, and walnut trees.²⁴⁵ Additionally, farms practicing alternative manure management can sell compost and compost bedding or boost yields by applying compost to their fields. AD operators can receive money for accepting off-farm waste and selling biogas, electricity, heat, and other byproducts. ADs' economic potential is greater in states with low carbon fuel standards. California's LCFS has added up to \$66 per one thousand cubic feet of Renewable Natural Gas (RNG),²⁴⁶ and in the San Joaquin Valley, LCFS credits can increase the revenue of a standard 2,000 cow farm by 11%.²⁴⁷
- **Reduced costs:** Diversification and manure management practices also help farmers reduce costs. Farmers who diversify with grains, for example, can supplement livestock feeds with home-grown grains and recycle manure by applying it as fertilizer to crop fields. Compost bedding pack barns reduce bedding costs,²⁴⁸ and alternative manure management grants would allow farmers to invest in more efficient equipment and technology and meet air and water regulations more affordably. Agricultural conservation easements produce similar benefits, helping farmers pay off debt and upgrade their operations.²⁴⁹ Finally, farms on which ADs are operated by a third-party can also receive discounted energy rates.
- **Job protection:** In 2019, the US lost 3,281 dairy farms and with them likely around 50,000 jobs.²⁵⁰ By improving dairy farms' financial sustainability, export promotion, supply management, diversification support, and improved manure management would all help to save dairy jobs. And by reducing odors and localized pollution, manure management makes rural communities more desirable places to live and work.
- **Job creation:** Farm diversification and alternative manure management practices tend to be labor intensive. An alternative manure management program would support businesses in the nutrients, manure solids, and energy markets²⁵¹ and would likely create thousands of jobs, including construction and installation jobs for management practices that require new equipment. Increasing the deployment of ADs would create contracting, site work, concrete, plumbing, electrical, permitting, and engineering jobs. In fact, the biogas projects supported just by an ITC could generate up to 825 short-term construction jobs, and up to 54 additional permanent jobs per year.²⁵²

- **Efficient government spending:** With fair and stable farmgate prices, additional revenue, and lower costs, farmers would rely less on costly farm support programs. Diversification, for example, would allow farmers to spread risk across multiple enterprises, thereby reducing reliance on disaster programs.²⁵³ Expanding technical assistance through the dairy diversification taskforce would improve the efficiency of government spending by promoting the success of new ventures. And in the long run, R&D investments could cut the cost of manure management technologies, reducing the need for some of the financial incentives proposed in this report.
- **Climate mitigation:** By boosting economic sustainability, this report's proposals would help prevent farms from being converted into residential and other types of development, mitigating up to 3.4 MMT CO₂e per hectare of prevented land use change.²⁵⁴ This is crucial, since 66% of dairy land is in the path of development.²⁵⁵ Also, because the emissions intensity of US dairy production, in terms of kilograms of CO₂e per kilogram of product, is below the global average,²⁵⁶ expanding exports of US products could shrink dairy's global environmental footprint.

Several of the proposals also tackle greenhouse gas (GHG) emissions more directly: an alternative manure management program would avoid 3.5 MMT CO₂e per year of funding and more with additional funding;²⁵⁷ on average, the AD deployment strategies would mitigate more than 3.6 MMT per year of funding;²⁵⁸ and RNG from AD biogas has a carbon footprint at least 80% lower than gasoline.²⁵⁹ Critics of ADs and clean fuel standards have raised concerns that developing stable RNG markets could have negative environmental consequences by competing with electrification efforts, but policymakers can avoid this tradeoff by prioritizing the use of RNG in sectors that are difficult to electrify and by phasing out the ITC program as AD capital and operation costs decrease.

- **Other Environmental Benefits:** Many diversification options are environmentally efficient — hazelnut trees, for example, don't require irrigation, and their roots prevent erosion, and beekeeping provides essential ecosystem services by supporting local bee populations. Manure management also benefits the environment across several metrics. Both ADs and alternative manure management practices can reduce air and water pollution, protect humans and animals from pathogens, and increase crop yields by converting manure into more accessible forms. ADs can generate additional benefits by accepting food waste. And supply management should eliminate unnecessary water, feed, land use, and GHG impacts by restricting excess supply.

AGRICULTURAL CONSERVATION PROGRAMS

Rural areas in the United States are particularly vulnerable to the economic fallout of the COVID-19 pandemic. As a result of the pandemic, farmers face low prices, shrinking export markets, and labor shortages, placing rural and semi-rural communities in dire straits.²⁶⁰

As part of ongoing efforts to support economic recovery, the US federal government has an opportunity to fund infrastructure and conservation projects that can supply much needed jobs to rural America and help improve the environmental and economic sustainability of American agriculture. One such opportunity is to increase funding for agriculture conservation programs on working lands — namely, the Conservation Stewardship Program (CSP) and the Environmental Quality Incentives Program (EQIP) — and fund efficiency improvements to agricultural machinery. Expanding funding to working land conservation programs and incentivizing the purchase of high tech, efficient equipment would provide short term economic stimulus, improve agricultural efficiency, and reduce environmental and climatic impacts of US agriculture.

EQIP EXPANSION

Total Spend: \$1.75 billion

Job creation: 25,000 jobs

To stimulate economic recovery in rural areas, create jobs in manufacturing, and improve the environmental impact of US agriculture, the US federal government can double funding for EQIP to a total of \$3.5 billion. EQIP is currently funded at \$1.75 billion for fiscal year 2020 but is authorized for increased funding throughout the duration of the 2018 Farm Bill.²⁶¹

As of 2015, EQIP funding only allowed for the acceptance of a quarter of applicants.²⁶² Even with the increased EQIP funding stemming from the 2018 Farm Bill, acceptance rates will remain low, leaving many farmers and producers without the financial ability to adopt cost-saving, efficient, and environmentally-beneficial practices. Doubling funding would increase acceptance rates and fulfillment of already-existing producers' plans to improve conservation and efficiency practices on working lands. Subsequently, many practices supported by EQIP — such as cover cropping — enhance agricultural productivity and improve profitability for farmers, making EQIP both environmentally and economically beneficial for US agriculture.

An increase of \$1.75 billion in funding for EQIP would result in the creation of roughly 25,000 jobs, mainly in on-field agricultural work, installation of conservation practices, and reforestation, but also in manufacturing and supply-chain work for agricultural equipment and products related to EQIP-funded practices.²⁶³

REBATE SYSTEM FOR AGRICULTURAL EFFICIENCY

Total Spend: \$2.6 billion

Job Creation: 49,000 jobs

Increasing technological advances in agriculture have not been well diffused across the country. As of 2013, only about half of producers of major crops used GPS guidance systems, while only around a fifth used variable-rate input applicators.²⁶⁴ Often, the main barrier toward the adoption of more efficient agricultural systems is cost.

To further stimulate the economy while improving the competitiveness, efficiency, and environmental impact of US agriculture, Congress can authorize and fund, at approximately \$2.6 billion, a farm equipment rebate program that would incentivize and partially fund the purchase of high-tech and efficient agricultural equipment that other conservation programs would not otherwise fund or incentivize. This could mirror existing programs in Texas and California aimed at increasing the efficiency of farm fleets, by offering payments to producers upgrading their equipment.^{265,266} These programs have received positive reviews from both farmers and environmentalists, especially for their impact on air quality in agricultural areas.^{267,268} The funding level is based on an expanded version of California's Funding Agricultural Replacement Measures for Emissions Reductions (FARMER) program, which, in 2020, funded \$65 million for agricultural equipment purchases across the state's farms, which make up only 2.7% of total farm acreage in the United States.^{269,270}

The rebate program should require that the equipment being upgraded be in-use at the time of the upgrade, and it should provide greater funding for greater efficiency improvements. This one-time funding could be authorized to NRCS and utilize their existing systems for applications and other processes. The rebate program would cover the cost of equipment like tractors, combines, variable rate applicators, and other large, high-cost equipment for which EQIP normally would not provide funding or cost-sharing. EQIP and other conservation programs tend not to fund or incentivize high-tech adoptions mainly due to cost constraints and existing classification of "conservation" practices. Because of this, rebates distributed by the program would not count toward or be limited by the \$250,000 payment cap that EQIP abides by for existing

funding programs. Instead of using the same cost-sharing breakdown as EQIP, the rebate program can employ a system that provides greater cost-shares for larger efficiency improvements. For example, a fertilizer spreader upgrade that would cut application rates by half would receive a substantially larger rebate than an upgrade that would only cut fertilizer input by a fifth.

A federally funded rebate program could cover great lengths in bringing technological advantages to smaller, family farmers who would otherwise be unable to invest in precision agriculture equipment. In fact, this kind of rebate would disproportionately benefit smaller, disadvantaged farmers, many of whom were already in financial distress prior to the COVID-19 outbreak. An influx of financial support for equipment purchases would provide long-term economic and efficiency benefits that would make those smaller producers both financially and environmentally sustainable.

A \$2.6 billion efficiency rebate program would create roughly 49,000 jobs, many of which would be in equipment manufacturing and agricultural supply chains.^{271,272} On top of the immediate economic benefits, funding the purchase of higher-efficiency equipment would help farmers grow more crops using less inputs, potentially increasing incomes while lowering costs, making small farmers more resilient to economic, environmental, or other shocks.²⁷³

CSP FUNDING MAINTENANCE THROUGH 2023

Total Spend: \$2.0 billion

Job Creation: 24,000 jobs

To further stimulate agricultural economies while supporting the continued use and adoption of environmentally beneficial practices, Congress can maintain CSP funding at the FY2020 level of \$2.2 billion until the next Farm Bill is passed in 2023, which would cost \$2 billion in total over the next 3 years. Along with EQIP, CSP is the major working-land conservation program funded through the USDA. While both CSP and EQIP fund conservation practices, their work is complementary. EQIP's main directive is to fund the installation of environmentally beneficial practices, while CSP promotes and funds the maintenance and continuation of conservation practices over 5- to 10-year contracts.

The 2018 Farm Bill cut long-term funding for CSP, even though CSP could already accept only a small portion of applications due to existing funding constraints — the contract acceptance rate was 27% as of 2015.²⁷⁴ Maintaining 2020 funding levels through 2023 would allow for the continuation of extant contracts while accepting new applicants who would otherwise have been denied.

Maintaining CSP funding at 2020 levels would add around 24,000 jobs between 2021 and 2023.²⁷⁵ Like EQIP, CSP funding would help create jobs in on-field agricultural work, conservation practices, and reforestation, as well as indirect jobs in agricultural supply chains and equipment manufacturing.

ECONOMIC AND ENVIRONMENTAL CO-BENEFITS OF FUNDING AGRICULTURAL CONSERVATION PROGRAMS

Conservation and efficiency are particularly important for environmental impacts. The conservation practices that EQIP and CSP fund — such as cover cropping, nutrient management systems, pasture restoration projects, and forest stand recovery — can reduce agriculture-related pollution and help mitigate climate impacts by reducing emissions and sequestering carbon.²⁷⁶ Widespread adoption of cover cropping, for example, could sequester around 100 MMT CO₂e/year, or almost a fifth of total emissions from US agriculture.²⁷⁷

At the same time, precision agriculture techniques and higher efficiency equipment could reduce agricultural runoff, increase yields, and limit land-use change. Widespread adoption of precision agriculture technologies could reduce emissions by around 30 MMT CO₂e/year, or almost a quarter of all emissions related to fertilizer application.²⁷⁸

Finally, conservation practices have also been shown to improve productivity and resilience, which could help farmers deal with unstable weather conditions, including issues related to flooding or drought.²⁷⁹

Expanding EQIP, establishing a rebate system for the adoption of more efficient technologies, and maintaining funding for CSP would go a long way towards stimulating rural and manufacturing economies and improving the long-term environmental sustainability of US agriculture.

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