Blueprint 2030:

An All-In Climate Strategy for Faster, More Durable Emissions Reductions

AMERICA IS ALL IN

About America Is All In

AMERICA IS ALL IN is the most expansive coalition of leaders ever assembled in support of climate action in the United States. Mobilizing thousands of U.S. cities, states, tribal nations, businesses, schools, and faith, health, and cultural institutions, the coalition is working alongside the federal government to develop a national climate strategy that meets the urgency of the climate crisis, scaling climate action around the country to empower workers and communities, and promoting the leadership of nonfederal actors on the world stage.

Led by Mike Bloomberg, the UN Secretary-General's Special Envoy for Climate Ambition and Solutions, Washington Governor Jay Inslee, Charlotte Mayor Vi Lyles, CommonSpirit Health CEO Lloyd H. Dean and climate champions across the country, the coalition is working to cut U.S. emissions in half by 2030* and reach net zero emissions by 2050, while guarding against the impacts of climate disruption.

* from 2005 levels

COUPLED WITH WHOLE-OF-GOVERNMENT ACTION ON CLIMATE, AMERICA IS ALL IN CHAMPIONS A WHOLE-OF-SOCIETY MOBILIZATION TO DELIVER THE TRANSFORMATIONAL CHANGE THAT SCIENCE DEMANDS, WITH THE GOAL OF A HEALTHY, PROSPEROUS, EQUITABLE, AND SUSTAINABLE FUTURE.

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America Is All In is a broad coalition championing ambitious, whole-of-society climate action in the United States. While this report was prepared on behalf of America Is All In, not all strategies and actions included in the report are endorsed by all members of the coalition.

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Introduction Letter from America Is All In Co-Chairs

September 3, 2021

The Intergovernmental Panel on Climate Change (IPCC) report in August made the urgency of the climate crisis clearer than ever. Never has it been more important for all levels of government and all parts of society to take widespread climate action to avoid even more devastating global consequences, from extreme heat waves to wildfires to floods. While the United States' re-entry into the Paris Agreement and more ambitious national commitment—a new NDC of 50-52% emissions reductions by 2030—both represent important progress, these announcements alone are not enough.

As the co-chairs of America Is All In, the most expansive coalition of climate change leaders in the U.S., we are glad to offer this report that demonstrates not only why an all-of-society approach is crucial to cutting emissions by 50-52% by 2030, but also how it is possible. The report offers a blueprint of critically ambitious actions for national, state, city, business, and civil society leaders to take across key sectors—particularly power, transportation, and buildings. This will be hard work, but the good news is that we know success is possible.

Washington State has enacted a 100% clean electricity standard, as well as an economy-wide, declining cap on climate pollution with a requirement for equitable investments. Charlotte, NC, is working with their utility to support an equitable, low-carbon transition. CommonSpirit Health is reducing energy consumption, increasing renewable energy, and highlighting the health and equity impacts of climate change. Bloomberg LP has committed to net-zero emissions by 2025 and Bloomberg Philanthropies continues to fund work that is advancing ambitious climate action across the U.S. and the world. And we are all working to encourage leaders around the globe to take concrete action as well.

While bottom-up leaders are continuing to drive progress, the federal government has a critical role to play in establishing needed policies and incentives, providing financing for climate-friendly projects, investing in infrastructure, and supporting research and development. These federal actions can reinforce non-federal leadership and promote a positive cycle of growing ambition that accelerates progress.

This report shows how much progress is possible, and now is the time for each of us to take on these ambitious actions. Together, we can meet our climate goals and forge a path to a cleaner, healthier, and more equitable future.

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Preface: A Political Context for this Report

This report provides a blueprint for an all-in, whole-of-society approach to climate change mitigation that combines the unique power and strengths of each part of society to give us the best chance for the rapid, durable, transformative change needed to cut emissions by at least 50 percent by 2030 and set the stage for a fully decarbonized economy well in advance of mid-century.

THE RECENT INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC) HIGHLIGHTS the dire consequences of climate change and the dramatic reductions in greenhouse gas emissions urgently required to limit global warming to 1.5°C.[1] President Biden's commitment to reduce U.S. emissions 50–52 percent below 2005 levels by 2030 represents major progress compared with previous U.S. goals. But considering the new IPCC report, it is vital to recognize that the 50–52 percent goal is only a down-payment that should be accelerated as soon as possible so that the U.S. and other industrial nations achieve net zero climate emissions well before 2050. Indeed, climate security demands that we do everything possible to exceed the 2030 goal and strengthen ambition before 2030 as new opportunities emerge and scale. While challenging, continuing to accelerate progress is not only feasible but has been demonstrated through actions taken across the economy and by all levels of government.[2]

This report provides a blueprint for an all-in, whole-of-society approach to climate change mitigation that combines the unique power and strengths of each part of society to give us the best chance for the rapid, durable, transformative change needed to cut emissions by at least 50 percent by 2030 and set the stage for a fully decarbonized economy well in advance of mid-century.

The past few months demonstrate that the federal government alone will not be sufficient to reliably achieve even the halving of emissions by 2030, and a whole-of-society approach is needed. The administration is achieving substantial progress but is already facing limits. President Biden has vigorously pursued a goal of 80 percent clean electricity by 2030 and 100 percent by 2035, but the Senate filibuster precludes the most reliable strategy to ensure that outcome: setting binding statutory zero-emissions standards. Similarly, the bipartisan infrastructure bill provides only a fraction of the funding for electric vehicle charging networks called for by the administration. Congressional Democrats are moving forward with major climate and clean energy investments through the budget reconciliation process, but the size and fate of that package are uncertain at this writing. And the auto emissions rules announced in August, while a critical step forward, do not fully compensate for the previous administration's rollbacks on clean car progress.

Accelerated leadership from states, cities, businesses, and civil society is needed and can create market pressure for more ambitious federal standards. Major U.S. emissions reduction successes and emerging efforts—tougher vehicle emissions standards in 2009, shifts to renewable power generation driven by state renewable standards and renewable purchase targets, coal plant shut-downs since 2010, and hydrofluorocarbons phase-out legislation in 2020, building decarbonization efforts led by cities—were driven not by federal leadership, but by bottom-up leaders setting the pace.

Building on past momentum and continued climate ambition, leaders outside of Washington can and must continue to set the pace of progress in an all-in national climate strategy. State, tribal, city, and business leaders are best positioned to raise the bar on climate ambition, test new ideas, and move farther and faster than the federal government. Civil society can educate the public on climate change, create demand for new technologies and approaches for reducing emissions and building resilience, help build public support for bold action, and hold other players accountable for their responses.

At the same time, states, cities, and businesses need federal support. Financial barriers can limit the ability of local governments to adopt ambitious climate policies. Unlike the federal government, cities and states must balance their budgets and often have limits on their ability to borrow funds, even when interest rates are at record-low levels. Federal financial support has thus always been critical in infrastructure revolutions—as evidenced with lighthouses and railroads in the 19th century or the Interstate Highway system in the 20th century.

When funds are available, cities and states can create local infrastructure but lack the jurisdiction to create national networks. The lack of public charging networks for drivers who do not have garages at home is a major barrier to high levels of EV sales, and cities and states cannot provide complete networks on their own, because many commuters cross city and state lines. Similarly, when cities in the Midwest sought to obtain low-cost renewable power for their residents, the lack of long-distance transmission connections meant that while such power was available on the national market, it could not be accessed.

The federal government must leverage bottom-up momentum by taking the best state and local benchmarks and making them national standards, investing in infrastructure, providing financing and incentives, and supporting research and development. The combination of the Infrastructure Investment and Jobs Act that passed the Senate in August and the Budget Resolution adopted by both houses of Congress will make a major difference if enacted in full. These two measures include significant investments that would support non-federal action across the country. Analysis conducted for Senator Schumer indicated that they would result in emissions 45 percent below 2005 levels in 2030, while planned administration and non-federal actions would drive those reduction to 50 percent. These infrastructure investments would represent major progress toward providing bottom-up actors with the clean-energy infrastructure that they can take advantage of; but we have barely begun that journey, and Washington must continue to lead.

Rising to the climate challenge calls for transformative change through the federal government, states, tribal nations, counties, and cities, combined with the private sector and investors, and with our cultural, research, and educational institutions working together.

A whole-of-society climate strategy is needed to capitalize on this momentum by integrating these elements in ways that leverage contributions across all actors. America has risen to the great challenges in the past to deliver ambitious changes through bold, all-in leadership from across our economy and from all levels of government. Rising to the climate challenge calls for transformative change through the federal government, states, tribal nations, counties, and cities, combined with the private sector and investors, and with our cultural, research, and educational institutions working together.

Addressing climate change and building a competitive and just economy for the future is an ambitious goal. Using our all-in leadership, we can deliver it.

Executive Summary

An all-in, all-of-society approach to climate that combines the unique power and strengths of each part of society and builds on the foundation of expanded bottom-up leadership gives us the best chance for rapid, durable, transformative change while promoting a clean and prosperous economy.

THE CLIMATE CRISIS DEMANDS SIGNIFICANTLY ACCELERATED, transformational, economy-wide change. Climate impacts are no longer off in the future but have become a regular occurrence today. Prolonged extreme drought has taken hold in the U.S. Southwest.[3] The summer of 2021 has seen several rounds of major heatwaves and wildfires across the western United States and Canada,[4] and across the world from Turkey[5] to Siberia,[6] and major flooding has hit Germany[7] and China.[8]

The recent report from the Intergovernmental Panel on Climate Change (IPCC) highlights the severe impacts of climate change and illustrates that the path to limit global warming to 1.5°C is quickly narrowing and requires urgent and dramatic cuts in greenhouse gas (GHG) emissions.[9] Incremental measures on climate and clean energy are no longer enough. Bold action and systemic change are needed to transform the economy to limit the impacts of global warming.

Over the past four years, nonfederal leaders have carried the torch on climate action in the absence of federal leadership, and this story of nonfederal leadership extends beyond the last four years. State adoption of vehicle emissions standards in the 2000s helped drive automakers to accept ambitious national standards under the Obama Administration. State renewable standards, coupled with municipal and corporate renewable energy purchase commitments have expanded renewable generation and driven down costs. Consumer and state regulatory pressures for coal fleet retirement resulted in greater emissions reductions than required by the targets under the Obama Administration's Clean Power Plan. State policies and commitments to phase down hydrofluorocarbons (HFCs) spurred industry to encourage Congress to pass the American Innovation and Manufacturing (AIM) Act of 2020.

While the Biden Administration has stepped up to lead on climate change, this does not mean that states, cities, businesses, and civil society can take a step back on climate leadership and ambition. The pace of federal action is limited by Washington politics; by the American system of checks-and-balances; and, critically, by the pace of action occurring at nonfederal levels across the country. Leaders outside of Washington can and must continue to set the pace of progress in an all-in national climate strategy. Nonfederal leaders can go farther and faster than the federal government and can set the example and build support for the federal government to do more. Federal clean-energy and infrastructure investments can then help other leaders to do even more. Tapping into these synergies is critical for meeting the U.S. climate goals.

An all-in, all-of-society approach to climate-change mitigation combines the unique power and strengths of each part of society and builds on the foundation of expanded bottom-up leadership. This approach gives us the best chance for rapid, durable, transformative change while promoting a clean and prosperous economy. In this all-of-society approach, every part of society has a critical role to play:

- **Federal:** Set national standards that build on bottom-up momentum; invest in infrastructure, financing and incentives, and research and development.
- **State:** Push ambition and set the pace of standards, invest in state action, and test new ideas.
- **Local:** Accelerate ambition and test new ideas with local action, codes, and zoning.
- **Business:** Shift markets and develop and deploy new technologies.
- **Civil Society:** Inspire, educate, and mobilize the public; create demand for new technologies and approaches; build public support for bold action; hold others accountable.

AMERICA IS ALL IN LEADERSHIP

Recognizing the urgent need to center climate change in all its work, the Biden Administration has established a whole-of-government approach to climate change. After rejoining the Paris Agreement on climate, President Biden committed the United States to reducing GHG emissions by 50 to 52 percent from 2005 levels by 2030 while putting the country on a path to net-zero emissions by 2050. Biden's agenda is designed to reduce climate pollution and increase resilience to climate impacts while protecting public health; conserving lands, waters, and biodiversity; delivering environmental justice; and spurring cheaper energy, good paying jobs, and economic growth.

Meanwhile, states, cities, businesses, and civil society have demonstrated leadership on climate, setting an ever-higher bar for ambitious legislation and targets. U.S. nonfederal leaders committed to climate action in support of the Paris Agreement represent 71 percent of U.S. GDP, 66 percent of the U.S. population, and 51 percent of U.S. emissions. These nonfederal leaders have catalyzed change for more than a decade, pioneering climate and clean-energy policies as the country's laboratories of democracy to deliver emissions reductions and set the pace for national climate ambition and federal action.

Over the last decade, states, cities, businesses, and civil society have led U.S. emissions reductions by creating guaranteed clean-energy markets. The intersection of this bottom-up leadership with subsequent responses from Congress and Executive Branch has driven U.S. emissions reduction progress. Examples abound:

- **2009 vehicle emissions** rules resulting from California and a dozen other states setting standards that threatened to divide the auto market and spurred automakers to support the Obama compromise.
- **Greater emissions reductions than required under the Clean Power Plan and extremely cost competitive wind and solar power** due to the combination of state 100 percent clean electricity standards (CES), public- and private-sector commitments to purchase 100 percent clean electricity, and public pressure in state regulatory forums to clean up the power sector.
- **Congressional standard to phase out HFCs** resulting from 14 states adopting phase-out rules such that the business community advocated for a national standard to restore a unified clean refrigerant market.

The federal government has a critical role to play in leadership and partnership with these nonfederal actors. It can set national policy floors to guide economy-wide decarbonization and support nonfederal leaders in accelerating more ambitious standards with incentives and investments. The federal government can use its technical expertise and resources to support research and development, fund deployment of new technologies, set performance standards, and provide critical technical and financial support to states and cities. The federal government also has access to very low borrowing rates, which are currently negative relative to inflation, that can overcome one of the key barriers to a rapid decarbonization transition, which is the cost of capital.

The time is ripe to capitalize on this momentum by integrating all these elements in a whole-of-society strategy that leverages contributions across all actors. For the great and transformational challenges in our history, America has been able to deliver big and ambitious changes through bold, all-in leadership from across our economy and from all levels of government. Transformative change can only come from the combined efforts of the federal government, states, tribal nations, counties, and cities, combined with the private sector and investors, and with our cultural, research, and educational institutions working together to deliver change. For the massive challenge of addressing climate change and building a competitive and just economy for the future, we have set an ambitious goal. Using our all-in leadership, we can deliver it.

The time is ripe to capitalize on this momentum by integrating all these elements in a whole-of-society strategy that leverages contributions across all actors.

SYNERGIES FROM JOINT ACTION

The speed, depth, and durability of the transformation to a clean and vibrant American economy will be enhanced through synergistic actions across federal and nonfederal actors (Figure ES-1). This transformation has played out for renewable energy, which has seen early adoption of state renewable portfolio standards (RPS) supplemented by cities, tribes, businesses, educational institutions, and cultural organizations committing to an increasing share of renewable and clean electricity purchases. These early movers and federal tax credits helped create a strong market for wind turbines and solar panels. As production ramped up to meet demand, costs fell, creating a positive feedback loop. Business commitments to procure renewable energy for their operations have spurred economic development agencies and utilities to prioritize renewable generation. As renewable generation has expanded, the focus of research, development, and demonstration (RD&D) spending, federal and state policies and incentives, and public and private procurement has increasingly shifted to include energy storage to better integrate variable resources into the power grid. Today solar and wind are often the lowest cost option for power, creating a durable shift to clean power.

Electric vehicles (EVs) provide one of many additional opportunities to exploit these synergies. States were early movers, adopting zero-emissions vehicle (ZEV) mandates, and California's Low Carbon Fuel Standard provided additional economic incentives for EV sales. These policies, combined with federal tax credits, helped grow the market for EVs. Public and private fleet owners are now making major commitments to ZEVs. The expanding market has spurred major investments in battery technology, with performance increasing while costs decline. As policies are put in place to fully transition from gasoline and diesel cars, major auto manufacturers have responded to the changing policy landscape. In the last year, there has been a proliferation of all-electric models from major auto companies. GM has announced a goal of eliminating tailpipe emissions from its light-duty fleet by 2035, and Ford has introduced an all-electric Mustang and the F-150 Lightning and committed to invest $25 billion in electrification through 2024. The momentum can continue to build through strategic actions by leading cities, businesses, and other organizations to make EV charging more accessible. Building out charging infrastructure will make it easier for people to shift to EVs, in turn increasing public support for and trust in the transition to EVs.

DELIVERING ON CLIMATE

Our analysis shows that an all-in climate strategy can deliver net GHG emissions reductions of 52 percent below 2005 levels by 2030 (Figure ES-2). The power sector contributes more than half the total reductions, with its emissions reduced 83 percent from 2005 levels by 2030. Transportation and buildings also contribute significantly, with emissions reductions of 39 and 26 percent, respectively.

These reductions result from an all-in strategy that leverages the strengths and capabilities of different actors including the federal administration; Congress; state, local and tribal governments; companies; and civic institutions (Figure ES-3). Nonfederal leaders are encouraged to pursue all relevant actions within their jurisdiction and authority. For example, some cities can adopt local building codes or implement other types of mandates, but not all have that authority. The policy framework includes actions that directly deliver substantial emissions reductions in the near term (e.g., CES implementation), actions that will set the table for additional reductions beyond 2030 (e.g., zero-emissions building standards), and actions that unlock the ability for others to deliver emissions reductions (e.g., installation of EV charging stations).

FIGURE ES-1

The All-In Climate Strategy

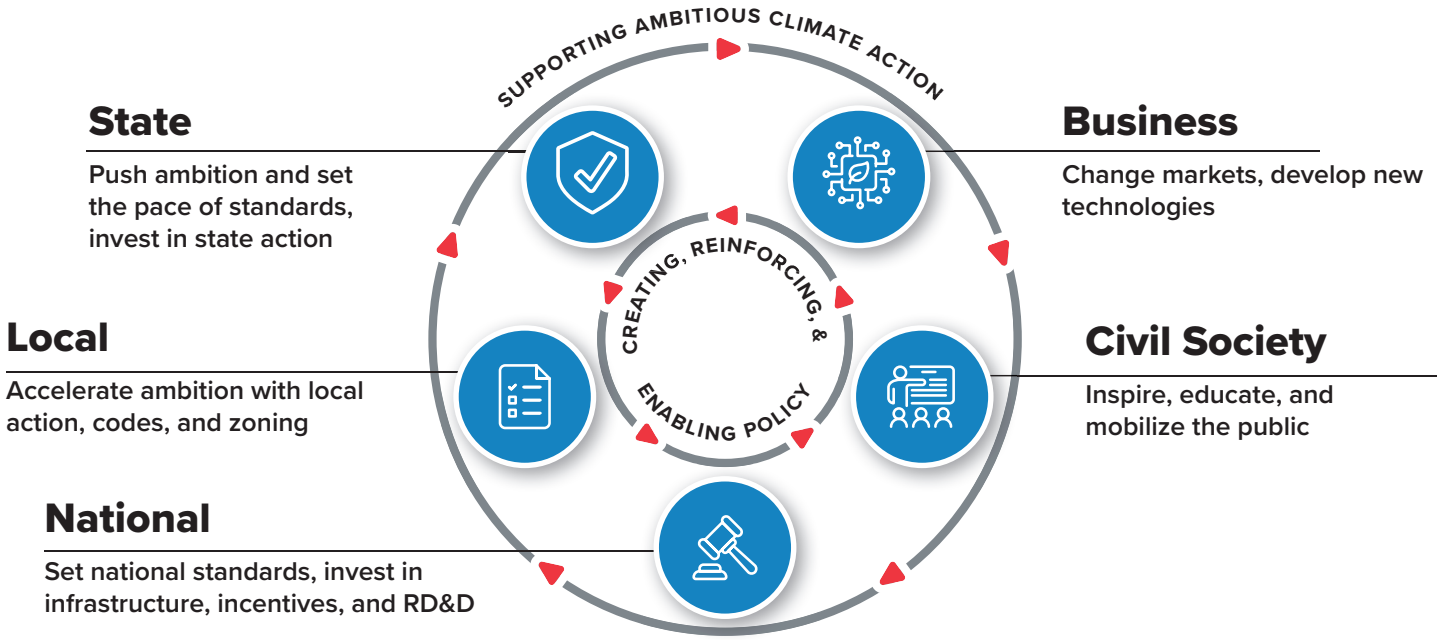
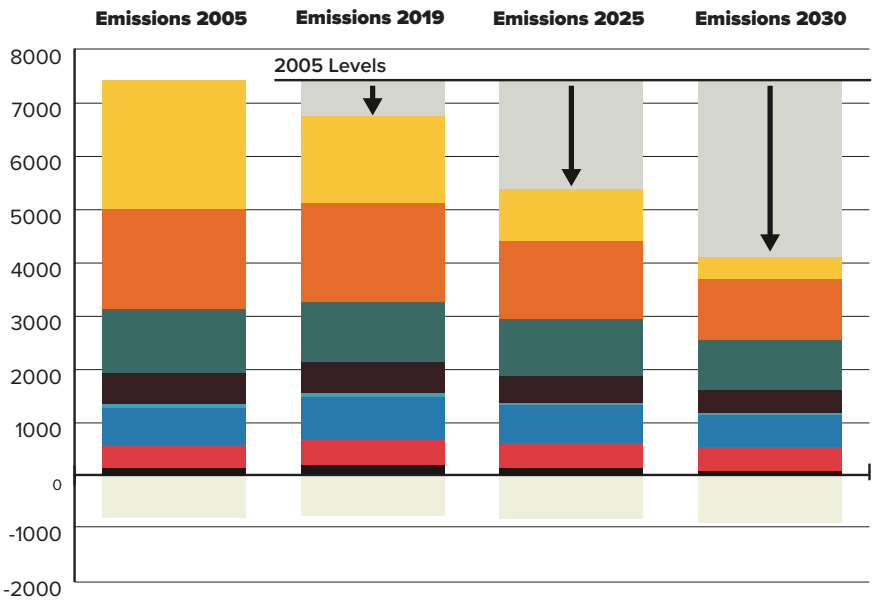


FIGURE ES-2

U.S. Greenhouse Gas Emissions under an All-In Climate Strategy ($MMTCO_2e$)



Sector/GHG	Change from 2005 to 2030 ($MMTCO_2e$)	Change relative to 2005 (%)
Electricity CO_2	-2008	-83%
Transport CO_2	-725	-39%
Industry CO_2	-263	-22%
Buildings CO_2	-154	-26%
Other CO_2	-33	-50%
CH_4	-105	-15%
N_2O	18	4%
F-Gases	-40	-27%
LULUCF	-98	-12%
Net GHG Total	**-3409**	**-52%**

FIGURE ES-3

All-In Strategy Breakthrough Policies

THE POWER SECTOR

- Mandate/incentivize 100% clean electricity by 2035 and 80% or more by 2030 (federal and state)
- Procure 100% clean electricity on a 24/7/365 basis as soon as possible (all)
- Invest in RD&D to ensure a reliable, resilient energy supply that is largely renewable (federal, business)
- Train and inspire the clean-energy workforce while supporting community transition (all, especially civil society)

THE TRANSPORTATION SECTOR

- Mandate/incentivize phase-out of internal combustion engines for light-duty vehicles by 2035 and medium- and heavy-duty vehicles by 2045 (federal and state)
- Produce and procure ZEVs, targeting 100% of light-duty vehicle sales by 2035 and at least 30% of heavy-duty vehicle sales by 2030 (all)
- Invest in mass transit and one million new EV charging plugs that are broadly available to all communities (all, led by federal)

THE BUILDING SECTOR

- Mandate/incentivize energy-efficient, all-electric appliances and zero-emissions new buildings by 2030 (federal, state, city)
- Invest in building electrification and efficiency upgrades, with a priority for low- and middle-income housing (federal and state, cities)
- Raise awareness of public health and climate dangers of gas (all, especially civil society)

THE INDUSTRIAL SECTOR

- Mandate best practices and prohibit venting and flaring at oil and gas sites, reducing fugitive methane leakage by at least 60% by 2030 (federal, state, cities in oil-producing regions)
- Incentivize carbon capture, utilization and storage (CCUS), innovation, and low-carbon solutions in hard-to-abate sectors (federal and state)
- Implement "buy clean" requirements for emissions-intensive goods and infrastructure (e.g., cement and steel) (all)
- Raise awareness about green products and construction practices (all, especially civil society)
- Mandate stringent refrigerant management protocols and use of low-GWP alternatives wherever viable, driving down HFC emissions by 40% or more by 2030 (federal, state)

THE NATURAL AND WORKING LANDS SECTOR

- Incentivize nature-based solutions, targeting an 18% increase (additional 140 MT) in annual carbon sequestration from present levels (federal, state)
- Incentivize and invest in waste-to-energy and sustainable agriculture (federal, state, business)
- Invest in enhanced GHG quantification and monitoring (federal, state, business)

Priority high ambition policies that can lead to **50–52% emissions reductions by 2030**

An All-In strategy to reach economy-wide 50–52% emissions reductions by 2030 will require concerted, robust action across all sectors of the economy, driven by leadership throughout society. Strong investment and mandates from the federal government will enable decarbonization in all regions of the country and set a high floor for ambition. Leadership from state governments will set the pace of transition and lock in stringent standards and emissions reductions. And action from cities, businesses, and civil society leaders can bolster this transition by establishing reliable markets for clean energy and challenging political leaders to enact policies that deliver lasting change and keep their communities and ecosystems healthy. All actions must prioritize equity and justice, with at least 40% of benefits flowing to overburdened and underserved communities.

FIGURE ES-4

Road to 2030 with an All-In Strategy

Delivering on a Clean and Prosperous Future

An all-in climate strategy can deliver a brighter future for America, helping create more livable communities, a cleaner economy, and healthier lands.

LIVABLE COMMUNITIES

An all-in climate strategy can deliver more livable communities across the country through policies and actions that focus on where we live and work, and on how people and goods move around our communities. Land-use planning changes, zero-pollution buildings and transportation, increasing energy efficiency, and improving transit can deliver deep air pollution and GHG emissions reductions. **Analysis for this report shows that these changes can result in a 26 percent reduction in GHG emissions from 2005 levels in all buildings by 2030 and a 39 percent reduction in transportation emissions by 2030.**

Changing how buildings are built and operated can increase comfort while reducing energy use and costs, carbon emissions and local pollution. Building codes and other policies can point the way to zero-emissions buildings by encouraging or requiring use of efficient electrical appliances, distributed generation of renewable energy, access to EV charging, and other clean-energy approaches.

Accessible, safe, and clean transportation is important to give people access to jobs, shopping, and recreational spaces. In more dense or urban areas, investment in rapid and low-carbon public transportation, safe biking and walking infrastructure, micro mobility, and other options provide alternatives to private vehicles and their local pollution, the high risk of crashes, inequitable land use for public parking, and regressive mandates for private parking.

Local communities will be healthier as EVs and expanded renewable energy reduce local air pollution that has typically disproportionately affected low-income and minority communities. For frontline neighborhoods that have experienced historical pollution, restorative efforts to clean up polluted land can enhance the wellbeing of residents and prevent further disproportionate exposure to pollutants. Retrofits to buildings can also make buildings safer and more comfortable for residents to live in.

The United States and the world stand today on the cusp of a major and transformational change in our economy that, if pursued broadly and across all sectors, will see us move quickly toward a cleaner and more vibrant economic pathway that also improves the lives of our citizens in many ways.

CLEAN ECONOMY

An all-in climate strategy can deliver a clean economy through significant near-term investments that provide long-term benefits in the form of reduced pollution, decreased energy costs, improved health, high-quality jobs, and improved local and national economies. Mandates and investments can work together to decarbonize the electric grid and industrial sector, including clean-energy portfolios, incentives for CCUS, and investments in infrastructure and technology such as large-scale transmission and distribution systems, energy storage, and infrastructure to stem methane leaks. **Our analysis shows that an all-in strategy can reduce power sector emissions by 83 percent relative to 2005 levels by 2030 and industrial sector emissions 22 percent below 2005 levels by 2030.**

Decarbonizing the power sector and industrial production can also improve the health of Americans. Achieving 80 percent clean electricity by 2030 could prevent more than 300,000 premature deaths through 2050, saving over a trillion dollars.[10] While estimates of such benefits vary across studies, the scale of the savings—trillions of dollars and hundreds of thousands of lives over many decades—is clear.[11] Reducing air pollution can also help address persistent health disparities, because people of color are historically disproportionally exposed to the

pollutants that worsen health outcomes.[12,13]

Achieving 80 percent clean electricity by 2030 can create hundreds of thousands of net new jobs annually while deploying up to trillions of dollars in clean-energy investment.[14] Clean-energy jobs today provide above- average pay, can have lower barriers to job entry (via lower educational requirements), and provide career stability in a growing field.[15,16] By ensuring that clean-energy jobs come with high labor standards, millions of workers can experience the benefits of an economic transformation that spurs inclusive growth.[17]

HEALTHY LANDS

An all-in climate strategy can deliver healthy lands that provide economic benefits for rural and urban communities while removing carbon from the atmosphere.[18] Ambitious policy actions to protect, preserve, and sustainably manage natural and working lands also help make forestry, agricultural, and urban systems resilient to increasing climate impacts, including wildfires, flood surges, and droughts.

Forests, grasslands, agricultural soils, and urban trees provide a large carbon sink, sequestering a net 750 Mt CO_2e every year on average.[19] Climate risks and shifting land uses have the potential to degrade the U.S. carbon sink within the next 10 years.[20] Concerted action at all levels of society is needed to resist degradation of this sink and to increase its capacity to remove and store carbon. Recent analyses have suggested that the U.S. land sector could deliver 800 to 1,000 Mt CO_2e of annual sequestration by 2030. **Analysis for this report indicates the potential for a net sink of 913 Mt CO_2e, by 2030, an improvement of approximately 18 percent from today's levels.**

Reforesting and restocking damaged forests on state, local, and private lands hold great potential for carbon removal, but concerted effort needs to be made at the federal, state, and local levels to realize this potential.[21,22] Agroforestry, treating forests in high fire risk areas to mitigate the risk of catastrophic wildfires, and urban tree cover can also enhance the carbon sink. Trees and climate-friendly forestry also improve water quality, prevent soil runoff, offer shade and cooling to urban communities, and help to protect forest-adjacent communities from the risk of wildfire.

Established agricultural practices, such as cover crops and managed grazing methods, can increase the carbon stored in agricultural soils, which is not only important for climate but can increase soil fertility, increase drought tolerance, and reduce erosion. The degree to which different management practices can sequester carbon in the soil and the length of time that carbon remains stored in soils is highly uncertain.[23]

Protecting forests, grasslands, wetlands, and coastal zones from conversion to other land uses is another key component of climate-friendly land management. Ecosystem restoration can offer sizable impact in locations with resources like wetlands and can help to restore ecosystem services, such as improved habitat for wildlife and resilience to climate-related impacts like sea level rise.

CONCLUSIONS

The United States and the world stand today on the cusp of a major and transformational change in our economy that, if pursued broadly and across all sectors, will see us move quickly toward a cleaner and more vibrant economic pathway that also improves the lives of our citizens in many ways. The technologies are ready, leadership is expanding rapidly, and the benefits are increasingly clear and valued by diverse actors across the country.

What remains is for us is to use our powerful all-in climate strategy to accelerate wherever possible the actions we already know work well; to capitalize on our ability to innovate, linking our robust research, capital markets, and private sector; and to continue to deploy new technological strategies across all communities. Doing this will enable the United States to achieve its ambitious climate targets—and in doing so to leverage other reductions globally[24] to help the world reach global climate goals.

The technologies are ready, leadership is expanding rapidly, and the benefits are increasingly clear and valued by diverse actors across the country.

Introduction

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As the United States and the world work to emerge from the COVID-19 pandemic, we face a critical moment in history that offers the opportunity for rebuilding and transformation that can deliver a stronger and cleaner economy. To address the climate crisis, significant investments and smart policies will be needed to steer the country in a more sustainable direction.

THE CLIMATE CRISIS CALLS FOR rapid and ambitious action. The impacts of climate change have been ever-present through the summer of 2021, with the world seeing a succession of drought, heatwaves, wildfires, and floods.

In August, the IPCC released *Climate Change 2021*, which makes clear the need for rapid reductions in GHG emissions to keep open the possibility of limiting climate change to 1.5°C.[25] Incremental measures on climate and clean energy are no longer enough. Bold action and systemic change are needed to transform the economy to limit the impacts of climate change.

As the United States and the world work to emerge from the COVID-19 pandemic, we face a critical moment in history that offers the opportunity for rebuilding and transformation that can deliver a stronger and cleaner economy. To address the climate crisis, significant investments and smart policies will be needed to steer the country in a more sustainable direction.

FEDERAL LEADERSHIP

In April, President Biden committed the United States to reducing GHG emissions by 50 to 52 percent from 2005 levels by 2030 while putting the country on a path to net-zero emissions by 2050. The new Nationally Determined Contribution (NDC) marks an ambitious but achievable climate mitigation goal as the United States returns to the international effort to address climate change under the Paris Agreement. The NDC is a call to action for building a resilient, clean, and equitable economy. Critically, the message of urgency in the August IPCC report highlights the need for the United States to deliver at least 50 percent reductions in GHG emissions from 2005 levels by 2030.

The administration has recognized that reducing GHG emissions is an opportunity to invest in the future of the country and has put forward an agenda designed to build a robust, equitable, resilient, and low-carbon economy ready for the 21st century. In his first week as president, Biden committed his administration "to organize and deploy the full capacity of its agencies to combat the climate crisis to implement a government-wide approach that reduces climate pollution in every sector of the economy; increases resilience to the impacts of climate change; protects public health; conserves our lands, waters, and biodiversity; delivers environmental justice; and spurs well-paying union jobs and economic growth, especially through innovation, commercialization, and deployment of clean-energy technologies and economy growth," with the Justice40 Initiative included such that "40 percent of the overall benefits flow to disadvantaged communities."[26]

Although the Biden Administration has placed addressing climate change at the center of its agenda, procedural and political hurdles put constraints on how far and how fast the federal government can move on its own. Meaningful climate legislation must make its way through a closely divided Senate, where there is a need for bipartisan support. The administration can adopt regulations using existing authority, but federal rulemakings don't move at the pace of urgency and are prone to compromise.

Correspondingly, bottom-up climate ambition needs federal support. Federal financial support has always been critical in infrastructure revolutions from railroads to interstate highways and is now critical for the clean-energy revolution. Even when funds are available, cities and states can face barriers in creating infrastructure networks for a national economy. The need for public charging networks is a major barrier to EV sales. Since many commuters cross city and state lines, federal support can be critical. Similarly, federal support for long-distance transmission connections can deliver low-cost renewable power to cities and companies looking to purchase clean power.

Such challenges demonstrate the critical importance of all parts of society to act on climate-change mitigation. It is vital that the administration's whole-of-government approach be expanded to a whole-of-society approach that can leverage the ability of nonfederal actors to move faster and farther than the federal government.

As the United States and the world work to emerge from the COVID-19 pandemic, we face a critical moment in history that offers the opportunity for rebuilding and transformation that can deliver a stronger and cleaner economy.

NONFEDERAL LEADERSHIP

Previous experience demonstrates the power of this strategy. State, city, tribal, and business leaders have delivered important emissions reductions, expanded the market for clean energy, and paved the way for federal action. Adoption of vehicle emissions standards by 11 states in the 2000s helped drive automakers to accept ambitious national standards under the Obama Administration. State RPS policies, coupled with municipal and corporate renewable energy purchase commitments, have expanded renewable generation across the United States and driven down costs. Consumer and state regulatory pressures for coal fleet retirement resulted in greater emissions reductions than required by the targets under the Obama Administration's Clean Power Plan. State policies and commitments to phase down HFCs spurred industry to encourage Congress to pass the AIM Act of 2020.

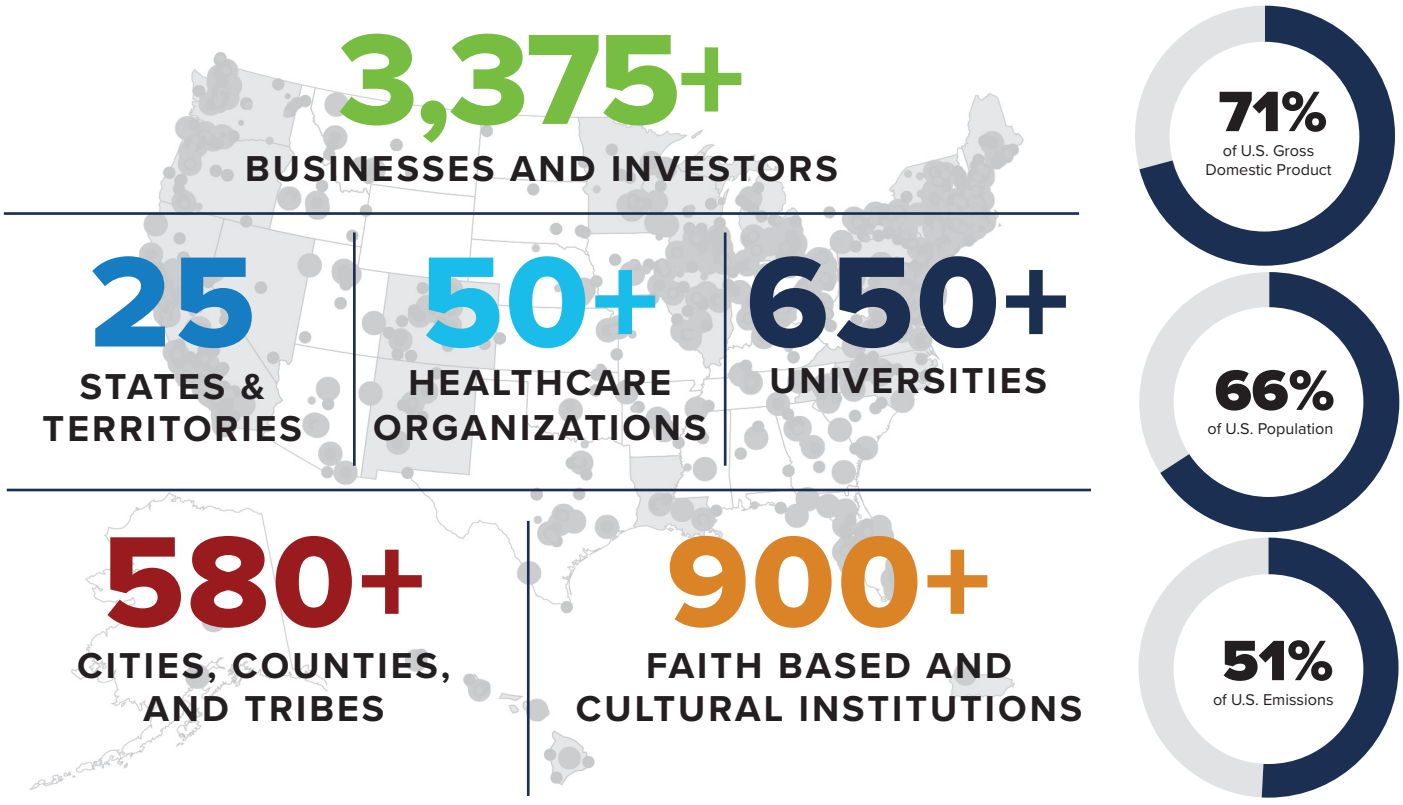
While the administration is reengaging the federal government on addressing the climate crisis, a robust and broad coalition of states, cities, tribes, businesses, and civil society organizations have an established track record as climate champions.[27] The America Is All In coalition includes members from all 50 states, representing the broader U.S. nonfederal climate movement that accounts for two-thirds of the U.S. population and economy (Figure 1). The coalition is eager to work with the Biden Administration to meet or exceed the NDC target.

Nonfederal leaders have played a critical role in climate action in the United States for many years. Over the last decade, states, cities, businesses, and civil society have driven the biggest emissions reductions by creating guaranteed clean-energy markets.

- Ten states and the District of Columbia, representing over 20 percent of U.S. electricity demand, have committed to 100 percent clean electricity standards, building off decades of experience with renewable portfolio standards. Major electricity purchasers in the public, private and non-profit sectors have committed to 100

FIGURE 1

Nonfederal Actors Committed to Climate Action in Support of Paris Agreement



percent clean electricity purchases. Major corporate buyers like Amazon, Facebook, and Walmart have used access to renewable power as a condition for locating new facilities, making access to renewable power an economic development issue.

- Adoption of vehicle emissions standards by eleven states in the 2000s helped drive automakers to accept ambitious national standards under the Obama administration. Continued pressure from state emission standards combined with ZEV requirements for fleets well before mid-century is helping create momentum for EVs among automakers
- State policies and commitments to phase-outs of HFCs spurred industry to encourage Congress to act, which it did in passing the AIM Act of 2020. Consumer and state regulatory pressures for coal fleet retirement resulted in greater emissions reductions than required by the targets under the Obama Administration's Clean Power Plan.

The importance of nonfederal leadership to climate action is being recognized globally. The Race to Zero campaign was launched at the 2019 Climate Action summit to mobilize support from cities, regions, businesses, investors and higher education institutions for ambitious climate action to unlock inclusive sustainable growth.[28] A recent assessment of global subnational and private-sector action found that subnational actors with post-2020 targets cover 11 percent of the global population and 12 percent of global emissions, while more than 800 firms with combined revenue over $13 trillion have quantifiable post-2020 targets.[29] In addition, the Alliances for Climate Action is a network of seven national alliances of non-federal leaders dedicated to driving ambitious climate action, increasing public support for addressing the climate crisis, and engaging national governments in efforts to decarbonize faster.[30]

FUTURE LEADERSHIP

Delivering on the U.S. NDC will require a whole-of-society approach: sustained political commitment from all levels of government; major public and private investments in clean-energy infrastructure; accelerated market transformation; and broad citizen mobilization led by schools, churches, museums, and other diverse anchor institutions.[31]

The most reliable way for the United States to achieve the needed emissions reductions of at least 50 percent by 2030 is for bottom-up climate leaders—states, cities, businesses, and civil society—to forge ahead of the Biden Administration's policy benchmarks, while the administration and Congress ensure that the entire country follows the leadership of these climate champions and provide the needed infrastructure to replace fossil fuels with clean energy. Critical investments to enable economy-wide net-zero emissions well before 2050 include a national macro-grid to move renewable electricity from the best wind and power generation zones to major urban load centers, a national network for public EV charging, consumer incentives to grow the market for such innovative products as EVs and heat pumps, and support for new and not yet fully commercialized technologies.

Building on the unprecedented momentum in recent years, bold action will now be needed to meet the challenge ahead. A wide range of policies and actions are needed to support the broad economic transformation ahead. As climate leaders adopt policies and actions in the next few years, they need to be guided by the North Star of full decarbonization. All actions must prioritize equity and justice, with at least 40 percent of benefits flowing to overburdened and underserved communities. Federal and bottom-up actors can claim the mantle of climate leadership by taking key actions as allowed by the scope of their authority, including:

- **Mandating and incentivizing 100 percent clean electricity by 2035 and 80 percent or more by 2030**
- **Phasing out production and sale of ICE light-duty vehicles by 2035 and medium- and heavy-duty vehicles by 2045**
- **Investing in mass transit and 1 million EV charging plugs by 2030**
- **Mandating and incentivizing energy efficient, all-electric appliances and zero-emissions new buildings by 2030**
- **Implementing "buy clean" requirements for emissions-intensive goods and infrastructure**
- **Mandating best practices and prohibiting venting and flaring at oil and gas sites, reducing fugitive methane leakage by at least 60 percent by 2030**
- **Mandating stringent refrigerant management protocols and the use of low-GWP alternatives wherever viable to reduce HFC emissions by at least 40 percent by 2030**
- **Investing in and incentivizing nature-based solutions, targeting an 18 percent increase in annual carbon sequestration**

LEVERAGING SYNERGIES OF CLIMATE ACTION

These actions can provide a strong foundation for a whole-of-society approach to addressing climate change. The federal government can leverage and support action across all levels of government, the private sector, and civil society. The federal government can build from the foundation laid by non-federal leaders, providing technical assistance and financial incentives that allow these nonfederal actors to take bolder action on climate change mitigation. Leaders at key federal agencies have experience as governors and mayors, providing insight into what has worked and what needs reform for federal support to be most effective at supporting state and local leaders. Federal agencies can also consider the real costs of climate change in making decisions on regulations and permits, creating a level playing field for low-carbon technologies and processes to replace emissions-intensive incumbents.

At the same time, state, local, and tribal governments and regulatory bodies play a central role in many areas critical for successfully addressing climate change, ranging from local land-use planning, adopting and enforcing building codes, utility regulation, waste management, and many more.[32] In many cases, they can be pacesetters, establishing standards and targets that require businesses to do more than meet federal requirements. These actions can provide a roadmap, allowing state and local agencies to test different approaches. When states and cities pull in the same direction, as they did in enacting phase downs for HFCs or adopting California's vehicle emissions standards, they can also encourage industry to call for equivalent national standards to ensure a single marketplace.

Companies can reduce emissions from their own operations and supply chains, invest and create jobs in disadvantaged communities, and offer goods and services that help their customers reduce their carbon footprint. Long-term anchor institutions in their communities such as cultural institutions, health care facilities, and colleges and universities, can educate their patrons, citizens, and students and showcase innovative technologies through creative programs and curated exhibits. Faith organizations can mobilize congregants and membership and help to shift political will across the political spectrum.

All of these actions are important individually, but if approached in a coordinated fashion could create a cleaner economy more quickly.

All of these actions are important individually, but if approached in a coordinated fashion could create a cleaner economy more quickly. Demonstrable improvements on the ground in the form of new wind and solar power plants, a built-out EV charging network, or zero-emissions buildings can make clear the economic, social, and environmental benefits of the clean-energy transition. These can build public support that helps maintain political will and would be difficult to undo if, in fact, the policy winds shift. As more businesses and institutions of all sizes embrace climate action, the momentum can build. An all-in strategy that weaves these strands together can deliver more ambitious and more durable change.

A prime example of these synergies at play is in renewable energy markets. In recent decades, states and cities have made commitments to renewable energy and large energy users such as businesses, hospitals, and universities have contracted or established the demand for utility-scale projects that have helped drive down their costs. Many major electricity buyers such as data centers and fulfillment centers now insist on access to renewable power consistent with corporate climate and clean-energy commitments. As renewables become cost-competitive with fossil fuels for power generation, the federal government can more easily adopt an ambitious national CES or similar policy to ensure that power providers in all parts of the country take advantage of low-cost renewables. Federal and state utility regulators can prioritize investments in transmission, distribution, and energy storage to further ease the transition to a zero-carbon electric grid. Local officials can use land-use plans and building codes and work with utilities to provide incentives to encourage building electrification, EV charging infrastructure, and distributed storage and generation that increases the reliability and resilience of the electric distribution grid. Local community colleges can

train a green workforce to install these systems. Museums can creatively engage an awareness campaign about these "hidden" parts of the city's infrastructure while trusted health care professionals can communicate the importance of resulting cleaner air to the health outcomes of their patients.

AN ALL-IN CLIMATE PLAN

This report examines how a whole-of-society approach integrating federal, state, and local governments; the private sector; and civil society can deliver on the U.S. NDC. We evaluated a set of investments, policies, and actions designed to deliver on, or exceed, the 50 to 52 percent emissions reduction that the United States has committed to delivering. Our analysis is rooted in a detailed assessment of the potential impact of both subnational and national actions using a robust analytical methodology.[38]

Section 2 considers what it will take to transform the economy through three overlapping lenses: creating livable communities, building a clean economy, and sustaining healthy lands. Underlying these descriptions is a careful analysis of the types of policies and actions that different players—federal, state, tribal, and local governments; companies; schools; and faith, cultural and other civic organizations—need to take to achieve our national goals.

The tool kit for action is vast, offering opportunities across the economy for all types of actors. Congress is currently considering significant clean-energy infrastructure investments and other measures that, if passed, would jump start this process. The Administration can move forward on a range of regulations, standards, research and development activities, purchasing requirements, and other programs. Leading states have shown the way in recent years with ambitious actions ranging from legislated emission limits, renewable and clean-energy standards, mandating ZEV deployment, low-carbon fuel standards, phasing down HFCs, putting methane limits in place, and cap-and-trade programs. Local governments are taking the lead on improving transit and mobility and where they have the authority, in using local building codes to improve the energy and environmental performance of buildings. Public and private fleet owners are shifting to EVs. Major corporate buyers

Precedents for Transformative Change in the U.S. Economy

The speed and scale necessary to meet ambitious emissions targets will require a whole-of-society mobilization only seen a handful of times in American history. The federal government's role in the rapid economic expansion from the Great Depression to the post World War II economic boom is well known. Federal programs such as The New Deal and The Arsenal of Democracy were instrumental in reviving the economy, as unemployment dropped from 14.6 percent in 1939 to 1.2 percent in 1944.[33] However, economists worried that when the war ended, the economy would return to recession as plants building war munitions closed and unemployed soldiers returned home.[34] Government officials worked alongside private businesses to transition the economy to one of peacetime prosperity, investing in infrastructure, building housing, cars, and appliances in place of war planes, bombs, and ammunition.[35] In the 15 years that followed, the Gross National Product (goods and services produced) increased from $300 billion to $500 billion in real terms.[36]

The same kind of prosperous transition can be channeled in modern times with government, businesses, and investors collaborating to turn jobs in the fossil fuel industry to home retrofits, clean energy installation, and clean manufacturing. Precedent for this kind of rapid response can be found in recent memory as the COVID-19 pandemic caused factories to respond by making medical equipment, facemasks, and cleaning products.[37] Federal and local government joining forces with medical research and industry led to the rapid development and administration of the of COVID-19 vaccine, which helped save hundreds of thousands of lives and avert a worse economic recession. Material and financial resources needed to meet the NDC appear daunting without context, but previous global crises like World War II and the COVID-19 pandemic show us that meeting the challenge is both possible and necessary.

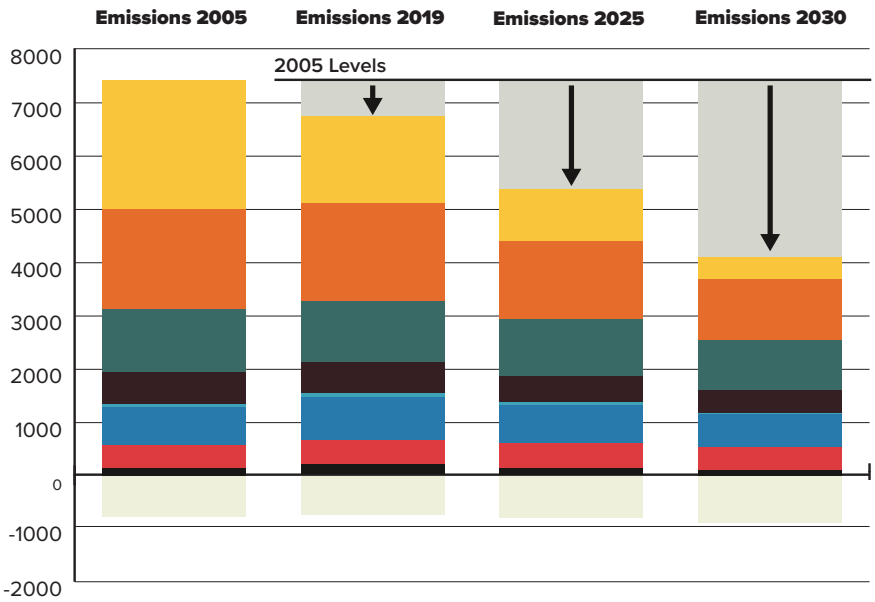
are looking to reduce emissions from their facilities and green their supply chains as commit to net-zero emissions. Cultural institutions, health care providers, and colleges and universities showcase innovative technologies. These are but a handful of the tools available to speed the transition.

Figure 3 provides an overview of the actions considered in this report. Additional detail on these policies and actions and information on the assumptions used for modeling GHG emissions are provided in the Technical Appendix. While we document a wide variety of actions, in modeling the GHG emissions impacts, we necessarily represented a subset of those policies and actions with the most direct and largest impacts in our models.

Taken together, the all-in climate strategy considered here can deliver 52 percent GHG emissions reductions from 2005 levels by 2030, as shown in Figure 2, resulting in emissions 46 percent below 2019 levels. The main reductions come from the power sector, where continued rapid phase out of coal generation, the start of a shift from gas, and increased deployment and integration of renewable power and energy storage will result in 83 percent reductions by 2030 from 2005 levels and 75 percent below 2019. With a cleaner electric grid, electrification together with measures to increase efficiency reduces emissions 39 percent and 26 percent, respectively, for transportation and buildings by 2030 from 2005 levels. Results by sector are illustrated in Figure 2, and detailed results and assumptions are described in the Technical Appendix.

FIGURE 2

U.S. Greenhouse Gas Emissions under an All-In Climate Strategy



Sector/GHG	Change from 2005 to 2030 ($MMTCO_2e$)	Change relative to 2005 (%)
Electricity CO_2	-2008	-83%
Transport CO_2	-725	-39%
Industry CO_2	-263	-22%
Buildings CO_2	-154	-26%
Other CO_2	-33	-50%
CH_4	-105	-15%
N_2O	18	4%
F-Gases	-40	-27%
LULUCF	-98	-12%
Net GHG Total	**-3409**	**-52%**

FIGURE 3

All-In Strategy Breakthrough Policies

THE POWER SECTOR

- Mandate/incentivize 100% clean electricity by 2035 and 80% or more by 2030 (federal and state)
- Procure 100% clean electricity on a 24/7/365 basis as soon as possible (all)
- Invest in RD&D to ensure a reliable, resilient energy supply that is largely renewable (federal, business)
- Train and inspire the clean-energy workforce while supporting community transition (all, especially civil society)

THE TRANSPORTATION SECTOR

- Mandate/incentivize phase-out of internal combustion engines for light-duty vehicles by 2035 and medium- and heavy-duty vehicles by 2045 (federal and state)
- Produce and procure ZEVs, targeting 100% of light-duty vehicle sales by 2035 and at least 30% of heavy-duty vehicle sales by 2030 (all)
- Invest in mass transit and one million new EV charging plugs that are broadly available to all communities (all, led by federal)

THE BUILDING SECTOR

- Mandate/incentivize energy-efficient, all-electric appliances and zero-emissions new buildings by 2030 (federal, state, city)
- Invest in building electrification and efficiency upgrades, with a priority for low- and middle-income housing (federal and state, cities)
- Raise awareness of public health and climate dangers of gas (all, especially civil society)

THE INDUSTRIAL SECTOR

- Mandate best practices and prohibit venting and flaring at oil and gas sites, reducing fugitive methane leakage by at least 60% by 2030 (federal, state, cities in oil-producing regions)
- Incentivize carbon capture, utilization and storage (CCUS), innovation, and low-carbon solutions in hard-to-abate sectors (federal and state)
- Implement "buy clean" requirements for emissions-intensive goods and infrastructure (e.g., cement and steel) (all)
- Raise awareness about green products and construction practices (all, especially civil society)
- Mandate stringent refrigerant management protocols and use of low-GWP alternatives wherever viable, driving down HFC emissions by 40% or more by 2030 (federal, state)

THE NATURAL AND WORKING LANDS SECTOR

- Incentivize nature-based solutions, targeting an 18% increase (additional 140 MT) in annual carbon sequestration from present levels (federal, state)
- Incentivize and invest in waste-to-energy and sustainable agriculture (federal, state, business)
- Invest in enhanced GHG quantification and monitoring (federal, state, business)

Priority high ambition policies that can lead to **50–52% emissions reductions by 2030**

An All-In strategy to reach economy-wide 50–52% emissions reductions by 2030 will require concerted, robust action across all major emissions sectors of the economy, driven by leadership at all levels of society. This means strong investment and mandates from the federal government to enable decarbonization in all regions of the country and set a high floor for ambition. It also means additional leadership from state and city governments to set the pace of transition in key sectors and lock in stringent standards and emissions reductions. Finally, an All-In strategy requires business and civil society leaders to bolster this transition by establishing reliable markets for clean energy and pushing on political leaders to enact policy that will deliver lasting change and keep their communities and ecosystems healthy.

Building a Clean and Prosperous Future

In this chapter, we look at the range of intertwined policies, actions, and investments needed to deliver on the U.S. climate commitment. The discussion considers this through three lenses, considering how that will play out in the context of local communities, key economic sectors, and natural and working lands.

THIS REPORT, INCLUDING THE ANALYSIS BEHIND IT, takes as its starting point the critical need to address climate change and focuses on actions and policies that can help achieve or exceed the U.S. NDC target of reducing GHG emissions by 50 to 52 percent from 2005 levels by 2030 while putting the country on a path to a net-zero emissions economy by 2050.

In this chapter, we look at the range of intertwined policies, actions, and investments needed to deliver on the U.S. climate commitment. The discussion considers this through three lenses, considering how that will play out in the context of local communities, key economic sectors, and natural and working lands.

In each section, we start with a brief discussion of what success can look like. We next summarize key benefits of this future, including emissions, health, and economic benefits, based on new analysis and modeling that we conducted for this report. Finally, in each section we document the policies and actions that can contribute to these results and reflect on the synergies that can come from the combination of actions from different levels of government, the private sector, and civil society.

In this chapter, we look at the range of intertwined policies, actions, and investments needed to deliver on the U.S. climate commitment.

Building a clean, prosperous, and equitable future

Successfully implementing a transformative climate plan requires a focus on delivering a prosperous and equitable future for all Americans. While all will benefit from addressing the climate crisis through reduced impacts, the bold actions we take in the coming decade will only win the sustained support needed to follow through if they are taken with an eye first to ensuring that all communities, including frontline communities and those that have benefited from coal, oil, and gas, can prosper and share in the economic, social, and environmental benefits. That will require working with communities to ensure the benefits of rooftop solar and EVs flow to low-income households; utility rate designs and tax structures avoid first adopters leaving others to pay legacy utility costs;[39] and addressing myriad other issues that impact who pays direct costs, who bears the burden from pollution, and who benefits.

In this report, we identify many examples of prioritizing equity in climate and clean energy policies and how climate policies might have equity benefits. However, our analysis focuses on emissions reductions and not equity impacts. In future work, we plan to treat climate equity more fully (e.g., how policies can be designed to align with Justice40 and how to overcome barriers faced by overburdened and underserved communities).

Livable Communities

LIVABLE COMMUNITIES: WHAT ARE WE BUILDING TOWARD?

We envision a future in which American communities offer the opportunity to lead healthy, fulfilling lives with equitable access to good housing, jobs, and transportation with reduced pollution and improved health.

The transition to a net-zero emissions economy offers opportunities to improve life in communities across the United States. This transformation can be accelerated by an all-in strategy of policies and actions that focus on where we live and work, and on how people and goods move around our communities. Government, business, and civil society can work together to achieve solutions that offer the dual benefits of improving community well-being while simultaneously reducing emissions. For the transition to be one that benefits all of America, investments must intentionally support low-income communities, communities of color, and communities currently dependent on fossil fuels.

We can build communities where housing is accessible for a range of income levels and household sizes and is situated near good jobs, schools, recreational opportunities, healthy food and clean water, shopping, and transit. Schools, local and state government funding, and partnerships with businesses can prepare a low-carbon workforce for well-paying jobs that support people and families. Retrofits and new building standards allow electrified homes, businesses, and public buildings to be safer and more comfortable. Policies and incentives can support low-income residents and renters who cannot cover upfront costs for clean-energy systems and can help ensure that long-term residents are not displaced as neighborhood buildings improve. In more dense or urban areas, investment in diverse low carbon transportation options, such as rapid public transportation, safe biking and walking infrastructure, and micro-mobility options can provide alternatives to private vehicles. Reducing reliance on private vehicles can reduce local pollution, the high risk of crashes, inequitable land use for public parking, and regressive mandates for private parking. In communities with lower density, private vehicles will remain dominant, and expanded EV charging infrastructure and affordable EVs will be needed. Companies can make use of electric vans, light-duty vehicles, and cargo e-bikes to handle last mile deliveries and improve logistics to reduce vehicle miles traveled (VMT) as e-commerce continues to expand. With reduced local pollution from less fossil fuels, community spaces will be healthier and less polluted.

LIVABLE COMMUNITIES: WHAT ARE THE BENEFITS?

Improving transportation systems and buildings can reduce GHG emissions, improve health, reduce costs for individuals, and offer other economic gains (Figure 4).

FIGURE 4

Road to 2030: Livable Communities

- GHG emissions reductions from transport and buildings
- Improved air quality due to reduced transportation emissions
- Improved indoor air quality due to appliance electrification
- Better access to jobs and amenities through improved transport and land use planning
- Energy cost savings
- Quality jobs revitalizing communities and increasing upward mobility

GHG Emissions Reductions

Our analysis shows that actions, such as deep retrofits in existing buildings, increased energy efficiency and requiring new buildings to be all electric by 2030, can result in a 26 percent reduction in emissions from 2005 levels in all buildings by 2030.

Similarly, achieving two-thirds of new light-duty vehicle sales being zero-emissions by 2030 and taking ambitious action to reduce per capita VMT can help significantly reduce transportation emissions. Our analysis shows that a rapid transformation of the transportation sector, backed by comprehensive measures toward vehicle electrification and efficiency and paired with a rapidly decarbonized power grid, can result in a 39 percent reduction in transportation emissions by 2030 relative to 2005 levels.

Local Pollution Reduction and Improved Health Outcomes

Electrifying buildings and transportation will reduce local air pollution. Electrifying personal and public vehicles, especially buses, can make cities healthier and promote equity. Diesel-powered school buses and transit buses create harmful air pollutants and affect the health of students, transit passengers, and people who live along bus routes.[40] In Los Angeles, the environmental benefits of operating an electric rather than a diesel bus fleet have been estimated at $65 million annually. Because people of color are 50 percent more likely to live near a busy road and because the median income of people living near busy roads is below the national average,[41] widespread adoption of EVs can help to address equity issues. Importantly, EVs must be made affordable for low-income households.

Replacing gas appliances with electric appliances in buildings can reduce indoor air pollution. Replacing a gas stove with an electric stove can reduce median NO_2 emissions by 51 percent in the kitchen. Low-income households may be at higher risk for exposure to gas stove pollution, so making electric stoves affordable for low-income households can also help to reduce their risk.[42]

Reducing VMT also offers diverse health benefits, including lowering the risk of traffic-related collisions, lowering rates of asthma, improving mental health, and increasing physical activity.[43] Because increased physical activity and reduced exposure to air pollution and traffic noise reduce premature death,[44] reductions in VMT can improve the health of residents.

Reduced Costs for Individuals

Equitable building electrification can help reduce the inequitable energy cost burden where low-income, African American, and Latino households experience an energy cost burden up to three times larger than the cost of energy in other homes.[45] Zoning laws to allow mixed-income housing in wealthy urban neighborhoods can help to address the housing shortage that is most prevalent in rentals for very low-income households, with both climate and equity benefits.[46] Inclusive zoning can also help address the racial wage gap and improve labor mobility.[47]

Recent research from RMI shows that new electric homes are now less expensive than new mixed-fuel homes across a series of case studies.[48] The new all-electric home has both lower upfront costs and utility bills compared to the new mix-fuel home in the eight cities studied, apart from higher upfront costs in Minneapolis, where colder weather requires a higher-capacity heat pump.[49]

EVs are also becoming increasingly cost-effective relative to combustion engine vehicles. Although the current upfront cost of an EV is generally higher than that of a combustion-engine vehicle, these can be offset by tax credits, other incentives, and lower operating costs.[50] A 2021 study found that the net present value of investment in an electric bus relative to a diesel bus is currently positive in about two-thirds of urban counties in the United States.[51]

In Los Angeles, the environmental benefits of operating an electric rather than a diesel bus fleet have been estimated at $65 million annually.

Job Creation

Electrification of buildings can create jobs. Building electrification in the state of California alone could support up to an average of 100,000 sustained jobs annually through 2045 (2.5 million job-years), even after accounting for associated job losses in the gas industry.[52] U.S. EV production could also be a source of high-quality, unionized jobs that support a strong middle class,[53] as has historically been the case with the auto industry.

LIVABLE COMMUNITIES: HOW DO WE GET THERE?

All parts of society have important roles to play to promote livable communities and reduce emissions based on their authorities, resources, and expertise.

While measures taken at all levels can deliver benefits on their own, a comprehensive, integrated approach in which nonfederal and federal actors work in tandem will be required in order to deliver the benefits and results outlined in this report. Figures 5 and 6 summarize key actions that each type of actor would need to take to further this transition for the transportation and buildings sector. Synergies are explored below for actions focusing on infrastructure investment, vehicle emissions standards, ZEV procurement goals and mandates, building standards, electrification incentives, and land use planning. Figure 7 offers an illustrative view of these interactions for promoting rapid EV adoption.

Building electrification in the state of California alone could support up to an average of 100,000 sustained jobs annually through 2045 (2.5 million job-years), even after accounting for associated job losses in the gas industry.

Infrastructure Investment

Doubling federal funding for public transit with support for operating expenses, including $80 billion for passenger and freight rail and 100 percent electrification of school bus fleets, can expand the reach and accessibility of transit as an alternative to private vehicles. To make best use of federal transit funding, cities can invest in low-cost, high-impact infrastructure interventions such as transit-only lanes. Investment in public transit will especially benefit low-income communities, communities of color, people with disabilities, and elderly communities, as these are the communities most affected by lack of access to transportation.[54] Access to jobs in small towns, suburbs, and under-resourced cities without public transit can be expanded by investing in shared means of transportation,[55] such as car-sharing and bike-sharing.

Public and private investment is also needed to vastly expand public EV charging infrastructure. A federal infrastructure investment that includes 1 million new EV charging plugs, along with partnerships with states to deploy EV charging infrastructure along major travel corridors, can help spur this expansion. Utilities can also invest in ZEV infrastructure and develop rate structures that value the grid benefits of flexible charging. Businesses can invest in and host charging infrastructure in their parking lots, with a goal of ubiquitous workplace and retail center charging. In turn, cities can expedite permits for charging infrastructure, making utility, business, and federal investments more effective, more quickly. Access to charging needs to be broadly distributed across all types of communities and all income levels. Targeting EV purchase incentives to low-income households, as well as funding the installation of charging infrastructure at off-street parking for low-income residences or at nearby public locations, could make access to EVs more equitable.

FIGURE 5

The Transportation Sector with an All-In Strategy

"ALL IN" BREAKTHROUGH ACTIONS:

- **Mandate/incentivize phase-out of internal combustion engines for light-duty vehicles by 2035 and medium- and heavy-duty vehicles by 2045 (federal and state)**
- **Produce and procure ZEVs, targeting 100% of light-duty vehicle sales by 2035 and at least 30% of heavy-duty vehicle sales by 2030 (all)**
- **Invest in mass transit and one million new EV charging plugs that are broadly available to all communities (all, led by federal)**

NATIONAL POLICIES

- Mandate strong vehicle emissions standards for light-, medium-, and heavy-duty vehicles
- Incentivize ZEVs through tax credits for light-, medium-, and heavy-duty ZEVs
- Invest in EV infrastructure, including one million new EV charging plugs
- Partner with states to deploy EV charging infrastructure along major travel corridors
- Accelerate the phase-out of internal combustion engines (ICE) through vehicle scrappage programs
- Invest in mass transit, including $80 billion for passenger and freight rail and 100% electrification of school bus fleets

STATE POLICIES

- Lock in stringent vehicle emissions standards for light-, medium-, and heavy-duty vehicles
- Mandate ICE vehicle phase-downs and ZEV sales targets for all on-road vehicle types
- Incentivize and procure ZEVs and charging infrastructure for public and private fleets
- Mandate emissions reductions through low carbon fuel standards and/or cap-and-invest policies

CITY POLICIES

- Procure 100% zero-emission vehicles and set targets for private fleets
- Incentivize ZEV deployment through low- and zero-emission zones and expedited permitting for charging infrastructure
- Update urban planning and zoning to incentivize per-capita vehicle miles traveled (VMT) reductions of 1% annually

BUSINESS ACTIONS

- ***Major auto manufacturers:*** Transition to all-electric light-duty sales by 2035
- ***Utilities:*** Invest in ZEV infrastructure and set rate structures that support efficient EV charging
- ***Large heavy-duty fleet owners:*** Pilot new models and transition toward 100% ZEV procurement

CIVIL SOCIETY ACTIONS

- Educate and promote adoption of ZEVs and reduced use of personal vehicles
- Procure 100% zero-emission vehicles for institutional fleets
- Educate and promote adoption of ZEVs and advocate for better mobility options that are safe, accessible, low-carbon, and equitable

Priority high ambition policies that can lead to **50–52% emissions reductions by 2030**

An All-In strategy to reach economy-wide 50–52% emissions reductions by 2030 requires a rapid transformation of the transportation sector. Emissions in the sector will need to decline by nearly 40% from 2005 levels, contributing to just over 20% of the needed economy-wide reductions (the second-largest sector reductions). A coordinated effort across all of society will accelerate and enable widespread electric vehicle production and sales. Through incentives, investments, and—importantly—reinstating strong vehicle emissions standards, the federal government can enable the broad changes required. States can further lock in emissions standards and sales targets, cities can lead by example (e.g., through investing in municipal fleet electrification), while cities, businesses, and civil society further bolster this effort by creating and educating a market that is ready for such a swift transformation—and in turn, reap its benefits.

FIGURE 6

The Building Sector with an All-In Strategy

"ALL IN" BREAKTHROUGH ACTIONS:

- **Mandate/incentivize energy-efficient, all-electric appliances and zero-emissions new buildings by 2030 (federal, state, city)**
- **Invest in building electrification and efficiency upgrades, with a priority for low- and middle-income housing (federal, state, city)**
- **Raise awareness of public health and climate dangers of gas (all, especially civil society)**

NATIONAL POLICIES

- Incentivize rapid efficiency upgrades by doubling the existing homes tax credit incentive rate and increasing the commercial buildings tax deduction to $3 per square foot through 2030
- Adopt a performance-based standard for all federal buildings, increasing the renovation rate to 3% per year with deep retrofits of 40% energy savings
- Invest in funding programs (e.g., Weatherization Assistance Program, Weatherization Readiness Program) to accelerate retrofits, with a priority for low- and middle-income homes
- Update appliance efficiency standards and expand tax credits to incentivize the transition to zero-emissions buildings
- Expand EPA EnergyStar, DOE Better Plants, and other model programs

STATE POLICIES

- Mandate/incentivize building efficiency and electrification through performance-based, zero-emissions building standards and fuel-neutral Energy Efficiency Resource Standards targeting 2% annual energy savings
- Mandate the incorporation of demand flexibility, including grid-interactive buildings, in state utility resource planning
- Mandate electrification and heating demand flexibility in building codes

CITY POLICIES

- Adopt stretch codes and building performance standards targeting 11% or more savings over base standards and 100% electrification
- Drive accelerated electrification by phasing out gas connections for new building construction
- Mandate electrification and heating demand flexibility in local building codes
- Lead by example through public benchmarking, rooftop solar, and deep efficiency retrofits for city-owned buildings

BUSINESS ACTIONS

- ***Companies and large real-estate holders:*** Invest in energy efficiency and participate in benchmarking and transparency programs
- ***Companies and large real-estate holders:*** Partner with cities, utilities, and DOE to drive investment in electrification and grid interactivity in commercial and institutional buildings

CIVIL SOCIETY ACTIONS

- Invest in facility efficiency and electrification upgrades
- Promote and advocate for energy efficiency in low-income communities
- Enact public pressure campaigns around the dangers of gas—for health and climate change

Priority high ambition policies that can lead to **50–52% emissions reductions by 2030**

An All-In strategy to reach economy-wide 50–52% emissions reductions by 2030 requires a rapid transition to zero-emissions buildings, with direct residential and commercial building sector emissions declining by 26% from 2005 levels. All levels of governance and society must come together to drive this transition, supported by federal government investments and programming that include tax credits and model programs. State and local policies can further enhance ambition to accelerate electrification and energy savings. Businesses, utilities, and civil society can partner to ensure access to affordable electricity—especially for our most vulnerable communities—and build heightened awareness and demand for beneficial electrification.

The federal government, states, and cities should invest in building electrification and efficiency upgrades with a priority for low- and middle-income housing. New federal investments can accelerate building retrofits, in turn helping residents, businesses, and municipalities to reduce their buildings' emissions and costs. For example, Columbia, South Carolina, received $1.4 million of funding through the American Recovery and Reinvestment Act Energy Efficiency and Conservation Block Grant.[56] This funding was used for lighting upgrades in 46 municipal buildings, saving the city $131,000 annually on energy and maintenance costs.[57]

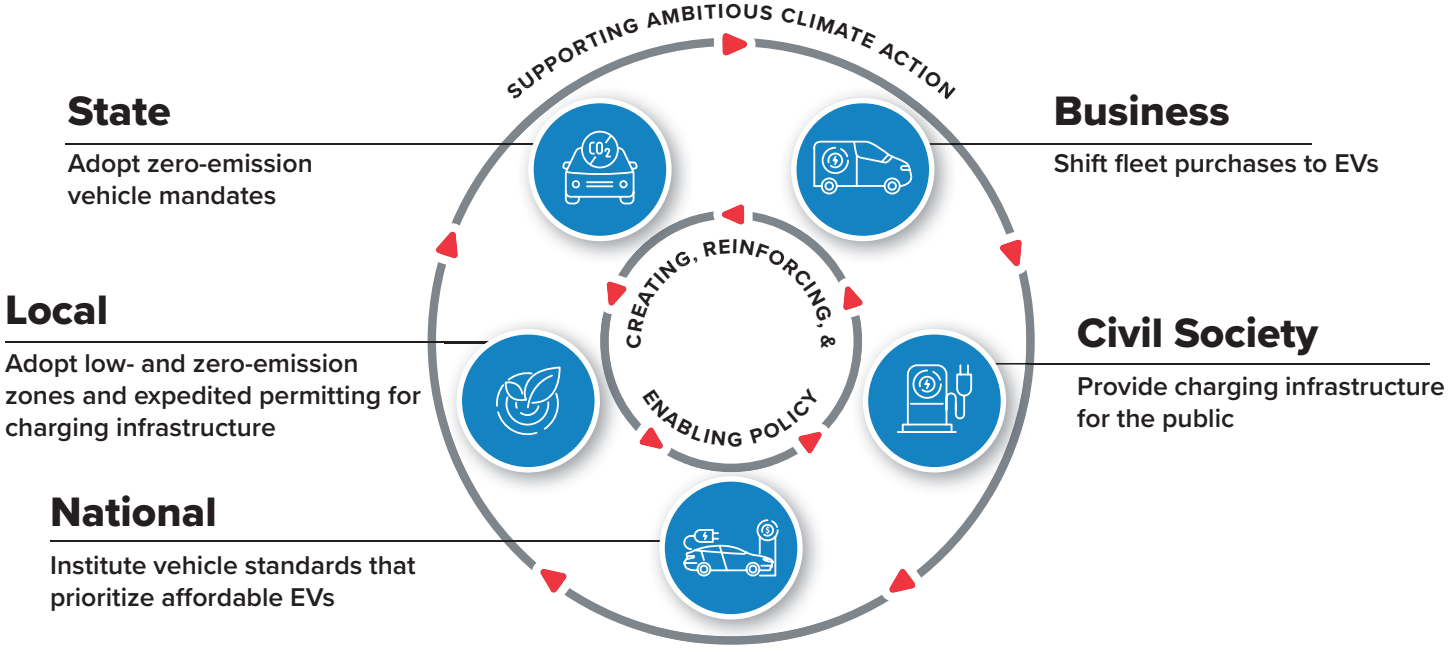
Additionally, while markets and incentives can drive building electrification in some parts of the country, direct federal investment with a priority for low- and middle-income community homes can put community benefits first and presents the opportunity to use building electrification for restorative justice in low-income communities.

The federal government, states, and cities should invest in building electrification and efficiency upgrades with a priority for low- and middle-income housing.

FIGURE 7

The All-In Climate Strategy

Policy Interactions Contributing to Rapid Electric Vehicle (EV) Adoption



Vehicle Emission Standards and ZEV Procurement Goals and Mandates

Significant progress is being made on multiple fronts in the shift to EVs. States are putting in place or accelerating ZEV standards, such as California's and Massachusetts' commitment to reach 100 percent ZEV car sales by 2035. Auto companies are increasingly embracing EVs, spurred in part by a global push to phase out internal combustion vehicles; already six U.S. automakers accounting for 42 percent of the U.S. light-duty vehicle sales market have made commitments to sell 100 percent ZEVs, with target years ranging from 2025 to 2040.[60] Fourteen cities, representing about 5.7 percent of the U.S. population, have made commitments to operate 100 percent electric or zero-emissions public bus fleets.[61]

Strengthened vehicle emissions standards for light-, medium-, and heavy-duty vehicles at the state level can help to accelerate the transition to zero combustion emissions. State mandated phasedowns of ICE vehicles, including 100 percent phase-down of ICE light-duty vehicles by 2035, can spur EV sales. These mandates can also include at least 30 percent new medium- and heavy-duty ZEV sales by 2030, a commitment now adopted in 15 states. Medium- and heavy-duty ICE vehicles should be fully phased out by 2045. Moreover, ambitious state standards can help drive ambitious federal vehicle emissions standards as automakers seek a single national auto market. Strengthened federal fuel economy standards that return at least to prior annual improvement rates by 2026—as proposed by the Biden Administration—and then further increase in stringency through 2030, can reduce emissions from ICE vehicles while encouraging the transition to ZEVs.

Fleet owners, including all levels of government, companies, school districts, universities, and other institutions can prioritize electrification of their fleets. To speed EV adoption, cities and private fleet owners can aim for 100 percent procurement of zero-emissions light-duty vehicles and light commercial trucks and buses. Large heavy-duty fleet owners can also pilot new models and transition toward 100 percent ZEV procurement as the heavy-duty EV market improves. Education and outreach efforts from civil society on adoption of ZEVs and

CASE STUDY

The Science Museum of Minnesota is increasing facility efficiency to meet sustainability goals and show the community the benefits of clean investment.

In 2015, using loans from the Saint Paul Port Authority and gifts from Target, Ecolab, and Wells Fargo, the Science Museum of Minnesota underwent a major building retrofit to capture and reuse the facility's waste heat, cutting its carbon emissions by 30 percent and saving $300,000 annually on utility bills. Encouraged by those results, in 2019 the museum adopted a carbon neutrality goal of cutting emissions by 50 percent by 2030 and becoming net zero by 2050. The museum then fully subscribed to Xcel Energy Windsource[58] - a program that allows customers to power their homes or businesses with regionally generated wind energy. Now, just two years later, the museum has achieved its 2030 goal nine years ahead of schedule. The museum is now pursuing a collaboration with Darcy Solutions, a start-up company based on University of Minnesota research, to demonstrate a new approach for using the Earth to heat and cool buildings.[59]

These efforts by a highly regarded institution that has educated visitors for more than a century are impactful and encouraging to the community. By working with businesses, utilities, and universities, the museum is making huge strides toward achieving its climate goals beyond what would have been possible had it worked alone.

benefits of reduced use of personal vehicles can further speed EV adoption.

Incentives can be designed to make EVs more affordable. A federal vehicle scrappage program with incentives for high-mileage vehicles together with enhanced and extended EV tax credits can be designed to benefit low-income households and small businesses. High profile anchor institutions like local community-based organizations and churches can help promote participation.

Cap-and-invest programs, clean fuel standards, and other carbon-pricing mechanisms covering transportation can also be pivotal in accelerating the transition to zero combustion emissions. For example, in California, Washington, and Oregon, clean fuel standards mandating a reduction in the carbon intensity of fuel over time provide incentives for low-carbon fuels produced from waste as an alternative to gasoline or diesel for heavy-duty vehicles.

Building Standards and Incentives to Promote Electrification

Building codes and appliance standards can reduce the energy and emissions footprint for new, updated, and replaced buildings. The federal government, states, and, to the extent they have the authority, cities should mandate/incentivize energy efficient, all-electric appliances, and new buildings should be zero-emissions by 2030. Strong appliance standards make it easier for everyone to set and meet stringent building codes. The federal government has the lead on establishing standards for most categories of appliances and can adopt heightened efficiency standards for appliances to drive the transition to zero-emissions buildings. States can do the same for appliance categories that lack federal standards.

Building energy performance standards can guide large commercial buildings to become more efficient. States can adopt performance-based, zero-emissions building standards and fuel-neutral Energy Efficiency Resource Standards (EERS) standards, targeting 2 percent annual energy savings and 100 percent electrification of newly sold building components and appliances by 2030. Regulators can direct utilities to provide energy efficiency, energy storage, and distributed generation incentives that are coupled with strong outreach programs to low-income neighborhoods and small businesses. Local anchor institutions like schools and hospitals can help extend the reach of these outreach programs.

CASE STUDY

New Orleans is working to bring solar power to low-income residents.

New Orleans is finding ways to reduce the energy burden by incentivizing retrofits. In early 2020, the city kicked off the Solar for All NOLA program[62] to provide free solar evaluations for city residents, encouraging solar and energy efficiency upgrades and driving energy bill savings. Led by the Greater New Orleans Housing Authority, the year-long campaign is focused on reducing the energy burden on lower income residents in the community by offering solar options for no money down, no credit requirement solar leases, or traditional financing for eligible homeowners.

Companies and large real estate holders can partner with cities, utilities, and U.S. Department of Energy programs to drive investment in electrification and grid interactivity in commercial and institutional buildings.

State and, where they have the authority, local governments can also incorporate electrification and heating demand flexibility, such as connected heat pumps, into building codes. States should also mandate the incorporation of demand flexibility into state utility resource planning. City stretch codes and building performance standards can target 11 percent or more savings over base standards and 100 percent electrification. Building codes that accommodate charging infrastructure can play a role in the electrification of personal vehicles. Cities can also speed electrification by ensuring that all new air conditioning units are heat pumps, banning gas connections for new residential and commercial development, and phasing out gas appliances. Public advocacy campaigns from civil society around the health and climate dangers of gas can help to accelerate the phase-out of gas in buildings.

Smart policies and incentives will be needed to improve the energy performance and comfort of existing buildings. Building codes apply to new construction and major renovations, limiting the number of buildings reached by building codes each year. State and local policies that require energy audits and set benchmarks for improvements when buildings are sold can ensure that a building's performance improves as it changes hands.

Enhanced and extended federal tax credits for efficiency upgrades in new and existing residential and commercial buildings can support the electrification of buildings, including doubling the existing homes tax credit incentive rate and increasing the commercial buildings tax deduction to $3 per square foot through 2030. Utility rate structures to minimize cost can help individuals moving toward electrified homes.

Expanded federal-state partnerships can also improve quality of life inside buildings.

Expanded federal-state partnerships can also improve quality of life inside buildings. By increasing funding for the federal Weatherization Assistance Program and Weatherization Readiness Program, the government can prioritize building maintenance, weatherization, and electrification in communities that have unsafe living conditions and high energy burdens. An expanded Low Income Home Energy Assistance Program can mitigate the cost of temporary energy bill increases in low-income homes after electrification.[63] Access to cooling should not be compromised through electrification, as a lack of access to cooling can become life-threatening, particularly as heat waves increase in frequency and severity across the United States.

Land Use Planning

Smart local and regional land-use plans can steer development and redevelopment in ways that balance jobs and housing while offering local shopping, entertainment, and green spaces. Policies to prevent displacement of long-term residents will be vital to ensuring equitable development and redevelopment of cities. Focusing increased density toward transit hubs and along transit corridors can be a principal element of these land-use plans. For example, with funding support from the U.S. Department of Transportation, Youngstown, Ohio, is investing $31 million in its SMART2 multi-faceted transportation infrastructure project, designed to connect all the major downtown economic players with a central transportation hub.[64]

States can support these local efforts by coupling VMT reduction targets with technical and financial support for cities and regions that create plans to meet or exceed those targets. Private developers can play an important role through the design of the projects they pursue, and states can support developers by eliminating regressive policies like mandatory parking requirements that increase VMT by incentivizing car ownership, inequitably subsidize car ownership, and raise the cost of housing.

VMT is a concern in terms of congestion, safety, and local pollution as well as carbon pollution. In large urban centers, measures like congestion pricing and low- or zero-emission zones can reduce emissions and improve quality of life. The rise of ride-hailing companies over the last decade are reshaping transportation in urban communities and has the potential to increase congestion. Ride-hailing companies like Uber and Lyft can work with states and localities to develop practices that limit VMT, while shippers and carriers can work to reduce their truck miles per ton-mile through cleaner modes, higher load factors, and improved information and communications technologies that improve the logistics of deliveries.

Restorative efforts are needed to clean up polluted neighborhoods. For example, the U.S. Department of Housing and Urban Development (HUD) can develop a voluntary relocation program for the relocation of residents whose homes were built on toxic land with HUD funds.[65] Expanded eligibility for the Clean Water State Revolving Fund can improve water quality in communities with a legacy of drinking water contamination.[66]

Mutually reinforcing actions can improve local food systems, which is a win for community wellbeing and climate. For example, the U.S. Department of Agriculture can provide grants and subsidies for local food cooperatives and community gardens.[67] This increase in funding can make it easier for local anchor institutions like churches and schools to host or partner with community gardens, and increased regional food production can allow local businesses to source more food from sustainable food cooperatives and gardens. Cities can change or introduce policies and zoning to support local gardening and food production, resulting in more benefits more quickly.

CASE STUDY

A county, a hospital, and a business are working with the community to bring healthy, sustainable food to the Bay Area.

Anchors in Resilient Communities (ARC) is convening an equitable multi-stakeholder table that brings together anchor institutions and community partners in the San Francisco Bay Area to build a stronger regional food system and increase access to sustainable food. Partners include diverse stakeholders ranging from the University of California at San Francisco, Kaiser Permanente, Alameda County, the City of Oakland, UC Berkeley Dining Services, and other community-based organizations. ARC is working with Kaiser Permanente to increase its procurement of local, sustainable food, which contributes to its goal of reaching 100 percent sustainable sourcing by 2025. The project partnership has led to a new $20 million, energy-efficient food production center to process local and sustainable food into patient meals. The partnership is working to engage and educate the community on sustainability, project financing, community ownership opportunities, and more.

With the opening of this new center, ARC partners are working with Dig Deep Farms, a project of Alameda County's Sheriff's Department, to increase local sourcing from black, indigenous, and people of color (BIPOC) farmers.[68]

ARC's coordinating role among the county, a local business, community partners, hospitals, and universities is creating climate solutions and prioritizing opportunities for BIPOC communities.[69]

Clean Economy for the Future

CLEAN ECONOMY FOR THE FUTURE: WHAT ARE WE BUILDING TOWARD?

We envision a future where the economy is powered by affordable, reliable, resilient, and renewable energy that is used increasingly alongside clean fuels to manufacture low-emissions goods and materials.

Sustaining a resilient, thriving, and inclusive economy necessitates rapid decarbonization of the electric grid and whole-of-society cooperation to reduce emissions in hard-to-abate industrial sectors. In addition to reducing emissions, the mobilization toward zero-emissions solutions for electric power and industry can create millions of good-paying jobs, improve public health outcomes, and create opportunities to build a more inclusive, resilient, and competitive economy. Economy-wide decarbonization will require active management of rapidly changing grid resources to ensure reliability, an equitable approach to workforce transition, and strategic investments in industrial solutions.

Today, solar and onshore wind are among the cheapest sources of new U.S. electricity generation as the cost of renewable energy systems continues to drop.[70] A nationwide high voltage grid can connect grid operators through interregional transmission and expanded energy markets, allowing low-cost renewable generation from rural communities to reach load centers in cities. Additional storage capacity can help match peak demand with supply and support grid balancing. The increased availability of clean, cheap, dispatchable renewable energy can bring down the cost of electricity and minimize the energy burden on low-income communities. Reclaiming coal mines and capping, plugging, and repairing abandoned and active oil and gas wells to prevent methane leaks can provide economic opportunity in communities where fossil fuel extraction is prevalent. As electricity, transportation, and buildings decarbonize, low-emission domestic manufacturing facilities can produce batteries, renewable energy components, EVs, heat pumps, and more. Products can be developed in modern plants that have been retrofitted and designed to use electricity, hydrogen, efficiency, and circular economies to set a new low-emissions standard for hard-to-abate industrial sectors. This mobilization can grow a strong, diversified supply chain, with important contributions from American, union-made materials.

CLEAN ECONOMY FOR THE FUTURE: WHAT ARE THE BENEFITS?

The shift to a clean economy requires significant near-term investments that provide long-term benefits, including significant emissions reductions, improved health outcomes, high-quality job creation, and renewed economic development at both the local and national levels. A clean-energy system is not only lynchpin of a decarbonized economy; it also unlocks benefits for individuals, communities, businesses, and others across society (Figure 8).

FIGURE 8

Road to 2030: Clean Economy for the Future

- GHG emissions reductions from power and industry
- A modernized and resilient renewable energy grid
- A revitalized manufacturing sector delivering low-carbon goods
- Economy-wide job creation to support the clean energy transition
- Improved health due to improved air quality
- Diverse local economy

Emissions Reductions

Policies and investments driving a decarbonized electric grid and industrial sector, including clean-energy mandates, significant investments in infrastructure and technology (ranging from large-scale transmission and distribution systems to infrastructure to stem methane leaks), and stronger CCUS incentives, can drive significant GHG emissions reductions. In the electric power sector, our analysis shows that the rapid shift to a cleaner grid can reduce emissions by 83 percent relative to 2005 levels by 2030. In the industrial sector, our analysis shows how an all-of-society policy framework can set the United States on a path toward deep decarbonization, reducing industrial emissions 22 percent under 2005 levels by 2030.

The transformation of the electric power sector is the centerpiece of the clean-energy transition. A modernized renewable energy grid unlocks a broad set of opportunities that could deliver a vast majority of U.S. emissions reductions in the current decade.[71] Emissions reductions in the electric power sector alone account for roughly 60 percent of emissions reductions achieved by 2030. As illustrated in the prior section, by electrifying end uses in other sectors—shifting from ICE vehicles to EVs, replacing gas-fired building heating with electric heat pumps, and replacing fossil sources of industrial process heat with electric furnaces where feasible (e.g., steel production)—the impact of a clean grid is felt economy-wide. These distributed end uses in turn can provide benefits back to the grid, functionally serving as levers to help manage a higher level of electricity demand.

Improved Health Outcomes

Investments in a decarbonized electric grid and cleaner industrial production also translate to improved health outcomes: lives saved, illness avoided, and healthcare costs reduced. A recent study finds that policies to achieve 80 percent clean electricity by 2030 would prevent more than 300,000 premature deaths through 2050, resulting in upwards of a trillion dollars in savings.[72] Estimates of air quality impacts vary as research and data monitoring on health burdens improve, but the scale of the savings—trillions of dollars and hundreds of thousands of lives over many decades—is clear.[73] Progress achieved to date in the power sector is already saving lives. One study found that early deaths attributable to power sector air pollution decreased by 60 percent between 2005 and 2018.[74]

CASE STUDY

Houston pursues public-private partnership to meet twin environmental justice and emissions reduction goals.

Houston, Texas is addressing environmental health injustices and combatting climate change through the largest brownfield solar installation in the nation. On January 13, 2021, Houston, Texas, approved a lease agreement with Sunnyside Energy, LLC, to advance the Sunnyside Solar Project, an innovative public-private partnership to convert a 240-acre closed landfill in the Sunnyside neighborhood into the largest brownfield solar installation in the nation. Closed and abandoned in 1970, the landfill has contributed to the stagnation of the neighborhood's economy and presented serious health and safety concerns for children, families, and residents for decades. The project is expected to generate enough clean energy to power 5,000 homes, offset 120 million pounds of carbon per year, bring an estimated $70 million in private investment to the community, and address public health concerns by remediating the landfill.[79]

Investments in clean energy and industrial systems can also mitigate existing disparities in health outcomes. Outdoor air pollution not only imposes steep costs on human life and wellbeing, but also exacerbates persistent health disparities among marginalized communities in the United States. Across virtually all sources of particulate matter air pollution, people of color are disproportionally exposed to the pollutants that worsen health outcomes.[75,76] The COVID-19 pandemic also illustrates how these disparities can be further magnified during a public health emergency. Research already indicates that exposure to air pollution leads to higher COVID-19 mortality.[77] As highlighted previously, transportation is a major driver of adverse air quality impacts; these impacts are also pronounced when it comes to industrial activity and electric power generation, underscoring the importance of policies that advance environmental justice.[78]

Revitalized American Economy

Finally, investments in a clean-energy economy can also be investments in an economy that features high-quality jobs, a re-energized U.S. manufacturing sector, renewed competitiveness abroad, and refreshed dynamism at home. The scale of the transformation required can support millions of jobs, creating opportunity to mobilize resources on a historic scale in a way that ensures that benefits are shared broadly, felt locally, and made to last.

Estimates of the job creation capacity of meeting 80 percent clean electricity by 2030 indicate that job creation would sum to hundreds of thousands of net new jobs created annually while deploying up to trillions of dollars in clean-energy investment.[80] Critically, this potential can be filled by good jobs: Clean-energy jobs today provide above-average pay, have lower barriers to entry (via lower educational requirements), and provide career stability in a growing field.[81,82] By ensuring that clean-energy jobs come with high labor standards, the benefits of an economic transformation that spurs inclusive growth can be felt by millions of workers.[83]

As the United States works to achieve its climate goals, investments in innovation, deployment, and commercialization of clean-energy technology can seed innovation ecosystems.

As the United States works to achieve its climate goals, investments in innovation, deployment, and commercialization of clean-energy technology can seed innovation ecosystems.[84] This, in turn, helps shape vibrant local economies that are more resilient to disruption and able to re-invest in their communities. It also propels a strong U.S. industrial and manufacturing base, composed of large actors alongside a revived ecosystem of small and medium enterprises, that invests in diversified supply chains and domestic manufacturing capabilities, advancing U.S. competitiveness in key industries and technologies for the energy transition (e.g., battery storage and EVs) and supporting economic and national security. A clean-energy economy is a more resilient, competitive, and dynamic economy.

CLEAN ECONOMY FOR THE FUTURE: HOW DO WE GET THERE?

This rapid, large-scale transformation of the electric and industrial sectors requires leadership from local, state, tribal, and federal governments along with business, financial, and cultural institutions.

Delivering on the emissions results and benefits outlined in this report will require coordinated action at all levels of government and society. Figures 9 and 10 summarize key strategies that could be taken by diverse types of actors to further this transition for the electricity and industry sectors, respectively, which are the basis for a prosperous, thriving economy that leaves no one behind. Every public and private actor has a unique role to play in driving down sectoral emissions. These contributions can be amplified by cross-actor and cross-sectoral interactions to accelerate emissions reductions. Key policy levers, roles of different groups of actors, and synergies are explored further in this section for clean electricity

standards and tax credits, support for distributed generation, public and private procurement policies, siting and investing in a resilient grid, investing in RD&D for storage and hydrogen, and workforce training. Figure 11 offers a conceptual view of these interactions contributing to 100 percent clean electricity.

Clean Electricity Standards, Programs, and Tax Credits

State-based RPS and clean electricity standards are major drivers in reducing electric sector emissions. Their impact could be enhanced with support from a strong national policy targeting 80 percent clean electricity nationally by 2030 and 100 percent clean electricity by 2035. A federal program could establish a national standard as a floor or offer direct incentive payments for those who meet their targets and fines for those that don't comply. Leading states can establish mandates that go beyond the federal floor. These policies can be designed to account for considerations of the energy burden on low-income electricity customers.

Federal clean-energy tax credits can further support long-term renewable industry growth. Long-term extensions of tax credits with direct pay provisions can provide industry certainty and encourage long term planning and investment. Current tax credits are used to offset tax liabilities, limiting their use by entities with little or no liability unless they work with tax equity investors or third-party developers, reducing the efficacy of the incentive. Direct-pay tax credits can allow for more efficient use of incentives by not-for-profit entities like municipal utilities, coops, and cultural institutions. Even regulated utilities only had enough tax appetite to build just 4GW of solar and wind combined in 2019.[85] Direct-pay tax credits for residential and commercial solar can also address equity issues by allowing low- to moderate-income homeowners, small businesses, and non-profits to receive the full value of the investment tax credit. This will also support continued growth of the distributed and rooftop solar industry. Allowing wind, solar and geothermal storage projects either the production tax credit or investment tax credit would further increase their value for developers, doubling emissions reductions from the tax credit[86] and creating jobs.

Direct-pay tax credits can allow for more efficient use of incentives by not-for-profit entities like municipal utilities, coops, and cultural institutions.

FIGURE 9

The Power Sector with an All-In Strategy

"ALL IN" BREAKTHROUGH ACTIONS:

- **Mandate/incentivize 100% clean electricity by 2035 and 80% or more by 2030 (federal and state)**
- **Procure 100% clean electricity on a 24/7/365 basis as soon as possible (all)**
- **Invest in RD&D to ensure a reliable, resilient energy supply that is largely renewable (federal, business)**
- **Train and inspire the clean-energy workforce while supporting community transition (all, especially civil society)**

NATIONAL ACTIONS

- Mandate/incentivize 100% clean electricity by 2035 and 80% or more by 2030, including a phaseout of coal
- Incentivize rapid clean energy deployment through a 30% investment tax credit and 2.5 cents/KWh production tax credit through 2030
- Invest in a reliable, resilient electric grid, including RD&D for energy storage and 10GW additional interregional transmission capacity
- Increase 45Q to $85/ton through 2030 and mandate/incentivize 90% carbon capture for all new baseload plants burning natural gas starting in 2025

STATE ACTIONS

- Lock in CES of 80% or more by 2030, with renewable resources making up at least 60%
- Incentivize nuclear fleet retention through zero emissions certificates and other policies that support reliable, zero-carbon generation
- Expand wholesale markets and coal securitization to accelerate coal and gas retirements
- Invest in infrastructure and sequestration site identification to expand CCUS projects
- Mandate/incentivize utility energy storage to adequately value grid services and other benefits

CITY ACTIONS

- Procure 100% clean electricity for municipal operations, using municipal rooftops where possible
- Partner with utilities and regulators to procure 100% clean electricity for all city-wide customers

BUSINESS ACTIONS

- ***Utilities:*** invest in and plan for transition to 100% clean power, including supporting the phaseout of coal
- ***Large corporate buyers:*** procure clean electricity on a 24/7/365 basis
- ***Utilities:*** partner with national labs and RTOs to implement utility-scale storage demonstration projects

CIVIL SOCIETY ACTIONS

- Inspire and train the clean-energy workforce
- Procure clean electricity on a 24/7/365 basis
- Advocate for a rapid phaseout of coal and gas

Priority high ambition policies that can lead to **50–52% emissions reductions by 2030**

An All-In strategy to reach economy-wide 50–52% emissions reductions by 2030 will deliver a transformed power sector. Emissions from electricity generation will need to decline by more than 80% from 2005 levels—contributing to more than half of needed economy-wide reductions. This means that an all-hands-on-deck approach is more important than ever to lock in the transition to a clean-energy economy. The national government can lead on many of these changes by setting a strong national CES that allows states to continue playing a pivotal role as innovator and implementer. Cities, businesses, and civil society reinforce the transition by partnering on aggressive procurement targets, investing in storage, and enhancing the call to action for stronger, more ambitious action at all levels.

FIGURE 10

The Industrial Sector with an All-In Strategy

"ALL IN" BREAKTHROUGH ACTIONS:

- **Mandate best practices and prohibit venting and flaring at oil and gas sites, reducing fugitive methane leakage by at least 60% by 2030 (federal, state, cities in oil-producing regions)**
- **Incentivize CCUS, innovation, and low-carbon solutions in hard-to-abate sectors (federal and state)**
- **Implement "buy clean" requirements for emissions-intensive goods and infrastructure (e.g., cement and steel) (all)**
- **Raise awareness about green products and construction practices (all, especially civil society)**
- **Mandate stringent refrigerant management protocols and use of low-GWP alternatives wherever viable, driving down HFC emissions by 40% or more by 2030 (federal, state)**

NATIONAL POLICIES

- Mandate best practices and prohibit venting and flaring at oil and gas sites, reducing fugitive methane leakage by at least 60% by 2030
- Increase the 45Q tax incentive to at least $85/ton to incentivize CCUS innovation and deployment in heavy manufacturing and fuel production
- Implement "buy clean" requirements for cement and steel
- Incentivize and promote U.S. clean manufacturing through the Section 48C advanced manufacturing tax credit and a carbon border adjustment mechanism
- Incentivize the uptake of low-carbon or zero-emissions fuels in heavy industry through a hydrogen production tax credit and a revamp of clean fuel mandates

STATE POLICIES

- Implement "buy clean" requirements for public infrastructure development
- Require stringent refrigerant management protocols and use of low-GWP alternatives to lock in HFC emissions reductions beyond federal requirements
- Incentivize CCUS in emissions-intensive, hard-to-abate sectors with performance credits that stack onto the federal 45Q CCUS tax credit
- Mandate/incentivize stronger industrial efficiency standards (e.g., with EERS policies and ISO 50001 energy management systems)
- Mandate best practices and prohibit venting and flaring at oil and gas sites, reducing fugitive methane leakage by at least 60% by 2030

CITY POLICIES

- Implement city-level enhanced efficiency targets
- Establish green building and infrastructure requirements

BUSINESS ACTIONS

- ***Heavy industry:*** Partner with the government to invest in CCUS and clean manufacturing to slash emissions in hard-to-abate sectors
- ***Large consumers of manufactured goods:*** Implement scope 3 emissions reduction targets to increase demand for clean products

CIVIL SOCIETY ACTIONS

- Increase demand for clean products by spreading awareness of their environmental and social benefits

Priority high ambition policies that can lead to **50–52% emissions reductions by 2030**

An All-In strategy to reach economy-wide 50–52% emissions reductions by 2030 requires a modernized U.S. industrial sector, with emissions from industry declining by 22% from 2005 levels. The federal government can play a major role in accelerating innovation and deployment of solutions. States can complement enhanced federal policies with additional—and stronger—incentives and efficiency standards to lock in the transition. Cities, corporations, and civil society can create demand across the supply chain—securing a reliable market and driving the production of clean products.

As new renewable generation comes on the grid, utilities will need to accelerate the retirement of existing fossil fuel infrastructure. This can be achieved through financing the clean-energy transition through low-cost rate-payer state-backed security bonds. These bonds help regulated utilities ease the burden of uneconomic investments like coal power plants, while allowing utilities to reinvest in renewable energy and storage. This can help ensure that ratepayers are not paying the short-term costs of early retirement of fossil fuel assets, reducing the burden on low-income residents.[87] The savings from renewable energy, energy efficiency, and electrification would pay for the cost of the loan over time, with the public fully recouping the investment. States and the federal government could use similar financing schemes to help industry refinance investments in high emitting factories to use new lower-emission technologies.

Procurement Using "Buy Clean" and Domestic Content with Strong Labor Standards

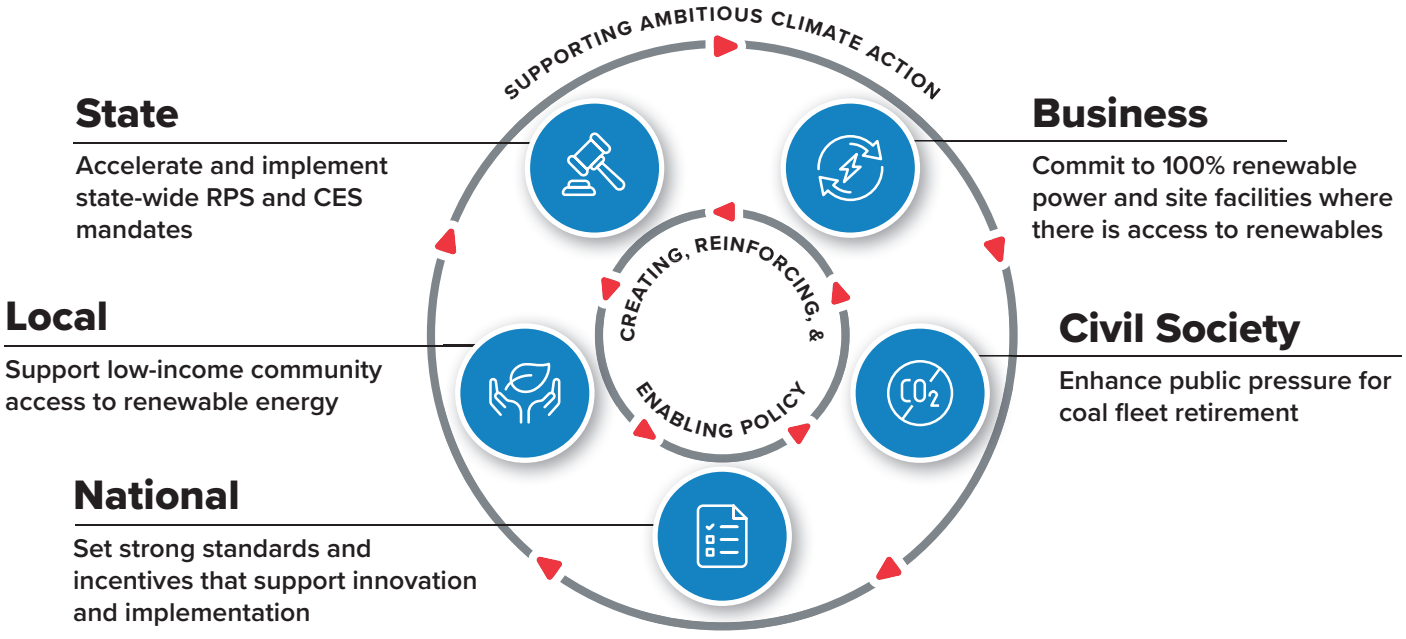
"Buy clean" standards for low-carbon construction materials can drive economies of scale for domestic low-emission technologies and help ensure high labor standards. Public and private purchasers can use these commitments to help catalyze markets for low-GHG products. In conjunction with smart performance-based standards and investments in RD&D to accelerate deployment of solutions for hard-to-abate sectors like steel and cement, procurement can pave the way toward a U.S. industrial sector that contributes to a carbon neutral future. Executed well, "buy clean" legislation can not only support the development of a thriving low-emission industry in the United States, but can also create good-paying union jobs by tightening labor standards, creating new avenues for enforcement, and opening up opportunity by spurring development of new fields.

Cities can play leading roles in public power procurement by requiring 100 percent clean electricity for all municipal operations and partnering with utilities and regulators to procure clean electricity for city wide customers. Local governments, businesses, tribes and community organizations can enter into power purchase agreements (PPAs) for solar, wind, and storage in areas with municipal utilities or retail choice, and virtual PPAs in states that are vertically integrated. These same

FIGURE 11

The All-In Climate Strategy:

Policy interactions contributing to 100% clean electricity



entities can bundle renewable electricity demand through community choice aggregation (CCAs), addressing community-wide load and helping regions with rapid power sector decarbonization. Additional legislation will be needed to expand access to CCAs as only a handful of states currently allow it. Solarize campaigns that help homes and businesses go solar together are another tool available to local governments to increase solar adoption in communities of color and low-income communities and neighborhoods. These campaigns often partner with community organizations and financial institutions to access bulk solar discounts and reduce financial barriers.

State and local programs to support low-income residential and community solar power can ensure the widespread accessibility of renewable energy benefits, while providing high quality jobs in underserved communities. For example, the GreenPower solar workforce training program in Madison, Wisconsin trains and hires workers locally from underrepresented populations to advance the solar transition.[88] The program has installed 1 MW of solar on city facilities as of October 2020. After 2020, Mayor Rhodes-Conway intends to ramp up the program and add 1 MW annually by 2022 to support a municipal goal of 100 percent renewable energy by 2030. Renewable energy companies, universities, and community colleges can work together to improve racial and gender diversity for jobs in wind, solar and geothermal, including positions in leadership.

Siting and Investing in an Interconnected, Resilient Grid and Distributed Generation

A nationally interconnected electric grid powered primarily by renewable energy is the backbone of a zero-emissions economy, improving reliability and preventing outages due to extreme weather like the recent disaster in Texas. Effective coordination among federal, state, tribal, and local governments and private entities is vital to siting transmission on existing rights of way, such as state and federal highways and rail lines to help alleviate grid congestion. Congress can direct the Federal Energy Regulatory Commission (FERC) to improve the interregional siting process by establishing a cost allocation methodology that better reflects the benefits of transmission solutions. A 30 percent investment tax credit for transmission projects could increase financial certainty for transmission investments.

Additional high-voltage direct-current transmission lines can help connect renewable energy generation to load centers in cities, helping local governments meet procurement goals and states meet RPS targets affordably. For example, the Morongo Band of Mission Indians is getting a portion of ownership and profits of a transmission line that runs through its reservation to power the heavily populated Southern California region with renewable energy.[89] This shared ownership is part of the Southern California Edison's West Devers Upgrade and triples the system's capacity to transmit renewable energy to city centers in Southern California, demonstrating the collaborative connections that must be in place to connect renewable energy supply and demand.

A modernized renewable energy grid also requires building out energy storage capacity. All sectors of society can play an important role in managing load and deploying dispatchable electricity. Federal, state, and local governments can incentivize energy storage—including pumped-hydro, battery, thermal and hydrogen storage—to ensure reliability as coal and gas powerplants are replaced by renewables. Electrified transportation and buildings can help with load balancing by using vehicle-to-grid and smart grid technology. Time-of-use pricing paired with EV charging can store energy during times of excess supply and dispatch energy when demand is highest.

Federal and University RD&D and Public-Private Partnerships

Investments in research and development can help emerging technologies for electric-sector storage and industrial processes reach technological readiness, while investments in late-stage development and deployment help ensure they can scale. For the development of long-duration energy storage, hydrogen electrolyzers, and CCUS, close collaboration is needed between federal research labs and universities and private sector developers, users, and customers. The imperative for coordinated RD&D investment extends to solutions for hard-to-abate sectors, including breakthrough technologies that have the potential to drive longer term GHG abatement. Public sector investments in innovation,

whether through direct investment or financing support, can unlock massive positive spillover effects that accelerate the clean-energy transition. Recent successes from Tesla and Nissan in developing EV technology with the help of the U.S. Department of Energy's Advanced Technology Vehicle Manufacturing Loan Program Office showcase this potential.[90]

Preparing the Workforce for the Clean Economy

A critical element of the clean-energy transition is to ensure that economic opportunity and good jobs meet the needs of adversely affected workers and drive growth in communities that have been historically overlooked for economic development. Investments in apprenticeships, community college degrees that support worker training, projects that create opportunities for fossil fuel workers to apply existing skillsets,[91] and solutions that help remediate past environmental harms can ensure that energy workers maintain quality employment opportunities. Many pieces of a just transition, such as where jobs will be concentrated and the skills needed to succeed, are driven as much or more by market forces than they are by policy planning. For example, analysis shows that fossil fuel employment hubs are some of the best candidates for large-scale wind and solar investment.[92] In one case, the Navajo Nation is deploying multiple utility-scale solar energy projects on its reservation, despite an economy that has been historically linked to fossil fuel development. The Cameron Solar Project and the Kayenta Solar Facility are training and employing hundreds of Navajo people in clean-energy construction and maintenance, and bringing in millions of dollars for the nation, which will help lower electricity rates for tribal customers, while connecting more Navajo homes to the grid.[93,94]

Meanwhile, clean-energy jobs already play an outsized role in driving employment in rural areas. Roughly 10 percent of all clean-energy jobs today are in rural counties.[95] In addition to jobs deploying wind, solar, and geothermal power, fossil fuel industry workers can find opportunities installing methane capture equipment on active oil and gas wells, while preparing lands for new economy industries by plugging and remediating abandoned wells and coal mines. Comprehensive leak detection and repair protocols, best-available-technology adoption, and a ban on flaring and venting can be implemented with the goal of achieving a reduction in methane leakage from oil and gas facilities of at least 60 percent in major producing states.

CASE STUDY

Community college partners with businesses and state government to train the clean-energy workforce.

Truckee Meadows Community College is working with Panasonic and Tesla to teach students the skills they need for technical, clean-energy jobs in Nevada.[96] The program, The Gigafactory Training Gateway, kicked off in 2017 and was designed in conjunction with Tesla and other industry partners to teach specific skills that the employer needs. In the 300-hour, 15-credit training program,[97] students learn advanced manufacturing skills needed to thrive at the gigafactory. This project is funded through the Workforce Innovation for the New Nevada, a state fund set up in 2015 by the Governor's Office of Economic Development. Truckee Meadows Community College has received $1.5 million for these types of programs to go toward scholarships, equipment, and staff. The program has a flexible training format, allowing students to take most classes online, start and stop the coursework as they need, and continue their existing jobs. By offering students advanced manufacturing skills training, this partnership provides secure, good paying jobs for the students and ensures quality performance for the company. The college, Tesla, Panasonic, and the State of Nevada are collaborating to ensure success for the Nevada workforce and clean economy.

Healthy Lands

HEALTHY LANDS: WHAT ARE WE BUILDING TOWARD?

We envision a future where natural and working lands continue to provide critical services like food and materials production and clean water, while increasing community resilience to climate impacts and storing increasing amounts of carbon.

U.S. landscapes can remove carbon from the atmosphere and help cities, states, and the nation meet climate targets while delivering economic benefits for rural and urban communities.[98] Ambitious policy actions to protect, preserve, and sustainably manage U.S. natural and working lands are also critical to ensuring that forestry, agricultural, and urban systems are resilient to increasing climate impacts, including wildfires, flood surges, and droughts. By expanding efforts to plant trees, restore forests, support climate-friendly agricultural practices, and protect other vital carbon-storing ecosystems, U.S. lands can deliver even more annual sequestration in 2030 and beyond.

HEALTHY LANDS: WHAT ARE THE BENEFITS?

Within the land sector, nature-based solutions, sustainable agriculture, and ecosystem restoration and management can remove and store large amounts of carbon and offer significant social and environmental benefits (Figure 12).

Carbon Sequestration

Although climate action in other sectors reduces emissions, lands have the potential to remove carbon from the atmosphere and store it, helping to move the country closer to a net-zero or net-negative emissions future. Forests, grasslands, agricultural soils, and urban trees currently provide a large carbon sink, sequestering a net 750 Mt CO_2e every year on average, reducing gross U.S. GHG emissions by more than 10 percent.[99] Studies assessing U.S. pathways to net-zero GHG emissions often assume that U.S. landscapes will continue to provide a robust carbon sink into the coming decades, offsetting emissions in sectors that are costly or technologically difficult to decarbonize.[100] However, climate risks like wildfire and shifting land uses have the potential to degrade the U.S. carbon sink within the next 10 years.[101,102,103,104,105,106,107,108]

Concerted action at all levels of society is needed to ensure that the land sink is not further degraded but

FIGURE 12

Road to 2030: Healthy Lands

- Increased carbon sink
- Reduced risk of wildfires
- Increased soil fertility and drought tolerance
- Improved water quality
- Increased and enhanced green spaces for community use
- Improved ecosystem services and increased resilience

increases its capacity to remove and store carbon. Recent analyses have suggested that the U.S. land sector could deliver 800 to 1,000 Mt CO_2e of annual sequestration by 2030. Analysis for this report indicates the potential for a net sink of 913 Mt CO_2e by 2030, an improvement of approximately 18 percent over today's levels. While this increase is a huge opportunity, the land-sector mitigation potential is uncertain due to the high level of variability in U.S. ecosystems and land uses and the difficulty of measuring and monitoring carbon in soils and biomass at scale. These sources of uncertainty heighten the importance of making rapid and significant investments in lands and GHG inventory improvements simultaneously, unlocking the many benefits of land-based climate mitigation pathways.

Reforestation and restocking forests on state, local, and private lands hold the greatest potential for carbon removal. These lands cover 296.2 million acres and offer the potential to remove 156 Mt CO_2e per year by 2030, and up to 312 Mt CO_2e per year in 2040 and beyond. Together, avoided grassland conversion and avoided forest conversion could offer a mitigation potential of 145 Mt CO_2e per year.[109] Agricultural soils could potentially store an additional 100–200 Mt CO_2e per year, but this would require a sizable investment in research and innovation.[110] The amount of carbon different management practices can sequester in the soil and the length of time that carbon remains stored in soils are both highly uncertain.[111] Tidal wetland restoration could offer a maximum of 12 Mt CO_2e per year and grassland restoration and peatland restoration could each offer 9 Mt CO_2e per year.

Environmental and Social Benefits

In addition to sequestering carbon, trees and climate-friendly forestry can offer benefits like improving water quality, preventing soil runoff, cooling urban communities, and helping to protect forest-adjacent communities from the risk of wildfire. Urban tree planting efforts that focus on lower income areas can help reduce historic inequities, thereby increasing access to green spaces and reducing heat island effects in those communities.

Preserving and enhancing carbon in soils is not only a key climate-mitigation pathway but can provide benefits such as increased soil fertility, increased drought tolerance, and reduced erosion. There is much to learn from indigenous communities who have been practicing sustainable farming for centuries to preserve soil health and maintain a rich

CASE STUDY

Orlando pursues several efforts to promote healthy lands.

As part of a set of wide-ranging efforts to improve sustainability and climate resilience in the city, Orlando, Florida is pursuing a number of efforts to support healthy lands. In partnership with the Arbor Day Foundation, the city has launched a free tree give-away program, Energy-Saving Trees, that uses an online platform to allow residents to order native trees each season. Since 2017, the city has given out more than 11,000 trees, in addition to planting thousands of street trees in city rights-of-way. In addition, the city also developed a 1,650-acre park that includes human-made wetlands designed to provide advanced treatment for reclaimed water. This park is also used for recreational purposes including bird watching, nature hikes, an environmental education center, and more. Orlando has also developed a local food initiative to decrease emissions from food transportation and has established more than 700 community gardens that provide educational opportunities and fresh food for surrounding neighborhoods. Orlando has been certified as an NWF Wildlife Habitat community, expanding no-mow-zones at city parks and transitioning to using organic pest management solutions in its operations.

biodiversity, which has also led to soil carbon sequestration.[112]

In addition to carbon sequestration benefits, restoration efforts can help to restore ecosystem services and improve resilience. For example, tidal wetland restoration offers protection from sea level rise and storm surge, while grassland restoration and peatland restoration improve habitat for wildlife.

HEALTHY LANDS: HOW DO WE GET THERE?

Given the size and complexity of the U.S. land sector, governments at every level will need to coordinate robust land sector policies and engage landowners, civic groups, and the private sector in meeting climate goals.

To reach the 2030 NDC, the United States will need to take action across all natural climate mitigation pathways and land-use categories. Our analysis indicates that there is a need for increased federal and state investment and policy action to target an 18 percent increase in the land carbon sink by 2030 (a net increase of 140 Mt CO_2e in annual sequestration from today's levels) to help meet U.S. climate goals.

Many policies and investments can support these efforts at the federal, state, and local levels. Figure 13 provides a summary of critical measures that may be taken at all levels of government and society to deliver on the results and benefits outlined in this report.

Given the size and complexity of the U.S. land sector, governments at every level will need to coordinate robust land sector policies and engage landowners, civic groups, and the private sector in meeting climate goals.

Key categories of policies and synergies are also described below, including investments in land carbon storage; conservation, restoration, and prevented land use change; greening urban areas; and improving inventories. Figure 14 offers a conceptual view of the interactions contributing to an improved land carbon sink.

Investments in Land Carbon Storage

Bolstering carbon sequestration and storage on public and private lands will require a sizeable increase in federal investment in reforestation, restocking degraded forests, mitigating the threat of catastrophic wildfire, and incentivizing climate-friendly land management techniques. Concerted effort also needs to be made at the federal, state, and local levels to create nursery infrastructure, plant trees, and steward forests to realize carbon storage potential.[113,114]

A federal investment of approximately $11 billion annually could fully realize carbon removal potential through these pathways and support job creation and economic growth across numerous sectors.[115] Policy vehicles to carry this investment could include budgetary increases for reforestation and wildfire risk mitigation on federal lands; and incentive structures like tax credits or direct landowner payments to support landowners in adopting agricultural and forestry practices on private lands. U.S. Department of Agriculture programs such as the Environmental Quality Incentives Program could be amended to include certain climate-friendly land management techniques as activities that would be eligible for cost share through the program, while tax incentives to support climate-friendly activities would require new congressional authority to implement.

Soils already store significant amounts of carbon; and certain established agricultural practices, such as using cover crops and

adopting managed grazing methods, have the potential to increase the amount of carbon in agricultural soils. Practices that increase carbon in soils also need to be accompanied by robust efforts to reduce on-farm N_2O and CH_4 emissions from livestock and fertilizer application. These practices include improved manure management and fertilizer management, including waste-to-energy digesters that turn the methane from manure or biomass into biogas.[116] Other climate-smart agricultural strategies that are in initial stages of development, such as breeding perennial cultivars of annual crops, and breeding plants with longer, deeper root systems, could also help store more carbon in agricultural soils, but significant work needs to be done to bring these crops into mainstream use and to understand the carbon impacts and food system impacts of their deployment.[117] Increased federal funding and capacity for research into agricultural soil carbon needs to accompany support for adoption of climate-smart agricultural practices on private lands.

At the state level, programs with funding to support state tree planting goals could help to increase carbon stored in forests. For example, Maryland's recently passed Tree Solutions Now Act lays out methods for the state to achieve its goal of planting 5 million trees. This includes incentivizing landowners to plant wind breaks and riparian buffers on marginal crop land through the state's Conservation Reserve Enhancement Program and leveraging public-private partnerships to plant native, climate-resilient tree species.

Companies and the private sector can also help to support these federal and state initiatives. Businesses can set ambitious targets for sourcing a greater percentage of agricultural and timber products from farms and forests that use sustainable and climate-friendly management practices. Private investment in in the form of carbon offsets or direct investment in nature-based climate solutions can also provide needed financing, but offsets need to be accompanied by robust guardrails.[118,119] The private sector has already been acting on supporting carbon sequestering projects and is looking to move ahead quickly. However, the large diversity of existing approaches risks lack of transparency at best and counterproductive outcomes at worst. Federal and state governments can play a critical role in creating rules of the road to ensure that land sector carbon markets and corporate investments are transparent, science-based, and aligned with long-term GHG reduction goals.

Businesses can set ambitious targets for sourcing a greater percentage of agricultural and timber products from farms and forests that use sustainable and climate-friendly management practices.

FIGURE 13

The Natural and Working Lands Sector with an All-In Strategy

"ALL IN" BREAKTHROUGH ACTIONS:

- **Incentivize nature-based solutions, targeting an 18% increase (additional 140 MT) in annual carbon sequestration from present levels (federal, state)**
- **Incentivize and invest in waste-to-energy and sustainable agriculture (federal, state, business)**
- **Invest in enhanced GHG quantification and monitoring (federal, state, business)**

NATIONAL POLICIES

- Invest in enhanced GHG quantification and monitoring
- Invest in and incentivize carbon sequestration and storage in trees and soils on private land through USDA cost-share programs
- Invest in reforestation on federal land and wildfire risk mitigation
- Invest in and incentivize sustainable agriculture practices and waste-to-energy project deployment to slash CH_4 and N_2O emissions

STATE POLICIES

- Invest in and incentivize carbon sequestration and storage in trees and soils on private and public lands
- Invest in reforestation and forestry practices to achieve cost-effective mitigation
- Incentivize sustainable agriculture practices to slash CH_4 and N_2O emissions, including payments for ecosystem services through direct incentives or market-based mechanisms
- Invest in and partner with federal government on enhanced GHG quantification and monitoring

CITY POLICIES

- Adopt expanded urban forestry efforts, targeting 40% tree canopy coverage within city limits and prioritizing low-income and vulnerable communities

BUSINESS ACTIONS

- Source a greater percentage of agricultural and timber products from farms and forests that use climate-friendly management practices
- Increase investment in land-based climate mitigation strategies

CIVIL SOCIETY ACTIONS

- ***Private landowners, Tribal groups, schools, and faith-based groups***: Enhance climate-friendly land management practices

Priority high ambition policies that can lead to **50–52% emissions reductions by 2030**

An All-In strategy to reach 50–52% emissions reductions by 2030 requires increased investment in land-based carbon sequestration—bolstering the U.S. land sink by 18% and storing an additional 140 MT of carbon back into the ground annually. Federal and state policies can support reforestation, improve agricultural practices, and deploy crucial monitoring programs—for both federal and private lands. Cities, businesses, and civil society not only have the potential to aid in these mitigation efforts but can also help improve resilience and quality of life, specifically for low-income, vulnerable communities.

Conservation, Restoration, and Prevented Land Use Change

Intact ecosystems across the United States, such as forests, grasslands, wetlands, and coastal zones, store significant amounts of carbon; so protecting these ecosystems from conversion to other land uses is a key component of climate-friendly land management. Forces like urban expansion and cropland expansion not only release the carbon stored in soils and biomass but compromise the other environmental benefits that these ecosystems provide. Where lands have already been degraded, ecological restoration can help improve their carbon-sequestering potential. Restoration can also accompany the phase-out of fossil fuel infrastructure; for example, remediating abandoned oil and gas wells and coal mines can incorporate reforestation and ecosystem restoration.

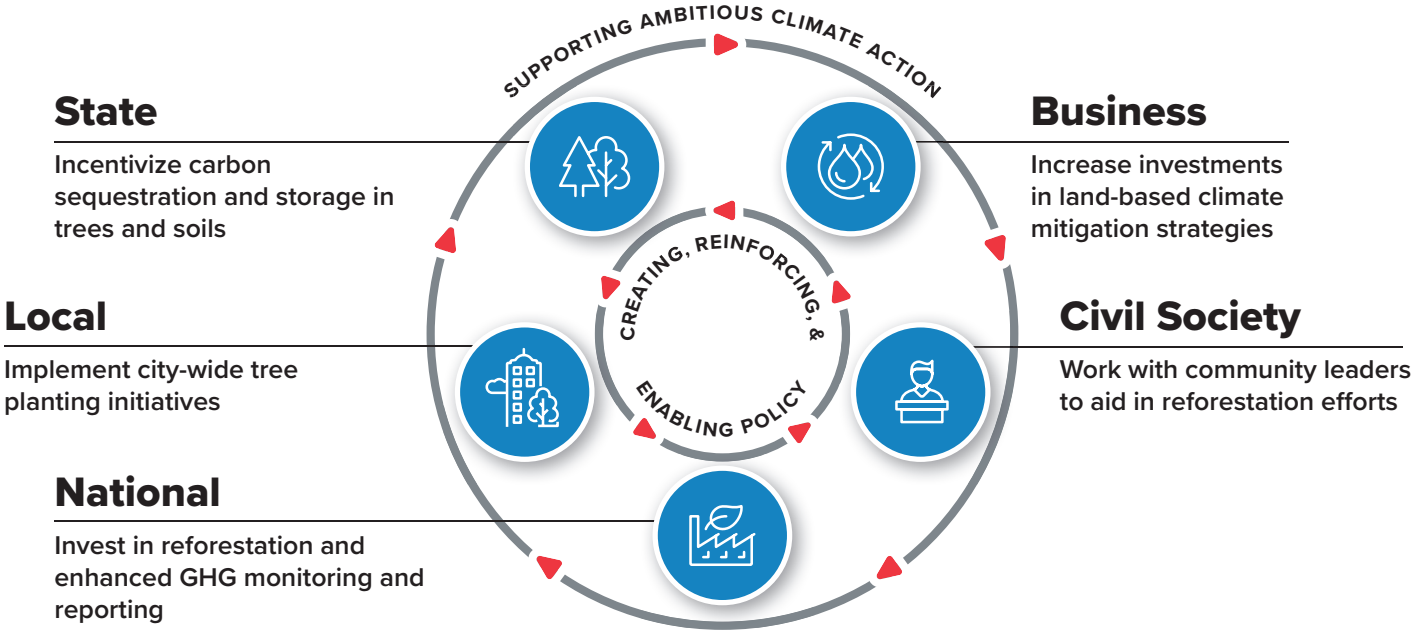
Greening Urban Areas

The potential for cities and suburbs to contribute to land-sector carbon storage is often overlooked, but urban trees currently contribute over 15 percent of the U.S. land-sector carbon sink. Urban trees are currently disproportionately concentrated in wealthier areas, leaving lower-income areas subject to heat island effects. Absent local action, urban tree cover is projected to decline from 39 to 31 percent of urban area by 2060. To avoid substantial carbon loss, and ideally to increase carbon sequestration, communities will need to plant 23 million urban trees annually over the next four decades.[120] Many cities across the United States know the value of urban tree cover and have set tree-planting targets. For example, the city of Detroit,

FIGURE 14

The All-In Climate Strategy:

Policy interactions contributing to an improved carbon sink



Michigan, has set a goal of planting 10,000 trees across the city,[121] and Philadelphia, Pennsylvania, set a goal of 30 percent canopy cover in all of the city's neighborhoods,[122] while Washington, DC, has set an ambitious target of 40 percent tree cover by 2032.[123] To realize these goals, cities will likely need to work with private-sector partners and community members to plan, plant, and steward urban trees.

Improving Inventories

Inventories of GHG emissions on natural and working lands are a critical tool for quantifying the role that lands will play in achieving climate goals. The federal government can invest in modernized national land-sector inventorying and monitoring to lower inventory costs at all levels of society and reduce uncertainty. This would allow states to better incorporate the land sector into their climate action plans, encourage subnational investment, and enable scaling up of federal policies. Top-priority inventory improvement needs include establishing a national soil carbon sampling network to better understand the impacts of management on agricultural, wetland, and forest soil carbon and incorporating LiDAR technology into federal forest carbon monitoring to allow for timelier and more accurate nation-wide forest carbon inventorying.

States have shown leadership in state-level land-sector inventorying as a first step to enacting land sector carbon programs. For example, many states in the U.S. Climate Alliance have committed to managing landscapes as carbon sinks while protecting communities and ecosystems and have supported these efforts by improving state-level land-sector GHG inventories. For example, Maryland and Delaware have prototyped a forest carbon monitoring system to improve upon federal estimates of state-level forest carbon fluxes. Oregon, California, and Washington created state-specific forest carbon inventories with a view to guiding forest management policies. Hawaii has also completed an initial natural working lands inventory while continuing to improve upon LiDAR-based forest carbon monitoring and soil carbon monitoring to inform future inventories. By taking the first step, states can help innovate monitoring methods to enhance the accuracy, precision, and resolution of land sector inventories, which may ultimately be incorporated into federal programs.

States have shown leadership in state-level land-sector inventorying as a first step to enacting land sector carbon programs.

3 Conclusions

Over the last four years, a bottom-up coalition of states, cities, tribes, businesses, higher education institutions, faith groups, cultural institutions, and others have sustained climate action in the United States.

OVER THE LAST FOUR YEARS, a bottom-up coalition of states, cities, tribes, businesses, higher education institutions, faith groups, cultural institutions, and others have sustained climate action in the United States. The Biden Administration has now joined that effort and is looking to a whole-of-government approach to addressing the linked problems of climate change, equity, and rebuilding the economy. In April, the United States pledged to reduce its GHG emissions by 50 to 52 percent below 2005 levels by 2030 while putting the country on the path to net-zero emissions by 2050.

In *Climate Change 2021*, the IPCC makes clear the need for rapid reductions in GHG emissions to keep open the possibility of limiting climate change to 1.5°C.[124] Bold action and systemic change are needed to transform the economy to limit the impacts of global warming, and the United States must aim to exceed its goal and strengthen ambition before 2030 as new opportunities emerge and scale.

Doing so will require a whole-of-society approach to deliver transformative change in the U.S. economy. While the administration has a strong climate agenda, procedural and political hurdles put constraints on how far and how fast the federal government can move on its own. Accelerated leadership from states, cities, businesses, and civil society is needed to create market pressures for more ambitious federal action. Broad-based support for these changes, which will be critical for them to be durable, can best be built and maintained if the policies and actions that deliver them provide widely shared tangible benefits through strengthened communities, good jobs, and an equitable sharing of the benefits.

The bottom-up coalition represented by America Is All In has helped lead the way, and its members have demonstrated many ways to build a stronger economy through climate action. The Biden Administration has willing partners across the country who will be able to achieve more with strong support and investment from the federal government. Local leaders have the desire and many of the tools to take needed actions, but having the federal government ready to work with, support, and learn from these leaders will increase our chances of success on climate, the economy, and equity.

Our analysis shows how an all-in climate strategy can deliver a 52 percent reduction in GHG emissions by 2030, achieving the country's climate pledge and setting the stage for deeper reductions in the years ahead. The all-in strategy also helps build on local knowledge and local success, helping more deeply embed in the economy the transition to a cleaner future in ways that will be difficult to undo.

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