# OVERALL POLICY FRAMEWORK

# EXECUTIVE SUMMARY

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## A Plan

All great national efforts require bold visions and plans, and the ability to adjust course along the way. President John F. Kennedy declared in May 1961, "I believe that this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the moon and returning him safely to the Earth." At the time that Kennedy set this goal, the U.S. had put a single astronaut into space for just 15 minutes. In other words, the bold goal was set before many of the key steps were known or knowable.

In the Great Depression, President Franklin Delano Roosevelt led the country at a time of mass unemployment and despair, and boldly devised new strategies to confront the crisis. He called for bold action and learning by doing. As FDR famously declared: "The country needs, and unless I mistake its temper, the country demands bold, persistent experimentation. It is common sense to take a method and try it. If it fails, admit it frankly and try another. But above all, try something."

A nation that is free of carbon is our generation's moonshot. We must set the goal for mid-century, embark boldly on what we know, and prepare in the spirit of FDR to experiment, learn and adjust course along the way. As demonstrated by this *Zero Carbon Action Plan* (ZCAP), many of the technological solutions are well understood and ready. To be achieved, it awaits the boldness of spirit and eagerness of will that has defined America for generations.

## A Plan to Decarbonize

The ZCAP is based on detailed technological pathways that demonstrate the feasibility of reaching zero emissions by 2050, as well as detailed background analyses of key sectors. Despite all of the heated debate surrounding the energy transformation, the ironic fact is that the incremental cost of running the U.S. economy on clean energy as opposed to fossil-fuel energy is very small. We find that as of 2050, the clean-energy economy is only 0.4 percent of GDP more costly per year than the fossil-fuel economy (and lower than that up to 2050). In other words, for less than one-half of 1 percent of GDP, we can shift the energy system to avoid climate disaster.

# A Plan for Industrial Policy, Employment, And Just Transition

We estimate that the clean energy sector and its supply chains will create around 2.5 million net jobs per year on average between 2020 and 2050, taking into account the decline in jobs in the fossil-fuel industries, with many industrial jobs created in America's industrial heartland in the Appalachian region and Midwest. This estimate includes the direct and indirect job creation in the clean-energy economy and subtracts the job losses in the fossil fuel industries. In other words, the shift to clean energy is a net job creator. Public policy at all levels should commit to ensuring that the jobs created through clean energy investments are high-quality in terms of wages, benefits and working conditions. This includes strong labor unions and job training programs, as well as policies to ensure that women and people and communities of color have access to new clean energy jobs. For workers and communities that are currently dependent on the fossil-fuel economy, the federal and state governments should enact just transition policies.

## A Plan for All Levels Of Government

The ZCAP will operate across all levels of government – federal, state, and local. Some elements of this policy will be broad-based and require action by the Federal Government – for example, investments in early-stage research, development, demonstration, and deployment (RDD&D), carbon-emission standards in transportation and electricity, and carbon pricing in some sectors to help point innovation in the right direction – often through hybrid regulatory-market policies such as trading of vehicle emission credits. Nor can the Federal Government alone provide the needed leadership in our federal system. States and localities must also play key leadership roles. In fact, a number of governors and mayors have already staked out leadership positions on renewable energy and vehicle electrification and have put forward policy innovations that offer important learning and demonstration effects. In addition, the states oversee much of the core energy infrastructure including power plants and roads and bridges.

Even more critically, these subnational governments have jurisdiction over critical regulatory and management functions. Notably, state public utility commissions regulate electric utilities and cities and states establish building codes and thus are positioned to determine the energy efficiency of much of the built environment. Local governments also invest in mass transit and roads, and regulate land use and housing. Further, states and cities have the ability to change more rapidly and can design transition strategies tailored to their local resources and communities. Success, however, will require the backing of the Federal Government with regard to regulatory frameworks, carbon reduction targets, and incentives as well as financing and federal investments.

## A Plan for Key Sectors

The ZCAP centers on the six major energy-producing and using sectors: power generation, transportation, buildings, industry, land use, and materials. These six sectors account for almost

all of the $CO_2$ emissions of the U.S. The key, therefore, is the deep transformation of these sectors by 2050, which may be summarized as follows:

*Power*

The single most important transformation is the decarbonization of power generation, which accounted for around 32 percent of total $CO_2$ emissions from energy and industry in 2019. The major shift is to wind and solar energy, with continued production from other zero-carbon sources, notably nuclear and hydropower. Since wind and solar power are already at or near grid parity with coal-fired and gas-fired power generation, inclusive of energy storage, the incremental energy costs compared with business-as-usual associated with the green transformation of the power sector are small.

*Transport*

The transportation sector includes light-duty vehicles, heavy-duty vehicles (trucks), off-road vehicles, buses, rail, shipping, and aviation. Transportation emissions accounted for 37 percent of total $CO_2$ emissions from energy and industry in 2019. The principal strategy for decarbonizing transportation is the electrification of all light-duty vehicles, urban-based trucks and buses, rail, much of long-haul trucking, and some short-haul shipping and aviation. The second strategy is to reduce vehicle-use and miles traveled while enhancing accessibility to health, education, jobs, and other services for the mobility disadvantaged, which involves a variety of actions by federal, state, and local governments.

*Buildings*

Buildings, both residential and commercial, account for 12 percent of direct $CO_2$ emissions; this rises to 35 percent when the building share of electricity emissions are taken into account. Buildings built between now and 2050 will comprise 30 percent of the building stock in 2050. A new National Energy Code for Buildings (NECB) should ensure that new buildings constructed after 2025 will not burn fossil fuels onsite, will be highly energy-efficient, and will be constructed using low-carbon techniques and materials. We recommend that around 5 percent of the national RDD&D budget (rather than less than 1 percent today) should be committed to advanced building technologies, building science, and building policies including through joint ventures with National labs and state analogues.

*Industry*

Industry accounts for 20 percent of $CO_2$ emissions from energy, of which 68 percent are related to energy demands (electricity and heat) and the other 32 percent result from various industrial processes. As such, a relatively large share of industry emissions from light industries such as manufacturing of durable goods, food and textile processing, and even mining and non-ferrous metal production may be avoided by coordinated efficiency improvements, electrification, and decarbonization of electricity generation. For sectors which are difficult to decarbonize – such as iron and steel, cement, and feedstock chemicals – there are technical solutions available such as Carbon Capture and Sequestration (CCS) at industrial facilities, hydrogen, supplementary materials and fillers, and other synthetic fuel replacements and substitutions.

*Land use*

Land use policies impact every aspect of the transition to zero greenhouse emissions, including: siting of renewable energy, next generation biofuels, reforestation, soil carbon, and emissions

from agriculture and livestock. The complexity of policy choices in this area will require new efforts at RDD&D, new inter-agency planning, and enhanced cooperation of all levels of government with each other and with impacted communities.

*Materials*

The ZCAP calls for a new national framework for sustainable materials management (SMM) and Circular Economy (CE) based on the pillars of "reduce, reuse, recycle." Both SMM and the CE will lead to reduced pollution, energy efficiency, and reduced GHG emissions. Specific SMM and CE policies include mandatory recycling and composting; national bans on plastic bags, polystyrene, and other polluting materials; SMM plans for materials management; green public procurement criteria and targets; restrictions of waste exports; and embrace of Basel Convention standards for electronic recycling.

## A Zero Carbon America

The ZCAP aims to put Americans back to work to build a vibrant 21st century U.S. economy based on advanced technologies, good jobs, clean energy, climate safety, and economic security. It is designed to achieve net-zero emissions of greenhouse gases by 2050 as America's contribution to the Paris Climate Agreement to pursue efforts to limit global warming to 1.5°C. It will hold other countries accountable for climate safety as well, ensuring that American industry will not be undercut by polluting competitors abroad. The new clean-tech economy will help to save the planet from human-induced climate change while creating millions of good jobs, many more than will be cut in the fossil-fuel industry, and coordinated policies at all levels of government can magnify those favorable trends.