



**NDC ASPECTS**

# Country report

## Transition pathways for the United States of America

September 2024

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NDC ASPECTS has received funding from the European Union's Horizon 2020 Research and Innovation programme under grant agreement No 101003866

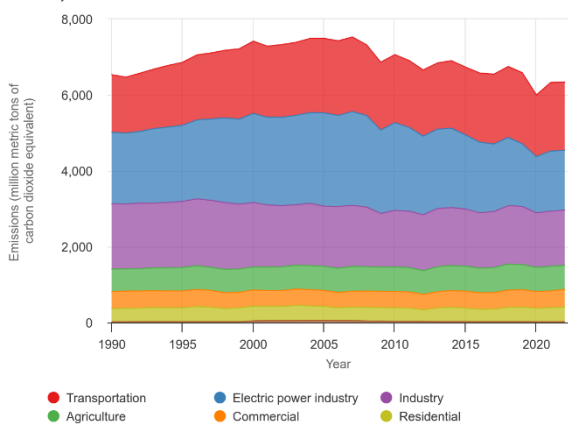


## Long-term perspective: key transformations to reach carbon neutrality

The main emitting sectors in the U.S. are transportation, electricity generation, and industry. Transportation has become the largest source of greenhouse gas emissions, representing 28% of all U.S. emissions in 2022. Emissions from this sector have been increasing in the past three decades despite efficiency improvements due to an increase in travel demand. The power sector makes up 25% of emissions in 2022. Emissions from this sector have been steadily decreasing since 1990 due to market and regulatory mechanisms that have been driving down coal generation. Industry emissions, which account for 23% of overall emissions, have also been on the decline thanks to a shift to less energy-intensive manufacturing products.<sup>1</sup> However, it has not been declining at the same pace as other sectors, given that many industry decarbonization options are not commercially available yet.<sup>2</sup>

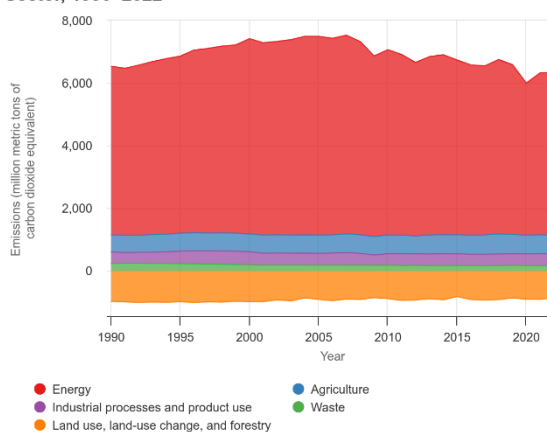
Many socio-economic trends could potentially impact the future of these sectors. Employment is expected to continue to rise, primarily in the healthcare and social assistance sectors.<sup>3</sup> Clean energy jobs will continue to outpace the overall workforce growth rate, enabling the clean energy transition.<sup>4</sup> Demographically, there is a projected rise in the elderly population and a reduction in the 35 to 54 age cohort, with population growth slowing and net immigration driving all growth from 2040 onwards.<sup>5</sup> The decrease in the population growth rate and the increasing diversity due to immigration will potentially change transportation patterns and demand, although the final result is still unclear. Economic growth is also anticipated to slow over the next three decades due to slower labor force growth and increased federal borrowing.<sup>6</sup> The slowdown of economic growth could slow the rise in emissions from the electricity and industry sectors as well. Urbanization is not growing at a significant rate.<sup>7</sup> Therefore, there is no expected considerable impact coming from urbanization rates.

**U.S. Greenhouse Gas Emissions by Economic Sector, 1990–2022**



Source: U.S. EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2022. <https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks>

**U.S. Greenhouse Gas Emissions by Inventory Sector, 1990–2022**



Source: U.S. EPA's Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2022. <https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks>

**Figure 1. U.S. Greenhouse gas emissions by a) economic sector and b) inventory sector from 1990 to 2022.<sup>8</sup>**

To achieve carbon neutrality and resilience by 2050, the United States must undertake comprehensive transformations across all sectors, but most importantly, from the two largest emitting sectors with readily

available decarbonization solutions: electricity and transportation. First, the power sector must shift away from fossil fuels and produce electricity only from clean energy sources. This shift involves rapidly deploying low-cost, abundant renewable energy resources such as wind and solar, phasing out unabated fossil fuel-based power generation, and retrofitting fossil fuel power plants with carbon capture and sequestration (CCS) where necessary. Moreover, it will be essential to invest in advanced grid management, storage solutions, and energy efficiency to improve the resiliency of the grid, ensuring that the energy supply can meet the demand at all times. These measures can also help mitigate recent increases in energy consumption coming from new data centers.

The second key transformation is electrifying end-use sectors, particularly transportation, buildings and the industry sector. In the transportation sector, there has been significant progress in electrifying light-duty vehicles (LDVs), with EV sales reaching over 9% in 2023. Yet deployment is uneven due to vehicle costs and insufficient charging infrastructure, especially in low-income communities and those who live in multi-family homes. Efforts must focus on making electric vehicles more affordable and ramp up the deployment of charging infrastructure across the country. It is also crucial to intensify the electrification of freight trucks, which face greater challenges in cost and infrastructure due to long-distance interstate travel. Other hard-to-abate sectors like aviation and shipping do not yet have a clear solution on how to reduce their emissions, highlighting the need for further research and development.

In the buildings sector, the U.S. uses more heat and hot water than other nations, highlighting the need for adopting electric heating systems and improving building energy efficiency on a large scale. The country must also overcome political obstacles related to changing building codes and legislation, as well as the cost and logistical challenges associated with retrofitting older buildings.

The industry sector requires significant transformations as well, especially for the most energy-intensive industries, such as cement, steel, and liquid refining. While emerging low-carbon fuels, feedstocks, and energy sources (LCFFES) could be used in these industries, these technologies are limited and have yet to be demonstrated at a commercial scale. In that sense, industry decarbonization requires both the implementation of existing solutions as well as research and demonstrations of potential solutions to electrify processes.

Finally, negative emissions are crucial for reaching the U.S. net zero goal by 2050, especially to offset emissions from the hard-to-abate sectors. Scaling up carbon dioxide removal (CDR) technologies and protecting and enhancing land carbon sinks will be necessary. Progress has been made in the development of CDR technologies thanks to IRA investments, which have spurred development in several states. However, further financial support and demonstration projects will be needed to scale them up across the entire country.

There are multiple economic impacts of the proposed transformations, including a rise in consumer savings, job creation, and economic growth. For instance, the electrification of light-duty vehicles through policies such as California's Advanced Clean Cars II rule (ACC II) could raise consumer savings due to the lower maintenance cost of EVs. A study found that if 16 states were to apply ACC II, households across the country could save an average of 238 USD every year, with higher savings in states with EV incentives. It would also create 300 thousand jobs by 2050 from the EV production industry.<sup>9</sup> Other measures, such as the promotion of Direct Air Capture (DAC) technologies, can bring similar benefits. For instance, the construction and operation of the South Texas DAC hub, operated by 1PointFive, is expected to generate between 1440 and 2230 jobs.<sup>10</sup> The U.S. Department of Treasury also analyzed IRA's impact and concluded that it has the potential to increase economic growth and reduce the economic

vulnerability of the country by spurring technological innovation, promoting energy independence, and mitigating the economic impacts of climate change.<sup>1</sup>

The design of urban, rural and suburban development plans that favor travel efficiency, accessibility, self-sufficiency and community engagement, as aligned with the principles of Smart Growth, should be applied widely across the country. EPA's Smart Growth approach prioritizes mixed land uses, compact building design, and walkable neighborhoods, among other measures, which can bring about both societal well-being and emissions reductions.<sup>12</sup> Smart Growth measures include investments in public transport, bike infrastructure, and sidewalks, as well as the promotion of alternative modes of transportation, which can reduce total road traffic volumes and the emissions associated with them. Community solar and community gardens can also help further reduce emissions while promoting self-sufficiency and enhancing the quality of life of residents. These improvements, paired with land use reform for compact development, have the potential to reduce annual pollution by 70 million tons of carbon dioxide equivalent in 2033.<sup>13</sup>

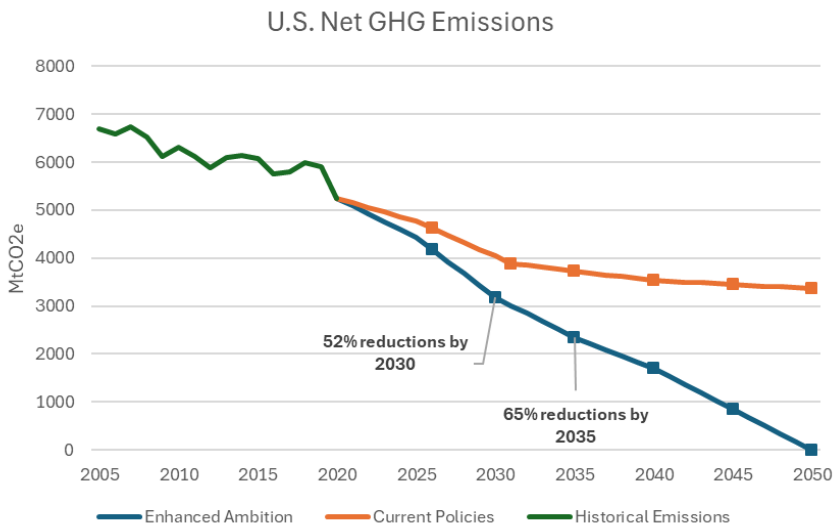
Additionally, environmental justice considerations should permeate all levels of decision-making to ensure societal well-being. With careful planning, climate policies have the potential to support historically marginalized communities and mitigate the negative health impacts of a fossil-fuel-based economy. For instance, investments in public transport, EV infrastructure, and walkable neighborhoods can reduce transportation costs and pollution levels, benefiting local communities. Communities should be involved to the maximum possible extent in the policies that impact them to guarantee their benefit and avoid any potential negative impacts.

## Informing the national NDC process : key short-term actions necessary to put the country on track to reach long-term goals

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Both of the global sectoral trends analysed have implications for South Africa's next NDC process. For context, Figure 4 shows two modelled net-zero CO<sub>2</sub> compatible pathways. Current indications are that 2035 emissions need to dip under 300 Mt CO<sub>2eq</sub>/a to reach net-zero CO<sub>2</sub> emissions by 2050, though this still depends on an acceleration of emissions reductions post 2045 relying global support to access newer technologies.

To align with the country's carbon neutrality objective, our analysis demonstrates that reducing total GHG emissions by 65% relative to 2005 levels would be a compatible 2035 NDC target (aka our *Enhanced Ambition* scenario). While a linear pathway from 50% reductions in 2030 to net zero in 2050 would require an average reduction of 2.5% per year from 2005 emissions levels (achieving 62.5% GHG reduction in 2035), faster rates of decarbonization in the near term may be required to offset slower reductions later. It is broadly agreed that as economies close in on net zero, decarbonization becomes more challenging due to the remaining emissions from hard-to-decarbonize sectors, including high-temperature heat applications in industry, aviation, shipping, and non-CO<sub>2</sub> emissions from agriculture. Our *Enhanced Ambition* scenario includes a suite of new and expanded policies from federal and non-federal actors, and results in reductions of 3.0% per year (relative to 2005) from 2030 to 2035, demonstrating that deeper reductions are possible through the first half of the next decade.



**Figure 2. U.S. Total GHG emissions, with historical emissions through 2020. Projected emissions through 2050 are shown for Current Policies and Enhanced Ambition scenarios.**

## Electricity sector

In the electricity sector, upgrading transmission infrastructure and expediting the permitting process will be critical, as many renewable projects are stuck in the interconnection queue. Investing in storage and grid-enhancing technologies to strengthen grid reliability is also necessary. At the same time, federal, state, and local policies are needed to help phase out coal and phase down gas while also supporting the communities that depend on these economic sectors.

## Transport sector

In the transport sector, lowering costs for EVs, particularly freight trucks, and building sufficient EV infrastructure are priorities. Beyond IRA’s EV tax credits, state and local governments can also offer additional incentives to subsidize EVs, and mandate fleet targets. Assistance from federal, state and local governments are particularly needed to expand EV infrastructure in multi-family homes and rural areas. Along with electrification, reducing vehicle miles traveled (VMT) will also be important to drive down emissions. Policymakers can do so by promoting car-sharing, active transport, and public transport through smart planning.

## Industrial sector

The industrial sector needs to focus on research, development, and demonstration of carbon capture and storage (CCS) and LCFES applications on a commercial scale. Addressing methane emissions is also vital for near-term decarbonization.

Methane mitigation is a critical opportunity for near-term emissions reductions. While EPA regulations and IRA provisions address methane emissions coming from the oil & gas industry, it is also necessary to reduce methane emissions in other sectors like agriculture and waste.



There are a few trade-offs that policymakers and other stakeholders should consider. For instance, the clean energy transition has the potential to negatively impact the communities that have depended on the income from the fossil fuel industry. This effect has already been felt by coal communities, who have lost their jobs after coal mine closures. By 2050, nearly one million coal mine jobs will cease to exist.<sup>14</sup> For that reason, the Department of Energy created the Coal Communities Commitment, which allocated more than 500 million USD to fund projects that could create jobs for the communities affected by coal mine closures. The projects funded under this program are expected to create more than 30 thousand jobs. Programs and policies like this should continue to be implemented to ensure a just transition. Aside from job losses from the clean energy transition, other potential trade-offs of the proposed policies include an increase in electricity prices, displacement due to the construction of renewable energy projects, and issues with grid reliability. However, these potential trade-offs can be addressed through careful policy implementation

The key policy packages that can drive action in key priority areas in the short and medium term are the full implementation of IRA, the BIL, the Renewable Portfolio Standards (RPS), EV sales targets paired with tax credits, the Coal Communities Commitment, the Federal-State Modern Grid Deployment Initiative, and Justice40. The IRA provisions have the power to cut down national emissions across many sectors, thanks to its tax credits, programs and funding opportunities aimed at promoting renewable energy deployment, ZEV sales, CCS, energy efficiency, and methane mitigation. The BIL also provides funding to electrification and infrastructure projects that are critical for decarbonizing the transport sector in particular, as well as funding for transmission infrastructure and grid resilience. At the state level, RPS help push for the clean energy transition by requiring utilities to meet a certain percentage of electricity from renewable sources. Similarly, widespread adoption of EV sales targets at the state level can impactfully reduce emissions through vehicle electrification. To minimize the job losses that occur as a result of coal phaseout policies, the Coal Communities Commitment program provides funding to projects that could create jobs and bring income to those who lost their jobs after the closure of coal power plants. Another key policy is the Federal-State Modern Grid Deployment Initiative, which provides technical assistance and commits 21 states to collaborate in the development of transmission infrastructure, which will be critical for renewable energy deployment. Finally, the Justice40 program is crucial for making sure that a significant percentage of all climate investments directly benefit disadvantaged communities, setting the standard for just climate action and maximizing the benefits of the decarbonization of the economy..

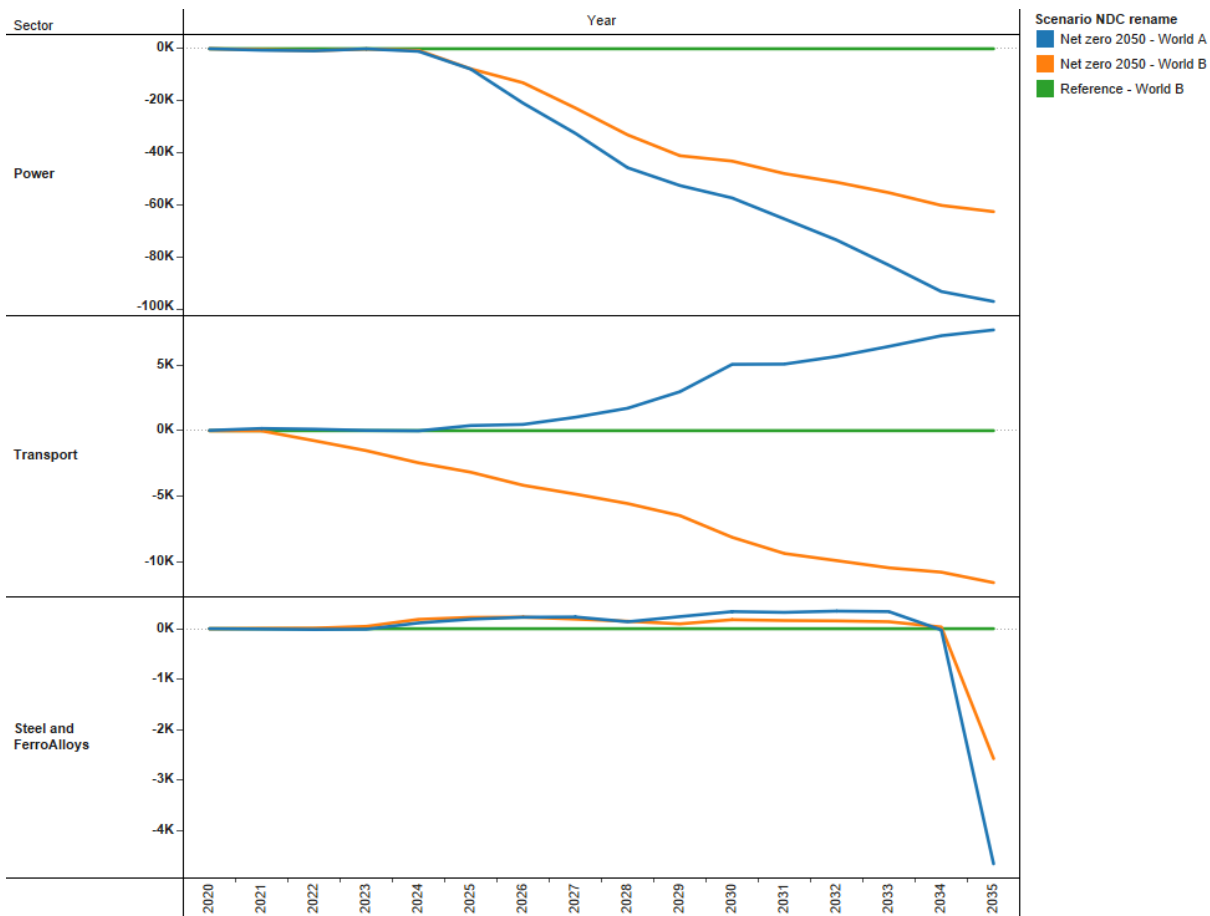


Figure 6: Emissions (kt CO2) difference relative to the 'Reference world B' scenario. Negative indicates fewer.

Innovations, such as a fast uptake of LEVs, were not included in this modelling. These require very little electricity and immediately cater for suppressed demand, lifting local economies with negligible new emissions, and displacing ICE transport in the best case. Innovation support to enhance LEV manufacture and use is a no-regrets key short-term action. It is recommended that the NDC update process pay attention to the scale and reach of LEVs.

In terms of socio-economic impacts, it is noted that the Electric Vehicles White Paper (DTIC, 2023) recognises the large and important auto-motive manufacturing industry in the country and introduces a number of support mechanisms for the manufacturers to transition so as to safeguard employment in this sector, which exports 60% of its production and thus needs to stay up-to-date with market regulations in importing countries, particularly Europe which accounts for 60% of the exports.

The short-term focus in the steel Industry should be to pursue future-proof strategies by investing into electric arc furnaces fed by direct-reduced iron. The analysis carried out in this work affirmed the steel industry's intentions in this regard. It allows the switch to green technologies (especially hydrogen-based iron production) in the future, but also making use of coal-based iron production methods until then. Emission reduction benefits are likely to be

seen only by 2035. This strategy is similar to the global trend of using gas DRI with electric arc furnaces, but with DRI technologies capable of switching from natural gas to 100% hydrogen use.

Ferrochrome producers must begin to invest money and effort into R&D for new technologies that can produce vital ferrochrome with lower fossil carbon emission for the global supply for steel alloys. These producers are at future risk of being exposed to further taxes and penalties for their carbon intensive operations should scope 3 emissions be included in various carbon tax schemes around the world. Owing to the need for carbon in the production process, investment into bio-based carbon technologies for chrome production and/or carbon capture for utilisation in chemical manufacture is required in the short term in order to allow sufficient time for development and potential deployment in the coming decade or two.

Vital to both these sectors, is the need to continue to invest in procuring energy from renewable electricity generation, this is a priority for both in the short term.

## Cooperation needs identified to accelerate climate action in the country

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Given the federalist government structure in the U.S., an all-of-society climate strategy with coordinated efforts from national and subnational actors will be critical. Subnational actors have already laid significant groundwork by implementing policies such as renewable energy standards, electric vehicle (EV) sales targets, and building efficiency standards. They have also served as an essential testing ground for different types of climate policies that are replicated in other states. For instance, the success of California's mandate for 100% EV sales by 2035 led ten other states to adopt the same policy. Additionally, California's Advanced Clean Trucks Regulations have led nine other states to adopt clean truck standards. Maintaining this momentum and embedding climate policies across all levels of governance and stakeholders will be important for ensuring the durability of policies.

The passage of the Inflation Reduction Act (IRA) and the Bipartisan Infrastructure Law (BIL) in 2022 and 2021, respectively, are expected to boost emissions reductions through investments and incentives for clean energy, carbon capture technologies, a methane reduction program, among other funding opportunities. However, full utilization of these funding sources is vital to maximize their impact. Stakeholders need to know about the existing incentives being provided and how to apply for them successfully. There are also many provisions embedded into these legislations that can be interpreted differently, which can lead to different level of emissions reductions or even gains. For instance, under the BIL, some of the funding for states could go toward EV infrastructure or highways. In these cases, a climate-smart interpretation of the provisions will be necessary to help achieve emissions reductions.

Federal and state cooperation is crucial to implementing programs and policies from the federal government effectively. An example of this cooperation is the National Electric Vehicle Infrastructure (NEVI) Formula Program, which provides funding to states for up to 80% of the costs of building EV charging stations and establishing an



interconnected national network. The program prioritizes construction near disadvantaged communities, following the guidelines of the Justice40 initiative. Through this program, the federal government can delegate responsibilities and engage with state governments, improving the reach and impact of this funding.

Cooperation between international actors is essential to reaching the necessary transformations for carbon neutrality. Joint actions with other large emitters, such as China, demonstrate the importance of combining strengths to decarbonize the economy and show climate leadership. The Sunnylands statement released last year by the U.S. and China exemplifies this cooperation, with commitments to rapidly build out renewable energy capacity, reduce methane emissions, develop a circular economy framework, and support subnational climate action in both countries. These commitments and similar agreements enable mutual learning and sharing of strengths and weaknesses.

Methane mitigation is a prime example of a sector that requires international cooperation. The challenges related to methane are complex, with limited real-world examples of mitigation, and require insights from various countries' experiences. Furthermore, addressing this issue cannot rely solely on top-down enforcement, but will require actions from all societal levels. U.S.-China and US-Canada-Mexico have made commitments to reduce methane emissions, and together, they would benefit from learning from each country's strengths and weaknesses to optimize their methane emissions reduction strategies.



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NDC ASPECTS has received funding from the European Union's Horizon 2020 Research and Innovation programme under grant agreement No 101003866

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