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U.S. House of Representatives Subcommittee on
Environment, Manufacturing, and Critical Materials
Hearing on America Leads the Way:
Our History as the Global Leader at Reducing Emissions
November 29, 2023

Summary

1. Climate change impacts are happening now, inflicting severe economic and environmental damage. Nations need to move aggressively to limit further temperature increases.
2. The bottom line of IPCC AR6, and all credible modeling of scenarios that meet the Paris Agreement goals, is that fossil fuel use has to dramatically decrease over the next 30 years. There is no scenario in which CCS allows fossil fuel use to continue at anywhere near its current level.
3. U.S greenhouse gas emissions slowly grew from 1990 up to their peak in 2007 and have slowly declined since 2007. Emissions are currently about 2% below 1990 levels. Cleaner electricity generation is largely responsible for the decline.
4. The Inflation Reduction Act and other recent legislation has positioned the U.S. to accelerate deployment of clean energy technologies and develop the new technologies and industries needed to solve the climate crisis, while spurring economic growth and employment in the U.S. Rapid and effective implementation of these legislative actions is essential. Additional policies will be needed to meet U.S. emission goals for 2030 and 2050. Based on decades of experience, we know that smart policy choices allow us to reach environmental goals while growing the economy and creating good jobs in the US.

Introduction

My name is Karl Hausker and I am a Senior Fellow at the World Resources Institute (WRI). WRI is a non-profit, non-partisan environmental think tank that goes beyond research to provide practical solutions to the world's most urgent environment and development challenges. My work at WRI focuses on net-zero emission pathways and policies, with special emphasis on the electricity sector. I served as an Expert Reviewer for Working Group III (Mitigation) and the Synthesis Report of the IPCC's Sixth Assessment Report. I bring over 30 years of experience working on climate and energy issues for the U.S. Senate Committee on Energy and Natural Resources, the U.S. Environmental Protection Agency, and leading consulting firms and research institutes.

This is a timely hearing for many reasons:

- In April 2023, the Intergovernmental Panel on Climate Change completed its *Sixth Assessment Report*, providing us with a comprehensive update on all aspects of climate change: the science, impacts and adaptation strategies, and mitigation strategies.[1]
- Earlier this month, the U.S. Global Change Research Program released the *Fifth National*

[1] https://www.ipcc.ch/assessment-report/ar6/

Climate Assessment, as mandated by Congress. This report covers the impacts and risks to the United States and actions underway to reduce emissions and build resilience.[2]

- This fall saw the release of two key reports that inform the negotiations at the COP28 meeting of the UNFCCC: the *UNEP Emissions Gap Report 2023*[3] and the UNFCCC's *Global Stocktake Report*).[4] Both reports estimate the gap between where global emissions are heading with current country commitments and where they need to be to limit warming to the goals of the 2015 Paris Agreement (i.e., to hold global temperature increase to well below 2°C above pre-industrial levels and pursue efforts to limit it to 1.5°C above pre-industrial levels).[5] The reports also assess mitigation strategies to close that gap.

- Earlier this month, WRI and partner organizations released the *State of Climate Action 2023* report providing a set of detailed indicators across economic sectors, for 2030 and 2050, and targets needed to achieve a 1.5°C goal. The report assesses progress toward those targets, covering power, buildings, industry, transport, forests and land, food and agriculture — as well as indicators on the scale-up of technological carbon removal and climate finance.

With this wealth of authoritative information and analysis, we can examine the record of U.S. -- and global -- efforts to reduce greenhouse gas emissions. We can also explore the future actions needed to limit warming – at the national and global level. With nations and civil society gathering for COP28, it's clear that much stronger, ambitious action is needed to achieve the goals of the Paris Agreement. With over a year's passage of time, we can also begin to assess the impact of the Inflation Reduction Act and other legislation on reducing GHG emissions, spurring new investments and jobs, and accelerating clean energy technology deployment in the U.S.

Climate Change Impacts Are Happening Now

The globe has warmed by just over 1°C since pre-industrial times. The impacts of this warming are escalating and will only become worse with each level of additional warming. With high confidence, the IPCC Sixth Assessment Report (AR6) found:

- Widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred. Human-caused climate change is already affecting many weather and climate extremes in every region across the globe.

- Evidence of observed changes in extremes such as heatwaves, heavy precipitation, droughts, and tropical cyclones, and, in particular, their attribution to human influence, has further strengthened since AR5.[6] Human influence has likely increased the chance of compound extreme events since the 1950s, including increases in the frequency of concurrent heatwaves and droughts.

- Climate change has caused substantial damages, and increasingly irreversible losses, in terrestrial, freshwater, cryospheric, and coastal and open ocean ecosystems.

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[2] https://nca2023.globalchange.gov/
[3] https://www.unep.org/resources/emissions-gap-report-2023
[4] UNFCCC, Technical Dialogue of the First Global Stocktake, 2023 https://unfccc.int/documents/631600
[5] https://www.un.org/en/climatechange/paris-agreement
[6] IPCC (2014), Fifth Assessment Report. https://www.ipcc.ch/assessment-report/ar5/

- Climate change has reduced food security and affected water security, hindering efforts to meet Sustainable Development Goals.
- In all regions increases in extreme heat events have resulted in human mortality and morbidity.
- Economic damages from climate change have been detected in climate-exposed sectors, such as agriculture, forestry, fishery, energy, and tourism.
- Hot extremes have intensified in cities. Urban infrastructure, including transportation, water, sanitation and energy systems have been compromised by extreme and slow-onset events, with resulting economic losses, disruptions of services and negative impacts to well-being.

The U.S. National Climate Assessment concluded that:

- The effects of human-caused climate change are already far-reaching and worsening across every region of the United States. Rapidly reducing greenhouse gas emissions can limit future warming and associated increases in many risks. Across the country, efforts to adapt to climate change and reduce emissions have expanded since 2018, and US emissions have fallen since peaking in 2007. However, without deeper cuts in global net greenhouse gas emissions and accelerated adaptation efforts, severe climate risks to the United States will continue to grow….
- In addition to reducing risks to future generations, rapid emissions cuts are expected to have immediate health and economic benefits. At the national scale, the benefits of deep emissions cuts for current and future generations are expected to far outweigh the costs.

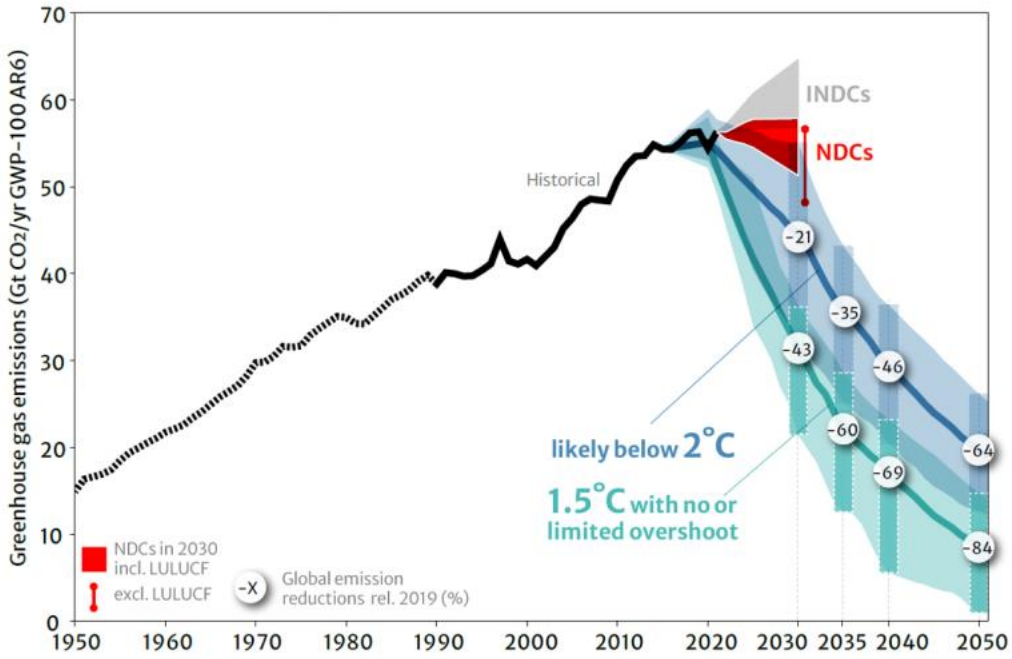
Climate change is among the most challenging problem humankind has ever faced. Carbon pollution from fossil fuels and other GHGs are changing our climate and killing people now. How much worse it gets depends on how quickly emissions are reduced in the United States and globally. No single nation causes climate change; no one nation acting on its own can solve it. Climate change requires both collective action among nations, and leadership from the U.S. on all fronts. At the same time, the solutions create huge opportunities for the U.S. to apply its technological and business prowess to providing those solutions, spurring continued economic growth and employment.

Emission Reductions Needed to Meet the Paris Agreement Goals

Ultimately to prevent further warming, global GHG emissions need to reach 'net zero'. This requires steep and rapid emission reductions; and any GHG emissions that cannot be eliminated need to be balanced by action to remove GHGs from the atmosphere. This is the decades long task ahead of us, but we need to accelerate our efforts now. Two recent reports quantify the difference between where global greenhouse gas emissions are currently headed and where they need to be by 2030 to stay on track to meet the goals of the Paris Agreement: the UNFCCC Global Stocktake Report and the UNEP Emissions Gap Report 2023. Both reports considered 2030 emissions in scenarios associated with current policies and with the commitments countries pledged under the Paris Agreement (known as nationally determined contributions, or NDCs). They then compared those emissions against pathways for limiting warming to 1.5°C and 2.0°C. The emissions gap is the difference in 2030 emissions between the policy scenarios and the different temperature pathways.

The figure below shows the results from the Global Stocktake Report, including global GHG emissions from 1950 to present. Global GHG emissions have grown fairly steadily for the past 70 years. Only in recent years has that growth slowed, and as the figure indicates, if countries can achieve the emission targets in their NDCs (Nationally Determined Contributions), global emissions could flatten and begin to decline this decade. However, the pathways to meeting the Paris goals now require very steep reductions. To hold warming to below 2.0°C will require a GHG reduction of 21 % below 2019 levels by 2030. The emissions gap to limit warming to 1.5°C (with no over limited overshoot) requires a reduction of 43% by 2030. Meeting either temperature goal will require maintaining a steep downward trajectory in emissions in the decades after 2030, as depicted in the figure, ultimately reaching net-zero after mid-century.

Figure 1: Global GHG Emissions 1950 to Present, with Scenarios to 2050



		Reductions from 2019 emission levels (%)			
		2030	2035	2040	2050
Limit warming to1.5°C (>50%) with no or limited overshoot	GHG	43 [34-60]	60 [49-77]	69 [58-90]	84 [73-98]
	CO_2	48 [36-69]	65 [50-96]	80 [61-109]	99 [79-119]
Limit warming to 2°C (>67%)	GHG	21 [1-42]	35 [22-55]	46 [34-63]	64 [53-77]
	CO_2	22 [1-44]	37 [21-59]	51 [36-70]	73 [55-90]

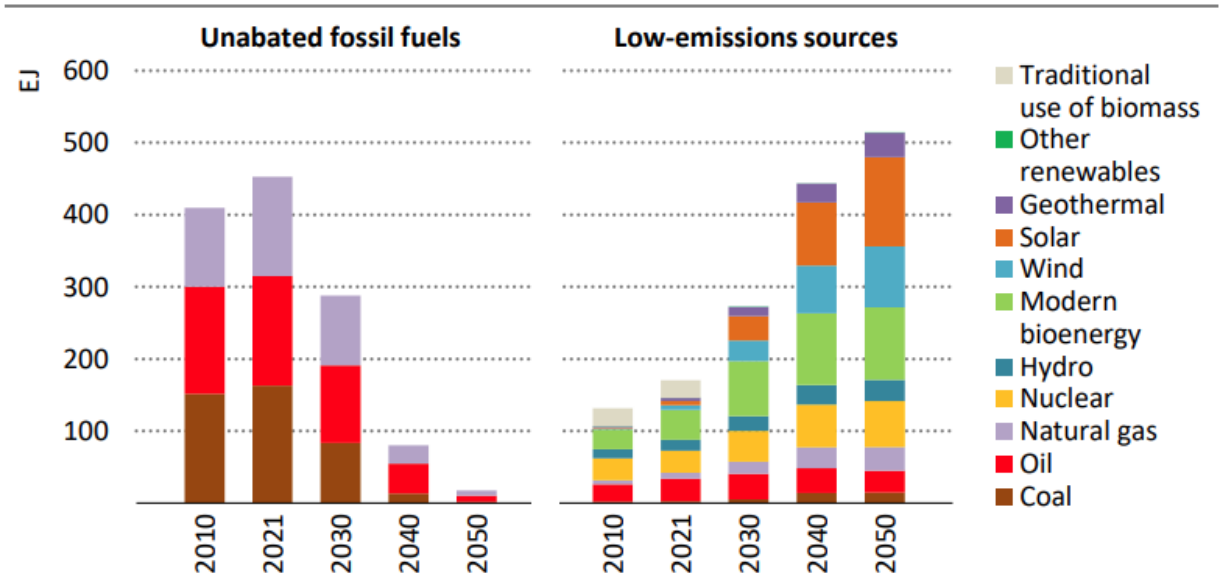
Source: UNFCCC Technical Dialogue of the First Global Stocktake, 2023

Scenarios for Reaching to Net-Zero Emissions

Only rapid, system-wide transformations can deliver the emission reductions needed to stay on track for the goals of the Paris Agreement. Transformations are needed in the electricity supply, industry, transport and buildings sectors, and in our agriculture and financial systems.

The International Energy Agency (IEA) Net Zero Roadmap presents one pathway for limiting warming to 1.5°C.[7] The figure below from the Roadmap presents the IEA scenario for how primary energy sources would shift to reach net-zero CO2 emissions by 2050. The left side of the figure shows how unabated fossil fuels (i.e., without carbon capture and storage) would decline sharply over the next 30 years. The right side of the figure shows how zero- and low-carbon energy sources would grow rapidly. Renewable capacity would rise more than seven fold by 2050, and nuclear generation more than doubles. Modern biomass energy use increases from a current 41 exajoules (EJ) to 100 EJ in 2050. The right side of the figure also shows some residual fossil use, either equipped with CCS or for non-energy use.

Figure 3.3 ▷ Total energy supply of unabated fossil fuels and low-emissions sources in the NZE Scenario, 2010-2050



This IEA scenario is one of many scenarios the world could pursue to achieve net-zero global emissions. The IPCC assessed several hundred scenarios from the peer-reviewed literature that are consistent with Paris Agreement goals. The key common theme in all of these scenarios is that electricity replaces fossil fuels as the major workhorse powering the world's economy. Electrification of end-uses in transportation, buildings, and industry, along with applications in hydrogen production and carbon dioxide removal, leads to a doubling or more of global power generation by 2050. And that electricity is overwhelming from zero-carbon sources such as solar, wind, and nuclear. Electricity produced from fossil fuels equipped with CCS plays a varying, but usually small role, in the IPCC scenarios.

[7] International Energy Agency, *Net Zero Roadmap: A Global Pathway to Keep the 1.5 °C Goal in Reach*, 2023. https://www.iea.org/reports/net-zero-roadmap-a-global-pathway-to-keep-the-15-0c-goal-in-reach

The IPCC found that, for the most stringent 1.5 degree C scenarios, global use of coal, oil and gas in 2050 must decrease by 95%, 60% and 45%, respectively, compared to 2019 (median values for those scenarios). Three major primary energy sources grow rapidly to displace fossil fuels (increases below are median values for 1.5°C scenarios, percentage increases compared to 2019):[8]

- Renewables (solar, wind, hydro, geothermal, etc.) increase 725%
- Modern biomass increases 290%
- Nuclear generation increases 90%

WRI's "deep dive" into the IPCC Mitigation report presents addition findings for the 2.0°C scenarios and the global electricity generation mix.

The bottom line of IPCC AR6, and all credible modeling of scenarios that can meet the Paris Agreement goals, is that fossil fuel use has to dramatically decrease over the next 30 years. There is no scenario in which CCS allows fossil fuel use to continue at anywhere near its current level. This makes intuitive sense because CCS is only feasible for large point sources, and much of fossil fuel use occurs in transportation and buildings.

System-wide transformations across all sectors of the economy are essential to reaching near-term 2030 goals and the ultimate goal of net-zero emissions. The *State of Climate Action 2023* report, a joint effort of WRI and partner organizations, provides a set of 42 indicators for 2030 and 2050, and targets needed to achieve a 1.5°C goal: across the electricity sector, buildings, industry, transport, forests and land, food and agriculture, and on the scale-up of technological carbon removal and climate finance. The report finds that progress made in closing the global gap in climate action remains inadequate — 41 of 42 indicators assessed are not on track to achieve their 2030 targets. Electric passenger car sales are the one indicator that is 'on track'. Some indicators are moving in the right direction but at a pace far below what is needed, e.g., deploying renewables, increasing green hydrogen production, and reducing deforestation. Others are moving in the wrong direction, such as phasing out fossil fuel subsidies and lowering the carbon intensity of steel production.

The History of U.S. Greenhouse Gas Emissions

The figures below show U.S. GHG emissions over the past 30 years. Figure ES-1 shows total 'gross' emissions were 6,487 MMT CO2e in 1990, when concerns over climate change were emerging and taking root. ('Net' emissions, accounting for LULUCF sinks,[9] were 5,606 MMT CO2e.) Gross emissions peaked in 2007 at a level of 7,501 MMT CO2e. For the most recent year estimated, 2021, gross emissions were 6,340 MMT CO2e, or about 2.3% below 1990 levels (net emissions were 5,586 MMT CO2e). For comparison, emissions from the United Kingdom have declined by about 50% since 1990, a trend that has continued through Conservative and Labour governments.

[8] World Resources Institute, A Deep Dive into the IPCC Workgroup III Mitigation Report, November 10, 2023. https://www.wri.org/technical-perspectives/deep-dive-ipcc-workgroup-iii-mitigation-report

[9] Land Use Land Use Change and Forestry, defined as emissions and removals of GHGs resulting from direct human-induced land use such as settlements and commercial uses, land-use change, and forestry activities.

Figure ES-1: U.S. Greenhouse Gas Emissions and Sinks by Gas

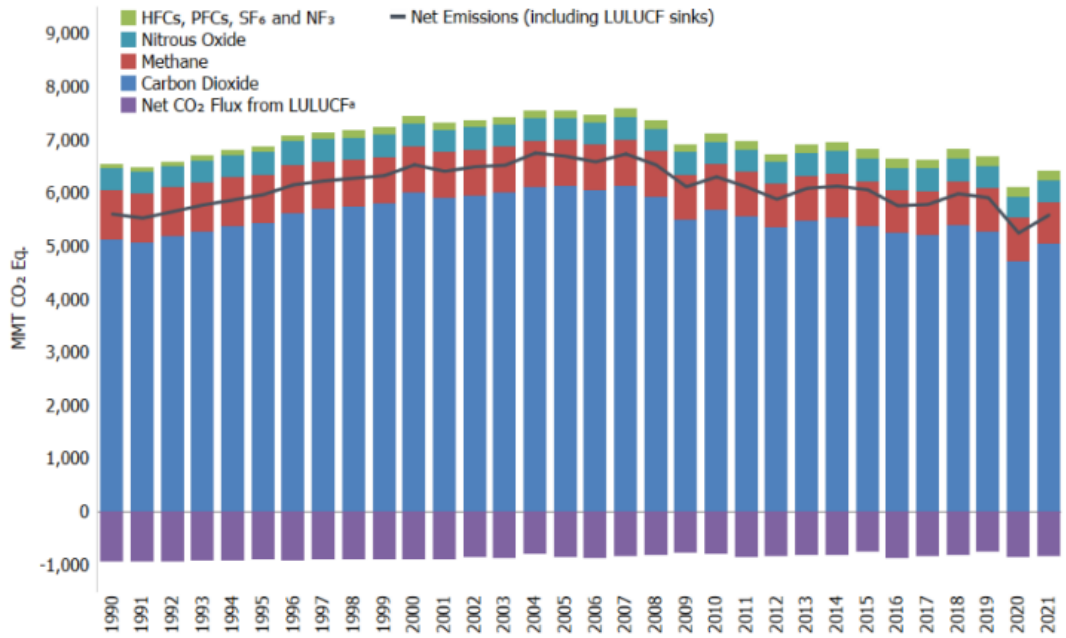
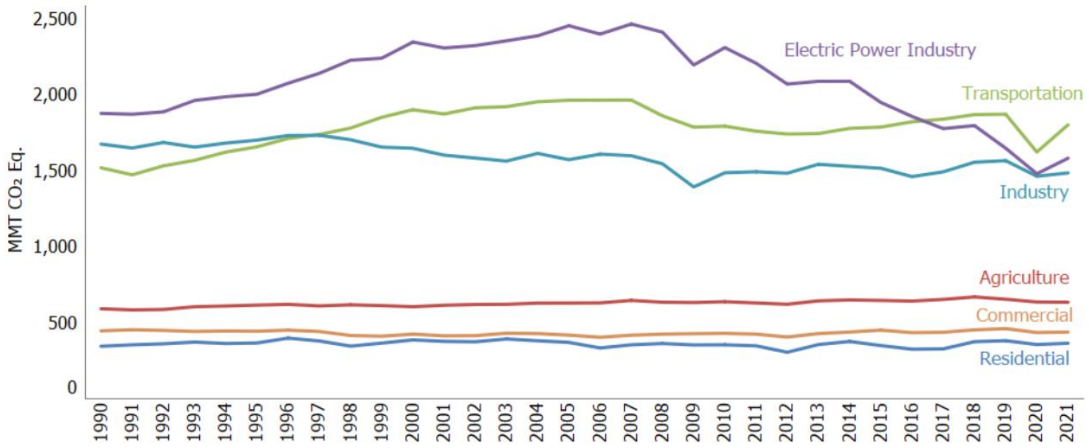


Figure ES-13: U.S. Greenhouse Gas Emissions Allocated to Economic Sectors



Note: Emissions and removals from Land Use, Land-Use Change, and Forestry are excluded from figure above. Excludes U.S. Territories.

Source: US EPA, US Greenhouse Gas Inventory, 2023.

Figure ES-13 above presents a sectoral breakdown of U.S. GHG emissions, providing some additional insights. The figure below shows emissions from the electric power, transportation, industry, agriculture, commercial, and residential sectors from 1990-2021. The electric power sector is mainly responsible for the decline of U.S emissions from 2007 to present. The main factors behind this are the growth in renewable generation and fuel switching from coal to gas. All other sectors show relatively small changes.

The U.S. Is Positioned to Lead the Needed Transformations

The challenge of climate change is clear, and the speed of the needed transformations across all sectors of the economy is equally clear. The good news is that the Inflation Reduction Act, the Bipartisan Infrastructure Law, the CHIPS and Science Act, along with the ratification of the Kigali Amendment to Montreal Protocol and supporting legislation have positioned the U.S. to lead the world in the needed transformations outlined above. Successful implementation of these laws is already spurring deployment and new investments in the technologies needed to address climate change. These laws will increase employment and equity across the U.S. economy.

Taken together, these laws are positioning the US as a global leader in multiple ways:

- Clean electricity: applying a technology-neutral set of incentives to spur zero-carbon electricity, including solar, wind, geothermal, nuclear, and anything else our inventors and entrepreneurs develop.
- Existing nuclear plants: established a production tax credit to promote continued operation.
- Carbon management: providing incentives and supporting infrastructure for
    - Carbon capture and storage to reduce emissions in industry and the power sector;
    - Carbon dioxide removal by technological means; and
    - Carbon dioxide removal by "nature-based solutions" using forestry and agriculture.
- Launching a clean hydrogen industry through incentives and supporting infrastructure.
- Ramping up deployment of electric vehicles of all types, along with charging infrastructure and battery manufacturing.
- Expanding incentives for energy efficiency and building electrification.
- Methane: establishing an incentive for industry to reduce leakage and utilize, rather than waste, this resource.
- HFCs: with the Kigali Amendment to the Montreal Protocol ratified, U.S. companies will help all nations reduce consumption and production of these potent greenhouse gases.

The Clean Investment Monitor, a collaboration between MIT researchers and the Rhodium Group, is tracking all announced public and private investments in the manufacture and deployment of clean technologies and infrastructure in the U.S. Their data provides a means of assessing the country's progress in transitioning to a cleaner economy. From July 2022 to June 2023, their research shows clean investments totaling $213 billion nationwide. The Energy Futures Initiative has estimated that the Inflation Reduction Act will create an additional 1.5 million jobs by 2030.[10] IRA incentives will cut household energy bills and help the average American save thousands of dollars on electric vehicles, climate-friendly heat pumps and solar installation.

The Inflation Reduction Act and other recent legislation has positioned the U.S. to accelerate deployment of clean energy technologies and develop the new technologies and industries needed to solve the climate crisis, while spurring economic growth and employment in the U.S. Rapid and effective implementation of these legislative actions is essential. Additional policies will be needed to

[10] Energy Futures Initiative, Jobs, Emissions, and Economic Growth—What the Inflation Reduction Act Means for Working Families, 2023. https://efifoundation.org/wp-content/uploads/sites/3/2023/03/NDC-Report-January-17-v2.pdf

meet U.S. emission goals for 2030 and 2050. Based on decades of experience, we know that smart policy choices allow us to reach environmental goals while growing the economy and creating good jobs in the US.