POLICY PAPER

Jobs, Emissions, and Economic Growth—What the Inflation Reduction Act Means for Working Families

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David Foster served as Senior Advisor to U.S. Secretary of Energy Ernest Moniz from 2014-2017 on energy, environmental, climate, economic development, workforce development and labor relations issues. During that period he designed and implemented the creation of the Department of Energy's Jobs Strategy Council, an initiative that linked the department's technical and financial resources to a wide group of external stakeholders including state and local governments, private sector energy and manufacturing businesses, non-profits, academic institutions, and labor unions. He led the interagency effort to create the Energy and Advanced Manufacturing Workforce Initiative, which formally linked the Department of Energy with the Departments of Labor, Education, Commerce, Defense, and the National Science Foundation on workforce development issues.

Prior to working at the Department of Energy, Foster served as the founding Executive Director of the BlueGreen Alliance (BGA), a strategic partnership of 14 of America's most important unions and environmental organizations with a combined membership of 14.5 million. The BlueGreen Alliance is the country's foremost labor/environmental advocacy group on climate change policy solutions with a special emphasis on energy-intensive industries, job creation, and the interchange between global warming and trade policy.

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Alex Maranville is a Research Associate at the Energy Futures Initiative (EFI), where he applies his skills in policy writing, energy modeling, and research to support a deeper understanding of the opportunities and challenges of addressing global climate change. Maranville has over three years of experience developing analytical frameworks to understand energy problems and solutions. He previously worked at the University of Michigan Energy Institute, where he developed a tool to explore the projected emissions savings from electric vehicles through 2035 in the United States. He also spent time at Ford Motor Company, adapting the Argonne National Laboratory GREET model to explain the non-linear relationship between battery mass and electric vehicle range.

Maranville received a BA in international relations and economics at Michigan State University's James Madison College in 2018. He received a Master of Public Policy at the University of Michigan's Gerald R. Ford School of Public Policy in 2020.

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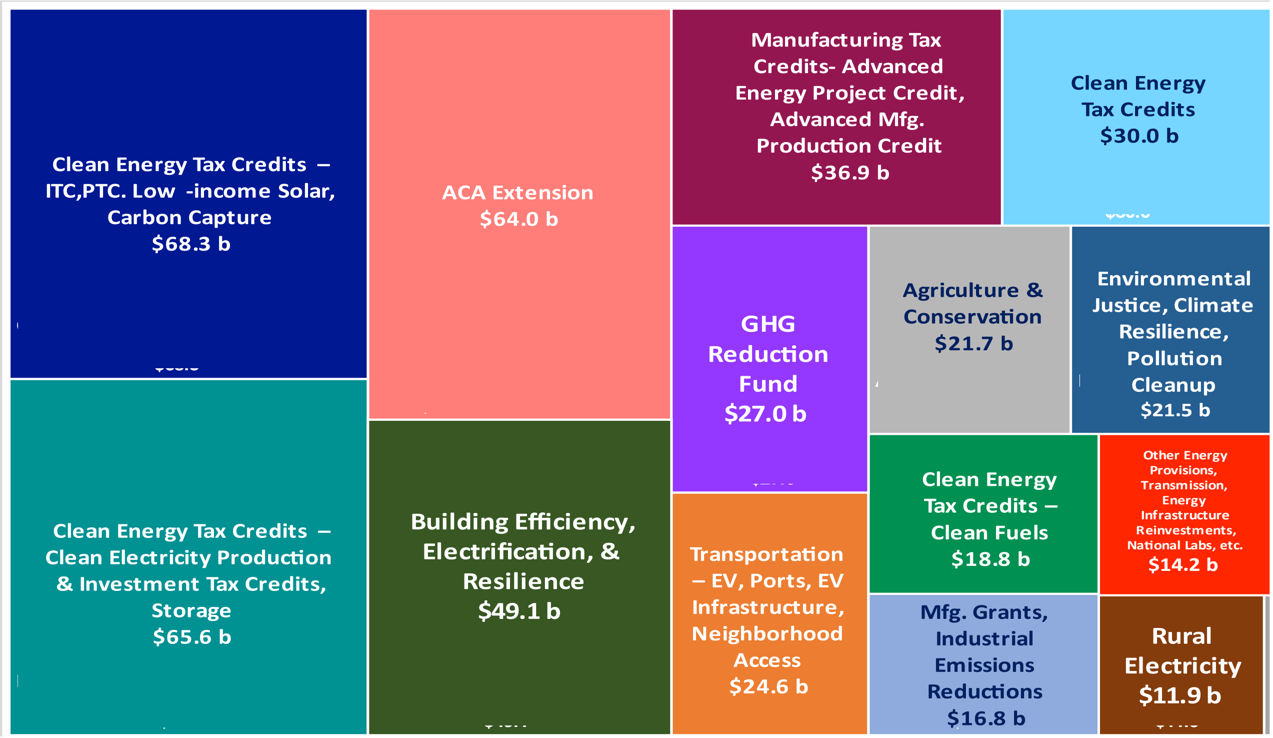
The Energy Futures Initiative advances technically grounded solutions to climate change through evidence-based analysis, thought leadership, and coalition-building. Under the leadership of Ernest J. Moniz, the 13th U.S. Secretary of Energy, EFI conducts rigorous research to accelerate the transition to a low-carbon economy through innovation in technology, policy, and business models. EFI maintains editorial independence from its public and private sponsors.

Executive Summary

The Labor Energy Partnership (LEP) is a collaboration between the AFL-CIO and the Energy Futures Initiative. The LEP regularly conducts new and policy-relevant research to address the climate crisis and support working people across America.

In August 2022, the LEP modeled key provisions and spending of the Inflation Reduction Act (IRA) to understand its potential impact on jobs, the overall economy, and greenhouse gas emissions (GHG) reductions. This effort demonstrated the unique benefits that well-directed energy investments can have simultaneously on job growth, gross domestic product (GDP), real disposable income, inflation reduction, targeted sectoral energy costs, and GHG emissions reduction. Figure 1 shows the spending levels by energy sector/subsector or technology included in the IRA.

Figure 1: Spending Authorized by the Inflation Reduction Act (billions of $)

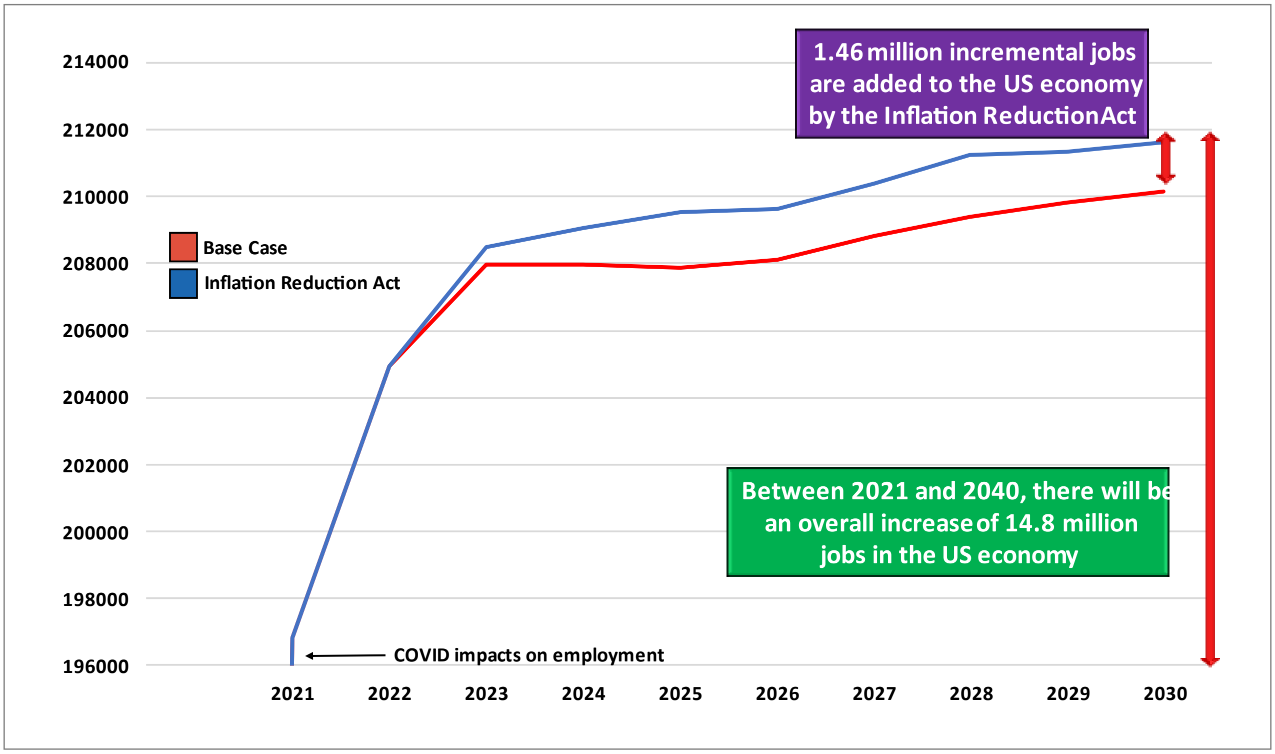


ACA, climate, energy, and infrastructure provisions total roughly $470 billion; Total energy tax credits: $258 billion; Energy efficiency, housing and resilience spending: $49 billion; Transportation: $25 billion; Manufacturing and industry: $54 billion.

This domino effect of energy investments speaks to the important role that energy plays in the architecture of modern industrial economies. When combined with public policies that support job quality and access, energy investments can also result in greater social equity.

These spending levels, when modeled, shows that the IRA will create an additional 1.5 million more jobs in the U.S. economy by 2030 compared to a Business as Usual (BAU) scenario (Figure 2), while reducing greenhouse gas (GHG) emissions by 37% relative to a 2005 baseline.

Figure 2: Job Creation from the Inflation Reduction Act, 2021-2030



However, it is important to note that the modeling did not include GHG reductions that could be achieved from non-energy related sources such as agriculture, land use and forest management, carbon direct removal, or waste management, initiatives that could increase emissions' reductions to 50% by 2030. Such initiatives, supplemented by complementary state policy and regulation, could credibly increase emissions' reductions to 50% by 2030.

In addition, the IRA will reduce overall energy demand by almost six percent between 2021 to 2032 through investments in and incentives for energy efficiency. During that timeframe, industrial and transportation energy costs will decrease by $30B and $25B respectively on an annual basis compared to BAU. The transition away from fossil fuels

also lowers residential energy costs significantly from 2022-2027 as electrification replaces higher-cost energy sources such as fuel oil for home heating.

As a result of the decrease in household residential energy costs, accelerated job growth, and increased productivity, real disposable per capita income increases in the IRA scenario by $6,200 per year by 2032. The beneficial impact of energy investments is also demonstrated in the growth of GDP over the coming decade, rising by an additional $240B per year in 2030 over the BAU scenario. Annual GDP with the IRA reaches $28.7T.

Finally, both the Base Case and IRA scenarios included the assumption that the Federal Reserve would continue raising interest rates during 2022 and 2023 until the government lending rate reached 3.5 percent. Although the Fed has now raised its rates to 4.25 percent, this modeling demonstrated that inflation declined in both scenarios at virtually the same rates with one interesting exception. The decline in energy consumption, sparked by IRA investments, led to a slightly quicker inflation reduction in the 2024-25 timeframe. Inflation, as measured by the Personal Consumer Expenditure Price Index, declined to 2.1 percent by 2030.

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1. Introduction

Passage of the Inflation Reduction Act marks a watershed moment in federal climate action, with far-reaching implications for U.S. energy markets, power and transportation infrastructure, industrial policy, supply chains, and the labor force. Crucially, the IRA will be instrumental in helping the world's largest historic emitter achieve significant GHG emissions reductions and activate emerging energy sectors and technologies.

The primary objective of this analysis by the Labor Energy Partnership is to understand the long-term economic, social, and environmental impacts of the IRA. Key questions that informed this analysis include:

- What are the employment effects of the major provisions of IRA?
- Which economic sectors will grow, and which will contract?
- How will electricity and fuel prices respond to mass electrification and grid transformation?
- How will the U.S. generation and capacity mix transform to achieve decarbonization targets?
- Which aspects of the labor market will face headwinds, requiring additional social policies?
- How will major federal investments and subsidies in the energy sector affect long-term inflation and overall economic output?

This analysis of the IRA involved utilizing three complementary models (Figure 3) to simulate the U.S. economy, its energy systems, and resulting emissions: (1) PLEXOS (2) the Carbon Tax Assessment Model (CTAM) and (3) Regional Economic Models, Inc. (REMI).

PLEXOS is an industry-standard energy market simulation tool used to forecast generation and capacity changes in the U.S. power, gas, and water sectors. PLEXOS computes both the cost of meeting day-to-day needs on the electricity grid and the cost of retiring legacy power units and building replacement resources.

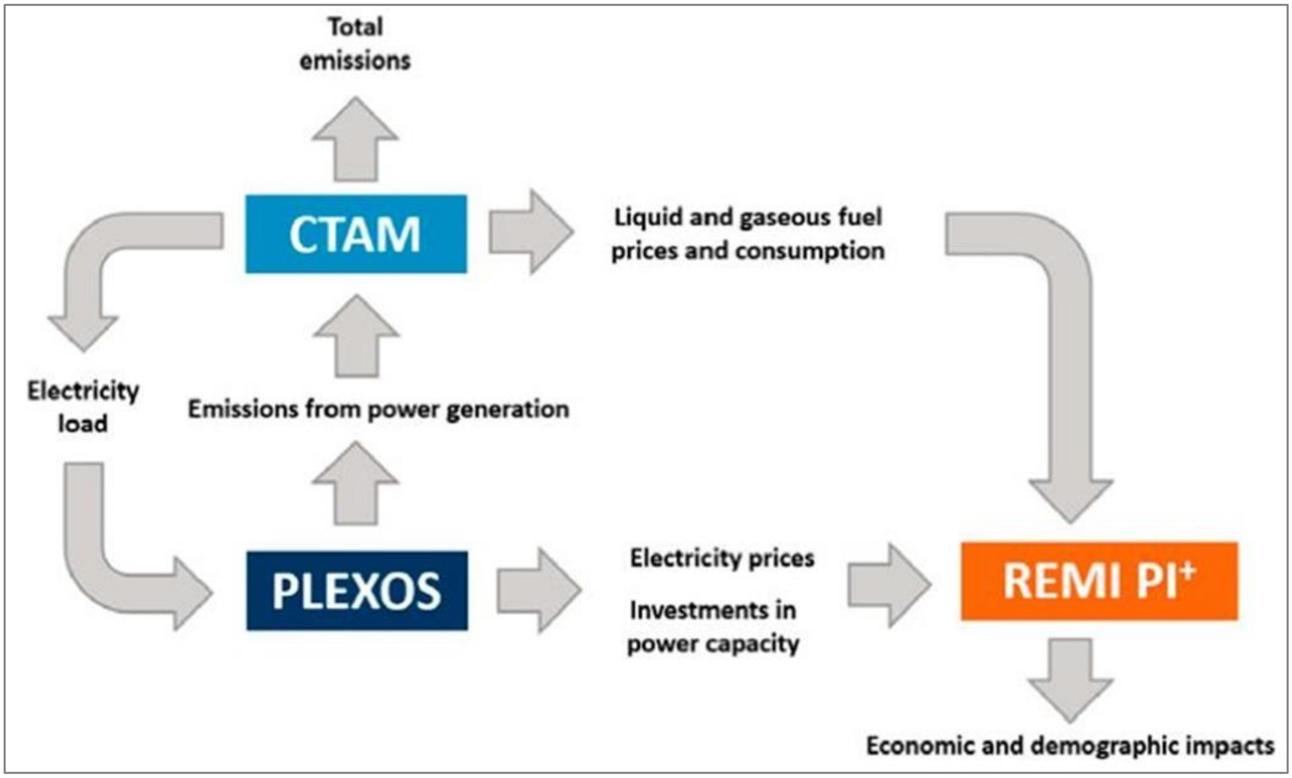
CTAM quantifies emissions by region in the United States and allows for analyzing carbon emissions and fuel use reductions as the energy system decarbonizes to meet specific targets. It is maintained by the Commerce Department of the state of Washington.

REMI is a dynamic, multiregional, computable general equilibrium model of the U.S. economy; REMI aggregates a comprehensive set of economic, demographic, and sectoral data and generates key macroeconomic forecasts such as gross domestic product, inflation

rate, job creation, real personal income, and industry-by-industry production. REMI integrates four modeling approaches to evaluate the impacts of complex policy interventions: input-output, general equilibrium, econometric, and economic geography.

PLEXOS, CTAM, and REMI interact and operate iteratively to ensure internal consistency. The schematic below represents the dataflows and outputs between the models and illustrates how each informs the other in the context of evaluating national decarbonization pathways.

Figure 3. Energy and Economic Modeling Schematic



2. Modeling Assumptions

2.1 Base Case Scenario Assumptions

The Base Case, "business as usual" (BAU), scenario provides a baseline to represent a "sluggish transition" of the U.S. energy system and economy, incorporating existing policies with no major changes in federal and state fiscal, regulatory, and energy conditions over the next decades. Assumptions in the Base Case are derived from the latest Annual Energy Outlook (AEO) reference case from the U.S. Energy Information Administration. While not an absolute status quo, the generally conservative outlook in the AEO energy data means this scenario simulates only gradual changes in the energy system and a slow reduction in total greenhouse gas emissions from the U.S. economy through 2030.

The Base Case incorporates the most up-to-date views on economic and demographic trends, technology improvements, energy consumption, and high and low parameters for fuel costs, fossil fuel supply, and renewable energy costs. It includes existing state legislative actions, such as California's carbon tax and the eleven-state Regional Greenhouse Gas Initiative (RGGI) in the Northeast.

It also includes the impacts of the IIJA, passed in 2021, a historic piece of infrastructure legislation that included $74 billion of energy spending and an additional $89 billion on climate impact and resiliency. Two charts and the allocation of the $1.2 trillion of IIJA spending in the REMI model are included in Appendix 2.

Finally, and most importantly, this reference scenario serves as a benchmark to evaluate the expected impact of the Inflation Reduction Act on a wide range of economic indicators, including job growth and loss across 160 sectors, gross domestic product, both nationally and by industry sector, inflation, energy demand and consumption, and per capita income.

2.2 Inflation Reduction Act (IRA) Case Scenario Assumptions

To simulate the energy systems impact of the IRA, this analysis utilized a modeling approach for the "least-cost" pathway to decarbonization of the electric power system from 2022-2032. Rather than constraining the model to specific resources, PLEXOS was allowed to find the most economical way to achieve an imposed emissions cap in the power sector.

For the overall U.S. economy, the Biden Administration's Nationally Determined Contribution (NDC) sets an emissions reduction goal of 50-52 percent for 2030 emissions relative to 2005. Our analysis of the economy with the IRA measures progress towards this goal, with the expectation that additional federal and/or state policy will be needed to make up for any deficit. A 65 percent emissions reduction for the power sector, which must continue to lead the economy-wide decarbonization, was imposed as a constraint on the model. Other key assumptions included in the IRA scenario analysis were:

Energy Efficiency and Electrification

- 10% improvement in energy efficiency in the industrial sector by 2030
- 7% increase in residential energy efficiency and 9% increase in commercial energy efficiency by 2030
- 18% of existing residential and commercial structures electrified by 2030, with building conversions starting in 2022
- All new and incremental energy demand in the residential and commercial sectors assumed to be electrified

Fuel Switching and Carbon Intensity

- 50% of remaining fossil fuel demand is converted to natural gas in the residential, commercial, industrial, and transportation sectors by 2030
- Renewable natural gas (RNG) penetration in the natural gas supply achieves 7.5% across residential, commercial, and industrial sectors by 2030

Transportation

- Electric vehicles achieve a third of total light-duty vehicle sales by 2030
- Electric vehicles achieve 22.5% of total heavy-duty vehicle sales by 2030
- In the transportation sector, diesel fuel is blended with 15% biofuels (up from <5% today)

Beyond the energy system, the analysis incorporated fiscal policy changes required to model the IRA case, including the corporate minimum tax, prescription drug reform, IRS tax enforcement, the excise tax on stock buybacks, and the methane fee. Fiscal variables present in the REMI model allowed for the integration of these policy components. The August 5, 2022, amendments to the IRA, which substituted the excise tax on stock buybacks and the methane fee for the carried interest loophole, had a negligible impact on the modeling result, increasing revenues by $6B and long-term deficit reduction by the same amount.

Notably, the Infrastructure Investment and Jobs Act (IIJA) was incorporated into the base case BAU REMI model at the time of the analysis, as well as a representation of the CHIPS and Science Act, which targeted specific sectors such as semiconductor manufacturing and research and development in related technology sectors. Additionally, the IRA case included

a set of fiscal policy changes, outlined in the next section, to ensure job quality and domestic manufacturing, as inputs to the REMI model.

As noted, the modeled IRA scenario was developed as the final details of the legislation were being negotiated; certain analytical assumptions differed slightly from the final bill. On the revenue side, these changes were immaterial to the modeling. On the expenditure side, while the form of some of the subsidies was different (e.g., increased solar tax credits for domestically manufactured projects, instead of time-sensitive mandates), the PLEXOS and REMI modeling accounted for similar financial supports for these seven industries.

3. Job Quality and the Energy Transition

Many past industrial transitions in the United States have been marked by dramatic job loss and community decline. Some of these transitions have been driven by technology, some by market factors, and others by public policy. Frequently, multiple factors are in play. For example, the dramatic changes in the steel industry in the U.S. from 1980-2000 were accelerated first by new technologies including basic oxygen furnaces, continuous casters, and electric arc furnaces, then global economic integration, and finally new trade agreements, including NAFTA and PNTR, which created globally integrated steel producers, consumers, and labor markets.[1]

One of the key issues to address when managing the current energy transition in the U.S. is how to create high-quality jobs to replace those that are lost in affected industries and communities. It will also be important to preserve as many jobs as possible in vulnerable sectors. To gauge the effectiveness of various social interventions to create or protect jobs, the following policies, noted in Section 4, were included in this study's modeling of the expenditures authorized by the Inflation Reduction Act:

- Davis-Bacon prevailing wage standards applied to all construction projects to minimize low-wage competition;
- 80% domestic content required on all battery production to ensure the growth of a domestic battery industry;
- 40% domestic content on wind turbine production through 2025, rising to 60% in 2026 to expand wind industry supply chains;
- Border adjustments for all energy-intensive, trade-exposed industries based on the social cost of carbon to provide decarbonization incentives and prevent carbon leakage;
- $20 billion allocated for targeted worker retraining in communities impacted by job loss;
- Expanded electric vehicle tax credits with 60% directed to domestic EV production to stimulate U.S. EV assembly plants; and
- 40% of identified expenditures allocated to Justice 40 and fossil-impacted communities.

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[1] Hoerr, John P., *And the Wolf Finally Came—The Decline of the American Steel Industry*, 1988, University of Pittsburgh Press. Williams, Lynn, *One Day Longer, A Memoir*, 2011, University of Toronto Press.

In addition, the modeling also included the mandated social and labor policies contained in the IIJA in both the BAU and the IRA scenarios. These included additional:

- Davis-Bacon prevailing wage standards;
- Buy America(n) provisions; and
- 40% of identified expenditures allocated to Justice 40 and fossil-impacted communities

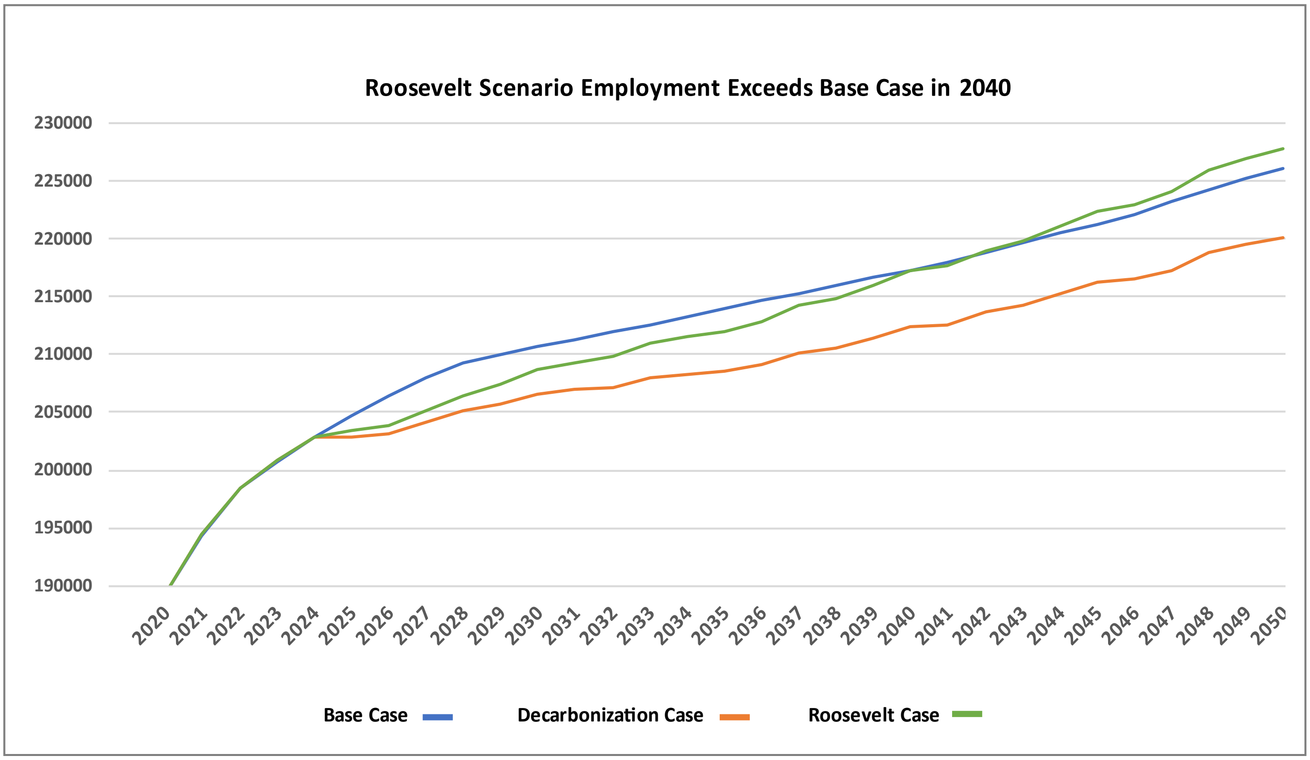
While many existing jobs impact studies quantify the specific job creation from direct investments in clean energy technologies, there are very few that measure the holistic effects of those investments on the economy. Frequently, no mention is made of the decline in jobs in fossil energy sectors, the resulting contraction in related or dependent economic sectors, and the unique regional effects. Nor are GDP, inflation, household income, or energy consumption impacts generally estimated.

One study, however, produced by the Roosevelt Project at MIT in 2021, and its four subsequent case studies in 2022, provide us with clear evidence of the importance of integrating supportive social policies with clean energy investments.2 These studies also provide additional data on the impacts of those social policies on broader economic indicators.

As seen in Figures 4 and 5, the Roosevelt Project studies demonstrate that without ameliorating social policies, such as those listed above, a market-driven, carbon price transition to a net zero economy in 2050 will result in substantially lower job growth when compared to the BAU scenario. In sharp contrast, the Roosevelt scenario, with the appropriate social policies, achieves the net zero carbon emissions' goal while producing 1.5M more jobs than the BAU scenario in 2050. The Roosevelt scenario also produced 7.5M more jobs than the Net Zero scenario, demonstrating the importance of these choices.

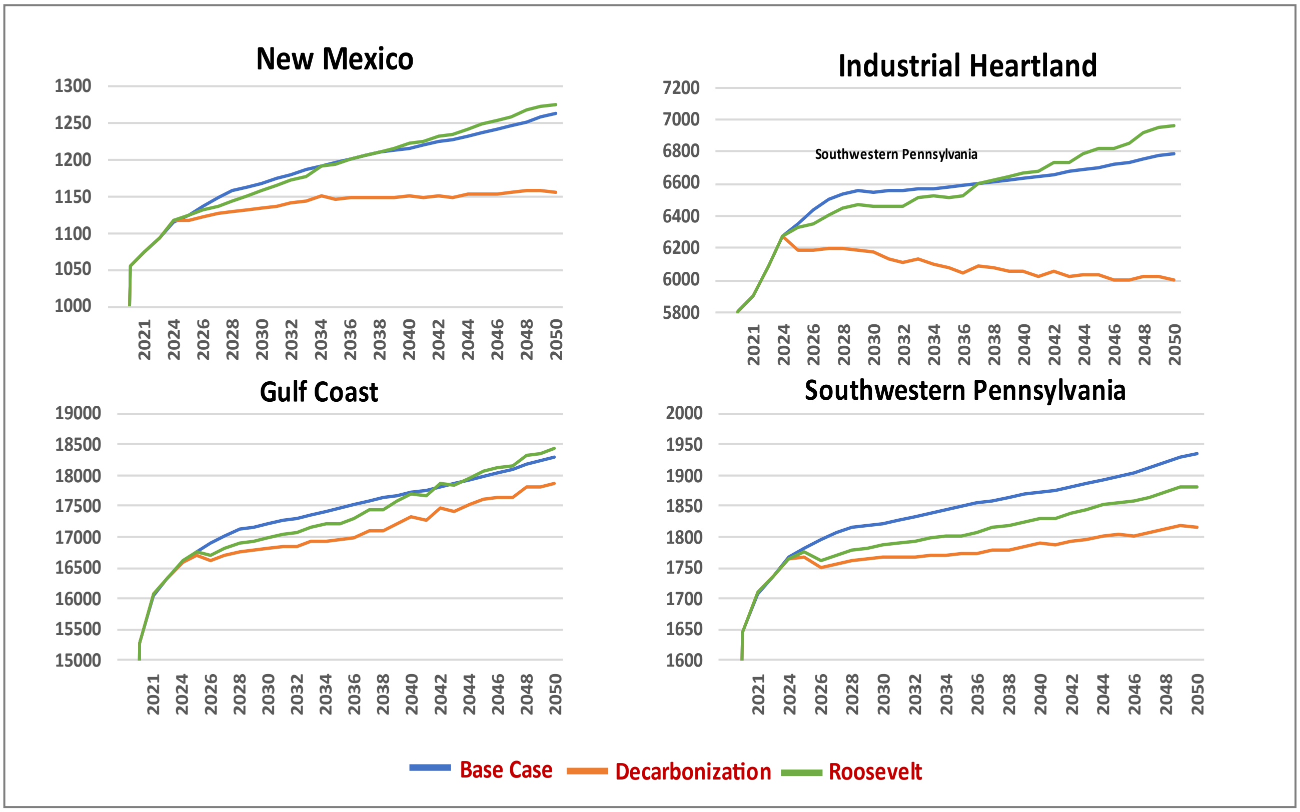
[2] https://ceepr.mit.edu/wp-content/uploads/2022/12/2022-The-Roosevelt-Project-Phase-2-Case-Studies-Overview.pdf

Figure 4. Job Growth, 2020-2050, MIT Roosevelt Project



In addition, the Roosevelt Project case studies demonstrate that these policies would also have beneficial impacts on those regions of the country that are especially susceptible to negative economic impacts from the energy transition. In three of the four cases—the Industrial Heartland (composed of MI, IN and OH), the Texas-Louisiana Gulf Coast (a 40-county region), and the state of New Mexico—the Roosevelt Project job growth outcomes exceed both the Net Zero and BAU scenarios. In the fourth, SW Pennsylvania—heavily dependent on coal, natural gas, and energy-intensive manufacturing—the Roosevelt scenario exceeds the Net Zero scenario but does not exceed the Base Case. This outcome in Figure 5 further demonstrates the need for additional social support.

Figure 5. Job Growth, 2020-2050 in MIT Roosevelt Project Case Studies.[3]



[3] https://ceepr.mit.edu/wp-content/uploads/2022/12/2022-The-Roosevelt-Project-Phase-2-Case-Studies-Overview.pdf

4. Key Findings from the Inflation Reduction Act Modeling Exercise

Overall, the LEP modeling of the IRA demonstrates the unique benefits that well-directed energy investments can have simultaneously on job growth, gross domestic product (GDP), real disposable income, inflation reduction, targeted sectoral energy costs, and GHG emissions reduction. This domino effect of energy investments speaks to the important role that energy plays in the architecture of modern industrial economies. When combined with public policies that support job quality and access, energy investments can also result in greater social equity.

The modeling shows that the IRA would create 1.5 million more jobs in the U.S. economy by 2030 than the BAU scenario while reducing GHG emissions by 37% over 2005 levels. It should be noted that the LEP modeling does not include GHG reductions that could be achieved from non-energy sources such as agriculture, land use, and forest management, carbon direct removal, or waste management, initiatives that could increase emissions reductions to 50% by 2030.[4] Complementary state policy and regulatory action could also assist in achieving higher GHG reductions by 2030.

In addition, the IRA would reduce overall energy demand by almost six percent from 2021 to 2032 through investments in and incentives for energy efficiency. During that timeframe, industrial and transportation energy costs will decrease by $30B and $25B respectively on an annual basis compared to BAU.

The transition away from fossil fuels also lowers residential energy costs significantly from 2022-2027 as electrification replaces higher-cost energy sources such as fuel oil for home heating. As a result of the decrease in household residential energy costs, accelerated job growth, and increased productivity, real disposable per capita income increases in the IRA scenario by $6,200 per year by 2032.

The beneficial impact of energy investments is also demonstrated in the growth of GDP over the coming decade, rising by an additional $240B per year in 2030 over the BAU scenario. Annual GDP with the IRA reaches $28.7T

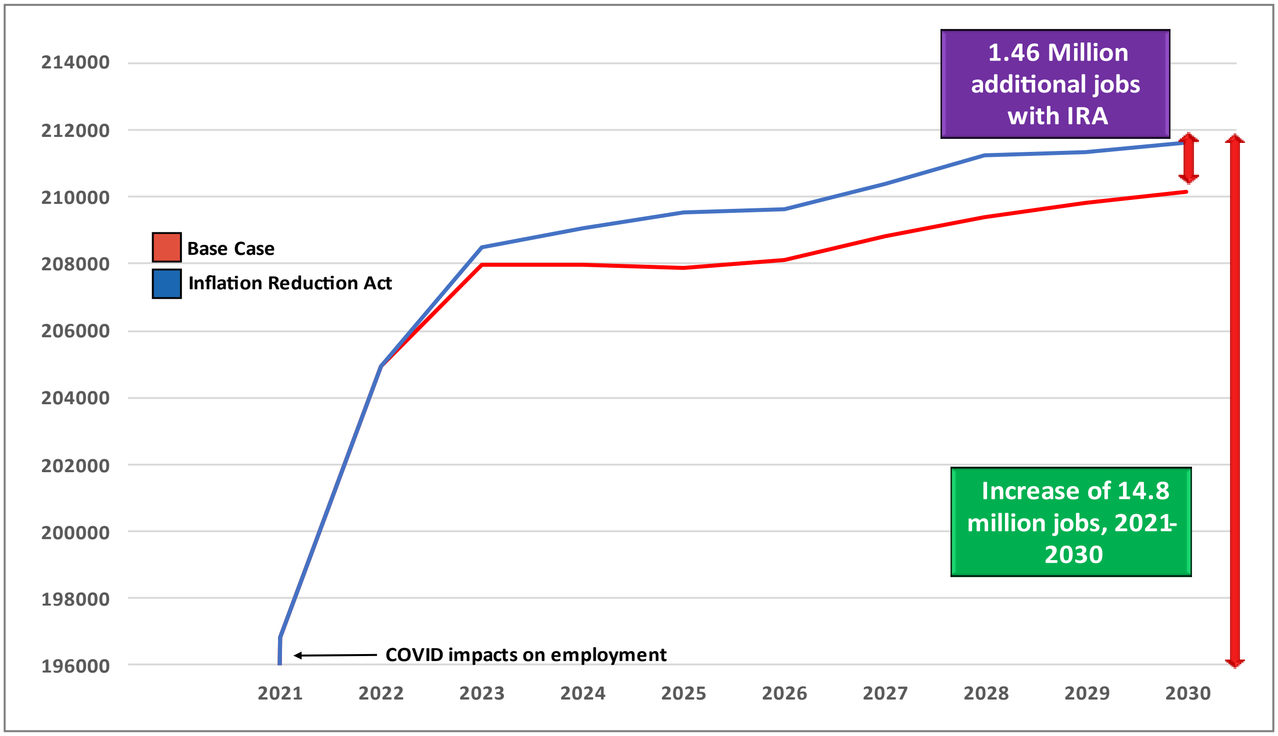
[4] See Appendix 8.

Finally, both the Base Case and IRA scenarios included the assumption that the Federal Reserve would continue raising interest rates during 2022 and 2023 until the government lending rate reached 3.5 percent. Although the Fed has now raised rates to 4.25 percent and may go higher in early 2023, this modeling demonstrated that inflation declined in both scenarios at virtually the same rate with one interesting exception. The decline in energy consumption, sparked by IRA investments, led to a slightly quicker inflation reduction in the 2024-25 time frame. Inflation, as measured by the Personal Consumer Expenditure Price Index, declined to 2.1 percent by 2030.

4.1 Job growth[5]

Under the IRA scenario, U.S. employment rises from nearly 197M in 2021 to almost 212M by the end of the decade. 1.457M more jobs are created in the U.S. economy by 2030 with the IRA than in the BAU case (Figure 6).

Figure 6. Job Creation from the Inflation Reduction Act, 2021-2030



Key sectors that experience the most growth include construction, manufacturing, and the electric utility sector, as IRA energy and climate investments stimulate infrastructure expansion and other capital spending.

- Construction grows by 1.16M jobs with 590,000 of those directly attributable to the IRA investments.
- Manufacturing expands by 1.1 million jobs, recovering many of the jobs lost in previous decades, 150,000 more than under the Base Case.

This growth is directly correlated to the domestic content requirements for electric vehicles, batteries, renewable energy tax credits, Buy America(n) provisions in the IIJA and IRA, and carbon border adjustments for energy intensive industries such as steel.

[5] See Appendix 5.

- As electricity generation shifts, the electric utility sector adds 190K more jobs than the Base Case, rising to 590,000.

Job quality improvement is also reflected in the type of jobs that increase under the IRA with the construction, manufacturing, and utility sectors all paying wages that average well-above median weekly earnings of $973 in the U.S. Each of these sectors also enjoys higher unionization rates than the private sector overall (Table 1).

Table 1. Key Areas of Job Growth, Weekly Earnings, and Unionization Rate, 2021-2030.[6]

Category	2021 Jobs	2030 Base Case Jobs	2030 IRA Case Jobs	2021 Median Weekly Earnings Union Members	2021 Unionization Rate
Construction	10,724,000	11,293,000	11,883,000	$1344	12.6
Manufacturing	13,315,000	14,326,000	14,477,000	$1016	7.7
Electric Utility	409,000	383,000	571,000	$1482*	19.7*
Private Sector	169,970,000	182,075,000	183,438,000	$973**	6.1

*Includes all utility sector wages
** Includes all employees, both union and non-union

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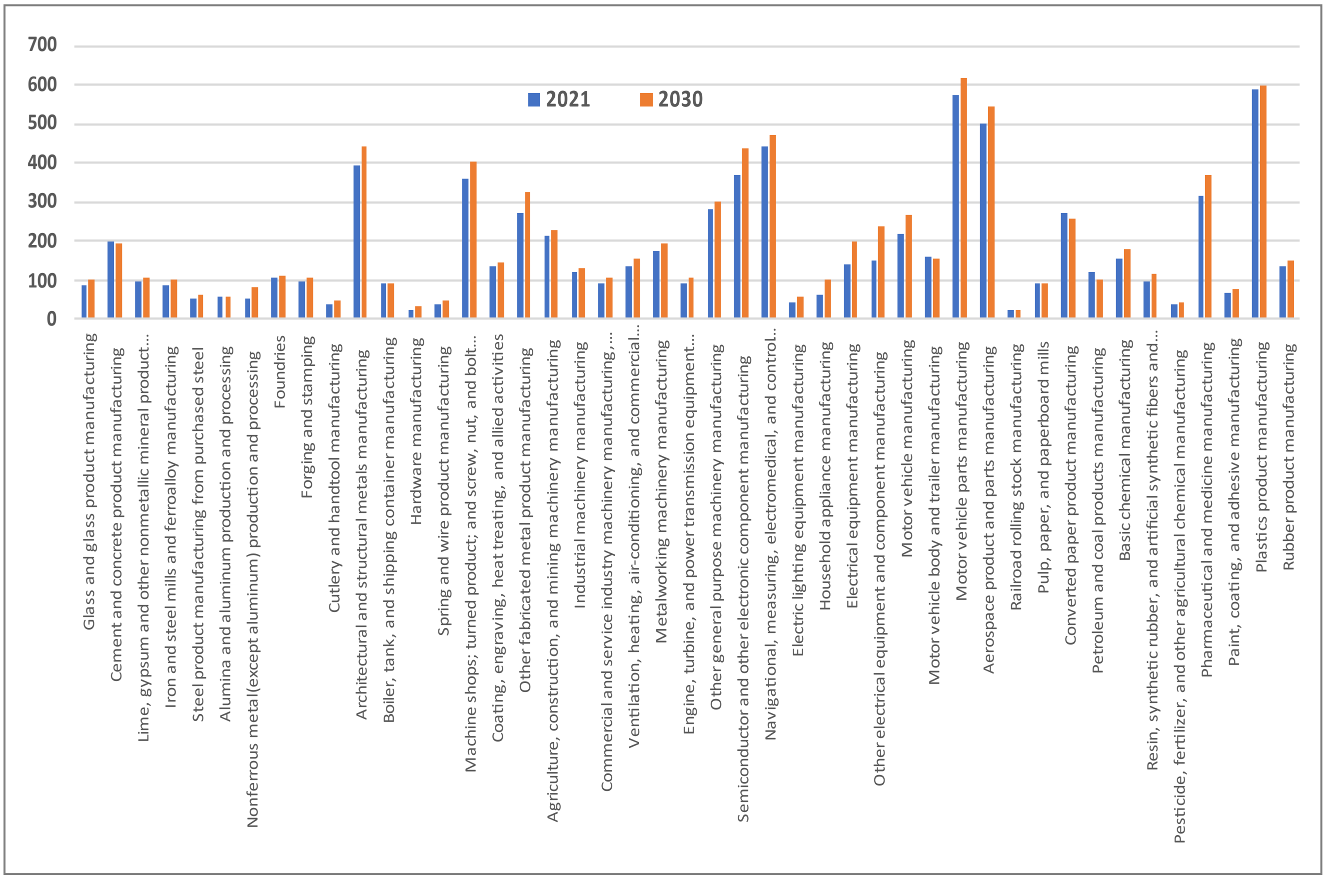
Impacts on the motor vehicle industry are also of note with the IRA and IIJA investments in electric vehicle infrastructure, domestic content incentives for EVs, and investments in domestic battery manufacturing and materials processing. Motor vehicle manufacturing jobs increase by 45,000 to over 1.1M in 2030. An additional 61,000 new MV battery manufacturing jobs demonstrate how domestic content rules ensure a net increase in job creation in the MV sector while jobs are lost from the manufacture of internal combustion parts and engines.[7]

Figure 7 below demonstrates the breadth of durable manufacturing growth across the entire sector. Durable manufactured goods generally have an average life of three or more years.

[6] https://www.bls.gov/cps/cpsaat43.pdf
[7] See Appendix 5.

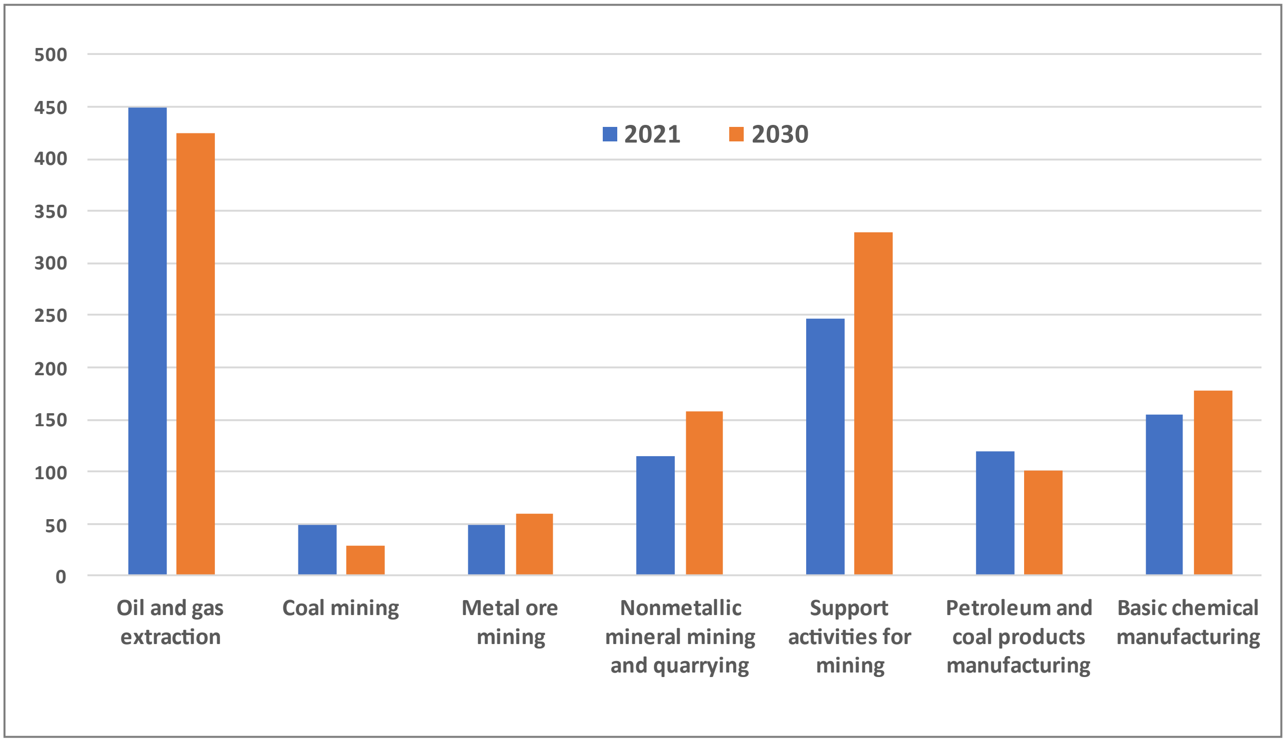
Figure 7. IRA Job Impacts on Select Durable Manufacturing, 2021-2030



4.2 Job Losses.[8]

Jobs are, however, lost in some sectors during the energy transition. The LEP analysis shows that the oil and gas extraction, coal mining, and petroleum refining sectors experience overall job losses during the next decade. However, jobs with similar skills in metal ore mining, nonmetallic mineral mining and quarrying, support activities for mining, and basic chemical manufacturing all show meaningful growth over that decade. These results are seen in Figure 8. Many of these new jobs are likely to be located in the same states where extraction and refining jobs are currently performed.[9] With supportive training, transition and economic development supports, the likelihood of an equitable social transition would increase significantly.

Figure 8. IRA Job Losses in Fossil Fuel Industries and Gains in Similar Industries, 2021-2030



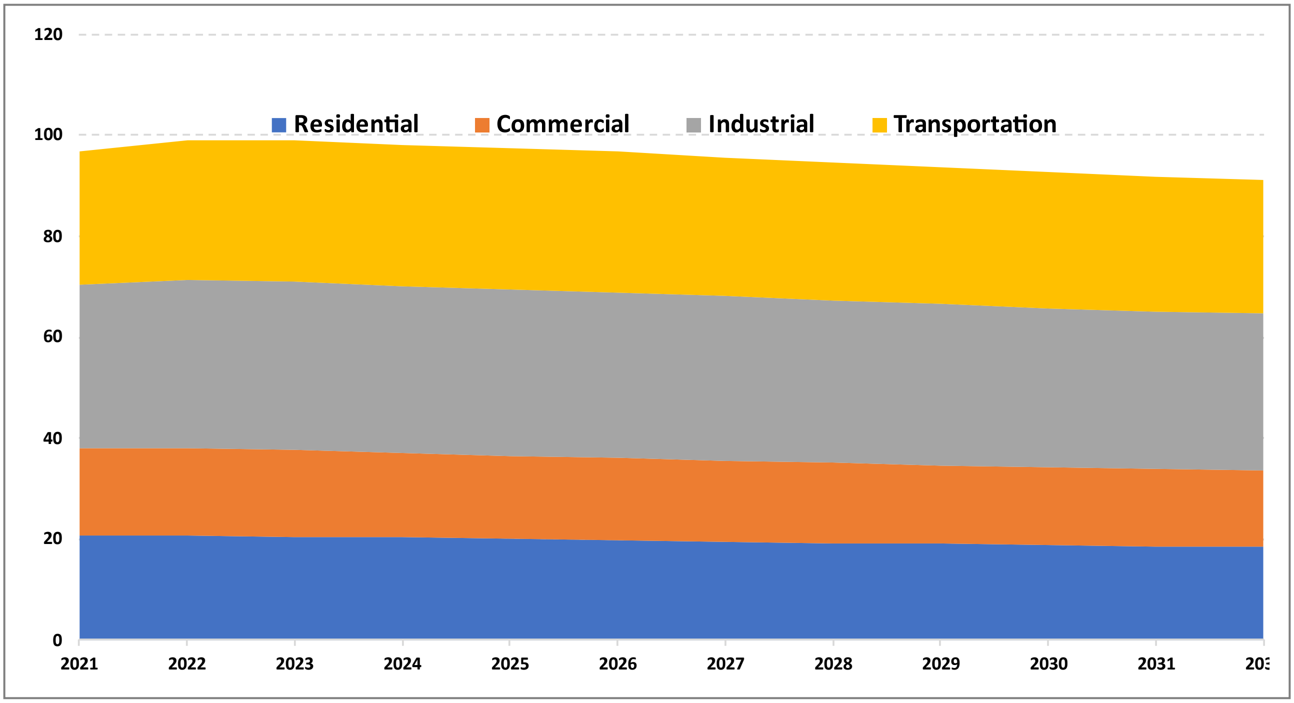
[8] See Appendix 5.
[9] Energy and Manufacturing in the United States, https://ceepr.mit.edu/wp-content/uploads/2021/09/The-Roosevelt-Project-WP-8.pdf.

4.3 Energy Cost Declines.[10]

The IRA committed $49B of investments to building efficiency, residential housing, and resiliency. Additional funding was committed to transportation electrification and industrial energy efficiency.

Together, these investments will contribute to an overall decline in energy demand in the U.S. over the next decade. This modeling exercise showed there will be a decline from 96.9 quads of energy in 2021 to 91.1 quads in 2032 or almost 6%. This is 9.5 quads less than the Annual Energy Outlook forecast for 2032, modeled in the BAU scenario.11 Energy demand reductions by the residential, commercial, industrial, and transportation sectors between 2021 and 2032 are seen in Figure 9.

Figure 9. IRA Case Energy Demand by Sector, 2021-2032, Residential, Commercial, Industrial, and Transportation (Quads)



Even though overall energy costs are expected to rise during this period, the changing mix of energy required for heating, cooling, and transportation, along with its more efficient use, will result in lower costs for American families through 2027. Average annual residential

[10] See Appendix 6.
[11] See Appendix 6.

household energy costs will drop from $4,867 in 2021 to $4,657 in 2025 before rising to $4,894 in 2029.[12]

While these residential household impacts will vary by state and region, depending on the current mix of energy use and efficiency, the overall benefits will accrue to the American economy as these savings are redistributed through consumer spending. For instance, in New Hampshire, heavily dependent on expensive fuel oil for home heating, total energy costs for the state are predicted to drop by 9% by 2032.[13]

Additional benefits are also experienced by the industrial and transportation sectors of the economy. The EIA's 2021 AEO predicts that industrial energy expenditures will rise to $475B per year by 2032, while transportation energy expenditures will rise to $636B per year in that same time frame. Under the IRA industrial energy costs will rise to $445B ($30B less than BAU) and transportation to $621B ($25B less than BAU), reflecting greater efficiency and competitiveness in those sectors. Again, the more efficient use of energy will stimulate these sectors as well as the overall economy.[14]

4.4 Real Disposable Income

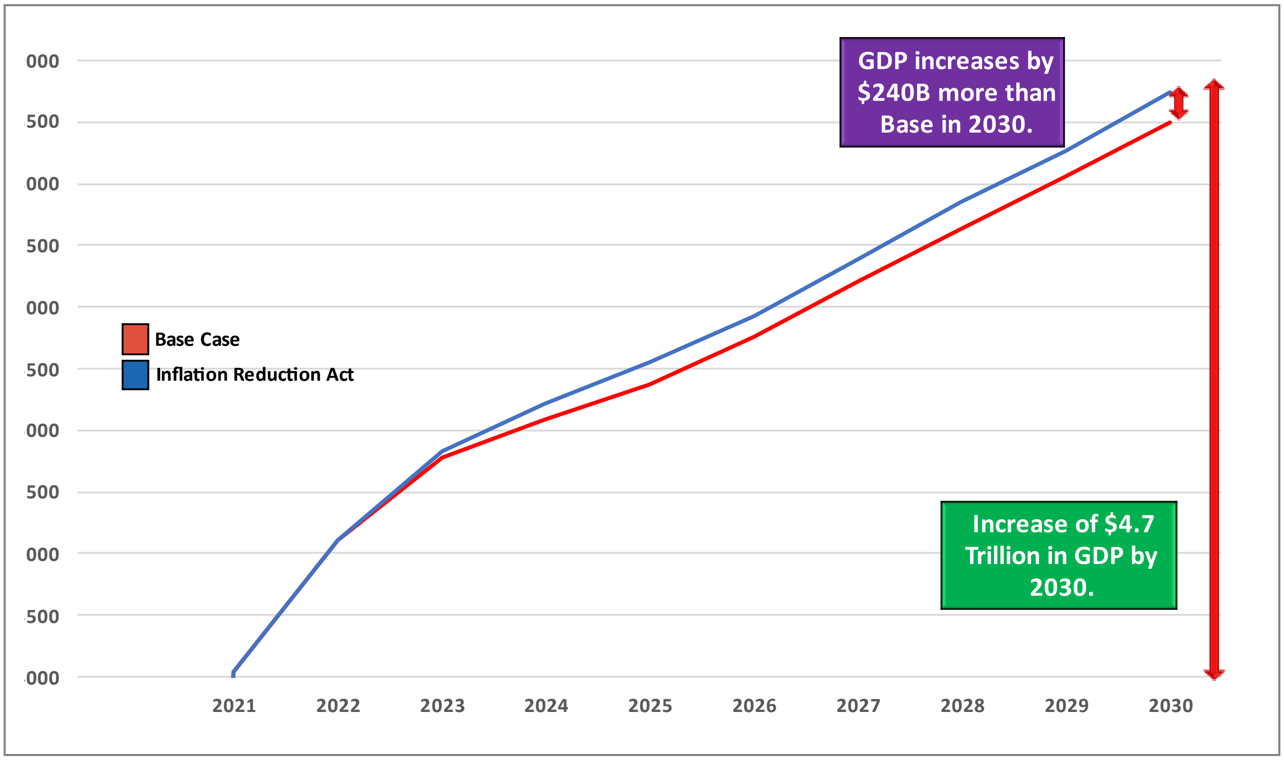
In the decade following passage of the IRA, real disposable income per capita in the United States is projected to rise from $48,306 in 2022 (fixed 2012 dollars) to $54,481 in 2032 (fixed 2012 dollars), an increase of 12.8 percent.[15]

4.5 GDP Growth

One of the key metrics for overall health of an economy is gross domestic product (GDP) and its year-over-year growth. In 2021, the GDP of the U.S. was $24.044T (fixed 2022 dollars), the largest in the world. Under the BAU scenario, GDP is projected to rise to $28.491T (fixed 2022 dollars) in 2030. Under the IRA scenario, GDP rises to $28.748T (fixed 2022 dollars), an increase of $243B (Figure 10). Cumulatively, over that decade, the IRA results in adding over $1.5T to U.S. GDP.[16]

[12] See Appendix 6.
[13] See Appendix 6.
[14] See Appendix 6.
[15] See Appendix 3.
[16] See Appendix 9.

Figure 10. Gross Domestic Product Growth, 2021-2030, (Billions of $)



GDP growth is concentrated in key energy sectors of the economy. For instance, electric power generation GDP increases by $180B annually under the IRA to $483B in 2030 an increase of 60 per cent. In the BAU case, electric power generation GDP remains relatively flat, reaching $324B in 2030, an increase of 8 per cent. Construction sector GDP also grows significantly to $1.19T over the decade, an annual increase of $164B.[17]

4.6 Inflation Impacts[18]

One of the most vexing problems of the post-pandemic economy and the Ukraine-Russia conflict, has been the growth of inflation, attributed to a variety of factors including supply chain disruption, workforce dislocation, logistics, energy and food shortages, profit-taking, labor shortages, and deficit spending by governments around the world. One of the key questions asked during congressional debate over the IRA was whether it would contribute to additional inflation.

[17] See Appendix 9.
[18] See Appendix 3.

Both the Base Case and IRA scenarios included the assumption that the Federal Reserve would continue raising interest rates during 2022 and 2023 until the government lending rate reached 3.5%. Although the Fed has now raised interest rates to 4.25 percent, the LEP analysis found that this aggressive intervention by the Fed resulted in a decline in inflation rates in both scenarios during 2023 and 2024.

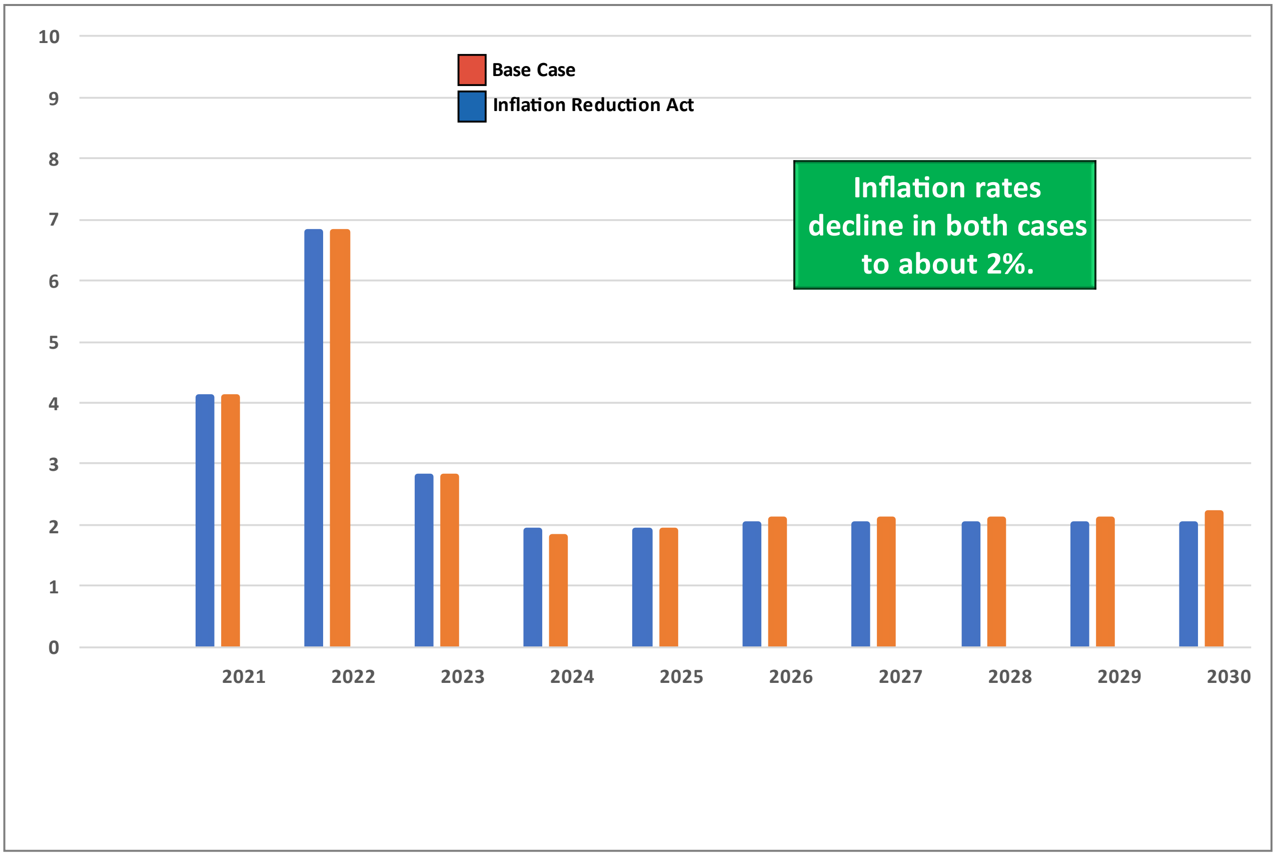
Interestingly, the investments in energy efficiency from the IRA resulted in slightly greater inflation reduction in 2024 and 2025. This decline in the inflation rate was reinforced by the targeted tax increases that will pay for all the IRA appropriations and reduce the federal budget deficit by $310B.[19]

In its August 3, 2022, scoring, the Congressional Budget Office found that the IRA raised $780B from new taxes, while allocating $470B in new spending. In addition to the $369B for energy programs, the IRA also funded an extension of the Affordable Care Act.[20]

Using the Personal Consumption Expenditures (PCE) Price Index—the Federal Reserve's benchmark measure of inflation for determining rate increases—the LEP analysis showed that inflation will moderate in both the Base Case and IRA Case, returning to the desired 2 to 2.1 percent annual level. This, of course, assumes that there will be no unpredictable shocks to the economy such as the Covid-19 pandemic or Russian invasion of Ukraine.

[19] See Appendix 1.
[20] https://www.cbo.gov/system/files/2022-08/hr5376_IR_Act_8-3-22.pdf

Figure 11. IRA Impact on Inflation Rates, 2021-2030



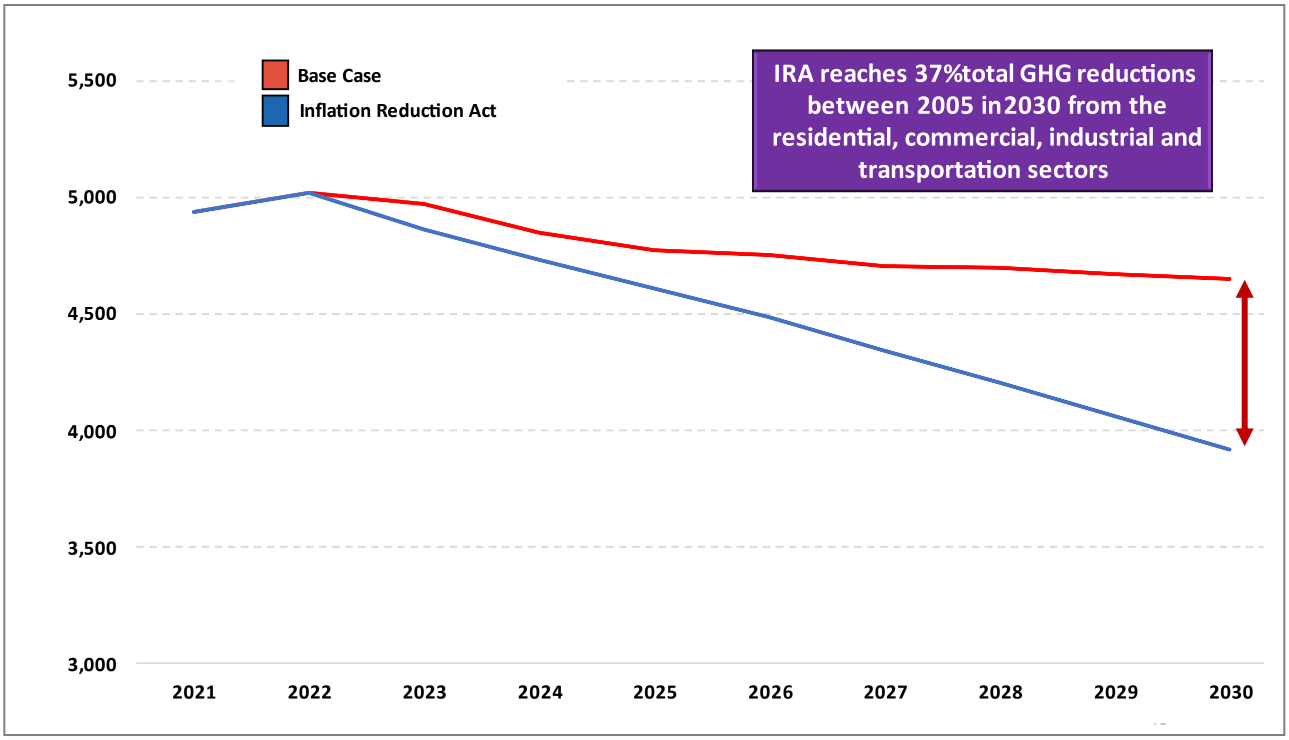
4.7 Net emissions reduction[21]

One of the goals of the LEP modeling exercise was to demonstrate that significant emissions reductions can take place while also preserving and creating more high-quality jobs than in the BAU scenario. The essential ingredients to reach this goal are: 1) clean energy investments which also reduce energy costs, 2) domestic content requirements, 3) strong labor standards, and 4) equitable distribution of both jobs and investments. The LEP modeling of the impacts of the IRA shows that U.S. GHG emissions would be reduced by 37% by 2030 from 2005 levels (Figure 12).

Figure 12. IRA Impacts on GHG Reductions, 2021-2030 (MMT)

[21] See Appendix 8.

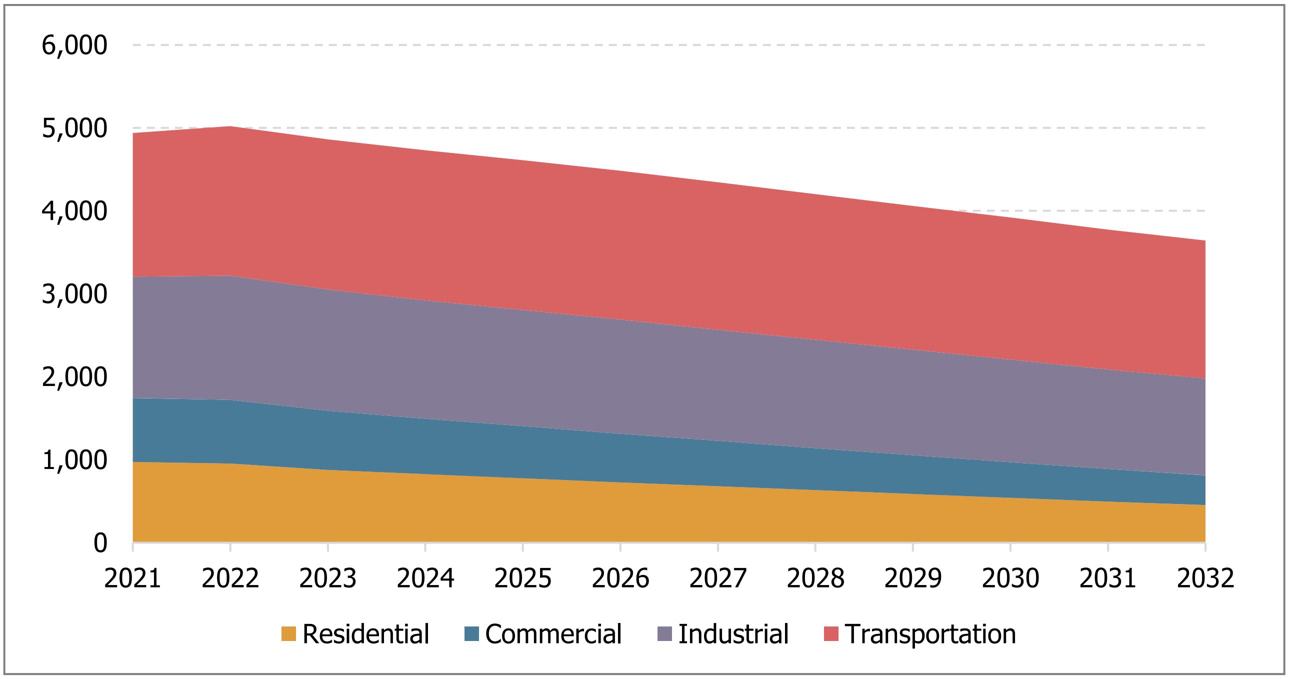
Figure 12. IRA Impact on GHG Reductions, 2021-2030 (MMT)



While this reduction is less than the stated goal of the Biden Administration of 50 percent by 2030, this modeling exercise showed GHG reductions of 41.3 percent by 2032.[22] However, it should be noted that these figures model only the direct impacts of the IIJA and IRA to decarbonize the residential, commercial, industrial, and transportation sectors of the economy. Emissions reductions by these sectors from 2021 to 2032 are seen in Figure 13.

[22] See Appendix 8.

Figure 13. IRA Case Emission Reductions by Residential, Commercial, Industrial, and Transportation Sectors, 2021-2032 (MMT)



In the preparatory analysis for modeling the IRA and IIJA, additional technologies and policies were identified which are essential to meet the goal of 50 percent reductions by 2030. These tools include carbon direct removal (CDR), land use reform and forest management such as tree planting, agricultural reductions from biogas capture and nutrient management, hydrogen fuels, and other forms of waste management and leak prevention.[23] We also modeled the rates of electric vehicle adoption for light duty and heavy duty vehicles for both the 2030 and 2050 timeframes.[24] Collectively, these tools, with the proper federal, state, and private sector support, could account for the additional GHG reductions necessary to meet the 50 percent target.

[23] See Appendix 8.
[24] See Appendix 4.

5. Conclusions

The Inflation Reduction Act is an historic piece of legislation that addresses the growing impacts of climate change with strategic energy investments that promote high quality, domestic job creation. The IRA also targets a significant share of its benefits to impacted workers and disadvantaged communities. The LEP modeling exercise demonstrates that this kind of deliberate, coordinated approach to the energy transition provides an opportunity to address simultaneously a complex set of technological, social, and environmental challenges in ways that increase jobs, substantially decrease GHG emissions, and lower energy costs to consumers.

It is important to recognize that this exercise was taken under many constraints that, with effective legislative, regulatory, or executive actions at both the federal, state, and regional levels, outcomes would be easier and potentially more economical. For instance, the significant increases in renewable electricity generation that were modeled were constrained by existing roadblocks to interstate transmission line approvals and construction. As a result, they were built only in locations where current transmission systems could handle the increased load within existing independent service organizations (ISOs).

In spite of these barriers, we hope this exercise demonstrates to policy makers and stakeholders, that it is not only possible, but preferable, to develop pathways that solve some of the nation’s greatest challenges in concert.

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1. **Modeling Expenditures under REMI for IRA.**
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    b. State Energy Costs, IRA Case Compared to Base Case, 2021-2032. Table 10.

1. Modeling Expenditures under REMI for IRA

Category	Estimated spending, in $B	Allocation Approach
HEALTH		
ACA Extension	$64.00	Household income/ transfers
TRANSPORTATION		
USPS Clean Fleet Investments	$3.00	Demand (Motor vehicle manufacturing)
Clean HD vehicles	$1.00	Demand (Motor vehicle manufacturing)
Clean Ports	$3.00	Capital expenditures (Transportation structures and highways and streets construction); Capital expenditures (Other nonresidential structures); Output (Water transportation)
Neighborhood Access and Equity Grants	$3.05	Output (State and Local Gov); Output (Transportation); Capital expenditures (Transportation structure and highways and streets construction)
Low Emission Aviation Grant	$0.30	Production costs (Air transportation)
Clean vehicles	$12.47	Demand (Motor vehicle manufacturing)
Clean vehicles infrastructure	$1.74	Capital expenditures (Transportation structures and highways and streets construction); Demand (Other electrical equipment manufacturing)
WATER		
Drinking water/wastewater/stormwater	$0.58	Capital expenditures (Other nonresidential structures); Output (Maintenance and repair of nonresidential structures); Demand (Water and sewage systems)
ELECTRICITY		
Grid transmission	$2.86	Capital expenditures (Power and communications structures)
GHG Reduction Fund	$27.00	Capital expenditures (Power and communications structures); Cost of Capital (Utilities)
Rural electricity	$11.90	Capital expenditures (Power and communications structures); Prices (Retail electricity prices)

Energy Infrastructure Reinvestments	$5.00	Cost of capital (Energy/utilities sector)
National Labs	$2.00	Capital expenditures (Other nonresidential structure)
Clean Energy Loan Guarantees	$3.60	Cost of capital (Energy/utilities sector)
Uranium investment	$0.70	Demand (Mining)
Tribal Energy Loan Guarantees	$0.08	Cost of capital (Energy/utilities sector)
Clean energy tax credits - ITC, PTC, low-income solar	$65.05	Prices (Electricity)
Clean energy tax credits - Carbon capture	$3.20	Demand (CCS industries)
Clean energy tax credits - nuclear	$30.00	Prices (Electricity)
Clean energy tax credits - clean fuels	$18.84	Demand (Hydrogen industries); Demand (Chemicals/biofuels)
Clean energy tax credits - clean electricity production and investment tax credits	$65.63	Prices (Electricity); Output (Utilities)
LANDS, EJ, RESILIENCE		
Environmental and climate justice	$4.01	Capital expenditures (Nonresidential maintenance and repair); Demand (Waste management and remediation services); Output (State and local government); Output (Federal civilian government); Demand (Social assistance)
Pollution cleanup	$7.15	Demand (Waste management and remediation services); Demand (Architectural, engineering, and related services); Output (Federal civilian)
Land protection, climate resilience	$10.35	Capital expenditures (nonresidential maintenance and repair); Output (State and Local Governments); Output (Federal)
BUILDINGS		
Affordable Housing Resilience and Efficiency Investments	$1.00	Capital expenditure (Maintenance and repair of residential structures); Demand (Other electrical equipment manufacturing)
Efficient Building Code Adoption Grants	$2.00	Output (Architectural, engineering, and related services); Output (State and Local gov)

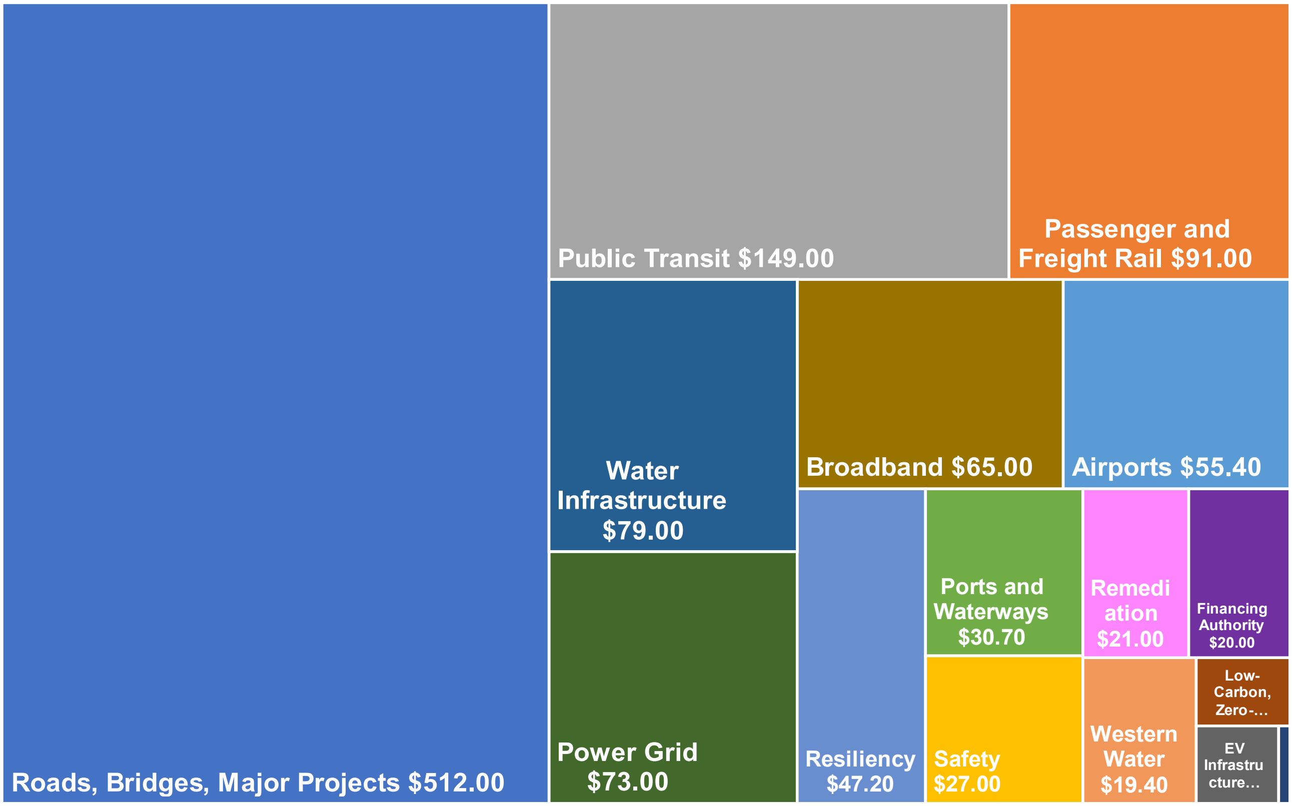
Federal Buildings	$0.25	Capital expenditure (Maintenance and repair of nonresidential structures)
Building tax credits	$36.88	Household income; Capital expenditure (Maintenance and repair residential structures); Capital expenditure (Maintenance and repair nonresidential structures)
Home Electrification and Energy Efficiency Rebates	$9.00	Household income
MANUFACTURING		
Industrial Emissions Reduction Investments	$5.81	Capital expenditure (Nonresidential/Manufacturing structures); (Power and communications structures); Production costs (Heavy/EITE manufacturing)
Low-Carbon Materials Investments	$5.48	Demand (Construction); Demand (Nonmetallic mineral product mftg); Demand (Primary metal manufacturing); Output (Federal civilian); Research and Development
Manufacturing tax credits - advanced energy project credit, advanced mftg production credit	$36.88	Production cost (Manufacturing)
EV Manufacturing Loans	$3.00	Cost of capital (Motor vehicle manufacturing)
EV Manufacturing Grants	$2.00	Demand (Motor vehicle manufacturing)
Defense Production Act	$0.50	Demand (Manufacturing)
AGRICULTURE		
Farmland conservation	$21.15	Output (Ag sector)
Biofuel Production Grants	$0.50	Output (Agriculture sector); Output (Chemicals)
LPO Principal loan commitments	$40.00	Cost of Capital
Energy Infrastructure Reinvestments loan guarantee authority	$250.00	Cost of Capital
Advanced Technology Vehicle Manufacturing loan program	$20.00	Cost of Capital (Motor vehicle manufacturing)
TOTAL (w/out loan guarantee)	**$469.94**	
TOTAL (w/loan guarantee)	**$780.94**	

2. Modeling Expenditures under REMI for IIJA

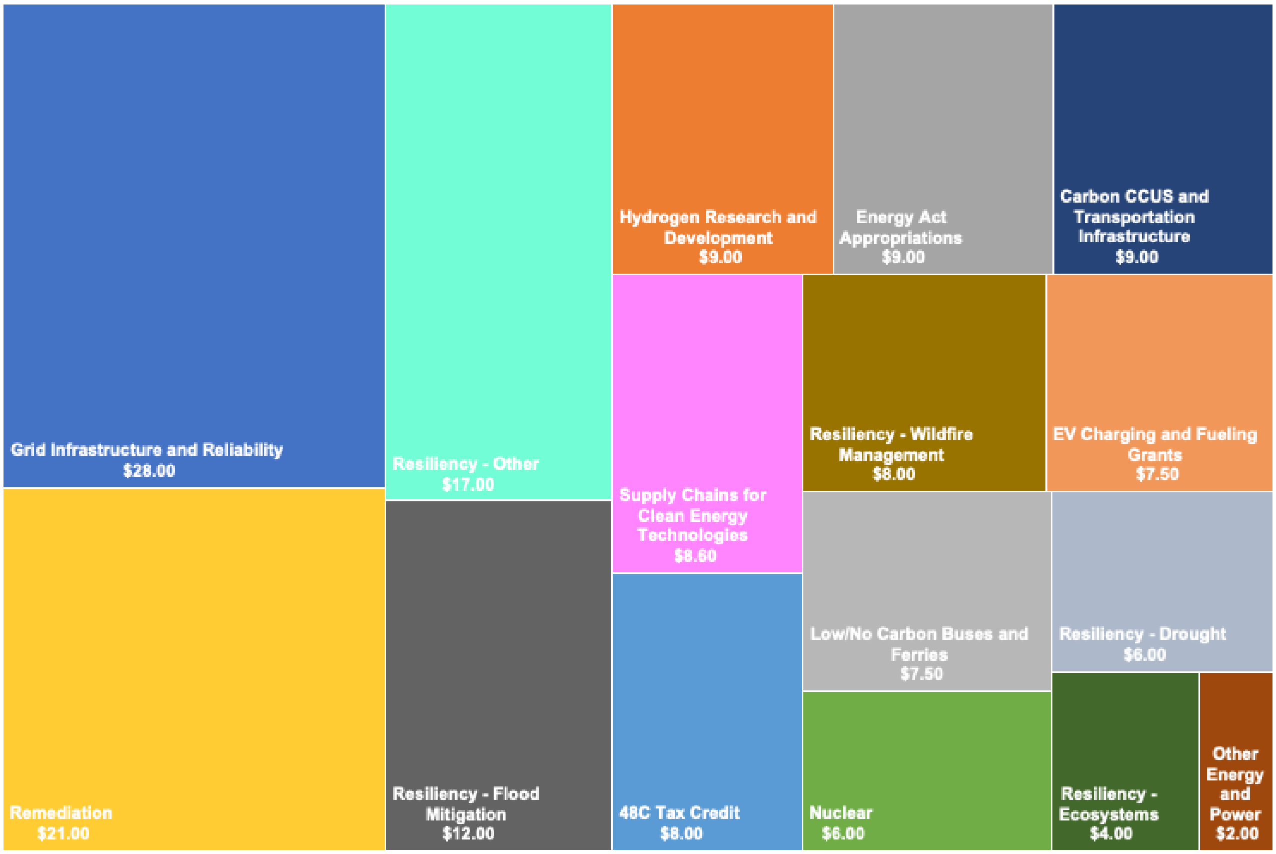
Category, spending in $B	Baseline	New Spending	Allocation Approach	TOTAL
Roads, Bridges, Major Projects	$402.00	$110.00	Capital expenditures (Transportation structure and highways and streets construction); Output (Maintenance and repair construction of highways, bridges, and tunnels)	$512.00
Passenger and Freight Rail	$25.00	$66.00	Capital expenditures (Transportation structure and highways and streets construction); Output (Rail transportation); Demand (Railroad rolling stock manufacturing)	$91.00
Public Transit	$110.00	$39.00	Capital expenditures (Transportation structure and highways and streets construction); Output (Transit and ground passenger transportation)	$149.00
Safety	$16.00	$11.00	Capital expenditures (Transportation structures, etc); Output (State and Local Governments); Output (Maintenance and repair construction of highway, etc.)	$27.00
Airports	$30.40	$25.00	Capital expenditures (Transportation structure and highways and streets construction); Capital expenditures (Other nonresidential structures); Output (Air transportation)	$55.40
Ports and Waterways	$14.40	$16.30	Capital expenditures (Transportation structure and highways and streets construction); Capital expenditures (Other nonresidential structures); Output (Water transportation)	$30.70
Reconnecting Communities	$ -	$1.00	Output (Architectural, engineering, and related services)	$1.00
Low-Carbon, Zero-Emission Buses and Ferries	$ -	$7.50	Demand (motor vehicle manufacturing)	$ 7.50

EV Infrastructure	$ -	$7.50	Capital expenditures (Transportation structure and highways and streets construction); Demand (Other electrical equipment manufacturing)	$ 7.50
Broadband	$ -	$65.00	Capital expenditures (Power and communications structures); Demand (Telecommunication services)	$ 65.00
Water Infrastructure	$ 24.00	$55.00	Capital expenditures (Other nonresidential structures); Output (Maintenance and repair of nonresidential structures); Demand (Water and sewage systems)	$ 79.00
Power Grid	$ -	$73.00	Capital expenditures (Power and communications structures); Output (Utilities)	$ 73.00
Resiliency	$ -	$47.20	Capital expenditures (nonresidential maintenance and repair); Output (State and Local Governments)	$ 47.20
Western Water	$14.40	$5.00	Capital expenditures (Other nonresidential structures); Output (Maintenance and repair of nonresidential structures); Output (Federal gov)	$ 19.40
Remediation		$21.00	Demand (Waste management and remediation services); Demand (Architectural, engineering, and related services); Output (Federal gov)	$ 21.00
Financing Authority			Capital expenditures (Other nonresidential structures)	$ 20.00
TOTAL				$ 1,205.70

Infrastructure Investment and Jobs Act: Overall Spending



Infrastructure Investment and Jobs Act: Detailed Energy and Climate Provisions

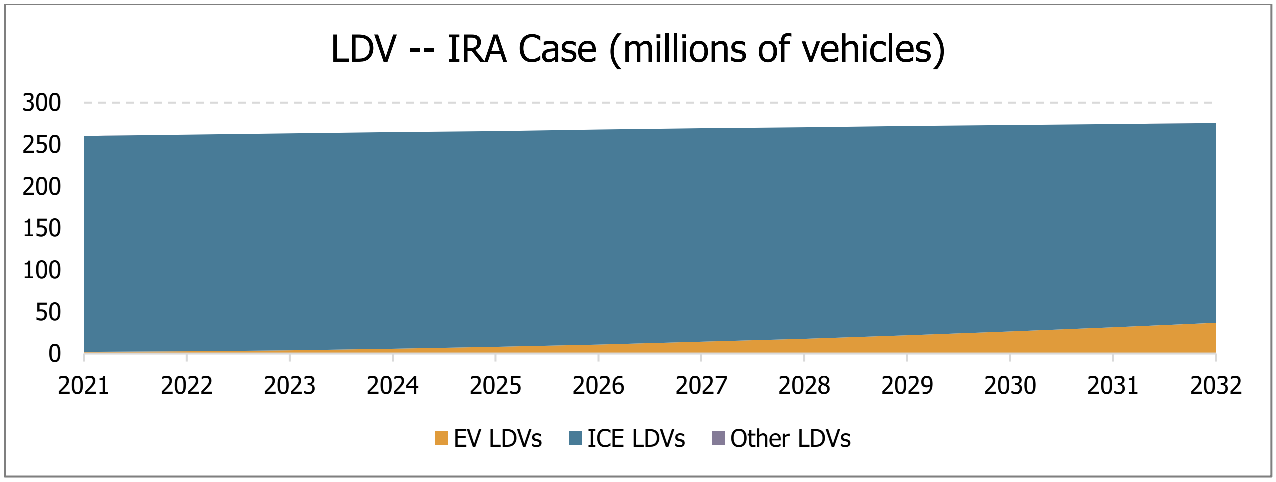


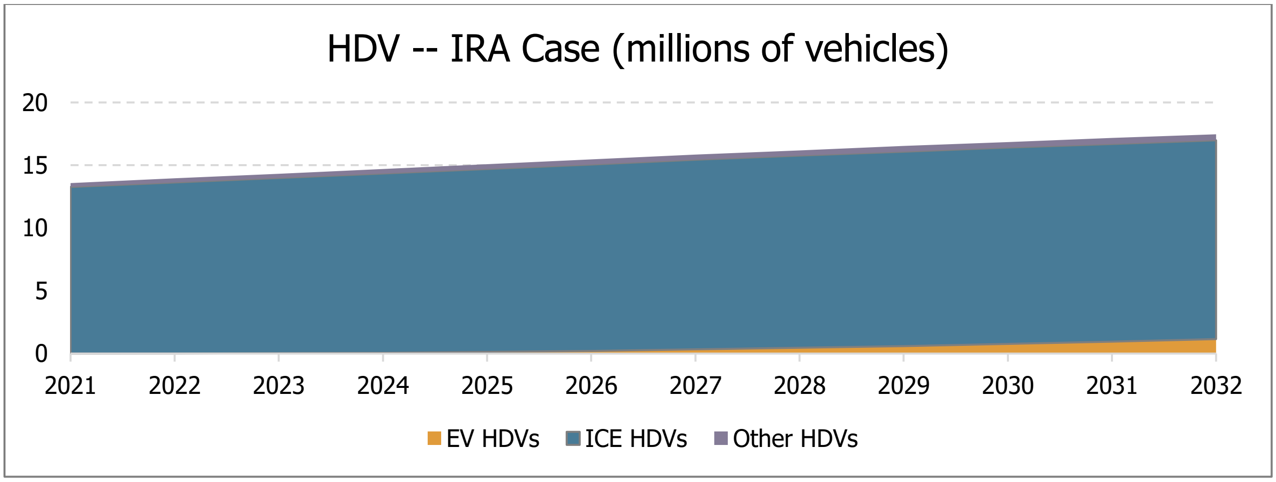
3. Summary Results, Base Case and IRA CASE, REMI Modeling

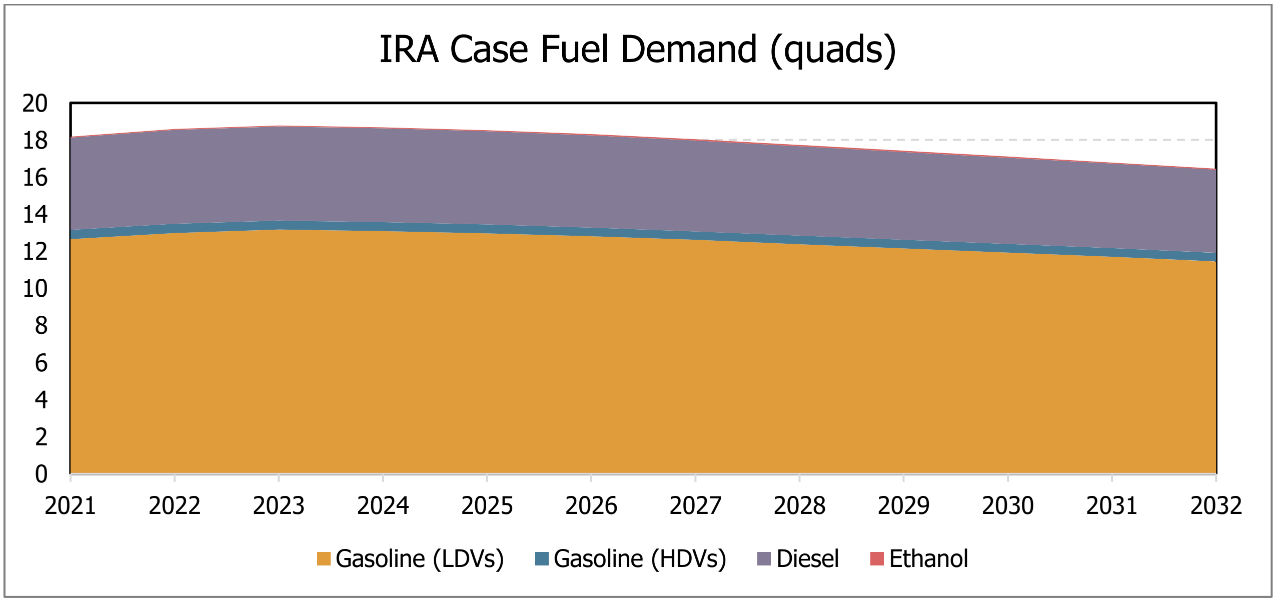
Category	Units	2021	2030 Base Case	2030 IRA Case
Total Employment	Thousands (Jobs)	196,812	210,144	211,601
Private Non-Farm Employment	Thousands (Jobs)	169,970	182,075	183,438
Residence Adjusted Employment	Thousands	194,307	207,615	209,054
Population	Thousands	331,179	346,957	346,958
Labor Force	Thousands	162,179	172,690	172,909
Gross Domestic Product	Billions of Fixed National (2022) Dollars	$24,044	$28,491	$28,748
Output	Billions of Fixed National (2022) Dollars	$42,199	$48,708	$49,067
Value-Added	Billions of Fixed National (2022) Dollars	$24,044	$28,491	$28,748
Personal Income	Billions of Fixed National (2022) Dollars	$22,118	$25,871	$25,954
Disposable Personal Income	Billions of Fixed National (2022) Dollars	$19,416	$22,061	$22,111
Real Disposable Personal Income	Billions of Fixed (2012) Dollars	$15,998	$18,177	$18,219
Real Disposable Personal Income per Capita	Thousands of Fixed (2012) Dollars	$48.306	$52.391	$52.509
PCE-Price Index	2012=100 (Nation)	115.4	143.4	143.9

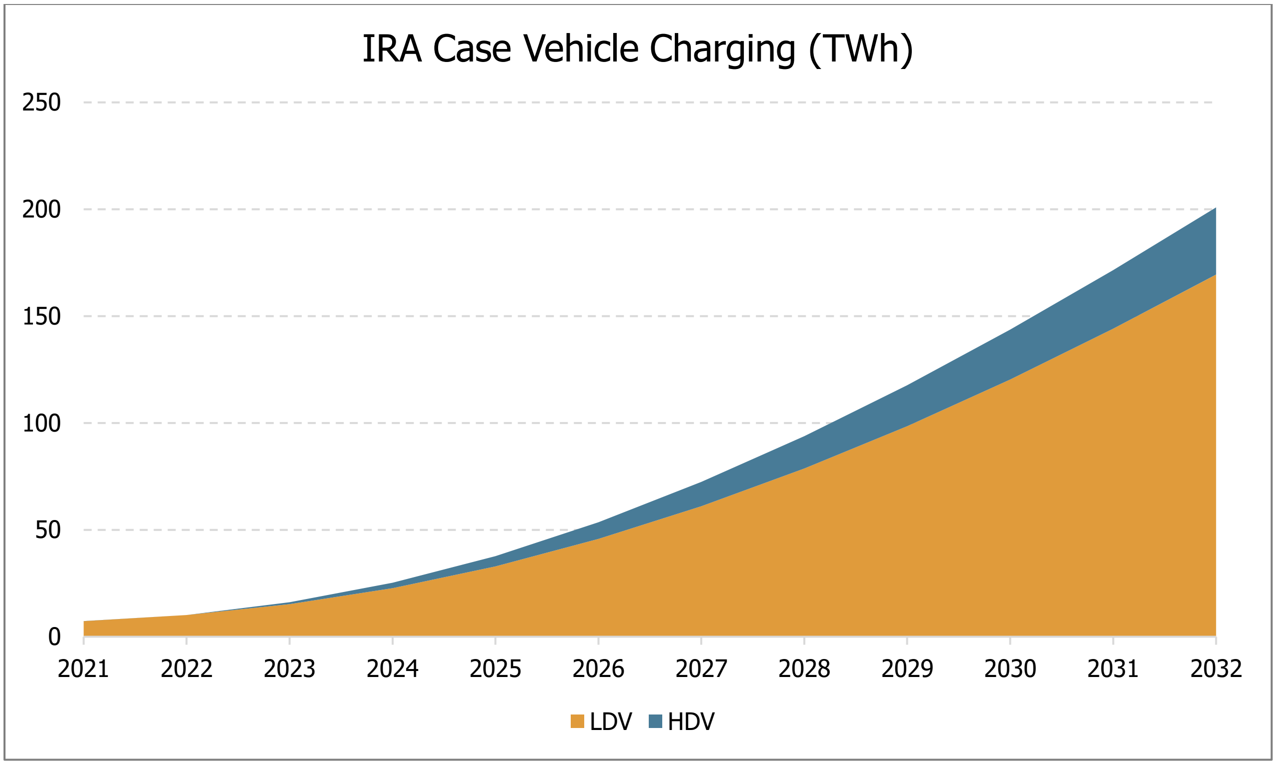
4. Transportation Electrification Assumptions

Year	LDV ICE Sales	LDV ZEV Sales	HDV ICE Sales	HDV ZEV Sales
2021	14,915,897	479,588	757,843	20
2022	14,772,066	701,487	767,553	19
2023	14,277,552	1,264,238	762,189	22,075
2024	13,671,000	1,817,667	741,305	44,199
2025	13,082,339	2,369,867	719,986	66,360
2026	12,595,715	2,942,736	704,378	89,299
2027	11,985,675	3,487,761	676,104	110,644
2028	11,318,254	4,006,195	644,558	130,856
2029	10,722,760	4,539,853	622,213	152,530
2030	10,133,559	5,070,034	601,287	174,567
2031	9,543,519	5,593,062	578,597	196,090
2032	8,972,914	6,121,262	555,683	217,434
2033	8,423,390	6,660,580	535,322	239,794
2034	7,867,969	7,193,067	514,997	262,342
2035	7,304,775	7,713,874	493,032	284,142
2036	6,773,415	8,266,669	472,428	306,810
2037	6,263,075	8,852,834	455,589	332,427
2038	5,741,370	9,435,197	437,942	358,280
2039	5,223,429	10,037,610	420,921	385,590
2040	4,716,474	10,684,748	404,230	414,412
2041	4,171,983	11,267,985	383,826	440,437
2042	3,618,013	11,832,040	363,148	466,834
2043	3,070,996	12,427,887	342,955	494,713
2044	2,516,124	13,005,081	321,351	521,439
2045	1,968,237	13,643,305	300,254	549,910
2046	1,413,358	14,282,957	279,139	579,617
2047	847,452	14,842,314	255,549	605,093
2048	282,308	15,413,423	231,310	629,196
2049	0	15,768,606	209,444	660,755
2050	0	15,830,293	188,153	697,011


LDV -- IRA Case (millions of vehicles)
300
250
200
150
100
50
0
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
EV LDVs
ICE LDVs
Other LDVs


HDV -- IRA Case (millions of vehicles)
20
15
10
5
0
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
EV HDVs
ICE HDVs
Other HDVs


IRA Case Fuel Demand (quads)
20
18
16
14
12
10
8
6
4
2
0
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
Gasoline (LDVs)
Gasoline (HDVs)
Diesel
Ethanol


IRA Case Vehicle Charging (TWh)
250
200
150
100
50
0
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
LDV
HDV

5. REMI Job Growth by Sector, 2021-30

Industry (Thousands of Jobs)	2021	2030 Base Case	2030 IRA Case
Forestry and Logging	118	131	134
Fishing, hunting and trapping	114	143	143
Support activities for agriculture and forestry	708	770	774
Oil and gas extraction	450	458	424
Coal mining	49	38	29
Metal ore mining	49	58	59
Nonmetallic mineral mining and quarrying	116	129	158
Support activities for mining	247	311	329
Electric power generation, transmission and distribution	409	383	571
Natural gas distribution	114	109	113
Water, sewage, and other systems	61	60	62
Construction	10,724	11,293	11,883
Sawmills and wood preservation	102	114	116
Veneer, plywood, and engineered wood product manufacturing	84	106	109
Other wood product manufacturing	259	291	295
Clay product and refractory manufacturing	44	53	55
Glass and glass product manufacturing	87	102	103
Cement and concrete product manufacturing	201	189	193
Lime, gypsum and other nonmetallic mineral product manufacturing	99	107	108
Iron and steel mills and ferroalloy manufacturing	86	99	100
Steel product manufacturing from purchased steel	55	61	62
Alumina and aluminum production and processing	57	56	56
Nonferrous metal (except aluminum) production and processing	52	80	83
Foundries	108	118	111
Forging and stamping	95	104	105
Cutlery and hand tool manufacturing	37	46	46
Architectural and structural metals manufacturing	394	434	442
Boiler, tank, and shipping container manufacturing	93	90	91
Hardware manufacturing	24	32	32
Spring and wire product manufacturing	40	50	50
Machine shops; turned product; and screw, nut, and bolt manufacturing	358	404	404

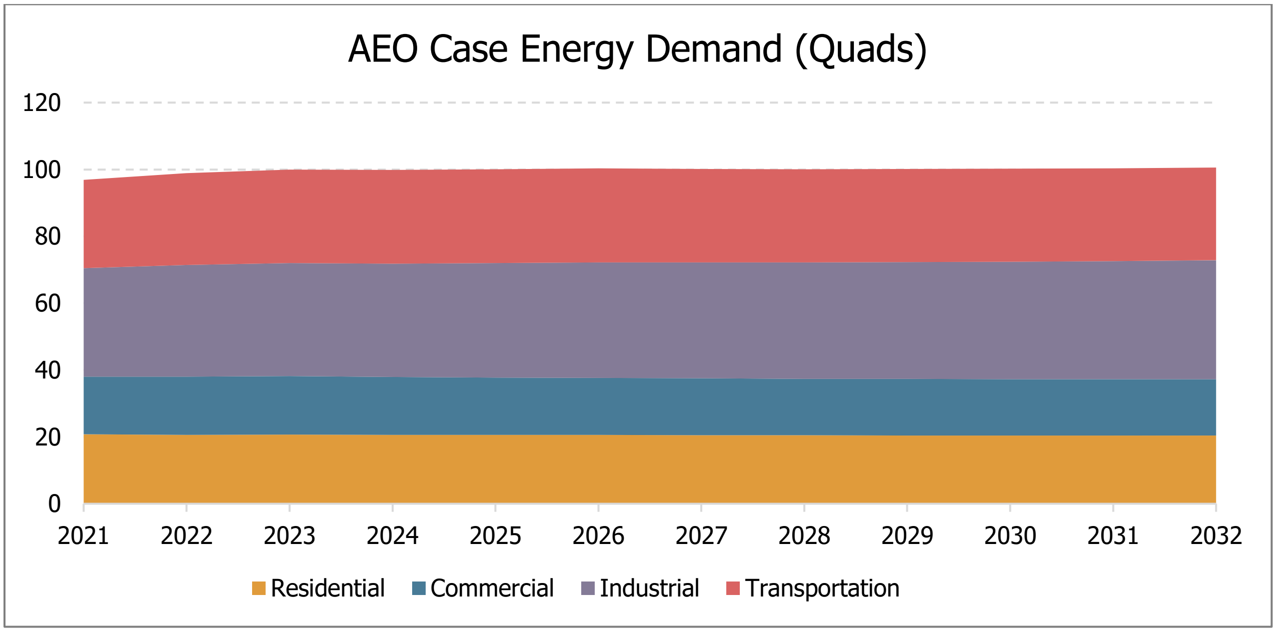
Coating, engraving, heat treating, and allied activities	136	142	144
Other fabricated metal product manufacturing	271	322	324
Agriculture, construction, and mining machinery manufacturing	215	226	229
Industrial machinery manufacturing	121	131	132
Commercial and service industry machinery manufacturing, including digital camera manufacturing	93	105	107
Ventilation, heating, air-conditioning, and commercial refrigeration equipment manufacturing	137	154	157
Metalworking machinery manufacturing	173	192	194
Engine, turbine, and power transmission equipment manufacturing	94	106	107
Other general purpose machinery manufacturing	284	300	304
Computer and peripheral equipment manufacturing, excluding digital camera manufacturing	172	163	165
Communications equipment manufacturing	87	94	94
Audio and video equipment manufacturing	25	14	14
Semiconductor and other electronic component manufacturing	370	434	437
Navigational, measuring, electromedical, and control instruments manufacturing	442	467	474
Manufacturing and reproducing magnetic and optical media	11	14	14
Electric lighting equipment manufacturing	42	56	58
Household appliance manufacturing	64	100	101
Electrical equipment manufacturing	140	170	200
Other electrical equipment and component manufacturing	152	179	240
Motor vehicle manufacturing	216	262	268
Motor vehicle body and trailer manufacturing	162	154	156
Motor vehicle parts manufacturing	573	651	619
Aerospace product and parts manufacturing	499	540	543
Railroad rolling stock manufacturing	25	24	24
Ship and boat building	141	124	125
Other transportation equipment manufacturing	38	36	36
Household and institutional furniture and kitchen cabinet manufacturing	289	380	389
Office furniture (including fixtures) manufacturing; Other furniture related product manufacturing	149	150	153
Medical equipment and supplies manufacturing	369	388	392
Other miscellaneous manufacturing	384	423	428

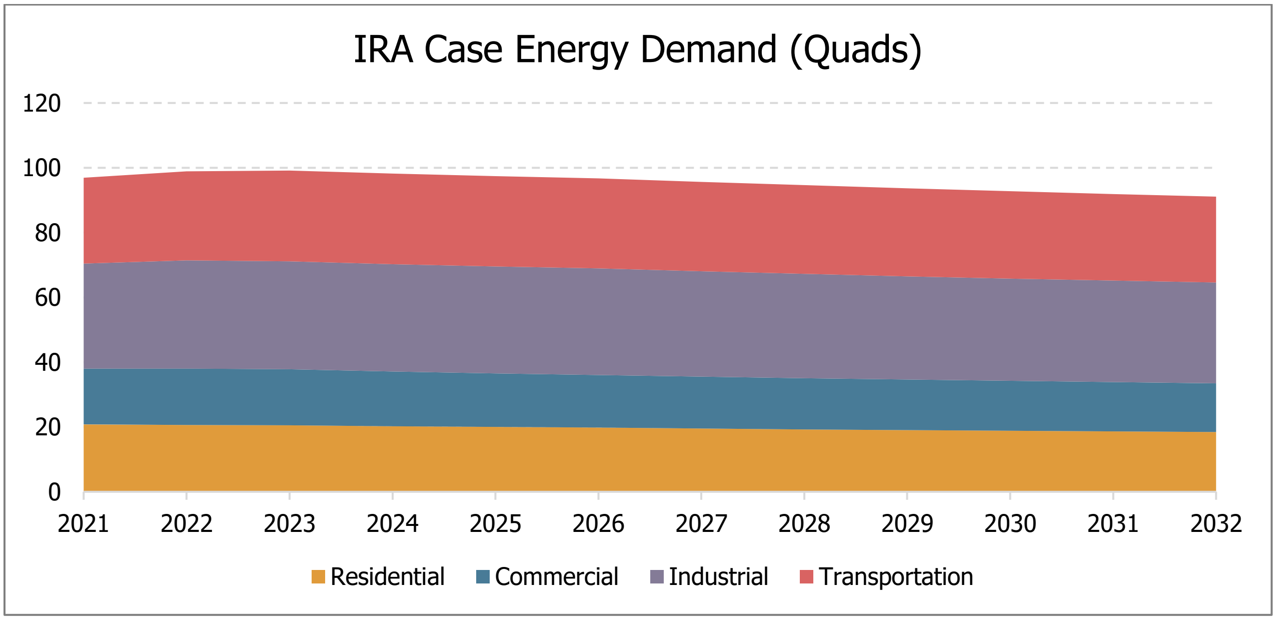
Animal food manufacturing	70	71	72
Grain and oilseed milling	64	68	69
Sugar and confectionery product manufacturing	76	74	75
Fruit and vegetable preserving and specialty food manufacturing	179	185	186
Dairy product manufacturing	162	168	168
Animal slaughtering and processing	575	605	606
Seafood product preparation and packaging	37	42	43
Bakeries and tortilla manufacturing	343	336	337
Other food manufacturing	241	263	264
Beverage manufacturing	295	315	315
Tobacco manufacturing	11	7	7
Textile mills and textile product mills	224	247	258
Apparel, leather and allied product manufacturing	366	341	350
Pulp, paper, and paperboard mills	94	93	94
Converted paper product manufacturing	270	254	256
Printing and related support activities	432	353	354
Petroleum and coal products manufacturing	119	124	101
Basic chemical manufacturing	155	176	178
Resin, synthetic rubber, and artificial synthetic fibers and filaments manufacturing	98	115	116
Pesticide, fertilizer, and other agricultural chemical manufacturing	37	42	43
Pharmaceutical and medicine manufacturing	317	389	368
Paint, coating, and adhesive manufacturing	69	74	75
Soap, cleaning compound, and toilet preparation manufacturing	127	127	128
Other chemical product and preparation manufacturing	82	81	81
Plastics product manufacturing	589	593	600
Rubber product manufacturing	136	146	148
Wholesale trade	6,532	6,407	6,451
Retail trade	19,228	17,082	17,183
Air transportation	564	564	570
Rail transportation	160	165	167
Water transportation	72	69	70
Truck transportation	2,353	2,389	2,401
Couriers and messengers	1,813	1,890	1,896
Transit and ground passenger transportation	2,061	2,785	2,795

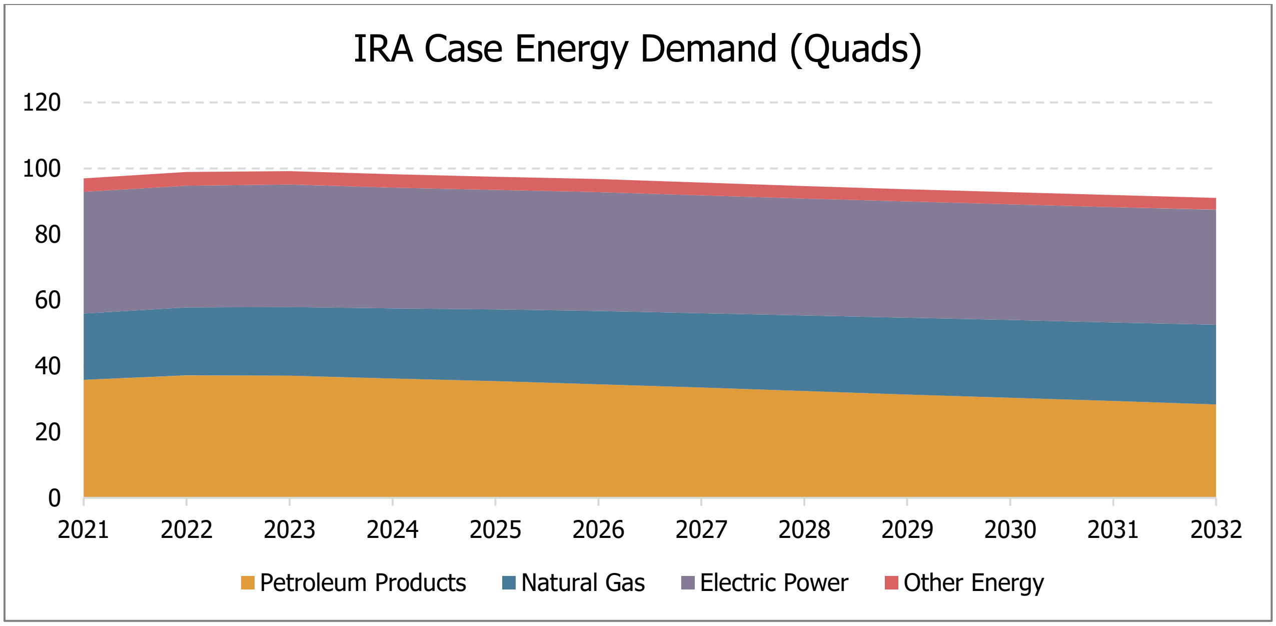
Pipeline transportation	53	55	52
Scenic and sightseeing transportation and support activities for transportation	860	913	929
Warehousing and storage	1,667	1,671	1,672
Newspaper, periodical, book, and directory publishers	348	304	305
Software publishers	617	665	669
Motion picture, video, and sound recording industries	390	404	405
Data processing, hosting, related services	452	481	484
Other information services	397	474	476
Radio and television broadcasting; Cable and other subscription programming	307	333	335
Telecommunications	851	746	748
Monetary authorities, credit intermediation, and related activities	2,898	2,862	2,865
Securities, commodity contracts, funds, trusts and other financial investments and related activities	4,217	4,187	4,185
Insurance carriers	1,971	2,046	2,045
Agencies, brokerages, and other insurance related activities	1,495	1,670	1,672
Real estate	8,290	8,881	8,876
Automotive equipment rental and leasing	260	289	288
Consumer goods rental and general rental centers	211	160	161
Commercial and industrial machinery and equipment rental and leasing	223	254	256
Lessors of nonfinancial intangible assets (except copyrighted works)	27	25	25
Legal services	1,822	1,883	1,888
Accounting, tax preparation, bookkeeping, and payroll services	1,584	1,610	1,615
Architectural, engineering, and related services	2,185	2,244	2,265
Specialized design services	373	366	366
Computer systems design and related services	3,286	4,094	4,117
Management, scientific, and technical consulting services	2,523	2,980	2,985
Scientific research and development services	1,092	1,225	1,237
Advertising, public relations, and related services	701	731	734
Other professional, scientific, and technical services	1,249	1,442	1,458
Management of companies and enterprises	2,791	2,824	2,819
Office administrative services; Facilities support services	898	1,020	1,024
Employment services	4,068	4,452	4,510
Business support services; Investigation and security services; Other support services	2,787	3,071	3,085

Travel arrangement and reservation services	253	257	258
Services to buildings and dwellings	3,574	3,720	3,727
Waste management and remediation services	485	545	548
Educational services; private	4,621	5,254	5,258
Offices of health practitioners	5,590	6,224	6,241
Outpatient, laboratory, and other ambulatory care services	2,007	2,409	2,417
Home health care services	1,924	2,340	2,347
Hospitals; private	5,291	5,633	5,632
Nursing and residential care facilities	3,237	3,587	3,585
Individual and family services; Community and vocational rehabilitation services	3,343	4,151	4,149
Child day care services	1,234	1,428	1,427
Performing arts companies; Promoters of events, and agents and managers	787	1,190	1,190
Spectator sports	455	640	640
Independent artists, writers, and performers	795	977	979
Museums, historical sites, and similar institutions	137	205	205
Amusement, gambling, and recreation industries	1,709	2,193	2,193
Accommodation	1,925	2,097	2,098
Food services and drinking places	11,915	13,169	13,168
Automotive repair and maintenance	1,629	1,676	1,678
Electronic and precision equipment repair and maintenance	177	184	184
Commercial and industrial machinery and equipment (except automotive and electronic) repair and maintenance	361	384	386
Personal and household goods repair and maintenance	199	201	202
Personal care services	2,439	3,012	3,007
Death care services	303	290	290
Drycleaning and laundry services	556	569	569
Other personal services	926	1,220	1,220
Religious organizations; Grantmaking and giving services and social advocacy organizations	2,021	2,370	2,370
Civic, social, professional, and similar organizations	786	876	876
Private households	1,139	1,349	1,352
State and Local Government	19,271	20,470	20,552
Federal Civilian	3,064	3,024	3,024
Federal Military	1,865	1,870	1,870
Farm	2,641	2,706	2,717

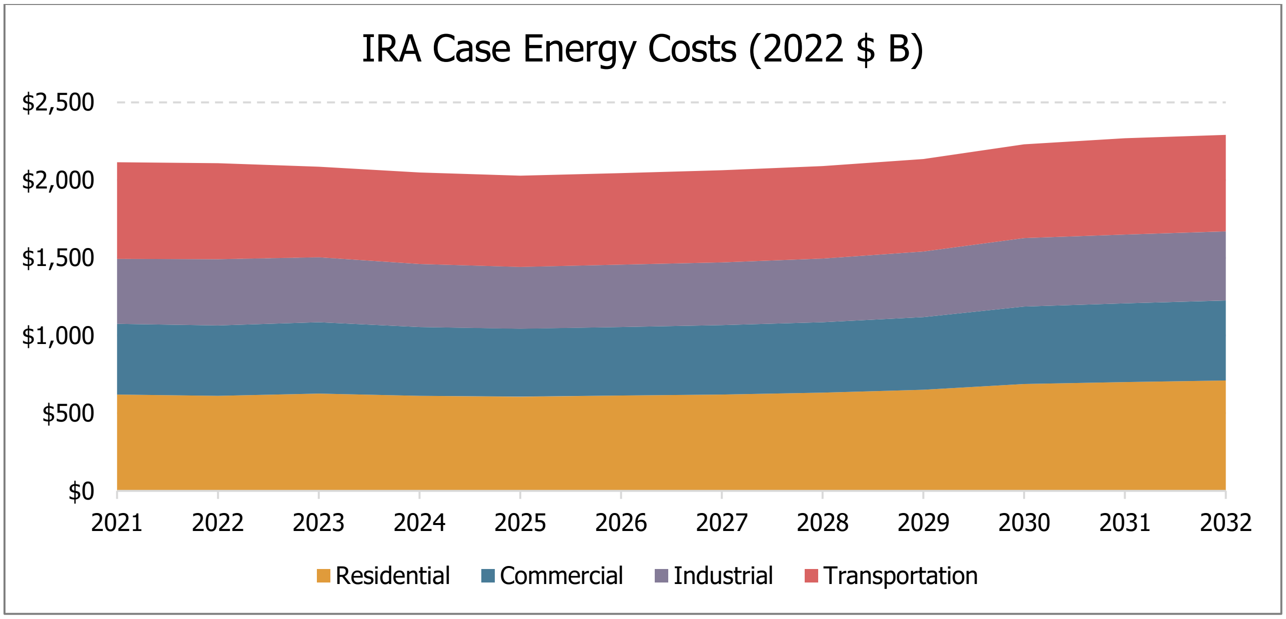
6. Energy Demand and Costs by Sector, 2021-32







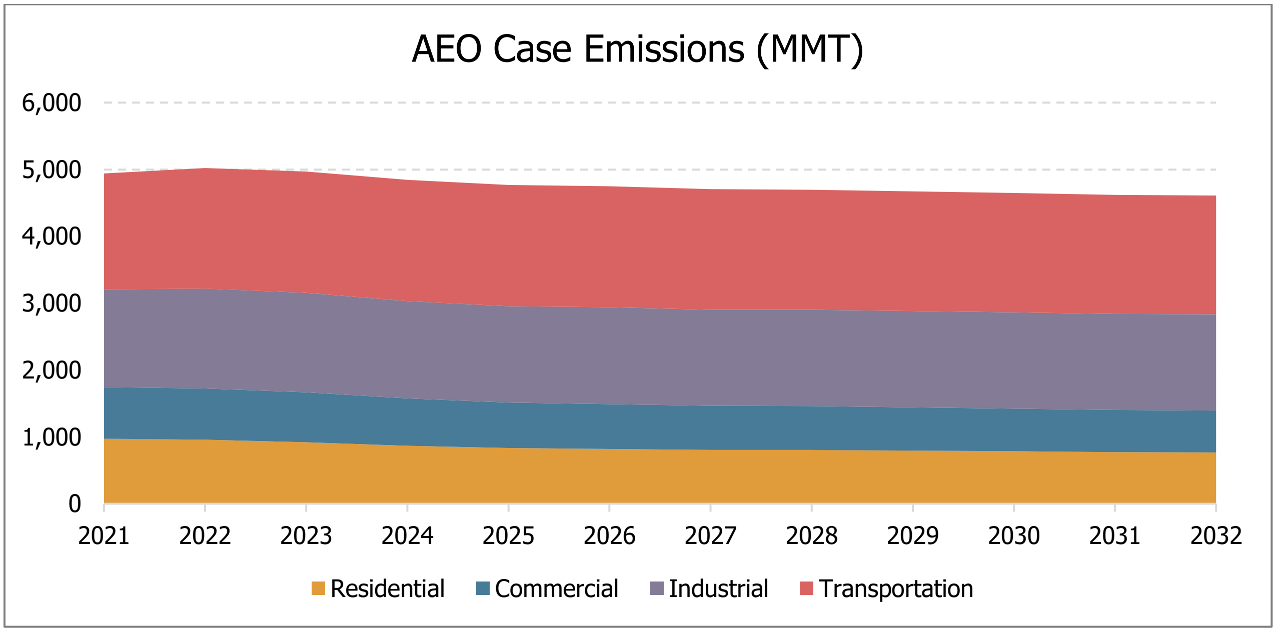
2022 $ B	**2021**	**2023**	**2024**	**2026**	**2028**	**2030**	**2032**
AEO Case	**$2,115**	**$2,078**	**$2,063**	**$2,081**	**$2,118**	**$2,160**	**$2,214**
Residential	$620	$622	$613	$620	$627	$638	$650
Commercial	$454	$454	$442	$439	$442	$448	$452
Industrial	$419	$418	$416	$428	$445	$460	$475
ransportatio	$622	$584	$592	$594	$603	$614	$636
IRA Case	**$2,115**	**$2,086**	**$2,050**	**$2,045**	**$2,090**	**$2,230**	**$2,291**
Residential	$620	$626	$611	$614	$631	$687	$710
Commercial	$454	$460	$444	$440	$454	$499	$514
Industrial	$419	$417	$404	$401	$411	$440	$445
ransportatio	$622	$583	$590	$589	$595	$604	$621

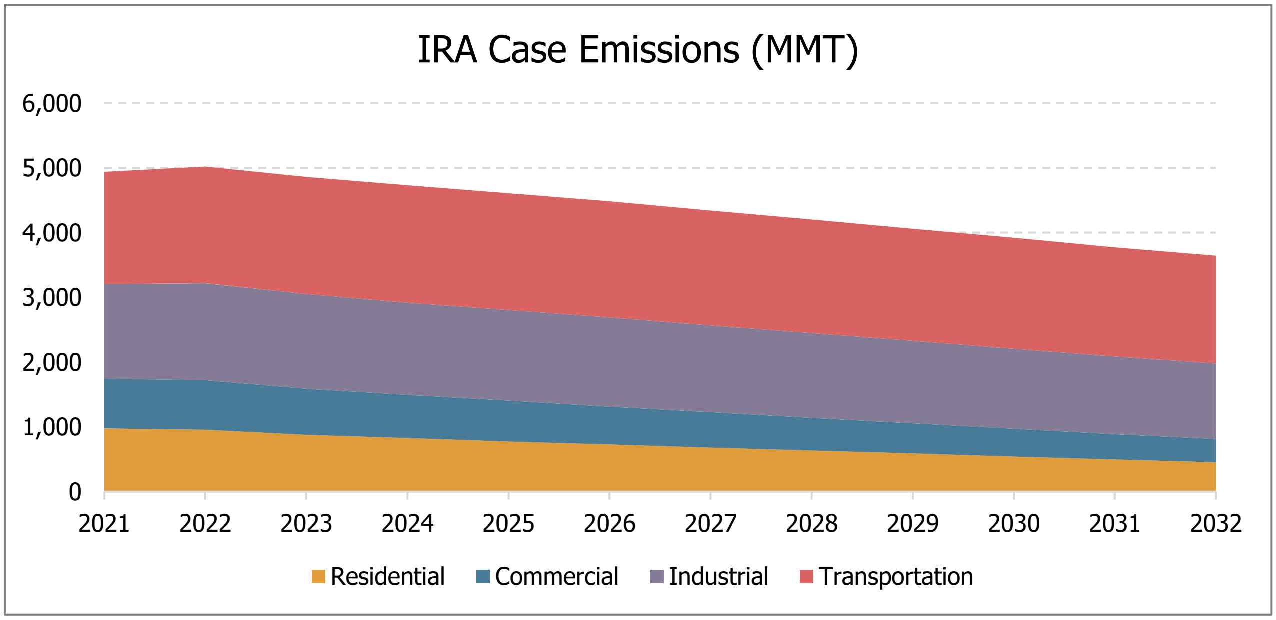

IRA Case Energy Costs (2022 $ B)
$2,500
$2,000
$1,500
$1,000
$500
$0
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
Residential
Commercial
Industrial
Transportation

7. Electricity Generation by Technology, 2022-2030

Installed Capacity (MW)	Fuel	2022	2024	2026	2028	2030
	Bio	7,364	7,907	8,203	8,499	8,625
	Coal	216,668	178,109	144,283	132,154	113,128
	Coal-CCUS	-	-	-	1,365	3,881
	DFO	26,401	24,957	24,908	24,099	24,097
	Gas	460,272	441,944	439,748	433,140	412,778
	Gas-CCUS	-	-	-	7,000	15,000
	Geo	2,364	3,364	5,364	7,839	9,364
	Hydro	114,226	114,619	115,532	115,516	115,276
	Petcoke	896	6	6	6	6
	Solar	74,894	123,926	201,754	282,878	363,968
	Uranium	93,460	94,560	92,260	92,260	90,164
	Wind	145,829	178,969	200,619	244,153	283,580
	Wind - Offshore	2,000	2,000	12,000	22,000	32,000
Generation (MWh)	**Fuel**	**2022**	**2024**	**2026**	**2028**	**2030**
	Bio	29,687	29,534	34,027	34,748	34,796
	Coal	937,237	654,566	482,749	384,484	237,597
	Coal-CCUS	-	-	-	9,725	27,562
	DFO	0	1	0	1	0
	Gas	1,260,172	1,440,000	1,470,148	1,271,673	1,167,327
	Gas-CCUS	-	-	-	53,240	111,054
	Geo	20,106	28,067	43,758	63,413	74,585
	Hydro	283,509	285,578	286,197	286,133	284,047
	Petcoke	2,252	3	1	0	-
	Solar	144,031	239,719	388,412	528,284	657,684
	Uranium	763,090	769,599	745,396	730,450	699,549
	Wind	491,319	634,924	726,306	909,886	1,067,643
	Wind - Offshore	8,365	8,376	50,193	92,131	133,758
Capacity Factors (%)	**Fuel**	**2022**	**2024**	**2026**	**2028**	**2030**
	Bio	46%	43%	47%	47%	46%
	Coal	49%	42%	38%	33%	24%
	Coal-CCUS	#N/A	#N/A	#N/A	81%	81%
	DFO	0%	0%	0%	0%	0%
	Gas	31%	37%	38%	33%	32%
	Gas-CCUS	#N/A	#N/A	#N/A	87%	85%
	Geo	97%	95%	93%	92%	91%
	Hydro	28%	28%	28%	28%	28%
	Petcoke	29%	5%	3%	0%	0%
	Solar	22%	22%	22%	21%	21%
	Uranium	93%	93%	92%	90%	89%
	Wind	38%	40%	41%	42%	43%
	Wind - Offshore	48%	48%	48%	48%	48%

8. GHG emissions reduction





Biden Administration GHG Emissions Reduction Goal vs. Annual Energy Outlook and IRA

MMT	2021	2022	2023	2024	2025	2026
AEO Case	**4,939**	**5,022**	**4,969**	**4,844**	**4,770**	**4,750**
Nonelectric	3,342	3,459	3,469	3,465	3,476	3,484
Power Sector	1,597	1,562	1,500	1,379	1,294	1,266
IRA Case	**4,939**	**5,022**	**4,863**	**4,731**	**4,610**	**4,484**
Nonelectric	3,342	3,459	3,442	3,409	3,389	3,363
Power Sector	1,597	1,562	1,421	1,321	1,221	1,121
Biden Goal	**4,939**	**5,022**	**4,859**	**4,697**	**4,535**	**4,372**
% of 2005 peak under IRA	-20.4%	-19.1%	-21.6%	-23.8%	-25.7%	-27.7%
Needed to meet Biden goal	0	0	-4	-34	-75	-112
MMT	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
AEO Case	**4,705**	**4,697**	**4,672**	**4,648**	**4,620**	**4,609**
Nonelectric	3,477	3,474	3,470	3,469	3,464	3,465
Power Sector	1,228	1,223	1,202	1,179	1,156	1,144
IRA Case	**4,343**	**4,204**	**4,061**	**3,920**	**3,775**	**3,644**
Nonelectric	3,322	3,282	3,239	3,199	3,154	3,114
Power Sector	1,021	921	821	721	621	530
Biden Goal	**4,210**	**4,048**	**3,885**	**3,723**	**3,560**	**3,398**
% of 2005 peak under IRA	-30.0%	-32.3%	-34.6%	-36.8%	-39.2%	-41.3%
Needed to meet Biden goal	-133	-156	-176	-197	-215	-246

9. Other economic results

GDP in Targeted Sectors

Category	2021	2022	2023	2024	2025
Gross Domestic Product--$B	$24,044	$25,104	$25,773	$26,093	$26,376
Gross Domestic Product--$B	$24,044	$25,104	$25,834	$26,216	$26,555
Construction--$B	$1,027.5	$1,037.5	$1,070.8	$1,078.5	$1,083.2
Construction--$B	$1,027.5	$1,037.5	$1,089.6	$1,103.1	$1,121.1
EPG, T&D--$B	$301.6	$313.8	$319.3	$319.4	$319.1
EPG, T&D--$B	$301.6	$313.8	$336.3	$331.5	$326.0
Category	**2026**	**2027**	**2028**	**2029**	**2030**
Gross Domestic Product--$B	$26,755	$27,206	$27,630	$28,054	$28,491
Gross Domestic Product--$B	$26,928	$27,394	$27,857	$28,265	$28,748
Construction--$B	$1,093.5	$1,108.8	$1,116.7	$1,123.2	$1,128.8
Construction--$B	$1,132.6	$1,153.7	$1,177.7	$1,177.3	$1,191.8
EPG, T&D--$B	$319.6	$320.9	$321.9	$322.8	$323.7
EPG, T&D--$B	$339.3	$355.7	$375.7	$414.8	$482.7

State Energy Costs

% Change	2021	2022	2023	2024	2025	2026
AL	0%	0%	2%	1%	-1%	1%
AK	0%	0%	-1%	-1%	-2%	-3%
AZ	0%	0%	0%	0%	-2%	0%
AR	0%	0%	2%	0%	-1%	1%
CA	0%	0%	0%	-2%	-3%	-3%
CO	0%	0%	2%	2%	2%	3%
CT	0%	0%	-1%	-2%	-3%	-4%
DE	0%	0%	1%	0%	-2%	-2%
DC	0%	0%	0%	-1%	-3%	-3%
FL	0%	0%	1%	0%	-2%	-1%
GA	0%	0%	1%	0%	-1%	1%
HI	0%	0%	-1%	-2%	-2%	-3%
ID	0%	0%	1%	-1%	-3%	-3%
IL	0%	0%	1%	0%	-1%	0%
IN	0%	0%	1%	0%	-2%	-1%
IA	0%	0%	2%	1%	0%	2%
KS	0%	0%	2%	1%	0%	2%
KY	0%	0%	2%	1%	-1%	1%
LA	0%	0%	1%	1%	-1%	1%
ME	0%	0%	-1%	-4%	-5%	-5%
MD	0%	0%	0%	-1%	-3%	-2%
MA	0%	0%	-1%	-2%	-3%	-4%
MI	0%	0%	1%	0%	-2%	-1%
MN	0%	0%	0%	0%	-2%	0%
MS	0%	0%	2%	1%	-1%	1%
MO	0%	0%	2%	1%	-1%	2%
MT	0%	0%	2%	0%	-2%	0%
NE	0%	0%	4%	3%	2%	5%
NV	0%	0%	1%	-1%	-2%	-1%
NH	0%	0%	-1%	-3%	-4%	-6%
NJ	0%	0%	0%	-1%	-3%	-3%
NM	0%	0%	0%	-1%	-2%	-1%
NY	0%	0%	-1%	-2%	-4%	-4%
NC	0%	0%	1%	0%	-1%	0%
ND	0%	0%	1%	0%	-2%	0%
OH	0%	0%	1%	0%	-2%	-1%
OK	0%	0%	2%	1%	-1%	1%
OR	0%	0%	0%	-2%	-4%	-4%
PA	0%	0%	0%	-1%	-2%	-1%
RI	0%	0%	-1%	-2%	-3%	-4%
SC	0%	0%	1%	0%	-1%	0%
SD	0%	0%	2%	0%	-1%	2%
TN	0%	0%	2%	2%	-1%	1%
TX	0%	0%	1%	1%	5%	2%

UT	0%	0%	1%	-1%	-2%	-1%
VT	0%	0%	-2%	-4%	-6%	-7%
VA	0%	0%	1%	0%	-2%	-1%
WA	0%	0%	1%	-2%	-4%	-4%
WV	0%	0%	0%	-1%	-2%	-1%
WI	0%	0%	1%	-1%	-2%	-1%
WY	0%	0%	1%	0%	-1%	0%

% Change	2027	2028	2029	2030	2031	2032
AL	2%	4%	9%	17%	18%	20%
AK	-4%	-4%	-5%	-5%	-6%	-6%
AZ	1%	2%	4%	8%	9%	9%
AR	2%	3%	6%	12%	13%	14%
CA	-4%	-4%	-4%	-3%	-4%	-4%
CO	4%	5%	7%	10%	12%	13%
CT	-5%	-6%	-7%	-7%	-7%	-8%
DE	-3%	-3%	-2%	2%	2%	2%
DC	-3%	-2%	0%	7%	7%	8%
FL	0%	2%	4%	11%	12%	13%
GA	2%	4%	7%	14%	16%	17%
HI	-4%	-5%	-6%	-7%	-7%	-8%
ID	-2%	-1%	2%	5%	6%	6%
IL	1%	2%	5%	12%	13%	14%
IN	0%	1%	4%	10%	11%	12%
IA	2%	6%	10%	17%	19%	21%
KS	4%	6%	9%	14%	15%	17%
KY	3%	4%	8%	16%	17%	19%
LA	2%	4%	8%	15%	16%	18%
ME	-6%	-8%	-9%	-10%	-11%	-12%
MD	-2%	-1%	1%	6%	6%	7%
MA	-5%	-6%	-6%	-6%	-7%	-8%
MI	-1%	0%	3%	7%	8%	9%
MN	0%	1%	4%	9%	10%	11%
MS	2%	4%	7%	15%	16%	18%
MO	3%	4%	7%	14%	15%	16%
MT	2%	4%	7%	12%	14%	15%
NE	7%	12%	17%	25%	27%	30%
NV	0%	1%	3%	7%	8%	9%
NH	-7%	-8%	-7%	-7%	-8%	-9%
NJ	-3%	-3%	-1%	2%	3%	3%
NM	0%	2%	4%	7%	8%	9%
NY	-5%	-6%	-6%	-5%	-5%	-6%
NC	1%	3%	6%	13%	14%	16%
ND	1%	2%	5%	11%	12%	13%
OH	0%	1%	4%	9%	10%	11%