MODELING THE INFRASTRUCTURE BILLS USING THE ENERGY POLICY SIMULATOR

MEGAN MAHAJAN AND ROBBIE ORVIS

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INTRODUCTION

The Build Back Better Act (BBB) currently moving through the House reconciliation process is poised to be the most significant climate legislation in United States history. To help understand its impacts, Energy Innovation modeled multiple climate provisions of the BBB and the Infrastructure Investment and Jobs Act, referred to together as the "Infrastructure Bills," using the Energy Policy Simulator (EPS). The EPS is an open-source and peer-reviewed policy model that estimates climate and energy policy impacts using publicly available data. Our findings confirm that passing the Infrastructure Bills could, with supporting state and regulatory policy, put the U.S. on a path to achieve its 2030 NDC of 50 to 52 percent below 2005 emissions and create at least 638,000 new job-years in 2030 concentrated in manufacturing, construction, and service industries. Additionally, the bills would avoid 4,600 to 7,000 premature deaths and 127,000 to 194,000 asthma attacks annually by 2030.

It is important to note that this analysis is not meant to be entirely comprehensive; some provisions or funding mechanisms were excluded from the modeling due to difficulty translating certain spending categories or incentives into emissions reductions. These programs would very likely yield additional emissions reductions beyond what we have modeled. Therefore, this analysis is not directly comparable to others which may have a wider scope. Our top-level finding is that the Infrastructure Bills' emissions reduction potential

ENERGY INNOVATION
POLICY & TECHNOLOGY LLC

www.energyinnovation.org

98 Battery Street, Suite 202
San Francisco, CA 94111
policy@energyinnovation.org

is in line with reductions outlined in an earlier memo from Senator Schumer's office, which includes additional provisions not included in this analysis. We also find the modeled provisions generate significant jobs and public health benefits, and the avoided deaths are more concentrated in communities of color.

Methodology

Energy Innovation used the U.S. Energy Policy Simulator (EPS) to estimate the impacts of provisions of the Infrastructure Bills on U.S. greenhouse gas (GHG) emissions through 2030. The EPS is an open-source, publicly accessible tool developed by Energy Innovation that can be used to assess the impacts of policy packages on emissions, costs and savings, jobs, gross domestic product, and health impacts. It is available online at https://us.energypolicy.solutions. For this analysis, Energy Innovation customized a version of the EPS to be able to accurately model the provisions included in the Infrastructure Bills.

The modeling includes major provisions, including those in the table below:

Electricity

- Clean Electricity Performance Program (CEPP)
- Extended Clean Energy Tax Credits and New Tax Credits
- Civilian Nuclear Credit
- Transmission Tax Credit and Funding
- Rural Cooperative Support for Retiring High-GHG Facilities

Industry

- 45Q Tax Credits for Carbon Capture Utilization and Storage
- Fees on Oil and Gas Methane Emissions
- Expanded Methane Royalties
- Funding for Abandoned Oil and Gas Well Capping
- 48C Advanced Clean Manufacturing Tax Credits

Transportation

- Tax Credits for EVs (light and heavy duty)
- Funding and Tax Credits for EV Chargers
- Funding for Electric Buses
- Funding for Federal Fleet Electrification

Buildings

- Residential and Multifamily Efficiency Rebates
- Weatherization Assistance Program Funding
- Energy Efficiency and Conservation Block Grant Funding
- Residential and Commercial Efficiency Tax Credits
- Funding for Distributed Solar

Land

- Funding for Forestry and Agriculture Emissions Reductions

Table 1: Provisions Included in Modeling

Additional provisions within the Infrastructure Bills that are not modeled are included in the table below. The list is not exhaustive, but highlights some important pieces that we did not model. We chose not to model these provisions given the difficulty in translating funding or incentive levels into market impacts and deployment. However, the provisions below would very likely yield additional emissions reductions in addition to what we modeled.

Industry	Buildings
• Hydrogen Production Tax Credit • Banning New Coastline Oil and Gas Drilling	• Updated State Building Codes • Rural Rental Housing Program • Critical Facility Modernization • School Electrification and Efficiency Improvements
Transportation	**Land**
• Increases in Public Transit Ridership • Passenger and Freight Rail Expansion • Zero Emissions Port and Airport Vehicles • Low- or Zero-Carbon Ferries • Biodiesel Tax Credits • Sustainable Aviation Fuel Tax Credits	• Farm Energy Efficiency
	Other
	• Grants for Federal Agency Decarbonization • Greenhouse Gas Reduction Fund

Table 2: Provisions Excluded in Modeling

Our modeling includes four core scenarios: a business-as-usual (BAU) Scenario that holds current policy constant and Low, Moderate, and High Scenarios that make different assumptions about the efficacy for certain provisions within the Infrastructure Bills. Our BAU Scenario relies heavily on the EIA's Annual Energy Outlook High Oil and Gas Supply scenario for energy demand in buildings and industry, transportation service demand, and fuel prices.[i]

More information on data sources is available online at https://us.energpolicy.solutions/docs/.

The varying assumptions are outlined in the table below and discussed in detail in the following section:

[i] Energy Innovation reviewed past AEO releases and actual gas prices and found that the High Oil and Gas Supply scenarios were typically significantly more accurate at predicting gas prices than the Reference scenarios, which is why use this as our baseline.

Assumption	Description	Defaults		
		Low	Moderate	High
Clean Electricity Share	% clean generation in 2030	70%	80%	85%
Percent of Electric Vehicle Sales Qualifying for Bonus Credits	%	50.00%	75.00%	100.00%
Union Representation for Power Plant Construction	%	12.7%	15.9%	19.05%
Domestic Content Share, onshore wind	%	100.0%	100.0%	100.0%
Domestic Content Share, offshore wind	%	100.0%	100.0%	100.0%
Domestic Content Share, solar PV	%	30.7%	65.4%	100.0%
Domestic Content Share, solar thermal	%	100.0%	100.0%	100.0%
Domestic Content Share, geothermal	%	100.0%	100.0%	100.0%
Domestic Content Share, MSW	%	100.0%	100.0%	100.0%
Domestic Content Share, storage	%	30.7%	65.4%	100.0%

Table 3: Variations in Assumptions Across Scenarios

Annual increases in clean generation were determined based on consultation with electricity sector experts. Projecting the share of vehicle sales that will qualify for bonus credits is difficult given uncertainty around the growth in domestic manufacturing, and we therefore explore a wide range between our Low and High Scenarios. For union representation and domestic content shares, we calculated values for the Low Scenario using historical data. The union representation values were then increased by 25 percent and 50 percent in the Moderate and High Scenarios. The High Scenario assumes 100 percent domestic content shares, with the Moderate Scenario representing the midpoint between Low and High.

RESULTS AND KEY FINDINGS

Our model results are discussed below, including emissions reductions, clean electricity shares, sales shares for electric light-duty vehicles, health impacts, and jobs. Note that modeling results will continue to change as negotiations unfold and the included provisions evolve. For more information on modeling assumptions, please see our documentation.

Greenhouse Gas Emissions

Emissions reductions from the provisions modeled as part of the Infrastructure Bills range from 1,067 to 1,510 million metric tonnes (MMT) in the year 2030.

Scenario	Annual GHG Emissions Reductions (2030)	Cumulative GHG Emissions Reductions (2022-2030)
Low	1,067	5,897
Moderate	1,343	6,848
High	1,510	7,431

Table 4: GHG Emissions Reductions

Figure 1 below presents emissions reductions by provision in our Moderate Scenario and demonstrates the key provisions driving GHG abatement.

The strongest set of provisions is the combination of clean energy tax credits and the Clean Electricity Performance Program (CEPP), which drives the power sector to 70 to 85 percent clean energy, as discussed below. These provisions together contribute 56 percent of total emissions reduction in 2030 in the Moderate Scenario, about 750 MMT. They also serve as the linchpin for decarbonizing the rest of the economy, as more end uses are electrified. The second strongest provisions is the fee on oil and gas methane emissions, which contributes about 12 percent of total reductions, or 165 MMT in 2030. Incentives for electric vehicles (EVs) and charging equipment are next, at 115 MMT in 2030, or 9 percent of total reductions (it is important to note that this provision, in particular, continues driving emissions reductions long after 2030, as discussed later).

Incentives for sustainable forestry and agriculture are next at 115 and 84 MMT, or 9 percent and 6 percent of total reductions. Funding for rural cooperatives to retire high-GHG facilities is next at 62 MMT in 2030, or 5 percent of total reductions. From there, the 45Q tax credit, incentives for storage and transmission, and distributed solar and building electrification and efficiency incentives round out reductions.

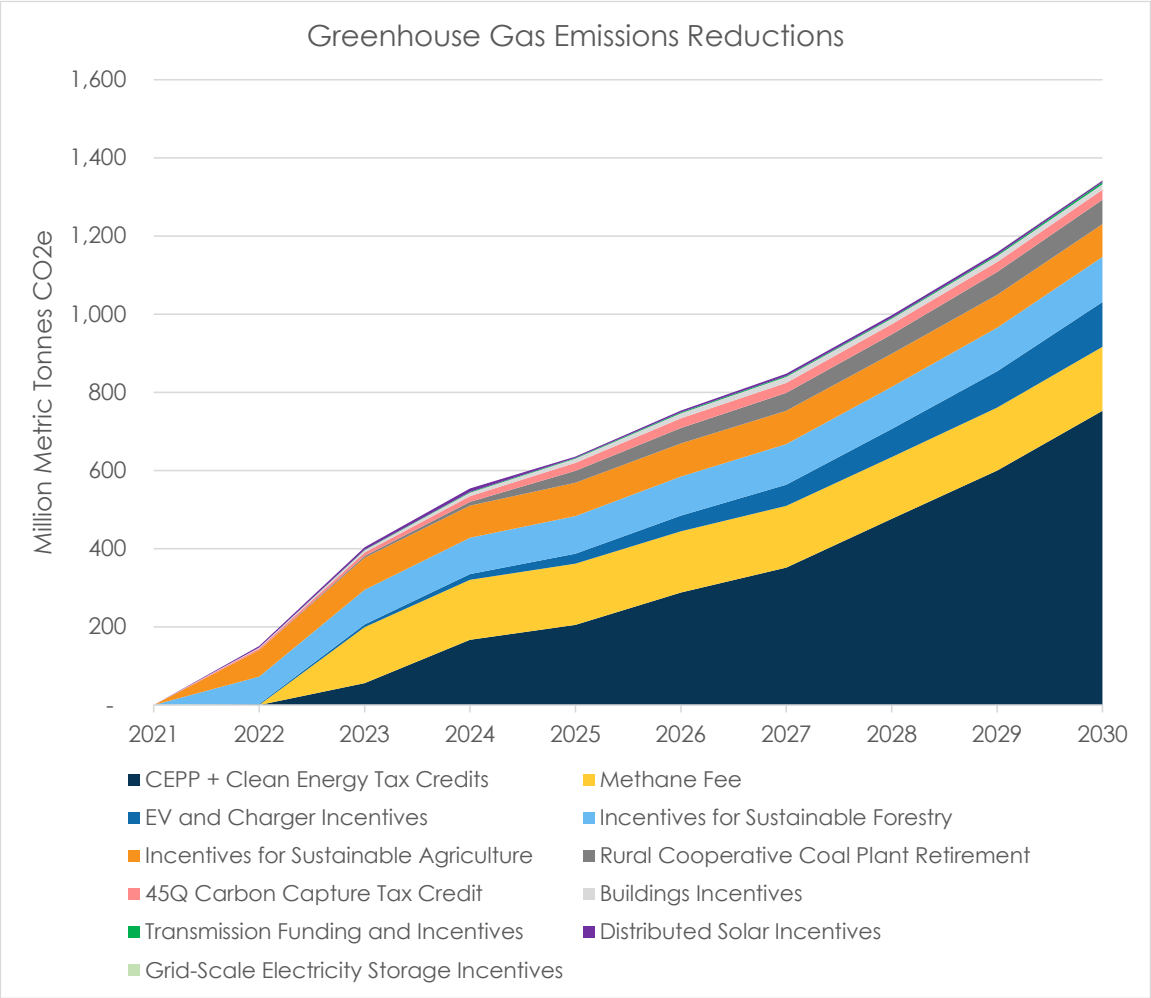

Figure 1: Annual GHG Emissions Reductions by Program in the Moderate Scenario

Clean Electricity and the CEPP

The largest emissions reductions are in the electricity sector, driven by the CEPP and clean electricity tax credits. Based on consultation with power sector modeling experts, we conclude that the share of clean energy in 2030 including both the CEPP and clean energy tax credits could reach 85 percent in our High Scenario, 80 percent in our Moderate Scenario, and 70 percent in our Low Scenario. The Low Scenario share of 70 percent represents the CEPP's floor of a 4 percent annual increase, given a baseline of 2019-2020 clean electricity. Percentages represent the share of generation, not sales, which would be higher given transmission and distribution losses.

Scenario	Share of Clean Electricity Generation (2030)
Business As Usual	48 percent
Low	70 percent
Moderate	80 percent
High	85 percent

Table 5: Clean Electricity Shares

To better understand the CEPP's impact, we modeled two variations of our Moderate Scenario: "Moderate – No CEPP Low" and "Moderate – No CEPP High." These scenarios outline a range of possible emissions reductions from the Infrastructure Bills absent the CEPP, with varying assumptions about how much clean electricity will be driven by the tax credits alone. The Moderate – No CEPP Low Scenario results in a clean electricity share of just 61 percent by 2030 compared to 80 percent in our Moderate Scenario (with CEPP and tax credits) and 85 percent in our High Scenario (with CEPP and tax credits), whereas the Moderate – No CEPP High Scenario reaches 69 percent.[ii] This range aims to capture uncertainties related to tax credit amounts (e.g. base versus bonus), fuel and technology prices, and deployment constraints, such as interconnection delays. Additionally, though tax credits could result in up to 69 percent clean electricity generation, it is important to caveat these results with the real-world challenges in deploying clean energy. For example, hundreds of gigawatts of clean energy proposals are waiting for approval in interconnection queues around the country, and approvals are required before developers can commence construction (though FERC is developing a rulemaking to expedite interconnections).

Nevertheless, our modeling underscores how important the CEPP is to achieving deep power sector decarbonization. Without it, emissions are likely to be 250 to 700 MMT higher per year in 2030, which could eliminate more than a third of the total emissions reductions under the Infrastructure Bills.

[ii] We use a recent Resources for the Future analysis to determine the upper bound of 69 percent clean in the Moderate – No CEPP High Scenario.

Scenario	Share of Clean Electricity Generation (2030)	Electricity Sector Emissions (2030)	Total Annual GHG Emissions Reductions (2030)
Business As Usual	48 percent	1,280	
Moderate – No CEPP Low	61 percent	965	854
Moderate – No CEPP High	69 percent	772	1,059
Moderate (CEPP + Tax Credits)	80 percent	506	1,343

Table 4: Comparison of Moderate and Moderate – No CEPP Scenarios

It is important to note that the CEPP design, and in particular, the penalty of $40 per megawatt hour is pivotal to achieving these modeled emissions reductions. Removing the penalty would likely dramatically reduce the CEPP's effectiveness by making it an opt-in program for electricity suppliers rather than raising the floor for all suppliers. As a result, we expect most of the CEPP's potential impact would be lost, leaving the clean energy share close to the 61-69 percent range in the No CEPP scenarios.

Passenger Electric Vehicles

Our modeling finds transportation electrification induced by EV incentives is the third largest contributor to 2030 emissions reductions in the Infrastructure Bills. The bulk of vehicle fleet turnover continues past 2030, and each EV contributes more to emissions benefits each year as the grid gets cleaner. EV incentives are also critical to meeting President Biden's goal of 50 percent zero-emission vehicle sales by 2030. However, the Low Scenario reaches only 41 percent sales, and the Moderate Scenario nearly reaches the target at 49 percent sales. The High Scenario achieves 60 percent sales, in line with 100 percent sales by 2035, a target set by California, New York, and other states.

Scenario	Share of Electric Passenger Light-Duty Vehicle Sales (2030)
Business As Usual	23 percent
Low	41 percent
Moderate	49 percent
High	60 percent

Table 6: Electric Vehicle Sales Shares

The main driver of the modeled EV incentive impacts is the assumption around what share of vehicle sales qualify for the bonus Domestic Assembly and Domestic Content credits, and what share continues to qualify for any credit after 2026 based on the requirement for final assembly using unionized labor within the U.S. Today, the large majority of domestically sold EVs are manufactured domestically, dominated by Tesla. However, a much smaller portion of these sales currently qualify for the union participation requirements outlined in the BBB. Additionally, the U.S. will need to significantly expand its domestic EV and battery manufacturing capabilities in order to supply the 10 to 14 million annual vehicle sales modeled by 2030. While the High Scenario assumes all vehicle sales qualify for the bonus credits, the Moderate and Low Scenarios assume 75 and 50 percent of vehicles qualify, respectively.

Although incentives will push EV costs well below those of internal combustion engine (ICE) vehicles, that alone is necessary but insufficient to ensure a rapid vehicle market transformation. Other factors dictate consumer hesitancy to purchase EVs such as concerns around charging availability and EV range, explaining why many ICE vehicle sales will persist through 2030 and could even rebound if the incentives are allowed to expire. These results highlight the importance of strong federal vehicle emissions standards under development by the U.S. Environmental Protection Agency (EPA) to ensure President Biden's goal is met.

The relative size of emissions reductions is affected by vehicles lasting for 10 to 20 years, and time requirements to achieve a large stock percentage of EVs, even if sales shares are high. Put another way, the impact of incentives grows considerably beyond 2030 as the vehicle stock becomes more electrified, but those reductions are not captured looking just at 2030 emissions reductions. The long-term emissions contribution from EV incentives is therefore larger than the share observed in 2030 alone.

Methane Fee

The methane fee of $60 per tonne of carbon dioxide equivalent (CO_2e) is a key provision included in the Infrastructure Bills. At this level, we find the fee is sufficient to realize essentially all of the available methane abatement potential in the oil and gas industry, as identified by the International Energy Agency.[1] This leads to a reduction of nearly 70 percent relative to BAU methane emissions, or roughly 160 MMT CO_2e in the year 2030. This may be a conservative estimate, as several organizations have found actual methane emissions may be even greater than those reported by the U.S. EPA.[2]

Building Electrification and Efficiency

Our modeling finds limited emissions reductions from buildings sector investments. This is not a reflection of the potential for reducing buildings emissions; buildings emit more than 550 MMT CO_2e annually. However, we find the amount of funding allocated to building electrification in

particular is not enough to transform this sector. For example, the American Council for an Energy-Efficient Economy (ACEEE) found the buildings sector could potentially absorb $180 billion in rebates for funding for the High Efficiency Electric Home Rebate Program, which would be enough to incentivize most consumers to purchase efficient heat pumps rather than gas heating equipment for the next decade.[3] However, this program is only slated for $9 billion in the current BBB text, or 5 percent of the amount required according to ACEEE.

The Infrastructure Bills also propose funding for efficiency programs such as the Weatherization Assistance Program, the Energy Efficiency and Conservation Block Grant Program, energy efficiency tax credits, and rebate programs for energy efficiency improvements in single family and multifamily buildings. While these programs do offer emissions benefits, they are also critical for ensuring equitable housing infrastructure. Much of this funding is targeted at low-income communities, which will deliver important improvements in health and living conditions as well as energy savings.

Public Health Impacts

In addition to significantly reducing GHG emissions, the Infrastructure Bills would cut particulate emissions that lead to negative health outcomes. We find that avoided air pollution in the modeled scenarios would lead to between 4,600 to 7,000 avoided deaths annually by 2030, in addition to 127,000 to 194,000 avoided asthma attacks and 511,000 to 783,000 avoided lost workdays. The majority of public health benefits are due to reduced air pollution from fossil fuel combustion in the power sector, particularly coal plants which are major sources of $PM_{2.5}$, SOx, and NOx.

Scenario	Avoided Premature Mortalities in Year 2030	Percent Change in Deaths by Race - White	Percent Change in Deaths by Race - Black	Percent Change in Deaths by Race - Asian	Percent Change in Deaths by Race – Other Race or Multiple Races
Low	4,600	-0.13 percent	-0.18 percent	-0.22 percent	-0.28 percent
Moderate	6,100	-0.18 percent	-0.23 percent	-0.29 percent	-0.37 percent
High	7,000	-0.21 percent	-0.27 percent	-0.33 percent	-0.43 percent

Table 7: Avoided Deaths

Of note, we find as a percentage decrease, avoided deaths are concentrated in communities of color, which have historically experienced the most harm from air pollution. Disadvantaged communities are often located in close proximity to polluting infrastructure and policies to mitigate these sources of local air pollution will be critical to environmental justice. For example, the funding

for rural cooperatives to retire high-GHG facilities, one of the most important provisions for reducing negative health outcomes in our modeling, is set to prioritize projects in disadvantaged communities.

Jobs

The Infrastructure Bills earmark billions in funding for climate and energy provisions, which is an engine of domestic job growth. Our modeling finds 449,000 to 638,000 additional jobs in the year 2030, concentrated in manufacturing, construction, and service industries. Of note, we find the funding mechanisms have a large impact on modeled job creation. These scenarios assume half of government funding comes from increased corporate taxes, while the other half comes from increased personal income taxes.[4] This assumption results in lower job growth than a scenario that assumes programs are entirely paid by deficit funding, for example. Individual pieces of our modeling align well with other estimates when we assume the same funding mechanisms. For example, we find 80 percent clean electricity by 2030 results in 711,000 annual jobs, compared to the range of 500,000 to one million annual jobs identified by researchers in a recent meta-analysis of clean energy policy modeling.[5]

Scenario	Annual Job-Years in 2030
Low	449,000
Moderate	539,000
High	638,000

Table 8: Job Creation

OTHER POTENTIALLY MEANINGFUL PROVISIONS

Because our analysis does not cover all provisions of the Infrastructure Bills, it is narrower in scope than some other analyses and excludes some emissions abatement opportunities. With a few exceptions, we do not expect the remaining provisions to provide significant GHG emissions reductions, although many would deliver other important benefits such as improved resiliency or a reduction in local air pollutants.

However, one particularly promising provision is the Greenhouse Gas Reduction Fund, which would set aside $27.5 billion to create a national green bank. This provision is not modeled here due to the difficulty in translating funding to specific outcomes, but it would represent a historic investment that could catalyze emerging clean energy industries. We also exclude funding for the

U.S. Department of Energy's Loan Programs Office, which has the potential to leverage a significant amount of private funding into energy infrastructure.

Another excluded provision with significant potential is the sustainable aviation fuel (SAF) tax credit. Domestic aviation emissions are projected to be roughly 150 MMT in 2030, and were the tax credit able to significantly scale the domestic SAF industry, it could help significantly reduce emissions from aircraft. These three examples highlight how provisions excluded from this analysis could yield additional reductions beyond what we modeled.

CONCLUSION

EPS modeling suggests the Infrastructure Bills could cut emissions by at least 1,500 MMT in 2030, which when combined with potential state and regulatory action could set the U.S. up to achieve its NDC of a 50-52 percent emissions reduction. Additional provisions not included in our modeling would further increase emissions reductions. An enforceable CEPP that includes the penalty is the most critical component to achieving these emission reduction levels by 2030. The Infrastructure Bills could also deliver important benefits for Americans by generating at least 638,000 jobs and avoiding more than 7,000 deaths in 2030.

NOTES

[1] "Methane Tracker 2021," International Energy Agency, https://www.iea.org/reports/methane-tracker-2021.
[2] "Methane Tracker 2021," International Energy Agency, https://www.iea.org/reports/methane-tracker-2021; Alvarez et al., "Assessment of methane emissions from the U.S. oil and gas supply chain," Science 361 (July 2018): 186-188.
[3] Lowell Ungar, Steven Nadel, and James Barrett, "Clean Infrastructure: Efficiency Investments for Jobs, Cliamte, and Consumers," American Council for an Energy Efficient Economy, September 2021, https://www.aceee.org/sites/default/files/pdfs/clean_infrastructure_final_9-20-21.pdf.
[4] Chuck Marr and Samatha Jacoby, "Ways and Means Revenue Bill Major Step Forward But Additional Steps Available," Center on Budget and Policy Priorities, September 13, 2021, https://www.cbpp.org/research/federal-tax/ways-and-means-revenue-bill-major-step-forward-but-additional-steps-available#_ftn1.
[5] Dan Esposito, "Studies Agree 80 Percent Clean Electricity by 2030 Would Save Lives and Create Jobs at Minimal Cost," Energy Innovation, September 2021, https://energyinnovation.org/wp-content/uploads/2021/09/Studies-Agree-80-Percent-Clean-Electricity-by-2030-Would-Save-Lives-and-Create-Jobs-at-Minimal-Cost.pdf.