Growing a Greener Economy: Job and Climate Impacts from Energy Efficiency Investments

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Executive Summary

KEY TAKEAWAYS

The proposed energy efficiency investments analyzed here could achieve:

- 660,000 added job-years through 2023, and 1.3 million added job-years over the lifetime of the investments and savings
- 910 million tons of reduced carbon dioxide (CO_2) emissions
- $120 billion in energy bill savings

Energy efficiency investments can create jobs now and reduce greenhouse gas (GHG) emissions for years to come, while also saving money for consumers and businesses and improving public health. These benefits are particularly critical for low-income families and communities of color, who have been most affected by the current COVID-19 pandemic and economic recession. Throughout the economy, efficiency investments can put people back to work, including the hundreds of thousands of efficiency workers who lost their jobs in the current crisis. These investments are also a down payment on achieving the potential of efficiency to cut U.S. GHG emissions in half.

We analyzed the likely energy saved and carbon emissions avoided from several proposed energy efficiency investments; we also used our DEEPER input-output economic model to estimate the net added jobs from both the investments and the energy savings. The proposed investments are in homes and commercial buildings, electric vehicles (EVs), transportation infrastructure, manufacturing plants, small businesses, states, and cities. They are designed for both short-term economic and long-term environmental benefits, and they promote social equity through increased investment in affordable housing. They can be implemented quickly, often using existing federal programs. They generally employ local construction workers and use equipment and components manufactured domestically. And because of the energy savings and other benefits they produce, the federal investments can leverage private funds to increase their impacts.

RESULTS

We estimate that, collectively, the proposed investments would result in 660,000 more job-years (that is, people working for a year) through 2023 and 1.3 million added job-years over the lifetime of the investments and savings. As Figure ES1 shows, the proposed programs would add about 200,000 jobs each year during the largest investments (2021–25) and then about 60,000 jobs per year through 2030.

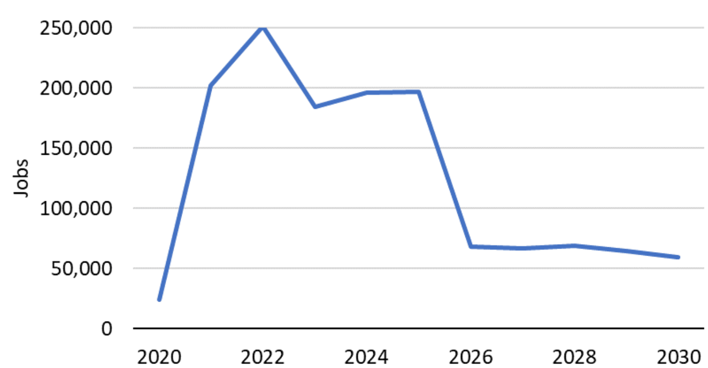

Figure ES1. Net added jobs by year (job-years)

Over time, the investments would reduce CO_2 emissions by more than 900 million metric tons (MMT)—

equivalent to the emissions of nearly 200 million cars and light trucks for a year. The investments would also produce $120 billion in energy bill savings (present value), as well as more than $40 billion in other financial benefits. Further, they would help develop long-term markets for advanced green technologies and practices, creating additional economic and environmental benefits that we did not quantify here.

Table ES1 shows the impacts by proposed investment. Tax incentives for efficiency improvements to commercial buildings and existing homes and for new EVs show the largest estimated impacts—as well as the largest investments. These incentives can achieve rapid market impacts because they build on current policies and, unlike limited grant programs, they are tax breaks available to everyone. Other proposals with large impacts include retrofitting affordable apartments and offering rebates for other home retrofits. Low-income home improvements also bring health benefits, while industrial measures bring process benefits that can exceed their energy savings. Indeed, those two types of investments, as well as investments in EVs, may also have the most transformational long-term market impacts.

The largest benefits per federal dollar are for investments that leverage significant private dollars, including subsidized loans for industry and the commercial buildings tax deduction. Other proposals would provide important savings for low-income families and small businesses that cannot currently afford to invest.

Pumping money into the economy in job-intensive sectors such as construction creates jobs regardless of the investment type. Energy efficiency investments do that and more; they also create long-term jobs and economic growth through energy savings that typically pay back more than the initial investment. The energy savings reduce GHG emissions and air pollution, help consumers and businesses financially, and can benefit both the health and finances of overburdened households. Efficiency investments are effective as stimulus, as the foundation for a green economy, and as assistance for American consumers and businesses.

Table ES1. Cumulative impacts from the proposed investments

	Federal investment (PV $billion)	Jobs created 2020–23 (thousand job-years)	Total jobs created (thousand job-years)	CO_2 emissions avoided (MMT)	Energy cost savings (PV $billion)
Buildings					
LI weatherization	4.0	30	14	12	1.7
LMI multifamily	6.5	70	98	54	8.9
HOPE4HOMES	4.7	42	85	58	9.6
Building incentives	20.2	235	567	340	53.3
Transportation					
EV incentives	31.0	40	219	138	18.8
Transport CO_2 progs.	6.3	89	161	52	7.7
Industrial programs	1.1	43	66	186	13.5

	Federal investment (PV $billion)	Jobs created 2020–23 (thousand job-years)	Total jobs created (thousand job-years)	CO_2 emissions avoided (MMT)	Energy cost savings (PV $billion)
Cross-cutting					
State Energy Program	2.7	27	49	32	4.5
Local block grants	2.4	27	31	19	3.4
Small business progs.	5.6	60	44	40	6.2
Total	**83.5**	**662**	**1,333**	**906**	**123.3**

We removed overlap between two programs from the totals. See below for leveraged private and state investments and for benefits other than energy savings that are not shown here but that affect the proposals' cost effectiveness.

Introduction

COVID-19 has created both a health crisis and an economic crisis. We currently have a higher proportion of unemployed people than any time since the Great Depression, with unemployment highest among low-income communities and communities of color. We need to create jobs in a way that benefits all. At the same time, we are facing a looming climate crisis and a need to cut greenhouse gas (GHG) emissions.

Energy efficiency can create jobs now while making a down payment on future carbon abatement. In 2019, an estimated 2.3 million people worked at least in part on energy efficiency (Foster 2020). As of April, however, more than 400,000 of them had become unemployed due to the general shutdown of commerce and the inability to work inside homes (Jordan 2020). We previously found that energy efficiency could cut U.S. GHG emissions in half by 2050 (Nadel and Ungar 2019). Achieving that goal would require a large and sustained increase in energy efficiency investments—and in the jobs to implement them. It would also result in long-term energy savings and job creation throughout the economy as families and businesses spend funds previously directed to energy bills.

The energy efficiency investment proposals listed below are designed for both short-term economic and long-term environmental benefits and to promote social equity through ramping up investments in affordable housing. They can be implemented quickly, often using existing federal programs and relationships. They involve local construction workers as well as equipment and components manufactured domestically. Further, because of the energy savings and other benefits these proposals provide, federal funding can often leverage private funds to increase the impacts.

The proposals will help achieve not only direct energy savings but also the development of technologies and practices needed for transformation to a greener economy. Electric vehicles (EVs), deep energy retrofits of homes and commercial buildings, and new industrial management and practices all are critical pathways to a low-carbon economy.

Some of the proposals are designed specifically to help communities hit hardest by the pandemic and the economic recession as well as households and businesses overburdened by energy bills. Improving the homes of low-income families both lowers their energy bills and provides a healthier, more comfortable place to live. Moreover, many jobs created by the proposals would provide income to the same communities.

In this paper, we analyze the following efficiency proposals across all economic sectors to estimate net jobs creation, carbon emissions reductions, and energy savings:

Buildings

- *Weatherization Assistance Program (WAP).* Fund local community agencies to provide home energy upgrades for low-income families.
- *HOPE for HOMES.* Implement new U.S. Department of Energy (DOE) and state rebate programs for home energy upgrades and contractor training.
- *Multifamily programs.* Fund energy upgrades to low- and moderate-income multifamily housing.

- *Building tax incentives.* Improve existing tax incentives for home improvements, new homes, and both new and upgraded commercial buildings.

Transportation

- *EV tax credits.* Expand tax credits for electric passenger vehicles and electric chargers and add a new credit for electric trucks.
- *Transportation carbon reduction programs.* Implement proposed transportation bill programs to fund investments to reduce fuel use and emissions.

Industry

- *Energy audits for large plants.* Help the largest industrial plants reduce their energy use and GHG emissions through assessments and technical assistance.
- *Industrial energy managers.* Provide matching funds for industrial plants to hire energy managers to help implement strategic energy management plans.
- *Loans for small and medium-sized manufacturers.* Underwrite bonds to provide low-interest loans to small and medium-sized industrial companies.
- *Domestic supply chains.* Implement a new DOE program to support agile and resilient domestic manufacturing capacity for supply chains.

Cross-cutting

- *State Energy Program.* Fund state energy offices to implement a wide range of energy efficiency, renewable energy, and energy resilience measures.
- *Energy Efficiency Conservation Block Grants.* Fund local governments to implement energy efficiency and renewable energy measures.
- *Small Business Energy Efficiency Grants.* Provide new federal funding for utility and state programs that help small businesses improve energy efficiency.

In the following, we briefly describe the analysis methodology, then each program and its estimated impacts, and finally the combined results. Appendix A offers detailed results.

Methodology

For each proposal, we estimated likely national electricity, natural gas, and oil savings; monetary and emissions savings; and costs. These are projections for what we believe is a likely scenario for implementation—not for the maximum potential impacts—and they represent the net change compared to a baseline scenario in which the proposals are not enacted.

For appropriated funds, we typically started from the amount of federal funding, then estimated the amount of private or state match (if any) and the administrative costs. We then estimated the annual energy savings over time from the combined investment. For tax incentives, we estimated the market uptake based either on experience with similar incentives or on a baseline market and price and an estimated price demand elasticity. We assumed that the measures would be enacted in the early fall, and that the investments would start in 2020 or 2021 and typically be spread over a few years, though the tax credit for electric passenger vehicles extends to 2030. Finally, we assumed that the savings and the financing costs would continue for up to 30 years. Appendix B presents details on the methodology and our assumptions for each proposal.

We estimated energy cost savings and carbon dioxide (CO_2) emissions reductions for each proposal by year using projected average retail prices by sector and average emissions intensities for electricity and each fuel from the U.S. Energy Information Administration's *Annual Energy Outlook 2020* (EIA 2020) reference case. In a few cases, we also included other financial ("non-energy") benefits from the measures—mostly health savings from improved low-income housing and process cost savings in manufacturing plants—but we made no attempt to be comprehensive, and we did not include other benefits such as the value of carbon abatement. All dollar amounts are in 2019 dollars, and we discounted cumulative financial impacts using a 5% real discount rate.

We estimated each proposal's net macroeconomic impacts using a version of our DEEPER input-output model (described in Appendix C). We estimated how many jobs would be created and lost due to the investment of government and consumer funds into the efficiency measures (and the loss of other uses of those funds) and due to the consequent energy bill savings for consumers and reduction in payments to utilities and fuel providers. We did not include the investments' nonenergy benefits, but those jobs impacts would not be large. Because the investments are intended as economic stimulus, we assumed that the federal funding would be financed using Treasury bonds over 30 years. Because all investments and savings are paid for, the net jobs impact can be negative in some years. Jobs are shown as the net increase in the number of full-time equivalent jobs by year, aggregated as "job-years."

These estimates have a high level of uncertainty. For some proposals, little existing data show a provision's impact; we therefore had to base the assumptions on our judgment, which was reviewed by outside experts.

Proposed Investments: Descriptions and Results

We now describe each of the proposals and the key results of our analyses. We report the investments, energy cost savings, and nonenergy benefits separately as cumulative discounted present values (except for appropriated investment amounts in the text, which are generally in nominal dollars like they are given in legislation, and hence differ from the present values in the tables). CO_2 reductions are cumulative (but not discounted). Jobs numbers are in cumulative net added job-years—that is, the additional full-time-equivalent employment for a year—considering both investments and savings. Appendix A offers more detailed results.

WEATHERIZATION ASSISTANCE PROGRAM

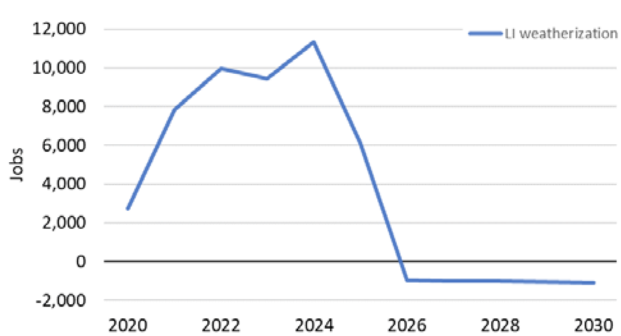

Figure 1. Net jobs from weatherization

Description

WAP provides funds to states for energy efficiency upgrades for low-income households. Weatherization reduces energy costs, improves health and safety, and supports energy efficiency jobs across the country. Since its launch in 1976, WAP has served more than 7 million homes with cost-effective efficiency measures including air sealing and insulation, as well as upgraded heating and cooling systems, water heaters, lighting, and appliances.

Through WAP, DOE provides funding to every state, the District of Columbia, five U.S. territories, and one Native American tribe to support a well-established network of Community Action Agencies, other nonprofits, and local government agencies that deliver weatherization services to roughly 35,000 low-income families each year using their own work crews and private contractors (DOE 2019). During the Great Recession, increased funding supported weatherization of 1 million homes from 2010–2012, demonstrating the program's capacity to ramp up services quickly. The number of WAP-supported jobs jumped from 8,500 to 28,000 during the Recovery period (DOE 2015). This successful program reduces the outsized energy burden that low-income families face, creates local employment opportunities, and improves health and safety, while generating long-term energy and water savings and climate benefits.

Impacts

We modeled $5 billion in additional funding for WAP through 2025. As table 1 shows, we estimate that this funding would result in saving $1.7 billion in energy and 12 million tons of reduced CO_2 emissions (equivalent to the emissions of 3 million cars and light trucks for a year). In addition to energy savings, the added WAP investments would yield significant nonenergy benefits from improved health and safety, which we conservatively value at $2.3 billion.

The work under WAP and the resulting energy savings would result in 30,000 more people working for a year (job-years) through 2023, but with total added lifecycle job-years of just under 14,000 due to a net loss of some jobs in later years when paying back the cost of the investment. Figure 1 shows the net added jobs by year through 2030.

Table 1. Cumulative impacts from WAP investment

	Federal investment (PV $billion)	Jobs created 2020–23	Total jobs created	CO_2 emissions avoided (MMT)	Energy cost savings (PV $billion)	Nonenergy benefits (PV $billion)
LI weatherization	4.0	30,019	13,907	12	1.7	2.3

Investment in the table is shown in present value, but it is presented in the text in cumulative nominal dollars.

WEATHERIZE LOW- AND MODERATE-INCOME MULTIFAMILY HOUSING

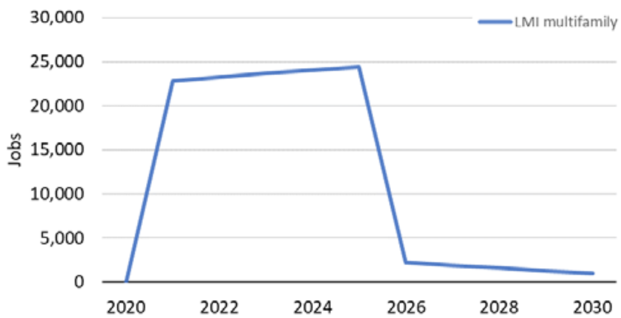

Figure 2. Net jobs from weatherizing multifamily housing.

Description

Lower-income households disproportionately live in apartments. An estimated 28% of households in apartments have an annual income of less than $20,000, and 61% have an annual income of less than $50,000 (NMHC 2019). The National Low-Income Housing Coalition (Aurand, Emmanel, and Crowley 2017) estimates that there are approximately 35 million U.S. rental units that are affordable to moderate-income households (with 30% or less of household income being devoted to housing and utility costs). This includes approximately 1.1 million units of occupied public housing managed by more than 3,000 public housing authorities (PHAs). In addition to public housing, the Department of Housing and Urban Development (HUD) has a variety of programs to assist privately owned affordable housing; together, these programs provide about 3.7 million units (HUD 2018). Most states have their own affordable housing programs; as of 2016, the portfolios of state Housing Finance Agencies (HFAs) contained more than 1.2 million apartments (NCSHA 2020).

Weatherizing these units can significantly reduce energy use and energy costs, thus reducing tenant energy bills, rents, and/or needed government subsidies. For public housing, energy use can typically be reduced about 25% with an investment of approximately $2,500 per unit, and reduced about 35-40% with an investment of approximately $4,500 per unit.[1] WAP, discussed above, emphasizes single-family homes, as it is difficult for WAP to work on central systems in apartment buildings.

We therefore recommend two efforts to complement WAP. First, we recommend that $2.25 billion be provided as grants to PHAs via an appropriation to the Public Housing Capital Fund spread over five years. These funds would enable deep retrofits of half a million units. To leverage additional investments, PHAs should be authorized to use these funds to contribute to energy performance contracting arrangements. Second, for the other affordable rental units, we recommend federal grants of $3,000 per unit. These funds would be administered by HFAs, which could provide grants or otherwise use these funds to help create financing packages.

Some HFAs already operate efficiency programs. Minnesota's HFA (Minnesota Housing) helped owners of 31 affordable multifamily buildings implement efficiency projects by collecting utility data, providing in-depth technical assistance, and providing financial assistance through its Energy Score Cards pilot (NCSHA 2019). In Maryland, the ratepayer-funded Multifamily Energy Efficiency and Housing Affordability program covers up to

[1] Morgan, S. 2020. Pers. Comm. on April 13, 2020. Clean Energy Solutions.

100% of the cost of comprehensive energy efficiency upgrades in both subsidized and unsubsidized affordable rental housing (Maryland DHCD 2020).

Impacts

We modeled the impacts of a program that invests $4,500 per unit in 500,000 public housing units, and $3,000 per unit (via HFAs) in an additional 1.7 million affordable apartments (5% of the total number of affordable apartments) over the 2021–25 period. We assume the HFAs arrange for or provide an additional $1,500 per apartment. The total cost to the federal government is $8.3 billion (nominal). We assume that these measures have an average simple payback of 10 years and that they provide additional nonenergy benefits (based on studies documenting them).

As table 2 shows, these investments result in savings of almost $9 billion in energy costs and reductions of more than 50 million tons of CO_2 emissions (equivalent to the emissions of 12 million cars and light trucks for a year). The work under these grants and the resulting energy savings would create 70,000 net job-years over the first three years, and 98,000 total lifecycle job-years, including additional jobs created due to the long-term energy savings. Figure 2 shows the net added jobs by year through 2030.

Table 2. Cumulative impacts from multifamily housing investment

	Federal investment (PV $billion)	Jobs created 2020–23	Total jobs created	CO_2 emissions avoided (MMT)	Energy cost savings (PV $billion)	Nonenergy benefits (PV $billion)
LMI multifamily	6.5	69,818	98,140	54	8.9	6.9

Investment in the table is shown in present value, but it is presented in the text in cumulative nominal dollars.

HOPE CONTRACTOR TRAINING AND HOMES REBATE PROGRAM

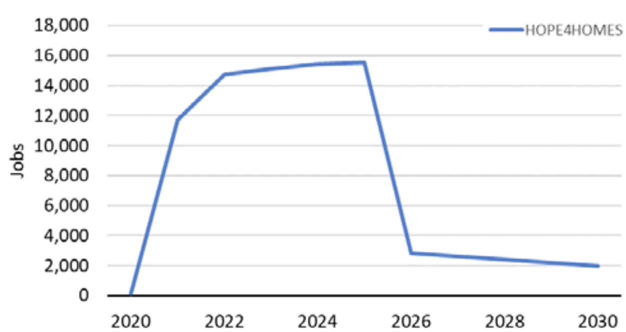

Figure 3. Net jobs from the HOPE for HOMES program

Description

The HOPE for HOMES Act would establish two initiatives to support residential energy-efficiency jobs. The Home Online Performance-Based Energy Efficiency (HOPE) Training program would provide grants to residential contractors to retain/rehire workers through COVID-19 shutdowns and the economic downturn. Workers would be paid to complete online training to advance their skills in home efficiency retrofits. HOPE training would qualify contractors to participate in the Home Owner Managing Savings (HOMES) rebate program. The HOMES rebate program would provide longer-term stimulus by incentivizing homeowners to make efficiency improvements, thus driving ongoing demand for a highly skilled local workforce in communities across the country.

Together, HOPE for HOMES will train workers in skills that increase the energy efficiency, health, and safety benefits of home retrofits while building consumer interest and demand. DOE will administer HOPE grants and HOMES rebates for partial retrofits covering (1) insulation and air sealing, or (2) insulation, air sealing, and HVAC system replacements. States will administer funds for whole-home retrofits that achieve 20–40% or more than 40% savings; this will allow states to adapt programs to their markets. Moderate-income homeowners will qualify for higher rebates.

Impacts

We modeled $500 million in funding for HOPE and $6 billion in funding for HOMES rebates through 2025. We estimate that this would spur an additional $6 billion in consumer investment in home retrofit projects. We did not include any added state or utility program funds that may supplement federal incentives. We estimate that this should result in saving almost $10 billion in energy and almost 60 million tons of reduced CO_2 emissions (equivalent to the emissions of 13 million cars and light trucks for a year); see table 3. Although we did not analyze other benefits, they can be substantial and are often important drivers of consumer investment.

The training and retrofits completed under HOPE for HOMES and the resulting energy savings would create 42,000 net job-years over the first three years and 85,000 total lifecycle job-years, including additional jobs created due to the long-term energy savings. Figure 3 shows the net added jobs by year through 2030.

Table 3. Cumulative impacts from the HOPE for HOMES program investment

	Federal investment (PV $billion)	Jobs created 2020–23	Total jobs created	CO_2 emissions avoided (MMT)	Energy cost savings (PV $billion)
HOPE for HOMES	4.7	41,674	84,844	58	9.6

Investment in the table is shown in present value, but it is presented in the text in cumulative nominal dollars.

EXTEND AND REFRESH BUILDING EFFICIENCY TAX INCENTIVES

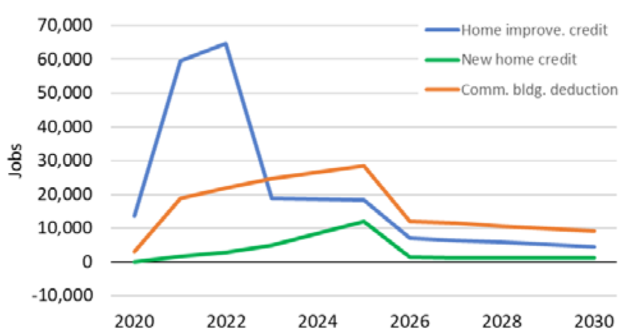

Figure 4. Net jobs from buildings tax incentives

Description

Three federal energy efficiency tax incentives—for efficient new homes (section 45L of the tax code), existing home retrofits (section 25C), and commercial building improvements (179D)—expire at the end of 2020. These incentives are overdue for a "refresh" to target incentives to the highest levels of efficiency and to better encourage commercial building retrofits. In addition, for stimulus purposes, incentives should be enhanced for a two-year period, building on the successful enhancements to the 25C incentives under the American Recovery and Reinvestment Act of 2009 (ARRA) (GAO 2012).

Specifically, we looked at adopting the 25C and 45L modifications in existing legislative proposals,[2] but doubling the 25C incentives for the first two years as proposed by the Alliance to Save Energy and other supporters (Alliance to Save Energy 2020). We also included updates to 179D, such as adding a higher tax deduction tier ($3 per square foot of floor area) to meet higher energy efficiency targets, as ASE and other supporters also proposed (Alliance to Save Energy 2020).

Impacts

As table 4 shows, by our estimates, these three incentives combined should result in $53 billion in energy cost savings and 340 million tons of reduced CO_2 emissions (equivalent to the emissions of 74 million cars and light trucks for a year). The work completed under these tax incentives and the resulting energy savings would create 235,000 net job-years over the first three years and 567,000 total lifecycle job-years, including additional jobs created due to the long-term energy savings. Figure 4 shows the net added jobs by year through 2030. The largest savings are from the commercial building deduction, in part because we assumed large leverage of additional private investments based on a REMI study (2017).

Table 4. Cumulative impacts from building tax incentives

	Federal investment (PV $billion)	Jobs created 2020–23	Total jobs created	CO_2 emissions avoided (MMT)	Energy cost savings (PV $billion)
Home improvement credit	14.4	157,002	195,704	127	22.4
New home credit	2.5	9,448	56,550	40	5.0
Commercial building deduction	3.3	68,350	314,980	174	25.9
Building incentives	**20.2**	**234,800**	**567,234**	**340**	**53.3**

[2] S. 2588/H.R. 4506 and S. 2595/H.R. 4646 in the 116th Congress, e.g., see www.congress.gov/bill/116th-congress/senate-bill/2588.

TAX CREDITS FOR ELECTRIC CARS, TRUCKS, AND EV CHARGING EQUIPMENT

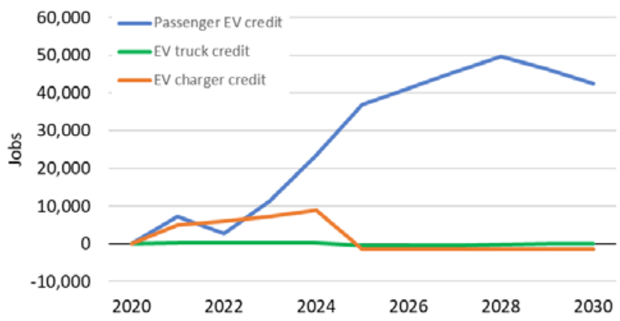

Figure 5. Net jobs from electric vehicle tax incentives

Description

Under the 30D tax credit, buyers of some light-duty plug-in EVs currently qualify for a federal tax credit to offset part of the upfront cost. The credit ranges from $2,500 to $7,500 but is phased out after the first 200,000 plug-ins sold by a given automaker. We modeled a proposal in S. 1094/H.R. 2256 to expand the per-automaker limit to 600,000, but with a lower maximum credit of $7,000.

Currently, there are no federal tax credits for medium- and heavy-duty electric trucks. We modeled a proposal in H.R. 5162 to add a 10% tax credit on battery electric and fuel cell vehicles sold through the end of 2024. We also modeled the impacts of extending the current 30C tax credit for EV charging infrastructure (that is, electric vehicle supply equipment, or EVSE) also through the end of 2024, as in H.R. 5164. In this proposal, new charging infrastructure would continue to qualify for a tax credit of up to 30% of the overall cost, with an additional 20% credit available for fleet-related installations and public stations.

In addition to reducing GHGs, EVs offer numerous benefits, such as reducing or eliminating local pollution, saving fuel, and reducing vehicle operating costs. Investing in EVSE is crucial to supporting the uptake of EVs and can create badly needed local manufacturing and installation jobs. While not modeled in this analysis, EVs can also provide storage services to the grid and complement the deployment of renewable energy.

The automotive industry is a vital component of U.S. manufacturing, with vehicle sales accounting for roughly 3.5% of GDP. EV tax credits support both domestic EV manufacturing and growth of the country's nascent EV market. Plug-in vehicles are more likely to be manufactured domestically than other vehicles, and 250,000 U.S. auto workers already work with alternative-fuel vehicles (Piotrowski 2018). Supporting the EV market can help create high-quality jobs and aid the stimulus effort.

Impacts

We estimate that these extended tax provisions would increase new EV sales by almost 2 million vehicles between 2021 and 2030, and the vast majority of these EVs would be light-duty vehicles. For the light-duty tax credit, our analysis projects that the cost to the federal government over the next 10 years would total $29 billion (present value). Although most of the tax credits would go to people who would buy EVs anyway, and in later years the credit would exceed the added cost, the added EVs are very cost effective. As table 5 shows, the result would be consumer fuel savings (minus added electricity use) of $18 billion. Given that the added cost of the vehicles (after financing) is $6 billion, the net savings is more than $12 billion (present value). For the medium- and heavy-duty tax credit and the EVSE tax credit, the costs to the federal government would be $0.2 billion and $1.8 billion, respectively. The light-duty tax credit would reduce CO_2 emissions by 135 million tons, while the medium- and heavy-duty tax credit would reduce emissions by 3 million tons, after accounting for the emissions caused by increased electricity use.

We assume that our analysis of the vehicle credits captures the emissions savings resulting from greater EVSE investment. There would likely also be some switching from EV charging at home to charging at public stations, which may not result in net energy or emissions savings.

These results do not include the very important impact that these credits would have on the EV market after they expire. Increasing EV sales should result in further price reductions from economies of scale and technological advancement, which will further increase sales and energy benefits beyond the life of these credits.

Combined, the credits would result in 40,000 additional job-years in the first three years, and almost 220,000 additional job-years over time as use of the credits grows with the EV markets. Figure 5 shows the net added jobs by year through 2030. The small job losses shown below for the EVSE credit are because the energy savings are included under the other credits.

Table 5. Cumulative impacts from EV tax incentives

	Federal investment (PV $billion)	Jobs created 2020–23	Total jobs created	CO_2 emissions avoided (MMT)	Energy cost savings (PV $billion)
Passenger EV credit	29.0	21,388	218,762	135	18.5
EV truck credit	0.2	652	2,323	3	0.3
EV charger credit	1.8	18,432	–2,551*	-*	-*
EV incentives	**31.0**	**40,472**	**218,534**	**138**	**18.8**

*The energy savings and impacts from the charger credit are included under the other credits.

TRANSPORTATION CARBON POLLUTION REDUCTION PROGRAM

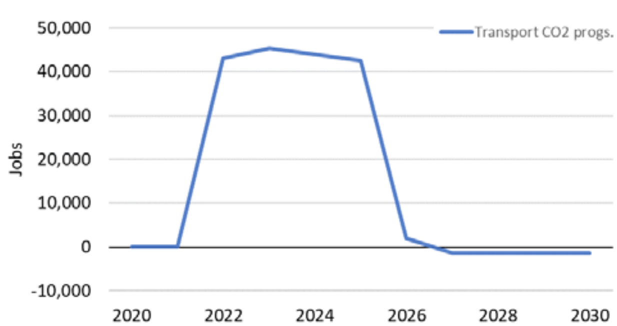

Figure 6. Net jobs from transportation CO_2 programs

Description

Transportation is now the biggest source of carbon emissions in the United States, and more than half of those emissions come from passenger vehicles (EPA 2020a). The proposed Carbon Pollution Reduction Program would provide states with $8.35 billion over a four-year period (2022–2025) to spend on transportation programs that are expected to reduce GHG emissions. In the House transportation bill (part of H.R. 2; a similar but smaller program is in the Senate bill, S. 2302), states have significant autonomy over the types of projects they can fund, with the restriction that the money cannot be spent to increase capacity for single-occupancy vehicles. The federal Department of Transportation would be required to monitor states' progress and report on their emissions reductions.

This program would allow states to test different approaches to increasing energy efficiency in personal transportation. Eligible projects vary but may include improving public transit, bike lanes, and pedestrian infrastructure, as well as increasing freight and traffic efficiency. In addition to helping consumers save on fuel costs, expected state investments can further the COVID-19 recovery effort by creating good construction jobs over the next decade.

Impacts

We estimate that this program will save almost $8 billion on energy bills for consumers and businesses and avoid more than 50 million tons of CO_2 (equivalent to the emissions of 11 million cars and light trucks for a year); see table 6. The program would result in almost 90,000 additional job-years in 2022–2023 and 160,000 total lifecycle job-years, including additional jobs created due to the long-term fuel savings. Figure 6 shows the net added jobs by year through 2030. We assume that one-third of the money would go toward public transit, thus decreasing vehicle miles traveled (VMT) in personal vehicles and overall emissions. Large amounts would also go toward systems operations efficiency and freight intermodality (19% each), with smaller amounts going toward travel demand management (13%), land use and smart growth initiatives (9%), and pedestrian and biking infrastructure (9%). All aim to increase the efficiency of and reduce emissions from transportation.

Table 6. Cumulative impacts from the transportation carbon reduction program

	Federal investment (PV $billion)	Jobs created 2020–23	Total jobs created	CO_2 emissions avoided (MMT)	Energy cost savings (PV $billion)
Transport CO_2 progs.	6.3	88,537	161,364	52	7.7

Investment in the table is shown in present value, but in the text it is in cumulative nominal dollars.

INDUSTRIAL PROGRAMS

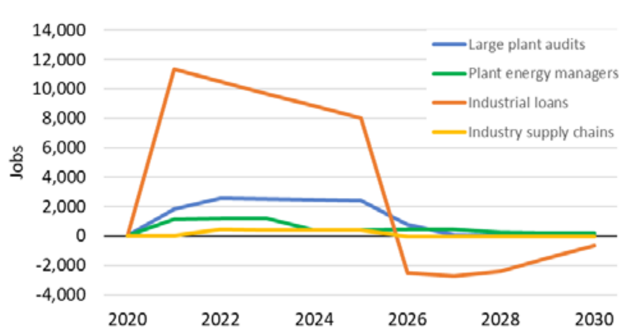

Figure 7. Net jobs from industrial programs

Description

The industrial sector accounts for more than 25% of U.S. GHG emissions (EPA 2020b) and 11% of the gross domestic product (NAM 2020). Industry occupies a unique position in our economy because it consumes vast quantities of energy, while also producing goods that allow the economy to decarbonize. COVID-19 has created multiple crises for the industrial sector, including reduced consumer demand, disruptions in plant operations and supply chains, and drastically reduced cash flow.

At the same time, companies and their suppliers are feeling pressure from governments and consumers to reduce their GHG footprints. By improving energy efficiency, industry can reduce its operating costs, reduce GHG emissions, and make companies more globally competitive.

We analyzed a suite of policy proposals aimed at building organizational capacity to implement energy efficiency and carbon-reduction measures, as well as addressing some of the challenges exposed by COVID-19. We also identified opportunities to reduce energy costs, provide access to capital, and build domestic capacity for agile manufacturing that could reshore our capacity to produce goods that are critical to the health and economy of the nation. Research (Junga and Rogers 2017) has shown that energy efficiency investments also offer plants nonenergy benefits (NEBs) that can be worth much more than the direct energy savings.

The four interrelated proposals analyzed below address challenges that companies are facing during this crisis. Implementing these proposals will enable companies to not only survive the crisis, but emerge stronger and more competitive, while also preserving jobs and providing a jump-start toward decarbonization.

ENERGY AUDITS AND TECHNICAL ASSISTANCE FOR LARGE MANUFACTURING

This initiative would expand the scope of the Better Plants program,[3] an existing voluntary program to encourage energy management and energy intensity reductions at the largest plants. The expansion would focus on energy use and GHG emissions reductions at the 1,500 largest carbon-emitting manufacturing plants. DOE would use Advanced Manufacturing Office staff, certified energy experts, national labs, and Industrial Assessment Center (IAC)[4] directors to provide expanded assessments, training, and technical assistance to support energy efficiency projects at these facilities. The program would facilitate strategic energy management (SEM)[5] efforts at the plants and seek to leverage other agency, state, and utility resources to support implementation. This program is modeled on the successful Save Energy Now effort launched in response to the natural gas supply crisis in 2005 following hurricanes Katrina and Rita. Through that effort, DOE assisted facilities in reducing natural gas use by more than 10% in less than two years (Olsen 2013).[6]

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[3] For more information see: betterbuildingssolutioncenter.energy.gov/better-plants/program-information.

[4] DOE's IACs help U.S. small to medium-size manufacturers (SMM) save energy, improve productivity, and reduce waste by providing no-cost technical assessments conducted by university-based teams of engineering students and faculty. For more information see: iac.university.

[5] Strategic energy management (SEM) is a systematic management approach that enables companies to save energy and make greater use of their energy resources by implementing continuous management principles. SEM has multiple levels, ranging from assessment tools such as DOE's 50001 Ready Navigator to the ISO 50001 Standard. For more information see: energytrust.org/commercial/strategic-energy-management.

[6] Scheihing, P. 2020. Pers. Comm. to ACEEE on July 21, 2020.

HIRING PLANT ENERGY MANAGERS

Research has shown that plants with an energy manager on site can reduce energy consumption by about 7% percent.[7] Companies with energy bills of more than $1 million/year and with a SEM program based on ISO 50001 in place—or plans to implement such a program in the first year—would be eligible for matching funds to hire an energy manager for three years. We anticipate that most of these new energy managers would save their employers more than the cost of their salaries. As a result, many companies would be likely to continue these positions after the initial funding period, resulting in a continuing stream of energy savings.

LOANS TO SMALL AND MEDIUM-SIZE MANUFACTURERS FOR ENERGY EFFICIENCY WORK

While many large corporations have access to private capital to make efficiency investments, most small and medium-size manufacturers (SMM) continue to face challenges in accessing capital—a challenge worsened by the current financial crisis. There are several programs that offer energy assessments to these firms. Such programs—including DOE's IACs and programs offered by state energy offices and utilities—identify opportunities that firms are unable to implement due to lack of capital. The transaction costs of securing Small Business Administration loans for these projects have created obstacles for companies. A preferred path for financing would be through community banks and mission-driven lending institutions that have existing relationships with these SMMs. The Community Development Financial Administration (CDFA) could authorize states to issue federally guaranteed bonds that would provide these lenders the capital they need to fund SMM investments.

AGILE AND RESILIENT DOMESTIC SUPPLY CHAINS

This program would build domestic manufacturer capacity by investing in agile and resilient manufacturing; it would thus create capacity to redeploy these facilities to address disruptions resulting from COVID-19 and future crises. The benefits of these agile supply chains have been highlighted at companies such as GM, which successfully redirected its suppliers' agile capacity to manufacture personal protective equipment (PPE) for GM's own employees, thus allowing continued operations and further production of PPE and other critical equipment such as ventilators for the national response.[8] This program would provide grants and technical assistance to SMM for investments that expand adoption of technologies such as additive[9] and smart[10] manufacturing.

Impacts

We modeled the impacts of each policy individually.

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[7] Boyd, G. 2019. Pers. Comm. to E. Rightor. Duke University.

[8] Hildreth, A. 2020. Pers. Comm. to N. Elliott on May 28, 2020. General Motors.

[9] Additive manufacturing, also known as 3-D printing, uses technology to construct a product from a digital model.

[10] Smart manufacturing is a category of technologies that use sensors, simulations, and control with computer-integrated manufacturing to optimize production.

ENERGY AUDITS AND TECHNICAL ASSISTANCE FOR LARGE MANUFACTURING

This initiative would provide $100 million in annual funding to DOE over five years to identify savings opportunities at the largest industrial plants, building on the existing Better Plants program and thus leveraging current resources to get funding into the field quickly. We assume that the resulting private sector investments in energy efficiency would be 2.5 times the federal program funding. Based on analyses of Save Energy Now and other industrial energy efficiency programs, we estimate that this policy would result in saving $3 billion in energy, $6 billion in nonenergy benefits to the companies, and 40 million tons of reduced CO_2 emissions (equivalent to the emissions of 9 million cars and light trucks for a year).

HIRING PLANT ENERGY MANAGERS

This initiative would give DOE $225 million for 2021–23 to provide manufacturers with matching funds of up to $50,000 a year for three years to hire new plant energy managers. We assume that the companies would continue to fully fund half of these new energy managers through 2035. We conservatively assume long-term energy savings that are twice the energy managers' full salaries. Based on past assessments of energy manager programs (Boyd 2019), we estimate that this program would result in saving more than $1 billion in energy, almost $3 billion in nonenergy benefits, and 17 million tons of reduced CO_2 emissions.

LOANS FOR ENERGY EFFICIENCY WORK TO SMALL AND MEDIUM-SIZE MANUFACTURERS

The Treasury would direct CDFA to provide underwriting for special purpose bonds to raise $1 billion in capital annually for five years, and those funds would be lent to SMMs. The loan period would be no more than 10 years, and interest rates would be subsidized at the 20-year Federal Bond rate. The Treasury would provide additional enhancements by covering the loan origination, and it would guarantee bond repayment, covering any defaults. Based on typical savings from industrial energy efficiency capital investments, we estimate that this program should result in saving more than $9 billion in energy, $19 billion in nonenergy benefits, and 125 million tons of reduced CO_2 emissions (equivalent to the emissions of 27 million cars and light trucks for a year).

AGILE AND RESILIENT DOMESTIC SUPPLY CHAINS

AMO would be funded at $100 million over five years for research, technical assistance, and grants to help build flexible supply chains and manufacturing. DOE would provide grants to manufacturing facilities to enhance their agile capabilities through engineering services, equipment purchases, and training. Because the grants' primary focus is rebuilding domestic capability and improving resilience, we anticipate that the energy savings rate would be half that of the other programs. Based on ACEEE's assessment of smart manufacturing impacts (Rogers and Junga 2017), we estimate that this should result in saving $0.2 billion in energy, $0.5 billion in nonenergy benefits, and 3 million tons of reduced CO_2 emissions.

SUMMARY OF IMPACTS

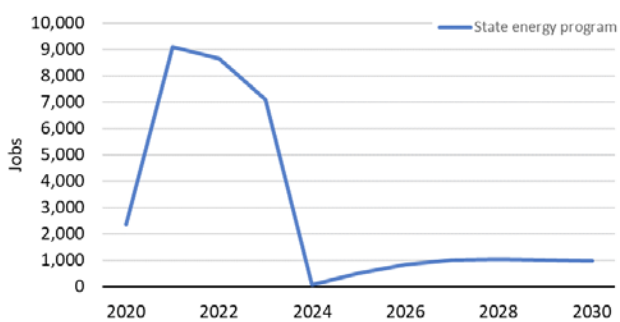
The work under these four policies and the resulting energy savings would create 43,000 net job-years over the first three years, and 66,000 total lifecycle job-years, including additional jobs created due to the long-term energy savings. Figure 7 shows the net added jobs by year through 2030, while table 7 shows a breakdown of individual program impacts. With significant leveraged investment from the companies and large opportunities for cost-effective savings, this sector provides opportunities for large impacts per federal dollar.

Table 7. Cumulative impacts from industrial investment

	Federal investment (PV $billion)	Jobs created 2020–23	Total jobs created	CO_2 emissions avoided (MMT)	Energy cost savings (PV $billion)	Nonenergy benefits (PV $billion)
Large plant audits	0.4	6,908	13,002	40	2.9	6.1
Plant energy managers	0.2	3,535	6,075	17	1.2	2.6
Industrial loans	0.5	31,555	45,639	125	9.1	19.3
Industry supply chains	0.1	894	942	3	0.2	0.5
Industrial programs	**1.1**	**42,892**	**65,657**	**186**	**13.5**	**28.5**

Investment in the table is shown in present value, but in the text it is in cumulative nominal dollars.

STATE ENERGY PROGRAM



Description

The State Energy Program (SEP) helps every state advance energy efficiency, renewable energy, and energy security. Since the 1970s, SEP has given state energy offices funding and technical assistance to train building owners, develop clean energy policies and programs, reduce state and local government energy waste, create state energy emergency plans, and much more.

As an existing DOE grant program that has helped build programs, policies, and energy plans in every state, SEP is well suited to invest money quickly while giving states flexibility in how they make investments. It proved effective in the Great Recession, especially for developing renewable energy markets (not included here), building energy codes, and building retrofit programs and loans. These innovative programs and policies bring long-term energy and climate benefits.

Impacts

We modeled $3.1 billion in funding for SEP over approximately three years. We did not include any added state or private funds because they were not included in the ARRA evaluation; previous evaluations, however, have found large leverage. Based on experience under ARRA, we estimate that this SEP funding should result in saving more than $4 billion in energy and 30 million tons of reduced CO_2 emissions (equivalent to the emissions of 7 million cars and light trucks for a year); see table 8. However, the savings vary by orders of magnitude for different fund uses and thus would depend on how states choose to use the money. The ARRA evaluation found that the greatest savings per dollar by far was for work on building energy codes.

Work under SEP and the resulting energy savings would create 27,000 net job-years over the first three years, and almost 50,000 total lifecycle job-years, including additional jobs created due to the long-term energy savings. Figure 8 shows the net added jobs by year through 2030.

Table 8. Cumulative impacts from State Energy Program investment

	Federal investment (PV $billion)	Jobs created 2020–23	Total jobs created	CO_2 emissions avoided (MMT)	Energy cost savings (PV $billion)
State Energy Program	2.7	27,196	48,577	32	4.5

Investment in the table is shown in present value, but in the text it is in cumulative nominal dollars.

ENERGY EFFICIENCY AND CONSERVATION BLOCK GRANTS

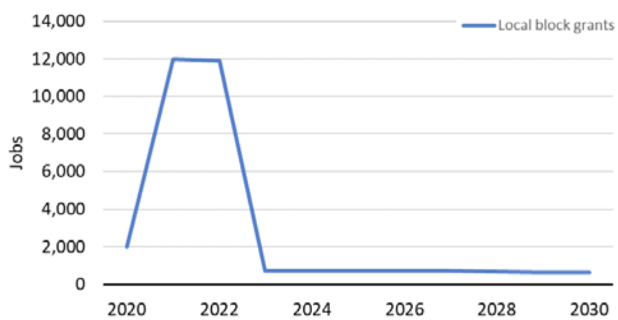


Figure 9. Net jobs from EECBG

Description

The Energy Efficiency and Conservation Block Grants (EECBG) Program provides grants and technical assistance to local governments and states for energy efficiency and renewable energy projects. EECBG funding was first offered as a one-time program through the 2009 ARRA stimulus. A revived EECBG Program will create jobs focused on implementing and managing clean energy projects, as well as longer-term initiatives to build community engagement, workforce skills, and other local priorities for ongoing deployment of clean energy at the local level. EECBG funding will support efforts such as energy efficiency retrofits, street and traffic lighting upgrades, financial incentives, building design, renewable and distributed energy projects, and related program and policy development.

During the Great Recession, DOE used its existing grant structure to quickly move EECBG funds to states for allocation to local communities. The program produced a net gain of more than 62,000 job years and increased community engagement with DOE's ongoing programs to support workforce development and clean energy projects (DNV GL 2015a).

Impacts

We modeled $2.7 billion in funding for EECBG over approximately three years. Assuming that cities built the capacity and expertise to implement more effective programs under ARRA, we estimate that this EECBG funding would result in saving more than $3 billion in energy and reducing CO_2 emissions by almost 20 million tons (equivalent to the emissions of 4 million cars and light trucks for a year); see table 9. However, the savings vary widely for different uses of the funds and would thus depend on how states and local governments choose to use the money.

As figure 9 shows, work under EECBG and the resulting energy savings would create almost 27,000 net job-years over the first three years, and more than 31,000 total lifecycle job-years, including those resulting from the long-term energy savings.

Table 9. Cumulative impacts from EECBG Program investment

	Federal investment (PV $billion)	Jobs created 2020–23	Total jobs created	CO_2 emissions avoided (MMT)	Energy cost savings (PV $billion)
Local block grants	2.4	26,580	31,241	19	3.4

Investment in the table is shown in present value, but in the text it is in cumulative nominal dollars.

SMALL BUSINESS ENERGY EFFICIENCY GRANT PROGRAM

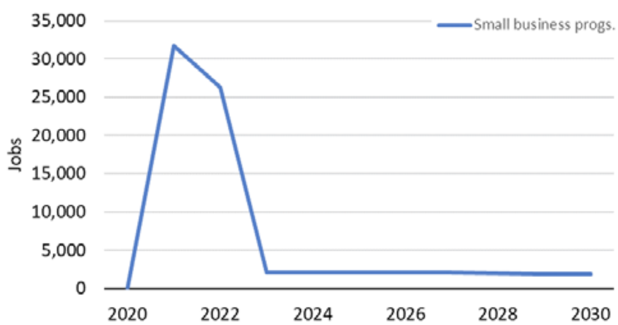


Figure 10. Net jobs from the small business program

Description

The COVID-19 crisis has been particularly devastating for small businesses, including the electricians, contractors, and other workers who deliver energy programs. The Small Business Energy Efficiency Grant (SBEEG) Program would provide small businesses with federal funding that would supplement utility incentives to make energy efficiency improvements to their properties. Grant funding from this new two-year program is intended to reduce customer contributions to energy efficiency projects to $0, making it easy for customers to say "yes" to program outreach. Grants would be administered through DOE to qualifying electric and natural gas utilities, demand-side management (DSM) program administrators, and city and state agencies that administer small business programs.

By operating through existing utility DSM program channels, this program will make federal funds available to flow immediately to customers upon receipt, helping to alleviate the economic impacts of COVID-19. Three-quarters of U.S. utilities—representing all 50 states—currently offer DSM programs, employing a vast network of small businesses and contractors to deliver energy efficiency to their customers (Berg et al. 2019, Reott 2020). These programs are typically funded either through a surcharge on utility customers' bills or by inclusion in the utilities' rate base, and they are subject to cost-effectiveness requirements, quality control, and energy savings performance targets.

Impacts

We project that the proposed $6 billion SBEEG Program would mostly protect qualifying small business programs from cuts over the next two years by filling in for customer investments. As table 10 shows, it would thereby prevent a possible reduction of $5 billion in energy efficiency project spending, delivering $6 billion in energy bill savings. This investment would save about 60,000 GWh of electricity and 320 TBtu of natural gas over the lifetime of the measures and reduce CO_2 emissions by 40 million tons. Those electricity savings are roughly equivalent to the annual electricity consumption of 5 million U.S. homes, and the avoided emissions are equivalent to the emissions of 9 million cars and light trucks for a year. Up to 10% of the federal grants could be used to offset utility program administration costs, which could be redirected toward incentives or returned to ratepayers.

Moreover, these improvements would help put our nation's energy efficiency workforce back to work supporting one of the segments of the economy hardest hit by COVID-19. As of early June, one in five small businesses remained closed, and 29% report having fewer employees now than in February (U.S. Chamber of Commerce and MetLife 2020). Many utility programs have also had to stop work. We estimate that this program would preserve 60,000 net job-years over the first three years, and 31,000 total lifecycle job-years, with a net loss of some jobs in later years when paying for the program. Figure 10 shows the net added jobs by year through 2030.

Table 10. Cumulative impacts from Small Business Energy Efficiency Grant (SBEEG) investment

	Federal investment (PV $billion)	Jobs created 2020–23	Total jobs created	CO_2 emissions avoided (MMT)	Energy cost savings (PV $billion)
Small business progs.	5.6	60,129	43,676	40	6.2

Investment in the table is shown in present value, but in the text it is in cumulative nominal dollars.

Combined Results

The investments we describe here create jobs, help consumers, and reduce GHG emissions. Tables 11 and 12 show the results for all the proposals; Appendix A offers more detailed results. The total federal investment is shown on the left in table 11, along with the added leveraged investment from private sources or from state or utility programs. In a few cases, the federal investment displaces other investment, as when tax incentives help pay for investments that would have been made anyway. Key long-term impacts are shown on the right, including the cumulative reduction in CO_2 emissions, the total energy cost savings, and selected financial nonenergy benefits such as reduced manufacturing costs and reduced healthcare costs.

Table 11. Cumulative impacts from the proposed investments

	Federal investment (PV $billion)	Other investment (PV $billion)	CO_2 emissions avoided (MMT)	Energy cost savings (PV $billion)	Nonenergy benefits (PV $billion)
Buildings					
LI weatherization	4.0	-	12	1.7	2.3

	Federal investment (PV $billion)	Other investment (PV $billion)	CO_2 emissions avoided (MMT)	Energy cost savings (PV $billion)	Nonenergy benefits (PV $billion)
LMI multifamily	6.5	2.0	54	8.9	6.9
HOPE for HOMES	4.7	6.3	58	9.6	-
Building incentives	20.2	8.4	340	53.3	-
Transportation					
EV incentives	31.0	−20.9	138	18.8	-
Transport CO_2 progs.	6.3	-	52	7.7	-
Industrial programs	1.1	4.9	186	13.5	28.5
Cross-cutting					
State Energy Program	2.7	-	32	4.5	-
Local block grants	2.4	-	19	3.4	-
Small business progs.	5.6	−0.6	40	6.2	-
Total	**83.5**	**−1.6**	**906**	**123.3**	**37.6**

We removed overlap between HOPE for HOMES and the tax credit for home improvements from the totals. We analyzed only selected nonenergy benefits for some of the investments.

Table 12. Estimated net job creation (thousand full-time-equivalent job-years)

	2020–23	2024–30	2031–	Total
Buildings				
LI weatherization	30	12	−28	14
LMI multifamily	70	56	−28	98
HOPE for HOMES	42	43	0	85
Building incentives	235	201	131	567
Transportation				
EV incentives	40	285	−107	219
Transport CO_2 progs.	89	83	-10	161
Industrial programs	43	16	7	66
Cross-cutting				
State Energy Program	27	5	16	49
Local block grants	27	5	-0	31
Small business progs.	60	14	−30	44
Total	**662**	**721**	**−50**	**1,333**

We removed overlap between HOPE for HOMES and the tax credit for home improvements from the totals.

The largest estimated impacts—and investments—are for tax incentives for efficiency improvements to commercial buildings and existing homes, along with those for electric cars and light trucks. These incentives can achieve rapid market impacts because, unlike limited grant programs, the tax breaks are available to all and because they build on current policies. However, the uptake and effects of these incentives are hard to predict (and can even be hard to determine in retrospect). Other proposals with large impacts include subsidized industry loans, retrofitting affordable apartments, rebates for other home retrofits, and transportation carbon reduction programs.

The largest impacts per federal dollar are for proposals that leverage significant private investments, including the industrial loans and the commercial buildings tax deduction. On the other hand, some proposed spending helps pay for investments that would have happened anyway; an example here is the expansion of the EV tax credit, much of which would support the already growing EV market. The proposed aid to small businesses is designed to substitute for both the investments the businesses would have made (if the economy were stronger) and a portion of utility spending to help those utility programs grow.

Expanding WAP and supporting retrofits for affordable apartments is particularly helpful for low-income families and communities of color, which have been most affected by the current pandemic and economic recession. Improving their homes not only reduces their monthly expenses, but also provides important health benefits.

The combined result of these investments would be significant. For a total of about $80 billion in investments, we estimate more than 900 million tons of CO_2 emission reductions. We also estimate cumulative energy savings of almost 20 quadrillion Btu, worth more than $120 billion (present value). We also quantified close to $40 billion in financial benefits other than energy savings, but we did not count all of them. We also did not count significant long-term benefits in advancing technologies and practices, reducing costs, and developing markets for key decarbonization tools—especially deep energy retrofits of homes and commercial buildings, EVs, and industrial energy management.

Figure 11 shows the creation of jobs over a longer time period than the previous figures, along with the total added investment and energy cost savings. Table 12 shows the jobs by investment. The investments themselves create jobs in the first few years due to the construction and manufacturing needed to implement the measures. In later years, multiple competing effects arise. The energy savings result in net added jobs as economic activity shifts from the energy sector, which requires relatively few workers, to more job-intensive sectors in which the energy savings are spent. We simultaneously assume that the debt that financed the government investment and part of the leveraged investment is paid back, resulting in fewer jobs.

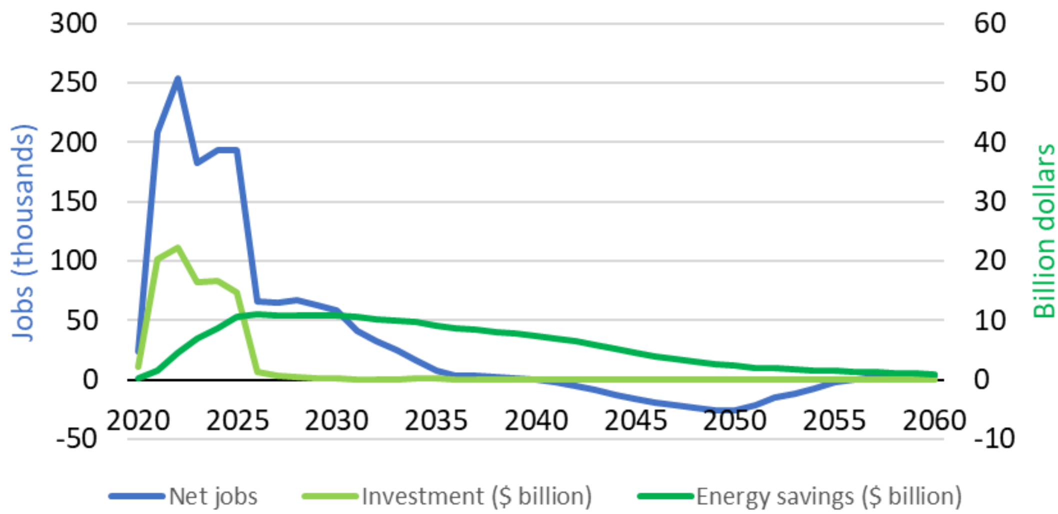


Figure 11. Net added jobs by year, compared to total investment and energy bill savings

Compared to other recent studies, we assume smaller investments and find somewhat fewer resulting jobs. E2, E4TheFuture, and BW Research Partnership (2020) found a total of 3.7 million job-years from a similar level of federal investments in buildings and industry, but with much larger private leverage. Their analysis also did not assume that the cost of investments would be paid back over time, did not consider the energy savings, and did not analyze specific investments. The Political Economy Research Institute at the University of Massachusetts, Amherst, analyzed a much larger efficiency investment totaling $500 billion in federal funds and an equal private match (Pollin and Chakraborty 2020). It found a total of 7.3 million job-years from building retrofits, industrial efficiency, and high-efficiency autos. The study's job-years per total investment were less than half of what we found, but the methodology used to determine that result is not clear.

Conclusions

Pumping money into the economy in job-intensive sectors such as construction will create jobs, regardless of the kind of investment. But paying back that investment (or exceeding prudent borrowing levels) will cost jobs in the long term. In contrast, energy efficiency investments create additional long-term jobs and economic growth through the investment of energy savings that typically more than pay back the initial investment. The energy savings also reduce GHG emissions and air pollution, help consumers and businesses financially, and, when targeted, can benefit the health and finances of low-income families.

The investments we discuss here make sense as stimulus, with the potential to create 660,000 added job-years over the next three years. They make sense as investments in a green economy, with the potential to avoid more than 900 million tons of CO_2 emissions. And they make sense for American consumers and businesses, for whom they could save more than $120 billion.

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Appendix A: Detailed Results

We removed overlap between HOPE for HOMES and the tax credit for home improvements from the totals in all the tables; as a result, the totals are not exactly the sum of the investments.

Table A1. Estimated energy savings and carbon abatement from the proposed investments for the year 2025

	Electricity (TWh)	Natural gas (Tbtu)	Oil (mbd)	Total energy (quads)	CO_2 emissions (MMT)
LI weatherization	0.7	5	—	0.01	0.5
LMI multifamily	6.3	17	—	0.08	3.1
HOPE for HOMES	4.4	21	0.00	0.07	2.8
Home improve. credit	12.6	54	—	0.18	7.4
New home credit	1.7	12	—	0.03	1.2
Comm. bldg. deduction	18.5	28	—	0.20	7.9
Passenger EV credit	−2.2	—	0.02	0.03	2.3
EV truck credit	−0.4	—	0.00	0.00	0.1
EV charger credit	—	—	—	—	—
Transport CO_2 progs.	−0.0	—	0.03	0.07	4.6
Large plant audits	3.0	24	—	0.05	2.4
Plant energy managers	1.2	9	—	0.02	0.9
Industrial loans	10.1	81	—	0.18	8.1
Industry supply chains	0.2	2	—	0.00	0.2
State Energy Program	1.9	4	0.00	0.02	0.9
Local block grants	2.0	3	0.00	0.02	0.8
Small business progs.	4.8	25	—	0.07	3.1
Total	**48.8**	**176**	**0.04**	**0.75**	**33.5**

Table A2. Estimated cumulative energy savings and carbon abatement from the proposed investments

	Electricity (TWh)	Natural gas (Tbtu)	Oil (mbd)	Total energy (quads)	CO_2 emissions (MMT)
LI weatherization	17	114	—	0.26	12
LMI multifamily	112	305	—	1.34	54
HOPE for HOMES	95	448	0.01	1.33	58
Home improve. credit	218	939	—	3.00	127
New home credit	63	439	—	0.87	40
Comm. bldg. deduction	471	722	—	4.46	174

	Electricity (TWh)	Natural gas (Tbtu)	Oil (mbd)	Total energy (quads)	CO_2 emissions (MMT)
Passenger EV credit	−126	—	0.37	1.47	135
EV truck credit	−9	—	0.01	0.00	3
EV charger credit	—	—	—	—	—
Transport CO_2 progs.	−1	—	0.11	0.77	52
Large plant audits	51	405	—	0.91	40
Plant energy managers	22	174	—	0.39	17
Industrial loans	157	1,255	—	2.81	125
Industry supply chains	4	30	—	0.07	3
State Energy Program	73	149	0.00	0.78	32
Local block grants	46	63	0.00	0.48	19
Small business progs.	62	324	—	0.93	40
Total	**48.8**	**176**	**0.04**	**0.75**	**33.5**

Table A3. Estimated cumulative present value investments and savings ($ billion)

	Federal investment	State/prog. Investment	Consumer investment	Energy bill savings	Nonenergy benefits
LI weatherization	4.0	—	—	1.7	2.3
LMI multifamily	6.5	0.5	1.6	8.9	6.9
HOPE for HOMES	4.7	0.4	6.0	9.6	—
Home improve. credit	14.4	—	0.3	22.4	—
New home credit	2.5	—	−0.5	5.0	—
Comm. bldg. deduction	3.3	—	8.5	25.9	—
Passenger EV credit	29.0	—	−22.9	18.5	—
EV truck credit	0.2	—	0.3	0.3	—
EV charger credit	1.8	—	1.8	—	—
Transport CO_2 progs.	6.3	—	—	7.7	—
Large plant audits	0.4	—	0.9	2.9	6.1
Plant energy managers	0.2	—	0.4	1.2	2.6
Industrial loans	0.5	—	3.5	9.1	19.3
Industry supply chains	0.1	—	0.1	0.2	0.5
State Energy Program	2.7	—	—	4.5	—
Local block grants	2.4	—	—	3.4	—
Small business progs.	5.6	1.8	−2.3	6.2	—

	Federal investment	State/prog. Investment	Consumer investment	Energy bill savings	Nonenergy benefits
Total	74.7	0.6	–3.4	98.2	19.1

Table A4. Estimated net job creation (full-time equivalent job-years)

	2020–23	2024–30	2031–	Total
LI weatherization	30,019	12,328	–28,439	13,907
LMI multifamily	69,818	56,461	–28,139	98,140
HOPE for HOMES	41,674	43,009	162	84,844
Home improve. credit	157,002	65,867	–27,165	195,704
New home credit	9,448	26,615	20,486	56,550
Comm. bldg. deduction	68,350	108,539	138,091	314,980
Passenger EV credit	21,388	285,687	–88,313	218,762
EV truck credit	652	–752	2,423	2,323
EV charger credit	18,432	530	–21,513	–2,551
Transport CO_2 progs.	88,537	82,915	–10,088	161,364
Large plant audits	6,908	5,857	236	13,002
Plant energy managers	3,535	2,284	256	6,075
Industrial loans	31,555	6,984	7,100	45,639
Industry supply chains	894	536	–489	942
State Energy Program	27,196	5,418	15,963	48,577
Local block grants	26,580	4,701	–41	31,241
Small business progs.	60,129	14,007	–30,460	43,676
Total	**662,116**	**720,988**	**–49,930**	**1,333,174**

Appendix B: Detailed Assumptions and Methodology

In this appendix, we briefly describe the methodology and key assumptions used in our impact estimates. We discuss the cost and savings estimates for individual measures below; because there is little overlap, we assume the estimates are additive in the packages (with one exception, as indicated).

We estimate the most likely impact of implementing the proposals compared to a baseline if the proposals are not enacted (assuming the administration tries to implement the proposals). Thus, the relevant federal and consumer investment is only the increase compared to what each would have spent in the baseline case. We calculate impacts for measures by year, and we assume the implementation would start in late 2020 or early 2021; the cumulative and cost-benefit numbers include savings through the lifetimes of those measures and financing as late as 2080 (though the savings and costs are fairly insignificant after 2050). We generally assume only half a year's savings on average in the year a measure is implemented, as the measures are spread over the year.

We include a rebound effect of 10% for residential and light-duty vehicle savings, 8% for heavy-duty vehicle savings, and 5% for commercial and industrial savings (except for the transportation CO_2 programs, for which we assume that any rebound is already included in the savings estimates); for the shift to electric vehicles (EVs), we base the rebound on the fuel cost savings (Nadel and Ungar 2019).

Energy prices by fuel, sector, and year, the carbon intensity by fuel and in some cases by year, and some baseline projections are taken from the Annual Energy Outlook (AEO) 2020 reference case (EIA 2020). We calculate present values using a real discount rate of 5%. The costs in some cases are financed (see details below). All monetary impacts are in constant 2019 dollars.

Because the 25C tax credit and HOMES rebates are alternate ways of supporting home energy upgrades, when summing total investments and savings for the combined investments, we reduced the projected total 25C investment by 26% of the HOMES investment (roughly two-thirds of the investments that receive partial rebates) to account for people who would take the rebates instead of the tax credit.

For several of the proposals, we had very limited data on which to base our assumptions. We therefore had to rely on our own expert judgment, along with that of other ACEEE staff and the reviewers. We previously analyzed a handful of the programs (Ungar 2018); although the overall methodology is similar, we assumed different funding amounts and completely revised the analyses.

We discuss the assumptions for specific provisions below; the methodology for estimating macroeconomic impacts is in Appendix C.

WEATHERIZATION ASSISTANCE PROGRAM (WAP)

Federal funding. We assume that a $5 billion nominal appropriation would be spent in 2020–25. This is the same as ARRA funding, but it is longer than the three-year ARRA program to allow for a smoother ramp-up and more sustainable growth in program activities.

Leverage. Previous evaluations have found a more than 2.5:1 leverage of state and private funding for regular WAP appropriations. However, the total leveraged amount stayed the same during ARRA (ORNL 2015), so we assume no additional leverage.

Administrative costs. Based on the WAP evaluation, typical federal administrative costs are 10%. We include 3.5% in federal administrative cost to reflect the larger overall annual federal funding amount. State and local program administrative costs are 10% of grant funds per WAP regulations.

Energy savings. Based on increases in the allowed average cost per project and adoption of enhanced quality control/assurance standards, we assume increased spending and savings per home relative to the ARRA period. We assume average electricity savings of 12% and natural gas savings of 24% of the total home energy use (assumed to be the average home energy use projected in the AEO), with an average cost of $6,250 per home.

Savings lifetime. Based on the ARRA evaluation, we assume an average 20-year lifetime for measures and a straight-line decay of savings.

Nonenergy benefits. We include only financial benefits in the first two tiers of certainty from the WAP evaluation; we do not include reduced food assistance, which will just transfer some of the savings to the governments. We obtained $526 per home per year in 2019 dollars, all lasting for 10 years, mostly from reduced asthma and better compliance with prescriptions.

WEATHERIZE LOW- AND MODERATE-INCOME MULTIFAMILY HOUSING

Federal funding. Our multifamily federal spending estimates are based on federal grants of $4,500 to half a million public housing units (about half of the stock) and $3,000 to Housing Finance Agencies (HFAs) for work on 1.7 million other low- and moderate-income units, for a total of $8.3 billion over five years.

Leverage. We estimate that half of the HFA funding will be matched by nonfederal spending, with most (80%) from building owners and the rest from energy service companies and other financiers. The remaining 20% of the assumed match will come from utility energy efficiency programs and state and local governments.

Administrative costs. We assume that 2% of the federal funding will go to federal administrative costs and that 8% of the state match will go to state administrative costs.

Financing. Of the building owner match, 50% is financed in commercial loans (15 years at 2% above 10-year Treasury rates) and another 45% is financed using energy savings performance contracts (25 years at 2.5% above 10-year Treasury rates).

Energy savings. We estimate that these funds will be spent on energy efficiency investments with an average 10-year simple payback period; we further estimate that 83.5% of the energy cost savings will be in electricity and the rest in fuels (EIA 2018a, based on data for buildings with five units or more).

Nonenergy benefits. In addition to direct energy savings, we add nonenergy benefits of 71% of the energy cost savings, largely due to reduced maintenance and replacement, based on work by Cluett and Amann (2015).

Savings lifetime. Measures have an average life of 15 years with straight-line decay, balancing long-lived measures such as new heating systems with shorter-lived measures such as hot water and lighting improvements.

HOPE FOR HOMES

Federal funding. We assume that a $6.5 billion nominal appropriation would be spent in 2020–25 with $500 million allocated to HOPE training and $6 billion to the HOMES rebate program as included in the House and Senate bill language.

Leverage. We assume consumer spending for the projects would be 148% of the amount of the rebates, based on estimated project costs.

Financing. We assume 25% of consumer costs are financed in mortgages (30 years at 2% above 10-year Treasury rates).

Administrative costs. We include 10% added federal administrative costs. State costs are included in the grant amounts for state-administered performance rebates and HOPE training and certification.

Energy savings. Savings vary by project types. Based on data from retrofit projects and programs including utility prescriptive programs, Home Performance with ENERGY STAR®, and weatherization, we developed savings assumptions for each of the four retrofit categories. We added a small savings increase of 2–3% per project to reflect improved contractor performance and savings associated with the HOPE training and certification requirements for participation in the HOMES rebate program. Table B1 summarizes energy savings and project cost assumptions for each.

Table B1. Estimated savings and costs for different types of HOMES rebates

Rebate category	Average whole-home energy savings per project (%)	Average project costs	Notes
Partial rebates			
Insulation + air sealing	14%	$2,150	
Insulation + air sealing and HVAC	25%	$5,850	Requires ENERGY STAR Most Efficient equipment and duct sealing
Performance rebates (based on modeled or measured savings)			
20+% savings	28%	$6,000	
40+% savings	42%	$15,000	

Savings lifetime. Based on measure lifetime estimates commonly used for residential retrofit programs, we assume an average measure life of 18.6 years with a straight-line decay of savings.

BUILDING EFFICIENCY TAX INCENTIVES

We modeled impacts of each of the three incentives in different ways. In all cases, we assume that the tax credits are effective in the last quarter of 2020 through the end of 2025.

25C tax credit for home improvements

Sales, federal cost, and leverage. We base our estimates of market uptake and federal cost on data compiled by GAO (2012) for the ARRA and pre-ARRA periods along with the Joint Committee on Taxation score for the provision in H.R. 2 (JCT 2020). We assume the incremental cost of the qualifying products compared to what people would have bought (if anything) is 120% of the federal spending while the incentive is doubled and 200% afterward. We further assume that 25% of purchases would be by "free riders" who would have bought the efficient products without the credit.

Financing. We assume 10% of consumer costs would be financed by mortgages (see above for terms).

Administrative costs. We include 1% federal administrative cost.

Energy savings. We assume a simple payback of six years and that electricity would account for 74% of the energy cost savings, with the balance being natural gas, based on average energy expenditures (EIA 2018a).

Savings lifetime. We assume a 15-year average measure life with straight-line decay of savings.

45L tax credit for new homes

Sales, federal cost, and leverage. We conducted a bottom-up analysis based on projected housing starts from the National Association of Home Builders (NAHB); ACEEE estimates of the proportion of new homes that would participate (starting at 10% and gradually increasing to 25% in the final year); free riders (starting at 75% and declining to 25%); incremental costs for ENERGY STAR and zero energy ready homes (assumed to be $3,415 on average); and tax incentive amounts in the Home Energy Savings Act ($2,500). NAHB estimates about 1.3–1.4 million new homes per year; we thus estimate that about 1.2 million new homes would qualify for the credit over the 2021–2025 period, with 0.7 million of those doing so because of the credit.

Financing. We assume that 90% of consumer costs would be financed by mortgages (see above for terms).

Administrative costs. We include a 1% federal administrative cost.

Energy savings. We assume average incremental annual savings per home of 3,572 kWh of electricity and 249 CCF of natural gas. These estimates were derived from data underlying the Perry 2019 analysis.

Savings lifetime. We assume a 30-year average measure life with straight-line decay of savings.

179D tax deduction for commercial buildings

Sales, federal cost, and leverage. We used the "strengthen and modernize" scenario in an analysis by REMI (2017) for federal spending, based on a Joint Committee on Taxation score. The one big change is that we assume that the tax incentives start in 2020, not 2017, but we do not adjust for inflation. We assume private spending would be four times the federal spending (this estimate of added spending is lower than REMI's estimate of qualifying spending), and we assume 25% free riders.

Financing. We assume 40% of consumer costs would be financed at commercial rates (see above).

Administrative costs. We include a 1% federal administrative cost.

Energy savings. We assume that electricity would account for 82% of the energy cost savings (based on expenditures in EIA 2016), with a simple payback of five years, and that the balance would be natural gas with a simple payback of 10 years.

Savings lifetime. We assume a 22-year average measure life with straight-line decay of savings.

ELECTRIC VEHICLE TAX CREDITS

In general, we assume no net increase in the total number of light-, medium-, or heavy-duty vehicles on the road from these policies, only switches from conventional gasoline or diesel vehicles to plug-in EVs. We assume a 17.5-year average life for light-duty vehicles and a 22.5-year life for medium- and heavy-duty vehicles, with a five-year decay of savings (EIA 2018b).

Light-Duty Tax Credit

Sales. The federal cost is based on the expected increase in plug-in hybrid (PHEVs) and fully electric vehicles (BEVs) as a percentage of total vehicle sales. We assume that BEVs receive the full $7,000, while PHEVs receive $4,500, on average (fueleconomy.gov 2020). We first constructed a baseline of EV sales through 2030 that was reasonably ambitious given the improving economics of EVs and the policy efforts to support them, with combined sales rising to almost 4 million vehicles in 2030. We chose to use Energy Innovation's baseline from its Policy Simulator tool as it provided a reasonable middle-ground estimate compared to other private and public forecasters (Energy Innovation 2020; Cooper and Schefter 2018). We also used the breakdown of BEVs vs. PHEVs from the Policy Simulator but supplemented it with EIA's *2020 Annual Energy Outlook* to get the car vs. light truck breakdown, and we analyzed each category separately for price and energy usage (EIA 2020). We also used information collected by the Edison Electric Institute (Cooper and Schefter 2018) on automakers' EV sales plans to estimate when automakers might reach their tax credit caps.

Our projected sales impact estimate for the tax credit is based on the projected costs of EVs and elasticities from the literature. For the four vehicle categories analyzed (car PHEVs, light truck PHEVs, car BEVs, and light truck BEVs), we used the sales price of a representative model for our estimate, chosen based on an average sales price and sales figures, finding an initial premium of $8,000 and $10,000 for the PHEVs and $12,000 for the EVs. EVs, however, are rapidly decreasing in cost as they proliferate and as battery manufacturing, in particular, improves. Therefore, we reduce the inflation-adjusted price of these vehicles over time to be close to cost-parity by 2028 (20% of initial cost difference would remain) based on an estimate by the International Council on Clean Transportation (Lutsey and Nicholas 2019). For elasticities, we use an EV-specific elasticity of –1.8 (Jack Faucett Associates 2015) applied to the full purchase price of the vehicles.

Financing. We assume that 70% of the purchase cost is financed for five years at an interest rate 2.5% above AEO's projection for the 10-year Treasury rate.

Energy Impacts. We used vehicle type-specific estimates of gasoline saved by replacing a conventional car with an EV—as well as the amount of electricity that an EV uses—for all four vehicle categories. For electricity, we assume a car BEV uses 3,000 kWh a year, a light truck uses double that, and the PHEV versions use 60% of those values (EPRI 2018). For PHEVs, this assumes that 40% of their miles traveled use gas and that there is no net energy change for that portion. For the gasoline usage of the conventional cars that are replaced, we use representative conventional vehicles (532 and 767 gallons a year) and assume that their gasoline usage is reduced by only 60% when they are replaced by PHEVs.

Medium- and Heavy-Duty Tax Credit

Sales. The sources and methodology used to estimate the impact of the tax credit for medium- and heavy-duty vehicles are similar to those used in the light-duty analysis. Once again, we use Energy Innovation's baseline for BEVs and fuel cell vehicles over 14,000 pounds. We differentiate between medium- and heavy-duty vehicles for our analysis and use separate costs for each (CARB 2019). Baseline sales are relatively modest, rising to nearly 140,000 medium-duty and 7,000 heavy-duty vehicles in 2030; added cost is $17,000 and $110,000, respectively, and remains constant. We also use an elasticity from the literature (–1) and apply it to the cost differential between a conventional truck and a battery electric truck and the tax credit's monetary value (NHTSA 2010). We then estimate the cost to the federal government based on the overall qualifying sales figures and the 10% tax credit multiplied by the average price of the electric trucks.

Financing. The assumptions here are the same as for light-duty vehicles above.

Energy Impacts. We use the electricity usage of lighter trucks and heavier trucks and the gasoline saved from conventional trucks to estimate our energy and emissions savings. Electricity usage (11,863 and 183,333 kWh/year) also comes from the California Air Resources Board (CARB 2019), while gasoline and diesel usage (828 and 10,683 gallons/year) are taken from a representative commercial truck and an average for long-haul trucks (AFDC 2020).

EVSE Tax Credit

Sales. Given that the tax credit differentiates between public and private (nonresidential) charging stations, we built a baseline of charging stations out to 2030. We use data from DOE to extrapolate growth based on historical trends (AFDC 2019), with sales rising by an order of magnitude to more than one million chargers in 2030. We also supplement these data, which combine public and private stations, with additional data suggesting that 90% of these stations are public (EVAdoption 2020). We assume a uniform average cost for public stations of $10,000, taken from a DOE report (for a Level 2 charger), and apply a 25% discount to private stations to account for lower administrative and compliance costs on private property (Castellano and Smith 2015). We use a cost of capital elasticity of –1 derived from the literature (Gilchrist and Zakrajšek 2007; Dwenger 2013) and apply the tax credit value (50% and 30% of the cost) to estimate the increase in sales above the baseline.

Financing. The assumptions here are the same as for the 179D commercial building deduction above.

Energy Impacts. We assume that there is no net change in energy use from this tax credit as the energy savings are already included in the two vehicle tax credit estimates. Some electricity usage at the added charging stations would likely replace electricity usage at the driver's residence.

TRANSPORTATION CARBON POLLUTION REDUCTION PROGRAM

Federal funding. We assume a total of $8.35 billion (nominal) spread over 2022–2025 based on the transportation bill that the House passed as part of the Moving Forward Act (HR 2).

Leverage. We did not assume any added funding.

Administrative costs. We assume 5% federal administrative costs.

Energy savings. The two main assumptions in our estimate are the projects that the Carbon Pollution Reduction Program would fund and the emissions reductions that would result. In our calculations, we use information produced to support the Transportation and Climate Initiative (TCI) currently being developed by 12 northeast states and Washington, DC. Under the TCI, revenues generated by transportation taxes and fees are reinvested in transportation efficiency programs. The Georgetown Climate Center and Cambridge Systematics produced a report on the potential emissions and economic impact of the TCI. Given the similarities between the investment programs of the TCI and the Carbon Pollution Reduction Program, we use the assumptions of the Georgetown report for our estimate.

We assume the same breakdown by project type as the TCI report, except that we exclude investments in EV charging infrastructure, as the impacts of those investments are assessed separately. Our breakdown directs almost a third of the money to public transit, with large amounts going to systems operations efficiency and freight intermodality, as well. Smaller amounts—less than 15% each—go to land use and smart growth, active transportation, and travel demand management programs (Cambridge Systematics 2015). Each of these six project types has a different emissions impact per million dollars of investment, and we use these impacts to estimate emissions reductions. We also supplement the TCI report with separate data to allocate the energy use from transit to electricity, for freight to diesel, and for other measures to gasoline (Filosa, Poe, and Sarna 2017).

Savings lifetime. We assume a 40-year lifetime for the four capital investment projects and one-year impacts for the systems efficiency and demand response programs, as they reduce emissions by changing behavior, which is a short-lived result (Cambridge Systematics 2015).

INDUSTRIAL PROGRAMS

Most of our assumptions were the same for all of the proposed industrial investments as follows.

Energy savings. We assume the investments are split equally between natural gas and electricity savings, with natural gas saved at a levelized cost of saved energy of $2.50/MMBtu and electricity saved at $0.02 per kWh, using a real discount rate of 5% and the savings persistence described below. We back out the incremental annual electricity and natural gas savings per dollar of investment. These assumptions apply to all proposals except the supply chain program, for which we estimate the savings at half this rate, as noted in the text. Any free riders are offset through free driver/spillover based on past evaluations of industrial programs (Mosenthal et al 2014).

Savings lifetime. Based on past assessment of industrial energy efficiency, we assume a 13-year average measure life with straight-line decay of savings.

Nonenergy benefits. We assume that investments in energy efficiency produce, in addition to the energy savings, financial benefits to the companies of twice the monetary savings from energy efficiency.

Administrative costs. We assume 7% federal administrative costs, except 5% of the loan value for that program.

Energy Audits and Technical Assistance for Large Manufacturing

Federal funding. We assume a total of $500 million, spread equally over 2021–25.

Leverage. We assume that the private sector investments would be 2.5 times the federal program funding. Because of lead time at plants for making investments, we assume that half of the private sector investment would lag by one year.

Financing. Of the private match, 50% is financed for seven years at 2.5% above the 10-year treasury rate.

Hiring of Plant Energy Managers

Federal funding. We assume a total of $225 million, spread equally over 2021–23, or enough for about 1,300 energy managers.

Leverage. The program requires an equal private-sector match. Because the energy manager produces operating savings, we assume this cost is not financed.

Loans for Energy Efficiency Work to Small and Medium-Size Businesses

Federal funding. In addition to the administrative cost, we assume a federal subsidy at the time of loan origination equal to the difference between the loan amount and the present value of the subsidized loan (at a discount rate equal to the interest rate of the industrial loans used for the audits).

Leverage. We assume $5 billion in subsidized loans, spread equally over 2021–25.

Financing. The loans are for seven years at 0.5% above the 10-year treasury rate.

Agile and Resilient Domestic Supply Chains

Federal funding. We assume a total of $100 million over five years, with $20 million going toward research and technical assistance in 2021–25, and $80 million going toward grants made in 2022–25.

Leverage. We assume that the private-sector investments would be two times the federal program funding.

Financing. Of the private match, 50% is financed for seven years at 2.5% above the 10-year treasury rate.

Note: We model this program's impacts as investments in domestic capacity replacing existing capabilities. In reality, we expect that a significant portion of this capability would be used to onshore overseas suppliers, which would create new U.S. manufacturing jobs and economic activity, so the jobs results presented here are conservative.

STATE ENERGY PROGRAM (SEP)

Federal funding. We assume that a $3.1 billion nominal appropriation (based on ARRA funding) would be spent in 2020–23.

Leverage. Although previous evaluations have found a more than 10:1 leverage of state and private funding for regular SEP appropriations, the ARRA evaluation (DNV GL 2015b) estimated savings attributed to federal funding. Thus, we do not include leverage (or financing) here.

Administrative costs. We do not include added federal administrative costs. State costs are included in the grant amounts.

Energy savings. Based on the ARRA evaluation, we assume cumulative savings of 25 GWh of electricity, 51,000 MMBtu of natural gas, 1,000 MMBtu of propane, and 59,000 gallons of oil per million dollars of investment.

Savings lifetime. Based on the ARRA evaluation, we assume five-year linear growth in savings, 20 years at peak savings, and 13-year linear decay.

ENERGY EFFICIENCY AND CONSERVATION BLOCK GRANTS PROGRAM (EECBG)

Federal funding. We assume that a $2.7 billion nominal appropriation (based on ARRA funding) would be spent in 2020–22.

Leverage. As this is a one-time grant program, we do not include leverage (or financing) here, although some local governments did leverage the federal funding during the ARRA program.

Administrative costs. We do not include added federal administrative costs. State costs are included in the grant amounts.

Energy savings. Based on the ARRA evaluation, but increasing the savings to account for local government learnings that will enable more effective programs, we assume cumulative savings of 18 GWh electricity and 25,000 MMBtu of natural gas per million dollars of investment.

Savings lifetime. Based on the ARRA evaluation, we assume 15 years of constant savings followed by a 15-year linear decay.

SMALL BUSINESS ENERGY EFFICIENCY GRANT (SBEEG) PROGRAM

Federal funding, leverage, and administrative costs. The proposal authorizes $6 billion through 2022. We estimate that utility electricity and natural gas efficiency programs spend about $2.5 billion and $0.2 billion each year, respectively, on small business companies (SBCs) as defined in this proposal. This assumes about $3.5 billion and $0.3 billion in total spending by commercial and industrial programs (CEE 2019, Gheewala 2020, including a portion of demand response programs), and that around 70% of all commercial and industrial funds support SBCs, either through targeted SBC programs (30% per the E Source Demand Insights Tool) or through SBC participation in larger programs (half of other programs, per comments from program implementers). We assume that 65% of electric program funds and 57% of gas program funds go toward customer incentives, with the balance covering program administrative costs (CEE 2019, Gheewala 2020). Utility incentives account for 39% of energy efficiency project spending, with SBCs currently covering the remaining 61%

(based on Hoffman et al. 2018 commercial and industrial overall numbers, with above administrative costs removed).

We further assume that, in the absence of this proposal, support for small business programs would drop by half to $1.4 billion, a conclusion we draw from the scale of small business closures due to the COVID-19 crisis and the projected timescale for them to recover. We assume that enough small businesses would be able to use the remaining funds by matching with their own $1.4 billion.

Under the proposal, we assume that the federal grants would fully cover what are currently customer costs and would also cover program administrative costs up to 10% of the grants (the proposal requires existing programs to continue to pay the same level of incentives). The saved administrative costs are either redirected to SBC incentives as described below or are returned to ratepayers. We expect that an additional 7.5% of federal funding will be used to cover DOE administrative costs.

In 2021, we assume that programs will not be able to expand but also will not contract as they do in the baseline. In 2022, we assume the remaining federal funds will cover only about 80% of qualifying programs at that level; we further assume that the remaining 20% of programs are cut in half as they are in the baseline.

Because these incentives will be distributed over the next two years, and because new utility programs require approval and set-up time, we do not anticipate significant savings originating from new programs. We also do not account for any new utility projects undertaken after 2022 that would not have occurred without the stimulus.

Table B2 shows the results.

Table B2. Estimated federal, program, and customer spending by year (million $2019)

	Measure investments			Program admin.		Federal admin.
	Program	Customer	Federal	Program	Federal	
2018	1,749	2,783		965		
Baseline	874	1,392		483		
2021	1,749		2,783	656	309	251
2022	1,569	286	2,212	621	246	199

Energy savings. Lifetime energy savings are calculated using savings and spending estimates for small business electricity and natural gas programs (Hoffman et al. 2018, Schiller et al. 2020), adjusted for measure rather than program spending, 2019 dollars, and the below lifetime. The result is an incremental (annual) savings of 2.1 GWh/$ million and 10,000 MMBtu/$ million, respectively.

Savings lifetime. We assume a 13-year lifetime (Hoffman et al. 2015).

Appendix C: Methodology of the Macroeconomic Model

To evaluate the macroeconomic impacts of energy efficiency policies, we use the proprietary Dynamic Energy Efficiency Policy Evaluation Routine model. The model, recently renamed DEEPER, has a 20-year history of use and development.

The DEEPER Modeling System is a quasi-dynamic input-output (I/O) model of the U.S. economy. I/O models use economic data to study the relationships among producers, suppliers, and consumers. They are often used to show how interactions among all three impact the macroeconomy. DEEPER draws on trade information from the IMPLAN Group LLC (IMPLAN 2015), energy use data from the AEO, and employment and labor data from the Bureau of Labor Statistics. Figure C1 shows a flow diagram of the model.

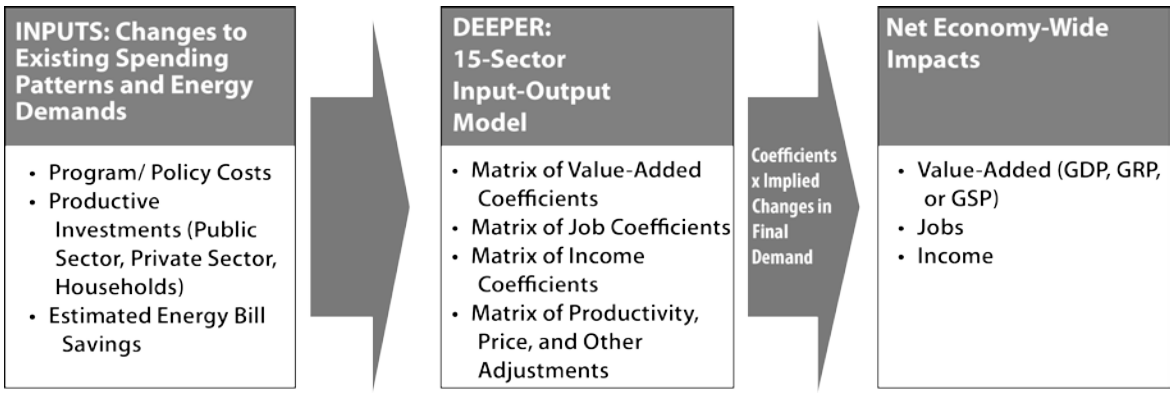

Figure C1. The DEEPER model

DEEPER results are driven by changes in demand for energy and other goods and services, as well as alternate investment patterns resulting from projected changes in policies and prices between baseline and policy scenarios. The inputs are changes in spending on efficiency measures and energy bills of residential, commercial, and industrial consumers, and of government; changes in program spending, revenue, and production of utilities; changes in investments in manufacturing, services, and multiple construction sectors; and changes in financial services. The end result is a net change between the reference and policy scenarios in jobs, income, and value added (the market value of all final goods and services), which is measured as gross domestic product (GDP).

Like all economic models, DEEPER has strengths and weaknesses. It is robust in comparison with some I/O models because it can account for price and quantity changes over time and is sensitive to shifts in investment flows. It also reflects sector-specific labor intensities across the U.S. economy. However, it is important to remember when interpreting results for the DEEPER model that the results rely heavily on the assumptions for individual policies, and like any prediction of the future, they are subject to uncertainty.

More details on the DEEPER model are available in previous papers (Young et al. 2013).

Besides the energy analysis results, a key input to DEEPER is the economic sectors in which the investments are made. Table D1 shows the basic sectors. Within those large sectors, we chose an appropriate subsector in each case, such as residential construction, light-duty vehicle manufacturing, and architecture and engineering.

Table D1. Allocation of investments by economic sector

	Construction	Manufacturing	Services
LI weatherization	32%	47%	21%
LMI multifamily	60%	25%	15%
HOPE for HOMES	42%	50%	8%
Home improve. credit	45%	45%	10%
New home credit	60%	20%	20%
Comm. bldg. deduction	60%	20%	20%
Passenger EV credit	0%	100%	0%
EV truck credit	0%	100%	0%
EV charger credit	50%	30%	20%
Transport CO_2 progs.	88%	0%	13%
Large plant audits	33%	33%	33%
Plant energy managers	0%	0%	100%
Industrial loans	50%	50%	0%
Industry supply chains	50%	50%	0%
State Energy Program	37%	62%	2%
Local block grants	38%	60%	2%
Small business progs.	50%	50%	0%