BUILD BACK BETTER, FASTER

How a federal stimulus focusing on clean energy can create millions of jobs and restart America's economy

© Dennis Schroeder/NREL

PRODUCED FOR:

E2

E4 THE FUTURE

IN PARTNERSHIP WITH:

[bw] RESEARCH PARTNERSHIP

TABLE OF CONTENTS

ACKNOWLEDGMENTS

Thank you to the American Council for an Energy-Efficient Economy (ACEEE) for reviewing our draft assumptions and methodology for the energy efficiency analysis.

Thank you to the GridWise Alliance for providing stimulus appropriations for the grid modernization analysis.

Thank you to the NRDC (Natural Resources Defense Council) for review of draft policy assumptions and methodology.

© Vestas

EXECUTIVE SUMMARY

The coronavirus (COVID-19) pandemic has caused millions of Americans—including as many as 620,500 clean energy workers—to lose their jobs over just a few months. E2 and E4TheFuture partnered with BW Research Partnership on this economic impact assessment to demonstrate the potential for creating jobs from federal stimulus investments in three major sectors of the clean energy economy: **Energy Efficiency**, **Renewable Energy**, and **Grid Modernization**.

These three sectors were selected specifically because of their proven track record of quick job creation from stimulus, ability to be conducted outdoors or in currently vacant buildings—with safety measures in place—in a pre-vaccine environment and are included in existing federal funding sources managed by the Department of Energy or other agencies. These projects have the added benefits of stimulating other segments of the economy, modernizing our energy systems and building stock, and improving health by reducing pollution including carbon emissions.

If Congress Directs
$99.2 BILLION
In federal stimulus, policy initiatives, and other investments

U.S. Workers Get
860,300
jobs for at least five years across every region and state (a total of 4.3 million job-years)

America's Economy Generates
$330 Billion
in economic activity (GDP) over the next five years

Economic benefits of the proposed federal stimulus package include high-quality jobs for U.S. residents, labor income, boosts to local, state, and federal tax revenues, contributions to Gross Domestic Product (GDP), and energy cost savings. All these benefits ultimately translate to greater spending in the economy. Clean energy jobs are proven to be sustainable-wage positions that are accessible to all localities across the U.S., regardless of geography, or politics, and provide new, equitable job opportunities that cannot be outsourced. Moreover, updates to the nation's energy infrastructure are an investment in the collective economic future of Americans; the creation of a more resilient energy system is vital to economic growth and security.

We look at the first five years of economic impacts from a robust federal clean energy stimulus totaling **$99.2 billion**—with targeted and strategic investments in energy efficiency, renewable energy, and grid modernization. Our modeling finds that such an investment in our shared future would create **860,300 full time direct, indirect and induced jobs that will last for at least five years (a total of 4.3 million job-years).**[1] A stimulus of this level and the jobs it would create would also generate more than **$66 billion in GDP each year for the next five years—resulting in $330 billion in economic activity, more than triple the amount of investment.** These are jobs that would support sustainable wages and help bring the U.S. economy out of the severe recession.

More specifically, the first five years of economic benefits resulting from federal stimulus investments in the clean energy industry are as follows:

Energy Efficiency | $60.7 Billion in Federal Stimulus Will Result In:

- // **737,200** direct, indirect, and induced jobs each year for five years as a result of accelerating building energy efficiency upgrades and retrofits
- // **$44.1 billion** in total earnings or income each year for five years
- // **$51.3 billion** in overall added value to the national economy each year for five years

Renewable Energy | $13.1 Billion in Forgone Tax Revenue & Investments Will Result In:

- // **50,000** in direct, indirect, and induced jobs per year for five years through the development of solar, wind, and other renewable energy generation projects
- // **$1 billion** in total tax revenues, including **$850 million** in state and local taxes per year for five years
- // **$7.6 billion** in overall added value to the national economy each year for five years

Grid Modernization | $25.4 Billion in Federal Stimulus & Various Initiatives Will Result In:

- // **73,100** direct, indirect, and induced jobs each year for five years
- // **$5.3 billion** in total earnings per year for five years
- // **$7.2 billion** in overall added value to the national economy each year for five years

U.S. states and territories—including the U.S. Virgin Islands, Puerto Rico, Guam, Northern Marianas, and American Samoa—would all benefit significantly from these investments and the subsequent economic growth they would bring.

Thirty-three states would each see more than 10,000 jobs created, and every state and territory (with the exception of the District of Columbia) would see at least 4,000 jobs created.

The states that would reap the most growth in average jobs per year over five years are as follows:

State	Energy Efficiency	Renewable Energy	Grid Modernization	Total
Texas	60,547	5,801	6,108	72,455
California	53,071	9,540	5,219	67,830
Florida	36,969	1,218	3,611	41,798
Illinois	28,756	2,533	2,955	34,244
New York	28,874	2,256	2,691	33,821
Ohio	27,811	742	2,858	31,411
Pennsylvania	25,340	1,119	2,423	28,883
Michigan	25,205	1,128	2,465	28,798
North Carolina	19,467	1,207	1,836	22,510
Georgia	19,560	488	1,864	21,912


© iStock

INTRODUCTION

The global COVID-19 pandemic has shocked the nation's labor market with massive job losses. Within just a few months, nearly every industry sector was affected by shelter-in-place orders and social distancing measures. The clean energy industry lost as many as an estimated 620,500 jobs since the start of the pandemic, an 18 percent decrease compared to total jobs at the end of 2019.[2]

Over the last decade, the clean energy sector was a rapidly growing source of well-paying jobs for workers across the country. As the nation works to address the pandemic-induced economic recession, policy solutions can focus on getting these skilled individuals back into the workforce, particularly in environments with reduced personal exposure to the public and workers. Policymakers have an opportunity to direct federal spending towards investments that will put citizens back to work while setting the stage for growth in the sector after recovery.

The clean energy industry is proven to provide a great return on stimulus investments. During the Great Recession, the American Recovery and Reinvestment Act of 2009 (ARRA) directed a portion of stimulus investments to supply chain components for major clean energy technology sectors such as advanced vehicles, batteries, renewable energy, carbon capture and sequestration, grid modernization, and energy efficiency. It is estimated that these $90 billion in strategic investments and incentives supported roughly 900,000 job-years[3] from 2009 through 2015.[4] These investments also set the stage for long-term job growth across the nation's clean energy industry in the years following the Great Recession. By 2019, the clean energy workforce was 3.4 million workers strong and had been growing two times faster than nationwide employment since 2017. New federal policies can support economic recovery and job growth again by investing in clean energy and expanding, extending, and/or reviving clean energy tax credits and other incentive and policy programs.

Economists worldwide agree that investing in clean energy and other environmentally focused policies are the best way to restart our economy. A May 2020 study by Oxford University, which included input from more than 230 economists and others, compared clean energy-focused stimulus projects with traditional stimulus measures. It found that clean energy-focused projects create more jobs, deliver higher short-term returns, and lead to increased long-term cost savings.[5]

Benefits of investing in the clean energy industry go well beyond direct job creation and include positive impacts to supply chains, household expenditures, and gross sales and national output. Economic models can properly identify these ripple effects, providing vital information to policy- and decision-makers.

ABOUT THE REPORT

To highlight the economic benefits of stimulus investments for the clean energy industry, E2 and E4TheFuture commissioned BW Research to develop custom models to identify the economic impacts of federal stimulus funding directed towards the following three sectors of the clean energy economy:

Energy Efficiency

Renewable Energy

Grid Modernization

This report highlights the findings of the model for each of the sectors. The data show the direct, indirect, and induced economic impacts in terms of jobs created, labor income, and value added per year. These impacts are reported at both the national level and for all 50 states plus the District of Columbia, the U.S. Virgin Islands, Puerto Rico, the Northern Mariana Islands, Guam, and American Samoa.

For a description of terms used throughout the report, please refer to the Glossary of Terms in Appendix A. For full detail on state-level impacts, please refer to Appendices B through D. For the input and modeling methodology used, please reference Appendix E.

ABOUT E2

E2 (Environmental Entrepreneurs) is a national, nonpartisan group of business leaders, investors, and professionals from every sector of the economy who advocate for smart policies that are good for the economy and good for the environment. E2 members have founded or funded more than 2,500 companies, created more than 600,000 jobs, and manage more than $100 billion in venture and private equity capital.

For more information about E2's reports and research into clean energy jobs, see e2.org/reports.

ABOUT E4THEFUTURE

E4TheFuture works for clean, efficient and safe energy solutions. A nonprofit organization, we promote energy efficiency, renewables, demand management, energy storage and electric vehicles to advance climate protection and economic fairness. We work to achieve an energy economy that is sustainable, lower cost, and resilient.

E4TheFuture's "Faces of EE" initiative shines a light on energy efficiency professionals nationwide. Visit www.E4TheFuture.org or follow us on Twitter at @E4TheFuture and @FacesofEE.

ABOUT BW RESEARCH PARTNERSHIP

BW Research Partnership is a full-service, economic and workforce research consulting firm with offices in Carlsbad, California and Wrentham, Massachusetts. It is the nation's leading provider of accurate, comprehensive energy and clean energy research studies, including the United States Energy and Employment Report (USEER), National Solar Jobs Census, wind industry analyses for the National Renewable Energy Laboratory and the Natural Resources Defense Council, and state-level clean energy reports for Massachusetts, New York, Illinois, Vermont, Iowa, Rhode Island, Florida, and Missouri, among others.

For more information and analysis on economic impacts related to COVID-19, please visit: http://bwresearch.com/covid.

© Oranat Taesuwani/Stock

ENERGY EFFICIENCY ECONOMIC STIMULUS IMPACTS

INTRODUCTION & POLICY OVERVIEW

The energy efficiency industry is experiencing severe disruptions stemming from the COVID-19 pandemic. Businesses, utilities, and homeowners halted efficiency improvement projects and investments, threatening the livelihood of contractors, engineers, factory workers, and other employees. This disruption ripples throughout the supply chain, slowing or halting the manufacture of efficiency equipment and components including insulation; windows; heating, ventilation, and air conditioning (HVAC) equipment; ENERGY STAR® appliances; and other building systems technologies. Along with local contractors and installers, factories across the United States that manufacture these materials are at risk of closure.

This is particularly concerning as energy efficiency is among the largest economic sectors in the energy economy and by far the largest in the clean energy space. At the end of 2019, energy efficiency businesses employed 2.38 million Americans out of the total 3.35 million clean energy jobs.[6] Seven in ten of those jobs are in the construction and manufacturing industries. Energy efficiency is also the single most effective solution for addressing climate change. According to the International Energy Agency, efficiency can account for nearly half of the emissions reductions needed to meet climate goals.[7] Importantly, it also serves to reduce the energy burden faced by low- and middle-income Americans, presenting an opportunity to help struggling families reduce living expenses.

The current situation threatens to stall the important economic and environmental progress made in the sector. Since the start of the pandemic, the energy efficiency sector has lost as many as 431,800 jobs—the largest share of losses within the clean energy industry.[8]

The energy efficiency sector was selected for this modeling analysis for several reasons:

- Energy efficiency policies and programs are already in place across all states and localities, allowing for rapid deployment of stimulus resources into the economy.
- Many projects are in the pipeline, with a lineup of skilled workers ready to be deployed as soon as projects can be launched.
- Energy efficiency measures save Americans money on utility bills, providing welcome relief in a time of great financial insecurity.

The EE Portfolio: Advocates support numerous existing and proposed initiatives addressing the wide diversity of energy efficiency activities—from manufacturing of high efficiency consumer products and retrofitting buildings, to upgrading industrial equipment. Energy efficiency touches every sector of the economy. Rather than advocate for a specific set of policies and funding levels, the analysis presented in this report is designed to provide decision makers with a high-level view of the power of investing in a range of energy efficiency strategies by modeling an illustrative portfolio (EE Portfolio) of low-income, residential, and commercial/industrial energy efficiency policies and programs.[9] The EE Portfolio reflects these priorities:

- Speed: To get workers off unemployment and back on the job quickly, the EE Portfolio relies heavily on policies that can be rapidly implemented using existing federal programs or funding vehicles.
- Safety: To get workers back to work and safeguard health, the EE Portfolio relies on both traditional programs, with strong worker and occupant safety protocols, and new initiatives designed specifically to focus on improving performance and resilience in buildings that are underutilized or vacant due to COVID-19.
- Scope: To reflect consensus from experts and advocates, the EE Portfolio is based on recommendations for energy efficiency stimulus already submitted to Congressional leadership, as well as new ideas targeting public buildings that are underutilized or vacant due to COVID-19.
- Scale: To distribute resources for the benefit of consumers and businesses in every state.

The illustrative EE Portfolio scenario presented in this report includes ARRA-level funding of proven federal policies such as weatherization assistance, state energy programs, and 25C tax credit extensions and initiatives such as the Hope for Homes Act of 2020, the Open Back Better Act of 2020, and addressing key facility shortfalls in our public schools. For specifics on the report scenario or to request additional scenarios please contact policy@e4thefuture.org.

Appropriately, many federal programs require state and local governments matching funds. At this time when state and municipal budgets have been crushed by COVID-19, these requirements would likely slow implementation and delay getting workers back on the job. Therefore, the EE Portfolio emphasizes both existing and proposed programs that would not require such matches.

Energy efficiency offers two powerful avenues of leverage: capital contributed to the project by the property owner, and private financing paid for out of future energy savings. Our team has completed a detailed analysis estimating the scale of these two leverage opportunities for the mix of policies included in the EE Portfolio. Significant economic and jobs benefits are unique to energy efficiency.

The report examines the economic and job creation benefits associated with energy efficiency in two phases: The EE Construction Phase and EE Dividend Phase. We define the EE Construction Phase as the first five years of the stimulus program and the EE Dividend Phase as the time when energy bill savings are reinvested into the economy.

For dollar value inputs and assumptions of all policies and programs used for our model, please refer to the Energy Efficiency Methodology section in Appendix F.

ENERGY EFFICIENCY STIMULUS MODEL OUTPUT

Five Year Construction Phase: The EE Portfolio illustrates the potential of building owner contributions and private financing for efficiency measures to amplify the power of federal stimulus dollars to jump start the economy. If Congress were to appropriate at least $60.7 billion for the energy efficiency sector, the total capital leverage—or the total economic stimulus to the industry—would amount to more than $254.7 billion.

The $254.7 billion invested would result in a total of 737,200 direct, indirect, and induced jobs[10] per year for five years during the construction and engineering phase of energy efficiency projects, $44.1 billion in total earnings or employee income per year for five years, and $51.3 billion in value added or increased GDP per year for five years (Table 1). The top ten states impacted by stimulus investments are shown in Table 2. For detailed state-level impacts of these investments, refer to Appendix B.

EE Dividend Phase: To develop the EE Dividend Phase of the analysis we first estimated the net present value of energy efficiency savings using two studies by Lawrence Berkeley National Laboratory (LBNL).[11] The LBNL studies use an extensive evaluation of historic energy program costs to develop metrics for estimating energy savings in kWh and therms based on program spending. These estimated savings are for the measure life of installed efficiency projects. The net present value of measure life savings is estimated at $500 billion. Since the focus of this report is on the first five years, we are not presenting modeling of the economic and job-creation impacts during the EE Dividend Phase—which can last 15 to 20 years. However, decades of energy bill savings will be redeployed in the economy by thousands of families, businesses, institutions, and local and state governments. Energy efficiency stimulus is truly the definition of a virtuous cycle.

FIGURE 1. ALLOCATION OF EE DIVIDEND FOR EE PORTFOLIO

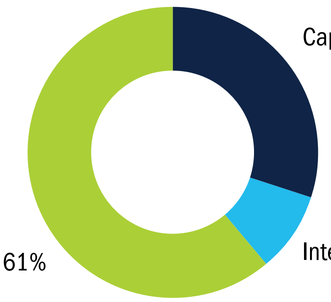

Figure 1 shows how the EE Dividend would be spent over the average 15 years of savings. The $149.2 billion (30%) in private capital from financial institutions, which enabled the initial construction of projects, must be repaid. The $44.0 billion (9%) of interest payments required on these accounts will be counted as revenues to financial services industries. The remaining $306.8 billion (61%) will be reinvested in the economy as people readjust their budgets by allocating energy bill savings to other priorities.

TABLE 1. NATIONAL ENERGY EFFICIENCY ECONOMIC STIMULUS OUTPUTS FIVE YEAR CONSTRUCTION PHASE

	Jobs Jobs per year for 5 years	Earnings Employee wages, salaries, etc. per year for 5 years (millions $)	Value Added GDP per year for 5 years (millions $)
Direct Effects	341,430	$21,957	$27,083
Indirect Effects	176,051	$11,308	$12,280
Induced Effects	219,742	$10,837	$11,937
Total Per Year for Construction Phase	737,223	$44,102	$51,301

TABLE 2. ENERGY EFFICIENCY STATE-LEVEL ECONOMIC STIMULUS—TOP TEN STATES IMPACTED

	Jobs Jobs per year for 5 years	Earnings Employee wages, salaries, etc. per year for 5 years (millions $)	Value Added GDP per year for 5 years (millions $)
Texas	60,547	$3,674	$3,978
California	53,071	$3,771	$4,473
Florida	36,969	$1,947	$2,227
New York	28,874	$2,150	$2,658
Illinois	28,756	$1,893	$2,254
Ohio	27,811	$1,576	$1,836
Pennsylvania	25,340	$1,600	$1,852
Michigan	25,205	$1,475	$1,644
Georgia	19,560	$1,084	$1,275
North Carolina	19,467	$1,069	$1,256

For full table of all energy efficiency state-level impacts, see Appendix B.

© Stephen Yang/The Solutions Project

RENEWABLE ENERGY ECONOMIC STIMULUS IMPACTS

INTRODUCTION & POLICY OVERVIEW

As with energy efficiency, the renewable energy sector was hard hit by the COVID-19 pandemic. Since the start of the pandemic, as many as 100,000 renewable energy workers have lost their jobs.[12] But also like the efficiency sector, the renewable energy sector has a proven track record of high economic return from federal stimulus investments, as exhibited in the last clean energy stimulus package under ARRA. Funding directed towards renewable energy helped create a large and vibrant industry, with many high-quality U.S. jobs for residents across the nation.[13] Before COVID-19, renewable energy employed over 522,000 workers.[14]

To repair the economic damage caused by COVID-19, and to reap the broader economic benefits that come with a growing renewables sector, federal stimulus funding can be directed towards extending three key components of current policy. These components would stop additional job losses, create new jobs, and bring skilled workers back into the clean energy labor market. Our model assumes a five-year extension of the Production Tax Credit (PTC) and Investment Tax Credit (ITC), a two-year extension of the Section 1603 Grant Program, plus $1.5 billion in port infrastructure investments for offshore wind. For detailed economic stimulus model methodology, refer to the Renewable Energy section in Appendix F.

// **Renewable Energy Tax Credits:** First enacted in 1992, the PTC has played a pivotal role in supporting U.S. wind energy deployment. In 2005, the ITC was established to support the development of solar projects nationwide. The stability and longevity of these tax incentives correlate to installations: An extension of the tax credits due to decline on December 31, 2020 would help stabilize the markets, promote private investment, and ensure development of more renewable energy projects.

// **Section 1603 Grant Program:** The U.S Treasury Department’s §1603 program, which provides one-time payments equal in value to the ITC, was designed under ARRA to minimize stagnation caused by weakened tax equity markets during recessions. The program is a proven job creator and, in the wake of the 2008/2009 economic crisis, helped remove economic uncertainties.[15] A two-year program extension would help overcome similar tax equity market uncertainty driven by COVID-19, and restore some certainty and stability for renewable energy project funding.

// **Port Infrastructure:** A 2016 Department of Energy study found that the U.S. has the potential for more than 2,000 GW of offshore wind energy, nearly double the country’s electricity use.[16] However, the nation’s ports require immediate additional infrastructure to meet project needs.[17] Investments in American ports will directly employ construction workers in outdoor environments; it will accelerate a nascent offshore wind market that is poised to be a reliable source of both jobs and clean energy throughout the next century. It will also benefit shipping and commerce broadly.

RENEWABLE ENERGY STIMULUS MODEL OUTPUT

The model identified a direct impact of 17,800 jobs per year for five years in the renewable energy industry by extending the PTC and ITC five years, extending the Section §1603 Grant Program two years, and investing in Port Infrastructure. The cost would be an estimated $36.1 billion in forgone tax revenue based on the five year tax credit and another $1.5 billion in federal investment which would leverage sizeable private investment.

In addition to these roughly 18,000 direct jobs per year, there are an expected 32,000 additional indirect and induced jobs for a total of almost 50,000 jobs per year over the five years the PTC and ITC are extended and the two years the §1603 is extended. Construction, manufacturing, professional services, and trade activity within the renewable energy sector would result in about $7.6 billion in added value each year, and $1 billion in tax revenue, including nearly $850 million in local and state tax revenue (see Table 3).

This model's outputs differ from the other two presented in this report due to a difference in multipliers. The multipliers used in this model are derived from a renewable energy industry impact analysis and thus are specific to the renewable energy industry. While this model provides accuracy in its analysis of the renewable energy industry, it unfortunately does not provide all the same outputs as the others. For more information, see the Renewable Energy section of Appendix F.

TABLE 3. NATIONAL RENEWABLE ENERGY ECONOMIC STIMULUS OUTPUTS

	Impacts per year for 5 years (millions $)	Total per year for 5 years (millions $)
Direct Jobs	17,764	
Indirect Jobs	8,058	**49,961**
Induced Jobs	24,139	
Direct Value Added	$3,353	
Indirect Value Added	$1,652	**$7,556**
Induced Value Added	$2,551	
Local Taxes	$469	
State Taxes	$380	**$1,008**
Federal Taxes	$159	

TABLE 4. RENEWABLE ENERGY STATE-LEVEL ECONOMIC STIMULUS—TOP TEN STATES IMPACTED

	Jobs per year for 5 years	Value Added GDP per year for 5 years (millions $)	Local Taxes per year for 5 years (millions $)	State Taxes per year for 5 years (millions $)	Federal Taxes per year for 5 years (millions $)
California	9,540	$2,308	$92	$75	$31
Texas	5,801	$732	$60	$48	$20
Illinois	2,533	$358	$25	$21	$9
New York	2,256	$498	$16	$13	$6
Colorado	1,696	$222	$18	$14	$6
Massachusetts	1,454	$303	$12	$10	$4
Washington	1,409	$152	$14	$11	$5
Indiana	1,379	$131	$14	$12	$5
Oregon	1,328	$173	$13	$10	$4
New Jersey	1,231	$192	$10	$8	$3

For full table of all renewable energy state-level impacts, see Appendix C.


© Dennis Schroeder/NREL

GRID MODERNIZATION ECONOMIC STIMULUS IMPACTS

INTRODUCTION & POLICY OVERVIEW

The grid modernization sector has also been affected by the COVID-19 pandemic, though to a lesser effect. Since the onset of the pandemic, the sector shed as many as 27,300 jobs.[18] Updating the nation's energy grid is as important to energy security and resiliency as improved building efficiency and renewable energy deployment. Aging grid infrastructure threatens national security, productivity, and economic growth potential. In 2015, the U.S. Department of Energy reported that 70 percent of power transformers were more than 25 years old, 60 percent of circuit breakers were more than 30 years old, and 70 percent of transmission lines were more than 25 years old.[19]

New smart grid, microgrid, and storage technologies can modernize America's grid infrastructure through energy consumption management, building controls, waste reduction, and storage capacity.[20] Grid modernization measures and upgrades contribute to reduced energy consumption, enable renewable energy expansion, and lower greenhouse gas emissions, benefiting individuals, families, and businesses with energy cost savings and reducing the nation's carbon footprint. It would also enhance productivity, rural development and effectiveness of trade and economic resilience.

Investments in grid modernization would further support economic recovery and growth. Below is an overview of policy initiatives that would aid in developing the nation's grid modernization sector. For full detail on the dollar value inputs for policies and programs used in our model, please refer to the Grid Modernization Input Methodology section in Appendix F.

// **Utility Communications & Broadband:** Upgrading the nation's communications network to fiber optics would better enable smart grid capabilities. One example is the city of Chattanooga, Tennessee, which successfully transitioned to fiber optics. Chattanooga's municipal utility, EPB, leveraged a $111.7 million ARRA Smart Grid grant to build a $222 million fiber optic communications network that enables the city's smart grid and provides high speed broadband access to all customers. This initiative created at least 2,800 jobs and added $865.3 million to the local economy by reducing power outages, improving Internet connectivity, and attracting businesses to the region.[21]

// **Grid Flexibility Enhancement:** Modernization of the U.S. electric power grid would allow greater connectivity to renewable generation sources. However, renewable integration increases the need for system flexibility as new sources of power generation have more variable load. Grid technologies like controls, sensors, and storage can provide flexibility. They improve system visibility for grid operators, help to quickly rebalance the system with autonomous controls, and facilitate the aggregation of distributed energy resources to serve as assets.

These technologies help integrate utility-scale and distributed renewables and can relieve transmission constraints and reduce the need for peak generation. These flexible technologies also build resilience by providing back up power, automatically rerouting power around damaged lines, and self-healing the grid when it is damaged.

- // **Building-to-Grid Integration:** Buildings consume large amounts of energy for heating, cooling, lighting, and other functions, but they can also be a significant asset to the grid through load shifting, demand response, and aggregation of distributed generation. Benefits of utilizing and automating buildings' energy demand and supply functions include cost savings, resilience, reduced peak loads, and improved energy efficiency.

- // **Cybersecurity Technology & Workforce Development:** Cybersecurity is an increasingly vital component of grid modernization. As the nation's infrastructure moves toward greater web connectivity, there are increased risks of exposure to cyberattacks. Unfortunately, skilled workers preventing cyberattacks are in short supply. In the U.S. alone, this shortage amounts to almost 500,000 workers.[22] Investments in cybersecurity workforce development would help ensure that the next generation of workers is adequately trained to support and protect the grid of the future. While updating and protecting the nation's energy system, these investments would result in the creation of high-quality, sustainable-wage jobs for Americans across the country.

GRID MODERNIZATION STIMULUS MODEL OUTPUT

Through these policy initiatives, the research team together with the GridWise Alliance estimated that if Congress appropriated $25.4 billion in stimulus spending for the grid modernization sector, total capital leverage would amount to $33.4 billion.

With $33.4 billion injected into the sector via policy initiatives, resulting economic outputs are more than 73,100 direct, indirect, and induced jobs each year for five years, $5.3 billion in earnings, and $7.2 billion in GDP added to the U.S. economy each year for five years.

TABLE 5. NATIONAL GRID MODERNIZATION ECONOMIC STIMULUS OUTPUTS

	Jobs per year for 5 years	Earnings Employee wages, salaries, etc. per year for 5 years (millions $)	Value Added GDP per year for 5 years (millions $)
Direct Effects	26,044	$2,690	$4,186
Indirect Effects	17,634	$1,175	$1,332
Induced Effects	29,388	$1,470	$1,717
Total	**73,066**	**$5,335**	**$7,235**

TABLE 6. GRID MODERNIZATION STATE-LEVEL ECONOMIC STIMULUS: TOP TEN STATES IMPACTED

	Jobs per year for 5 years	Earnings Employee wages, salaries, etc. per year for 5 years (millions $)	Value Added GDP per year for 5 years (millions $)
Texas	6,108	$435	$569
California	5,219	$457	$610
Florida	3,611	$232	$306
Illinois	2,955	$232	$309
Ohio	2,858	$195	$262
New York	2,691	$256	$362
Michigan	2,465	$174	$229
Pennsylvania	2,423	$189	$265
Georgia	1,864	$128	$176
North Carolina	1,836	$125	$171

For full table of all grid modernization state-level impacts, see Appendix D.

APPENDIX A: GLOSSARY OF TERMS

Direct Effects: The effect of new input purchases by the initially changed industries; direct effects represent the initial change in earnings or jobs. This is the first round of impacts.

Energy Efficiency Dividend: The dollar value in future saved energy costs that result from energy efficiency upgrades. This is the money that would have been spent on energy but is instead saved due to increase system efficiencies. The Energy Efficiency Dividend ultimately feeds into additional household expenditures.

Indirect Effects: The subsequent ripple effect in further supply chains resulting from the direct change. This is the second round of impacts. An example of an indirect effect is the jobs created at a high-efficiency boiler manufacturer from an HVAC installation firm purchasing their products.

Induced Effects: This change is due to the impact of the new earnings created by the Direct and Indirect Effects. These earnings enter the economy as employees spend their paychecks in the region on food, clothing, and other goods and services.

Private Financing: This refers to debt-leveraged funding from financial institutions. The money paid out by financial institutions creates the initial construction impacts.

Property Owner Contribution: This refers to what is captured by the energy efficiency dividend. It is used to “frontload” the saved money from energy efficiency projects.

Total Capital Leverage: Expressed as a percent of federal stimulus, this refers to the amount of money leveraged for stimulus inputs from all sources. When multiplied by federal stimulus amount, we calculate Total Economic Stimulus, defined below.

Total Earnings: The total industry earnings for a region. This includes wages, salaries, supplements (additional employee benefits), and proprietor income. Total Earnings is one of the four components of Gross Domestic Product (GDP). The other elements are profits/property income, taxes on production and imports, and subsidies.

Total Economic Stimulus: The amount of money infused into the economy after property owner contributions, private financing, and investments are considered.

Value Added: This represents the difference between total output (or Sales) and the cost of intermediate inputs (consumption of goods and services purchased from other industries or imported). Value Added is equivalent to an industry’s contribution to GDP.

APPENDIX B: ENERGY EFFICIENCY STATE-LEVEL ECONOMIC STIMULUS IMPACTS

The following table provides the sum of economic outputs from stimulus investments in the energy efficiency industry sector. The total values include the direct, indirect, and induced impacts to jobs, earnings, and value added from the construction and engineering phase of the project. These impacts are interpreted as impacts **per year for five years**.

Average Impacts per year for 5 years	Total Jobs per year	Direct Jobs per year	Indirect Jobs per year	Induced Jobs per year	Total Earnings Employee Income per year ($ millions)	Total Value Added GDP per year ($ millions)	Total Jobs over 5 years	Total Value Added over 5 years ($ millions)
Alabama	12,729	6,591	2,894	3,245	$649	$750	63,645	$3,749
Alaska	4,544	2,284	1,099	1,161	$299	$342	22,720	$1,708
Arizona	13,967	5,563	3,569	4,835	$798	$909	69,837	$4,543
Arkansas	9,448	5,319	1,971	2,158	$455	$527	47,242	$2,637
California	53,071	19,234	14,254	19,583	$3,771	$4,472	265,357	$22,362
Colorado	13,284	5,128	3,590	4,566	$836	$990	66,421	$4,949
Connecticut	8,010	4,246	1,763	2,001	$543	$663	40,050	$3,317
Delaware	3,738	2,129	800	808	$233	$307	18,688	$1,534
District of Columbia	2,466	1,873	407	186	$203	$231	12,330	$1,154
Florida	36,969	14,894	9,123	12,952	$1,947	$2,227	184,846	$11,134
Georgia	19,560	8,537	4,954	6,069	$1,084	$1,275	97,800	$6,374
Hawaii	4,490	2,106	973	1,411	$298	$341	22,449	$1,706
Idaho	6,973	3,598	1,590	1,784	$336	$386	34,863	$1,930
Illinois	28,756	11,714	7,113	9,930	$1,893	$2,254	143,781	$11,272
Indiana	16,690	8,500	3,714	4,476	$911	$1,054	83,451	$5,271
Iowa	9,508	5,067	1,988	2,453	$521	$634	47,542	$3,169
Kansas	9,500	4,423	2,590	2,488	$543	$643	47,499	$3,217
Kentucky	12,039	6,744	2,480	2,815	$622	$698	60,195	$3,491
Louisiana	15,900	7,780	3,577	4,543	$885	$998	79,500	$4,988
Maine	7,070	3,803	1,429	1,838	$353	$412	35,351	$2,062
Maryland	10,160	5,313	2,252	2,595	$659	$805	50,800	$4,026
Massachusetts	12,572	5,493	2,984	4,095	$954	$1,158	62,861	$5,791
Michigan	25,205	10,993	6,283	7,929	$1,475	$1,644	126,024	$8,220
Minnesota	15,521	6,407	3,803	5,311	$988	$1,113	77,604	$5,563
Mississippi	9,415	5,642	1,744	2,029	$422	$488	47,075	$2,442
Missouri	14,724	7,068	3,523	4,133	$823	$920	73,621	$4,601
Montana	6,239	3,298	1,338	1,602	$309	$336	31,196	$1,680
Nebraska	7,194	3,640	1,553	2,000	$387	$483	35,968	$2,413
Nevada	6,224	2,966	1,461	1,797	$382	$447	31,118	$2,233
New Hampshire	5,345	2,863	1,168	1,315	$333	$393	26,727	$1,967

Average Impacts per year for 5 years	Total Jobs per year	Direct Jobs per year	Indirect Jobs per year	Induced Jobs per year	Total Earnings Employee Income per year ($ millions)	Total Value Added GDP per year ($ millions)	Total Jobs over 5 years	Total Value Added over 5 years ($ millions)
New Jersey	15,839	7,893	3,700	4,246	$1,108	$1,294	79,193	$6,469
New Mexico	6,815	3,679	1,456	1,680	$347	$414	34,076	$2,072
New York	28,874	13,998	6,646	8,230	$2,150	$2,658	144,370	$13,292
North Carolina	19,467	8,756	4,989	5,721	$1,069	$1,255	97,335	$6,277
North Dakota	4,428	2,460	926	1,042	$277	$316	22,139	$1,581
Ohio	27,811	12,602	6,673	8,536	$1,576	$1,836	139,054	$9,182
Oklahoma	11,879	5,991	2,760	3,128	$607	$702	59,393	$3,512
Oregon	9,696	4,177	2,550	2,969	$589	$678	48,482	$3,391
Pennsylvania	25,340	11,866	5,998	7,476	$1,600	$1,852	126,701	$9,258
Rhode Island	4,763	2,603	1,018	1,142	$287	$346	23,817	$1,729
South Carolina	11,432	5,939	2,561	2,932	$590	$680	57,159	$3,402
South Dakota	4,793	2,664	929	1,200	$253	$305	23,963	$1,526
Tennessee	14,427	7,321	3,246	3,860	$794	$941	72,136	$4,706
Texas	60,547	22,870	16,670	21,007	$3,674	$3,978	302,733	$19,888
Utah	9,005	3,887	2,292	2,826	$494	$571	45,025	$2,854
Vermont	4,990	2,872	989	1,130	$262	$300	24,951	$1,498
Virginia	14,794	7,606	3,393	3,796	$892	$1,049	73,970	$5,243
Washington	12,950	5,706	3,271	3,972	$872	$993	64,748	$4,964
West Virginia	6,817	4,443	1,110	1,264	$350	$396	34,084	$1,982
Wisconsin	14,982	6,977	3,495	4,510	$871	$1,008	74,912	$5,039
Wyoming	4,413	2,847	771	795	$233	$273	22,067	$1,366
American Samoa	3,213	1,524	694	996	$211	$252	16,067	$1,258
Guam	3,328	1,578	718	1,031	$218	$260	16,640	$1,302
Northern Marianas	3,201	1,518	691	992	$210	$251	16,005	$1,253
Puerto Rico	8,556	4,750	1,751	2,056	$424	$513	42,782	$2,565
U.S. Virgin Islands	3,550	1,683	766	1,100	$233	$278	17,750	$1,389

APPENDIX C: RENEWABLE ENERGY STATE-LEVEL ECONOMIC STIMULUS IMPACTS

The following table provides the sum of economic outputs from stimulus investments in the renewable energy industry sector. The total values include the direct, indirect, and induced impacts to jobs, total value added, and local, state, and federal taxes. These impacts are interpreted as impacts **per year for five years**.

Average Impacts per year for 5 years	Total Jobs per year	Direct Jobs per year	Indirect Jobs per year	Induced Jobs per year	Total Value Added GDP per year ($ millions)	Total Jobs over 5 years	Total Value Added over 5 years ($ millions)	Local Taxes per year ($ millions)	State Taxes per year ($ millions)	Federal Taxes per year ($ millions)
Alabama	218	68	35	114	$19	1,090	$96	$2	$2	$1
Alaska	25	8	4	13	$2	126	$11	$0	$0	$0
Arizona	1,169	412	185	571	$164	5,844	$818	$11	$9	$4
Arkansas	140	42	23	74	$10	698	$51	$2	$1	$1
California	9,540	3,558	1,494	4,488	$2,308	47,699	$11,538	$92	$75	$31
Colorado	1,696	545	274	876	$222	8,478	$1,108	$18	$14	$6
Connecticut	655	376	93	187	$143	3,276	$713	$3	$2	$1
Delaware	53	19	8	25	$7	265	$33	$1	$0	$0
District of Columbia	83	32	13	39	$10	417	$50	$1	$1	$0
Florida	1,218	420	194	604	$152	6,088	$762	$13	$10	$4
Georgia	488	180	77	232	$68	2,439	$338	$5	$4	$2
Guam	48	18	8	23	$6	241	$32	$0	$0	$0
Hawaii	297	113	46	138	$41	1,487	$203	$3	$2	$1
Idaho	622	200	100	322	$53	3,108	$266	$6	$5	$2
Illinois	2,533	800	411	1,323	$358	12,667	$1,788	$25	$21	$9
Indiana	1,379	430	224	725	$131	6,895	$655	$14	$12	$5
Iowa	1,109	343	180	585	$98	5,543	$492	$11	$9	$4
Kansas	443	137	72	234	$38	2,216	$188	$5	$4	$2
Kentucky	85	34	13	38	$8	423	$42	$1	$1	$0
Louisiana	192	76	30	87	$20	962	$99	$2	$2	$1
Maine	905	343	174	388	$97	4,527	$484	$5	$4	$2
Maryland	489	180	77	232	$72	2,445	$358	$5	$4	$2
Massachusetts	1,454	557	245	652	$303	7,272	$1,517	$12	$10	$4
Michigan	1,128	363	182	583	$126	5,639	$629	$12	$9	$4
Minnesota	855	285	137	433	$109	4,274	$543	$9	$7	$3
Mississippi	68	26	11	31	$5	338	$24	$1	$1	$0
Missouri	466	157	75	234	$47	2,331	$235	$5	$4	$2
Montana	123	41	20	62	$10	614	$51	$1	$1	$0
Nebraska	242	83	39	120	$27	1,211	$134	$2	$2	$1
Nevada	992	361	156	475	$111	4,960	$556	$9	$8	$3
New Hampshire	351	114	57	181	$40	1,755	$201	$4	$3	$1
New Jersey	1,231	467	224	541	$192	6,157	$959	$10	$8	$3

Average Impacts per year for 5 years	Total Jobs per year	Direct Jobs per year	Indirect Jobs per year	Induced Jobs per year	Total Value Added GDP per year ($ millions)	Total Jobs over 5 years	Total Value Added over 5 years ($ millions)	Local Taxes per year ($ millions)	State Taxes per year ($ millions)	Federal Taxes per year ($ millions)
New Mexico	441	151	70	220	$38	2,205	$190	$4	$4	$1
New York	2,256	1,074	311	871	$498	11,278	$2,489	$16	$13	$6
North Carolina	1,207	528	206	473	$184	6,036	$919	$7	$6	$3
North Dakota	510	157	83	270	$39	2,552	$195	$5	$4	$2
Ohio	742	269	117	356	$89	3,709	$444	$7	$6	$2
Oklahoma	666	210	108	348	$53	3,332	$264	$7	$5	$2
Oregon	1,328	445	213	669	$173	6,638	$867	$13	$10	$4
Pennsylvania	1,119	368	180	571	$140	5,596	$702	$11	$9	$4
Puerto Rico	315	118	49	147	$30	1,573	$149	$3	$2	$1
Rhode Island	380	164	77	140	$51	1,901	$257	$2	$2	$1
South Carolina	400	137	64	199	$37	2,002	$186	$4	$3	$1
South Dakota	476	149	77	250	$41	2,382	$204	$5	$4	$2
Tennessee	262	102	41	119	$31	1,309	$154	$3	$2	$1
Texas	5,801	1,799	944	3,057	$732	29,004	$3,659	$60	$48	$20
Utah	514	194	80	240	$60	2,570	$299	$5	$4	$2
Vermont	164	59	26	79	$17	820	$84	$2	$1	$1
Virgin Islands	34	13	5	15	$5	169	$24	$0	$0	$0
Virginia	872	324	175	372	$119	4,359	$593	$6	$5	$2
Washington	1,409	460	227	722	$152	7,047	$760	$14	$11	$5
West Virginia	221	71	36	115	$18	1,107	$90	$2	$2	$1
Wisconsin	420	143	67	210	$45	2,100	$225	$4	$4	$1
Wyoming	127	41	20	65	$9	634	$45	$1	$1	$0

APPENDIX D: GRID MODERNIZATION STATE-LEVEL ECONOMIC STIMULUS IMPACTS

The following table provides the sum of economic outputs from stimulus investments in the grid modernization industry sector. The total values include the direct, indirect, and induced impacts to jobs, earnings, and value added. These impacts are interpreted as impacts **per year for five years**.

Average Impacts per year for 5 years	Total Jobs per year	Direct Jobs per year	Indirect Jobs per year	Induced Jobs per year	Total Earnings Employee Income per year ($ millions)	Total Value Added GDP per year ($ millions)	Total Jobs over 5 years	Total Value Added over 5 years ($ millions)
Alabama	1,175	467	261	447	$77	$109	5,877	$546
Alaska	556	307	98	151	$35	$48	2,780	$241
Arizona	1,428	414	374	640	$97	$128	7,140	$638
Arkansas	882	392	201	288	$55	$76	4,409	$378
California	5,219	1,191	1,432	2,596	$457	$610	26,096	$3,048
Colorado	1,323	387	332	605	$99	$129	6,617	$643
Connecticut	745	298	184	264	$66	$90	3,725	$448
Delaware	390	197	88	105	$29	$42	1,951	$208
District of Columbia	282	205	49	29	$27	$36	1,412	$178
Florida	3,611	1,002	919	1,690	$232	$306	18,057	$1,528
Georgia	1,864	573	487	804	$128	$176	9,320	$881
Hawaii	486	203	94	190	$37	$52	2,429	$260
Idaho	675	274	164	236	$41	$54	3,373	$270
Illinois	2,955	894	731	1,330	$232	$309	14,774	$1,546
Indiana	1,642	653	385	604	$112	$153	8,212	$767
Iowa	923	395	197	331	$62	$91	4,617	$453
Kansas	975	428	217	331	$63	$85	4,875	$426
Kentucky	1,223	566	266	391	$79	$104	6,116	$519
Louisiana	1,692	683	386	623	$108	$146	8,459	$728
Maine	658	264	138	256	$43	$60	3,290	$299
Maryland	1,006	397	239	370	$83	$119	5,031	$593
Massachusetts	1,227	348	321	558	$120	$158	6,136	$789
Michigan	2,465	827	612	1,027	$174	$229	12,327	$1,147
Minnesota	1,634	527	391	716	$121	$158	8,169	$792
Mississippi	962	483	185	294	$53	$75	4,810	$376
Missouri	1,488	567	371	549	$101	$131	7,439	$655
Montana	599	253	129	217	$38	$50	2,994	$251
Nebraska	723	301	156	267	$45	$68	3,616	$339
Nevada	652	257	157	238	$46	$62	3,258	$311
New Hampshire	501	196	121	184	$42	$57	2,505	$283

Average Impacts per year for 5 years	Total Jobs per year	Direct Jobs per year	Indirect Jobs per year	Induced Jobs per year	Total Earnings Employee Income per year ($ millions)	Total Value Added GDP per year ($ millions)	Total Jobs over 5 years	Total Value Added over 5 years ($ millions)
New Jersey	1,601	607	406	588	$140	$187	8,005	$936
New Mexico	685	328	131	226	$42	$59	3,427	$295
New York	2,691	958	659	1,074	$256	$362	13,456	$1,810
North Carolina	1,836	616	471	750	$125	$171	9,179	$855
North Dakota	483	252	86	145	$33	$48	2,417	$238
Ohio	2,858	998	705	1,155	$195	$262	14,291	$1,312
Oklahoma	1,154	474	273	408	$70	$98	5,771	$488
Oregon	967	296	265	405	$72	$97	4,833	$484
Pennsylvania	2,423	847	575	1,002	$189	$265	12,116	$1,327
Rhode Island	448	191	103	154	$35	$49	2,241	$245
South Carolina	1,091	445	250	396	$69	$98	5,456	$491
South Dakota	494	240	88	166	$31	$47	2,470	$233
Tennessee	1,465	577	358	529	$99	$134	7,323	$672
Texas	6,108	1,760	1,599	2,748	$435	$569	30,540	$2,844
Utah	931	292	248	392	$62	$82	4,657	$412
Vermont	443	195	96	151	$31	$42	2,213	$212
Virginia	1,380	538	321	521	$108	$150	6,901	$750
Washington	1,226	378	320	528	$104	$140	6,130	$698
West Virginia	666	353	131	182	$46	$61	3,329	$306
Wisconsin	1,495	544	356	595	$102	$141	7,475	$706
Wyoming	431	238	85	108	$29	$38	2,153	$192
American Samoa	342	142	66	133	$26	$37	1,708	$183
Guam	354	148	68	138	$27	$38	1,768	$189
Northern Marianas	340	142	66	133	$26	$36	1,701	$182
Puerto Rico	814	378	153	282	$51	$74	4,068	$371
U.S. Virgin Islands	377	157	73	147	$28	$40	1,886	$202

APPENDIX E: TOTAL STATE-LEVEL ECONOMIC STIMULUS IMPACTS

The following table provides the sum of economic outputs from all three stimulus investments. The values include the total impacts to jobs and value added. These impacts are interpreted as impacts **per year for five years**.

Average Impacts per year for 5 years	Total Jobs per year	Total Value Added GDP per year ($ millions)	Total Jobs over 5 years	Total Value Added over 5 years ($ millions)
Alabama	14,122	$878	70,611	$4,392
Alaska	5,125	$392	25,625	$1,960
Arizona	16,564	$1,200	82,821	$5,999
Arkansas	10,470	$613	52,348	$3,066
California	67,830	$7,390	339,152	$36,948
Colorado	16,303	$1,340	81,515	$6,701
Connecticut	9,410	$896	47,051	$4,479
Delaware	4,181	$355	20,904	$1,774
District of Columbia	2,832	$276	14,159	$1,382
Florida	41,798	$2,685	208,991	$13,425
Georgia	21,912	$1,519	109,559	$7,594
Hawaii	5,273	$434	26,364	$2,170
Idaho	8,269	$493	41,344	$2,465
Illinois	34,244	$2,921	171,222	$14,606
Indiana	19,711	$1,339	98,557	$6,693
Iowa	11,540	$823	57,702	$4,114
Kansas	10,918	$766	54,590	$3,831
Kentucky	13,347	$810	66,733	$4,052
Louisiana	17,784	$1,163	88,921	$5,816
Maine	8,634	$569	43,169	$2,845
Maryland	11,655	$995	58,276	$4,977
Massachusetts	15,254	$1,620	76,269	$8,098
Michigan	28,798	$1,999	143,991	$9,996
Minnesota	18,010	$1,379	90,048	$6,897
Mississippi	10,445	$568	52,223	$2,842
Missouri	16,678	$1,098	83,390	$5,491
Montana	6,961	$396	34,803	$1,982
Nebraska	8,159	$577	40,795	$2,886
Nevada	7,867	$620	39,336	$3,100
New Hampshire	6,197	$490	30,987	$2,451
New Jersey	18,671	$1,673	93,356	$8,364
New Mexico	7,942	$511	39,708	$2,557

Average Impacts per year for 5 years	Total Jobs per year	Total Value Added GDP per year ($ millions)	Total Jobs over 5 years	Total Value Added over 5 years ($ millions)
New York	33,821	$3,518	169,105	$17,592
North Carolina	22,510	$1,610	112,550	$8,052
North Dakota	5,422	$403	27,109	$2,015
Ohio	31,411	$2,188	157,054	$10,938
Oklahoma	13,699	$853	68,496	$4,264
Oregon	11,991	$948	59,953	$4,741
Pennsylvania	28,883	$2,258	144,413	$11,288
Rhode Island	5,592	$446	27,959	$2,231
South Carolina	12,923	$816	64,616	$4,080
South Dakota	5,763	$393	28,815	$1,963
Tennessee	16,154	$1,107	80,768	$5,533
Texas	72,455	$5,278	362,277	$26,391
Utah	10,450	$713	52,252	$3,565
Vermont	5,597	$359	27,985	$1,793
Virginia	17,046	$1,317	85,231	$6,586
Washington	15,585	$1,285	77,925	$6,423
West Virginia	7,704	$476	38,520	$2,378
Wisconsin	16,897	$1,194	84,487	$5,969
Wyoming	4,971	$321	24,853	$1,604
Guam	3,730	$305	18,649	$1,524
Puerto Rico	9,685	$617	48,423	$3,085
U.S. Virgin Islands	3,961	$323	19,806	$1,615

APPENDIX F: ECONOMIC MODELING METHODOLOGY

ENERGY EFFICIENCY

Input Methodology

Instead of advocating for specific policies or attempting to precisely forecast jobs and economic benefits of specific policy proposals, this report aims to meet decision makers where they are in the midst of the COVID-19 financial crisis, considering at a high-level what stimulus strategies to pursue. To achieve this objective, the first step of our input methodology was to assemble a reasonable illustrative EE Portfolio of policies, which if adopted by Congress could rapidly deploy federal stimulus dollars through existing programs and funding vehicles to jump start the economy.

This report echoes a joint memo[23] to Congressional leaders offering consensus policy recommendations for energy efficiency stimulus, authored by organizations and companies who promote energy efficiency (informally known as the EE Strategy Group). Our research team also considered a non-leveraged school energy retrofit grant payment of $11 billion over five years, to reflect rapidly deployed funds for public school districts to implement energy efficiency projects in buildings underutilized due to COVID-19. This type of "direct payment to school" mechanism would enable skilled energy efficiency workers to safely return to work and give local governments the opportunity to upgrade outdated infrastructure while improving learning environments and reducing annual operating costs.

Once policies and funding levels for our EE Portfolio were set, we worked with partners including American Council for an Energy-Efficient Economy (ACEEE), the Alliance to Save Energy, National Association of Energy Service Companies (NAESCO), National Association of State Energy Officials (NASEO), and others to identify typical property owner contributions to projects and private financing levels based on past program and American Recovery & Reinvestment Act of 2009 (ARRA) experience.[24]

Economic Impact Model Methodology

The economic impacts measured in this model are from the construction and engineering of energy efficiency programs funded by this stimulus.

A. Economic Input

The total economic stimulus model includes five inputs: 1) federal stimulus, 2) total capital leverage, 3) property owner contribution, 4) private financing, and 5) interest rate on private financing. Inputs 2, 3, and 4 are input as a percent of federal stimulus. Total capital leverage multiplied by the federal stimulus is the input for total economic stimulus for construction of energy efficiency projects. Private financing is multiplied by the state allocation described in Section B.2. to calculate the portion of energy efficiency Dividend spent on debt retirement and interest payments.

To account for interstate economic activity, we ran EE stimulus program impacts at the state and national level, using state and national level multipliers. The final, reported direct and indirect impacts are calculated using national level multipliers which are broken out by state by using each state's share of total aggregated impacts when run using the state level multipliers. The induced impacts are the total aggregated induced impacts for all 50 states, D.C., and the territories. We chose this method of calculating total impacts to capture indirect impacts that are not accounted for when limiting impacts to state boundaries, while avoiding overestimation of induced impacts.

B. Energy Efficiency Program Stimulus Spending Assumptions

1. Industry:
We allocate spending by industry based on the employment within each six-digit industry code (NAICS) for each state. To do this, we extrapolate NAICS-specific industry employment in the following way:

- // Start with USEER 2020 employment by value chain (Construction, Professional and Business Services [PBS]) for each state.
- // Collect employment by state for all Construction and PBS NAICS we sampled for the USEER, see Table 7 and Table 8 for specific NAICS codes.[25]
- // Assume distribution of non-energy engineering-specified (NAICS 5413) employment among Professional and Business Services (PBS) NAICS Group is the same as in energy sector.
- // For energy-specific engineering NAICS employment, use proportion of engineering NAICS within PBS NAICS Group to split engineering employment out from USEER 2020 PBS employment into the different NAICS codes.
- // Assume distribution of non-energy construction employment across sampled NAICS is the same in the energy sector.
- // For energy-specific construction NAICS employment, use proportion of construction NAICS within Construction NAICS Group to split construction employment out from USEER 2020 Construction employment into the different NAICS codes.
- // Sum energy-specific construction and engineering NAICS employment, divide employment for each NAICS by sum to get industry percent allocation of spending within each state.

2. Region:
We base state allocation of funds on the US Department of Energy's (DOE) State Energy Program FY20 allocation distribution. This distribution was recently removed from the DOE website at the time of writing this report, but a downloaded version can be found in Table 9.[26] Total economic stimulus input is distributed through the percent allocation.

3. Region & Industry:
To calculate the allocation of spending by region and industry, we multiply the state allocation of total economic stimulus by the industry percent allocation of funds for each state. This final region-industry allocation is used as the input for the energy efficiency Program economic impact analysis.

C. Multipliers
Multipliers are pulled from Emsi, a labor force analytics and economic modeling tool built by Economic Modeling, LLC, using 2019 data, by industry, state, and nationally. Emsi uses BEA National Income and Product Accounts, Input-Output Make and Use Tables, and Gross State Product data for their multipliers. Imports of final and intermediate goods are properly accounted for in the purchase content of each industry multiplier. These do not include Puerto Rico, American Samoa, Guam, Northern Marianas, or U.S. Virgin Islands. Puerto Rico uses New Mexico as a proxy region for multipliers due to a similar industry mix and amount of employment.[27] The remaining territories are using Hawaii as the proxy region for multipliers.

D. EE Program Stimulus Direct, Indirect, and Induced Impacts
Economic impact analyses report Direct, Indirect, and Induced Impacts. The region-industry allocation is used as the initial Sales input value. This is used to derive Jobs, Earnings, and Value Added input values for a specific industry within a specific state through the Jobs to Sales, Earnings to Sales, and Value Added to Sales multipliers. These Jobs, Earnings, and Value Added input values are then used to find the Direct, Indirect, and Induced Impacts through the different multipliers. These impacts are interpreted as capital expenses, meaning they happen once.

E. Financial Services
Interest payments on the debt financed privately provide economic impacts to financial service institutions, the industries of which are found in Table 10. The private financing input percentage is multiplied by the state allocation of funds to calculate the amount of stimulus per state that is privately financed. The interest rate provided as an input is used to calculate the total interest payments over 15 years using a loan amortization calculator.[28] This serves as the value of interest rate payments included in the Energy Efficiency Stimulus Model section of the report.

F. Energy Cost Savings

Energy cost savings of $500 billion, described in the Input Methodology section, are used to estimate the EE Dividend savings, described in the Energy Efficiency Stimulus Model Output section of the report. To determine this, we calculate the sum of the cost of electric and heat savings made possible through the hypothetical energy efficiency stimulus. This resulted in $625 billion which was then reduced to $500 billion to be conservative in our estimations.

1. Energy Cost Savings Input:

The input for each of the electricity and natural gas cost savings models is the property owner contribution percentage multiplied by the state allocation described in Section B.2. This is allocated by Census Division between electricity and heating cost savings using EIA Form 861 data found in Table 4 of their 2015 report with Leidos Engineering LLC, *Analysis of Energy Efficiency Program Impacts Based on Program Spending*.[29] The five territories use the Pacific Census Division. These values are then allocated by NAICS by multiplying by the industry percent allocation of funds for each state.

2. Electricity Cost Savings Calculation:

- // The Lawrence Berkeley National Laboratory (LBNL) provides the savings-weighted average total cost of saved electricity ($/kWh) by residential, commercial, and all sectors in their 2015 report, *The Total Cost of Saving Electricity through Utility Customer-Funded Energy Efficiency Programs: Estimates at the National, State, Sector and Program Level*.
- // The inverse of these data points gives us kWh saved per $1 invested in EE programs for residential, commercial, and all sectors.
- // Multiply the kWh saved by the input described in subsection 1, above, according to NAICS specification and divide by the number of NAICS within each specification to find total kWh saved by the input stimulus amount. Construction industries are segmented into residential, commercial, and unspecified (Table 7).
- // The EIA Electric Power Monthly provides in Table 5.6.A the average price of electricity to ultimate customers by end-use sector, which includes residential, commercial, and all sectors, by cents/kWh for each state as of February 2020. Multiply the total kWh saved from the previous step by the cost of electricity within each state and by specification to find the total cost of electricity saved by NAICS for each state.
- // We use Puerto Rico as an electricity price proxy region for American Samoa, Guam, Northern Marianas, and U.S. Virgin Islands.

3. Natural Gas Heat Cost Savings Calculation:

- // The LBNL provides the average cost of saved energy (CSE) for natural gas energy efficiency programs by residential, commercial, and all sectors and four subregions, Northeast, South, Midwest, West, and All, in Table 2 of their May 2020 report, *Cost of saving natural gas through efficiency programs funded by utility customers: 2012-2017.*[30] The inverse is taken for each datapoint to calculate the number of therms saved per $ spent on natural gas energy efficiency programs.
- // Like the electric cost savings methodology, therms saved is multiplied by the input described in subsection 1, above, according to NAICS specification and divided by the number of NAICS within each specification to find total therms saved by the input stimulus amount.
- // The EIA provides monthly natural gas prices in dollars per thousand cubic feet by each state and by residential and commercial end-use sector.[31] This data is current as of February 2020, except for Delaware and New Mexico which use January 2020 data, and Minnesota which uses December 2019 data.
- // Since prices for All Sectors are not provided like they are with electric prices, the unspecified price of natural gas is the average between the residential and commercial prices.
- // Prices are converted to therms by dividing by 10.36, the conversion rate according to EIA.[32]
- // Multiply the total therms saved from the previous step by the cost of gas within each state and by specification to find the total cost of natural gas heat saved by NAICS for each state.
- // Hawaii is used as the natural gas price proxy region for the five territories.

The total cost of electricity saved and the total cost of heat saved by industry and state are summed to get the total cost of energy saved by industry and state, now defined as the EE Dividend Allocation.

G. Final Outputs:

The impact analysis produces the following outputs for each state, the five territories, and the US as a whole, per year over the course of five years:

- // Direct, Indirect, Induced, and Total Jobs
- // Direct, Indirect, Induced, and Total Earnings
- // Direct, Indirect, Induced, and Total Value Added

Earnings can be interpreted as employee income, and Value Added can be interpreted as GDP.

TABLE 7. CONSTRUCTION NAICS GROUP

NAICS	NAICS Description	Specification
236115	New Single-Family Housing Construction (except For-Sale Builders)	Residential
236116	New Multifamily Housing Construction (except For-Sale Builders)	Residential
236117	New Housing For-Sale Builders	Residential
236118	Residential Remodelers	Residential
236210	Industrial Building Construction	Commercial
236220	Commercial and Institutional Building Construction	Commercial
237110	Water and Sewer Line and Related Structures Construction	Unspecified
238110	Poured Concrete Foundation and Structure Contractors	Unspecified
238120	Structural Steel and Precast Concrete Contractors	Unspecified
238140	Masonry Contractors	Unspecified
238150	Glass and Glazing Contractors	Unspecified
238160	Roofing Contractors	Unspecified
238170	Siding Contractors	Unspecified
238210	Electrical Contractors and Other Wiring Installation Contractors	Unspecified
238220	Plumbing, Heating, and Air-Conditioning Contractors	Unspecified
238310	Drywall and Insulation Contractors	Unspecified
238320	Painting and Wall Covering Contractors	Unspecified
238330	Flooring Contractors	Unspecified
238350	Finish Carpentry Contractors	Unspecified
238390	Other Building Finishing Contractors	Unspecified
238910	Site Preparation Contractors	Unspecified
238990	All Other Specialty Trade Contractors	Unspecified

TABLE 8. PROFESSIONAL AND BUSINESS SERVICES (PBS) NAICS GROUP

NAICS	NAICS Description	Specification
523920	Portfolio Management	Other PBS
523930	Investment Advice	Other PBS
541110	Offices of Lawyers	Other PBS
541211	Offices of Certified Public Accountants	Other PBS
541310	Architectural Services	Engineering
541330	Engineering Services	Engineering
541340	Drafting Services	Engineering
541350	Building Inspection Services	Engineering
541380	Testing Laboratories	Engineering
541511	Custom Computer Programming Services	Other PBS
541612	Human Resources Consulting Services	Other PBS
541613	Marketing Consulting Services	Other PBS
541614	Process, Physical Distribution, and Logistics Consulting Services	Other PBS
541618	Other Management Consulting Services	Other PBS
541690	Other Scientific and Technical Consulting Services	Other PBS
541713	Research and Development in Nanotechnology	Other PBS
541714	Research and Development in Biotechnology (except Nanobiotechnology)	Other PBS

TABLE 9. DOE STATE ENERGY PROGRAM (SEP) FY20 ALLOCATION

	Dollar Allocation	Percent Allocation
Alaska	$447,530	0.8%
Alabama	$914,490	1.6%
Arkansas	$692,700	1.2%
American Samoa	$298,870	0.5%
Arizona	$885,880	1.6%
California	$3,809,360	6.8%
Colorado	$895,290	1.6%
Connecticut	$769,830	1.4%
District of Columbia	$376,440	0.7%
Delaware	$402,630	0.7%
Florida	$2,058,830	3.7%
Georgia	$1,320,210	2.4%
Guam	$309,520	0.6%
Hawaii	$425,070	0.8%
Iowa	$814,800	1.5%
Idaho	$479,780	0.9%
Illinois	$2,148,950	3.8%

	Dollar Allocation	Percent Allocation
Indiana	$1,302,570	2.3%
Kansas	$712,270	1.3%
Kentucky	$905,080	1.6%
Louisiana	$1,238,430	2.2%
Massachusetts	$1,158,640	2.1%
Maryland	$991,160	1.8%
Maine	$496,260	0.9%
Michigan	$1,762,710	3.1%
Minnesota	$1,127,430	2.0%
Missouri	$1,072,710	1.9%
Northern Marianas	$297,710	0.5%
Mississippi	$678,650	1.2%
Montana	$439,200	0.8%
North Carolina	$1,314,330	2.3%
North Dakota	$440,680	0.8%
Nebraska	$577,510	1.0%
New Hampshire	$473,170	0.8%

	Dollar Allocation	Percent Allocation
New Jersey	$1,471,080	2.6%
New Mexico	$538,150	1.0%
Nevada	$538,460	1.0%
New York	$2,825,340	5.0%
Ohio	$2,006,330	3.6%
Oklahoma	$825,480	1.5%
Oregon	$737,810	1.3%
Pennsylvania	$2,078,180	3.7%
Puerto Rico	$664,240	1.2%
Rhode Island	$433,770	0.8%
South Carolina	$841,860	1.5%
South Dakota	$415,820	0.7%

	Dollar Allocation	Percent Allocation
Tennessee	$1,087,870	1.9%
Texas	$3,703,180	6.6%
Utah	$599,080	1.1%
Virginia	$1,250,720	2.2%
U.S. Virgin Islands	$330,170	0.6%
Vermont	$387,830	0.7%
Washington	$1,054,960	1.9%
Wisconsin	$1,157,140	2.1%
West Virginia	$606,000	1.1%
Wyoming	$407,840	0.7%
TOTAL US	**$56,000,000**	

TABLE 10. FINANCIAL SERVICES FIRMS NAICS GROUP

NAICS	NAICS Description
523120	Securities Brokerage
523991	Trust, Fiduciary, and Custody Activities
523110	Investment Banking and Securities Dealing
522292	Real Estate Credit

TABLE 11. REGION DEFINITIONS

	Region
Alaska	West
Alabama	South
Arkansas	South
Arizona	West
California	West
Colorado	West
Connecticut	Northeast
District of Columbia	South
Delaware	Northeast
Florida	South
Georgia	South
Hawaii	West
Iowa	Midwest
Idaho	West
Illinois	Midwest
Indiana	Midwest
Kansas	Midwest
Kentucky	South
Louisiana	South

	Region
Massachusetts	Northeast
Maryland	South
Maine	Northeast
Michigan	Midwest
Minnesota	Midwest
Missouri	Midwest
Mississippi	South
Montana	West
North Carolina	South
North Dakota	Midwest
Nebraska	Midwest
New Hampshire	Northeast
New Jersey	Northeast
New Mexico	West
Nevada	West
New York	Northeast
Ohio	Midwest
Oklahoma	South
Oregon	West

	Region
Pennsylvania	Northeast
Rhode Island	Northeast
South Carolina	South
South Dakota	Midwest
Tennessee	South
Texas	South
Utah	West
Virginia	South
Vermont	Northeast
Washington	West
Wisconsin	Midwest
West Virginia	South
Wyoming	West
American Samoa	All
Guam	All
Northern Marianas	All
Puerto Rico	All
U.S. Virgin Islands	All

RENEWABLE ENERGY

Input Methodology

The inputs for the renewable energy economic impact model include a five-year extension of the Production Tax Credit and Investment Tax Credit, and a two-year extension of the Section 1603 Grant Program. The total costs of these programs in lost tax revenues are found in a 2014 Government Accountability Office report titled *Information on Federal and Other Factors Influencing U.S. Energy Production and Consumption from 2000 through 2013*.[33] Additional assumptions for the model include a total of $1.5 billion in port infrastructure investments for the following select states: Rhode Island, Massachusetts, Connecticut, Maine, North Carolina, Virginia, New Jersey, and New York.

Economic Impact Model Methodology

This model studies the impact of a renewal of the Production Tax Credit and Income Tax Credit programs, as well as the Section 1603 grant program has on Renewable Energy Generation. The economic impacts measured in this model capture impacts from the engineering, construction, and operation of renewable energy projects funded by these stimulus programs. This model also captures impacts from investments into port infrastructure. Total economic impacts are all interpreted over the course of five years.

A. Economic Input

1. PTC and ITC Program Inputs:

Inputs to our model from the PTC and ITC programs are derived from a 2016 NREL report titled *Impacts of Federal Tax Credit Extensions on Renewable Deployment and Power Sector Emissions*. In Table A2 of the report, annual changes to renewable energy installed capacity are modeled under two scenarios, one with an extension to the PTC and ITC programs and one without an extension. Table A2 also assumes a low Natural Gas price scenario in which Natural Gas has an estimated Henry Hub spot price of $3.12/million Btu in 2020, which is above the $2.02/million Btu measured in January of this year.[34] Annual installed capacity changes are distinguished by Solar, Wind, and All Renewable Energy and are modeled over five years.

To adjust for increases in installed capacity since 2016, we take annual changes to installed capacity as a percentage of 2015 installed capacity, found in NREL's *2018 Renewable Energy Data Book*, released February 2020. Using this most recent installed capacity data from the same source, 2018 data serves as the new base, and we apply the percentage change in installed capacity to update the modeled changes. We subtract solar and wind capacity changes from the All Renewable changes to derive All Other Renewable Energy changes in installed capacity.

We use the share of 2019 annual total net generation data for Small-Scale Solar and Utility Solar data from Table 1.1.A from EIA's Electric Power Monthly to split the Solar modeled annual changes to installed capacity into Residential and Utility scale for input into our multipliers.

Lost tax revenue was calculated by assuming annual costs equal to the Government Accountability Office's annual cost estimate of PTC, ITC, and Section 1603 grants from 2000 to 2013.[35] These are calculated for five years for the PTC and ITC programs, and two years for the Section 1603 programs. This final cost is then adjusted for inflation.

2. Section 1603 Inputs:

The Department of the Treasury released a 2018 report titled *Final Overview of the §1603 Program*. Figure 3 of this report details Section 1603 funded renewable installed capacity from 2009 through 2017 for Wind, Non-Residential Solar, Residential Solar, Biomass, Geothermal, and Other Renewable. We combine Residential and Non-Residential Solar into Solar, and combine Biomass, Geothermal, and Other into All Other Renewables. We calculate the share of Section 1603 funded installed capacity from 2009-2017 by taking the change in installed capacity over the same period from NREL's *2018 Renewable Energy Data Book* for Solar, Wind, and All Other Renewables as defined above.

15 years of projected installed capacity for Solar, Wind, and other Renewables is found in the EIA's Annual Energy Outlook 2020, which projects installed capacity out to 2050. We combine Solar Thermal and Solar Photovoltaics into Solar, Wind and Offshore Wind into Wind, and Conventional Hydroelectric Power, Geothermal, Municipal Waste, and Wood and Other Biomass into All Other Renewables. We apply the percentage of Section 1603 funded installed capacity to each annual

projected increase in installed capacity for each technology: Solar, Wind, and Other Renewables. Projected Solar installed capacity is then further distinguished into Residential and Utility by taking the share of total Section 1603 funded Solar installed capacity and applying it to each annual projected increase in installed capacity. The Section 1603 adjusted projected MW of installed capacity for Residential Solar, Utility Solar, Wind, and All Other Renewables from 2020 to 2022 serve as the two years of inputs into our model.

B. Multipliers

We derive economic impact multipliers from a 2017 report conducted by BW Research on behalf of Vote Solar and the Union of Concerned Scientists.[36] This report studied the economic impact of increased installed capacity of solar and wind electric power generation in Michigan. Multipliers from this study generate output in terms of Direct, Indirect, and Induced Jobs per MW, as well as Local, State, and Federal Tax impacts per MW specific to Wind Construction, Wind Operations and Maintenance (O&M), Utility Solar Construction, Utility Solar Operations and Maintenance (O&M), and Distributed Solar Construction. Other Renewable Energy (RE) Construction and Other Renewable Energy (RE) Operations and Maintenance (O&M) multipliers were derived by taking a weighted average of the previously listed impacts. Wind, Distributed Solar, Utility Solar, and Other RE are our four technologies, and Construction and O&M are our two project phases.

Annual changes in installed capacity of Residential Solar are input into Distributed Solar Construction multipliers, changes in installed capacity of Utility Solar are input into Utility Solar Construction and Utility Solar O&M multipliers, changes in installed capacity of Wind are input into Wind Construction and Wind O&M multipliers, and changes in installed capacity of All Other Renewables are input into Other RE Construction and Other RE O&M multipliers.

We use multipliers from this study as they were specifically designed to capture the full economic impact of renewable energy project construction, engineering, development, and maintenance, something other industry multipliers fall short of. What these multipliers lack in regional differences, they make up for with their specificity to renewable energy activity.

C. Impacts

We model impacts from the PTC and ITC under both scenarios, one in which there is an extension of the programs and one in which there is not. After impacts are calculated by running our inputs through our multipliers, we aggregate the total impacts of five years under both scenarios and subtract the difference for each technology and project phase. This ensures we are only capturing the additional economic impact of these programs. Section 1603 impacts are run for two years and aggregated for each technology and project phase.

D. Outputs and State Disaggregation

This model produces outputs in terms of Direct, Indirect, and Induced Jobs and Value Added, as well as Local, State, and Federal Tax impacts, at the national and state level and for Guam, Puerto Rico, and the U.S. Virgin Islands. These outputs are to be interpreted as per year over the course of five years.

PTC and ITC impacts are run at the national level and split out by state using US Energy and Employment Report (USEER) state employment for Solar Electric Power Generation, Wind Electric Power Generation, and All Renewable Electric Power Generation. The three territories included in this analysis used Delaware as an employment proxy region when calculating state impacts for the PTC and ITC programs.

Section 1603 impacts are run at the national level and split out by state using the state share of total Section 1603 funded installed capacity from 2009-2018 provided in Table 12.

Value Added outputs use a weighted average of Emsi multipliers from the Grid Stimulus Model Industry Mix. These outputs are calculated using the final direct jobs as the initial input value and direct, indirect, and induced impacts are calculated using the same methodology described in the Grid Stimulus methodology section.

E. Port Infrastructure

Increased use of investments into port infrastructure will be necessary to develop the future increase in installed capacity of offshore wind. To calculate the impacts of such activity, we use Emsi multipliers for the Port Operations industry, NAICS code 488310 for Connecticut, Massachusetts, Maine, North Carolina, New Jersey, New York, Rhode Island, and Virginia. We assume $200 million input value for each state except Rhode Island, which we assume will receive $120 million. These values serve as the initial input value, which when run through the Emsi multipliers, calculate Direct, Indirect, and Induced Jobs, as well as Local, State, and Federal Tax impacts.

TABLE 12. SECTION 1603 STATE ALLOCATION

	Installed Capacity (MW)	MW Share
Alabama	5.41	0.0%
Alaska	25.59	0.1%
Arizona	1,323.46	3.8%
Arkansas	0.13	0.0%
California	8,377.72	24.2%
Colorado	668.46	1.9%
Connecticut	103.94	0.3%
Delaware	47.68	0.1%
District of Columbia	1.27	0.0%
Florida	211.38	0.6%
Georgia	248.19	0.7%
Guam	38.43	0.1%
Hawaii	231.47	0.7%
Idaho	899.66	2.6%
Illinois	2,092.34	6.0%
Indiana	637.61	1.8%
Iowa	997.77	2.9%
Kansas	212.00	0.6%
Kentucky	2.51	0.0%
Louisiana	33.90	0.1%
Maine	457.36	1.3%
Maryland	231.03	0.7%
Massachusetts	405.10	1.2%
Michigan	506.63	1.5%
Minnesota	677.32	2.0%
Mississippi	0.64	0.0%
Missouri	352.27	1.0%

	Installed Capacity (MW)	MW Share
Montana	190.67	0.6%
Nebraska	183.85	0.5%
Nevada	1,202.40	3.5%
New Hampshire	261.70	0.8%
New Jersey	822.09	2.4%
New Mexico	327.74	0.9%
New York	1,063.45	3.1%
North Carolina	338.09	1.0%
North Dakota	483.55	1.4%
Ohio	526.26	1.5%
Oklahoma	684.47	2.0%
Oregon	1,782.61	5.1%
Pennsylvania	1,009.09	2.9%
Puerto Rico	264.44	0.8%
Rhode Island	43.50	0.1%
South Carolina	80.74	0.2%
South Dakota	469.83	1.4%
Tennessee	63.24	0.2%
Texas	3,406.56	9.8%
Utah	368.91	1.1%
Vermont	87.62	0.3%
U.S. Virgin Islands	11.01	0.0%
Virginia	139.96	0.4%
Washington	1,469.67	4.2%
West Virginia	256.13	0.7%
Wisconsin	115.31	0.3%
Wyoming	200.02	0.6%

GRID MODERNIZATION

Input Methodology

The inputs for the economic impact model of grid modernization stimulus investments are as follows:

Utility Communications & Broadband:

- $2 billion for Rural Utility Services for rural co-operatives
- $2 billion for DOE OE Smart Grid Matching Grant Program for Investor Owned Utilities (IOUs)

Grid Flexibility Enhancement:

- $6 billion for DOE OE Smart Grid Matching Grant Program
- $5 billion to DOE Power Marketing Administration

Building-to-Grid Integration:

- $2 billion to DOE OE Smart Grid Matching Grant Program for reaching 100 percent deployment of smart meters or smart inverters
- $3 billion to DOE Federal Energy Management Systems for procurement and installation of grid-integrated Energy Management Systems for federal buildings
- $1 billion to DOE Energy Efficiency and Conservation Block Grants program for states to establish or continue rebate program for smart appliances with capability for demand response
- $3 billion for procurement and installation of grid-integrated Energy Management Systems for state and local government buildings

Cybersecurity Technology Workforce:

- $500 million to DOE Cybersecurity for Energy Delivery Systems (CEDS) for cybersecurity workforce development
- $500 million to DOE CEDS for cyber assessments and cyber threat monitoring for small and medium utilities
- $1 billion to DOE Office of Cybersecurity, Energy Security, and Emergency Response (CESER) and USDA Rural Utilities Service (RUS) for cybersecurity technology deployment

Mission Critical Infrastructure:

- $1 billion for Microgrids
- $6 billion for Hardening and Resilience

Workforce Development:

- $400 million to DOE Office of Electricity for workforce training for digital, high-tech grid jobs
- $100 million to DOE Office of Economic Impact and Diversity

Economic Impact Model Methodology

The economic impacts measured in this model capture impacts from the construction, manufacturing, engineering, and workforce development of Grid programs funded by this stimulus.

A. Economic Input

The total economic stimulus model includes two inputs: 1) federal stimulus, and 2) total capital leverage rate. The total capital leverage rate is derived from the stimulus portfolio and is input as a percent of federal stimulus. Total capital leverage rate multiplied by the federal stimulus is the total economic stimulus input for the execution of Grid projects.

To account for interstate economic activity, we ran grid stimulus program impacts at the state and national level, using state and national multipliers. The final, reported direct and indirect impacts are calculated using national level multipliers which are broken out by state by using each state's share of total aggregated impacts when run using the state level multipliers. The induced impacts are the total aggregated induced impacts for all 50 states, D.C., and the territories. We chose this method of calculating total impacts to capture indirect impacts that are not accounted for when limiting impacts to state boundaries, while avoiding overestimation of induced impacts.

B. Grid Program Stimulus Spending Assumptions

The programs listed as inputs for this model determine the allocation of funds into different industries. Table 13 shows how the different programs allocate funds to different industries. We allocate funds into the Industry Mix, a group of Computer Engineering industries, and Workforce Development, classified by the North American Industry Classification System (NAICS) as code 611420, Computer Training.

1. Industry Mix:

Some stimulus programs target a swath of industry activities, we call this group of industries the Industry Mix. A breakdown of allocated funds by industry or industry group within the Industry Mix, as well as industry group definitions, are found in Table 14. Funds allocated to the Industry Mix are allocated to specific industries based on the percent allocation stated in the table.

We allocate spending by specific industry within the Manufacturing and Computer Engineering industry groupings based on the share of employment within each six-digit industry for each state.

2. Region:

We base state allocation of funds on the US Department of Energy's (DOE) State Energy Program FY20 allocation distribution. This distribution was recently removed from the DOE website at the time of writing this report, but a downloaded version can be found in Table 15.[37] Economic stimulus input is distributed through the percent allocation.

3. Region & Industry:

To calculate the allocation of spending by region and industry, we multiply the state allocation of economic stimulus by the industry allocation of funds for each state. This final region-industry allocation is used as the input sales for the Grid Program economic impact analysis.

C. Multipliers

Multipliers are pulled from Emsi using 2019 data, by industry, state, and nationally. Emsi uses BEA National Income and Product Accounts, Input-Output Make and Use Tables, and Gross State Product data for their multipliers. Imports of final and intermediate goods are properly accounted for in the purchase content of each industry multiplier. These do not include Puerto Rico, American Samoa, Guam, Northern Marianas, or U.S. Virgin Islands. Puerto Rico uses New Mexico as a proxy region for multipliers due to similar industry mix and amount of employment.[38] The remaining territories are using Hawaii as the proxy region for multipliers.

D. Grid Program Stimulus Direct, Indirect, and Induced Impacts

Economic impact analyses report Direct, Indirect, and Induced Impacts. The region-industry allocation is used as the initial input value. This is used to derive Jobs, Earnings, and Value Added input values for a specific industry within a specific state through the Jobs to Sales, Earnings to Sales, and Value Added to Sales multipliers. These Jobs, Earnings, and Value Added input values are then used to find the Direct, Indirect, and Induced Impacts through the different multipliers. These impacts are interpreted as capital expenses, meaning they happen once.

E. Final Outputs

The impact analysis produces the following outputs for each state, the five territories, and the US as a whole, per year over the course of five years:

- Direct, Indirect, Induced, and Total Jobs
- Direct, Indirect, Induced, and Total Earnings
- Direct, Indirect, Induced, and Total Value Added

Earnings can be interpreted as employee income, and Value Added can be interpreted as GDP.

TABLE 13. PROGRAM DESCRIPTION AND INDUSTRY ALLOCATION OF FUNDS

Federal Stimulus (Billion $)	Match	Total Stimulus (Billion $)	NAICS	Description
2	0%	2	Industry Mix	Rural Utility Services for rural cooperatives
1	100%	2	Industry Mix	DOE OE Smart Grid Matching Grant Program for Investor Owned Utilities and Public Power
3	100%	6	Industry Mix	DOE OE Smart Grid Matching Grant Program
5	0%	5	Industry Mix	DOE Power Marketing Administrations with a portion being used for grant programs to preference customers to modernize their interconnections and distributions systems
1	100%	2	Industry Mix	DOE OE Smart Grid Matching Grant Program for reaching 100% deployment of smart meters (could also be used for smart inverters)
3	0%	3	Industry Mix	DOE Federal Energy Management Systems for procurement and installation of grid-integrated Energy Management Systems for federal buildings
3	0%	3	Industry Mix	DOE State Energy Program for procurement and installation of grid-integrated Energy Management Systems for state and local government buildings
1	0%	1	Industry Mix	DOE Energy Efficiency and Conservation Block Grants program for states to establish or continue rebate program for smart appliances with capability for demand response
0.5	0%	0.5	Workforce Development	DOE Cybersecurity for Energy Delivery Systems (CEDS) for cybersecurity workforce development
0.5	0%	0.5	Computer Engineering	DOE CEDS for cyber assessments and cyber threat monitoring for small and medium utilities
1	0%	1	Computer Engineering	DOE CESER and USDA RUS for cybersecurity technology deployment
1	0%	1	Industry Mix	Microgrids
3	100%	6	Industry Mix	Hardening/Resilience
0.4	0%	0.4	Workforce Development	DOE Office of Electricity for workforce training for digital, high tech grid jobs with $100 million to DOE Office of Economic Impact and Diversity

TABLE 14. INDUSTRY MIX ALLOCATION OF FUNDS AND INDUSTRY GROUPING SPECIFICATION

Share	Grouping	NAICS	Description
5%	N/A	221121	Electric Bulk Power Transmission and Control
5%	N/A	221122	Electric Power Distribution
30%	N/A	237130	Power and Communication Line and Related Structures Construction
10%	N/A	238210	Electrical Contractors and Other Wiring Installation Contractors
30%	Manufacturing	334220	Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing
		334514	Totalizing Fluid Meter and Counting Device Manufacturing
		334515	Instrument Manufacturing for Measuring and Testing Electricity and Electrical Signals
		335999	All Other Miscellaneous Electrical Equipment and Component Manufacturing
20%	Computer Engineering	511210	Software Publishers
		518210	Data Processing, Hosting, and Related Services
		541511	Custom Computer Programming Services
		541512	Computer Systems Design Services
		541519	Other Computer Related Services

ENDNOTES

1 Our modeling defines "jobs" as a full-time job lasting one year or job-years for direct, indirect, and induced jobs. For this report we present the total of direct, indirect, and induced jobs created during the construction phase of stimulus projects divided by five, which provides the average total jobs for each year of the stimulus program. By presenting the net jobs created, we show how stimulus spending could positively impact overall employment levels.

2 BW Research, E2, E4TheFuture, American Council on Renewable Energy. Clean Energy Employment Initial Impacts from the COVID-19 Economic Crisis, May 2020, available at https://e2.org/wp-content/uploads/2020/06/Clean-Energy-Jobs-May-COVID-19-Memo-Final.pdf.

3 Job-years are defined as a full-time job for one year.

4 Executive Office of the President. A Retrospective Assessment of Clean Energy Investments in the Recovery Act, February 2016. https://obamawhitehouse.archives.gov/the-press-office/2016/02/25/fact-sheet-recovery-act-made-largest-single-investment-clean-energy.

5 https://www.smithschool.ox.ac.uk/publications/wpapers/workingpaper20-02.pdf.

6 Energy Futures Initiative and the National Association of State Energy Officials. *United States Energy and Employment Report, 2020*, available at http://usenergyjobs.org.

7 International Energy Agency. Energy Efficiency 2018: Analysis and outlooks to 2040. https://www.iea.org/reports/energy-efficiency-2018

8 BW Research, E2, E4TheFuture, American Council on Renewable Energy. Clean Energy Employment Initial Impacts from the COVID-19 Economic Crisis, May 2020, available at https://e2.org/wp-content/uploads/2020/06/Clean-Energy-Jobs-May-COVID-19-Memo-Final.pdf.

9 See Appendix F for more information.

10 Our modeling defines "jobs" as a full-time job lasting one year or job-years for direct, indirect, and induced jobs. For this report we present the total of direct, indirect, and induced jobs created during the construction phase of stimulus projects divided by five, which provides the average total jobs for each year of the stimulus program. By presenting the net jobs created, we show how stimulus spending could positively impact overall employment levels.

11 Lawrence Berkeley National Laboratory. Cost of saving natural gas through efficiency programs funded by utility customers: 2012-2017, available at: https://eta-publications.lbl.gov/sites/default/files/cose_natural_gas_final_report_20200513.pdf.

12 BW Research, E2, E4TheFuture, American Council on Renewable Energy. Clean Energy Employment Initial Impacts from the COVID-19 Economic Crisis, May 2020, available at https://e2.org/wp-content/uploads/2020/06/Clean-Energy-Jobs-May-COVID-19-Memo-Final.pdf.

13 The White House. FACT SHEET: The Recovery Act Made The Largest Single Investment In Clean Energy In History, Driving The Deployment Of Clean Energy, Promoting Energy Efficiency, And Supporting Manufacturing, February 2016. https://obamawhitehouse.archives.gov/the-press-office/2016/02/25/fact-sheet-recovery-act-made-largest-single-investment-clean-energy.

14 https://e2.org/wp-content/uploads/2020/04/E2-Clean-Jobs-America-2020.pdf.

15 National Renewable Energy Laboratory. Preliminary Analysis of the Jobs and Economic Impacts of Renewable Energy Projects Supported by the §1603 Treasury Grant Program, April 2012.

16 Department of Energy. Computing America's Offshore Wind Energy Potential, September 2016. https://www.energy.gov/eere/articles/computing-america-s-offshore-wind-energy-potential.

17 Department of Energy. Assessment of Ports for Offshore Wind Development in the United States, March 2014.

18 BW Research, E2, E4TheFuture, American Council on Renewable Energy. Clean Energy Employment Initial Impacts from the COVID-19 Economic Crisis, May 2020, available at https://e2.org/wp-content/uploads/2020/06/Clean-Energy-Jobs-May-COVID-19-Memo-Final.pdf.

19 U.S. Department of Energy. Quadrennial Technology Review. Chapter 3: Enabling Modernization of the Electric Power System, 2015. https://www.energy.gov/sites/prod/files/2015/09/f26/QTR2015-3F-Transmission-and-Distribution_1.pdf.

20 *See generally:* U.S. Department of Energy, Office of Electricity Delivery and Energy Reliability.

21 Chattanooga Times Free Press. Study Finds EPB Fiber Optics Generates Over $865 Million in Benefits for Chattanooga, September 2015. https://www.timesfreepress.com/news/business/aroundregion/story/2015/sep/15/study-finds-epb-fiber-optics-generates-over-865-million-benefits-chattanooga/325235.

22 Lindsey, Nicole. Cybersecurity Workforce Shortage Continues to Grow. CPO Magazine, November 2019. https://www.cpomagazine.com/cyber-security/cybersecurity-workforce-shortage-continues-to-grow.

23 Link to copy of memo on E4 website.

24 For further details on specific policies and leveraging assumptions please contact E4TheFuture at policy@e4thefuture.org.

25 Employment pulled from EMSI, which includes BLS QCEW employment and non-QCEW employment derived from County & ZIP Business Patterns, the Railroad Retirement Board, and the American Community Survey.

26 https://www.energy.gov/sites/prod/files/2020/03/f73/PY20-SEP-Formula-Allocations.pdf.

27 BLS, Feb 2020 employment. PR: https://www.bls.gov/eag/eag.pr.htm, NM: https://www.bls.gov/regions/southwest/new_mexico.htm#eag.

28 https://www.calculator.net/loan-calculator.html.

29 Definitions of Census Divisions: https://en.wikipedia.org/wiki/United_States_Census_Bureau#Census_regions_and_divisions.

30 Regions defined in Table 12.

31 Residential prices: https://www.eia.gov/dnav/ng/ng_pri_sum_a_EPG0_PRS_DMcf_m.htm. Commercial prices: https://www.eia.gov/dnav/ng/ng_pri_sum_a_EPG0_PCS_DMcf_m.htm.

32 https://www.eia.gov/tools/faqs/faq.php?id=45&t=8.

33 Information on Federal and Other Factors Influencing U.S. Energy Production and Consumption from 2000 through 2013.

34 Natural gas spot prices: https://www.eia.gov/dnav/ng/hist/rngwhhdm.htm. Low gas scenario definition: https://www.eia.gov/outlooks/aeo/pdf/0383(2015).pdf.

35 US Government Accountability Office. Information on Federal and Other Factors Influencing U.S. Energy Production and Consumption from 2000 through 2013, September 2014.

36 https://votesolar.org/files/9115/2037/6259/VoteSolar_Memo_Report_2.1_2.pdf.

37 https://www.energy.gov/sites/prod/files/2020/03/f73/PY20-SEP-Formula-Allocations.pdf.

38 BLS, Feb 2020 employment. PR: https://www.bls.gov/eag/eag.pr.htm, NM: https://www.bls.gov/regions/southwest/new_mexico.htm#eag.