ECONOMIC IMPACT OF STIMULUS INVESTMENT IN ADVANCED ENERGY

AN ECONOMIC ASSESSMENT OF APPLYING STIMULUS FUNDS TO ADVANCED ENERGY TECHNOLOGIES, PRODUCTS, AND SERVICES IN TEXAS

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TEXAS ADVANCED ENERGY BUSINESS ALLIANCE

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ABOUT ANALYSIS GROUP

Analysis Group is one of the largest international economics consulting firms, with more than 1,000 professionals across 14 offices in North America, Europe, and Asia. Since 1981, Analysis Group has provided expertise in economics, finance, health care analytics, and strategy to top law firms, Fortune Global 500 companies, government agencies, and other clients worldwide.

ABOUT TEXAS ADVANCED ENERGY BUSINESS ALLIANCE

Texas Advanced Energy Business Alliance (TAEBA) includes local and national advanced energy companies seeking to make Texas's energy system secure, clean, reliable, and affordable. TAEBA's mission is to raise awareness among policymakers and the general public about the opportunity offered by all forms of advanced energy for cost savings, electric system reliability and resiliency, and economic growth in the state of Texas. Learn more at texasadvancedenergy.org and follow our latest news @TXAdvEnergyBiz.

EXECUTIVE SUMMARY

In the wake of the coronavirus pandemic, states will need to make decisions about where and how to invest government dollars – whether state funds dedicated for this purpose or potential stimulus funding from the federal government – to get their economies moving again.

This report focuses on one way in which government stimulus dollars could be put to work in the state of Texas – investment in advanced energy technologies. Focusing stimulus spending on programs and infrastructure in advanced energy technologies can generate economic activity while also helping Texas maintain its national leadership in energy.

For the purpose of this analysis, we postulate a hypothetical level of stimulus spending invested across a range of advanced energy technologies and services: energy efficiency, renewable energy (solar and wind), electrification of buildings, electrification of transportation (electric vehicles and charging infrastructure), energy storage, grid modernization (microgrids, combined heat and power), and high-voltage transmission.

We then estimate the economic impact of these investments using an industry-standard macroeconomic model (IMPLAN), focusing on overall contribution to the Texas economy, level of private spending and investment stimulated by these investments, jobs created, and consumer savings on energy costs.

$55 B in Stimulus Produces

- **$350 B** Added to the Texas Economy
- **$18 B** in Tax Revenue
- Over **2 M** New Jobs (job-years)
- Over **$14 B** in Annual Consumer Savings

For Texas

The results of the analysis point to strong economic benefits associated with advanced energy technology investments. In short, **an advanced energy stimulus investment of $55 billion** in Texas would produce the following economic benefits:

- **$350 billion** added to the Texas economy;
- **Over 2 million new jobs**, measured in job-years, resulting in a mix of short-term construction or installation employment and more ongoing positions;
- **$18 billion of additional tax revenue** to local and state governments; and
- **Over $14 billion in annual consumer savings**.

A greater or lesser level of stimulus investment would result in greater or lesser economic impact. But our analysis finds that advanced energy stimulus can generate **a return on investment on the order of six times the level of public expenditure** for the state of Texas, adding substantial value to the Texas economy, creating millions of jobs, and sending additional revenue to state and local governments.

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As of September, over 190 countries have responded to the worldwide coronavirus pandemic with some form of economic relief.[1] The specifics vary widely, but the basic idea is the same: introduce public money to bolster health care efforts, support people's ability to meet basic needs, help businesses that are threatened, and stimulate economic activity to generate income and jobs.

In the U.S., individual states have also had to respond to the public health crisis with emergency spending measures. Going forward, they too will be faced with the challenge of jumpstarting their economies in its wake. Whether in dedicating state funds for this purpose or making decisions about where to put federal stimulus funds (should they be forthcoming), states will need to make decisions about how to deploy dollars to stimulate economic growth.

In this report we focus on one way in which government stimulus dollars could be put to use in the state of Texas – investment in advanced energy technologies. Focusing stimulus spending on programs and infrastructure in advanced energy technologies can generate economic activity while also helping Texas maintain its global leadership position in energy. The advanced energy technologies considered for the analysis include:

- Energy efficiency (EE) measures and programs;
- Renewable electric generating resources (solar, wind);
- Electrification of buildings (electric heating, cooling, and appliance installations);
- Electrification of transportation (public investment in or support for private or commercial vehicle charging infrastructure, and support for the purchase of electric vehicles (EV));
- Energy storage installation;
- Grid modernization and distributed grid resources (e.g., microgrids, combined heat and power, and other integrated distribution system technologies);
- High-voltage transmission to access remote renewable resources (e.g., new wind and solar resources); and

[1] International Monetary Fund, *Policy Responses to COVID-19*, updated as of August 28, 2020. https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19.

- Other low/zero-carbon fuel sources.

The analysis sets a hypothetical level of stimulus spending and allocates the stimulus dollars across advanced energy technologies. It then estimates the economic impacts of these investments using an industry-standard macroeconomic model (IMPLAN), focusing on a number of key questions:

- How would public investments in a range of advanced energy technologies affect the state's economy, and generate jobs and tax revenues?
- To what extent would public spending in these areas stimulate private investment, and amplify the economic impacts of the stimulus spending?
- How do the results in overall economic activity, job growth, and other economic benefits vary across the technologies and programs?

The starting point for the analysis is a hypothetical $55 billion of economic stimulus investment, spread across a range of advanced energy technologies (as described in Section II). Allocation of this investment is weighted toward technologies and products that based on historical experience are likely to generate significant in-state economic activity, with proven capacity to attract participation from customers and investors, thereby adding private investment to the overall economic impact.

The results of the analysis point to advanced energy stimulus spending as a strong pump-primer for private investment, job creation, and economic growth. In short, **$55 billion of advanced energy stimulus investment** in Texas would generate the following economic benefits:

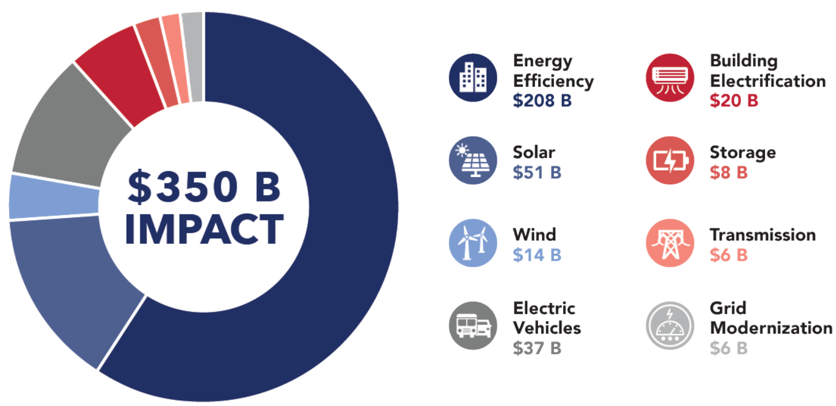
- **$350 billion** added to the Texas economy;
- **Over 2 million new jobs,** measured in job-years, resulting in a mix of short-term construction/installation employment and more ongoing positions;
- **$18 billion of additional tax revenue** to local and state governments; and
- **Over $14 billion in annual consumer savings.**

All categories of advanced energy stimulus spending generate positive impact on the economy, jobs, and tax revenue. The overall benefits accrue due to the direct impact of stimulus spending and private investment, as well as additional economic activity induced by the additional flow of dollars in the economy.

Figures 1 and 2 show how our allocation of $55 billion in stimulus – which is representative rather than prescriptive – translates into economic activity on a technology-by-technology basis, as measured by overall economic impact (addition to Gross State Product or GSP) and jobs created. In total, **$55 billion of advanced energy stimulus results in $134 billion in complementary private investment, $350 billion in overall economic activity, and increase in employment of 2.2 million jobs, measured in job-years, for Texas.**

Energy efficiency investments give the greatest overall boost to the Texas economy, totaling $208 billion in GSP. The next biggest impact comes from renewable energy generation (solar and wind), totaling $65 billion, followed by electrification of transportation, with $37 billion in economic activity. Building electrification contributes $20 billion and transmission and grid modernization combine for another $12 billion. Energy storage contributes $8 billion in GSP. (See Figure 1.)

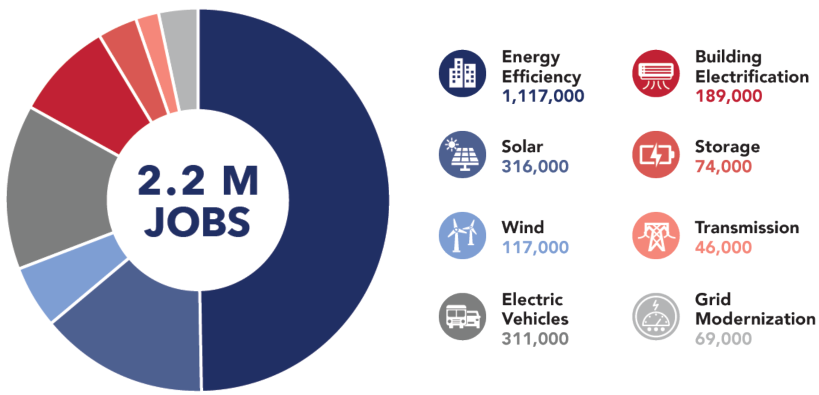
Figure 1. Total Impact of $55 Billion Stimulus Investment on the Texas Economy (GSP), by Technology



Analysis Group for TAEBA: *Economic Impact of Stimulus Investment in Advanced Energy*

In terms of jobs, energy efficiency creates over 1 million jobs, calculated in job-years (i.e., a job created by stimulus spending that lasts one year equals one job-year; a new job that is supported by the spending for three years equals three job-years) and resulting in a mix of short-term construction or installation employment and more ongoing positions. Renewable energy investments produce more than 433,000 jobs and electric vehicles nearly 311,000. Building electrification investments generate 189,000 jobs, and grid modernization and transmission 115,000 jobs; over 74,000 new jobs result from energy storage investments. (See Figure 2, next page.)

Figure 2. Impact of $55 Billion Stimulus Investment on Texas Employment (job-years), by Technology



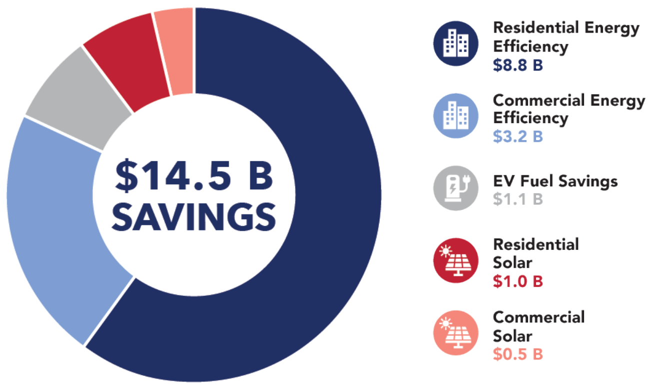
Analysis Group for TAEBA: *Economic Impact of Stimulus Investment in Advanced Energy*

In addition, certain advanced energy investments provide direct savings to consumers associated with reduced electricity consumption, increased savings from onsite solar production, and reduced fuel costs by use of electric vehicles.[2] Based on our representative allocation of $55 billion of stimulus funds for Texas, energy savings would come to nearly $15 billion annually. Of this total, $9 billion in savings would come from residential energy efficiency, $1 billion from residential rooftop solar, $1 billion from EV fuel savings, and nearly $4 billion from commercial energy efficiency and onsite solar. (See Figure 3, next page.)

Finally, the additional economic activity created by $55 billion in advanced energy stimulus is projected to **increase tax revenues for state and local government by $18 billion.**

[2] For electric vehicle consumer savings, the reduced fuel cost is equal to savings on gasoline net of the cost of electricity to charge the EV.

Figure 3. Impact of $55 Billion Stimulus Investment on Texas Consumer Savings (annual), by Technology



Analysis Group for TAEBA: *Economic Impact of Stimulus Investment in Advanced Energy*

A greater or lesser level of stimulus investment would result in greater or lesser economic impact. But our analysis finds that advanced energy stimulus investments can generate economic benefits in the state of Texas on the order of **six times the level of public investment**, adding substantial value to the Texas economy, creating millions of jobs, and sending additional revenue to state and local governments.

In Section II we provide more detail on the analytic method and economic model behind this analysis, the data and assumptions applied, and the various modeling inputs and outputs resulting from the analysis.

II. ANALYTIC METHOD

In this report, the economic impacts of stimulus spending are modeled by running a scenario through an industry-standard macroeconomic input-output model, IMPLAN. We first hypothesize an overall level of stimulus spending in Texas based on a review of recent proposals and historical stimulus spending. Next, we identify advanced energy technologies and products as potential candidates for stimulus spending and apportion the overall stimulus budget among the advanced energy options on a representative, rather than prescriptive, basis. We then estimate a level of private investment in each technology/product category based on the level of public investment, historic relationships between public and private spending, and current technology cost estimates. We then run the total dollars of investment (combining public and private) through IMPLAN, generating results for key economic metrics (Gross State Product, jobs, tax revenues, and customer savings). Each of these steps is described below.

Public Spending Level and Allocation

The first step in the analysis is to identify an overall level of stimulus spending, and then to allocate the total amount among the various advanced energy technology/product options. There presently is no specific commitment to a stimulus amount by the state of Texas or commitment at the federal level, nor a commitment to direct some or all of a stimulus package toward the energy sector. So we make an assumption about a potential level of spending based on a review of past stimulus spending at the state and federal level as well as current federal discussions around potential stimulus packages.

The source of stimulus funding is presumed to be a federal stimulus package, a Texas-specific package, or some combination of the two. Moreover, the level of stimulus spending could be from a single package or the total across multiple stimulus bills over some period of time (e.g., two years). Thus, the starting point level of stimulus spending is an assumption made for the purpose of modeling the resulting economic impact.

Considering the level of economic dislocation (reduced economic activity and increased unemployment) caused by the pandemic and discussions at the federal level of a potential $2 trillion stimulus package, our analysis starts with total COVID-related stimulus spending of roughly three times the stimulus level under the American Recovery and Reinvestment Act (ARRA). We then estimate an amount of stimulus spending in Texas based on Texas' portion of the federal ARRA funding. We thus postulate a hypothetical investment in Texas of $55 billion, whether from state funds or federal, on advanced energy technologies over one to two years.

The next step is to identify how such a stimulus amount could be allocated across advanced energy technologies and products. To inform an allocation scenario we could treat as representative, rather than prescriptive, we reviewed state-specific industries, technologies, and policies in the energy sector and ongoing discussions among energy industry stakeholders with respect to interest and investment in advanced energy technologies and products. As with the overall level of stimulus spending, the allocation of stimulus dollars across technologies is an assumption, based on all of the above, and considering the following factors:

- the technical potential and feasibility of advanced energy technology development in the state;
- the current status of the technologies in terms of development, commercialization, and consumer uptake;
- technology economics and the current/historic level of subsidies supporting installations in the state;
- the goal of spreading the stimulus across a number of technologies to promote diversity in energy resources;
- the degree to which the technologies or products involve in-state manufacturing;
- the potential for consumer savings and the freeing up of consumer income from lower energy bills, as well as associated benefits, such as the wide geographic dispersion of energy efficiency investments;
- the extent to which public investment would require or likely induce complementary private investment;
- existing laws, regulations, and policy pertaining to energy or emissions, and any focus on specific advanced energy technologies in the state; and
- any unique technical or cost circumstances in the state related to energy supply and use in the power, transportation, and building sectors.

For this analysis, we decided on the following as a representative allocation of $55 billion in total stimulus spending in Texas across advanced energy technologies:

- **Renewable Resources –** Renewables receive 30% of the public funding, with 20% ($11 billion) going to solar and 10% ($5.5 billion) to wind. We assume that these public funds are used as financial incentives for the development of additional grid-connected wind and solar facilities and behind-the-meter solar installations.
- **Energy Efficiency –** Energy efficiency is allocated one-quarter of the total stimulus dollars assumed, or $13.8 billion. It is assumed that these investments are incremental to what would

otherwise be spent on energy efficiency through existing programs, and would be focused on a subset of programs and measures that in past practice tend to require or induce additional private spend by homeowners and businesses (e.g., high-efficiency appliances; heating, ventilation and air conditioning (HVAC) upgrades; and whole-home retrofits).

- **Electric Vehicles –** Electric vehicles receive 20%, or $11 billion, of the total public dollars. EV investments are divided as follows: 10%, or $5.5 billion, to defray the cost of purchasing EVs (including both light-duty and medium- and heavy-duty vehicles); 5%, or $2.8 billion, to support the installation of EV charging in residences and businesses; and 5% ($2.8 billion) as incentive for the development of commercial charging stations.

- **Grid Modernization –** Grid modernization receives 5% of the public funding, or $2.8 billion. Grid modernization investments could include technologies, products, and software development for residential and commercial energy management, microgrid management, and other improvements the efficiency of power system distribution.

- **Energy Storage –** Energy Storage is allocated 5% of the public funding, or $2.8 billion. Energy storage contributions defray the cost of grid-connected and behind-the-meter battery applications.

- **High Voltage Transmission –** Transmission receives 5% of the public funding, or $2.8 billion. This would provide incentives for the development of new transmission to access additional grid-connected renewable resources that are distant from load centers, and that are incremental to the renewable resources that would be developed due to the stimulus dollars targeted specifically to renewables (see above).

- **Building Electrification –** Building electrification is allocated 10% of the public funding ($5.5 billion). Investments of public money for building electrification would be designed to reduce the cost of switching to electric heating and appliances.

Private Investment Motivated by Public Spending and Total Investment

In calculating the economic impact of public stimulus spending on advanced energy technologies, it is also necessary to estimate the additional investments by private actors that would not occur *but for* the stimulus. This was also a consideration in allocating the total amount of the assumed stimulus in different technologies. For this purpose, we reviewed current technology costs, current and historic levels of public incentives for advanced energy technologies, and the private investment that has accompanied those incentives.

This analysis was used to develop approximate Private-Public Ratios (PPR) for each technology. The PPRs represent an expected level of private investment for each dollar of stimulus funding. For example, a PPR of 2.0 indicates that for every dollar of stimulus funding, we would expect two dollars of private investment that would not otherwise occur. The PPRs applied for each technology and the basis for the estimated PPRs is as follows:

- **Energy Efficiency and Grid Modernization –** The PPR for energy efficiency and grid modernization is based on a comparison of the cost of saved electricity for program administrators (PA) versus participants using select program data from Lawrence Berkeley National Laboratory (LBNL).[3] For example, for HVAC programs, the PA pays on average $0.072 per kilowatt-hour (kWh) compared to $0.067 per kWh for the participant. For new construction, the PA pays $0.046 per kWh compared to $0.041 per kWh for the participant on average. Comparing the administrator cost for HVAC and new construction, the analysis assumes a 1:1 PPR for energy efficiency. For grid modernization/smart grid/demand response, the analysis assumes a 1:1.5 PPR, which is based on a review of the public/private sharing of costs associated with ARRA stimulus spending on similar technologies.[4]

- **Renewable Resources –** The PPR for wind and solar investments are determined based on a comparison of the levelized costs of electricity (LCOE) for renewable resources to available tax credits and rebates. The analysis assumes an average LCOE for onshore wind of $0.041 per kWh and residential/commercial and industrial (C&I) rooftop solar of $0.10 per kWh.[5] For wind, the 1:2.5 PPR assumption is based upon a comparison of the LCOE with an average federal production tax credit for onshore wind of $0.0125 per kWh.[6] The PPR for solar is 1:3 based on a

[3] The Cost of Saving Electricity Through Energy Efficiency Programs Funded by Utility Customers: 2009-2015, Lawrence Berkeley National Laboratory, page 44, available at https://eta-publications.lbl.gov/sites/default/files/cose_final_report_20200429.pdf.
[4] American Recovery and Reinvestment Act of 2009, Smart Grid Investment Grant Program Progress Report, U.S. DOE Office of Electricity Delivery & Energy Reliability, July 2012, page 12, available at https://www.smartgrid.gov/document/smart_grid_investment_grant_progress_report
[5] Lazard's Levelized Cost of Energy Analysis - Version 13.0, Lazard, November 2019, page 2, available at https://www.lazard.com/perspective/lcoe2019.
[6] Advancing the Growth of the US Wind Industry: Federal Incentives, Funding, and Partnership Opportunities, DOE Office of Energy Efficiency & Renewable Energy, available at https://www.energy.gov/sites/prod/files/2020/02/f71/weto-funding-factsheet-2020.pdf.

comparison of the LCOE with a 26% investment tax credit for rooftop solar installation costs and other state-level incentives and rebates.[7]

- **Energy Storage –** The PPR assumption for battery storage is 1:5 based on a comparison of battery storage project costs with corresponding incentive spending. For example, in one state's program, bulk-incentive spending totaled $78 million across nine battery storage projects with a total cost of $430 million.[8] In addition, NREL estimates the cost of storage to be between $750 and $1,500 per kWh, while one of the state programs has a retail storage incentive set at $250 per kWh.[9]

- **Transmission –** For transmission to access renewable resources over and above those developed due to direct wind/solar investment in this stimulus program, development and construction costs for the utility or merchant developer are ultimately collected from consumers through regional transmission rates, and thus do not represent incremental private investment. However, the availability of additional transmission spurs incremental private investment in wind, with the resulting private investment in renewables estimated based on (1) the carrying capacity of the transmission (at an NREL estimate of transmission at $128/kW), (2) an average onshore wind capacity factor from EIA of 34.8%, and (3) a levelized cost of onshore wind from Lazard ($28/MWh).[10]

- **Electrification –** For electrification investments, the PPR is assumed 1:3 for electric vehicles, 1:2.5 for EV charging stations, and 1:4 for building electrification. The 1:3 PPR for EVs is based on a comparison of EV costs to public funding for EVs. We base this on an estimated price for a standard light-duty EV of $30,000 to the standard federal tax credit for the purchase of an EV ($7,500).[11] Absent comparable funding program data for medium and heavy duty EVs, we assume the same PPR across all classes of vehicles. The 1:2.5 PPR for EV charging stations is based on the current 30% federal tax credit with a limit up to $30,000 for commercial charging stations, and $1,000 for home charging stations.[12] The 1:4 PPR for building electrification is based on a comparison of the average unsubsidized cost of a 65-gallon Heat Pump Water Heater

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[7] Solar Energy Tax Credit (ITC), Solar Energy Industry Associates, available at https://www.seia.org/initiatives/solar-investment-tax-credit-itc. For Texas state rebates and incentives, see https://www.energysage.com/local-data/solar-rebates-incentives/tx/.
[8] Two Years In New York's Storage Market Has Grown Faster Than Expected, Green Tech Media, available at https://www.greentechmedia.com/articles/read/two-years-in-new-york-storage-market-has-grown-faster-than-we-expected.
[9] Solar Plus: A review of the end-user economics of solar PV integration with storage and load control in residential buildings (2018), NREL, available at https://www.osti.gov/biblio/1465658. See also Retail Storage Incentives (2020), NYSERDA, available at https://www.nyserda.ny.gov/All-Programs/Programs/Energy-Storage/Developers-Contractors-and-Vendors/Retail-Incentive-Offer/Incentive-Dashboard.
[10] Aaron Bloom, Interconnections Seam Study, Presented to TransGrid-X Symposium, 2018, available at https://wiresgroup.com/wp-content/uploads/2020/05/2019-03-06-Brattle-Group-The-Coming-Electrification-of-the-NA-Economy.pdf. See alsoTable 6.07.B. Capacity Factors for Utility Scale Generators Primarily Using Non-Fossil Fuels, Electric Power Monthly, EIA, available at https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_6_07_b. See also Lazard LCOE Analysis - Version 13.0.
[11] State and Federal Electric Vehicle Incentives, California Clean Vehicle Rebate Project, available at https://cleanvehiclerebate.org/eng/ev/incentives/state-and-federal.
[12] Electric Car Tax Credits Explained, Green Energy Consumers Alliance, available at https://blog.greenenergyconsumers.org/blog/electric-car-tax-credits-explained.

($7,500) to the average incentive provided by a leading state program for such a purchase ($1,850).[13]

On the basis of these PPRs, we find that **$55 billion in public stimulus spending** results in an **additional $134 billion in private investment.**

These investments are factored into the IMPLAN model (as described below) in two ways. First, the actual level of investment is included in the model consistent with how the dollars would flow through the Texas economy. Second, for certain categories of investments (i.e., energy efficiency, behind-the-meter solar, and EVs), we estimate the total reduction in consumer spending on energy that flows from the investments. This is included in the model as additional consumer usable income, using the following estimation methods:

- **Residential/C&I Energy Efficiency –** The calculation of consumer savings from residential and C&I energy efficiency investments is derived from savings rates (dollars of EE spending to kWh savings) from ACEEE's 2019 State Energy Efficiency Scorecard.[14] For each state, the total public/private investment in EE is multiplied by the savings rate to determine the total reduction in electricity demand for residential and commercial customers. The reduction in total electricity demand is multiplied by an annual average customer cost of electricity ($/kWh) to determine annual consumer savings.[15] The total consumer savings reflect a recurring annual consumer savings (through 10 years), adjusted for inflation.

- **Electric Vehicle Replacement of Gasoline Vehicles –** Savings from EV replacement of gasoline vehicles is calculated by comparing the cost of increased electricity demand with reduced gasoline demand. The increase in electricity is calculated as the number of new EVs multiplied by average annual electricity consumption by a standard EV (3,330 kWh).[16] The cost of increased electricity demand is calculated as the increase in electricity demand multiplied by an average electricity cost for Texas.[17] Total reduction in gasoline consumption is calculated as the number of vehicles replaced multiplied by annual average gallons consumed by a standard light-duty vehicle (534).[18] The decrease in cost from reduced gasoline consumption is calculated as total

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[13] CPUC Equity Considerations for Heat Pump Water Heaters (2020), California Public Utilities Commission, available at https://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/Utilities_and_Industries/Energy/Energy_Programs/Demand_Side_Management/Customer_Gen_and_Storage/SGIP.HPWH.Workshop.Part2.pdf.

[14] Berg, W., et al., The 2019 State Energy Efficiency Scorecard, American Council for and Energy –Efficient Economy, October 2019, available at: https://www.aceee.org/sites/default/files/publications/researchreports/u1908.pdf.

[15] EIA-861, Table 2.10. Average Price of Electricity to Ultimate Customers by End-Use Sector, EIA, available at: https://www.eia.gov/electricity/annual/html/epa_02_10.html.

[16] Average electricity consumed by an EV is calculated based on an estimate of 0.3 kWh per mile and 11,101 average vehicle miles traveled. Fuel economy is estimated from State of Charge: Electric Vehicles Global Warming Emissions and Fuel-Cost Savings Across the United States, page 5, Union of Concerned Scientists, available at https://www.ucsusa.org/sites/default/files/2019-09/electric-car-global-warming-emissions-report.pdf. For average VMT, see also Annual Vehicle Distance Traveled in Miles and Related Data - 2018, Federal Highway Administration, available at https://www.fhwa.dot.gov/policyinformation/statistics/2018/vm1.cfm.

[17] Average retail price of electricity, State Electricity Profiles, EIA, available at https://www.eia.gov/electricity/state/.

[18] Average gallons consumed by a LDV is calculated based on an estimate of 20.8 average miles per gallon and 11,101 average vehicle miles traveled. Fuel economy is estimated from Light Duty Automotive Technology and Fuel Economy Trends: 1975-2008, NEPIS, available at https://nepis.epa.gov/Exe/ZyPDF.cgi/P1004N5Y.PDF?Dockey=P1004N5Y.PDF. For average VMT, see also Annual Vehicle Distance Traveled in Miles and Related Data - 2018, Federal Highway Administration, available at https://www.fhwa.dot.gov/policyinformation/statistics/2018/vm1.cfm.

gallons of gasoline saved multiplied by the average price of gasoline ($3.25) over the past decade.[19] Final consumer savings is equal to total gas savings minus the cost of increased electricity consumption. The total consumer savings reflect the recurring annual consumer savings (through 10 years), adjusted for inflation.

- **Residential and C&I Rooftop Solar –** The calculation of savings from residential and commercial & industrial rooftop solar is derived from the average mix or residential versus C&I rooftop solar, levelized capital cost of rooftop solar estimates, and average annual customer electricity costs. The total public and private investment is split as 67% residential and 33% commercial based on the current rooftop solar mix nationally.[20] These investments are then translated into annual electricity savings (kWh) using capital costs for residential rooftop ($2,875 per kW) and commercial rooftop ($2,350 per kW) solar, and average capacity factors.[21] The final dollar value of the consumer savings is then calculated by multiplying the electricity savings by the average annual customer electricity cost for residential and commercial & industrial customers.[22] The total consumer savings reflect the annual consumer savings (through 10 years), adjusted for inflation.

Macroeconomic Model

Investments in energy technologies can affect the economy in multiple ways. In our analysis, we pay attention to two key factors. First, when public and private dollars are spent to fund an activity (like a home energy audit), make a purchase that otherwise would not occur (like an electric heat pump) or develop a resource or technology (such as a new renewable resource), those investments result in purchases of goods and services in the economy. Second, investments in certain advanced energy technologies generate consumer savings on energy (e.g., reduced consumption of electricity or heating fuel due to energy efficiency, or lower fuel costs when switching from a gasoline-powered vehicle to an electric vehicle).

IMPLAN is a social accounting/input-output model that attempts to replicate the structure and functioning of a specific economy (in this case, Texas), and is widely used in public and private sector economic impact analyses. It estimates the effects on a regional economy of a change in economic activity by using baseline information capturing the relationships among businesses and consumers in the economy based on historical economic survey data. IMPLAN tracks dollars spent in a region, including dollars that circulate within it (e.g., transfers of dollars from consumers to producers), dollars that flow into it (e.g., purchases of goods and services from outside the local economy), and

[19] Over the last decade, gasoline prices have generally fluctuated between $2 and $4.50 per gallon. See US All Grades All Formulations Retail Gas Prices (Dollars Per Gallons), EIA, available at https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=pet&s=emm_epm0_pte_nus_dpg&f=m.
[20] Solar Industry Research Data, Solar Energy Industries Association, available at https://www.seia.org/solar-industry-research-data.
[21] Lazard's Levelized Cost of Energy Analysis - Version 13.0, Lazard, November 2019, page 2, available at https://www.lazard.com/perspective/lcoe2019.
[22] EIA-861, Table 2.10. Average Price of Electricity to Ultimate Customers by End-Use Sector, EIA, available at: https://www.eia.gov/electricity/annual/html/epa_02_10.html.

dollars that flow outside of it (e.g., payments to the federal government). The model thus examines inflows, outflows, and interactions within the economy under study.

The IMPLAN model allows one to investigate interactions in Texas, and to calculate various economic impacts in the state's economy when a new activity (such as investments in energy efficiency or new construction of energy infrastructure or lost revenues for owners of power plants) involves money flows around the economy. Specifically, the model captures various impacts, including:

- Employment impacts (total number of jobs created or lost);
- Income impacts (total change in income to employees that results from the economic activity); and
- Gross State Product impacts (total economic value added to the economy, which reflects the gross economic output of the state less the cost of the inputs).

These economic impacts reflect the following:

1. **Direct effects:** the initial set of inputs that are being introduced into the economy. In our study, these include the direct effects of the stimulus and private investments on energy markets and energy consumers (e.g., end users of electricity and natural gas), and on the purchase of goods and services in the economy (e.g., investment in energy efficiency, construction services, manufacturing, etc.).

2. **Indirect effects:** the new demand for local goods, services and jobs that result from the new activity. Examples include the spending on labor to retrofit buildings with energy efficiency measures, or to train workers in these skills. Some stimulus investments lead to payments to suppliers located outside the state of Texas (e.g., the purchase of efficient lighting equipment or solar panels manufactured outside of the state); IMPLAN traces those dollars that do not stay within the local economy. Since our focus is on the state of Texas, we do not report on the positive economic impacts of stimulus spending on neighboring states.

3. **Induced effects:** the economic impacts of the increased spending of workers resulting from income earned from direct and indirect economic activity.

In this analysis, the inputs to the IMPLAN model include the total dollars invested in the economy that otherwise would not have been spent on advanced energy technologies, and the increases in consumer income that flow from the investments.

III. FINAL OBSERVATIONS

Based on our analysis and modeling of energy-focused stimulus investments in the Texas economy, we make the following additional observations:

Advanced energy stimulus investments can generate important and positive economic benefits in the state of Texas, adding substantial value to the Texas economy, creating millions of jobs, and sending additional revenue to state and local governments. Our results strongly support a focus on advanced energy technologies and products for the spending of state or federal stimulus funds in Texas based on economics alone. Such investment would generate meaningful economic activity in Texas, create jobs across a wide range of skills and industries, increase revenues for state and local government, and save households and businesses money. The benefits flow from the direct investment of stimulus dollars, an associated influx of private investment spurred by the structure of incentives in a potential advanced energy stimulus package, consumer savings that flow from the impact of new advanced energy products and technologies on energy supply and use, and economic activity induced by changes in the flow of dollars due to stimulus investments.

Energy-related stimulus investments can prime the pump for substantial private investments in these technologies. Stimulus spending on advanced energy technologies, products, and services would attract a significant amount of private investment.

Advanced energy investments stimulate economic activity not only through public and private investment, but also through consumer savings that flow back into the economy. Many forms of investment in advanced energy can generate long-run benefits to business and residential consumers. Spending on energy efficiency and onsite renewable resources lowers consumer energy bills and can reduce utility spending on transmission and distribution system infrastructure. Supporting adoption of electric vehicles can lower consumer spending on fuel and reduce fleet costs for small and large businesses. Similarly, the installation of electric heat pumps and/or electric appliances may reduce consumer costs over time.

All forms of advanced energy stimulus investments appear effective in generating strong, positive economic growth. Weighted as it is toward technologies and products likely to maximize the economic benefits of the public stimulus spending, our analysis shows both the potential economic impact of the investments themselves (e.g., investments that tend to keep more of the money in the local economy, sending less to out-of-state manufacturers), and on the potential for inducing private investment (i.e., products which involve significant cost sharing with customers or private investors), resulting in economic benefits on the order of six times the public stimulus investment.

Advanced energy technology investments can help reduce energy and economic supply chain risk and more equitably disperse economic activity associated with the energy sector. Growth in advanced energy technologies may open the door to the development of energy sources and technologies that rely primarily on domestic manufacturing and materials industries, reducing supply chain risks and reliance on concentrated energy/fuel supply sectors. With an economy operating on advanced energy technologies, there is far less geographic concentration of the fuels and industries needed to meet demand, providing opportunities to more equitably disperse the economic activity driving energy supply and infrastructure.

Advanced energy technology stimulus investments are aligned with the state's interest in continued leadership in energy innovation. While this report focuses on the economic impacts of advanced energy investments, there are clear and substantial additional benefits in directing stimulus dollars in this way. Texas has long been a leader in energy in all its forms. The competitive energy market serving most of the state has been a hotbed of innovation, and the state has made far-sighted investments to diversify Texas's energy sources and keep costs down. The advanced energy investments outlined here would continue Texas's energy leadership, accelerating the state's energy diversification, electric grid flexibility, and customer focus. Investing stimulus dollars in advanced energy would keep Texas at the head of the pack nationally for energy-related development as a driver of private investment and economic growth.