Electric Vehicles: A Growing Opportunity in Georgia

An analysis on the impact of an electric vehicle tax incentive on Georgia's economy

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Authors

This analysis was conducted by Greenlink Analytics on behalf of the Southeast Energy Efficiency Alliance. Greenlink Analytics is an Atlanta-based analytics firm that uses advanced data analytics to solve the world's most pressing issues.

About Us

The Southeast Energy Efficiency Alliance (SEEA) is a 501(c)(3) nonprofit organization headquartered in Atlanta, Georgia. Established in 2007, SEEA is a Regional Energy Efficiency Organization (REEO) serving eleven states across the Southeast, including Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee and Virginia.

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Analysis Summary

This analysis evaluates the economic development implications of a $2,500 tax credit for the purchase of an electric vehicle (EV) in Georgia. The analysis used IMPLAN, a nationally recognized macroeconomic model of Georgia's economy, based on three forecast scenarios (Energy Information Administration (EIA), Bloomberg New Energy Finance (BNEF) and Advanced Energy Economy (AEE).

The analysis shows that a $2,500 state tax credit for EV purchases in Georgia would lead to additional EV purchases. This increase would boost economic growth in Georgia within the vehicle sector in the form of jobs, labor income and total GDP – including new vehicle construction, hardware manufacturing, electrical equipment specific to electric vehicles, as well as scientific and technical services.

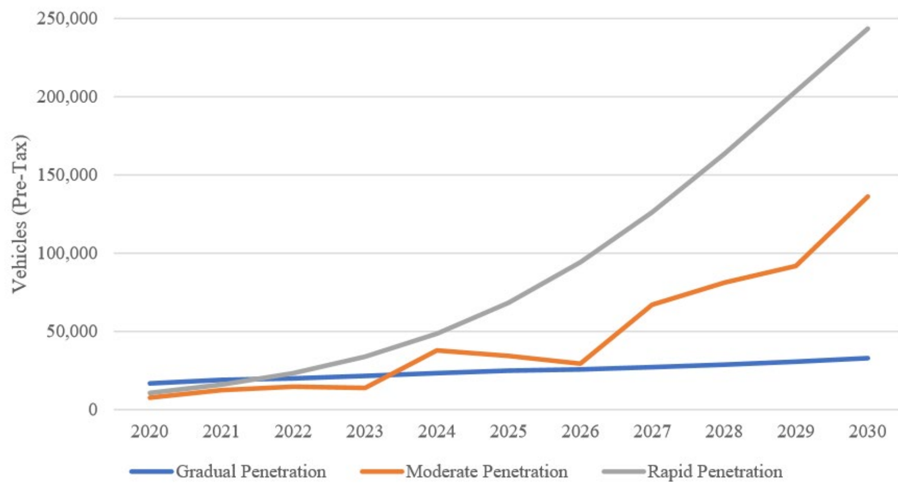
The Results

- Between 8,000-17,000 additional EVs would be sold over the next three years as a result of the tax credit (regardless of whether the purchaser claims the credit);
- 2,000-4,000 net job-years would be attributable to the tax credit over the next three years. The variability is based on three forecast scenarios (gradual, moderate, and rapid EV growth). Annual net job-years is a full-time equivalent position held for a year. In the tax credit's first year, 2020, new net job-year values are relatively high due to an expected increase in initial interest. In subsequent years, EV purchases and other economic indicators grow more steadily;
- $240-$490 million net GDP growth to the state over the next three years;
- $123-242 million in net labor income through 2022;
- The leverage ratio – the quantity of private dollars brought into the market per dollar of tax credit– is close to 3 for the lower forecast, and about 1.5 for the moderate and rapid forecasts, since the most-enthusiastic Georgians are spurred to participate early in the program and additional users become incrementally more difficult to attract.

The Analysis

Electric vehicles (EV) have the potential to revolutionize passenger travel and goods movement, spur economic development, and improve public health in Georgia, the U.S., and around the world.[1] This new technology brings a host of new jobs to local and regional economies and increases gross domestic product (GDP). While these economic opportunities are growing in Georgia, there are measures to further enhance these benefits. This report specifically examines how incentivizing electric vehicles purchases can broadly contribute to the state's economic wellbeing.

Figure 1. Annual Vehicle Sales Projections in Georgia before State Tax Credit



We analyzed the economic impact of incentivizing Georgia's citizens to purchase electric vehicles with a state tax credit for EV purchases of at least $2,500. We examined three widely different projections for EV growth to accommodate for the uncertainty around adoption in Georgia. Each projection is influenced by the cost of technology, economics, and changing consumer preferences. Figure 1 shows three current EV projections for Georgia without a tax credit: a rapid penetration scenario, derived from Advanced Energy Economy (AEE); a moderate penetration scenario, derived from Bloomberg New Energy Finance; and a gradual penetration scenario, derived from the U.S. Energy Information Administration (EIA). While the gradual scenario, derived from EIA, has the lowest long-term projection, the gradual projection starts the highest for 2020, and through 2023 it predicts more EV adoption than the moderate EV penetration (orange line).

In order to understand the impact of a $2,500 tax credit introduction, we studied how Georgians' EV purchasing decisions change at various historical price points with the findings applied to each of these three projections. More details regarding the methodology can be found in the appendix.[2] The year 2020 was chosen for the first year of the tax credit, though it may be realistic to consider the 2020 impact as a proxy for the first 12 months of when this policy would go into effect.

[1] Bansal, P. (2015). Charging of Electric Vehicles: Technology and Policy Implications. Journal of Science Policy & Governance, 6(1).

[2] A full discussion of elasticities can be found in the appendix.

Economic Development[3]

IMPLAN, a nationally recognized macroeconomic model of Georgia's economy, was used to assess economic development implications of this proposed EV tax credit. A $2,500 state tax credit for EV purchases would lead to additional EV purchases. This increase will boost economic growth in Georgia within the vehicle sector in the form of jobs, labor income, and total GDP, including new vehicle construction, hardware manufacturing, electrical equipment specific to electric vehicles and scientific, and technical services. Some examples of these are: SK Group, VW, Nissan, Honda Precision Parts, and KIA Parts Distribution Center.

Figure 2. Net Job-Years Created from EV Tax Credit

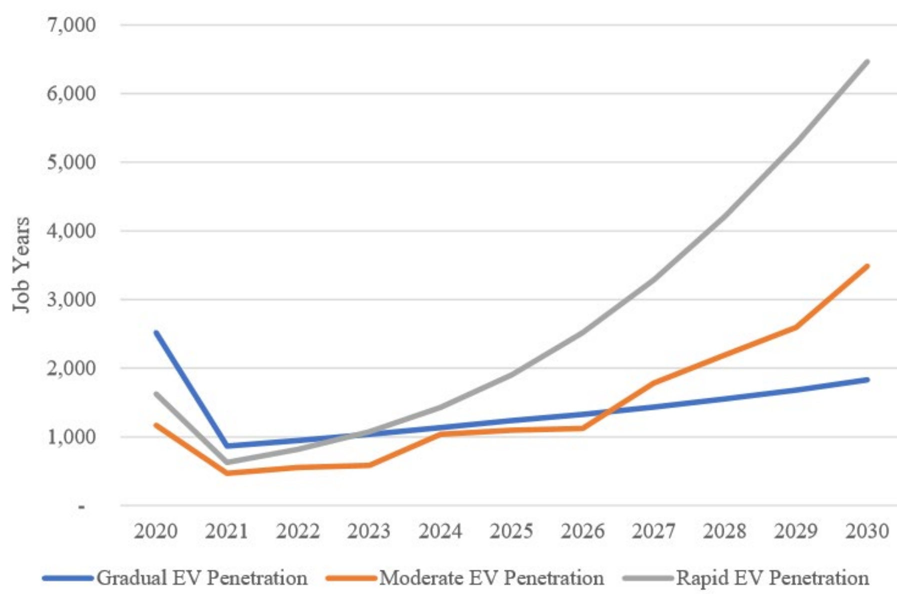
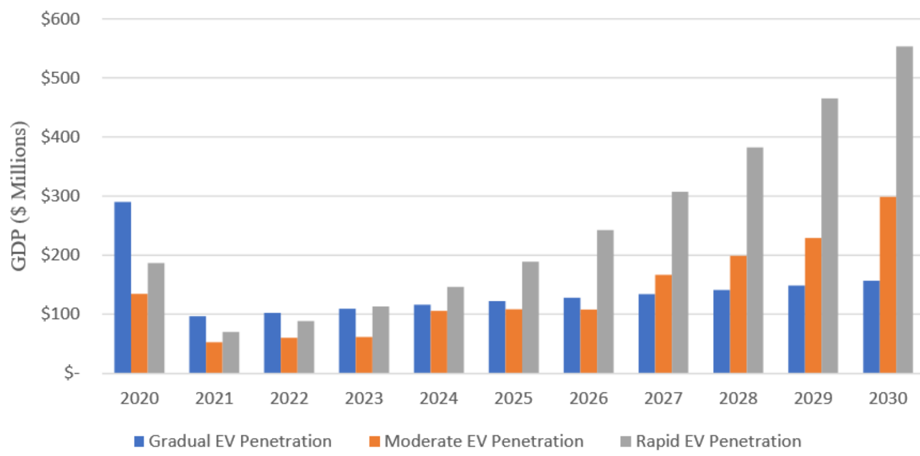


Figure 2 shows 16,000 new net job-years years through 2030, attributable to the tax credit for the Moderate EV Penetration projection. Annual net job-years, a full-time equivalent position held for a year, that would be spurred by the introduction of a tax credit and increased EV sales are plotted for each scenario. In the tax credit's first year, 2020, new net job-year values are relatively high due to an expected increase in initial interest. In subsequent years, EV purchases and other economic indicators grow more steadily.

[3] The impacts in this section do not include those related to the associated charging infrastructure brought on by EV adoption. Existing research is not yet sufficient to obtain reliable economic multipliers from the IMPLAN dataset used throughout this analysis. However, it can be assumed that additional charging infrastructure would be expected to increase State GDP, jobs, and income.

Figure 3 shows the total net GDP impacts expected from the tax incentive. The net GDP and labor income increases are spurred by job creation. GDP growth in 2020 follows the same pattern as that in Figure 3. In every scenario, the tax credit results in net economic gains to Georgia.

Figure 3. Net-Total GDP from Tax-Credit within All Scenarios



Tables 1-3 show the forecast for EV growth by year, with and without the tax credit for each of the three forecasts. These tables also show the additional jobs, GDP, and labor income associated with the increased incremental EV vehicle purchases. The projections add between $754 and $1,357 million in labor income through 2030. The leverage ratio – the quantity of private dollars brought into the market per dollar of tax credit– is close to 3 for the lower forecast, and about 1.5 for the moderate and rapid forecasts since the most-enthusiastic Georgians are spurred to participate early in the program and additional users become incrementally more difficult to attract.

Table 1: Gradual EV Penetration											
	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
EVs Sold w TC	29,800	21,000	22,000	23,600	25,600	27,200	28,000	29,400	31,100	33,200	35,500
Original Projection	16,800	19,000	20,000	21,600	23,400	24,900	25,700	27,100	28,700	30,700	32,900
Net-Job Years	2,520	867	946	1,040	1,140	1,240	1,330	1,430	1,550	1,680	1,830
Net-GDP ($M)[3]	290	97	103	109	116	123	128	134	141	148	157
Net-Labor Income ($M)[5]	143	48	51	54	57	61	63	66	70	73	78
Leverage Ratio											**2.84**

If additional charging stations are installed to support electric vehicles, the economic benefits would be greater (see appendix). Additionally, electric vehicles are cleaner than conventional gasoline vehicles.[4] Therefore, increased EV investments will also provide clean air benefits across the state, lowering the economic burden of these emissions.

[4] Emissions from Hybrid and Plug-In Electric Vehicles. (n.d.).

Table 2: Moderate EV Penetration											
	2020	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
EVs Sold w TC	13,800	13,700	16,200	15,300	41,400	37,500	32,000	72,900	88,000	99,300	147,000
Original Projection	7,790	12,500	14,700	13,900	37,800	34,300	29,400	67,100	81,100	91,800	136,000
Net-Job Years	1,170	472	553	585	1,040	1,090	1,120	1,780	2,190	2,600	3,490
Net-GDP ($M)[3]	134	53	60	62	106	109	108	167	199	229	298
Net-Labor Income ($M)[3]	67	26	30	31	52	54	54	83	99	113	148
Leverage Ratio											**1.56**

[5]

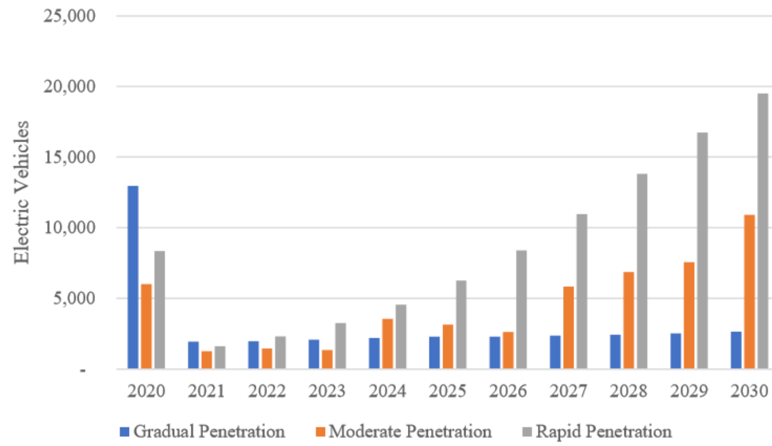
Table 3: Rapid EV Penetration											
	2020	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
EVs Sold w TC	19,200	17,600	25,600	37,100	53,100	74,600	103,000	137,000	177,000	220,000	263,000
Original Projection	10,800	15,900	23,300	33,900	48,500	68,400	94,200	126,000	163,000	204,000	244,000
Net-Job Years	1,620	630	817	1,080	1,430	1,900	2,520	3,290	4,210	5,280	6,470
Net-GDP ($M)[3]	187	70	89	113	146	189	243	307	382	465	553
Net-Labor Income ($M)[3]	92	35	44	56	72	93	120	152	189	230	274
Leverage Ratio											**1.45**

[5] Analyzed at a 3% discount rate

Appendix - Methodology

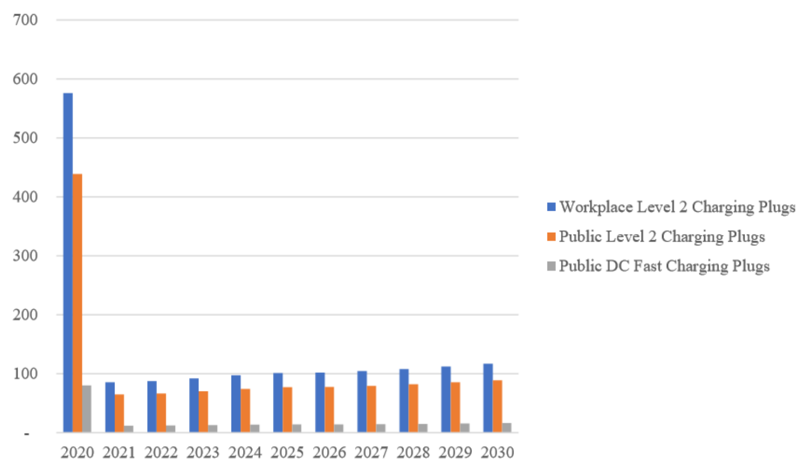
Figure A.1 shows the additional electric vehicle sales that are produced by the $2,500 tax credit (i.e. the difference between row 1 and 2 in Tables 1-3). All scenarios experience a higher uptake in vehicle adoption within the first year, due to the initial introduction of the tax-credit.

Figure A.1. Net Annual Electric Vehicle Sales Projections in Georgia



Increased electric vehicle sales creates demand for charging infrastructure, which can be seen in Figures A.2 through A.4 for each projection scenario. Infrastructure projections are calculated using the Department of Energy's Electric Vehicle Infrastructure Projection Tool (EVI-Pro) Lite.[6] Using IHS/Polk projections for the year 2016, it was determined that plug-in hybrid vehicles (PHEV) make up 36% of market penetration, leaving the rest to all-electric plug in vehicles. While there is limited research on the effects of increased electric vehicle charging infrastructure on job creation and GDP growth, based on potentially increased sales of electricity and electric vehicle charger production and sales, it is expected that this type of demand would further improve our economic development indicators.

Figure A.2. Increased Charging Infrastructure due to Tax Credit: Gradual Vehicle Penetration



[6] Department of Energy Electric Vehicle Infrastructure Projection Tool

Figure A.3. Increased Charging Infrastructure due to Tax Credit:
Moderate Vehicle Penetration

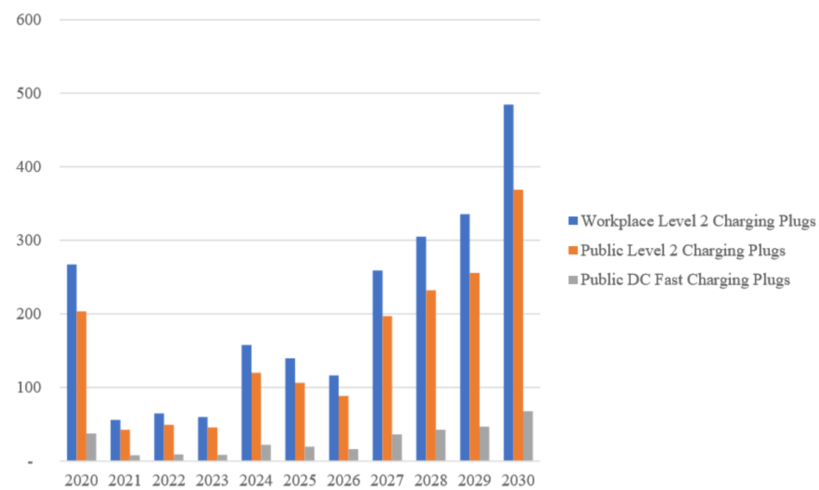
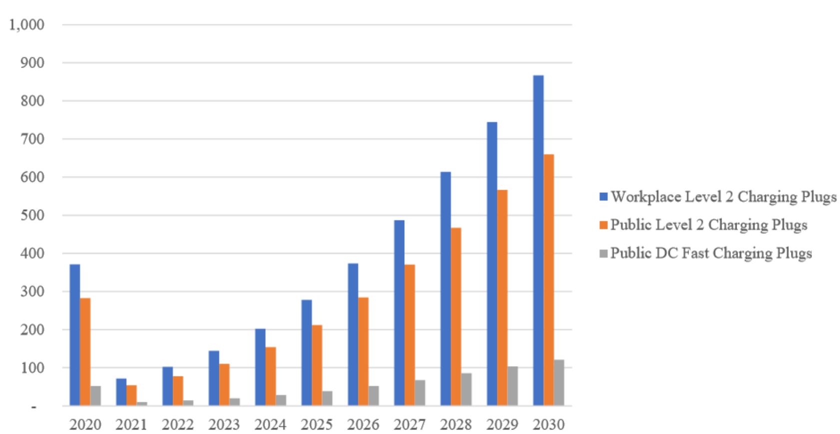


Figure A.4. Increased Charging Infrastructure due to Tax Credit:
Rapid Vehicle Penetration



Initial Quantification

Data on EV registration by make and model from 2010 through 2016 were obtained by IHS/Polk in a previous study conducted by The Greenlink Group. Historical new vehicle sales were obtained from Auto Alliance.[7] Other initial vehicle sale projections were obtained from Bloomberg New Energy Finance (BNEF) and EIA's Annual Energy Outlook.[8,9] As with our previous analysis, the Nissan LEAF is the dominant EV in the Georgia marketplace, so the LEAF is used to calculate the price elasticity of demand, the key metric of consumer price-responsiveness used to drive this analysis.

[7] Consumer and Auto Sales Dashboard. (n.d.)
[8] Electric Vehicle Outlook 2019. (2019)
[9] Annual Energy Outlook 2019. (2019)

Calculating Elasticity

Trends in the pricing of Nissan LEAF SV and S models were tracked from 2011 through 2019, as applicable given the model's introduction dates. These were taken from cars.com average MSRP tracking and Kelley Blue Book.[10] To determine the first-year purchase price faced by consumers, all applicable state and federal tax credits were subtracted from the cost. After this step, a total cost of ownership for the vehicles was determined through a deconstruction of the IRS standard mileage rate.[11] Coupling the mileage rate with the Georgia-specific annual VMT estimate, the average cost of gasoline, and the fuel efficiency of the internal combustion engine equivalent offered by Nissan, allows for the calculation of the annual cost of ownership of the vehicle as well as a determination of the percent in the cost of ownership that is due to fuel costs.[12] Fuel costs can be then backed out of the annual cost of ownership and replaced with the average cost of electricity, coupled with the electric efficiency, as measured in kWh/mile.[13] Historical information for these data was collected back to 2011. A total operating cost of ownership was calculated, assuming a ten-year useful lifetime of the vehicles. The total cost of ownership was then compared to the marginal increase in quantity of Nissan LEAFs on Georgia roadways, as captured by the initial quantification.

From these values, a range of marginal price elasticity of demand was calculated for Georgia consumers:

Generally

$$e_{(p)} = \frac{\frac{dQ}{Q}}{\frac{dP}{P}}$$

Specifically

$$e_{(p)} = \frac{\frac{dQ}{Q}}{\frac{dP}{P}} \; ; P = f\left(MSRP, E, \sum B, F, I, M, S, T\right)$$

where: MSRP = manufacturer's suggested retail price

E – vehicle fuel efficiency
B – annual financing cost
F – annual fuel cost
I – annual insurance cost
M – annual maintenance cost
S – annual subsidies
T – annual taxes

In this calculation, P is a function of vehicle prices, fuel prices, maintenance expenditures, insurance, financing costs, vehicle operational efficiency, tax and subsidy policies, and Q incorporates the resultant behavioral preferences change. Thus, the calculation solves for the annual change in the lifetime cost of

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[10] Nissan Leaf 2011; Nissan Leaf 2012; Nissan Leaf 2013; Nissan Leaf 2014; Nissan Leaf 2015; Nissan Leaf 2016; Kelley Blue Book – Nissan Leaf
[11] 2019 IRS Mileage Rates
[12] Georgia VMT Estimate; Average Gas Price; Average Nissan Versa Fuel Efficiency
[13] Average Energy Prices, Atlanta-Sandy Springs-Roswell – November 2019; U.S. DOE Fuel Economy

ownership of the vehicle. The Nissan LEAF is a normal good with a negative price elasticity of demand in Georgia; when the tax credits were not available in 2016, consumers reduced their purchases substantially.

Projecting Future Years

A range of elasticities were evaluated to estimate the historical consumer response to changes in the total cost of ownership. An elasticity of -20 was the best estimator of consumer responses under a stable tax regime, suggesting highly elastic demand. To better capture some of the uncertainty related to this elasticity, we did sensitivity analysis of the economic indicators for elasticities of -10 and -30 in addition to -20. However, in the main report, -20 is the elasticity used to evaluate future LEAF purchasing behavior in Georgia. The expected change in the cost of electricity and general cost increases of other goods were taken from the Energy Information Administration's Annual Energy Outlook. The change in vehicle price was calculated based on historical trends for the model.

The additional EVs sold are calculated from each of the three forecasts by calculating a factor from the combination of the change in forecasted total cost of EV ownership and the elasticity. Once the quantity of vehicles was predicted the annual investment and Georgia foregone tax revenues could be calculated. These were evaluated relative to the baseline scenarios, where the tax credits were not reinstated, enabling the calculation of new investments spurred by the reintroduction of the tax credits.

Jobs, Gross State Product, and Labor Income Analysis

We used the IMPLAN I/O model to assess the economic development impacts of the proposed tax policy. The first step in this process is to procure the Georgia data for IMPLAN. Afterwards, an assessment of the cost of various components in the lifecycle costs of ownership for an electric vehicle was constructed, based on recent industry studies and reports.[14,15] These were then matched with the appropriate IMPLAN codes to construct a specific profile for an electric vehicle, as shown in Table A.1.

Table A.1. Cost Distribution and Associated IMPLAN Code for Electric Vehicles

Component	Electric Vehicle Cost	IMPLAN Code
Battery	20.9%	336
Chassis/Body	11.7%	346
Other Equipment	11.5%	356
Insurance	10.5%	438
Maintenance/Repairs	9.6%	504
Taxes	7.9%	523
Financing	5.8%	433
Electric Motor/Charger/Vehicle Control Unit	4.7%	351
Fossil Fuel Electricity Generation	4.5%	42
Inverter	3.8%	313
Manufacturing/Assembly	3.1%	343
Distribution	3.1%	396
Nuclear Electricity Generation	2.2%	43
Transmission	0.9%	353

[14] Kochhan, Robert, et al. 2017. An Overview of Costs for Vehicle Components, Fuels and Greenhouse Gas Emissions and Total cost of Ownership Update 2017
[15] Cost to Own a 2017 Nissan LEAF

The IMPLAN model was aggregated and compiled using this distribution. The resulting output coefficients are weighted by the total computation and then summed to produce the impact coefficients for state GDP impacts and income impacts. Full-time equivalents require an additional FTE adjustment factor (provided by IMPLAN) prior to establishing the FTE impact coefficients.

A similar approach was taken to construct the same coefficients for the standard internal combustion engine (ICE) vehicle to account for the shift in investment flows in Georgia that result from individuals who were incentivized to buy an EV who would have otherwise not been participating in the EV market. A review of the recent purchase trends of both EVs and gasoline vehicles showed that the market trends between the two were similar in direction but different in magnitude. We estimate based on the trends in the larger market that slightly more than 8% of EV vehicle purchases were induced by Georgia's tax policies after accounting for these trends; we assume this number is applicable in future years with the associated changes in policy proposed and evaluated by this study.

State Economic Impact Analysis

Once all impact coefficients are established, they can be matched with the spurred investment trajectory produced by the projection analysis previously summarized. This is accomplished by multiplying each impact coefficient by the spurred investment and then subtracting out the economic activity that would have otherwise arisen from the purchase of an ICE, representing an annual net impact analysis. This is due to the spurred investment value being the marginal investment above the baseline in each year, and the difference in benefits from an ICE investment represents the opportunity cost of purchasing an EV. Gross values (which is the full result Georgia could experience should the proposal be adopted) can also be calculated by swapping the total investment for the spurred investment in the annual and sum-total calculation. Job-years, while an accurate measure of full-time equivalents year-to-year, would represent an overestimate of all individuals receiving employment since individuals are regularly in a job for more than one year. To estimate total and net jobs, job-years could be divided by 4, assuming individuals maintain the same job for four years on average.