APPENDIX

Initial Quantification

Data on EV registration by make/model from 2010 through 2016 were obtained from IHS/Polk. Total conventional registrations were also obtained from the same source. It became obvious at this point that the Nissan Leaf is the dominant EV in the Georgia marketplace.

Elasticity

Trends in the pricing of Nissan Leaf SV and S models were tracked from 2011 through 2017, as applicable given the model's introduction dates. These were taken from cars.com average MSRP tracking for both models.[1] 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.[2] 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.[3] 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.[4] Historical information on all of these datapoints 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, the marginal price elasticity of demand was calculated for Georgia consumers:

---

[1] https://www.cars.com/research/nissan-leaf-2011; https://www.cars.com/research/nissan-leaf-2012; https://www.cars.com/research/nissan-leaf-2013; https://www.cars.com/research/nissan-leaf-2014; https://www.cars.com/research/nissan-leaf-2015; https://www.cars.com/research/nissan-leaf-2016

[2] https://www.irs.gov/uac/2017-standard-mileage-rates-for-business-and-medical-and-moving-announced

[3] VMT: https://www.transportation.gov/transportation-health-tool/indicators/detail/ga/state/georgia#indicators ; Average gas price: https://www.bls.gov/regions/southeast/news-release/averageenergyprices_atlanta.htm; Average fuel efficiency: http://www.fuelly.com/car/nissan/versa

[4] https://www.bls.gov/regions/southeast/news-release/averageenergyprices_atlanta.htm; http://www.fueleconomy.gov/feg/Find.do?action=sbs&id=37066&id=37067&id=34918&id=34699.

Generically:

$$e_{\langle p \rangle} = \frac{\mathrm{d}Q/Q}{\mathrm{d}P/P}$$

Specifically:

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

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 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

Several 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. As the proposal evaluated in this study is suggesting the implementation of a stable and long-lived tax policy change, this is the primary 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 2016 Annual Energy Outlook. The change in vehicle price was calculated based on historical trends for the model.

Once the quantity of vehicles was predicted using the cost inputs and the elasticity, the lifetime investment, annual investment, and Georgia foregone tax revenues could be calculated. These were evaluated in a scenario where the tax credits were also not reinstated, creating a baseline case for a point of comparison and enabling the calculation of new investments spurred by the reintroduction of the tax credits.

Jobs, Gross State Product, and Labor Income Analysis

Greenlink 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.[5,6] 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

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.

---

[5] Kochhan, Robert, et al. 2017. "An Overview of Costs for Vehicle Components, Fuels and Greenhouse Gas Emissions". *Forthcoming.* Available at: https://www.researchgate.net/publication/260339436_An_Overview_of_Costs_for_Vehicle_Components_Fuels_and_Greenhouse_Gas_Emissions

[6] https://www.edmunds.com/nissan/leaf/2017/st-401695947/cost-to-own/

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. The distribution of costs used to characterize the standard internal combustion engine vehicle is shown below in Table A.2.

Table A.2 Cost Distribution and Associated IMPLAN Code for ICE Vehicles

Component	ICE Vehicle Cost	IMPLAN Code
Fuel Costs	21%	402
Maintenance/Repairs	16%	504
Equipment	15%	356
Insurance	14%	438
Chassis/Body	11%	346
Taxes	6%	523
Financing	5%	433
Manufacturing/Assembly	3%	343
Motor	3%	350
Distribution	3%	396
Auxiliary Units	2%	351
Transmission	2%	353

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. FTEs, 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, FTE values are divided by 4, assuming that individuals maintain the same job for four years on average. Lastly, the elasticity evaluation needs to grow to represent the entire EV market as opposed to only the Nissan Leaf. The proportion of EVs relative to the Nissan Leafs currently registered in Georgia is used to proxy the expected impact of the tax policy proposal on the Georgia economy; this ratio is held constant over the projection.