



Effectiveness and Equity Assessment of Plug-In Electric Vehicle (PEV) Purchase Incentives in the United States

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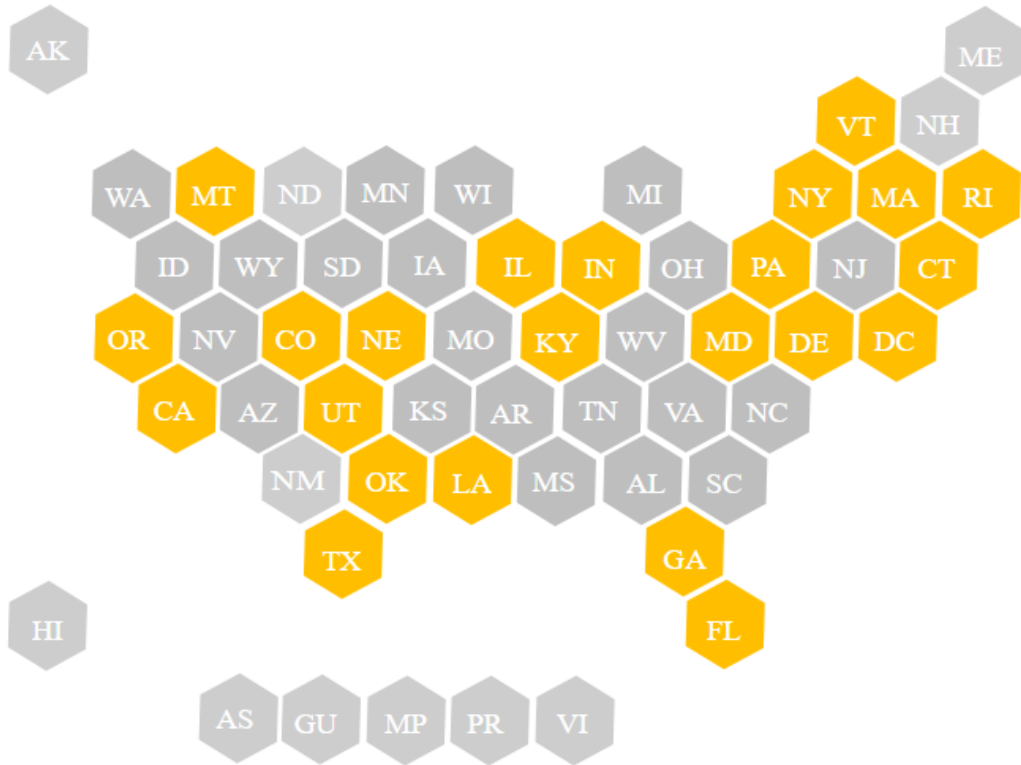
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Sponsor:



Center for Transportation
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Federal, 23 state, and D.C. governments have offered PEV purchase incentives

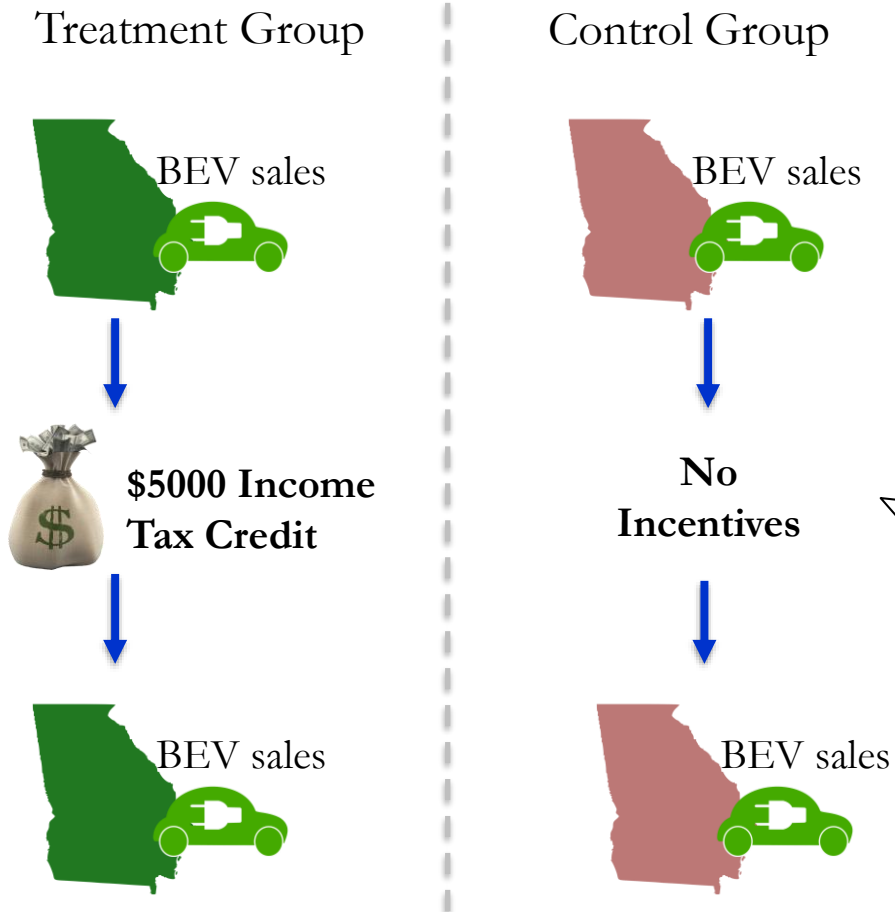
- Federal: up to \$7,500 for purchasing qualified PEVs
- California, Oregon, DC, Louisiana, ...
- Georgia: \$5,000 for purchasing or leasing qualified ZEVs (terminated in July 2015)

Policy Evaluation

- Effectiveness: number of induced EVs sales due to the incentive policy
- Equity: whether incentives have comparable accessibility to the public

Effectiveness Evaluation of Georgia Tax Credit

Quasi-experiment design



Challenge

Identifying an appropriate “control Georgia” is difficult (the control pool is too small)

Treatment state



Control state



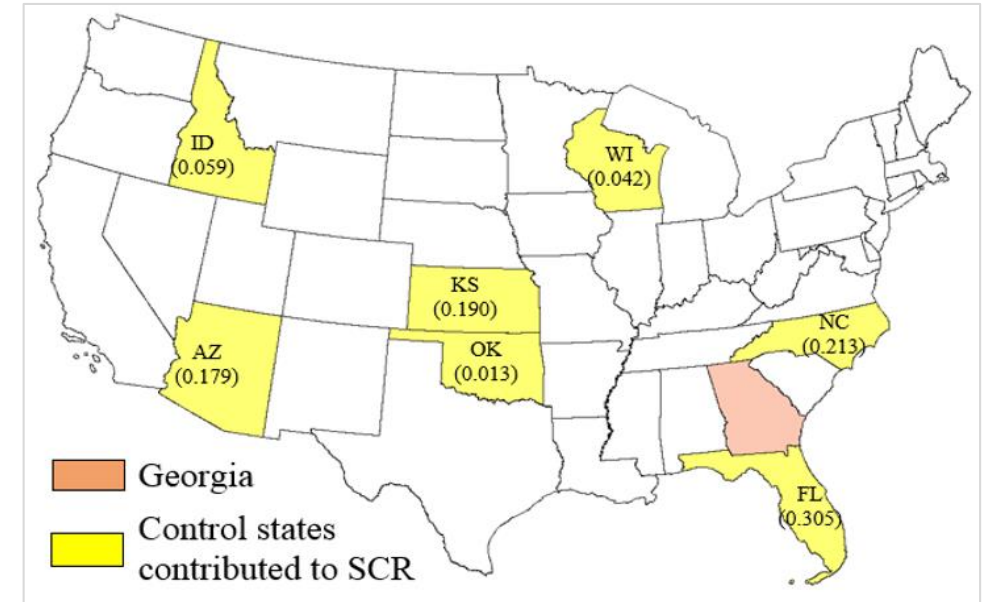
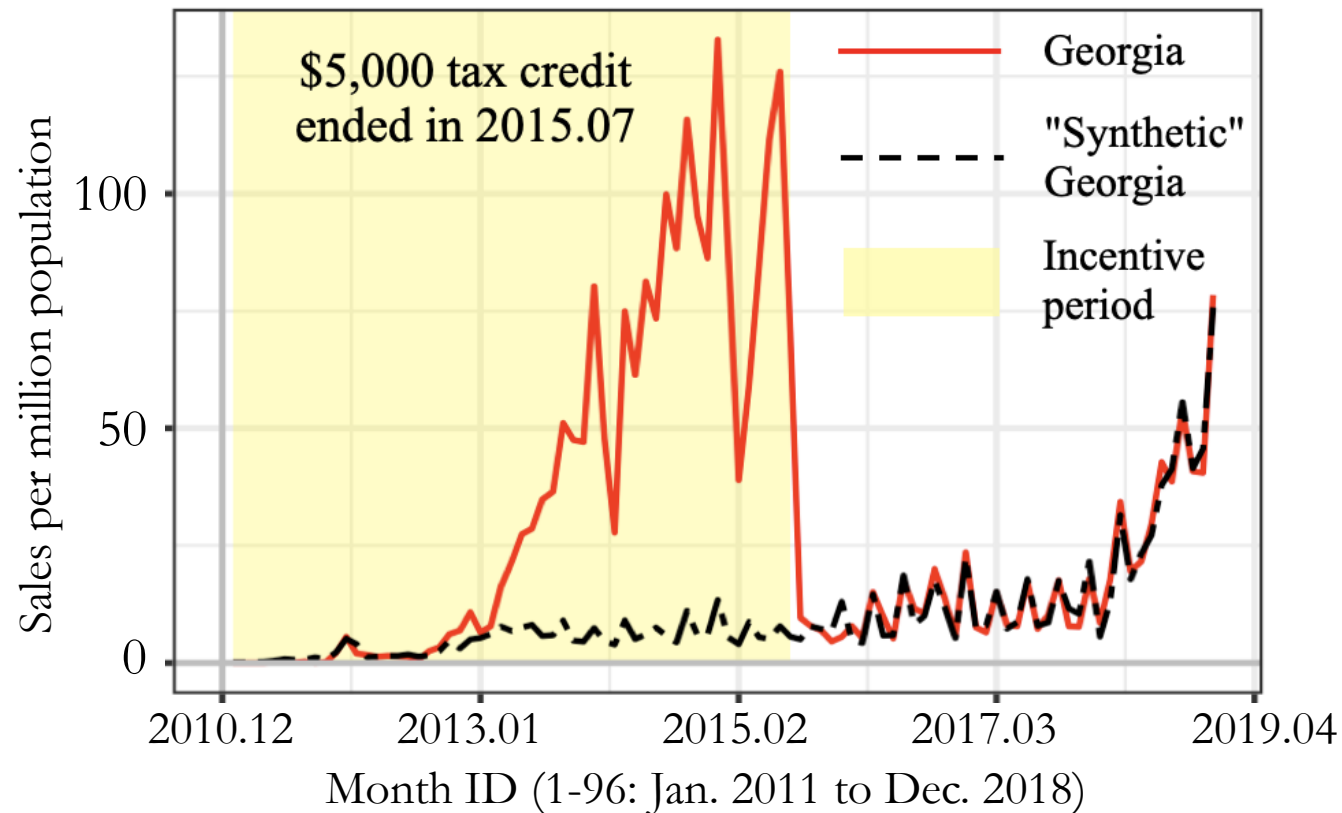
Compare

Control pool (27 states with no incentives)



Effectiveness Evaluation – “Synthetic” Georgia

Georgia BEV Sales (Observation vs. Synthetic Control)



Weights States

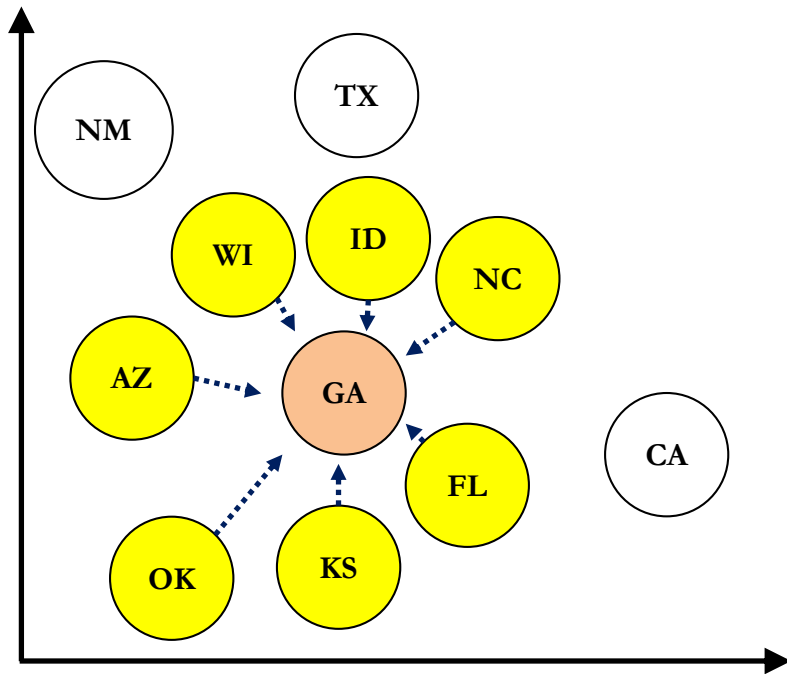
“Synthetic” Georgia = 0.305 Florida +
0.213 North Carolina +
0.190 Kansas +
0.179 Arizona +
0.059 Idaho +
0.042 Oklahoma +
0.013 Oklahoma

Effectiveness Evaluation – Synthetic Control Method* NM

Target Function:

$$W_{vi}^* = \underset{\text{State weights}}{\operatorname{argmin}} \left\{ \overbrace{\left(S_i^0 - S_i^{0c} W_{vi} \right)' \left(S_i^0 - S_i^{0c} W_{vi} \right)}^{\text{Penalty for discrepancy of EV sales}} + \underbrace{\lambda_{vi} \left(X_i^0 - X_i^{0c} W_{vi} \right)' V_v \left(X_i^0 - X_i^{0c} W_{vi} \right)}_{\text{Penalty weight} \quad \text{Penalty for discrepancy of all the control properties}} \right\}$$

$$\text{s.t. } w_{vi}^j \geq 0 \quad \forall j = 1, \dots, R_v^c; \quad \sum_{j=1}^{R_v^c} w_{vi}^j = 1$$



Control Properties Compared to Synthetic GA

Variables	Real GA	Model 1 – Keep all control properties		Model 2 – Exclude all control properties	
		Value	Diff(%)	Value	Diff(%)
Charging station	45.99	40.83	11.26%	37.70	16.95%
Gasoline price	2.27	2.32	3.10%	2.33	3.11%
Electricity price	9.53	10.01	5.65%	9.94	5.37%
Vehicle model	11.02	10.05	8.93%	10.05	8.93%
CO ₂ in Transport	56.17	54.21	3.44%	63.22	12.59%
% democrats	34.00	33.00	2.36%	36.00	5.57%
Driver population	0.78	0.80	2.00%	0.81	2.96%
Household income	57.02	55.91	1.94%	54.68	4.10%
Winter temperature	8.80	6.43	26.94%	7.10	19.32%
Education	25.90	0.28	2.19%	0.27	5.41%
Summer temperature	0.29	24.91	3.82%	24.78	4.34%
ZEV mandate	0.00	0.00	0.00%	0.00	0.00%
Unemployment	3.40	3.62	6.61%	3.81	11.98%
Urbanization	0.75	0.80	6.47%	0.78	4.52%

*Abadie, A. and Gardeazabal, J., 2003. The Economic Costs of Conflict: A Case Study of the Basque Country. *American Economic Review*, 93(1), pp.113-132.

Equity Evaluation – Federal Income Tax Credit (ITC)

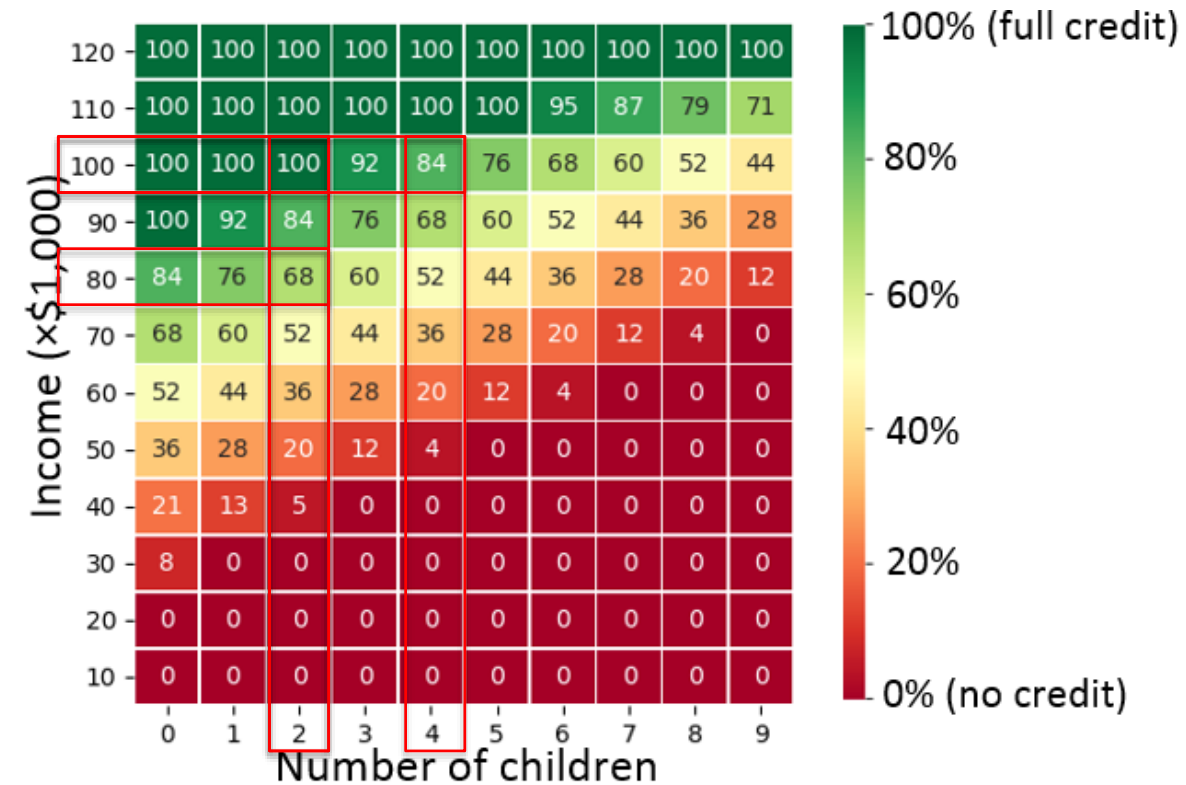
- Federal PEV Credit: up to **\$7,500 federal income tax credit (ITC)** for the purchase of a new qualified PEV
 - Only worth \$7,500 to customers **whose federal tax bill at the end of the year is \$7,500 or more**
- Significant income disparity across households in qualifying for federal PEV tax incentives

A married couple with two children whose family income is \$100,000 in 2018 qualifies for **100%** (**\$7,500**) of the federal PEV ITC

A married couple with two children whose family income is \$80,000 in 2018 qualifies for **68.5%** (**\$5,139**) of the federal PEV ITC

A married couple with four children whose family income is \$100,000 in 2018 qualifies for **84.5%** (**\$6,339**) of the federal PEV ITC

Federal PEV credit Eligibility for U.S. Married Couple

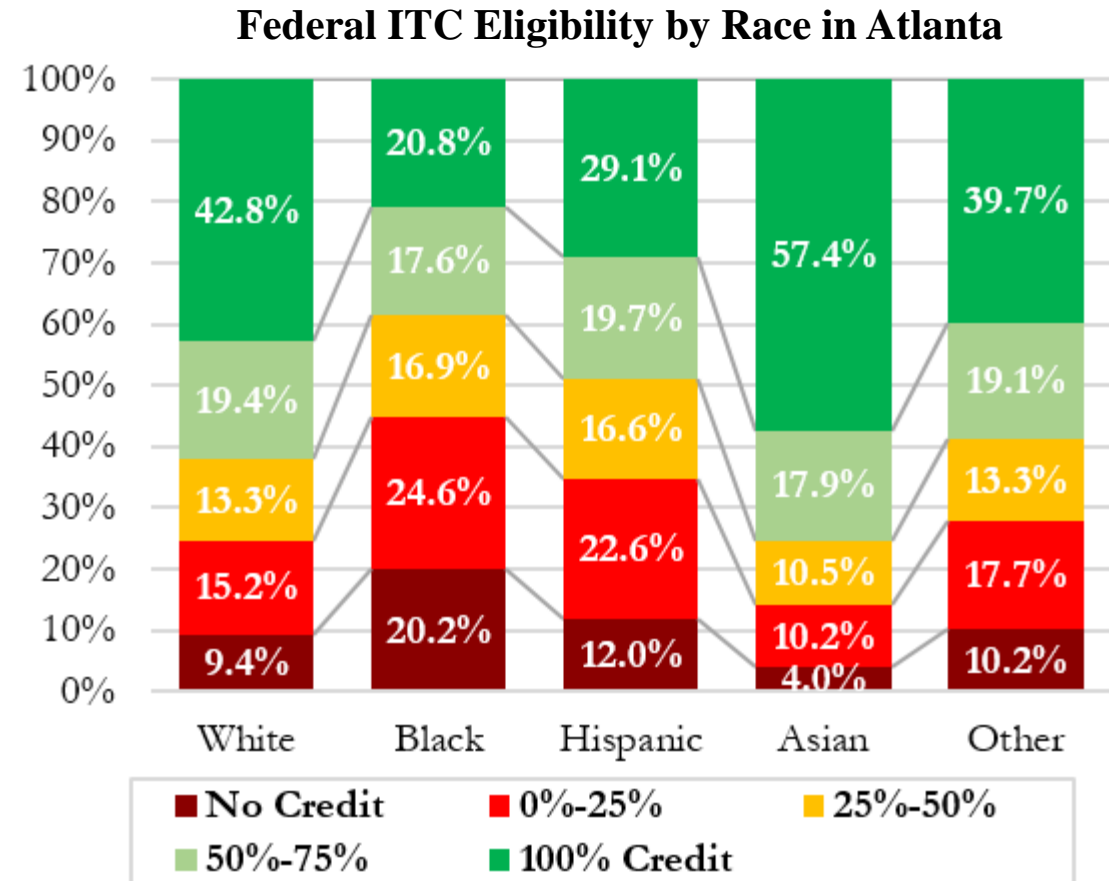
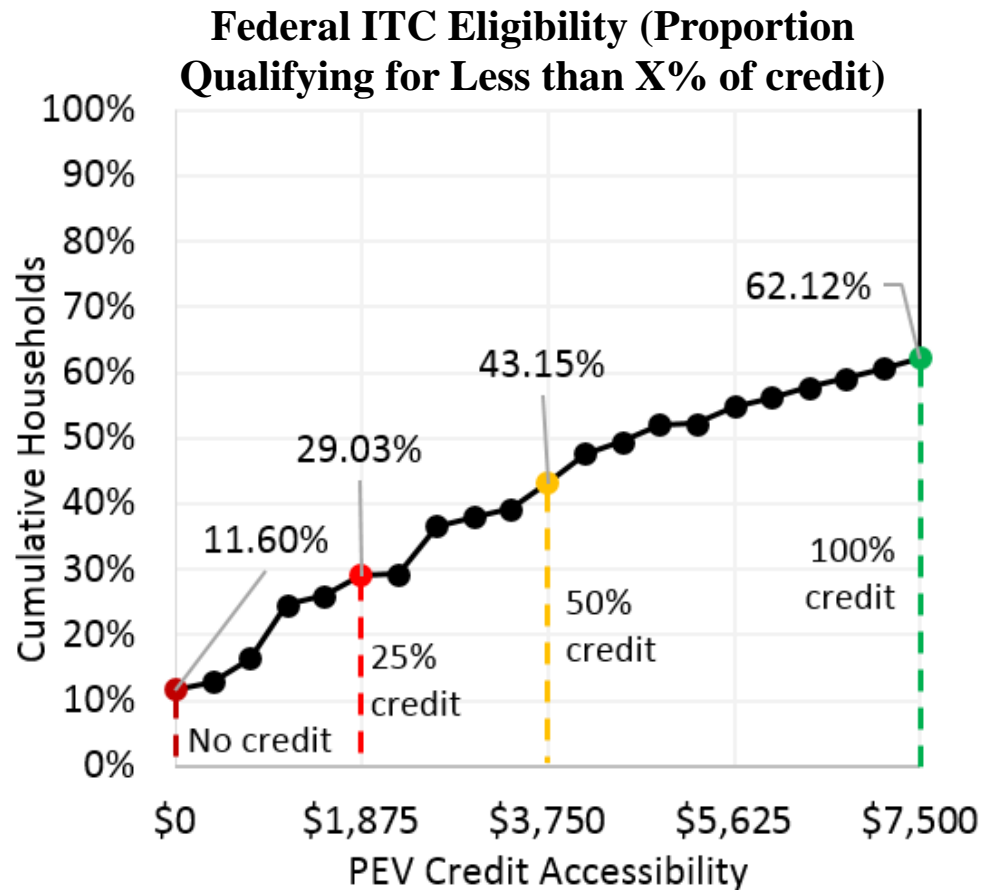


Accessibility of Federal PEV ITC in Atlanta



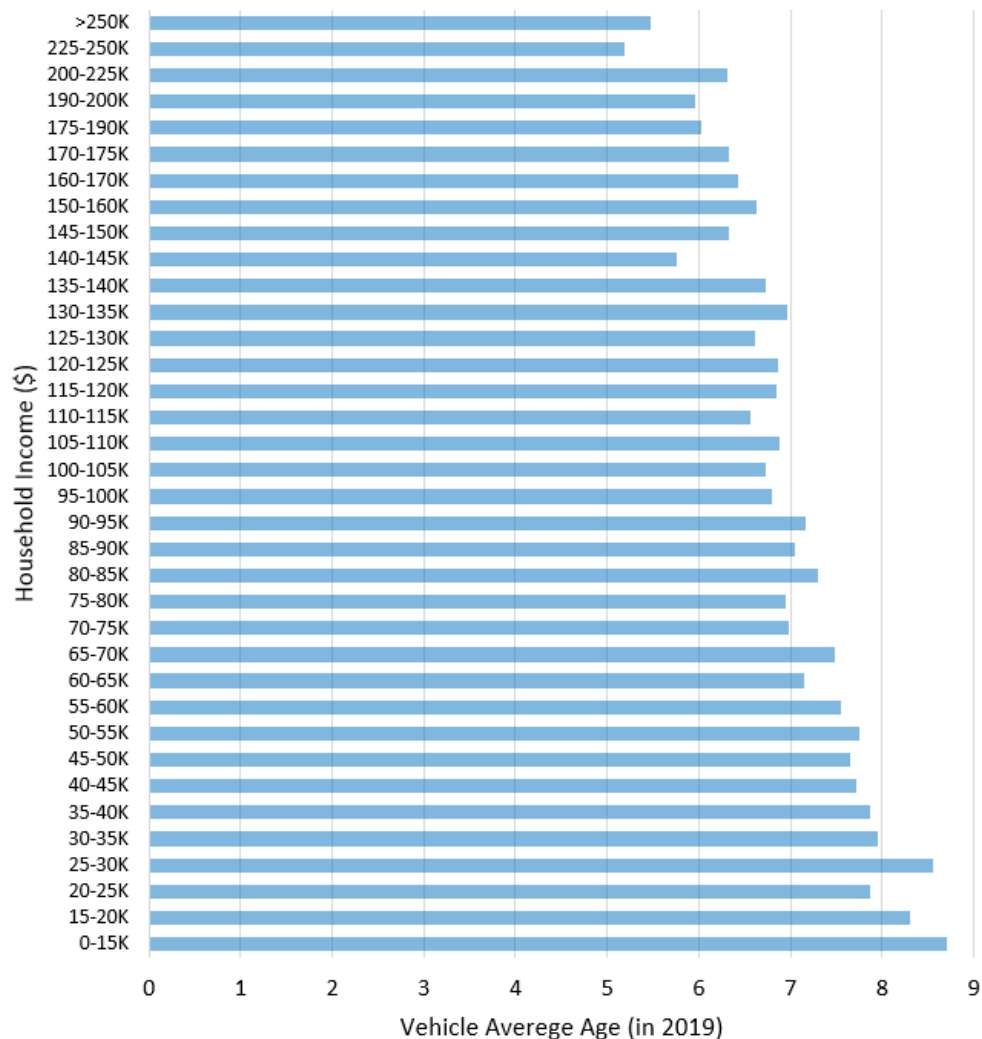
- 62.1% of households are not eligible for full credit
- 43.2% of households are not eligible for 50% credit

- Significant race disparity across households in qualifying for federal PEV tax incentives

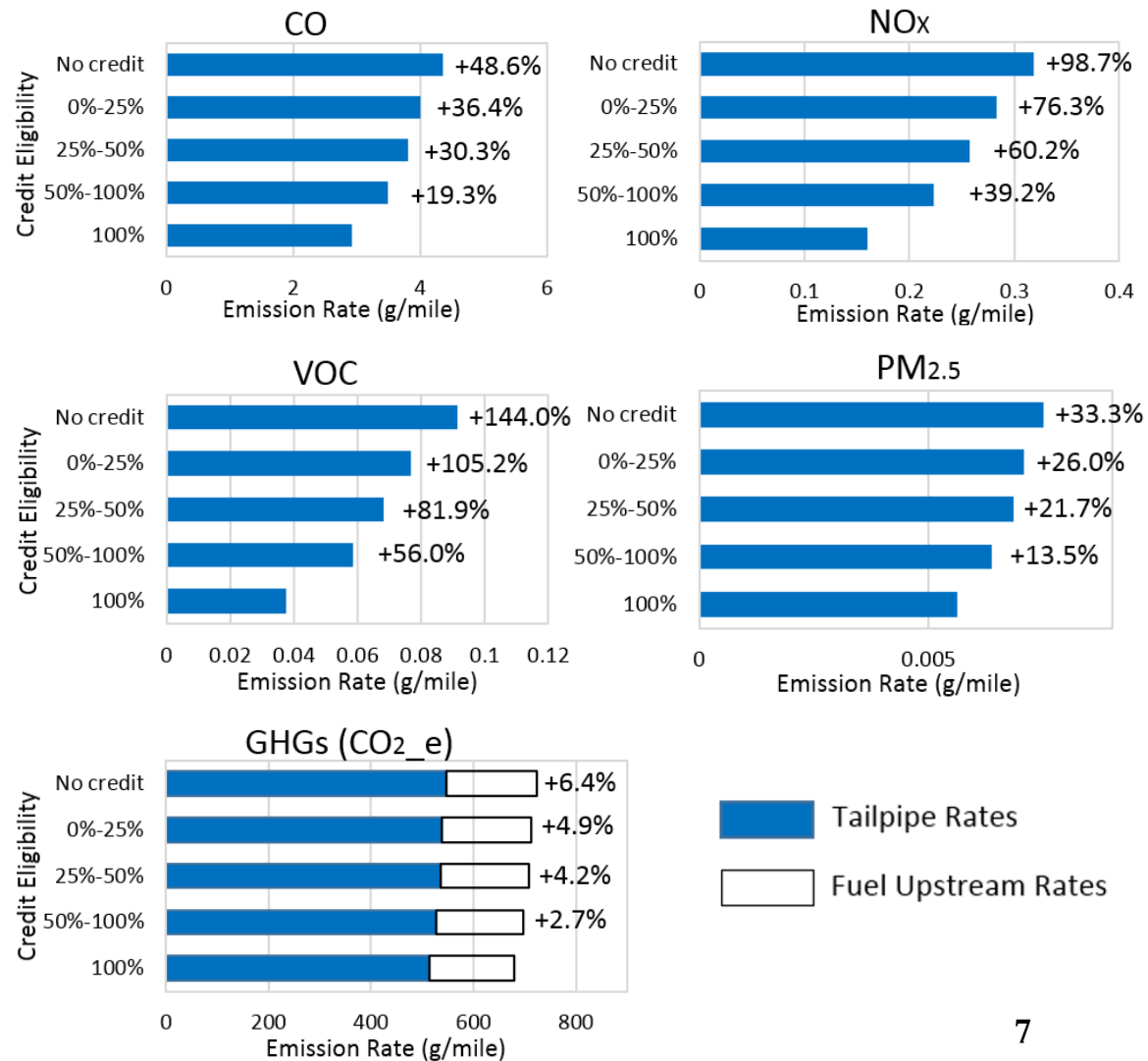


Vehicle Age and Emission Rates

- Households with lower income tend to own older vehicles (and higher emissions)



MOVES Emission Rates of Household LDTs by Credit Eligibility (FTP75 Cycle without Cold Start)



Effectiveness Analysis:

- Liu, H., Kim, D., Li, H., Rodgers, M. and Guensler, R. (submitted). Synthetic Control Methods for Estimating the Effect of Purchase Incentives on Battery Electric Vehicles Sales in Georgia, USA. Under Review. (Available Upon Request)

Equity Analysis

- Liu, H., Guensler, R. and Rodgers, M., (2020). Equity Assessment of Plug-In Electric Vehicle Purchase Incentives with a Focus on Atlanta, Georgia. CTEDD 019-21. <https://ctedd.uta.edu/research-projects/equity-assessment-of-plug-in-electric-vehicle-purchase-incentives/>