Value Pricing Fellowship Project

EV Daytime Charging – What is the Hierarchy of Opportunities and Customer Needs?

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Overview

The Value Pricing Fellowship Project enabled Georgia Tech to collaborate with five outside groups in the analysis of Commute Atlanta data, in addition to an in-house investigation of privacy protection in GPS-based vehicle activity data. The project has resulted in two journal publications so far, along with two manuscripts under review. The research team also anticipates additional publications and conference presentations. The results from this project have also fed into national level research proposals and the collaboration efforts will likely result in continuations in research with external funding.

In June and July, 2013, the GT team collaborated with theArgonne National Laboratory (ANL) on electric vehicle (EV) related research focus on daytime charging opportunities. This study uses the Commute Atlanta data base to examine a full year of data, contrasting its implications with those previously developed with NHTS single day data. Financial viability is contrasted with technical viability of plug-in electric vehicles (PEVs).

The study found that plug-in hybrid electric vehicles (PHEVs) may adequately serve the market, based on the Atlanta, GA case study.

Background

The Charging Pyramid illustrates a narrowing and shrinking charge point market size hierarchy from 1) residential to 2) workplace to 3) public charging for plug-in electric vehicles (PEVs). Required electric vehicle supply equipment (EVSE) power level increases with pyramid level.

The higher the kW rating, the higher charger cost will be.

The Business Case is best when a charge point can use the least amount of charger kW possible and still meet customer needs. This is related to the amount of time that the PEV can be parked and charged at the charge point without any customer inconvenience.

Data

The Commute Atlanta data provide exceptional opportunities for electric-vehicle related research:

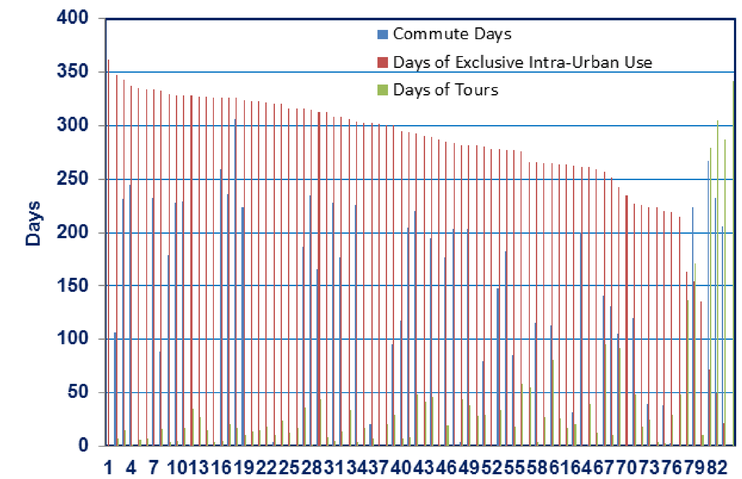
- GIS enabled identification of out of metro area tours (> 50 miles from origin & outside metro area boundary)
- Continuous patterns of use data for same vehicle for a year or more (year used here)
- Vehicle make, model allows examination of 3 vehicle categories
  - Car definition including FWD SUV
  - Passenger hauling vehicles up to 3 rows includes Minivans and RWD SUVs
  - Pickup trucks
- Previously tagged commuting use allowed identification of intense commuting
- Monthly summaries were compiled to allow a check for seasonal variation

Hypotheses and Results

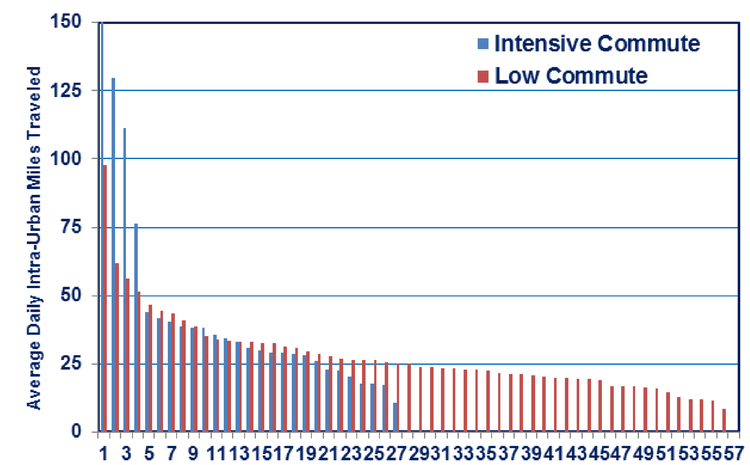
- Atlanta is more dependent on the motor vehicle than the nation on average. For the sample chosen the days of use are greater than the national average.
- Cars are more likely to be used in intense commuting than otherwise. This is **contradicted** by the data.
- The share of cars used in intra-urban travel will rise as daily distance increases, due to fuel cost per mile. This is **contradicted** by the data.
- People hauler tour mileage share should be higher (the vacation vehicle). This is **supported**.
- Pickups are least likely to be driven on tours. This is contradicted.
- The data base bias is toward the target market (high days of use, high annual miles, newer vehicles). Days of use are higher than average, daily miles may not be.
- Vehicles that regularly commute will have higher daily driving than others. This is **supported**. However, effect is weak and the statistical fit is very small with $R^2 = 0.09$

	Local days	Mean local miles	Local miles Coef. of Var.	Median /mean local miles	Local miles/ local day	Hours /local day	Local mph	Com-mute Days	Tour days	Tour miles	Tour miles CV	Miles /tour day	Tour mph	Share miles in tours
CV	22.3	1364	0.48	1.0	61	2.6	23.7	3.0	3.8	290	1.5	76	38	18%
PV	23	933	0.63	0.9	41	1.7	24.3	7.6	3.1	251	1.8	81	42	21%
PVI	22.9	1039	0.56	0.9	45	1.8	25.7	18.3	4.2	293	1.9	70	42	22%
PVL	23	882	0.67	0.8	38	1.6	23.6	2.6	2.6	231	1.8	89	42	21%
PVIC	23.7	987	0.48	1.0	42	1.7	25.1	18.7	3.8	226	1.7	59	40	19%
PVICIS5	23.6	1061	0.47	0.9	45	1.7	26.5	18.3	4.1	284	1.6	69	41	21%
PVICIC7	23.7	935	0.48	1.0	39	1.6	24.2	19.0	3.6	184	1.8	51	38	16%
PVLC	22.7	798	0.74	0.9	35	1.5	23.0	2.0	2.5	208	1.9	83	41	21%
PVIV	21.5	1041	0.70	0.8	48	1.9	25.2	17.0	4.3	395	2.0	92	44	28%
PVLV	24.9	1073	0.44	0.9	43	1.8	23.4	4.9	3.1	318	1.5	103	45	23%
PVIP	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
PVLP	24.4	1173	0.75	0.7	48	1.8	26.6	4.9	3.4	354	1.4	104	45	23%
PVICIA	26.3	914	0.42	1.0	35	1.4	25.1	18.8	1.1	103	2.4	93	44	10%
PVICIS5	26.6	1011	0.40	1.0	38	1.4	26.4	18.5	1.4	157	2.2	112	45	13%
PVICIC7	26.1	845	0.43	1.0	32	1.3	24.0	18.9	0.9	64	1.9	71	42	7%

Discussion



Days of Use per Year, by Vehicle



Average Miles per Day for Each of the Private Vehicles

- High-usage vehicles do not have a clear tendency to be intensive commuting vehicles.
- On days when used, very vehicles average over 50 intra-urban miles per day.

Summary

- Although previous studies identified a hypothetical pattern of driving that could make all-electric vehicles (AEVs) consistently financially superior to PHEVs, that pattern of driving — considerably more than 50 miles per day — is found for very few of the vehicles in the Commute Atlanta sample.
- A 60 kW battery pack PHEV with about 30 miles of range would consistently be superior to other plug-in HEV types and the AEV
- With regard to the charging pyramid, it can be argued that it is best to build the base before the peak

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