How do two-car households experience a battery electric vehicle?

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The set-up







Inclusion criteria:

- Small changes: same home, same workplace, etc.
- High quality of data from baseline period.
- Positive response rate: ≈ 90%.

Result: 25 participating households

The EV: VW e-Golf

- Stated range: 170-190 km (~ 105-120 miles) - NEDC
- Experienced range 120 km (~75 miles)

The data

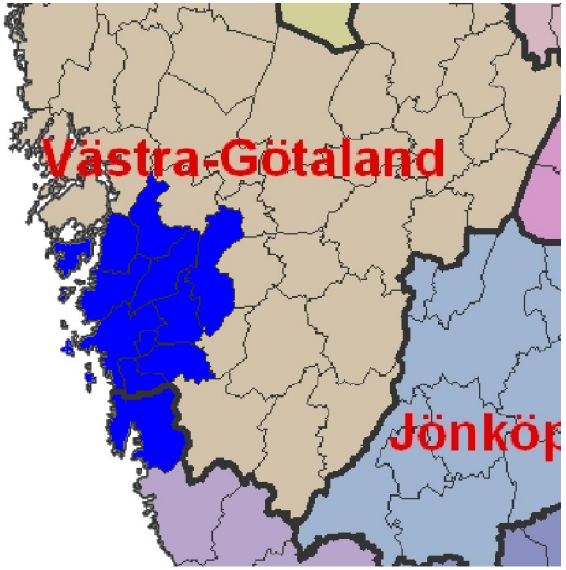
- GPS data on both conventional vehicles
- GPS data on conventional and EV
- Interviews before and after trial period
- Data from home-charging station

- 3 measurement periods
  - 10 households: April – September 2015
  - 10 households: October 2015 – January 2016
  - 5 households: February 2016 – May 2016

Target group first measurements period

Households

- Gothenburg region (13 municipalities)
- 2 cars (private, no company car)
- ≤ 65 years old (commut



Cars

- MY 2002+
- ≤ 2000 kg
- ≤ 200 kW

- Random selection from the vehicle register
- Recruitment by mail from households, + commuting ≥ 10km one way?

  \+ ≥ 2 actively used driving licences?

Spring 2013 and spring 2014

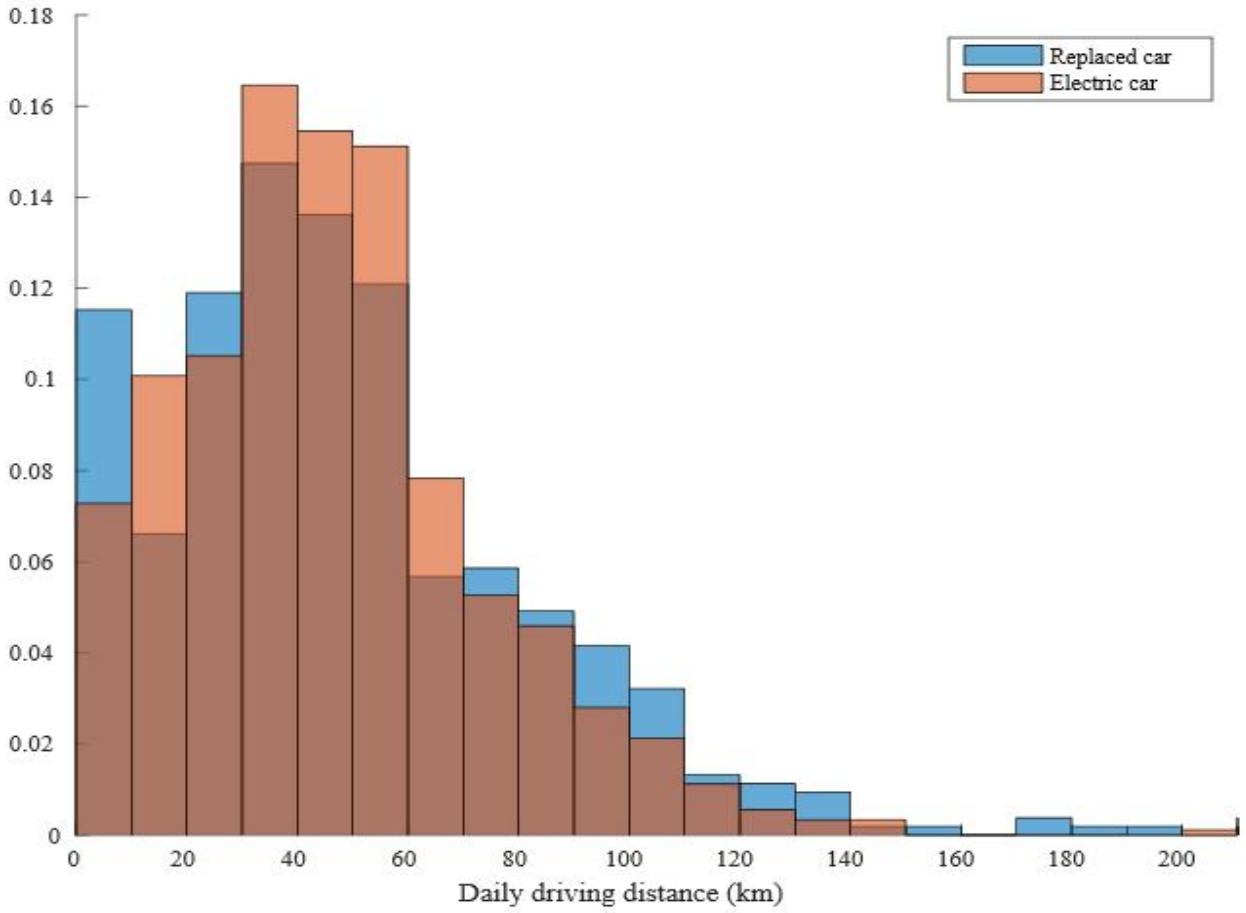
The data (II)

- 25 household
  - Gothenburg region, 2 cars, 1 replaced by EV,
  - Selected from 60 household previously measured GPS on both cars
    - Criteria: good data in measurement period 1; not major changes in commuting

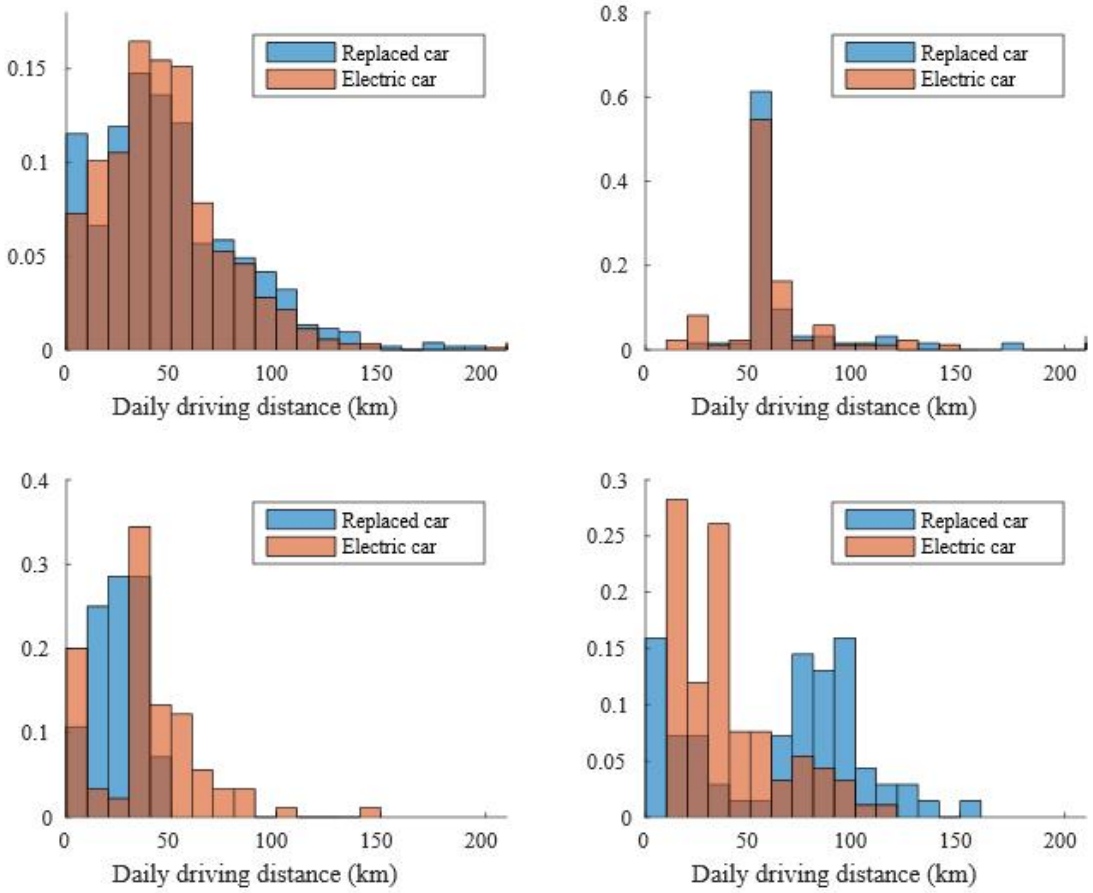
The data (III)

- EV on trial
  - VW e-Golf – stated range 170 -190 km (experienced range 120 km)
- GPS frequency 1HZ
- From OBD: SOC (in %), odometer, outside temperature, engine power (1/minute)
- Home charging stations: starting time of charge, length of charge, energy (kWh)
- Interviews before and after EV trial
- Interested but not (only) early adopters

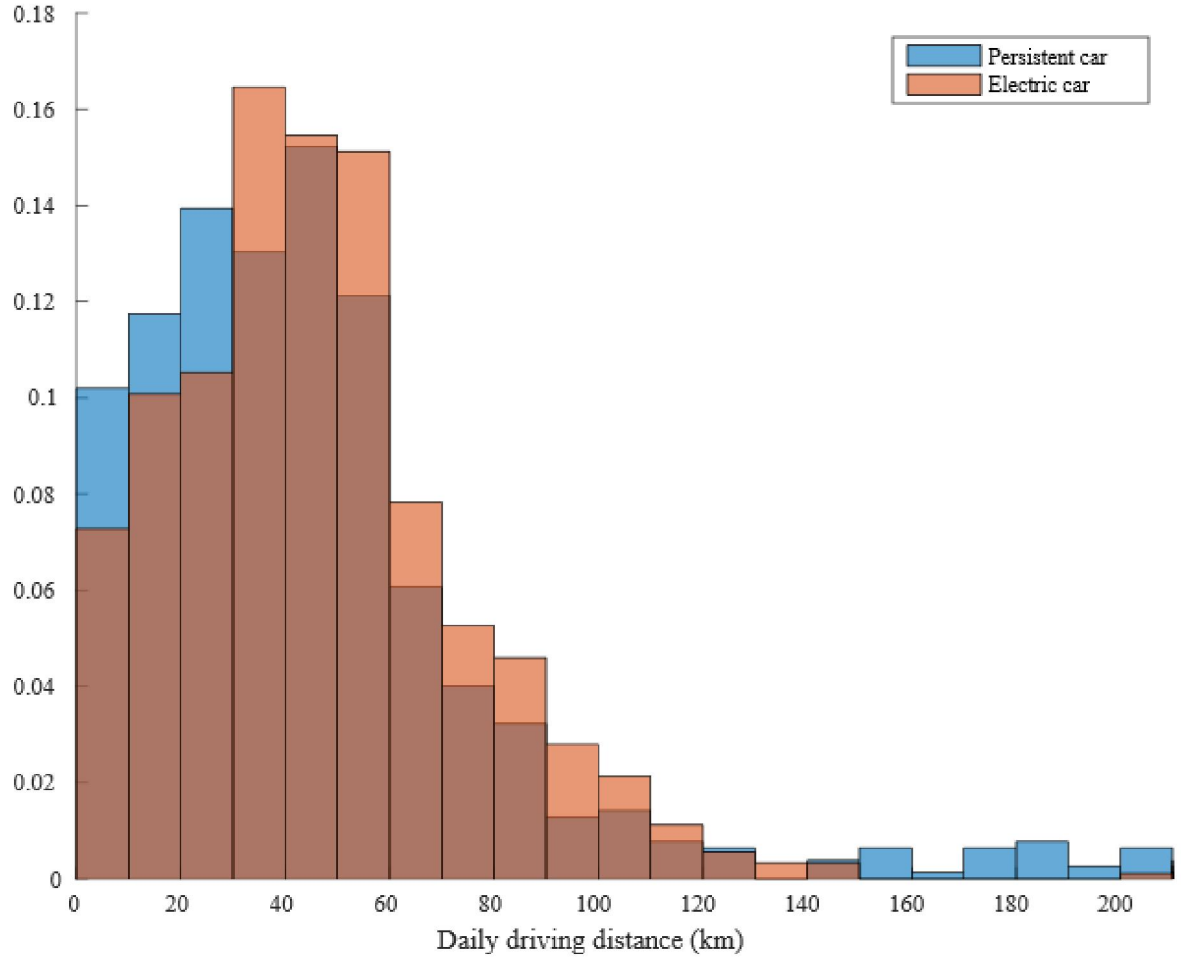
Histogram of daily driving distance compared to replaced car (aggregated for 10 households)



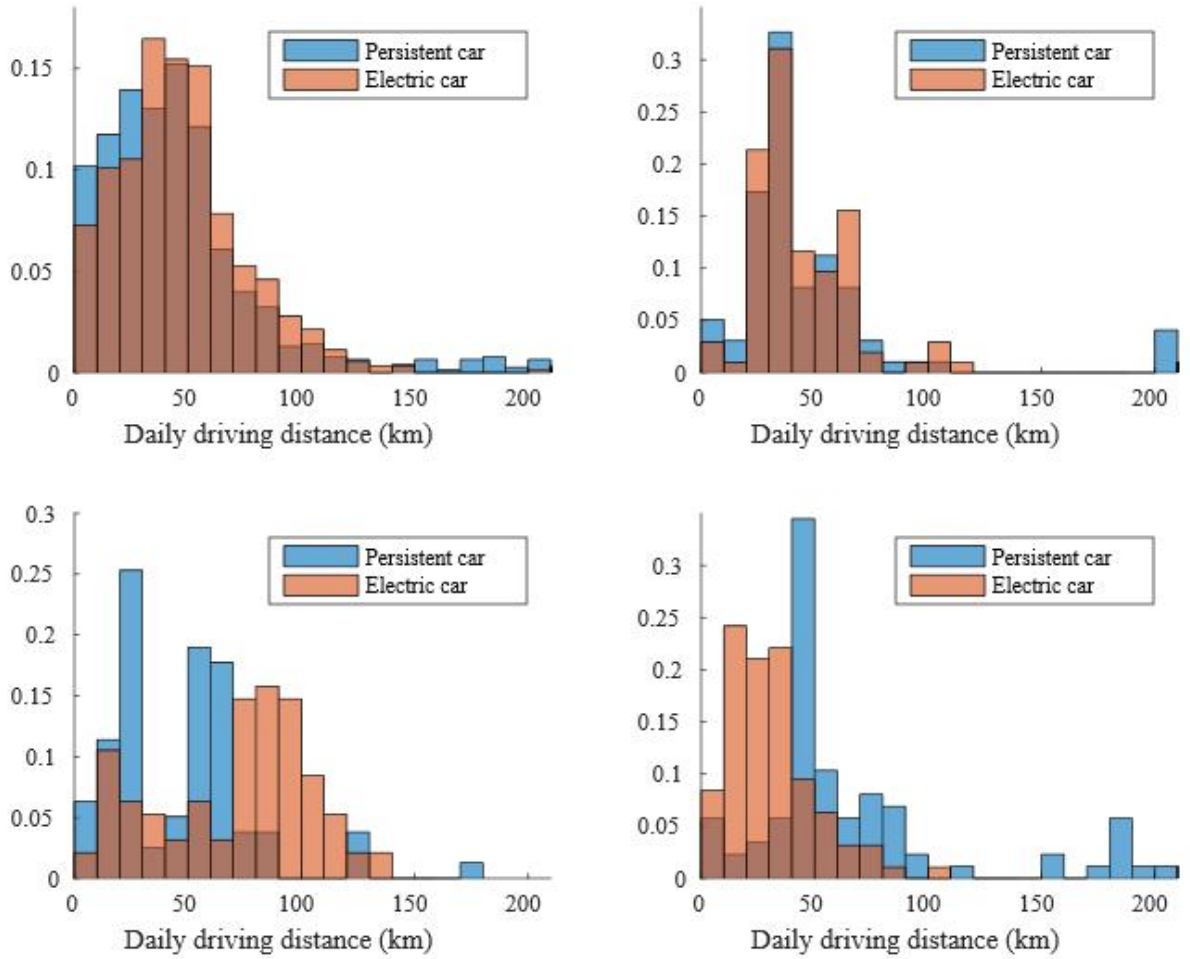
Histogram of daily driving distance compared to replaced car - aggregated + 3 cases



Histogram of daily driving distance compared to kept conventional vehicle (aggregated for 10 households)



Comparing daily driving distances between EV and ICE – aggregated + 3 cases

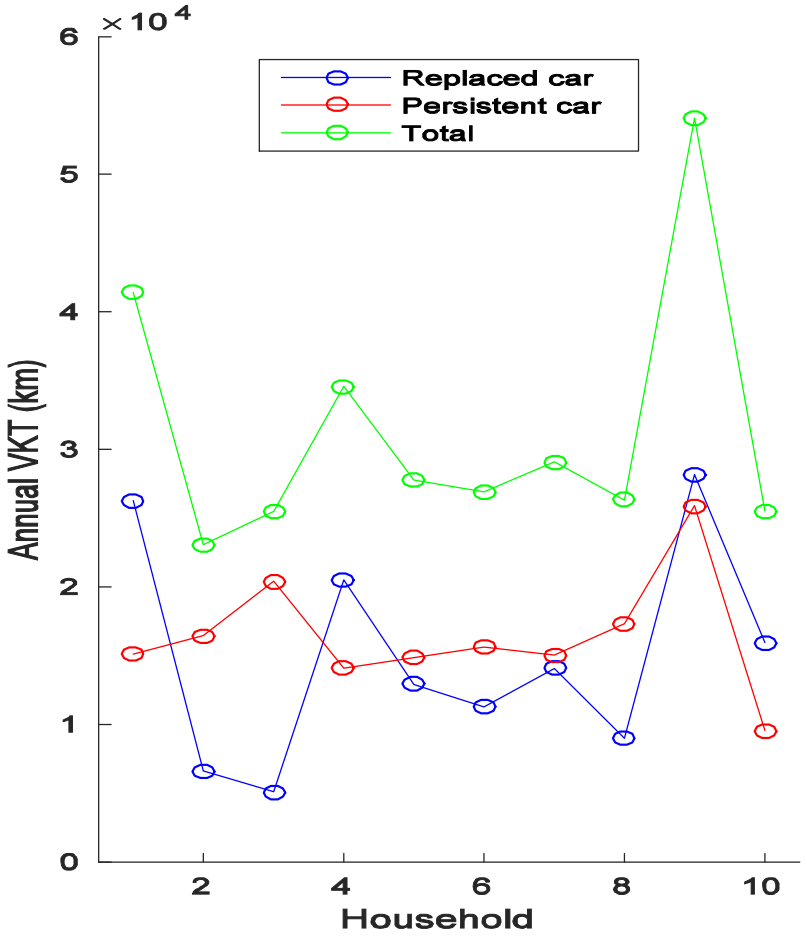


Share of driving and fractional increase in share of driving for EV

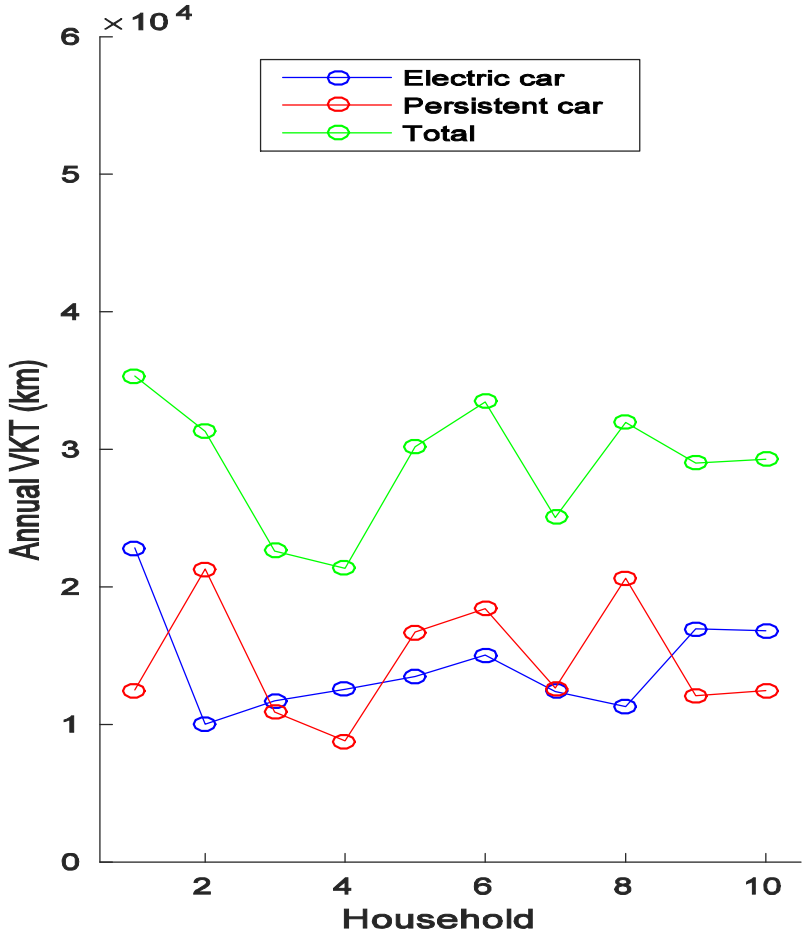
Household	EV	Replaced car	Fractional increase
1	65%	63%	2%
2	32%	29%	12%
3	52%	20%	160%
4	59%	59%	-1%
5	45%	47%	-4%
6	45%	42%	7%
7	50%	48%	3%
8	35%	34%	4%
9	58%	52%	12%
10	57%	63%	-8%

Extrapolated annual VKT for both vehicles and total in the two measurement periods

Two ICE cars



One EV and One ICE



Some interview results

- Everyone liked the car
  - ”It’s the future”
  - Driving experience, quiet
  - Exceeded expectations for almost all
- Limited range experienced as negative
  - “but we have managed all our driving”
- Insecurity:
  - How much range is actually left?
  - Will charging stations work?
  - Lifetime of battery – leasing more attractive than buying
- Price probably biggest barrier
  - Want similar price as conventional vehicle

Some observed behaviors

- Not many have taken long trips with EV
- Environmental rebound?
  - No bad conscience when driving EV
- Cold spell in winter had a negative effect on experience (including winter tires) – most estimate a reduction in range of 25%
- Experience of range much relate to attitude to risk taking
  - One woman – refills gas when half-empty

Early conclusions

- There is a large heterogeneity in how driving is adjusted to the use of a BEV.
- On average, the increase in driving the BEVis small
- Price is probably the largest barrier

Potential of electictric driving