

Electricity consumption for electric vehicles

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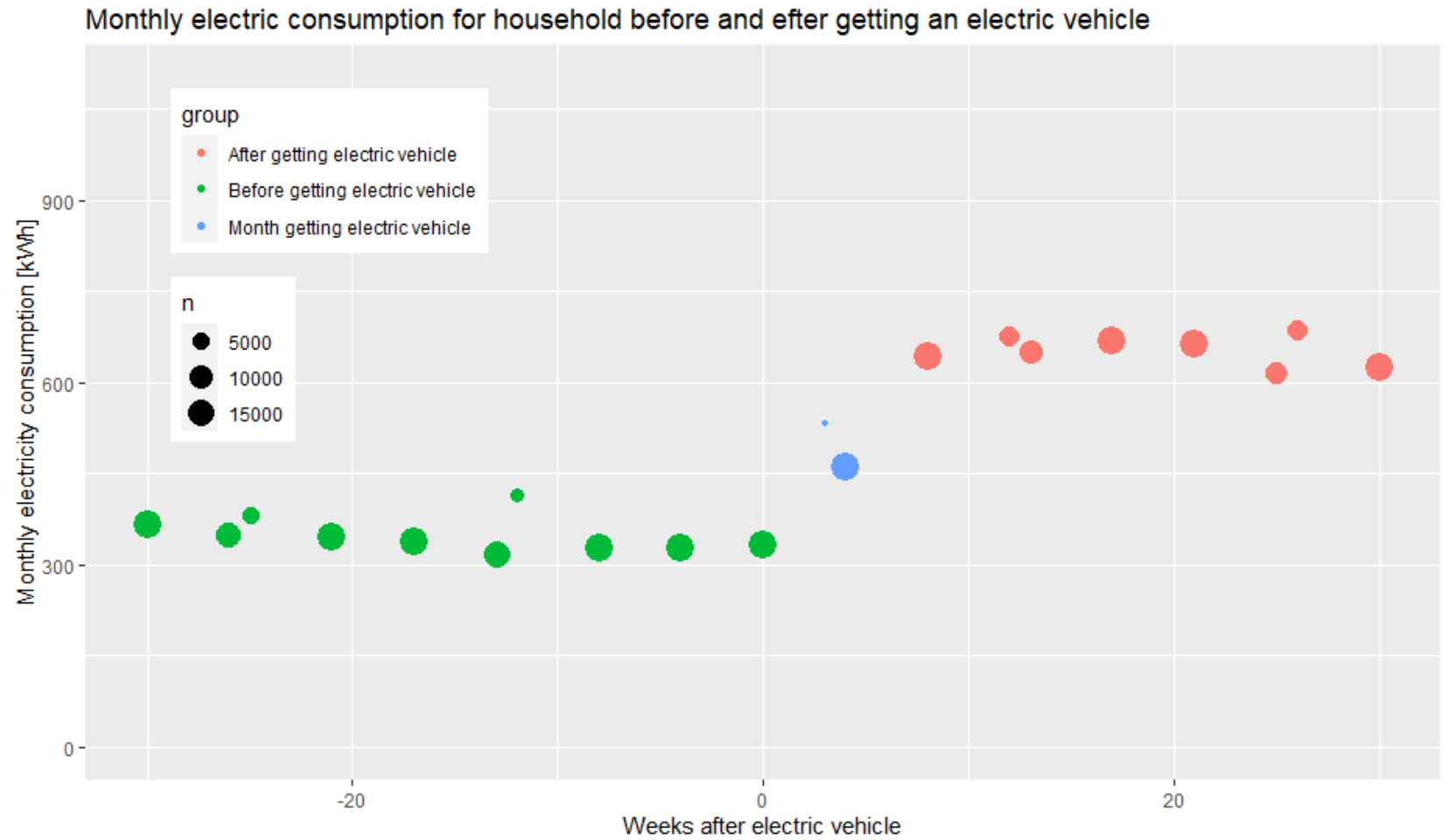


The purpose

- Fill the gap in energy accounts that EV creates – the energy consumption used for EVs
- Energy consumption for conventional vehicles running on fossil fuels is based on the sales of fuels
- EVs is not only charging at commercial charging points but also at home – and in both cases the consumption is mixed with electricity consumption for other purposes
- The goal of the project was to see if smartmeter data measuring electricity consumption in households can be used for estimation of domestic charged energy for EVs

The idea

When a household acquires an electric vehicle, there is an increase in household electricity consumption provided that some charging takes place at home



What kind of data

Vehicle Register

- Complete monthly updated vehicle register
- Identification of both owner and user regardless of private or business
- Date of registration
- Including odometer readings from vehicle roadworthiness inspections

Population data

- Complete population register at household level
- Identification of all household members
- Address and composition over time
- Demographic, economic and geographic information

Smartmeter data

- Complete registered electricity consumption at an hourly basis
- Covers all end-users (as of 2020)
- Identified by address

First version

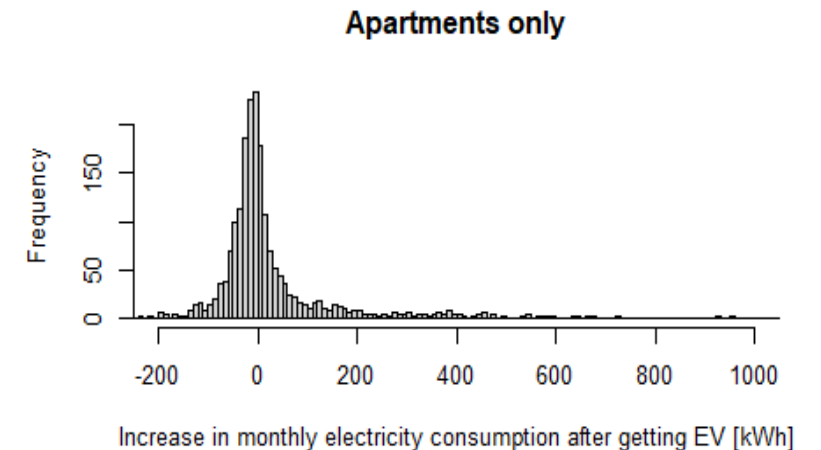
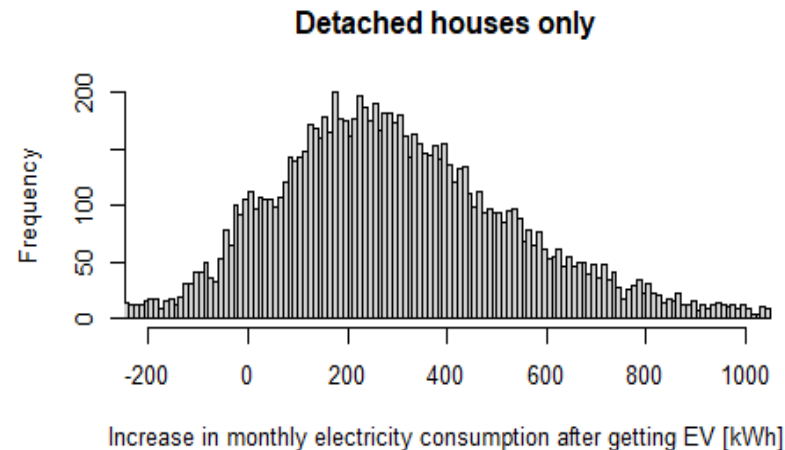
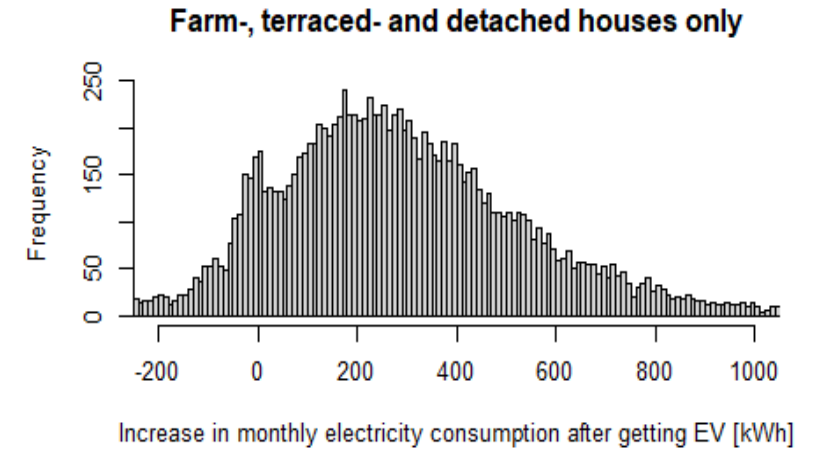
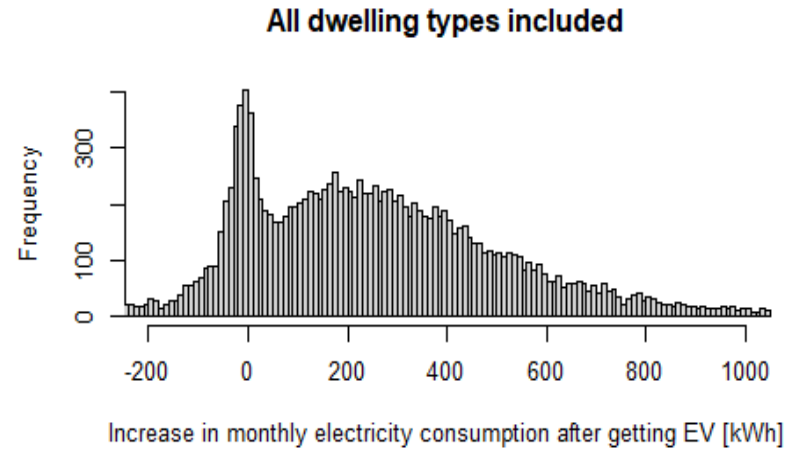
- Focus on household fleet of pure EV and consumption in household
 - To simplify: plugin electric hybrids might have too small a footprint on electricity consumption to be measurable
 - In private households, the energy consumption of an EV is significant where as it might not be the case for business vehicles
 - It is the registered vehicle user that is used for determining the household to eliminate leasing and similar arrangements
 - Linking businesses to smartmeter data through addresses is not without complications, typically of the form several businesses share one meter or several businesses and meters at the same address
 - Household consumption can be linked with high probability to one (or few) EV where as public charging stations cannot be linked at all

What did we do

- For each acquisition of an EV, we link it to the user household by the personal identification
- That in turn is linked via the address to electricity consumption
- The average electricity consumption for the three months following the acquisition month is compared to the same month the year before
- Provided that the same household lives at the same address
- This gives us the baseline consumption and the EV included consumption
- What is a significant increase of consumption? A good question that should balance the average consumption (and thus mileage) and the share of EV-users that charge at home. We chose with input from the industry a level consistent with 80 percent home charging boxes in detached houses

Who charge at home

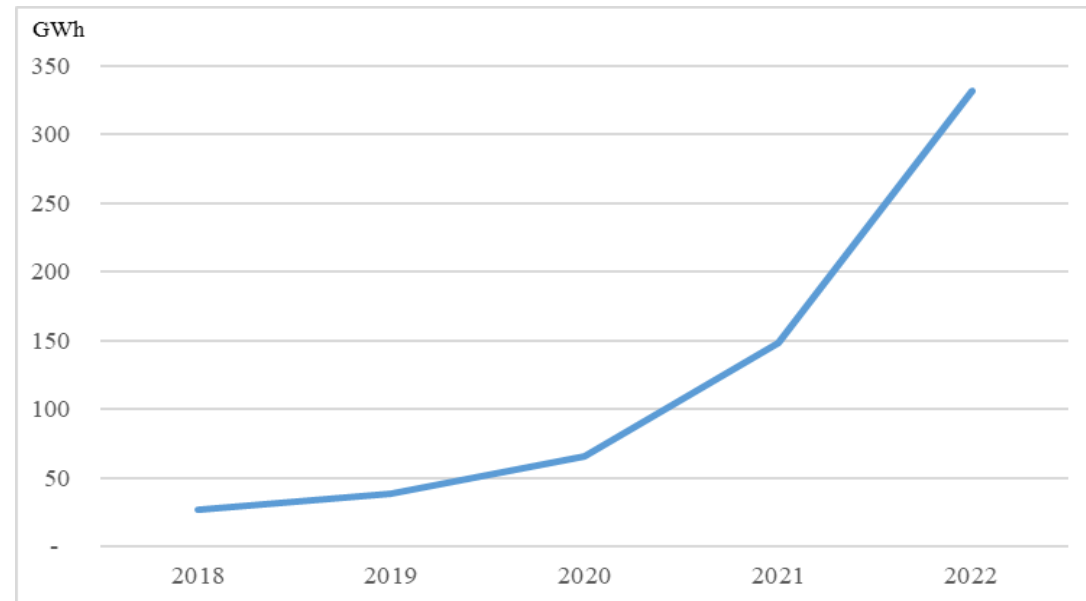
- To no-ones surprise we saw that the type of dwelling determined whether the EV was home charged or not
- Especially EV users living in detached houses charged at home
- Whereas apartment dwellers showed no significant increase in consumption



How did we use this

- Using the vehicle register, we saw no difference in vehicle composition between types of dwelling
- However a difference in annual millage between types of dwellings (table to the left)
- So we calculate consumption for EV in detached dwellings
- And estimate consumption in other dwelling based on annual millage using a factor determined by the relative millage to detached dwellings

Type of dwelling	Avg. annual millage [1,000 km per year]	Factor	EV Consumption [KWh per month]
Not recorded	18.4	0.958	374,7525
Farmhouse	21.3	1.109	434,245
Detached house	19.2	1.000	391,804
Terraced, linked or semi-detached house	16.5	0.859	337,8731
Multi-dwelling houses	16.9	0.880	345,4947
Student hostels	18.5	0.964	377,4993
Residential buildings for communities	18.0	0.938	367,081
Other	14.6	0.760	297,1831
NA	18.3	0.953	372,8919



Uncertainties - what to do with them

- We have estimated home charging for EVs in detached dwellings and the equivalent for other types of dwellings. However we miss still the charging done elsewhere
 - Project with the industry to gather all information on public and semi-public charging stations
- If there is a general up- or downward trend in energy consumption, that would over or under estimate the EV energy consumption
 - We do see that. We expect to use the smartmeter data to derive a trend to adjust for this
- Shifts in the relative usage of vehicle across dwellings
 - This needs to be monitored using odometer data from vehicle inspections data
- We assume EVs are used as fossil fuelled vehicles
 - Maybe increasingly true but not necessarily true when the first EVs came

More to be done

- Address the uncertainties
- Include charging away from home
- Include plug-in hybrids
- ...