38th International Electric Vehicle Symposium and Exhibition (EVS38)
Göteborg, Sweden, June 15-18, 2025

BEV Laggards: Barriers to Car Electrification in Sweden

Jakob Rogstadius[1], Magnus Karlström[2], Hampus Alfredsson[1]
[1]*RISE Research Institutes of Sweden AB, Lindholmspiren 7A, 417 56 Göteborg, jakob.rogstadius@ri.se*
[2]*Lindholmen Science Park AB*

Executive Summary

We investigated which demographic groups in Sweden are lagging in battery-electric vehicle (BEV) adoption and whether the deployed public charging infrastructure has contributed to reducing these gaps. Using high-resolution national registry data, we analyzed vehicle-age-adjusted BEV and PHEV ownership patterns across income levels, housing types, and access to charging. We found that low income and living in apartments are the strongest barriers to adoption, and that public charging availability has not significantly increased BEV uptake among apartment residents. Based on these findings, we recommend policies that lower public charging costs, strengthen incentives linked to vehicle use, improve charging access quality for apartment dwellers, and support retention of used BEVs in Sweden.

Keywords: Electric Vehicles, Consumer Behavior, Social Equity, Consumer Demand, Public Policy & Promotion

1 Introduction

The European Union will ban the sale of new cars and vans with non-zero tailpipe emissions from 2035, and targets net zero emissions by 2050. Under the EU Effort Sharing Regulation, Sweden is required to reduce greenhouse gas emissions from domestic transport (excluding aviation), buildings, agriculture, small industry, and waste by 50% relative to 2005 levels by 2030 [1]. Nationally, Sweden has committed to a more ambitious 70% reduction in GHG emissions from domestic transport relative to 2010 levels by 2030 [2]. A 25% reduction had been achieved by the end of 2024 and on the current trajectory, the national target will not be met [3].

Global adoption of electric vehicles is accelerating, with zero tailpipe battery-electric vehicles (BEVs) making up an increasing share of global car sales. BEVs have been the most popular powertrain for new cars in Sweden since 2022, though Swedish sales of both BEVs and plug-in hybrid electric vehicles (PHEVs) have remained largely unchanged for 2023 and 2024. A parallel slowdown in EV sales growth in the EU suggests that structural barriers may be limiting further adoption by demographic segments with lower EV uptake. Understanding which groups are likely to be late adopters is critical for designing policies, vehicles and charging solutions that facilitate further decarbonization of road transport.

1.1 Related work

Global electric car sales maintain an upward trajectory. However, demand varies significantly between different countries and cities. Several studies have attempted to identify factors that explain these differences.

For example, Chen et al. analyzed EV adoption in the Nordics and found car buyers were more likely to choose a plug-in electric vehicle if they had higher income, were younger males, had a higher number of children, had experiences with EVs, and generally held environmental values [4].

In contrast, another study found that in the EU, income, education levels, ownership of charging outlets, and ages over 55 were positively correlated with the electric vehicle market share. US ownership of charging outlets was also positively associated with the EV market share [5].

Through a review, Hardman et al. identified key challenges when trying to increase demand for electric vehicles. Demographic groups including renters and lower-income households are currently underrepresented among EV buyers. Incentives are therefore important but have mainly supported higher-income new-car buyers and are now being phased out. Charging infrastructure meanwhile has insufficient and uneven availability, poor usability, and is unavailable for some households [6]. While prior work has shown the importance of access to private outlets for charging, the role of public charging is less clear. Hardman et al assessed the research literature and concluded that the impact of public charging on PEV sales, PEV purchases, or preferences is not yet clear [6].

A new trend is to conduct studies with high geographical resolution. This is probably needed to understand better the influence of local factors on adopting electric vehicles. For example, Sinton et al. did a study examining electric vehicle adoption at the postal code level in US states. They concluded that geographic variations in sociodemographic and land use measures influence adoption [7].

An important methodological issue is how public charging is measured. Often, the number of charging points is used as the measure, but in one study, other metrics are also included, such as the total charging capacity of all charging points in an area or the average charging capacity per charging point. The researchers concluded that all three measures have a weak but positive association with EV adoption [8].

Our study focuses on the Swedish situation, which is characterized by having a relatively high number of plug-in vehicles in the fleet (approx. 14%), but also by the fact that a relatively large proportion of households (approx. 50%) live in multi-family dwellings. A study carried out by Kristoffersson et al. analyzed Swedish registry data during 2019 found that access to private charging had a significantly greater impact on EV adoption than did access to comparable public charging [9].

1.2 Contribution

This study extends prior work by focusing on causal relationships, rather than only identifying statistical correlations. We use mostly complete high-resolution public registry data to answer the following research questions:

1. What combinations of observable demographic variables most strongly contribute to low rates of BEV and PHEV ownership in Sweden? (Housing type and disposable income)

2. For identified late adopter groups, how strongly has access to public infrastructure for fast or slow charging so far contributed to BEV adoption? (We cannot show a contribution)

3. To what extent can barriers to BEV adoption be expected to persist over time? Are there structural differences that must be addressed? (We believe they will persist and that the quality rather than quantity of public charging must improve)

We conclude by discussing the strong implications of our findings for policy makers, vehicle manufacturers and charging infrastructure planners.

2 Methods

We perform quantitative analysis of data from the Swedish car, population, household, and income registries, extracted at the end of 2023. Registry data were complemented with records from a database of public chargers. Our geographic analysis uses a subdivision of Sweden into 5985 demographic statistical areas (DeSO) with between 700 and 2700 inhabitants. DeSOs are subdivisions of municipalities that match demographic differences within the Swedish population relatively well, making this spatial segmentation particularly suitable for analysis such as ours.

Swedish national registry data are nearly complete, with documented relationships between people, households, cars, and buildings. A relatively small number of individuals with protected identities were excluded. Only imputed values are available for annual driven distance for most cars below three years of age, as these do not require annual inspection. High-resolution data is not public data, which necessitated preprocessing on a secure server provided by Statistics Sweden. Due to limitations in how data could be exported from this secure server, we only present averages (as opposed to distributions) in some plots.

An immediate challenge with analyzing EV adoption patterns is that these age disproportionately new vehicles – 80% of BEVs in the data are less than three years old. This makes BEV adoption strongly correlated with all demographic factors that are correlated with ownership and use of newer cars, including higher income, higher education, older age, living in a wealthy neighborhood and greater household size. As the novelty of EVs in the fleet is a transient phenomenon, most of our analysis looks at EV adoption normalized by vehicle age. By first calculating the BEV and PHEV shares of the national car fleet for each vehicle model year, we can calculate expected BEV and PHEV shares in any subset of vehicles given the age distribution of those vehicles. A 100% age-normalized EV share implies that the set of vehicles contains the same number of EVs as we would expect if EVs follow the same patterns of propagation through society as cars have done in the past. If a demographic group has an age-normalized EV share significantly below 100%, that group for some reason has lower incentives or faces greater barriers to EV adoption than the general Swedish population.

For the purposes of this analysis, the main weakness of the Swedish data is that while individuals with a taxable company car benefit (a benefit car for short) can be identified, it is not possible to identify which company car is being used by which individual. By the end of 2024, approximately 28% of Sweden's BEVs were benefit cars, and approximately 23% of all benefit cars were BEVs.

We addressed this data quality problem by assigning a sample of company cars to users of benefit cars based on income, car value, and biased towards local EV uptake of non-benefit cars. This assignment was done as follows: 1) calculate the national shares of BEVs and PHEVs among all cars and among company cars; 2) calculate the age normalized BEV and PHEV ratios per DeSO; 3) count the individuals with a taxable car benefit per DeSO; 4) assign a powertrain (BEV, PHEV or ICEV) to each benefit car user, based on the national ratios among company cars scaled by the age-normalized ratios within the DeSO; 5) rank all individuals within a municipality (one of 290 Swedish administrative regions) by disposable income; 6) per powertrain, sample the desired number of company cars from companies with presence in the municipality and rank these cars by taxation value; 7) assign cars to individuals matching ranks. Note that our goal is not necessarily to assign the correct car to the correct user, but to compensate for missing data that skews the distributions of powertrains differently in different locations depending on the local predisposition towards benefit cars. Benefit cars are a subset of all company cars and company cars not assigned to a person were excluded from the analysis.

Data on public chargers were taken from the Nobil database, which contains information about sites, number of chargers, maximum power per outlet and a registration date. The database is not complete and registration dates of chargers in the database do not necessarily correspond to the start of operation in the real world. Some cleaning was performed to flag dates on which unusually many chargers were registered as unreliable. This flag is considered in the analysis of public charger impact on EV adoption. While prior work suggests access to private charging is associated with EV adoption, we lack access to any dataset that directly captures individual households' access to private charging, or private parking which is a prerequisite for private charging. In general, detached houses in Sweden have at least one private parking space, with many suburban and rural houses having access to multiple private spaces. Residents in detached houses are also typically free to install chargers if they wish. It is more complex for apartment residents.

We have access to the construction years for all residential buildings and we know that access to private parking for apartment residents in Sweden varies significantly by building age and area density. Buildings constructed before 1950 usually lack private parking, with only municipal on-street parking available. Due to population growth and urbanization, Swedish cities have expanded in size since then and most older buildings are now in the city centers. High parking norms between approximately 1950 and 1990 mean that off-street parking is available for most residents in apartment buildings constructed during this period. As cities have mostly grown outwards, these buildings are often located in suburban areas. Societal norms have now become more favorable towards active and public transport and newer buildings (post-2010) have often been constructed with some off-street parking, but less than one parking space per household. Regardless of construction year, residential buildings in high-density, high land-price areas (e.g., city centers) are less likely to have access to private parking than are residents in suburban and rural areas.

With regards to charging infrastructure, apartment residents may still depend on investment by a housing association or landlord if they wish to have charger access at their reserved parking space. A Swedish study recently showed that apartment residents are more likely to have an electric car if they live in buildings where the housing association has applied for and received public subsidies for installing chargers [10]. The direction of causality for this association is however unclear – do subsidized chargers drive adoption of EVs, or does a will to adopt EVs drive application for charger subsidies?

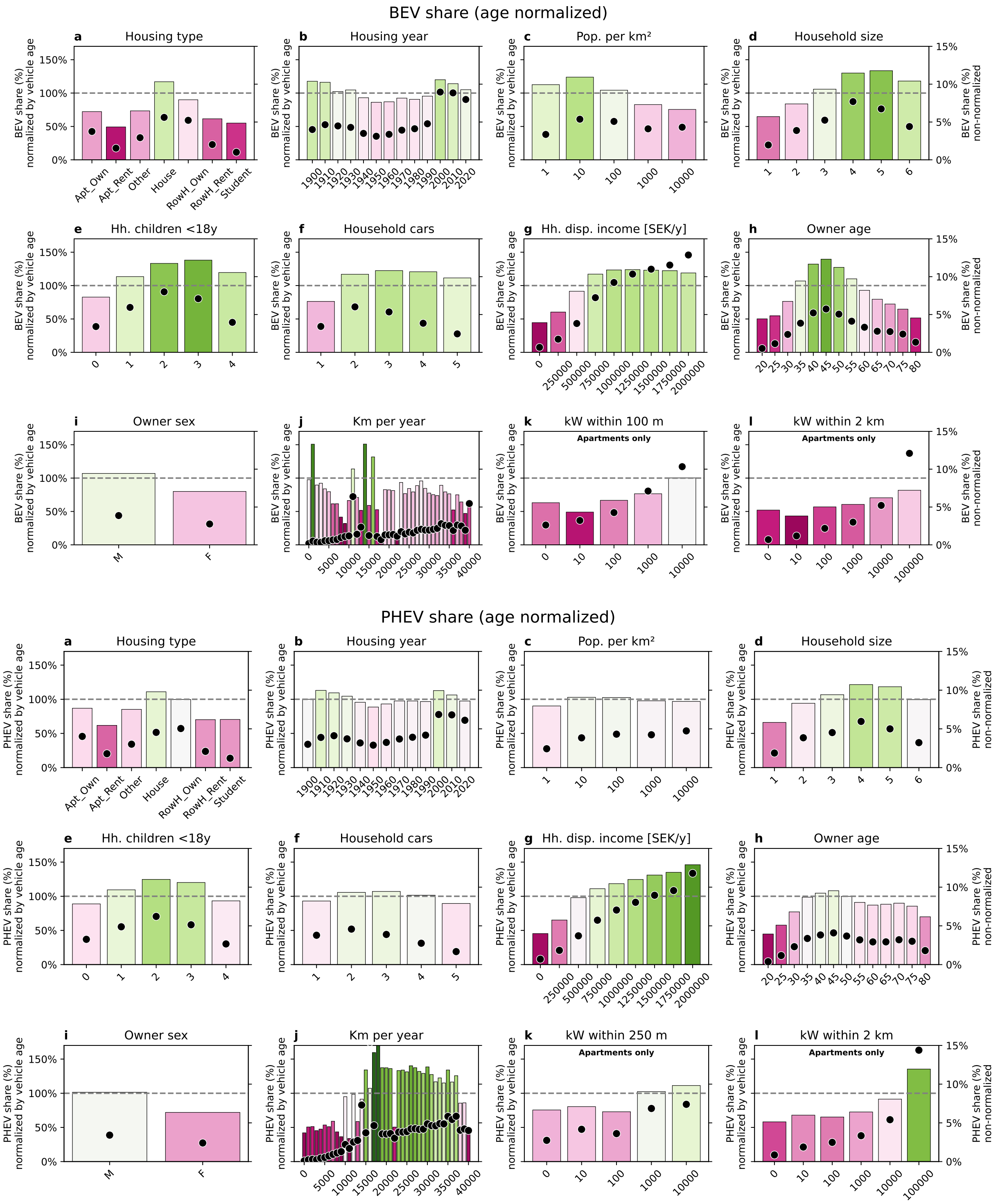

Figure 1: Single-variable distribution plots for age-normalized (bars) and non-normalized (circles) BEV (a-l) and PHEV (m-y) shares in the Swedish car population as of January 2024, segmented by twelve attributes previously identified in scientific literature as associated with EV uptake. Bar colors are consistent with those in figures 2 and 3 (a-f). Subplots k-l and w-x include only cars belonging to apartment residents.

3 Results

3.1 Single-variable association with EV adoption

We begin by verifying that findings from prior research are representative also of our Swedish dataset. Figure 1 shows the distributions of non-normalized and age-normalized BEV and PHEV ratios for twelve

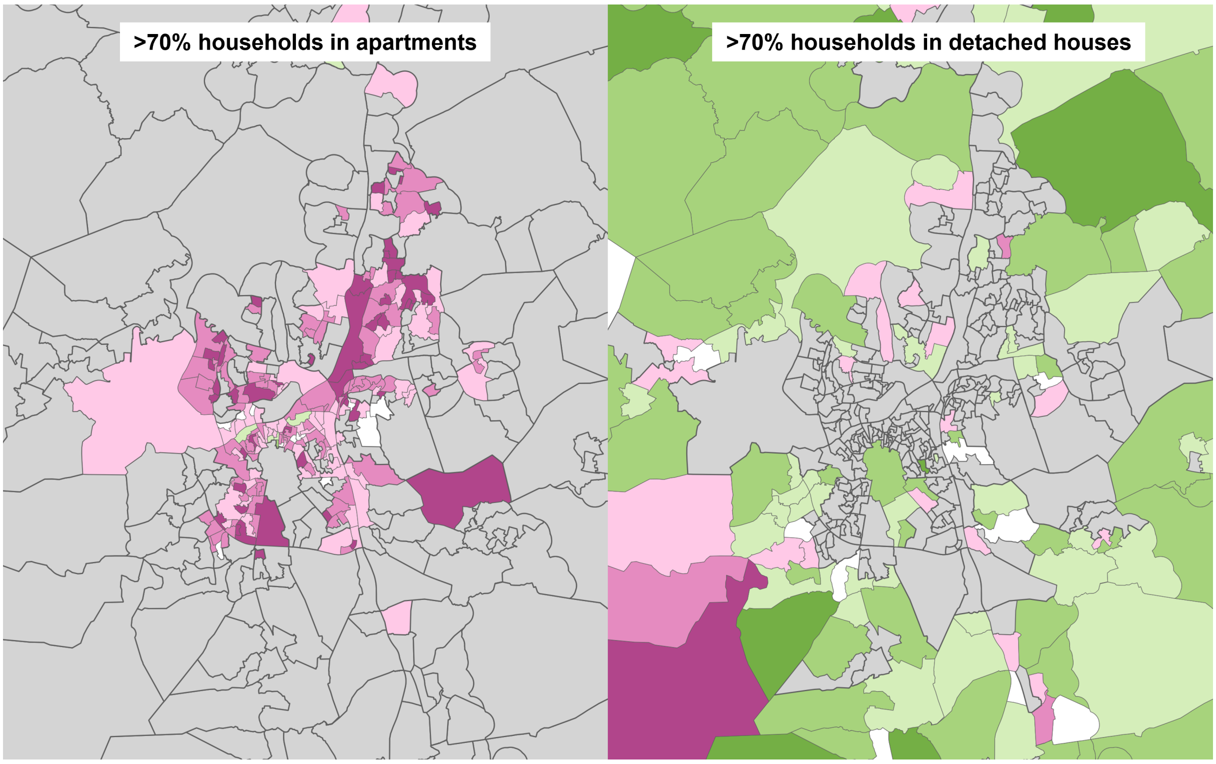

Figure 2: DeSO map of Gothenburg, indicating the age-normalized BEV share. Colors are consistent with those in figures 1 and 3 (a-f), with greens indicating greater than expected shares of BEVs, and purples indicating lower than expected shares of BEVs.

demographic attributes identified in prior research as being associated with EV uptake: housing type, housing construction year, population density, household size, number of children per household, number of cars per household, household disposable income, car owner age, car owner sex, annual driven distance, and (for apartment residents only) access to nearby public charging infrastructure.

With regards to access to public charging, we tested segmenting the population by distance from the household to the nearest public charger, by total installed charging power within [100, 250, 500, 1000, 2000] m radius from the household, and by number of public charging outlets within the same radius. The figure includes total power within 100 m and 2000 m radius for BEV uptake and total power within 250 m and 2000 m for PHEV uptake, as these distributions showed the strongest separations between the lowest and highest bins, though differences were likely not statistically significant.

All segmentations exhibit differences in EV uptake between groups. Differences of particularly great magnitude can be seen for non-normalized BEV and PHEV uptake by household disposable income and access to public charging within 2000 m; for age-normalized BEV uptake by housing type, household income, household size and car owner age; and for age-normalized PHEV uptake by household income, annual driven distance, and public charging access.

Normalizing EV uptake by vehicle age influences all distributions in subtle but important ways. For instance, the association between low income and EV adoption becomes clearer, rural areas no longer exhibit low EV adoption, and annual driven distance is no longer associated with BEV adoption but more strongly associated with PHEV adoption. Threshold effects appear to be present for household disposable income and annual driven distance.

Figure 2 presents a map of the city of Gothenburg, indicating how BEV adoption normalized by vehicle age in each DeSO differs strongly by dominant type of housing. Nearly all DeSOs with more than 70% of households in detached houses have normalized shares above 100%, while nearly all DeSOs with more than 70% of households in apartments (owned or rented) have normalized shares below 100%. The distributions look similar for other Swedish cities. Some regional differences in normalized BEV adoption exist within the country, but the pattern that adoption is lower in urban centers with high shares of households in apartments persists nationally. Unlike age-normalized BEV adoption, non-normalized ratios are lower in rural areas of Sweden than in DeSOs with predominantly detached houses closer to urban centers – i.e., non-normalized BEV uptake exhibits a donut pattern around cities, with low uptake both in city centers and in rural areas. Maps segmented only by disposable household income do not show as clear separation of normalized BEV ratios as do maps segmented by housing type.

3.2 Factors that jointly predict EV ownership

Several of the demographic attributes exhibit strong mutual correlation. This means that a demographic attribute can be highly correlated with BEV adoption without being a factor that drives adoption. For instance, it is possible that household size has no causal impact on the choice of car powertrain, but cars owned by larger families still tend to be electric if larger families more often live in detached houses and if access to a private driveway facilitates BEV adoption.

Greedy forward selection of factors for training linear regression models was used to identify which of the observed factors best predict age-normalized BEV and PHEV adoption at DeSO level. This methodology iterates over all input variables – e.g., share of households in apartments, mean age, average household size – and performs stepwise selection of the variable that contributes the greatest marginal improvement to the model fit when added to the set of previously selected variables. By starting with an empty set and adding input variables iteratively, minimal sets of variables can be identified that alone can explain most of the variance in the entire dataset. Redundant variables are less likely to have a strong causal effect on the output variable. The direction of causality is not determined by this method, but it can be reasoned about. For instance, it is possible that a desire to own a BEV increases the likelihood of choosing to live in a detached house, but it is not plausible that that a decision to buy an electric car changes the buyer's age or gender. It is also possible that selected observed variables are merely proxy variables for unobserved factors with direct causal effect – e.g., housing type may correlate strongly with parking conditions, which is the real factor driving BEV adoption but for which Swedish registry data is not available.

In our dataset with per-DeSO statistics, the full set of 33 observed variables could explain 55.9% of the variation in age-normalized BEV share and 48.2% of the variation in age-normalized PHEV share. The strongest predictors of BEV share were share of households in apartments (31.8%) followed by mean (log-transformed) disposable household income (47.6%, +5.8%) and mean annual driven distance (50.0%, +2.4%). The strongest predictors of PHEV share were disposable household income (37.9%), share of households in rented housing (39.7%, +1.8%) and mean annual driven distance (41.6%, +1.9%).

Prior research suggested that access to private charging facilitates EV adoption. As discussed in Methods, the best proxy variables we have for private charging access are housing type and building construction year. Share of residents in apartments and share of renters were identified as variables with high predictive value, but average year of construction was not. It is however possible that the relationship with construction year is too non-linear for the linear regression to pick up on it.

Figure 3 explores the interrelationship between these variables of special interest – year of housing construction, household disposable income, age-normalized BEV and EV adoption rates, annual driven distance, and local availability of public charging at the time the current owner took possession of the car. All 18 heatmaps (subplots a-i) share the same structure, with construction year on the horizontal axis and household disposable income on the vertical axis. The heatmaps are organized in columns for each of the three main housing types (rented apartments, owned apartments and detached houses). Heatmap cells representing fewer than 500 cars are not shown.

Heatmaps a-f indicate the age-normalized BEV and PHEV share within each subgroup. Previously identified relationships now emerge visually – BEV adoption is high only with a combination of high income and residence in a detached house, while PHEV adoption primarily requires a high income and housing that is not rented. What does not emerge however is the expected negative association between on-street parking and EV adoption. In fact, it appears that the least favorable housing from an EV adoption perspective was built between approximately 1940 and 1990 – when parking norms were the highest and where cars are most likely to be parked in a private parking space.

There are possible explanations for why this pattern emerges, though these are only hypotheses to be explored in future work. Private parking in a shared parking facility could be a short-term barrier to EV adoption if during an early adopter phase charger access requires that all parking spaces are equipped with chargers and such an investment is difficult to motivate while most cars are still ICEVs. It could also be a long-term barrier if providing charging at all parking spaces raises the levelized cost per user compared with if parking is flexible and several cars can share the same charger, as is typically the case for on-street parking. It is also possible that decision making processes within housing associations are a barrier to installation of chargers in the association's shared parking facility. Neither of these hypotheses offers any explanation for why EV adoption also seems to be lower in detached houses constructed during the same period, at least in lower-income segments.

Heatmaps j-l show annual driven distance per car tends to be significantly lower in households with lower disposable income. There is no apparent association between annual distance and housing type, but a

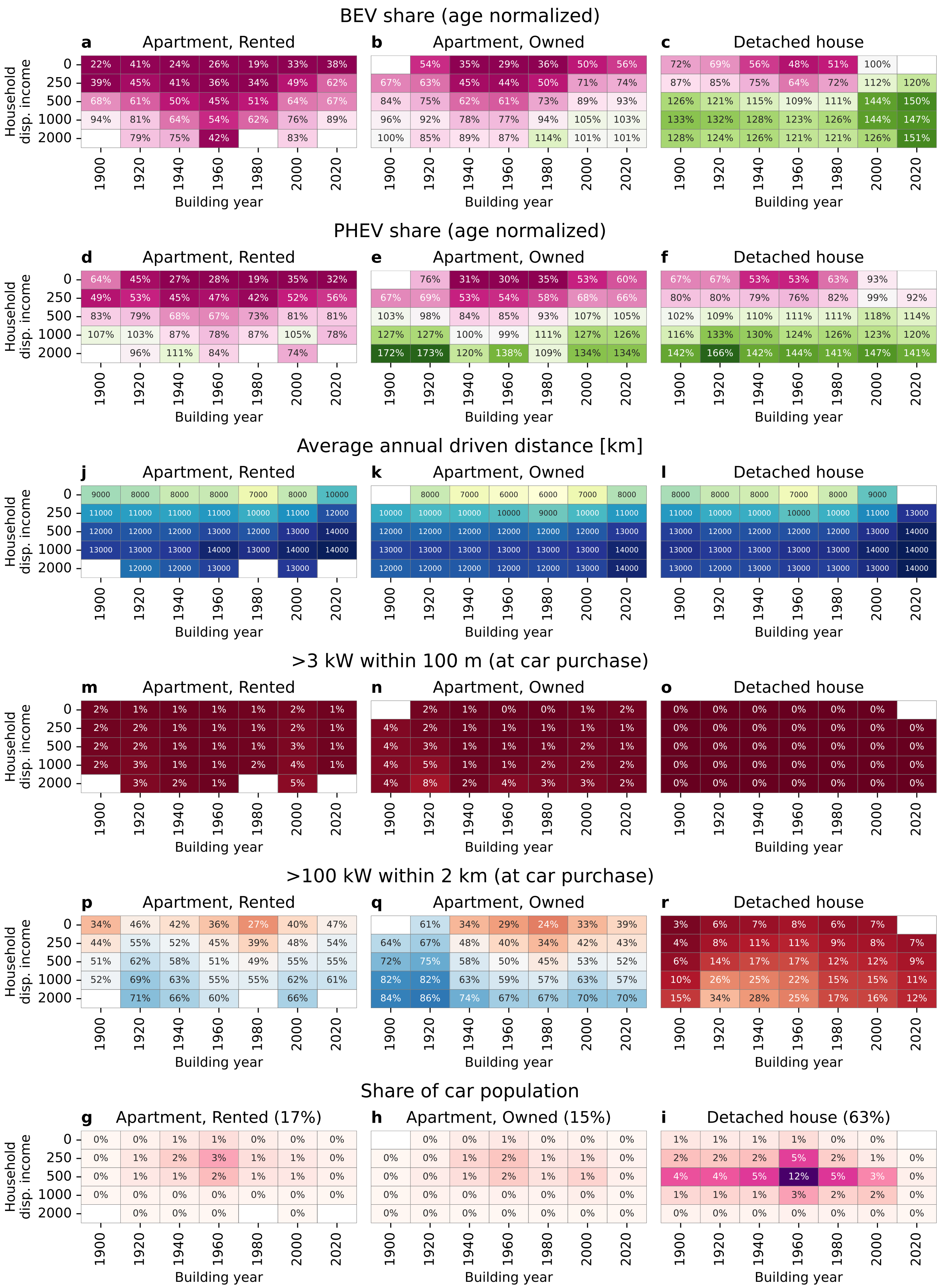

Figure 3: The Swedish car population segmented by type of housing, building construction year and household disposable income. Distributions for six key factors are shown: age-normalized BEV and PHEV share; number of cars; annual driven distance; and access to public charging within 100 meters and 2 km of the home at the time the current owner took possession of the car. See the main text for discussion.

weak association between annual distance and building construction year.

Heatmaps m-r indicate that when the current owners of the cars in the database took possession of their cars, only a very small minority had access to public charging within 100 meters of the household. Higher income households were more likely than lower income households to have access to charging within 2 km – either because of the placement of public chargers, or because of slower turnover of cars in low-income households. By the end of 2023, most households had access to more than 100 kW of charging within 2 km, but few households still had public charging within 100 m. Visual inspection also indicates that particularly PHEV adoption has been higher where public charging was available, even for residents in detached houses. However, given that the earlier greedy forward selection of features did not identify access to public chargers as predictive of PHEV adoption, we should be cautious to interpret this association as a causal relationship. It is possible, perhaps even likely, that the association indicates that chargers were first built predominantly where early adopters of EVs were located.

Finally, heatmaps g-i indicate where the greatest population of vehicles reside in the feature space. 95% of Swedish cars are owned by residents in either apartments or detached houses, with detached houses making up 63%. Clearly visible in these plots is that a large share of the current Swedish housing stock was built between 1950 and 1970. The figure also highlights how disposable household incomes are lowest in rented apartments and highest in detached houses.

3.3 Impact of public charging infrastructure on EV adoption

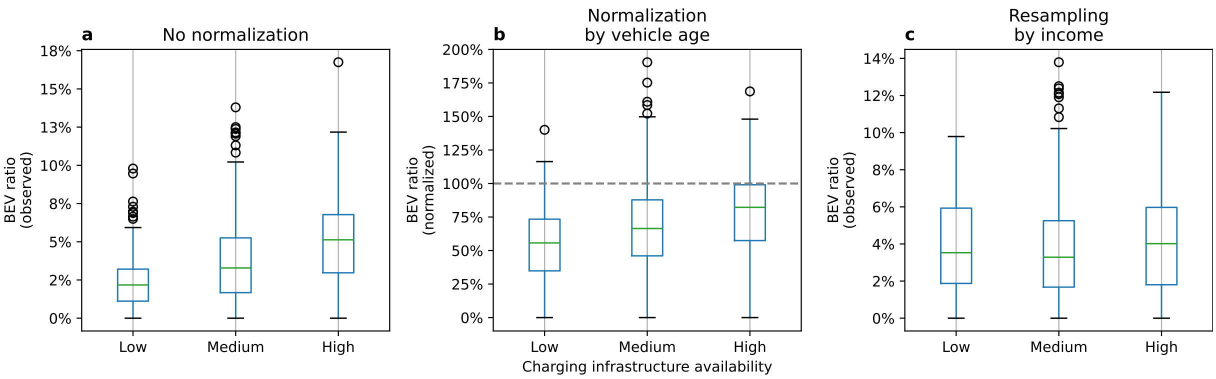

Figure 4: BEV uptake is observed to be higher in apartment districts with greater availability of charging infrastructure (a). Within apartment districts, normalization by vehicle age does not change this pattern significantly (b). However, the effect disappears after compensating for income differences (c), indicating that public charging infrastructure has not contributed to increased BEV uptake among nearby apartment residents.

Figure 3 showed that in the snapshot of Swedish cars in use by the end of 2023, the owners took possession of their cars when there was no public charging infrastructure available in immediate proximity to the home (within 100 meters). However, charging infrastructure density improves rapidly. Has BEV adoption been held back by public charger access and will BEV adoption accelerate due to increased availability of public charging?

Figure 4 tries to answer this question. Swedish DeSOs with 70% of more of households in apartments were filtered out and analyzed (n=1776). The sample was further segmented by average access to public charging at the time of car purchase, into:

Low $<$ 300 kW within 2 km and $<$ 3 kW within 100 m, n=201,

Medium $>$ 3000 kW within 2 km and $<$ 3 kW within 100 m, n=524,

High $>$ 3000 kW within 2 km and $>$ 10 kW within 100 m, n=127.

As figure 3 indicated that there is an association in the data between income and charger access, the data were resampled to compensate for this bias. For each sample (DeSO) in the Medium condition, the sample with closest matching mean household disposable income was sampled from the Low and from the High conditions, with replacement. This resulted in 524 samples in each condition, with 156 and 116 unique samples in the Low and High conditions.

Both with and without normalization by car age (subplots a-b), there is an association between BEV uptake and availability of public charging. However, this association disappears when compensating for income differences. If income is kept constant, BEV adoption is not higher even in DeSOs where apartments on average have public charging within 100 m than where charging is not even available within 2 km. This indicates public charging has been built where car buyers are more likely to opt for an electric car, rather than the other way around. Compensation for income differences also removes the association between PHEV adoption and public charger access.

3.4 Persistence of demographic gaps in EV adoption

As seen from this analysis, a rapid recent increase in EV sales means that both PHEVs and BEVs are currently reserved for users of relatively new cars. As the vehicle fleet ages, more used EVs should become available and the current EV ownership distributions shown in figure 1 should converge towards the age-normalized distributions presented in the same figure. While early EV adopters have primarily been affluent residents in detached houses, expansion of public charging should ideally also enable late-adopter population segments to transition to zero tailpipe emission cars. This section explains why neither outcome can be taken for granted in Sweden – adoption is not yet spreading past detached houses, and EVs remain inaccessible to users of older cars.

3.4.1 The gap between housing types

The missing causal relationship in figure 4 between construction of public chargers and nearby BEV adoption should raise concern. This suggests that even if public charging is made available to all, the stark differences we see in BEV adoption rates by type of housing and household income are likely to persist. We also note that most Swedish apartment residents live in buildings where off-street parking should be available, and that this in fact appears to make the situation even worse than for on-street parked cars. Still, what could explain the observed differences in age-normalized BEV uptake between detached houses and apartments if not the form of parking and access to charging? We speculate that significant improvements will be needed in the quality of charging for apartment residents – not only improvements in quantity – combined with strengthened incentives for BEV use in urban environments.

The incentive for switching to an EV is objectively weaker for low-income apartment residents than high-income residents in detached houses and differences in charging contribute to this. We illustrate this with a simplified calculation of operational costs.

Case 1 A high-income detached house resident with a premium SUV, driving 13 000 km per year. A survey of the five most sold petrol and BEV models in Sweden during 2024 indicates that average WLTP energy consumption is approximately 6.5 liter per 100 km for petrol models, versus 16.5 kWh per 100 km for BEV models. At approximately €1.5 per liter petrol and an average price of €0.25 per kWh for charging – mostly at home – a switch from ICEV to BEV yields operational savings of €840 per year. The BEV is fully charged every morning with a greater average range than the partially fueled ICEV.

Case 2 A medium-income apartment resident with on-street parking and a basic model car, driving 11000 km per year. A survey of the five most sold lower-end petrol and BEV models in Sweden in 2024 indicates that average WLTP energy consumption is approximately 5 liter per 100 km, versus 16 kWh per 100 km. At approximately €1.5 per liter petrol and an average price of €0.5 per kWh for charging – mostly public – a switch from ICEV to BEV yields an increase in operational costs of €55 per year. The BEV is partially charged every morning with shorter range than the ICEV it replaces.

The two cases are not representative of all residents, but they highlight how BEVs offer a greater marginal increase in utility for demographics segments that currently see higher BEV adoption rates. Raising fuel prices would strengthen the incentive for BEV adoption in both cases but would not affect the incentive gap. Reducing the cost of public charging to €0.25 per kWh only partially closes the incentive gap, due to differences in annual driving distance and differences in the relative reduction in energy consumption going from ICEV to BEV.

3.4.2 The gap between income levels

Trends in the Swedish market for used cars raises further concerns that current gaps in BEV adoption may not disappear with time. Figure 5 reveals how both PHEVs and BEVs have been exported at much higher rates than ICEVs, resulting in national survival curves that are much steeper for EVs. It is unclear to the authors why ICEV survival rates start off lower than BEV survival rates. Furthermore, annual exports of BEVs have increased at approximately the same rate as new BEV registrations, with a lag of around five years. As residents with lower incomes are more likely to be using older cars, the EV adoption gap between income levels in the population will increase if this trend persists.

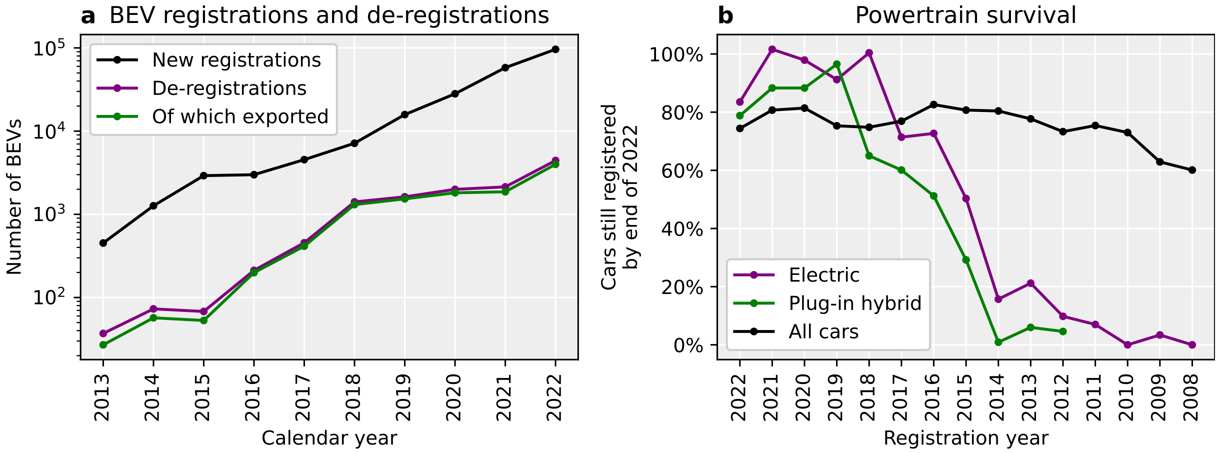

Figure 5: Historical registrations and de-registrations of BEVs in Sweden (a) and resulting survival curves (b). Data source: Swedish registry data.

We are not certain what causes this high rate of EV exports, but a logical explanation would be that policies that favor utilization of EVs are stronger in neighboring countries than in Sweden, which has focused on purchase subsidies for new cars and for installation of chargers. Such utilization-phase policies may include differentiated vehicle taxes, parking fees or road tolls, zero-emission zones, access to bus lanes, higher fuel prices, or public charging subsidies. Willingness to pay for used BEVs should increase in countries with policies incentivizing BEV utilization, which would drive export out of markets with weaker incentives. The objective gap in vehicle utility illustrated by cases 1 and 2 above also highlights how Swedish buyers of second-hand cars may at present be less interested in EVs than buyers of new cars.

4 Conclusions

Our results show that housing type and disposable income are strong structural barriers to BEV and PHEV adoption in Sweden. Public charging infrastructure deployment to date has not contributed to closing the gap between apartment and detached house residents. We also find that Sweden's domestic supply of EVs for the second-hand market is not increasing, due to rising exports that keep pace with the increase in new registrations. In the absence of further targeted interventions, these disparities are likely to persist.

We recommend the following actions:

1. Systematically track real and age-normalized BEV ownership rates by region, household income and housing type to evaluate the effectiveness of future interventions. Make existing statistical public record data available at sufficient granularity to enable further investigative research into cause and effect relationships.

2. Bring down the prices of public charging, e.g., through parking bans for non-EV cars and booking systems that improve utilization rates, various peak shaving strategies to reduce grid-associated costs, and reverse auctions for infrastructure concessions.

3. Explore wireless static charging and dynamic charging to reduce behavioral inconvenience and leverage economies of scale as greater shares of traffic are electrified.

4. Investigate if individually reserved parking spaces in shared parking facilities are acting as a barrier that prevents charging infrastructure access for early EV adopters in apartments with off-street parking.

5. Strengthen incentives tied to vehicle use rather than purchase, to increase national retention of used EVs. Establish a national strategy for how to phase out the ICEV stock, taking into account that national supply of used BEVs may not meet future demand.

6. Encourage vehicle OEMs to develop and market BEV models targeted toward lower-income segments.

7. Investigate strategies to reduce the cost and improve the market appeal of converting used ICEVs in good condition to electric propulsion, both for domestic use and export. Increased retention of domestically sold BEVs would reduce used-BEV supply for other countries.

References

[1] European Commission, "Effort sharing 2021-2030: Targets and flexibilities," 2024, accessed: 2025-04-28. [Online]. Available: https://climate.ec.europa.eu/eu-action/effort-sharing-member-states-emission-targets/effort-sharing-2021-2030-targets-and-flexibilities_en

[2] Naturvårdsverket, "Utsläpp av växthusgaser från inrikes transporter," 2025, last updated: 14 april 2025. Accessed: 2025-04-28. [Online]. Available: https://www.sverigesmiljomal.se/etappmalen/utslapp-av-vaxthusgaser-fran-inrikes-transporter/

[3] Trafikverket, "Pm vägtrafikens utsläpp 2024," Trafikverket, Tech. Rep., 2024, accessed: 2025-04-28. [Online]. Available: https://bransch.trafikverket.se/contentassets/bdc6eaecf796497dbf5720a71e607fd1/pm-vagtrafikens-utslapp-2024.pdf

[4] C. fei Chen, G. Zarazua de Rubens, L. Noel, J. Kester, and B. K. Sovacool, "Assessing the socio-demographic, technical, economic and behavioral factors of nordic electric vehicle adoption and the influence of vehicle-to-grid preferences," *Renewable and Sustainable Energy Reviews*, vol. 121, p. 109692, 2020. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S1364032119308974

[5] R. Peng, J. H. C. G. Tang, X. Yang, M. Meng, J. Zhang, and C. Zhuge, "Investigating the factors influencing the electric vehicle market share: A comparative study of the european union and united states," *Applied Energy*, vol. 355, p. 122327, 2024. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S0306261923016914

[6] S. Hardman, A. Chakraborty, K. Hoogland, C. Sugihara, J. P. Helveston, A. F. Jensen, A. Jenn, P. Jochem, P. Plötz, F. Sprei, B. Williams, J. Axsen, E. Figenbaum, J. Pontes, G. Tal, and N. Refa, "Demand-side challenges and research needs on the road to 100% zero-emission vehicle sales," *Progress in Energy*, vol. 7, no. 2, p. 022001, jan 2025. [Online]. Available: https://dx.doi.org/10.1088/2516-1083/ad9f1a

[7] J. Sinton, G. Cervini, K. Gkritza, S. Labi, and Z. Song, "Examining electric vehicle adoption at the postal code level in us states," *Transportation Research Part D: Transport and Environment*, vol. 127, p. 104068, 2024. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S1361920924000257

[8] U. Illmann and J. Kluge, "Public charging infrastructure and the market diffusion of electric vehicles," *Transportation Research Part D: Transport and Environment*, vol. 86, p. 102413, 2020. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S1361920920306003

[9] I. Kristoffersson, R. Pyddoke, F. Kristofersson, and S. Algers, "Access to charging infrastructure and the propensity to buy an electric car," *Transportation Research Part D: Transport and Environment*, vol. 139, p. 104588, 2025. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S1361920924005467

Presenter Biography

Jakob Rogstadius is a Senior Researcher at RISE and holds a Ph.D. in Informatics. His current work focuses on factors that enable decarbonization of motorized road transport, in particular buildout of public and private infrastructure for static and dynamic charging.