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# How do EV grant recipients use their vehicles?

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## EXTENDED ABSTRACT

This study presents the results of a new survey of Battery Electric Vehicle (BEV) grant recipients in Ireland, issued alongside a similar survey of Internal Combustion Engine (ICE) Vehicle owners. The main focus was to determine the usage levels of BEVs compared to ICEs, with a view to improving our understanding of the potential energy savings associated with electrification of the passenger vehicle fleet. The results suggest that BEVs are driven more per year than their ICE counterparts, even after controlling for household characteristics, attitudes, and geographic attributes.

## Introduction / background

To accelerate Ireland's decarbonisation of its transport sector, the Sustainable Energy Authority of Ireland administers a grant scheme available to qualifying new Battery Electric Vehicle (BEV) purchases, with the aim of reducing the upfront cost differential between new BEVs and Internal Combustion Engine Vehicle (ICE) purchases. While BEVs are clearly growing in new car market share, it is unclear what the impact has been of this BEV purchase subsidy on carbon emissions. National statistics show that private vehicles are driven 15,196 km/year on average. Taking a naïve approach using average fossil fuel versus national grid electricity carbon factors, where driving distances are assumed to be uniform across the population and constant when switching fuel, this would suggest a new annual $CO_2$ savings of 0.585 $tCO_2$, or a reduction of 51%, for each BEV. However, this estimate may be biased due to two hypothetical effects: *1) self-selection of high- or low-driving owners into BEVs and/or 2) a behavioural effect whereby driving distances are longer or shorter when switching to a BEV*.

While international evidence suggests a move from fossil fuel to electric vehicles can bring substantial emissions savings, questions remain on the self-selection patterns and potential rebound effects associated with BEVs adopted by private households. BEVs may be more popular among households who normally travel shorter distances by car, such as in urban areas[1,2], whereas greater benefits might be realised by uptake in rural areas[3]. Rebound effects may arise if households change their car travel upon adopting a BEV, either due to decreased

[1] Mukherjee, S. C., & Ryan, L. (2020). Factors influencing early battery electric vehicle adoption in Ireland. Renewable and Sustainable Energy Reviews, 118, 109504. https://doi.org/10.1016/J.RSER.2019.109504
[2] Huwe, V., Gessner, J. (2020). Are there Rebound Effects from Electric Vehicle Adoption? Evidence from German Household Data EW Discussion Papers, No. 20-048, ZEW - Leibniz-Zentrum für Europäische Wirtschaftsforschung, Mannheim. https://hdl.handle.net/10419/225079
[3] Newman, D., Wells, P., Donovan, C., Nieuwenhuis, P., & Davies, H. (2014). Urban, sub-urban or rural: Where is the best place for electric vehicles? International Journal of Automotive Technology and Management, 14(3–4), 306–323. https://www.inderscienceonline.com/doi/full/10.1504/IJATM.2014.065295

operating costs[4] or a perception of low environmental effects[5], although it is also possible that BEVs are driven less than ICEs due to range limitations[6].

In all of the above possibilities, reliable data on BEV usage for Ireland is lacking, partly because the number of BEVs in the Irish fleet has until recently been small, and partly because national car testing data is only available after a car is first tested, which in the case of a new vehicle is not until the car is four years old. To fill this gap and address the two hypotheses above, a new survey commissioned by SEAI has shed light on these questions by collecting data on BEV users' car ownership, BEV usage habits, and overall characteristics, and comparing these to a comparable group of ICE users.

## Methodology

A survey was distributed in January 2025 to a stratified sample of new BEV and PHEV[7] purchase grant recipients in Ireland, focusing on purchases for the period 2020 to 2024, as well as to a separate panel of diesel, petrol, and conventional hybrid-electric owners who purchased their vehicles in the same period. In total, 2,988 EV owner and 1,010 ICE owner responses were received. Combining the datasets and filtering for vehicles bought new, there were 1864 BEVs along with 244 ICEs and hybrids (including plug-in) that included sufficient valid responses. The survey included questions related to vehicle ownership, home type and tenure, features of the home such as having a private driveway, bicycle possession, access to public transport, environmental attitudes, perceptions toward electric vehicles, and household socio-economic and demographic characteristics.

To address the self-selection and behavioural hypotheses, the analysis approach consisted of first estimating annual kilometres travelled; second, estimating a propensity score as the likelihood of choosing a car eligible for the government-backed grant (i.e. for a BEV), using a logistical model estimated on household characteristics; third, adjusting the propensity scores to account for overrepresentation of BEVs relative to the Irish population of passenger vehicles; fourth, executing a matching algorithm to create a balanced dataset; fifth, estimating a log-linear model of annual kilometres travelled as a function of household characteristics and car choice; and finally, estimating average treatment effects on each group using predicted annual kilometres travelled. Estimates of annual $CO_2$ emissions were also estimated by joining data from the European Environmental Agency on passenger vehicle emissions rates.

## Results

Annual kilometres travelled was estimated using the reported odometer readings combined with date of (new) car purchase, to calculate the average distance travelled on an annual basis. To minimise the instability of use in the first period of ownership, any vehicles less than six months old were removed. On average, BEVs were driven 18,313 km/year, while other vehicles were driven 14,608 km/year on average.

This difference in averages set an envelope for the potential range of new annual $CO_2$ savings. If only the self-selection hypothesis is true, and fully so, then BEV grants could reduce emissions by fully 0.705 $tCO_2$/year by targeting the cars used the most, where this is still a 51% reduction for those owners affected. On the other

[4] Sorrell, S. (2007). The Rebound Effect: An Assessment of the Evidence for Economy-wide Energy Savings from Improved Energy Efficiency. In UKERC | The UK Energy Research Centre. https://ukerc.ac.uk/publications/the-rebound-effect-an-assessment-of-the-evidence-for-economy-wide-energy-savings-from-improved-energy-efficiency/

[5] Seebauer, S. (2018). The psychology of rebound effects: Explaining energy efficiency rebound behaviours with electric vehicles and building insulation in Austria. Energy Research & Social Science, 46, 311–320. https://doi.org/10.1016/J.ERSS.2018.08.006

[6] Hasan, S., & Simsekoglu, Ö. (2020). The role of psychological factors on vehicle kilometer travelled (VKT) for battery electric vehicle (BEV) users. Research in Transportation Economics, 82, 100880. https://doi.org/10.1016/J.RETREC.2020.100880

[7] Note that PHEVs are no longer grant-supported, so are not the focus of this study.

hand, if only the behavioural hypothesis is true, and fully so, then BEV grants might reduce emission by only 0.522 $gCO_2$/year, a more modest 39% reduction.

After carrying out the modelling exercise above, the matched dataset using a population-weighted propensity score allowed average treatment estimates to be calculated for each respondent. A propensity score model was estimated where the choice of a new BEV, in lieu of an other type of new car, was more likely for those in the Dublin and surrounding Mid-East regions, with higher incomes, their own driveways, and answering on average positively to a set of five environmental attitude questions. Using the propensity score-weighted dataset, a linear regression model of annual kilometres driven found that even after controlling for significant effects such as region, settlement type, household size, and social grade, BEVs continued to be driven longer distances than their counterparts. Similar results were found when modelling $CO_2$ emissions. Using the model results, the average treatment effects on the treated were an increase in distance travelled by 4935 km/year or 35.6% on the treated group, and 5287 km/year or 37.9% on the untreated. With these increases, switching fuels would reduce $CO_2$ emissions by only 0.377 $tCO_2$/year or 33.6% for the treated group, and 0.342 $tCO_2$/year or 32.5% for the untreated.

## Conclusion & discussions

The findings here suggest that a combination of both hypotheses is true, however that the behavioural effects are particularly pronounced. Because the treated group was estimated to drive somewhat longer distances regardless of car choice, due to differences in household characteristics and location, the BEV grants appear to partially target a higher-than-average replacement of annual kilometres travelled. On the other hand, because there was also a constant difference in expected kilometres travelled regardless of household characteristics, a behavioural response partially erodes the potential $CO_2$ savings.

Surprisingly, the estimated average effect, both for the treated and untreated groups, was greater than the rough estimation using only the average kilometres travelled. This suggests that the average differences between BEV and other vehicle types' usage levels are even greater, once responses have been properly matched between the groups using measured characteristics. However, it must be remembered that the survey only included a limited number of characteristics, and a large variation in responses remained, particularly for the non-BEV groups where the sample size was limited when filtering for cars purchased new. Taking these caveats into account, the results provide some indication that emissions savings may be substantially eroded by behavioural effects.

Overall, the observed behavioural effect leads to an erosion of the naïve emissions reduction from 0.585 $tCO_2$/year to 0.377 $tCO_2$/year, i.e. 35.6% of the potential reduction in emissions due to fuel switching would be compensated by an increase in kilometres travelled. However, the results here must be taken with considerable caution, as there are some important limitations to the methodology applied. While the propensity score matching approach can help control for certain factors, it cannot control for differences in the sample groups that are not observed. Moreover, the small sample of non-BEV new vehicles results in a high degree of variation, and with the propensity score adjustment for vehicle population statistics, the estimations tend to overweight this small subsample. Further evidence is required to more firmly establish this behavioural effect.