

Economic Assessment of Using Electric Vehicles and Batteries as Domestic Storage Units in the United Kingdom

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Low-carbon grids are becoming increasingly prevalent, especially in developed countries, as an “energy transition” is underway from conventional fossil fuels, towards renewable sources of energy. The most mature and predominant technologies with the highest growth rates in the renewable sector are solar photovoltaics (PV) and wind. Both suffer from intermittency issues, and the question of large scale short and long-term electricity storage continues to grow as efforts towards decarbonising grids are made. Simultaneously, the transport sector, especially automotive, is seeing a shift towards Electric Vehicles (EVs). EV batteries are performing better than expected and could last longer than the car’s lifetime. Therefore, alternative uses may be investigated to optimise battery usage, and value for money for the owner. The closest related use for an EV owner would be Vehicle-to-Home (V2H), where the EV battery is used for domestic electricity storage. This way electricity bought in off-peak periods could be used during peak hours to save money on energy bills.

Home battery systems can achieve almost all benefits that the V2H concept promises for households. Therefore, the problem statement behind this study is; in economic terms, which one, home battery systems of EVs used as V2H, makes more sense from a home owner’s perspective in the UK?

The main aim of this paper is to determine whether using an EV (UKEV) or a home battery (UKBat) for domestic electricity storage is economically preferable from a residential customer’s perspective. Furthermore, this project aims to present findings from UK as a case study, which can be studied later on for larger customer groups in Europe, as well as in the rest of the world. To achieve these aims the following objectives must be met:

- Consider the potential and future of EVs and home battery systems
- Find an a current average EV and home battery in the UK market
- Highlight consumer behaviour with electricity and EV use
- Compare the average EV and home battery on an economic basis
- Evaluate policy options to introduce more suitable tariff options to facilitate V2H or batteries as domestic electricity storage devices

The findings indicate that both an EV and a domestic battery are likely to create some savings for the households in the United Kingdom (UK) when used for shifting consumption from peak to off-peak periods with time-of-use tariffs. Around 90% of UK consumers would fall under Profile Class 1 (PC1). If PC1 customers switch to a three-rate tariff, then the UKEV annual savings will range from £20 to £73 (5% to 16% on annual electricity bills) for the medium and low battery degradation scenarios respectively. For UKBat, these ranged from £81 to £149 (18% to 33% on annual electricity bills) again for the medium and low degradation scenarios respectively.

In this study, rate of return of the investment analysis is neglected intentionally. The primary function of the EV will be mobility and transportation, whereas V2H will be a secondary benefit for the EV owners. Similarly, the residential customers will likely to own batteries together with their rooftop PV panels. By that way, the primary objective will be storing the solar energy produced during day time, when the customer will be away from home. When considered for load shifting purposes alone, the V2H scheme does not promise significant savings to motivate consumers to adopt it. The expected yearly savings vary from £20 to £94. Thus, mobility and transport will be the preeminent benefits of owning an EV. As an alternative to V2H, let us assume the UKBat system is used only for peak-demand shifting. Then, under the medium battery degradation scenario, the annual saving for a PC1 customer shifting from flat-rate tariff to three-rate tariff will be £81. The cost of UKBat is around £5,060. This means the investment will be returned only after 62.5 years, which is not an appealing payback.

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