Energy storage for grid stability trinidad and tobago

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The rise of V2G technology necessitates innovative business models to facilitate consumer adoption. A prime example is Octopus Energy"s, from the UK, Vehicle-to-Grid bundle called Powerloop. This bundle includes a new Nissan LEAF 40 kWh, a Wallbox charger, an App, 100% renewable energy, a Smart meter, and offers ?30 cashback every month for ?235/month. The package runs on a 4-year contract. Importantly, Powerloop is only available in areas where the local energy grid is managed by UK Power Networks [19].

This study investigates the effects of 10% of the total vehicle population in Trinidad and Tobago, approximately 10,000 vehicles being BEV"s and connecting to the electricity grid to charge. Three scenarios are investigated: a scenario that represents non-incentivized charging or business-as-usual, a charging at work scenario and a V2G program. A Nissan leaf is used as the representative BEV for this study and a V2G program with a generous tariff and a battery degradation payment is proposed.

This study is aimed at investigating the effects of ten percent of the total registered vehicle population being electric and the effect of these vehicles connecting and charging on the local electricity grid. Ten percent of the total number of vehicles registered locally is 10,000 vehicles and, in this study, the total population of BEV is modelled as 10,000 BEVs [22]. The study also presents realistic and relevant mitigation strategies to manage any adverse effects on the power grid. Three charging scenarios are developed and explored, un-incentivized BEV charging, BEV charging at work and the implementation of a vehicle-to-grid program.

The existing daily electrical demand curve for Trinidad and Tobago is presented in Fig. 2. The peak demand occurs at 7 pm and is 1250 MW, the second highest peak demand occurs at 8 pm and 1200 MW. There is also a daytime peak of 1180 MW that occurs at 1 pm. Power at these peak periods is provided by inefficient simple cycle natural gas turbines that produce the most carbon emissions per kWh or unit of energy produced.

Three scenarios were investigated: non-incentivized charging, incentivized charging, and a vehicle-to-grid program. A custom MATLAB simulation model was developed to evaluate the scenarios that used MATLAB and its various Simulink toolboxes.

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The results of the scenarios are presented in this section.

This scenario investigates the use of a Vehicle to Grid (V2G) program to reduce the peak demand associated with BEV charging in the business-as-usual scenario, Scenario 1. To participate in the V2G program, BEV owners must have a V2G enable level 2 charger. Level 1 chargers are unable to participate in the V2G program because they don"t allow for DC charging and the use of CCS and CHAdeMO connectors that enable the V2G capability. In Scenario 1, 60% of the BEV users charge using a level 2 charger. For the V2G Scenario, it is assumed that half of the BEV users with a level 2 charger, have a V2G enabled level 2 charger and participate in the V2G program. The V2G program is as follows:

Fig. 5 presents the results of the simulation for the V2G program. The V2G program reduces all the peak demand due to BEV charging and maintains the existing peak demand without BEV charging on the grid. The V2G program delays charging till after 9 pm, this causes a greater power demand between the off-peak period from 12 am to 3 am. Moving electrical load to the off-peak period will ensure efficient utilization of the combined cycle powerplant as it would be operating closer to its rated capacity and not at a lower inefficient capacity.

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