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# The Profitability of Vehicle to Grid for System Participants - A Case Study from the Electricity Reliability Council of Texas

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## Abstract

Operating costs and market rules are likely to have an impact on the rewards of participating in a Vehicle to Grid system. This paper investigates these impacts by developing a model of a centralized Vehicle to Grid system and applying it to the 2015 wholesale electricity market in Texas (Houston Hub) for selling energy and capacity. Three scenarios are examined. In the first scenario, electric vehicles are paid based on a fixed retail market price; in the second, they are paid a time-varying retail market price; in the third, the virtual power plant shares 50% of its total reward with the participating vehicles. The results demonstrate that, while this system is always financially profitable to the virtual power plant and the system operator gets grid services, the electric vehicles could lose money. Further, results show that these vehicles with lower per unit output-battery cost could lose more money because of extensive battery over-use and insufficient reward at current market prices. Lower battery costs, subsidies for participation in this system, and more rewarding market products could all make their participation more economically viable.

*Keywords:* Electric vehicles, Electricity market, Vehicle to Grid

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## Highlights

1. A centralized architecture-based Vehicle to Grid system is modeled.
2. Dynamic Programming and Unit Commitment are used for determining rewards.
3. Rewards to electric vehicle owners are based solely on electricity prices.
4. Repeated charge/discharge cycles reduce battery life in electric vehicles.
5. Without compensation for battery life, rewards to vehicles are insufficient.

## Abbreviations

BAU	Business As Usual
BESS	Battery Energy Storage System (BESS)
CAISO	California Independent System Operator
DA	Day Ahead
EV	Electric Vehicles

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