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Denmark: Nuvve to trial EV V2G systems

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Denmark will be one of the first test markets for Vehicle-to-Grid (V2G) energy transfer with technology developed from University of Delaware research by a start-up called Nuvve, whose servers will aggregate multiple EVs into a "virtual storage network."

Nuvve states on its [website](#) that with Nuvve's solution "the car is always charged to the level you expect it to be when you need your car." In V2G mode, because the amount of time the battery is charged or discharged is very short, the level of charge in the battery does not change much. Over an hour, the amount of energy charged is equal to the amount of energy discharged. The net energy change on the meter is zero."

Nuvve says users will get paid for the power capacity they are offering (the capacity of the plug in kW), and not for the actual amount of energy going in and out of the car, "that is very minimum and a net of zero."

An EV participating in Nuvve's V2G network will communicate with Nuvve's server and be told every 2 seconds to either take power from the grid, similar to charging for a very short time, or give power back to the grid which is similar to discharging the battery but also over a very short time.

After an hour the amount of energy that an EV car battery charged from the grid will roughly equal the amount of energy that it sent back to the grid. During this hour, the maximum amount of charge or discharge of your battery is "tightly" monitored in order to make sure there is no battery wear.

An algorithm in Nuvve's system determines when the EV needs to go back into a regular charging mode in order to make sure that the battery is charged at the appropriate level when you need it.

As a result of this "intelligent" use of EV batteries, the wear is "very low". Estimates of the added battery wear after eight years range from well below 5% to about 1%, says Nuvve, quoting Ricardo's study for the UK National Grid. These differences in battery wear relate to the type of battery used.

Since Nuvve's solution balances the net energy to zero every hour, there will be no tax implications in an EV owner buying energy at one price and selling it back as a taxable income. While Nuvve says this is true of Denmark, its system rules are easy to adjust to different local energy price regulations.

Nuvve says the key benefit for EV owners is that Nuvve shares with them a large percentage of the money it receives from the grid operator, based on the power capacity (meaning the capacity of the plug to the car) and not the actually energy.

The Nuvve solution has been tested in a field trial with the regional transit operator PJM in the US for two years with nine EVs. During this trial it was determined that each EV on average could "earn" US\$2,500 per year by participating in Nuvve's V2G solution. Assuming an eight year lifetime of the EV (battery) and taking into account the cost of Nuvve's operation, it corresponds to around US\$10,000 per car over the lifetime of the EV's battery, discounted to today's dollar value.

The world market for grid frequency regulation is currently worth around US\$6bn, and is estimated to grow to US\$12bn by 2020, according to Nuvve.

Nuvve says that for EVs equipped with AC electric drivetrains capable of bi-directional power flow, there is no need to change any hardware to link up to its V2G network. Such vehicles include the 2012 Mitsubishi i-MiEV, the 2012 Daimler Smart E, and the BMW Mini E.

Nuvve is in the process of opening an office in Horsens, Denmark.