

Electric Vehicle to Grid (V2G)

Potential benefit for renewable-energy-supported electrical grids

One of the major challenges with utilizing renewable energy to support the world's electrical energy grids is that renewable sources are frequently unavailable: at night or during certain weather conditions. Grid utilities are scrambling to provide backup supplies for these times, generally requiring traditional fossil-fuel power plants to be on hot standby. Grid-level storage solutions including batteries are becoming available and being installed, but these currently are nowhere near sufficient in size, or cost-efficient enough, to power the grid. Enter electric vehicle V2G as a helper.

Electric vehicles have presented the opportunity to use the vehicles' batteries to power external things, via bi-directional charging where the battery can be either charged or discharged through its port. The various options are:

| Label | Meaning | Usage |
|-------|---------------------|---|
| V2L | Vehicle to Load | The vehicle provides an outlet to power external appliances. |
| V2H | Vehicle to Home | The vehicle can provide power to a house. |
| V2G | Vehicle to Grid | The vehicle's battery can be used when needed to support the overall electrical grid. |
| V2X | Vehicle to Anything | All the above. |

(These terms can be searched for online – there is a lot of information available.)

The critical fact here is that there is going to be a lot of vehicle-based storage available - enough that it needs to be factored into future projections of grid-storage requirements:

1. Electric vehicle batteries are rather large from a consumer viewpoint: 40-90kWh (perhaps 65kWh average) for a car. A vehicle battery of this size can supply the electrical needs of a reasonably sized house during power outages!
2. There are going to be a great many electric vehicles deployed, regardless of whether they are purchased with grid support in mind. Grid support will be an almost free benefit.
3. Many electric vehicles will or could be plugged in at any given time, making available a significant amount of electrical energy storage capacity which, properly managed, could be used to supplement the grid utility's own storage capability.

There are of course many current obstacles to having this capability universally available. But there are no research-level difficulties – V2X is becoming more common and will become standard. The major needed advances are development and regulatory:

1. Control systems, including the user-interface where the consumer must have control to choose when the vehicle is available to participate in grid support. This is primarily a matter of software development backed with basic electric control paths (additional wires, or data over power lines) and more-sophisticated charging systems.

2. Changes in pricing by the grid utilities will be needed to make V2G attractive to consumers. This should be addressable by a commonsense recognition of a mutually beneficial relationship between vehicle owner and grid utilities, like the still-developing consumer solar panel to grid options, to drive updated pricing regulations and practices, likely by offering some version of variable-rate pricing to consumers who are able and willing to sometimes provide power to the grid.

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