## Will EV's pose a problem for electricity producers and grid operators?

Not if the Swiss to Grid approach is implemented. S2G adapts itself to the load conditions on the grid. It facilitates a better use of the existing grid infrastructure without requiring the enormous initial hard and software investments that would be needed to set up a centralized smart grid system or update production and distribution capabilities.
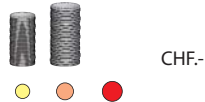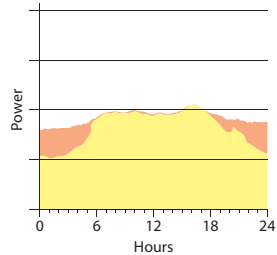
The 'distributed-intelligence' approach requires significantly less infrastructure investment to achieve the same goal and maintains the independence of consumers. The Swiss to Grid approach also facilitates the integration of local renewable energy generation (e.g. photovoltaic) and local storage (e.g. battery packs). Using 'distributed-intelligence' it will be possible to allocate locally generated electricity to either the grid or to local storage according to the current condition of the grid. Since energy generation from renewable sources follows the rhythms of nature and not demand, achieving and maintaining balance using flexible storage and intelligent switching systems will be essential.
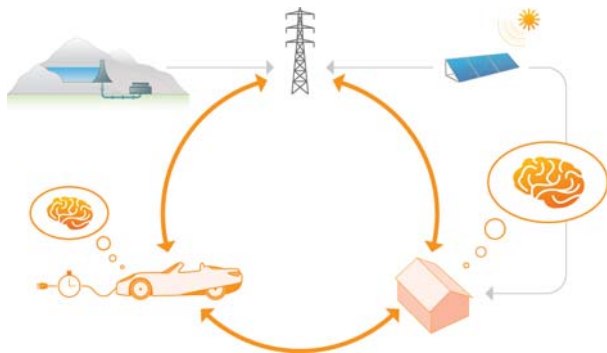
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Management and partners contributing to the S2G project

- **KWO**: Project management, conceptual supervision
- **SUPSI**: Photovoltaic and EV integration, S2G-Algorithm development
- **BATTERIE CONSULT**: conceptual supervision, concept for bi-directional charger
- **BFH-Ti Biel**: Grid modeling and simulation
- **Bacher Energie**: grid measurements and development of the theoretical basis of the S2G-Algorithm
- **Alpen Energie / aet / AIM**: collaboration for grid measurements
- **drivetek / SMART IN OVATION**: bi-directional charger prototype
- **Protoscar**: public relations, automotive industry consultancy, home charge devices

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Swiss to Grid Smart Grid – an innovative approach

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Premise

The most difficult problem to be solved in relation to electric vehicle (EV) charging is not how to generate sufficient electricity – it is how to deal with the demand peaks that will occur when thousands of car owners all start charging at the same time. It can be anticipated that EV owners will generally start charging when they get home from work in the evening. This means that the existing evening demand-peak will grow dramatically and become difficult to manage.
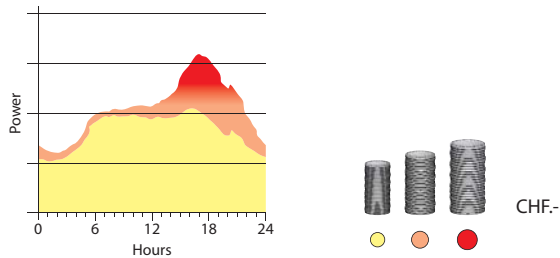
If these peaks are not controlled, we can expect major disruptions to the grid. Problems will start at the low-voltage local level, propagate through the medium-voltage regional networks and finally disrupt the national high-voltage supply systems.

Can we avoid this problem?

Yes. Swiss to Grid (S2G) offers a solution. Generally speaking, if selected electric devices in households (including the battery charger) could be made to use less power or turned off whenever the grid is in a critical condition, the problem of over demand can be avoided. Conventionally, this idea would be realized by creating a centralized control mechanism that would be monitored and managed by the grid operator. Swiss to Grid, however, proposes an alternative 'distributed-intelligence' approach. All major electrically-powered household devices (e.g. heat pumps, refrigerators, EV's etc.) would be equipped with intelligence to enable them to detect and respond to grid conditions. During critical periods, the devices would reduce or stop their power consumption, but still be capable of fulfilling the user's needs (i.e. warm house, cooled food and drink, EV charged by morning).

Should car manufacturers be concerned about EV charging?

No. Not if charging at loads higher then 8A/2kW is done with S2G switching systems. Without S2G and increasing market penetration of EV's, a maximum of 8A/2kW per EV may be the limitation imposed by the electricity grid.

What are the advantages for EV-users?

The overall costs will be much lower and the implementation more flexible. EV-users will want to re-charge their vehicles at any time, wherever they happen to be and at the lowest possible cost. Since S2G is basically a software-solution, it does not require the major infrastructure investments of a centralized system. Neither does it need a huge number of EV's (a so called critical mass) to be effectively and economically implemented.

How does S2G work?

It analyses frequency and voltage changes and adjusts household electricity usage. FREQUENCY is influenced by TOTAL load, VOLTAGE is influenced by LOCAL load.
Every S2G-equipped electrical device is able to monitor the frequency and voltage of the grid. By tracking variations in these parameters, a sophisticated algorithm is able to compute the current status of the grid. Without altering comfort, non-critical household devices and installations will be adjusted to use less electricity or temporarily turned off in response to extreme load conditions.

S2G can also adapt to situations where local electricity is sporadically available. For instance, if the household has photovoltaic panels and the sun comes out, the EV charger will automatically switch to this source.
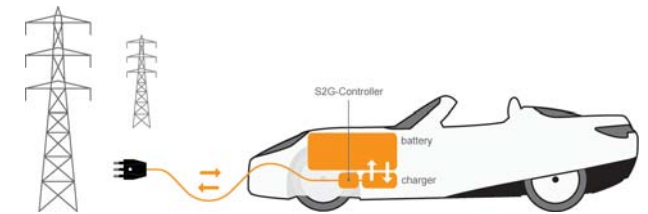
In the event that future EV's are equipped with bi-directional chargers, S2G can decide the direction of the energy flow, to or from the grid, dependent on the current status of the grid and preferences set by the EV owner.

Why isn't S2G already available?

The S2G project is currently in the research phase.
The algorithm is scheduled for completion by October 2011. A pilot project will be implemented to test S2G under real life conditions. The pilot project phase is open for partners (e.g. car manufacturers) who wish to evaluate the potential benefits of S2G with regard to EV diffusion.

www.s2g.ch