

# Accelerating high-impact innovations of cutting-edge, first-of-its-kind sustainability solutions



## Challenge

A major renewable energy and sustainable urban development company asked Lux to identify new opportunities to accelerate high-impact innovations in cutting-edge sustainability solutions poised to alter the utility industry.



## Solution

Lux addressed the client's need by establishing a proactive, objective, and efficient dialogue with various stakeholders. Lux analyzed industry trends impacting the future of the electricity sector and identified key enabling technologies and business models in their respective domains.



## Value

Lux's analysis played an integral part in the client's strategic decision-making and international involvement in first-of-its-kind projects in renewable energy and mobility.

### VEHICLE-TO-GRID TECHNOLOGIES FOR GRID SUPPORT

**INTRODUCTION**

With increasing adoption of battery electric vehicles (BEV), plug-in hybrid (PHEV), and hydrogen fuel cell electric vehicles (FCEV), grid managers are becoming worried about supplying electricity to these vehicles without overtaxing air infrastructure. As a solution, electric vehicle car manufacturers, such as **Nissan**, companies, including **Enel**, propose a vehicle-to-grid (V2G) strategy. In this vehicles (EVs) are not only modes of transportation, but also act as small-scale power plants. The EVs would communicate with the power grid and either feed to the grid or throttle their charging rate depending on electricity demand. A 2015 study from the International Journal of Automotive Technology claims that generate an annual profit of between US\$300 to US\$450. Another study by **Nissan** where frequency regulation prices are high, found that operators of its V2G earn up to €1,300 annually.

**VEHICLE-TO-GRID TECHNOLOGIES FOR GRID SUPPORT**

**KEY DEVELOPERS**

Company	Founded (Country)	Description	Differentiator
<b>Nissan</b>	1933 [Japan]	Automotive OEM.	<b>Nissan</b> is the only company with a V2G compatible EV on the market.
<b>Honda</b>	1948 [Japan]	Automotive OEM.	Leading developer of V2G charging stations for home and public with fast-charging capabilities.
<b>Tokyo Electric Power Company (TEPCO)</b>	1951 [Japan]	Japanese electric utility holding company.	One of few utility companies heavily involved in V2G pilot projects. Developing V2G with partners <b>Mitsubishi Motors</b> , <b>Hitachi</b> and <b>Shizuoka Gas</b> with support from the Japanese government.
<b>Engie</b>	2008 [France]	French multinational electric utility company.	One of few utility companies heavily involved in V2G pilot projects. Currently developing behind-the-meter energy storage for Vehicle-to-Building configuration in partnership with <b>Mitsubishi</b> and <b>Hitachi</b> .
<b>Nuvve</b>	2010 [US]	Develops high-powered, bidirectional charging stations for V2G systems as well as software for V2G EV aggregation and power control.	One of the leading players in V2G EV aggregation and power control software solutions. Has participated in many pilot projects through the US and Denmark, has partnered with <b>Nissan</b> and is currently expanding to other European countries like the UK.
<b>Greenlots</b>	2008 [US]	Subsidiary of the <b>Shell Group</b> ; develops software for V2G EV charging/discharging optimisation and grid balancing.	Participated in many EV charging programs throughout the US including California, Illinois, Massachusetts, and several others.
<b>Fermata Energy</b>	2013 [US]	Energy technology company developing V2G charging stations.	As of March 2020, the only company to receive the UL certification for a V2G charging system.

**Takeaway and Recommendations**

The rise in EV adoption is increasing the strain on energy generation assets and the grid. V2G technology gives utilities flexibility to not only meet this demand, but also to address challenges such as frequency regulation and load shifting. As such, EV developers are beginning to develop V2G compatible vehicles to enable this flexibility and unlock new streams of revenue for consumers. Start-ups are also participating in the space, developing bidirectional charging stations as well as the software needed to control and regulate charging protocols for EVs. However, while numerous pilot projects have been conducted, mass consumer adoption still remains a challenge. V2G proponents still need to convince EV owners that the economic benefits will outweigh battery replacement costs. Business cases are still unclear for cities and business owners to invest in building onsite EV charging stations. In the near term, V2G is best suited to deliver grid services such as frequency regulation that do not overtax the lithium-ion battery. V2G solutions are likely to see more widespread adoption as batteries become more robust to rapid charge/discharge, improve cycle life, and as flexible algorithms and controls become widely available.

Metrics	Comments
<b>Technology value:</b> Medium	V2G technology has potential to enable grid-scale utility providers to access 1600Wh of energy storage in the US by 2025. This would minimise the need to immediately upgrade grid infrastructure or add grid-scale energy storage, which are capital intensive undertakings.
<b>Momentum:</b> Medium	Many major OEMs are already participating in V2G, including <b>Nissan</b> , <b>VW</b> , <b>Honda</b> , and others. Many start-ups are now piloting V2G compatible charging stations and control software.
<b>Maturity:</b> Medium	There are at least 50 projects on V2G technology that have been implemented globally. <b>Nissan</b> already has a V2G compatible vehicle on the market; others are likely to follow suit in the near term.
<b>Risks:</b> Medium	The business case for V2G is still unclear, as liabilities and payback schemes are as yet uncertain. Technologies, such as smart controls, will help unlock applications and dampen battery degradation, but limited availability of EV charging infrastructure still limits potential for V2G deployment today.