

Institute for Economy
and the Environment



University of St.Gallen

A customer perspective on vehicle-to-grid concepts

What factors drive electric car owners' willingness to co-create flexibility?

Input by

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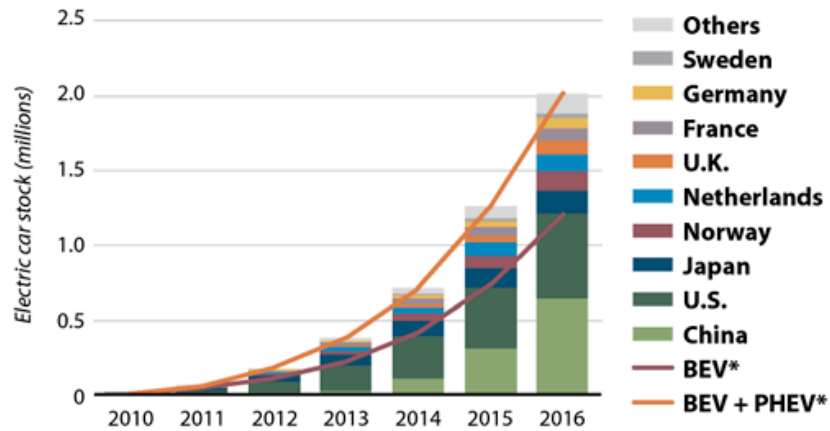
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Renewable energy supply and demand fluctuations and higher stress on the grid require new forms of flexibility

EVOLUTION IN GLOBAL ELECTRIC CAR STOCK

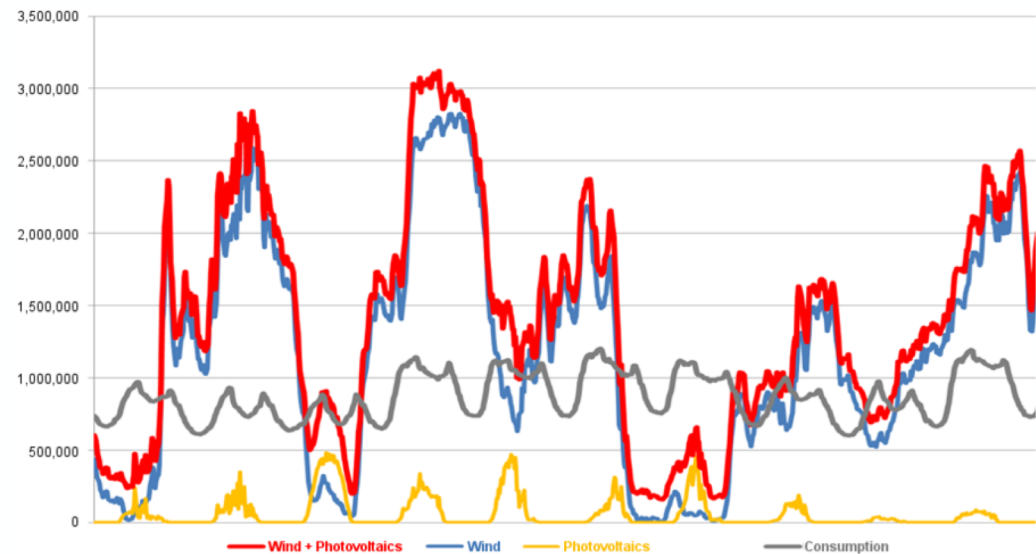
In millions, 2010-2016



*BEV=Battery-powered electric vehicles; PHEV=Plug-in hybrid electric vehicles

NOTE: The electric car stock shown here is primarily estimated on the basis of cumulative sales since 2005

Electric car stock growth 2010-2016



Fluctuations in renewable energy supply and customer consumption

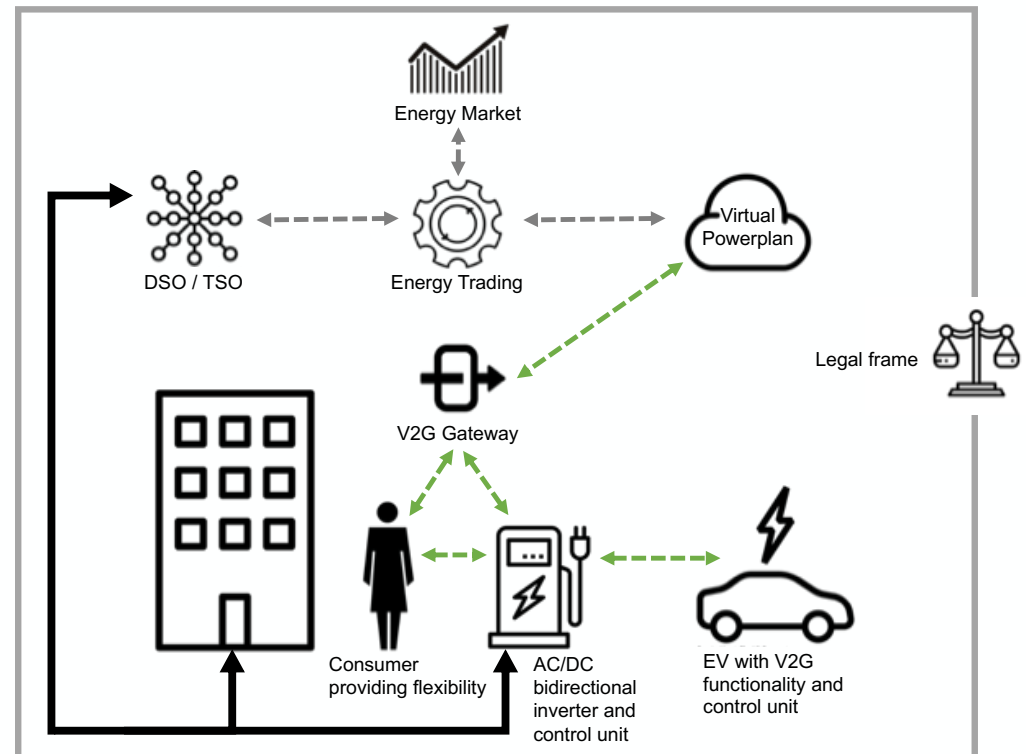
Source: omv.com (2019), IEA (2017), Global EV Outlook (2017), insideclimatenews (2017)

Vehicle-To-Grid (V2G) describes a concept that enables electric vehicles to become temporary energy storages to balance the grid

V2G Technologies

- EV owners can give grid operators access to their car batteries as resource options when grid system reliability is jeopardized
- Bidirectional flow of energy and smart communication between the EV and the power grid enable EVs to balance the grid

Consumers do need to provide some sort of flexibility and agree on potential impacts on the availability of their electric car. Under which circumstances are they willing to participate in V2G systems?



The aim of this research project was to find out more about customers' drivers to provide flexibility and derive implications for a V2G business model

Research Objectives:

- Identification of customer segments most willing to co-create V2G flexibility
- Derivation of a value proposition for a V2G business model

The following research questions were derived and answered

- (1) What are the prerequisites of EV owners' willingness to co-create flexibility?
- (2) What role do the assessed behavioral scales, political party preferences and technology-specific factors play in the EV owners' willingness to co-create flexibility?
- (3) What are the implications for value propositions of business models of V2G concepts?

Secondary and primary data of both quantitative and qualitative nature were selected, collected and analyzed in a multistage and iterative process

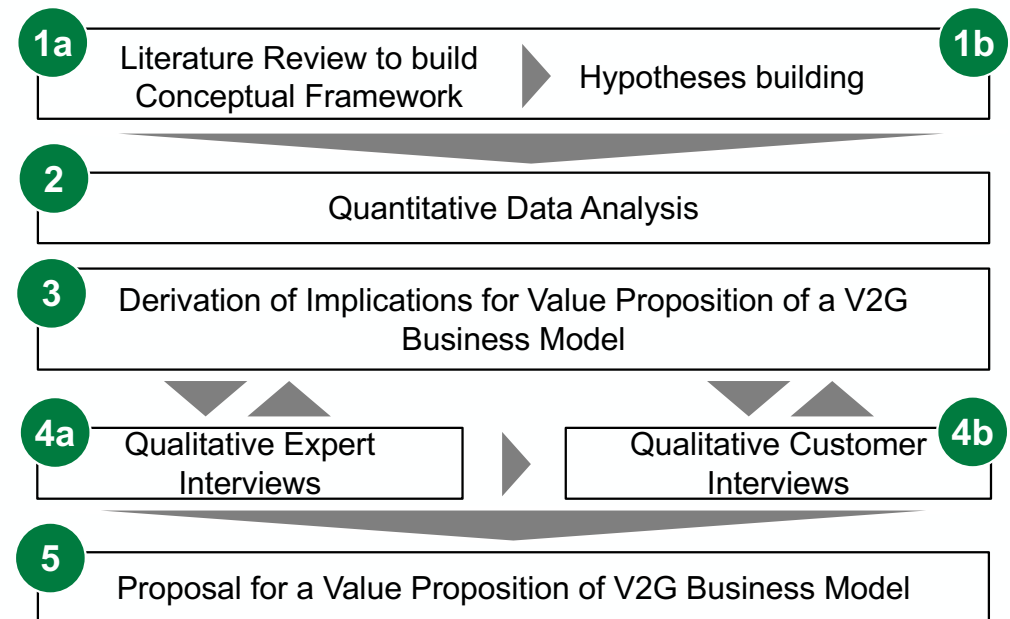
Data and Methodology

(1) Quantitative data

- **Conjoint Experiment** incl. V2G contract attributes: (a) energy mix, (b), contract duration, (c) energy cost and (d) flexibility option
 - Flexibility options measured by min. state of charge and amount of (dis)charging cycles
- **Behavioral Scales:** Innovativeness, Collectivism, Energy Interest, Ambiguity Tolerance, involvement with energy provider
- **Sociodemographic factors, Political Preferences, technology-specific attributes**

(2) Qualitative data

- Expert and customer (EV owner) interviews



The results indicated that respondents' EV buying motivations correlate with their motivations to provide flexibility

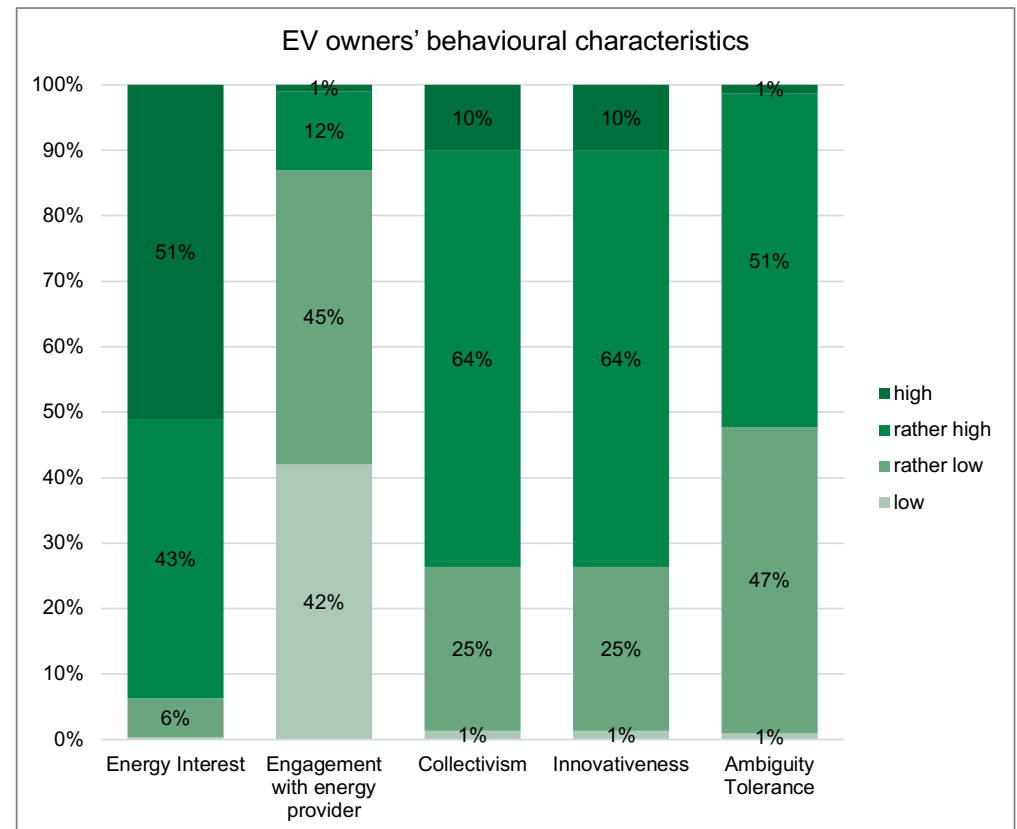
Quantitative Results

(1) Conjoint Experiment

- Importance in descending order: (1) electricity mix, (2) electricity cost, (3) flexibility attribute, (4) contract duration

(2) Results of Regressions

- Significant correlations with cost-sensitive respondents
- Innovative and collective people would most likely participate in V2G systems
- No correlations with political party preferences or socio-demographic factors



Three main customer segments were evolved: (1) innovation-driven collectivists, (2) eco-conscious drivers and (3) cost savers.

Customer Segments	Innovation-driven collectivists	Eco-conscious drivers	Cost Savers
Description	<ul style="list-style-type: none"> – Desire to feel innovative – Like to be part of a community – Have a flexible attitude 	<ul style="list-style-type: none"> – Appreciate higher renewable energy share and energy efficiency 	<ul style="list-style-type: none"> – Want to make extra earnings with their EV – Aim to reduce their total cost of EV ownership
Key Messages	<i>Collective effort in participating in a highly innovative system increases the benefits of grid stability and renewable energy enhancement.</i>	<i>The share of renewable energies in the grid will be increased.</i>	<i>Financial benefits are achieved by selling ancillary services to the grid.</i>
Preferred Incentives	Financial compensation Functional and social incentives	Financial compensation Ecological: more renewable energies	Financial compensation

Buying motivations for EV owners also represent their motivations to participate in V2G systems

Implications from all results indicate a flexible pay-as-you-go concept as the most feasible business model for all customer segments

Contract model

Flexible pay-as-you go:

- EV owners plug in as much as they want
- Compensation volume-based
- Financial incentives: revenue gains for ancillary services to the grid, cost savings for electricity
- No one-time incentives

Address customer segments in the right way

Attractive incentives for all customer groups

- Financial incentives for everyone
- Community and neighbor concepts to address collectivists
- Higher share of renewable energies for eco-conscious drivers

Effective communications for all customer groups

Limitations and recommendations for future research

Research Limitations

- Limited amount of data, only 20% actual EV owners
- Geography of data
- Bias of interview partners
- Interpretations of customers' answers

Recommendations for future research

- More data on actual EV owners' motivations
- Experiment with communication messages
- Pilot projects and iterative feedback loop

Concluding Remarks & Thank You!

We cannot tell the people ‘The grid will collapse’. We need to convince them that smart charging and Vehicle-To-Grid technologies are good things and ask them ‘Why don’t you have a flexible attitude?’
– *Expert Interviewee*

Thank you for your
attention!