

V2G: Measuring electric vehicle drivers' willingness to co-create flexibility for smart grids

- Growing share of renewables leads to a search for new sources of flexibility in the power system.
- Electric vehicles (EV) are a promising source of distributed flexibility, if drivers are willing to allow utilities to access their batteries.
- We investigate EV drivers' willingness to provide flexibility through a choice experiment (N=300), and compare with PV and heat pump owners.
- EV drivers show moderate willingness to provide flexibility in return for cheaper or greener electricity.
- Vehicle-to-Grid (V2G) business model design needs to account for discomfort costs of owners.

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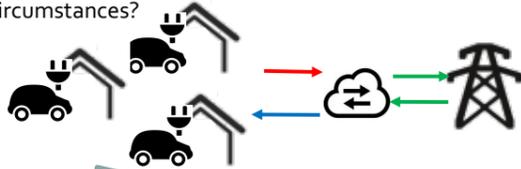
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Introduction

Vehicle-to-Grid (V2G) systems, as well as other sources of distributed flexibility, are a potentially promising concept to manage distribution grids more efficiently and provide ancillary services to smart grids (1,2,3,4, 5). An important, but under-researched question is: Are EV drivers actually willing to participate in distributed flexibility business models? And if yes, under which circumstances?



Research Question

To what extent are EV drivers willing to co-create flexibility?

Choice experiments

Choice situation: Respondents choose among electricity contracts providing different amounts of flexibility.

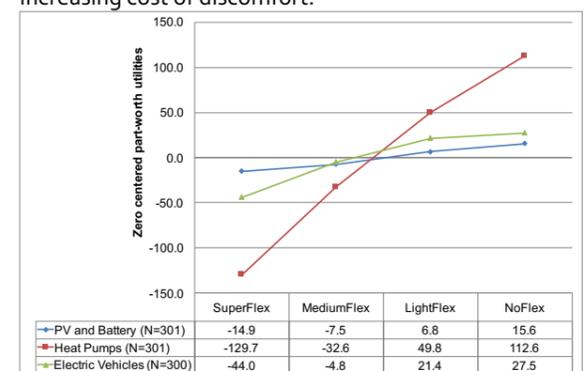
Attributes	Levels			
Power costs per month	110 CHF	90 CHF	70 CHF	50 CHF
Use of flexibility	Super Flex*	Flex Medium*	Flex Light*	No Flex*
Power mix	100% uncertified grey power	100% nuclear power	100% hydro power	100% solar power
Contract duration	4 years	2 years	1 year	Can be cancelled anytime

Specific design of the flexibility attribute for 3 domains of residential energy use (e.g. electric vehicles).

	Levels of the attribute "Use of flexibility" for EV drivers			
Electric vehicles	Super Flex Guaranteed charging level 40%; Unlimited amount of discharging cycles per 24 h	Flex Medium Guaranteed charging level 60%; max. 3 discharging cycles per 24 h	Flex Light Guaranteed charging level 80%; max. 1 discharging cycle per 24 h	No Flex No access to battery for the utility

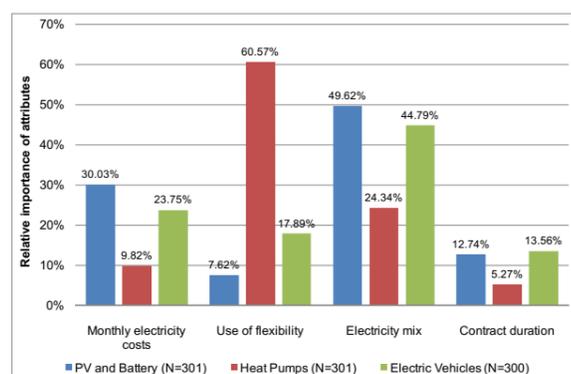
The price of distributed flexibility

While higher guaranteed charging levels increase customer value, EV drivers exhibit a willingness to provide flexibility also at 60-80% charging levels. At the highest amount of flexibility (only 40% charging guaranteed), the utility curve sharply declines, reflecting increasing cost of discomfort.



Results

By comparing choice experiments with EV drivers with similar analysis of two other types of potential providers of distributed flexibility, namely owners of PV+battery systems and heat pumps, we assess the importance of product attributes. EV drivers are less price sensitive and more willing to co-create flexibility than, for example, heat pump owners.



References

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