

# THE FLEXIBLE PROSUMER: CUSTOMER CO-CREATION OF ANCILLARY SERVICES IN SMART GRIDS

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## Overview

Rising shares of fluctuating renewables increase the need for flexibility in the power market. Distributed generation units and storage have a large potential to contribute to flexibility provision (Gordijn & Akkermans, 2007; Veldman et al., 2013), by synchronizing supply and demand on a decentralized level (Helms, Loock, & Bohnsack, 2016). This paper empirically investigates customers' willingness to co-create flexibility in three main domains of energy use: (a) solar PV plus storage, (b) heat pumps, (c) electric mobility. While it has been extensively documented that there is a significant technical potential to adapt supply and demand in these domains, there is surprisingly little empirical analysis in terms of whether consumers are actually ready to contribute to flexibility provision, and if so, under which conditions these resources can be mobilized. In other industries, segmenting consumers based on their willingness to co-create flexibility is standard practice and has become key for successful business models and efficient asset utilization (e.g. dynamic pricing of airline or railway tickets, Kimes 1989). In the electricity industry, such approaches are still in their infancy, but with the increasing diffusion of the above-mentioned distributed energy technologies, their importance is set to rise. We address this gap in the energy economics literature by conducting an empirical analysis of more than 900 Swiss electricity consumers who own or are interested in owning solar PV plus storage, heat pumps or electric cars, respectively.

## Methods

We develop and test a model to measure prosumers' willingness to co-create flexibility, where prosumers can allow the electric utility to take partial control over their infrastructure in return for a price advantage. The attributes of the choice object, the electricity supply contract, are monthly cost, degree of flexibility, electricity mix and contract duration. While the overall design of the choice experiment is consistent across the three domains of energy use that we investigate, the levels of the flexibility attribute are operationalized in specific ways for each of the three domains (PV plus storage, heat pump and electric car).

Our empirical findings are based on the analysis of 7.216 individual choices in a series of three choice experiments with 902 Swiss prosumers in different technological set-ups, allowing us to measure differences in prosumers' willingness to co-create flexibility.

## Results

While all three studies show that prosumers are willing to co-create some degree of flexibility, they also highlight significant differences across domains of energy use. Owners of solar PV plus storage and electric cars exhibit a higher willingness to provide flexibility than heat pump owners. There are two possible interpretations of this result: (a) willingness to provide flexibility may be lower where it has direct impacts on personal comfort level (e.g. lower room temperature), (b) given that heat pumps are already more widespread than PV plus storage systems or electric cars, innovators may be more willing to provide flexibility than early adopters.

## Conclusions

Prosumers could potentially play an important role in co-creating ancillary services in smart grids, but little is known about their preferences in doing so. Our paper closes this gap by conducting a large-scale survey in Switzerland and deriving prosumers' willingness to co-create flexibility in three important domains of distributed energy: PV plus storage, heat pumps and electric mobility. Our results provide specific insights into factors determining whether and to what extent prosumers can be motivated to engage in flexibility provision. This has important implications for policy makers seeking to integrate high shares of distributed renewables in the grid, as well as for electricity companies trying to develop successful business models for smart grids.

## References

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