Energy Week 2024
PATHFNDR CONFERENCE

Input presentation

Federica Bellizio, Empa

Enabling demand-side flexibility provision from e-mobility and buildings

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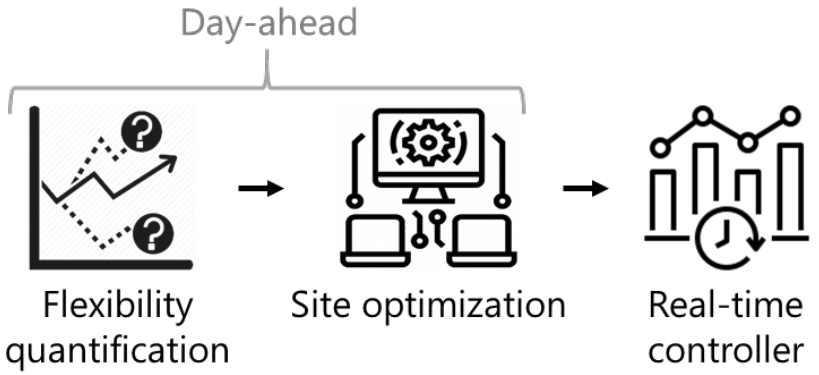
Motivation

- High shares of renewables and distributed energy resources cause congestion in grids
- 35% of the Swiss electricity consumption comes from households, 50% of passenger cars will be fully electric by 2035
- Availability of large amount of data, heterogeneous and many controlled devices
- Demand-side flexibility as alternative to grid reinforcement

Research questions

- **Q1**: How much demand-side flexibility can electric vehicles (EVs) and buildings provide?
- **Q2**: How to optimally schedule the local resources for flexibility provision?
- **Q3**: How to develop flexibility-aware real-time controllers?



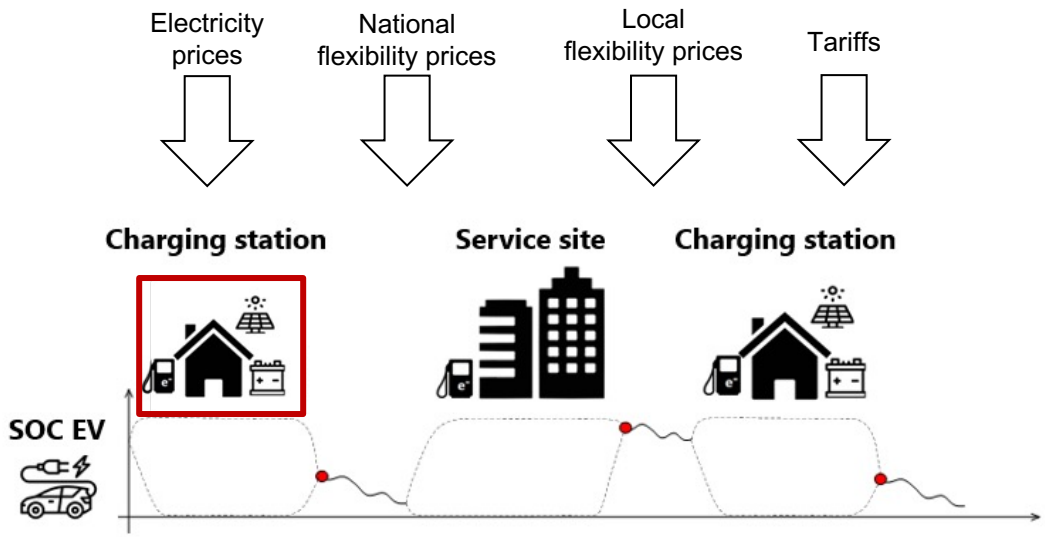
Data-driven approaches to enable demand-side flexibility provision

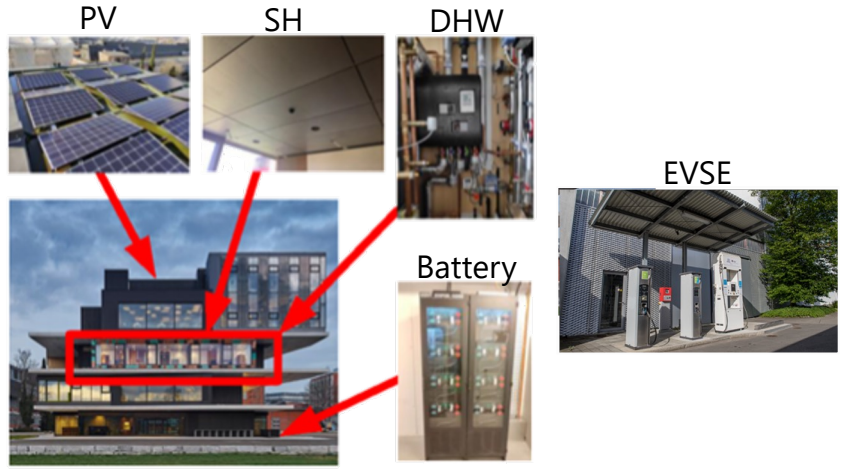
→

A novel operational vehicle-to-everything (V2X) tool for EV aggregators for flexibility quantification and provision

Use-case description

- A fleet of 4 EVs moving between a mixed-use building acting as a charging station and a service site
- Sites are exposed to electricity and flexibility (local and national) prices, grid tariffs
- Proof-of-concept using NEST and move demonstrators
- The charging station includes battery (BESS), photovoltaics, EV charge-points and heat pumps (HPs)
- HPs provide space heating (SH) and domestic hot water (SHW) for the UMAR residential unit





Bellizio, F., & Heer, P. (2023). Optimal V2X operation of EV fleets with PV-battery charging station for demand-side flexibility provision. TechRxiv. DOI: 10.36227/techrxiv.24590955.v1

The tool in action

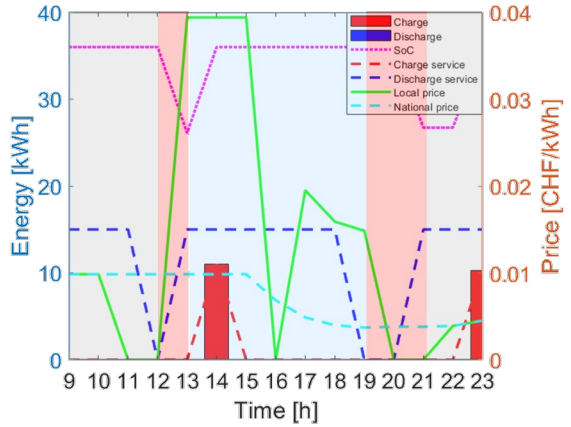
Load

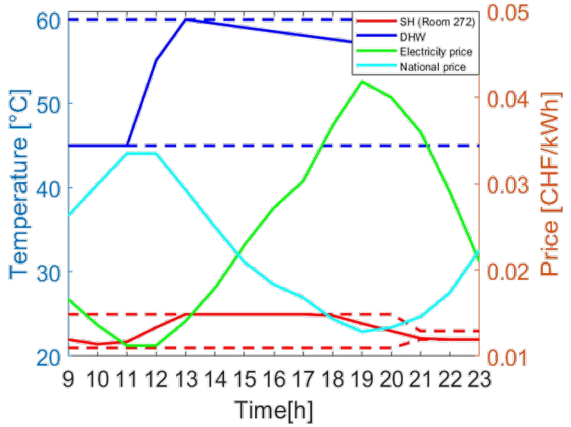
PV generation

EV availability/ demand

24-hour ahead forecasts

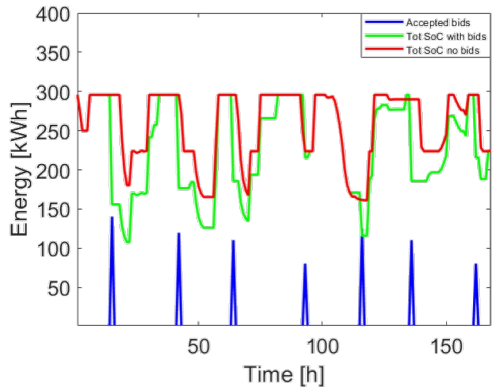
Multi-site optimization





Flexibility bids

Real-time controller



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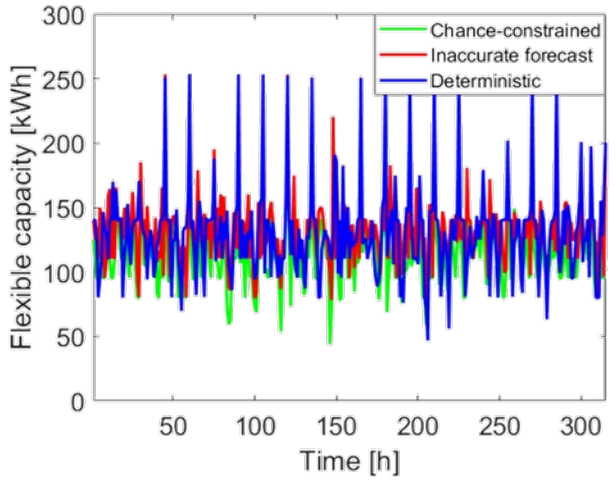
Key results

- The tool results in conservative quantification of available flexible energy, preventing overbidding
- The revenues from flexibility provision can reduce or even offset the energy costs under effective policies and market designs
- The revenues can increase by up to 14% over a month using V2G technology and by up to 5% with EV users flexible with their parking times
- Battery and EVs offer higher flexibility than HPs in mixed-use buildings. The HP flexibility potential increases in large residential units, such as multi-family houses (MFHs)



	Deterministic	Inaccurate Forecast	Chance-constrained
Net revenue [CHF]	1′582	1′772	1′542

	BESS	EV	SH	DHW
Empa mix [%]	65.7%	34.0%	0.2%	0.1%
MFH mix [%]	61.0%	32.0%	–	7.0%

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Electric vehicle and building owners can **offset their energy costs** entirely by providing flexibility – the **lack of effective policies and market designs** remains the greatest barrier.