25 April 2024

Enabling two-way communication: Principles for bidirectional charging of electric vehicles

Electrification Academy

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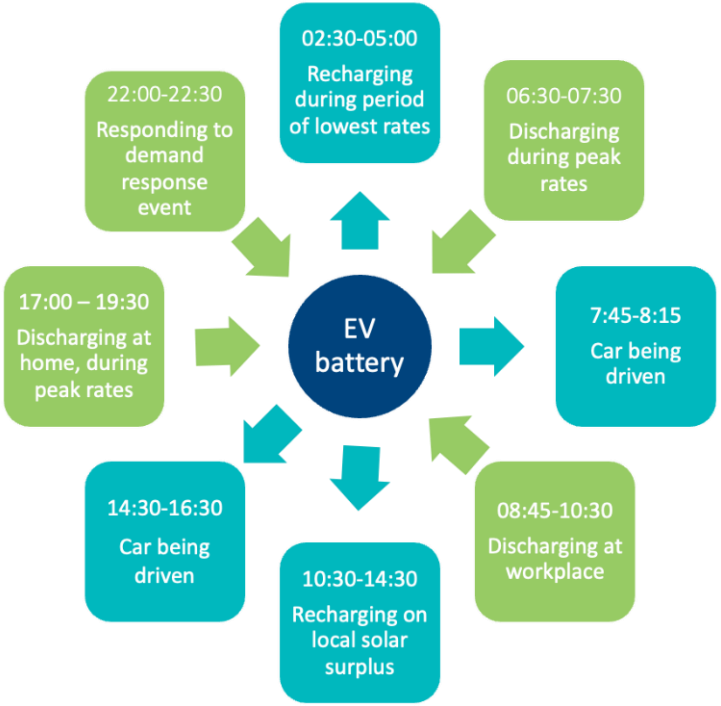
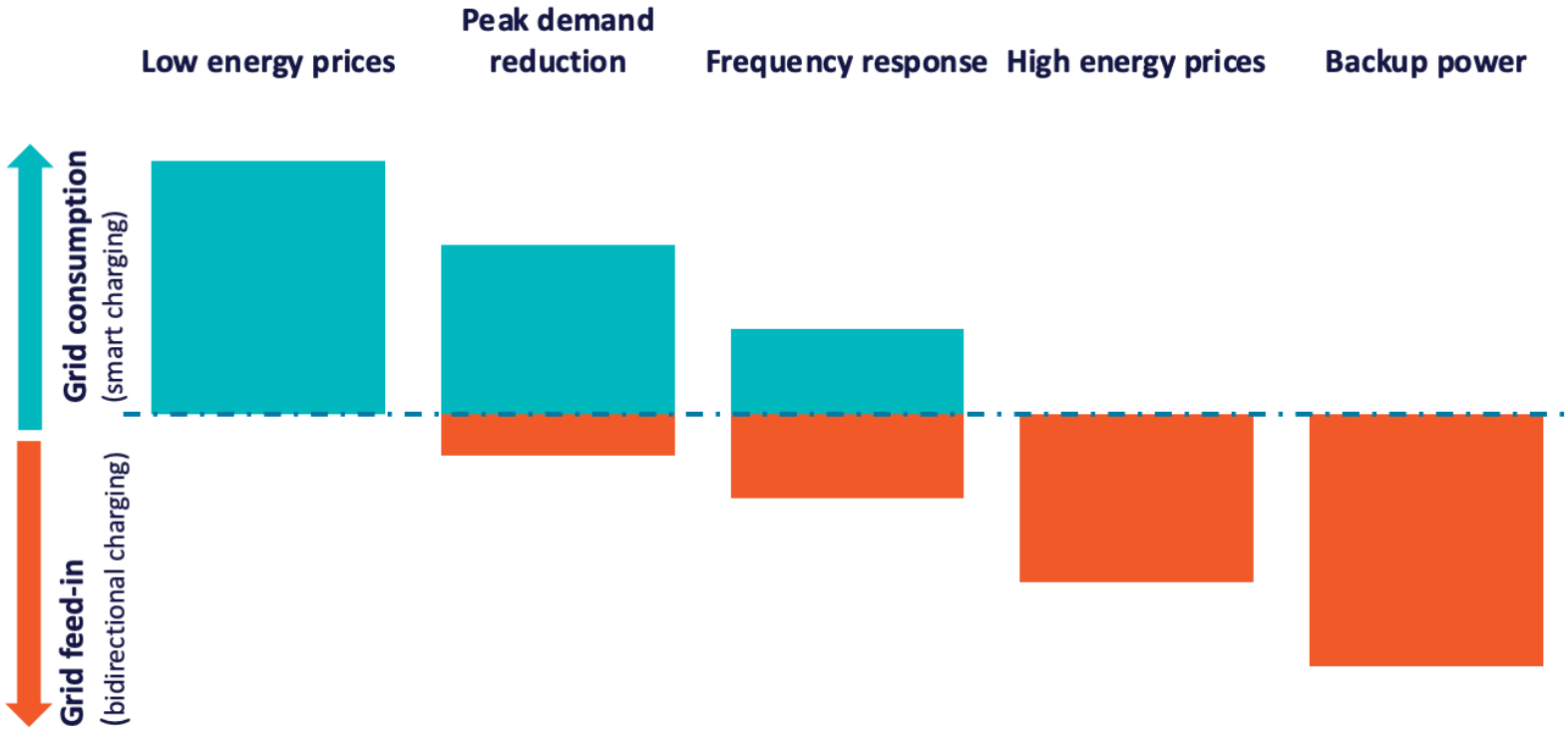
Regulatory Assistance Project

A day in the life of an EV battery…



Smart and bidirectional charging



Principle: Build trust and establish common standards

Principle: Get the prices right to guide charging and discharging

Principle: Ensure equal access and treatment

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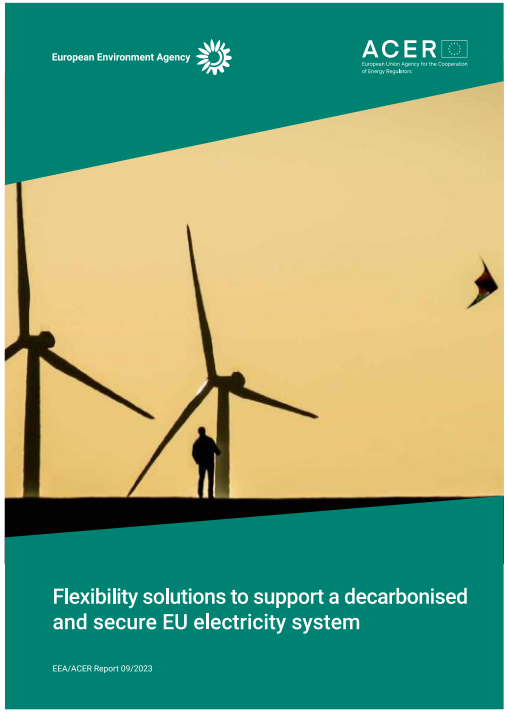
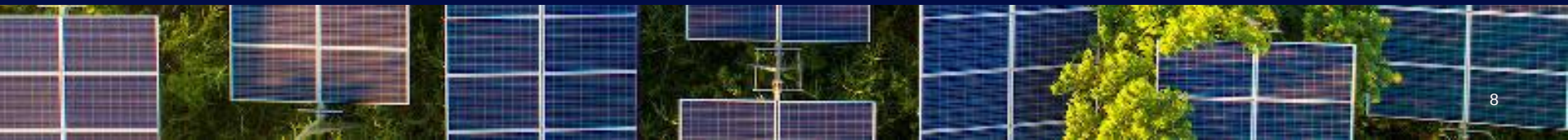


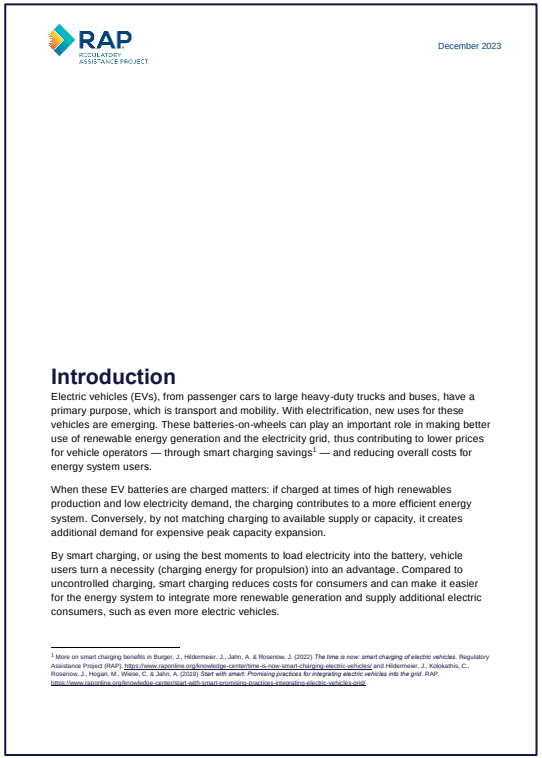
Build trust and establish common standards

Get the prices right to guide charging and discharging

Ensure equal access and treatment



- https://www.raponline.org/knowledge-center/enabling-two-way-communication-principles-for-bidirectional-charging-of-electric-vehicles/



RAP
REGULATORY ASSISTANCE PROJECT

December 2023

Introduction

Electric vehicles (EVs), from passenger cars to large heavy-duty trucks and buses, have a primary purpose, which is transport and mobility. With electrification, new uses for these vehicles are emerging. These batteries-on-wheels can play an important role in making better use of renewable energy generation and the electricity grid, thus contributing to lower prices for vehicle operators — through smart charging savings[1] — and reducing overall costs for energy system users.

When these EV batteries are charged matters: if charged at times of high renewables production and low electricity demand, the charging contributes to a more efficient energy system. Conversely, by not matching charging to available supply or capacity, it creates additional demand for expensive peak capacity expansion.

By smart charging, or using the best moments to load electricity into the battery, vehicle users turn a necessity (charging energy for propulsion) into an advantage. Compared to uncontrolled charging, smart charging reduces costs for consumers and can make it easier for the energy system to integrate more renewable generation and supply additional electric consumers, such as even more electric vehicles.

[1] More on smart charging benefits in Burger, J., Hildermeier, J., Jahn, A. & Rosenow, J. (2022) *The time is now: smart charging of electric vehicles*. Regulatory Assistance Project (RAP). https://www.raponline.org/knowledge-center/time-is-now-smart-charging-electric-vehicles/ and Hildermeier, J., Kolokathis, C., Rosenow, J., Hogan, M., Wiese, C. & Jahn, A. (2019) *Start with smart: Promising practices for integrating electric vehicles into the grid*. RAP. https://www.raponline.org/knowledge-center/start-with-smart-promising-practices-integrating-electric-vehicles-grid/

V2X Suisse

Insights from a pioneering V2G-project

Electrification Academy, 25 April 2024

Aby Chacko / Stefan Doerig

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tiko Energy Solutions

An architect of the energy transition

- Aggregator and technology provider for Home Energy Management, Smart Charging and Virtual Power Plants
- Founded in 2012 in Switzerland, operating one of the first Virtual Power Plants since 2013
- Part of the Engie Group since 2019
- 60+ employees, working from our HQ in Zurich, and from offices in Paris and Milano
- Clients and projects in Europe, but also in Australia and New Zealand

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Agenda

- Presentation of the project
- Learnings from the project
- Regulatory aspects
- Questions and discussion

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The Project

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The Team

Six companies

Project Lead: Mobility

Partners: Honda (car manufacturer), sun2wheel (software developer), EVTEC (charging station developer), tiko (aggregator), novatlantis (consultant)

In collaboration with ETH Zurich
Supported by Swiss Federal Office of Energy (SFOE)

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The Fleet

Fifty Honda-e

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The Goal

Three answers

How to charge efficiently?

The project is exploring how V2X-technology can help stabilize the electricity grid and how buildings with bidirectional charging points and PV-production can optimize self-consumption.

How to use flexibility?

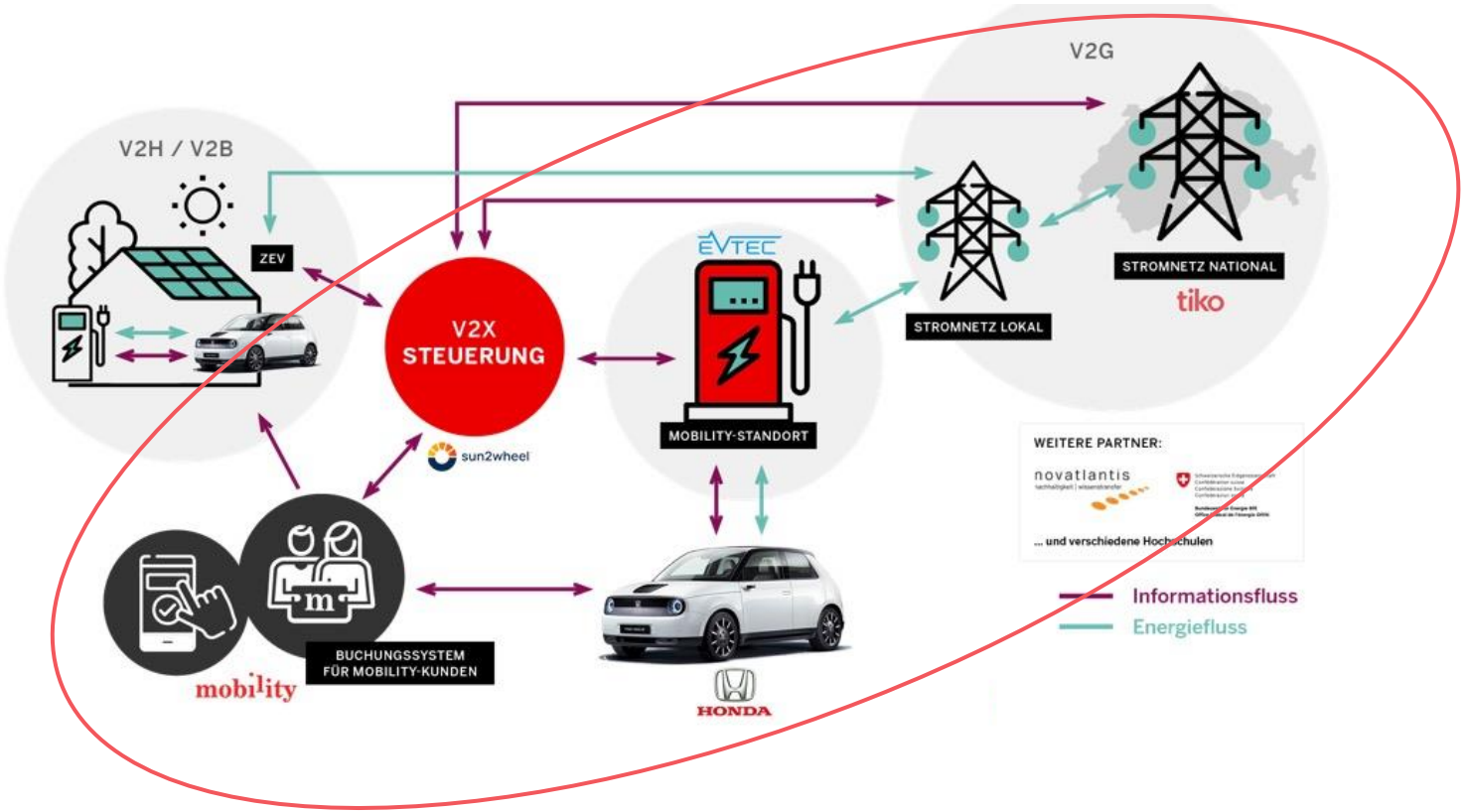
The project is testing the value for potential flexibility users (Swissgrid, distribution system operators, self-consumption communities).

How to create a business case?

The project is investigating the potential of different V2X-business cases in Switzerland.

The Organisation

Extended view



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The Organisation

Players and communication for V2G

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Aggregator with cloud-to-cloud-link to V2X-platform (sun2wheel)

sun2wheel

Software platform in the center of the system

Mobility

Booking platform of the car sharing company linked to V2X-platform and V2X-cars in the fleet

EVTEC

Charge points communicating with V2X-platform and connected cars

Honda

V2X-cars communicating with the booking platform and EVTEC

Learnings

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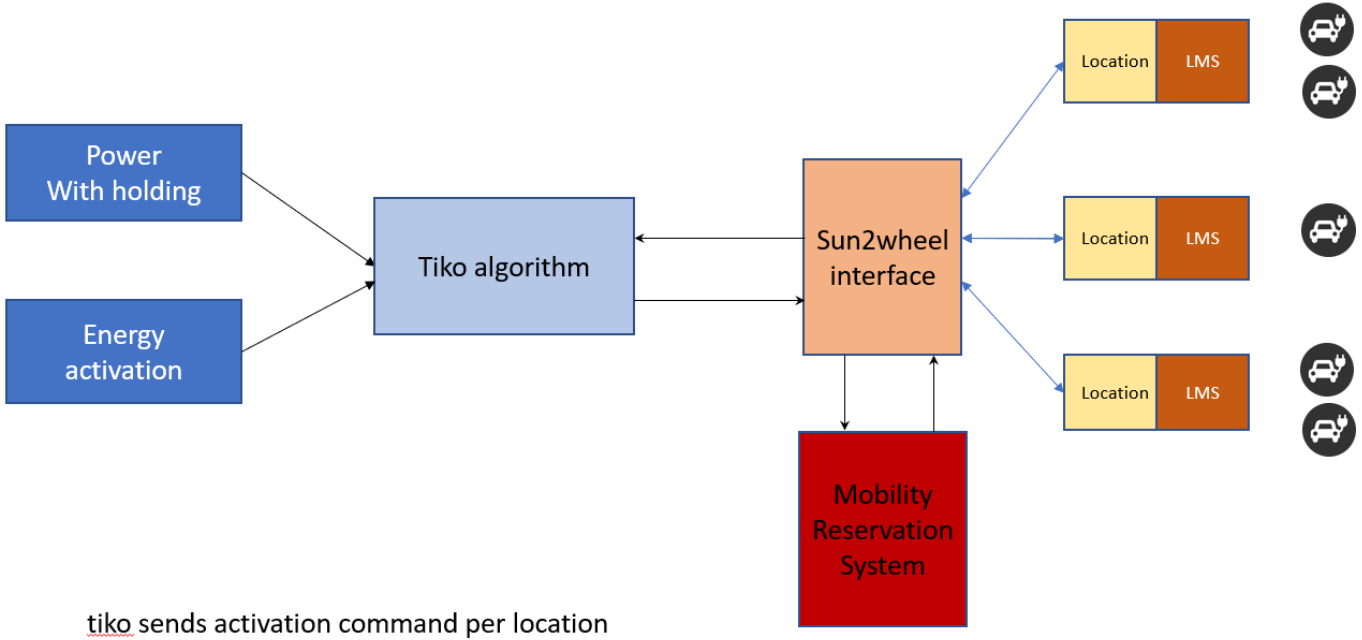
Flexibility with EVs in a car sharing pool

Technical concept



tiko sends activation command per location

LMS: Load Management System of Sun2wheel

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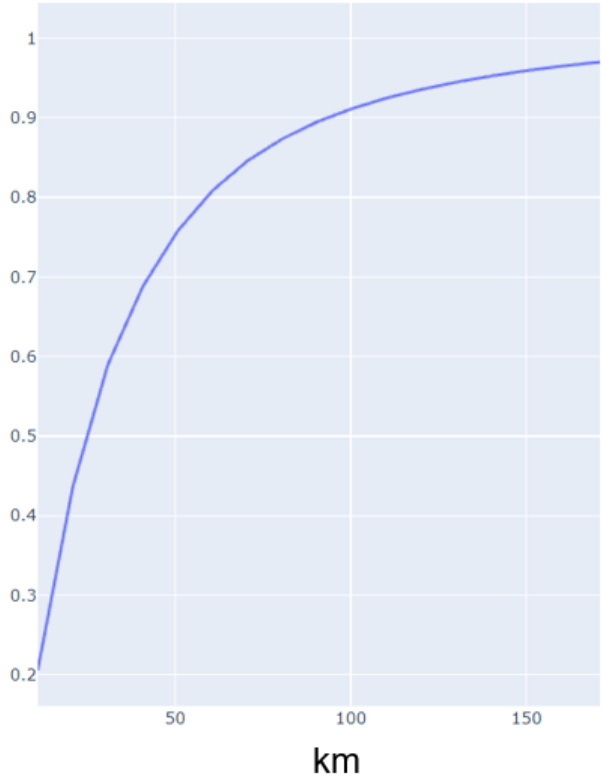
Availability of cars in the mobility car sharing pool in Switzerland

It is not an “auto-mobile” but an “auto-stationary”

- A car is booked on average only 25% of the time over a year.
- 90% of the mobility sessions are trips shorter than 100 km.

Mobility sessions distribution



Source: Mobility AG

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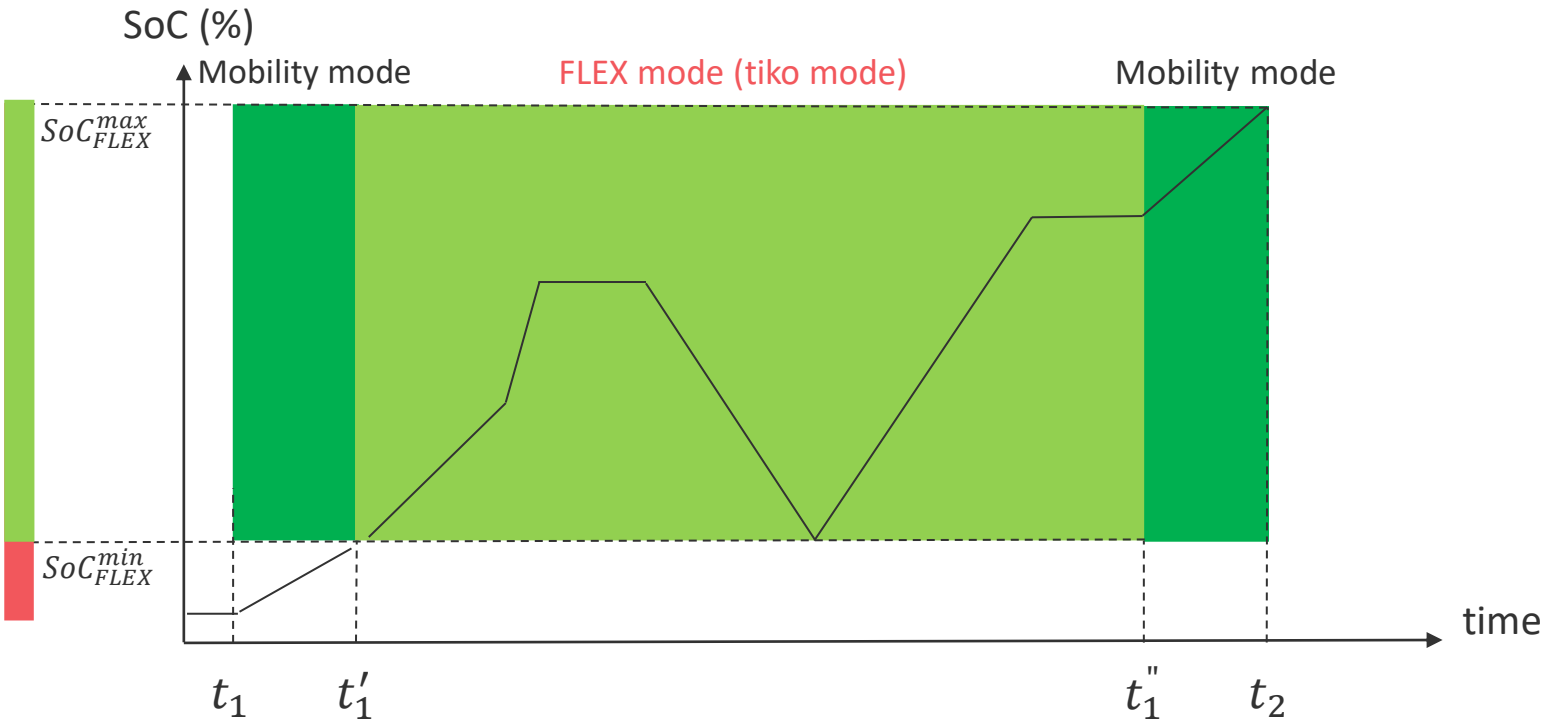
Control strategy

Flexibility is offered only in the FLEX mode



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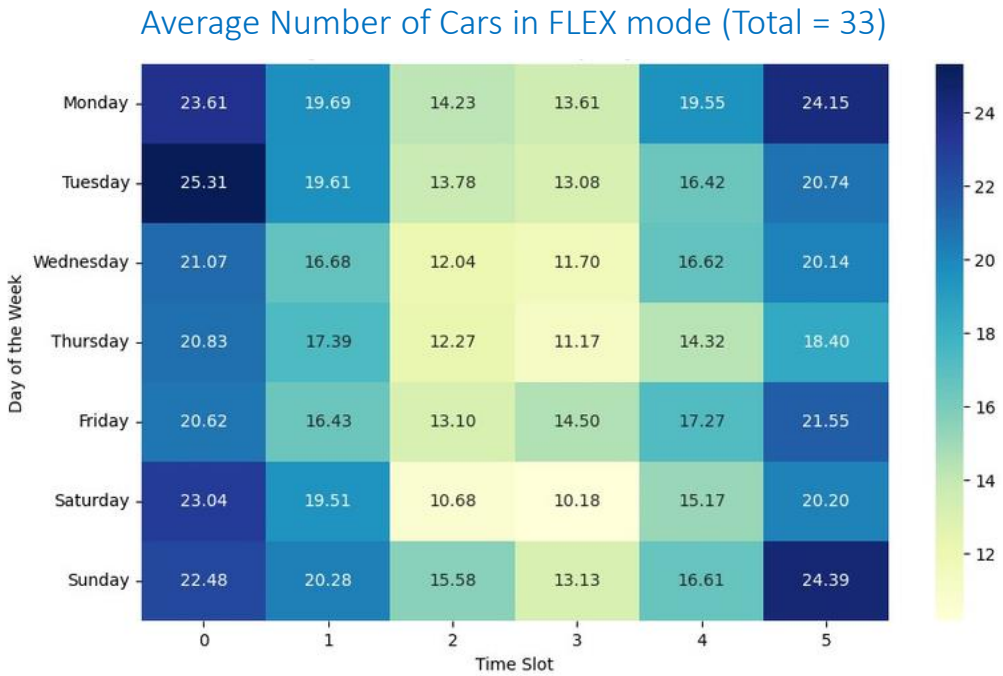
Calculating the available flexibility

Example of the FCR product



- FCR is a 4-hour product
- The bid amount is determined by the 6 four-hour blocks, with more FCR capacity in the blocks 00:00-04:00, 20:00-00:00 and less capacity in the blocks 08:00-12:00, 12:00-16:00.
- For example, with 15 available cars in FLEX mode, we theoretically have flexibility of (15*7) kW symmetrically.

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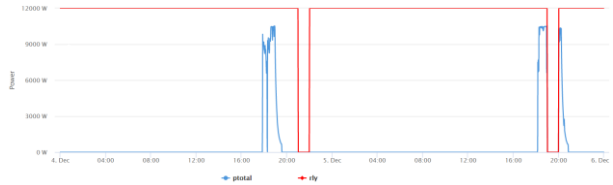
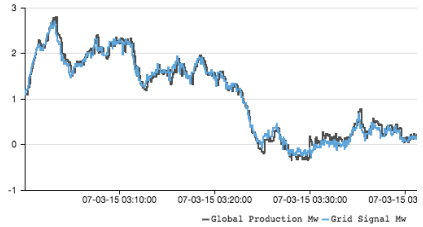
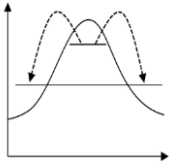
Flexibility: Use cases

Flexibility stakeholders and products

	Intended for	Functionality
Focus today	1 Energy supplier	Day-Ahead optimisation
	2 TSO	FCR /aFRR*
	3 DSO	Shift of consumption peaks







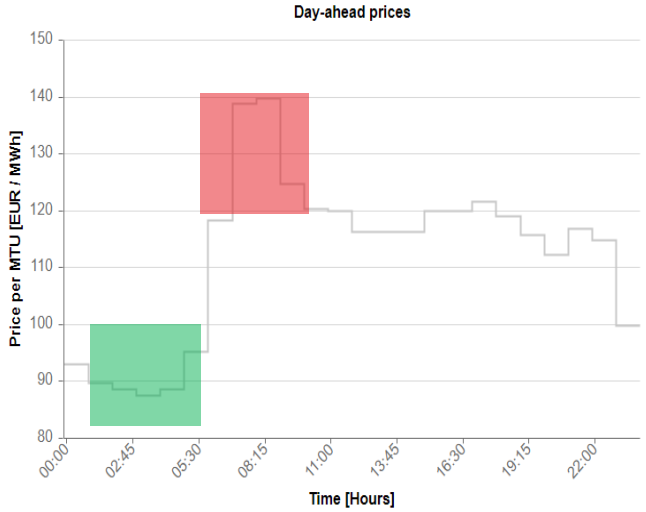
*FCR: Frequency Containment Reserves; aFRR: automatic Frequency Restoration Reserves

Energy supplier use case: Day-ahead optimisation

1

Charging in low price hours / discharging in high price hours

Concept



Day-Ahead optimized operation

Charge during low-price hours

Discharge during high-price hours

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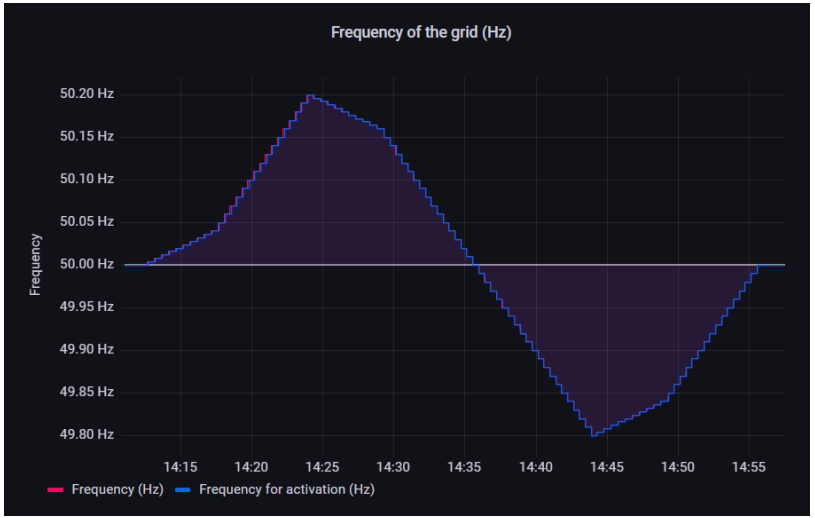
TSO use case: Ancillary services (1/2)

2

Frequency Containment Reserves / automatic Frequency Restoration Reserves

FCR prequalification test



aFRR prequalification test

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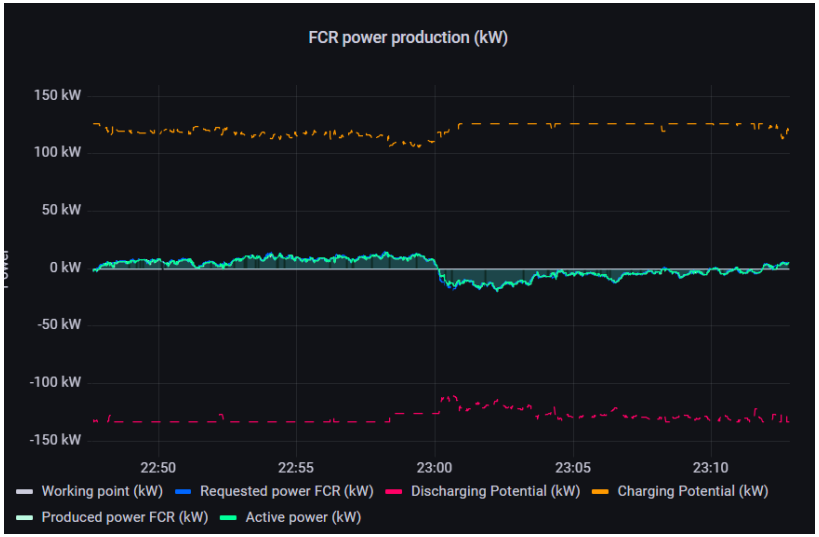
TSO use case: Ancillary services (2/2)

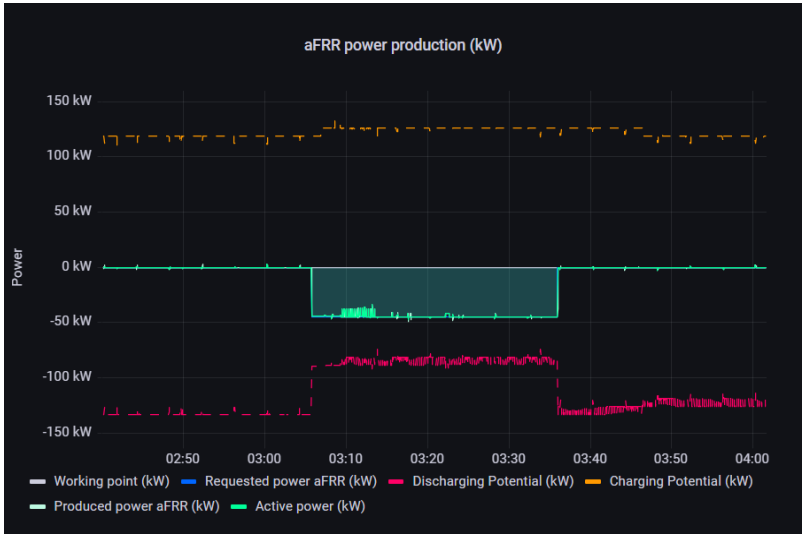
2

Frequency Containment Reserves / automatic Frequency Restoration Reserves

Example FCR operations



Example aFRR operations



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Main learnings with flexibility delivery

Technical feasibility is demonstrated

The project consortium obtained a **world premiere** with the technical prequalification for FCR and aFRR of 50 bidirectional vehicles controlled cloud-cloud in a car sharing service.

\+ The technical feasibility was demonstrated with the tests and operations in the project

\- High cost of V2G infrastructure, low number of V2G vehicles/models available in the market

Open regulatory aspects

tiko | V2X

World Premiere: "V2X Suisse" project successfully demonstrates the fulfillment of the Swissgrid technical prequalification requirements for ancillary services with a distributed fleet of bidirectional charging electric vehicles in a car sharing pool with CCS-Combo2 standard plugs

In June 2023, the **V2X Suisse project** achieved a major milestone, by aggregating the regulation-power of a distributed fleet of bidirectional charging **electric vehicles** (EVs) and successfully fulfilling the ancillary services technical requirements of Swissgrid, the Swiss Transmission System Operator (TSO). The services provided are Frequency Containment Reserves - FCR - (Primary Control Reserves) and automatic Frequency Restoration Reserves - aFRR - (Secondary Control Reserves). These services are used by the TSO to balance the electrical grid since the demand and production are continuously fluctuating. FCR is the first service involved in the **grid stabilization process**, requiring participants to react within 2 seconds of the frequency deviations. aFRR is the second step, which ensures that any power imbalances are corrected. These services help to ensure that the European Grid frequency is kept stable at 50 Hz.

The V2X Suisse project aims to demonstrate the technical feasibility and the economic potential of V2G technology to provide ancillary services through a pool of EVs. It is composed of a fleet of **50 Honda e electric vehicles**, each of which is bidirectional and connected to a direct current charging station. These vehicles are distributed **across 40 different locations**. The V2X Suisse project consists of companies active in the electric mobility field and currently focused on developing and implementing vehicle-to-everything (V2X) technology applied to a car-sharing use case in Switzerland.

In partnership with:

HONDA tiko sun2wheel novatlantis mobility

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Regulatory Aspects

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Regulatory aspects

Switzerland is not a flex heaven (yet)

1. Storage Regulation

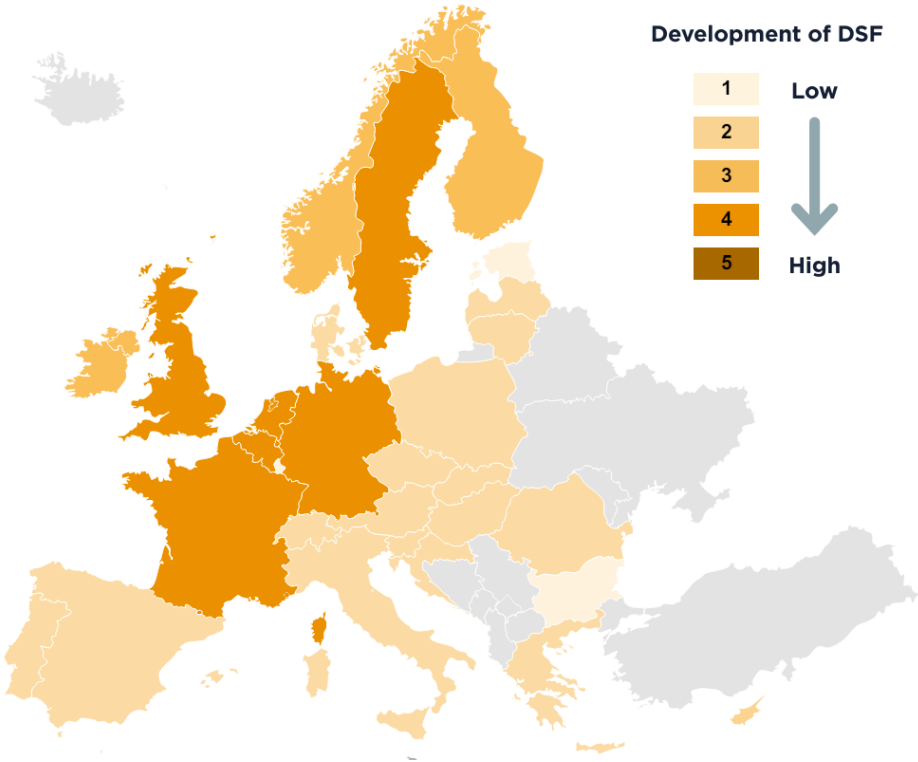
- Equal treatment of all technologies
- No double taxation
- Pragmatic solution for the guarantee of origin

2. Flexibility Regulation

- Transparency in the distribution grid
- Restriction of access rights for grid operators
- Market mechanisms for local flexibility

3. Access to Markets

- Open access to all markets for aggregators
- No discrimination against small suppliers
- Access to the European electricity market



Source: smartEn/LCP Delta Market Monitor for Demand Side Flexibility (2024)

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Double taxation

Exemption for small storage assets

The **exemption** from the network tariffs applies for:

- Pumped storage (as before)
- Pure grid storage
- Storage in small batteries with final consumption and after feeding back electricity into the grid
- P2X with reconversion to the grid
- P2X for pilot and demonstration plants up to max. 200 MW

Reimbursement for storage with final consumption and for P2X projects is only granted **on application**.

(Art. 14 StromVG)

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Source: Swiss Parliament

Questions / Discussion

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www.tiko.energy
www.mobility.ch/en/v2x