HUME

Closing Event

Hubs for Urban Mobility and renewable Energy

14 November 2024 @ Tour & Taxis (Brussels)

AGENTSCHAP INNOVEREN & ONDERNEMEN

Vlaanderen is ondernemen

Agenda

12u00-13u00: Registration & Sandwich Lunch

- ✓ 13u00-13u05: Welcome (VITO / EnergyVille – Carlo Mol – Moderator): For more information on HUME project contact carlo.mol@vito.be
- ✓ 13h05-13h15: HUME within the FLUX50 activities on collective energy solutions and flexibility (FLUX50 –Patrick Devos)
- ✓ 13u15-13u25: HUME measurement sites: challenges/opportunities (VITO - Wim Cardinaels)
- ✓ 13u25-13u35: Charging ahead: Insights into EV driver behaviour and preferences (VITO - Guillermo Borragán)
- ✓ 13u35-13u55: Using smart charging to optimize parking and building energy flows (KULeuven - Klaas Thoelen & VITO - Jef Verbeeck)
- ✓ 13u50-14u10: Looking deeper into the charging hardware: electrical systems and operating efficiencies (KULeuven - Johan Driesen)
- ✓ 14u10-14u40: New insights in service and business models for EV charging (Blink Charging – Thais Lopez & MOVE – Jasmien Vanvooren)

15h00-15h30: Coffee Break

- ✓ 15h30-15h50: HUME integrated architecture (VITO - Dominic Ectors)
- ✓ 15h50-16h30: An overview of the HUME demonstration sites
  - ✓ Tour & Taxis (Brussels) (Nextensa – Tim Van Dorpe)
  - ✓ EnergyVille1 (Genk) (VITO – Dominic Ectors)
  - ✓ Multiobus (Tienen) (Multiobus – Peter Vicca)
- ✓ 16h30-17h00: What is the impact of “EV Fire Safety” aspects on your parking and building (VITO – Carlo Mol)
  - ✓ Practical hands-on experiences will be shared by bus depot owner Multiobus and parking owner Nextensa.
- ✓ 17h00-17h30: Q&A (KULeuven – Prof. Johan Driesen)
  - ✓ Questions can be sent in during the event via a QR-code and will be handled in the Q&A session moderated by Prof. Johan Driesen (KULeuven)
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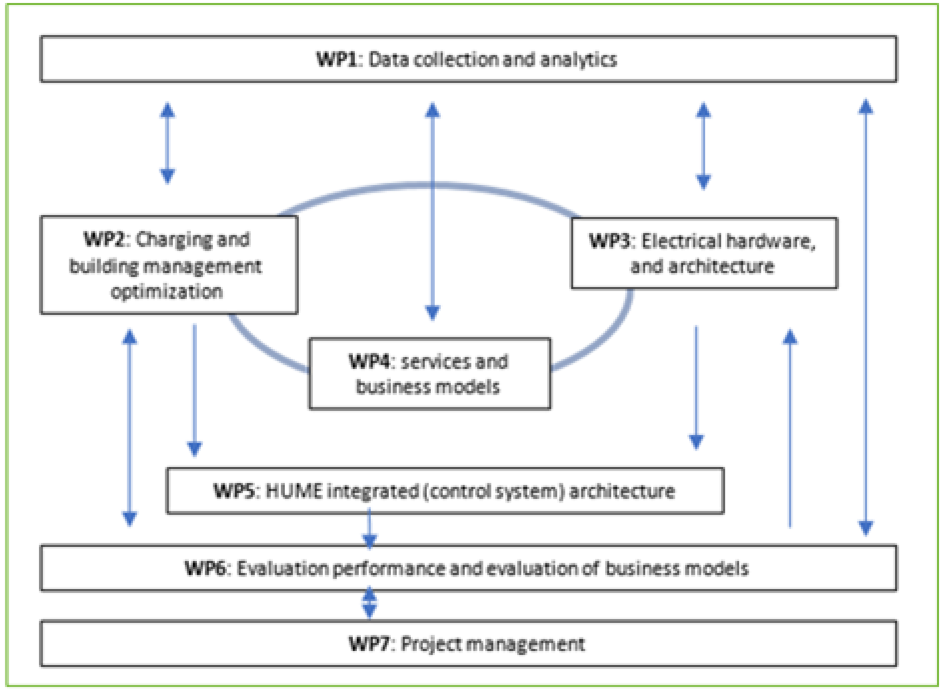
17h30-19h00: Reception & Networking

HUME: Hubs for Urban Mobility and renewable Energy

- *ICON project (Interdisciplinair Coöperatief Onderzoek)*
- *Project duration: 01/09/2021 until 30/11/2024 (39 months)*
- *Project coordinator: Blue Corner (now Blink Charging Belgium)*
- *Project partners & Workpackages:*

AGENTSCHAP INNOVEREN & ONDERNEMEN

Vlaanderen is ondernemen



Q&A Session

Moderator Prof. Johan Driesen – KULeuven / EnergyVille

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Clusters for Growth

HUME Closing Event

HUME within the Flux50 activities on collective energy solutions and flexibility

Patrick Devos

14/11/2024

Flux50 strategy 2030

VLAIO flux50

Clusters for Growth

‘Clean energy’ as driver of economic development

Accelerate the energy transition for Flemish companies.

Climate neutrality with maximum amount of Renewable Energy Sources

Flanders as ‘Smart Energy Region’.

Neutral, strong connecting and accelerating role for Flux50

Impact of cluster organization Flux50

VLAIO flux50
Clusters for Growth

Increasing competitiveness and resilience of companies

Strategic

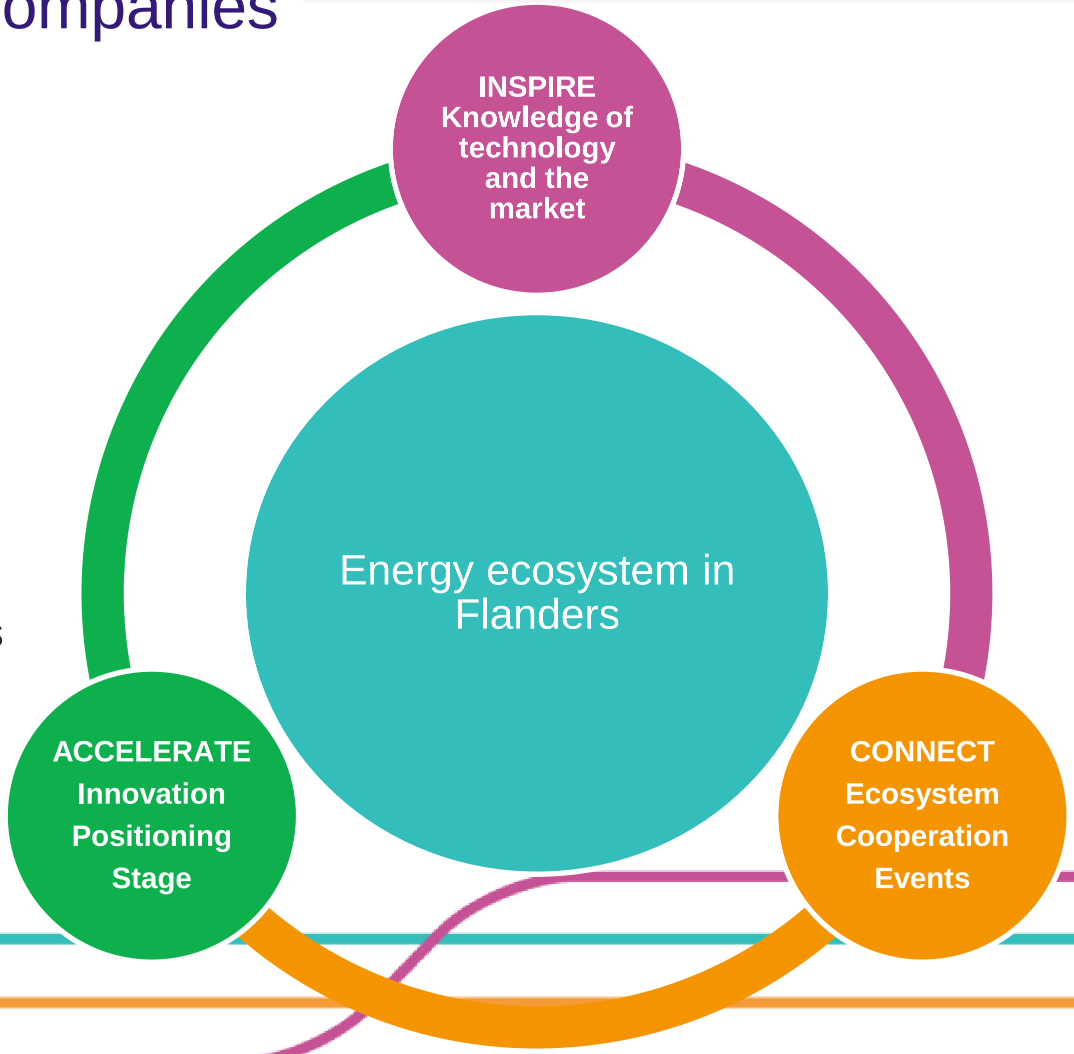
- Promoting competitiveness and economic growth
- Catalyst in the innovation ecosystem, at the interfaces of the quadruple helix
- Serving the public interest

Operational

- Forum for discussion on specific challenges faced by companies
- Connecting various stakeholders, companies, sectors, clusters

Facilitator

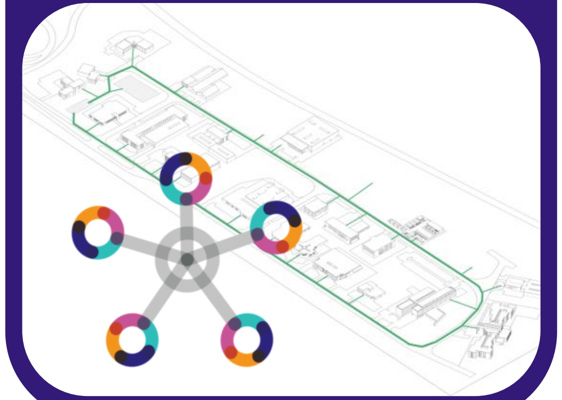
- Promoting knowledge development, knowledge sharing and knowledge retention



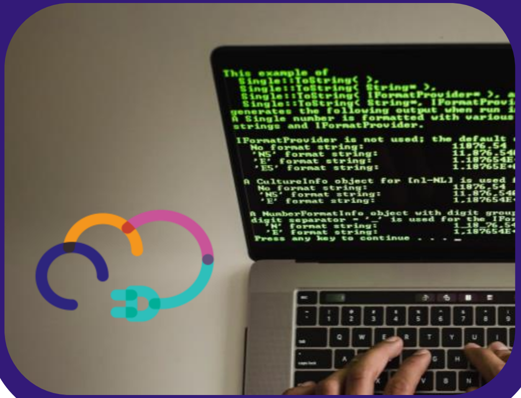
5 INNOVATOR ZONES

Multi-energy solutions at district level

Micro-Grids



Energy Cloud Platforms



Energy Harbors

Intelligent Renovation

Flux50 focus groups

Replicable Renovation

Renovation of buildings for Energy Efficiency.
Installation RES
Collective approach

Energy Communities (EC) Positive Energy Districts (PED)

Maximal local use of local Renewable Energy Sources (RES)
E-mobility
Flexibility by Storage,
Peak shaving and
Price signals/dynamic pricing

Sustainable Thermal Energy

Heatpumps
Thermal networks

Large-scale Energy Storage Security of supply

Large scale Storage (electrical and thermal)
Flexibility
Power to X
Import of molecules

Energy Communities and Positive Energy Districts (EC &PED)

Ambition

Energy communities are a tool for supporting the energy transition. They can contribute to the goals of energy efficiency and renewable energy.

FROM 2022 → **TO 2050**

⬇ Reducing CO_2-emissions on local and regional scale

⬆ Increasing the local use of the most possible renewable energy sources

Energy communities

- >Increase **renewables**
- >Awareness about **sharing energy**
- >**E-mobility**
- >**Flexibility** => decentralised energy system

- >**Energy-efficiency**
- >Thorough renovation (FG Renovation)
- >Increase of **renewables**

Positive Energy Districts

SURPLUS RENEWABLES

- >**E-mobility hub**
- >**Flexibility:** decentralised energy system
- >Contribute to other **sustainable goals**
  Decreasing energy poverty
  Well-being and social cohesion

Flux50 focus groups

Replicable Renovation

Renovation of buildings for Energy Efficiency.
Installation RES
Collective approach

Collective Energy solutions and flexibility

Maximal local use of Renewable Energy Sources (RES)
Collective heating/cooling
Collective E-mobility – Smart Charging
Flexibility by Storage,
Peak shaving and
Price signals/dynamic pricing

Sustainable Thermal Energy

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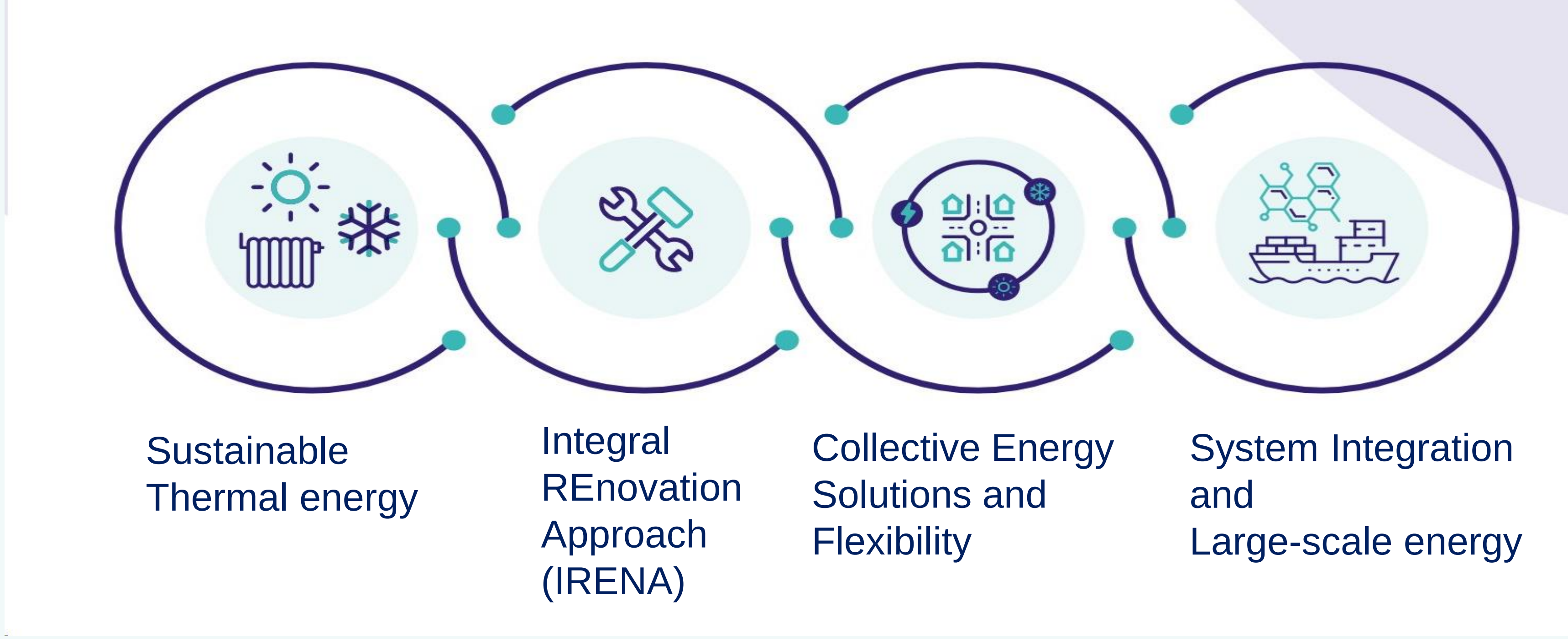
Inspirere – Connect - Accelerate

Innovation becomes a success story: **FOCUS | ROADMAPS | CO-CREATION**



MEMORANDUM 2024: Energy transition, a higher acceleration.

The General Logic:

- first focus on **energy efficiency** and **circularity**
- extensive **electrification** based on **renewable energy sources**
- promoting **renewable and low-carbon fuels**, including **hydrogen**, in sectors that are difficult to electrify or decarbonize.

1. SYSTEM INTEGRATION
   Holistic Energy Transition Atrium – HET Atrium

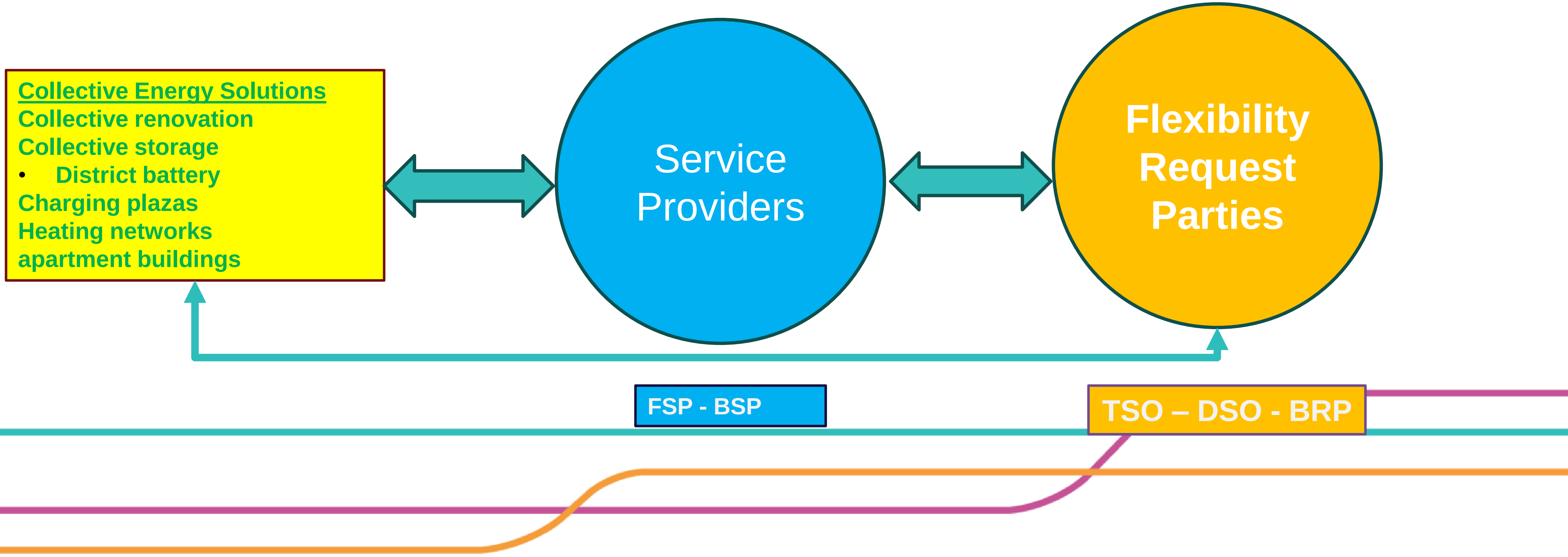
2. RENOVATION
   Towards a large-scale breakthrough of an integrated renovation approach

3. ENERGY COMMUNITIES AND ENERGY POSITIVE DISTRICTS
   Maximum inclusivity with collective and system solutions in energy communities and districts

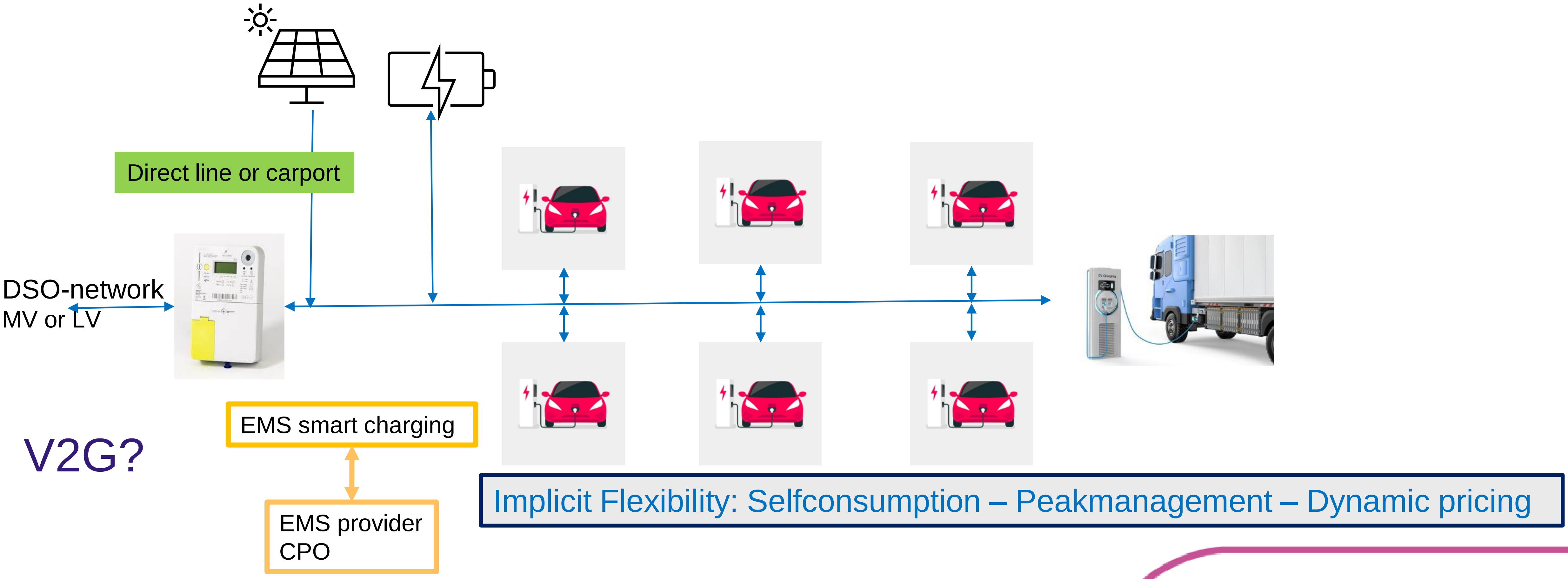
Value Chain for Flexibility (explicit): Collective Energy Solutions

Markets for Retail – Balancing – Congestion – auxiliary services

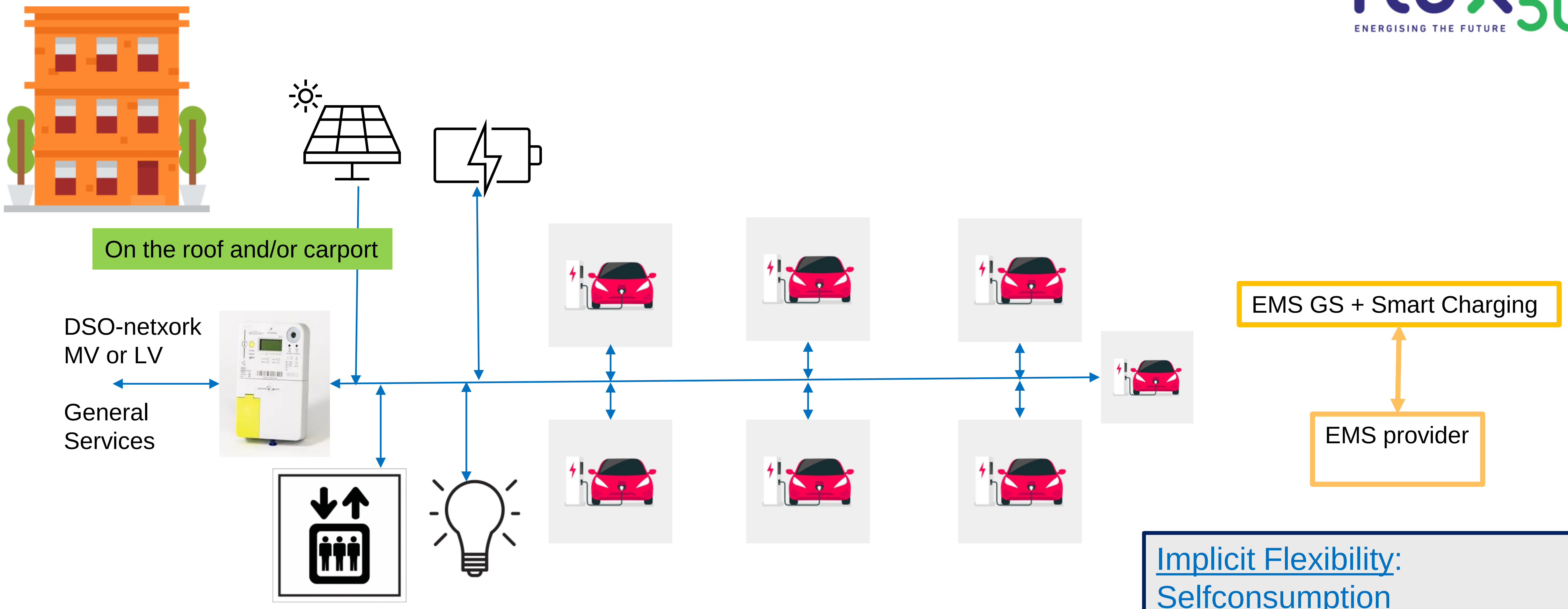
Manufacturers - Installers ICT – consultancy - Platforms



C.E.S. USE CASE Charging Plaza



C.E.S.USE CASE APARTEMENT BUILDING – SMARTCHARGING PLAZA



Implicit Flexibility:
Selfconsumption
Peakmanagement
Dynamic pricing

Flexibility value Chain: MATURITY

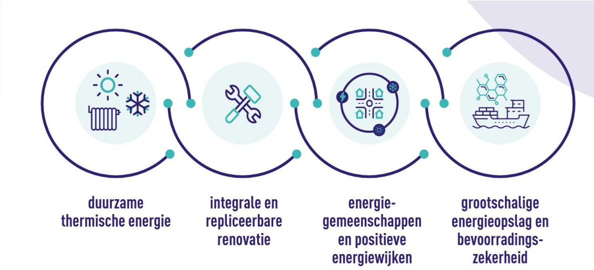
Flex provider

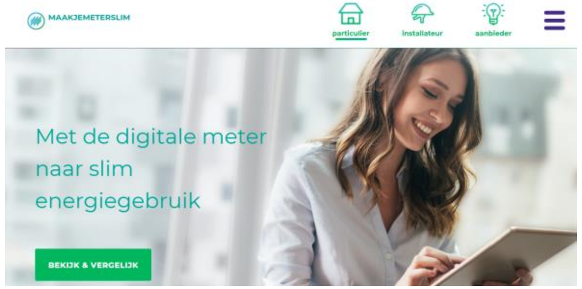
Hardware
IoT
EMS

EMS-
Providers/
operators

Flexibility
Service
Providers
Platforms

FRP
Platforms
TSO-DSO-BRP
Retail
Balancing
Congestion
Aux. Services





Clusters for Growth

Let's stay in touch

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info@flux50.com

ENERGISING THE FUTURE

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WP1 - Measurement Sites Challenges and Opportunities

Wim.Cardinaels@vito.be

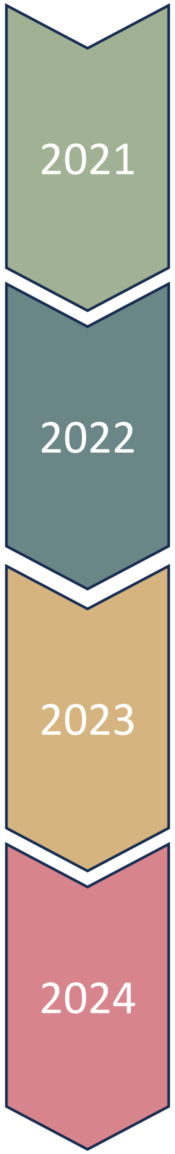
14-11-2024 Hume closing event

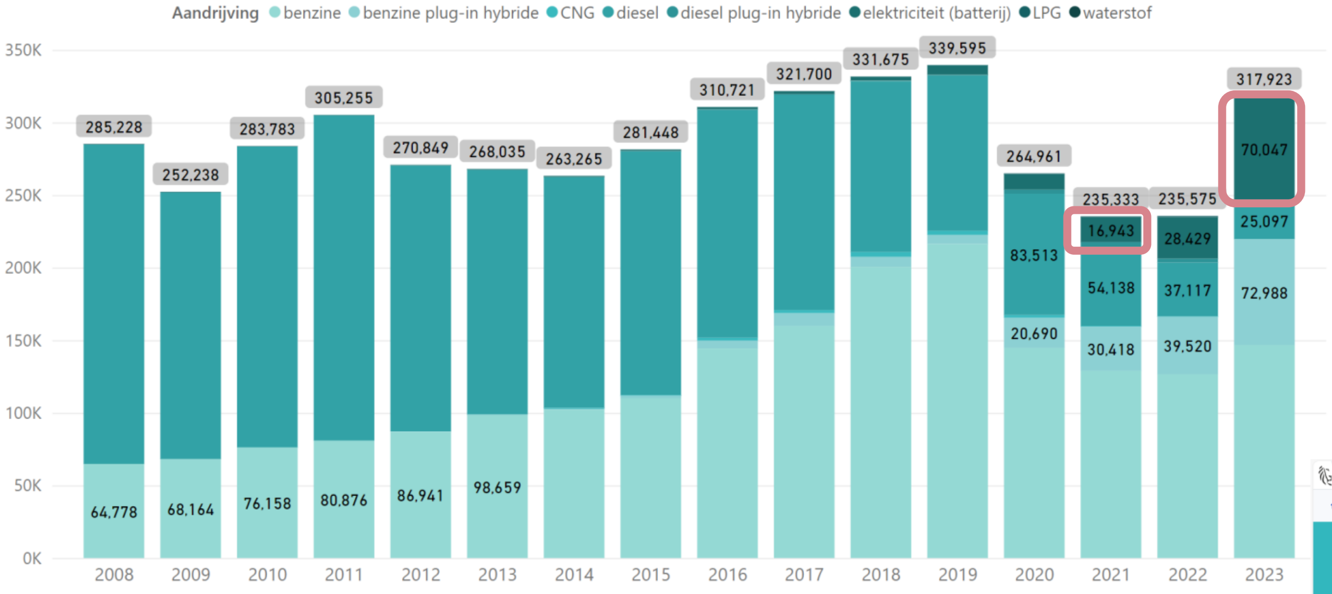
AGENTSCHAP INNOVEREN & ONDERNEMEN

Vlaanderen is ondernemen

Timeframe

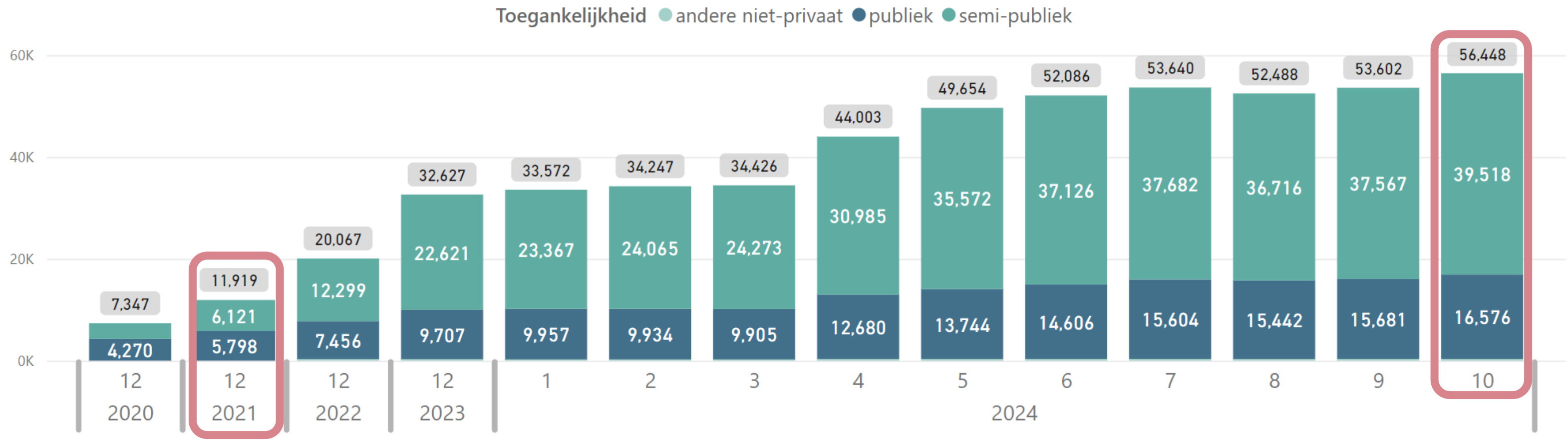
Hume
WP1





Regering vergroent autofiscaliteit vanaf 1 juli 2023

Tegen 2026 zal de autofiscaliteit, weliswaar in verschillende fases, grondig wijzigen. Hoe zit dat dan met de aftrekbaarheid van uw huidige wagen? En waarmee moet u rekening houden indien u zich een nieuwe auto wilt aanschaffen?



Details van de laatst beschikbare periode - Jaar: 2024 Maand: 10

User Needs – Theoretical Calculations

HUME

- Company cars drive on average 28 000km / year (2017)
  - Suppose 3 000km during holidays + 50 weeks of 500km
  - Since COVID increase in home-based work

- Charging mainly at the office => kWh/charging session
  - 12..25 kWh/100km: summer ⇔ winter
  - Charging sessions per week
    - 1*60kWh = 300..400km
    - 2*40kWh = 400..500km
  - Average Power
    - 3,7kW * 8h = 30kWh

days in the office	5	4	3	2	1	
500 km/week	100	125	167	250	500	(km/day)
15kwh /100km	15	19	25	38	75	(kWh/session)
25kWh/100km	25	31	42	63	125	(kWh/session)
300 km/week			100	150	300	(km/day)
15kwh /100km	0	0	15	23	45	(kWh/session)
25kWh/100km	0	0	25	38	75	(kWh/session)

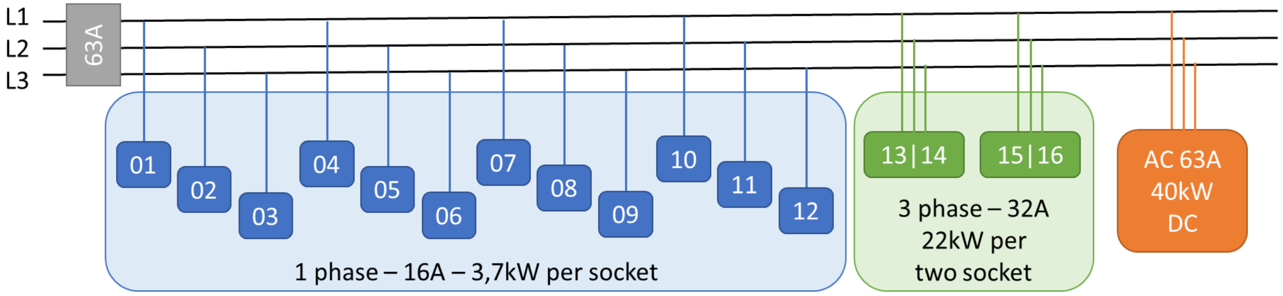
Small Office Challenge

Grid Connection

- Low Voltage Grid Connection: 125A/400V = 85kVA
- 50% for computer, network, light, coffee, HVAC (gas boiler), …
- 63A for charging equipment!
  - How many cars and charging stations can be served?

Challenges

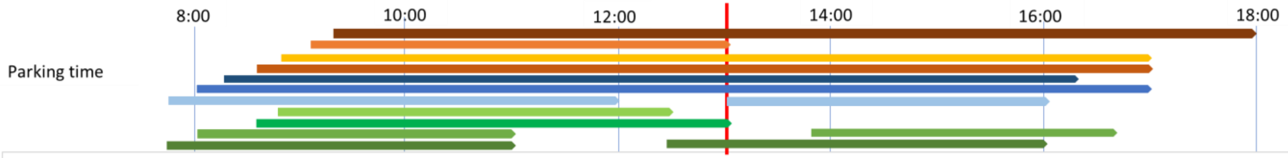
- 1 phase ⇔ 3 phase?
- PV reliable?
- Battery?

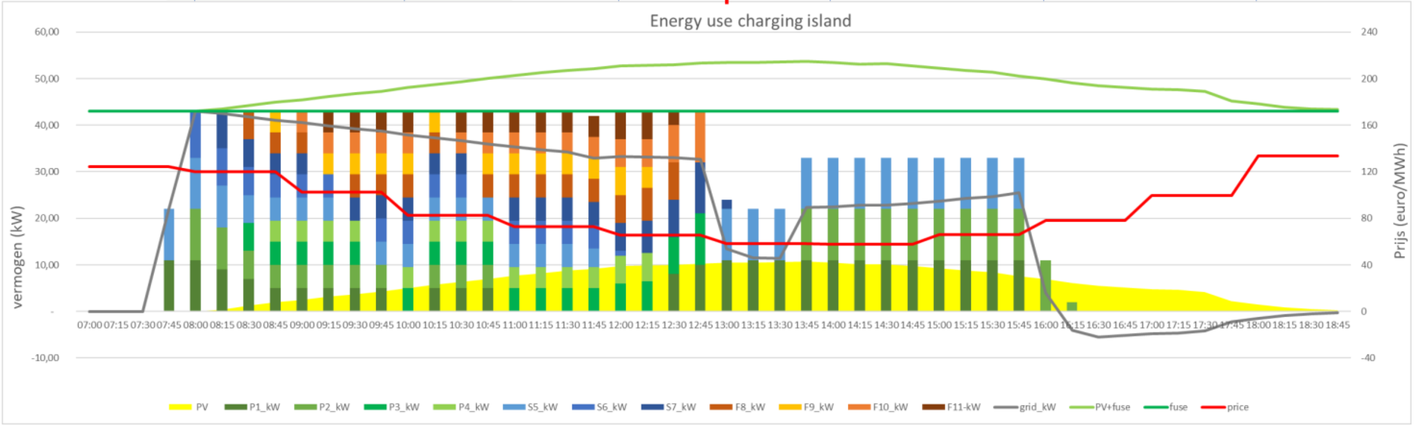


Smart Charging ⇔ Load Balancing

Load Balancing (embedded)

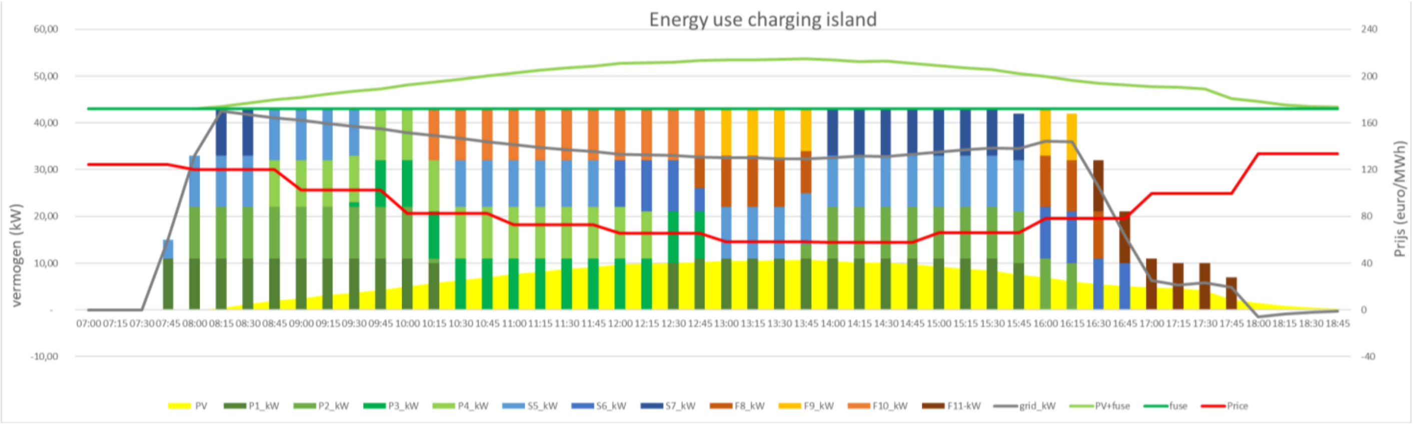
- Divide available power
- No idea of user needs
  - Departure time
  - Energy need
  - 20% less energy supply
    20% less turnover
    some customers not satisfied





Smart Charging

- Respect user constraints
- Minimize energy cost



Measurement Sites - Input

Input for scenarios, data, analytics

- Constraints
- Users
- Opportunities
- Optimization objectives

Diverse context

Office	Retail	City	Mixed

Measurement Sites - Overview

	Operational hours	Flexibility potential	Grid constraints kVA / parking spaces	Locations
Office	Work days 8:00 – 18:00	Average parking time > 8 hours	40/10=4 => 32kWh 400/100=4 => 32kWh 300/300=1 => 8kWh	• Thor Park, Genk • EnergyVille, Genk • Motstraat, Mechelen • Octa+, Vilvoorde
Retail	All days (Sunday?) 9:00 – 19:00	Average parking time	Multiple grid connections 250+6*170+110 280 parking spaces = +/- 5	• Brixton, Zaventem
City	All days Day & Night	From several hours till several days	630/123=5	• Moorkensplein, Antwerpen
Mixed	All days Day & Night	Several hours	250/650=0,4 !	• Tour & Taxis Brussel • Multiobus Tienen

Analytics 2021/2022

Charged Energy ifo Parking Time and Average Power

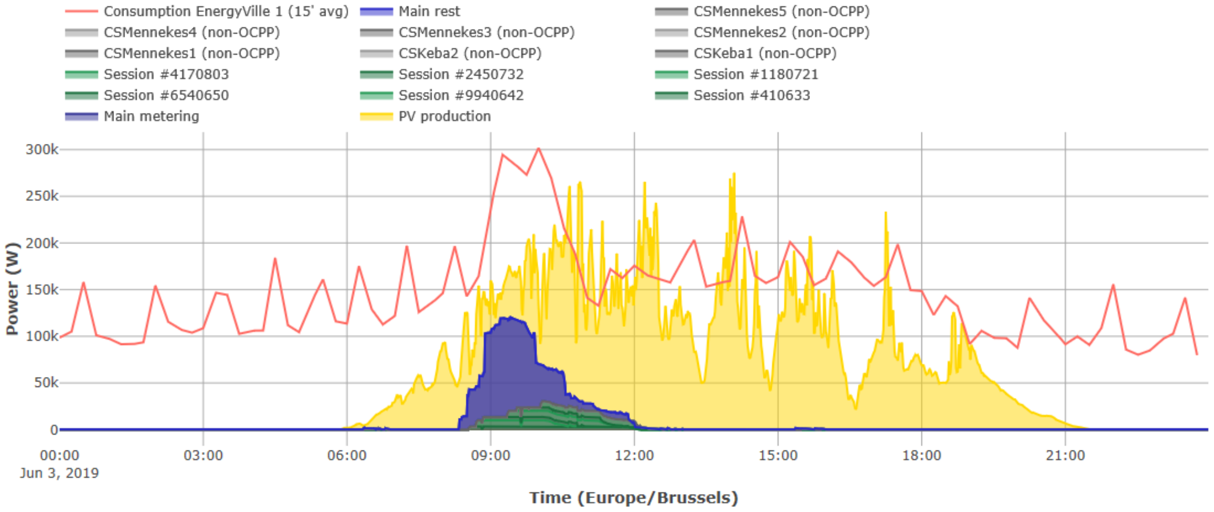
parking time	average power	kWh supplied																					
Sum of Energie (kWh)	Column Labels																						
Row Labels	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	Grand Total
0-2	0	0		12	5		18	30		13	36	37	7		26		114	130	101	145	599	87	1.360
2-4	0		22	42	13		54		76	61	119	202	243	308	277	171	231	143	173	128	41		2.305
4-6	0	5	48	43	24	59	243	188	179	278	95	51											1.214
6-8	0	336	25	76	170	244	47	94															991
8-10	14	287	24	138	210	144	54																870
10-12	20	26	75	32	240	65																	457
12-14	4	151	290	675	170																		1.290
14-16	33	169	282	156																			641
16-18	43	98	501	114																			756
18-20	26	184	402																				612
20-22	9	144																					153
22-24	48	77																					125
24-26	6	186																					191
26-28		80																					80
28-30		106																					106
30-32	0																						0
32-34	15																						15
36-38	19	154																					173
38-40		45																					45
40-42	25																						25
44-46	18																						18
46-48	23																						23
48-50	24																						24
62-64	93																						93
66-68	9																						9
70-72	26																						26
72-74	45																						45
76-78	8																						8
90-92	0																						0
94-96	19																						19
98-100	51																						51
152-154	0																						0
Grand Total	576	2.048	1.669	1.288	833	512	416	312	255	353	250	290	250	308	303	171	346	273	274	273	640	87	11.726

Analytics 2021/2022

Daily power consumption overview

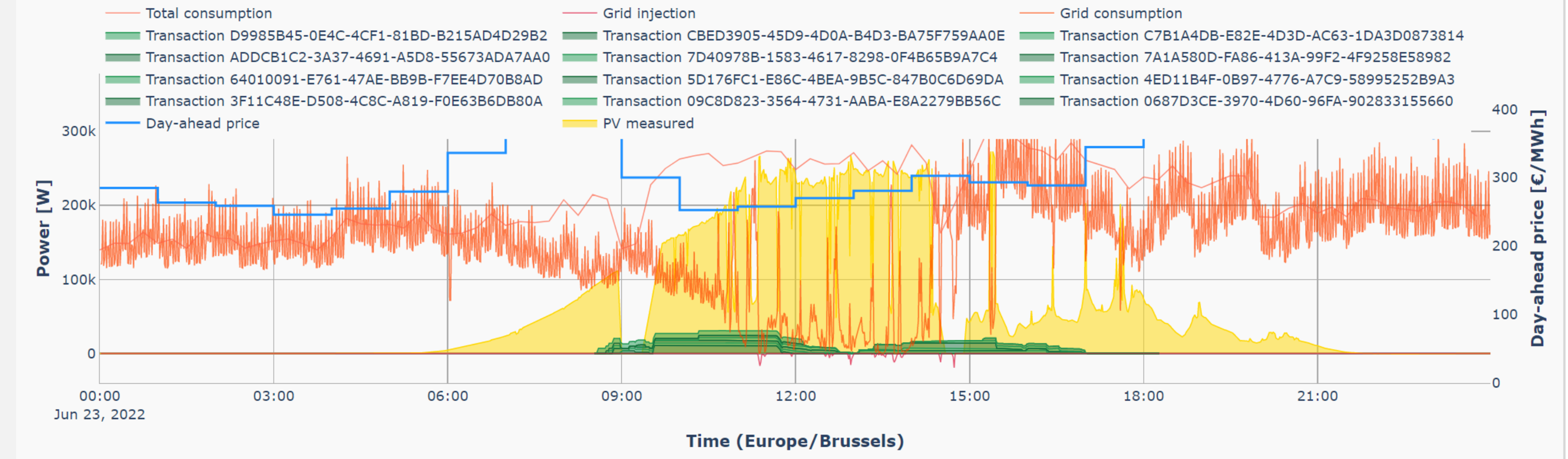
Note: The graph below presents a lot of data and takes about 30 seconds to load.

Select date: 2019-06-03



Before

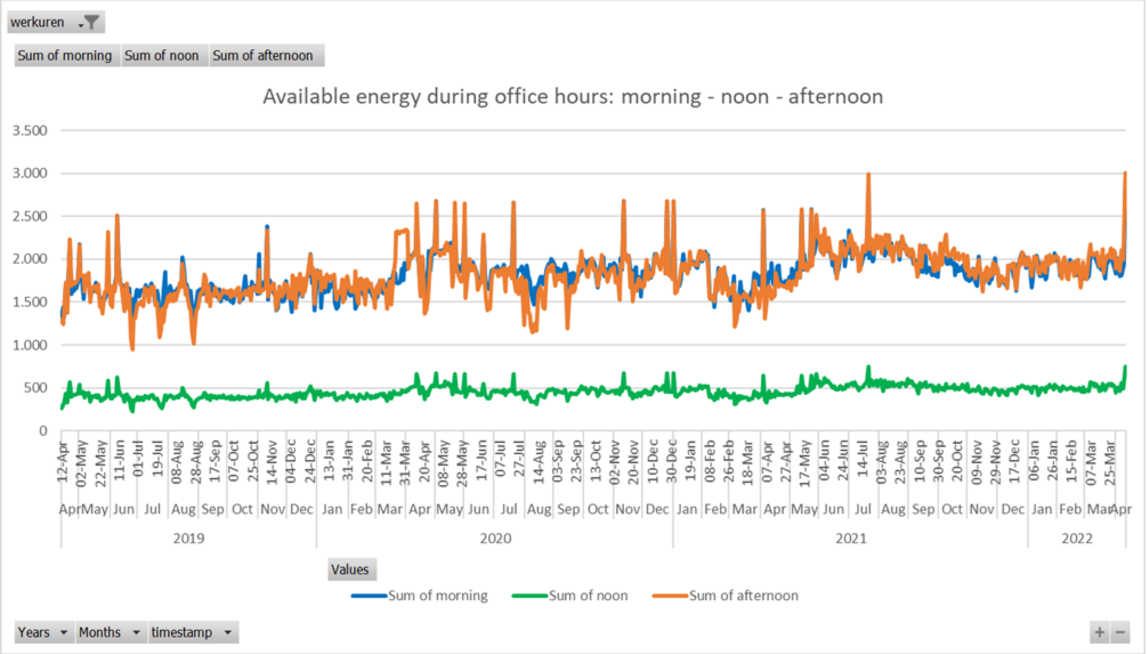
After



Analytics 2021/2022

Peak Power Profile → Energy Available for Charging

Impact of HVAC cooling systems on power profile



1000 kWh

- 50 cars 20kWh
- 30 cars 33kWh
- 20 cars 50kWh

More details will follow in the upcoming presentations

Charging ahead: Inzichten in het gedrag en de voorkeuren van EV-bestuurders
(VITO - Guillermo Borragán)

Nieuwe inzichten in service- en bedrijfsmodellen voor EV-laden
(Blink Charging – Thais Lopez & MOVE – Jasmien Vanvooren)

Tour & Taxis (Brussel)
(Nextensa – Tim Van Dorpe)

EnergyVille1 (Genk)
(VITO – Dominic Ectors)

Multiobus (Tienen)
(Multiobus – Peter Vicca)

Thank you

Wim Cardinaels, VITO/EnergyVille

AGENTSCHAP INNOVEREN & ONDERNEMEN

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Q&A Session

Moderator Prof. Johan Driesen – KULeuven / EnergyVille

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Charging ahead: Insights into EV driver behaviour and preferences

14 November 2024

Guillermo Borragán, VITO/EnergyVille (POLARIS)

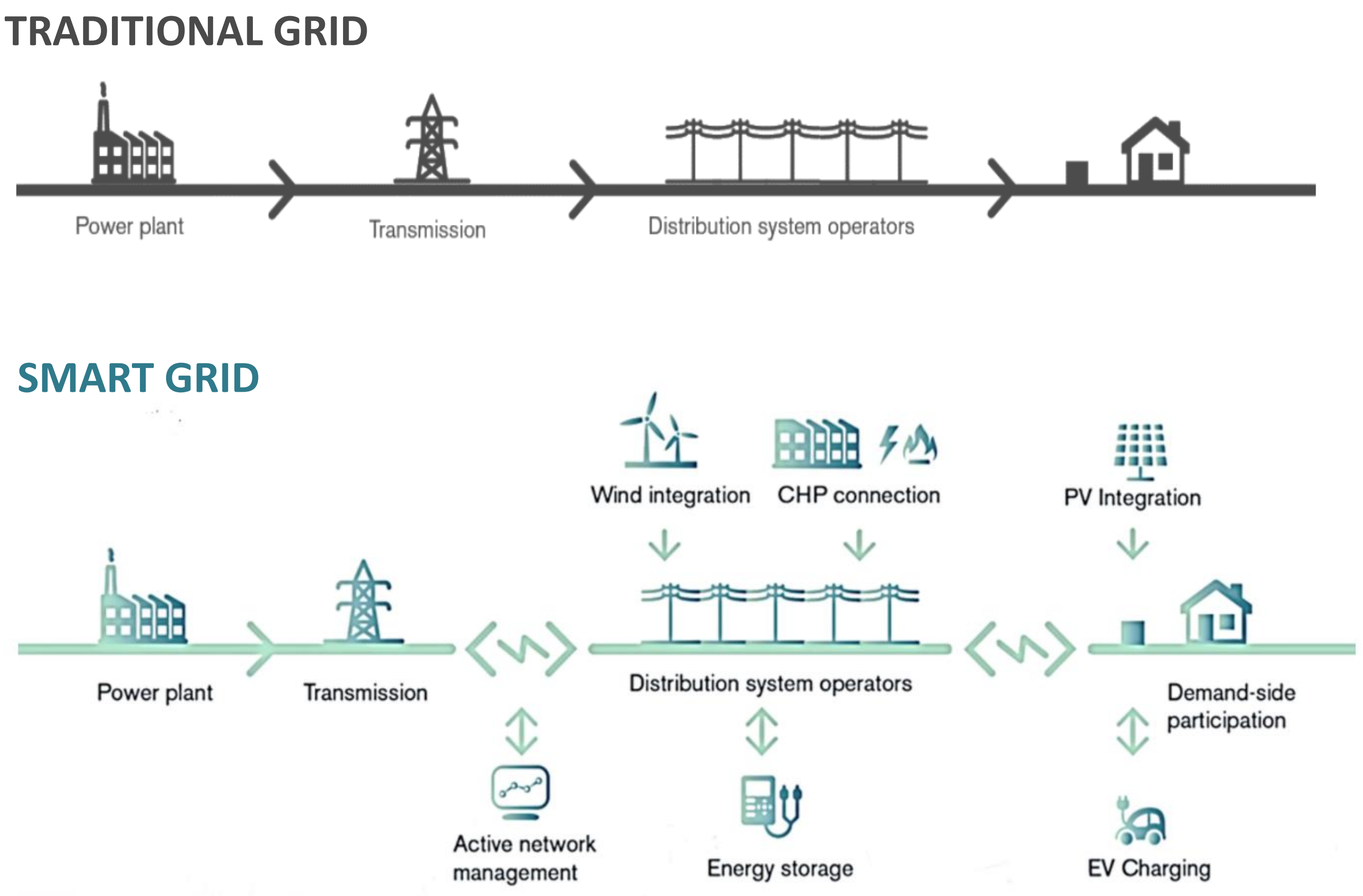
AGENTSCHAP INNOVEREN & ONDERNEMEN

Vlaanderen is ondernemen

WHAT DOES THIS PICTURE MAKE YOU THINK OF?

HUME

FROM CENTRALISED TO DECENTRALISED GRIDS



Generation structure	Planning and operation	Investment costs
Centralized	Flexible supply	Mainly marginal
↕	↕	↕
Decentralized	Flexible demand	Mainly capital

Source: Adapted from UserTCP webinar

XHUME

EV DEPLOYMENT COMES WITH CHALLENGES

HUME

RESEARCH OBJECTIVES

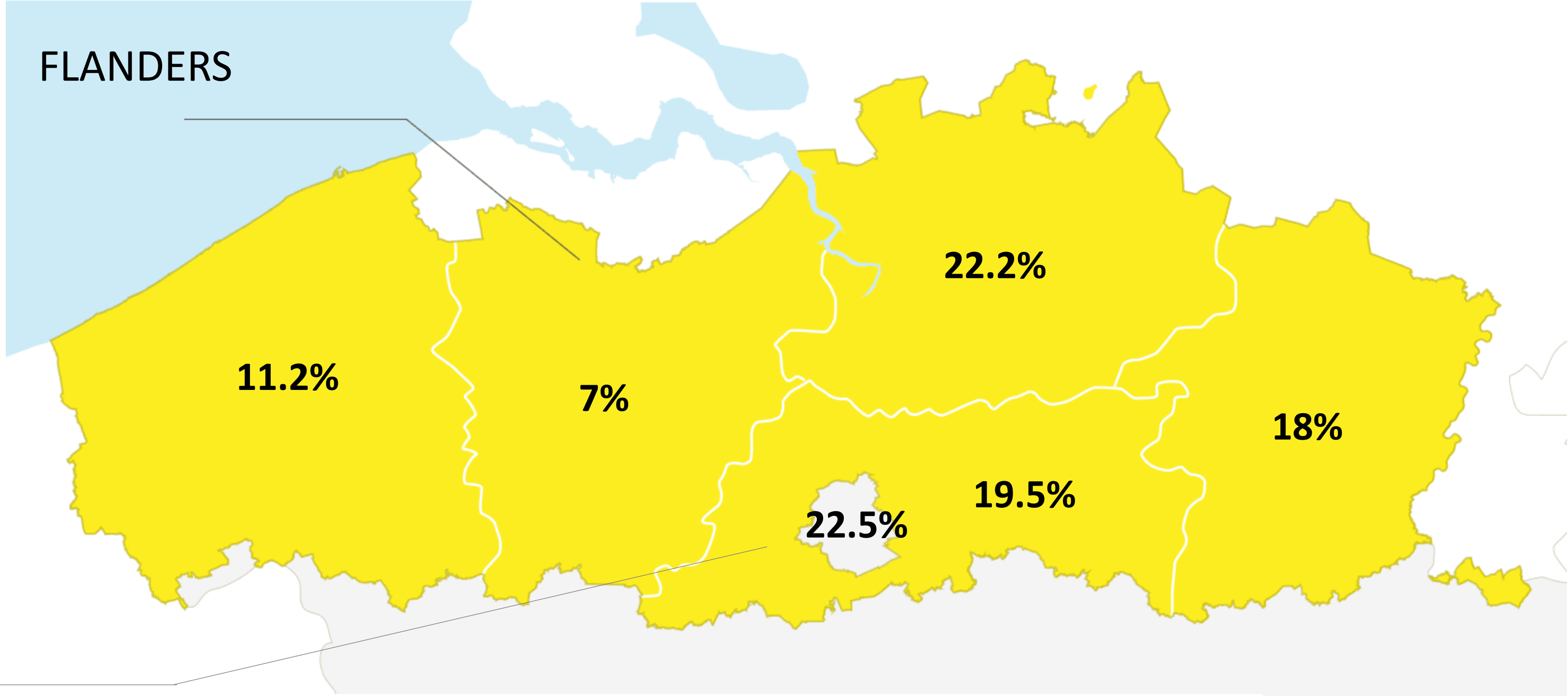
- New policies and grid models will accelerate the sales of electric vehicles in the next years
- Proving sufficient collective parking and charging infrastructure will become a challenge
- This is especially important for urban areas and charging at workplace

MAIN OBJECTIVES OF THE USER SURVEY

1) EV driver rationale in Belgium
2) Determine parking and charging preferences
3) Importance of boundary conditions: Barriers & Drivers
4) Facilitate the integration of renewables in the charging
5) Bring in information to define future BM: Identify user-profiles
6) Adoption predictive model

DEMOGRAPHICS (n = 450)

HUME



Gender

Male	64.5%
Female	34.75%
Other	0.75%

Age

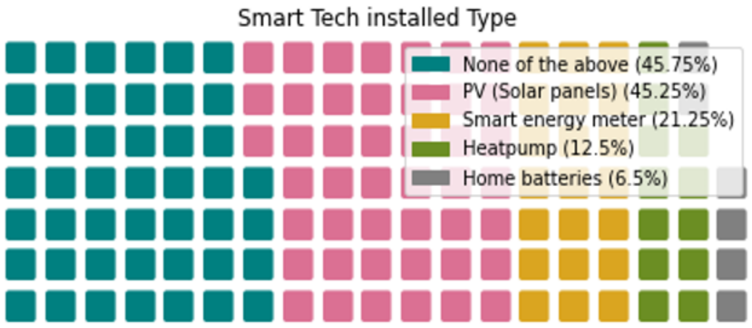
18-34	30%
35-59	65%
60 and above	5%

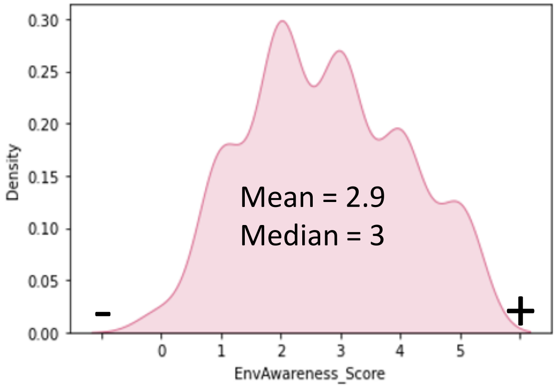
Educ

High	63.5%
Medium	22.2%
Low	14.2%

Income

< 1.200€	4%
Between 1.201 and 1800€	6.2%
Between 1.801 and 2.500€	24.5%
Between 2.501 and 3.500€	32.2%
Between 3.501 and 4.500€	16.5%
> 4501€	14.7%





Vehic

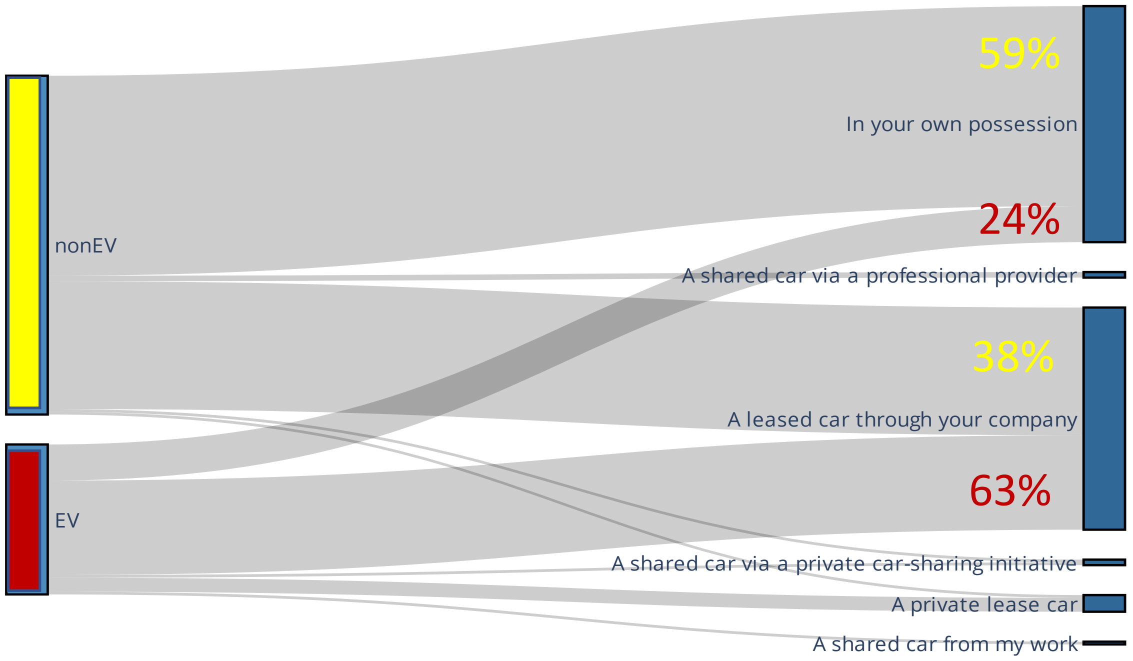
Internal Combustion Engine vehicle (ICEV)	43.7%
Electric Vehicle (EV)	39%
- Battery electric vehicle (BEV)	28.5%
- Plug-in-hybrid electric vehicle (PHEV)	10.5%
None	17%

HUME

DESCRIPTIVES: Car usage and ownership

What are respondents using their car for?

Car ownership origin in Flanders split by car typology

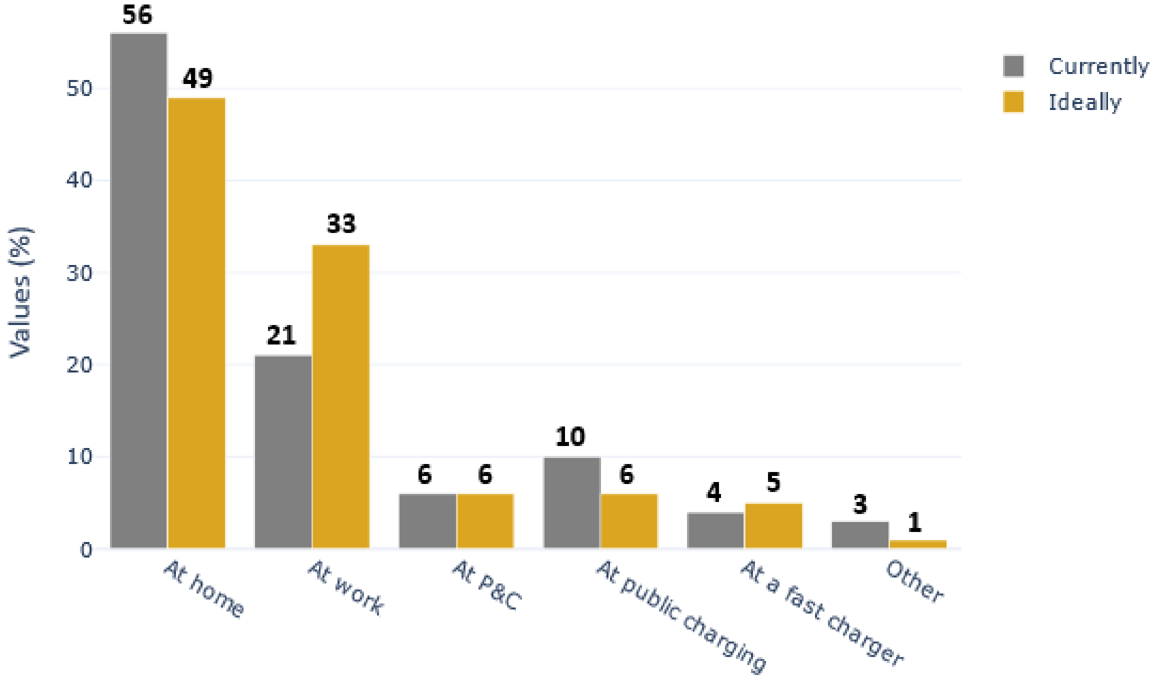


1 Employer as a key facilitator for EV adoption

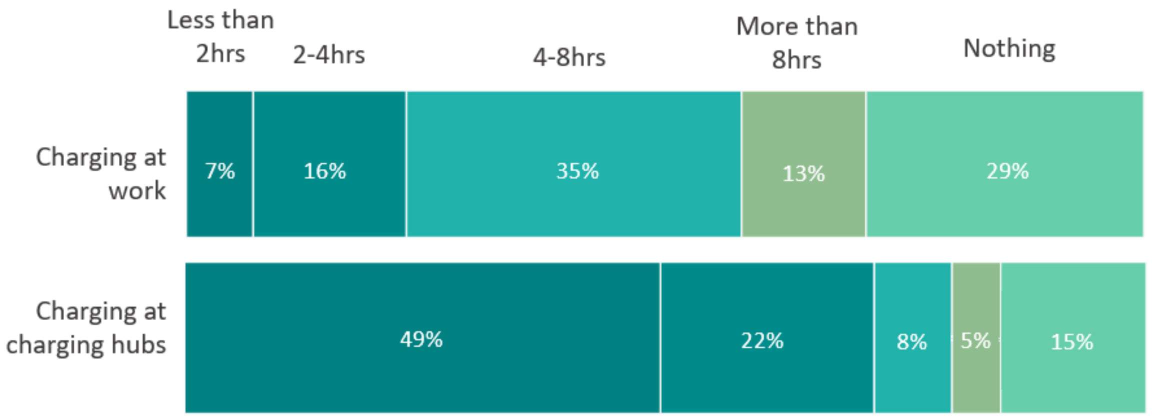
HUME

DESCRIPTIVES: Charging and parking preferences

Current vs. ideal charging location



Charging sessions duration at work and at charging hubs for EV drivers



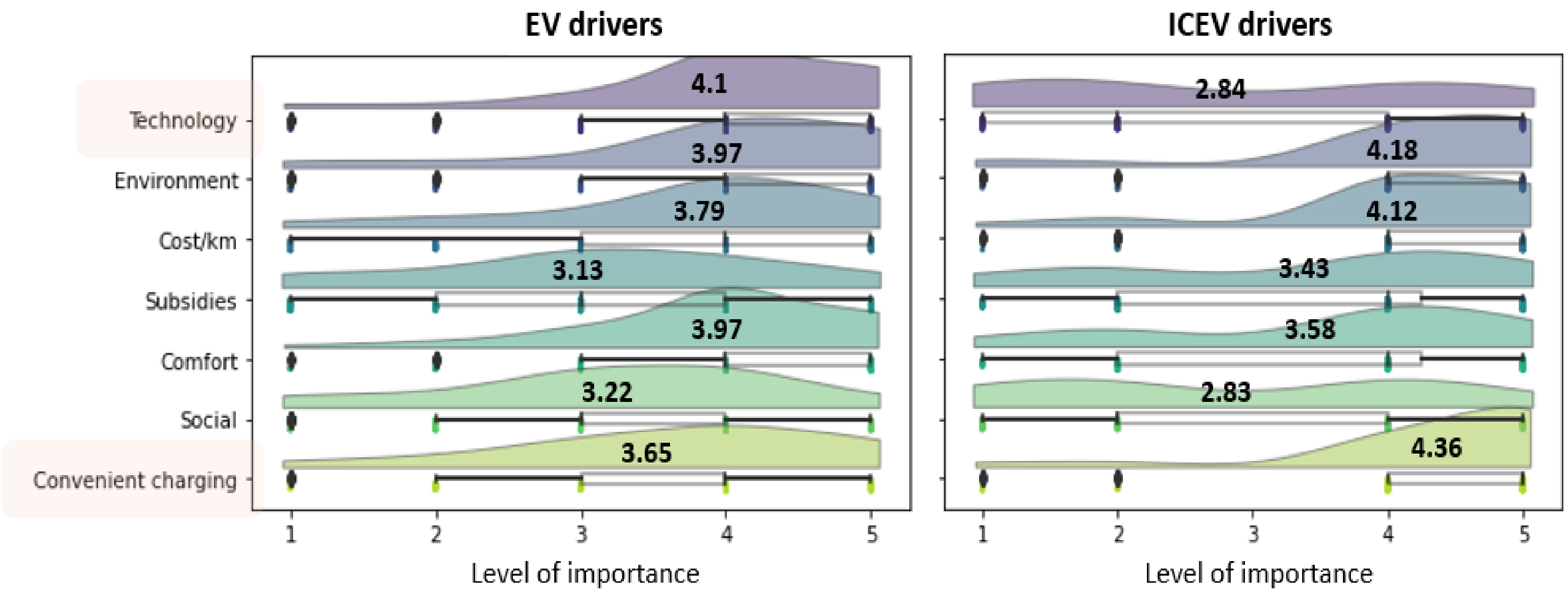
Word cloud illustrating the issues reported by the respondents

2 Charging at work is desired

HUME

DESCRIPTIVES: Boundary conditions for EV charging by car typology

3a Drivers

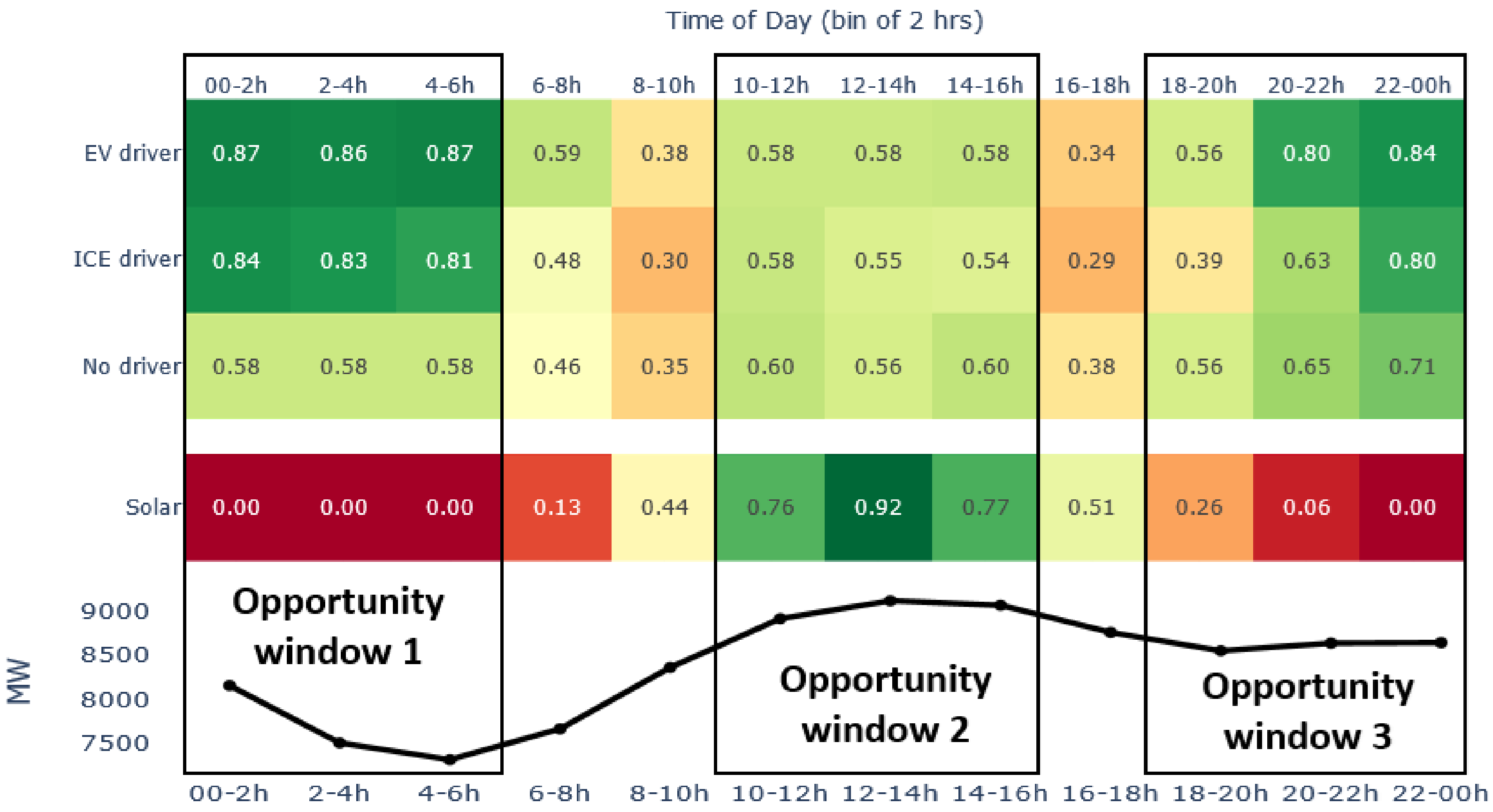


3b Experienced Barriers not to adopt EV (only for ICEV drivers)

- Absence of charging points
- High price
- Lack of interest
- Difficulty to find a parking spot
- Lack of electric car sharing services
- Ownership of an ICEV

HUME

DESCRIPTIVES: Charging convenience and potential for PV integration



4 Focus on EV charging at work

MODEL: Profiling by charging preferences behavior

K-prototypes - dissimilarity coefficient

$$d(x_i, q_l) = y \sum_{s=1}^{p} \partial(x_{i,s}^{C} - q_{l,s}^{C}) + \sum_{s=p+1}^{m} \sqrt{(x_{i,s}^{N} - q_{l,s}^{N})^2},$$

$$\text{where } \partial(X_{i,s}, q_{l,s}) = \begin{cases} 0, X_{i,s} = q_{l,s} \\ 1, X_{i,s} \neq q_{l,s} \end{cases}$$

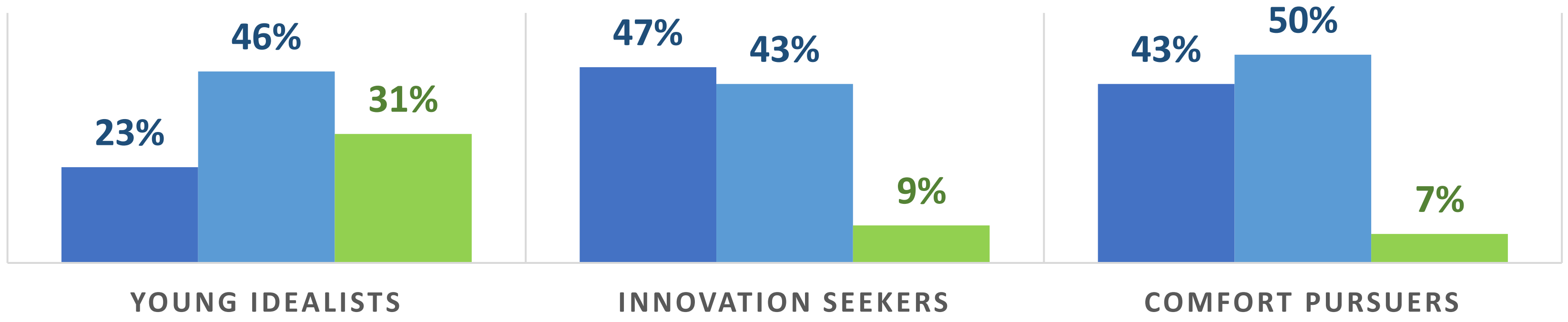
Source: Jia and Song, 2020

HUME

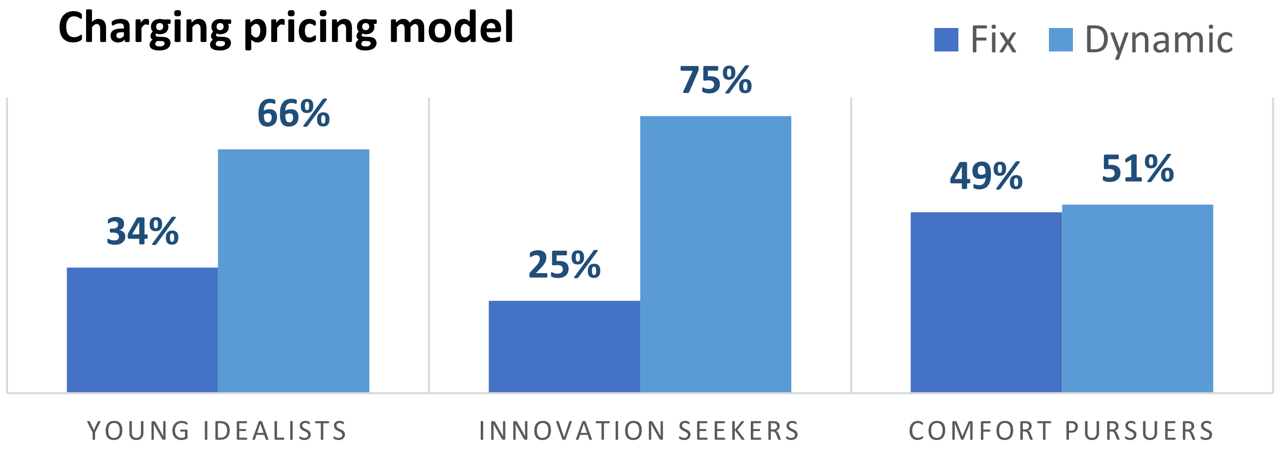
MODEL: Charging preferences by group

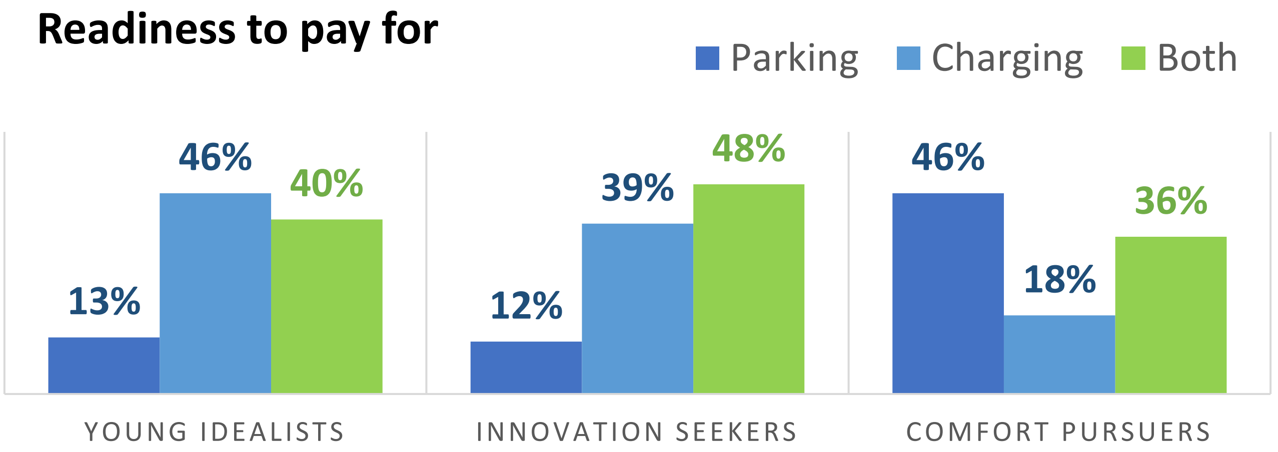
Demographics	**Profile 1: Young idealists**  Sensitive to climate issues and familiar with technology. Idealist, critical spirit	**Profile 2: Innovation seekers**  Straddling between Millennials and GenX. Pragmatic and conformists	**Profile 3: Comfort pursuers**  Wary of quick technological advancements, comfort seekers
Respondents (n)	96	99	118
Age (median)	36,5	43	44
Gender (% of men)	49%	68%	70%
Education (% high)	79%	63%	56%
Income (% >2500€)	58%	68%	65%
Housing type (% house)	54%	80%	71%
Living area (% city)	65%	51%	49%

Car type:



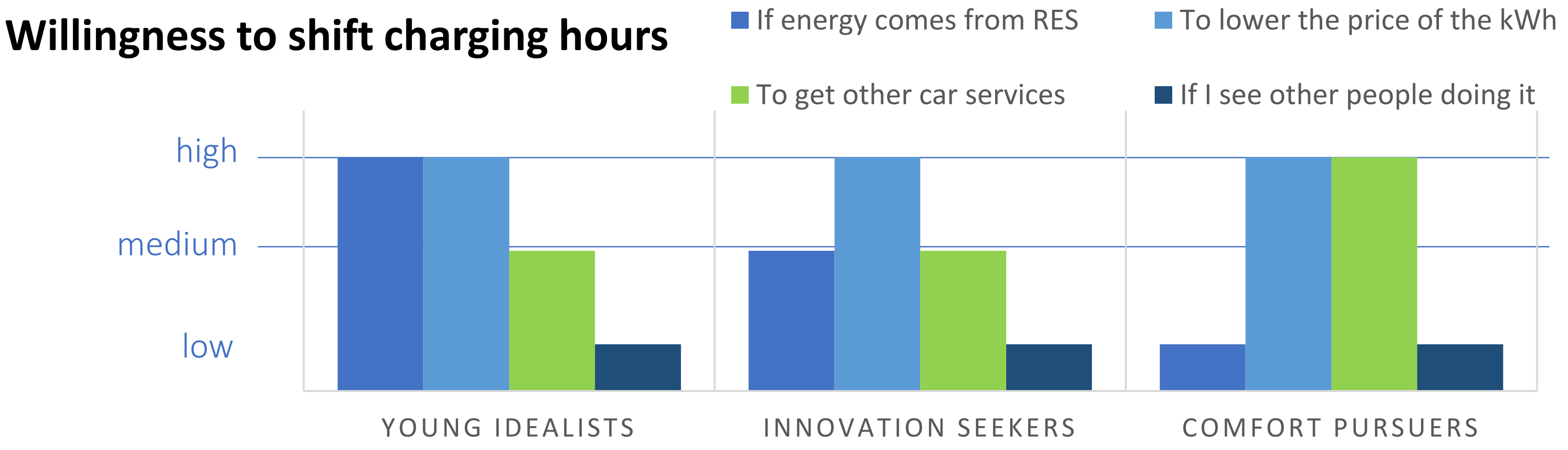
MODEL: Charge price and time flexibility

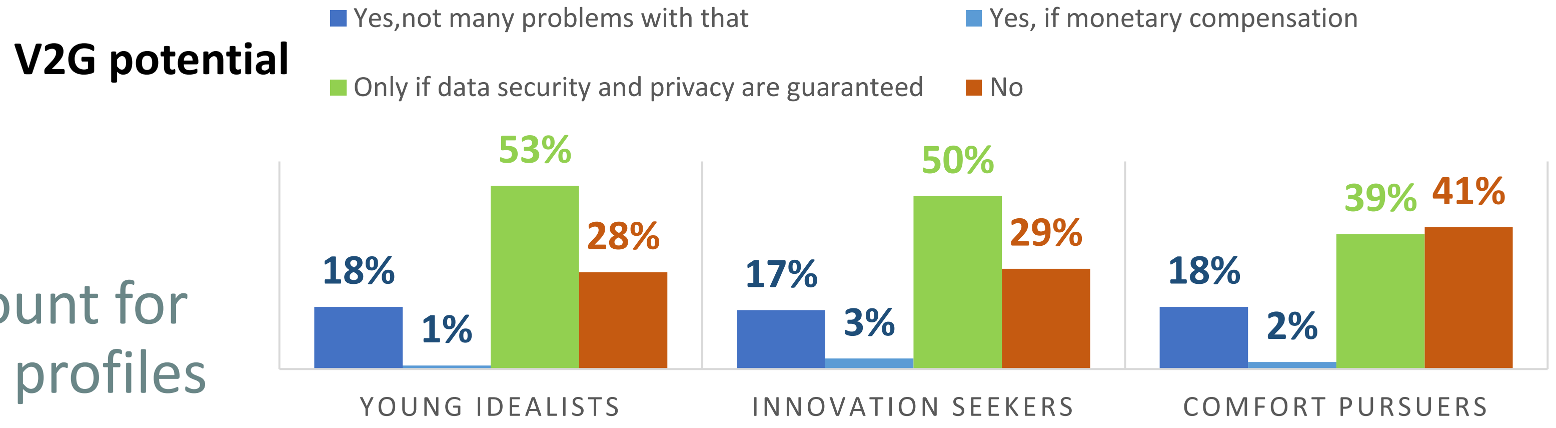




HUME

MODEL: Willingness to shift charging and V2G potential





5 Need to account for the different profiles

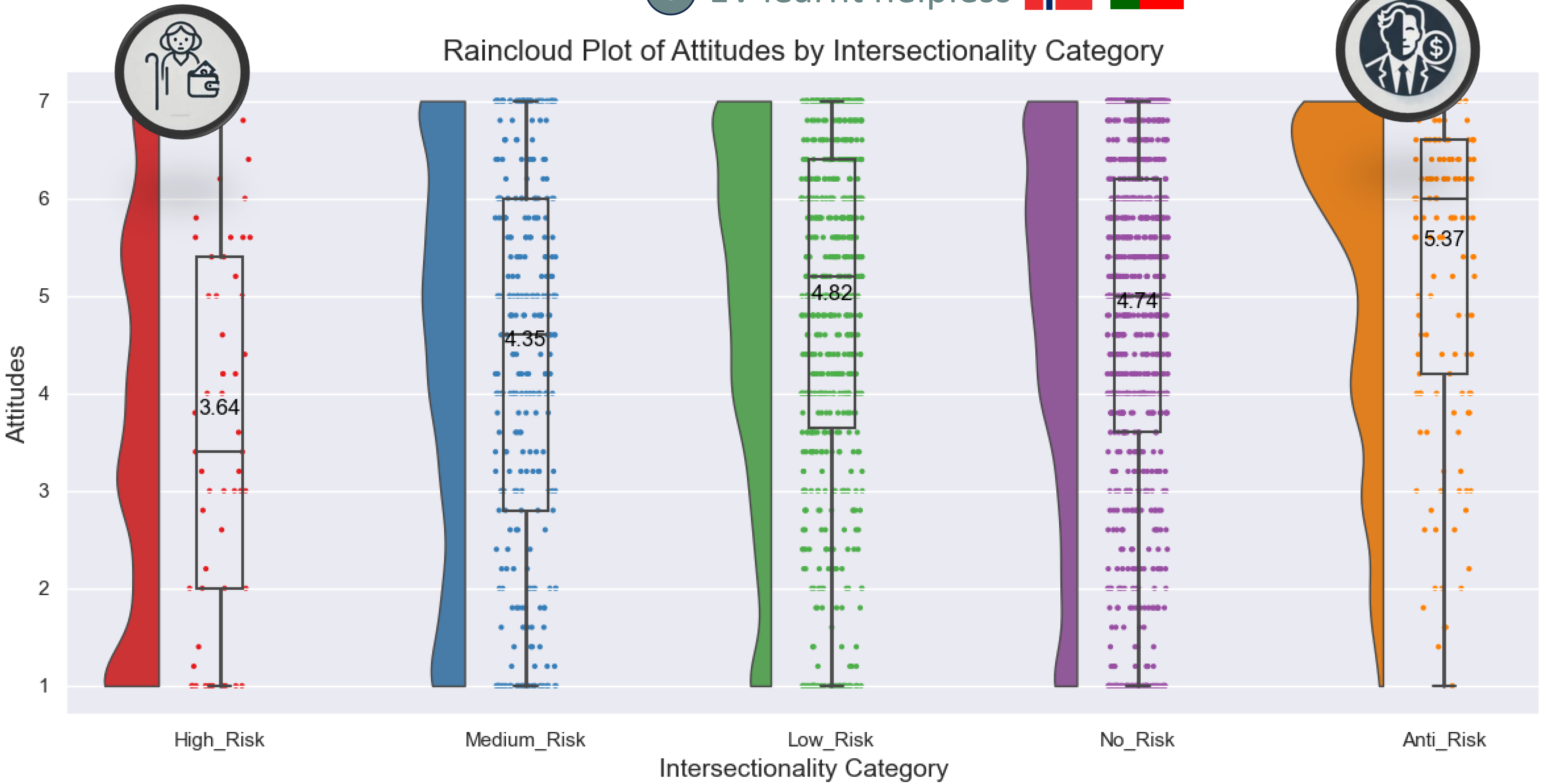
HUME

MODEL: EV adoption

Intersectionality as learnt helpless

MODEL: EV adoption

6 EV learnt helpless



THANKS FOR YOUR ATTENTION

Q&A Session

Moderator Prof. Johan Driesen – KULeuven / EnergyVille

Agenda

12u00-13u00: Registration & Sandwich Lunch

- ✓ 13u00-13u05: Welcome (VITO – Carlo Mol – Moderator)
- ✓ 13h05-13h15: HUME within the FLUX50 activities on collective energy solutions and flexibility (FLUX50 –Patrick Devos)
- ✓ 13u15-13u25: HUME measurement sites: challenges/opportunities (VITO - Wim Cardinaels)
- ✓ 13u25-13u35: Charging ahead: Insights into EV driver behaviour and preferences (VITO - Guillermo Borragán)
- ✓ 13u35-13u55: Using smart charging to optimize parking and building energy flows (KULeuven - Klaas Thoelen & VITO - Jef Verbeeck)
- ✓ 13u50-14u10: Looking deeper into the charging hardware: electrical systems and operating efficiencies (KULeuven - Johan Driesen)
- ✓ 14u10-14u40: New insights in service and business models for EV charging (Blink Charging – Thais Lopez & MOVE – Jasmien Vanvooren)

15h00-15h30: Coffee Break

- ✓ 15h30-15h50: HUME integrated architecture (VITO - Dominic Ectors)
- ✓ 15h50-16h30: An overview of the HUME demonstration sites
  - ✓ Tour & Taxis (Brussels) (Nextensa – Tim Van Dorpe)
  - ✓ EnergyVille1 (Genk) (VITO – Dominic Ectors)
  - ✓ Multiobus (Tienen) (Multiobus – Peter Vicca)
- ✓ 16h30-17h00: What is the impact of "EV Fire Safety" aspects on your parking and building (VITO – Carlo Mol)
  - ✓ Practical hands-on experiences will be shared by bus depot owner Multiobus and parking owner Nextensa.
- ✓ 17h00-17h30: Q&A (KULeuven – Prof. Johan Driesen)
  - ✓ Questions can be sent in during the event via a QR-code and will be handled in the Q&A session moderated by Prof. Johan Driesen (KULeuven)
  - ✓ Presentations will be shared to all participants after the event

17h30-19h00: Reception & Networking

Slim laden gebruiken om de energiestromen van parkeren en gebouwen te optimaliseren

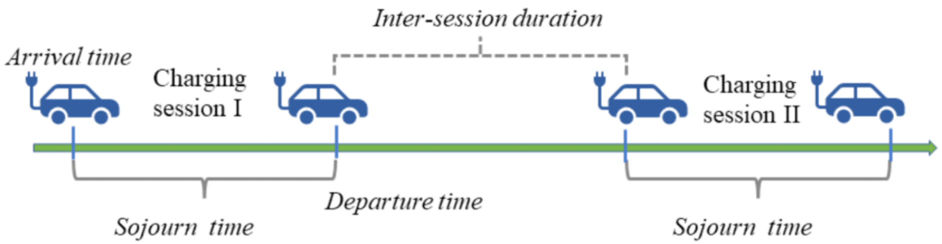
Deel 1 – KU Leuven/EnergyVille

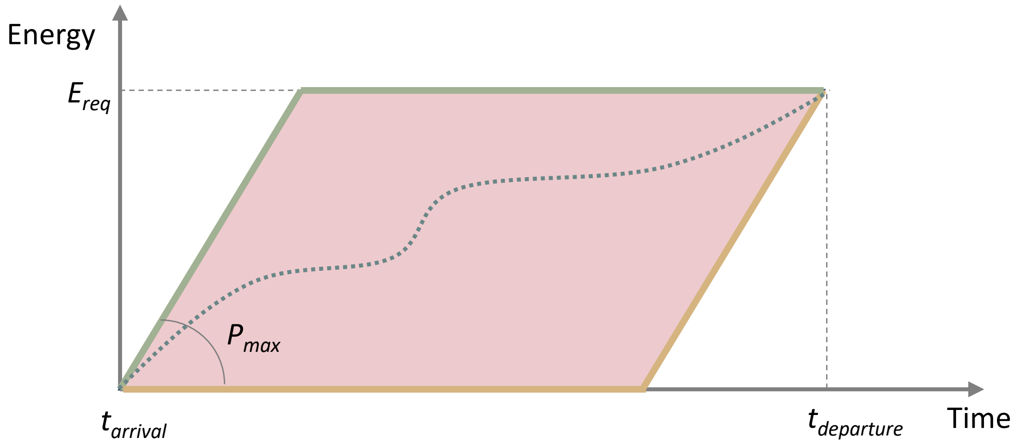
Klaas Thoelen, Terry Zhang, Hossein Fani,
Thijs Peirelinck, Geert Deconinck

AGENTSCHAP INNOVEREN & ONDERNEMEN
Vlaanderen is ondernemen

Smart charging in HUME

- Exploiting the flexibility in time and power
- From uncontrolled to controlled charging profile
- Context:
  - Office building, parking lot, bus depot, …
  - Often limited capacity to the grid
  - Possibly local PV and battery
  - Multiple charging stations
- Various objectives and constraints
  - Input from HUME sites





Smart charging in HUME

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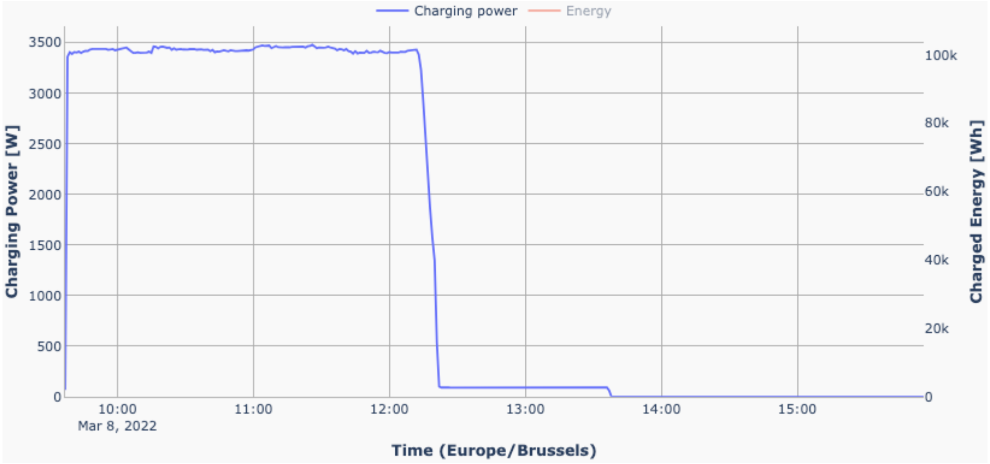

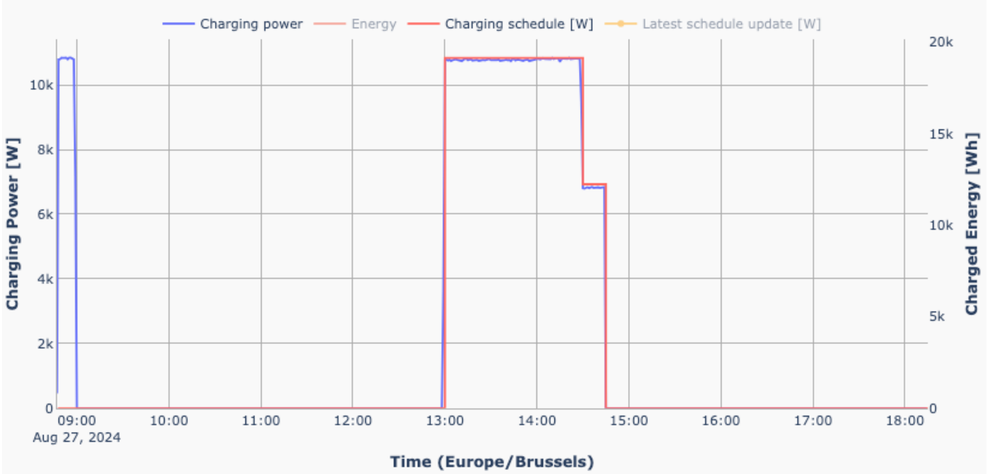

Smart charging in HUME

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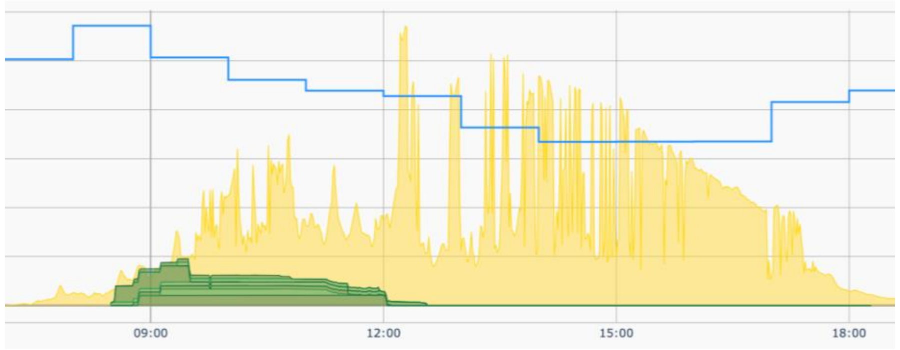
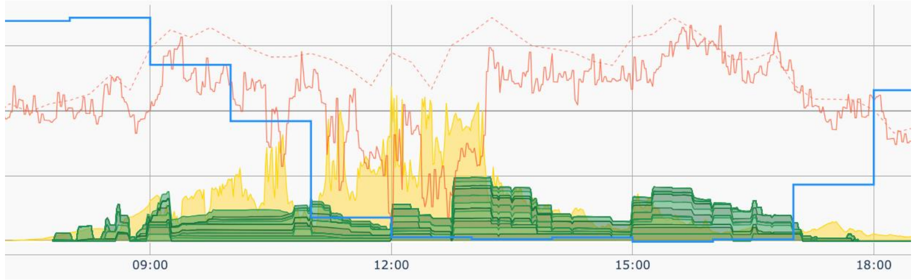




A data-driven approach

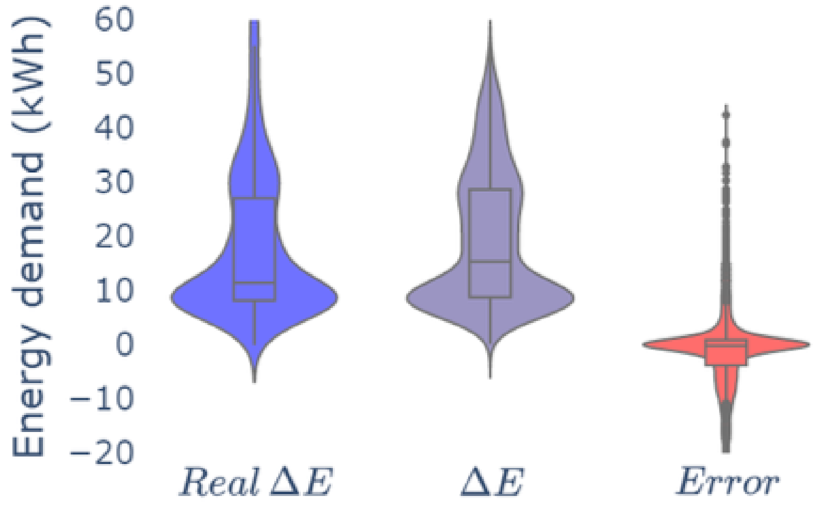
Selected contributions:

1. *Data-driven estimation of user preferences*
2. *Data-driven charging scheduling: A reinforcement learning approach*

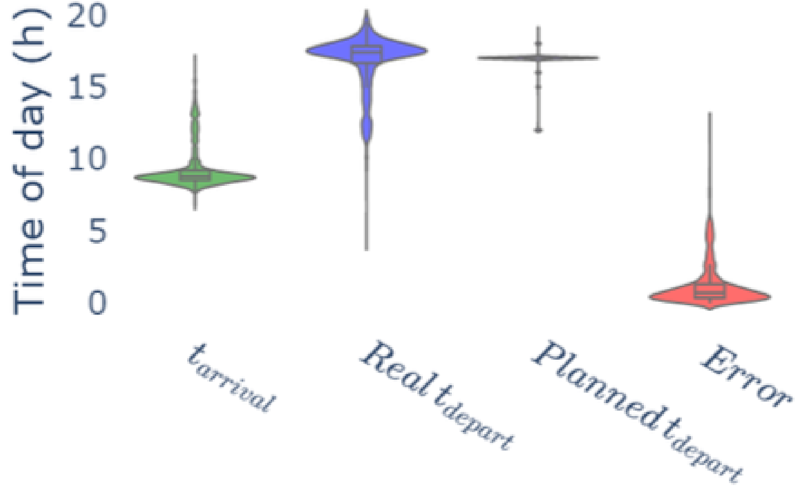
Data-driven estimation of user preferences

- Smart charging requires data
  - Data about users, their EVs, and context
- Considerable uncertainty in data
  - Only estimations for: *departure time and energy*
    - *No SoC available from EV (yet)*
  - Users prefer plug-and-forget
  - Users often misestimate:
    - Difficult, range anxiety, uncertain plans, …

→ Results in uncertainty on available flexibility



(a) Energy requirement

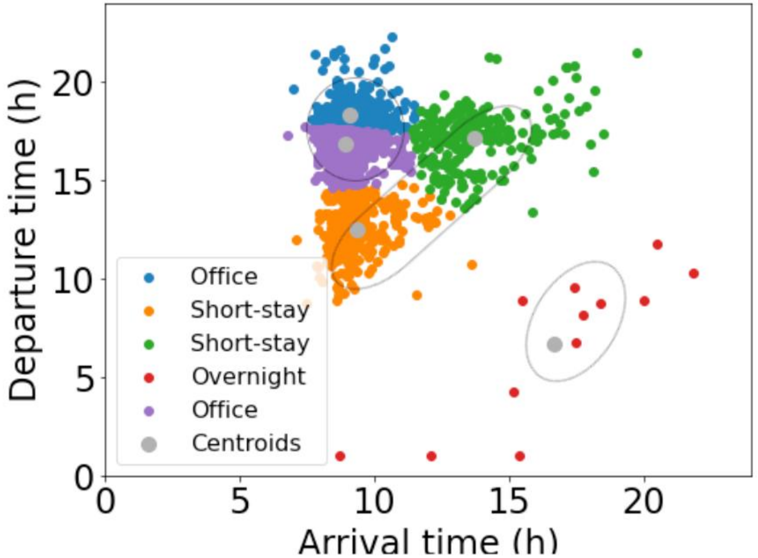


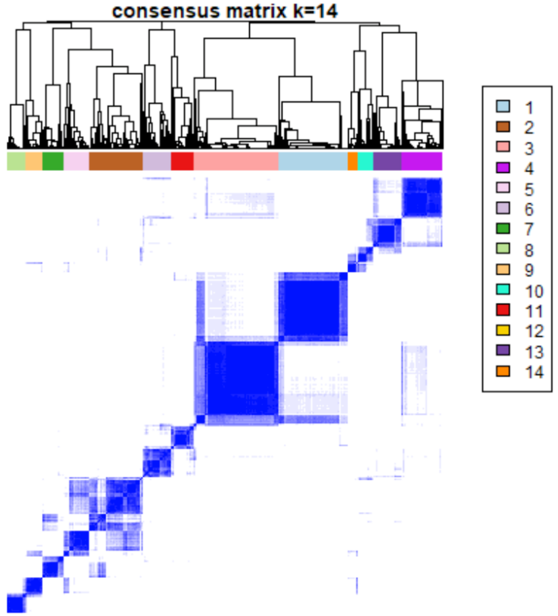
(b) Arrival and departure time

Data-driven estimation of user preferences

1. ***Classify charging sessions based on patterns in historical data***

- Cluster sessions on arrival and departure time
  - Approach: K-means clustering
  - 3 session types: short-stay, office-hours, overnight
- General clustering of charging sessions
  - Additional parameters: energy requirement, maximum power
  - Approach: K-means based concensus clustering





(a) The color-coded heat maps K=14

Data-driven estimation of user preferences

2. *Include clusters in the data-driven energy estimation*

- Methods:
  - Statistics: Bi-variate Gaussian Distribution (BGD)
  - Machine learning: Random Forests (RF), Extreme Gradient Boosting (XGB)
  - Neural networks: Mixture Density Networks (MDN)

Table 3.3: Benchmark on energy requirement estimation in EnergyVille dataset

(kWh)			Without Clusters			K-means Clusters			KCC Clusters		
	Baseline	KCC	RF	XGB	MDN	RF	XGB	MDN	RF	XGB	MDN
R^2	0.59	0.60	0.60	0.60	0.42	0.65	0.62	0.61	0.64	0.61	0.64
MAE	5.54	5.70	5.52	5.56	5.26	5.079	5.38	4.42	5.11	5.38	4.09
MSE	**81.17**	**78.19**	77.79	77.69	72.66	68.74	75.03	61.75	69.46	75.22	**54.21**
%	-	**3.67**	4.16	4.28	10.48	15.31	7.56	23.93	14.43	7.33	**33.21**

In simulations on EnergyVille data: Potential daily cost reduction between *6,6% and 14,7%*

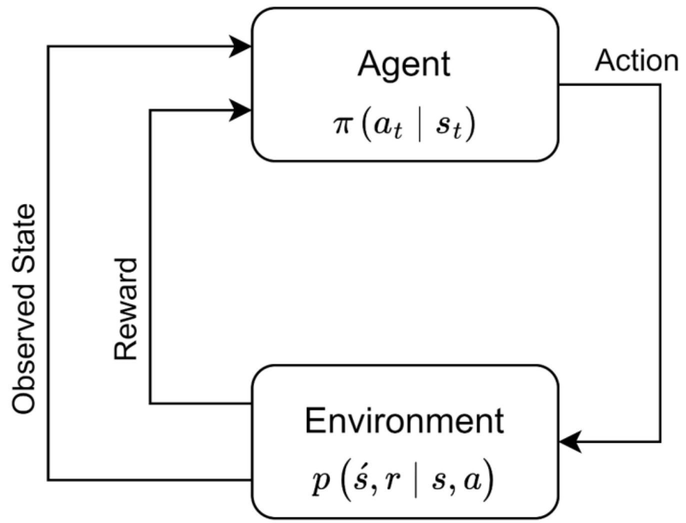
Zhang, et al. - *User Preference Cluster-Based Optimization for Electric Vehicles Charging in Smart Buildings Under Uncertainty*, Submitted to Applied Energy

Data-driven charging scheduling: A reinforcement learning approach

- Reinforcement learning = machine learning + optimal control
  - Which actions to take in an environment to optimize a reward?

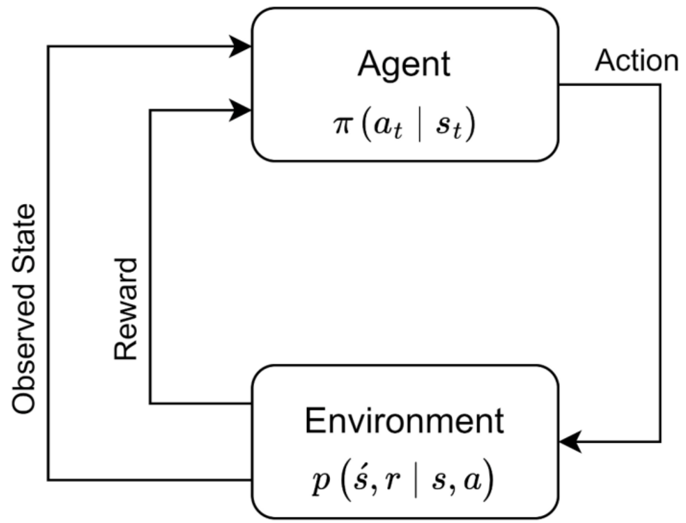
  - Discrete-time stochastic control process
    - Executed periodically
    - Uncertainty on arrival and departure of Evs, available power, requested energy

  - Large number of possible actions
    - Data driven approach → Machine Learning
    - Fitted Q-Iteration based on neural networks
      - Learn the Q-function = value of taking an action in a given state



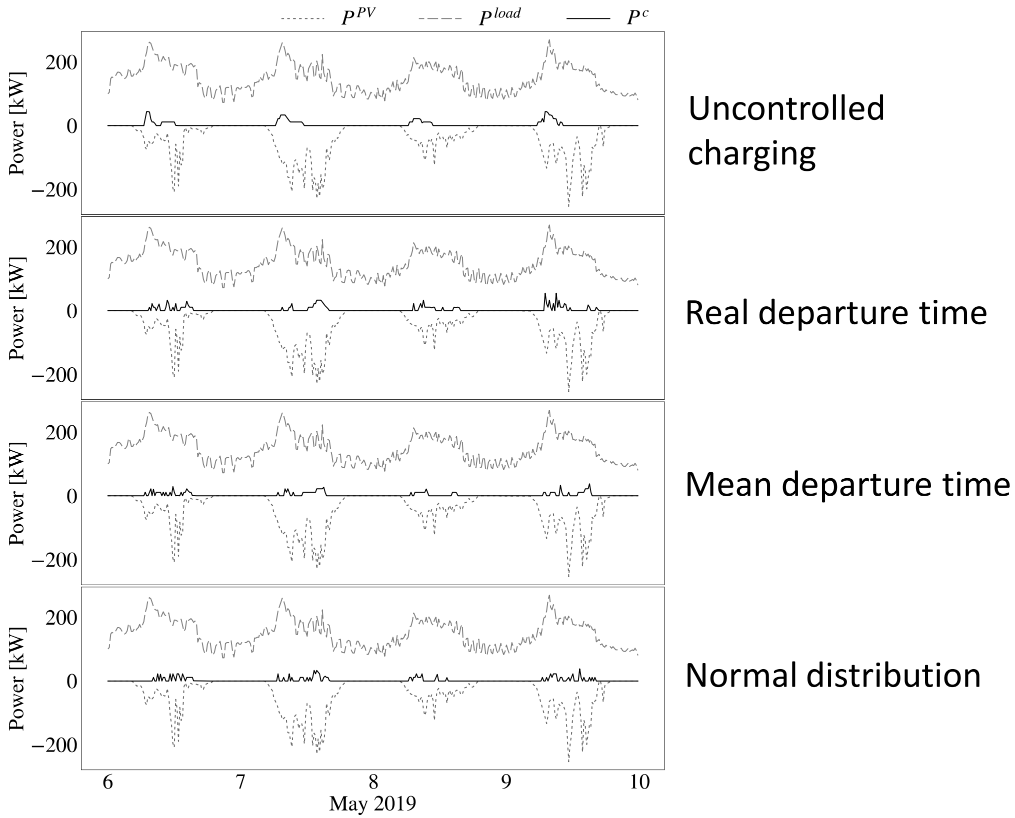
Data-driven charging scheduling: A reinforcement learning approach

- Environment:
  - Grid connection + PV installation
  - Residual building load
  - 8 charging sockets
  - EV charging session data: start time, departure time, requested energy
- State:
  - **X** = (**SoC**, **ΔT*charge***, **ΔT*depart***, t)
  - SoC = energy charged
  - ΔT*charge* = time needed to fully charge
  - ΔT*depart* = time until departure
  - t = time step
- Action:
  - Per charging socket, charge or not charge, with P^{max} = 11kW
  - Every 15'
- Cost:
  - Cf. PV self-consumption and peak reduction
- Real-time controller (or back-up controller)
  - Overrule RL agent actions to make sure EVs are fully charged (when feasible)



Data-driven charging scheduling: A reinforcement learning approach

- Evaluation:
  - Peak reduction and PV self-consumption
  - For various departure time estimates
- Results:
  - Charging is moved to dip in power consumption and spike in solar production
    - Peak is reduced with ~7kW or ~4%
    - Self-consumption increased from 8% to ~25%
    - No clear difference between RL versions
  - But, good departure time estimate is needed to maximize user comfort



	Mean daily peak (kW)	Self-consumption rate
Uncontrolled charging	*167.62*	*0.08*
Real departure time	*161.42*	*0.25*
Mean departure time	*160.19*	*0.29*
Normal distribution sampling	*159.6*	*0.28*

Peirelinck, et al. - *Forecasting Sensitivity Analysis of Reinforcement Learning Based Smart Charging*, Presented at ISGT Europe 2023

Data-driven charging scheduling: A reinforcement learning approach

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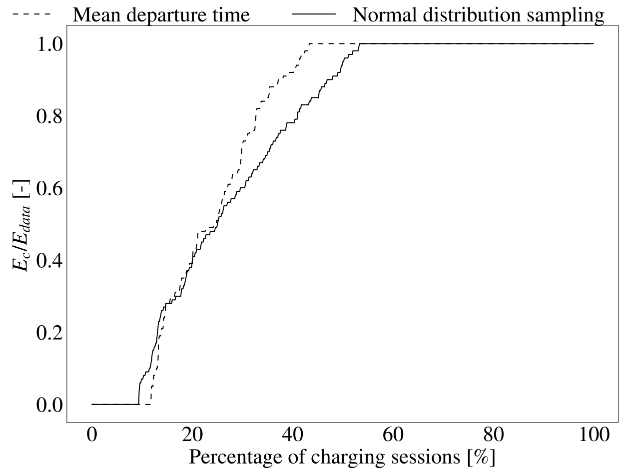
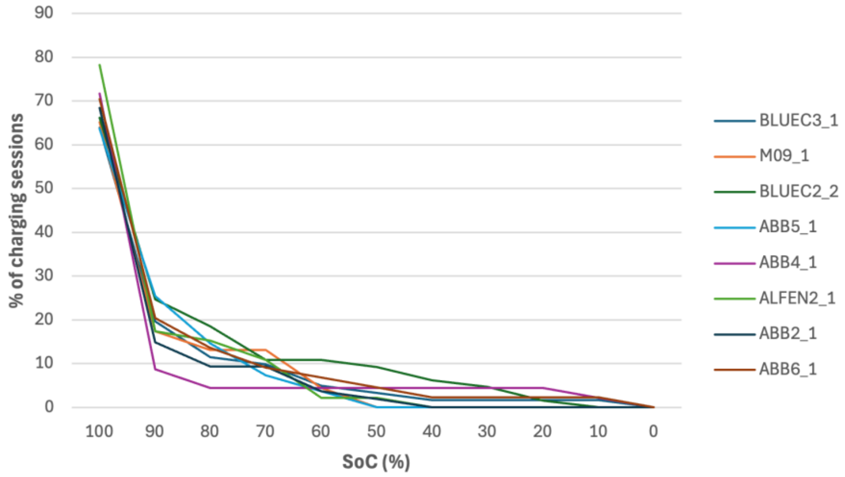




Peirelinck, et al. - *Forecasting Sensitivity Analysis of Reinforcement Learning Based Smart Charging*, Presented at ISGT Europe 2023

Using smart charging building energy flows

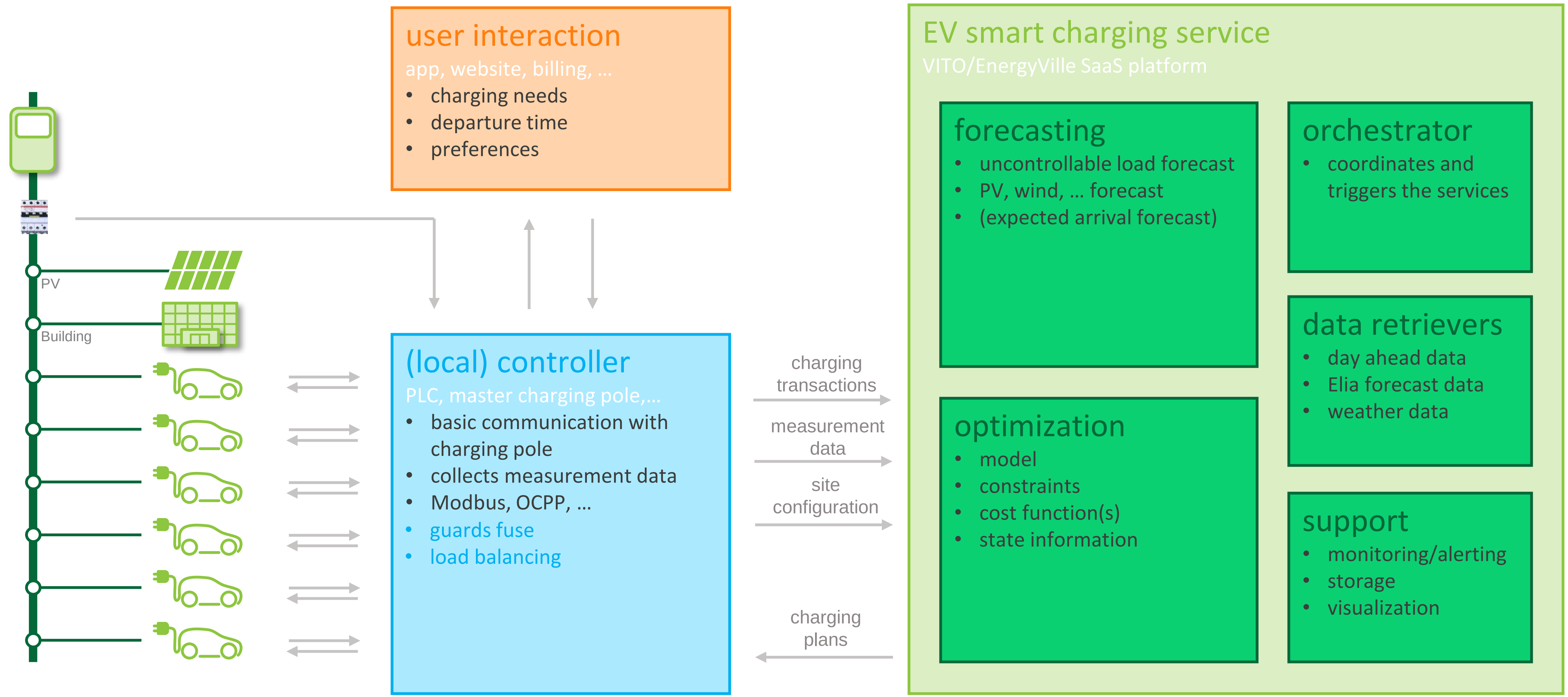
Mixing model based and data driven methods(AI) in a Model Predictive Control (MPC) approach

Presented at the Hume end-event, 14-11-2024

Jef Verbeeck, Chris Hermans, Dominic Ectors, Milan Findura, Tom Cuypers

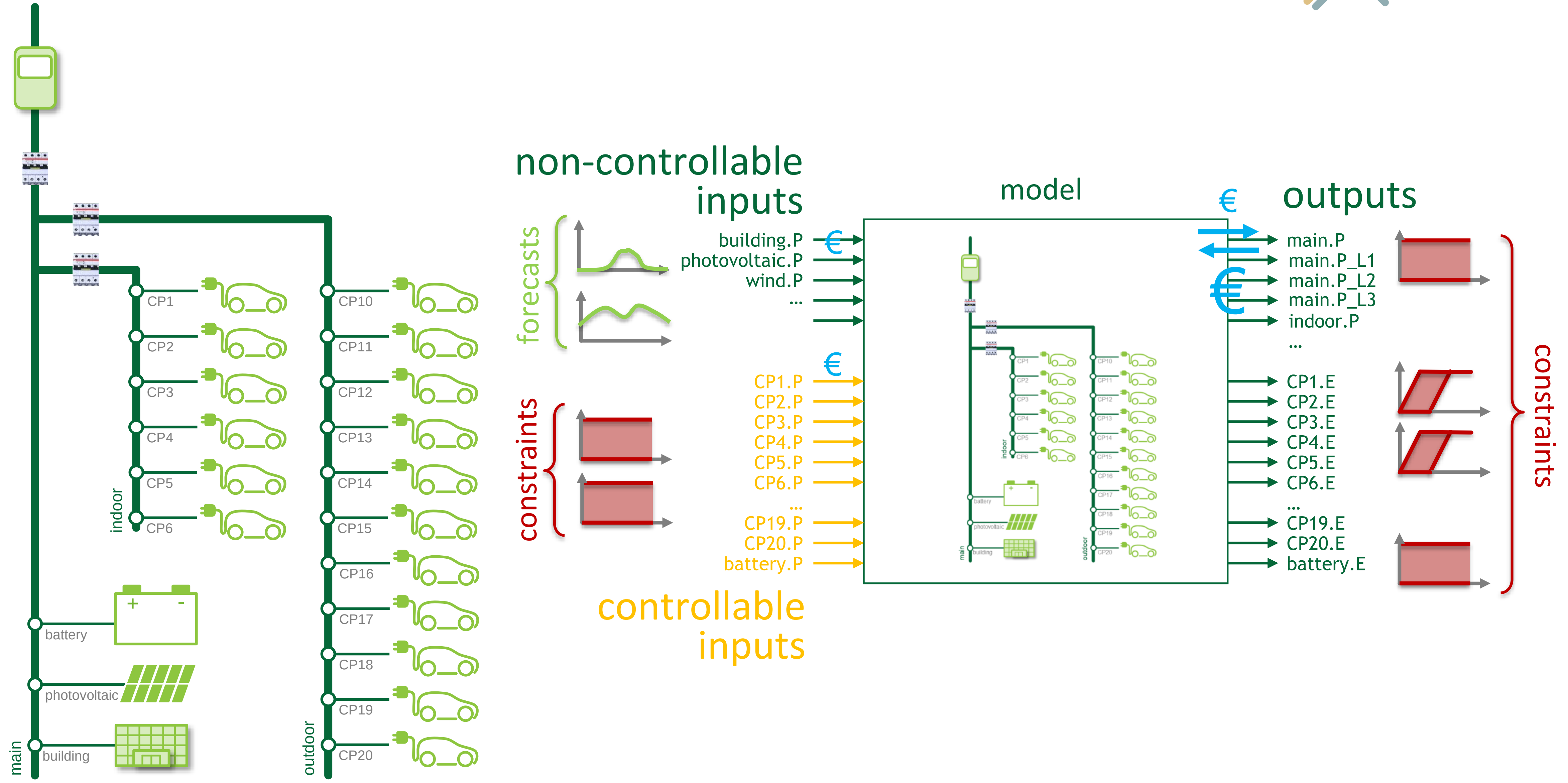
AGENTSCHAP INNOVEREN & ONDERNEMEN
Vlaanderen is ondernemen

Charging infrastructure today **and what we add to it**

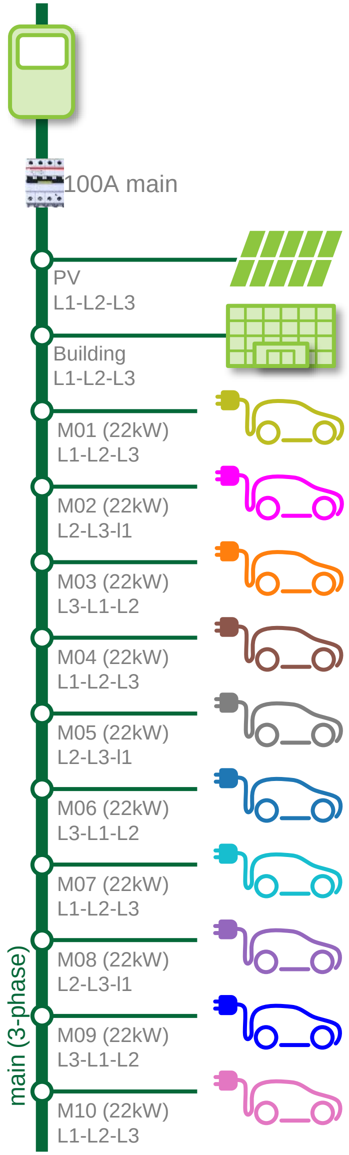


Model Predictive Control

bringing model, constraints, forecasts and costs together



Example planning
Configuration and optimization settings

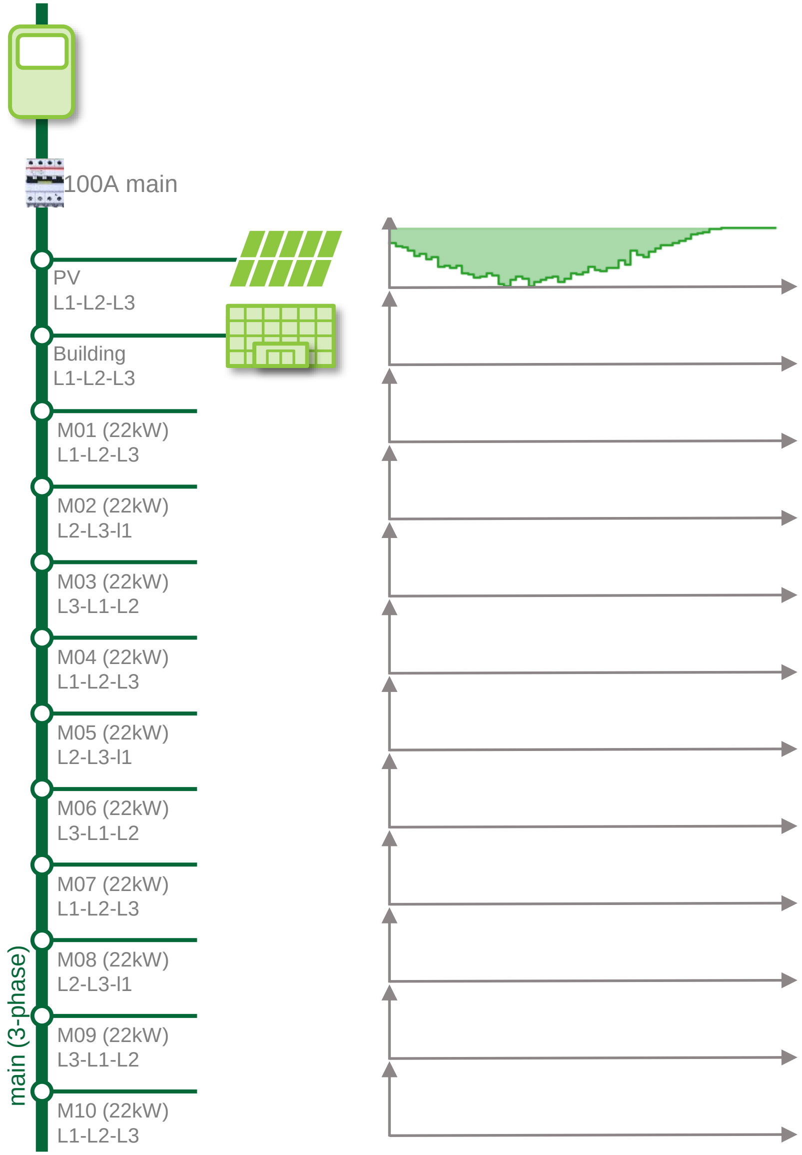


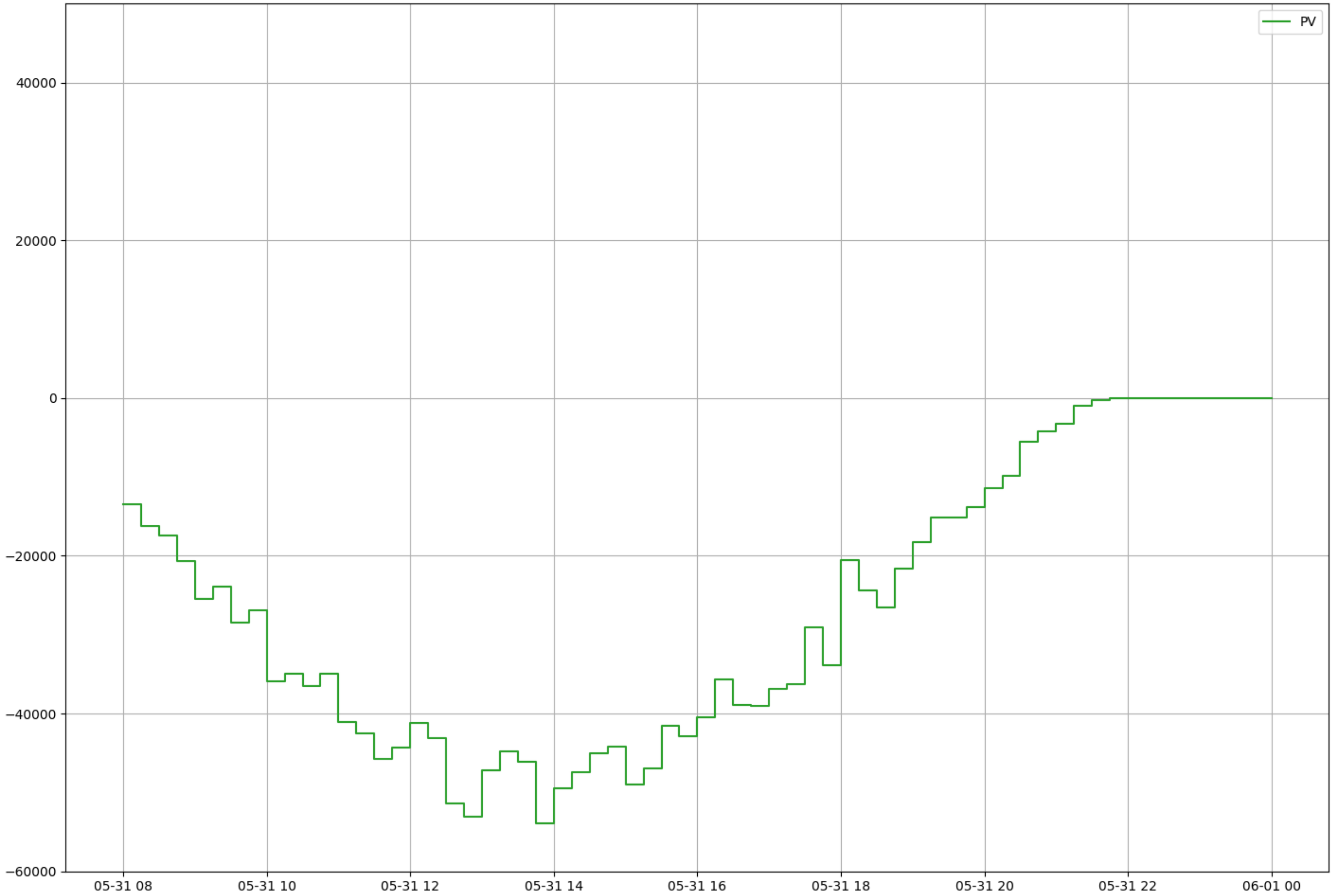
optimization settings:

- Dynamic electricity offtake price (day-ahead market)
- Fixed (low) electricity injection price (0.04€/kWh)
- Peak price when offtake power exceeds 40kW (capacity tariff)
- In case there are multiple solutions possible:
  - Charge car as fast a s possible
  - Prioritize based on departure time of the car

Example optimization

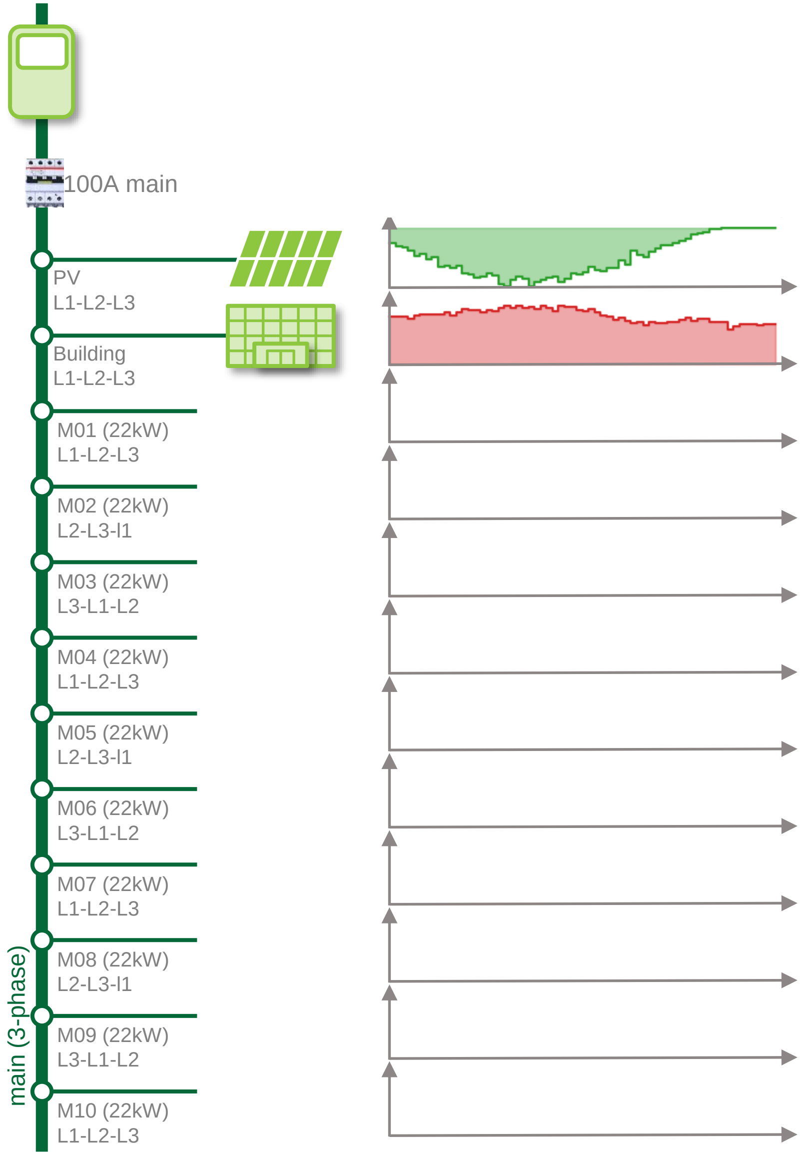
Step 1: PV forecast

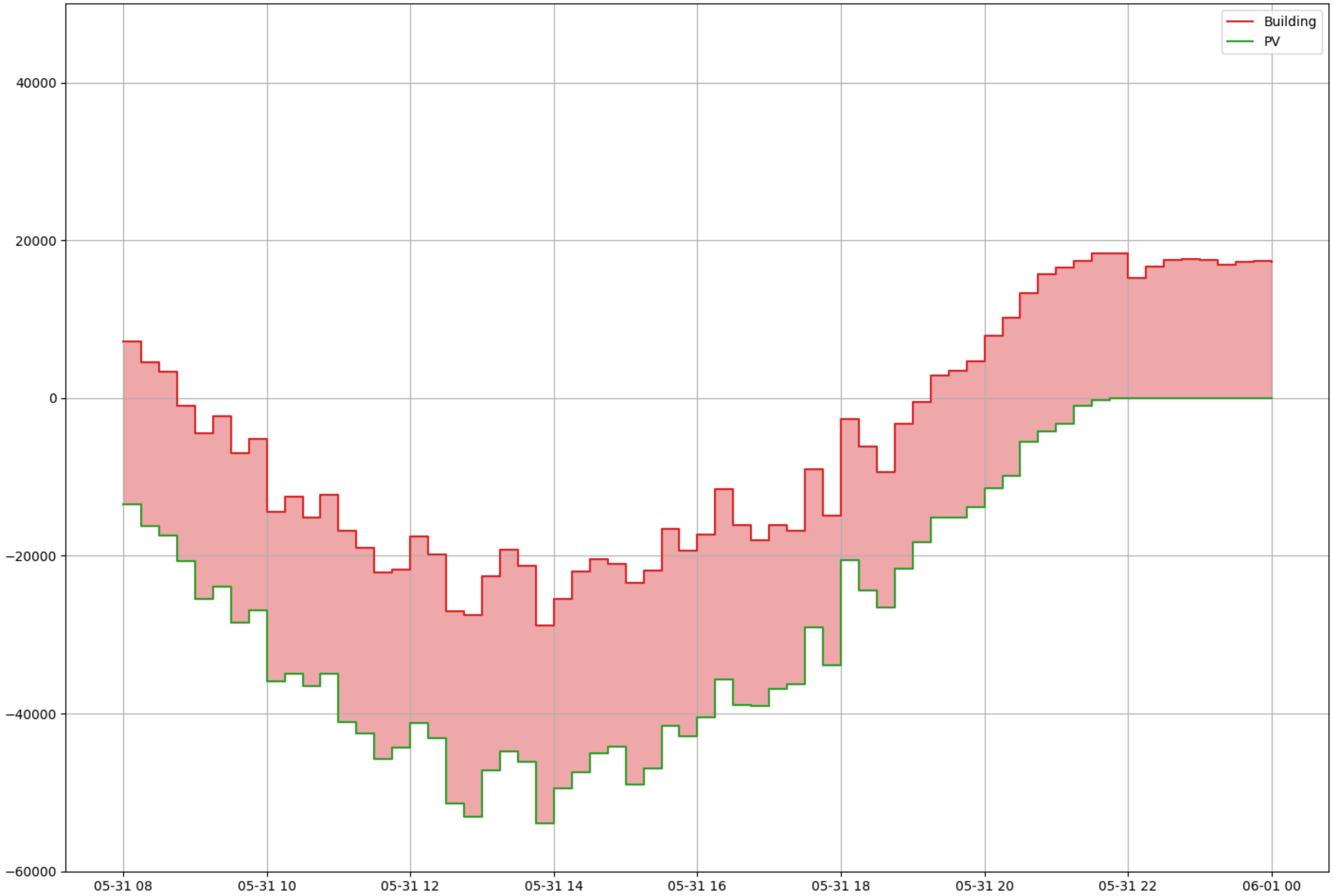




Example optimization

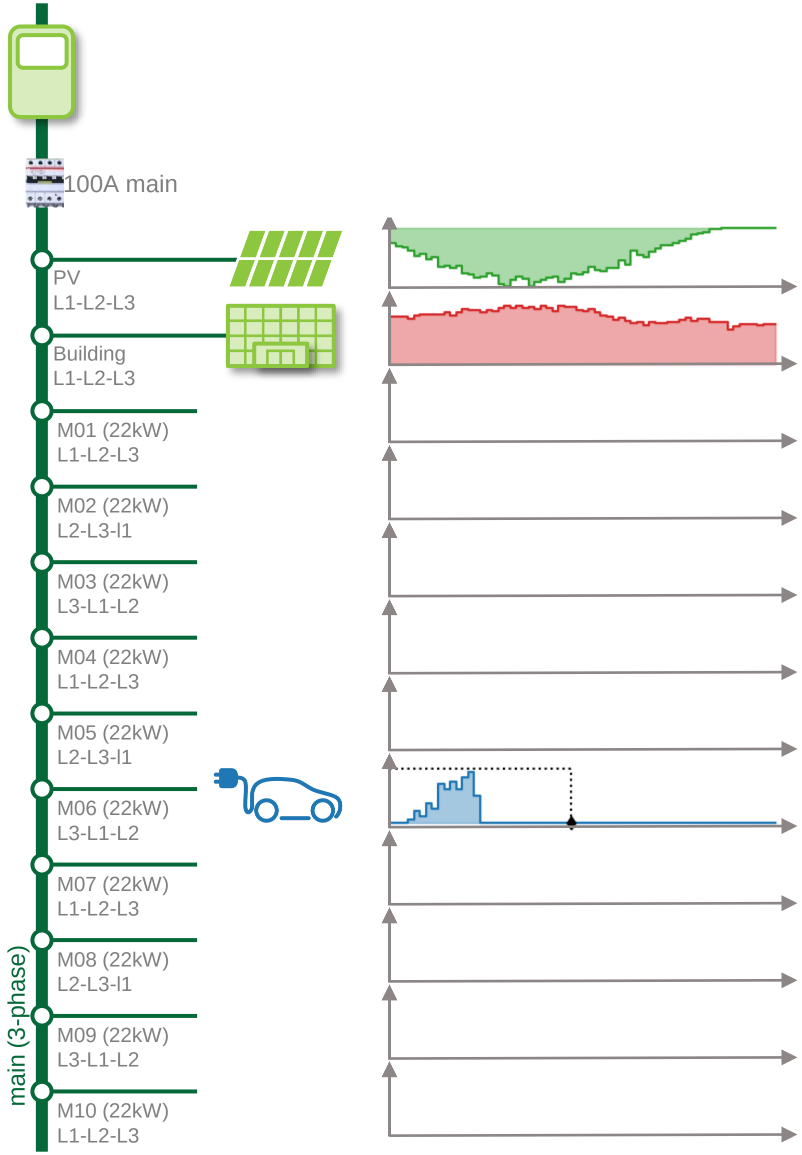
Step 2: PV and building consumption forecast

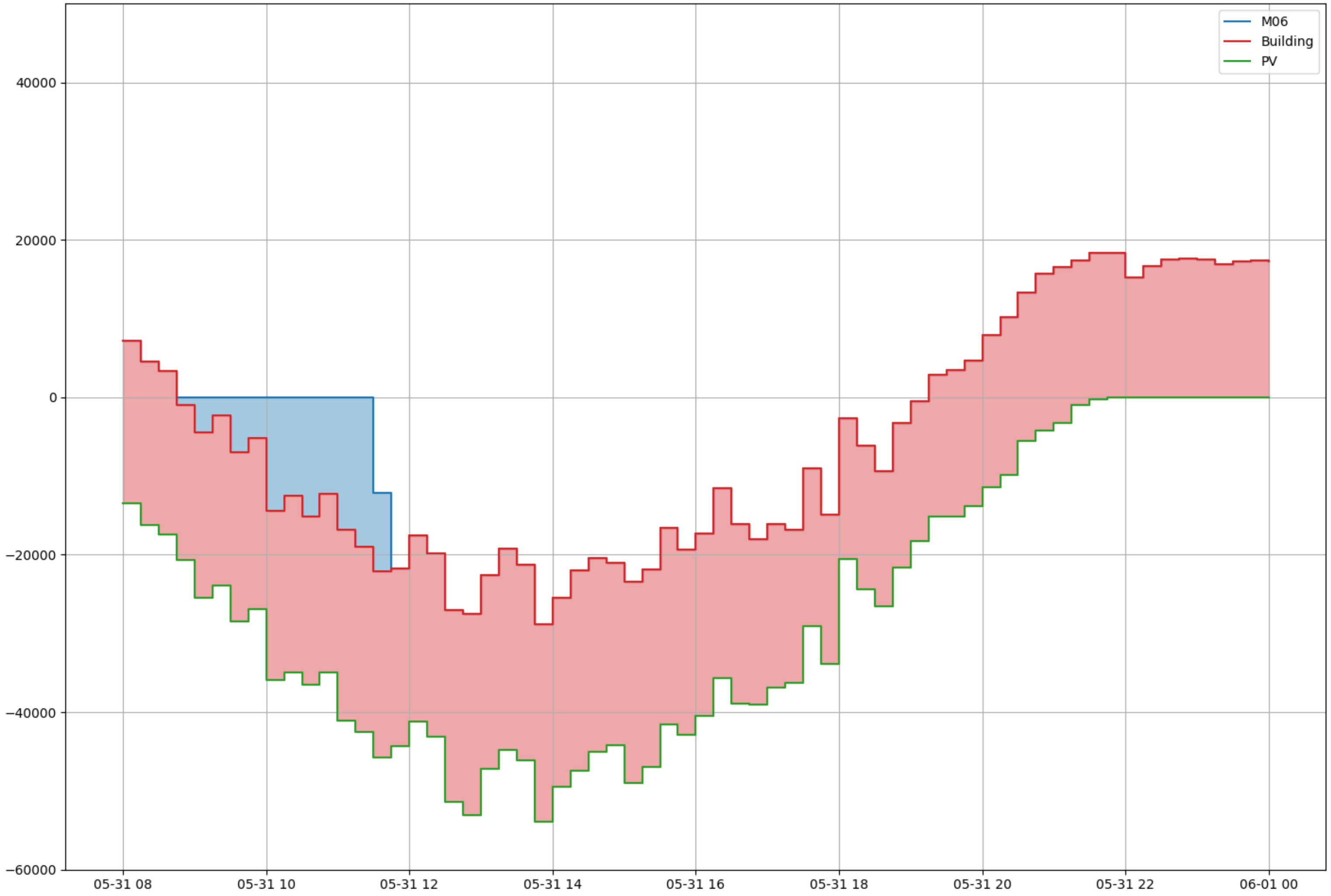




Example optimization

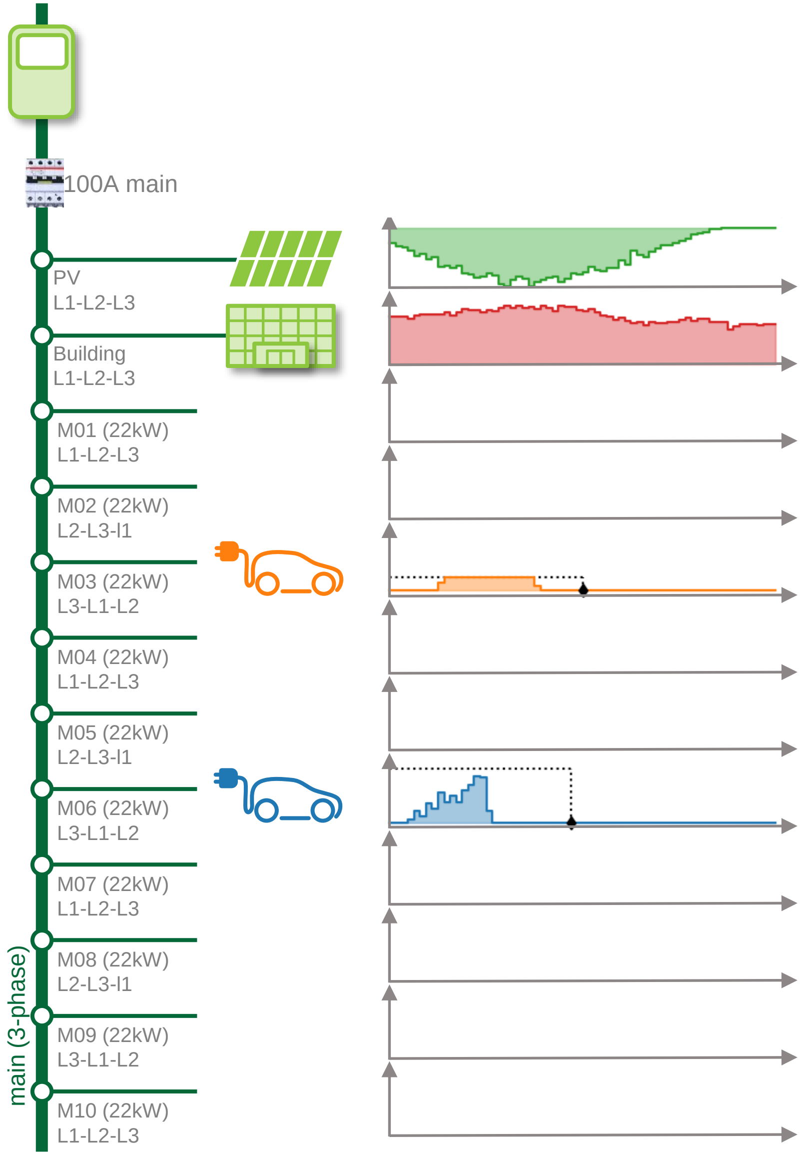
Step 3: 1st car → ASAP on PV self consumption

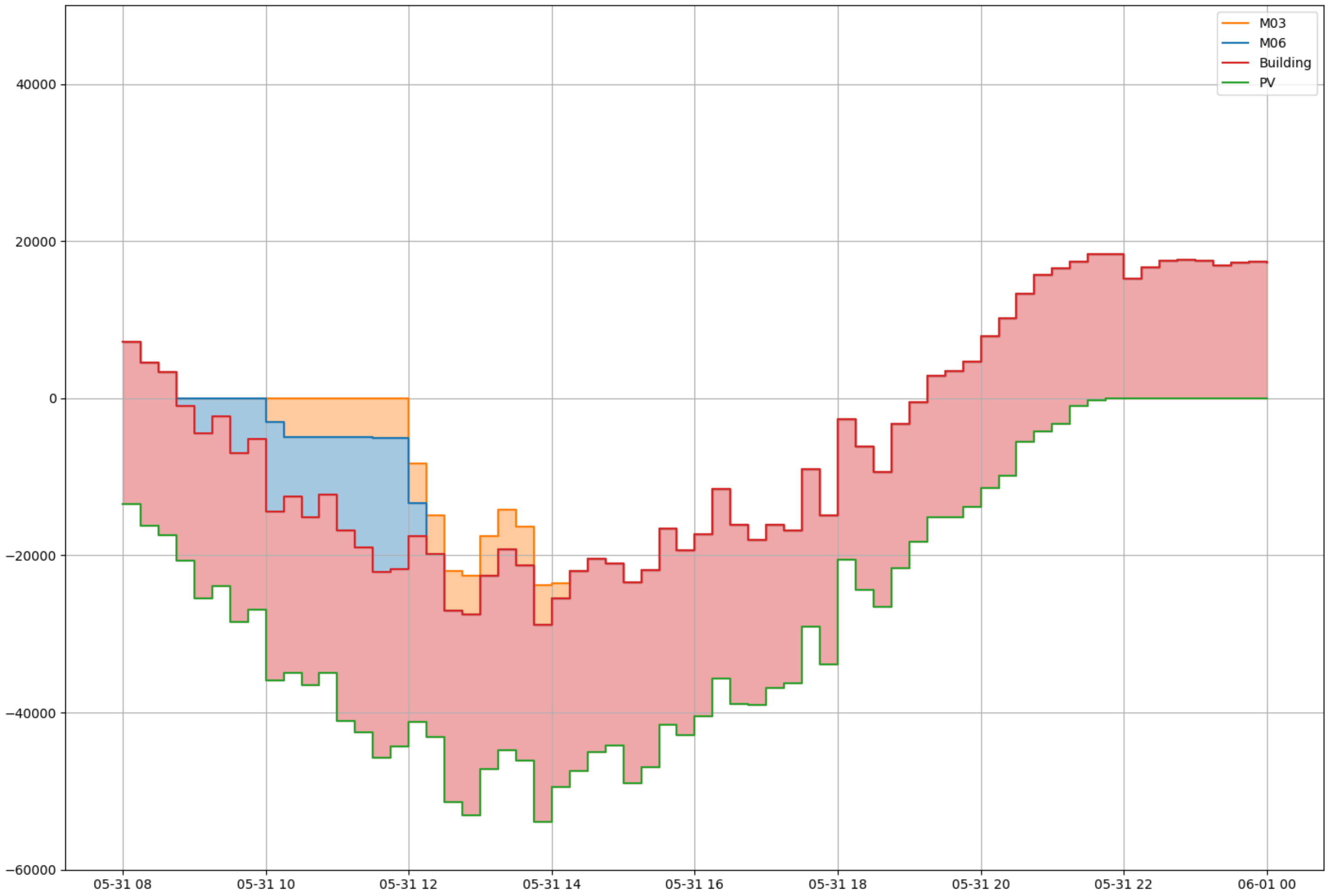




Example optimization

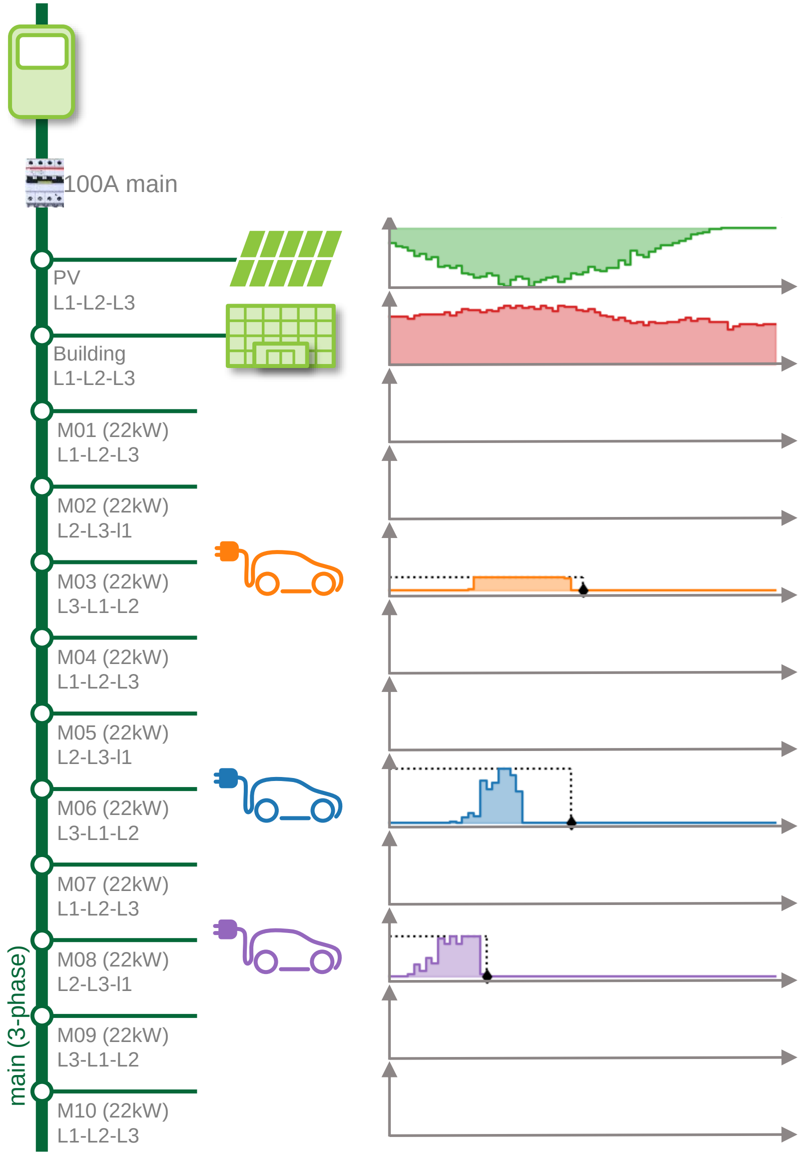
Step 4: 2nd car → charge after car 1 on PV

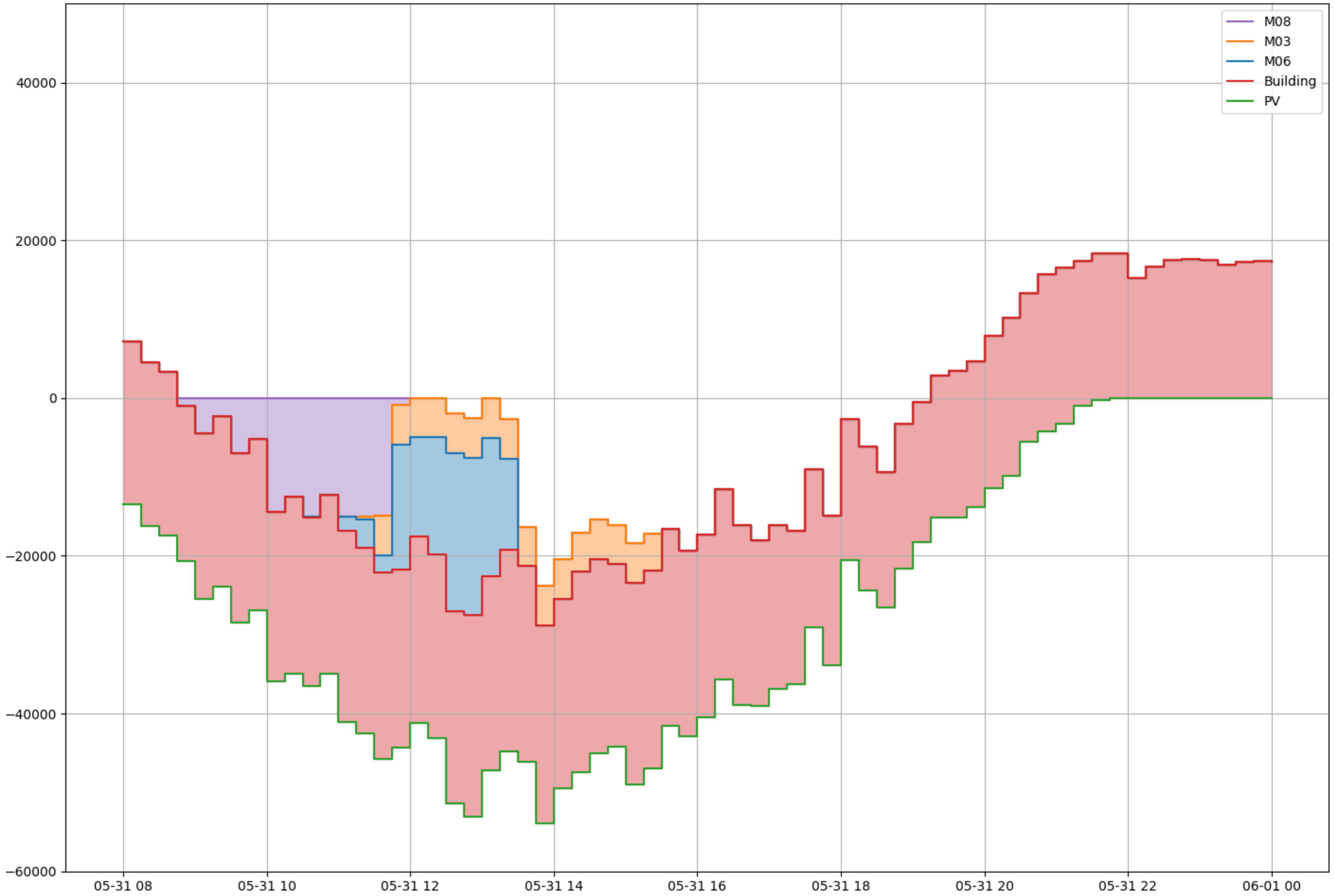




Example optimization

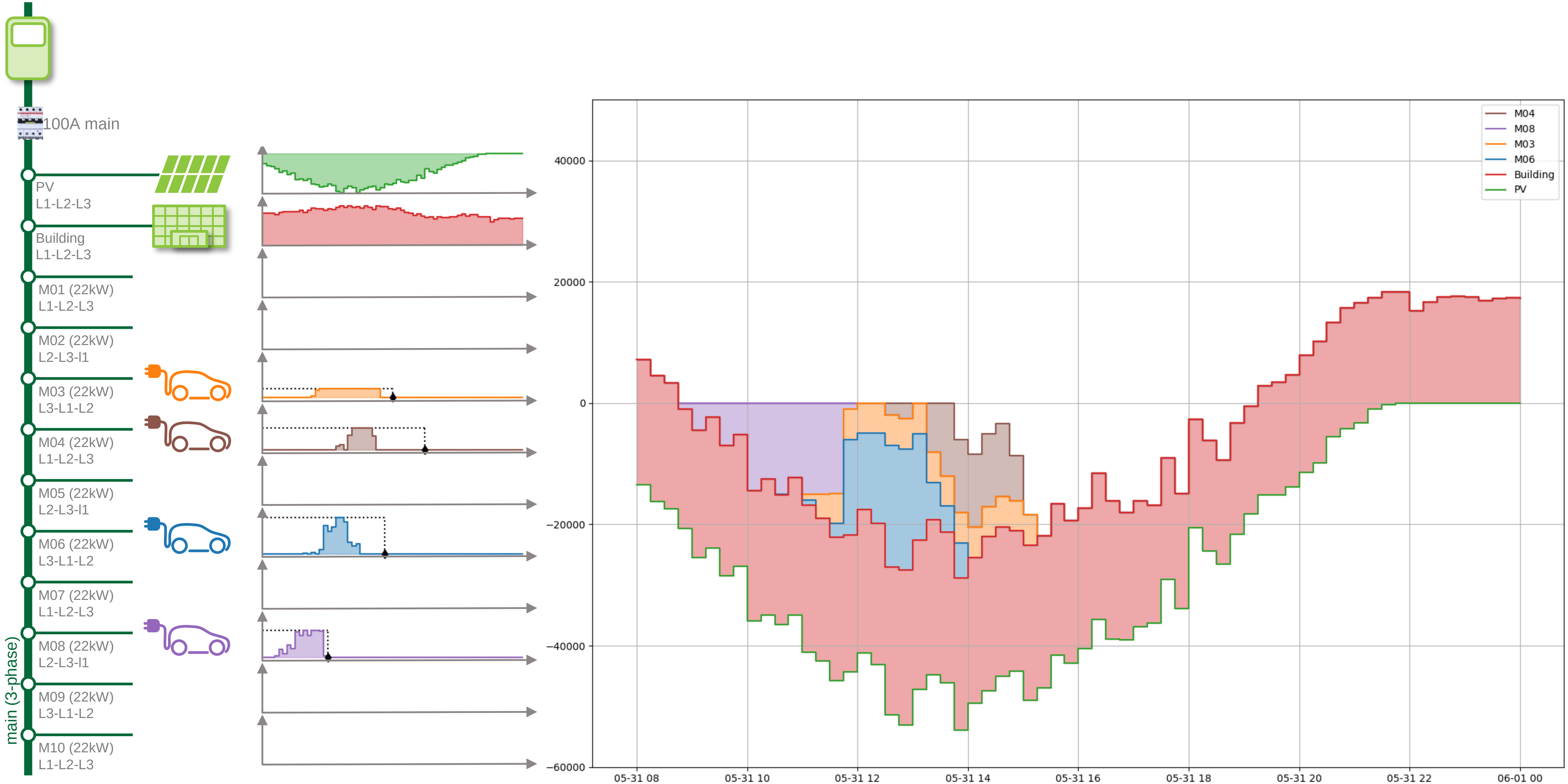
Step 5: 3rd car → shifts before other cars because early departure





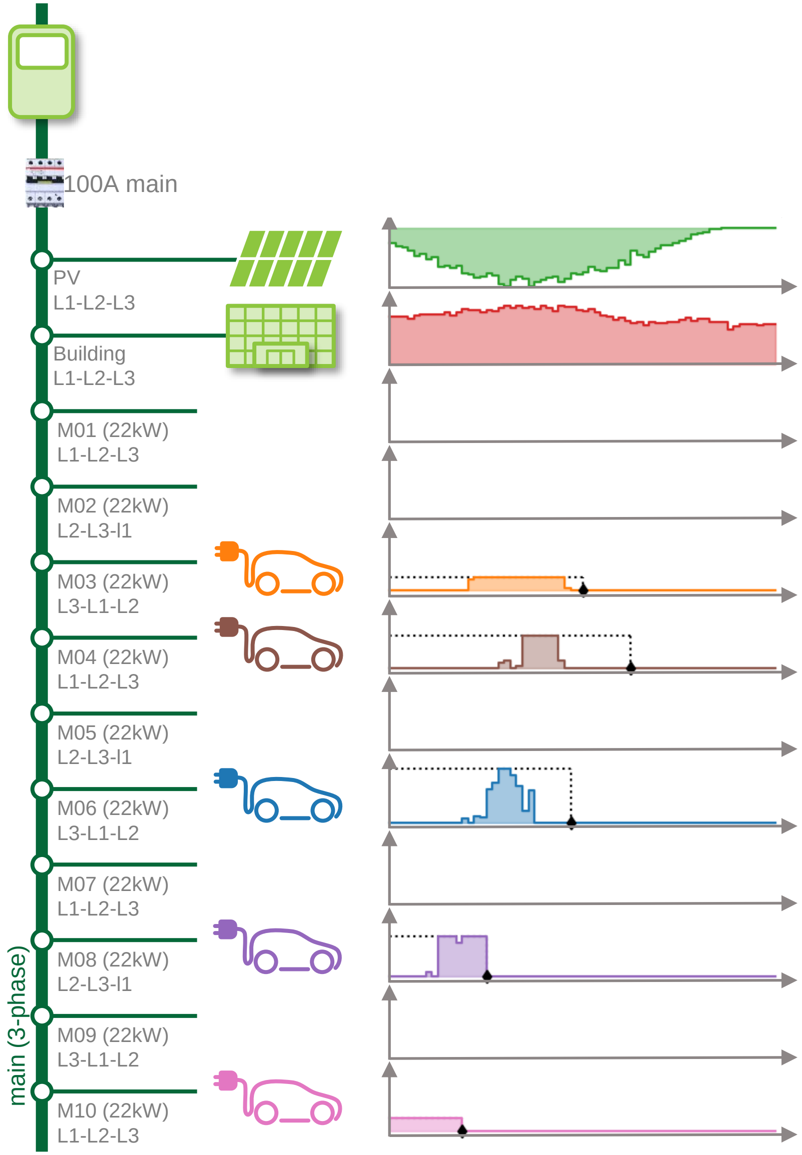
Example optimization

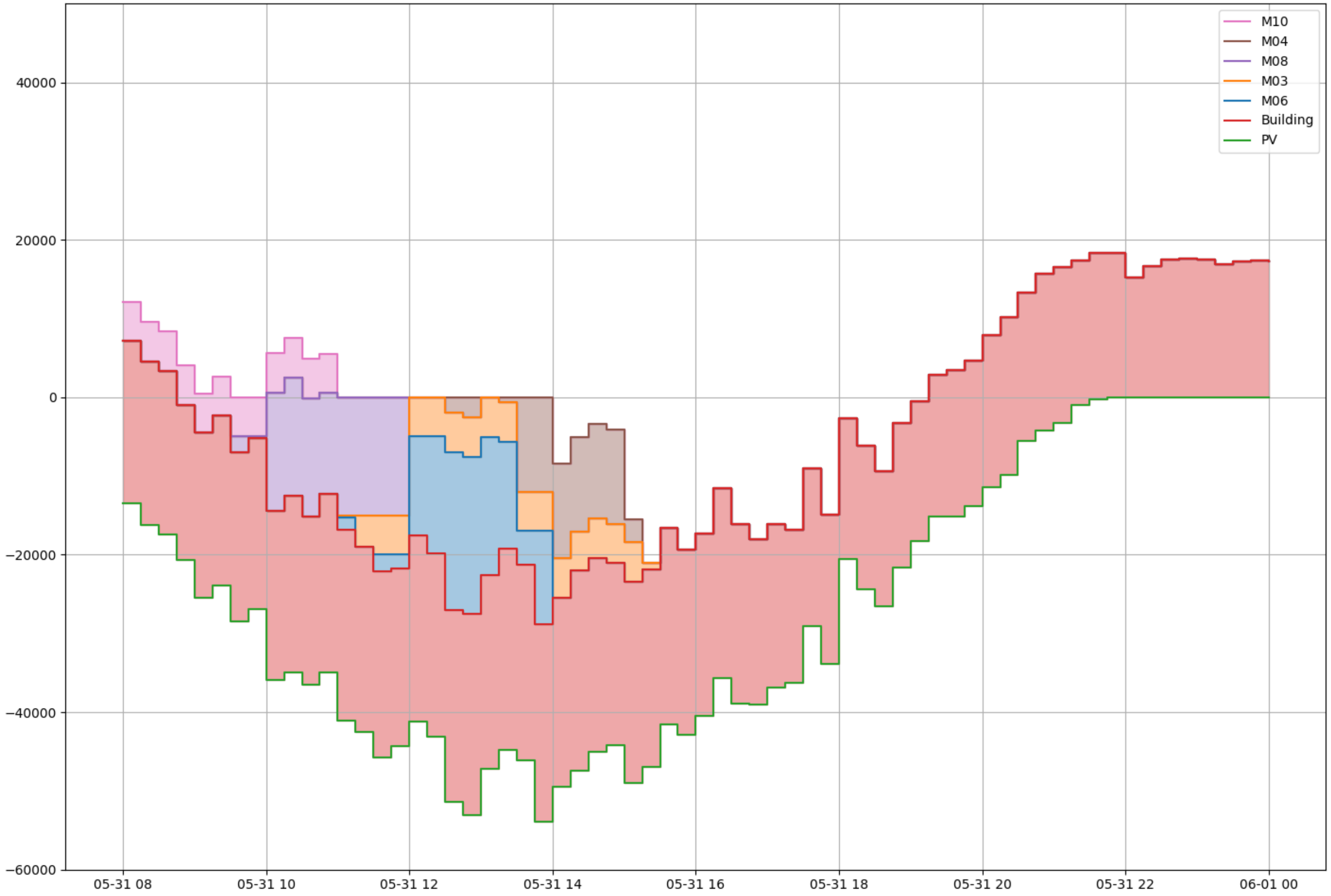
Step 6: 4th car → next on PV self consumption



Example optimization

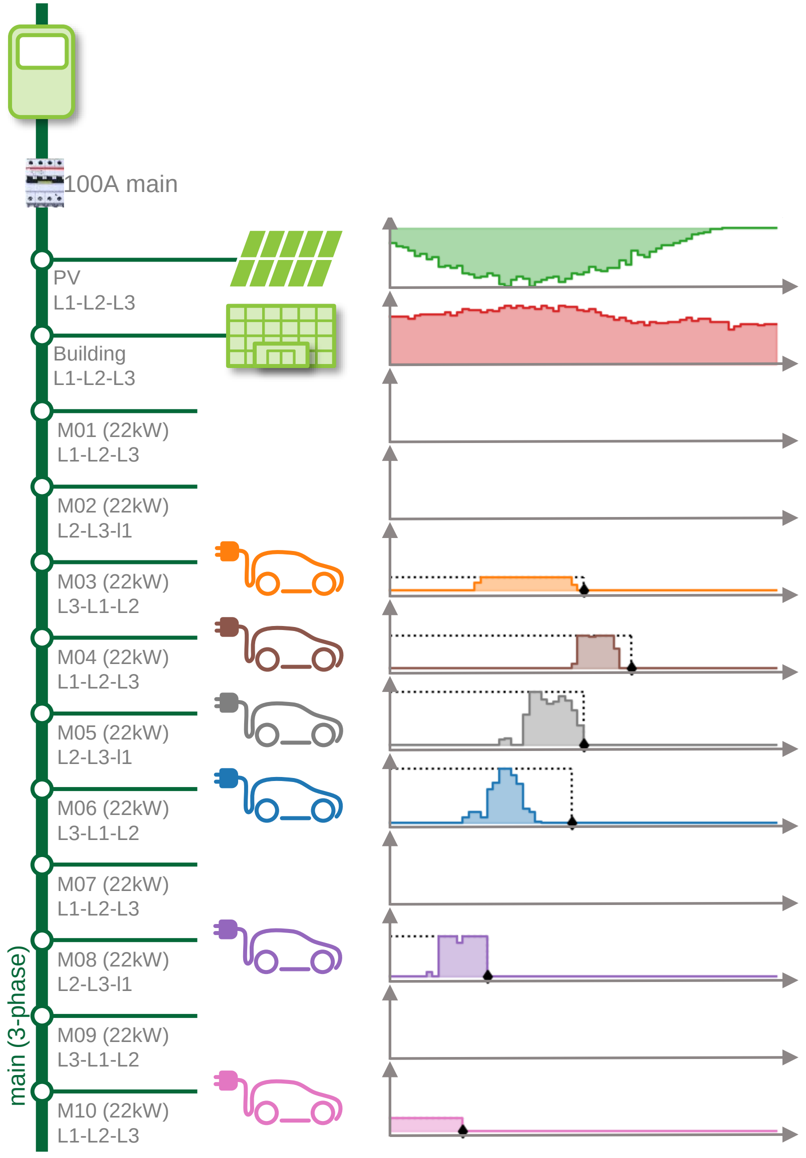
Step 7: 5th car → charges immediately at any price

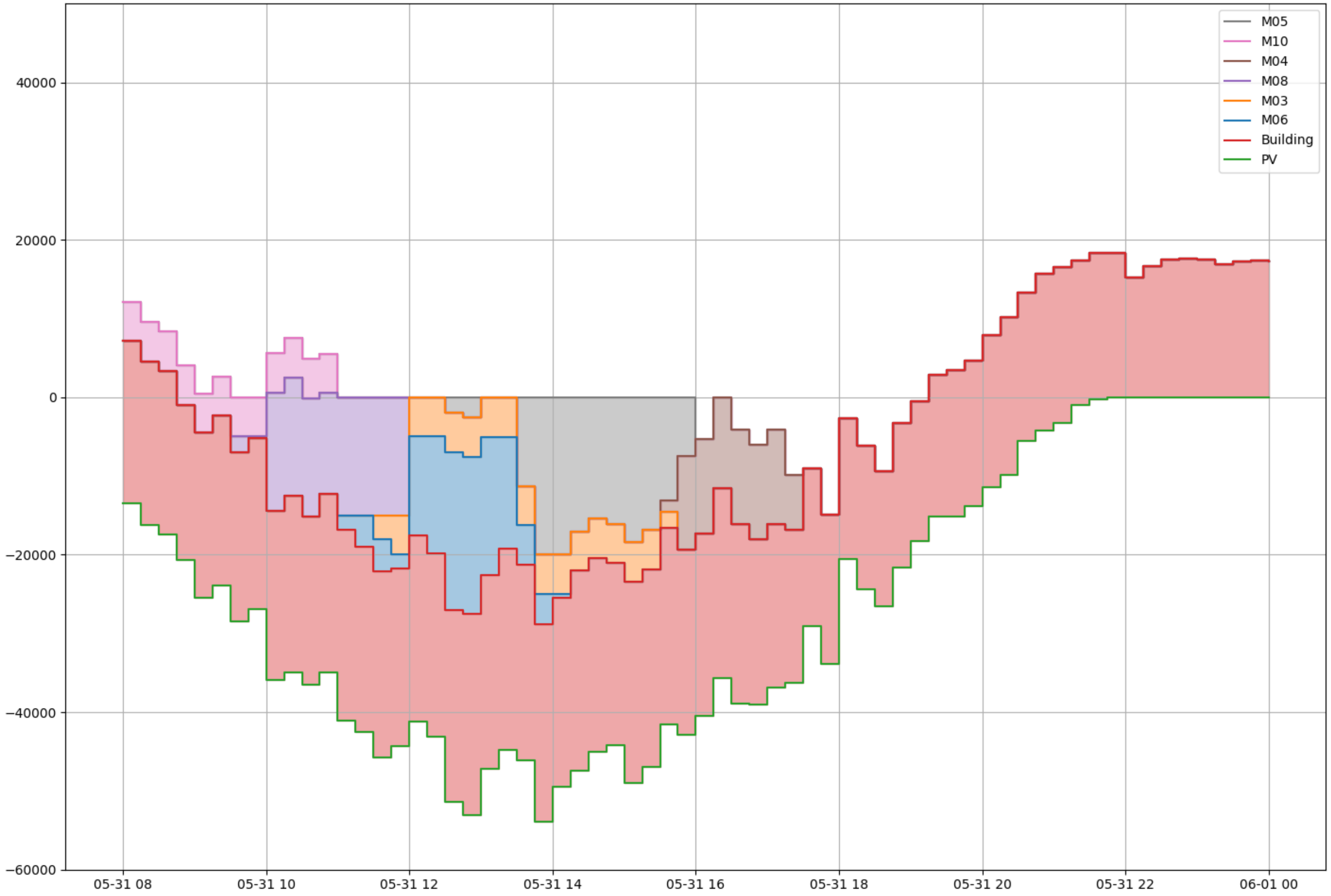




Example optimization

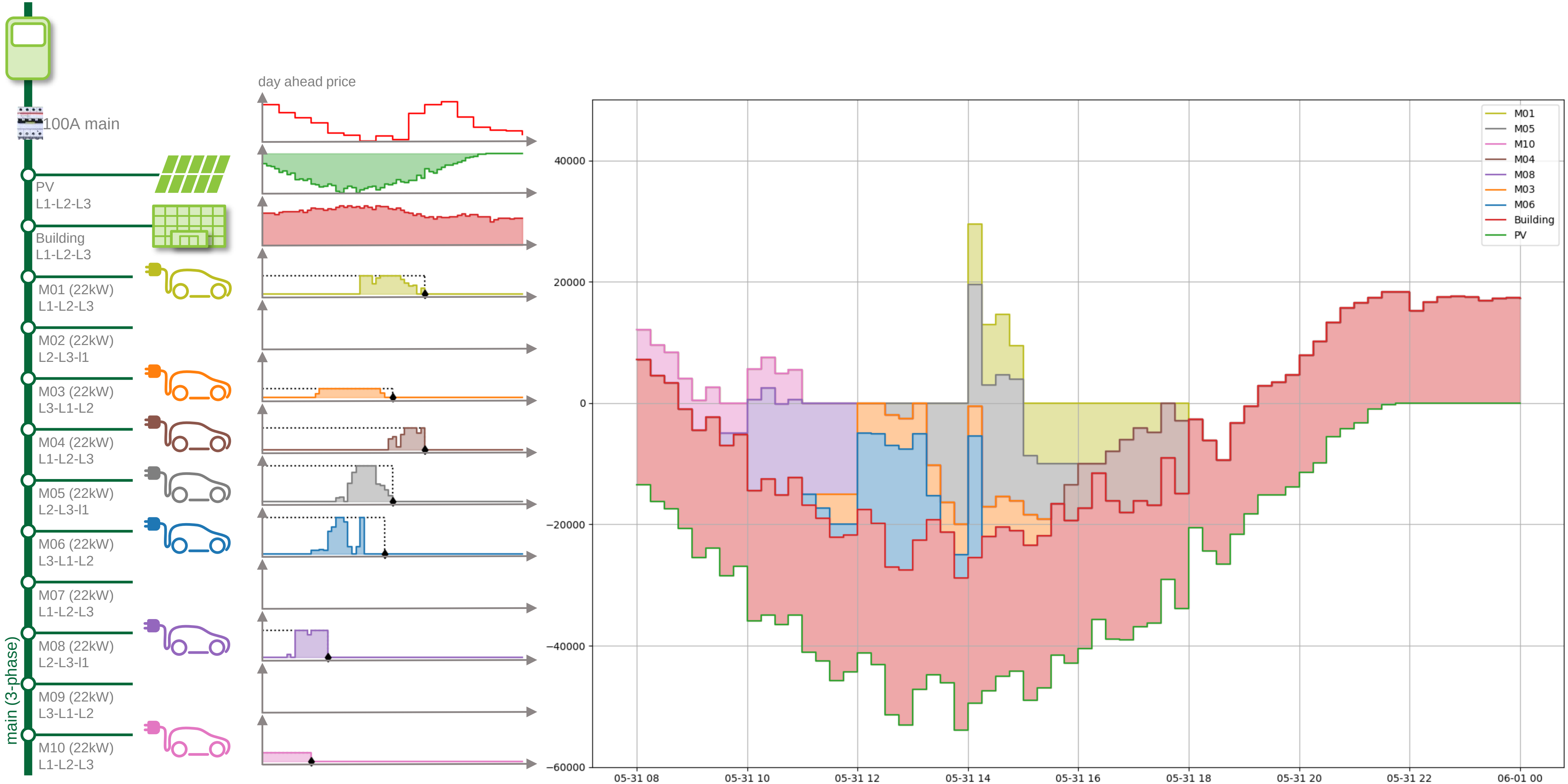
Step 8: 6th car → shifts before last car on PV





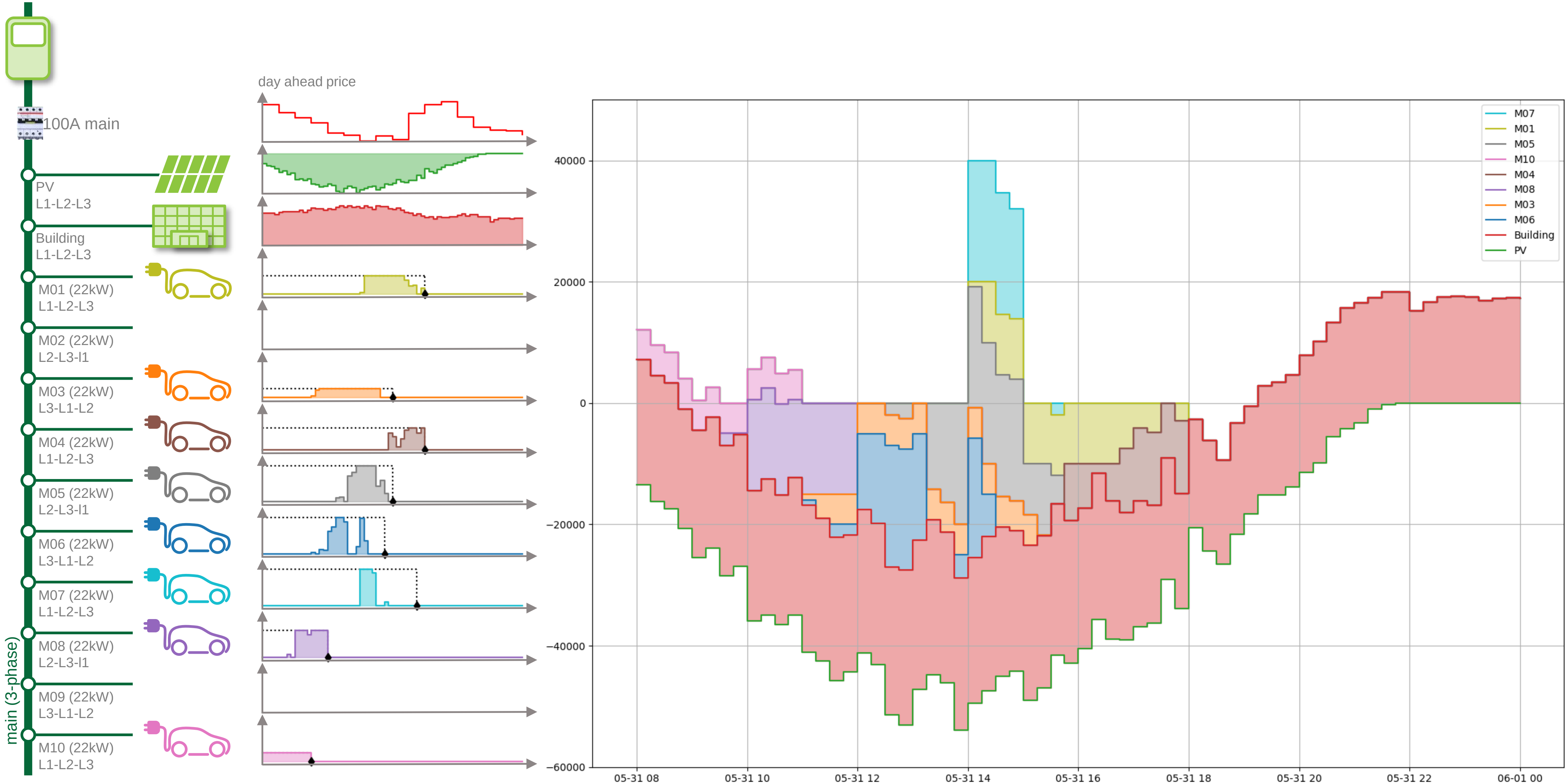
Example optimization

Step 9: 7th car → starts using the cheapest day ahead price



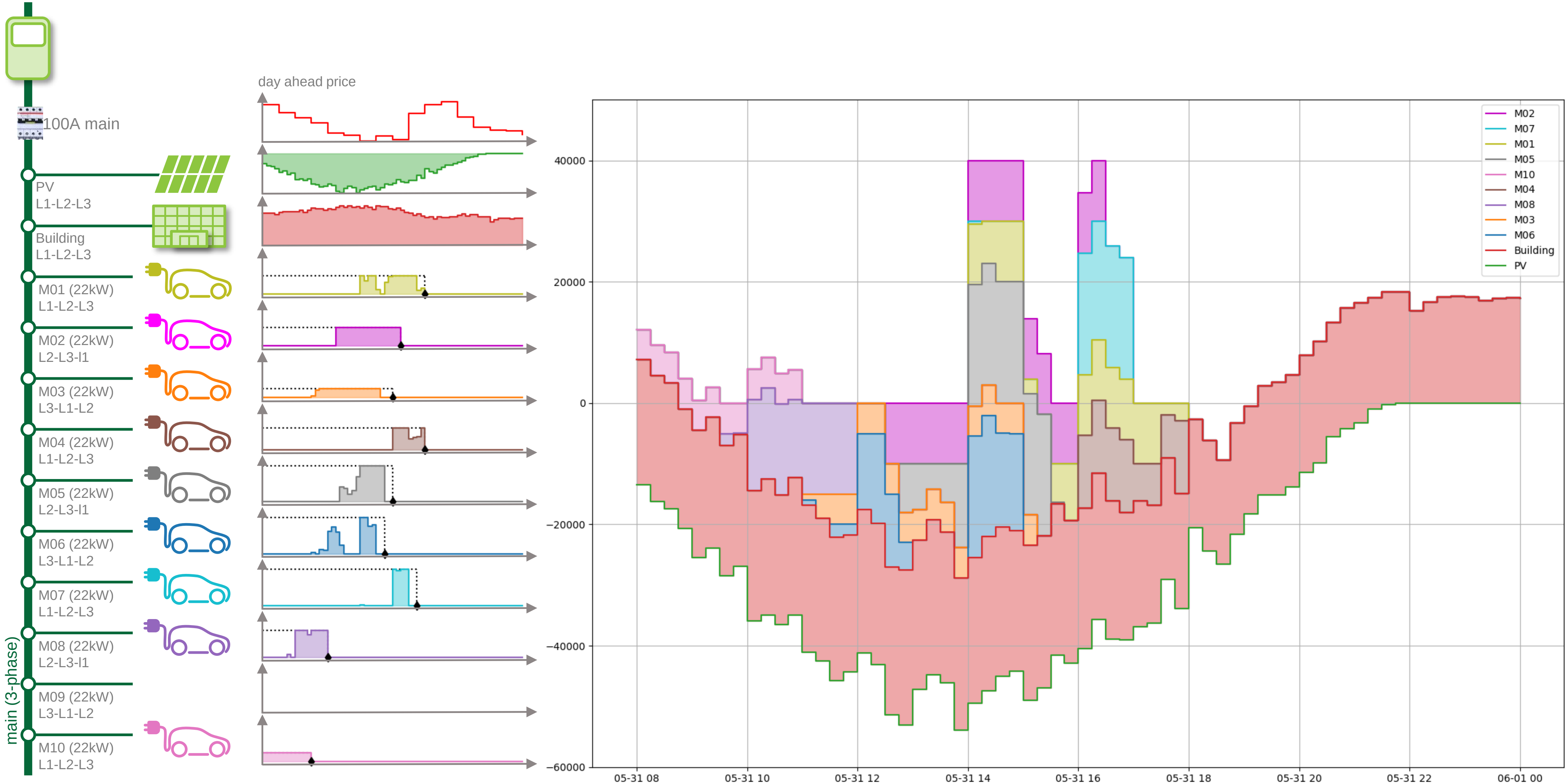
Example optimization

Step 10: 8th car → continues using the cheapest day ahead price



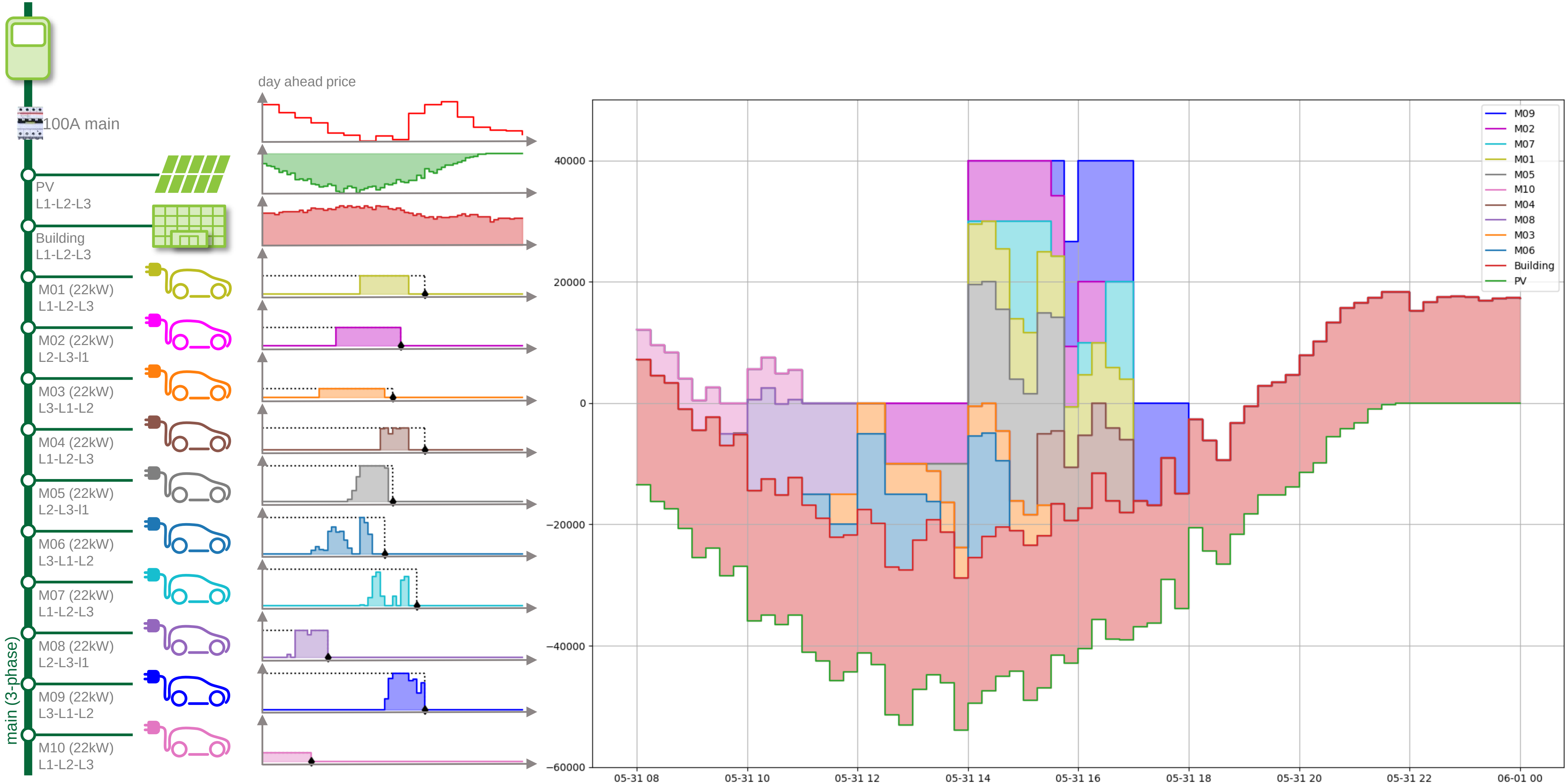
Example optimization

Step 11: 9th car → capacity price kicks in, second cheapest DA spot



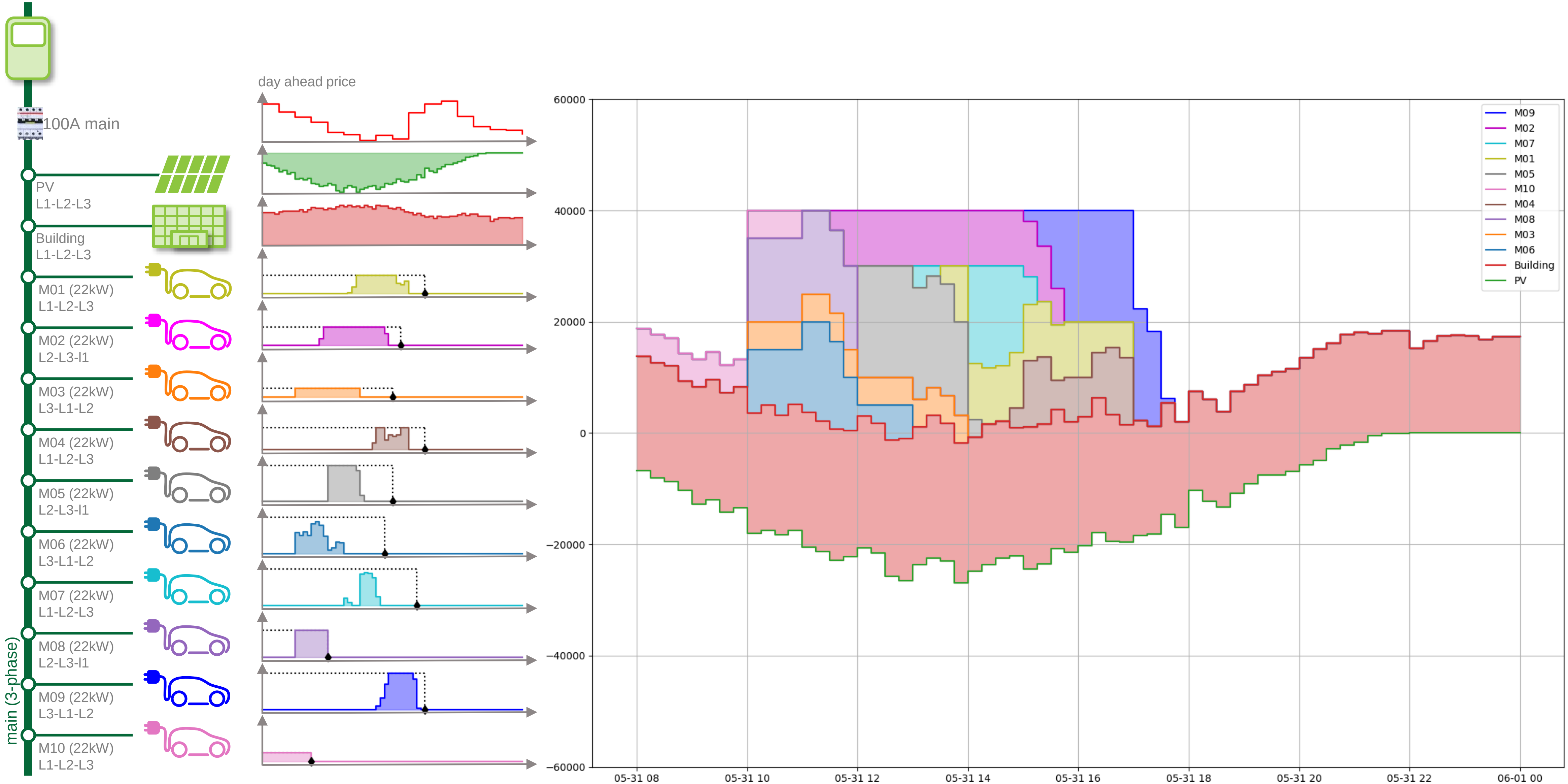
Example optimization

Step 12: 10th car → keeps spreading peak at 40kW



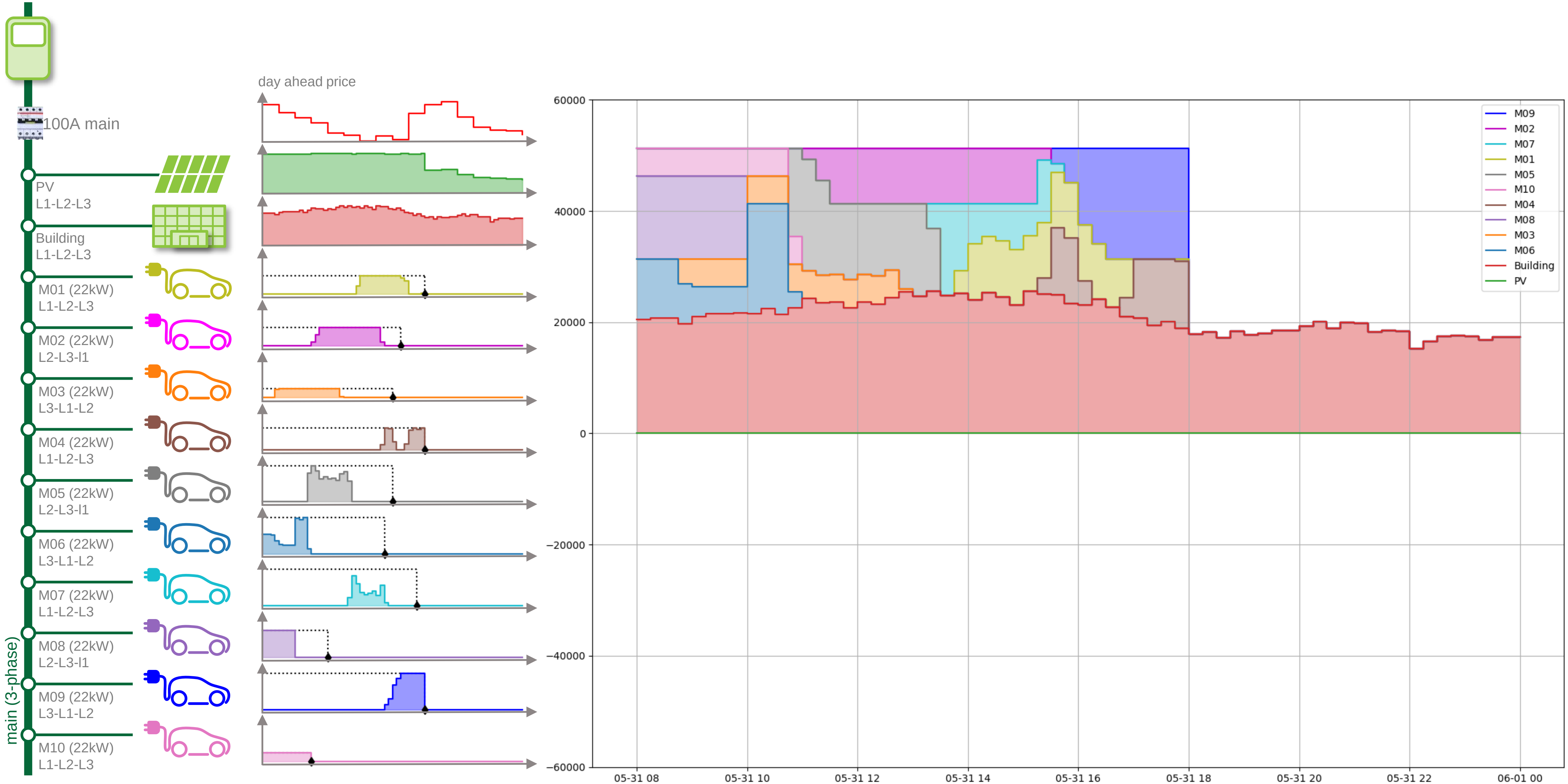
Example optimization

Step 13: Reduced PV → planning focuses on the 40kW peak



Example optimization

Step 14: No PV → new peak can not be avoided but as low as possible



Some final thoughts

- Results in practice → see later presentations
- MPC keeps making the best of all situations
- Collecting user data is a challenge and is not streamlined today

Q&A Session

Moderator Prof. Johan Driesen – KULeuven / EnergyVille

Agenda

HUME

12u00-13u00: Registration & Sandwich Lunch

- ✓ 13u00-13u05: Welcome (VITO – Carlo Mol – Moderator)
- ✓ 13h05-13h15: HUME within the FLUX50 activities on collective energy solutions and flexibility (FLUX50 –Patrick Devos)
- ✓ 13u15-13u25: HUME measurement sites: challenges/opportunities (VITO - Wim Cardinaels)
- ✓ 13u25-13u35: Charging ahead: Insights into EV driver behaviour and preferences (VITO - Guillermo Borragán)
- ✓ 13u35-13u55: Using smart charging to optimize parking and building energy flows (KULeuven - Klaas Thoelen & VITO - Jef Verbeeck)
- ✓ 13u50-14u10: Looking deeper into the charging hardware: electrical systems and operating efficiencies (KULeuven - Johan Driesen)
- ✓ 14u10-14u40: New insights in service and business models for EV charging (Blink Charging – Thais Lopez & MOVE – Jasmien Vanvooren)

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- ✓ 15h30-15h50: HUME integrated architecture (VITO - Dominic Ectors)
- ✓ 15h50-16h30: An overview of the HUME demonstration sites
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17h30-19h00: Reception & Networking

Looking deeper into the charging hardware: electrical systems and operating efficiencies

Johan Driesen, Mohamed Yasko, Attila Balint

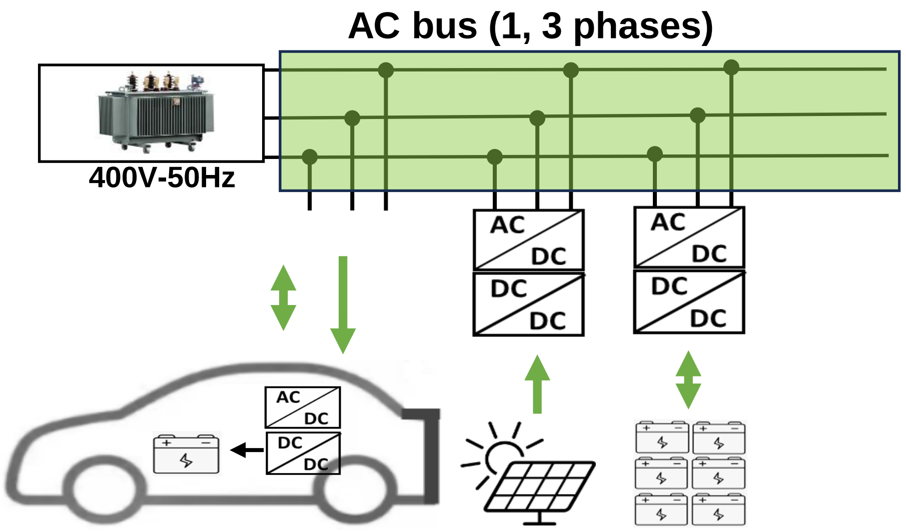
KU Leuven/EnergyVille

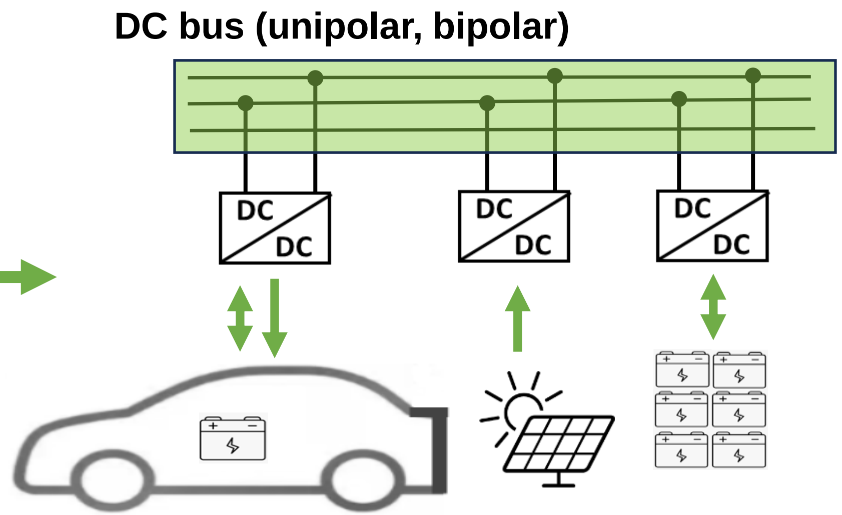
14 November 2024

Content

- Electrical system architecture
- Charging efficiency tests
  - ❑ AC charging system
  - ❑ V2G charging system
  - ❑ DC fast charging system
- Main contributions
- Future Works

Electrical system architecture





Operating Efficiency?

mature protection system
standardized technology

complex control
more conversions
power quality issues

simple control
less conversions
less power quality issues

Better integration of PV/BESS

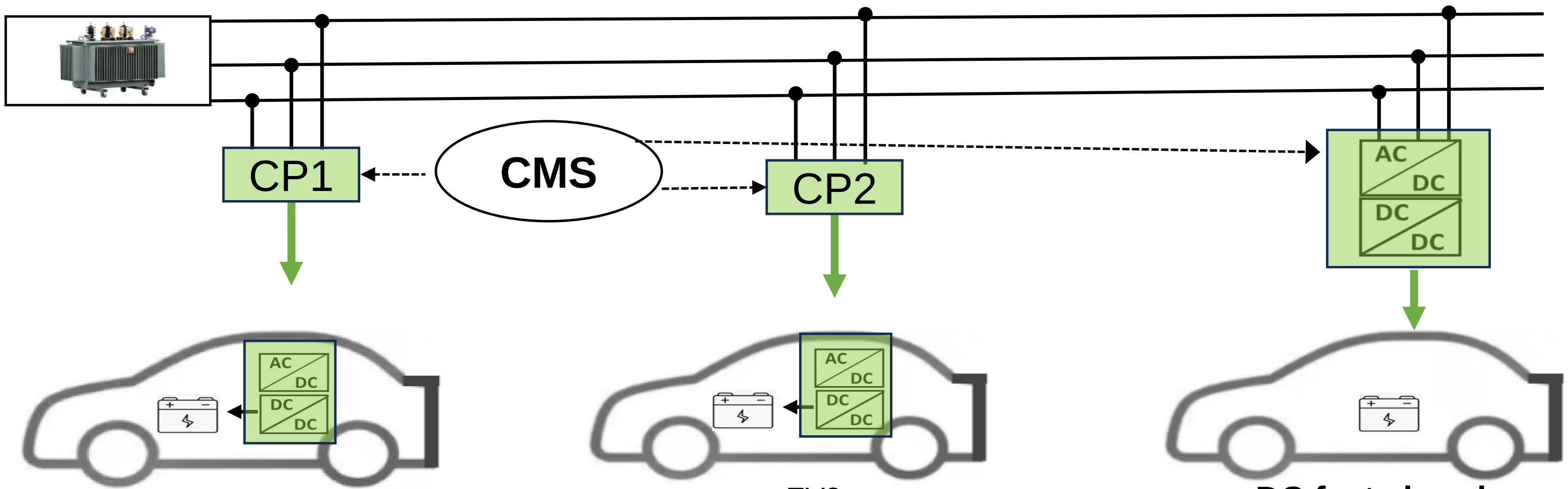
complex protection system
non-standardized technology

What is important for a CPO from an operation/business perspective?

CPO: charging point operator
BESS: Battery Energy Storage Systems

Electrical system architecture

Large scale EV charging system



EV1
Charger efficiency
SoC…kWh
Battery NMC
Time flexibility

EV2
Charger efficiency
SoC…kWh
Battery LFP
Time flexibility

DC fast charging
Charger efficiency
SoC…kWh
Battery LFP/NMC
Time flexibility

Impact of operating efficiency?

CP: charging point
CMS: charging management system

Content

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- Charging efficiency tests
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  - ❑ V2G charging system
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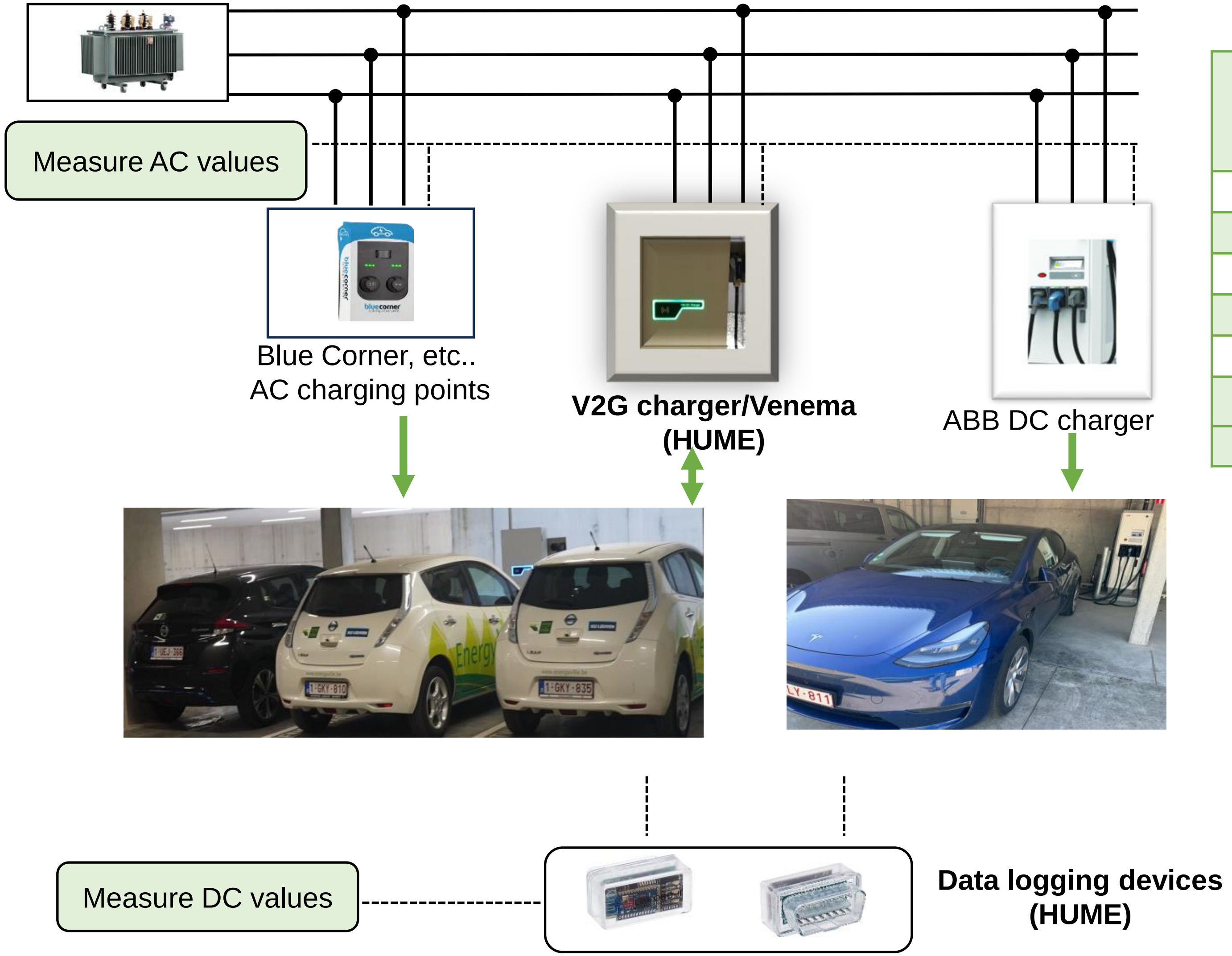
Charging efficiency tests

Selected testing works

Research works	Country-Year	Charging tech.	EV models diversity	Testing env.	Max power (kW)
A. Elpiniki et al.,	USA-2017	AC/V2G	Yes	Field/Lab	18
W. Schram et al.,	NL-2020	AC/V2G	Yes	Field	10
B. Reicket et al.,	DE-2021	AC	Yes	Field	11
K.Sevdari et al.,	DK-2023	AC/DC	Yes	Field	22
S. Silva et al.,	NZ-2023	AC/DC	Yes	Field	50
HUME	**BE-2024**	**AC/V2G/DC**	**Yes**	**Field**	**50/150/250**

Charging efficiency tests

Measurement setup (EnergyVille site)

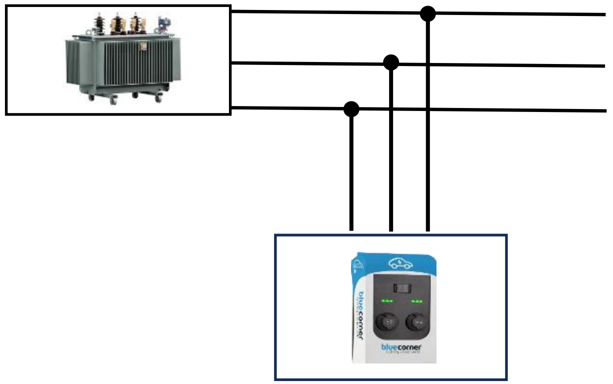


EVs	Models	Bat. Tech.	Bat. (kWh)	AC (kW)	DC (kW)	V2G
1	Nis. Leaf	LMO	24	1.3-6.6	46	Yes
2	Nis. Leaf	LMO	24	1.3-6.6	46	Yes
3	Nis. Leaf	NMC	40	1.3-6.6	50	Yes
4	Peug. e 208	NMC	46	1.3-7.4	150	No
5	Renault Zoe	NMC	25	4.4-43	-	No
6	Tesla Y SR	LFP	58	4.4-11	170	No
7	Tesla Y LR	NCA	75	4.4-11	250	No

Combination of personal and company EV models with different energy requirement and power capabilities representing the EV industry

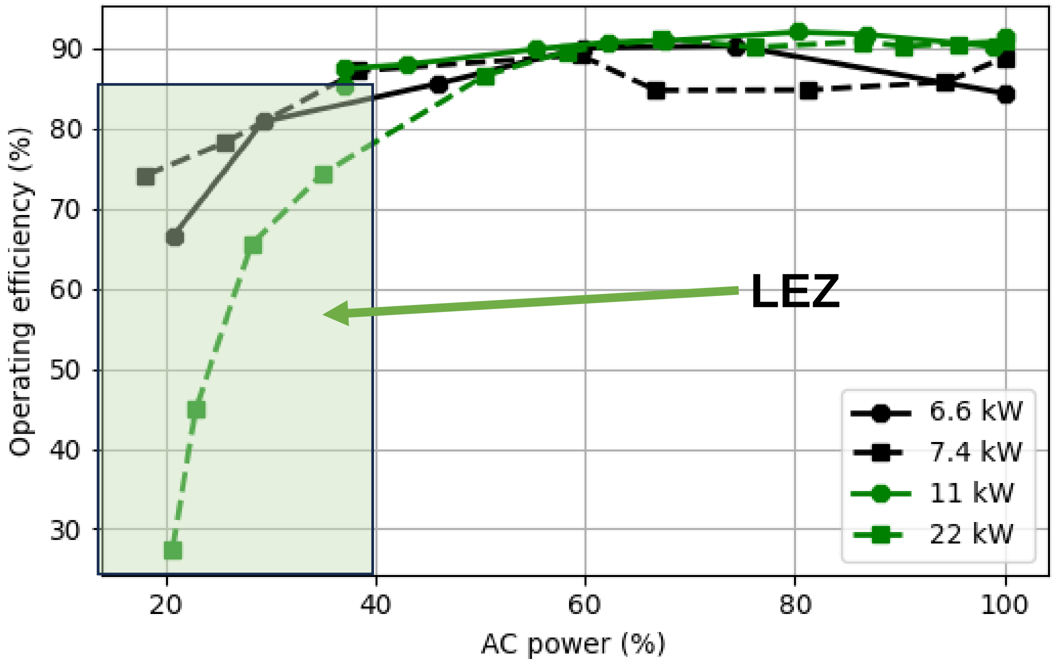
Charging efficiency tests

❑AC charging system



AC charging points

Operating efficiency at different charging power level



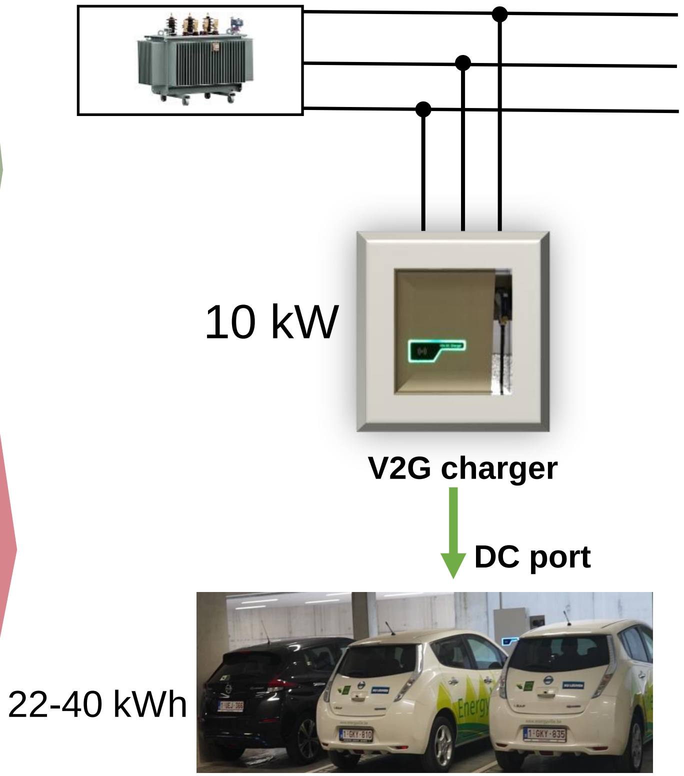
40% charging power level means less than 85% efficiency

M. Yasko, J. Driesen and W. Martinez, "Efficiency measurement and maximization for EV charging technologies," IEEE Transportation Electrification Conference and Expo (ITEC), Chicago, IL, USA, 2024.

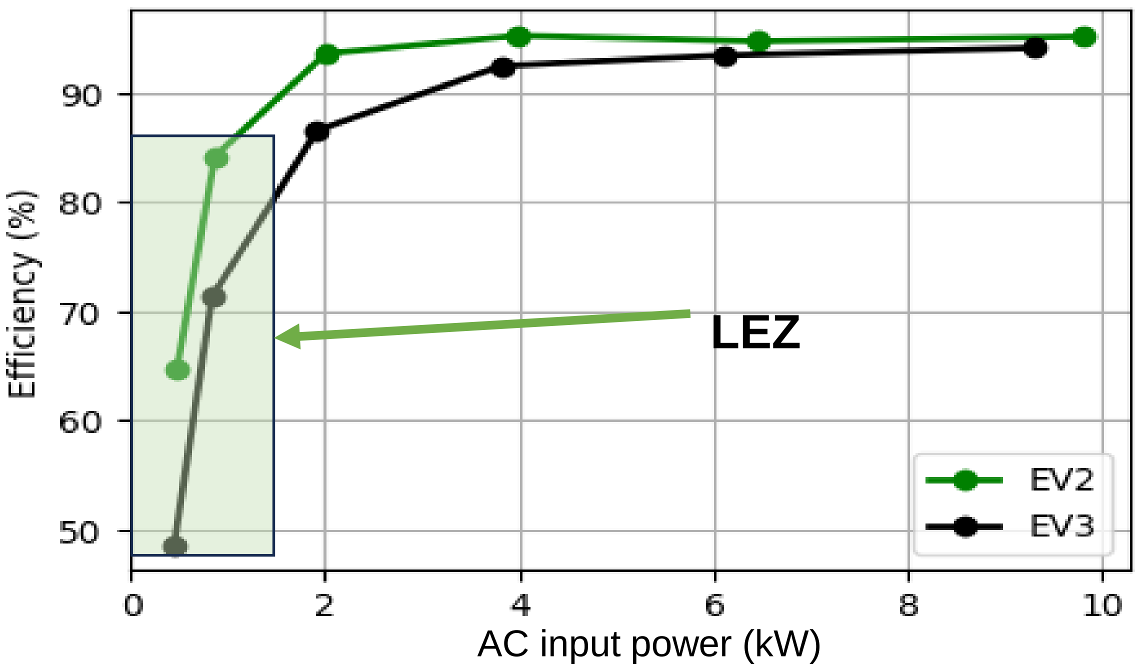
LEZ: Low Eff. Zone

Charging efficiency tests

❑V2G charging system



Operating efficiency at different charging power level



10-15% charging power level means less than 85% efficiency

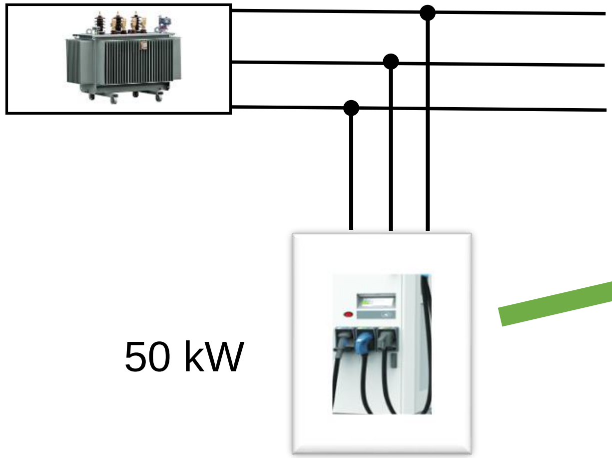
Round trip efficiency could be very low if V2G is operated in LEZ

M. Yasko, J. Driesen and W. Martinez, "Efficiency measurement and maximization for EV charging technologies," IEEE Transportation Electrification Conference and Expo (ITEC), Chicago, IL, USA, 2024.

LEZ: Low Eff. Zone

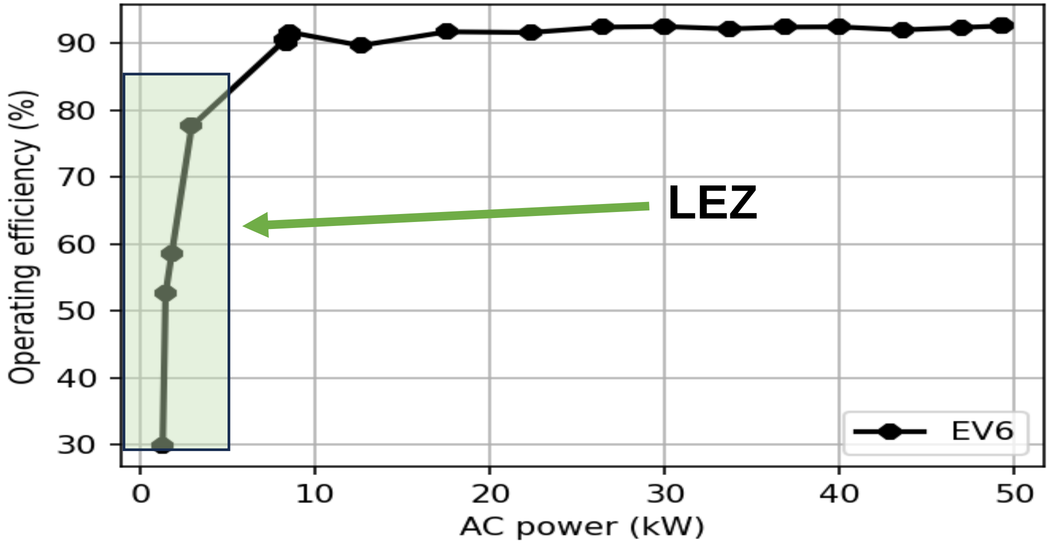
Charging efficiency tests

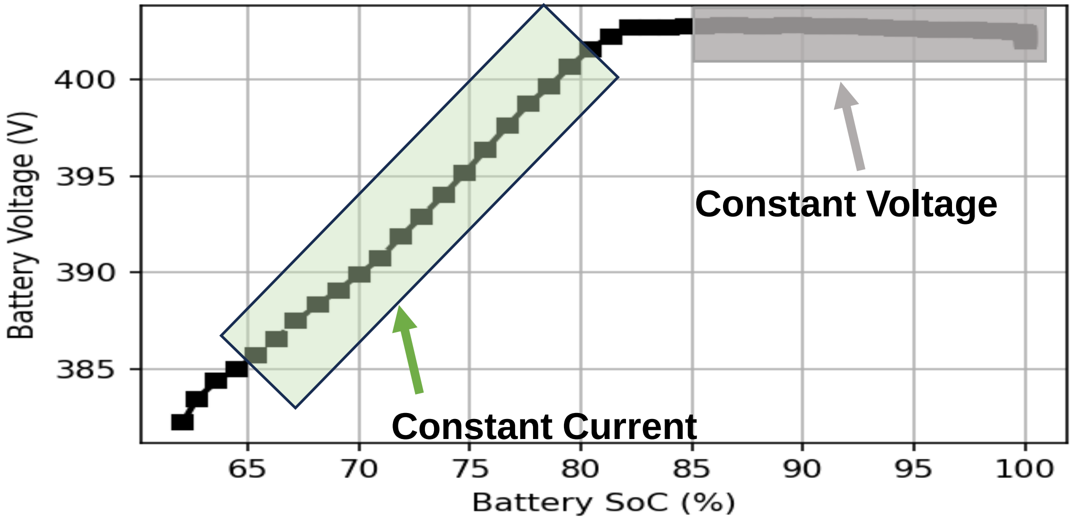
❑DC charging system – 50 kW



75 kWh

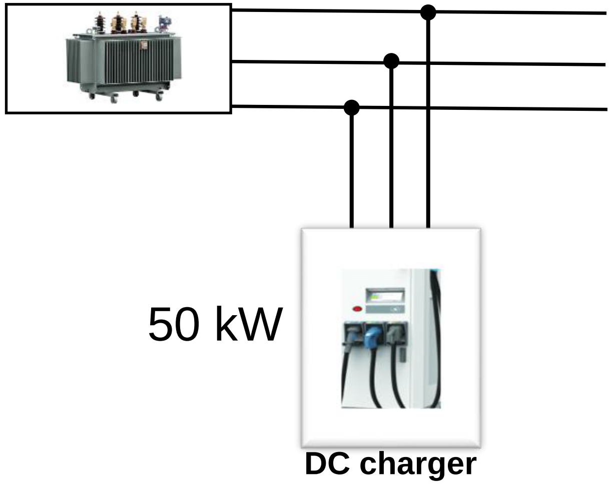
12% charging power level means less than 85% efficiency (modular design)





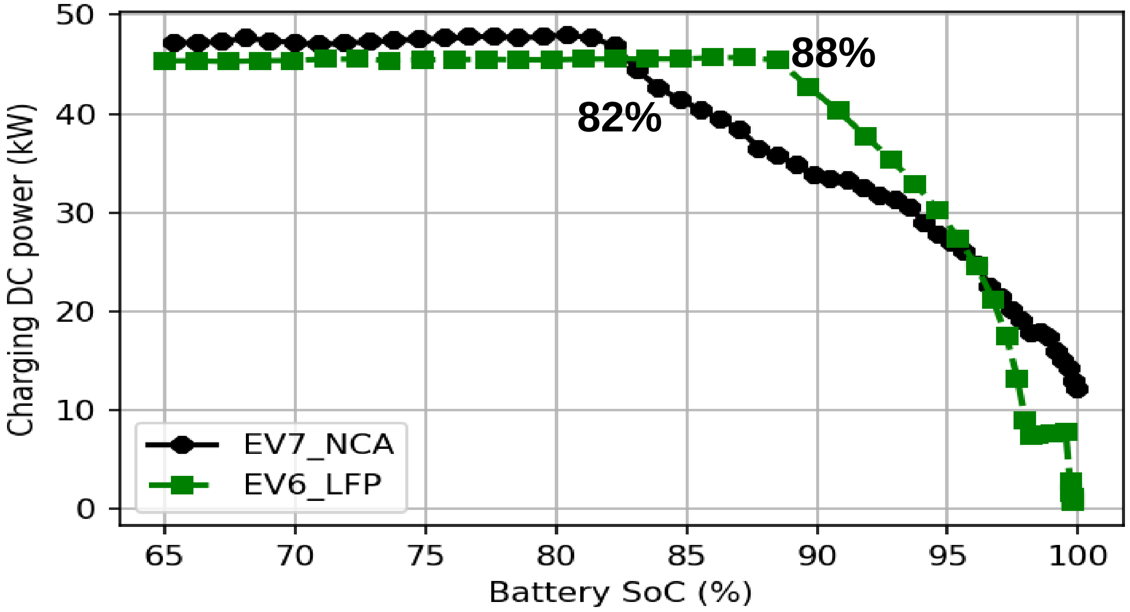
Charging efficiency tests

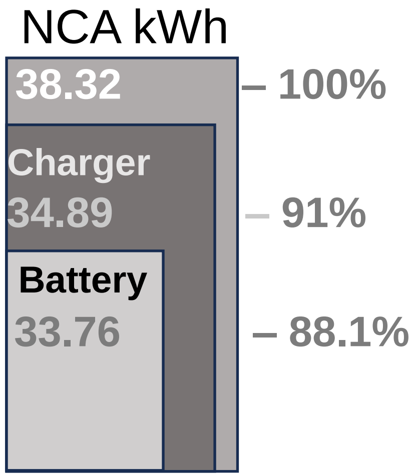
❑DC charging system – 50 kW

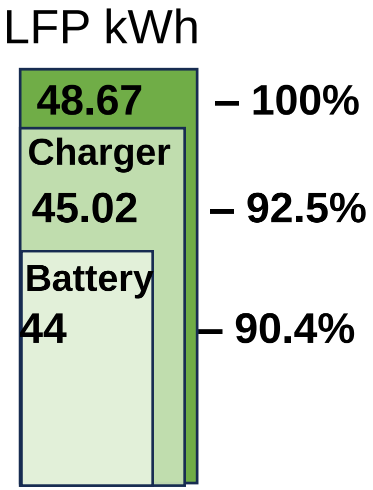


75 kWh

Duration= 80 min
SoC = 61-100%
Temp.= 32-57°C



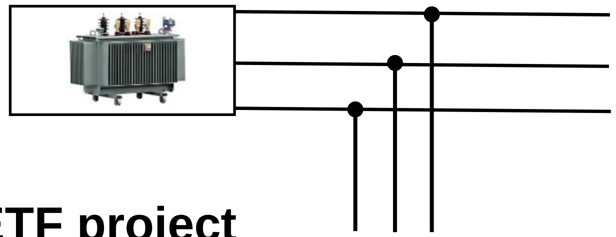




Duration= 73 min
SoC = 28-100%
Temp.= 22-47°C

Charging efficiency tests

❑DC charging system – 150 kW



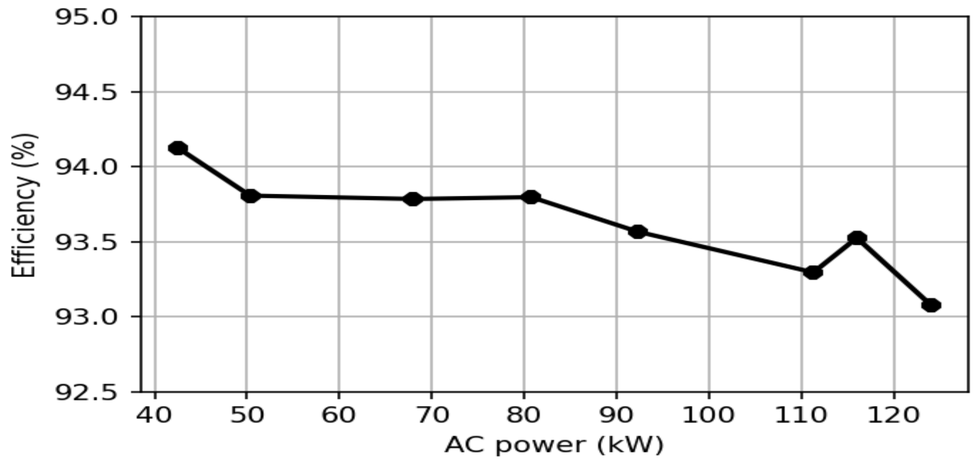
ETF project

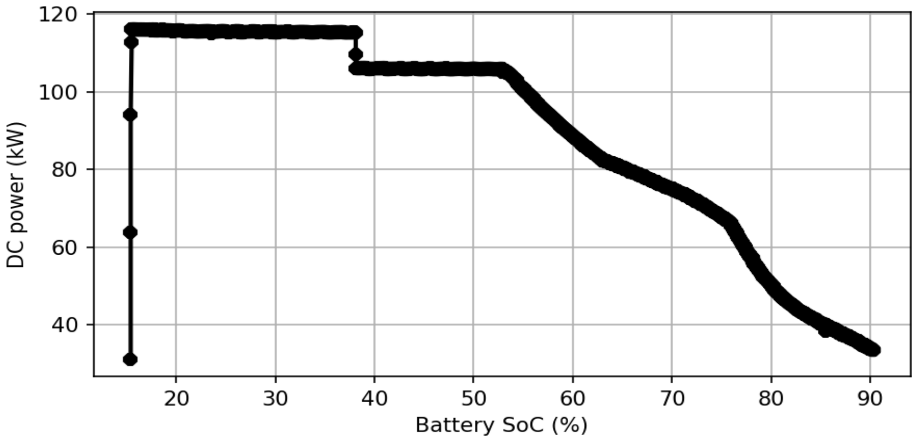
150 kW

Alpitronic DC charger

75 kWh

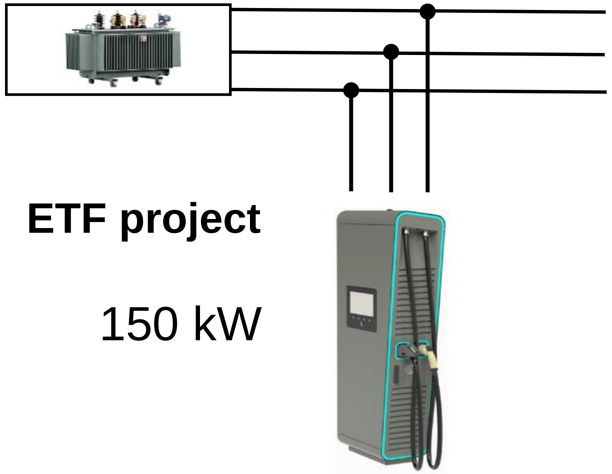
Efficiency 93-94% (modular design, 25-80% of rated power)





Charging efficiency tests

❑DC charging system – 150 kW



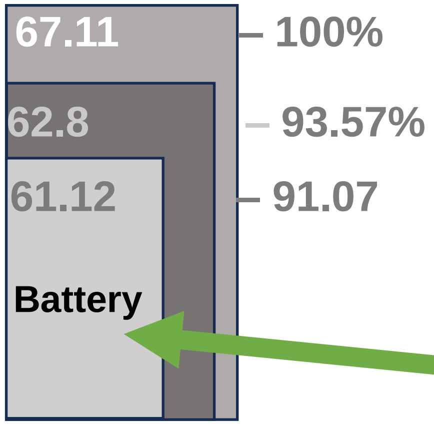
ETF project

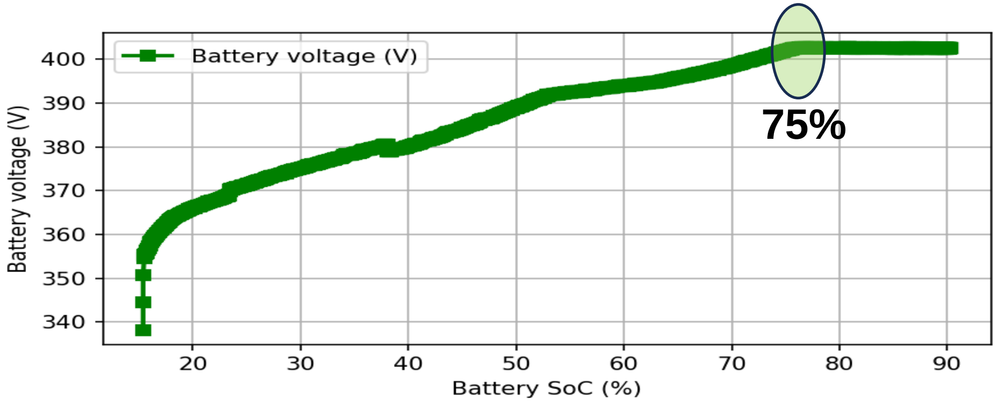
150 kW

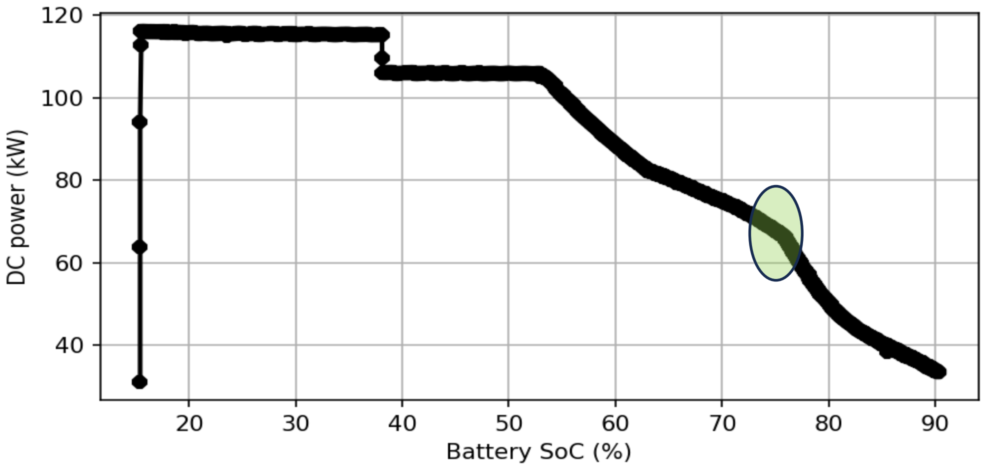
Duration= 48 min
SoC = 15-90%
Temp.= 40-61°C

75 kWh

NCA kWh







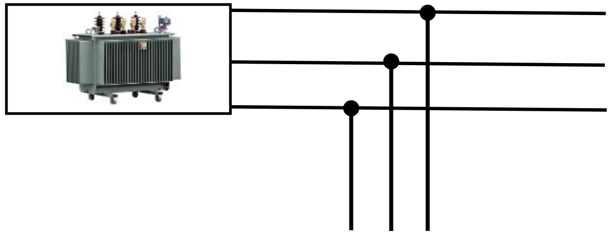
Efficiency for 1.5C is around 95.9%

Battery internal eff. (not measured in this project)

L. Uwalaka, et al. "Experimental Performance Analysis of LG E-66 Cells from a Fast-Charging Porsche Taycan Battery Module," IEEE Transportation Electrification Conference and Expo (ITEC), Chicago, IL, USA, 2024,

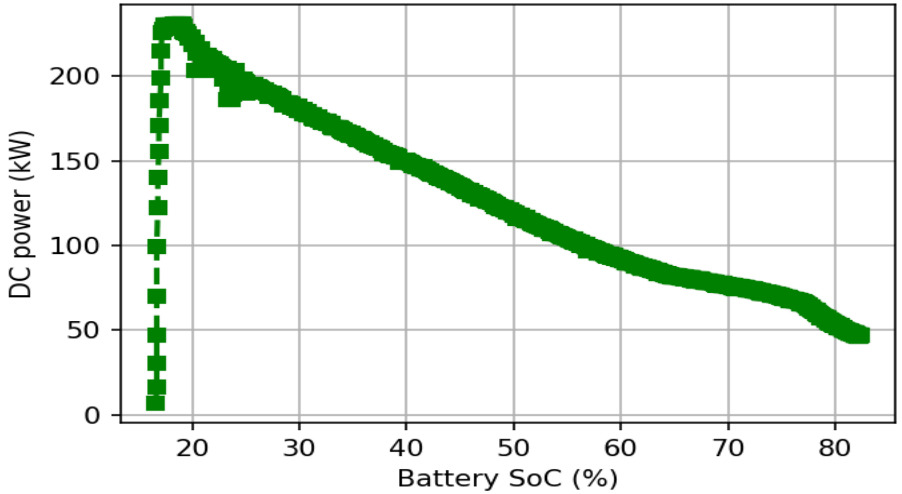
Charging efficiency tests

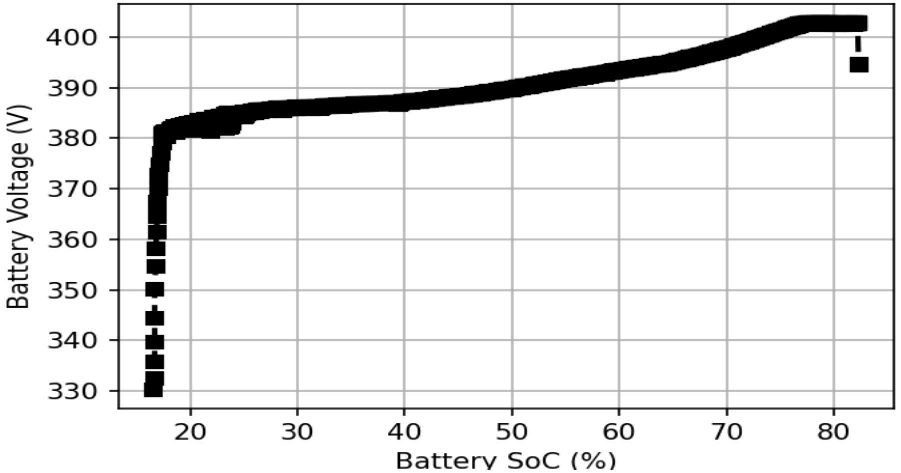
❑DC charging system – 250 kW (ongoing)



250 kW

75 kWh





Charging efficiency tests

HUME

❑AC system (On-board)

Charger 11 kW/22 KW

Low charger kW/Batt. kWh

Batt. tech.

Efficiency range can go lower than 85%

❑DC system (Off-board)

V2G 10 kW round trip eff.

charger 50kW/150kW

High charger kW/batt. kWh

Batt. tech.

Efficiency range= 90-94% (general)

EV users can limit the power…impact on the smart charging strategy and business model??

System knowledge: CPO, charging system integrators/designers, EV user etc…

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Main contributions

HUME

❑Project partners:

Detailed knowledge sharing with deliverables (D3.1, D3.2, D3.3, D3.4)

Efficiency consideration in:

-user input estimation improvement (WP2)

-upper-level optimization (WP2/WP5)

❑BE and worldwide:

Energy Transition Fund project (CPO related research),

Industry in Electric Vehicle Symposium (Seoul/Korea),

Academia (improving modeling), paper cited, etc…

M. Yasko, A. Balint, J. Driesen and W. Martinez, "Future workplace EV charging architectures: DC and AC charging choices," IEEE Conference on Electrical Systems for Aircraft, Railway, Ship Propulsion and Road Vehicles & Transportation Electrification Conference (ESARS-ITEC), Venice, Italy, 2023.

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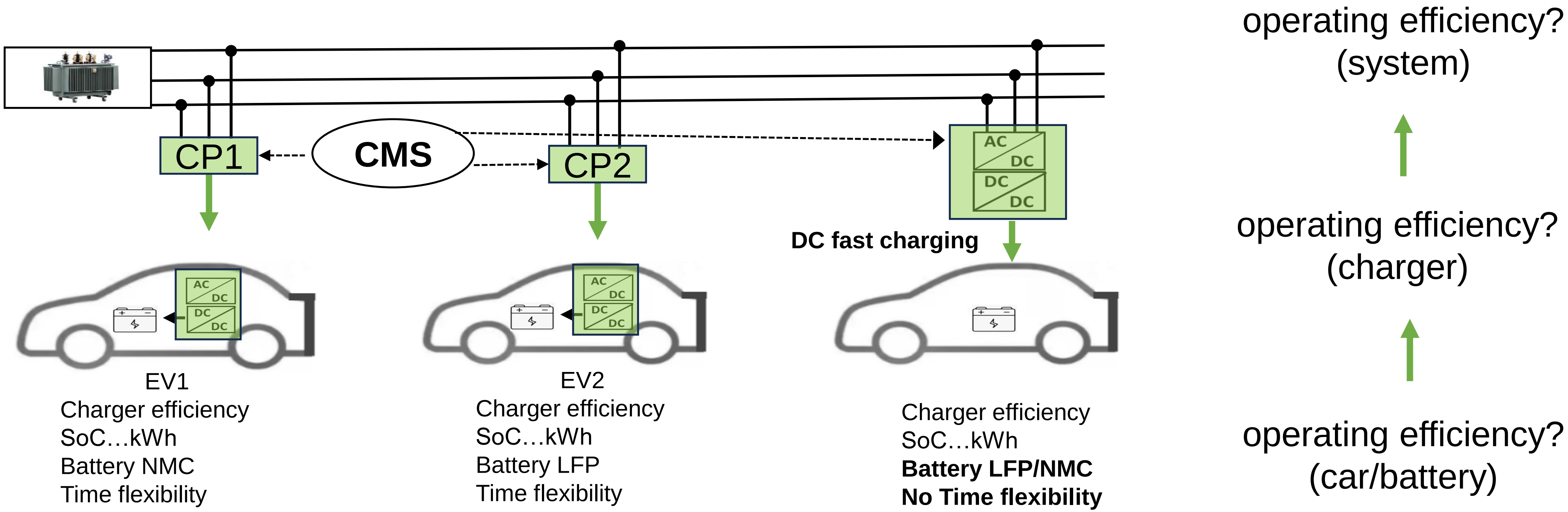
Future works

- ❑Collect more measurement at 250 kW (Tesla supercharger)/ 300 kW (Fastned)
- ❑Build models based on realistic operating conditions
- ❑Train AI models to predict/control **system efficiency**



Testing/controlling capabilities for higher power are needed

CP: charging point
CMS: charging management system

HUME

Thanks

Q&A Session

Moderator Prof. Johan Driesen – KULeuven / EnergyVille

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17h30-19h00: Reception & Networking

4.2 Value of new parking and charging services

Sam De Frene

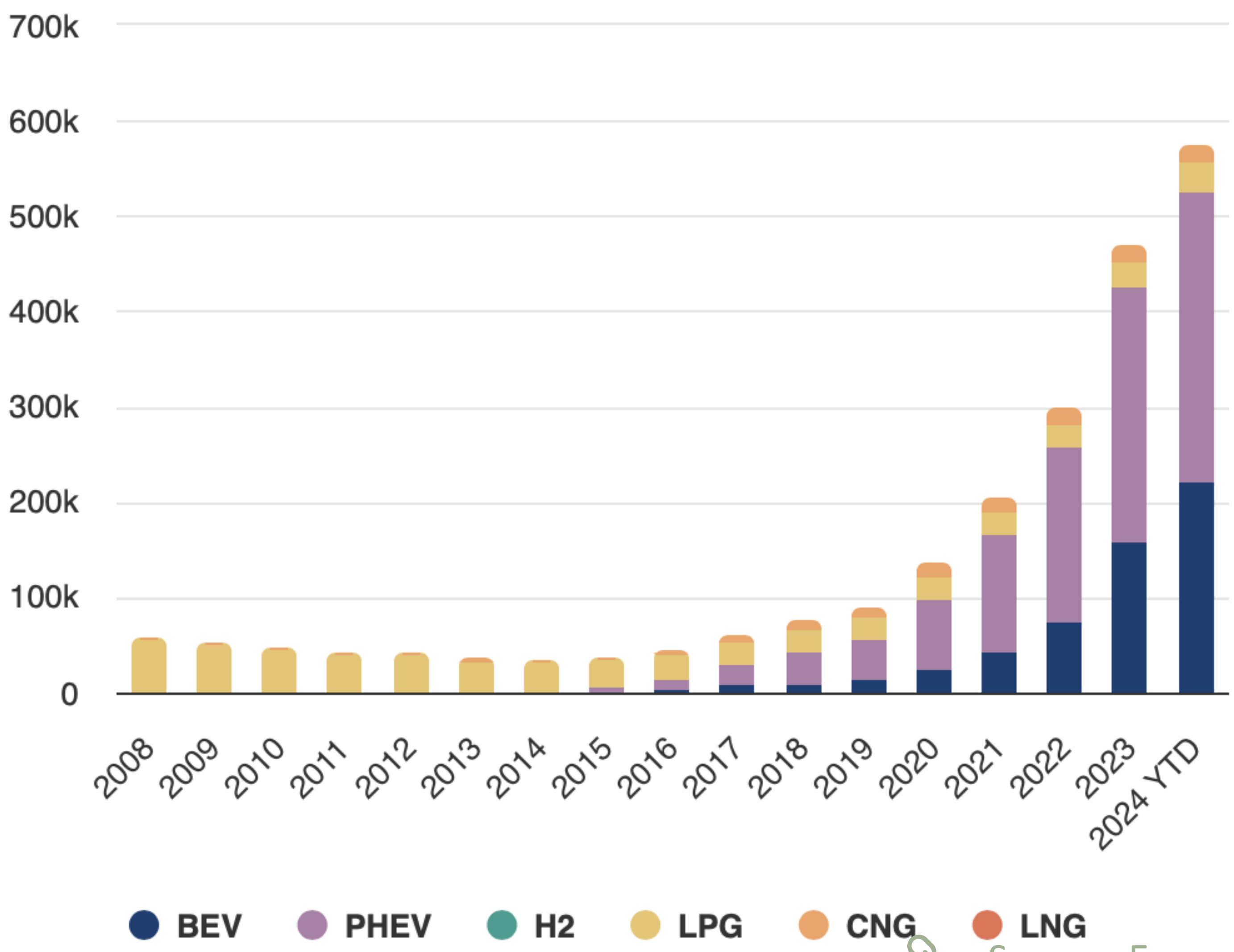
Blink Charging

Workpackage 4.2: goal

- Business impact of optimizing EV Charging spots
  - Increase amount parking spots with chargers
  - Increase utilization of EV spots
  - Decrease usage of non-renewable sources
  - Use charging flexibility to ensure grid stability

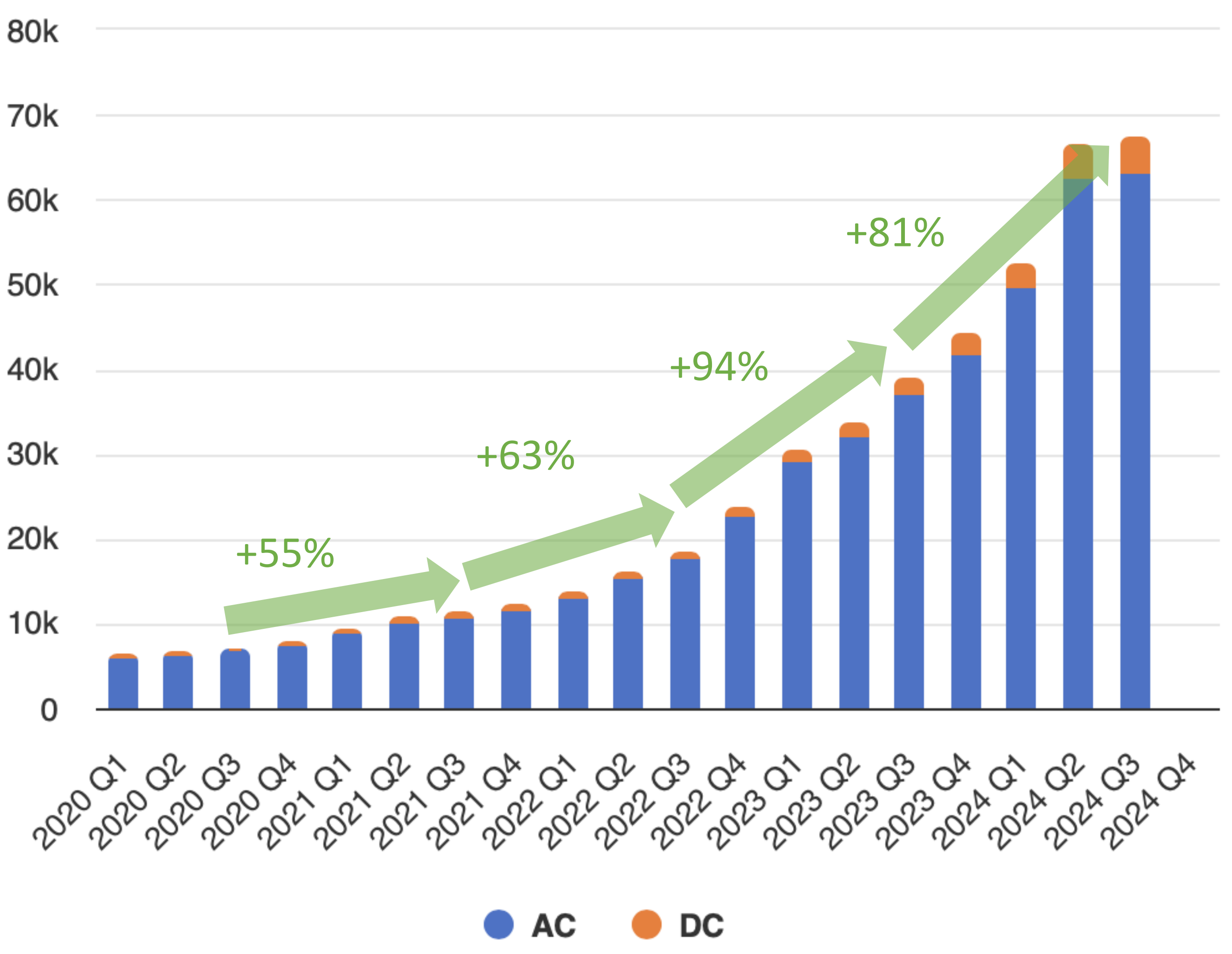
- Business model innovation within contractionary environment

EV Growth in Belgium



Source: European Alternative Fuels Observatory

AC and DC Chargers in Belgium



68.000 chargers

Source: European Alternative Fuels Observatory

Charging is more than technology

HUME

Understanding the EV Charging Ecosystem

Technology

People

Business Models

Charging Requirements

HUME

One charger per 75 citizens

Cities: want to give the streets back to its citizens

Car Ownership: 4 out of 10 citizens own a car

EV: 1 out of 3 cars will be electric in 2030

Target Europe: 1 EV charger per 10 EV's

Gent: 268.000 citizens → 107.200 cars → 35.700 EV's → 3.500 chargers

Antwerp: 536.000 citizens → 214.000 cars → 71.500 EV's → 7.000 chargers

Where will we charge?

Paal volgt wagen?

Al 1.300 publieke laadpalen aangevraagd. "We zitten op schema"

Sinds september 2022 kun je een publieke laadpaal aanvragen in het kader van het "Paal volgt Wagen"-initiatief. Er zijn ondertussen 1.300 aanvragen ontvangen. Volgens Vlaams minister van Mobiliteit Lydia Peeters (Open VLD) loopt alles volgens plan en zit de installatie van laadpalen op schema.

Aanvragen voor "Paal volgt wagen" zijn er genoeg: 1.300 sinds september 2022. Er zijn er ondertussen 46 actief, 165 wachten nog op een aansluiting door Fluvius.

Cities have their Plans…

Oslo bant auto's uit centrum hoofdstad

19 oktober 2015 19:29

In het centrum van de Noorse hoofdstad Oslo zijn vanaf 2019 geen wagens meer toegelaten. De overheid wil zo de uitstoot van broeikasgassen met de helft verminderen, aldus de Arbeiderspartij, de Linkse Socialistische Partij en de Groenen, die na de verkiezingen van 14 september Oslo zullen leiden. In de zone die autovrij wordt, woont slechts een duizendtal mensen, maar werken wel ongeveer 90.000 anderen. Het is nog niet bekend welke voorwaarden zullen gelden in de zone, maar de handelaars in de winkelcentra in het centrum van de stad vrezen voor minder inkomsten.

Gent, ineens een voetgangers-oase maar nog wel met kinderziekten

Van de ene dag op de andere is Gent totaal veranderd. Waar eerst de auto regeerde, hebben nu voetgangers en fietsers het voor het zeggen. De ervaringen van het autoluwe Groningen dienden als richtlijn.

Leen Vervaeke 5 april 2017, 02:00

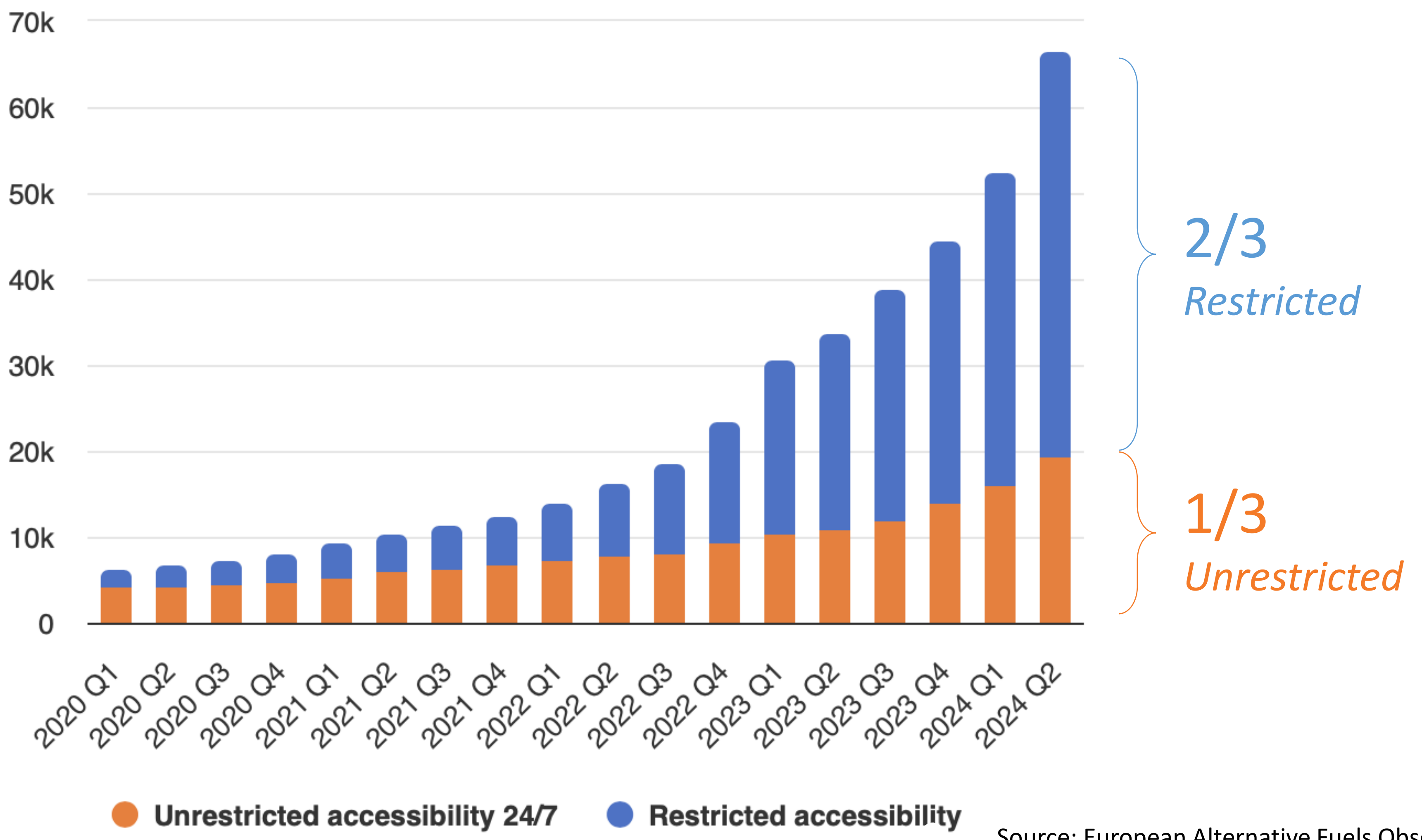
Antwerpen bant straatparkeren voor bezoekers binnenstad: 'Nieuwe parkeerregels zullen stad aangenamer maken'

How to get more chargers?

…without the need for more public space

1. Shared use of infrastructure
2. Transform private to semi-public
3. Optimized hubs outside city center
4. Innovation

Better access Semi-Public



Source: European Alternative Fuels Observatory

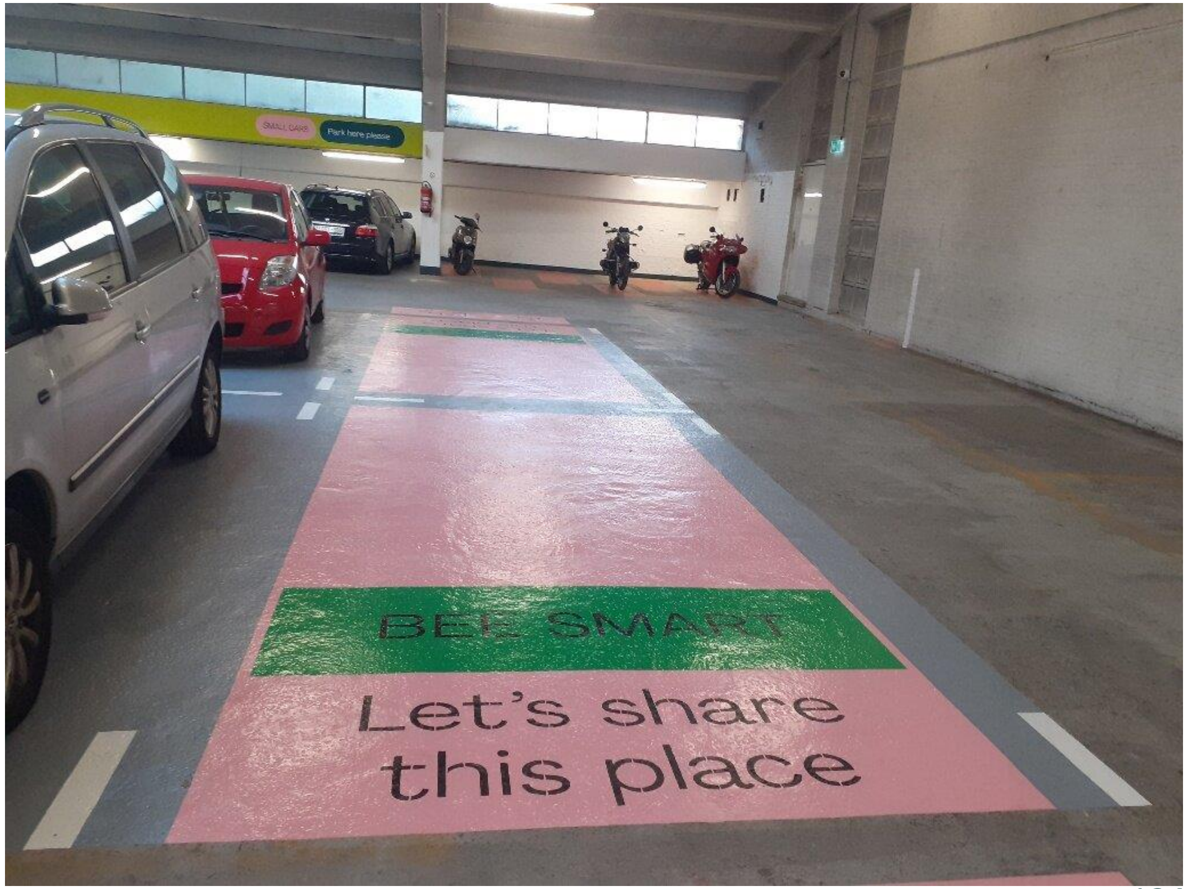
Better access to semi-public

Optimized Charging Islands

Neighbourhood parkings and association of co-owners

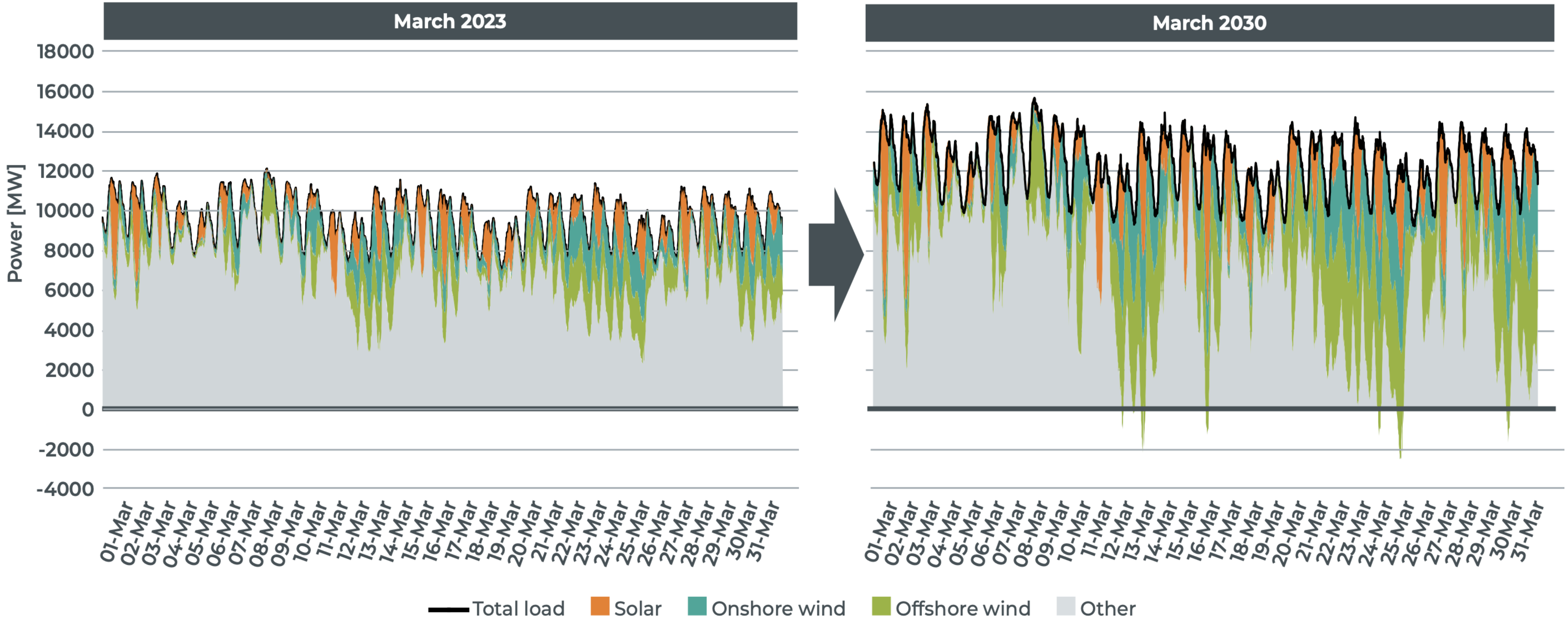
How to get more chargers available

…and parking



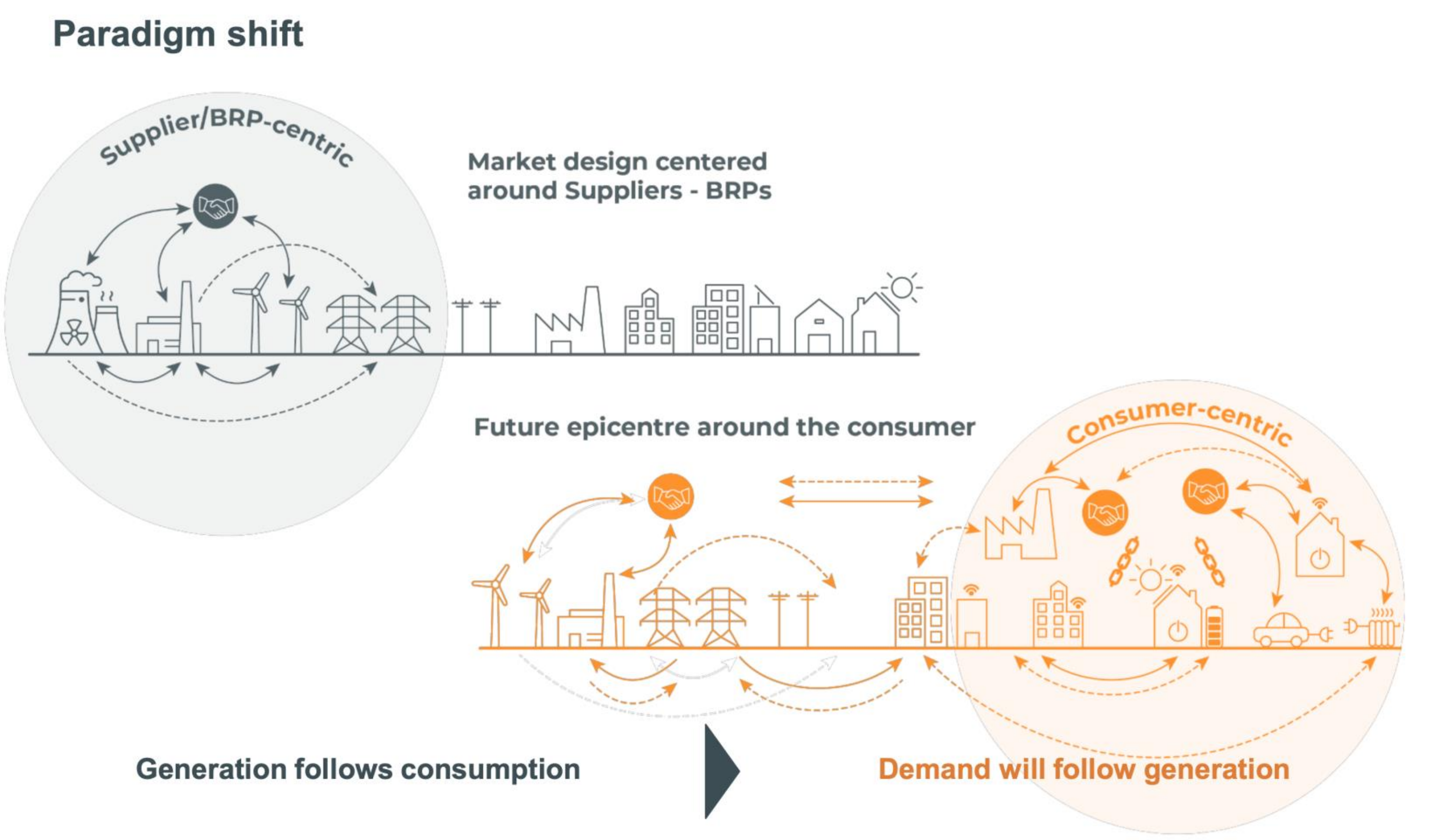
What about electricity and grid capacity?

Evolution of RES and Consumption: exprapolated



Source: Elia Adequacy & flexibility study for Belgium (2024-2034)

Energy System of the future = Consumer Centric



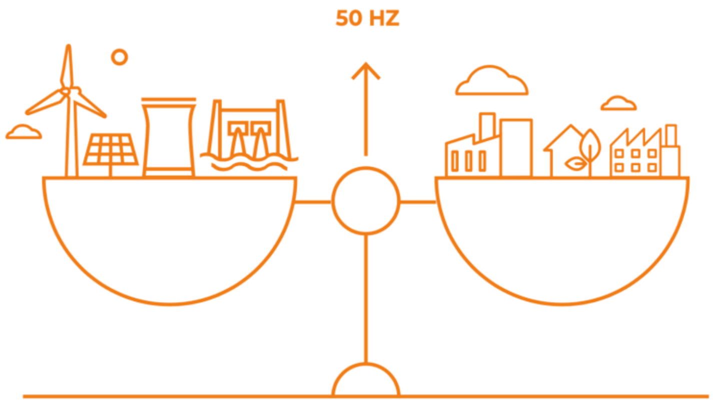
Demand follows generation: Flexibility

- Implicit Flexibility
  - Activation decided by owner
  - Price signal based

  - Day Ahead Market
  - Intraday
  - Imbalance

- Explicit Flexibility
  - Activation by Elia (hard signal)
  - Auction Based
  - Obligation to deliver

  - FCR
  - aFFR
  - mFFR



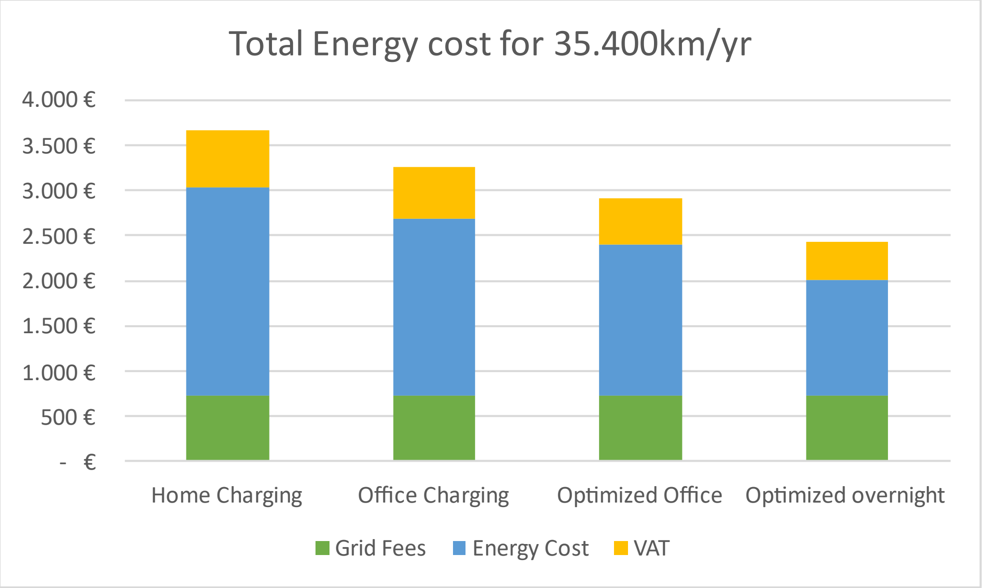
Day-Ahead based charging (Time of Use)

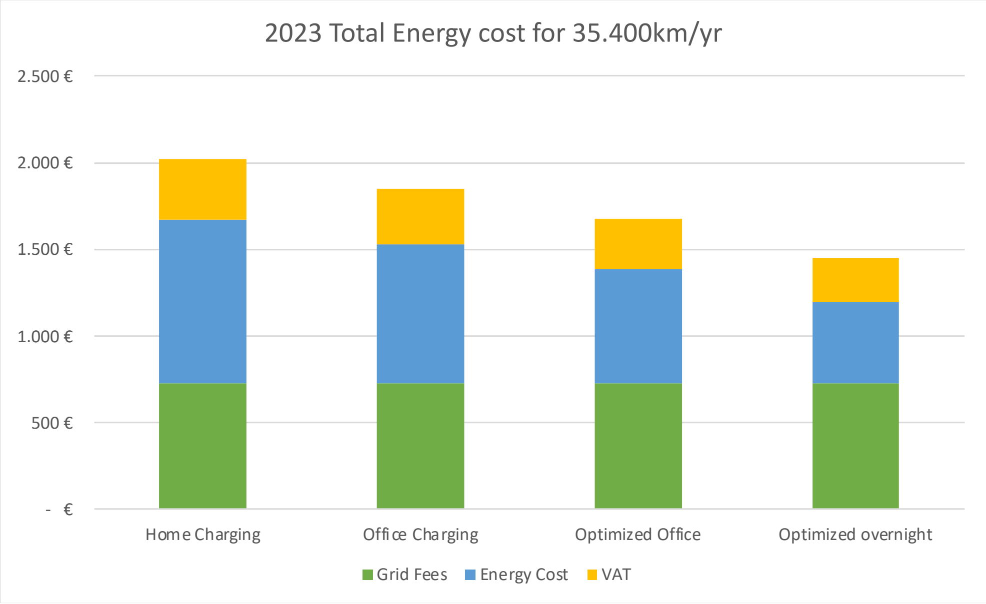
Prijs	Uur																							
Dag	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1	98,90	95,97	93,29	91,01	87,50	92,00	109,25	125,25	126,84	111,28	102,21	96,52	92,02	88,90	85,63	88,51	85,73	99,81	118,60	132,32	133,57	127,80	118,56	114,65
2	107,46	102,70	100,00	94,78	87,83	81,96	99,09	101,09	100,22	94,58	89,77	79,90	76,00	62,99	55,35	69,40	80,01	93,45	110,00	121,86	126,90	115,19	105,64	97,34
3	105,28	100,81	101,94	101,64	96,25	96,67	97,04	93,17	87,04	81,85	60,30	43,43	21,37	11,33	4,94	15,71	53,66	91,61	105,86	123,15	134,80	119,32	108,66	99,88
4	97,18	89,08	86,19	87,17	86,44	92,28	121,21	140,10	129,92	109,36	92,88	82,07	77,65	72,51	72,00	76,71	82,33	103,91	128,00	163,53	164,92	125,08	104,99	94,98
5	85,57	80,86	79,69	81,91	72,00	88,91	102,48	124,34	118,11	97,78	88,00	81,85	78,65	75,20	79,53	83,00	88,51	103,26	129,10	177,73	153,13	121,95	107,61	96,03
6	88,89	85,52	80,27	76,50	74,24	83,96	113,92	137,72	119,19	97,73	88,65	82,10	75,31	76,43	75,48	82,50	91,44	105,87	145,83	184,97	166,04	123,13	105,50	95,72
7	95,42	91,37	89,07	83,88	85,65	91,17	113,19	130,00	126,00	102,68	88,50	85,57	78,04	72,76	79,00	82,00	88,30	103,14	133,53	167,27	146,74	118,00	101,40	88,95
8	84,62	81,52	82,06	82,10	81,44	86,60	106,38	125,67	122,49	100,15	90,14	82,48	77,31	71,33	72,83	80,23	88,41	107,90	162,30	211,65	187,39	132,08	113,93	105,98
9	105,20	102,47	100,01	100,00	95,94	92,50	103,45	103,38	96,09	89,77	79,02	65,53	37,82	21,69	17,08	57,89	78,80	95,63	118,20	144,57	152,80	131,78	110,90	103,16
10	105,85	103,44	101,98	98,60	90,63	92,20	93,23	95,65	91,65	88,66	56,02	18,00	8,28	0,03	0,00	26,38	79,00	98,86	119,97	140,62	146,96	131,57	113,93	100,86
11	105,00	96,49	96,03	87,79	82,45	93,36	103,58	146,61	136,44	113,00	95,16	99,00	92,92	88,05	89,80	92,53	100,18	125,99	247,99	325,84	330,36	189,52	143,48	119,94
12	103,52	90,89	89,29	85,16	83,46	87,30	112,47	167,89	144,32	123,22	112,57	101,59	97,50	97,97	97,31	99,90	108,34	135,00	177,80	227,57	178,05	136,62	115,55	93,77
13	106,45	99,90	97,81	93,62	78,70	73,58	87,58	113,57	137,72	124,91	103,21	96,86	95,36	93,01	91,88	87,65	92,70	101,42	123,81	138,20	138,93	122,79	106,41	98,07
14	96,30	93,78	88,73	82,81	70,30	86,11	125,60	163,40	138,75	118,02	96,82	88,77	85,00	83,00	87,82	85,18	93,75	102,30	139,21	167,56	159,72	128,00	114,11	99,37
15	100,89	97,01	95,75	88,92	84,30	94,39	100,68	130,56	125,07	104,38	93,58	89,46	78,77	63,32	71,22	82,70	93,45	110,15	131,19	146,04	130,50	112,72	97,94	95,77
16	96,24	94,02	88,40	83,70	82,16	87,28	95,63	98,25	100,68	90,79	79,00	64,97	54,48	32,44	34,40	74,46	79,83	90,57	113,35	145,00	131,00	116,80	105,03	99,21
17	108,99	105,31	100,00	93,10	83,32	91,49	92,16	93,24	89,56	79,50	66,40	38,57	21,21	4,08	4,30	38,70	72,60	100,96	121,19	143,89	126,55	118,25	108,91	99,18
18	97,00	86,72	81,73	72,76	57,50	70,21	110,29	129,11	140,45	105,85	90,65	74,30	57,03	39,01	17,45	3,40	38,31	70,24	106,90	139,90	125,68	96,00	89,36	67,00
19	1,14	-0,09	-0,08	-0,12	-0,82	-1,05	71,08	105,38	109,98	90,00	20,82	1,99	-1,10	-3,55	-3,68	-2,95	0,00	48,36	98,50	116,33	111,08	87,97	68,50	18,40
20	2,65	0,80	-1,15	-1,90	-1,78	2,31	37,70	95,25	105,64	81,31	7,77	1,85	-1,17	-3,77	-3,43	-1,41	3,98	69,79	99,00	135,62	118,21	96,00	86,77	76,58
21	70,45	49,59	39,17	12,70	18,08	46,69	84,75	112,69	115,82	108,37	108,98	101,30	96,30	90,90	94,20	93,80	105,47	112,22	132,97	170,71	132,27	114,80	100,10	94,75
22	88,93	87,16	78,51	71,31	67,44	81,01	90,70	131,06	130,23	118,23	99,64	90,93	85,65	77,11	70,89	72,10	80,33	87,23	115,64	134,36	133,50	114,73	105,93	103,06
23	109,04	100,66	97,05	91,72	88,68	91,78	98,88	107,20	109,99	104,68	90,75	84,90	79,89	70,55	53,22	71,41	78,23	92,44	126,83	149,51	145,00	117,91	106,92	105,10
24	98,71	87,24	77,73	65,85	66,10	62,91	54,40	68,98	60,84	59,36	1,06	0,85	-0,02	-1,57	-2,35	-0,21	2,98	49,22	109,78	146,11	134,98	105,00	82,33	68,28
25	34,63	10,00	1,09	0,00	0,49	43,31	86,87	139,15	143,00	118,32	99,68	89,01	89,71	76,11	84,09	92,06	97,46	109,19	183,01	300,00	203,50	131,50	120,57	110,09
26	114,12	107,99	104,93	104,58	103,95	107,99	131,21	190,42	153,71	117,88	100,71	95,75	91,47	84,05	90,11	98,02	104,51	127,35	151,98	186,24	160,34	126,27	108,06	101,28
27	105,51	102,00	102,50	101,73	100,40	105,88	127,77	180,21	153,27	128,59	102,33	93,26	90,20	87,34	84,74	83,28	103,80	126,08	148,91	155,28	124,89	106,48	96,38	80,81
28	82,72	72,11	63,09	32,66	42,15	68,90	93,77	126,25	129,56	110,85	93,36	88,56	83,58	82,07	87,70	92,02	99,89	114,82	143,09	180,65	149,47	122,34	112,80	105,27
29	108,50	93,70	71,10	65,35	26,00	51,48	91,00	126,27	130,05	106,82	92,07	87,37	82,05	72,44	77,04	90,70	96,49	112,52	135,52	140,83	133,01	113,40	106,57	101,07
Grand T	**89,83**	**83,07**	**78,83**	**73,43**	**68,65**	**77,35**	**98,46**	**124,20**	**119,75**	**102,69**	**82,42**	**72,65**	**65,56**	**58,13**	**57,54**	**66,06**	**78,22**	**99,63**	**133,73**	**166,11**	**151,04**	**120,79**	**105,75**	**94,29**

Charging cost per scenario

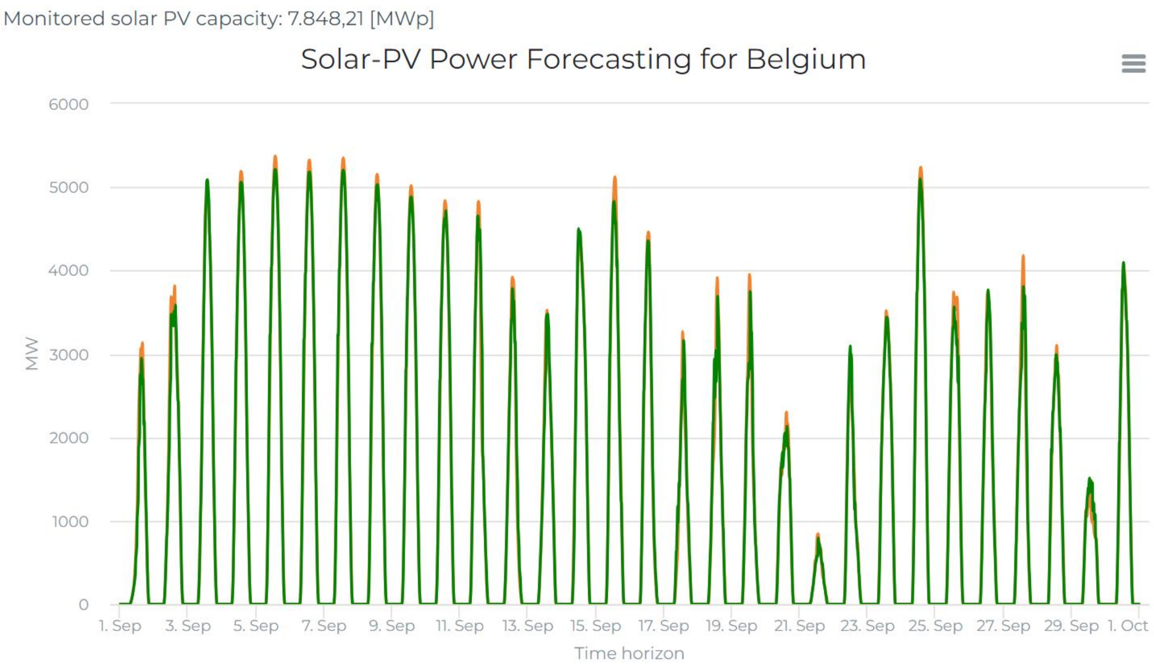
- One EV
  - Aprox 100km/day
  - 20kWh/100km

- Schedule 1: Home Charging
  - Daily at Home @18:00
  - Avg 2022: 0,50 €/kWh
  - Avg 2023: 0,28 €/kWh
- Schedule 2: Office Charging
  - Daily at Work @ 9:00
  - Avg 2022: 0,45 €/kWh
  - Avg 2023: 0,25 €/kWh
- Schedule 3: Optimized office
  - Daily at work @ 12:00
  - Avg 2022: 0,40 €/kWh
  - Avg 2023: 0,23 €/kWh
- Schedule 4: Optimized home
  - Optimized at Night @3:00
  - Avg 2022: 0,33 €/kWh
  - Avg 2023: 0,20 €/kWh

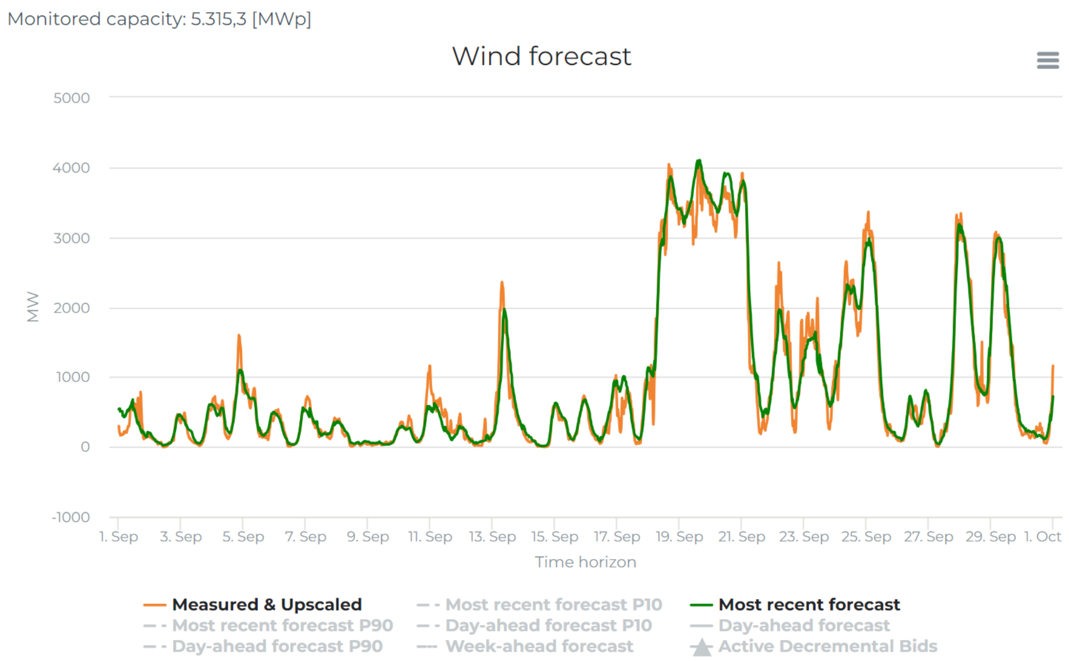




Charge when the renewable energy is available

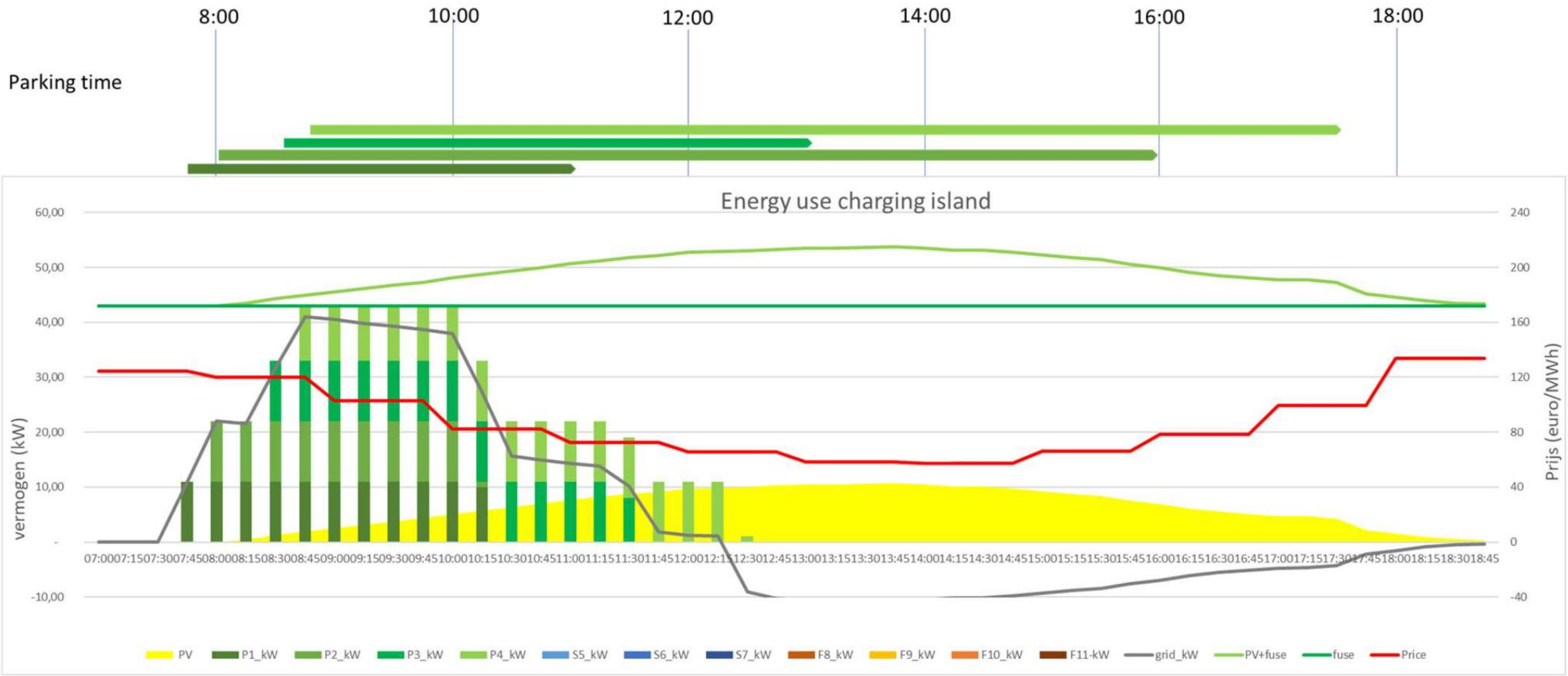


Solar Forecast



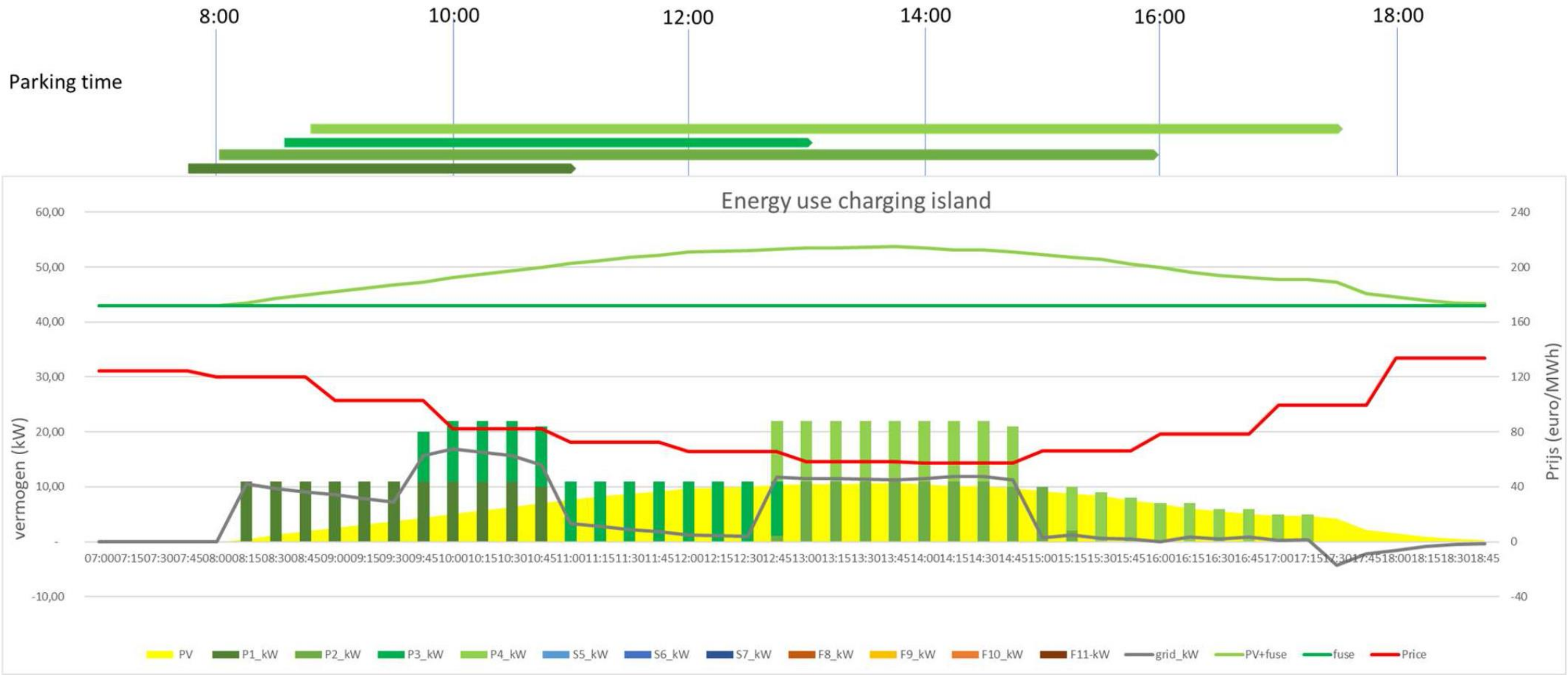
Wind Forecast

Algorithms: unoptimized



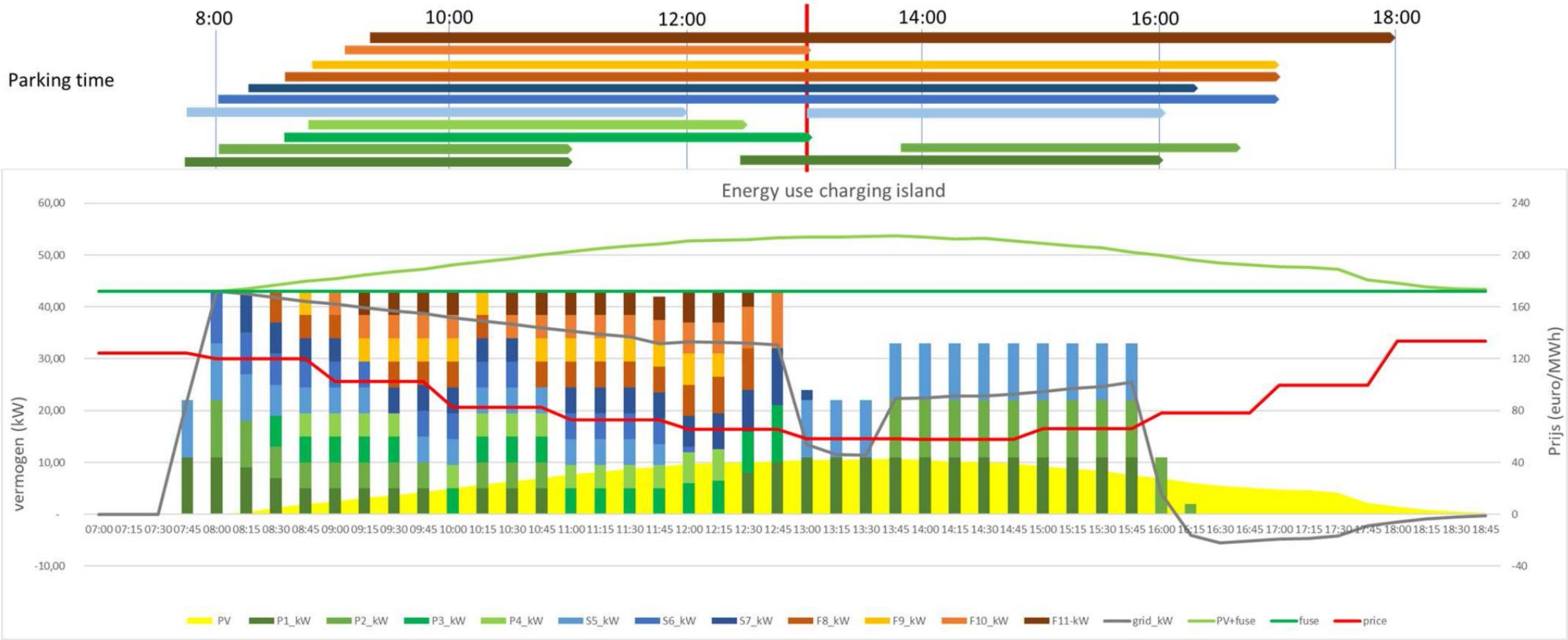
- High Peak usage (44kW)
- At higher average cost (0,19 €/kWh)

Algorithms: Solar and price optimized



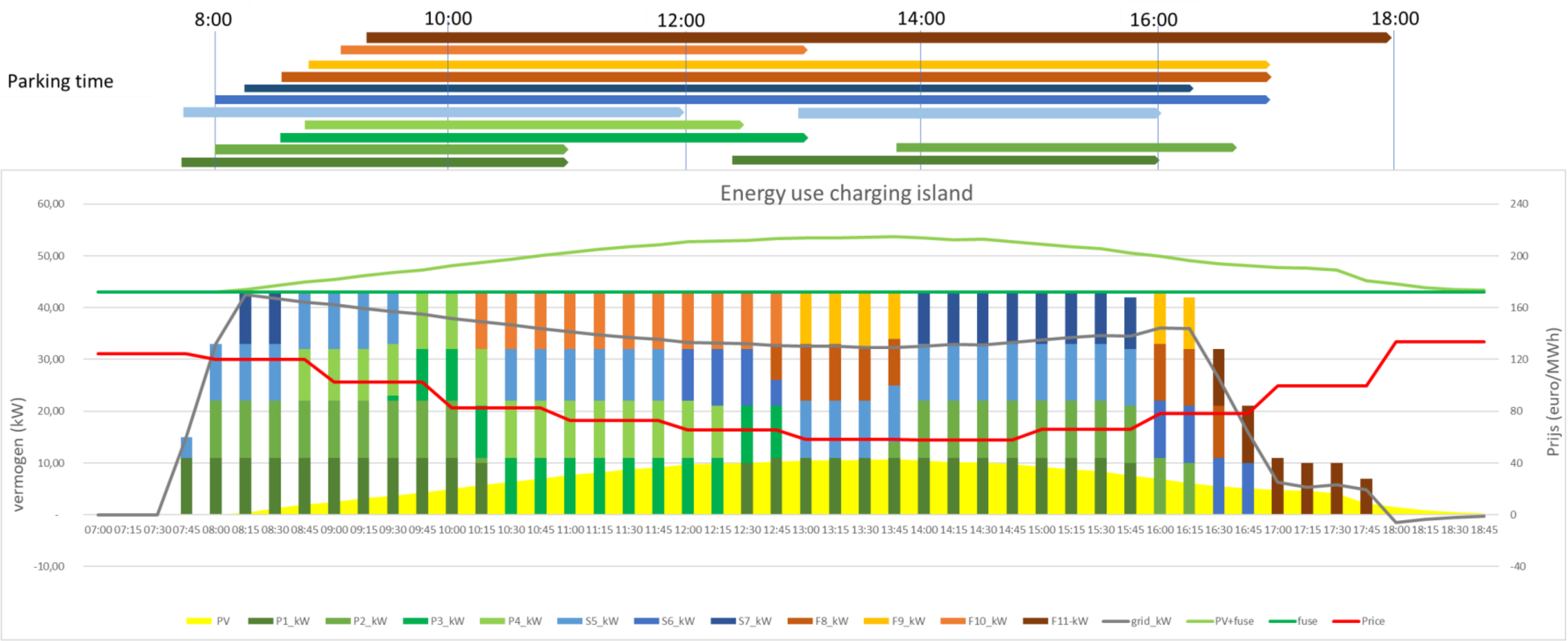
- Solar optimized

Algorithms: Loadbalancing



- Not all charging need met
- Higher Energy cost (0,09 €/kWh)

Agorithms: Smart Charging



- All demand is met
- At a lower total cost (0,08 €/kWh)

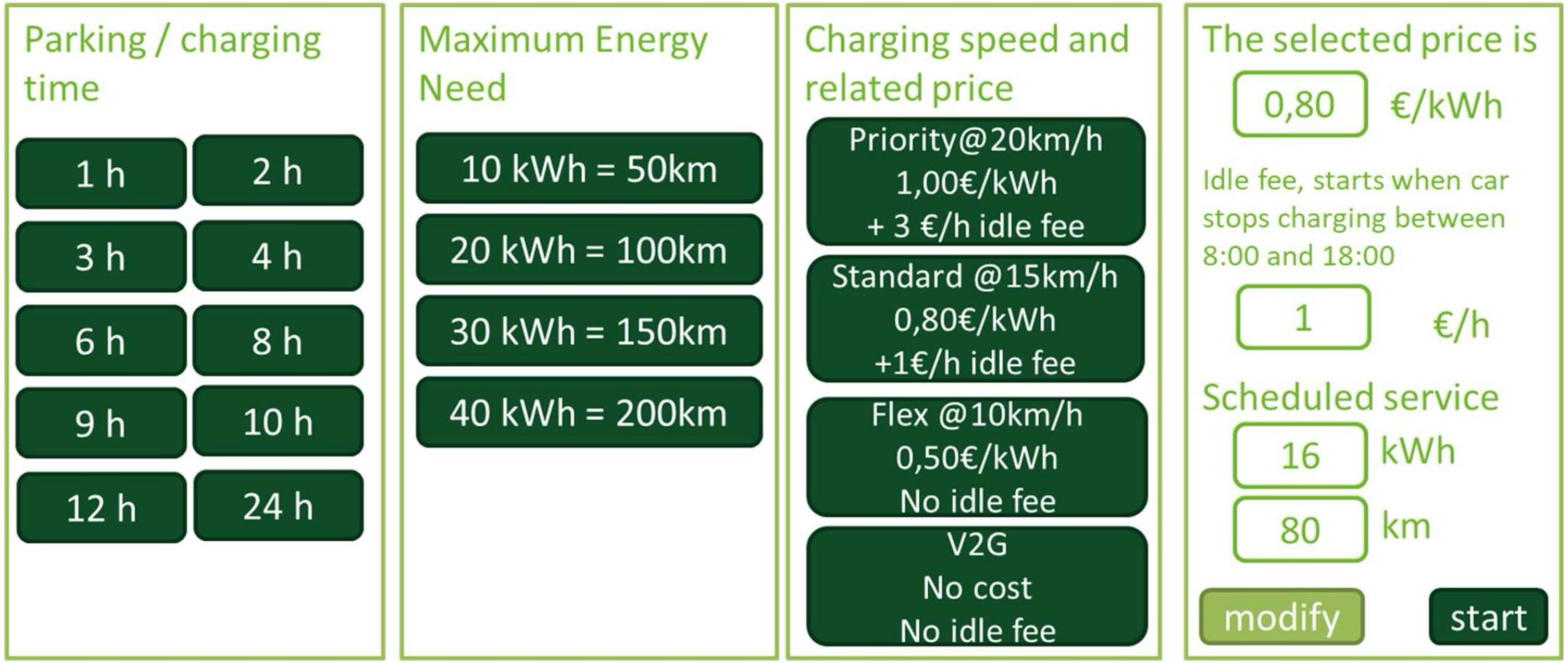
Optimal Public Charging

- What does the customer need?
  - Volume of kWh
  - Time to leave?

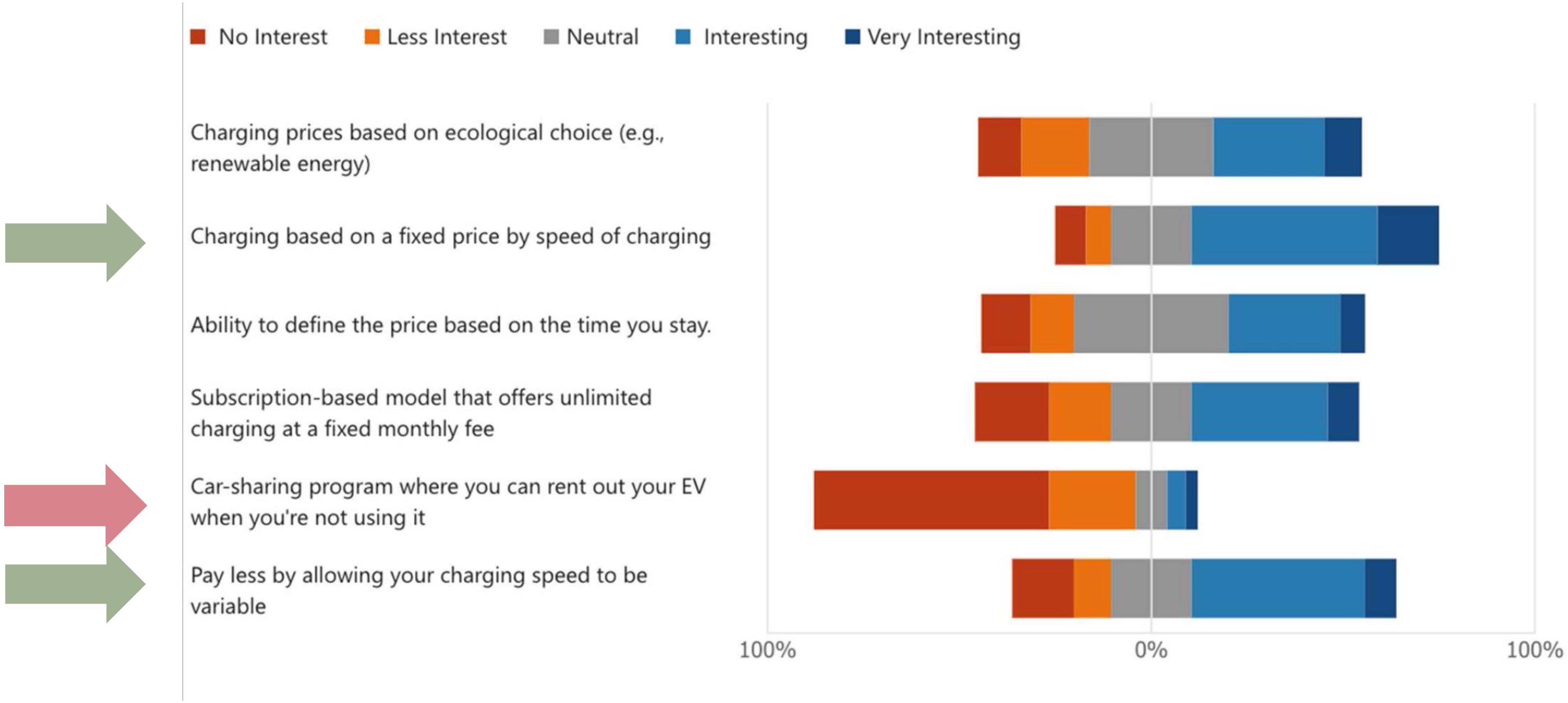
- What is the customer preference? (willing to pay)
  - Flex Charging (Cheapest)
  - Standard Charging
  - Greenest Charging
  - Priority Charging (Fastes)

Optimal optimization?
-> user interaction required

- User interaction will be needed to feed the algorithms
  - Example

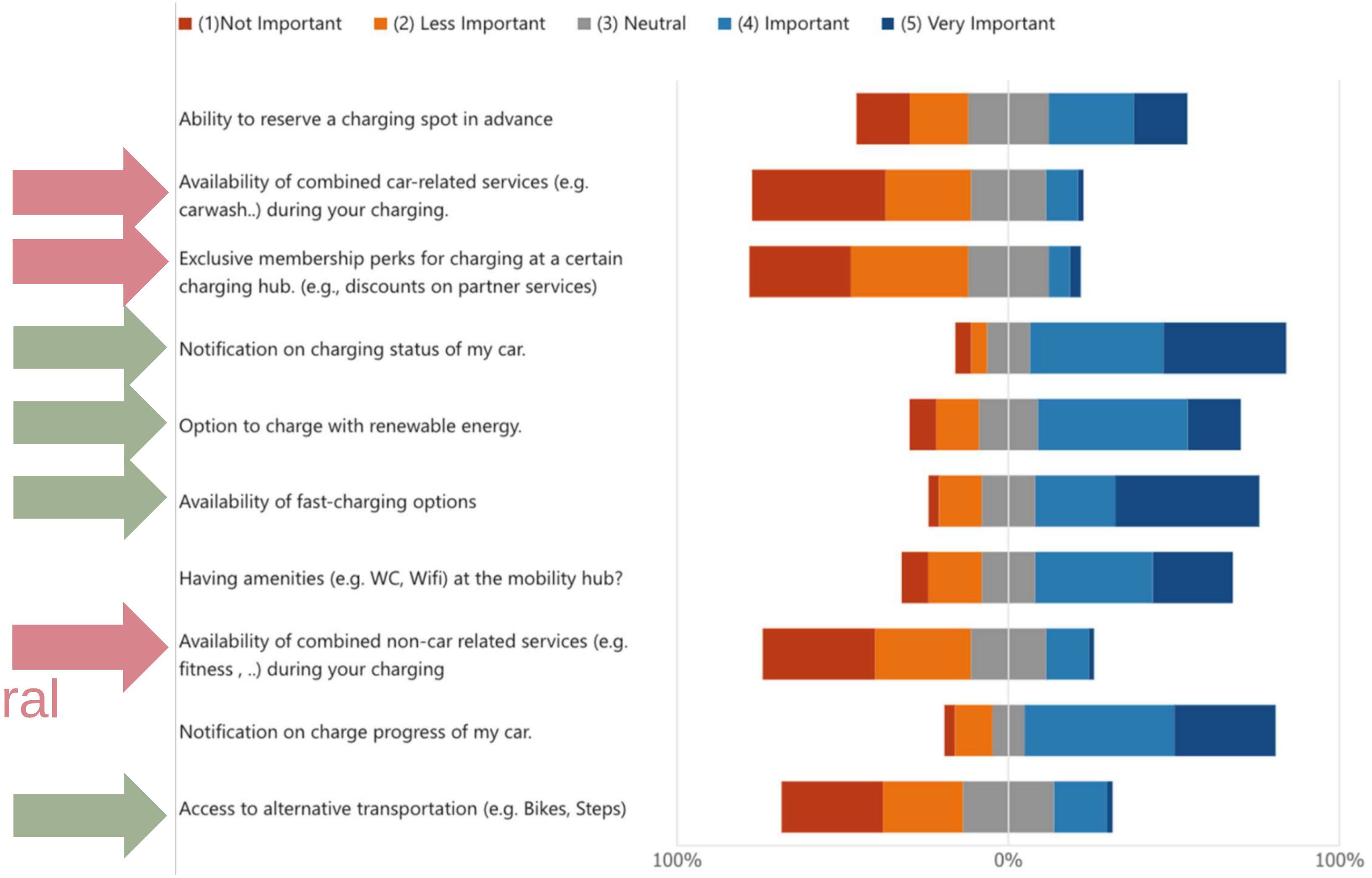


What do Employees want? Pricing options



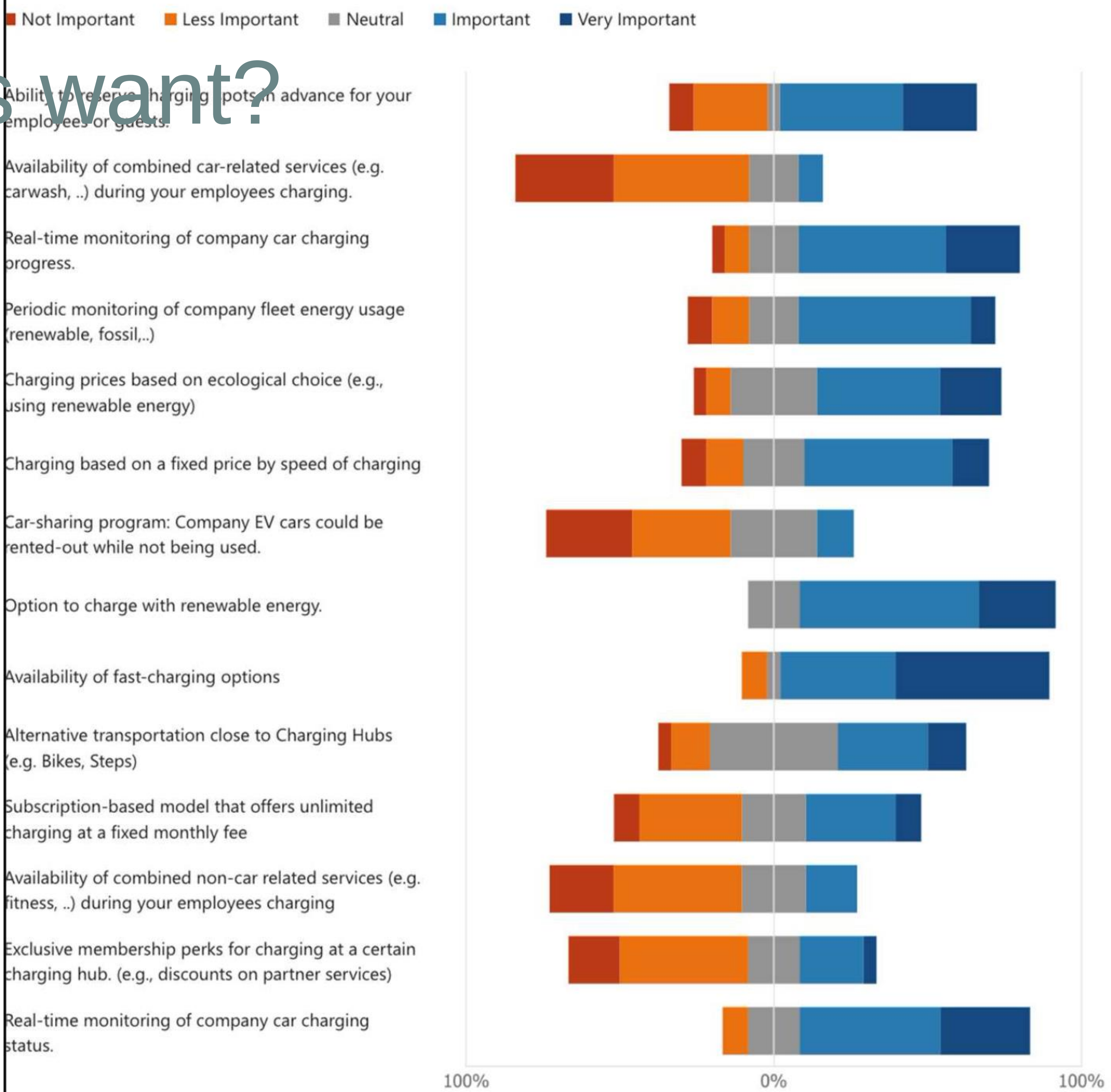
What do Employees want? Services

- Want
  - Visibility, monitoring, Renewable Energy option
  - Fast Charging
- Don’t want
  - Car sharing
  - Other services in general



What do employers want?

- Want
  - Visibility, monitoring, reporting
  - Charge rates on origin of energy
  - Renewable Energy option
- Don’t want
  - Car sharing
  - Other Services



Vision towards 2030

- EV’s will continue to grow to 2M by 2030
- Business model cost drivers (rotation fees, starting fee) will evolve to a more transparent model
- Interest in add-on services on top of EV charging will increase.
- EV’s cause an important impact on the energy need of a country. But these EV’s will play an important role in the grid stability services.
- Connected cars will create value if there is a frictionles transfer of signals and financial retrun between the different actors

Thank you for your attention

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AGENTSCHAP INNOVEREN & ONDERNEMEN

Vlaanderen is ondernemen

New insights in service & business models

Citibee

AGENTSCHAP INNOVEREN & ONDERNEMEN

Vlaanderen is ondernemen

Citibee
Integrale aanpak en knowhow

1. Infrastructuur beter benutten
2. Veiligheid en comfort creëren
3. Stakeholders betrekken in community

Leegstand van parkings
= onderbenutting van laadpalen

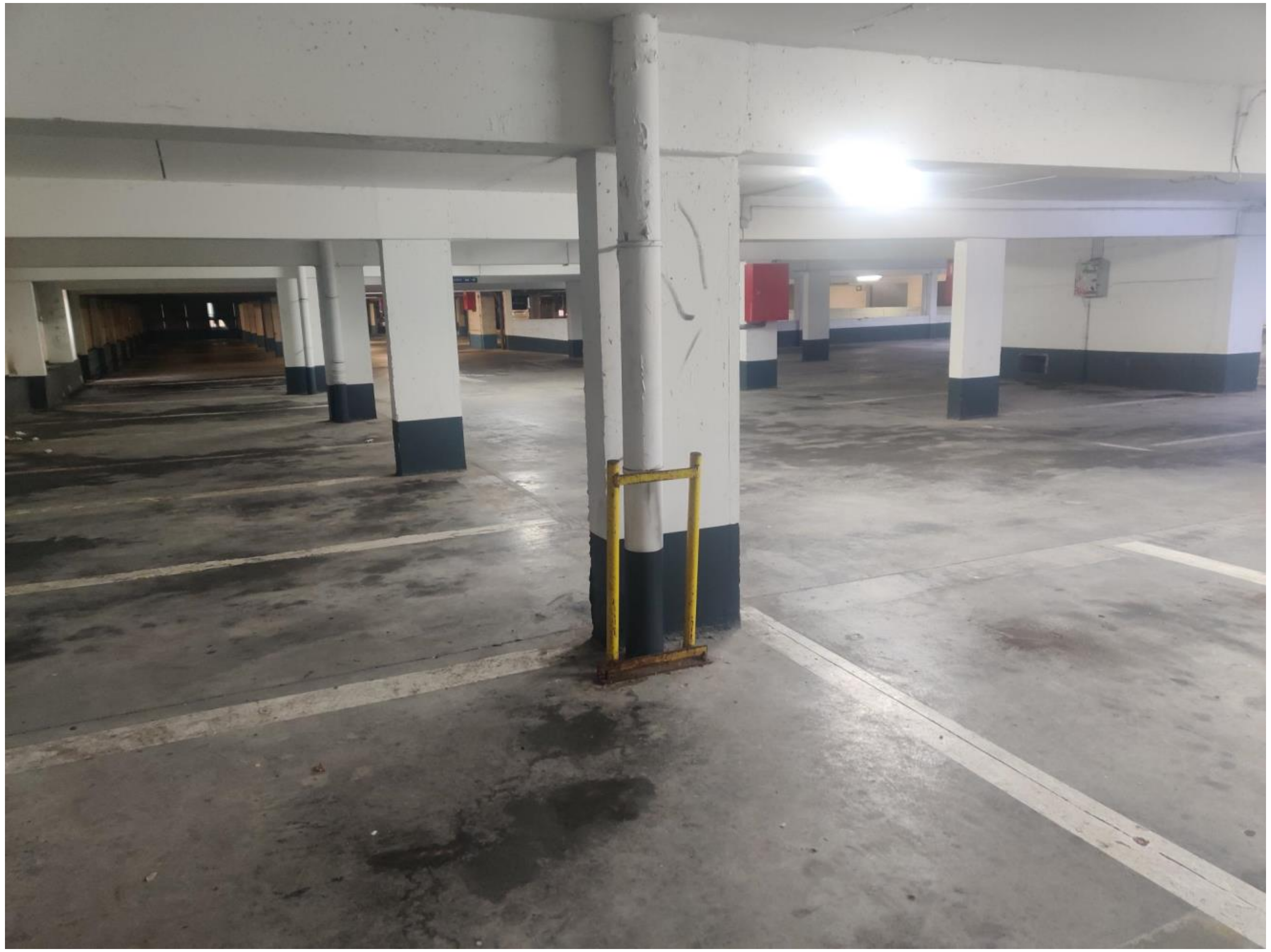
Leegstand parking plekken

↓

Ongebruikte laadstations

↓

Verloren zonne-energie



Investeren we te veel?

- Bestudeer de nodige capaciteit
- Werk modulair en zorg voor uitbreidbaarheid

- Stop over-investeren bij het plaatsen van zonne-energie en laadpalen

Parking Moorkensplein – winstgevend model

- 150 parkeerplaatsen
- 100 fietsplaatsen
- 13 laadpunten
- 1600m² PV op het dak
- 15% oververhuring excl. reservaties
- Omzet verdrievoudigd op 3 jaar

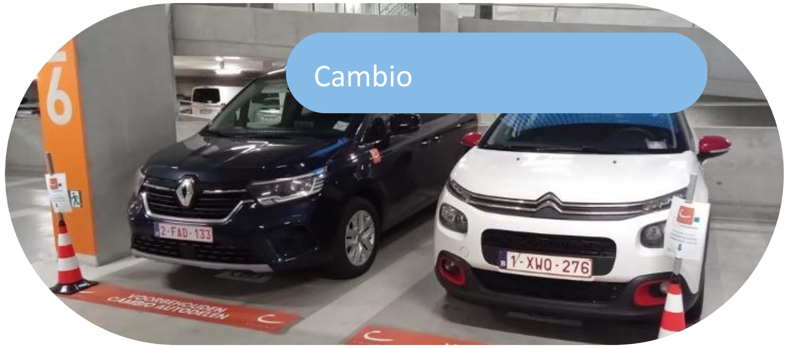
Stakeholders helpen bij de optimalisatie van energieverbruik

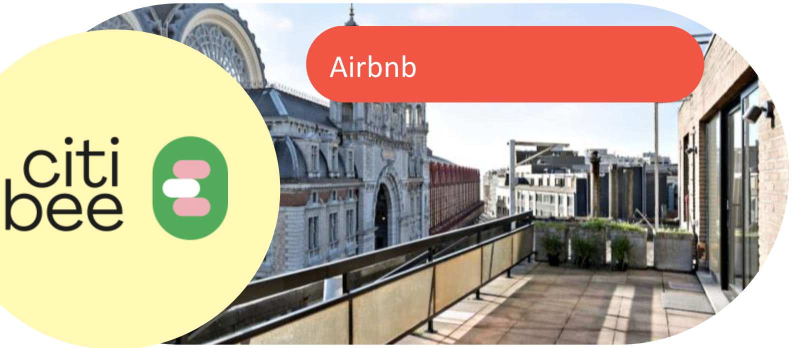

Zonnepanelen


De Roma Antwerpen


Stofzuigers Antwerpen


UZE.energy


Cambio


Airbnb


Huwelijken


Elektrische fietsen

BEDANKT

Jasmien Vanvooren – jva@citibee.be

AGENTSCHAP INNOVEREN & ONDERNEMEN

Vlaanderen is ondernemen

Q&A Session

Moderator Prof. Johan Driesen – KULeuven / EnergyVille

Agenda

HUME

12u00-13u00: Registration & Sandwich Lunch

- ✓ 13u00-13u05: Welcome (VITO – Carlo Mol – Moderator)
- ✓ 13h05-13h15: HUME within the FLUX50 activities on collective energy solutions and flexibility (FLUX50 –Patrick Devos)
- ✓ 13u15-13u25: HUME measurement sites: challenges/opportunities (VITO - Wim Cardinaels)
- ✓ 13u25-13u35: Charging ahead: Insights into EV driver behaviour and preferences (VITO - Guillermo Borragán)
- ✓ 13u35-13u55: Using smart charging to optimize parking and building energy flows (KULeuven - Klaas Thoelen & VITO - Jef Verbeeck)
- ✓ 13u50-14u10: Looking deeper into the charging hardware: electrical systems and operating efficiencies (KULeuven - Johan Driesen)
- ✓ 14u10-14u40: New insights in service and business models for EV charging (Blink Charging – Thais Lopez & MOVE – Jasmien Vanvooren)

15h00-15h30: Coffee Break

- ✓ 15h30-15h50: HUME integrated architecture (VITO - Dominic Ectors)
- ✓ 15h50-16h30: An overview of the HUME demonstration sites
  - ✓ Tour & Taxis (Brussels) (Nextensa – Tim Van Dorpe)
  - ✓ EnergyVille1 (Genk) (VITO – Dominic Ectors)
  - ✓ Multiobus (Tienen) (Multiobus – Peter Vicca)
- ✓ 16h30-17h00: What is the impact of "EV Fire Safety" aspects on your parking and building (VITO – Carlo Mol)
  - ✓ Practical hands-on experiences will be shared by bus depot owner Multiobus and parking owner Nextensa.
- ✓ 17h00-17h30: Q&A (KULeuven – Prof. Johan Driesen)
  - ✓ Questions can be sent in during the event via a QR-code and will be handled in the Q&A session moderated by Prof. Johan Driesen (KULeuven)
  - ✓ Presentations will be shared to all participants after the event

17h30-19h00: Reception & Networking

Agenda

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  - ✓ EnergyVille1 (Genk) (VITO – Dominic Ectors)
  - ✓ Multiobus (Tienen) (Multiobus – Peter Vicca)
- ✓ 16h30-17h00: What is the impact of "EV Fire Safety" aspects on your parking and building (VITO – Carlo Mol)
  - ✓ Practical hands-on experiences will be shared by bus depot owner Multiobus and parking owner Nextensa.
- ✓ 17h00-17h30: Q&A (KULeuven – Prof. Johan Driesen)
  - ✓ Questions can be sent in during the event via a QR-code and will be handled in the Q&A session moderated by Prof. Johan Driesen (KULeuven)
  - ✓ Presentations will be shared to all participants after the event

17h30-19h00: Reception & Networking

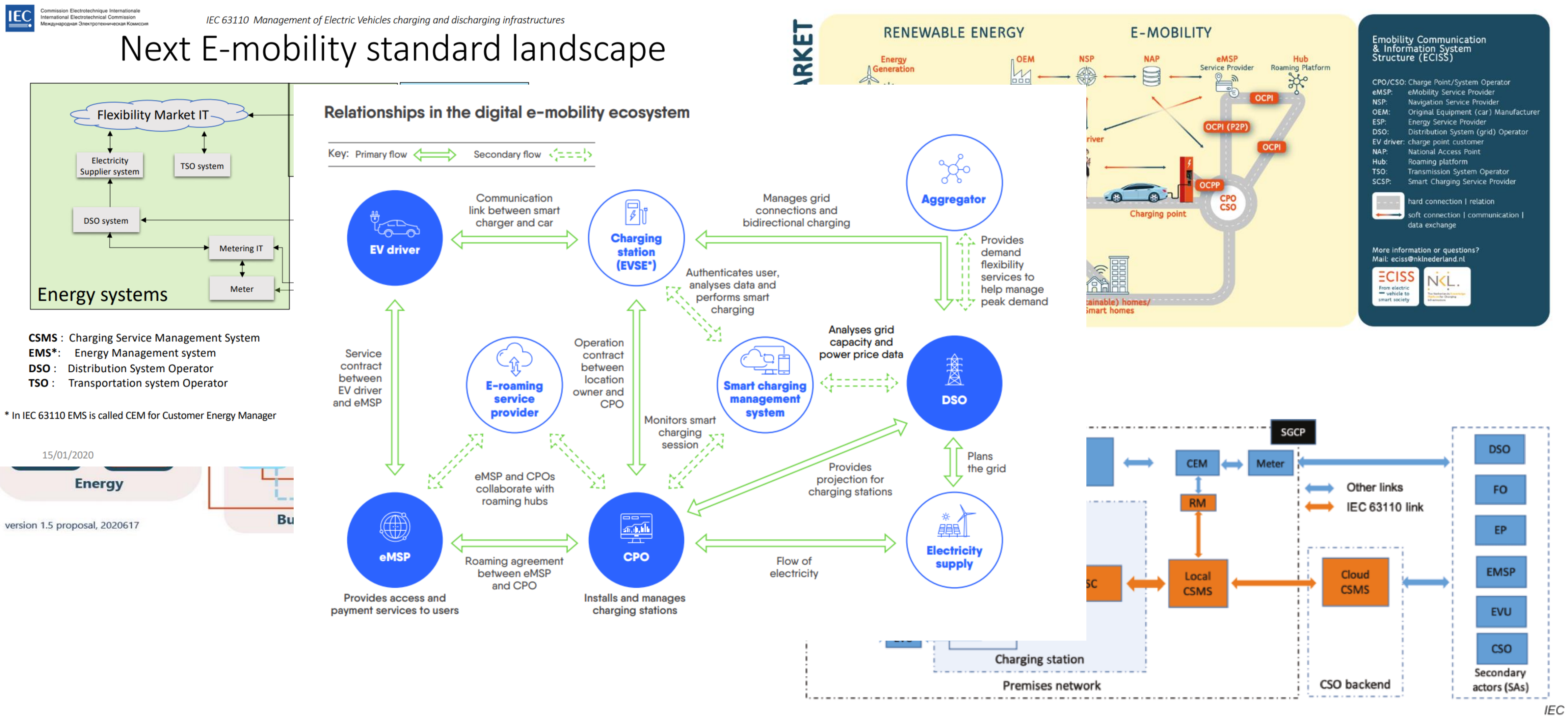
XHUME

WP5 : architecture

Dominic Ectors (VITO)

AGENTSCHAP INNOVEREN & ONDERNEMEN
Vlaanderen is ondernemen

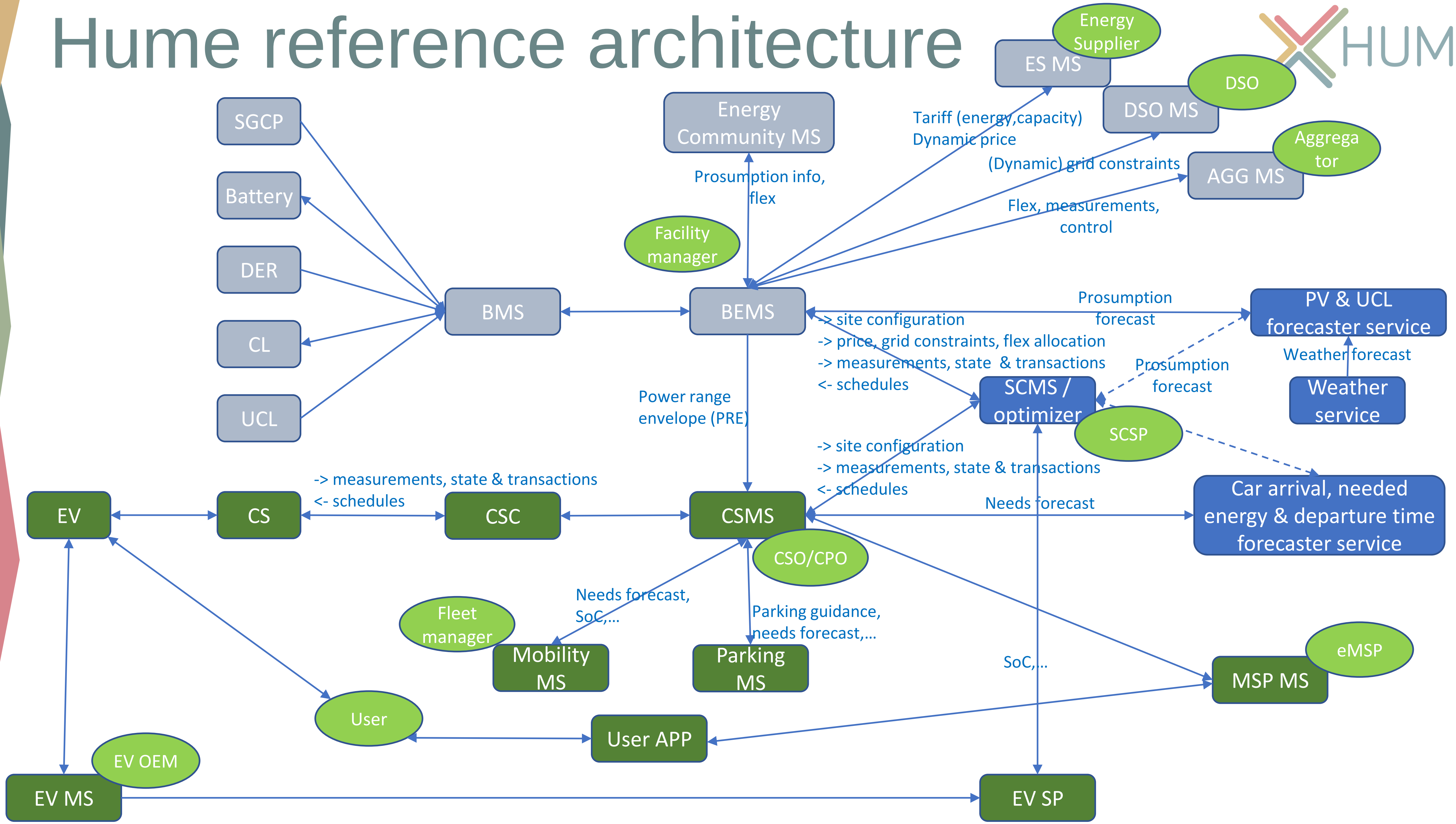
Existing reference architectures



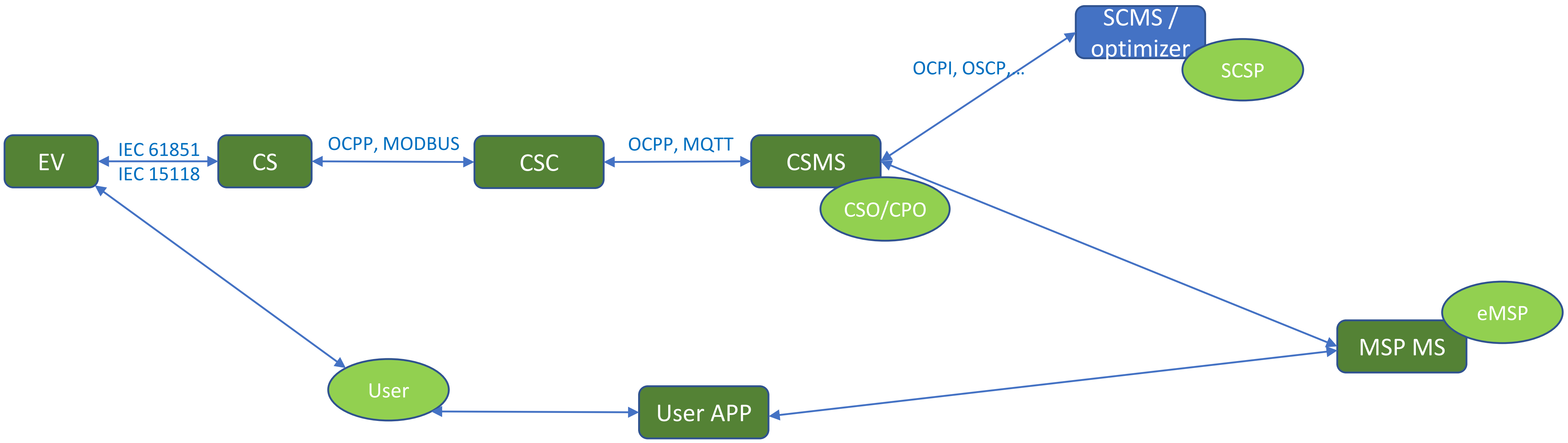
Reference architecture

- For Hume focus on :
  - Site optimization
  - Interaction with other management systems:
    - BEMS (local DER resources), mobility planning system, local controller,…
  - Interaction between a CSMS (CPO/CSO) and SCMS (SCSP)
  - Interaction with the end-user

Hume reference architecture



Hume reference architecture



Interaction between CSO and SCSP

- Open Charge Point Interface (OCPI) was selected as protocol
- A gap analysis was done between OCPI 2.2.1 and the existing REST API that was used at EnergyVille
- Defined several protocol extensions
  - Smart charging preferences from CSO to SCSP
  - Site configuration
  - Site measurements
- Implemented an OCPI version based upon an open source implementation
- Deployed it at the EnergyVille1 site

Conclusions

- Focus is on **site** optimization in this reference architecture taking into account local DER, site constraints, e-mobility requirements
- Decided not to transform OCPI from a mobility protocol into a EMS protocol
  - SCSP still needs additional protocols to retrieve the necessary site info (configuration of the site, information about non-mobility assets,…) to perform a site optimization
- Architecture allows multiple coordinating (energy) management systems. In Hume we choose for an overall optimization.
- E-mobility architecture and protocol landscape is still evolving
  - Multiple competing protocols, regulation (billing,…) , grid constraints, flex harvesting, …

Open for future exploration

- How to improve retrieval of user charging preferences
  - IEC/ISO 15118, forecasting, CAR OEM path, …
- Charging flexibility is in Hume used for local cost optimization. Flexibility can also be offered to external actors.
- Benchmarking cooperating EMS systems vs overall optimization
- V2G
- …

Thank you

Dominic Ectors, VITO/EnergyVille

AGENTSCHAP INNOVEREN & ONDERNEMEN

Vlaanderen is ondernemen

Q&A Session

Moderator Prof. Johan Driesen – KULeuven / EnergyVille

Agenda

12u00-13u00: Registration & Sandwich Lunch

- ✓ 13u00-13u05: Welcome (VITO – Carlo Mol – Moderator)
- ✓ 13h05-13h15: HUME within the FLUX50 activities on collective energy solutions and flexibility (FLUX50 –Patrick Devos)
- ✓ 13u15-13u25: HUME measurement sites: challenges/opportunities (VITO - Wim Cardinaels)
- ✓ 13u25-13u35: Charging ahead: Insights into EV driver behaviour and preferences (VITO - Guillermo Borragán)
- ✓ 13u35-13u55: Using smart charging to optimize parking and building energy flows (KULeuven - Klaas Thoelen & VITO - Jef Verbeeck)
- ✓ 13u50-14u10: Looking deeper into the charging hardware: electrical systems and operating efficiencies (KULeuven - Johan Driesen)
- ✓ 14u10-14u40: New insights in service and business models for EV charging (Blink Charging – Thais Lopez & MOVE – Jasmien Vanvooren)

15h00-15h30: Coffee Break

- ✓ 15h30-15h50: HUME integrated architecture (VITO - Dominic Ectors)
- ✓ 15h50-16h30: An overview of the HUME demonstration sites
  - ✓ Tour & Taxis (Brussels) (Nextensa – Tim Van Dorpe)
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17h30-19h00: Reception & Networking

Closing Event: 14/11/2024

Tour & Taxis
Proof of Concept: Royal Depot

Tim Van Dorpe – Energy Manager

HUME: Proof of Concept (PoC)

- Introduction Nextensa
- Location: Tour & Taxis / Royal Depot / PoC
- Objectives
- Technical specifications
  - Electric capacity
  - PV-installation
  - EV-installation
  - Uncontrollable load
- Setup & Optimisation settings
- Results: key figures & findings

Introduction Nextensa

nextensa·
PLACES
YOU PREFER

HUME

KEY FIGURES BALANCE SHEET AND INCOME STATEMENT

KEY FIGURES BALANCE SHEET	31/12/2023
Fair value investment portfolio (€ 000s)	1,298,074
Fair value investment properties, incl. participation Retail Estates (€ 000s)	1,385,369
Investment value investment properties (€ 000s)	1,323,221
Net asset value group share (€ 000s)	834,048

KEY FIGURES INCOME STATEMENT	31/12/2023
Rental income (€ 000s)	70,522
Income from development projects (€ 000s)	18,136

PIPELINE DEVELOPMENT PROJECTS

The pipeline of development projects in Belgium and Luxembourg is as follows:

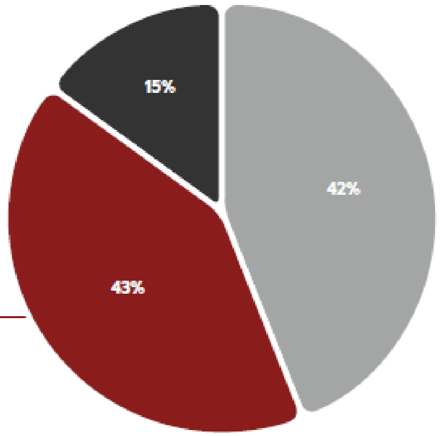
PROJECT DEVELOPMENT

	UNDER CONSTRUCTION		PERMITS OBTAINED		IN STUDY	
Residential	36,520 sqm	33,766 sqm	N/A	32,401 sqm	93,000 sqm	12,000 sqm
Offices	N/A	N/A	N/A	13,500 sqm	37,500 sqm	66,066 sqm

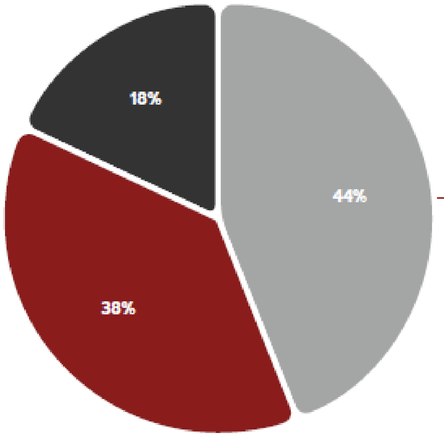
TOTAL: 167,020 sqm 157,733 sqm

THE CONSOLIDATED INVESTMENT PORTFOLIO

The consolidated investment portfolio of Nextensa NV at the end of 2023 comprises 30 buildings (including the re-developments of investment properties) with a total lettable surface area of 403,207 sqm. The investment portfolio is geographically spread across the Grand Duchy of Luxembourg (43%), Belgium (42%) and Austria (15%).



Belgium
Luxembourg
Austria



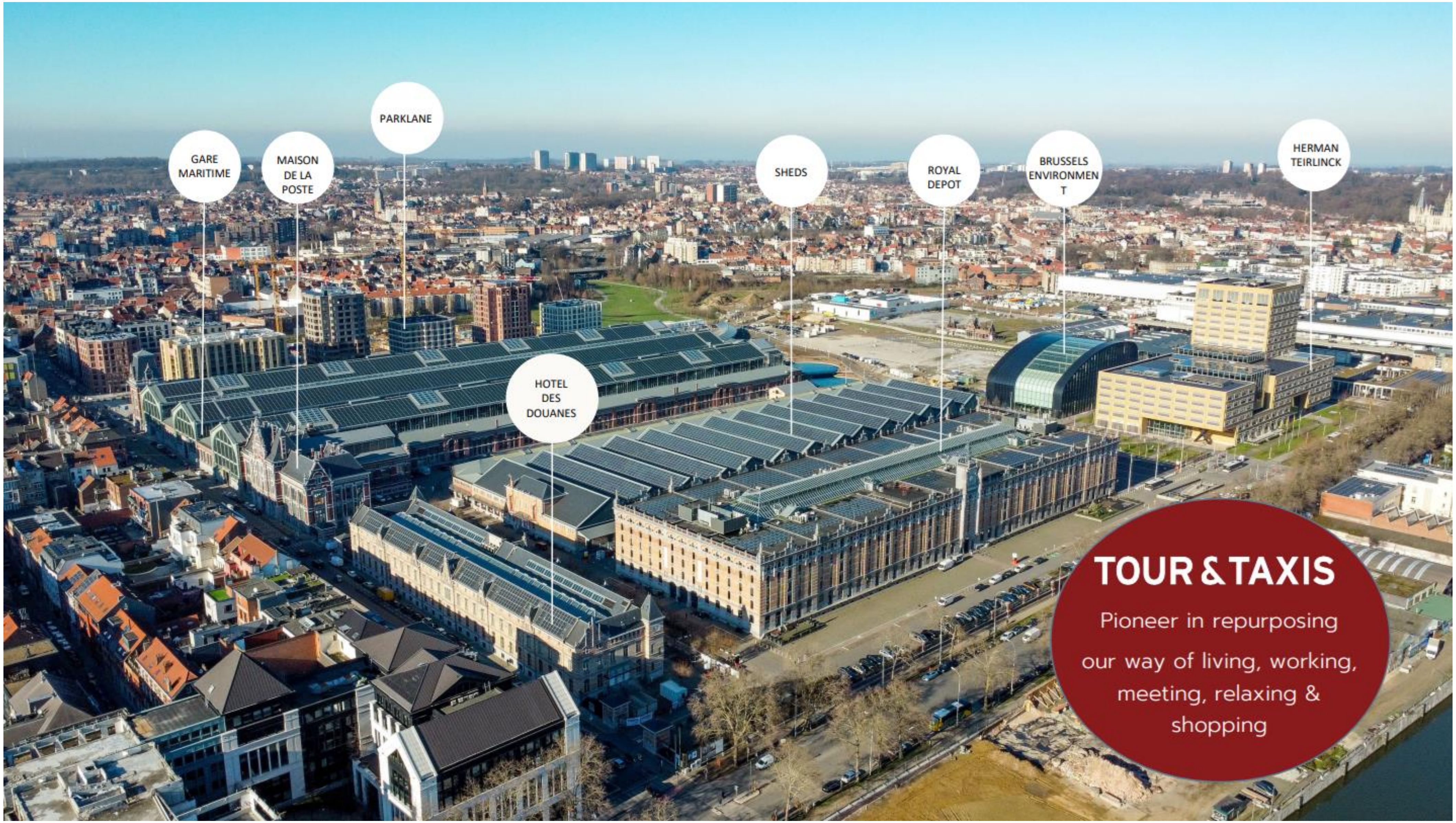
Retail
Offices
Other

THE FAIR VALUE OF THE INVESTMENT PORTFOLIO

The fair value of the investment portfolio amounts to € 1.30 billion at the end of 2023 compared to € 1.28 billion at the end of 2022. This increase is explained by the acquisition of a couple of buildings during 2023.

Consequently, the company held 38% offices in portfolio, 44% retail and 18% others at the end of 2023 (compared to 47% offices, 44% retail and 9% others at the end of 2022).

Introduction Tour & Taxis site



Introduction Royal Depot

Year of construction: 1904-1906

Purpose: storage of goods under government supervision

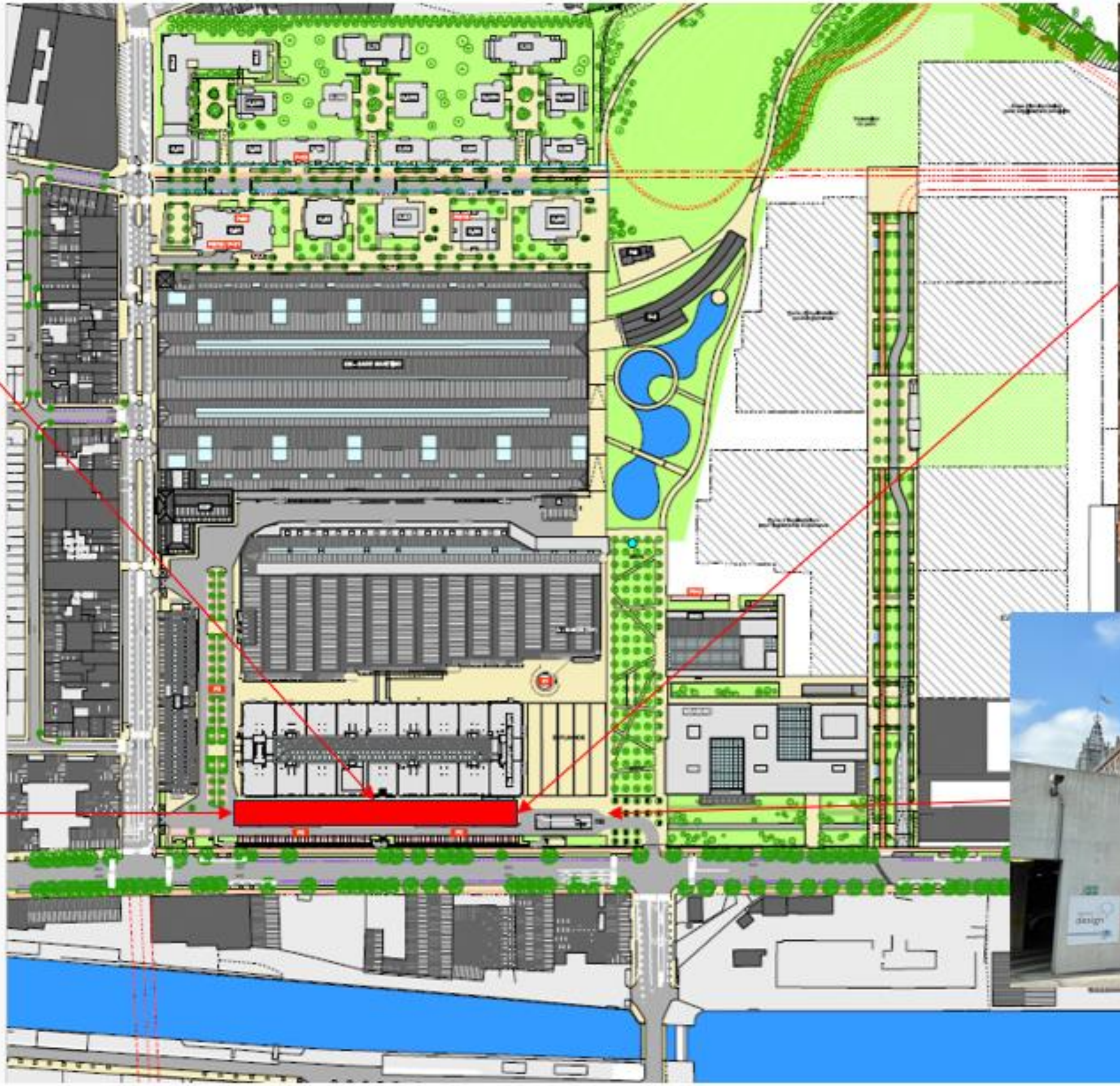
Completely renovated in 2003/2004

ROYAL DEPOT,
TOUR & TAXIS,
HAVENLAAN 88, BRUSSELS

Type: Mixed-use
Surface: 45,204 sqm
Status: Completed

Multi-functional and 'multi-tenant' building with 4 floors, spread across offices (32,076 sqm), commercial spaces (7,293 sqm) and archives (5,835 sqm).

Introduction: Proof of Concept

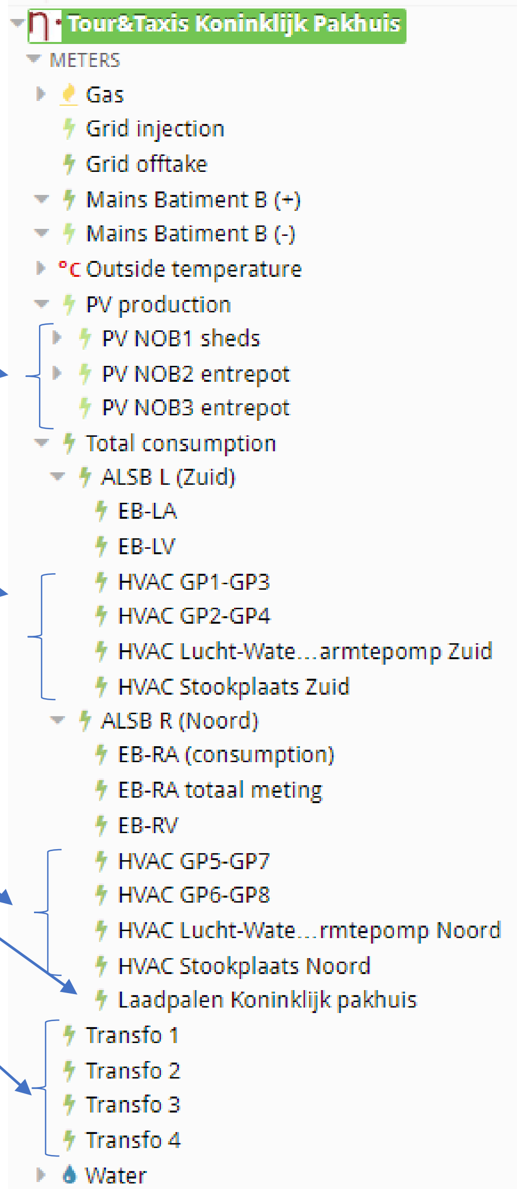


Proof of Concept: objectives

1. Peak shaving
2. Maximize current per phase
3. Increase PV self-consumption
4. Shift consumption to low hourly prices
5. Integrate different services levels and related prices (priority management)
6. Charge session reservation / guarantee
7. Integrate battery + inverter supporting phase balancing
8. Minimize CO_2 emissions
9. Integrate vehicle-to-grid + inverter supporting phase balancing
10. Balancing services – FCR
11. Increase energy efficiency

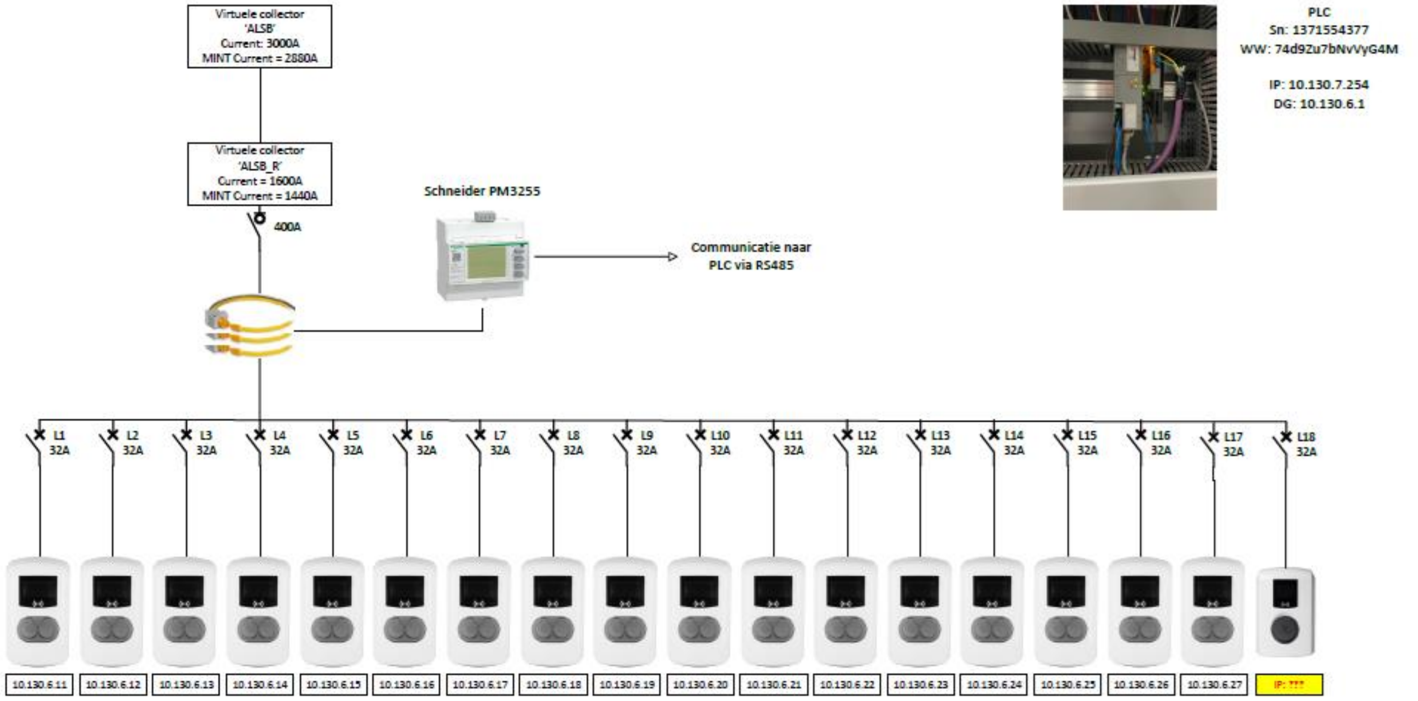
Tour & Taxis: Proof of Concept

- Technical specifications
  - PV-installation:
    - Capacity: 860,62 kWp
    - Production: 650 MWh/year
  - Uncontrollable load:
    - HVAC system: 346kW
  - EV-installation:
    - Main power switch: 400A
    - 35 charging points of 11kW
  - Electric capacity:
    - Building: 2.520 kVA (4 x 630 kVA)
  - Grid connection (contract):
    - Sibelga: 2.230 kVA



Tour & Taxis: Proof of Concept (PoC)

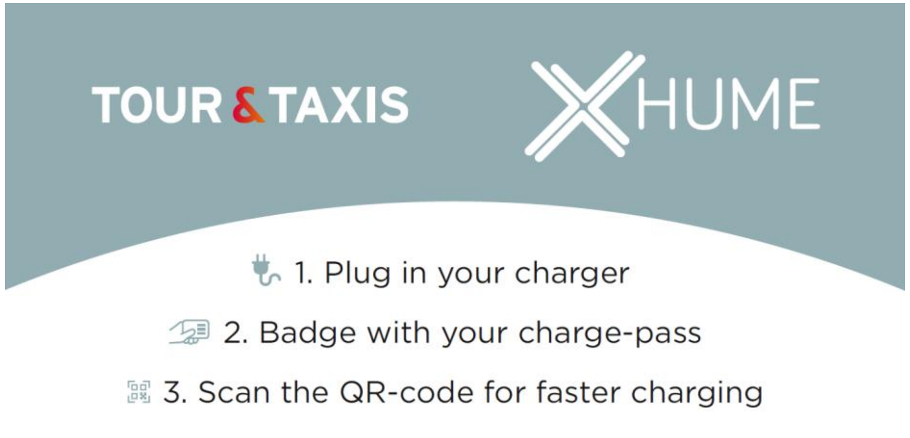
- Setup technical: Phoenix Contact PLC

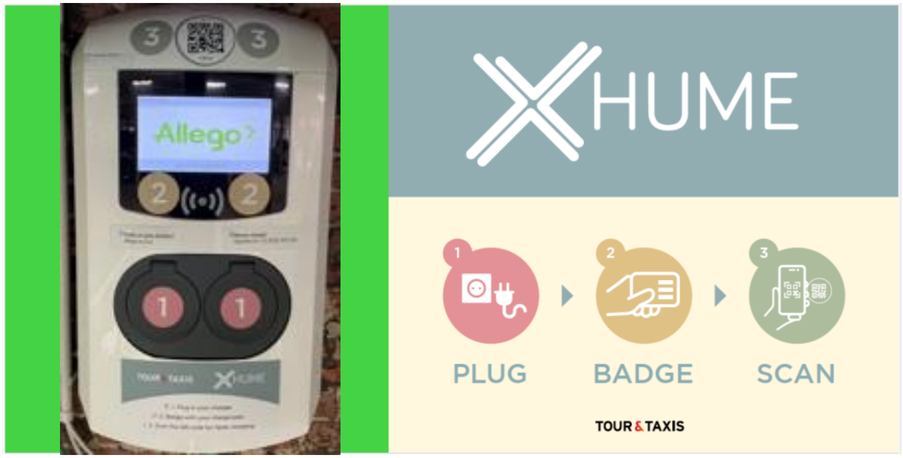


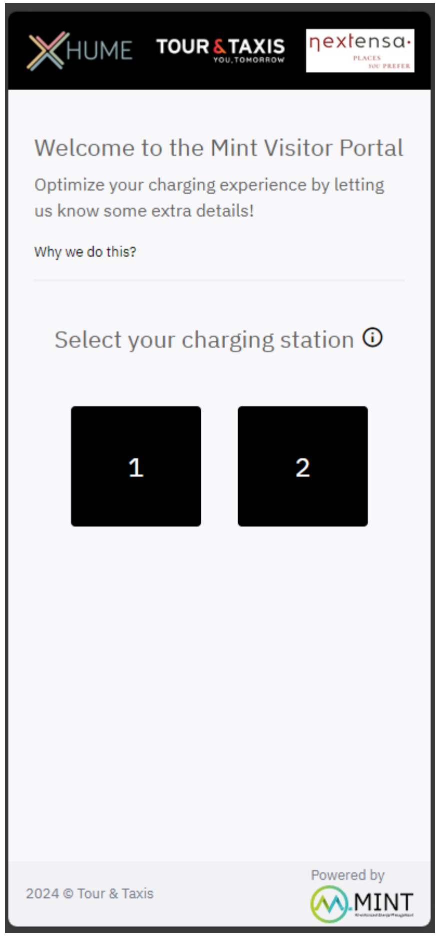
nextensa PLACES YOU PREFER	PHOENIX CONTACT NV/SA - Minervastraat 10-12 - B-1930 Zaventem-Keiberg II Tel. +32 2 723 98 11 - Fax +32 2 725 36 14 - www.phoenixcontact.be		
	2024 1041 Config MINT Parking Koninklijk Pakhuis		
PHOENIX CONTACT	Creator Micheas Goethals	Company / Project Nextensa	Date 14/06/2024

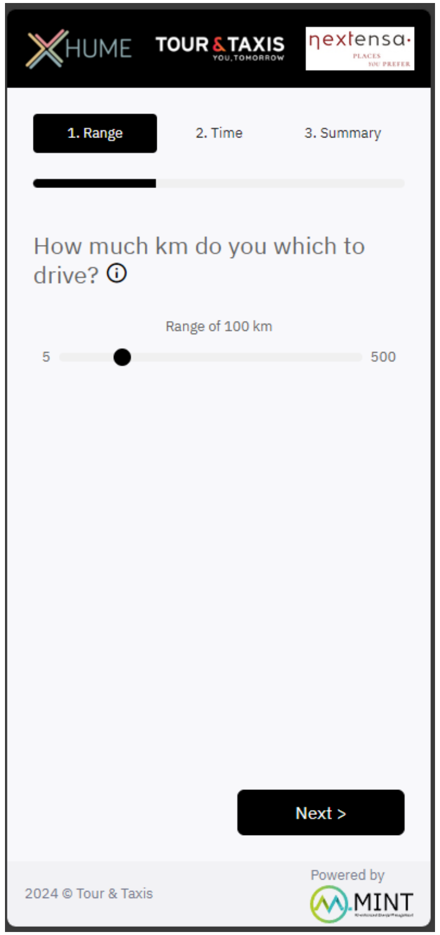
Tour & Taxis: Proof of Concept (PoC)

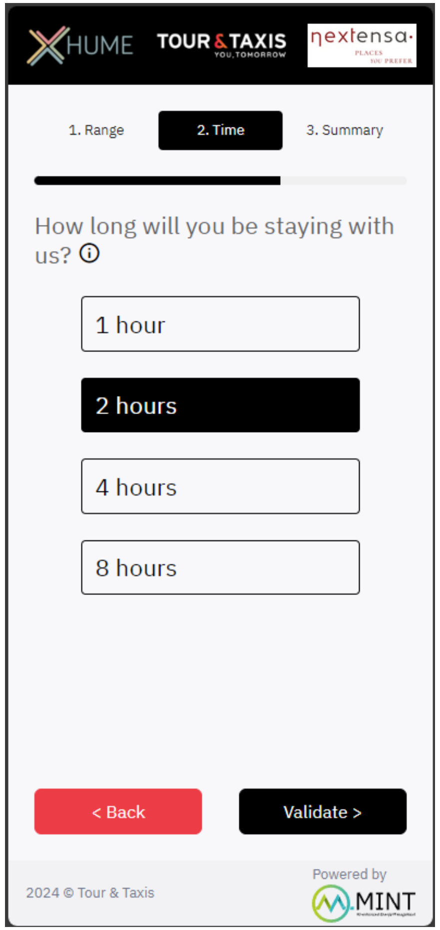
- Communication: 1 QR-code per charging station + 3 step plan



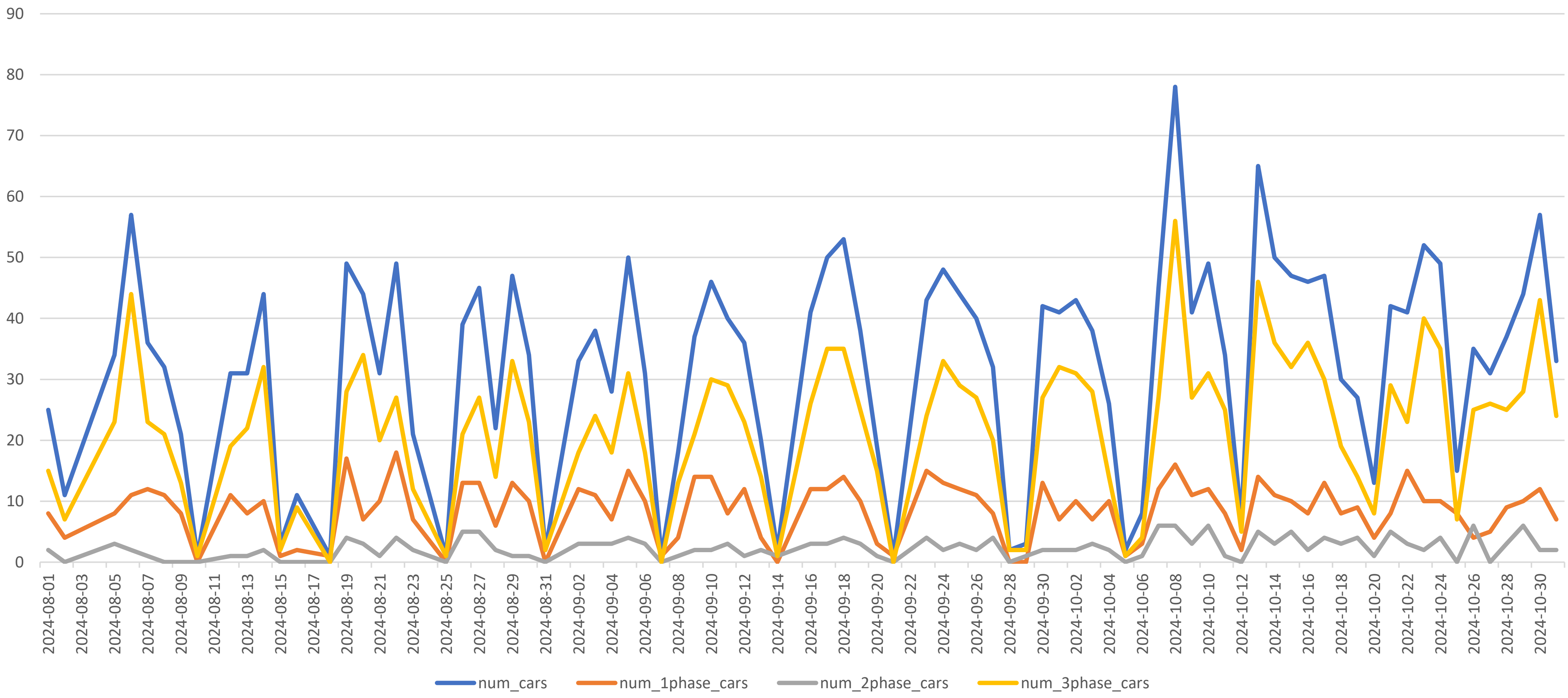




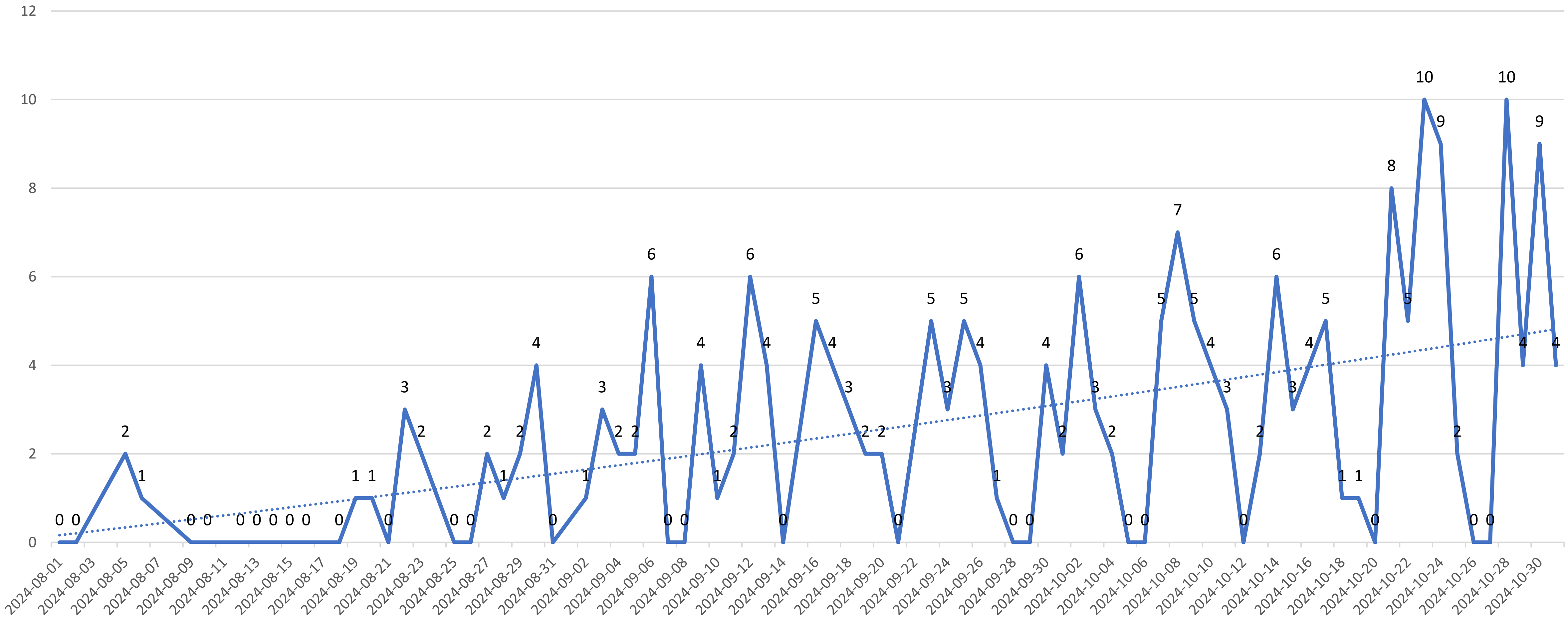




Tour & Taxis PoC: # Car sessions per day



Tour & Taxis PoC: # Users with charging preferences filled-in (QR code)



Tour & Taxis PoC: Charged Energy (kWh)

HUME

Total monthly (kWh)

(Daily average) (kWh)

Aug	Sep	Oct
9.697	12.313	16.491
(373)	(456)	(532)

Weekday

Aug	Sep	Oct
9.460	12.142	15.260
(438)	(578)	(663)

Weekend

Aug	Sep	Oct
56	171	1.230
(14)	(28)	(154)

Tour & Taxis PoC: Simultaneous car sessions

HUME

 # charging Poles : 35

#cars simultaneously connected

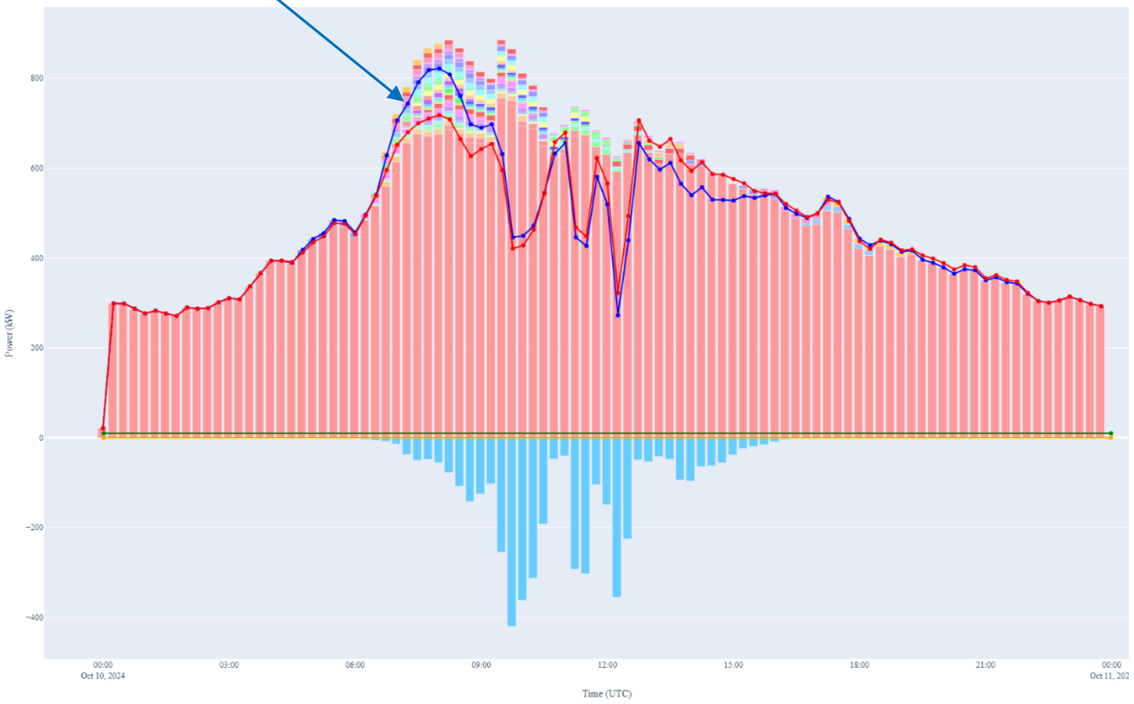
	Aug	Sep	Oct
Daily max (Daily average)	32 (18)	32 (22)	34 (25)
Weekday	32 (21)	32 (28)	34 (29)
Weekend	2 (1)	11 (3)	30 (13)

#cars simultaneously charging

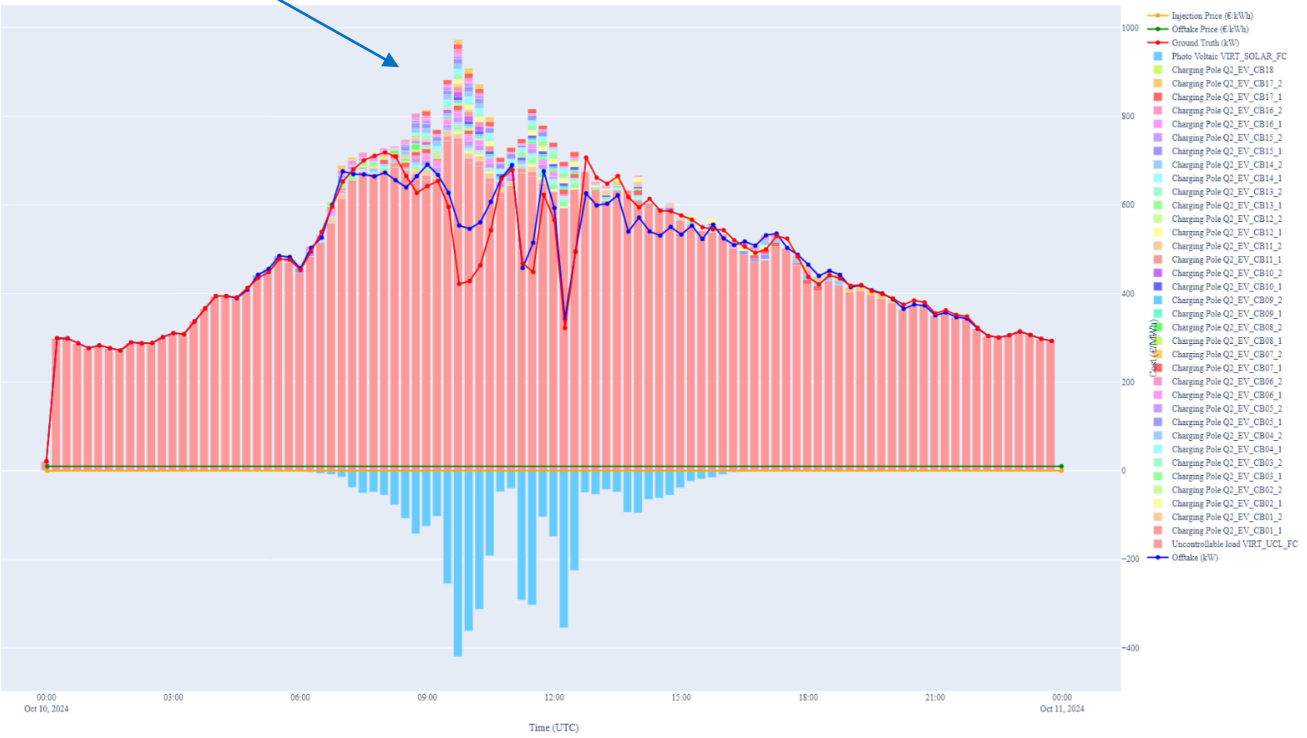
	Aug	Sep	Oct
Daily max (Daily average)	28 (15)	30 (19)	34 (22)
Weekday	28 (17)	30 (24)	34 (26)
Weekend	2 (1)	9 (3)	23 (10)

Tour & Taxis PoC: Charging session simulation 1 day

Load balancing



Optimizer : user preferences set



Real situation

Load balancing (max available power)

Real situation

Load balancing (max available power)

Tour & Taxis PoC: Facts & Figures

Financial benefit using the optimizer : Offtake **peak** reduction

Offtake peak (KW)	Load balancer	Optimizer (without user preferences)	Optimizer without user pref - Load balancer			Optimizer (with user preferences)	Optimizer with user pref - Load balancer		
			kW	%	€ 2,5/kW		kW	%	€ 2,5/kW
Augustus	1156,38	1074,52	-81,86	-7,08%	-€ 204,65	1062,46	-93,93	-8,12%	-€ 234,81
September	1116,30	1013,95	-102,35	-9,17%	-€ 255,88	950,33	-165,98	-14,87%	-€ 414,96
October	971,86	888,62	-83,24	-8,57%	-€ 208,10	821,98	-149,88	-15,42%	-€ 374,71
Total			**-267,45**		**-€ 668,63**		**-409,79**		**-€ 1.024,48**

Tour & Taxis PoC: Findings & advices

- When the users (drivers) don't fill-in their session charging needs using the App (scan QR code) charging will be done at min power creating no flexibility.
  - Charging power: 6A
- Users (drivers) should get some kind of incentive to fill-in their charging needs and creating flexibility.
  - Flexible pricing, f.i. discount on charging cost, ..
  - Voucher : Free parking, drink, …
- Benefit of cost reduction (lower peak limit) will increase with the amount of users using the app.
  - In this PoC: +/- 4.000€/year with an average of 5 users
- Promote charging in the weekend to improve self consumption & avoid injection to the grid
  - 100% usage by buildings (except weekend)

Tour & Taxis PoC: Findings & advices

- Current parking contains 296 parking places with only 35 charging poles
  - Using the optimizer and users filling-in their charging needs the number of charging poles can be doubled without the need to increase the grid connection
- Using simulations different options can be calculated
  - Usage of day-ahead
  - Imbalance market
  - Extention of #charging poles
- Flexibility depends on the accurancy of the user preferences set : estimated departure time, km’s to drive / requested energy to charge
  - Often overestimated -> loss off flexibility
  - OEM car data access will be benefical
- Fixed electricity price contract
  - No gain by shifting (f.i. day ahead)

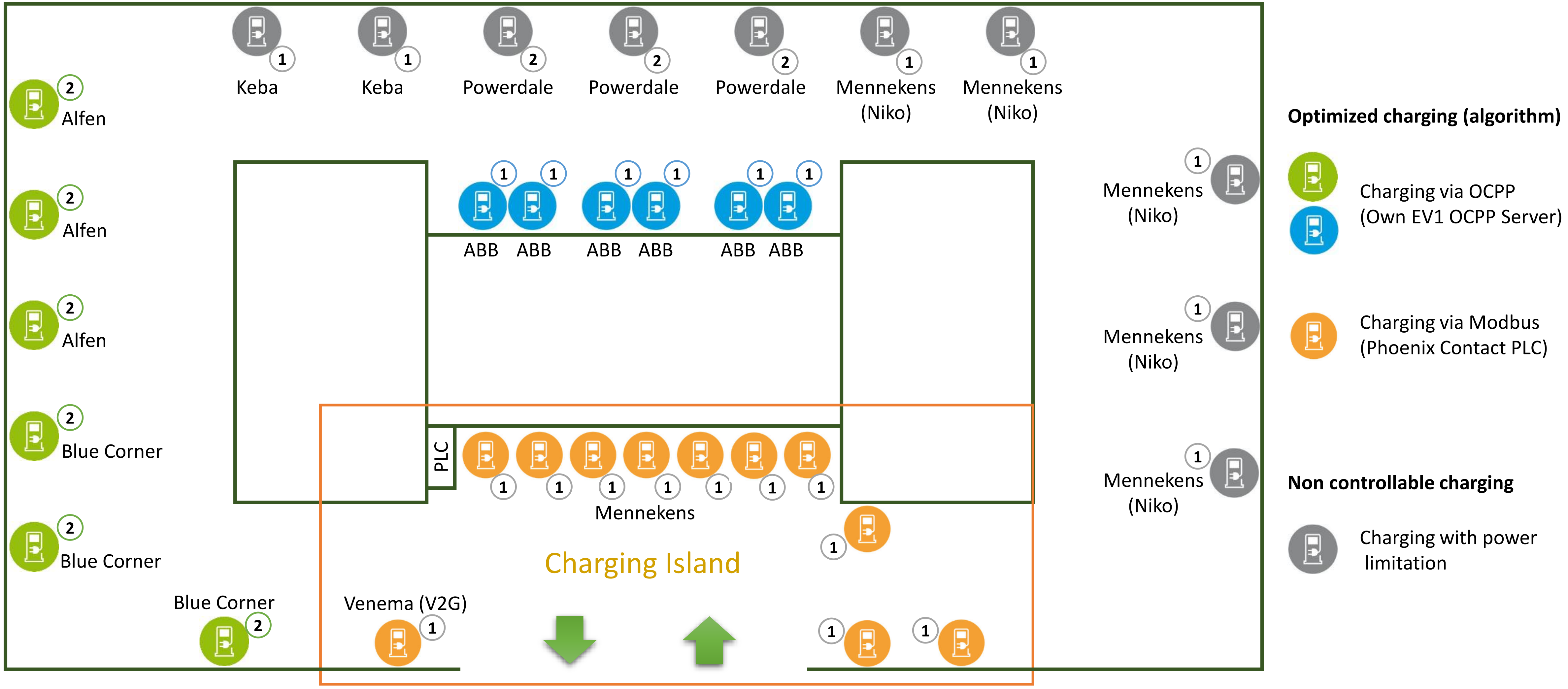
WP5 : EnergyVille1 demonstration site

Dominic Ectors (VITO)

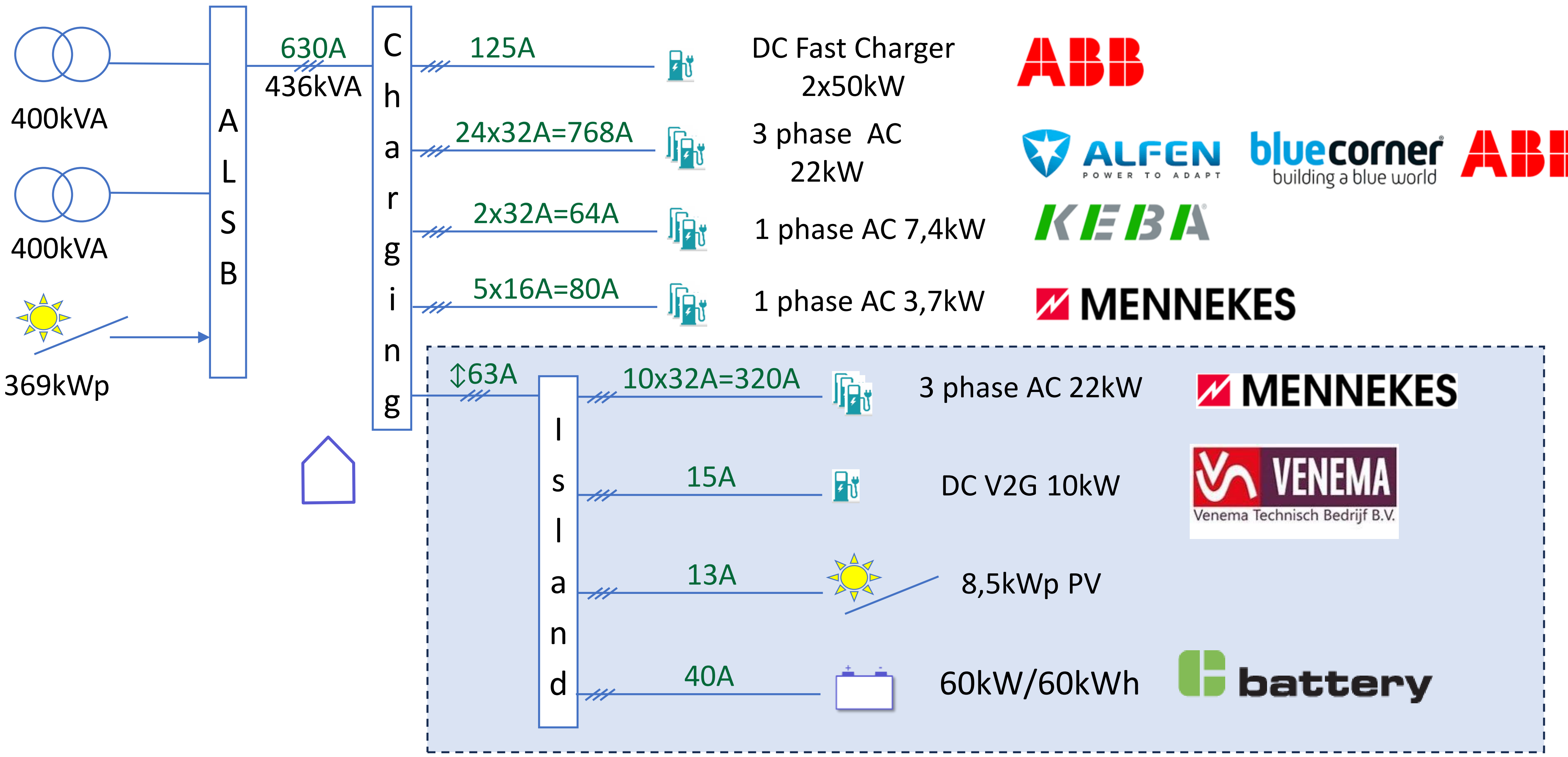
AGENTSCHAP INNOVEREN & ONDERNEMEN
Vlaanderen is ondernemen


EnergyVille1

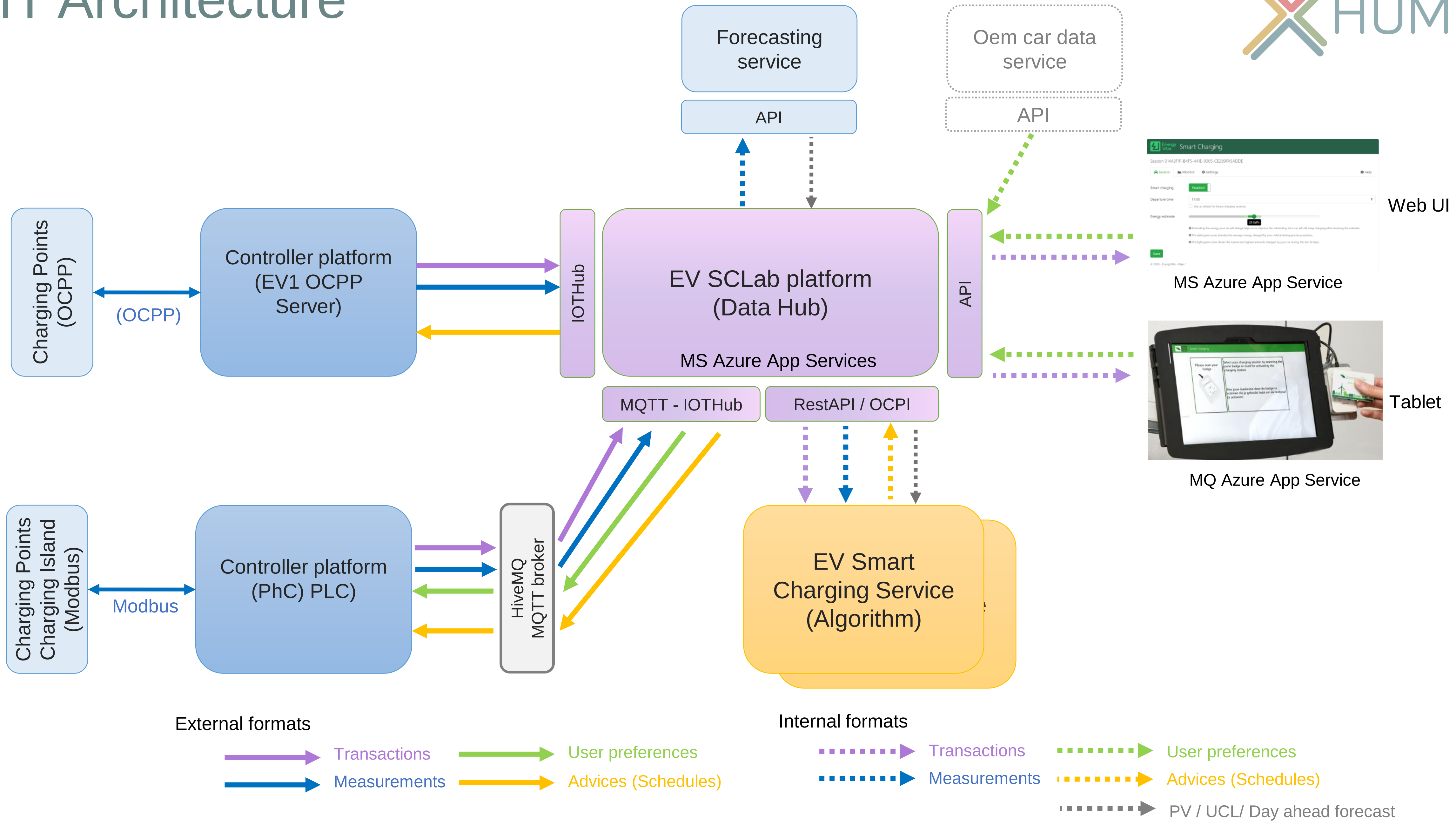
EnergyVille 1 demo site: Parking lay-out



Electrical diagram



IT Architecture



EV1 Charging session: Mail

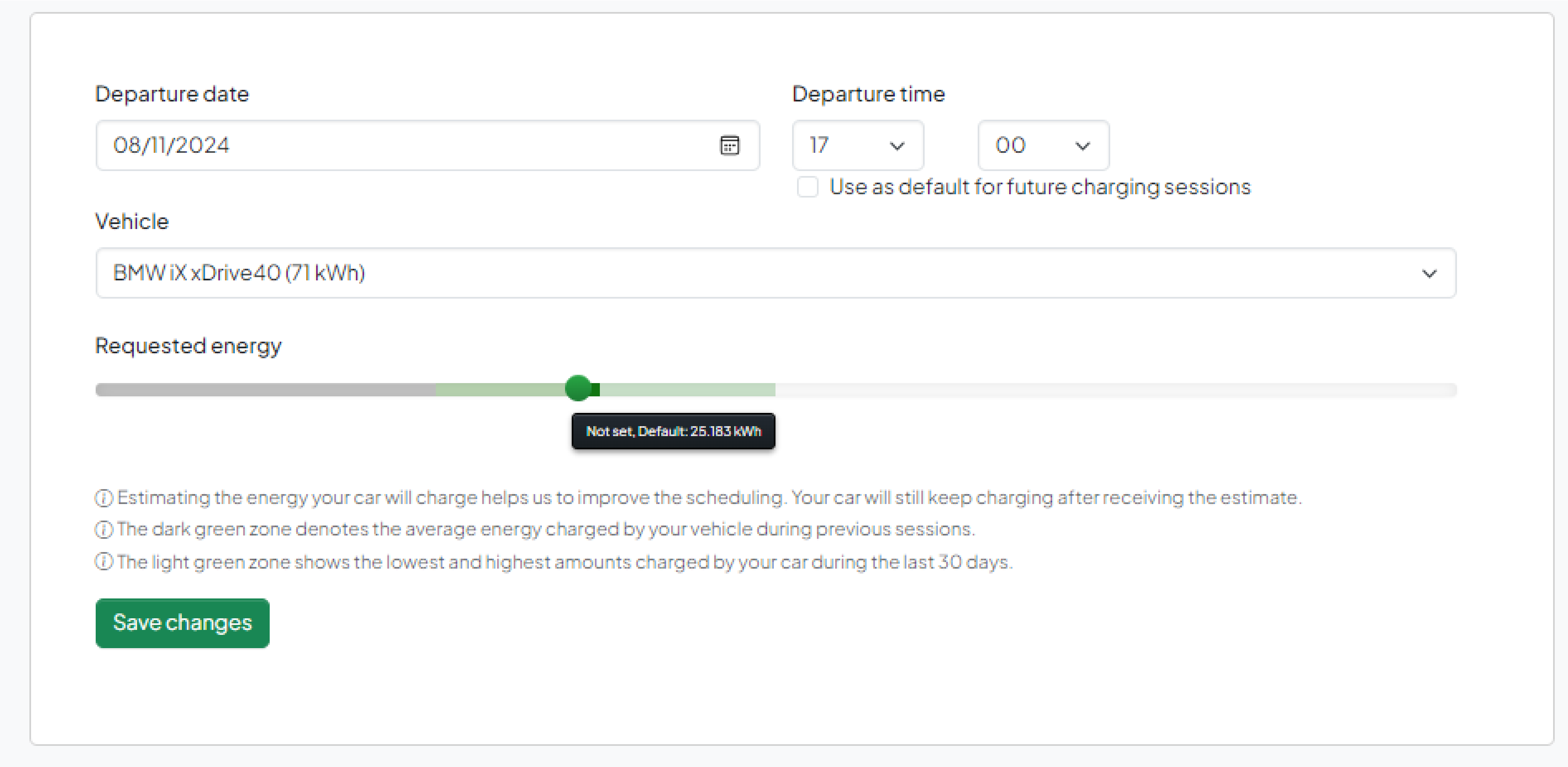
Hello,

You started a charging session on connector 1 of charge point "BLUEC3".
Follow and manage your charging session online here.

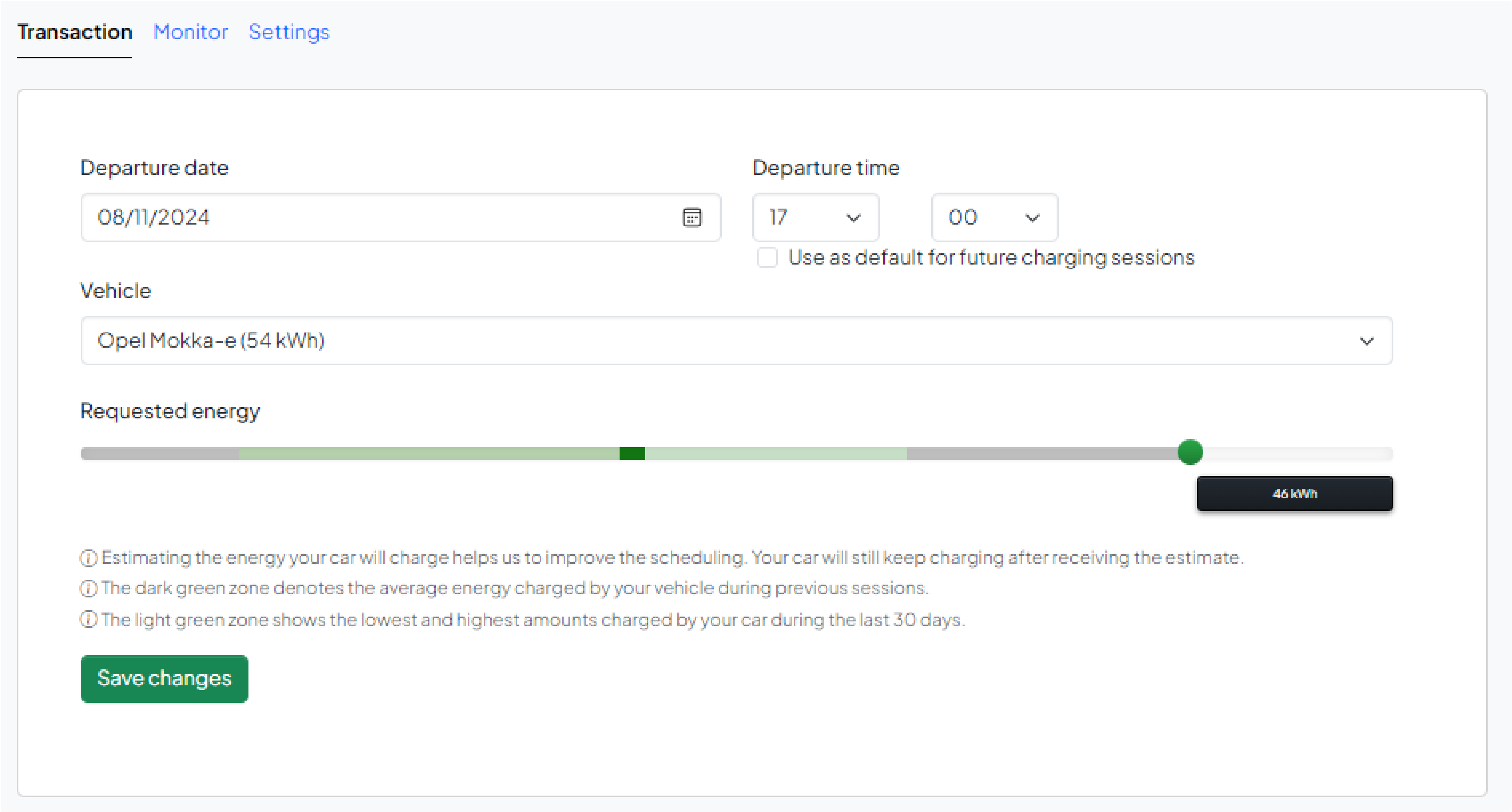
For additional help or questions, feel free to send us an email.

Energy Ville

EV1 Charging session: Default settings

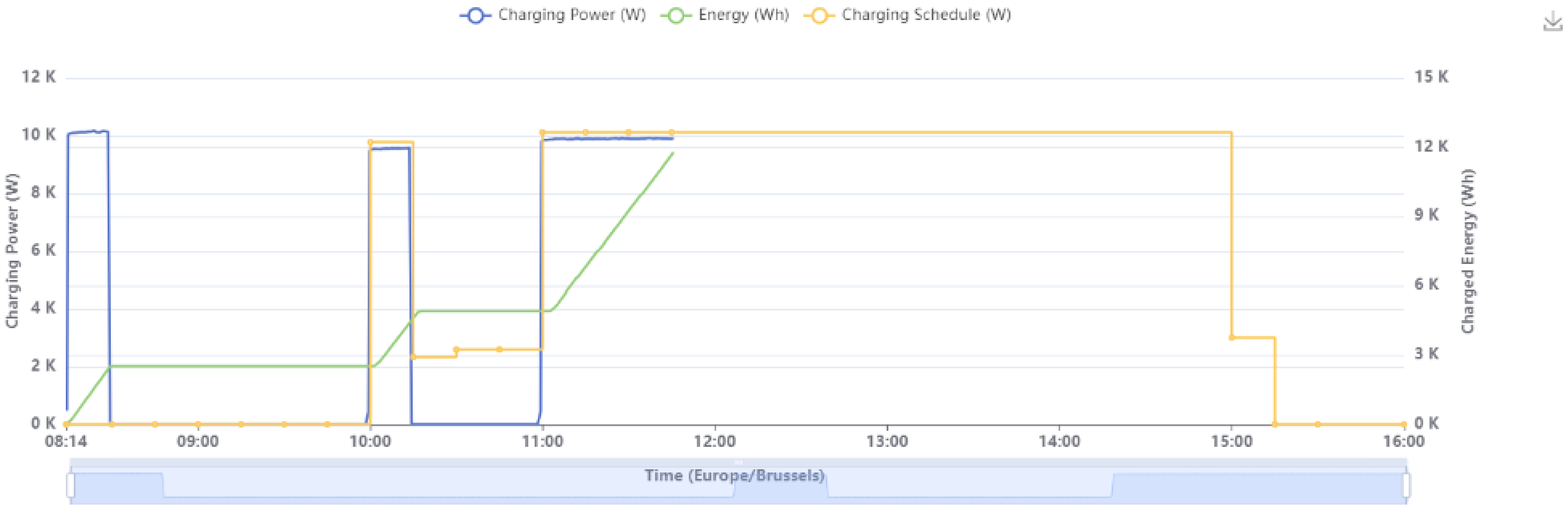


EV1 Charging session: Transaction

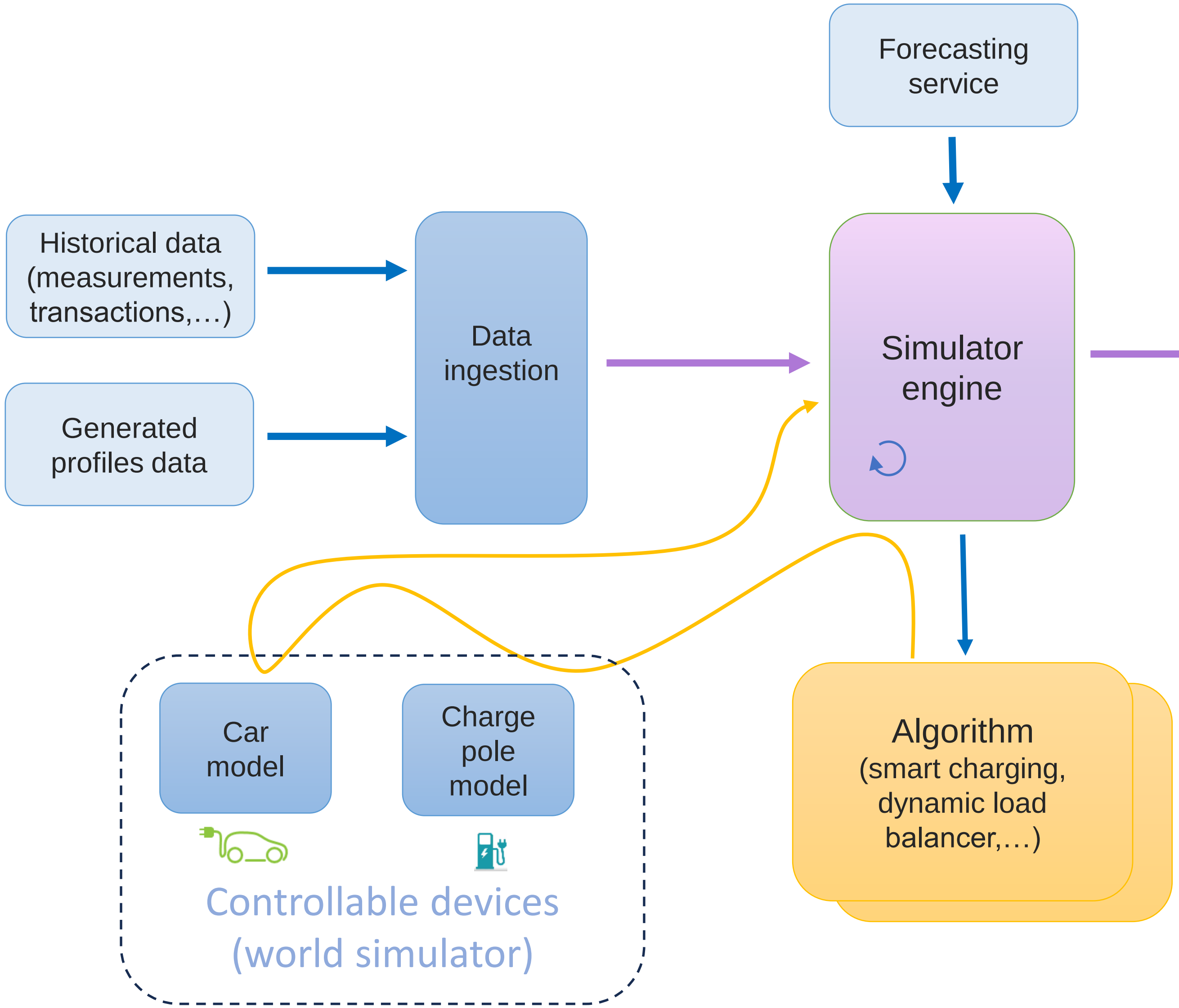


EV1 Charging session: Monitoring

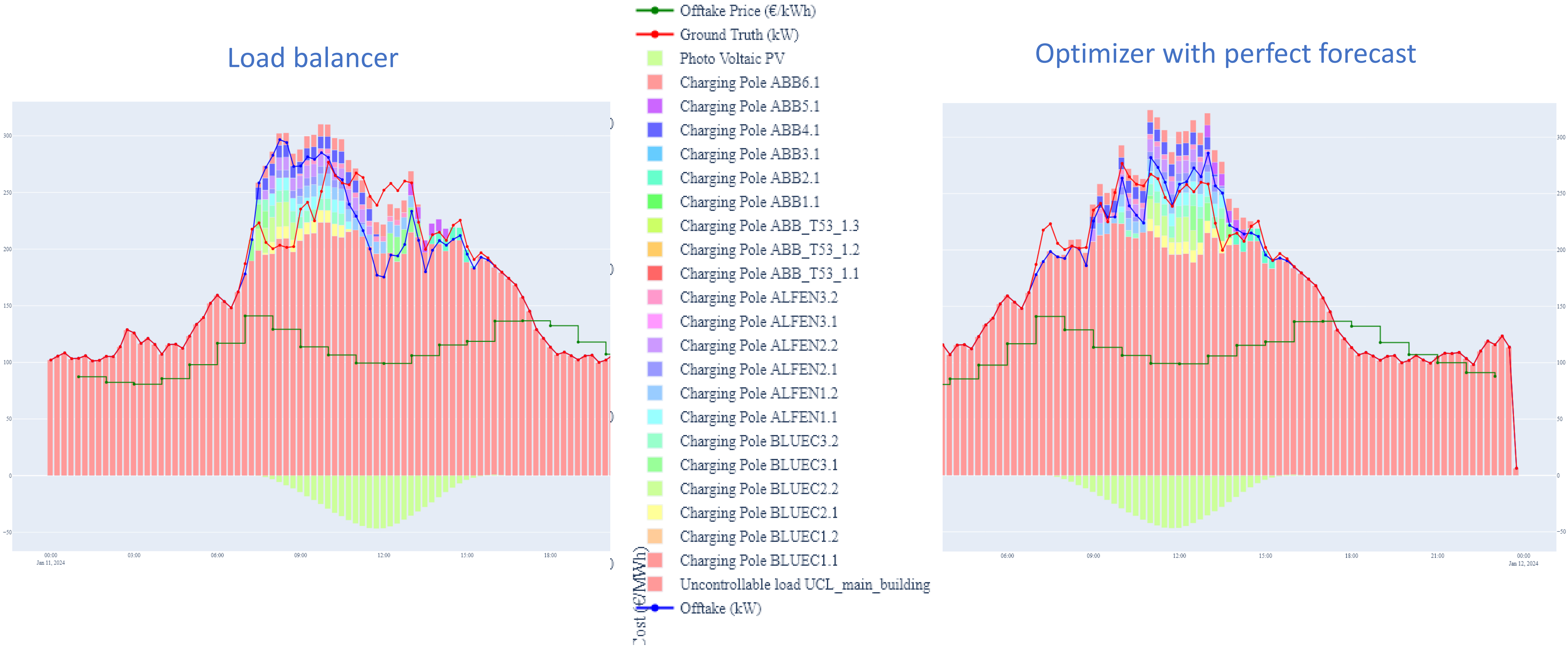
Transaction Id	Charging Station	Connector	Start Time	Estimated Departure Time	Requested Energy	Finished
a6a83985-4bff-49c5-9297-cda13a3de252	BLUEC3	2	2024-11-08 08:14	2024-11-08 17:00	46 KWh	



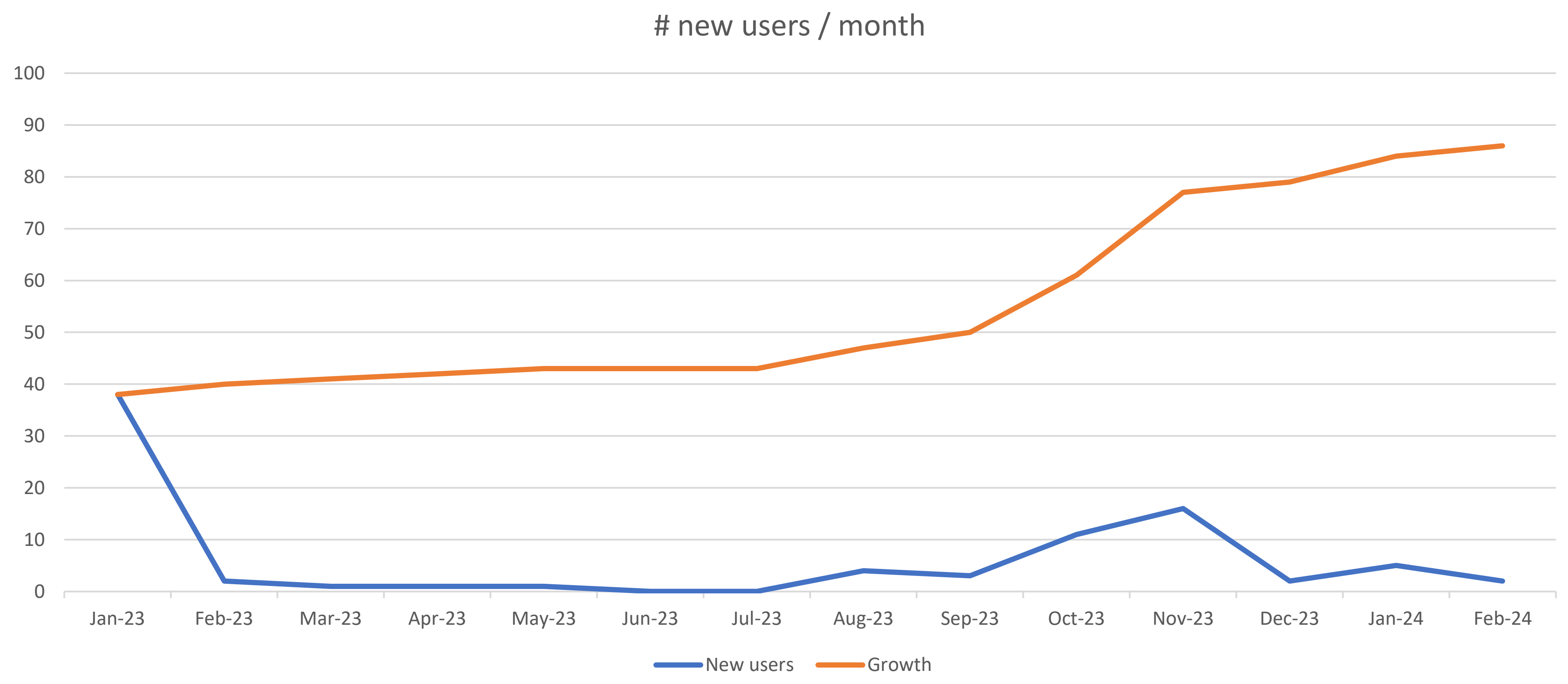
Simulator for benchmarking



Results

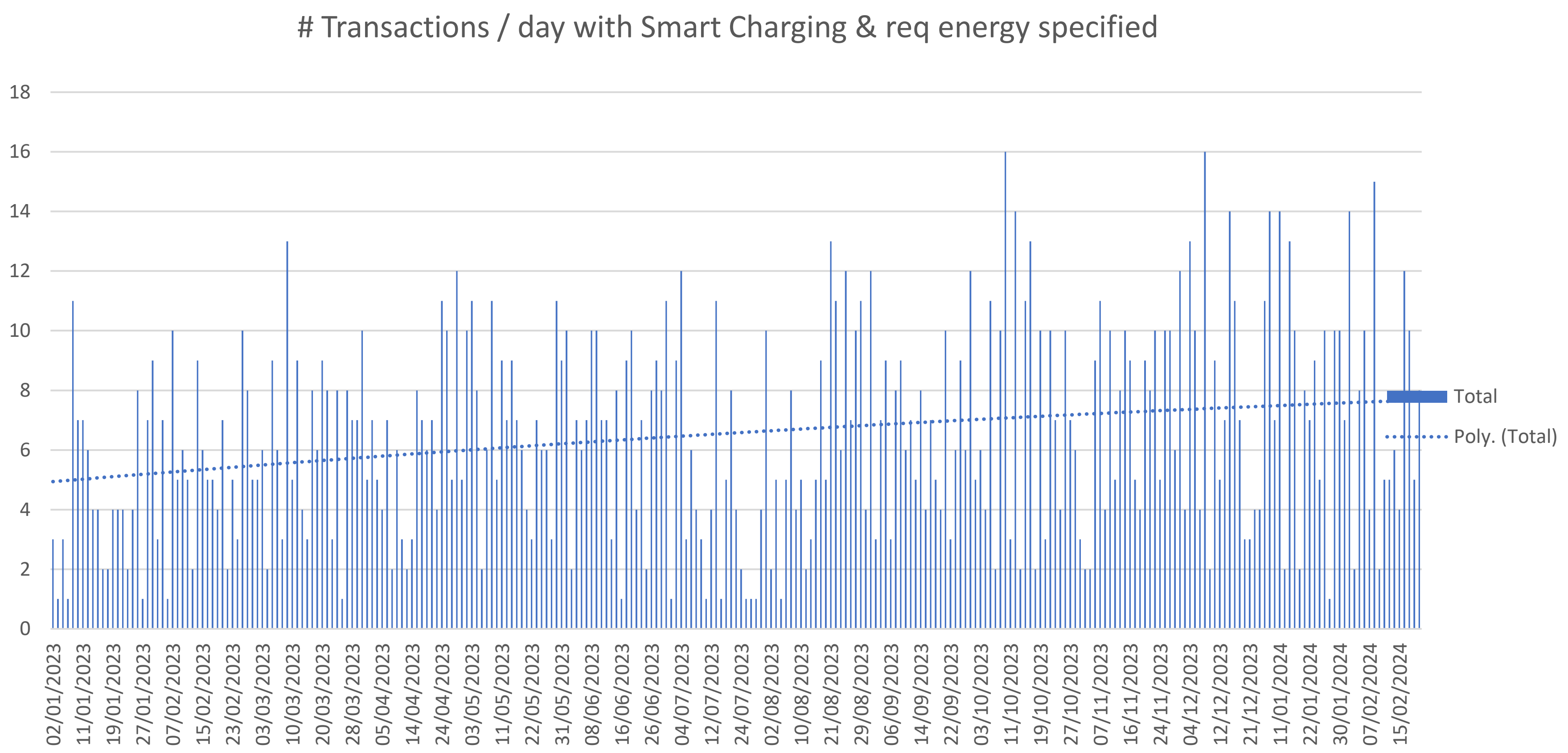

Load balancer
Optimizer with perfect forecast
Offtake Price (€/kWh)
Ground Truth (kW)
Photo Voltaic PV
Charging Pole ABB6.1
Charging Pole ABB5.1
Charging Pole ABB4.1
Charging Pole ABB3.1
Charging Pole ABB2.1
Charging Pole ABB1.1
Charging Pole ABB_T53_1.3
Charging Pole ABB_T53_1.2
Charging Pole ABB_T53_1.1
Charging Pole ALFEN3.2
Charging Pole ALFEN3.1
Charging Pole ALFEN2.2
Charging Pole ALFEN2.1
Charging Pole ALFEN1.2
Charging Pole ALFEN1.1
Charging Pole BLUEC3.2
Charging Pole BLUEC3.1
Charging Pole BLUEC2.2
Charging Pole BLUEC2.1
Charging Pole BLUEC1.2
Charging Pole BLUEC1.1
Uncontrollable load UCL_main_building
Offtake (kW)
Cost (€/MWh)
300
250
200
150
100
50
0
−50
00:00
Jan 11, 2024
03:00
06:00
09:00
12:00
15:00
18:00
21:00
00:00
Jan 12, 2024

#Users

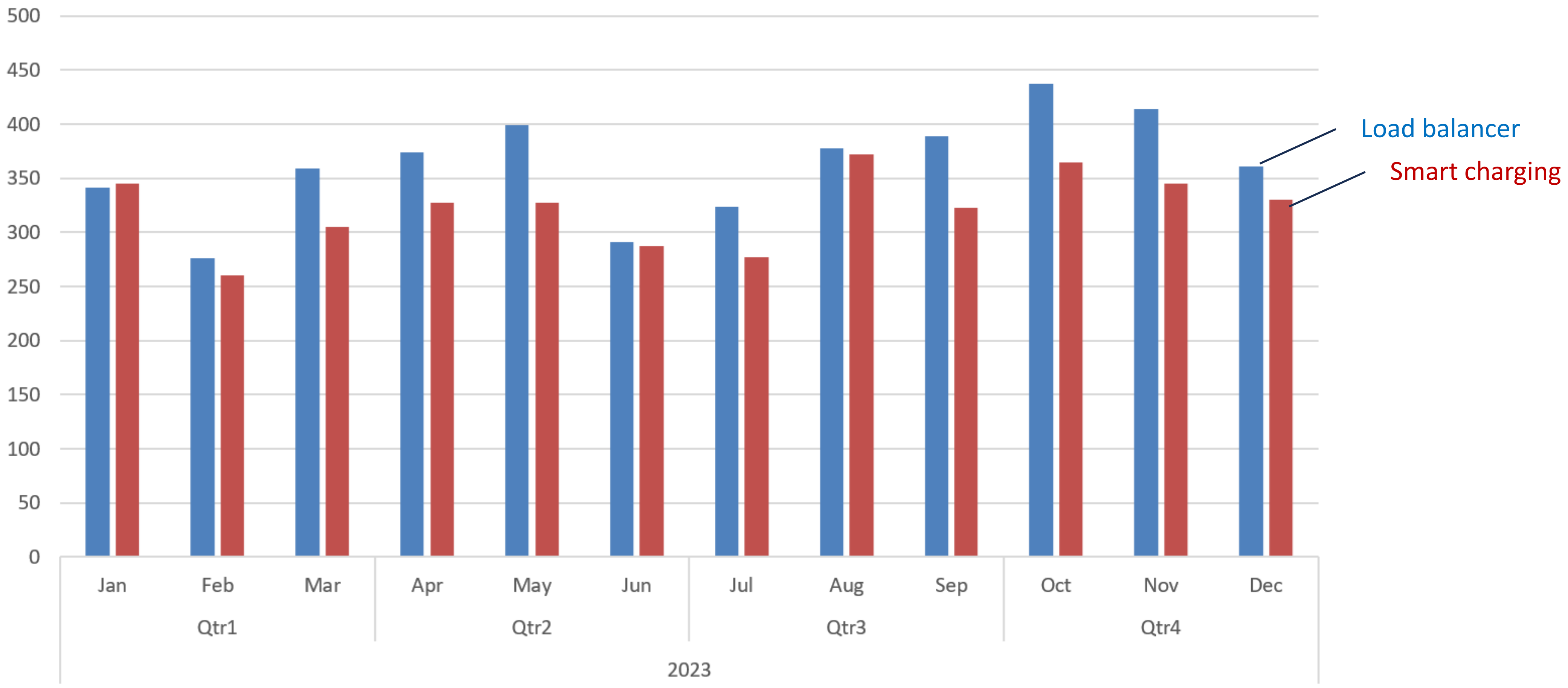


new users / month
100
90
80
70
60
50
40
30
20
10
0
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
Jul-23
Aug-23
Sep-23
Oct-23
Nov-23
Dec-23
Jan-24
Feb-24
New users
Growth

Transactions / day



Peak in KW



500
450
400
350
300
250
200
150
100
50
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Qtr1
Qtr2
Qtr3
Qtr4
2023
Load balancer
Smart charging

Performance results

HUME

Self-consumption	Dynamic load balancing	Smart charging
Self-consumption	97,4%	97,7%

Cost	Dynamic load balancing	Smart charging	Cost reduction	% cost reduction	Reduction part
Commodity cost	4.116,01 €	3.657,95 €	458,06 €	11,13%	19%
Peak cost	17.351,03 €	15.438,88 €	1.912,15 €	11,02%	81%
Total cost	21.467,04 €	19.096,83 €	**2.370,21 €**	11,04%	

Total cost reduction per pole per month: 11€

Cost, complexity versus gains

Commercial flexibility not yet activated
Additional comfort (priority, more charged,…)

Thank you

Dominic Ectors, VITO/EnergyVille

AGENTSCHAP INNOVEREN & ONDERNEMEN

Vlaanderen is ondernemen

Multiobus - Setup

Overview depot Tienen

AGENTSCHAP INNOVEREN & ONDERNEMEN

Vlaanderen is ondernemen

Multiobus setup Tienen

Multiobus setup Tienen

- Busdepot 2 hangars (North / South)
- Located in Industrial Zone
- Gridconnection: 1.000 kVA
- PV installation 800 solar panels
- BESS (1,6 MWh)

- Daily use of 2 MWh
(2021-2023)

Multiobus setup Tienen

HUME

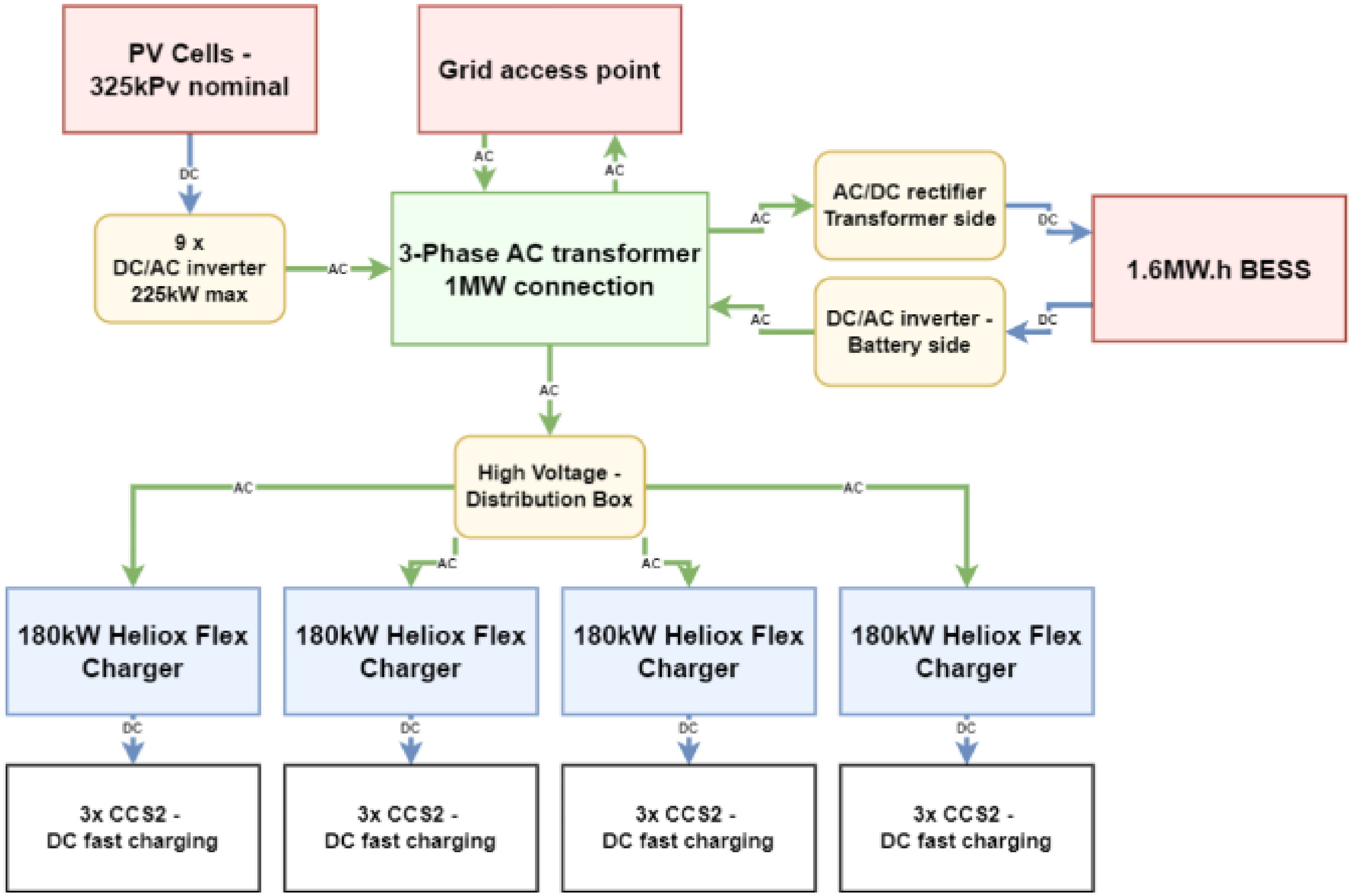
- Hangar for 24 buses,12 chargers available (CCS-2, 3 DC-outlets/180kW, dynamic charging)
- Nominal DC charging power of 50 kW, max performance 150 kW
- Charging and buses are monitored by Chargepoint® software
- PV installation and BESS (1,6 MWh) on site



Multiobus - Technical data

Overview depot Tienen

Multiobus setup Tienen



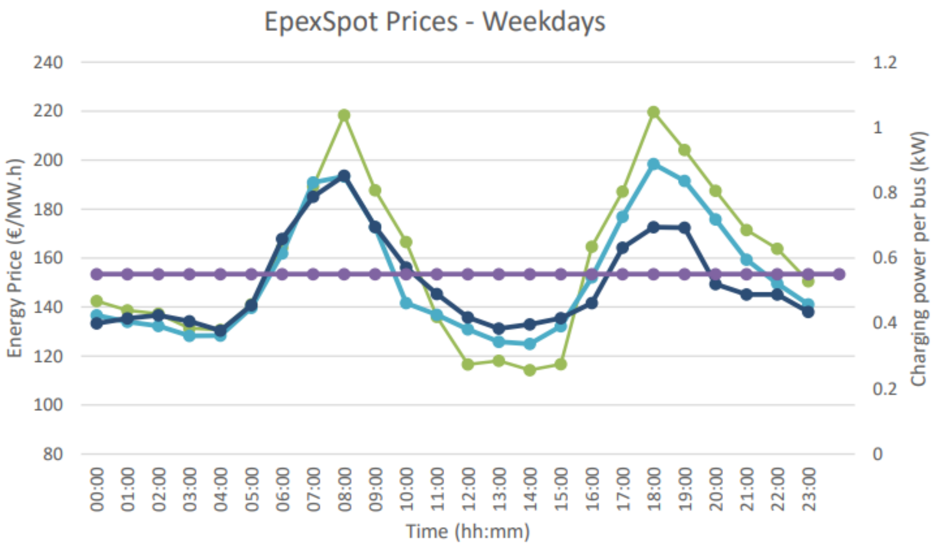
Multiobus setup Tienen

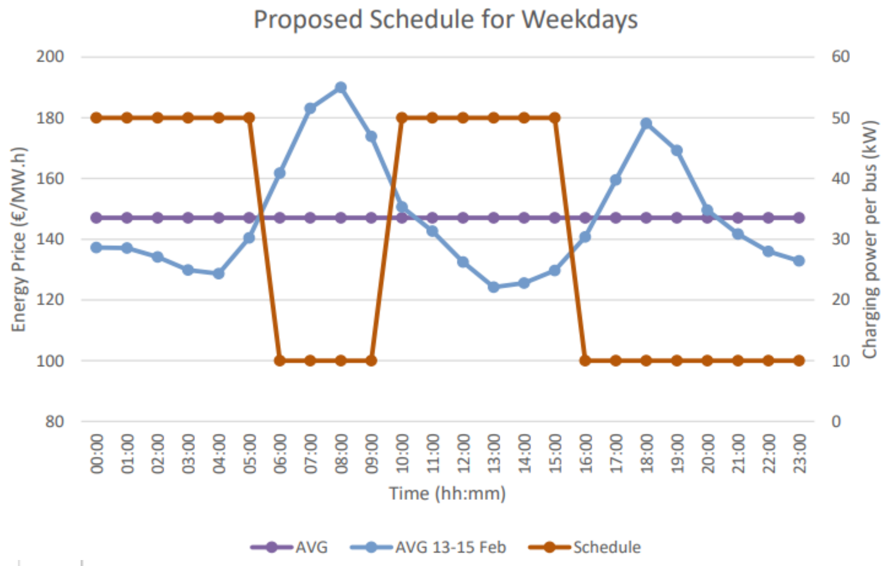
- Overview of bus fleet during test period
- Avg consumption 1.1 kWh/km (12 meter bus), 1.7 kWh/km (18 meter)

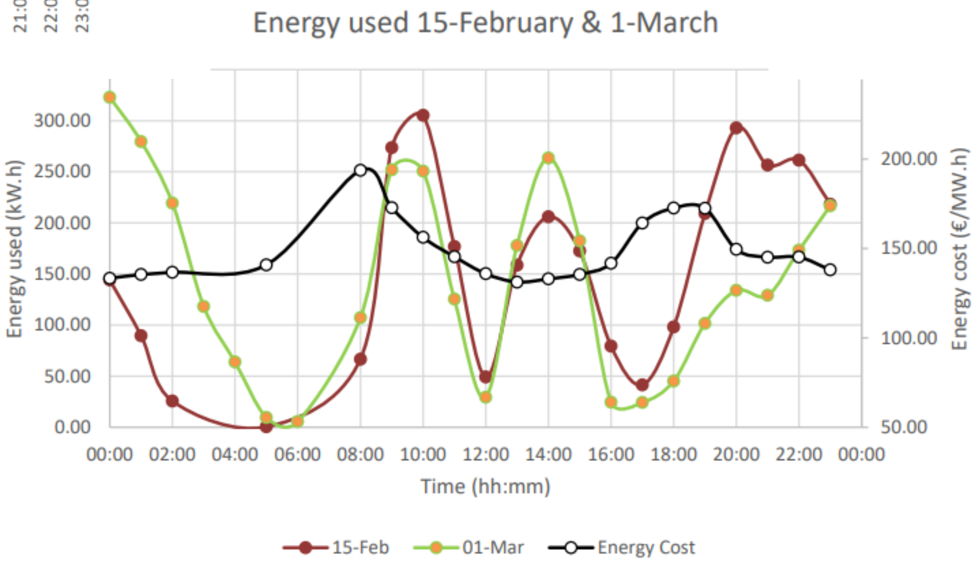
Nr. Buses	Bus Type	Battery Capacity (type)
4 x Ebusco 2.1	12-meter	211kW.h (LFP)
10 x Ebusco 2.2	12-meter	360kW.h (LFP)
2 x Ebusco 3.0	12-meter	390kW.h (LFP)
2 x Mercedes-Benz e-Citaro	18-meter (Articulated)	590kW.h (NMC)

Multiobus setup Tienen

- Prices vs charging needs (2023)







Multiobus setup Tienen

- Planned maximum power (per set of 3 connected outlets per charger)

Groep	Laadstations		Geplande groepslimieten				Geplande start op afstand
Laadstation 1	3 laders	Bewerk	Actief		Bewerk		Inactief
T01-01 T05-01 T06-01							
			Dagdeel 1 (150 kW)	✓	Mon, Tue, Wed, Thu, Fri	09:45-16:00	
			Dagdeel 2 (15 kW)	✓	Mon, Tue, Wed, Thu, Fri	16:00-23:45	
			Nachtdeel 1 (150 kW)	✓	Sun, Mon, Tue, Wed, Thu, Fri, Sat	00:00-05:00	
			Ochtenddeel1 (15 kW)		Mon, Tue, Wed, Thu, Fri	05:00-09:45	
			Dagdeel Weekend (15 kW)		Sun, Sat	05:00-23:45	

Multiobus setup Tienen

- Further finetuning of the charging schedule:
    - During split services in day time
    - Further delayed charging at night
    - Weekend charging with adapted schedule

Schedule	€/kW.h week	€/kW.h weekend	Improvement Week (%)	Improvement Weekend (%)
1	0.127	0.115	-	-
2	0.119	0.108	6.12	6.53
3	0.123	0.11	3.09	4.52
4	0.113	0.103	10.62	10.55

Q&A Session

Moderator Prof. Johan Driesen – KULeuven / EnergyVille

Agenda

12u00-13u00: Registration & Sandwich Lunch

- ✓ 13u00-13u05: Welcome (VITO – Carlo Mol – Moderator)
- ✓ 13h05-13h15: HUME within the FLUX50 activities on collective energy solutions and flexibility (FLUX50 –Patrick Devos)
- ✓ 13u15-13u25: HUME measurement sites: challenges/opportunities (VITO - Wim Cardinaels)
- ✓ 13u25-13u35: Charging ahead: Insights into EV driver behaviour and preferences (VITO - Guillermo Borragán)
- ✓ 13u35-13u55: Using smart charging to optimize parking and building energy flows (KULeuven - Klaas Thoelen & VITO - Jef Verbeeck)
- ✓ 13u50-14u10: Looking deeper into the charging hardware: electrical systems and operating efficiencies (KULeuven - Johan Driesen)
- ✓ 14u10-14u40: New insights in service and business models for EV charging (Blink Charging – Thais Lopez & MOVE – Jasmien Vanvooren)

15h00-15h30: Coffee Break

- ✓ 15h30-15h50: HUME integrated architecture (VITO - Dominic Ectors)
- ✓ 15h50-16h30: An overview of the HUME demonstration sites
  - ✓ Tour & Taxis (Brussels) (Nextensa – Tim Van Dorpe)
  - ✓ EnergyVille1 (Genk) (VITO – Dominic Ectors)
  - ✓ Multiobus (Tienen) (Multiobus – Peter Vicca)
- ✓ 16h30-17h00: What is the impact of "EV Fire Safety" aspects on your parking and building (VITO – Carlo Mol)
  - ✓ Practical hands-on experiences will be shared by bus depot owner Multiobus and parking owner Nextensa.
- ✓ 17h00-17h30: Q&A (KULeuven – Prof. Johan Driesen)
  - ✓ Questions can be sent in during the event via a QR-code and will be handled in the Q&A session moderated by Prof. Johan Driesen (KULeuven)
  - ✓ Presentations will be shared to all participants after the event

17h30-19h00: Reception & Networking

HUME Closing Event – 14 November 2024 – Tour & Taxis (Brussels)

IEA HEV TCP Task49 - EV FIRE SAFETY

What is the impact of “EV Fire Safety” aspects on your parking and building

Carlo Mol – VITO / EnergyVille

Agenda

- Due to the unfortunate fire incident at the bus depot of Multiobus in October 2023, the HUME partners decided to add an extra presentation not directly linked to smart charging but on the topic of "EV Fire Safety" and its impact on the installation of extra charging points in parkings.
- An overview of the activities within Task49 on "EV Fire Safety" by Carlo Mol (VITO). VITO initiated a dedicated Task on "EV Fire Safety" within the framework of IEA HEV TCP and will give an overview of lessons learned related to changes in parking legislation in different EU member states.
- Practical hands-on experiences will be shared by bus depot owner Multiobus and building/parking owner Nextensa.

Van de 24 bussen blijven enkel wat stalen frame's over. © Bollen

24 Lijnbussen en 700 zonnepanelen vernield na zware brand in loods

Brandweer kon voorkomen dat de brand oversloeg, maar de loods waar de brand uitbrak was niet meer te redden. © Bollen

IEA HEV TCP: IEA Hybrid and Electric Vehicle Technology Collaboration Programme

International Energy Agency (IEA)

- IEA is an organization of 31 member countries focused on energy issues.
- Founded in 1974, based in Paris.
- IEA works to ensure reliable, affordable and clean energy.
- IEA has four main areas of focus:
  - energy security
  - economic development
  - environmental awareness
  - engagement worldwide.

- IEA has 39 different Technology Collaboration Programs (TCPs) focused on topics across many sectors, including buildings, transport, industry, renewable energy, fossil energy and fusion power
  - one of these is the Hybrid & Electric Vehicle TCP (HEV TCP)

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IEA HEV TCP: IEA Hybrid and Electric Vehicle Technology Collaboration Programme

Hybrid & Electric Vehicle Technology Collaboration Program (HEV TCP)

- HEV TCP was formed in 1993; today it is a working group of 18 countries working together on electric drive vehicle technologies
- An Executive Committee (ExCo) directs the work of the task forces, plans new initiatives, and disseminates the information produced
- Countries participate in various task forces (working groups) on specific technologies of their choice

Information or material of the Technology Collaboration Programme (TCP) on Hybrid and Electric Vehicles (HEV TCP) (formally organized under the auspices of the Implementing Agreement for Co-operation on Hybrid and Electric Vehicle Technologies and Programmes), does not necessarily represent the views or policies of the IEA Secretariat or of the IEA's individual Member countries. The IEA does not make any representation or warranty (express or implied) in respect of such information (including as to its completeness, accuracy or non-infringement) and shall not be held liable for any use of, or reliance on, such information.

HEV TCP Participants

- Executive Committee – 18 member countries

Austria	France	South Korea
Belgium	Germany	Spain
Canada	Ireland	Sweden
China	Italy	Switzerland
Denmark	Netherlands	UK
Finland	Norway	USA

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IEA HEV TCP: IEA Hybrid and Electric Vehicle Technology Collaboration Programme

Current & Recent Work

Electric Cars

- Light EVs
- Batteries
- Fuel Cell Electric Vehicles
- Vehicle/Grid Interface

Beyond Cars

- Electric Trucks
- Hybrid/Electric Ships
- Electric Buses
- Electric Bicycles

Infrastructure

- Electrified Roadways
- Extreme Fast Charging
- Electrification in Ports
- Battery Swapping

Analysis

- Critical Raw Materials for EVs
- Life Cycle Analysis
- EV Fire Safety
- Battery Second Use

Active Tasks (Working Group)

- Task 1: Information Exchange
- Task 23: Light Electric Vehicle Infrastructure
- Task 38: Marine Application of Hybrid/Electric Systems (eShips)
- Task 43: Vehicle/Grid Integration
- Task 45: Electrified Roadways
- Task 46: Life Cycle Analysis
- Task 47: Electrification in Ports
- Task 48: Battery Swapping
- Task 49: EV Fire Safety
- Task 50: Light Electric Vehicles
- Task 51: Battery Second Use

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IEA HEV TCP: IEA Hybrid and Electric Vehicle Technology Collaboration Programme

Recently Completed Tasks

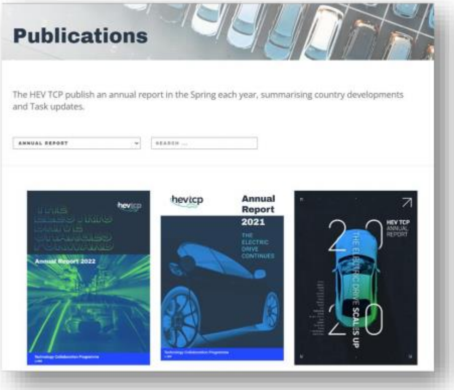
- Task 29: Electrified, Connected and Automated Vehicles (e-CAVs)
- Task 30: Environmental Effects of Electric Vehicles
- Task 31: Fuels and Energy Carriers for Transport
- Task 32: Small Electric Vehicles
- Task 33: Hybrid and Electric Buses
- Task 34: Battery Systems
- Task 35: Fuel Cell Electric Vehicles
- Task 36: Electric Vehicle Purchase and Use Patterns
- Task 37: Extreme Fast Charging
- Task 39: Interoperability of e-Mobility Services
- Task 40: Critical Raw Materials for EVs
- Task 41: Electric Freight Vehicles
- Task 42 Scaling Up EV Markets and EV City Casebook

Task 01 – Information Exchange

Task Manager: Urban Foresight (UK)
Gary.mcrae@urbanforesight.org

Activities:

- Annual report
- Newsletter
- Website (www.ieahev.org)
- Information sharing workshops



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IEA HEV TCP: IEA Hybrid and Electric Vehicle Technology Collaboration Programme

Task 23 – Light Electric Vehicle Parking and Charging Infrastructure

Task Manager: EnergyBus.org (Germany)

hannes.neupert@energybus.org

Objectives:

- Document existing solutions for best practice
- Create turnkey guidelines for local governments
- Workshops for interested communities

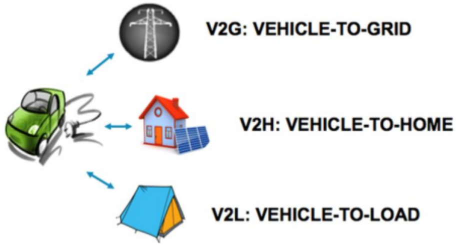
Task 43 – Vehicle/Grid Integration

Task Managers: Cristina Corchero and Josh Eichman (Spain)

ccorchero@irec.cat , jeichman@irec.cat

Objectives:

- Analyze the challenges of the integration of electric vehicles into our electricity and transport system in order to improve economic and environmental performance
- Explore, identify and give answers to the gaps preventing the electric vehicles to be fully integrated in the electrical grid
- Improve the joint work between electric sector and mobility sector, which is a key point for the real energy transition



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IEA HEV TCP: IEA Hybrid and Electric Vehicle Technology Collaboration Programme

Task 49 – EV Fire Safety

Task Manager: VITO (Belgium)

Carlo Mol, carlo.mol@vito.be

Objectives:

- Although there is growing interest in electric mobility from policymakers, companies and end-users, there is still some lack of trust in the safety aspects of electric vehicles. Task objective is to collect and share objective information on different EV fire safety related aspects to increase the overall trust in electric vehicles.

Objectives:

- Collect statistics on EV fire incidents, since risk assessments based on limited statistics could lead to a too negative perception of EV fire safety risks hampering the roll-out out EV's and charging infrastructure in e.g. underground parking facilities.
- Stimulate knowledge exchange on EV fire safety aspects by sharing experiences between country experts to increase insights in EV fire safety risks and to share best practices in preventing or mitigating EV fire incidents (from both the technological and regulatory perspective).
- Target groups are building and parking owners, OEMs (vehicles and charging infrastructure), fire rescue workers, transport and tow companies, insurance companies, policy makers, regulations, and up to the EV drivers and general public.

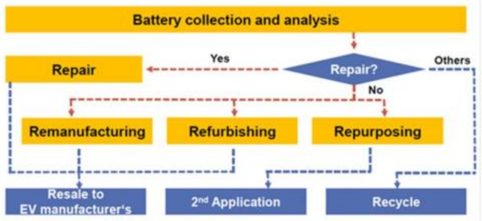
Task 51 – EV Battery Re-Use

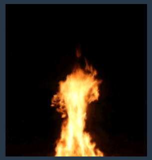
Task Manager: University of Ulsan (South Korea)

Ock Taeck Lim, otlim@ulsan.ac.kr

Objectives:

- Explore EV battery re-use techniques and battery re-use initiatives
- Investigate technical issues for re-purposing EV batteries for new energy storage solutions
- Understand upcoming environmental regulations and safety standards for managing end-of-life batteries
- Life cycle analysis (LCA) for environmental benefits of re-use





Task49 “EV Fire Safety” : Topic & Background

Knowledge exchange on EV fire safety aspects: exchange best practices, share experiences and work towards common guidelines how to deal with specific EV fire safety risks

Task49 is triggered due to many different perceptions of EV fire safety risks

Not that much statistics available yet. Risk assessments based on limited statistics could lead to a too negative perception of EV fire safety risks hampering the roll-out out EV’s and charging infrastructure in e.g. underground parkings

Task49 wants to collect and share information to relevant stakeholders: building and parking owners, fire rescue workers, transport and tow companies, insurance companies, OEMs (vehicles and charging infrastructure), policy makers, regulations, … up to the EV drivers and general public

Sharing experiences between country experts to increase insights in EV fire safety risks and to share best practices in preventing or mitigating EV fire incidents (from technological and regulation perspective).

Task49 “EV Fire Safety” : Tasks

Task1: Collection of information

- Desktop research, interviews, conferences, …

Task2: Stakeholders database

- Building up database of task49 working group (first point of contact & key members) & interested stakeholders in member countries

Task3: Collaboration IEA HEV TCP tasks

- Collaboration on their specific expertise e.g. on vehicle side (LEV, marine, ..), on batteries or charging infrastructure (extreme fast charging, battery swapping, …), … ambition is to intensify exchanges between IEA TCP HEV tasks (input for scoping, workshops, stakeholder database, literature, …)

Task4: Workshops

- Organize 5 online workshops on selected topics, prioritization in agreement with member countries

Task5: Dissemination

- Task49 chapter in IEA TCP HEV annual reports, newsletters, conferences, …

Task6: Task management

- 6-monthly meetings with FPOC of member countries (status update, planning, …)

Task49 “EV Fire Safety”: Task49 Member Countries

- 13 Member Countries
  - Belgium (Task Manager), Austria, Germany, Italy, Norway, South Korea, Spain, Switzerland, Sweden, The Netherlands, UK, USA and European Commission

- Close to join Task49
  - Denmark, Canada, Japan as observer (Link to IEA Combustion TCP)

- Next slides: Activities related to impact of “EV Fire Safety” aspects on parking and building regulation

Task49 “EV Fire Safety” : AEC2023 (Utrecht – NL) (27/09/2023)

WEDNESDAY 27..09.2023. Cloud 9

11h00 - 12h00

Electrification of transport and Fire safety

In this session, representatives from fire fighting organisations, parking associations, electromobility associations and policymakers will take a look at the risks associated with EVs (especially when parked/charging in parking lots) and explain why the decarbonisation of road transport will be perfectly safe

Speakers

Raphaël Héliot - Moderator
Policy Manager, AVERE

Aleksandra Klenke
Policy officer, STF TF Fire safety - DG MOVE

Tom Antonissen
Brussels representative, European Parking Association

Ron Galesloot
Fire Department, City of Amsterdam

Tommy Borger
Dutch City Council

Carlo Mol
Vito

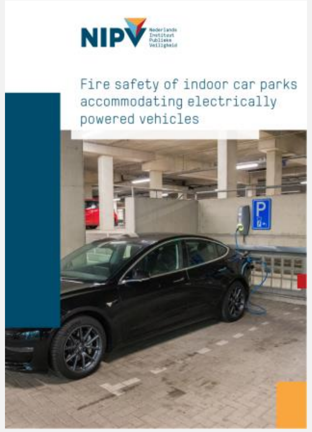
Task49 “EV Fire Safety”

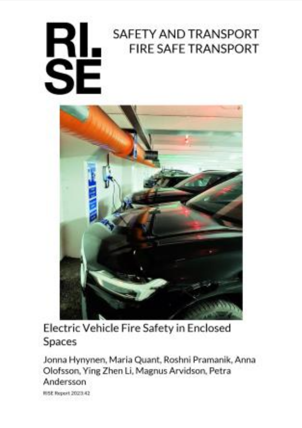
Workshop 1: “Impact of electric vehicles on parking regulation”

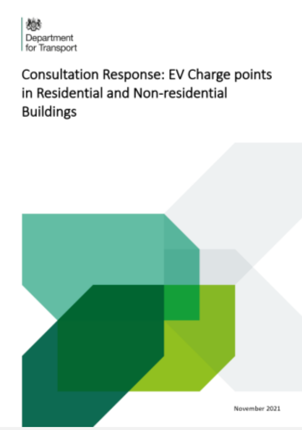
17 July 2024 – ONLINE

- Welcome & introduction to IEA HEV TCP – Task49 – “EV Fire Safety” (Carlo Mol, VITO) (15’)
- Impact of electric vehicles on parking regulation (15’ for each presentation)
  - In Belgium (Bart Vanbever, Agoria and FireForum)
  - In The Netherlands (Tom Hessels, NIPV)
  - In Austria (Hannes Kern, IRIS)
  - In UK (Asiq Mohamed or Grace Carroll, UK Office for Zero Emission Vehicles)
  - On European level (Aleksandra Klenke – DG MOVE & Eugenio Quintieri - Fire Safe Europe, EC Sustainable Transport Forum Task Force Fire Safety)
- Q&A – Interaction with speakers and participants on experiences and expectations (30’)

- Recording and presentations of workshop 1: send email to carlo.mol@vito.be for link
- Next Workshop will be on “EV Fire Statistics”







Task49 “EV Fire Safety” : Task1 : Collection of Information: Future Conferences

- European Fire Safety Week (18-22 November 2024 in Brussels)
- https://www.europeanfiresafetyalliance.org/european-fire-safety-week/

Dear Mr. Carlo Mol,

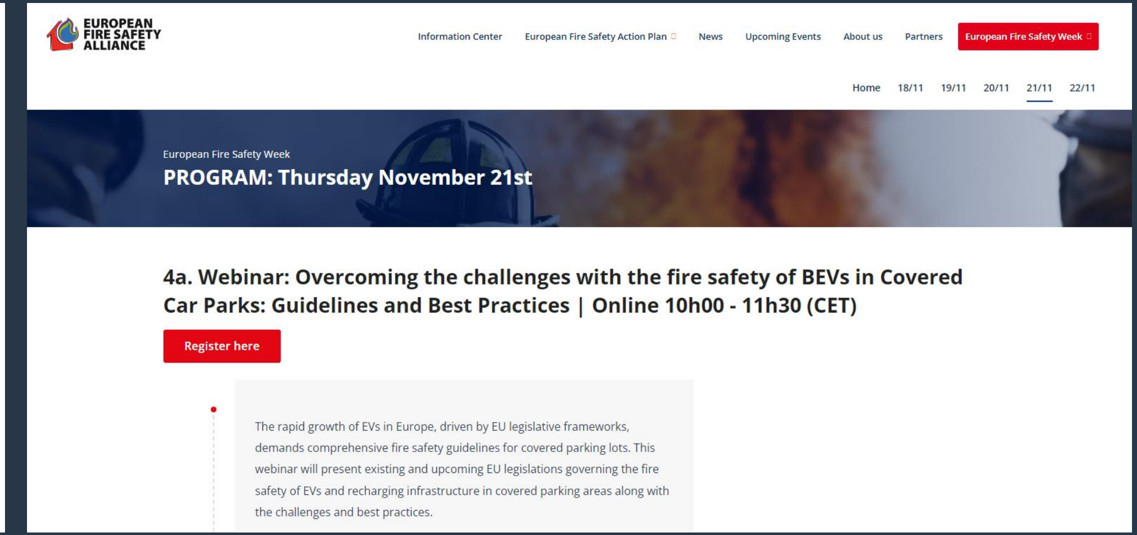
Thank you for signing up! We are looking forward to a productive week filled with an inspiring program and participation from delegates of EU institutions, fire safety professionals, researchers, and other key stakeholders. This broad and diverse group once again highlights the importance of our shared mission: improving fire safety.

Your registration overview:

In-Person Events

- Tuesday 19/11 - 2a. Workshop: Implementation of fire and electrical safety measures under the new EPBD. In-person from 09h30-12h30 (CET), Brussels

Participation in the in-person events will be confirmed separately by the organizers within one week after receiving your registration, starting from October 1st.



Task49 “EV Fire Safety” : Task1 : Collection of Information: Future Conferences

- International Conference on Fires in Vehicles (FIVE 2025) (7-8 April 2025 in Reykjavik - Iceland)
- https://www.ri.se/en/five : registration will open in January 2025
- Presentation on IEA HEV TCP Task49: "Electric vehicle fire safety and the impact on parking regulations"
- Draft paper by 15/12/2024 and final paper by 03/03/2025

The Eight International Conference on Fires in Vehicles FIVE 2025 will be held April 7 - 8, 2025 in Reykjavik, Iceland.

RISE will host FIVE 2025 and ISTSS 2025 (International symposium on tunnel safety and security) during the same week (7-11 April, 2025). Read more about ISTSS here

In response to the pressing need for international dialogue RISE organise the conference FIVE (Fires in Vehicles). The objective of this conference is to exchange knowledge of fires in vehicles, including both on-road, off-road and rail vehicles. In recognition of the fact that many of the fire problems faced by these vehicles are the same, the solutions to them can also be similar.

FIVE brings together scientists, regulators, test engineers, rescue services, suppliers, manufacturers, operators, insurance companies and other organisations from the diverse field of transportation to discuss important fire issues.

We believe that this exchange of knowledge will significantly enhance economic, safe and sustainable solutions to problems in the fire area.

Task49 “EV Fire Safety”

Task49 Member Countries

Contacts with other initiatives on passenger cars

- Close cooperation with EC STF TF Fire Safety: “Guidelines on fire safety for Battery Electric Vehicles parked in underground and above ground covered car parks” will be presented during European Fire Safety week (21 November 2024)
- DG REFORM - Study “Accelerating Sustainable Mobility by Building Agile, Proportionate and Risk Based Safety Regulations and Scaling Up Carsharing in the Netherlands” – Deloitte
- CTIF (International Fire Service Association)
- EPA – ARUP: Fire Safety Advice Toolbox will be launched soon

What about guidelines for heavy-duty vehicles and stationary batteries?

- Belgium - new WG under FireForum on heavy-duty vehicles and guidelines for parking
- Belgium - new ad-hoc group of stakeholders focusing on guidelines for stationary batteries implementation

Agenda

- Due to the unfortunate fire incident at the bus depot of Multiobus in October 2023, the HUME partners decided to add an extra presentation not directly linked to smart charging but on the topic of “EV Fire Safety” and its impact on the installation of extra charging points in parkings.
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Van de 24 bussen blijven enkel wat stalen frame's over. © Bollen

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Task49 “EV Fire Safety”

Contact Details: Task Manager

- Carlo Mol
- VITO / EnergyVille
- Thor Park 8300 | 3600 Genk (Belgium)
- Tel : +32 492 58 61 24
- Email : carlo.mol@vito.be
- www.vito.be & www.energyville.be
- https://ieahev.org/tasks/49/

hevtcp

ieahev.org

Closing Event: 14/11/2024

Tour & Taxis
EV Fire Safety

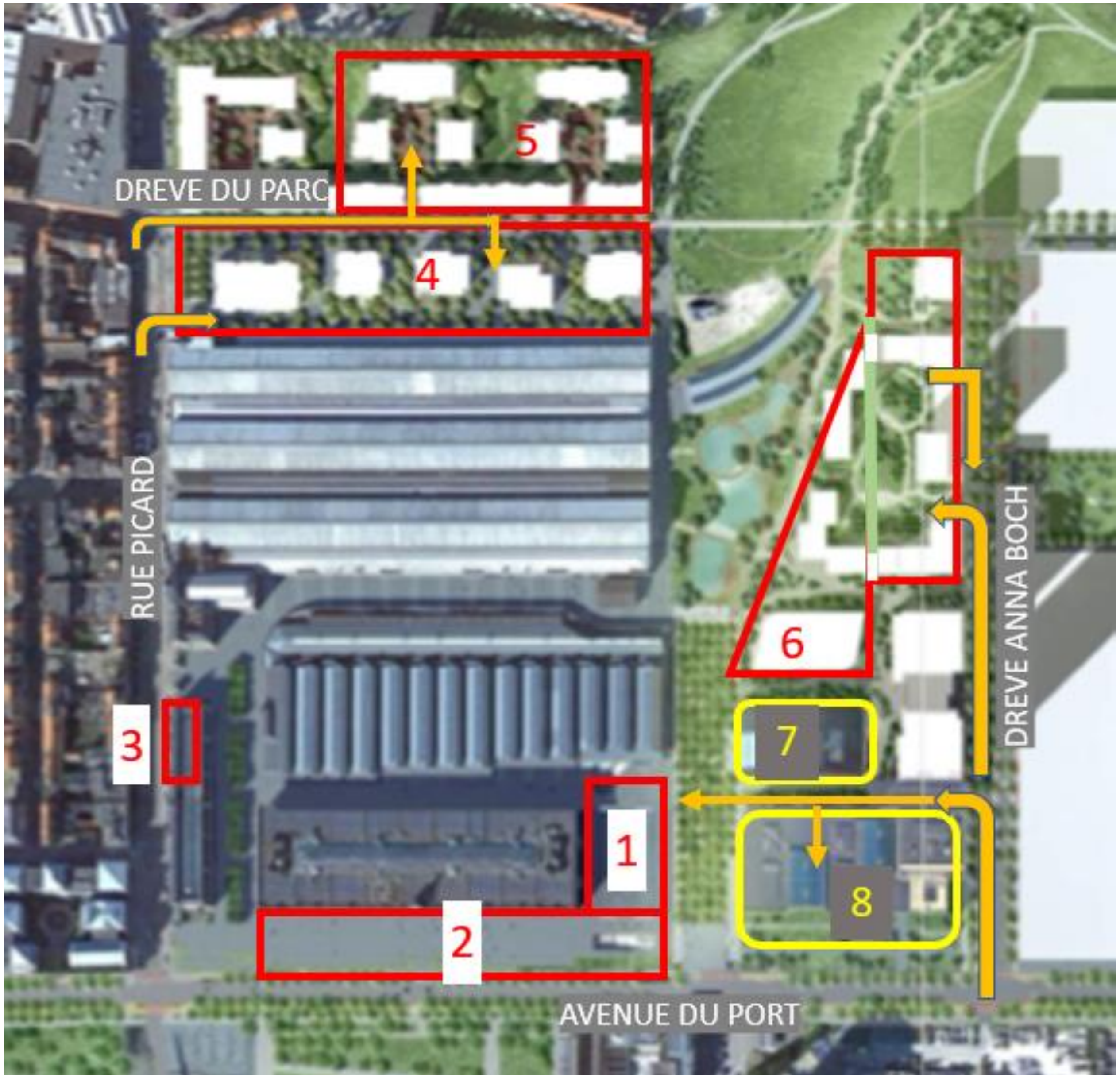
Tim Van Dorpe – Energy Manager

AGENTSCHAP INNOVEREN & ONDERNEMEN
Vlaanderen is ondernemen

HUME: EV Fire Safety

- Parking infrastructure @ Tour & Taxis
- Charging infrastructure @Tour & Taxis
- Extensions @ Esplanade & Park Lane I
- Fire department Brussels
  - Request for preliminary approval
  - Answer on request preliminary approval
    - Antecedents
    - Regulation
    - Description
    - Fire prevention measures already provided
    - Advice
    - Fire insurance company
- Environmental department Brussels
  - Regularization of the environmental permit
- Fire insurance company

Tour & Taxis: parking infrastructure



Nextensa:

1	Esplanade Wapenplein	2 Niv	354
2	Koninklijk Pakhuis	1 Niv	298
3	Hôtel des Douanes	1 Niv	13
4	Park Lane I	2 Niv	918
5	Park Lane II	1 Niv	256
6	Lake Side	2 Niv	627

Other:

7	Building Green One (Cofinimmo)	77
8	Herman Teirlinck (Vlaamse Overheid)	311

TOTAL : 2.854 pp

Tour & Taxis: charging infrastructure

HUME

Charging infrastructure T&T 2024

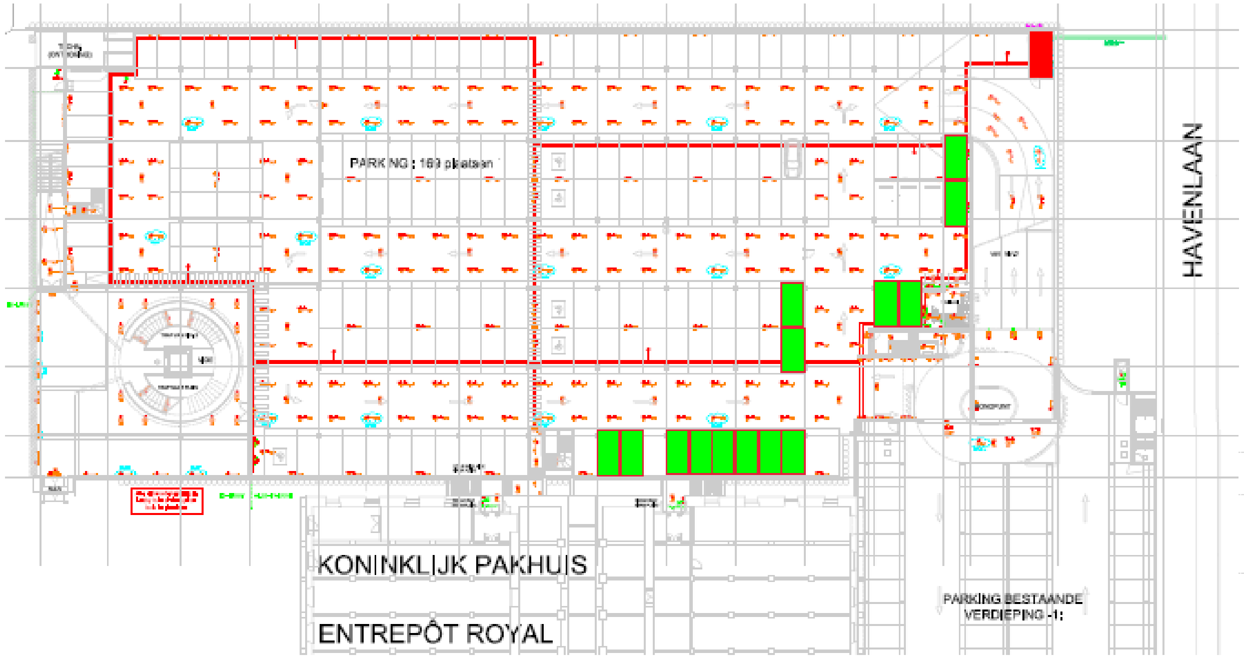
PARKING :		NIV	PLACES	CHARGING POINTS	
1	Esplanade	2 Niv	354	14	
2	2 Koninklijk Pakhuis	1 Niv	296	35	
3	Hôtel des Douanes	1 Niv	13	2	
4	Park Lane I	2 Niv	918	56	
5	Park Lane II	1 Niv	256	0	
6	Lake Side	2 Niv	627	design phase	**=> TOTAL: 123**

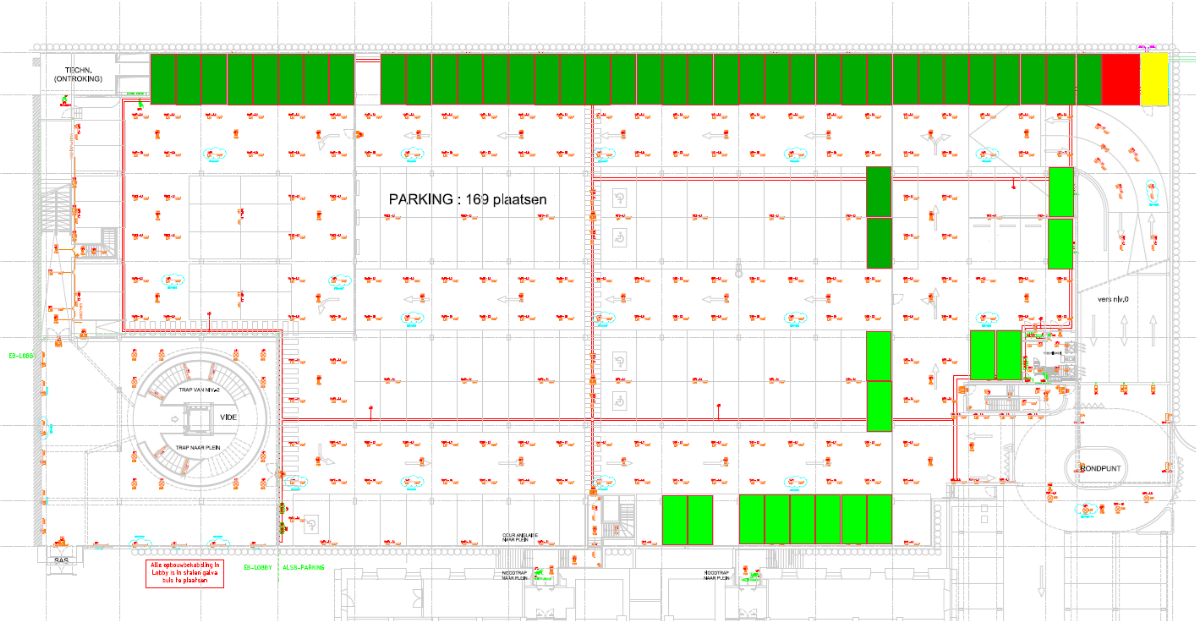
Charging infrastructure T&T 2025 (and later)

PARKING :		NIV	PLACES	CHARGING POINTS	EXTRA	
1	Esplanade	2 Niv	354	54	=> +40	
2	Koninklijk Pakhuis	1 Niv	296	70	=> +35	
3	Hôtel des Douanes	1 Niv	13	13	=> +11	
4	Park Lane I	2 Niv	918	96	=> +40	
5	Park Lane II	1 Niv	256	15	=> +15	
6	Maison De La Poste	0 Niv	6	6	=> +6	
7	Lake Side	2 Niv	627	design phase		**=> TOTAL: 254**

Extensions @ Esplanade & Park Lane I HUME

Existing EV-installation in **Parking Esplanade**: 14 charging points on 250kVA transformer

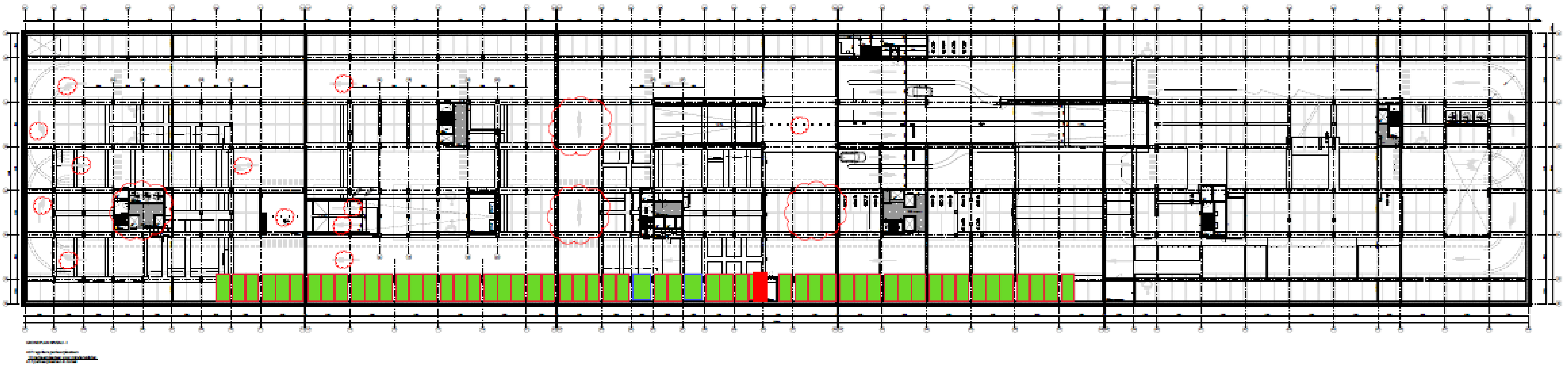




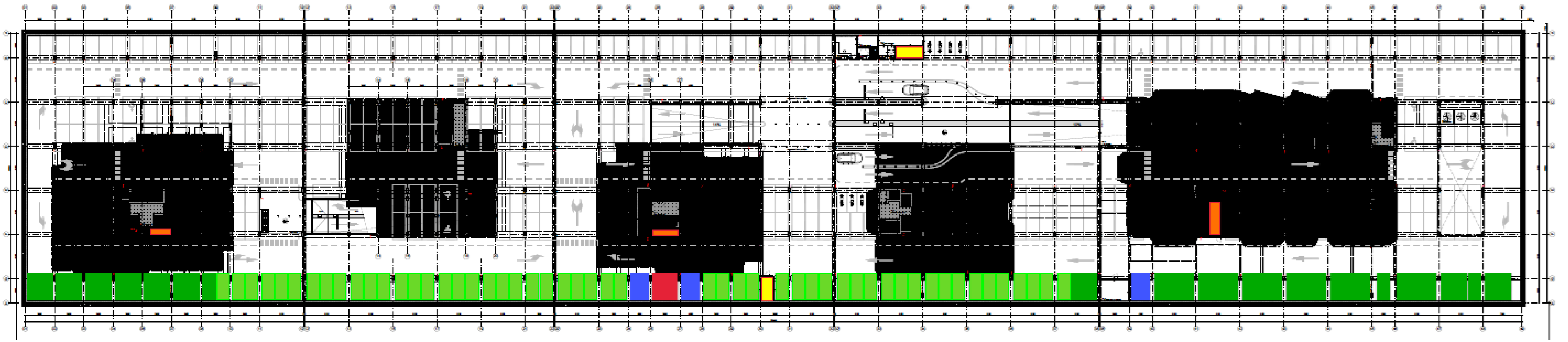
Future EV-installation in **Parking Esplanade**: 54 charging points on a 1.000kVA transformer

Extensions @ Esplanade & Park Lane I

Existing EV-installation in **Parking Park Lane I**: 56 charging points on a 400kVA transformer



Future EV-installation in **Parking Park Lane I** 96 charging points on a 1.000kVA transformer



HUME: EV Fire Safety

- Fire department Brussels
  - Request for preliminary approval (aanvraag tot voorakkoord)
  - Answer on request preliminary approval (antwoord op aanvraag voorakkoord)
    - Antecedents: Brandpreventieverslag van 30/05/2024 (Ref.:M.2007.1157/89)
      Brandpreventieverslag van 08/04/2024 (Ref.:M.2007.1157/88)
    - Regulation:
      A. Het gebouw waarvan de conventionele hoogte groter is dan 25 m (> 25 m), moet beantwoorden aan de technische specificaties opgenomen in de bijlagen 1, 4/1, 5/1 et 7 van het Koninklijk Besluit van 7 juli 1994 (gewijzigd door het Koninklijk Besluit van 20 mei 2022) tot vaststelling van de basisnormen voor de preventie van brand en ontploffing waaraan de gebouwen moeten voldoen.
      B. Besluit van de Brusselse Hoofdstedelijke Regering van 25 februari 2021 tot vaststelling van de algemene en bijzondere uitbatingsvoorwaarden van toepassing op parkings
      C. Besluit van de Brusselse Hoofdstedelijke Regering van 29 september 2022 tot vaststelling van de verhouding van de oplaadpunten voor parkings evenals bepaalde bijkomende veiligheidsvoorwaarden die van toepassing zijn
      D. De Regel van Goed Vakmanschap Elektrische Voertuigen in parkings (2° editie - 02/10/2023) van Fireforum.
      E. Algemeen Reglement voor de Arbeidsbescherming (ARAB) en de Codex over het Welzijn op het Werk, meer bepaald de titel 3 (brandpreventie op de arbeidsplaatsen) van boek III van de codex.
    - Description: Op de Tour & Taxis site te Brussel zijn parking Esplanade en Park Lane gelegen. Deze 2 parkings hebben momenteel respectievelijk 14 en 56 laadplaatsen en de wens is om dit uit te breiden naar respectievelijk 54 en 96. De elektrische voertuigen zullen telkens op het niveau -1 geplaatst worden. Er zullen hoogspanningsposten bijgeplaatst worden om de laadpalen te voeden.

HUME: EV Fire Safety

- Fire department Brussels
  - Request for preliminary approval (aanvraag tot voorakkoord)
  - Answer on request preliminary approval (antwoord op aanvraag voorakkoord)
    - Fire prevention measures already provided:

De ondergrondse parkings zijn uitgerust met:

- een sprinklerinstallatie in parking Park Lane (parking Esplanade niet gesprinklerd)
- een RWA-installatie (Rook- en Warmte-Afvoer)
- een branddetectie
- signalisatie en veiligheidsverlichting
- brandblussers, muurhaspels en muurhydranten

- Advice:

Is er voor deze uitbreidingen een vergunning nodig?

Antwoord van de brandweer: Het is Leefmilieu Brussel dat beslist of er al dan niet een (milieu)vergunning nodig is. Waarschijnlijk is dit vereist voor de hoogspanningsposten. Onze dienst zal enkel tussenkomen wanneer wij een aanvraag ontvangen van Leefmilieu Brussel. Bij vernieuwing van de milieuvergunning voor de parkings zal Leefmilieu Brussel ons sowieso uitnodigen om de parking te controleren.

Dient de brandweer deze uitbreiding te valideren?

Antwoord van de brandweer: Enkel wanneer wij een uitnodiging krijgen van Leefmilieu Brussel, zie hierboven.

Moeten er bijkomende (brand)veiligheidsmaatregelen getroffen worden in deze parkings?

Antwoord van de brandweer: Met de reeds genomen brandpreventiemaatregelen is het veiligheidsniveau waarschijnlijk voldoende. Wij raden u echter aan om een risicoanalyse uit te voeren volgens de *Regel van Goed Vakmanschap Elektrische Voertuigen in Parkings* (2e editie - 02/10/2023) van Fireforum.

HUME: EV Fire Safety

HUME

- Environmental department Brussels
  - Regularization of the environmental permit

leefmilieu brussel .brussels

FORMULIER

Brussels Hoofdstedelijk Gewest
***easyPermit*-formulier** **Aanvraag tot Wijziging van de Milieuvergunning**
(artikelen 7bis en 64 van de ordonnantie van 5 juni 1997 betreffende de milieuvergunningen)

- Fire insurance company
  - Different requirements per company

Wettelijk kader ontbreekt, dus voorlopig nog geen probleem voor ons, zolang het om een conforme installatie gaat van officiële laadpalen. (dus geen auto's ingeplugd in een 'conventioneel stopcontact').
Graag met aandacht voor de bereikbaarheid voor de brandweer. (liefst zo dicht mogelijk bij ingang/uitgang, indien mogelijk)

EV Fire Safety: a few insights

Peter Vicca - Multiobus

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Vlaanderen is ondernemen

EV Safety - Compartmentation

- Compartmentation/separation of vehicles:
  - By means of uninterrupted walls (fire resistance typically >2 hours), fire resistant doors need to be used in case. Emergency exits if completely closed area's
  - 1 meter overdimensioned compared to the dimensions of the vehicles
  - By means of space between vehicles (typically 10 meters)
  - Quantity of vehicles per compartment depending on insured value
  - Water curtains on the market; effective?

EV Safety – Fire suppression

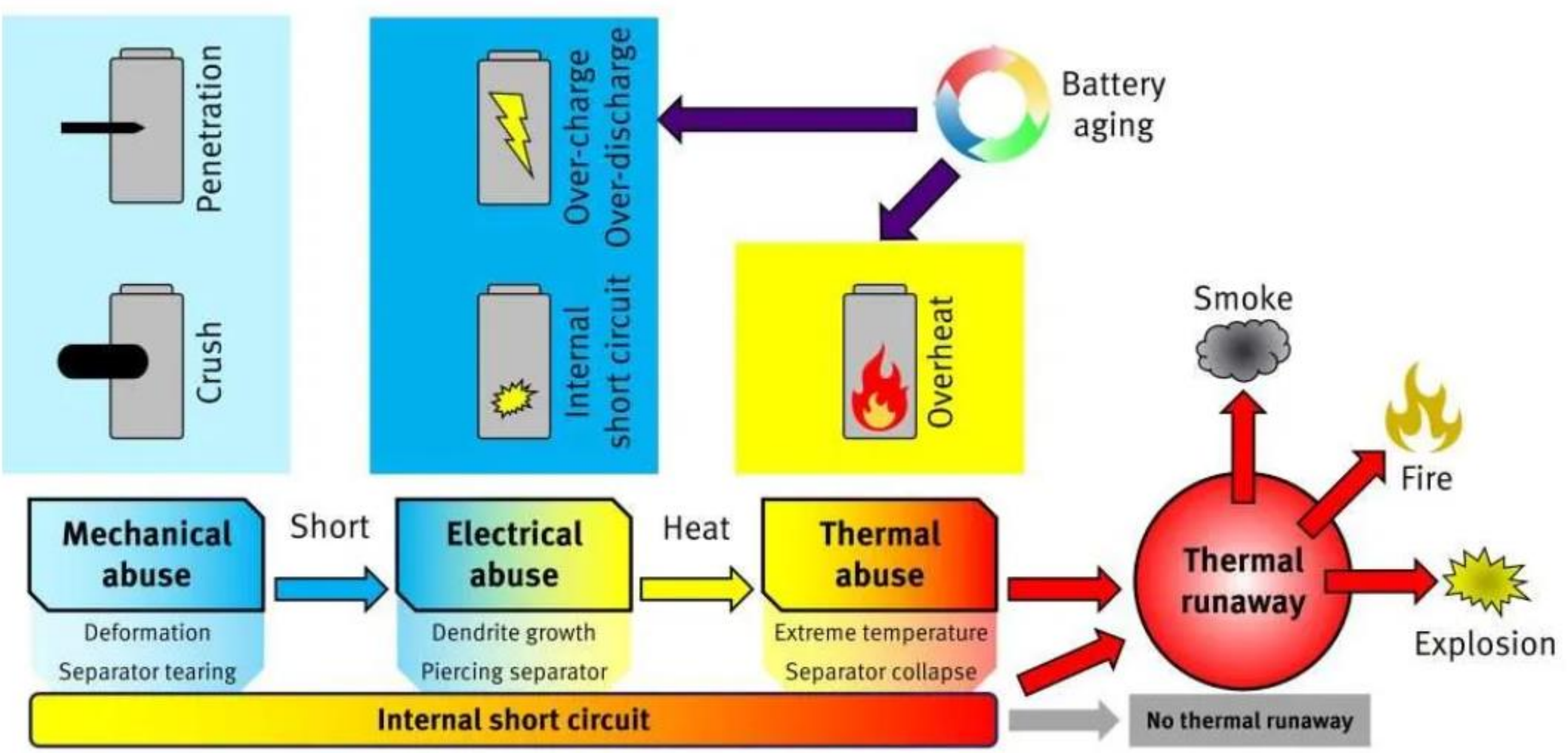
- Sprinklers:
  - Fast respons, water based, different types
  - Expensive (requires independent setup), maintenance
- Foam suppression:
  - Mainly used for fuel fires (avoiding oxygen supply)
- Water mist:
  - Effectively used in tunnels, but effectiveness in open depot setup?
  - Expensive (see sprinkler)
- Powder:
  - Effective (ABC types of fires)
  - Maintenance and collateral damage due to corrosive nature
- Fire extinguishers
  - Local, small fire
  - Depending on human involvement, limited amount

EV Safety – Fire suppression

- Batteries commonly used in buses are NMC and LFP types:
  - Normal fire: oxygen – ignition – fuel
  - Battery fire: reduction – oxidation reaction on the loose, highly exothermal
- Main cause for fire after damage (penetration), charging issues (although BMS should prevent this)
- NMC more susceptible to external damage
- LFP in casing can still explode when

gas formation exceeds LEL

EV Safety – Fire suppression



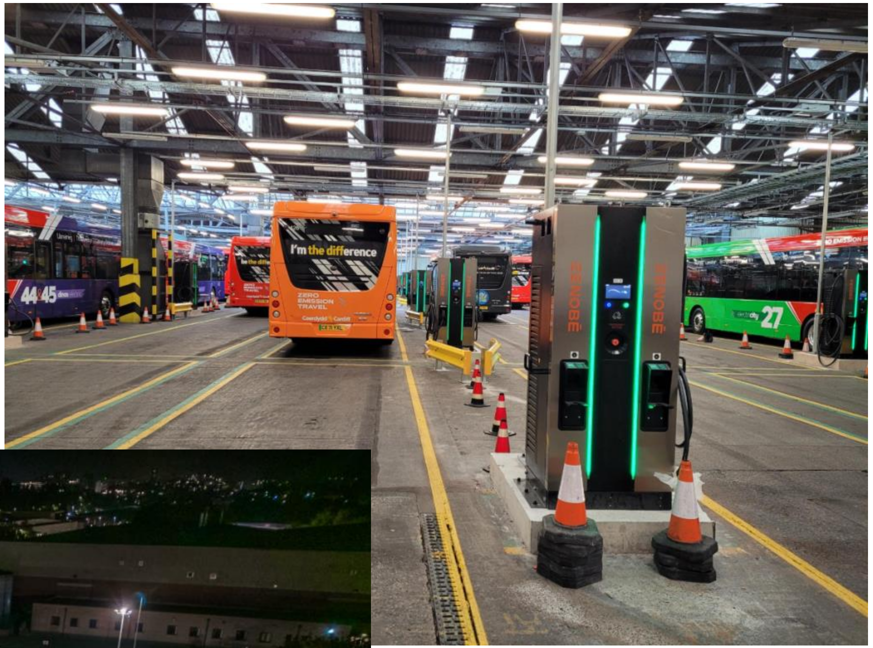
EV Safety – Fire detection

- Smoke detection:
  - Optical (Photoelectric) or ionization
- Heat detection:
  - Fixed temperature or Rate-of-rise heat detectors
- Flame detectors:
  - IR, UV or combination of both
- Gas detection:
  - Different types per detectable gas targeted
- Wired or wireless, connection with alarm station, camera monitoring combined, regulations (law or insurance), … but all activated once the fire has started

EV Safety – Fire detection

- BMS as a safeguard and predicting fire potential
- BMS functions; cell voltage, current sensors, temperature sensors work together to balance module and pack.
- Temperature monitoring as a predictive value for fire safety; detection of early thermal runaway
    - Cut-off charging process
    - Disconnection of the battery pack
    - Warning through central alert system for quick response team
    - Activation of fire suppression system in time
- Autonomous on-board telematic system through 4G/5G connection

EV Safety



Fire – the unwinding process

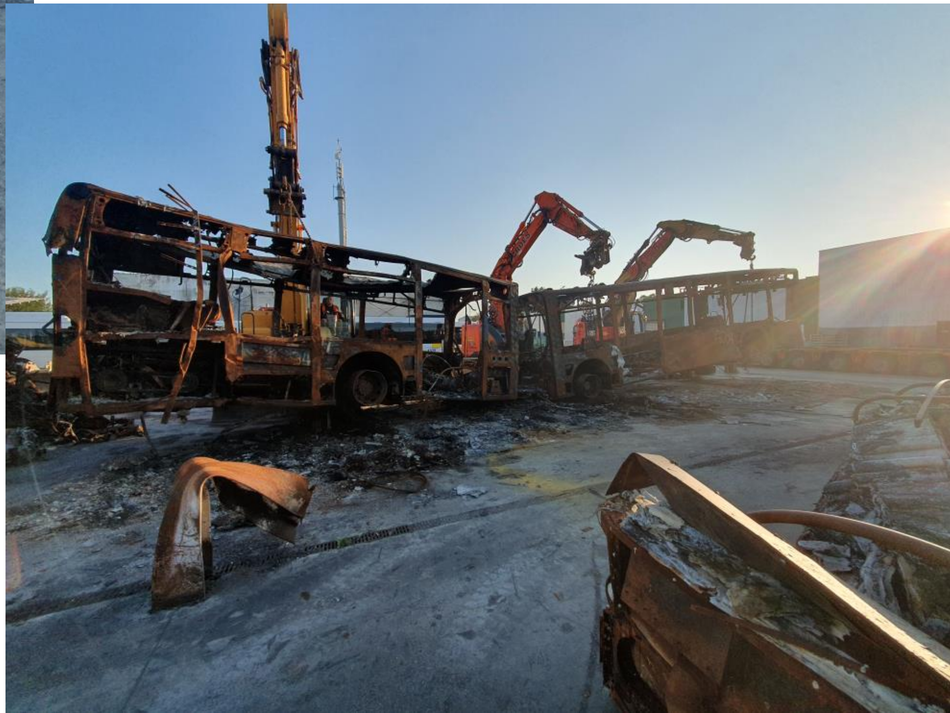
- Roles of authority during the fire
  - Fire fighters, local authorities:
    - Safety of the perimeter, neighbourhood, environmental impact, …
  - Police/department of justice:
    - Arson investigation (loss of environmental permit, start of forensic process)
    - Clearing activities can be started (consult with parties involved regarding removal)
  - Insurance investigation/expertise:
    - In agreement with all parties involved clearing of the premises, saving parts for investigation, contradictional investigation with all parties.
    - Involves site owner, insurance companies, constructors, bailiff, witness, …

- Complete documentation (photographs, video's, witness reports, maintenancy history, inspection reports, …) is mandatory

Multiobus fire October 2023

Fire – managing the evidence

HUME



EV Fire Safety

Disclaimer: The information provided in this presentation is intended for informational purposes only and should not be considered as legal, professional, or regulatory advice. It may not reflect the latest developments or standards related to fire safety or (bus) depot setups. Always consult with a qualified professional or refer to relevant laws and regulations for authoritative guidance and compliance.

Q&A Session

Moderator Prof. Johan Driesen – KULeuven / EnergyVille

Agenda

12u00-13u00: Registration & Sandwich Lunch

- ✓ 13u00-13u05: Welcome (VITO – Carlo Mol – Moderator)
- ✓ 13h05-13h15: HUME within the FLUX50 activities on collective energy solutions and flexibility (FLUX50 –Patrick Devos)
- ✓ 13u15-13u25: HUME measurement sites: challenges/opportunities (VITO - Wim Cardinaels)
- ✓ 13u25-13u35: Charging ahead: Insights into EV driver behaviour and preferences (VITO - Guillermo Borragán)
- ✓ 13u35-13u55: Using smart charging to optimize parking and building energy flows (KULeuven - Klaas Thoelen & VITO - Jef Verbeeck)
- ✓ 13u50-14u10: Looking deeper into the charging hardware: electrical systems and operating efficiencies (KULeuven - Johan Driesen)
- ✓ 14u10-14u40: New insights in service and business models for EV charging (Blink Charging – Thais Lopez & MOVE – Jasmien Vanvooren)

15h00-15h30: Coffee Break

- ✓ 15h30-15h50: HUME integrated architecture (VITO - Dominic Ectors)
- ✓ 15h50-16h30: An overview of the HUME demonstration sites
  - ✓ Tour & Taxis (Brussels) (Nextensa – Tim Van Dorpe)
  - ✓ EnergyVille1 (Genk) (VITO – Dominic Ectors)
  - ✓ Multiobus (Tienen) (Multiobus – Peter Vicca)
- ✓ 16h30-17h00: What is the impact of “EV Fire Safety” aspects on your parking and building (VITO – Carlo Mol)
  - ✓ Practical hands-on experiences will be shared by bus depot owner Multiobus and parking owner Nextensa.
- ✓ 17h00-17h30: Q&A (KULeuven – Prof. Johan Driesen)
  - ✓ Questions can be sent in during the event via a QR-code and will be handled in the Q&A session moderated by Prof. Johan Driesen (KULeuven)
  - ✓ Presentations will be shared to all participants after the event

17h30-19h00: Reception & Networking

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HUME

Thank you!

Closing Event - 14 November 2024 @ Tour & Taxis (Brussels)

Hubs for Urban Mobility and renewable Energy

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Vlaanderen is ondernemen