Workshop on Electrical Load Flexibility in retail

Towards a market design for retail flexibility – a journey of challenges and opportunities

Workshop 5/12/2023

Helena Gerard

About EnergyVille

We help **system operators, regulators and market parties** in preparing **the system for 2030** at the lowest possible cost.

KU LEUVEN imec vito UHASSELT

Helping grid operaters with the integration of (D)RES via smart grids

Energy market design for the integration of residential and industrial flexibility, storage

Assisting in human capital development

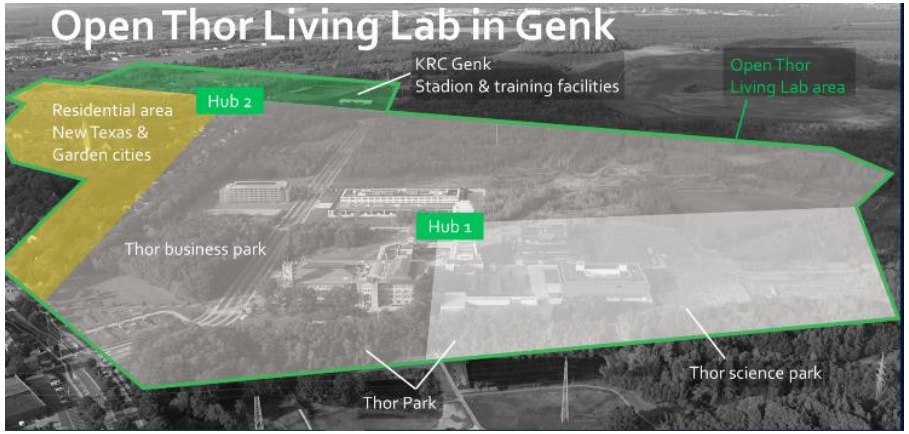
Enabling the participation of consumers in the energy transition via energy communities and innovative grid tariffs

406 colleagues

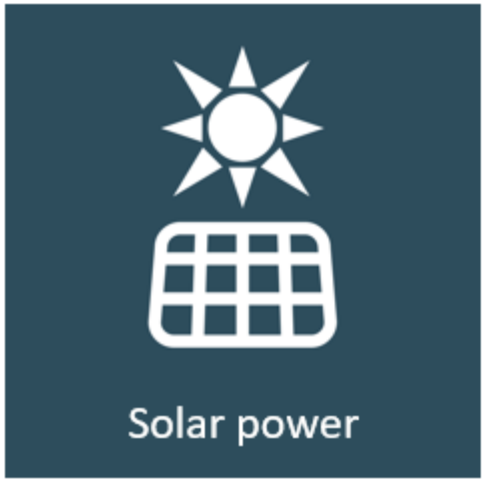
165 PhD

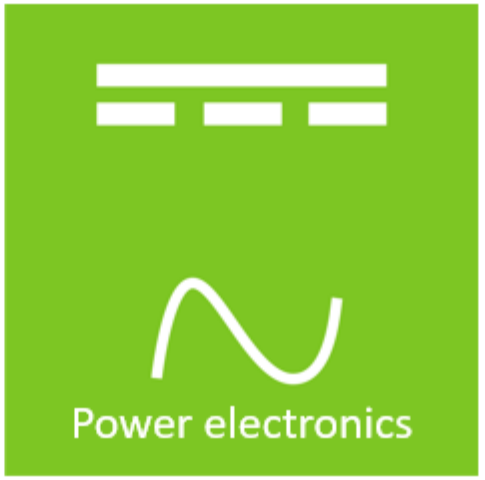
42 Nationalities

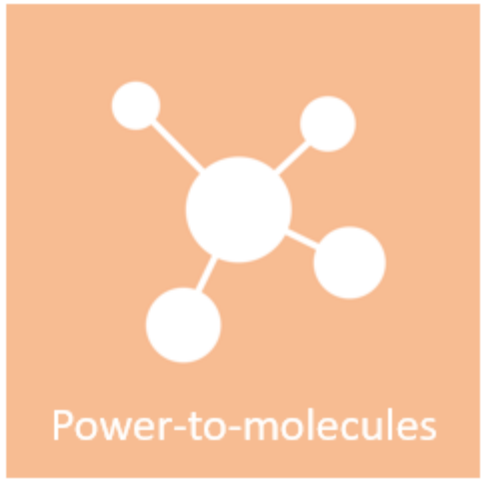
EnergyVille

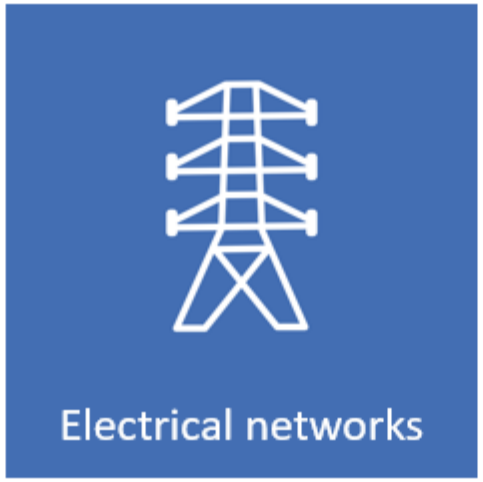


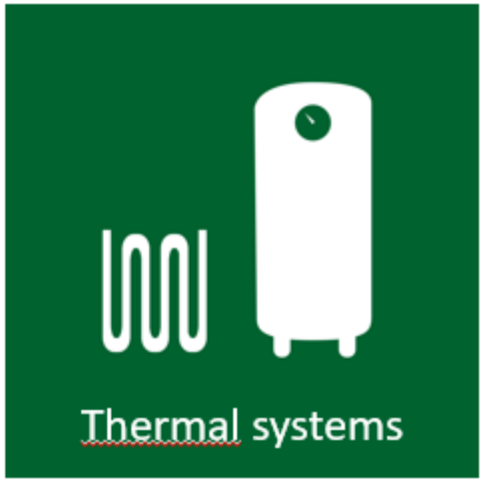
About EnergyVille











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2023 – the year of the consumer?

The Consumer is 'more than ever' at the center of the public debate

Energy crisis resulting in extreme consumer prices

Electricity prices in Europe, October 2022-January 2023, GMK Center

E-Mobility taking up

Energy sharing and related community concepts

EU energy communities map

Towards an integrated, coordinated and consumer-centric market design

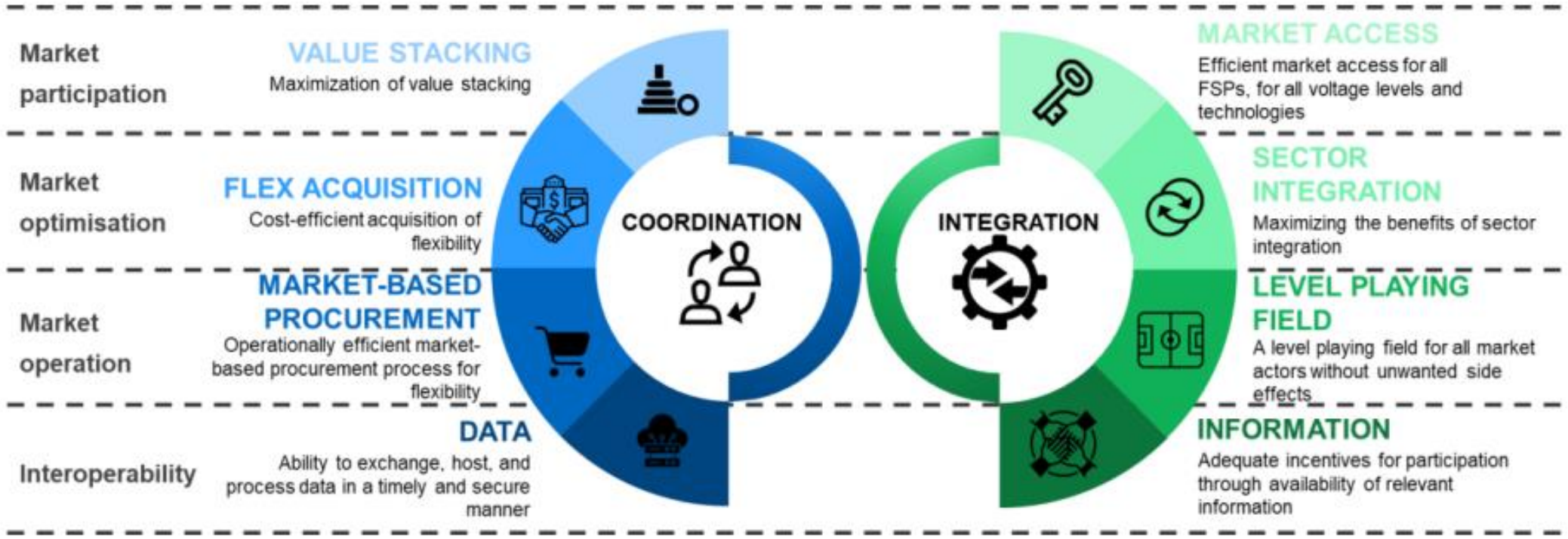
The 2023 Challenge

Towards coordinated, integrated and consumer-centric markets

Coordinated and integrated

Process efficiency across the entire value chain

Equal level playing field for technologies and agents

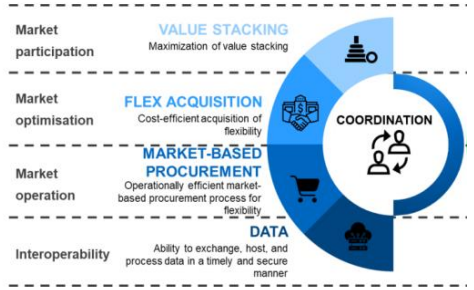


Source: OneNet (2023)

A multi-dimensional problem with multiple stakeholders involved

Barriers for a Pan-European Integrated Energy Market

ONENET
one network for Europe



Coordination objectives				
	Maximization of value stacking	B1	Insufficient coordination of flexibility markets for system services with energy markets with regard to timing.	★
		B2	Insufficient coordination of different system services over different timeframes, valid for all market phases, i.e., prequalification, baselining, procurement, activation, monitoring and settlement.	
		B3	Lack of harmonization of flexibility products for system services for both TSO and DSO	
		B4	Exclusivity clauses and non-harmonised contracts	
	Cost-efficient acquisition of flexibility	B5	Coordination of explicit procurement of flexibility (flexibility markets) with implicit procurement of flexibility (tariffs, connection agreements,...)	★
		B6	No specific incentives in the regulatory mechanism (remuneration) that support a common approach between SOs for flexibility procurement	
	Operationally efficient market procurement process for flexibility	B7	Limited cross-border coordination/integration	
		B8	Limited coordination for procurement of flexibility by DSO and TSO	
		B9	Lack of alignment in supporting processes such as prequalification, monitoring and settlement processes including baseline approach.	★
		B10	Lack of established methodology for network representation for the distribution grid	★
	Ability to exchange, host, and process data in a timely and secure manner	B11	ICT challenges: Large uncoordinated collection of data, timely exchange of (confidential) network information, etc.	★

★ *Relevant for consumer flexibility*

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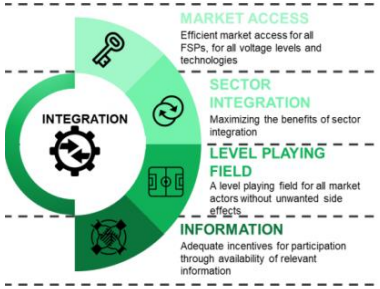
Barriers for a Pan-European Integrated Energy Market



Integration objectives				
	Efficient market access for all FSPs, for all voltage levels, for all technologies	B12	No appropriate baseline methodology and process established for new flexibility markets and new types of flexibility providers (e.g. low voltage flexibility)	★
		B13	No uniform access and registration process/platform for assets willing to participate to flexibility markets.	★
	Ensuring an equal level playing field for all market actors without unwanted side effects such as market power or risk of gaming	B14	Risk of gaming due to exertion of market power and/or shortcomings in the market setting	
	Maximizing the benefits of sector integration	B15	Lack of coordination of markets of different carriers	
		B16	Quantification of the benefits of sector integration is missing	★
	Adequate incentives for participation through availability of relevant information (e.g., anticipated flex needs, etc.)	B17	Unavailability of adequate information allowing FSPs to anticipate the value of their participation and hence not being able to quantify their business case	★

★ *Relevant for consumer flexibility*

Challenges and opportunities

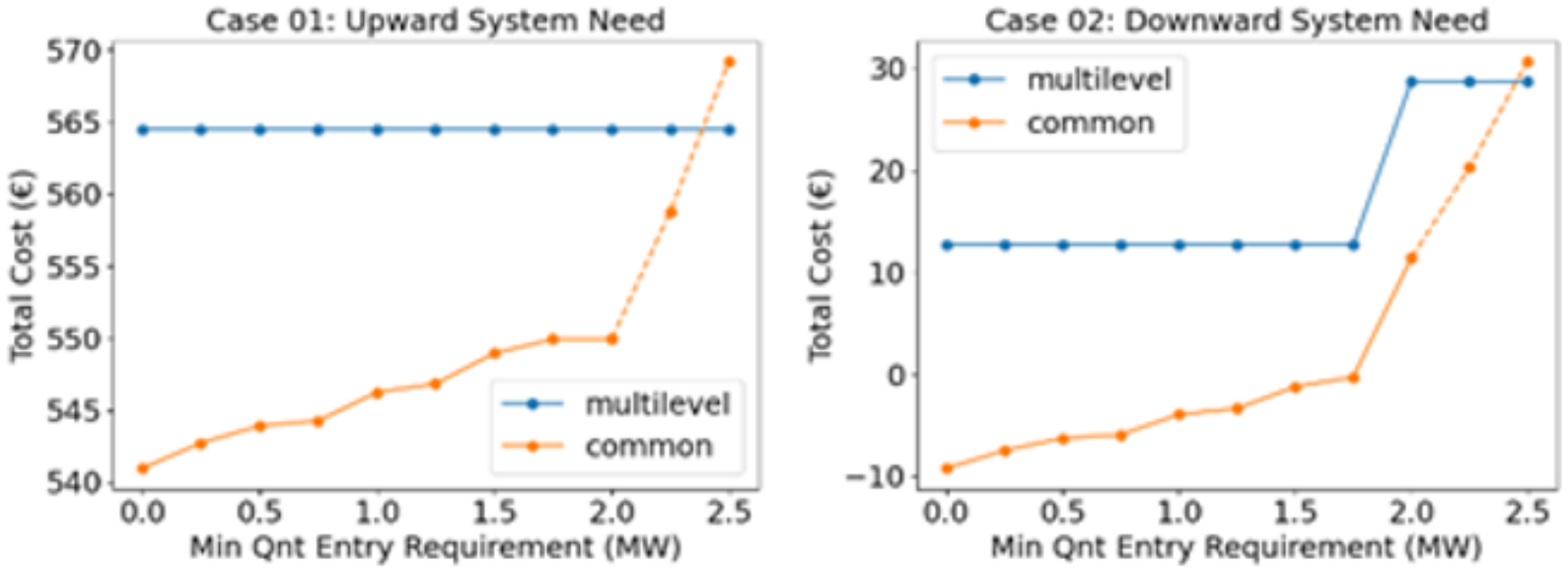
The Challenge

"MARKET ACCESS"

How to organize the **energy and flexibility market (TSO-DSO Coordination)** for **system services** to solve the problem at **lowest cost** while **maximizing synergies between system operators**, between flexibility products and between other system services

MARKET ACCESS

Example of the impact of minimum bid size requirements on the total costs of the system



Impact of markets' minimum bid quantity entry requirement on their total

Impact of minimum bid size to be addressed together with overall market design

Source: EnergyVille

Challenges and opportunities

The Challenge

The system operator should select from a variety of flexibility mechanisms which solution is most efficient (**economically and operationally**) to solve the congestion problem.

The FLEXIBILITY TOOLBOX

"A Flexibility Toolbox for congestion – a menu of solutions for system operation"

Technical grid flexibility

Flexibility coming from smart use of grid assets or curtailment actions (in case of emergency)

Implicit flexibility

Flexibility coming from changed production/consumption pattern of consumers who react on a certain price-signal

Explicit flexibility

Flexibility coming from direct control/activation of flexibility offered and procured upfront via a flexibility market

How to define the trade-off between grid investments and the use of flexibility?

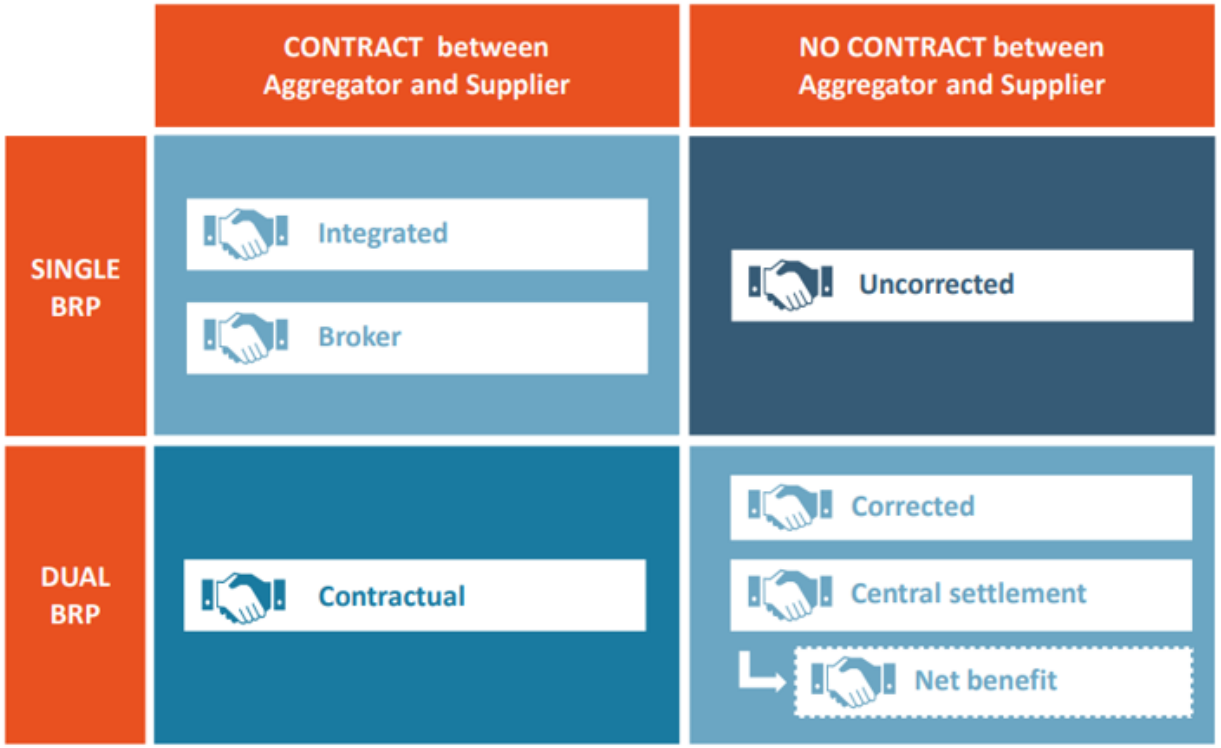
How to define the flexibility mechanism with the biggest impact?

Challenges and opportunities

The Challenge

What is the appropriate process for Transfer of Energy for flexibility from the low voltage grid?

Transfer of Energy



- the principles for **determining the activated flexibility volume**;
- the **principles for correcting** the quarterly imbalance created by the activation of the DSF by a FSP
- the **exchange of information and data** necessary for the implementation of the ToE process

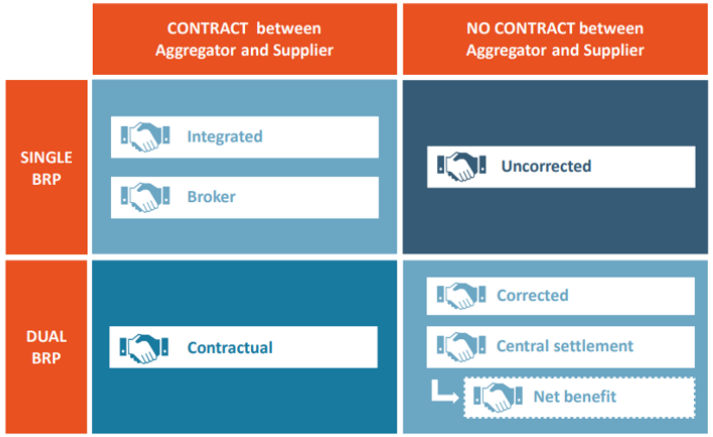
Challenges and opportunities

The Challenge

What is the appropriate process for Transfer of Energy for flexibility from the low voltage grid?

Transfer of Energy

"A complex discussion incorporating a lot of fundamental market design questions"



- *Consumer response to implicit flexibility incentives (tariffs, prices,…)*
- *Market dynamics: expected trading volumes LV?*
- *Inherent natural variability on consumer side versus effect of activation*
- *Variability in retail contracts*
- *Visibility at low voltage grid and allocation of imbalances*
- *Rebound effect: impact on BRP and impact on supplier*
- *Avoidance of double payment (activated flex helps to balance the system)*
- *From static to dynamic SLP/RLP*
- *Overall system benefit of DSF: wholesale prices, imbalance costs,..*
- *…*

A Roadmap for flexibility from the low voltage grid for Belgium

TECHNICAL

- LV grid characteristics
- Grid constraints
- Technical capabilities DSO
- Digital meter

END USER

- Smart appliances
- Consumer knowledge
- Consumer engagement
- Vulnerable consumers
- Collective flexibility
- Tariff methodology

MARKET

- Products and services
- Dynamic connection agreements
- Prequalification
- Curtailment
- Procurement and activation
- Settlement – baseline methodology

DATA

- Data availability
- Privacy
- Data sharing
- Data Manager

Analyse van het wettelijk, reglementair en regulerend kader van de flexibiliteitsmarkt

('Analysis of the legal, regulatory and regulating framework in the context of the flexibility market')

Final Report

Authors: Annelies Delnooz, Helena Gerard, Kris Kessels, Koen Vanthournout, Janka Vanschoenwinkel,

Date: August, 2021

Disclaimer: Dit document is het eindverslag van een studie die Vito/EnergyVille op verzoek van BRUGEL heeft uitgevoerd. Het document geeft niet noodzakelijk de mening van BRUGEL over het onderwerp weer en de inhoud ervan valt volledig onder de verantwoordelijkheid van de auteurs. BRUGEL kan de volledigheid of juistheid van de gegevens in dit document niet garanderen.

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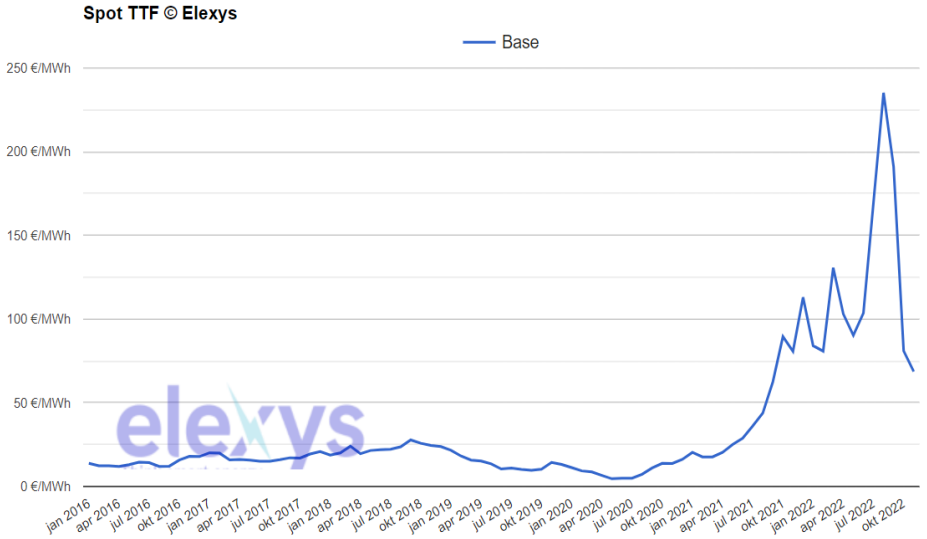
EU Policy driving the change

The 2022 crisis …

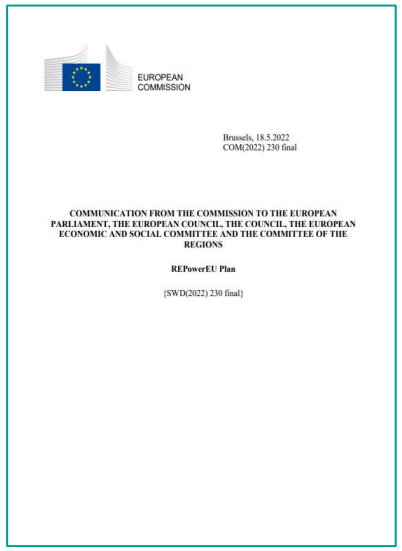


… Europe in crisis mode …
… but a turning point for energy and flexibility markets

The 2023 answer

Regulatory initiatives– supporting 2030 and 2050 goals

REPower EU


EUROPEAN COMMISSION

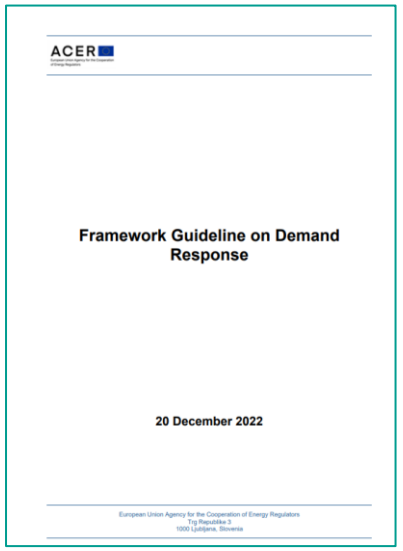
Brussels, 18.5.2022
COM(2022) 230 final

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

REPowerEU Plan

{SWD(2022) 230 final}

Network Code Demand Response

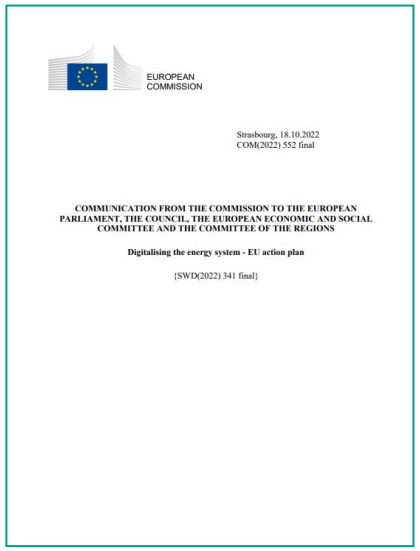

ACER

Framework Guideline on Demand Response

20 December 2022

European Union Agency for the Cooperation of Energy Regulators
Trg Republike 3
1000 Ljubljana, Slovenia

Digitalisation of Energy Action Plan


EUROPEAN COMMISSION

Strasbourg, 18.10.2022
COM(2022) 552 final

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

Digitalising the energy system - EU action plan

{SWD(2022) 341 final}

Reform EU Electricity Market Design


EUROPEAN COMMISSION

Strasbourg, 14.3.2023
COM(2023) 148 final

2023/0077 (COD)

Proposal for a

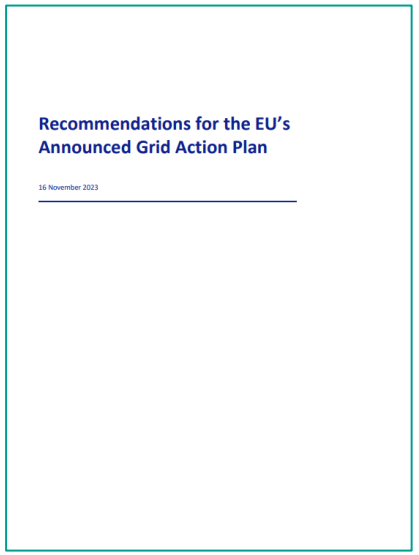
REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

amending Regulations (EU) 2019/943 and (EU) 2019/942 as well as Directives (EU) 2018/2001 and (EU) 2019/944 to improve the Union's electricity market design

(Text with EEA relevance)

{SWD(2023) 58 final}

Grid Action Plan


Recommendations for the EU's Announced Grid Action Plan

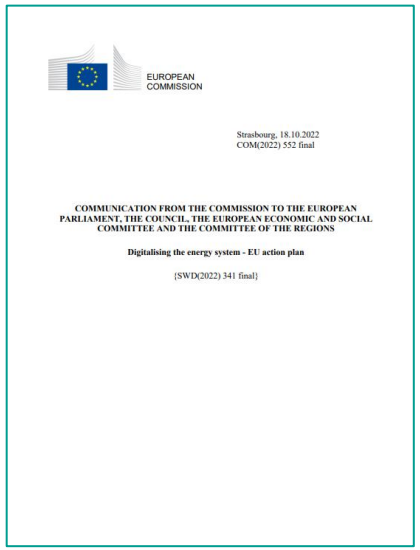
16 November 2023

…driving the change, but open the door for a lot of questions, discussions and new developments!

The 2023 answer

Regulatory initiatives– supporting 2030 and 2050 goals

Digitalisation of Energy Action Plan


EUROPEAN COMMISSION

Strasbourg, 18.10.2022
COM(2022) 552 final

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

Digitalising the energy system - EU action plan

{SWD(2022) 341 final}

- ✓ **helping consumers increase control** over their energy use and bills through new digital tools and services, with a strong governance framework for a common European energy data space, leading to new business models and energy services.

? *Study on health data space – "consumers uneasy with sharing personal health data" – in particular data related to their behavioural patterns (source BEUC)*

*! Importance for including **consumer preferences** from the start in the design*
*! Need for a good view on which use cases the energy data space is most **value creating***

The 2023 answer

Regulatory initiatives– supporting 2030 and 2050 goals

Reform EU Electricity Market Design

EUROPEAN COMMISSION

Strasbourg, 14.3.2023
COM(2023) 148 final
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(Text with EEA relevance)
{SWD(2023) 58 final}

- ✓ **One of the main goals to better protect consumers against high and volatile prices**
  - A wide choice of contracts for consumers (from foxed to variable to dynamic)
  - Clearer information for consumers before signing contracts
  - More protection for vulnerable consumers
  - New support schemes for demand response and storage

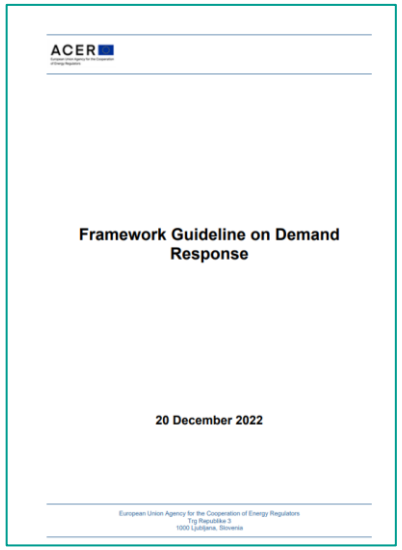
? *How to guide the consumer in the 'increased number of options'?*

Increasing need for education from the start to engage consumers

The 2023 answer

Regulatory initiatives– supporting 2030 and 2050 goals

Network Code Demand Response


ACER

Framework Guideline on Demand Response

20 December 2022

European Union Agency for the Cooperation of Energy Regulators
Trg Republike 3
1000 Ljubljana, Slovenia

Based on Article 59(9) of the Regulation (EU) 2019/943, on 9 March 2023 the EU Commission invited DSO Entity and ENTSO-E to submit a proposal to ACER for the network code Demand Response in accordance with the relevant framework guidelines, within a reasonable period of time that should not exceed 12 months.

To foster transparency and receive your views, **DSO Entity and ENTSO-E** are delighted to invite you to participate in the **public consultation on** the content of the proposal for **the Network Code Demand Response.**

Product and service design	Baseline approach	Aggregation
Prequalification	Markets for local services	Settlement
TSO-DSO coordination	Flexibility mechanisms versus investment	Data exchange and information

…a lot of important building blocks introduced but currently very complex and lack of harmonization

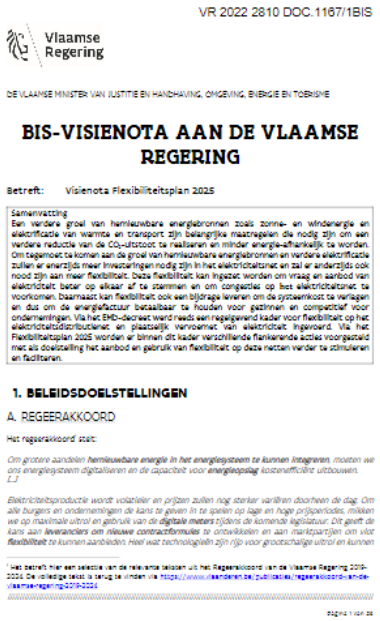
Between harmonisation and customization

The 2023 Challenge

Towards coordinated, integrated and consumer-centric markets

Awareness → ***Customer-oriented*** → ***Consumer-centric***

Consumer-centric



VR 2022 2810 DOC.1167/1BIS

Vlaamse Regering

DE VLAAMSE MINISTER VAN JUSTITIE EN HANDHAVING, OMGEVING, ENERGIE EN TOERISME

BIS-VISIENOTA AAN DE VLAAMSE REGERING

Betreft: Visienota Flexibiliteitsplan 2025

Samenvatting

Een verdere groei van hernieuwbare energiebronnen zoals zonne- en windenergie en elektrificatie van warmte en transport zijn belangrijke maatregelen die nodig zijn om een verdere reductie van de CO_2-uitstoot te realiseren en minder energie-afhankelijk te worden. Om tegemoet te komen aan de groei van hernieuwbare energiebronnen en verdere elektrificatie zullen er enerzijds meer investeringen nodig zijn in het elektriciteitsnet en zal er anderzijds ook nood zijn aan meer flexibiliteit. Deze flexibiliteit kan ingezet worden om vraag en aanbod van elektriciteit beter op elkaar af te stemmen en om congesties op het elektriciteitsnet te voorkomen. Daarnaast kan flexibiliteit ook een bijdrage leveren om de systeemkost te verlagen en dus om de energiefactuur betaalbaar te houden voor gezinnen en competitief voor ondernemingen. Via het EMD-decreet werd reeds een regelgevend kader voor flexibiliteit op het elektriciteitsdistributienet, en plaatselijk vervoernet, van elektriciteit, ingevoerd. Via het Flexibiliteitsplan 2025 worden er binnen dit kader verschillende flankerende acties voorgesteld met als doelstelling het aanbod en gebruik van flexibiliteit op deze netten verder te stimuleren en faciliteren.

1. BELEIDSDOELSTELLINGEN

A. REGEERAKKOORD

Het regeerakkoord stelt:

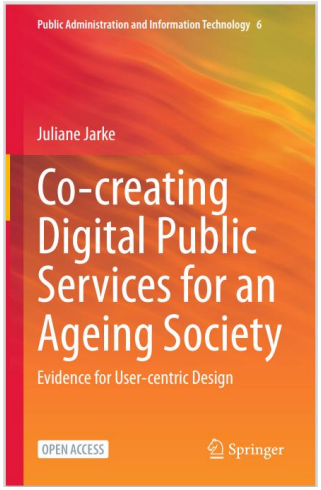
*Om grotere aandelen **hernieuwbare energie in het energiesysteem te kunnen integreren**, moeten we ons energiesysteem digitaliseren en de capaciteit voor **energieopslag** kosteneffectief uitbouwen.*
[...]

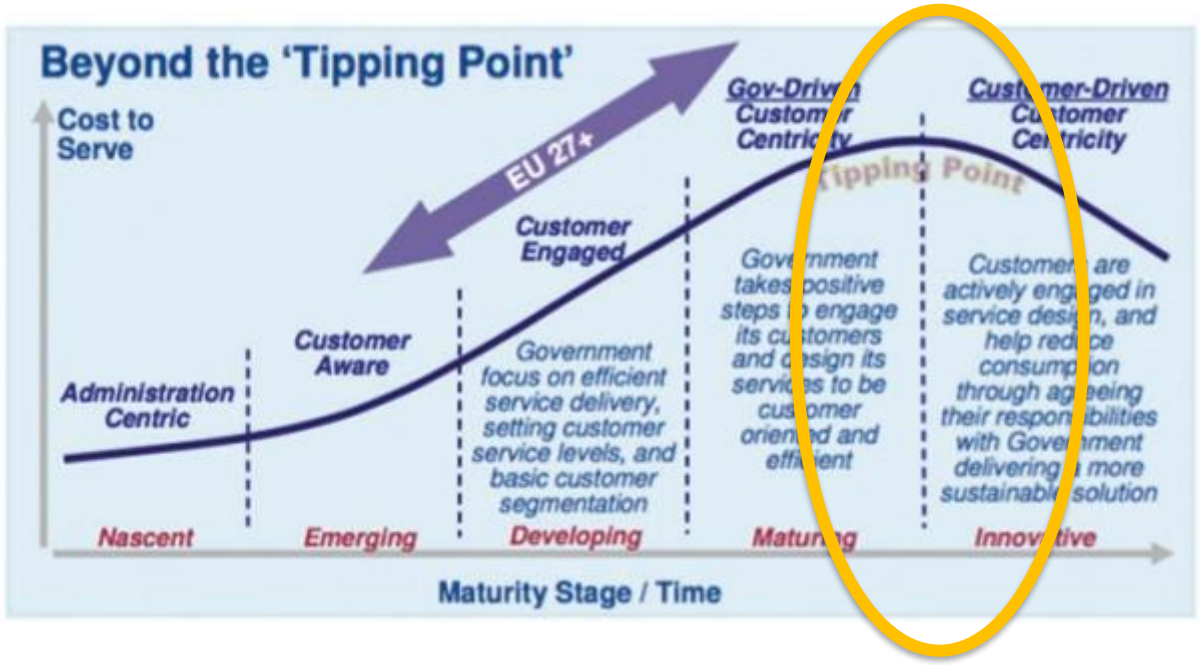
*Elektriciteitsproductie wordt volatieler en prijzen zullen nog sterker variëren doorheen de dag. Om alle burgers en ondernemingen de kans te geven in te spelen op lage en hoge prijspieken, moeten we op maximale uitrol en gebruik van de **digitale meters** tijdens de komende legislatuur. Dit geeft de kans aan **leveranciers om nieuwe contractformules** te ontwikkelen en aan marktpartijen om vlot **flexibiliteit** te kunnen aanbieden. Heel wat technologieën zijn rijp voor grootschalige uitrol en kunnen*

[1] Het betreft hier een selectie van de relevante teksten uit het Regeerakkoord van de Vlaamse Regering 2019-2024. De volledige tekst is terug te vinden via https://www.vlaanderen.be/publicaties/regeerakkoord-van-de-vlaamse-regering-2019-2024

Flexibility Plan 2025

Vlaanderen





The 2024 challenge and beyond

The case of bounded rationality and heterogeneous preferences

Communication and awareness raising for specific target groups

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The End user challenge

The Challenge

The **potential impact for the system operator of LV flexibility** (and by extension the potential of the digital meter) is dependent on the **level of knowledge and engagement of the consumers**

The Solution

*"A unified vision for low voltage flexibility, considering the **consumer**, the **grid** and the overall **system**"*

With support from

Increased understanding of heterogeneous consumer behaviour

- ✓ *Individual versus collective flexibility provision*
- ✓ *Drivers for consumer participation*
- ✓ *Role of consumer preferences in relation to the adoption of tariff schemes, traffic light concepts,…*

&

Operational models for secure procurement and activation of LV flexibility

- ✓ *Grid monitoring and control*
- ✓ *Traffic light concepts*
- ✓ *How flexibility can support congestion management*

&

Integrated BE framework for the use of LV flexibility

- ✓ *TSO-DSO coordination*
- ✓ *System impact in case of large-scale adoption of LV flexibility*
- ✓ *Integration of market flexibility with tariff structures and connection agreements*

? Which 'human factors' impact adoption of flexible technologies?

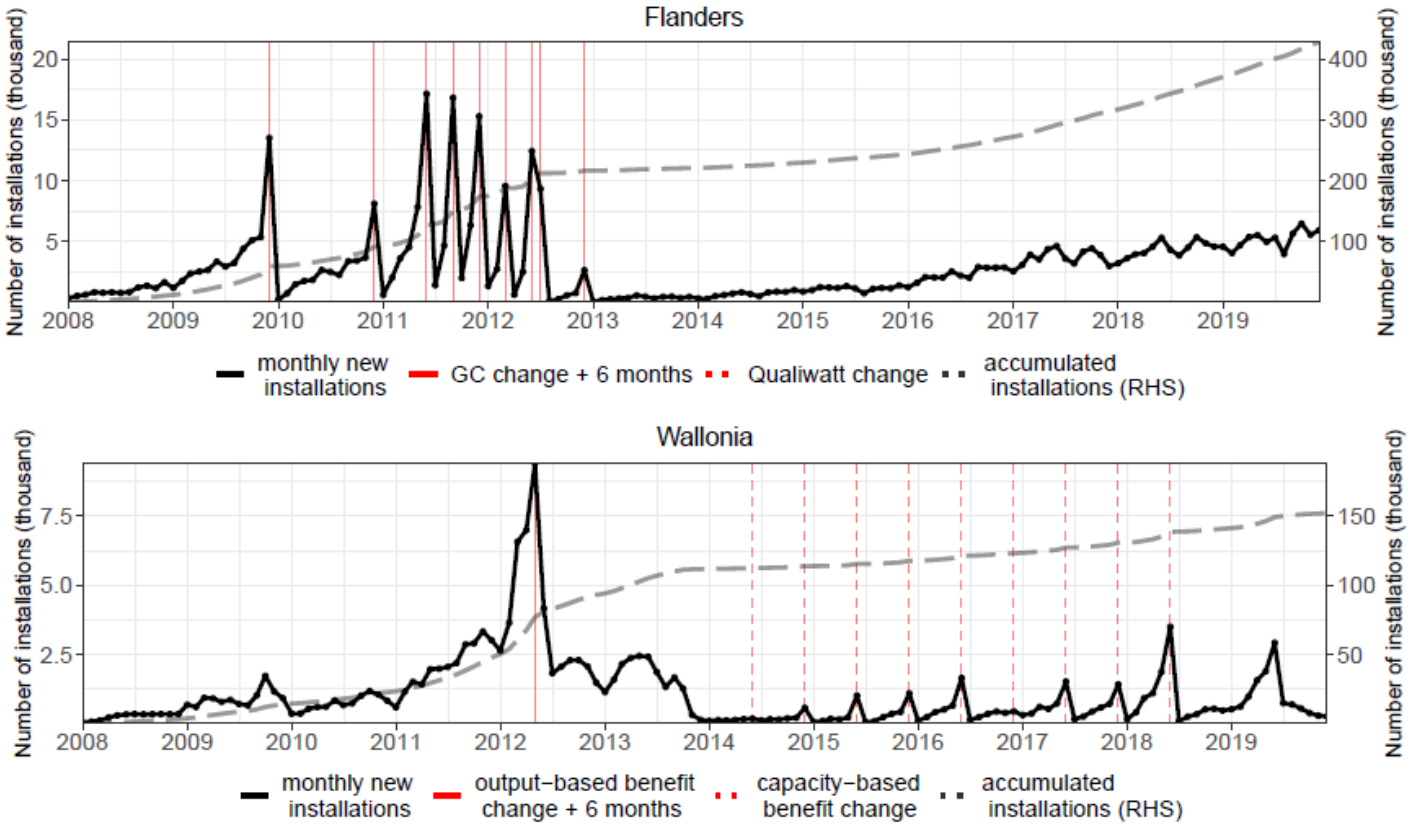
? Which 'human factors' impact provision of flexibility by end consumers?

The End user challenge

The Challenge

What is the **impact of increased subsidies** for PV on the amount of newly installed installations?

Energy-related technology adoption & future benefits, monthly photovoltaic (PV) installations



Source: Böning et all.

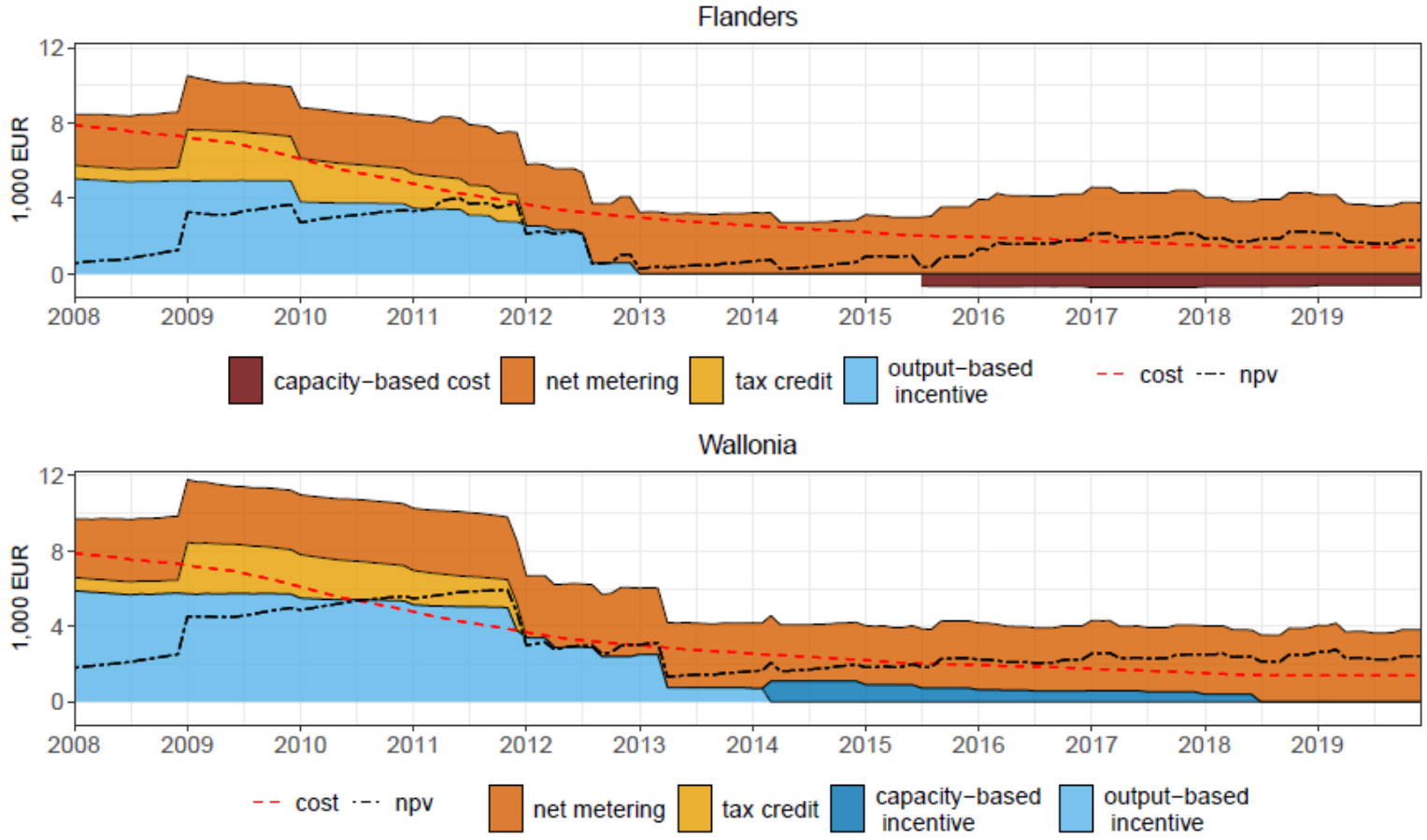
A rational reaction on a financial benefit or do other factors play a role?

The End user challenge

The Challenge

What is the **impact of increased subsidies** for PV on the amount of newly installed installations?

Present value of available incentive schemes per kW



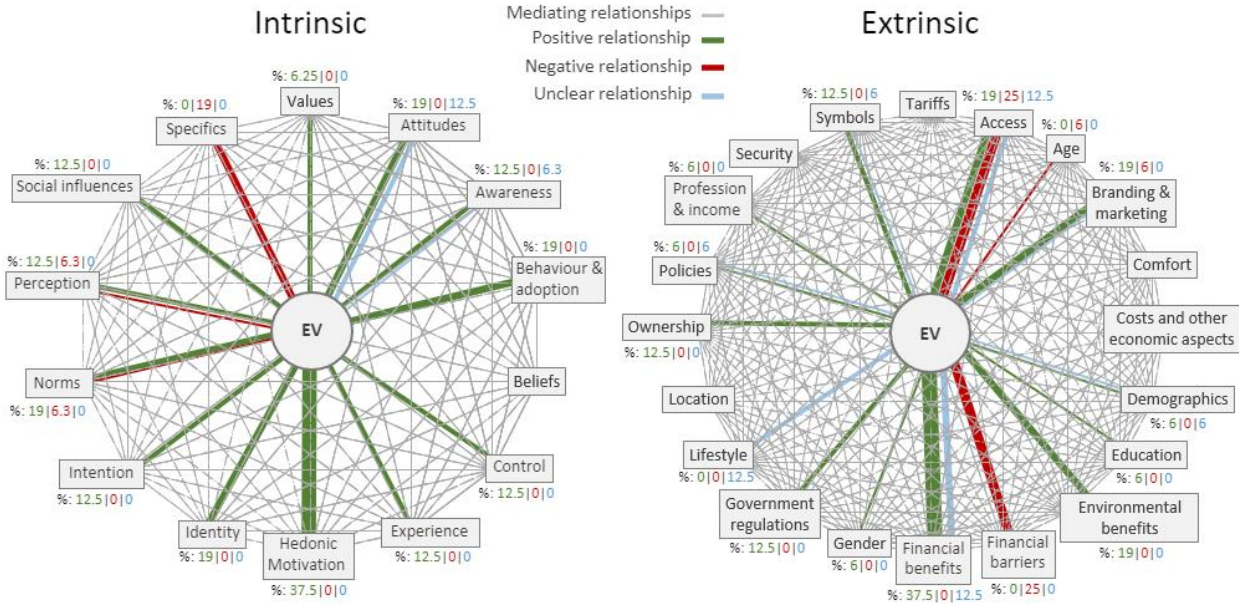
Source: Böning et all.

A rational reaction on a financial benefit or do other factors play a role?

The End user challenge

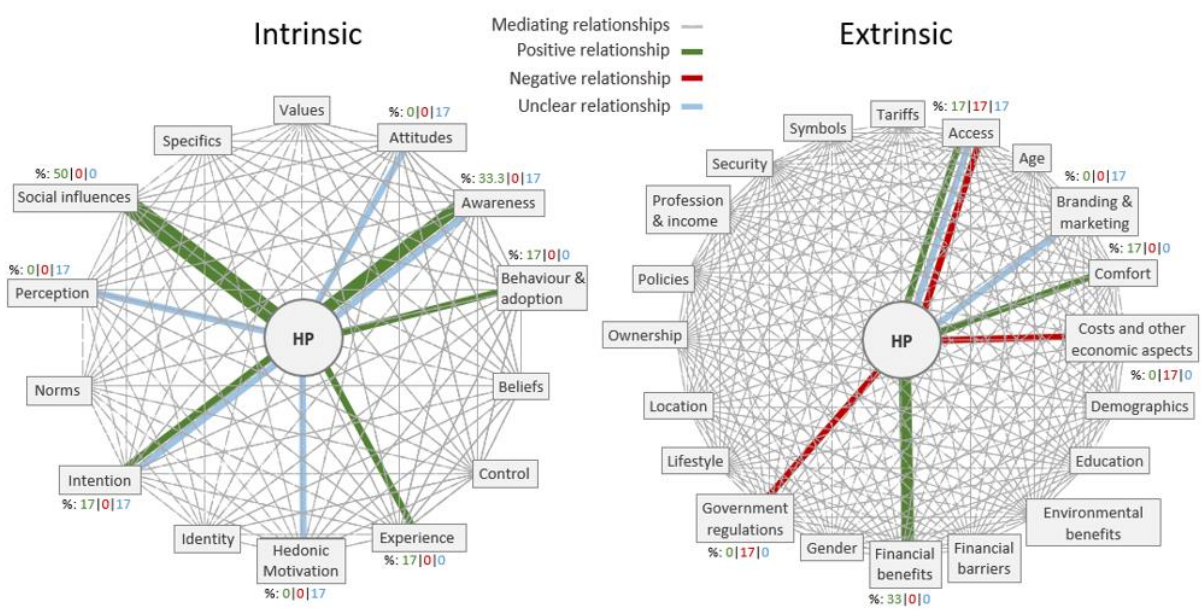
Adoption of new technologies

Electric Vehicles



Adoption factors for Electric vehicles (EV)

Heat Pumps

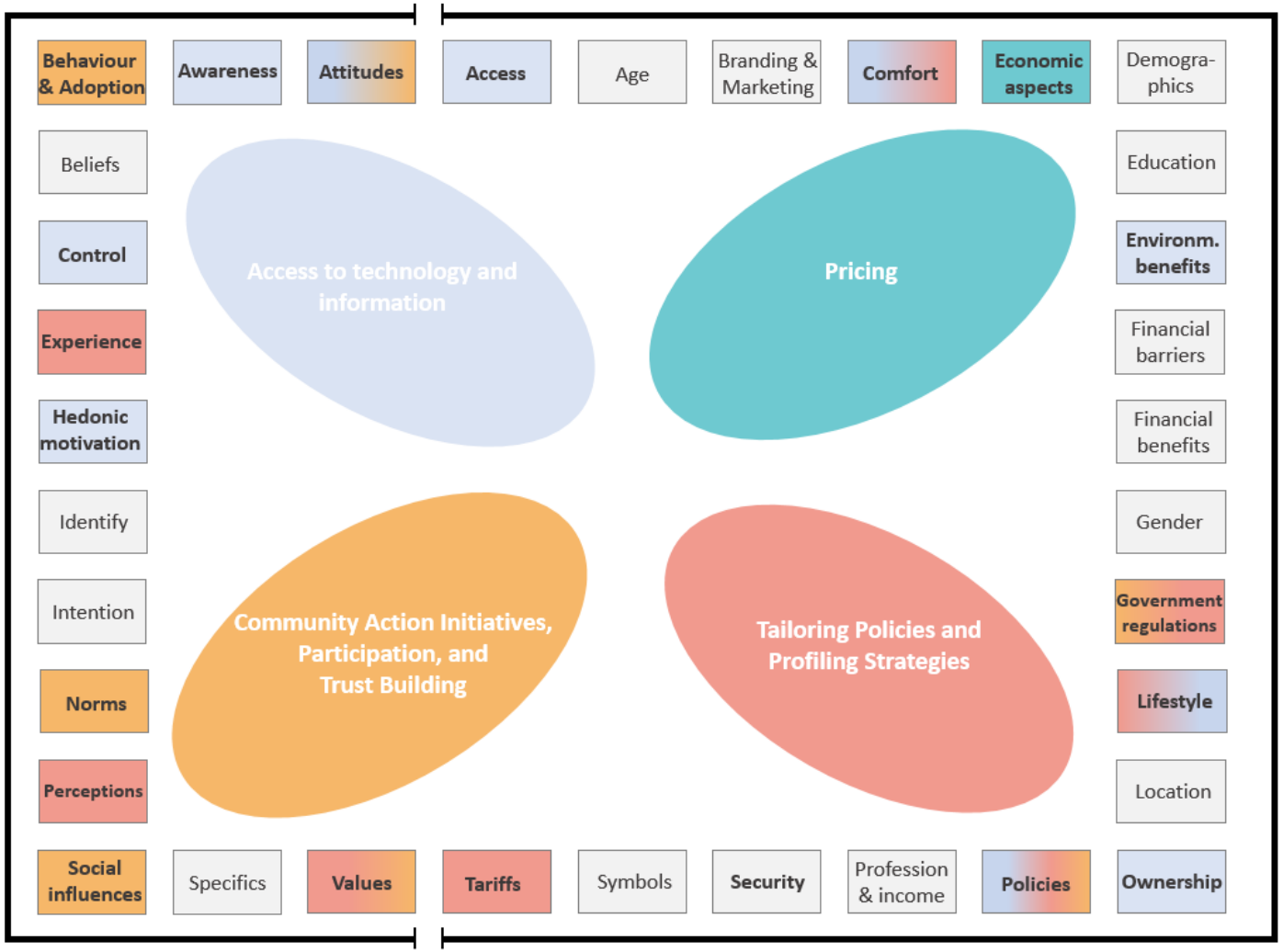


Adoption factors for Heat pumps (HP)

- ✓ *Drivers for **consumer adoption** differ significantly between technology*
- ✓ *In particular for EV, a large combination of human characteristics will play a role*
- ✓ *Factors for EV and PV more correlated compared to heat pumps*

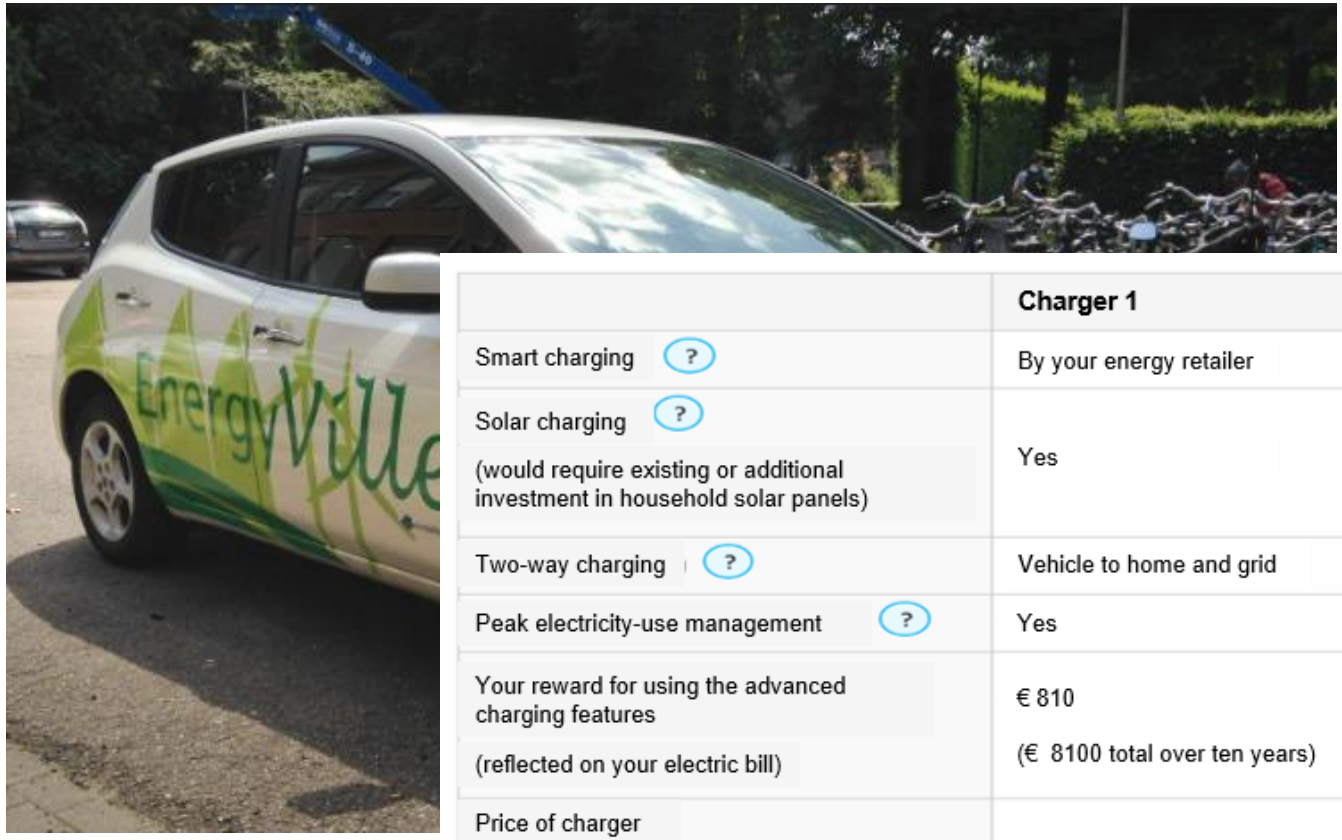
The End user challenge

Flexible use of new technologies



Large set of potential intrinsic and extrinsic factors impact the use of flexibility by end users

The End user challenge

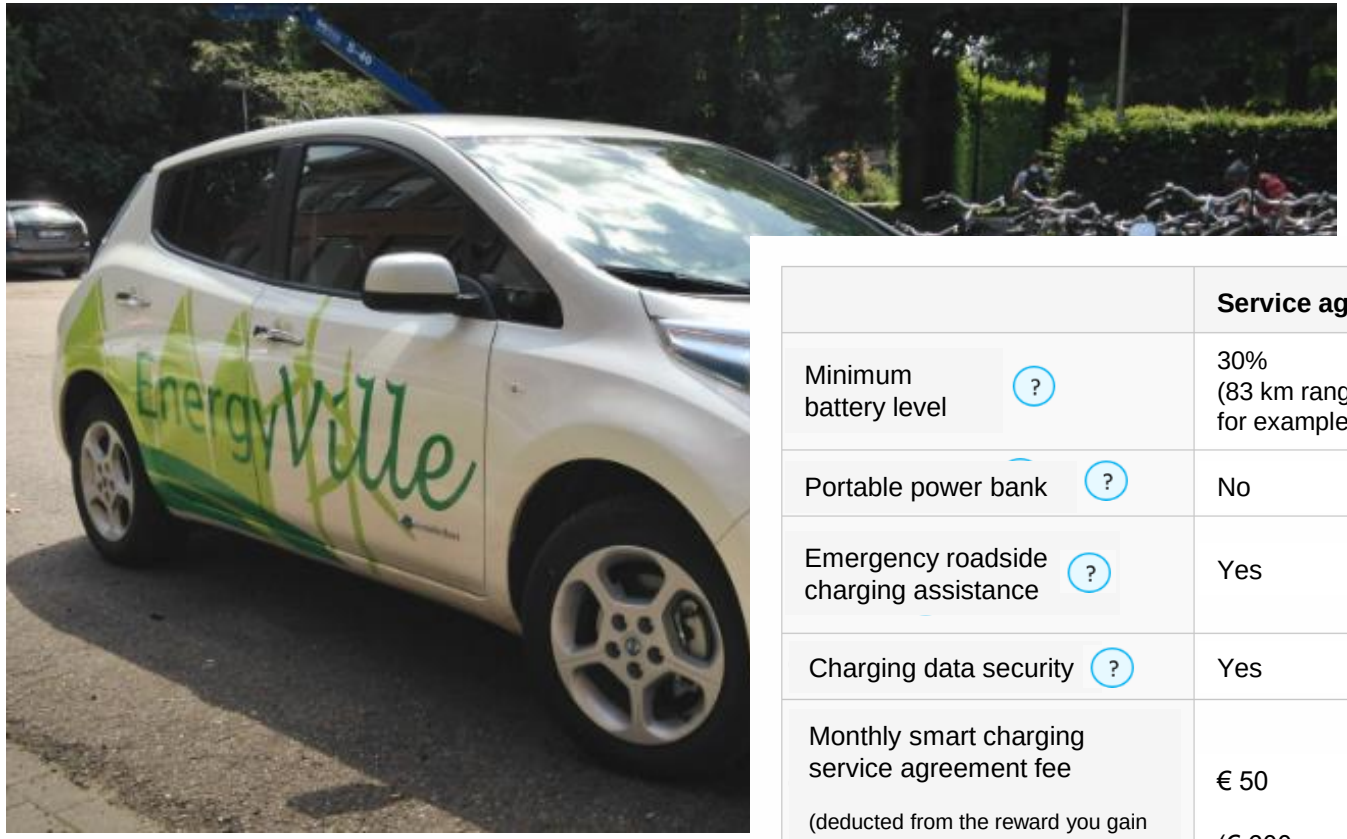


Discrete choice experiment: If you drove an EV, would you buy a charger that has advanced charging features?

	Charger 1	Charger 2	Use your current charger
Smart charging ?	By your energy retailer	By your energy retailer	The current charger has no advanced features. It simply charges your car at the regular price until it is fully charged.
Solar charging ? (would require existing or additional investment in household solar panels)	Yes	No	
Two-way charging ?	Vehicle to home and grid	Vehicle to home	
Peak electricity-use management ?	Yes	No	
Your reward for using the advanced charging features (reflected on your electric bill)	€ 810 (€ 8100 total over ten years)	€ 550 annually (€ 5500 total over ten years)	
Price of charger (including installation)	€ 4200	€ 2900	
	○	○	○

What individual (survey-taker) characteristics correlate with the decision to adopt smart charging features?

The End user challenge



If you drove an EV and had a charger capable of two-way charging and smart charging, would you pay for extra provisions of a service agreement?

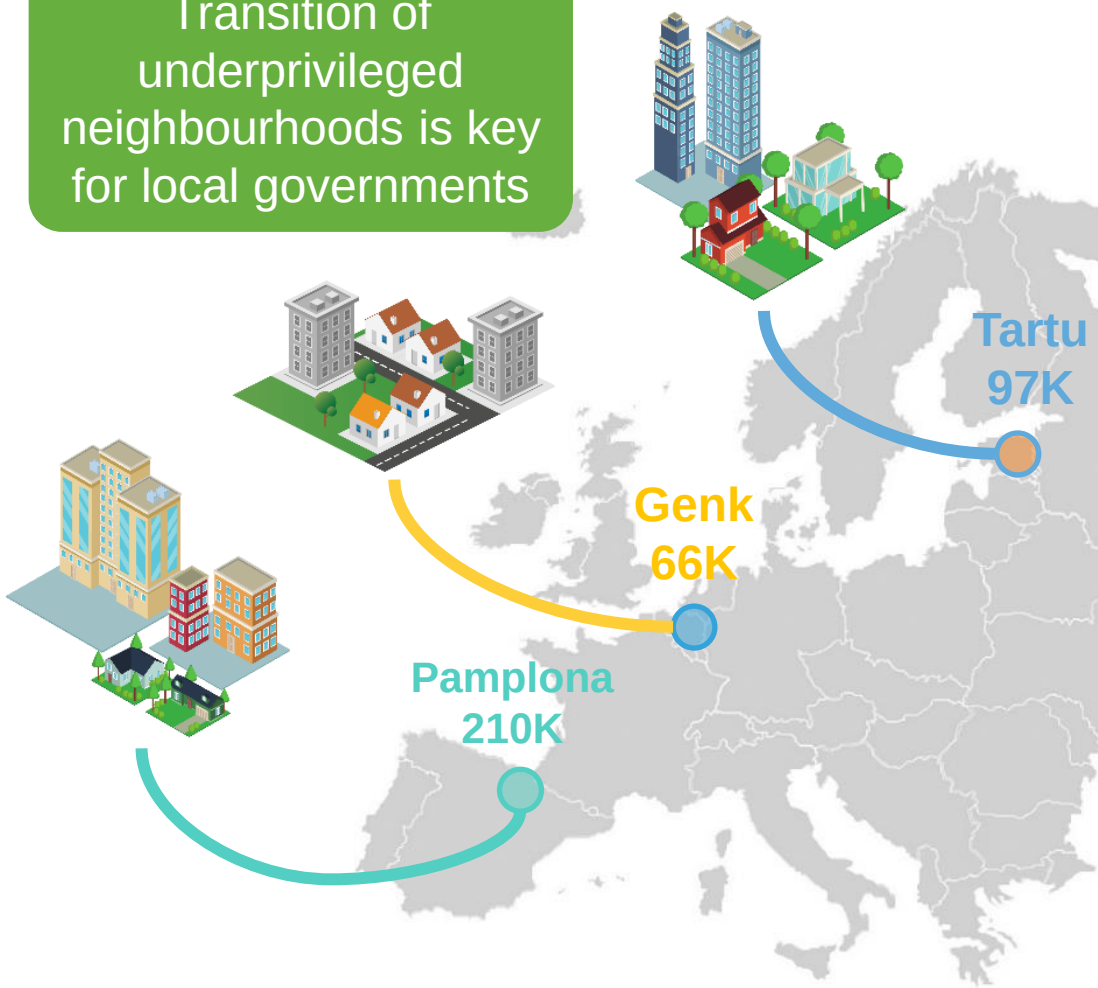
	Service agreement 1	Service agreement 2	No service agreement
Minimum battery level	30% (83 km range for a Nissan Leaf, for example)	10% (28 km range for a Nissan Leaf, for example)	I will control the charger myself, charging at the hours when electricity is cheapest and selling electricity when it is most expensive, connect the charger to a smart home management system, or allow the car to begin charging at the regular price once it is plugged in.
Portable power bank	No	Yes	
Emergency roadside charging assistance	Yes	No	
Charging data security	Yes	Yes	
Monthly smart charging service agreement fee (deducted from the reward you gain by using the smart charging and two-way charging features)	€ 50 (€ 600 per year)	€ 10 (€ 120 per year)	
	○	○	○

Do individual consumers make a different trade-off between costs and perceived benefits?

From Theory to Practice

Revitalisation of urban areas towards Positive Energy Neighbourhoods

Transition of underprivileged neighbourhoods is key for local governments



75%

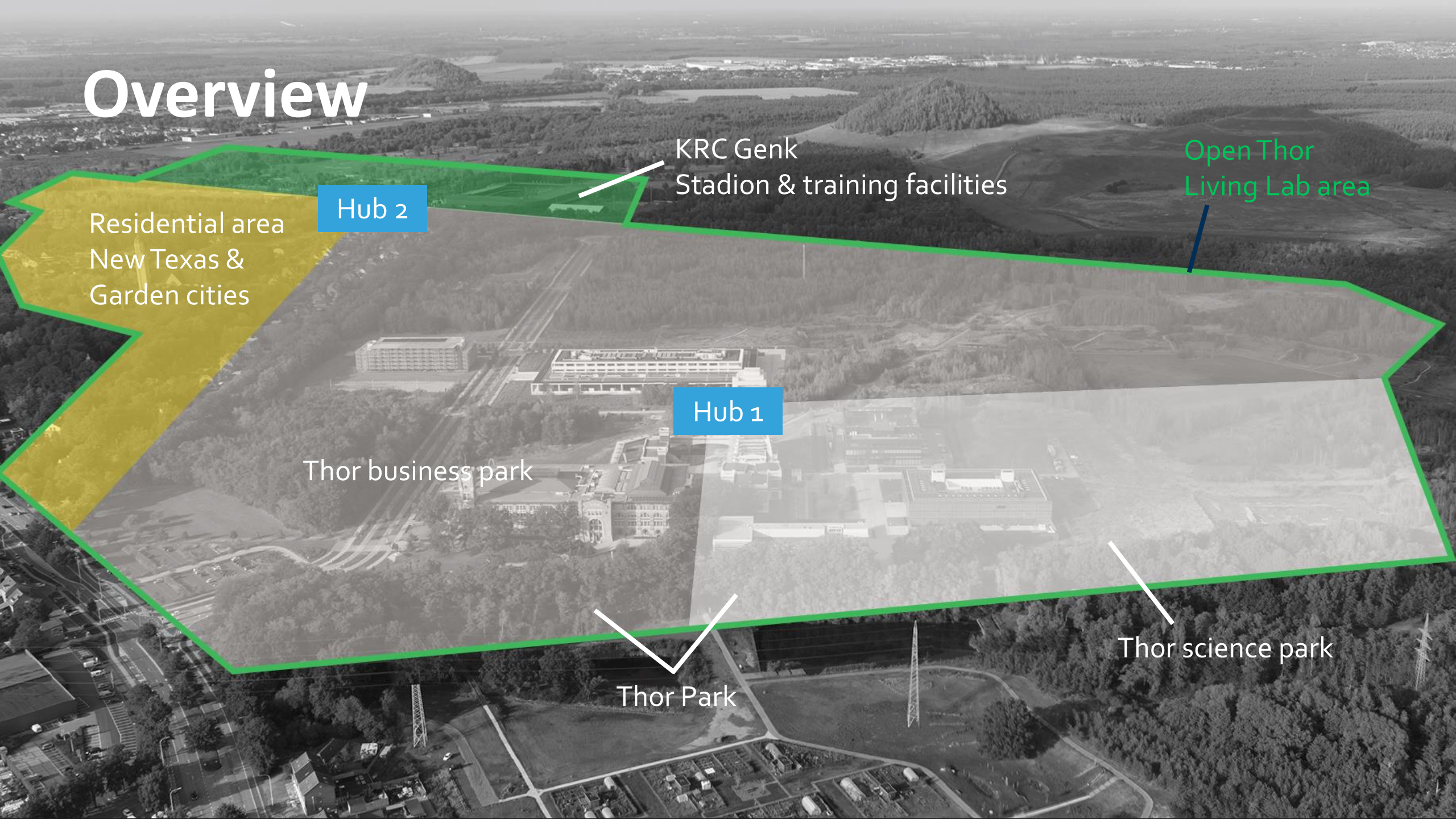
of Europeans live in urban areas

700

out of 800 European cities are small to medium-sized

1. **POSITIVE ENERGY NEIGHBOURHOODS** *within existing urban contexts*
2. **LIVING LAB** *innovation processes in real-life test environment*
3. **OPEN INNOVATION** *to enable commercially viable solution packages*

Overview


KRC Genk
Stadion & training facilities
Open Thor
Living Lab area
Residential area
New Texas &
Garden cities
Hub 2
Hub 1
Thor business park
Thor Park
Thor science park

Quadruple helix: cross-sector collaboration

oPEN Lab
TARTU PAMPLONA GENK LEADING THE TRANSITION TO POSITIVE ENERGY NEIGHBOURHOODS

Research

vito
KU LEUVEN
imec

Industry

LITO
FUTECH zonnepanelen & batterijopslag
VAN ROEY
dcinergy
HABENU-VD KREEKE
»cast4all TECHNOLOGIES
DAIKIN
flux50 ENERGISING THE FUTURE

Public Sector

wil Wonen in Limburg
IEDEREEN GENKT GENK

Citizens

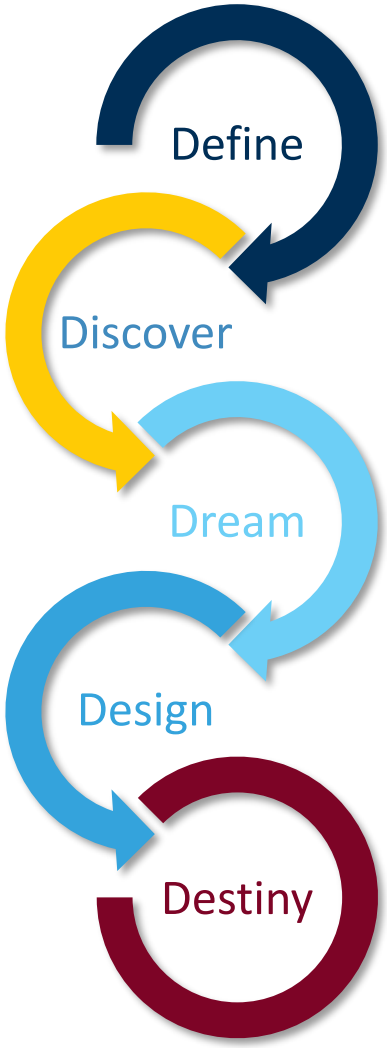
stebo ondernemend voor de samenleving

DIGITAL INNOVATION
TECHNOLOGICAL INNOVATION
SOCIAL INNOVATION

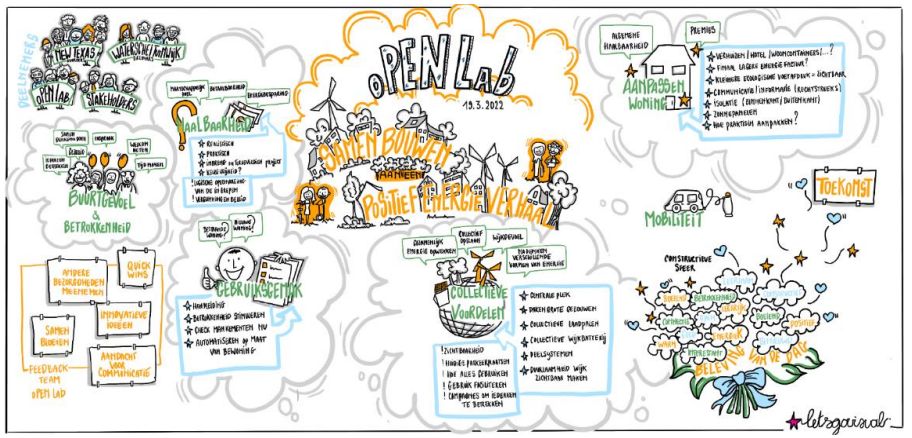
Social innovation

Building the living lab through co-creation

Appreciative Inquiry



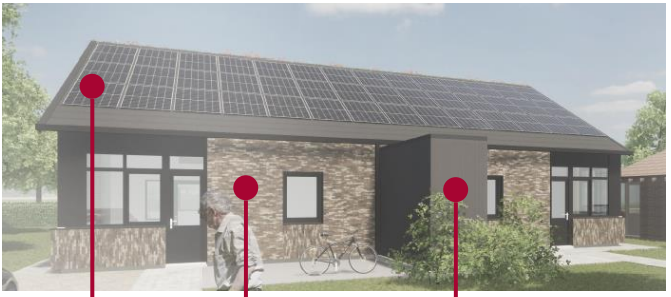
Formal co-design sessions - one-to-one conversations - information sessions - **FUN**



Technological innovation: unique playground for innovative building energy systems

Pre renovation

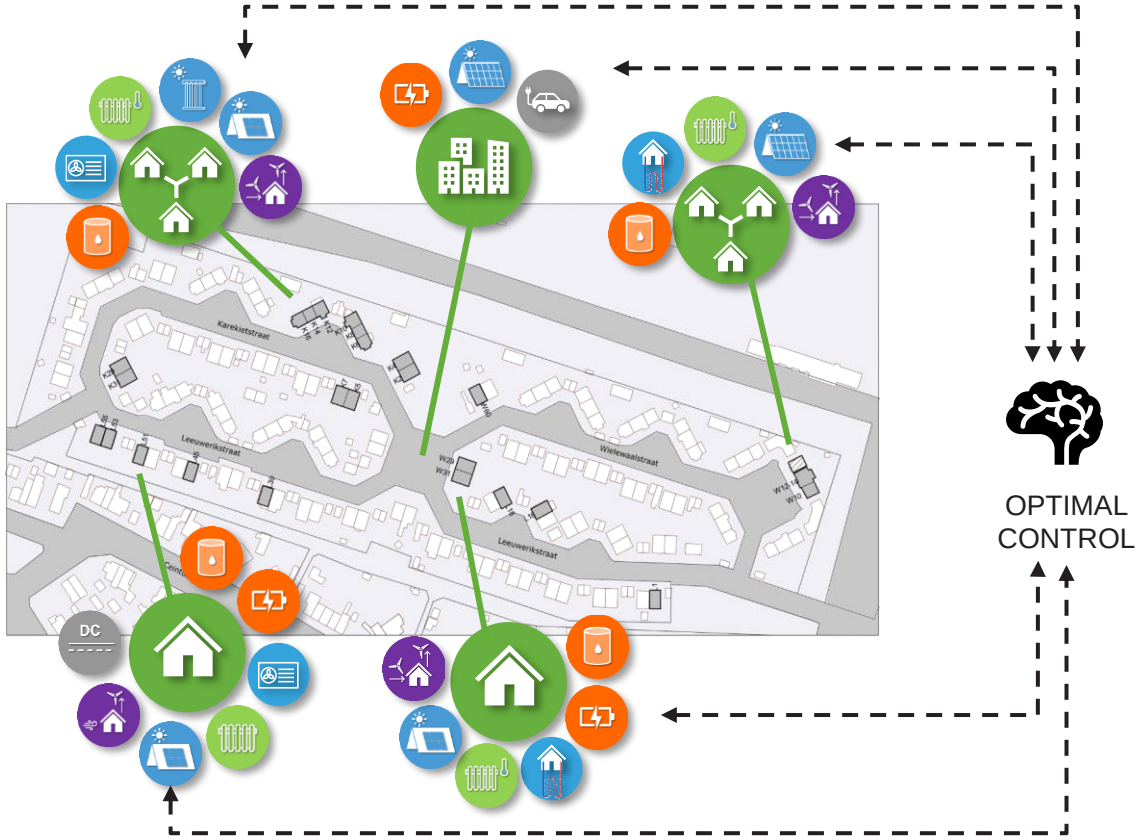
Post renovation



living lab energy box

prefab building envelope

renewable energy production



OPTIMAL CONTROL

TECHNOLOGY BOXES
- INDIVIDUAL
- MICROGRID
- NEIGHBOURHOOD INFRASTRUCTURE

HEAT PUMPS
- AIR-WATER
- GEOTHERMAL

RENEWABLE ENERGY
- PV
- BIPV

VENTILATION
- EXTRACT with DEMAND CONTROL
- BALANCED with HEAT RECOVERY

EMISSION SYSTEM
- EXISTING RADIATORS
- LOW-TEMP RADIATORS
- SURFACE HEATING

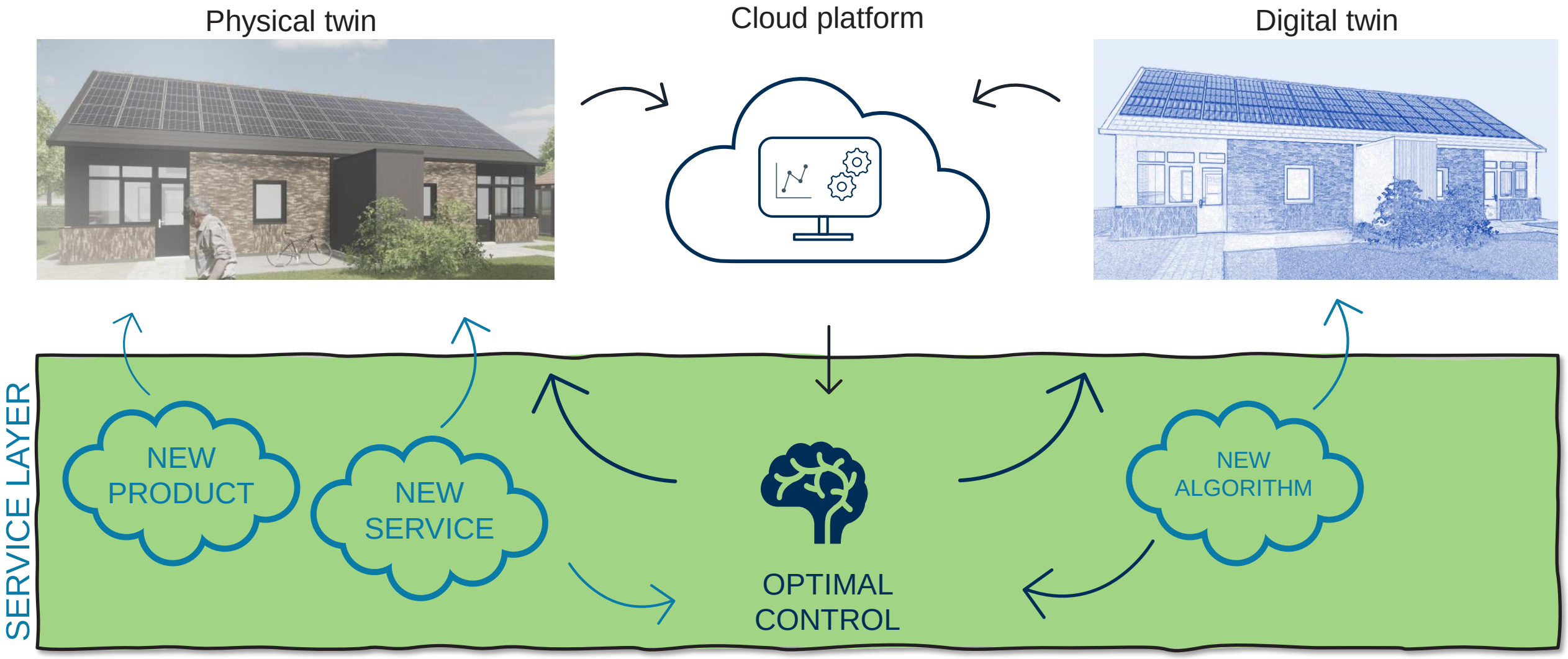
STORAGE
- THERMAL
- ELECTRIC

RENEWABLE ENERGY
- SOLAR THERMAL
- HYBRID (PVT)

OTHER
- DC GRID
- EV CHARGING

Digital innovation:

A digital twin for district-level optimal control



Conclusions

- Evolving towards a consumer-centric market design is **not a one-dimensional problem** and should be tackled in an integrated way.
- The **EU regulatory framework is driving the change**, but still a lot of work to be done
- The choice of **the right financial support schemes** is essential
- Understanding the **drivers for consumer behavior** in addition to financial benefits becomes even more important
- A **trade-off** needs to be found between **harmonization and customization**
- Consumer-centricity requires a fundamental **rethinking of the overall energy system**
- The design of consumer-centric solutions is **a journey with the consumer**, integrating preferences from the start

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