FLEXMYHEAT FINAL REVIEW MEETING

SEPTEMBER 1 2025

INTRODUCTION

- Context: shift to heat pump heating systems will increase peak loads in the Belgian electricity grid (on top of increased peak loads caused by electrification of transport and industry)
  - Challenge to upgrade the grid in a cost-effective way and assure security of supply
- Goal: understand the role that heat pumps and decentralized storage solutions can play in 2030 and beyond as source of flexibility for the national electricity system
- Project main objectives
  - Assess the impact and value in 2030 and beyond (heat pumps + PV + storage solutions)
  - Adapt the market: valorize flex on energy markets via smart control algorithms
- Evaluate these objectives under 3 scenarios
  - Business-as-usual (no smart control, only control based on local PV production)
  - Exploitation of flexibility on energy markets for individual assets via smart control algorithms
  - Integrated smart control of heat pump, battery and thermal storage

MAIN RESULTS

- Year 1
  - D1.1: results of data collection, asset modeling and business-as-usual scenarios
- Year 2 (7 months)
  - D2.1 / D3.1 / D4.1a: results of the smart control scenarios
  - D4.1b: technical report on heat pump deployment
  - D4.1c: comparison of electric and thermal batteries for decentralized storage

MAIN RESULTS

- Scientific publications
  - Published
    - **Multi-source Transfer Learning in Reinforcement Learning-based Home Battery Controller**
      Reuse of smart control strategies over households using transfer learning. Use of ORES load data for validation.
    - **Control policy correction framework for reinforcement learning-based energy arbitrage strategies**
      Ensure safety of RL based control algorithms
    - **Distill2Explain: Differentiable decision trees for explainable reinforcement learning in energy application controllers**
      Improve explainability of RL based control policies for flexible residential loads
    - **Explainable reinforcement learning-based home energy management systems using differentiable decision trees**
      Improve explainability of RL based control policies for flexible residential loads
    - **Distributional reinforcement learning-based energy arbitrage strategies in imbalance settlement mechanism**
      RL based control policies that take into account uncertainty to minimize risks
  - Accepted
    - **Gaming Strategies in European Imbalance Settlement Mechanisms**
      accepted for ISGT Europe, 20-23 October 2025
  - Submitted
    - **Model Predictive Control-Guided Reinforcement Learning for Implicit Balancing**
      submitted to IEEE Transactions on Smart Grid
- Deliverables & publications are publicly available on our website (https://flexmyheat.ilabt.imec.be/)

AGENDA

- Introduction [Matthias Strobbe – imec]
- Overview results of the smart control scenarios [Seyed Soroush Karimi Madahi – imec]
- Heat pump deployment outlook [Guillaume Cambier – ORES & Michael Piron – Elia]
- Comparison of electrical and thermal storage [Clement Martin – Destore]
- New developments on valorization of residential battery flex on energy markets [Jeremy Bailleux - LifePowr]
- Lessons learned for the building construction sector [Loïc de Moffarts – Thomas & Piron]
- Combine energy sharing & flexibility services - suggestions for regulatory changes [Olivier Boveroux – Energy Commune]
- Q&A

OVERVIEW SMART CONTROL SCENARIOS

SEYED SOROUSH KARIMI MADAHI - IMEC

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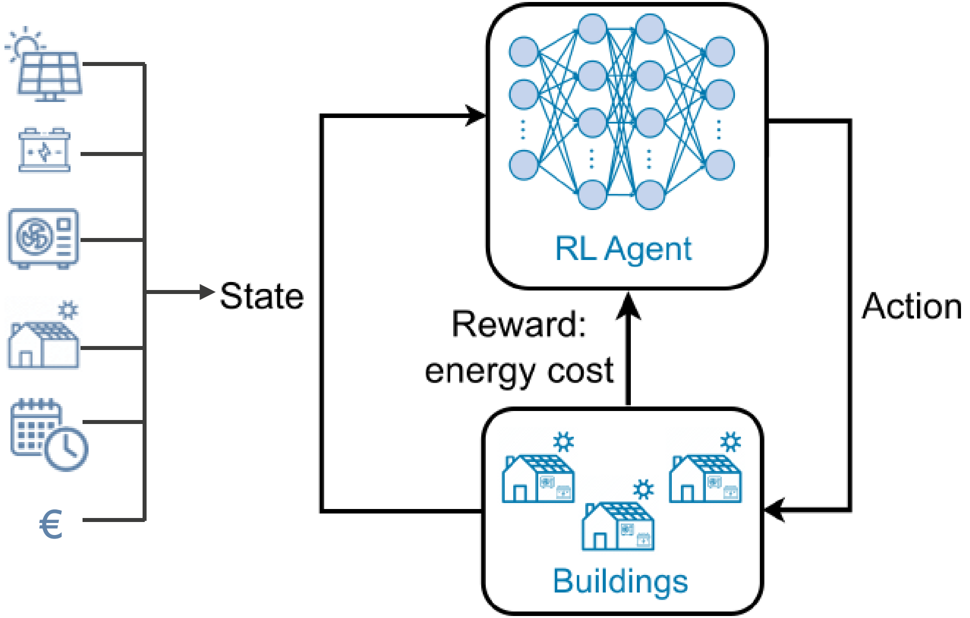
INTRODUCTION

- Deliverable D1.1
  - Integrate flexible assets using business-as-usual controller (PV self-consumption optimization)
  - Significant increase in daily peak power by widespread adoption of heat pumps in 2030
  - Results showed that integrating heat pumps with storage moderates their effects
  - Importance of smart control logic for flexible assets

BATTERY SMART CONTROL – METHOD

- Goal:
  - Day-ahead market: reduce electricity bill
  - Imbalance market: maximize imbalance revenue
- Train reinforcement learning agent for each market

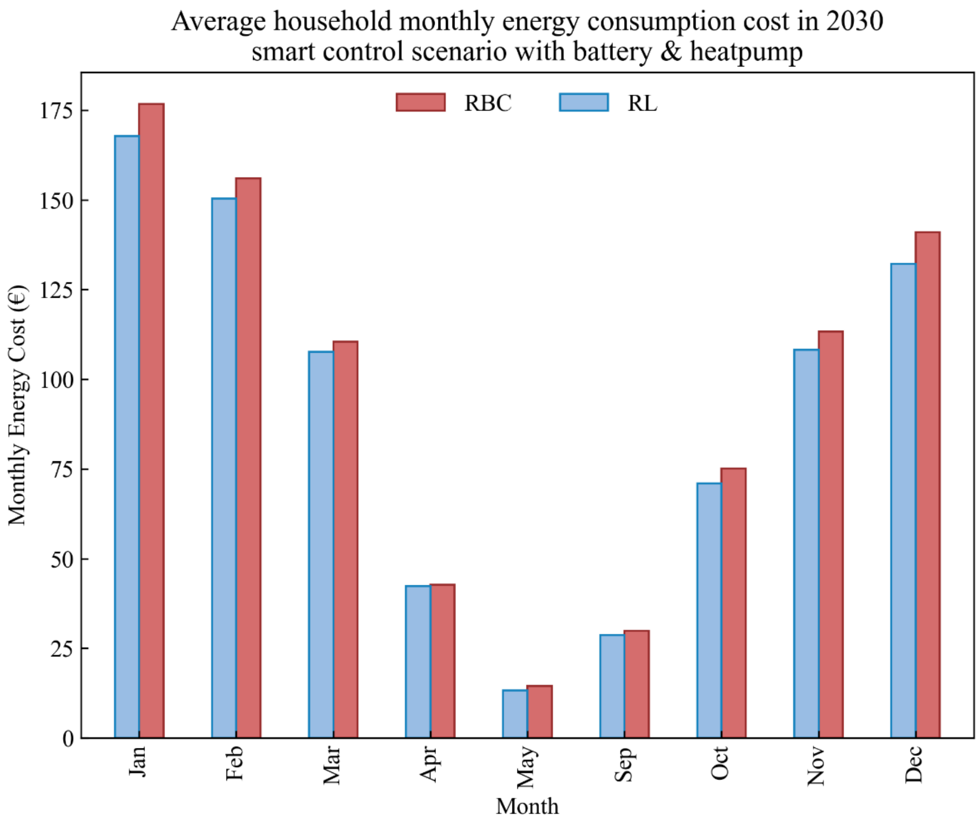


BATTERY SMART CONTROL – EXPERIMENT SETUP

- Case study
  - Choose 24 residential load profile based on clusters → 120 Users
  - PV profiles for 5 location + 3 different orientations + noise
  - 3 heatpumps + 3 thermal storage + 5 batteries + 3 building models
- Split dataset
  - Training: first 20 days of each month
  - Validation: 21-25th of each month
  - Test: 26th till end of each month

BATTERY SMART CONTROL – DAY-AHEAD MARKET RESULTS

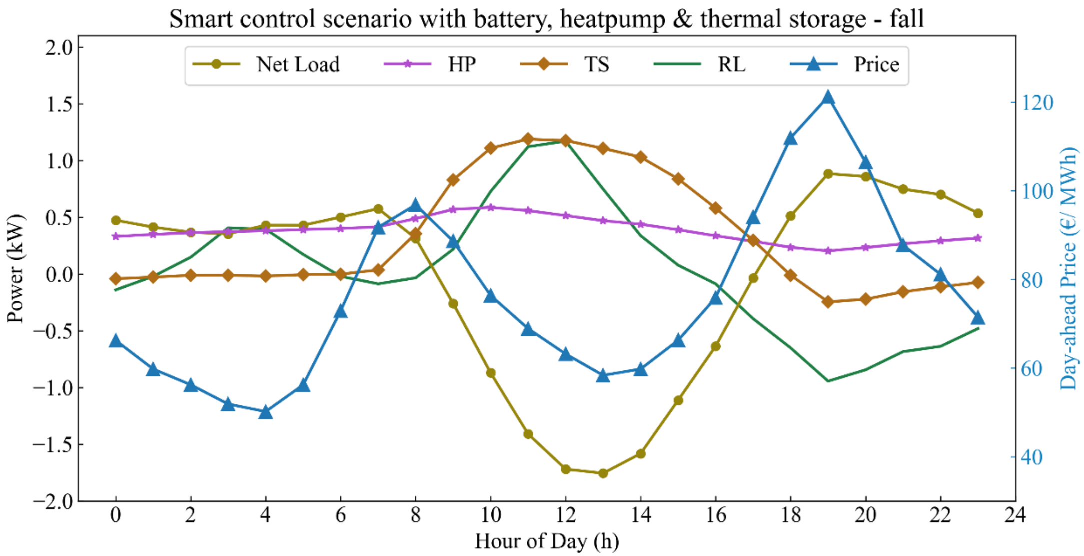
- Reduction of annual electricity bill on average by 2-5%
- RL agent provides a constant cost reduction over the rule-based controller



BATTERY SMART CONTROL – DAY-AHEAD MARKET RESULTS

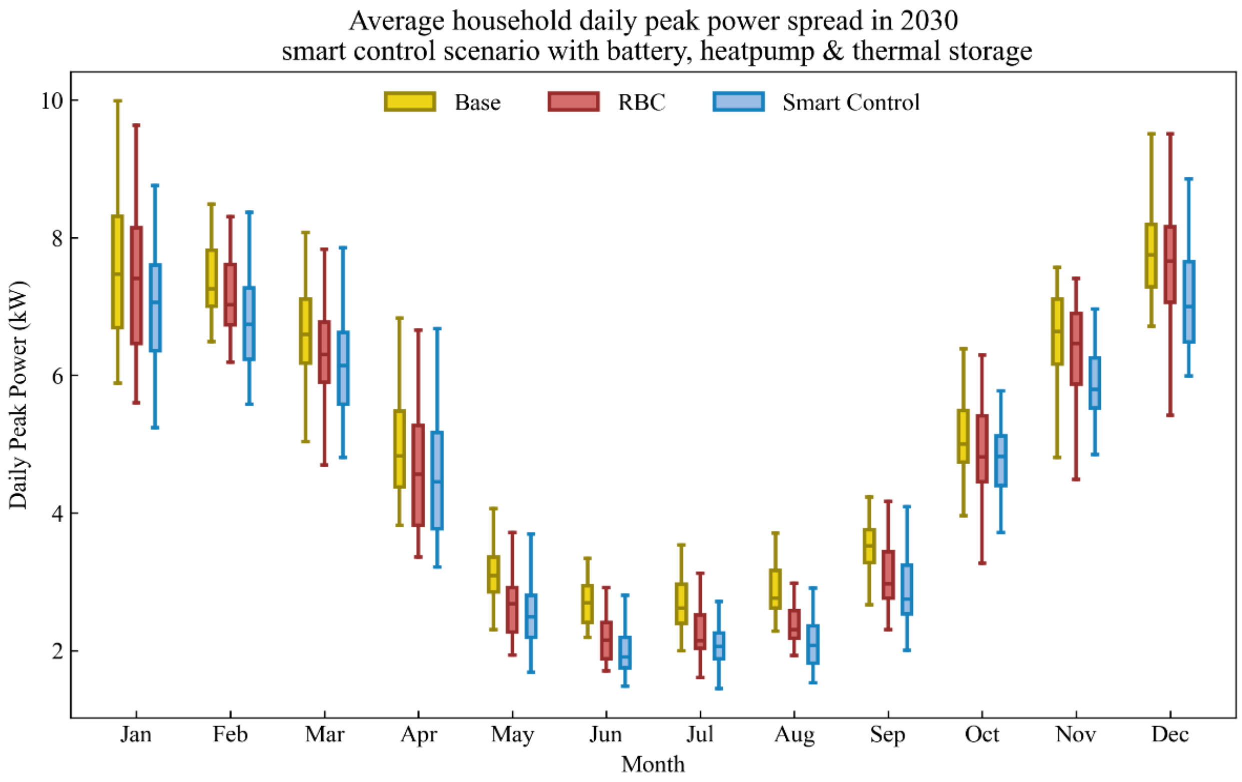
Assets contribution to cost reduction:

- Two main peaks in battery consumption
- Charge of thermal storage during hours with an excess of PV
- Dip in the heat pump profile in the evening



BATTERY SMART CONTROL – DAY-AHEAD MARKET RESULTS

Reduction of the daily peak power on average by 11.5% and 5.6% compared to the base and rule-based controller

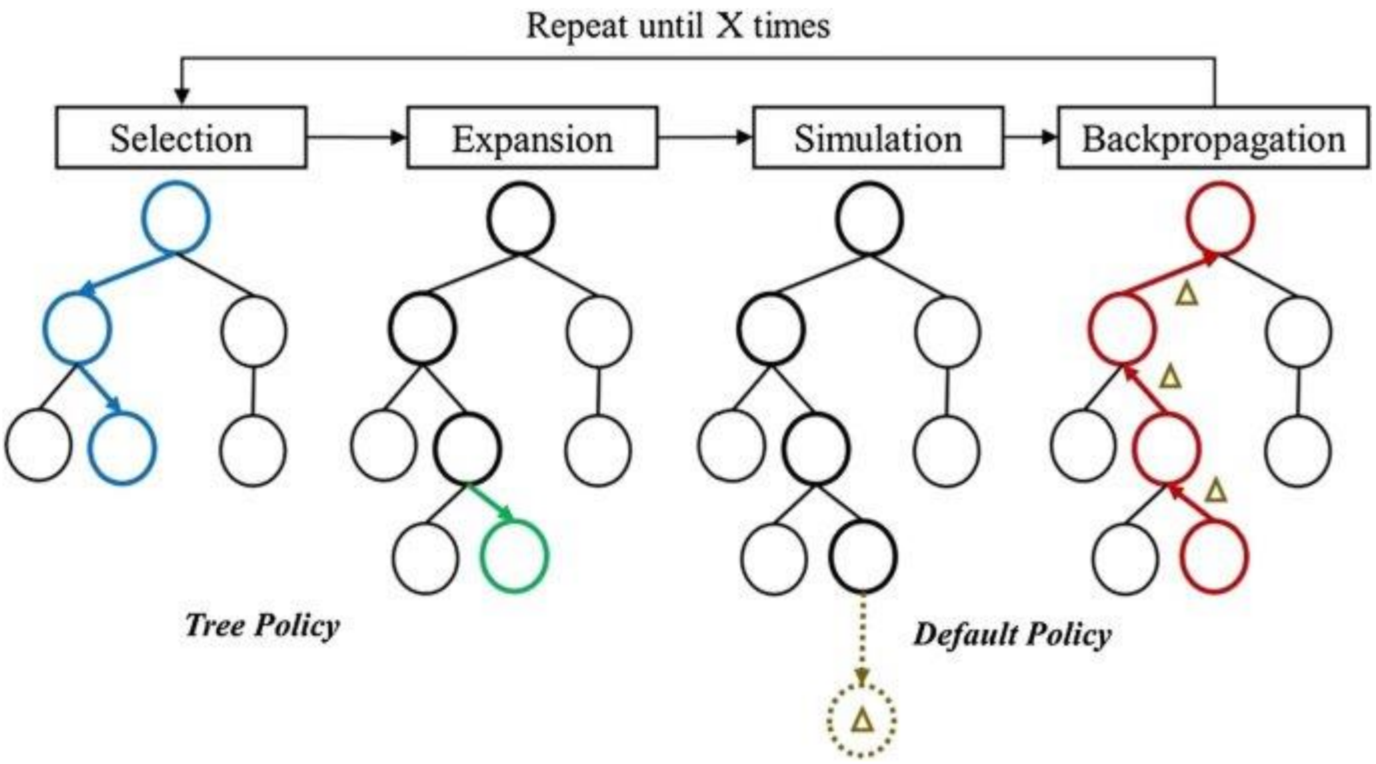


BATTERY SMART CONTROL – IMBALANCE MARKET RESULTS

- Decrease annual electricity cost by 367.8€ with a 20% revenue-sharing rate
- Battery consumes an average of 5.7 cycles per day
- Enhance social welfare
  - Reduce balancing costs
  - Capacity reserve mechanism costs savings

revenue-sharing rate	Control Logic	w/o flexible asset (€)	Bat (€)	Bat+HP (€)	Bat+HP+TS (€)
0%	No control	557.34	557.34	1073.22	1018.02
20%	RL	557.34	189.59	705.47	650.27
30%	RL	557.34	5.72	521.60	466.40
40%	RL	557.34	-178.15	337.73	282.53

HEAT PUMP SMART CONTROL – MONTE CARLO TREE SEARCH



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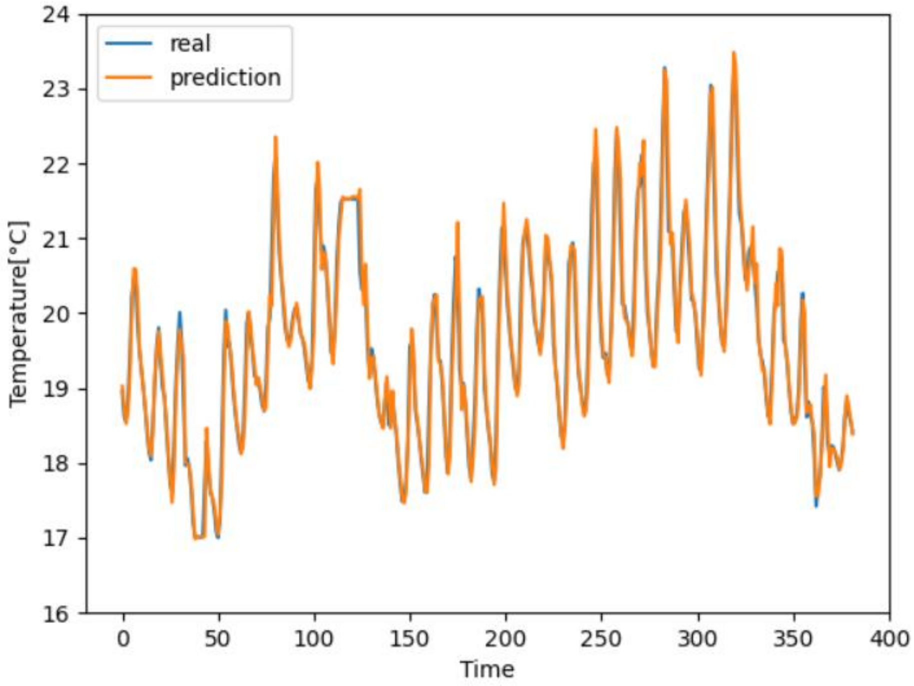
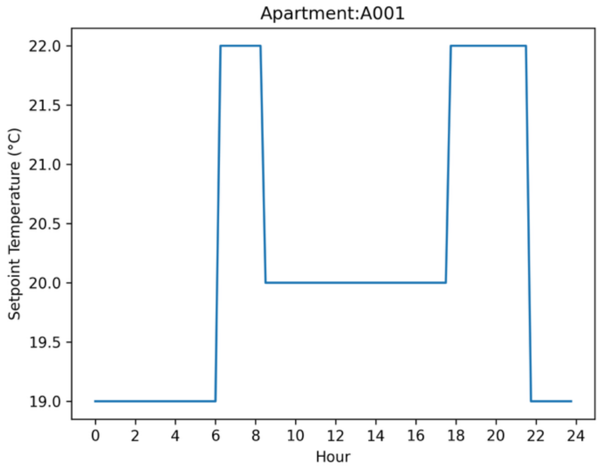
HEAT PUMP SMART CONTROL – PHYSICS-INFORMED MODEL

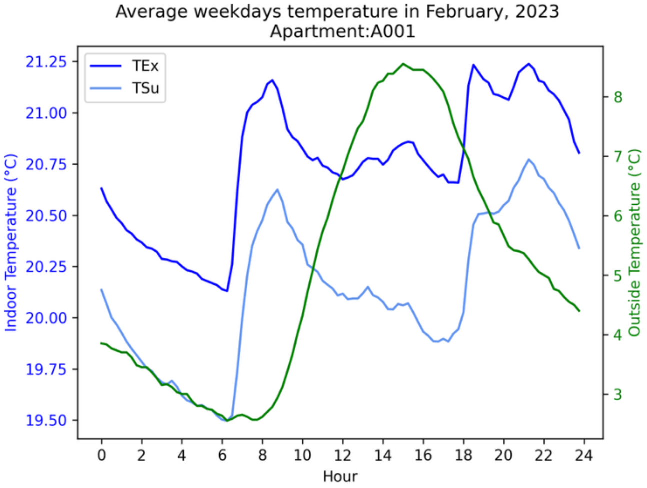
- Simulate the thermal behavior of buildings using physics-informed neural network
- An encoder-based model to project the most recent building states into a compact hidden state (building's mass temperature)



INDOOR TEMPERATURE SETPOINT

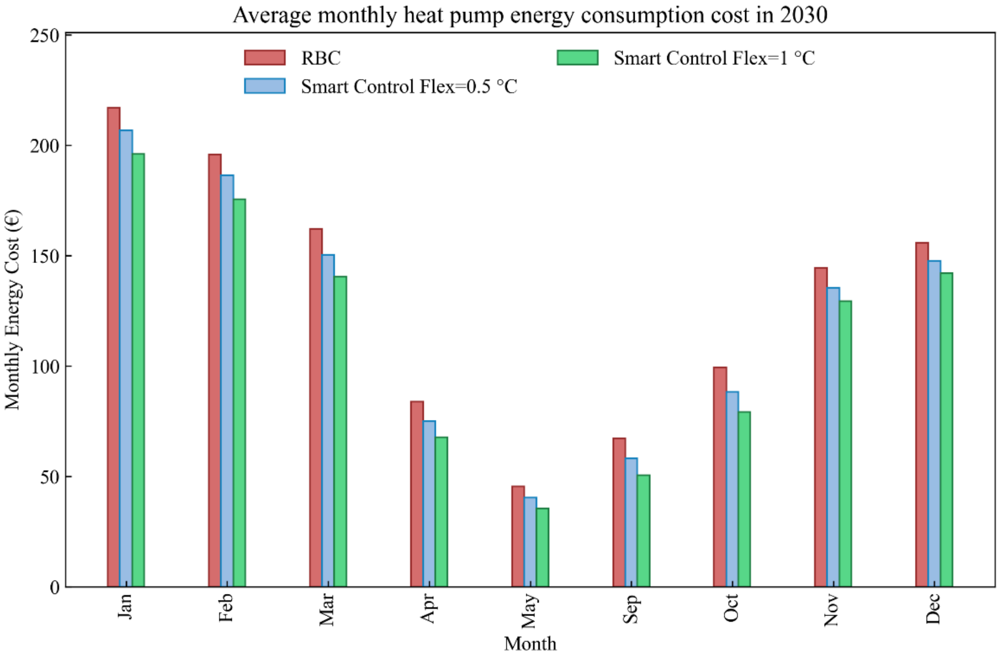
- Analyze residential indoor temperature data from Thomas & Piron
- Choose 4 different apartments
  - A001: 2 bedroom, 87.74 m^2
  - B103: 1 bedroom, 58.35 m^2
  - C204: 2 bedroom, 83.02 m^2
  - A401: 3 bedroom, 152.92 m^2





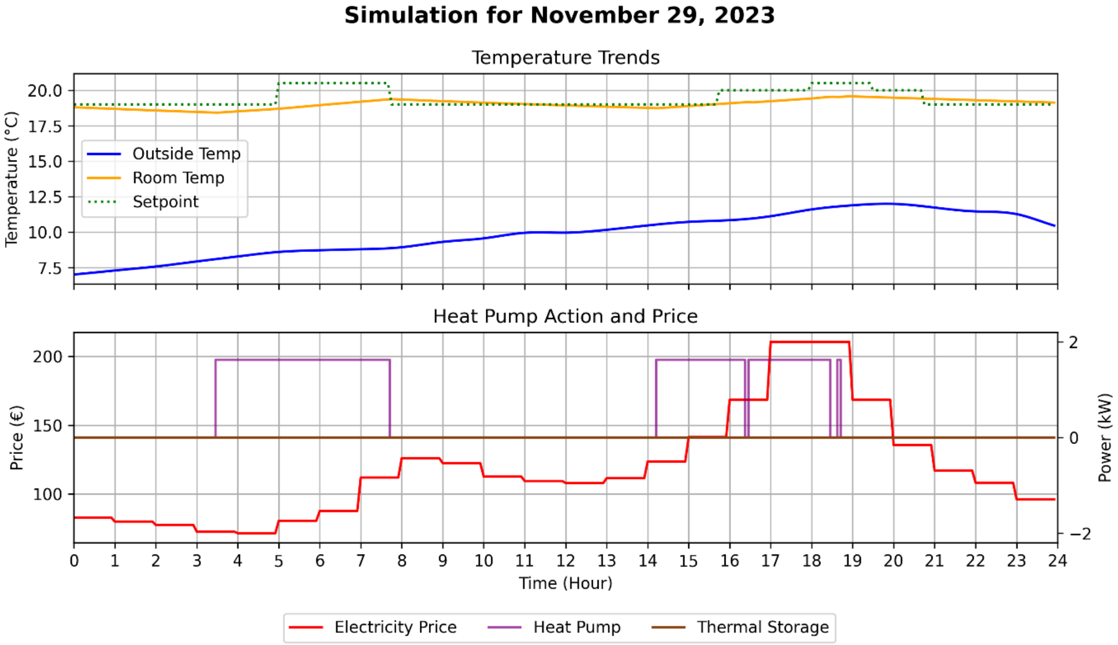
HEAT PUMP SMART CONTROL – RESULTS

- Reduction of electricity cost by 10-13% compared to the business-as-usual controller
- Decrease of peak power by 9.4% and 13.3% for 0.5 °C and 1 °C deadbands



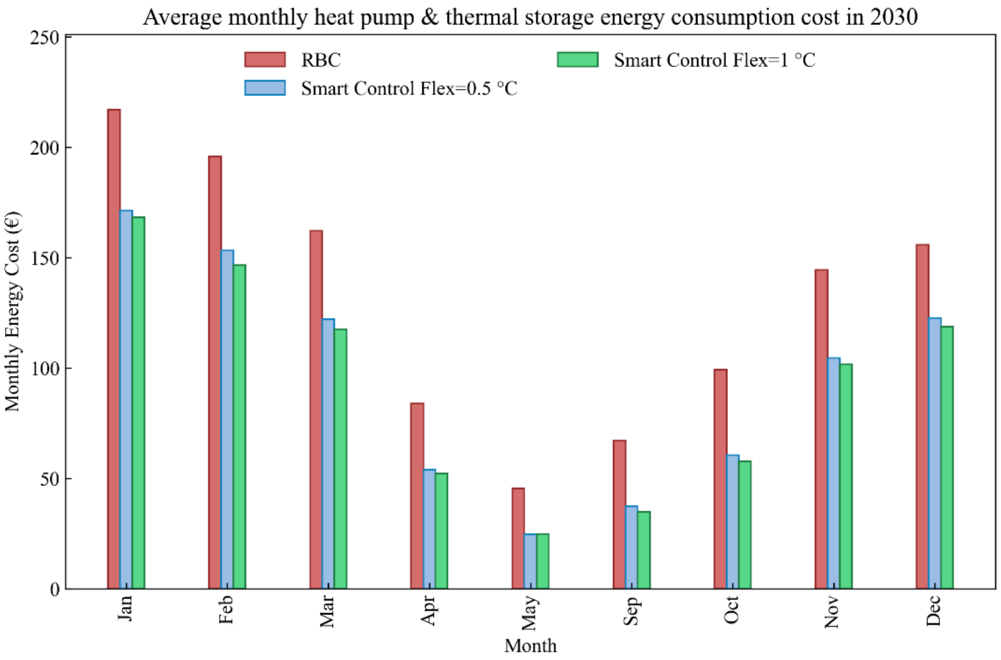
HEAT PUMP SMART CONTROL – RESULTS

Preheating as backbone of the smart control strategy, i.e., start the heat pump earlier to preheat the building when prices are low



HEAT PUMP & THERMAL STORAGE SMART CONTROL – RESULTS

- Reduction of electricity cost by 26-30% compared to the business-as-usual controller
- Decrease of peak power by 23% and 25% for 0.5 °C and 1 °C deadbands



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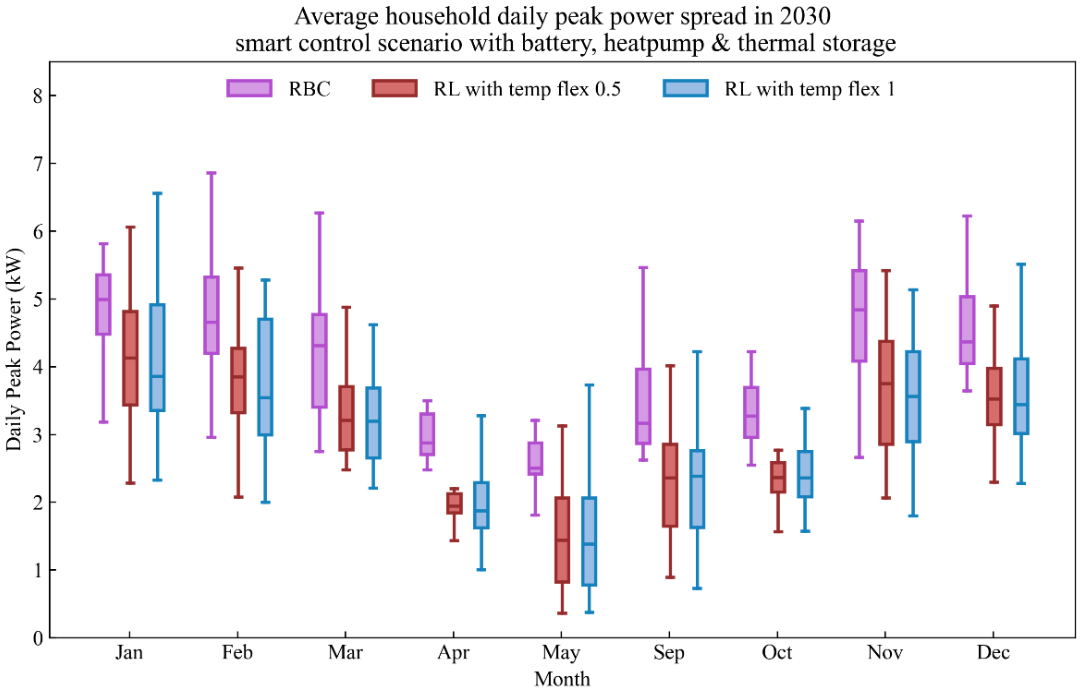
MULTI-ASSET CONTROL – METHOD

- Control all flexible assets (battery, heat pump, and thermal storage) simultaneously
- Control heat pump and thermal storage using MCTS
  - Decision-making time resolution: 5 min
- Control battery using RL
  - Decision-making time resolution: 1 h

MULTI-ASSET SMART CONTROL – RESULTS

PRIORITIZE ELECTRIC BATTERY OVER THERMAL STORAGE

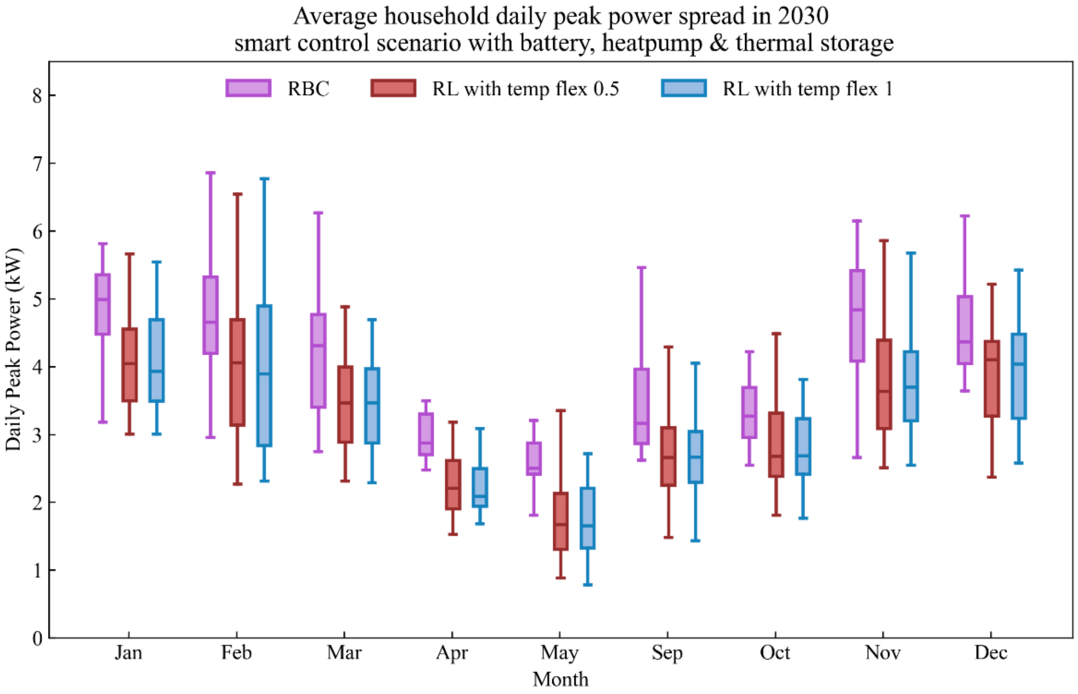
- Reduction of electricity cost by 30-35% compared to the business-as-usual controller
- Decrease of peak power by 25% and 26% for 0.5 °C and 1 °C deadbands



MULTI-ASSET SMART CONTROL – RESULTS

PRIORITIZE THERMAL STORAGE OVER ELECTRIC BATTERY

- 1% reduction in electricity cost compared to the previous case
- Slightly smaller reduction in peak power than in the previous case



CONCLUSION

- Significant reduction in the impact of residential heat pumps on the electricity grid by simultaneously controlling all flexible assets
  - Warm months: cost reduction mostly from smart battery control
  - Cold months: cost reduction mostly from heat pump + thermal storage
- Wider user temperature comfort deadband increases flexibility and reduces peak power
- Indirect reduction of CO_2 emissions through smart control of heat pumps and storage

TECHNICAL REPORT ON HEAT PUMP DEPLOYMENT

GUILLAUME CAMBIER – ORES
MICHAEL PIRON - ELIA

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I. INTRODUCTION

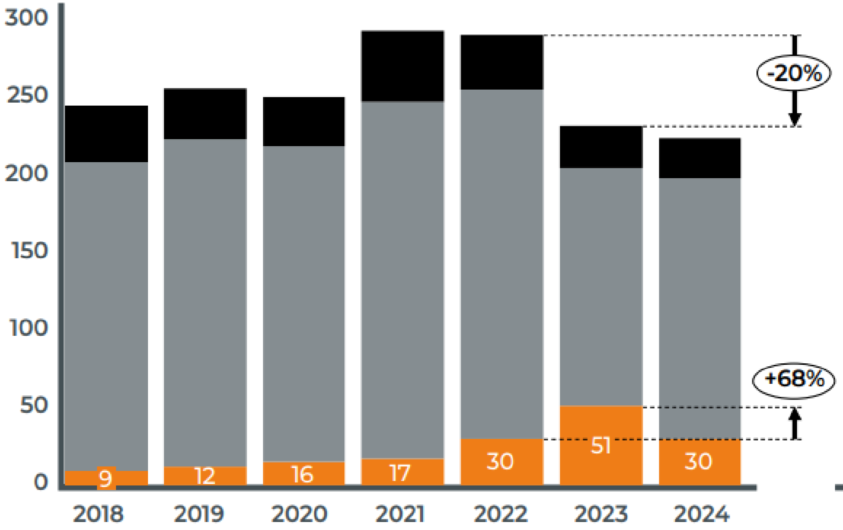
- Heat pumps reduce energy use and emissions by using ambient air or ground for space heating and hot water.
- Large-scale adoption of Heat Pump will significantly increase residential electricity consumption.
- Grid challenges: Higher consumption peaks can affect energy security, net balance, and cause local grid congestion.

II. EVOLUTION OF HEAT PUMPS IN THE FUTURE

HISTORICAL SALES OF HEATING APPLIANCES IN BELGIUM

Sales of new heating appliances in Belgium

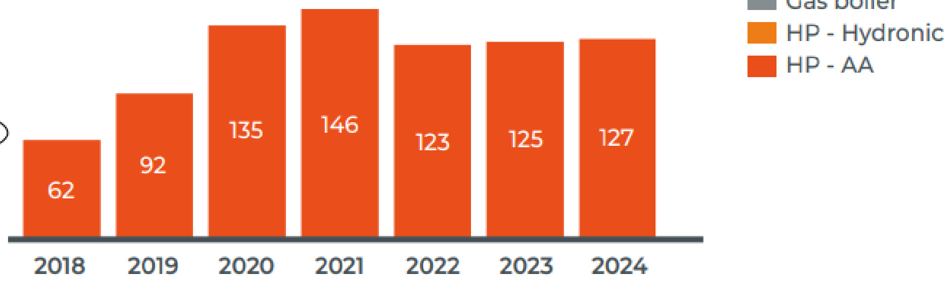
Thousands



Source: Climafed

… Sales of Air-Air heat pumps*

Hydronic : air-water and ground-water
AA : air-to-air (mostly for cooling)

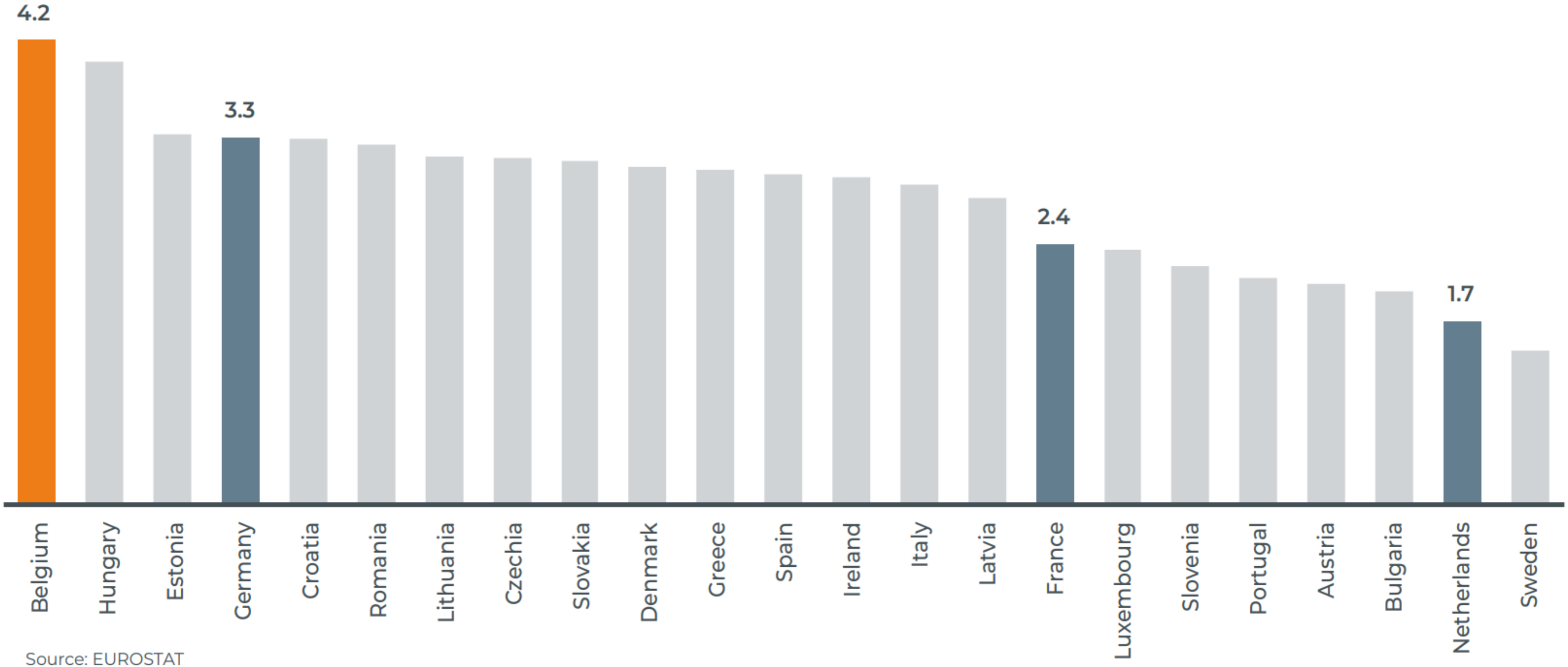


* Includes both cooling and heating units

II. EVOLUTION OF HEAT PUMPS IN THE FUTURE

RATIO OF ELECTRICITY TO GAS PRICES AMONG ALL EUROPEAN UNION COUNTRIES

Belgium has the highest price of electricity when compared to gas

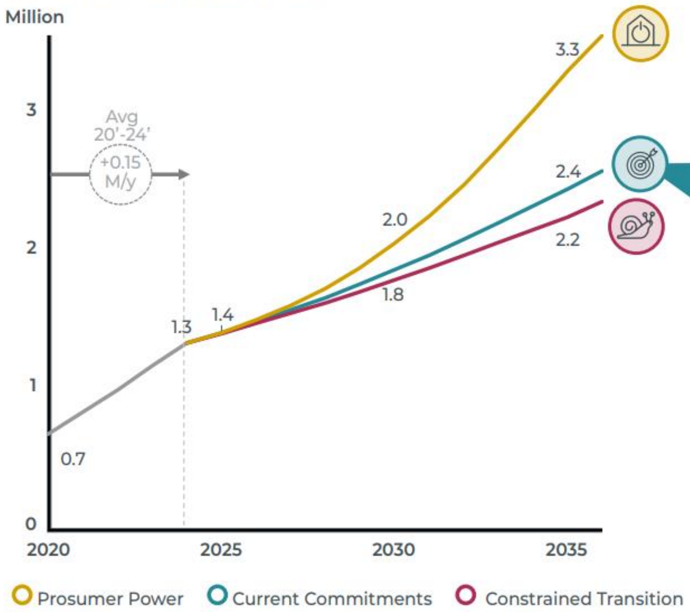


Source: EUROSTAT

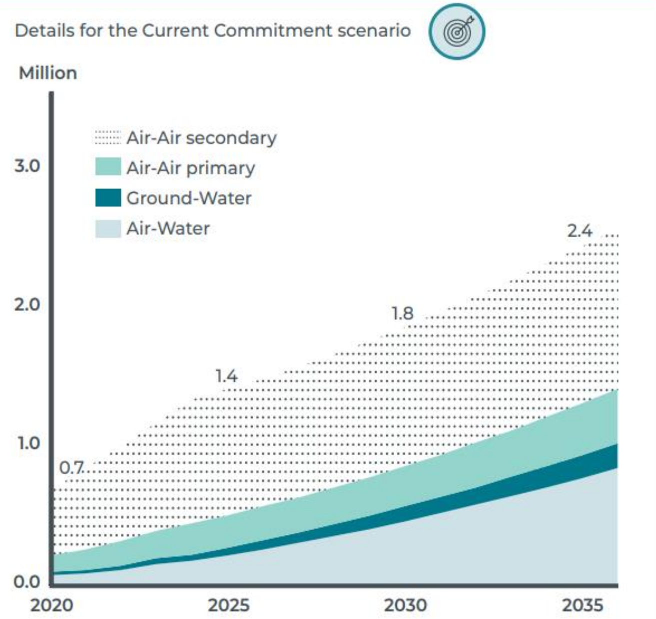
II. EVOLUTION OF HEAT PUMPS IN THE FUTURE

PREVISION OF EVOLUTION OF HEAT PUMPS **STOCK**

RESIDENTIAL AND TERTIARY SECTOR



Source: historical data received from ClimaFed
Data assumed at the end of the year



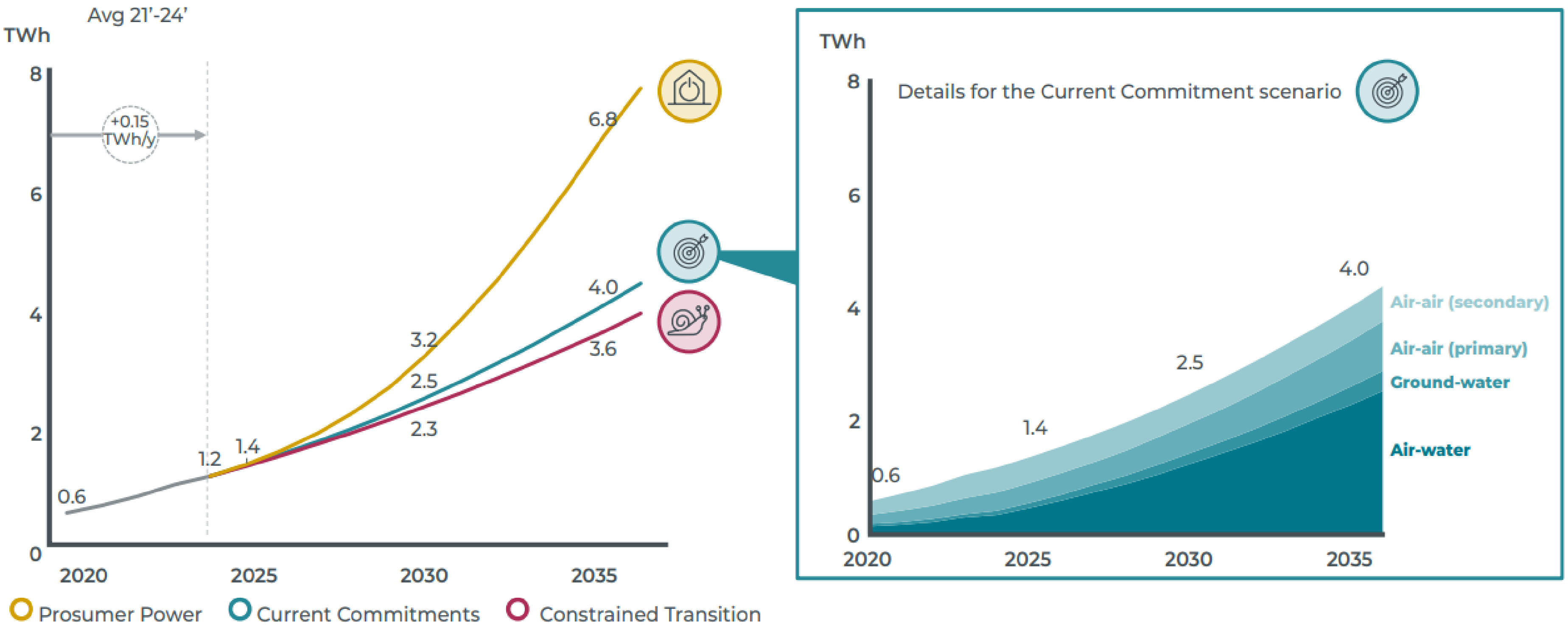
Primary heat pumps cover 100% of the heating needs of homes in which they are installed. Secondary heat pumps are air-air heat pumps assumed to cover 20% of yearly heating needs of a home

II. EVOLUTION OF HEAT PUMPS IN THE FUTURE

PREVISION OF EVOLUTION OF HEAT PUMPS **CONSUMPTION**

RESIDENTIAL AND TERTIARY SECTOR

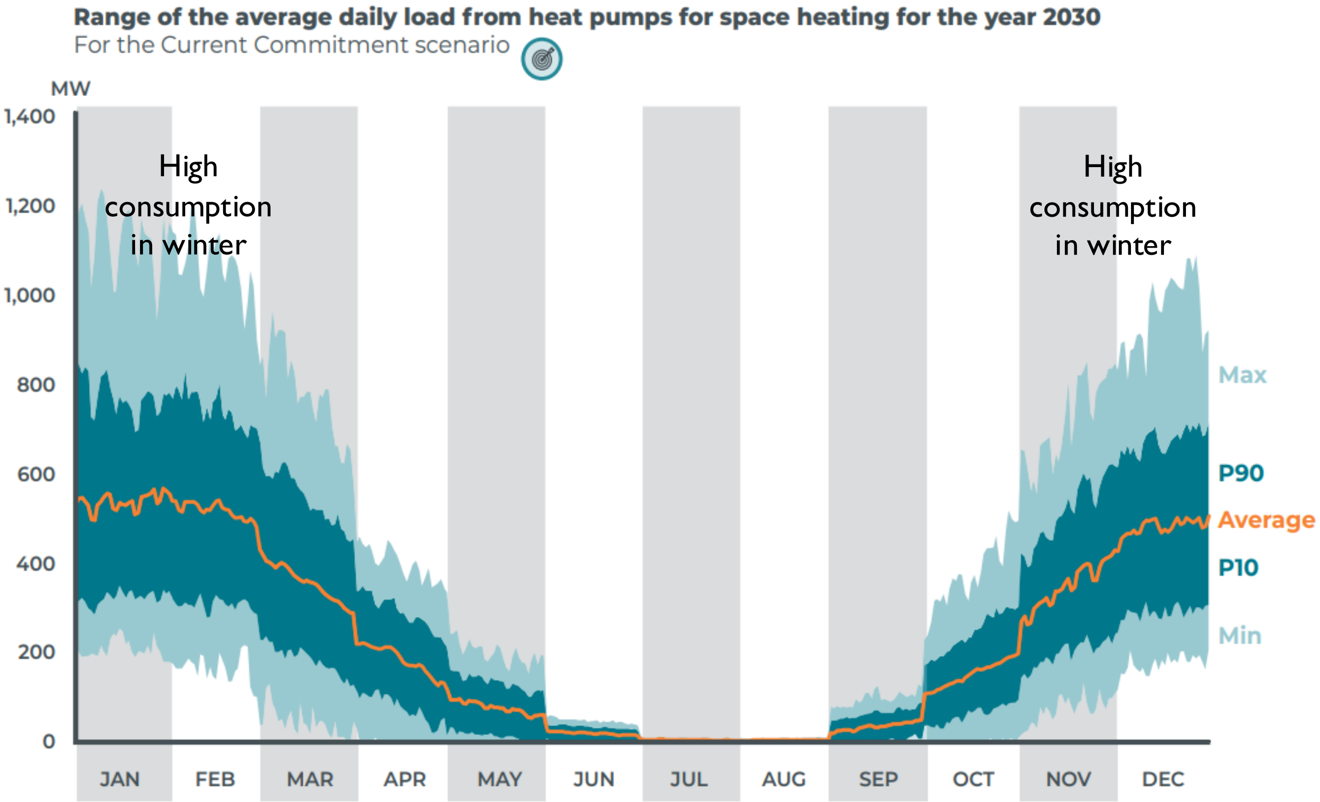
Assumed evolution of heat-pumps stock consumption



II. EVOLUTION OF HEAT PUMPS IN THE FUTURE

PREVISION OF EVOLUTION OF HEAT PUMPS **CONSUMPTION**

RESIDENTIAL AND TERTIARY SECTOR



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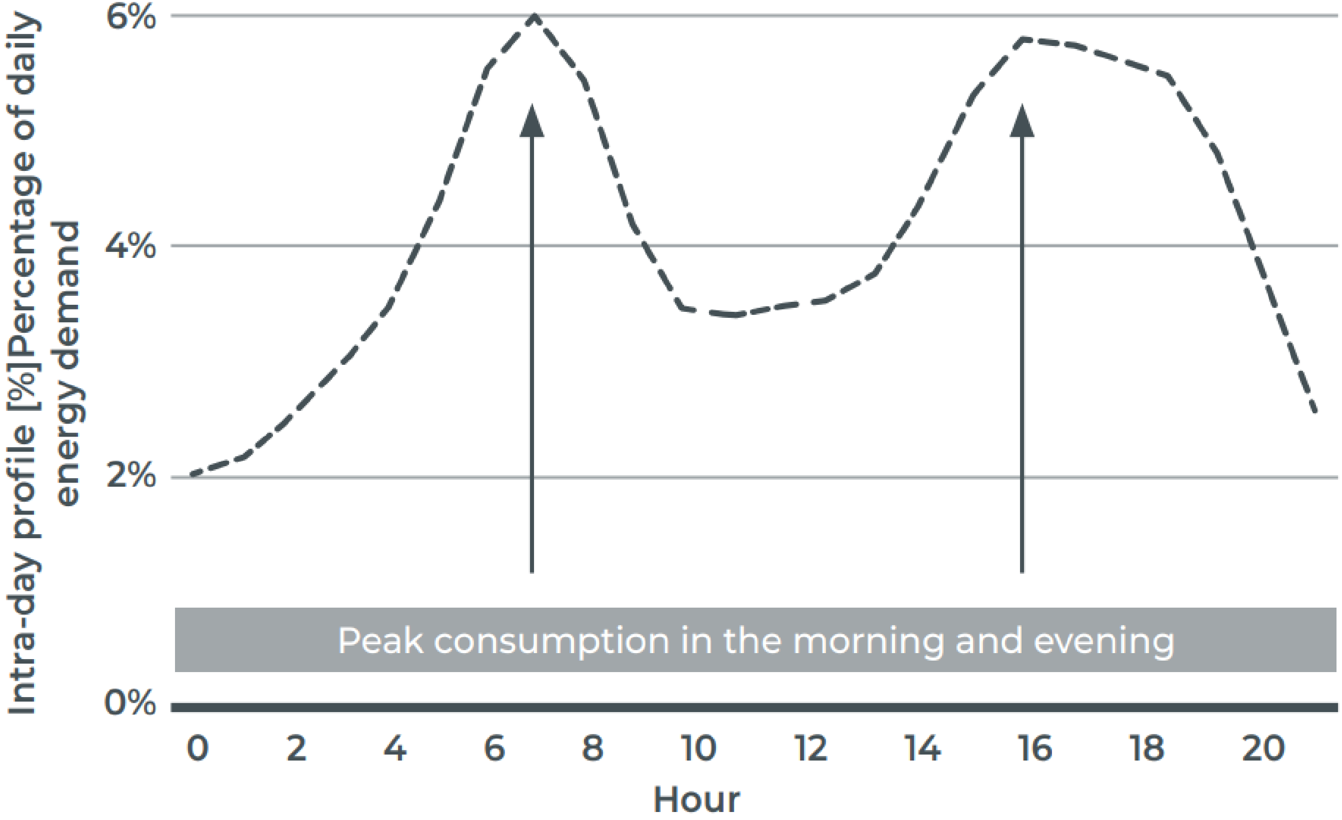
III. IMPACT OF HEAT PUMPS COMBINED WITH BATTERIES ON THE GRID

TYPICAL PROFILE OF A HEAT PUMP – **WITHOUT** FLEXIBILITY



III. IMPACT OF HEAT PUMPS COMBINED WITH BATTERIES ON THE GRID

IMPACT OF THE HEAT PUMP ON THE NETWORK

- Simulations show that the addition of a heat pump (**without batteries**) results in an increase in average peak demand of **0.53 kW**. If we compare this value with the average peak for customers in Flanders (4.26 kW) this represents an increase of 12.5%, which is not negligible
- The recent CREG report on the analysis between the cost of heating with sustainable technologies (including heat pumps) and the cost of heating with fossil fuels shows similar results:

Reference dwelling	Insulation level	Added peak [kW]
Floor heating (FH)	Well insulated	0.246
Floor heating (FH)	Insulated	0.451
Radiator	Well insulated	0.301
Radiator	Insulated	0.706
Radiator	Not insulated	1.015
High-temperature radiator	Not insulated	1.289

III. IMPACT OF HEAT PUMPS COMBINED WITH BATTERIES ON THE GRID

BATTERIES AND FLEXIBILITY HELP REDUCE POWER PEAKS

- **Electrical battery:** Stores off-peak renewable electricity to run the heat pump during peak hours, reducing grid stress and fossil fuel use => use of dynamic supplier tariffs or incentive tariffs (like in Wallonia in 2026).
- **Thermal battery:** Stores heat (e.g., in water tanks or phase-change materials) so the heat pump can operate off-peak and supply heating later, improving efficiency.
- Allowing a **small comfort tolerance** (e.g., ±1 °C) around the target temperature increases the model's performance and flexibility.

When combined with smart control strategies and storage technologies, heat pumps become a powerful source of flexibility - enabling households to shift their energy consumption in time, reduce costs, and support grid stability.

III. IMPACT OF HEAT PUMPS COMBINED WITH BATTERIES ON THE GRID

BATTERIES AND FLEXIBILITY HELP REDUCE POWER PEAKS

- In summary, while the raw addition of heat pumps increases peak demand, the coordinated use of batteries, thermal storage, and smart control not only mitigates this impact but also creates significant value by:
  - Reducing energy costs (up to 35% in some scenarios)
  - Lowering peak demand (up to 26% reduction)
  - Improve self-consumption of PV
  - Supporting grid balance and renewable integration
- This shift from passive to active flexible energy systems is essential for a resilient and sustainable energy future !

IV. CURRENT LIMITATIONS

- **Economic barrier:** Heat pumps remain expensive compared to fossil fuel systems due to investment costs and electricity prices, which provide little incentive for households to adopt them.
- **Coordination barrier:** The lack of smart controls prevents heat pumps from optimizing their operation based on prices, grid constraints, and renewable energy availability.
- **Key challenge:** Although technically mature, heat pumps face barriers in terms of cost competitiveness and system integration, which must be overcome if they are to fully support the energy transition.

COMPARISON OF THERMAL AND ELECTRICAL STORAGE

CLEMENT MARTIN - DESTORE

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DECENTRALIZED STORAGE SOLUTIONS ARE THE KEY FOR FLEXIBILITY

Increasing electrification of heating and cooling induces **more stress on the grid**.

The focus here is made on

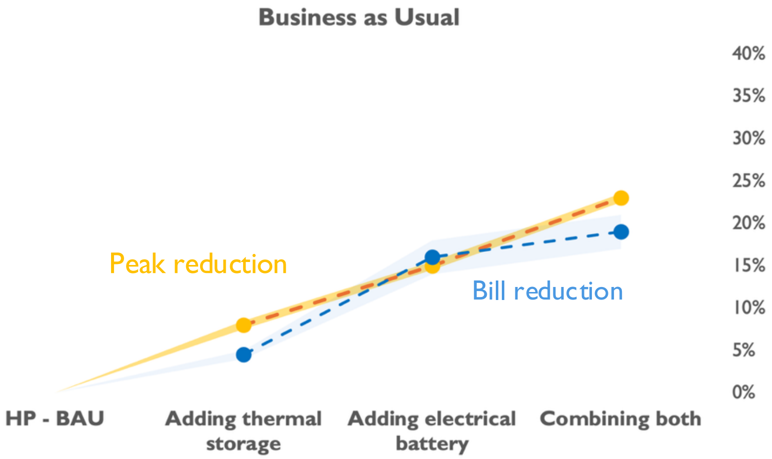
1. Electrical Batteries (**BESS**)
2. **PCM Thermal Storage** (combined with HP)

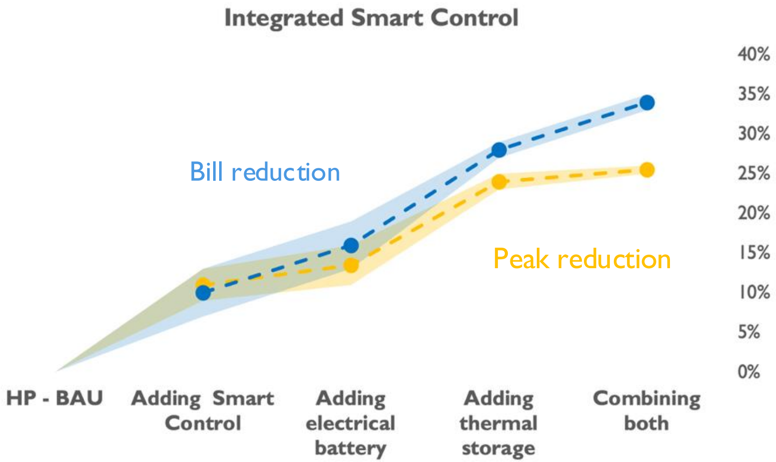
The following analysis is based on simulation scenarios for 2030 households

CONTROL STRATEGIES SCENARIOS

Business as Usual	Simple PV self-consumption
Individual Smart Control	One flexible asset optimized under smart controller, other under BAU
Integrated Smart Control	All assets controlled simultaneously to achieve shared objectives
Goal	**Reduce electricity bill and peak power**

INTEGRATED SMART CONTROL UNLOCKS THE HIGHEST POTENTIAL FOR HOUSEHOLD SAVINGS AND GRID SUPPORT.





TECHNOLOGIES COMPARISON

	Electric Battery	Thermal Storage (PCM)
Cost	400–800 €/kWhe	300–500 €/kWh$_{th}$ (lower future costs)
Lifetime	10–15 years, 500–3000 cycles	10–15 years, up to 10,000 cycles, dependending on conditions Designed to easily replace
Materials	Critical (Li, Co, Ni)	Abundant, low impact and cheaper Not subject to same supply risks
Flexibility	Direct, fast (ms response)	Indirect flexbility by shifting the electricity demand of the heating system

INTEGRATED SMART CONTROL ALLOWS UP TO 35% BILL REDUCTION AND 26% PEAK REDUCTION

Other key takeaways :

- **No single "winner"**: technologies are complementary
- **Synergy requires integrated smart control** : rule-based systems are insufficient
- Integrated multi-asset control :
  - **35% reduction** in household **electricity bills**
  - **26% reduction** in **peak demand**

- Strategic priority : **build an ecosystem that allows dynamic tariffs & interoperable platforms** to turn **homes** into **active, flexible energy assets**

NEW DEVELOPMENTS ON VALORIZATION OF RESIDENTIAL BATTERY FLEX ON ENERGY MARKETS

JEREMY BAILLEUX - LIFEPOWR

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ABOUT LIFEPOWR

LIFEPOWR is at the forefront of transforming the energy landscape by orchestrating energy flows to balance the grid while unlocking the flexibility of thousands of decentralized energy assets.

Our technology empowers consumers to lower their energy bills and even earn from the energy market—effortlessly. At the same time, we accelerate the energy transition by directly cutting CO_2 emissions from gas-fired peaker plants.

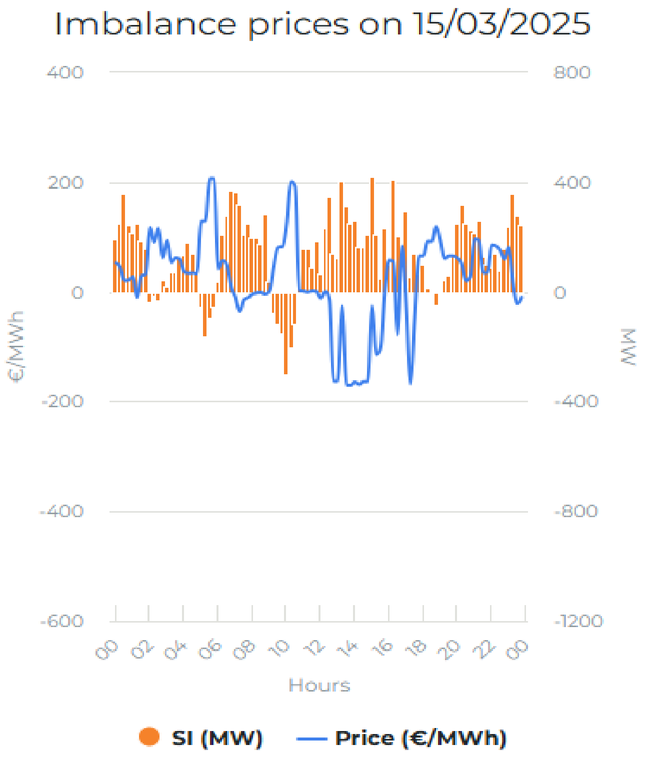
Based in Antwerp and active since 2015, our team of experts develops cutting-edge solutions built on years of experience in energy management and storage.

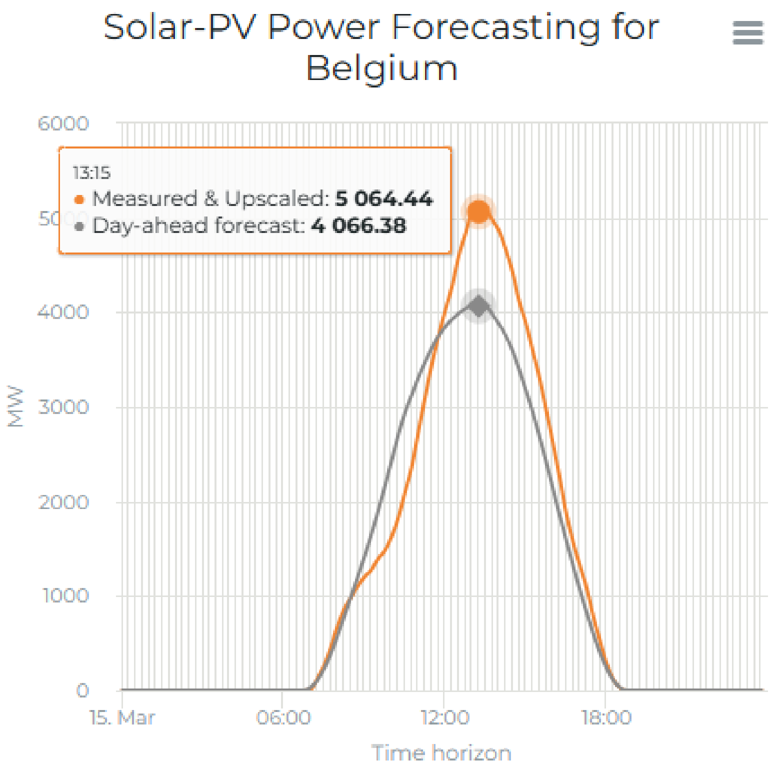
Our flagship platform, FlexiO, is more than just an EMS. Going beyond traditional energy management, FlexiO optimizes energy flows, reduces costs, and monetizes flexibility in one seamless solution. It integrates behind-the-meter energy management with market optimization, unlocking value for households, businesses, and energy providers alike.

Originally launched under its own name as a demo-client, FlexiO is now scaling rapidly as a white-label solution, adopted by leading players across the energy sector.

WHY

SOLAR AND WIND VOLATILITY IS DOMINATING THE ENERGY SYSTEM.

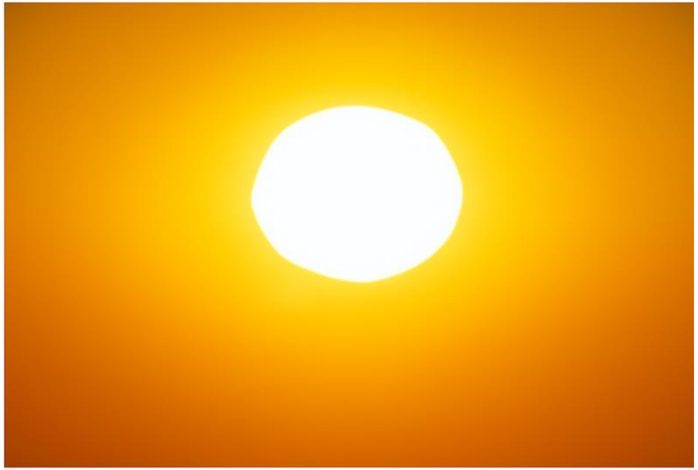




WHY

GENERAL AWARENESS RISES

Those who produce too much energy must solve it themselve



Paying to put your own solar power on the grid? Here’s how to limit the damage

WHY

Energy Flexibility
is **KEY**
to the success
of the **Energy Transition**

SOLUTION

We aggregate tens of thousands of distributed renewable energy assets to operate a multi-asset & multi-market Virtual Power Plant

SOLUTION

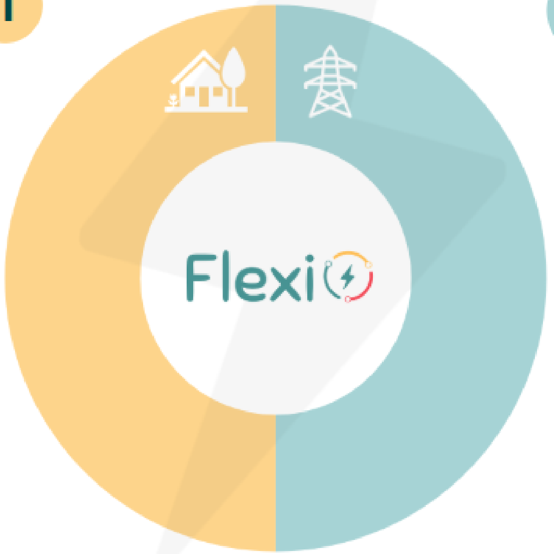
LINKING INDIVIDUAL PROSUMERS TO ENERGY MARKETS

advanced forecasting and optimization brings balance and economic benefits.

Prosumers 1

Pay less for energy thanks to **optimized energy flows**

Get payouts from **capacity reservations**



2 Market players

Grid and **System operators** pay for aggregated **Flex Services** to ensure grid stability

Energy Suppliers pay for **Energy Portfolio Balancing** to improve their energy procurement and reduce imbalance exposure

SOLUTION Flexi IS A COMPLETE FLEXIBILITY OPTIMIZER

Stacking Value across multiple value drivers

Behind-the-meter 1

Value drivers:

- **Self-Consumption *** — Taxes & grid tariffs
- **Peak-shaving** — Peak-based grid tariffs
- **Tariff Arbitrage** — ToU or market based energy tariffs

*Ready for the world after saldering

2 Multi-Market

- **Reserve Markets** — FCR as BSP
- **Energy markets** — Nomination of **Day Ahead** Positions + Response to **Real-Time Imbalance**
- **Congestion markets** — Analyzing market opportunities for DSO support

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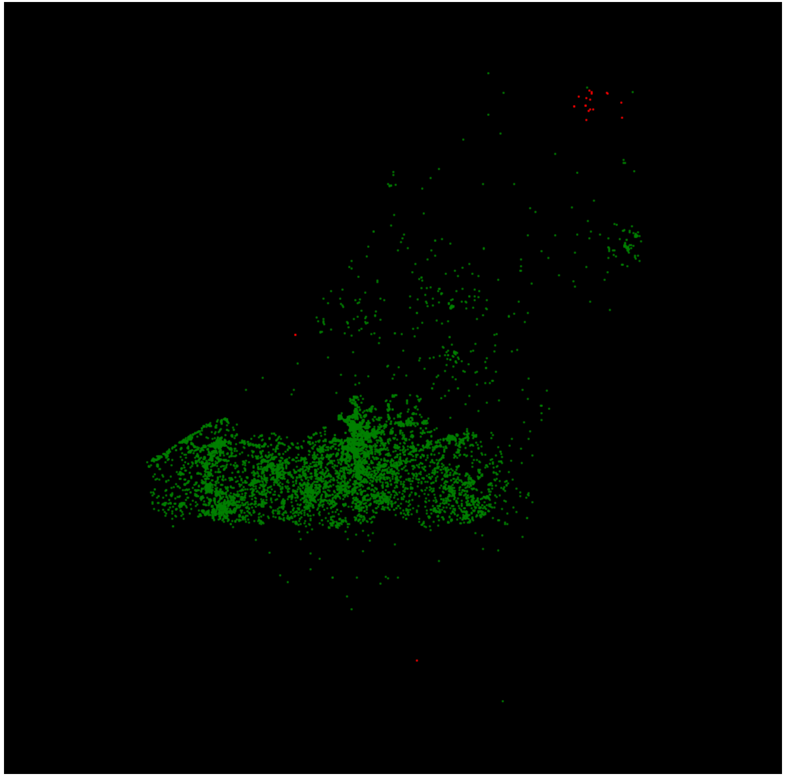
SOLUTION

TRACTION



PROVEN CAPABILITIES & MARKET VALIDATION

Milestones

- ✔ Operating a **Fully Virtual Power Plant** since February 2024
- ✔ First **Balancing Service Provider** for **LV assets** in Belgium
- ✔ **Pioneering** eBalancing solutions for energy suppliers
- ✔ **Market Leading** aggregator and growing authority

KPI's

***Real*, directly connected portfolio**

>84MWp
Flex Powr

BESS 38MW / 97MWh
EV CH 205MWh/month
PV 46MWp (curtailable)

>17'057
Assets under management

Monthly Energy (E) Volumes
4.7 GWh - PV production
1.4 GWh - E bought
2.6 GWh - E sold
3.1 GWh - E consumed

BESS 6451
EV 897
PV 6409

>50
Industry Partners

>15'200
Gateways sold

R1 (FCR) BE
Core share
35%
elia 9 MW / 26 MW

FUTURE OF BATTERIES?

- ✔ **More volume** : reduce the needs of alternatives fossil source of energy
- ✔ **More markets** : will lower the general cost, which comes back to customers
- ✔ **Smarter** : will make other assets more attractive (ex: heat pump)

LESSONS LEARNED FOR THE BUILDING CONSTRUCTION SECTOR

LOIC DE MOFFARTS – THOMAS & PIRON

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LESSONS LEARNED FOR THE BUILDING SECTOR

The construction sector has already shifted toward a more sustainable design approach by integrating **renewable energy systems**.

FMH project shows that managing **flexible assets** within buildings will bring measurable **return on investment** for occupants.

That helps **reducing energy bills** of occupants, while significantly **lowering the carbon footprint** of buildings.

LESSONS LEARNED FOR THE BUILDING SECTOR

As part of **pilot initiatives**, decentralized energy storage solutions equipped with smart controllers are already being tested to **improve self-consumption** rates.

FMH project illustrates the potential of **monetizing energy flexibility** through dynamic pricing mechanisms.

While this innovation represents a promising step forward, the formalization of **contractual frameworks** remains a key challenge for all parties.

LESSONS LEARNED FOR THE BUILDING SECTOR

Looking ahead, the sector should consider driving energy innovation in buildings empowering households to **leverage their flexibility** (not only for heating as studied in FMH project, but also for domestic hot water production and electric vehicle charging).

This will enable them to actively **support grid balancing** in response to the intermittency of renewable energy sources.

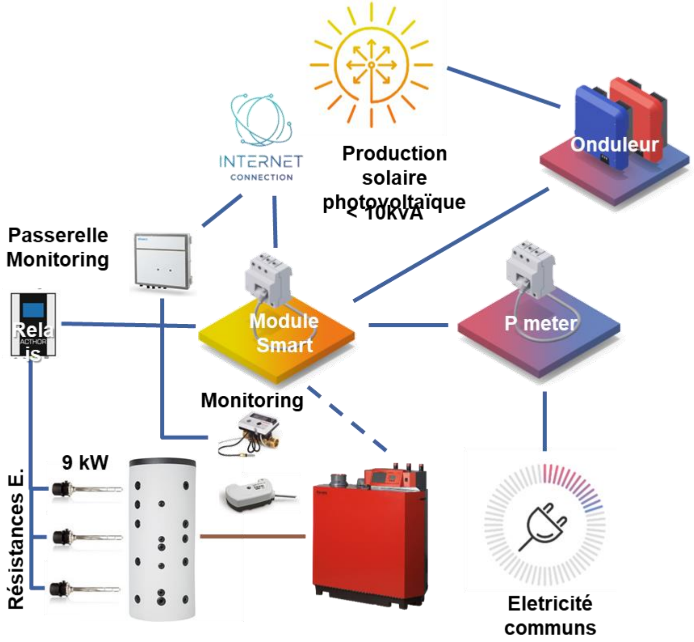
LESSONS LEARNED FOR THE BUILDING SECTOR

Industry stakeholders are increasingly investing in **R&D** to deploy advanced technologies such as AI-powered smart controllers for the flexibility management.

These innovations would not be possible without **supportive mechanisms and incentives** provided by public authorities.

EXAMPLES OF PILOTS INITIATIVES

FLEURUS GARE



IN OPERATION

- PV PRODUCTION
- THERMAL STORAGE
- SMART CONTROLLER
- MAX. SELF-CONSUMPTION

EXAMPLES OF PILOTS INITIATIVES

HANNUT TILLEUL

AS-BUILT SITUATION

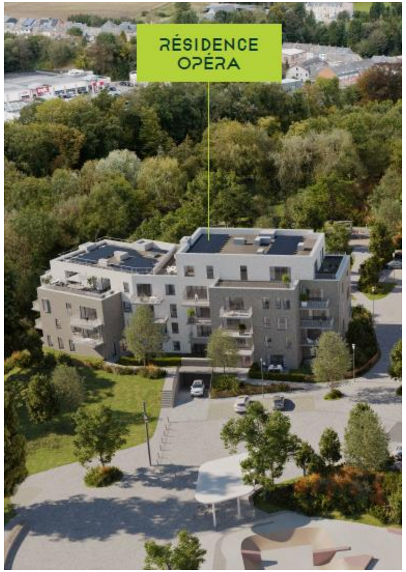
- 12 APPARTMENTS
- 12 EV CHARGING POINTS
- PV PRODUCTION
- COLLECTIVE HEAT PUMPS IN CASCADE (HEATING AND DHW)
- SMART CONTROLLER (w/o flex)
- ENERGY MONITORING

UNDER STUDY (with the trustee)

- ADDING ELECTRICAL BATTERY
- ADDING SMART CONTROLLER (w/ flex)
- JOINING ENERGY COMMUNITY
- CONTRACT FOR DYNAMIC PRICING

EXAMPLES OF PILOTS INITIATIVES

CINEY LAMBERT



CURRENT DESIGN

- 32 APPARTMENTS
- 32 EV CHARGING POINTS
- PV PRODUCTION
- COLLECTIVE HEAT PUMPS IN CASCADE (HEATING AND DHW)
- SMART CONTROLLER (w/o flex)
- ENERGY MONITORING

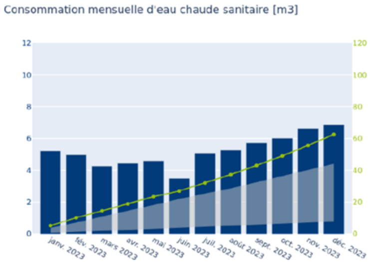
UNDER STUDY

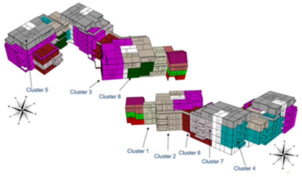
- ADDING ELECTRICAL BATTERY
- ADDING SMART CONTROLLER (w/ flex)
- JOINING ENERGY COMMUNITY
- CONTRACT FOR DYNAMIC PRINCING

EXAMPLES OF PILOTS INITIATIVES

TPEE PROJECT

- 200 HOUSINGS MONITORED
- With IoT METERS/SENSORS
- ENERGY CONSUMPTION PROFILES
- (DHW, DCW, Heating, Elec.)
- INDOOR PARAMETERS (Temp., RH, CO2)





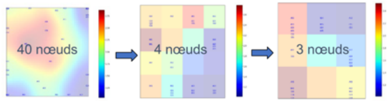
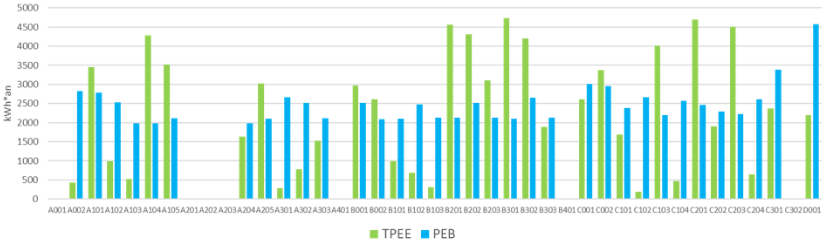


Figure 2: Exemples de SOMs à 40, 4 et 3 nœuds, pour le critère « nombre de chambres ».

Cenaero

THOMAS & PIRON BATIMENT

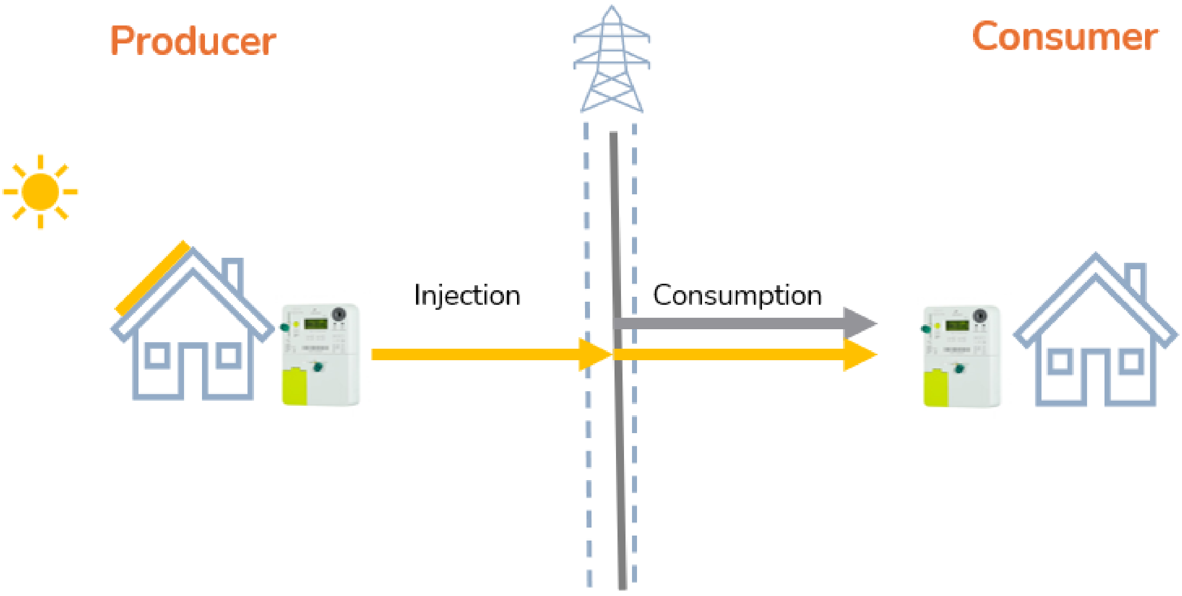


BATTERY FLEXIBILITY SERVICES AND ENERGY SHARING

OLIVIER BOVEROUX – ENERGIE COMMUNE

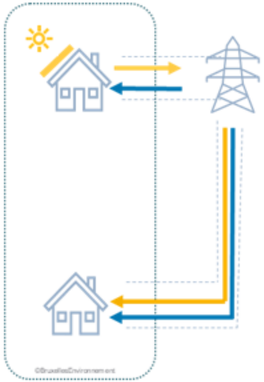
CONFIDENTIAL

PRINCIPLE OF ENERGY SHARING

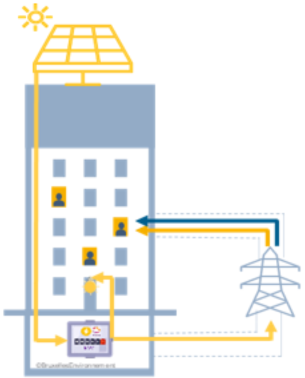


PRINCIPLE OF ENERGY SHARING

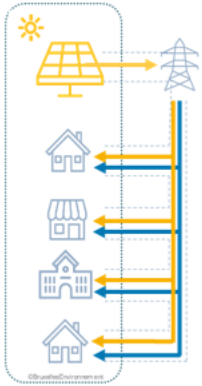
3 CONFIGURATIONS



Peer to peer



Within a
same building



Sharing between
different buildings

Energy communities

BATTERY FLEXIBILITY SERVICES AND ENERGY SHARING

HOW TO COMBINE THESE TWO ACTIVITIES ?

- Battery storage and energy sharing are in competition as they use the same resource (electricity surplus)
  - But could also be seen as complementary, as battery does not easily handle all the PV surplus
- Flex services also improve the battery rate of use (#cycles/year)
  - Typically during periods where PV self-consumption is limited (e.g. winter period)
- European Directive requires that shared electricity should be **renewable & produced by the members**
- Flexibility services via a FSP implies that
  - The battery sometimes charges from the grid → not 100% renewable & not 'self-produced'
  - The battery owner could want to sell the stored electricity to consumers via energy sharing (e.g. in summer, when he does not manage to discharge totally the battery at night for his own needs)
- In Brussels & Wallonia, energy sharing is **not allowed** if the battery charges from the grid

BATTERY FLEXIBILITY SERVICES AND ENERGY SHARING

HOW TO COMBINE THESE TWO ACTIVITIES ?

- Interpretation of the legislation could be less strict as it is today :

  Future regulatory change could allow energy sharing with batteries regardless of where the electricity source, given that it is **fostering the energy transition** by

    - Helping balancing the grid
    - Contributing to the RE integration in the power mix

- Political levels concerned :
  - Regional & EU (energy sharing legislation) and federal (high voltage flexibility)

- Batteries & energy sharing could be combined for enhanced grid services imec

embracing a better life

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