ENEA

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Joint event

30th November 2021

10:30 am - 12:30 pm (CET)

Some rules for the webinar

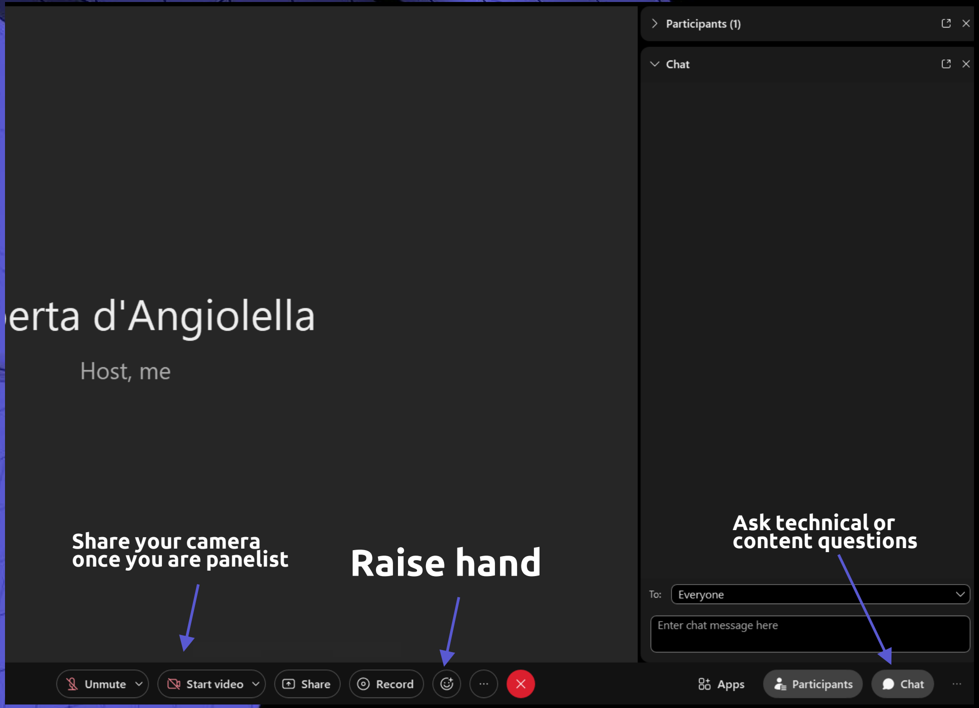
How to ask questions?

- Please use the chat function to ask questions during the sessions or raise your hand to be unmuted for verbal questions

Technical support

- Please address all technical questions via the chat function to Roberta D'Angiolella, BPIE

Note: *Today's presentation is being recorded and will be made available within one week. The discussion part will not be recorded.*



Active building Energy Performance Contracting (AEPC) in Italy

AmBIENCe Italian workshop

30 November 2021

Aim of the workshop

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Make the stakeholders present throughout the country aware about the opportunities associated with the implementation of the Active Building EPC, both with a view to expanding their business and in terms of reduction of environmental impacts related to buildings consumption

Agenda

Active building Energy Performance Contracting (AEPC) in Italy

10:30 Welcome and introduction to the event, Marialaura Di Somma, ENEA
10:35 Introduction to the AmBIENCe project, Annick Vastiau, VITO
10:40 Status of regulatory framework (and barriers) in Italy related to flexibility in buildings, Marialaura Di Somma, ENEA
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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No #847054.

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AmBIENCe Project

November 30, 2021

Annick Vastiau
Project coordinator
VITO

Vision and Mission

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VISION: Reduced building emissions in the EU, as well as lower energy consumption, thanks to the application of **electrification combined with active control.**

- **Electrification** (of heating and hot water production) reduces emissions because compared to gas, electricity produces heat more efficiently and has a lower carbon intensity.

- **The carbon intensity of electricity** will continue to drop by more investments in wind and PV.

- **The carbon intensity** varies over the day, and the intra-day variability increases: emissions can be reduced by being smart and conscious about **WHEN** energy is consumed.

MISSION: Improve the economic attractiveness of building emission reduction measures by combining energy efficiency improvements with electrification and active control.

Active managed Buildings
with Energy Performance Contracting

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GOALS: WHAT will we do?

- Extend the Energy Performance Contracting concept to include Demand Response value streams, valorizing the flexibility that is available in Active Buildings*.
- Make this Active Building EPC concept applicable to a broader range of buildings (incl. residential) and clusters of buildings.
- Develop a tool that supports the forecast of the DR value stream in the EPC contracting phase, along with a matching M&V methodology for the operational phase.
- Validate the concept, tool and M&V methodology through two pilots (real buildings, real ESCOs).
- Engage with all relevant actors and stakeholder groups (from building managers to ESCOs, policy makers and financial institutions) to remove barriers and ensure applicability.

***Active Buildings:** equipped with sensors, meters, ICT that enables them to optimally control the consumption of flexible assets and storage.

Active managed Buildings
with Energy Performance Contracting

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INTENDED IMPACT: WHY are we doing it?

- To reduce emissions by actively steering electricity consumption to times when the carbon intensity is low.
- To reduce energy costs by actively steering electricity consumption to times when the prices are low*.
- To accelerate electrification – thereby further reducing emissions – by leveraging the value of active control of flexibility: lower prices and flexibility services.
- To support investments in more wind and PV by increasing demand for emission-free energy, and by offering flexibility services to deal with the generation variability and congestions.

* There should be a coupling between carbon intensity and price: regulatory advice.

Active managed Buildings
with Energy Performance Contracting

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BENEFICIARIES – WHO will benefit?

ENVIRONMENT /SOCIETY

Greenhouse gas emissions will be reduced by electrification and by moving electricity consumption to times when the carbon intensity is lowest.

CONSUMERS

Energy cost savings will be achieved by shifting consumption to times when the cost is low, or by offering flex services.

ENERGY SYSTEM STAKEHOLDERS

Access to more – and distributed – flexibility from buildings can avoid or mitigate problems resulting from increased wind and solar energy and electrification.

ESCOs

Enriched EPC contracts, with higher value and applicable to a wider selection of buildings, will grow the ESCO business opportunity.

Consortium

AmBIENCe project involves **eight partners** (research and commercial partners) from four countries.

WHEN

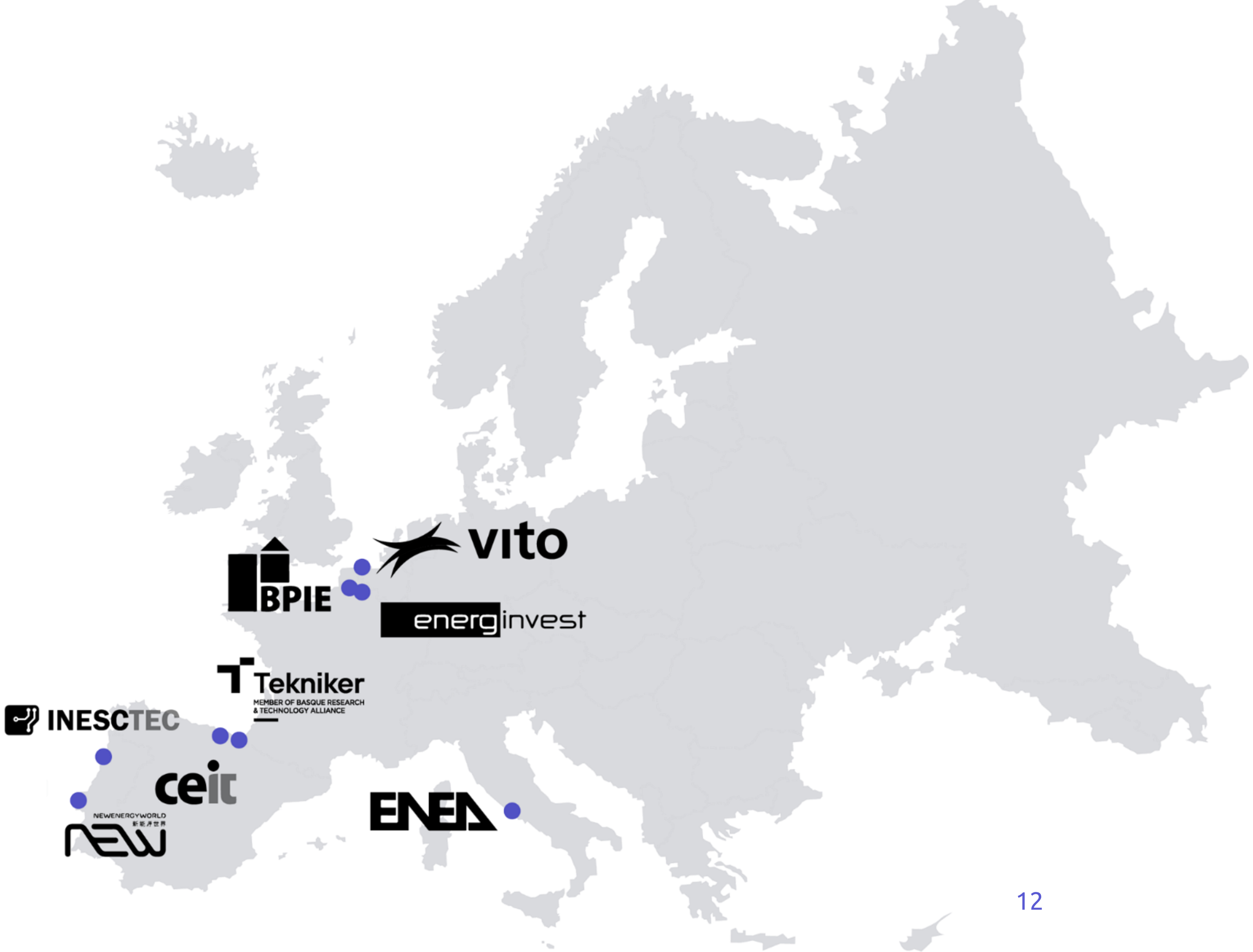
June 2019 -

May 2022

€

2 Million

EU Horizon 2020



AmBIENCe - Implementation

AmBIENCe project's objectives will be achieved by implementing the work organised in **7 different work packages**:

- **WP1** – Assessment of (enhanced) Energy Performance Contracts and Building Demand Response Services in Europe — **ENEA**
- **WP2** – Development of an Active Building Energy Performance Contract concept and Business Model — **INESC TEC**
- **WP3** – Implementation and validation of the Active Building EPC concept and business model in two pilots: — **EDP CNET**
- **WP4** – Energy System Impact Assessment Calculation Mythology and tool. — **VITO ENERGYVILLE**
- **WP5** – Economic Evaluation, Exploitation and replication. — **ENERGINVEST**
- **WP6** – Market Actors Engagement through communication and dissemination — **BIPE**
- **WP7** – Project Management — **VITO ENERGYVILLE**

Thank you

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Enablers and barriers for the Active Building EPC in Italy

AmBIENCe Italian workshop

30 November 2021

Dr. Marialaura Di Somma,
Research Scientist & Project Manager
WP Manager
ENEA

The goal

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- The analysis of the current directives, policies and measures that are relevant for the Active Building EPC concept across the Member States is the key to understand what are the **best practices and gaps** that might have a **significant impact in the successful deployment of the Active Building EPC**

Status of EPC/ESCO and DR services offered by buildings at MS level

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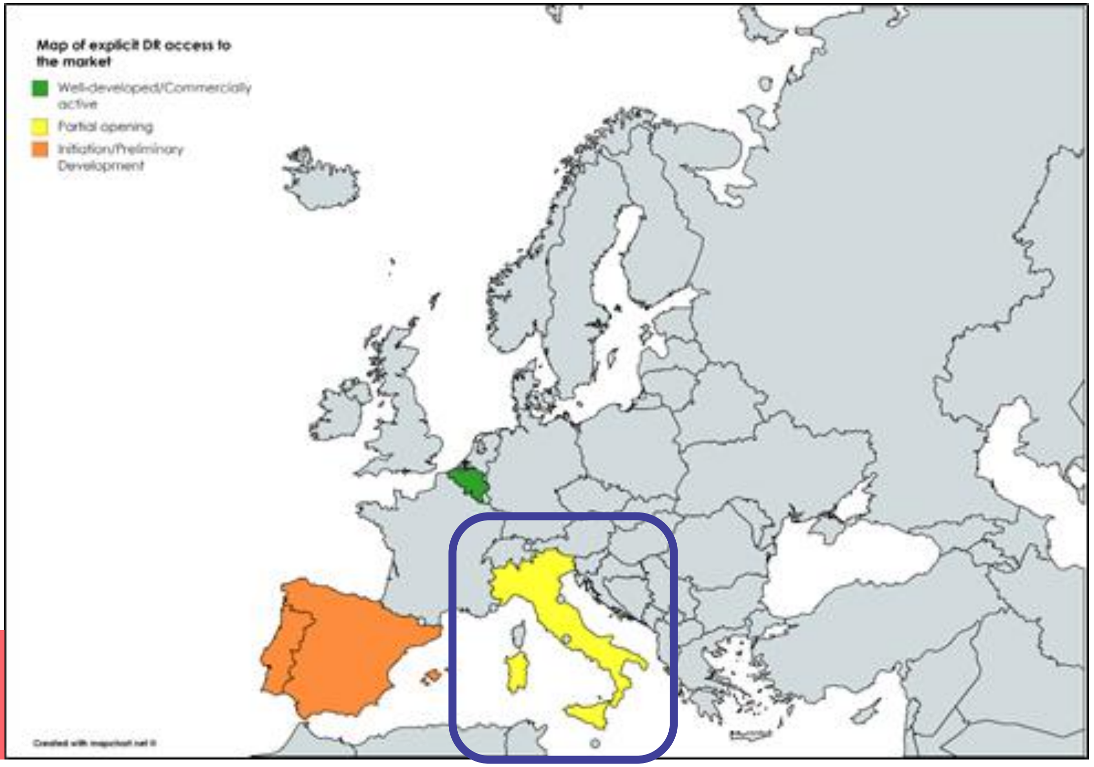
ESCO/EPC development status in the countries represented in the Consortium



Status of explicit DR in the countries represented in the Consortium

Main findings for EPC/ESCO market

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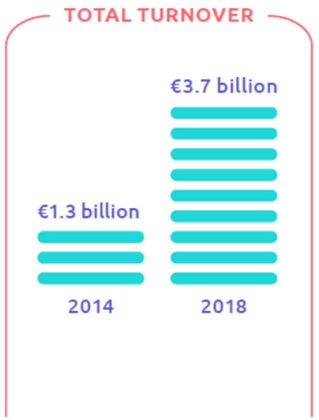
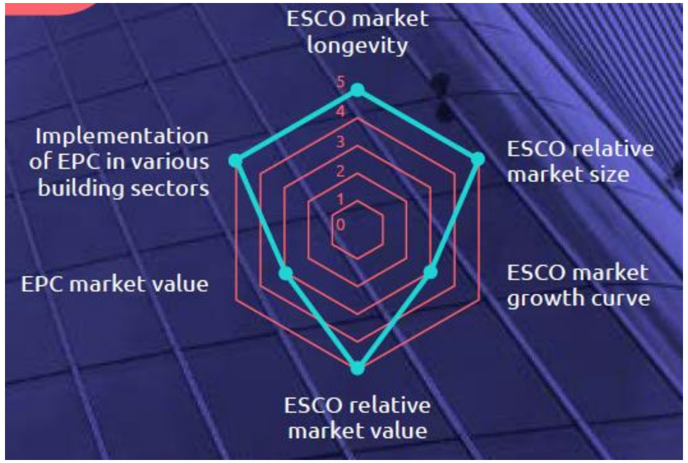
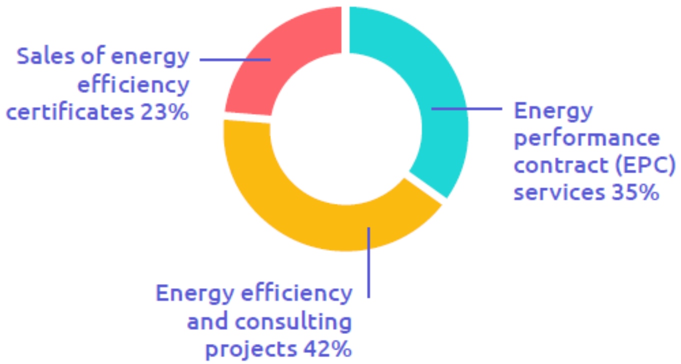
- **Italy** is the most advanced country in the consortium regarding EPC/ESCO market
    - ❖ The ESCO market is among the biggest ones in Europe, and this is mainly due to the strong legislative background and standards established for energy efficiency in buildings

In Italy, there are about
1,045
BUSINESSES REGISTERED AS
ESCOs

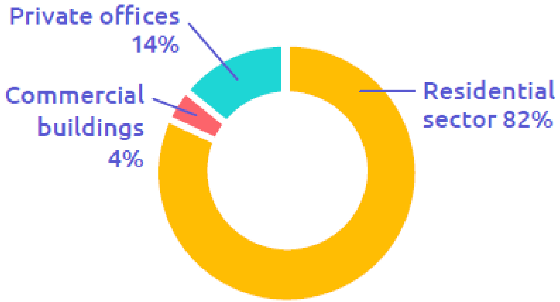




ENERGY SERVICES COMPANY (ESCO) MARKET IN ITALY:



ENERGY EFFICIENCY INVESTMENTS



EPCs are mostly used in the commercial and offices sector – their penetration level is still low in the residential sector. As for public administration, EPCs were behind about 35% of the sector's energy efficiency investments.12

Main findings for DR flexibility and exploitation

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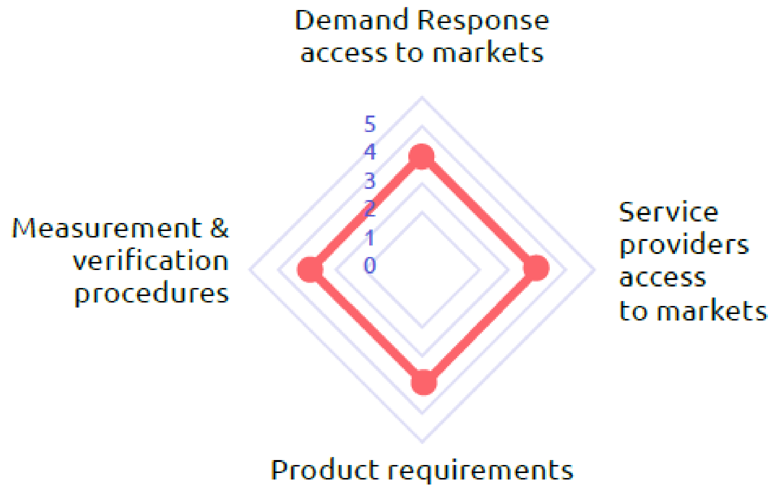
- **Italy** is not very much advanced with reference to exploitation of buildings flexibility
  - The relevant regulatory framework has been subject to substantial changes starting from 2017. A complete review process of the ancillary service market is ongoing towards an opening to the participation of new subjects by introducing the figure of aggregator



The Resolution 300/2017 proposes the launch of pilot projects to test a first opening of the MSD as well as addressing flexible electricity demand. Moreover, through this Resolution, for the first time in Italy, the figure of aggregator has been introduced.
This corresponds to the balancing service provider (BSP), i.e., the party managing the virtually aggregated units (UVA) and responsible for provision of services traded on the MSD, which is not necessarily the same as the BRP

Main enablers for active EPC in Italy

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- Italy is well placed for the introduction of enhanced EPCs, both in all the key areas investigated for the EPC/ESCO market and in the potential for DR services offered by clusters of buildings.
- The main EPC/ESCO enablers are:
  - The very high competence of the ESCOs
  - Responsibility borne by the ESCO
  - Normative obligations
  - Incentives management
- The main enablers for DR services offered by clusters of buildings are:
  - The ongoing revision of the regulatory framework according to the concept of 'technology-neutrality'
  - The ongoing revision of the regulatory framework in order to allow independent aggregators
  - Consumers' data availability in real time made possible through the plan established for the roll-out of 2G smart meters, which represent an essential element in the full opening of the markets to new resources

Factors affecting the demand side flexibility

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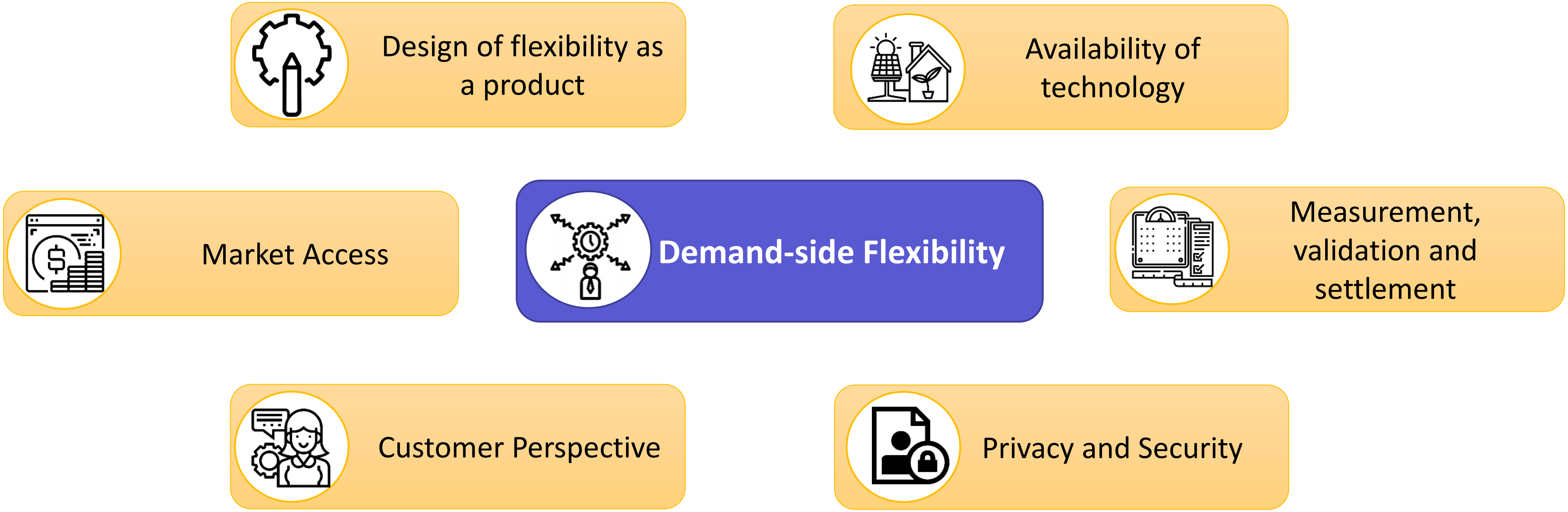

Factors: Customer Perspective

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- Barriers
  - Standardisation & interoperability,
  - Lack of awareness,
  - Lack of financial incentives,
- How to make them enablers
  - Define use-cases with the customer-centric approach
  - Encouraging the interoperability to facilitate the energy management

Factors: Market Access

- Barriers
  - Lack of standard definition and framework for demand side resources and providers:
    - Roles and responsibilities of aggregators and demand flexibility provider
    - Quantification of flexibility
    - Data sharing procedure
  - Conflicts on remuneration among balancing responsible parties, retailers and demand side flexibility provider and its differences with generation side flexibility
  - Integration of implicit and explicit DR
- How to make them enablers
  - Ensuring flexibility delivery by improving the Energy Management systems and smart metering
  - Design the framework of interactions and roles for the stakeholders
  - Reflect the implicit and explicit DR on the baseline methodology

Factors: Design of flexibility as a product

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- Barriers
  - Lack of definition on flexibility
    - What is the flexibility product with the attributes of change in the consumption pattern or reaction to price?
    - What are the qualifications needed for the demand-side flexibility provider?
  - Short-term vs. long-term flexibility
    - Lack of clear understanding for contribution of demand-side flexibility to the required capacity
    - Contradictions of providing long-term availability with short-term compensation
  - Unclear responsibility and roles of BRP
- How to make them enablers

Provide proper definition through rules and regulation improvement

Factors: Availability of Technology

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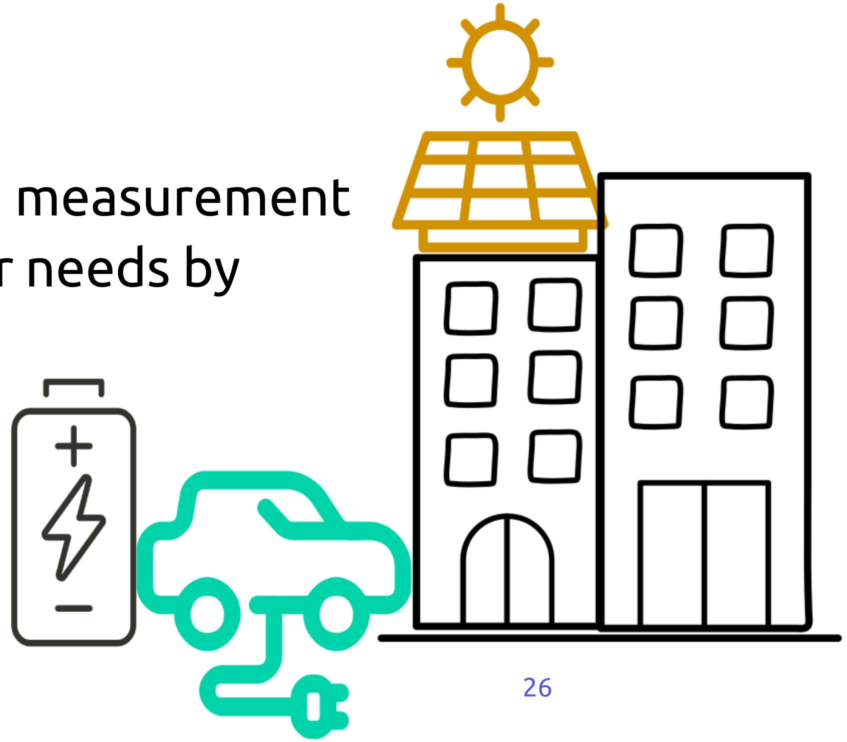
- Barriers
  - Lack of availability of measurement/metering equipment on building level
  - Lack of digitalization and ICT solutions
  - Lack of smart appliances
- How to make them enablers
  - Providing CAPEX for an increased sensoring and measurement
  - Encourage digitalization adaptation to customer needs by introducing new platforms



Factors: Measurement, validation and settlement

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- Barriers
  - Baseline creation methodology
    - Complex baseline methods
    - Accuracy of baselines
    - Biased baselines
  - Place of measurement
  - Information exchange for verification and settlement purposes
- How to make them enablers
  - Provide an adequate baseline methodology for specific flexibility resources
  - Standardise the requirements for metering equipment and measurement process to enable flexibility calculation

Factors: Privacy and security

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- Barriers
  - Consent of consumer on accessing and analyzing smart meter data
- How to make them enablers
  - Provide clarification on the process of flexibility calculation and deployment

Thank you

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Dr. Marialaura Di Somma - WP1 Leader

ENEA – Energy Technologies and Renewable Sources Department | Smart Grid and Energy Networks Lab

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AEPC concept & Business Model

November 30, 2021

Tiago Soares
Senior Researcher
INESC TEC

What is an energy performance contract?

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Energy Performance Contracting

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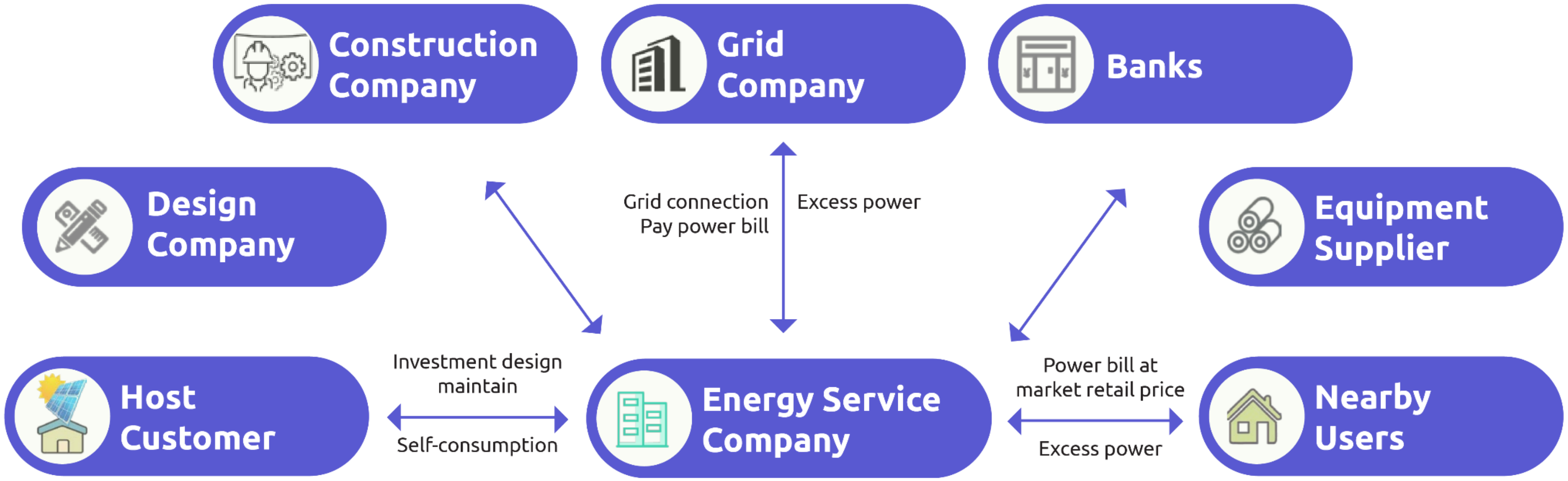
- Energy performance contracts (EPC) are a form of financing capital improvements and energy upgrades using the financial savings resulting from the energy savings measures. Under an EPC, an external organisation (typically an ESCO) implements an energy-saving project, or a renewable energy project, and uses the stream of income from the cost savings, or the renewable energy produced, to repay whole or part of the project.



What is the difference between the classical approach and the one developed in ambience?

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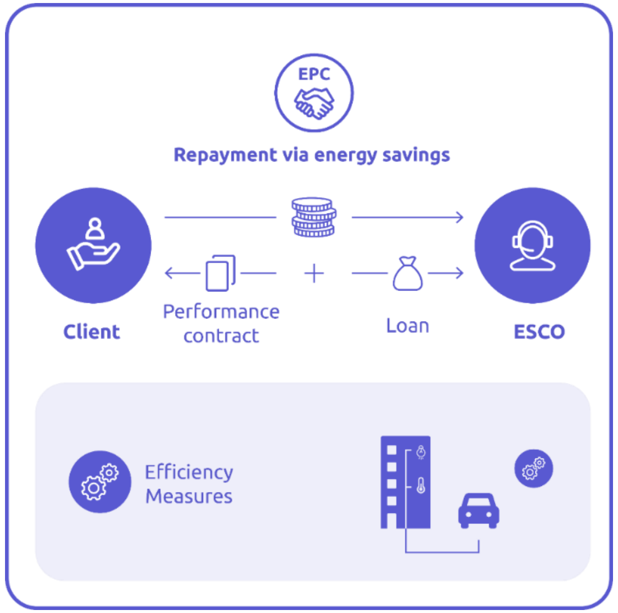
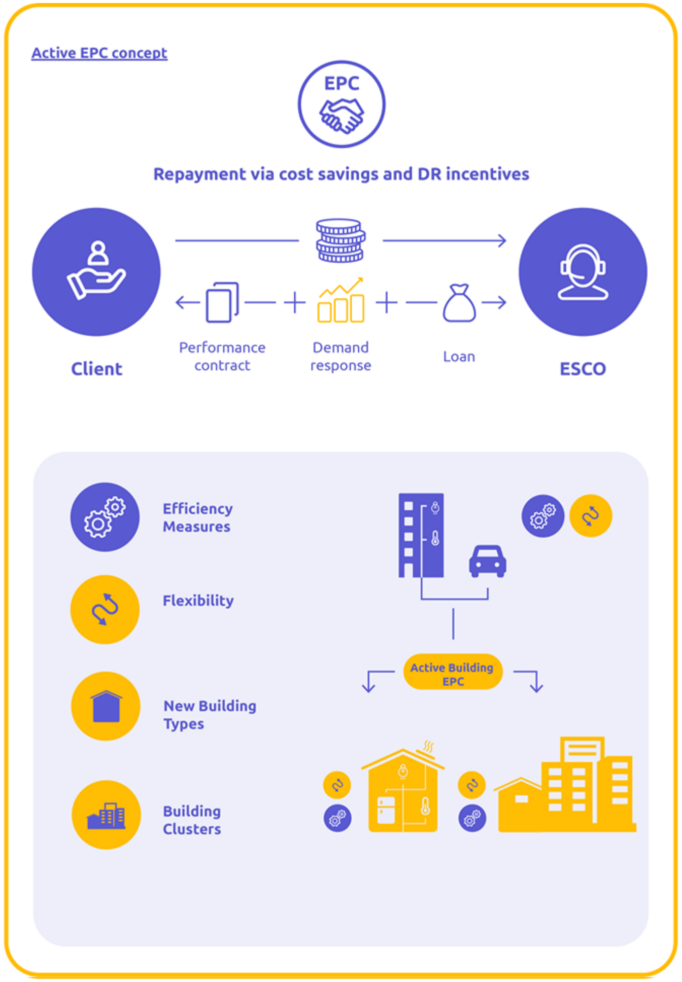
Active Building Energy Performance Contracts

- The ABEPC concept extends the traditional EPC concept in **3 dimensions:**



Traditional EPC



Active Building EPC

Extending energy performance guarantees related to energy efficiency to include the valorisation of flexibility through Demand Response (DR) services

Tailor EPCs to a broad scope of building types: residential, hospitals, education, offices, commerce, etc

Extending the scope of EPCs to groups/clusters of buildings under the concept of (local) energy communities.

New Opportunity for buildings to become more digital and smarter

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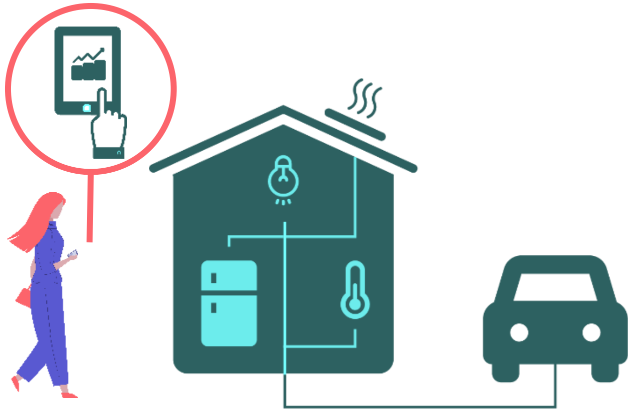

Smarter: Active control based on data and measurements. Active management enables significant emission savings in a cost-effective way.

Smarter: Active control leveraging machine learning (e.g. smart thermostats)

More digital: adding sensors, meters, ICT, …

- to improve comfort, security, …. (non-energy)

- to support M&V (e.g. but not exclusively in the context of EPC)

The Value Chain of Active Building EPC

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The new active energy services value chain

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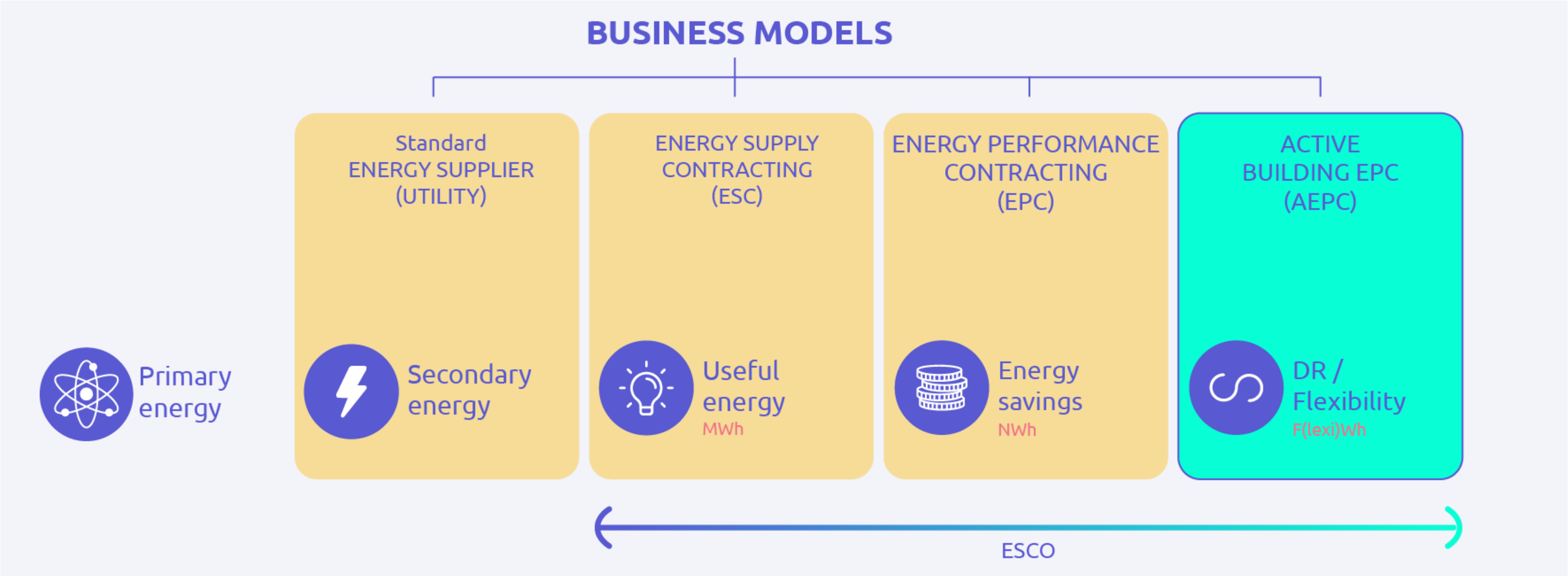

The business value of DR in AEPC

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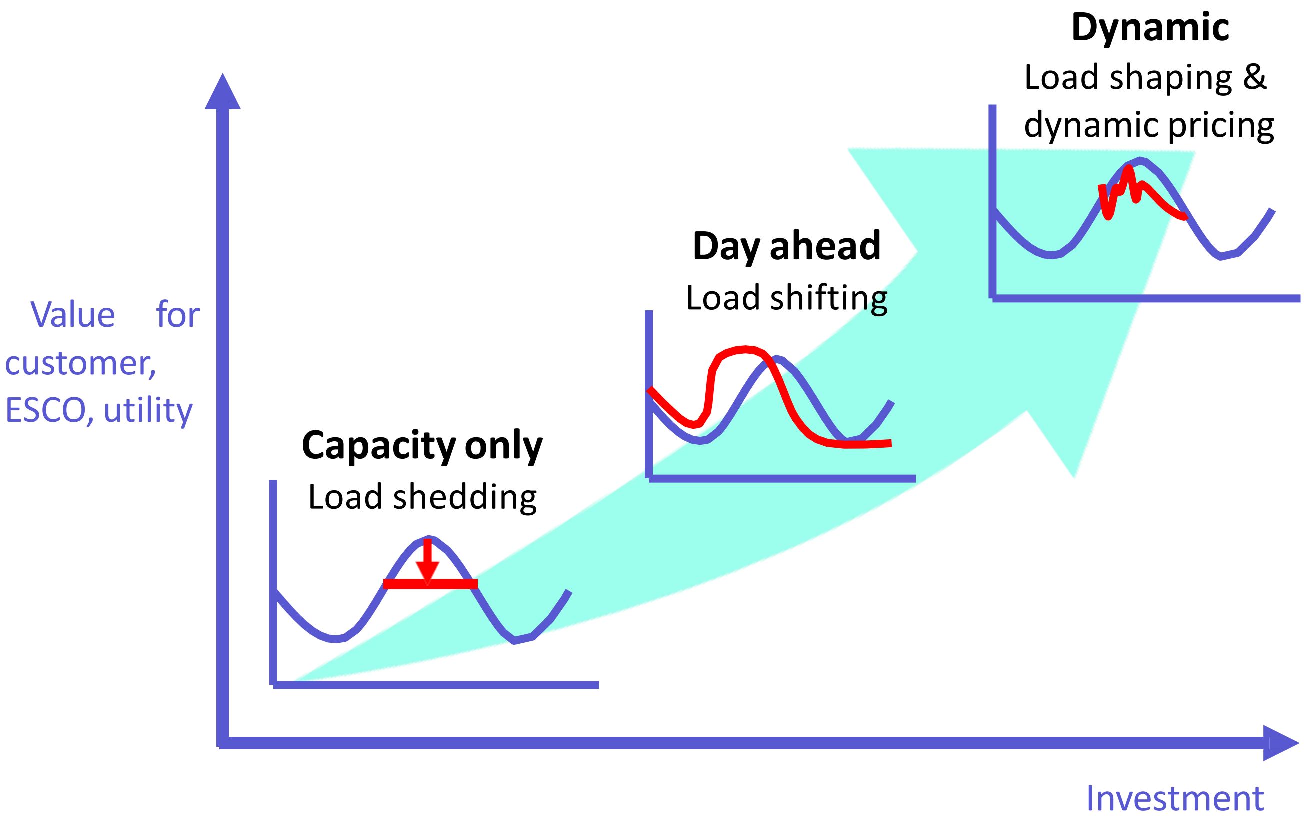

Business value for end-customer

- Cost reductions by avoiding higher energy prices
- Additional revenue streams (onsite generation, storage, or shiftable loads)
- Better understanding of consumption patterns

Active Building EPC Business Model

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Generic Business Model

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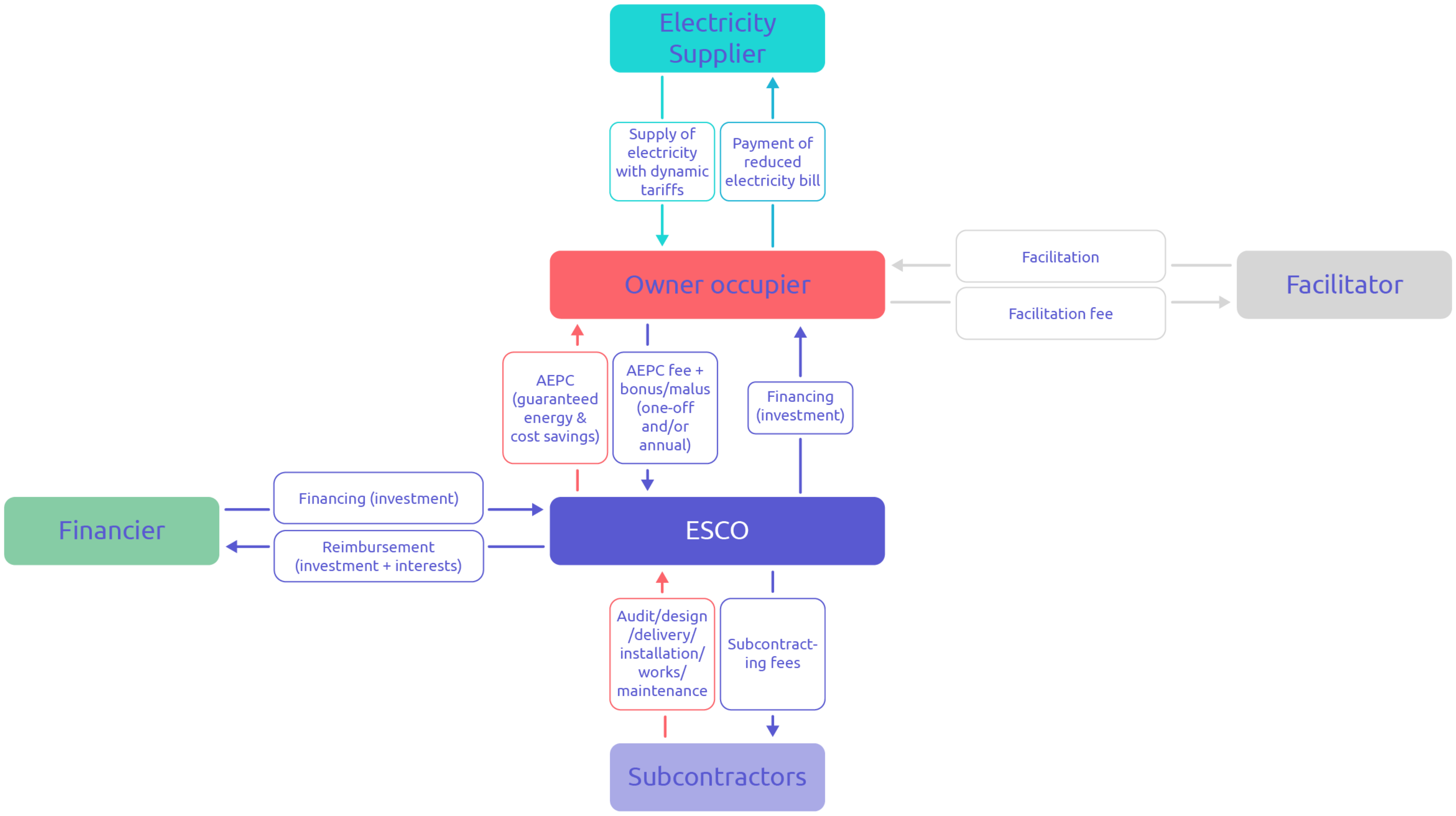

Implementation of AEPC

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AEPC procedure

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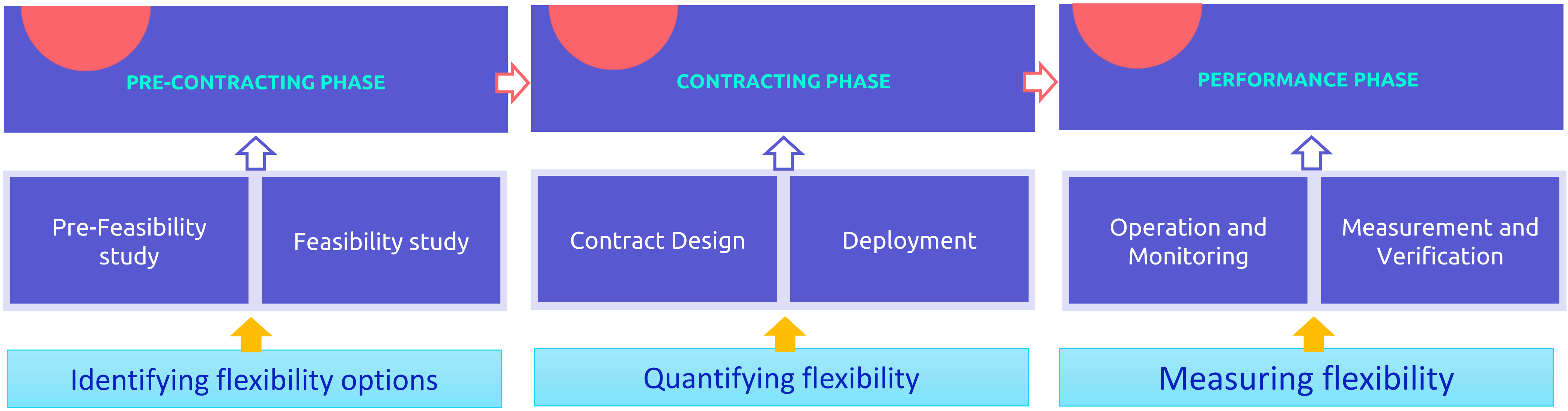

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The “ABEPeM” platform

“Making the value of demand response tangible for ESCO’s”

Presented at Ambience Italian Workshop, 30 November 2021.

Jef Verbeeck

Energy Technology Researcher – algorithms, modelling & optimization

VITO / EnergyVille

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multiple stakeholders

multiple renovations

multiple DR control strategies

multiple DR cash flows

What is ABEPeM ?

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Active Building Energy Performance Modelling platform

ABEPeM

1. *Calculate and guarantee* ***operational cost savings*** *and performance* ***KPIs***
2. *Calculate the* ***financial viability*** *of the renovation*
3. *Update* ***performance guarantees*** *during operational phase*

ABEPeM during the contracting phase

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Step 1: collect building historical data

Configuration sub-tool

Energy Cost Cash Flow Estimation sub-tool

Financial / Economic calculation sub-tool

Historical data
- weather
- energy consumption
- price info
- …

Flex model creation sub-tool

Scenario creation sub-tool

ABEPeM during the contracting phase

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Step 2: create baseline and reference configuration

Historical data
- weather
- energy consumption
- price info
- …

Configuration sub-tool
- baseline config
- reference config

Flex model creation sub-tool

Scenario creation sub-tool

Energy Cost Cash Flow Estimation sub-tool

Financial / Economic calculation sub-tool

ABEPeM during the contracting phase

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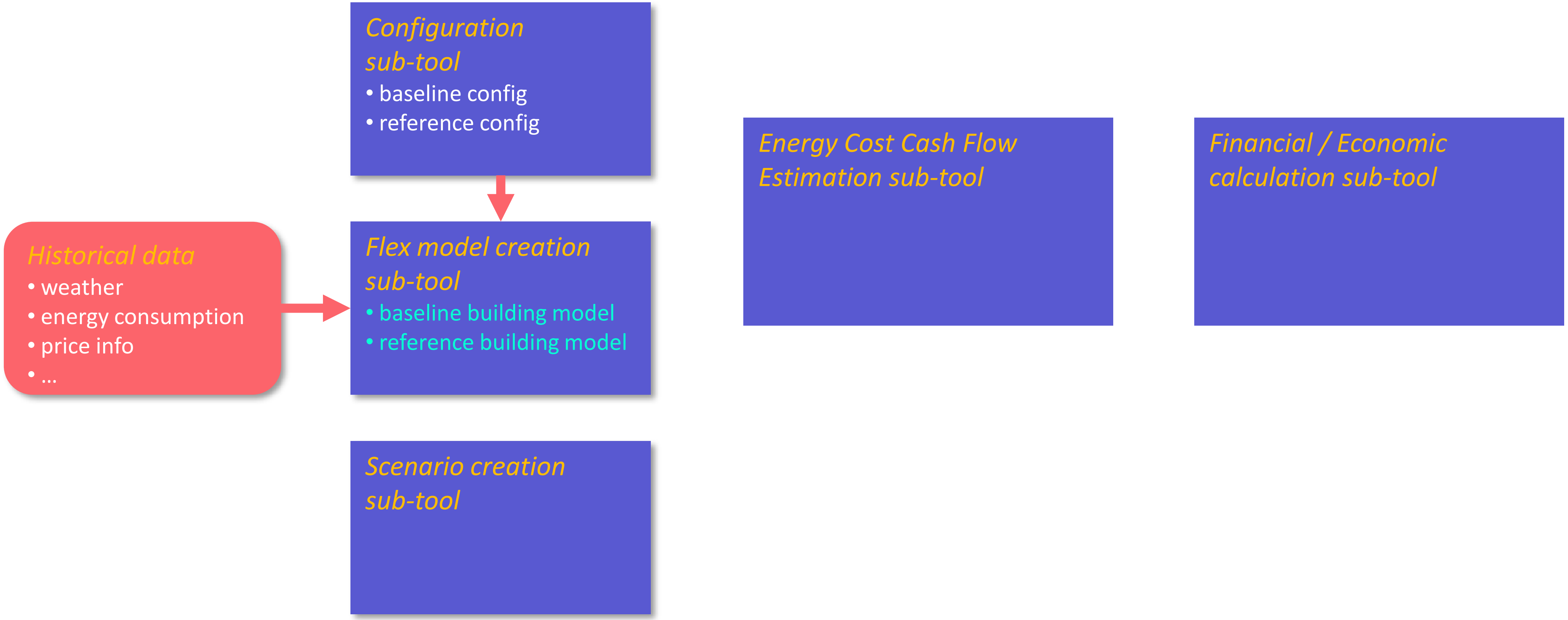
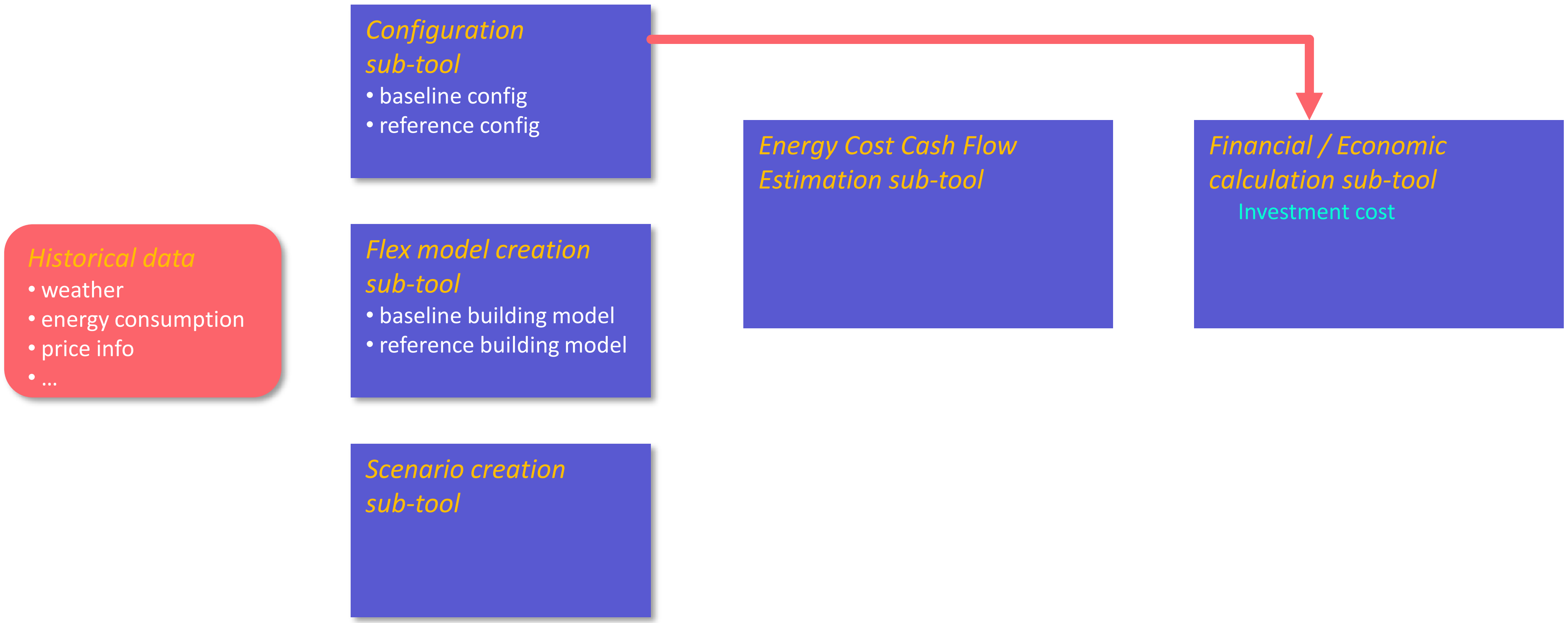
Step 3: create baseline and reference building models



ABEPeM during the contracting phase

Step 4: calculate investment cost



ABEPeM during the contracting phase

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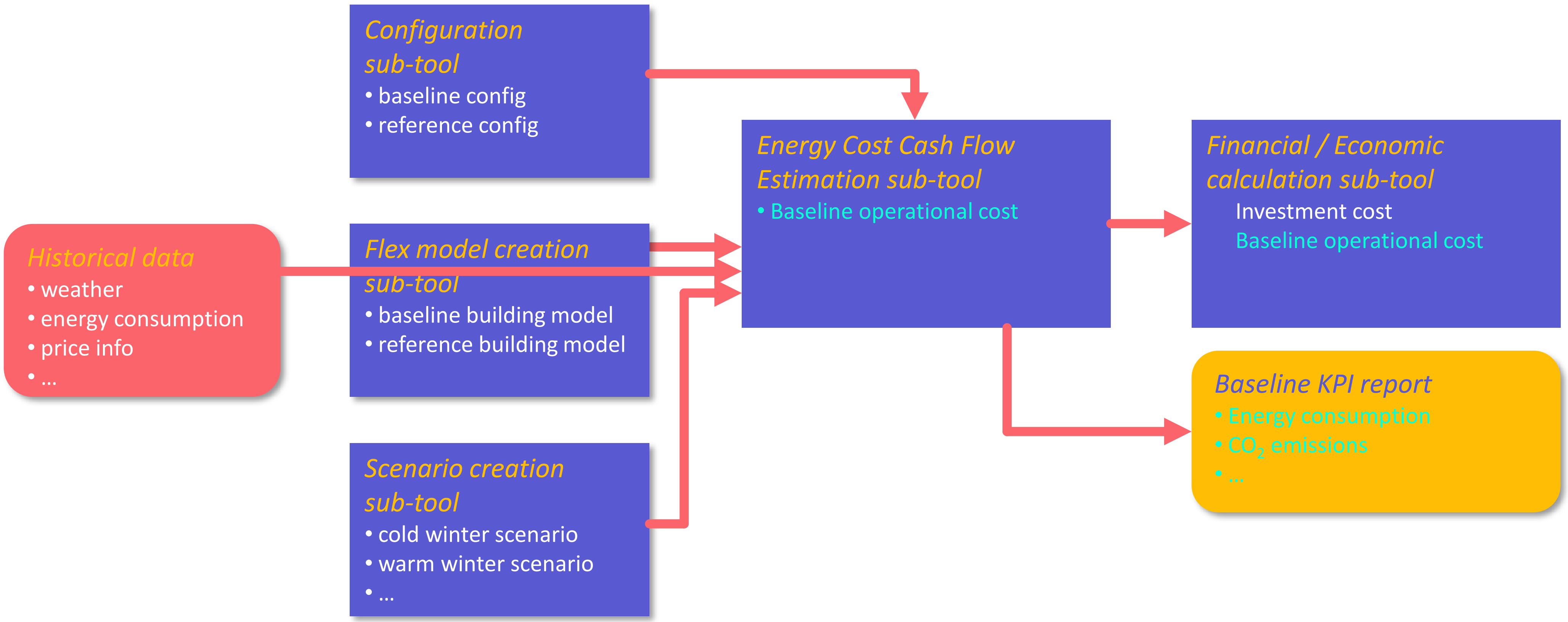
Step 5: calculate baseline operational cost



ABEPeM during the contracting phase

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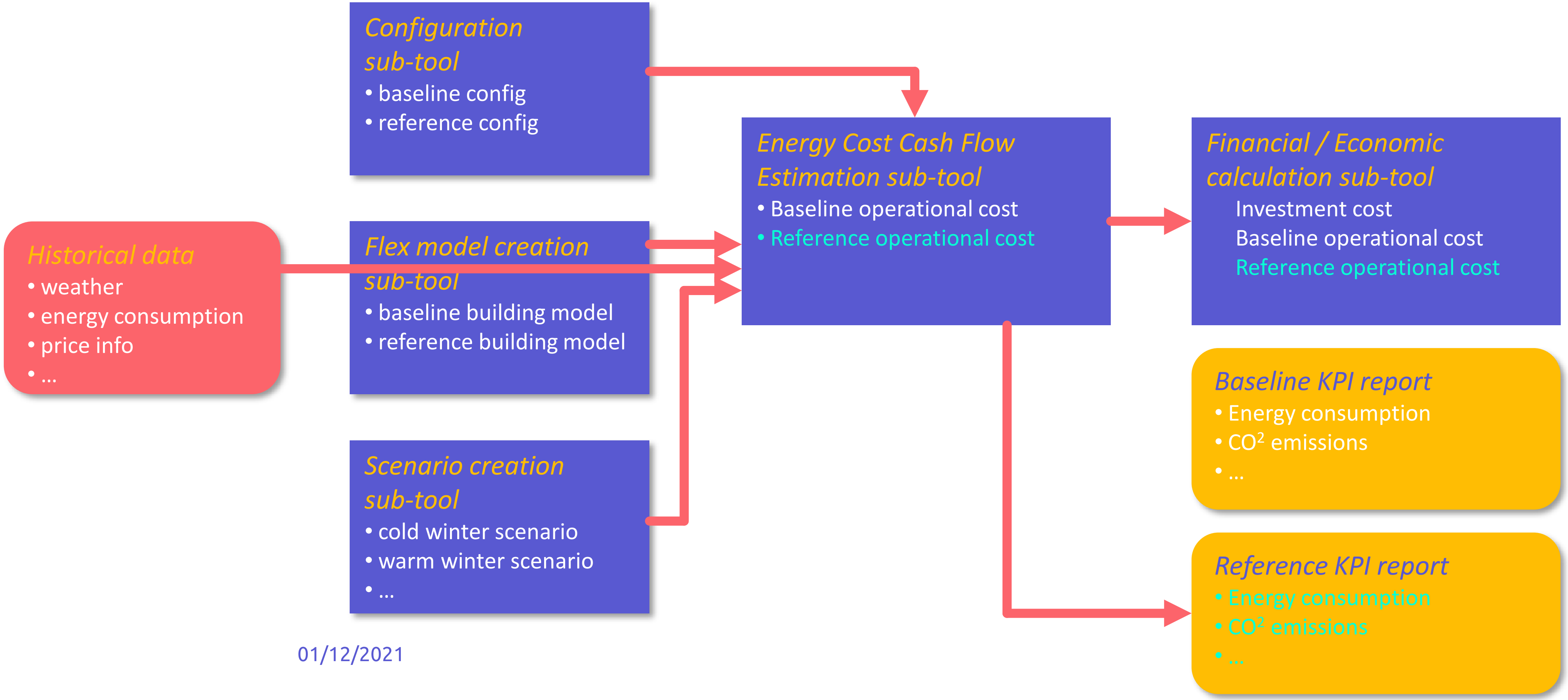
Step 6: calculate reference operational cost



ABEPeM during the contracting phase

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Step 7: generate investment report

Historical data
- weather
- energy consumption
- price info
- …

Configuration sub-tool
- baseline config
- reference config

Flex model creation sub-tool
- baseline building model
- reference building model

Scenario creation sub-tool
- cold winter scenario
- warm winter scenario
- …

Energy Cost Cash Flow Estimation sub-tool
- Baseline operational cost
- Reference operational cost

Financial / Economic calculation sub-tool

Investment cost
Baseline operational cost
- Reference operational cost

Operational cost savings

Investment report
- NPV
- ROI
- financing
- …

Baseline KPI report
- Energy consumption
- CO^2 emissions
- …

Reference KPI report
- Energy consumption
- CO^2 emissions
- …

ABEPeM during the performance phase

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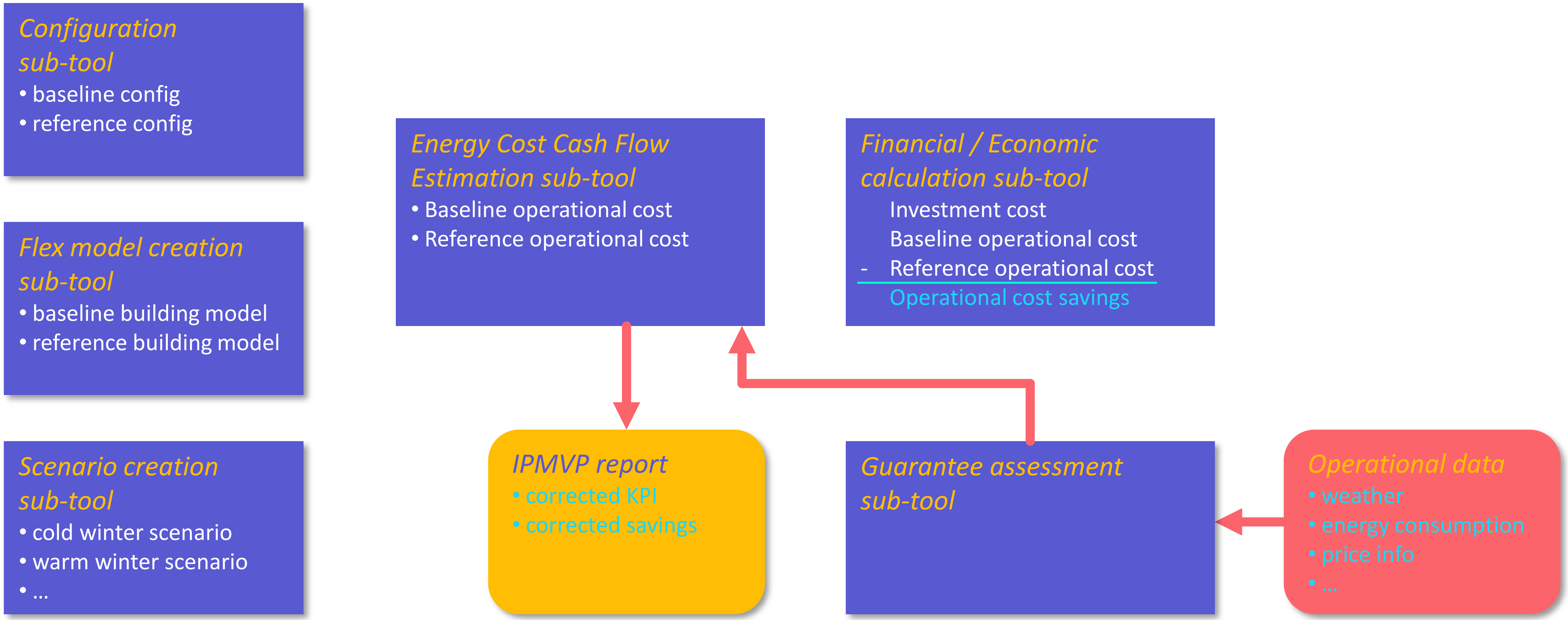

01/12/2021

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Multiple commodity collector concept

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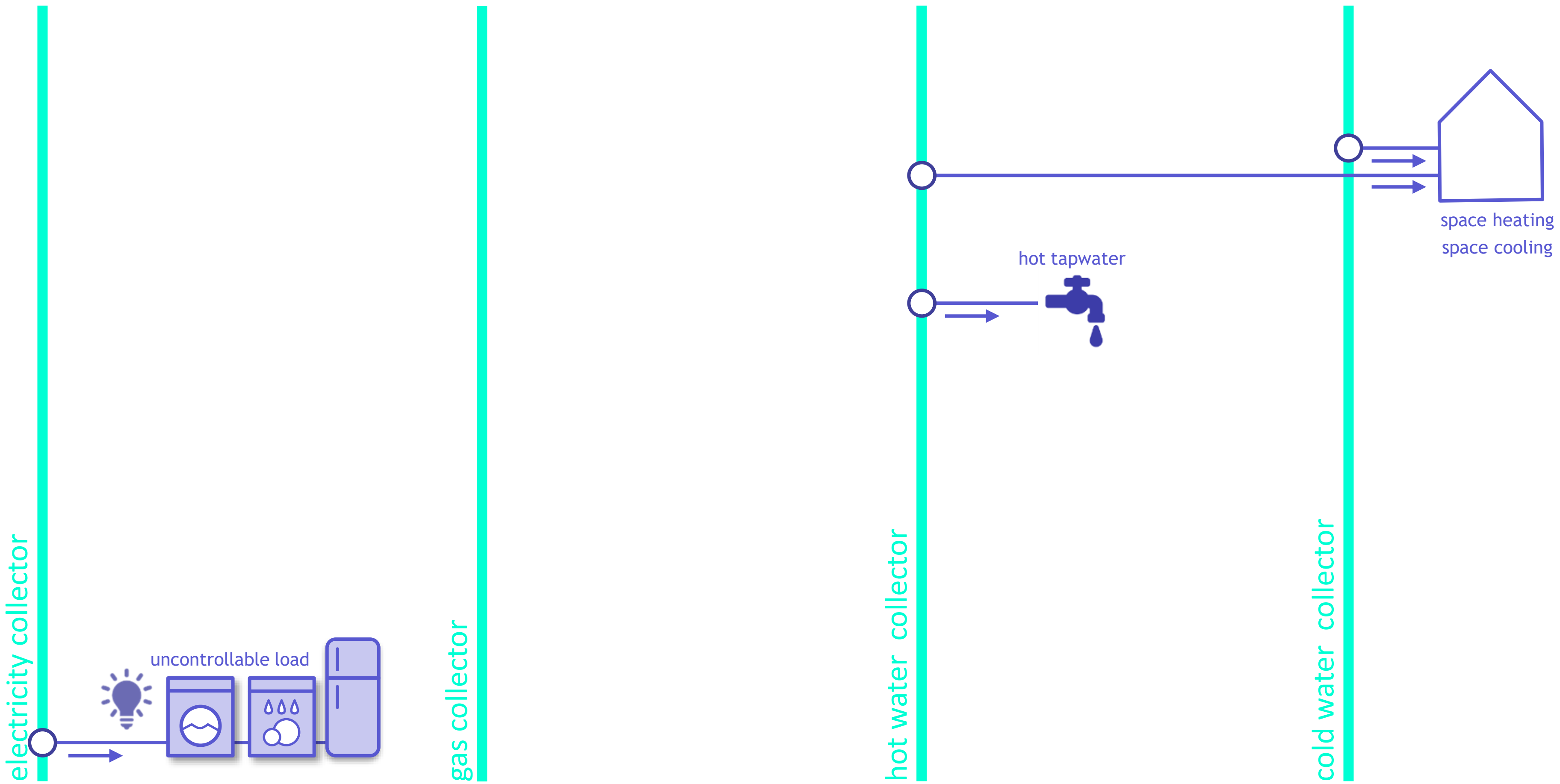
electricity collector

gas collector

hot water collector

cold water collector

Commodity consuming devices



Commodity producing devices

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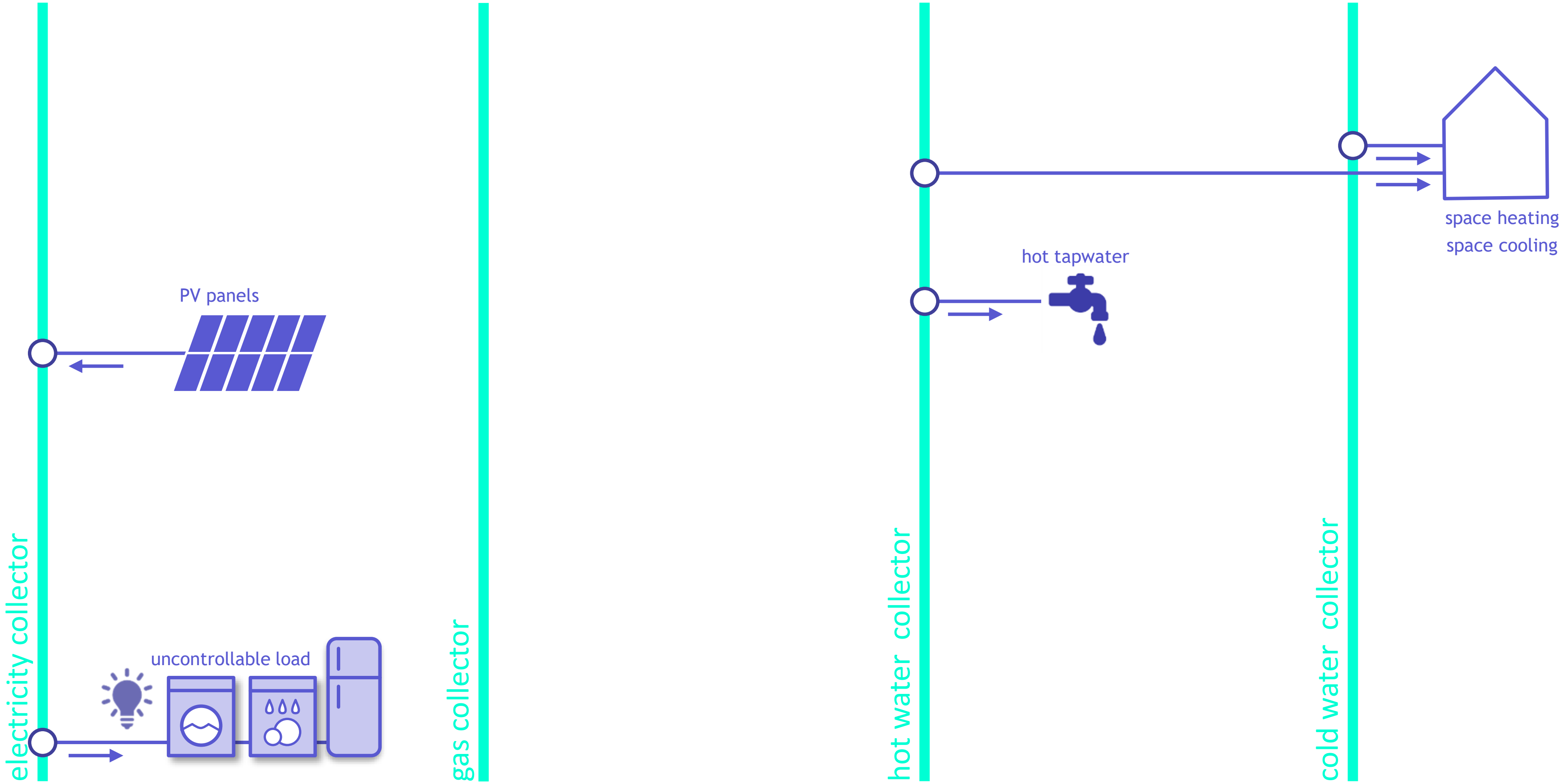
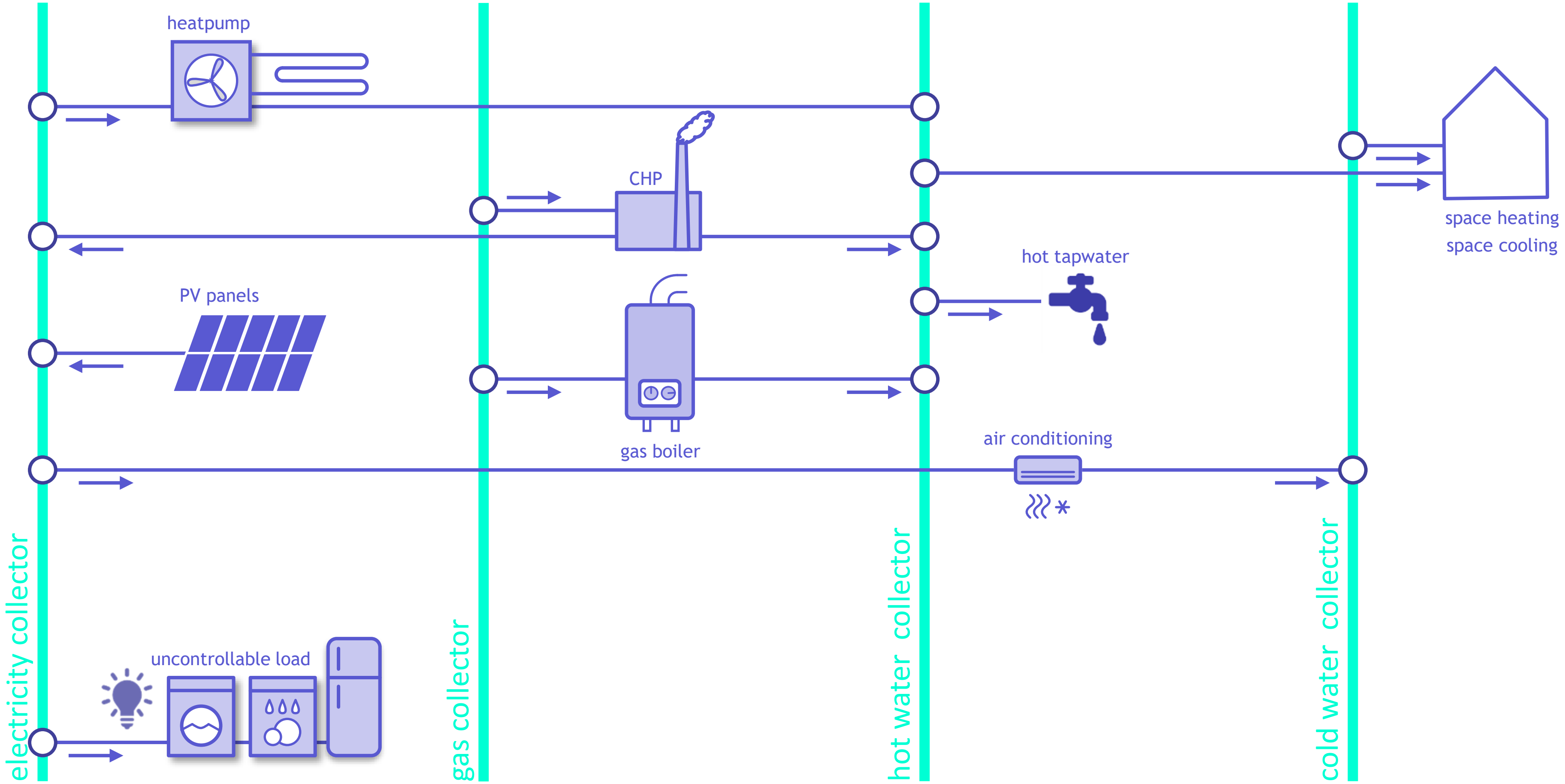


Commodity converting devices



Commodity storage devices

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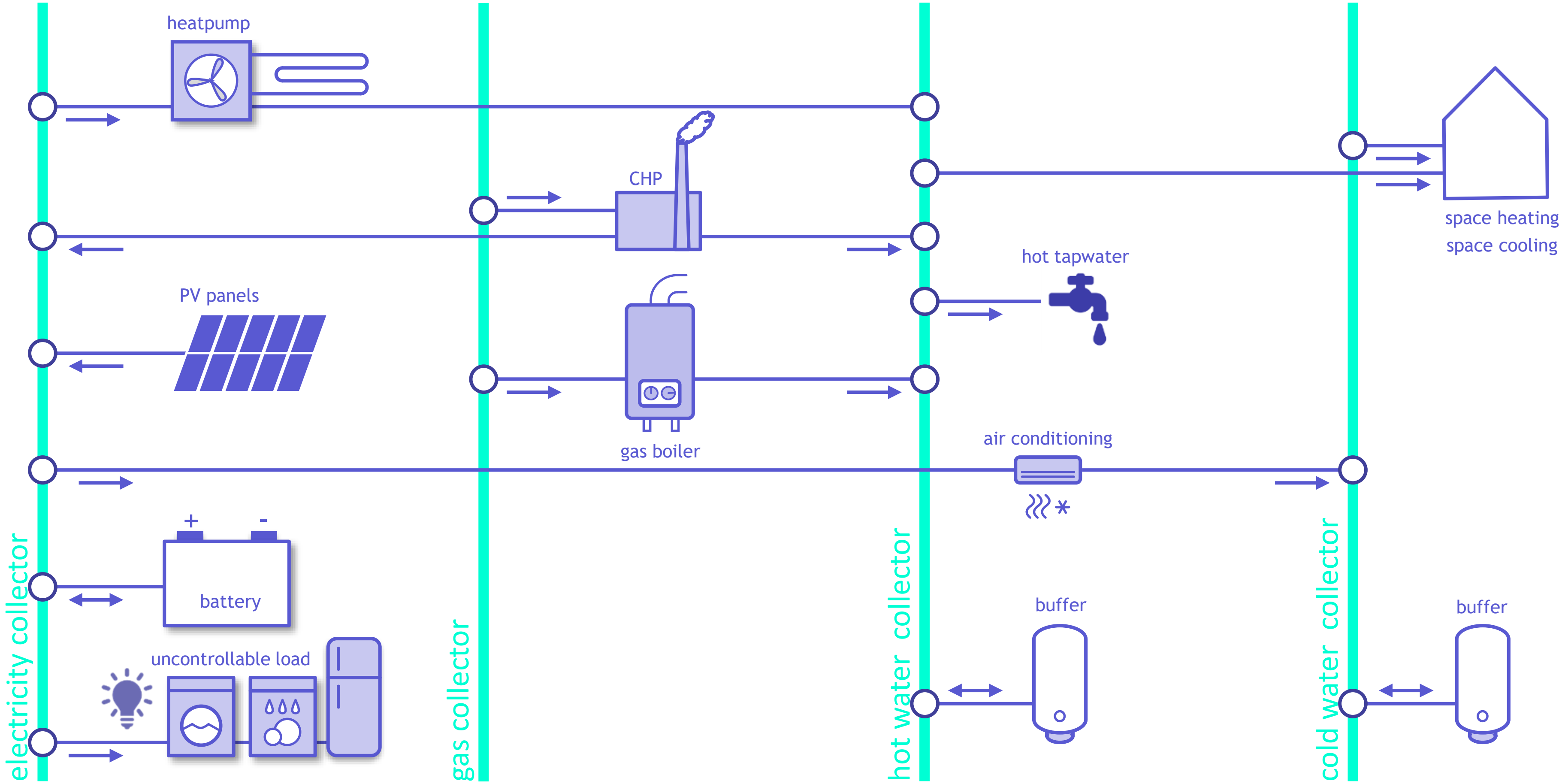

Commodity exchange with the outside

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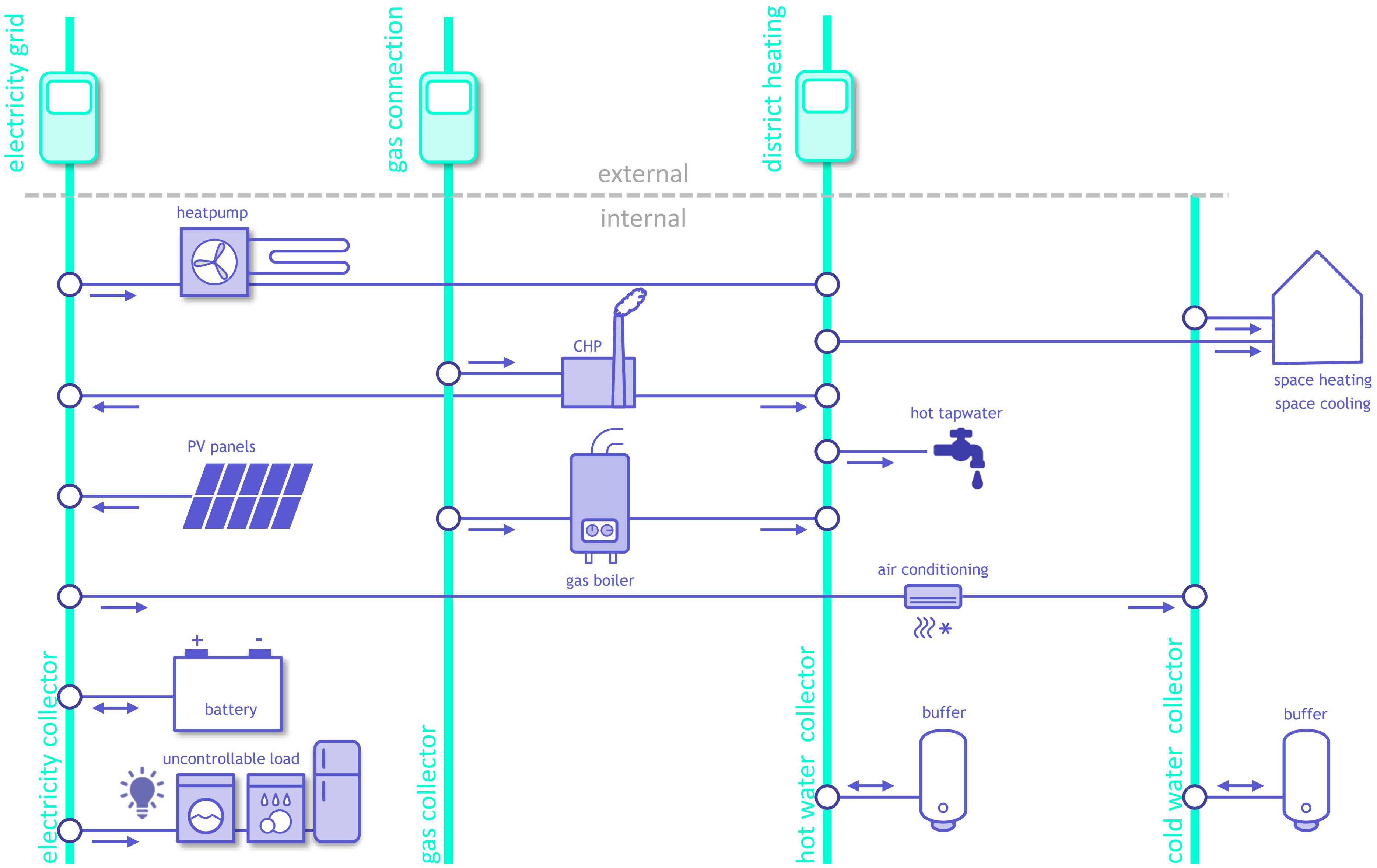

Operational cost coupling to commodity flows

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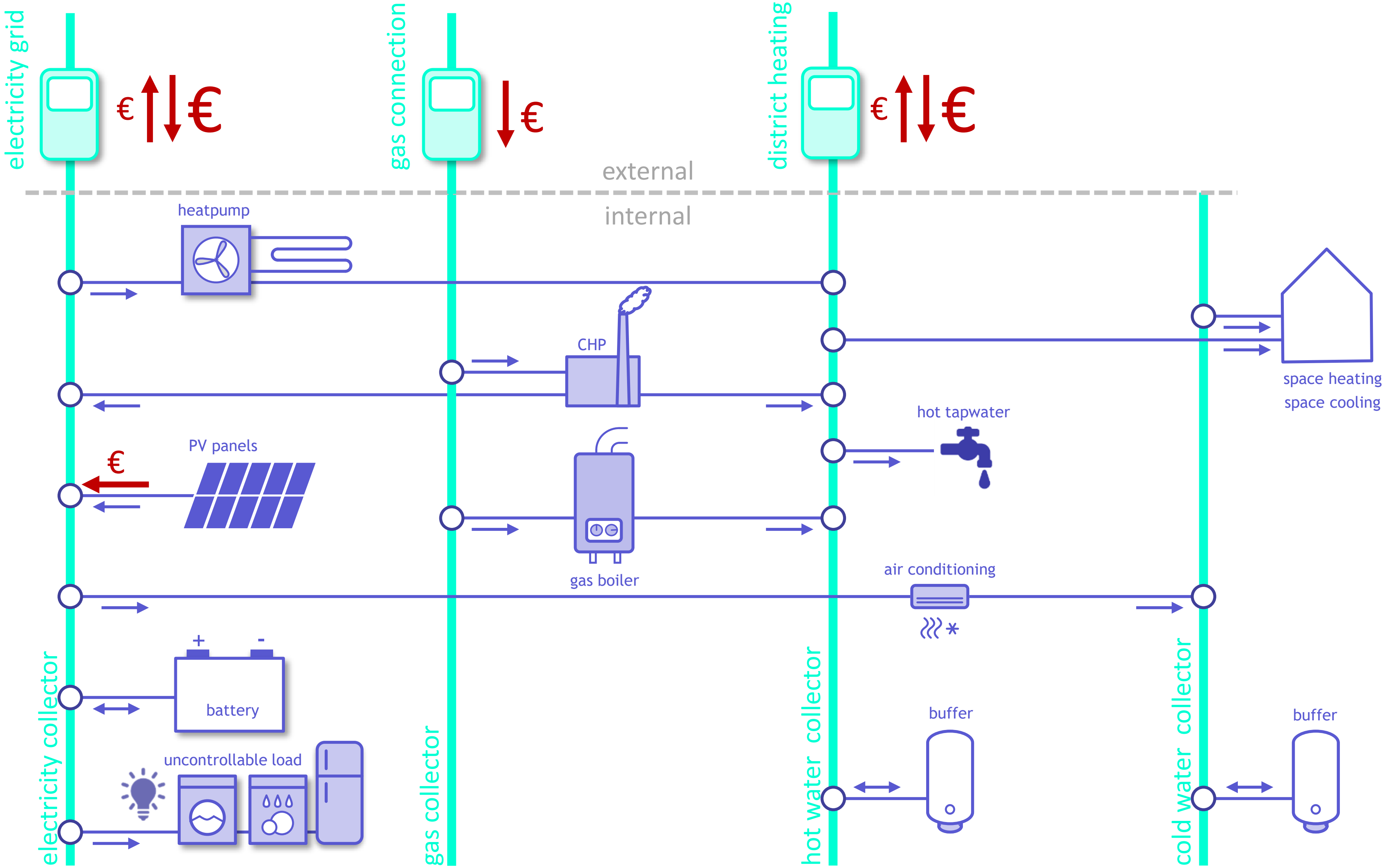

Building + infrastructure simulation model

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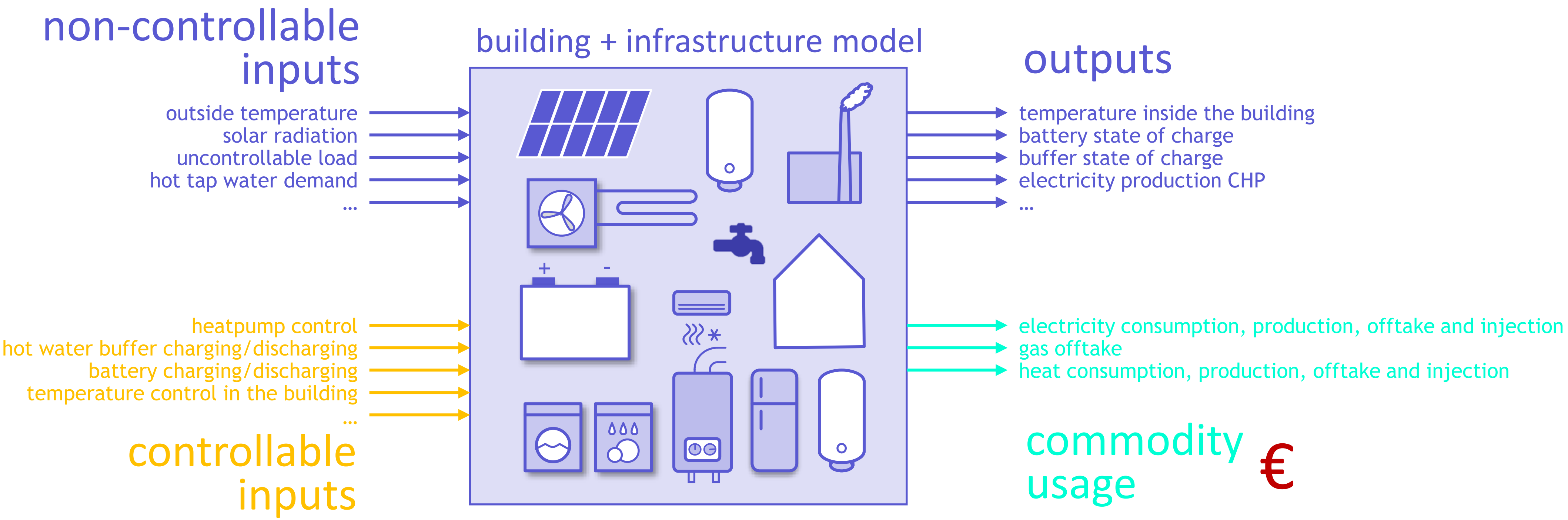

Model reuse in the Ambience approach

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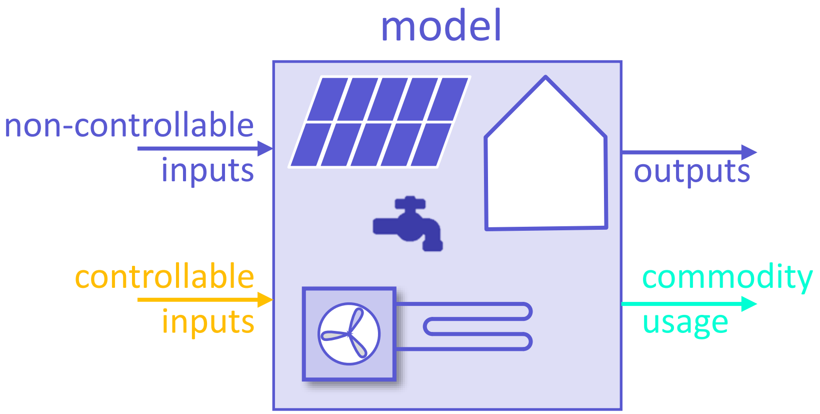

1 *Contracting phase:*
Energy Cost Cash Flow Estimation sub-tool

2 *Operational phase:*
Model used for the "model predictive control"

3 *Measurement & monitoring phase:*
Guarantee Assessment sub-tool (IPMVP)

Contents

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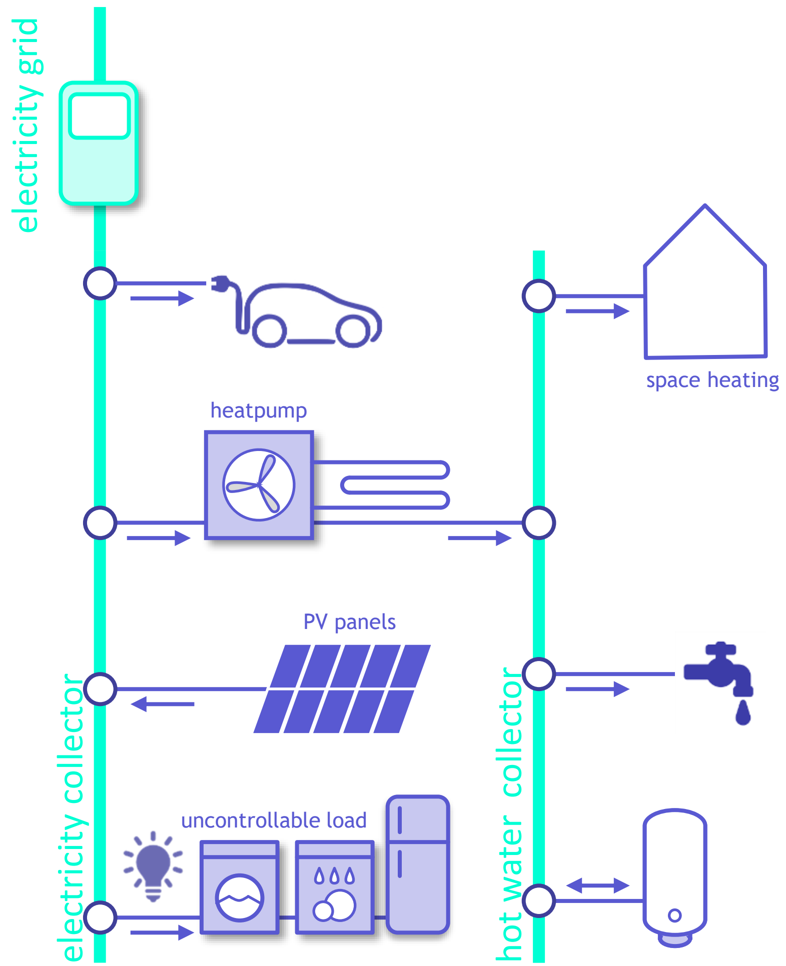
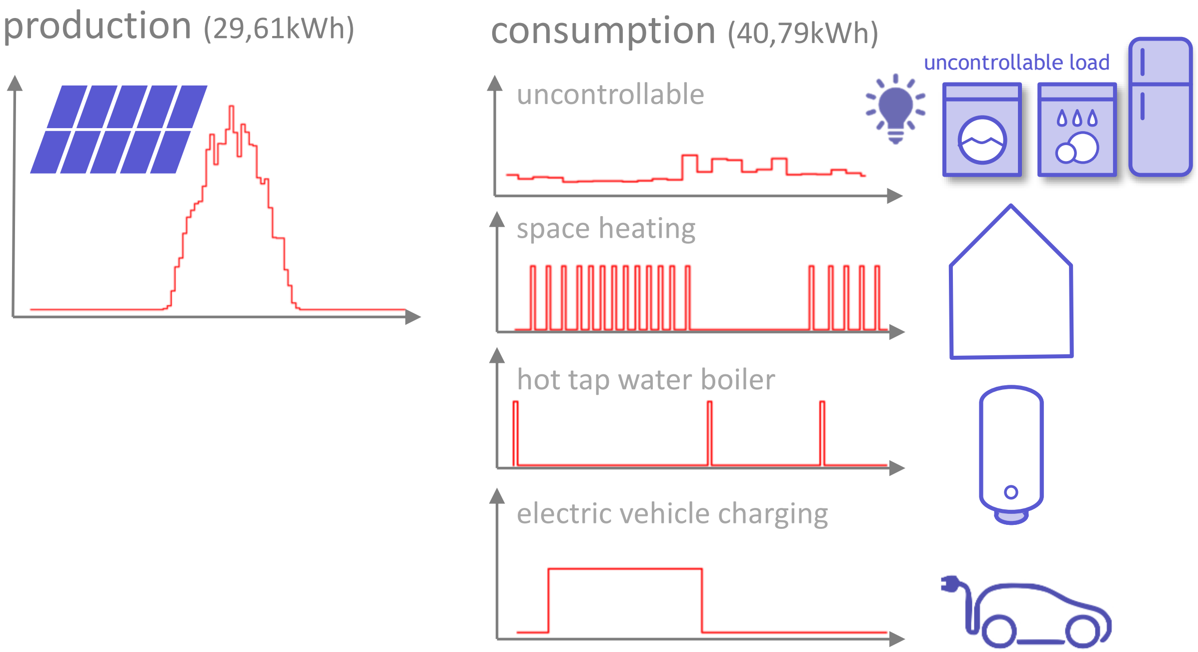
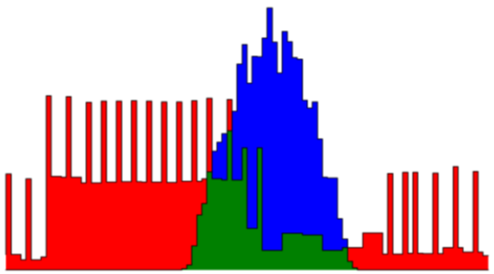
1. Simple example, simple control

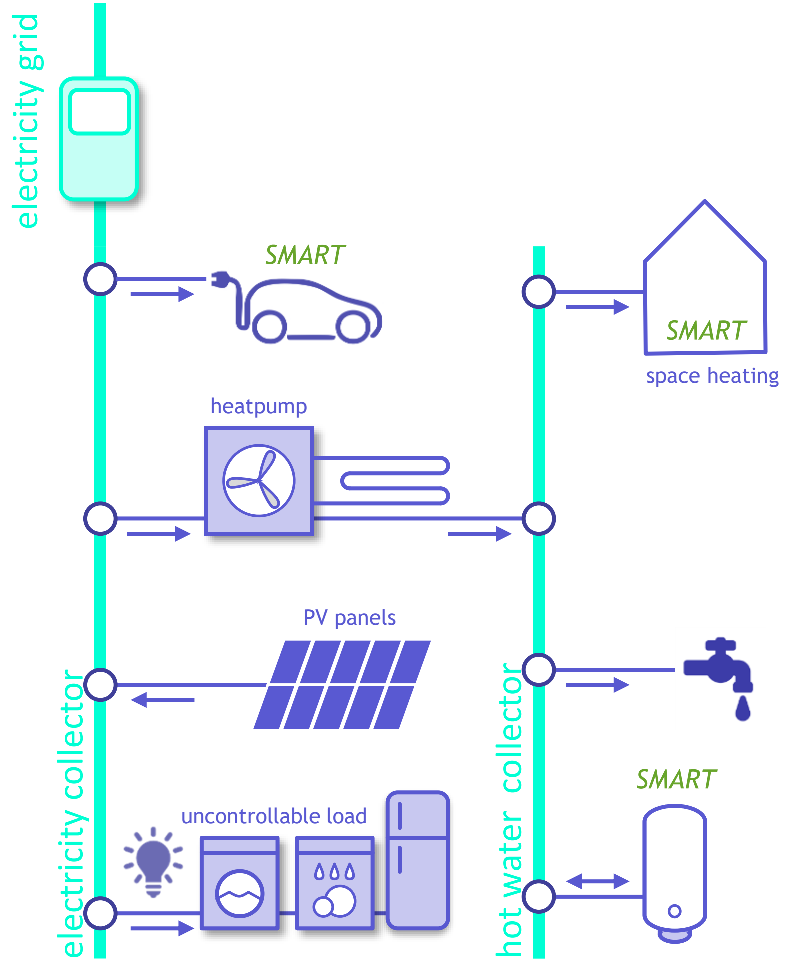


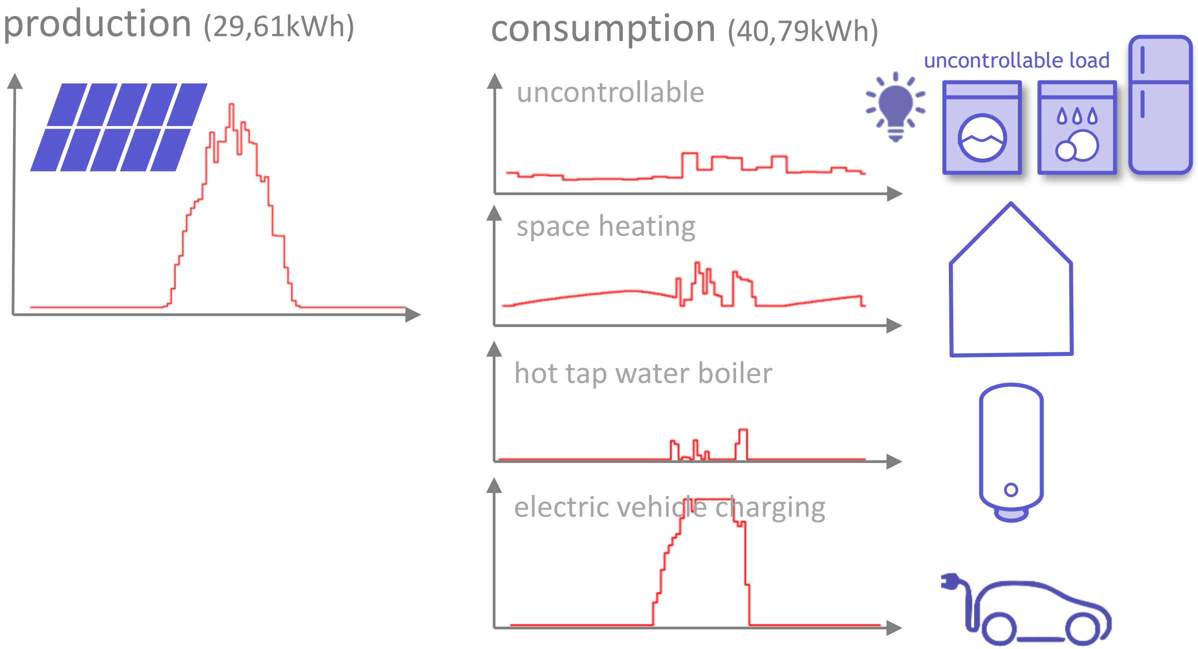


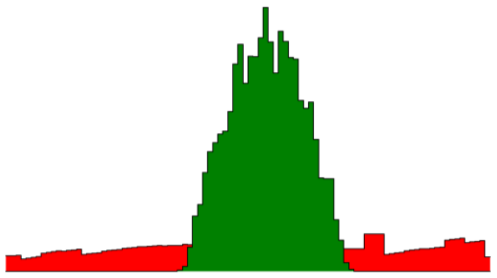


offtake (30,62kWh)
injection (19,53kWh)
self consumption (10,08kWh)

1. Simple example, optimal control







offtake (9,17kWh)
injection (0,0kWh)
self consumption (29,61kWh)

2. Preliminary Belgian pilot case study

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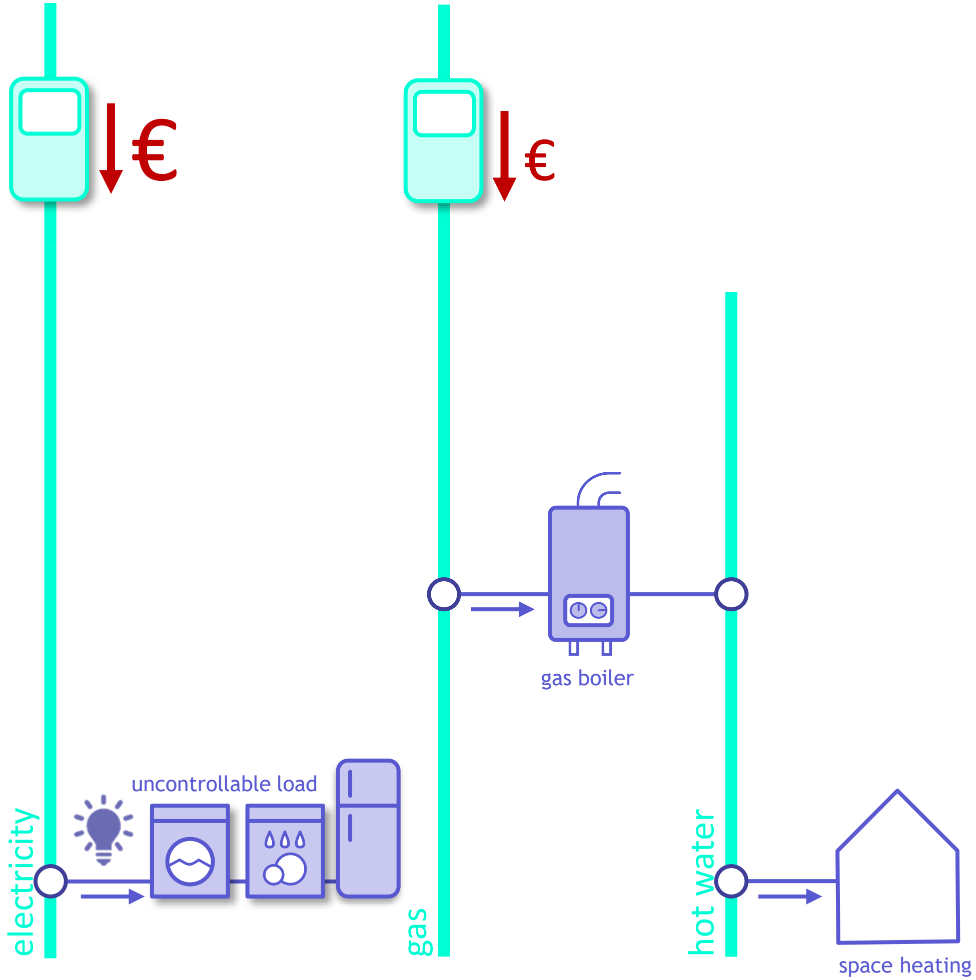
Case 1: before renovation (baseline)



Simulation conditions:

- Electricity consumption:
  - 2.795 kWh/year in peak time
  - 5.387 kWh /year in OFF peak time
- Realistic thermostat settings were used.
  - 7:00-23:00h: T >= 20.5 deg C
  - 23:00h-7:00h: T>= 15 deg C
- Gas boiler with 92% efficiency
- Gas consumption of 35.929 kWh /year
- Electricity prices:
  - 0,3051€/kWh in peak time
  - 0,2187€/kWh in OFF peak time
- Gas price of 0,0455 €/kWh

2. Preliminary Belgian pilot case study

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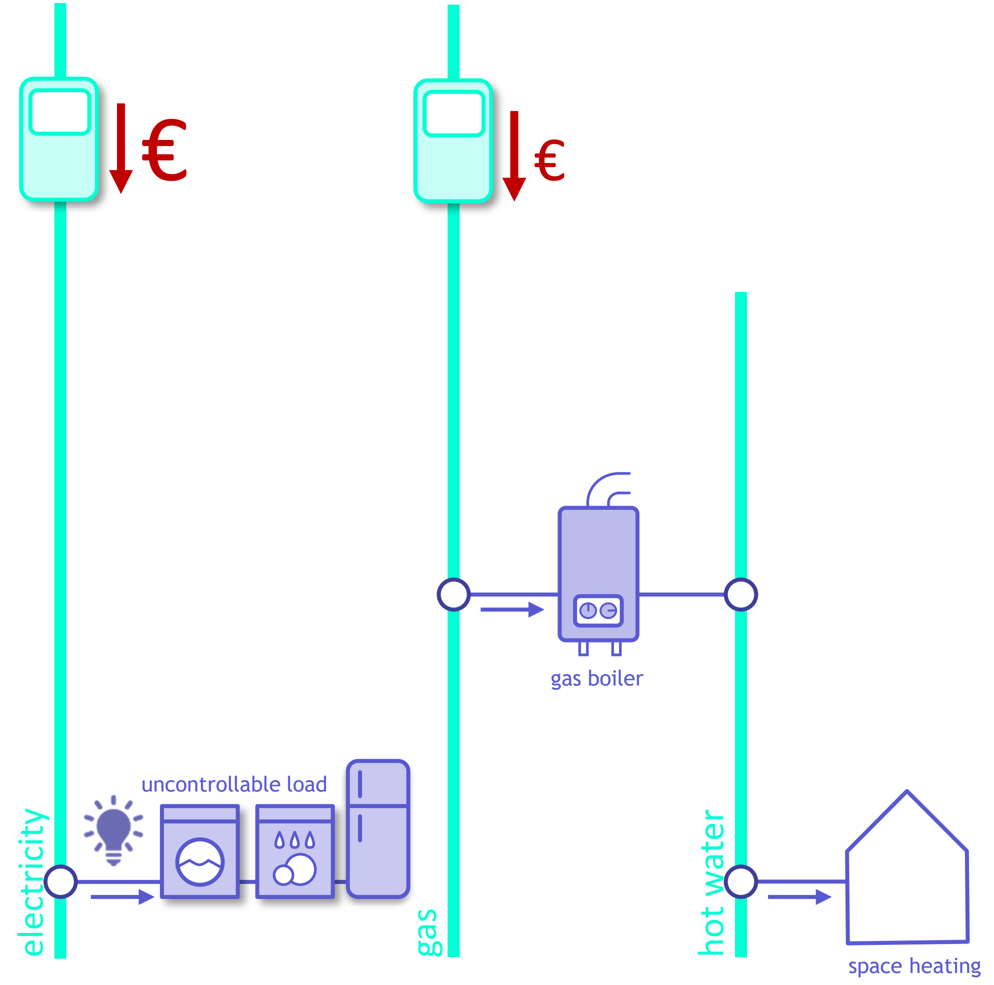
Case 1: before renovation (baseline)

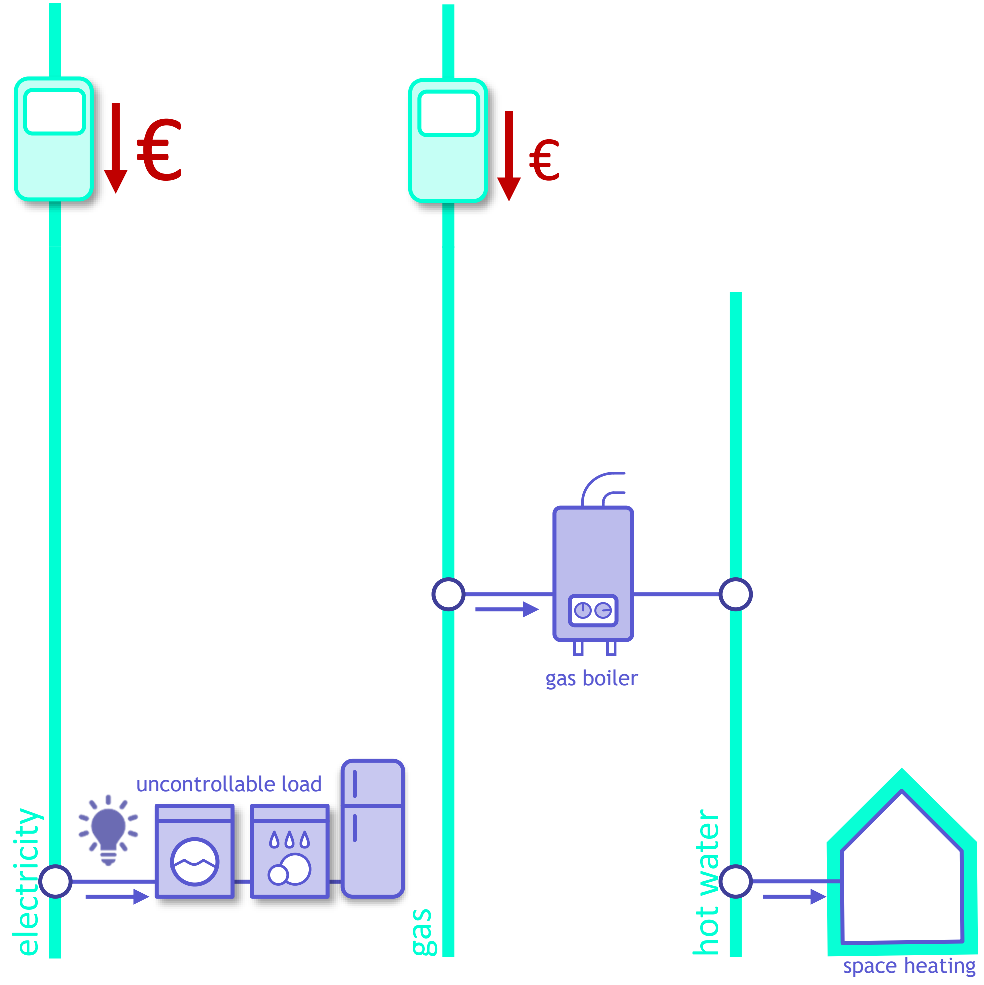


Simulation results:

- Electricity:
  - Uncontrollable load: 8.183 kWh /year
  - Cost: 2.031,12 €
- Gas:
  - Gas boiler: 35.929 kWh/year
  - Cost: 1.640,66 €
- Total cost: **3.671,78€**

2. Preliminary Belgian pilot case study

Case 2: envelope renovation



Simulation conditions:

- Building model was adapted to represent the behavior of the building after the insulation measures are in place
- Thermostat settings, gas boiler and electricity consumption are identical.
- Electricity and gas prices identical

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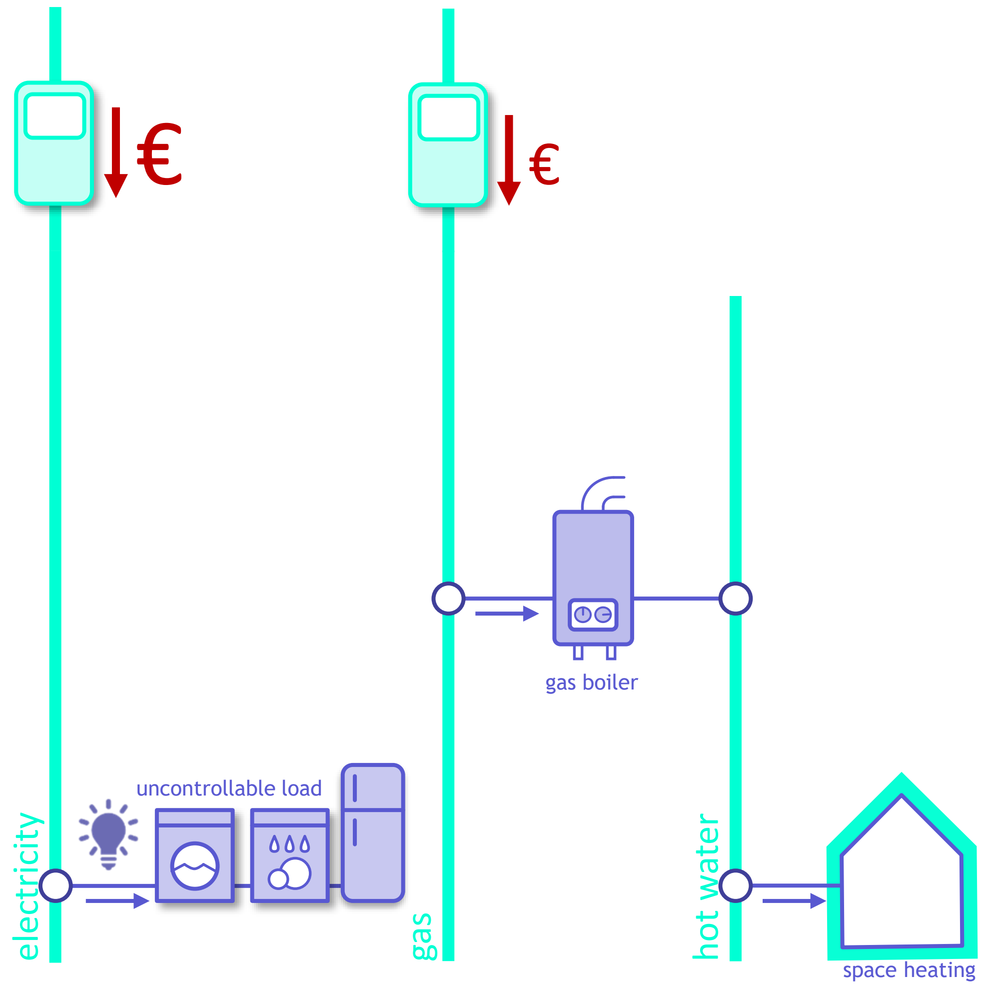
Case 2: envelope renovation



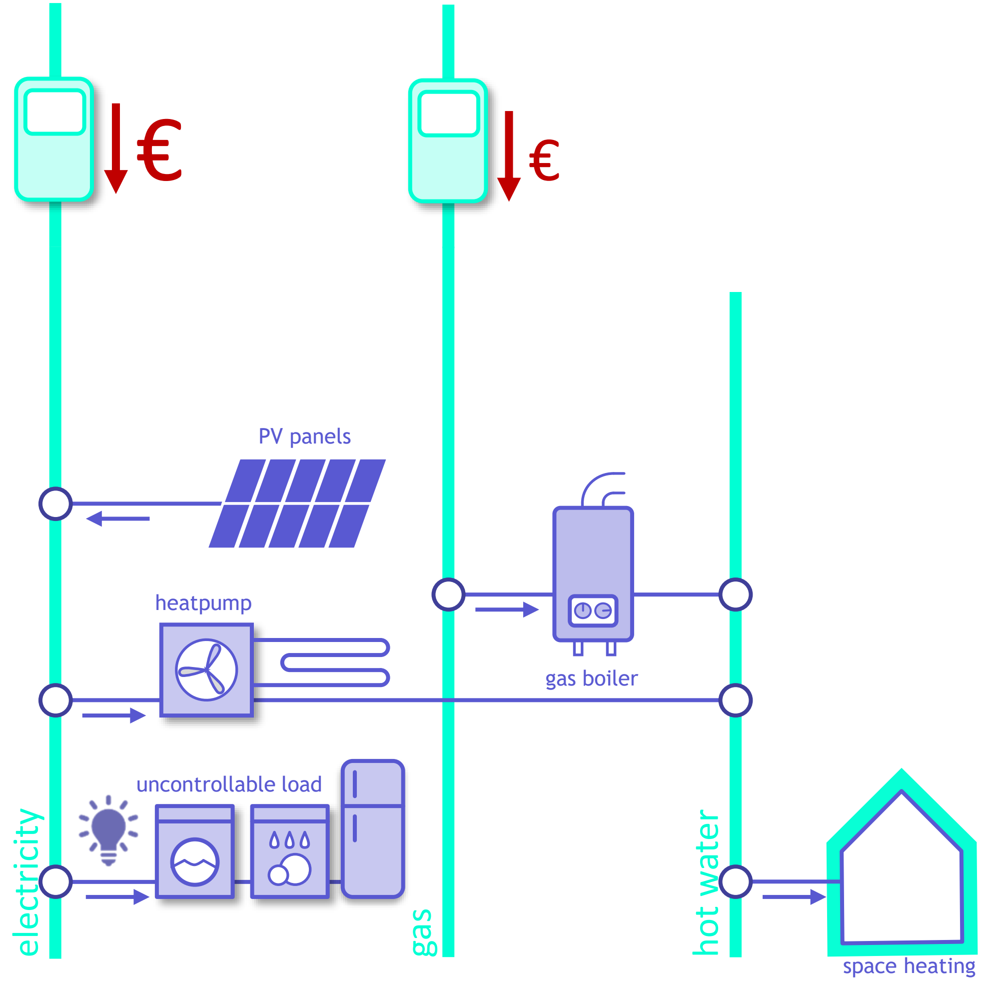
Simulation results:

- Electricity:
  - Uncontrollable load: 8.183 kWh /year
  - Cost: 2.031,12 €
- Gas:
  - Gas boiler: 15.112 kWh/year
  - Cost: 687,58 €
- Total cost: **2.718,70 €**

➔ Cost saving of **26%**

2. Preliminary Belgian pilot case study

Case 3: electrification + PV



Simulation conditions:

- Gas boiler is replaced by a heat pump
- Expected avg COP heat pump of 2.97
- Introduction of PV
  - 10,7 kWp
  - Injection price: 0,0676€/kWh
- Thermostat settings and uncontrollable load electricity consumption are identical.
- Electricity offtake and gas prices identical

2. Preliminary Belgian pilot case study

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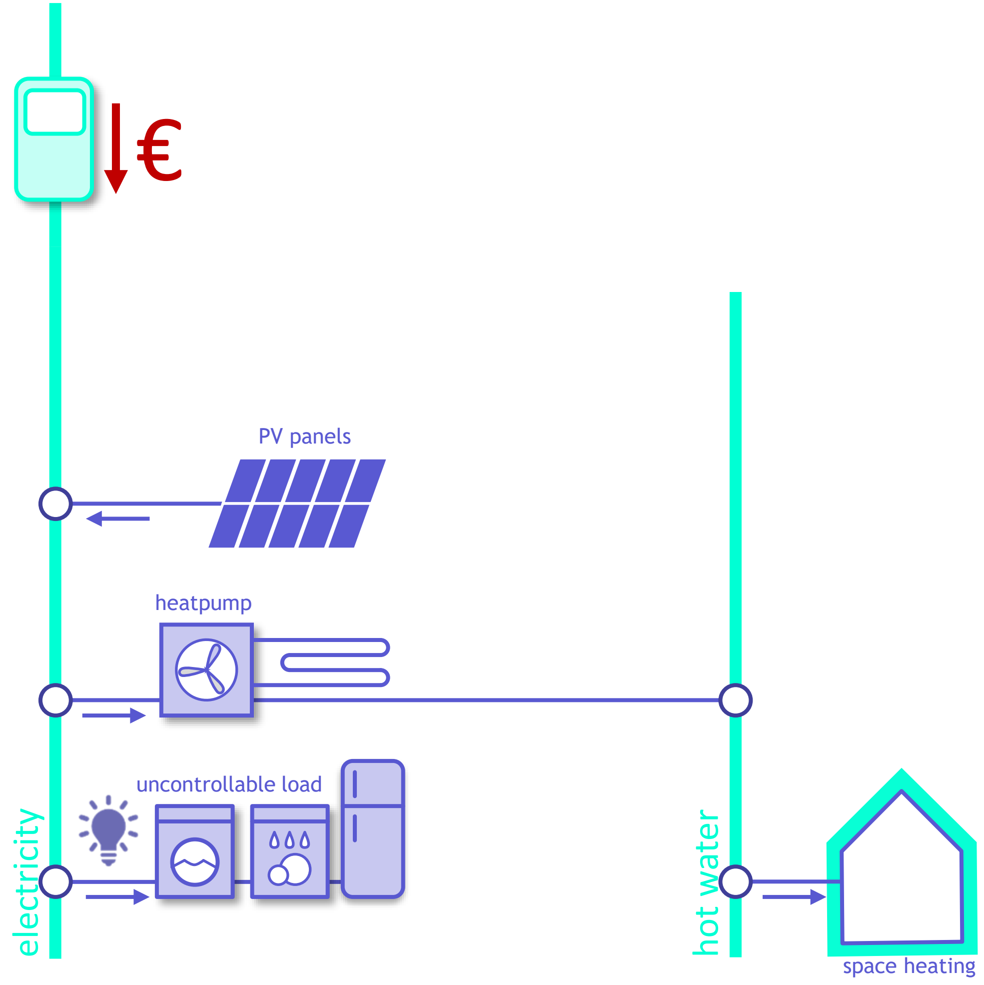
Case 3: electrification + PV



Simulation results:

- Electricity consumption:
  - Uncontrollable load: 8.183 kWh /year
  - Heatpump: 4.661 kWh/year
  - Total: **12.844** kWh/year
- PV:
  - PV production: **6.729** kWh/year
- Electricity meter:
  - Offtake volume: 10.364 kWh
  - Offtake cost: 2.465,62 €
  - Injection volume: 4.140 kWh
  - Injection income: 281,13 €
- Total cost: **2.184,49 €**

➔ Cost saving of **20%**

2. Preliminary Belgian pilot case study

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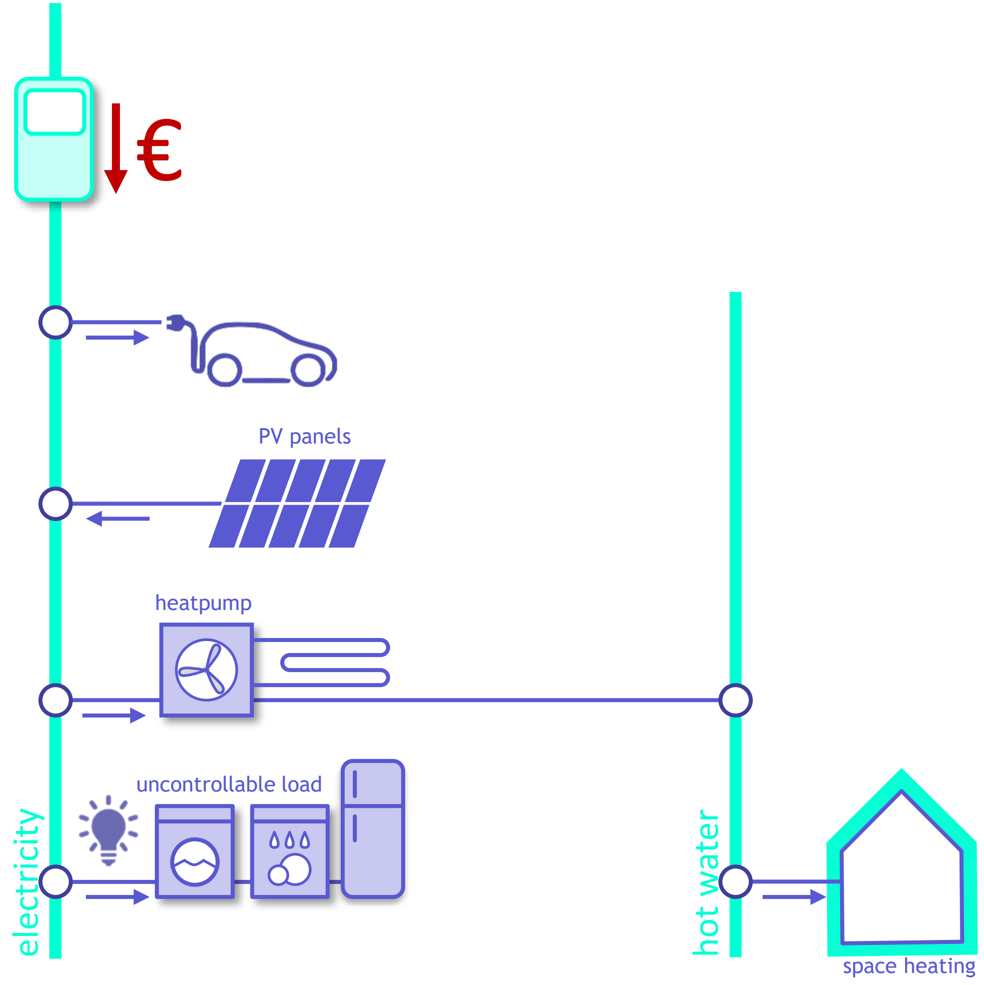
Case 4: introduction of an electric vehicle



Simulation conditions:

- Electric vehicle:
  - All charging is done at home
  - 19.227 km/year
  - Standard commuter profile (9.00-18:00h)
  - 10kW charger at home
  - Immediate charging when arriving at home
- Thermostat settings, heat pump, PV production and uncontrollable load electricity consumption are identical.
- Electricity and gas prices identical

2. Preliminary Belgian pilot case study

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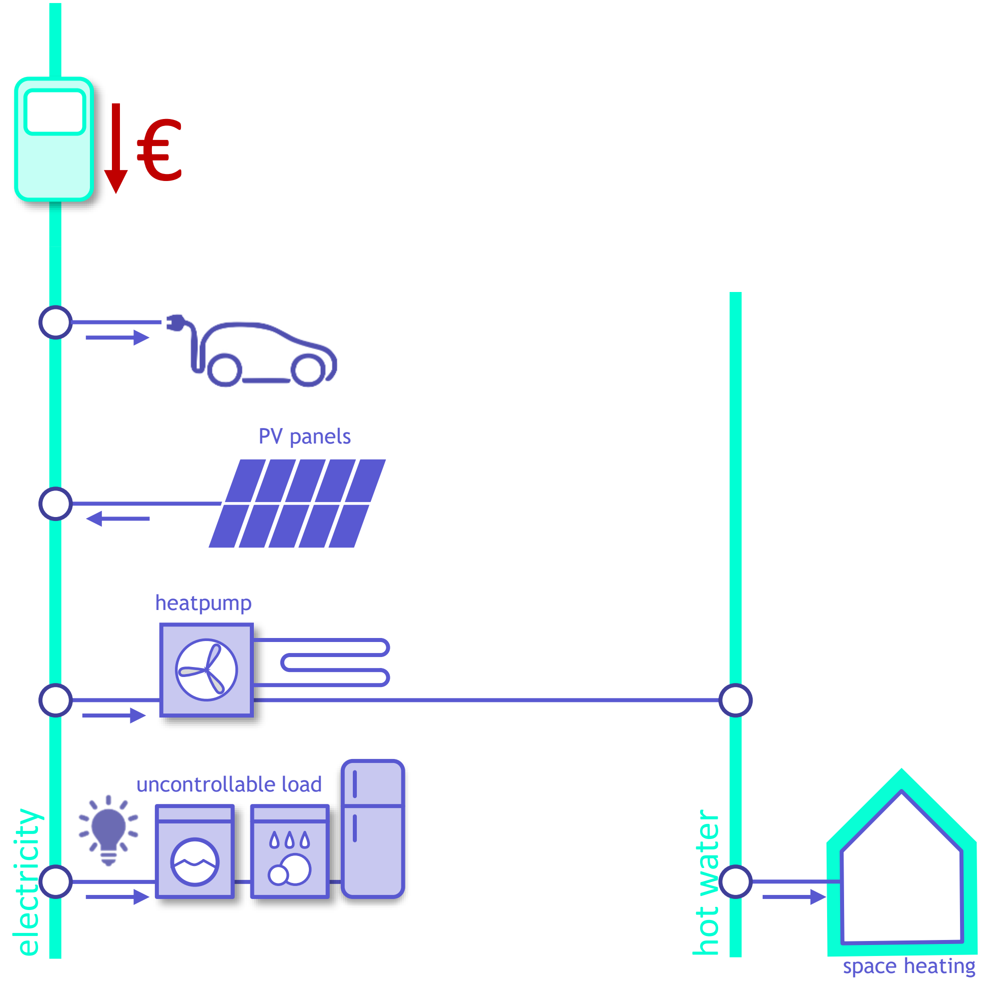
Case 4: introduction of an electric vehicle



Simulation results:

- Electricity consumption:
  - Uncontrollable load: 8.183 kWh /year
  - Heatpump: 4.661 kWh/year
  - EV charging: 3.269 kWh/year
  - Total: **16.113** kWh/year
- PV:
  - PV production: **6.729** kWh/year
- Electricity meter:
  - Offtake volume: 13.522 kWh
  - Offtake cost: 3.377,71 €
  - Injection volume: 4.138 kWh
  - Injection income: 279,96 €
- Total cost: **3.097,75 €**

2. Preliminary Belgian pilot case study

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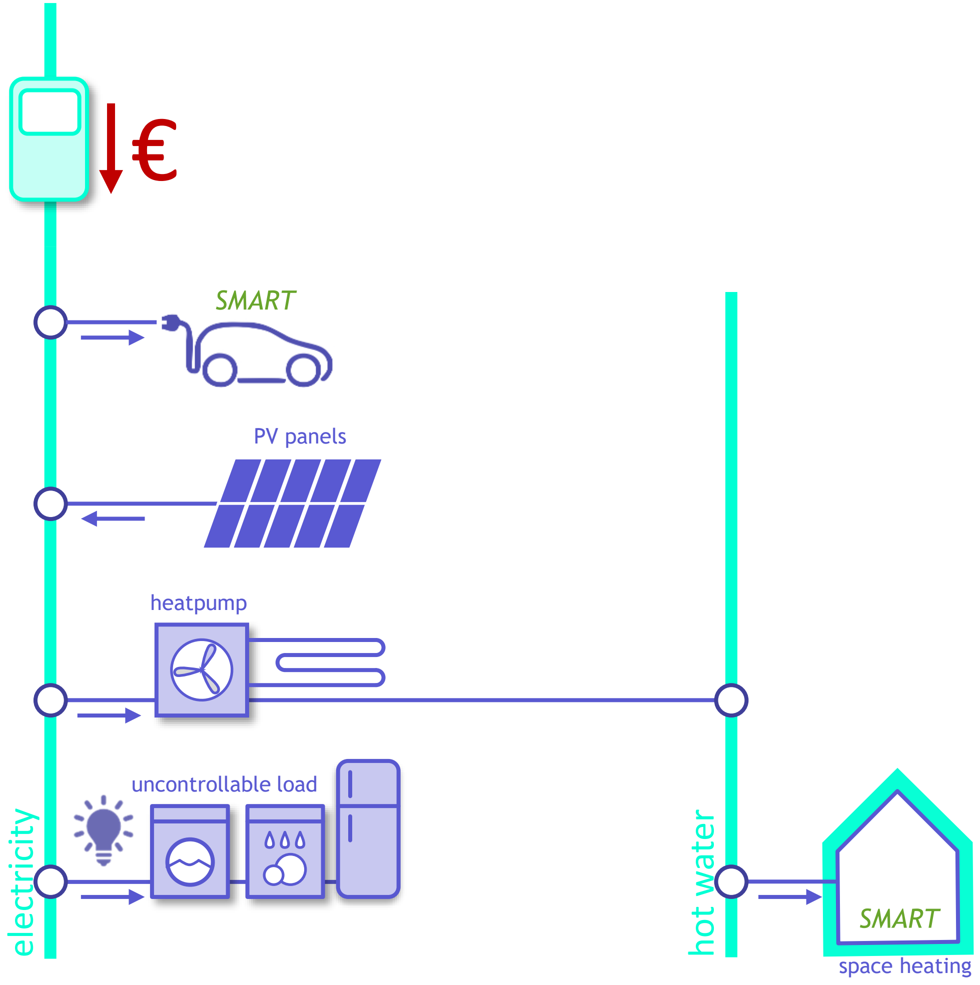
Case 5: smart control



Simulation conditions:

- Smart control on heating system:
  - 7:00-23:00h: **21.5 >=** T >= 20.5 deg C
  - 23:00h-7:00h: **21.5 >=** T>= 15 deg C
- Smart control on electric vehicle charging:
  - 10kW charger at home
  - charging at the cheapest moment to reduce injection or at low offtake price
- Heat pump, PV production and uncontrollable load electricity consumption are identical.
- Electricity and gas prices identical

2. Preliminary Belgian pilot case study

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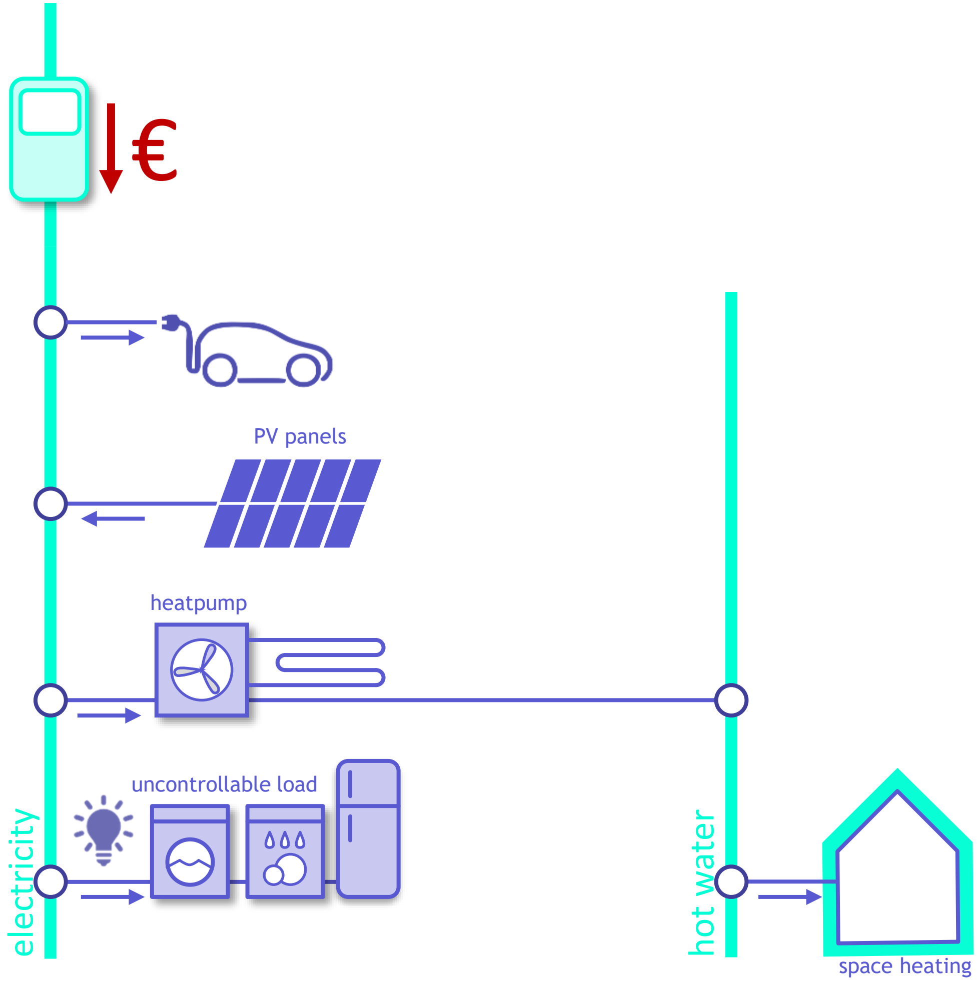
Case 5: smart control



Simulation results:

- Electricity consumption:
  - Uncontrollable load: 8.183 kWh /year
  - Heatpump: 4.724 kWh/year
  - EV charging: 3.269 kWh/year
  - Total: **16.176** kWh/year
- PV:
  - PV production: **6.729** kWh/year
- Electricity meter:
  - Offtake volume: 12.911 kWh
  - Offtake cost: 2.943,55 €
  - Injection volume: 3.466 kWh
  - Injection income: 234,48 €
- Total cost: **2.709,07 €**

➔ Cost saving of **12,5 %**

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Questions?

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Agenda

Active building Energy Performance Contracting (AEPC) in Italy

10:30 Welcome and introduction to the event, Marialaura Di Somma, ENEA
10:35 Introduction to the AmBIENCe project, Annick Vastiau, VITO
10:40 Status of regulatory framework (and barriers) in Italy related to flexibility in buildings, Marialaura Di Somma, ENEA
10:50 AEPC Concept & Business Model, Tiago Soares (INESC TEC)
11:00 ABEPeM Platform, Jef Verbeek(VITO)
11:20 AEPC Market Potential and Outlook, Lieven Vanstraelen (Energinvest)
11:30 Concepts implementation in project pilots (Belgium and Portugal), Lieven Vanstraelen (Energinvest) and Claire Harvey (EDP)
11:40 Roundtable discussion with stakeholders
12:25 Conclusions and next steps, Marialaura Di Somma, ENEA

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Market Potential and Outlook

30 November 2021

Lieven Vanstraelen
Senior Partner & EPC Expert
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Agenda

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- The driving forces behind Active Building EPC?
- What is driving market potential?
- Market potential
- Results from stakeholder survey
- Market outlook

What is driving AEPC market potential?

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- Regulatory environment
- Current EPC/M-EPC market potential
- Flexibility potential, linked to
  - Technology (e.g. Heatpums)
  - Applications
  - Customer acceptance
- Dynamic pricing availability and market potential
- Business case comparison of AEPC vs EPC
- Existing aggregator market
- Collaboration potential between ESCOs and Aggregators
- ESCO & Facilitator uptake of the AEPC model

What could be the driving force for market actors to develop Active Building EPC?

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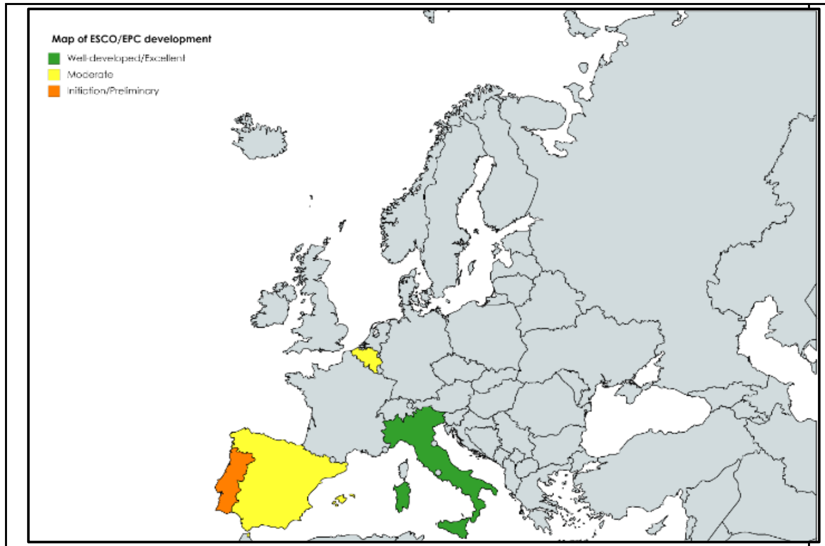
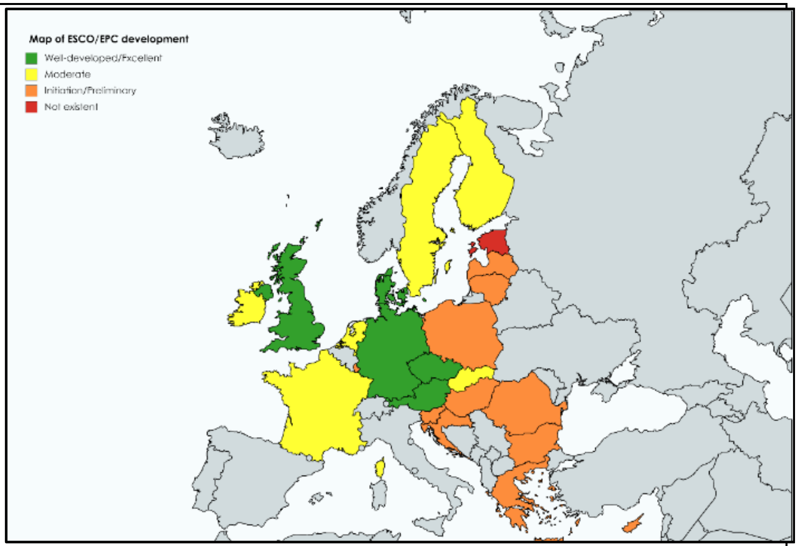
- ESCOs
  - Improve the business case for EPC in buildings
  - Create business opportunities in new and existing customer segments
  - Play a new role in the aggregation value chain
- EPC Project Facilitators
  - Convince end customers and investors of alternative revenue models
  - Explore new advisory services that explore the flexibility potential
  - Adapt business models and tendering models to include AEPC
- DSOs/TSOs
  - Unlock the untapped potential of flexibility in buildings
  - Develop new relations with ESCOs wanting to offer AEPC
  - Improve electricity network resilience

Regulatory and market status on EPC

Detailed survey of directives, policies, measures and regulation that are relevant for Active Building EPC concept at MS level

1. **Current status of EPC/ESCOs** (Main regulations, directives and polices on EPC; Main types of EPC implemented; Main actors involved; ESCO market overview (e.g., number of ESCO, volume of ESCO projects, application sectors, market longevity, etc)

	
Map of ESCO/EPC development status for the countries represented in the consortium	*Map of ESCO/EPC development status for the other EU Member States*

Regulatory and market status on flexibility

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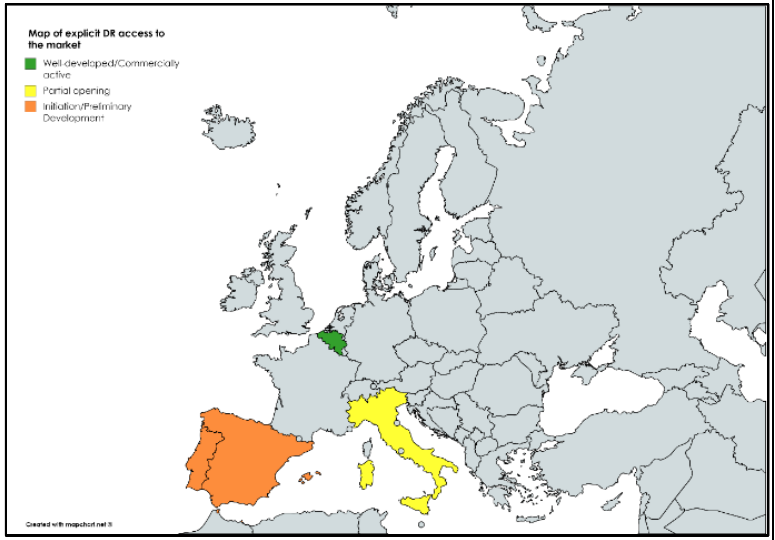
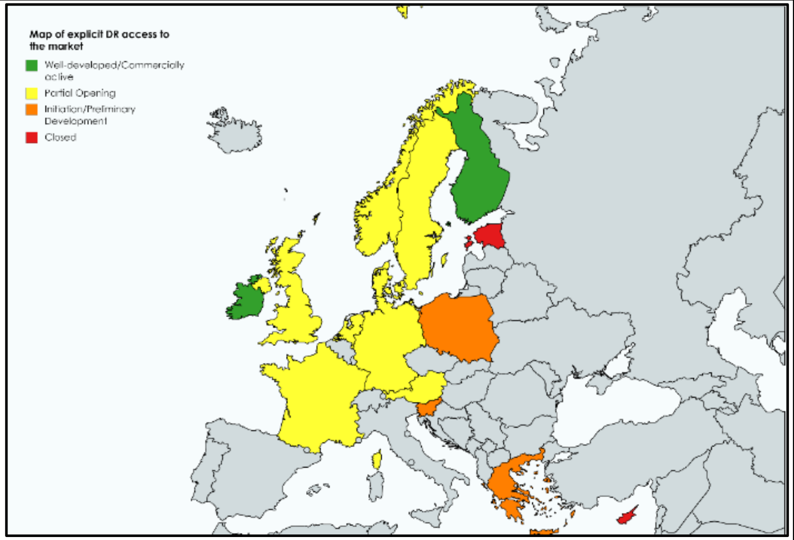
Detailed survey of directives, policies, measures and regulation that are relevant for Active Building EPC concept at MS level

1. **Current status of DR services**, through the analysis of the implicit DR and main type of schemes implemented, explicit DR and demand access to the market to understand to which extent demand is allowed as a resource within the different national electricity markets, independent aggregators, regulations/policies supporting aggregation of distributed energy resources, etc.

	
Map of the status of buildings' flexibility aspects for DR services for the countries represented in the consortium	*Map of the status of buildings' flexibility aspects for DR services for the other EU Member States*

General drivers for AEPC

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FLEX / EPC	IT	BE	ES	PT
IT				
BE				
ES				
PT				

No country in the EU is fully green

Energy Services Market dynamics per EU country

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Source: Energy Service Market in the EU, JRC , 2019

The ESCO market (not only EPC)

Source: «ESCO market: revenue by region», Energy efficiency 2018 – International Energy Agency

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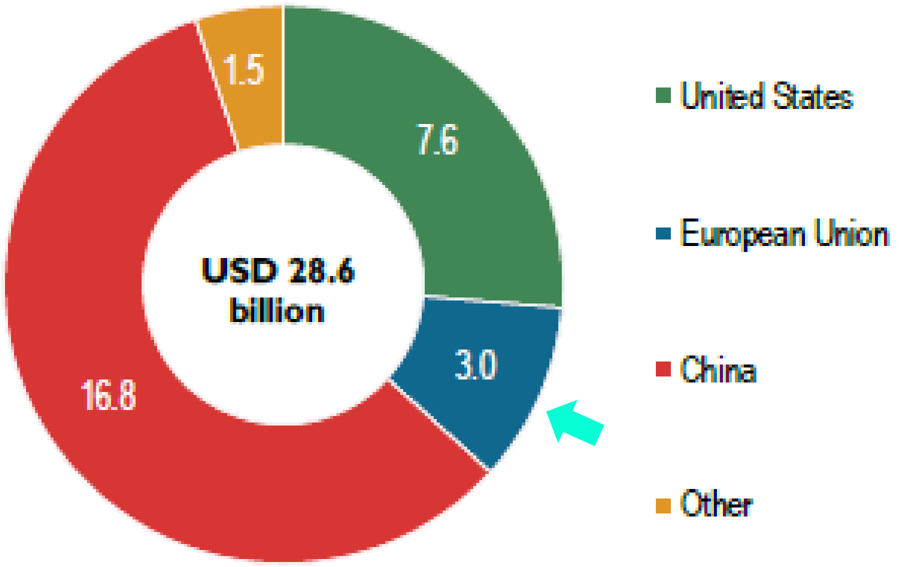

ESCO Market in 2018

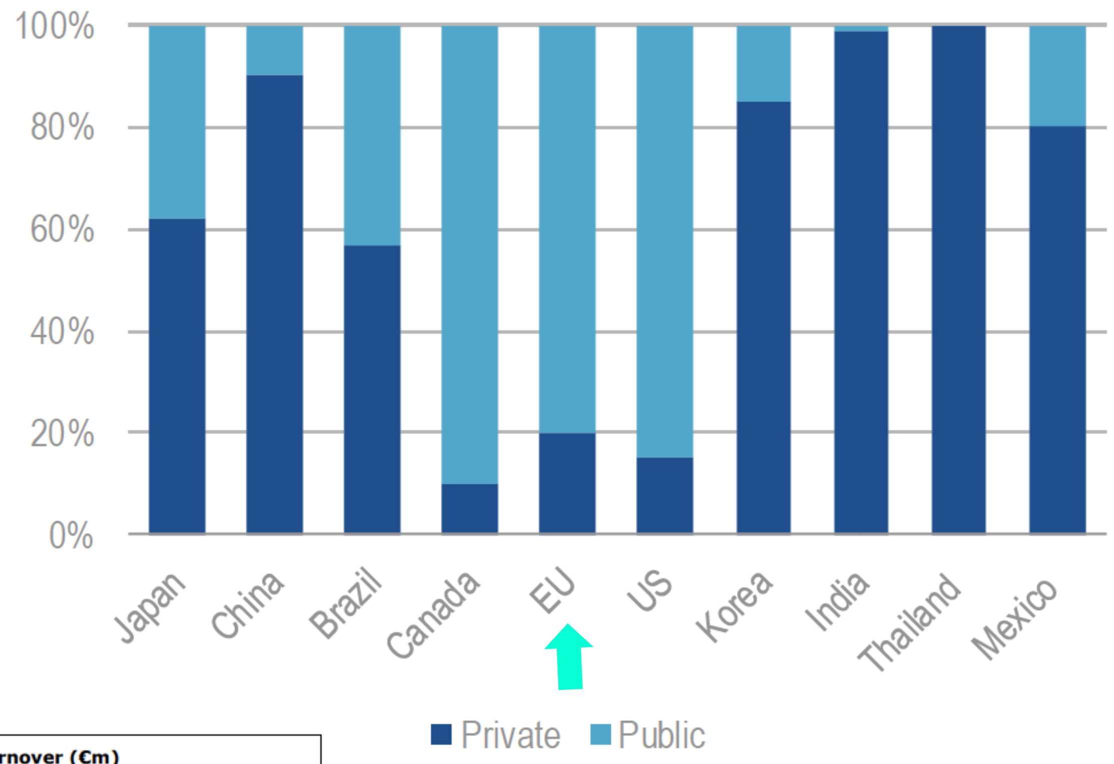

Table 23. ESCO turnover in Italy

Year	ESCO turnover (€m)
2008	275
2009	387
2011	500
2015	1 500

Source: Energy Service Market in the EU, 2019, JRC

The EU ESCO Market per country (2019) (1)

Source: Energy Service Market in the EU, JRC , 2019

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MS	first ESCO[9]	Number of ESCOs[10 1112]					ESCO market, EUR million annual [13]
		2007	2010	2013	2015	2018	2018
Austria	1995	ca. 30	5-14	over 50	41	400 (EnS); 27 (EES); 36 (ESC)	30-40 (only public buildings)
Belgium	1990	ca. 30	13-15	10-15	10-15	6-13	20-30
Bulgaria	1995	1-3 (12)	20	7-12 (?)	15	12	Less than 10
Croatia	2003	1(-2)	2	10	10	8-15	20 (EnS); 14 (ESCO)
Cyprus	2016	0	0	0	19	22	0
Czech Rep.	1993	7 (15)	8-10	20	15	15	9-15
Denmark	ca. 2010	4-5	10	15-20	15-20	4	70
Estonia	ca. 2014	2	2	2 (3?)	2-3 (<10)	4	5
Finland	2000	9-11	8	5-8	6-8	15	6.5
France	1800's /1937	3 (100)	10+100	350	300	45	13.5 billion (EnS); 40-60 million (EnPC)
Germany	1990-1995		250-500	500-550	ca. 500	560 (EnS); 138 (EnPC)	9 billion (EnS); 7.7 billion (EnPC)
Greece	ca. 2003	0-3	2	5	47	86 (3 providing EnPC)	n/a
Hungary	1990s		20-30	10	ca. 8-9	10 (5 EnPC)	n/a
Ireland			15	ca. 30		25	20
Italy	early 1980s	15-25	50 (100)	50-100	200-300	1500 (EnS); 340 (ESCO)	2 billion

The EU ESCO Market per country (2019) (2)

Source: Energy Service Market in the EU, JRC , 2019

MS	first ESCO[9]	Number of ESCOs[10 1112]					ESCO market, EUR million annual [13]
		2007	2010	2013	2015	2018	2018
Latvia	2001	40	5	8	50-60	60 (EnS); 3-6 (ESCOs)	2-3
Lithuania	1998	6	6	3-5	6	n/a	n/a
Luxembourg	1990s	3-4	3-4	3-6	3-6	n/a	n/a
Malta	not yet	0	0	0	0	n/a	n/a
Netherlands	mid 2000	very few	50	50	100	57 (EnPC): 28 public, 27 private	90-150
Poland	1995	<5	3-10	30-50	3-4 (30)	25 (EnS), 20 (EnPC)	n/a
Portugal	n/a	ca. 7-8	10-12	n/a		12-15	50-100
Romania	1996	2	14	15-20	20	7-13	47
Slovakia	1995	30	5	6-8	8 (20-50)	40 (10 EnPC providers)	
Slovenia	2001	1-2	2-5	5-6	5-6	10 (4 EnPC providers)	25 million (EnPC in public sector only)
Spain	n/a	ca.100	> 15	20-60	1000	70	1-1.5 billion
Sweden	1978	12-15	5-10	n/a	4-5	~20	3.79 (public sector only)
UK	1966	20-24	20	30-50	>50	136 (EES); 62 (ESCOs);	108.3

Estimated EPC public building market size (2020)

MS	Number of contracts	Overall size (m€)	Public employment (x1000)	Market/ public sector (€/employee)	Public buildings (Mm2)	Market/ public sector (€/m2 x1000)
AT	11	6.5	347	19	70	93
BE[120]	11	20	1064	19	50	400
BG	10	3	138	22	30	100
HR	50	25	317	79	10	2500
CY[121]	0	0	58	0	1	0
CZ	25	21	532	40	50	420
DK	9	70	717	98	55	1273
EE[122]	1	1	118	8	2	500
FI	5	3.5	536	6.5	50	70
FR[123]	50	70	6180	11	355	197
DE	58	**90**	4609	20/65	390	**231**
GR[124]	**8**	**100**	566	176	20	5000
HU[125]	20	2.8	873	3	50	56
IE	4	16.6	298	56	20	830
IT	**230**	**250**	3233	77	140	1786
LV[126]	**6**	**12.6**	227	55	10	1260
LT[127]	6	3.2	315	10	15	213
MT	-	-	33	-	1	-
NL[128]	-	-	844	-	165	-
PL	13	39	2527	15	165	236
PT	13	50	658	76	35	1429
RO	0	0	1190	0	35	0
SK	25	25	350	71	70	357
SL	44	96	163	590	2	48000
ES	**59**	**60**	2479	24	135	444
SE	1	10	1079	9	80	125
sum	617	965	29459	1428	2058	63830
Avg	27	42	1091	62	76	2775

source: Energy Performance Contracting in the Public Sector of the EU – 2020, JRC, 2020

Stakeholder survey

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Survey of (currently) 22 stakeholders from
8 countries, either Flex providers (mainly ESCOs)
or Flex requesters (mainly DSOs/TSOs)

Flex Requesters’ interest in flexibility

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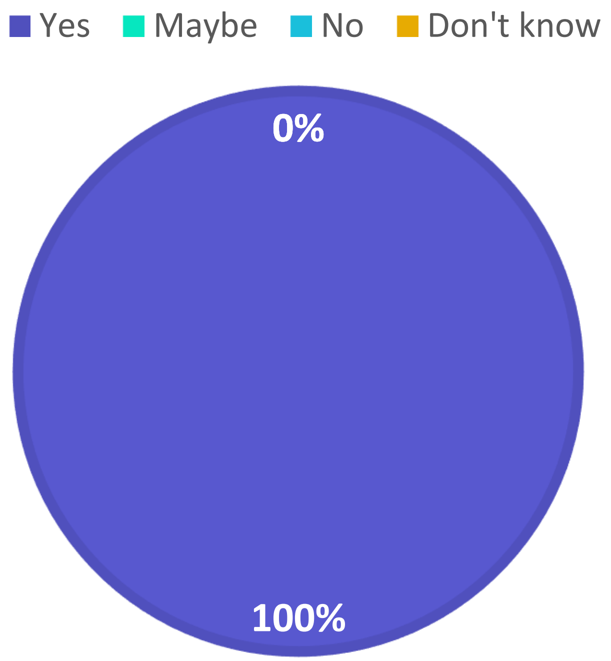
Are you using or would you be interested in using flexibility provided by BUILDINGS, if this would be ‘ready-to-use’ flexibility (that is responding to your technical requirements)?



Flex Requesters' intentions

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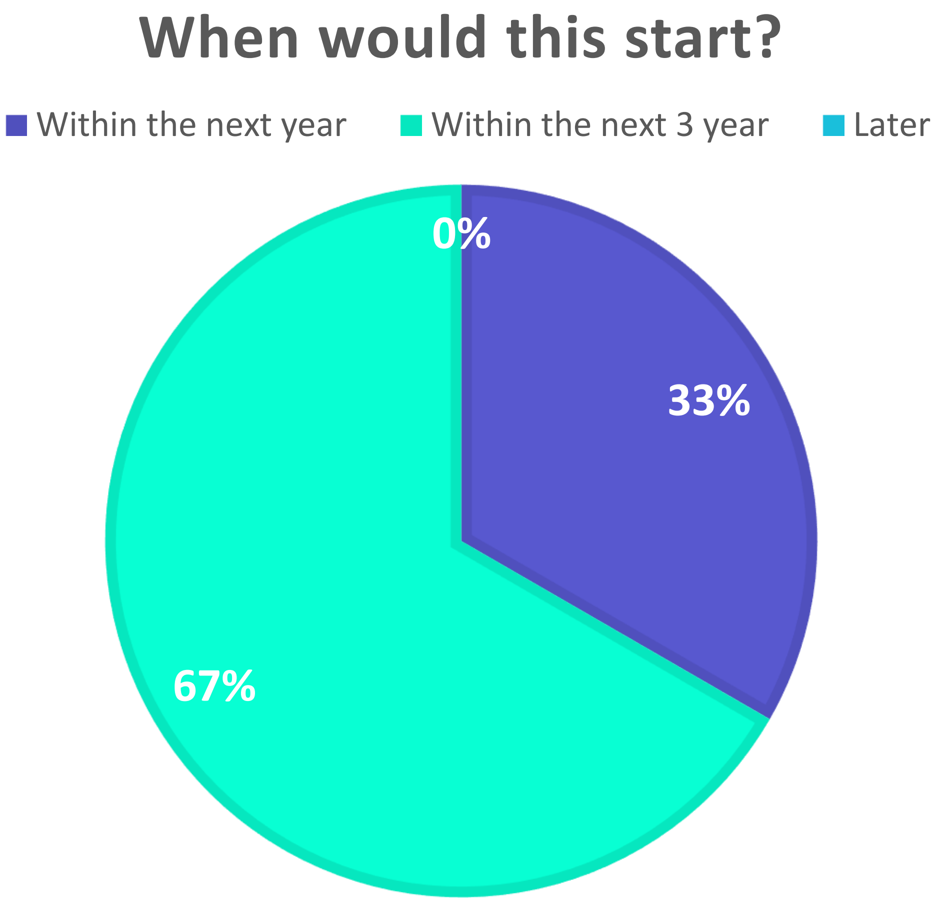

ESCOs'/Flex Providers' drivers

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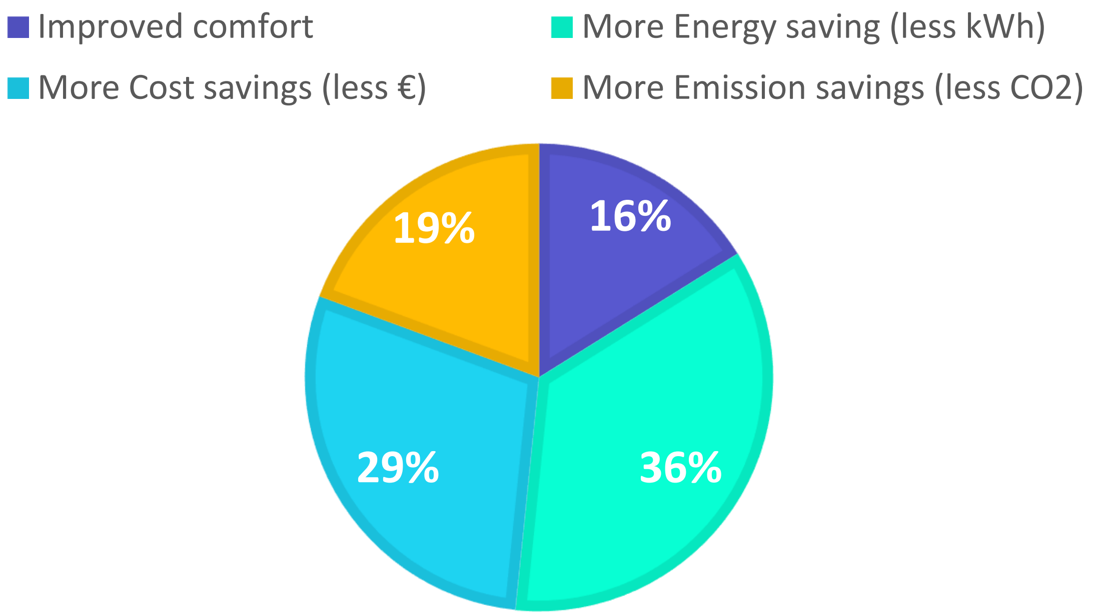
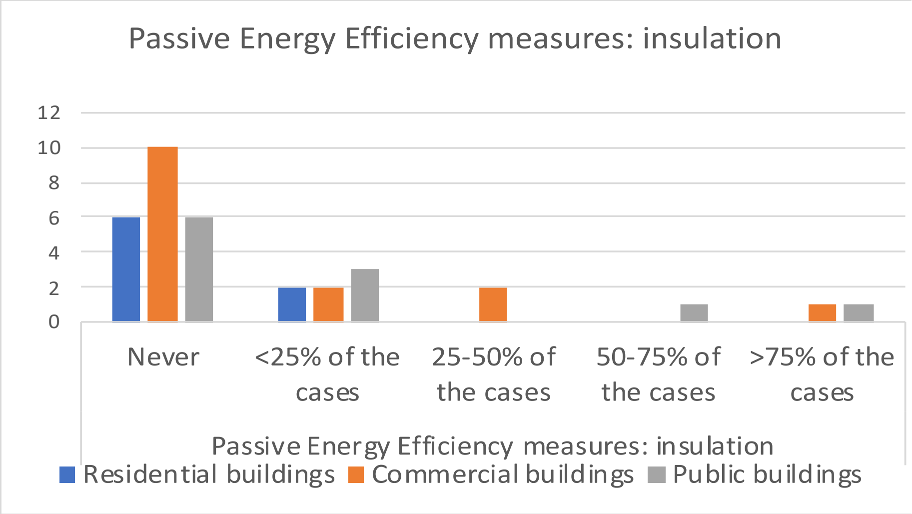
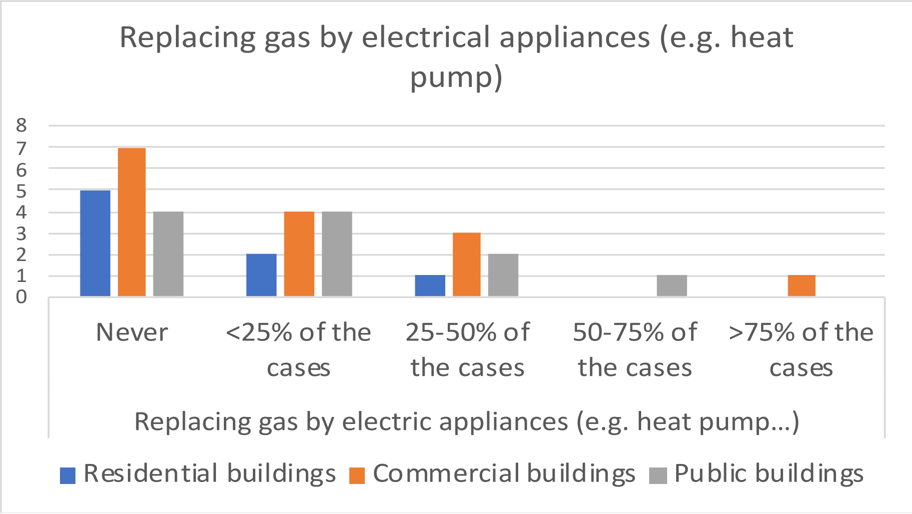
If you indicated previously that you are incorporating active/automated control measures: what is the driving factor?

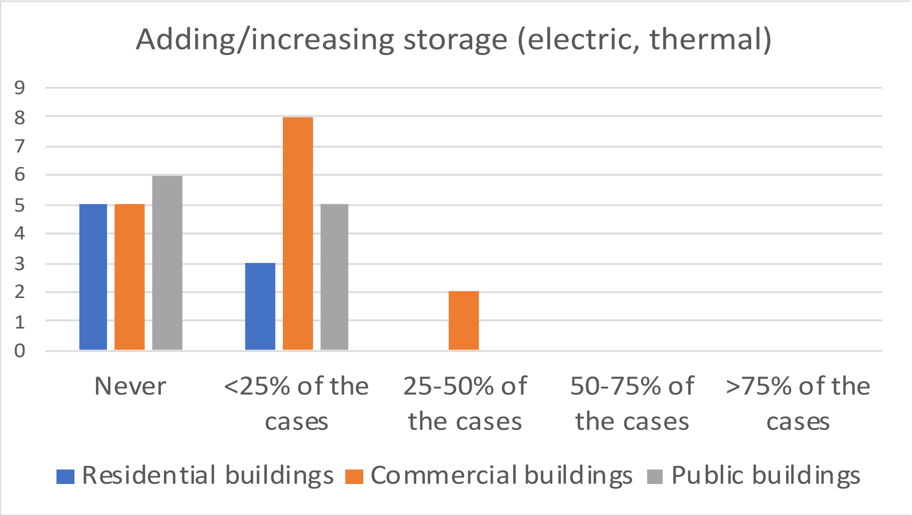


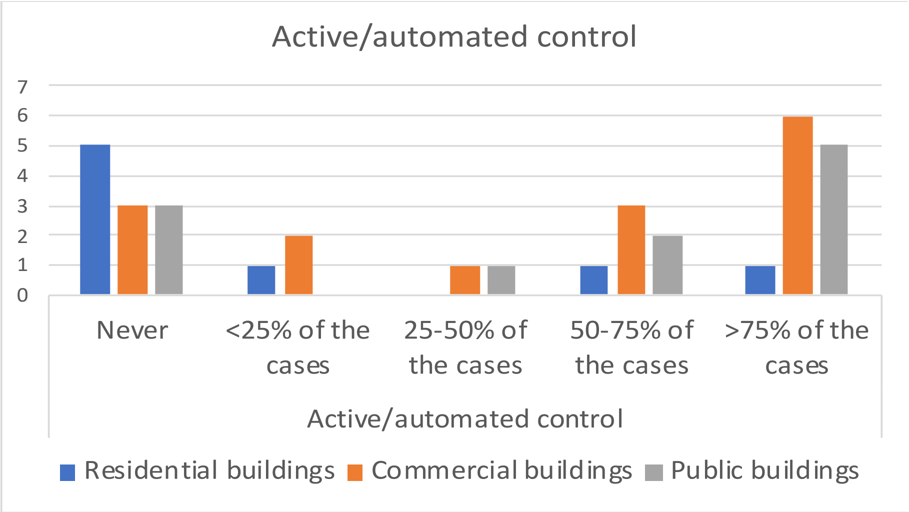
ESCOs' flexibility practices

Source: AmBIENCe survey, 2020



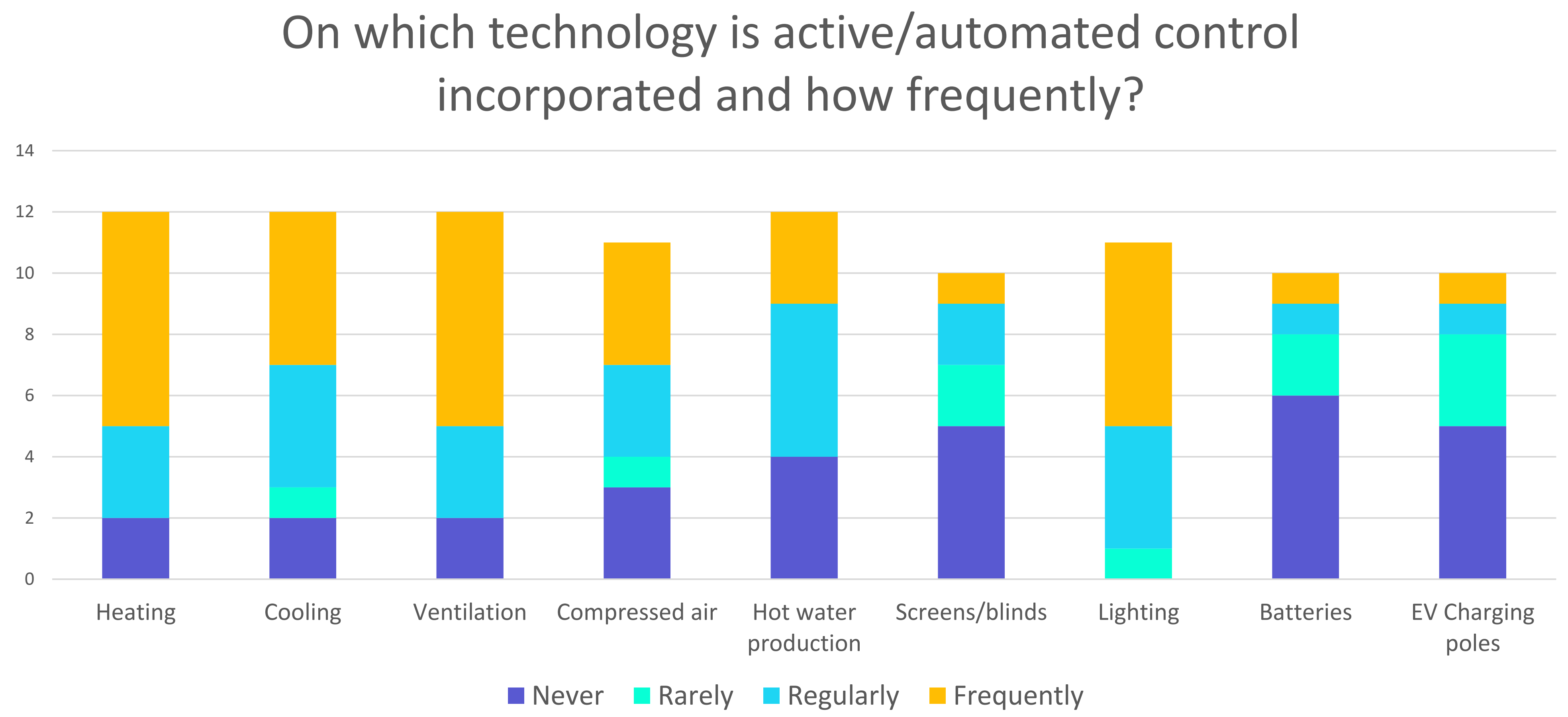






ESCOs' (as Flex Providers) use of Active Control today

Source: AmBIENCe survey, 2020



Building segments for AEPC

Building segments		EPC potential today	DR/Flexibility potential today
Residential	Private Individual	Very low	Low
	Private Collective	Moderate	Low
	Public (social) Collective	Low	Low
Public		High	Moderate
Commercial		Moderate	Moderate
Industrial	Small/Medium	Moderate	High
	Large	Low	Very High

Business case EPC vs AEPC

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Simulation for a uninsulated residential building

		Project Cashflow KPIs		
		IRR	NPV	Discounted Payback Period
Option 1: gas	EEM only	5,00 %	€ 27.616	26,07 years
Option 2: HP	EEM only	4,90 %	€ 30.789	26,63 years
	EEM + DR	5,10 %	€ 33.702	26,00 years

Does this allow us to estimate the AEPC market potential?

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- It remains very difficult because of the amount of variables
- The current EU annual ESCO Market is estimated at €1-3 Bn dollars
- There is high potential for electrification, in combination with solar (BI)PV, although the pace will depend on price evolutions with 2 conflicting tendencies
- The need to increase ambition levels will increase the need for deeper energy renovation, making heat pumps even more feasible
- Dynamic prices are likely to become more commonly available in ±5 year
- An improvement in the business case of AEPC vs EPC of 5-20% is realistic
- It is not unlikely that 20 – 30% of the EPC projects will become AEPC projects in the next 5 – 10 years
- We will survey stakeholders in the coming months on the replication potential in 10 countries, incl. Italy

Thank you for your attention!

Lieven Vanstraelen

Senior Partner & Co-owner of Energinvest/President of BELESCO

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Agenda

Active building Energy Performance Contracting (AEPC) in Italy

10:30 Welcome and introduction to the event, Marialaura Di Somma, ENEA
10:35 Introduction to the AmBIENCe project, Annick Vastiau, VITO
10:40 Status of regulatory framework (and barriers) in Italy related to flexibility in buildings, Marialaura Di Somma, ENEA
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11:40 Roundtable discussion with stakeholders
12:25 Conclusions and next steps, Marialaura Di Somma, ENEA

Italian Workshop – Belgian Pilot

30 November 2021

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Content

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- Key Elements of Belgian Pilot
- Flexibility potential
- Methodology
- Key Outputs

Key elements of Belgian Pilot

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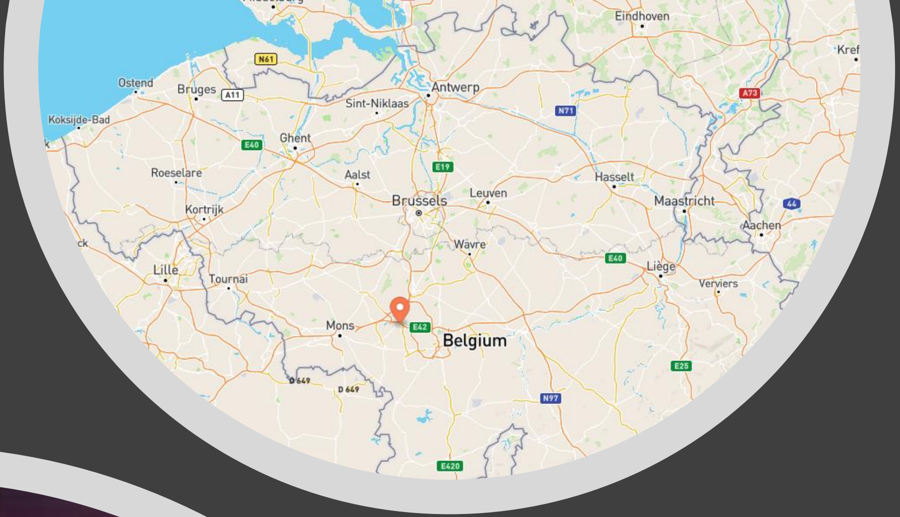
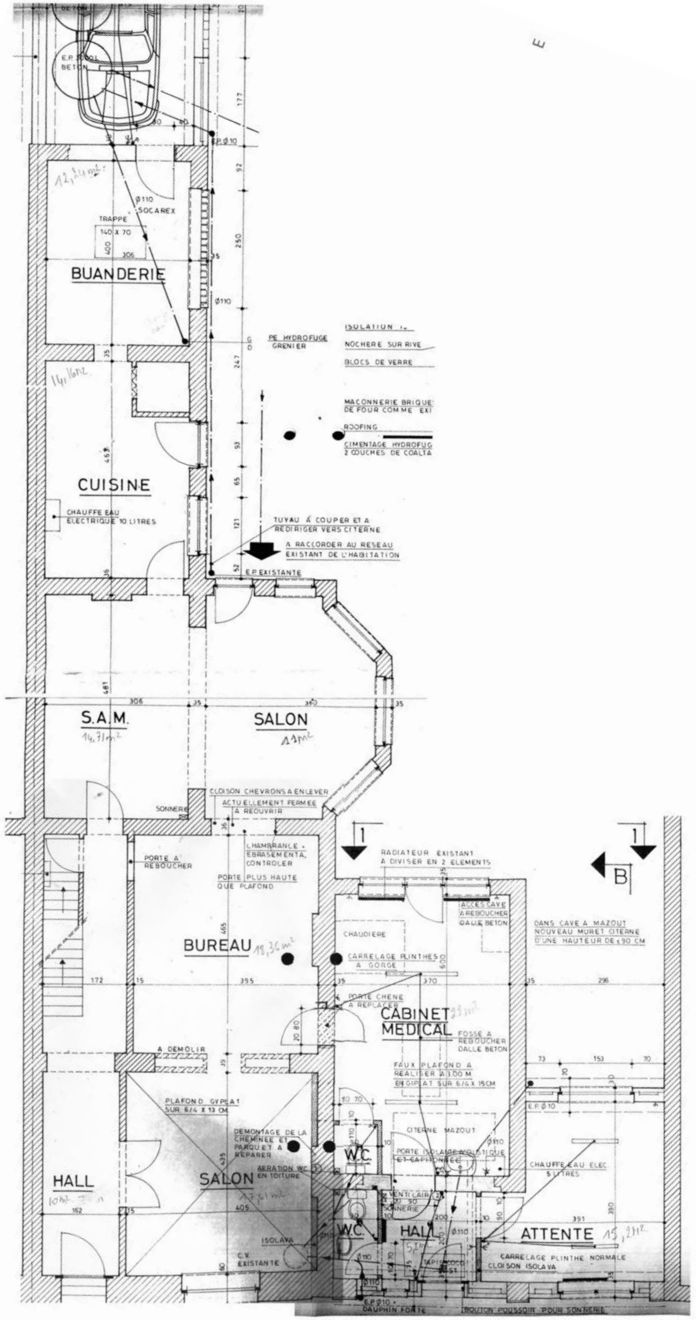
- Residential House, built in 1912
- « Maison de Maître »
- 337 m2 (excl. Basement and Garage)
- Occupied by a couple (and 2 dogs)
- Groundfloor + 2 floors
    - 1 main bedroom + bathroom
    - 3 previous bedrooms transformed into artist space (mainly for workshops)
    - Annex being transformed in main bedroom, shower room, dressing and sculpture/ceramics workspace
    - Home office space, living/dining room, small sitting room, kitchen, attic
- Heating: Wood pellet stove (2012) + condensing gas boiler (2016); mainly LED
- Mainly first generation double glazing, except home office space windows replaced by high insulation glazing (U=1.1)
- Uninsulated except terrace on top of home office (2016) and roof on bedroom/bathroom (2020)
- Very modular use and heating of spaces in winter period



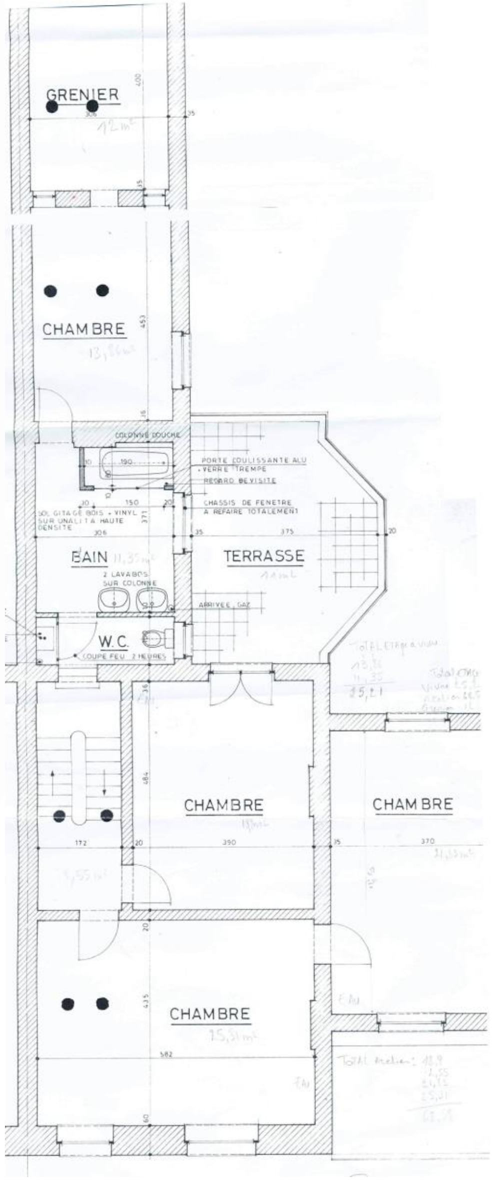
Address: rue des Canadiens 7, 7180 Seneffe, Belgium

The Seneffe Pilot Building (« Château Parmentier »)

The Pilot Building
(built in 1912)



Ground floor



1st floor

Flexibility potential

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Electrification with Heat pump to replace gas boiler

PV Panels on main and secondary roofs and some walls

Electrical vehicle, planned for 10/2021 (with V2L, later V2G capability)

Belgian Pilot Methodology

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1. Define and collect building, comfort and energy data
2. Study Energy Scan and Audit (realised as part of local energy accompaniment program)
3. Perform static simulation (LC)
    1. Define building model
    2. Perform building visit (if necessary)
    3. Determine minimum insulation (k-level < 40)
    4. Determine HP power
    5. Design scenario (incl. Investments) and calculate energy savings
    6. Build (static) BAU and EPC cases (possible more than one)
4. Perform dynamic simulation
    1. Measurement campaign (T° sensors and heat production sensor)
    2. Define input parameters and assumptions
    3. Calculate energy savings using ABEPeM tool
    4. Build (dynamic) BAU and EPC cases using EFCM-module of ABEPeM-tool
5. Monitoring
6. AEPC contract development
7. Design and implement monitoring solution
8. Lessons Learnt

Energy Scan & Energy audit (incl. Subsidies if updated)

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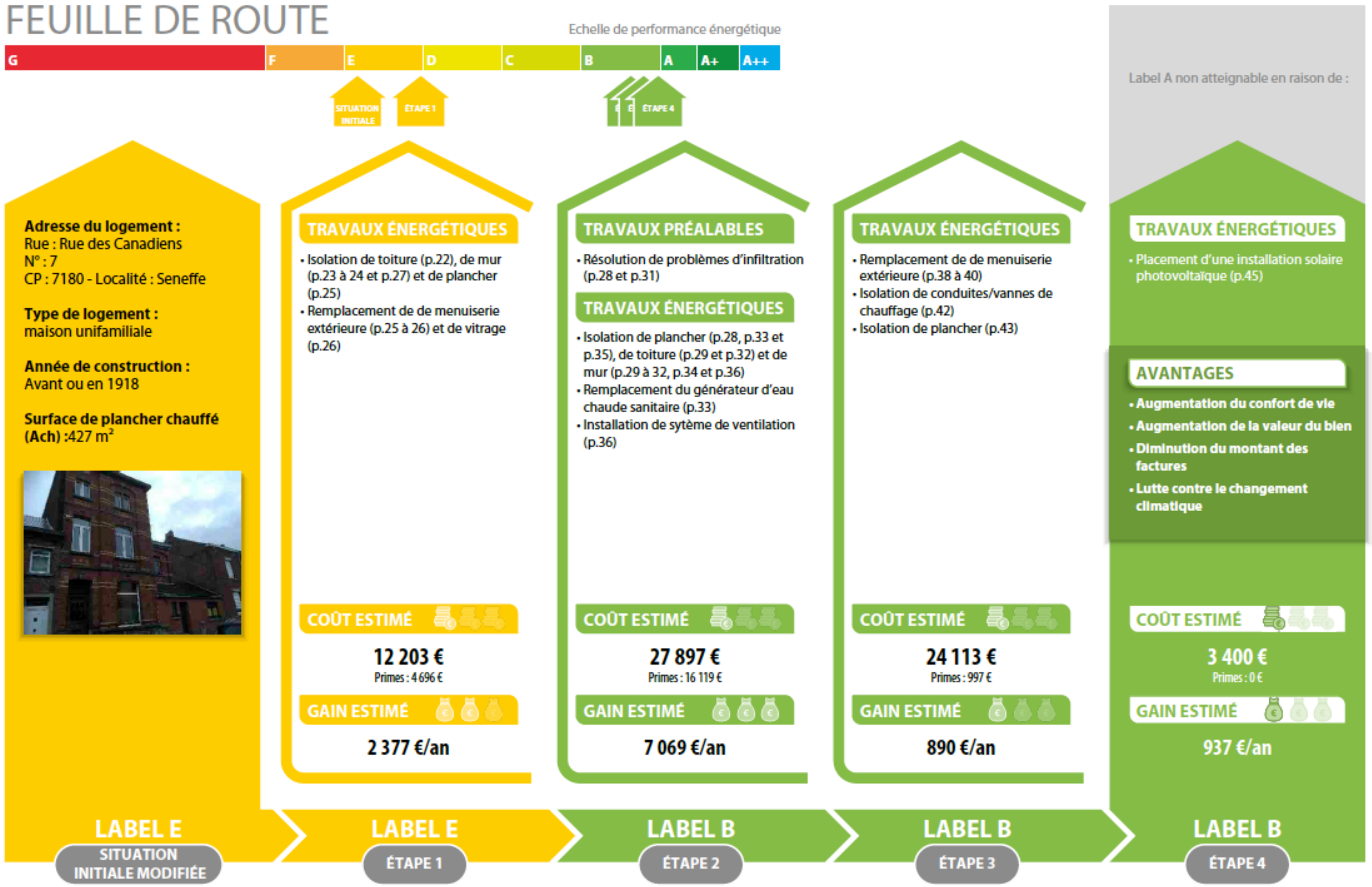


Wallonie énergie SPW

WALLORENO EN ROUTE VERS LE LABEL A

Avec l'aide de l'instrument financier LIFE de la Commission Européenne
LIFE IP CA 2016 BE-REEL

Static Simulation (Energinvest)

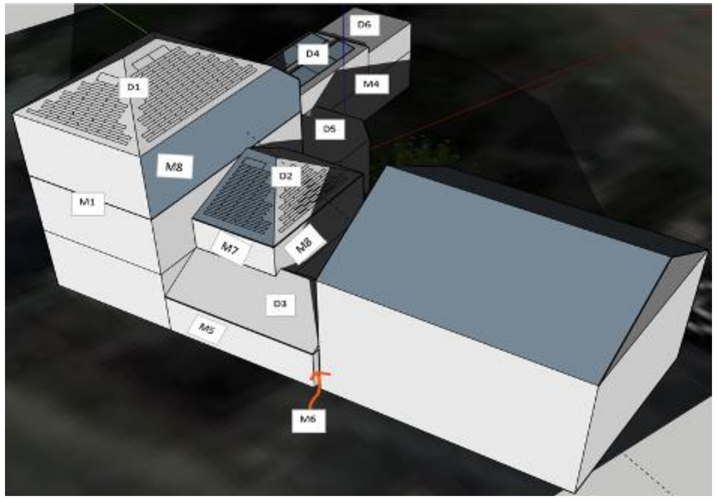
ROOF				Basecase		Scenario 1	
Code	Name	Measure (scenario 1)	Surface [m²]	U-value [W/m²K]	R-value [m²K/W]	U-value [W/m²K]	R-value [m²K/W]
D1	Main roof	Sarking roof: 10 cm PIR-insulation	81,48	5	0,20	0,2	5,00
D2 & D3	Roof annex (right)	Sarking roof: 10 cm PIR-insulation	63,79	5	0,20	0,2	5,00
D4	Flat roof annex (back)	/	54,8	0,2	5,00	0,2	5,00
D5	Terrace (BW)	8cm extra insulation on the inside (4cm is already present on the outside)	18,8	0,7	1,43	0,2	5,00
D6	Saddleback roof annex (back)	Sarking roof: 10 cm PIR-insulation	19,02	5	0,20	0,2	5,00

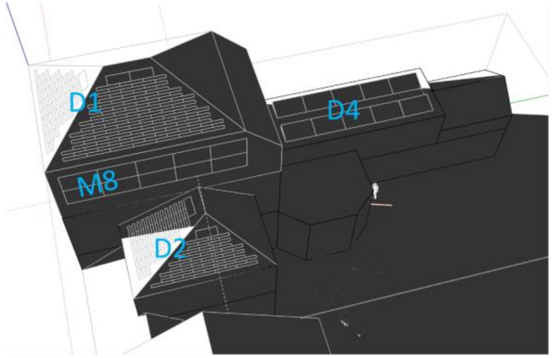
WALLS				Basecase		Scenario 1	
Code	Name	Measure (scenario 1)	Surface [m²]	U-value [W/m²K]	R-value [m²K/W]	U-value [W/m²K]	R-value [m²K/W]
M1	Facade main building	/	52,73	2,2	0,45	2,2	0,45
M2	Left facade (excl. shared surface)	/	101,06	2,2	0,45	2,2	0,45
M3	Back wall (garage)	Insulation on the outside (side garage) (10cm PUR)	11,74	1,53	0,65	0,22	4,55
M4	Right facade (back annex)	Exterior wall insulation (10cm PUR)	35,25	2,2	0,45	0,22	4,55
M5	Walls right annex (ground floor)	Cavity wall insulation (5cm rock wool)	21,89	1,41	0,71	0,6	1,67
M7	Walls right annex (1st floor)	/	9,03	2,2	0,45	2,2	0,45
M8	Right facade (cemented)	Exterior wall insulation (10cm PUR)	98,86	1,26	0,79	0,22	4,55
M9	Back walls	Exterior wall insulation (10cm PUR)	39,87	2,2	0,45	0,22	4,55

WINDOWS				Basecase		Scenario 1	
Code	Naam	Measure (scenario 1)	Surface [m²]	U-value [W/m²K]	R-value [m²K/W]	U-value [W/m²K]	R-value [m²K/W]
	Simple glazing, solid wood	Hight quality double glazing (U_{glas} = 0,9), PVC	6,3	5	0,20	1,1	0,9
	Double glazing, solid wood	Hight quality double glazing (U_{glas} = 0,9), PVC	6,8	3,1	0,32	1,1	0,9
	Double glazing, PVC	Hight quality double glazing (U_{glas} = 0,9), PVC	19,6	3,06	0,33	1,1	0,9
	Glass blocks	Hight quality double glazing (U_{glas} = 0,9), PVC	4,5	3,5	0,29	1,1	0,9
	Reinforced insulation glazing, solid wood	/	13,9	1,1	0,91	1,1	0,91
	Double reinforced insulation glazing, solid wood	/	0,6	0,9	1,11	0,9	1,11

DOORS				Basecase		Scenario 1	
Code	Name	Measure (scenario 1)	Surface [m²]	U-value [W/m²K]	R-value [m²K/W]	U-value [W/m²K]	R-value [m²K/W]
	Door to cellar + door to laundry room	/	3,04	2,94	0,34	2,94	0,34
	Kitchen door + door BW	/	5,72	3,46	0,29	3,46	0,29
	Wooden door (right annex)	/	1,81	3,64	0,27	3,64	0,27
	Front door	/	4,15	4,32	0,23	4,32	0,23

FLOOR				Basecase		Scenario 1	
Code	Name	Measure (scenario 1)	Surface [m²]	U-value [W/m²K]	R-value [m²K/W]	U-value [W/m²K]	R-value [m²K/W]
	Floors above basement	PUR-insulation on underside (4 cm)	92,86	1,12	0,89	0,45	2,2
	Floors on full ground	/	94,13	1,35	0,74	1,35	0,74





	Base case	Scenario 1
k-value	180	60

PV-INSTALLATION					
Code	Name	Slates/panels	Number	Installed power [Wp]	Yearly generated [kWh/jaar]
D1	Main roof	Slates	145	3.442	2.249
D2	Roof annex (right)	Slates	75	1.781	1.146
D4	Flat roof annex (back)	Panels	10	2.750	1.948
M8	Right facade (cemented)	Panels	10	2.750	1.382
			Total	**10.723**	**6.725**

	Base case		Scenario 1	
Total energy demand (thermal) (normal year: 2.252 degree days)	31.694	kWh/year	13.194	kWh/year
Total energy demand (thermal) (normalised for 2020: 1.867 degree days)	26.276	kWh/year	10.938	kWh/year

Investments

INSULATION MEASURES

ROOF			Scenario 1				
Code	Name	Measure (scenario 1)	U-value [W/m²K]	R-value [m²K/W]	Surface [m²]	Cost [€/m²]	Total investment [€]
D1	Main roof	Sarking roof: 10 cm PIR-insulation	0,2	5	81,48	€160/m² + €100/running meter for finishing	€ 17.137,80
D2 & D3	Roof annex (right)	Sarking roof: 10 cm PIR-insulation	0,2	5	63,79	€160/m² + €100/running meter for finishing	€ 12.753,40
D4	Flat roof annex (back)	/	0,2	5	n.a.	n.a.	n.a.
D5	Terrace (BW)	8cm extra insulation on the inside (4cm is already present on the outside)	0,2	5	18,8	€ 75,00	€ 1.410,00
D6	Saddleback roof annex (back)	Sarking roof: 10 cm PIR-insulation	0,2	5	19,02	€160/m² + €100/running meter for finishing + €1.500 dormer	€ 5.761,20
						Total	**€ 37.062,40**

WALLS			Scenario 1				
Code	Name	Measure (scenario 1)	U-value [W/m²K]	R-value [m²K/W]	Surface [m²]	Cost [€/m²]	Total investment [€]
M1	Facade main building	/	2,2	0,45	n.a.	n.a.	n.a.
M2	Left facade (excl. shared surface)	/	2,2	0,45	n.a.	n.a.	n.a.
M3	Back wall (garage)	Insulation on the outside (side garage) (10cm PUR)	0,22	4,5	11,74	€ 132,00	€ 1.549,68
M4	Right facade (back annex)	Exterior wall insulation (10cm PUR)	0,22	4,5	35,25	€ 132,00	€ 4.653,00
M5	Walls right annex (ground floor)	Cavity wall insulation (5cm rock wool)	0,6	1,7	21,89	€ 24,00	€ 525,36
M7	Walls right annex (1st floor)	/	2,2	0,45	9,03	n.a.	n.a.
M8	Right facade (cemented)	Exterior wall insulation (10cm PUR)	0,22	4,5	98,86	€ 132,00	€ 13.049,52
M9	Back walls	Exterior wall insulation (10cm PUR)	0,22	4,5	39,87	€ 132,00	€ 5.262,84
						Total	**€ 25.040,40**

WINDOWS			Scenario 1				
Code	Naam	Measure (scenario 1)	U-value [W/m²K]	R-value [m²K/W]	Surface [m²]	Cost [€/m²]	Total investment [€]
	Simple glazing, solid wood	Hight quality double glazing (U_{glas} = 0,9), PVC	1,1	0,9	6,3	€ 550,00	€ 3.465,00
	Double glazing, solid wood	Hight quality double glazing (U_{glas} = 0,9), PVC	1,1	0,9	6,8	€ 550,00	€ 3.740,00
	Double glazing, PVC	Hight quality double glazing (U_{glas} = 0,9), PVC	1,1	0,9	19,6	€ 550,00	€ 10.780,00
	Glass blocks	Hight quality double glazing (U_{glas} = 0,9), PVC	1,1	0,9	4,5	€ 550,00	€ 2.475,00
	Reinforced insulation glazing, solid wood	/	1,1	0,9	n.a.	n.a.	n.a.
	Double reinforced insulation glazing, solid wood	/	0,9	1,1	n.a.	n.a.	n.a.
						Total	**€ 20.460,00**

DOORS			Scenario 1				
Code	Name	Measure (scenario 1)	U-value [W/m²K]	R-value [m²K/W]	Surface [m²]	Cost [€/m²]	Total investment [€]
	Door to cellar + door to laundry r	/	2,94	0,34	3,04	n.a.	n.a.
	Kitchen door + door BW	/	3,46	0,29	5,72	n.a.	n.a.
	Wooden door (right annex)	/	3,64	0,27	1,81	n.a.	n.a.
	Front door	/	4,32	0,23	4,15	n.a.	n.a.
						Total	**nvt**

FLOOR			Scenario 1				
Code	Name	Measure (scenario 1)	U-value [W/m²K]	R-value [m²K/W]	Surface [m²]	Cost [€/m²]	Total investment [€]
	Floors above basement	PUR-insulation on underside (4 cm)	0,45	2,2	92,86	€ 25,00	€ 2.321,50
	Floors on full ground	/	1,35	0,7	94,13	n.a.	n.a.
						Total	**€ 2.321,50**

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SUMMARY (excl. VAT)	
Total cost (all investments)	€ 84.884,30
Total PV	€ 20.668,71
Total heat pump	€ 10.763,00
	€ 116.316,01

01/12/2021

Measurement campaign (T° and heat production)

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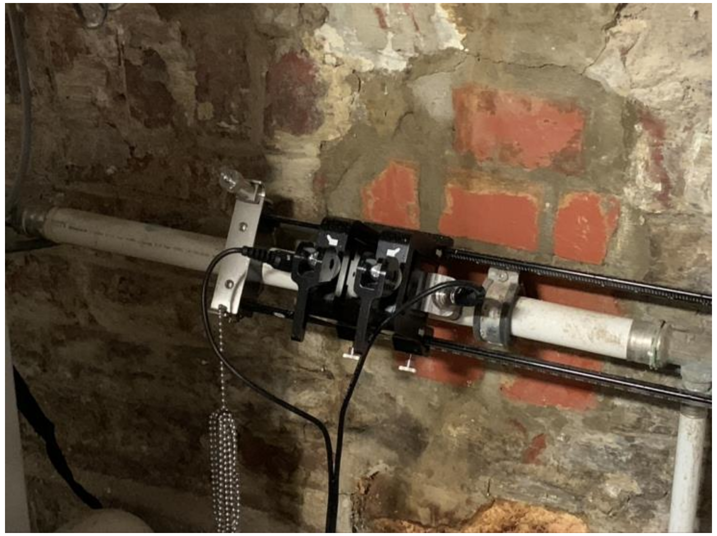

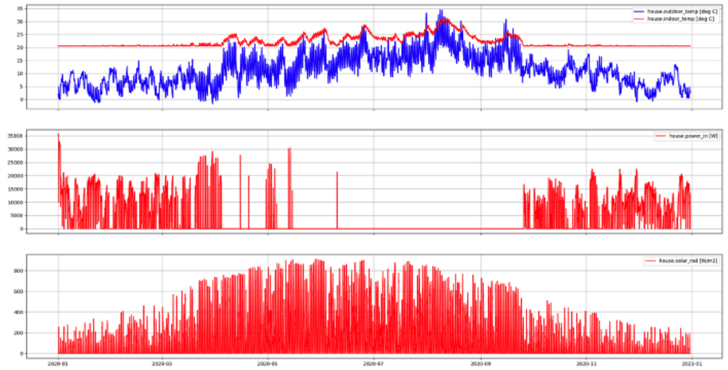

Seneffe building pilot: Key outputs

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- (Partial) Residential AEPC Business model validation
- Requirements for Active control and ABEPeM integration in “Home Control” EMS
- Residential AEPC contract, validated by several Belgian ESCOs & basis for template that be used by other ESCOs
- Monitoring solution design and evaluation
- Measurement and Verification (M&V) methodology for residential AEPC case
- BE Pilot Business Case calculations and evaluation

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Italian Stakeholder Workshop – Portuguese Pilot

30 November 2021

Claire Harvey

EDP CNET

EDP Porto HQ Pilot

- Building A, built in 2011
- No implemented EPC
- ~18.654 m^2
- 10 floors
    - open office space on floors 2-6
    - “critical rooms” which need cooling
    - 3 underground floors with 15 EV chargers
- ~600 users
- Mainly LED lighting controlled via Schedule
- Solar PV (all self consumed)
- Power driven shading blinds

Building HVAC

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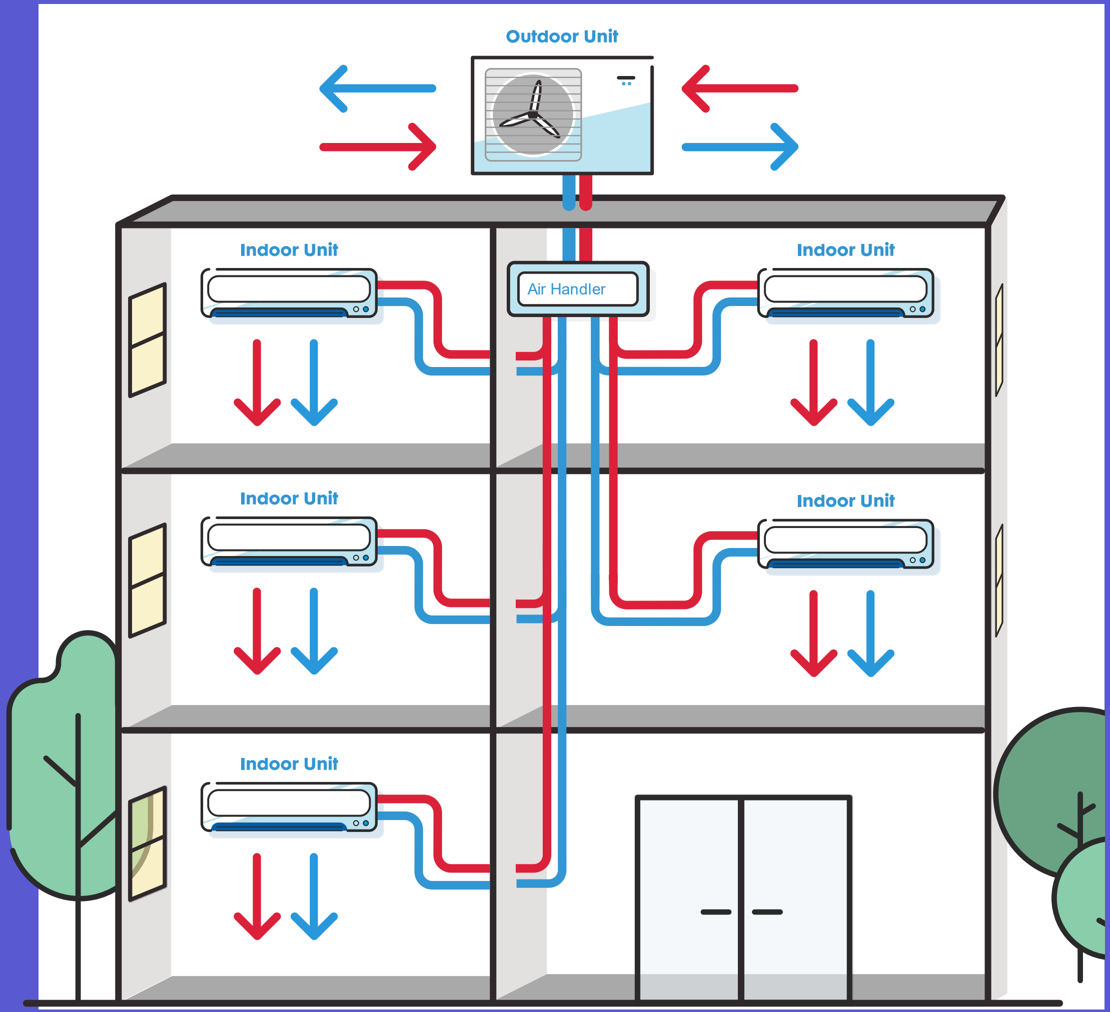
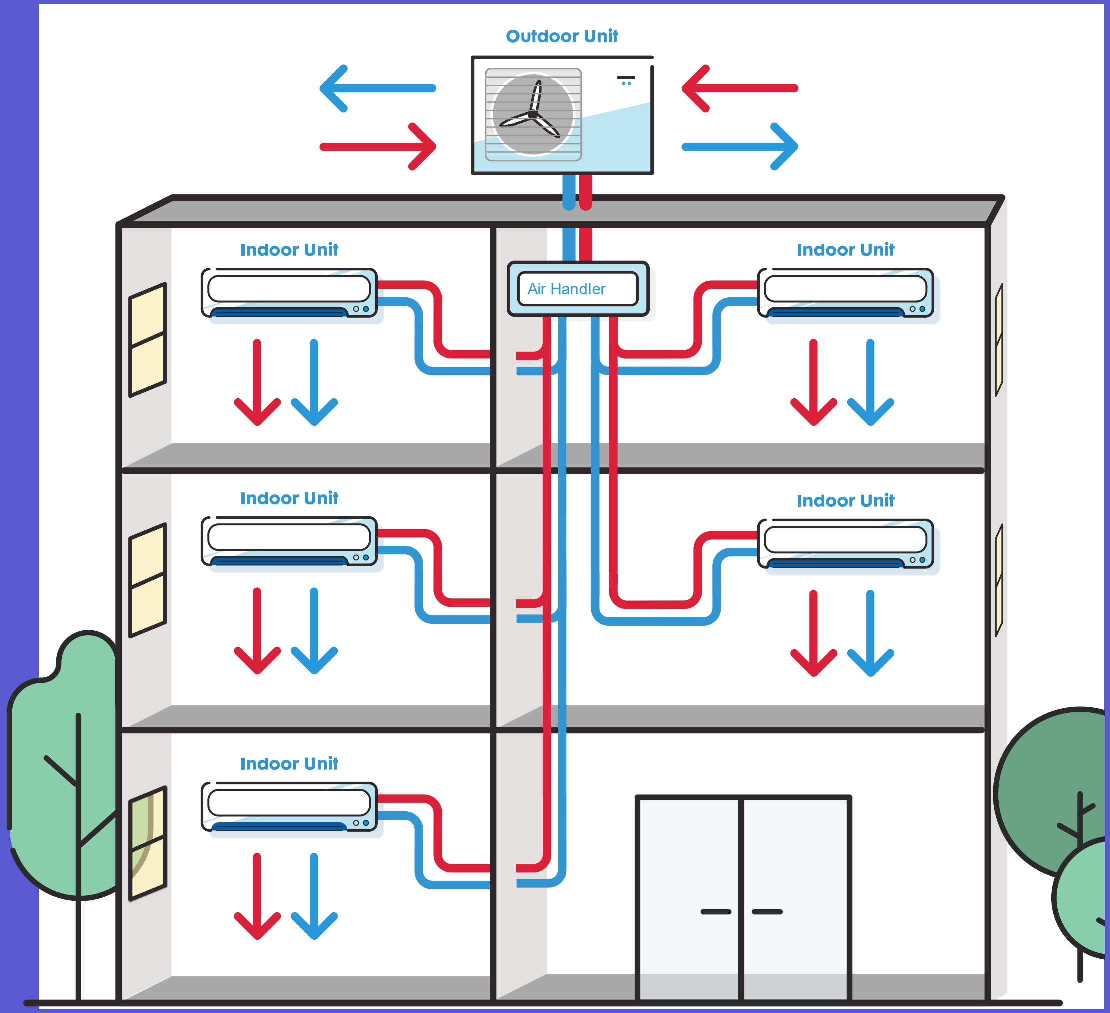


VRF system:

- Centrally controlled HVAC for most spaces, operated by adjusting temperature of fan coils in open space offices – provided from 3 chillers and a heat pump located on rooftop
- 2 large Air Handling Units (AHUs) supply the office space floors
- BMS and associated Thermal Control System (TCS) has real-time information of all the indoor units setpoints and temperatures and can control all the indoor units.

Building HVAC



- The Thermal Control System (TCS):
  - Defines the comfort band (CB)
  - Compares the CB with the real temperature
  - Actuates if the real time temperature is out of the CB range plus the dead band (DB) tolerance
  - 3 levels of comfort (economy/pre comfort/comfort)

Making use of the Flexibility of HVAC

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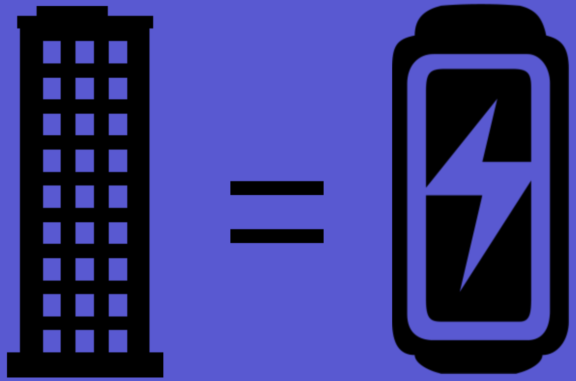

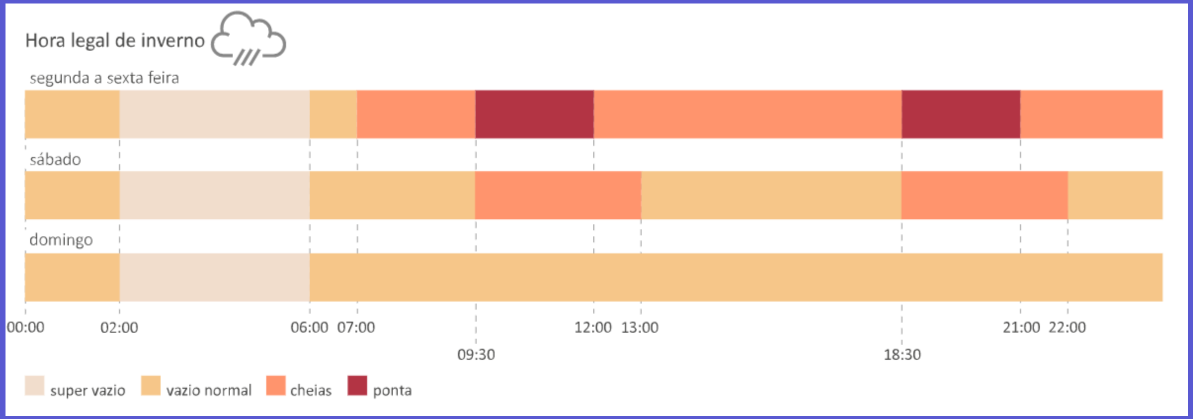

- Building acts as a **thermal battery** taking advantage of its thermal inertia.
- Shift energy consumption across different periods through **active control.**
- Taking advantage of the different **time of use (ToU)** energy tariffs.

Classic EEM

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	Measure	Estimated investment cost	Reduction in the annual electricity bill	Payback period
1	Substitution for LED lighting	51 378 €	11 145 €	5 years
2	Stand-by optimisation	0 €	11 654 €	Immediate
3	Installation of variable speed drives in the ventilation system	32 005 €	10 646 €	3 years
4	Chillers substitution	146 649€	11 629 €	13 years
5	Installation of 8 kWp of PV	22 303 €	1 817 €	12 years
	TOTAL	105 686 €	35262 €	

Porto Building Pilot : Key Outputs

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- Business models combining classic EEM and Demand Response Flexibility measures for optimised control of building's assets, while maintaining comfort levels
- Detailed requirements for active control: software/algorithm integration, monitoring, hardware. Including technical and financial considerations for the development of the BMS for actuating the active control measures
- Collaboration between various stakeholders – Ambience team, Asset Management, Building Managers, Building operators, etc to realise the AEPC concept
- Template AEPC contract with all relevant technical clauses will be produced to be used in future services by EDPs ESCO department

Agenda

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Roundtable discussion

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Thank you for participating

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Joint event

30^{th} November 2021

10:30 am - 12:30 pm (CET)