

An aerial, high-angle photograph of a dense urban environment, likely a city center, with numerous high-rise buildings and a complex network of streets. The entire image is overlaid with a semi-transparent blue filter. In the center, there is a white logo consisting of a stylized 'a' followed by three horizontal lines, and the word 'ambience' in a lowercase, sans-serif font.

a≡ ambience



The “**ABEPeM**” platform

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

Presented at FLEXCON online webinar, 28 October 2020.

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VITO / EnergyVille

what is **ABEPeM** ?

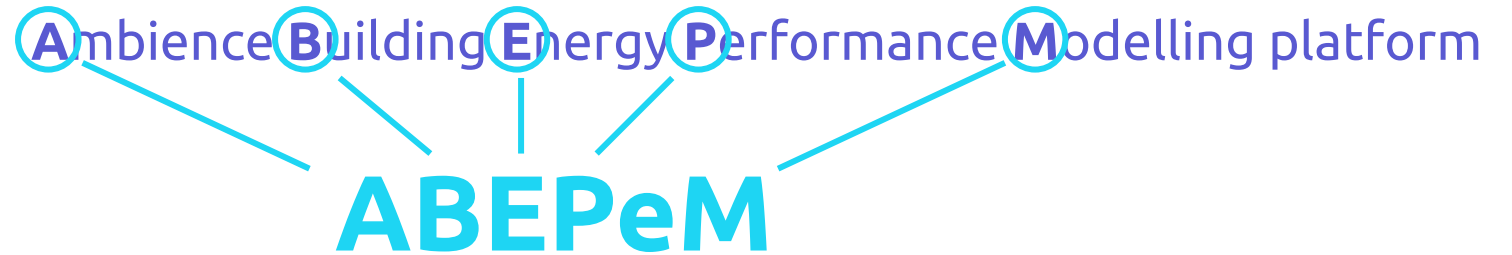
building blocks of **ABEPeM**

energy cost cash flow estimation sub-tool

some examples

final remarks

What is 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*



multiple
stakeholders



multiple
renovations



multiple
DR control
strategies



multiple
DR cash flows

Multiple stakeholders



multiple
stakeholders



multiple
renovations



multiple
DR control
strategies



multiple
DR cash flows

- tenant
- building owner – tennant
- building owner – landlord
- real estate corporation
- financial institutions
- 3rd party investors

Multiple renovations

In principle very generic approach (not limited to buildings), but focus on:

- insulation
- electrification of heating system
- electrification of domestic hot tap water
- local (renewable) energy production
- energy storage
- electric vehicle charging



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multiple
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multiple
DR control
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multiple
DR cash flows

Multiple DR control strategies **ambience**

- Standard control strategies (PI, ON/OFF)
- Smart control with multiple objectives
 - minimize energy consumption
 - maximize self consumption
 - minimize cost
 - minimize emissions



multiple
stakeholders



multiple
renovations



multiple
DR control
strategies



multiple
DR cash flows

Multiple DR cash flows

In principle support for **direct** and **indirect** demand response schemes, but focused in indirect demand response:

- fixed or TOU electricity prices
- dynamic electricity prices
- different price for grid and renewable energy
- net metering
- injection tariff
- peak prices
- capacity tariff

Poll

What type of demand response is most suitable for buildings in your opinion?

- Direct demand response
- Indirect demand response
- Both
- No opinion

what is **ABEPeM** ?

building blocks of **ABEPeM**

energy cost cash flow estimation sub-tool

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ABEPeM during the contracting phase

Step 1: collect building historical data

Historical data

- weather
- energy consumption
- price info
- ...

*Configuration
sub-tool*

*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

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

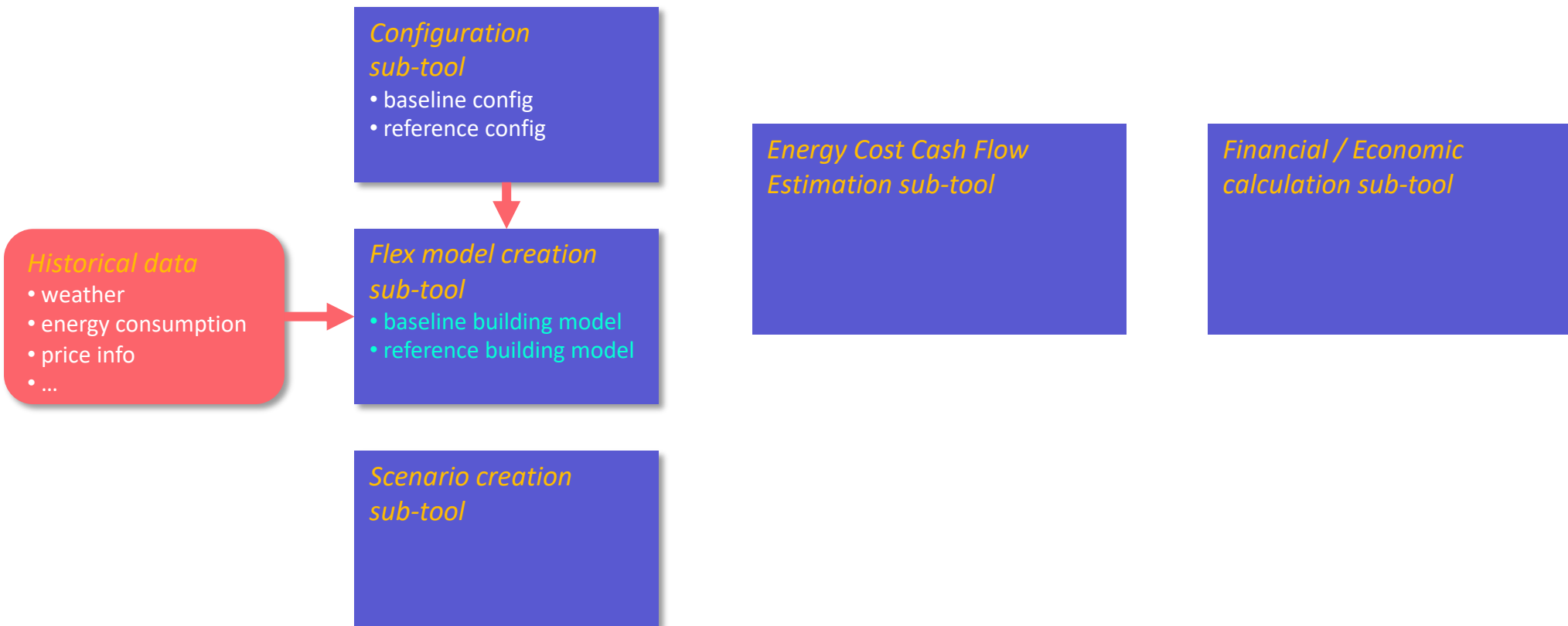
Scenario creation sub-tool

Energy Cost Cash Flow Estimation sub-tool

Financial / Economic calculation sub-tool

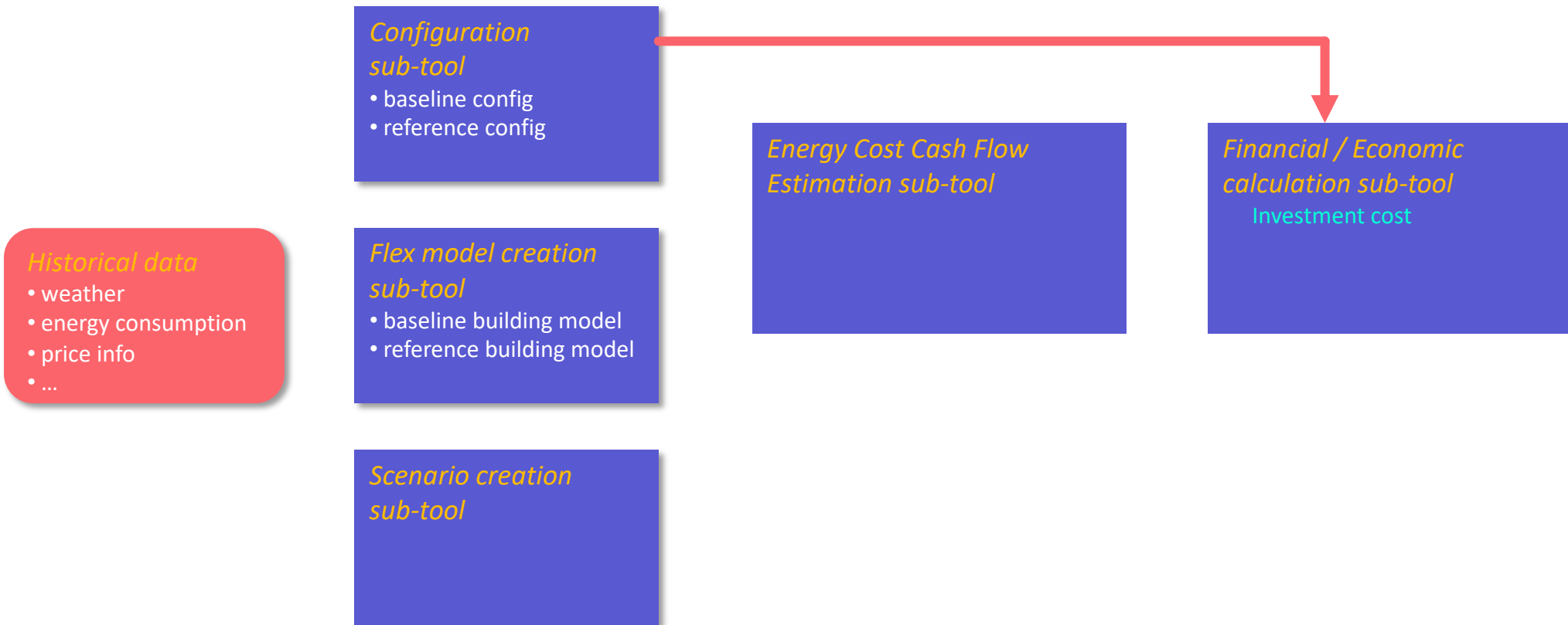
ABEPeM during the contracting phase

Step 3: create baseline and reference building models



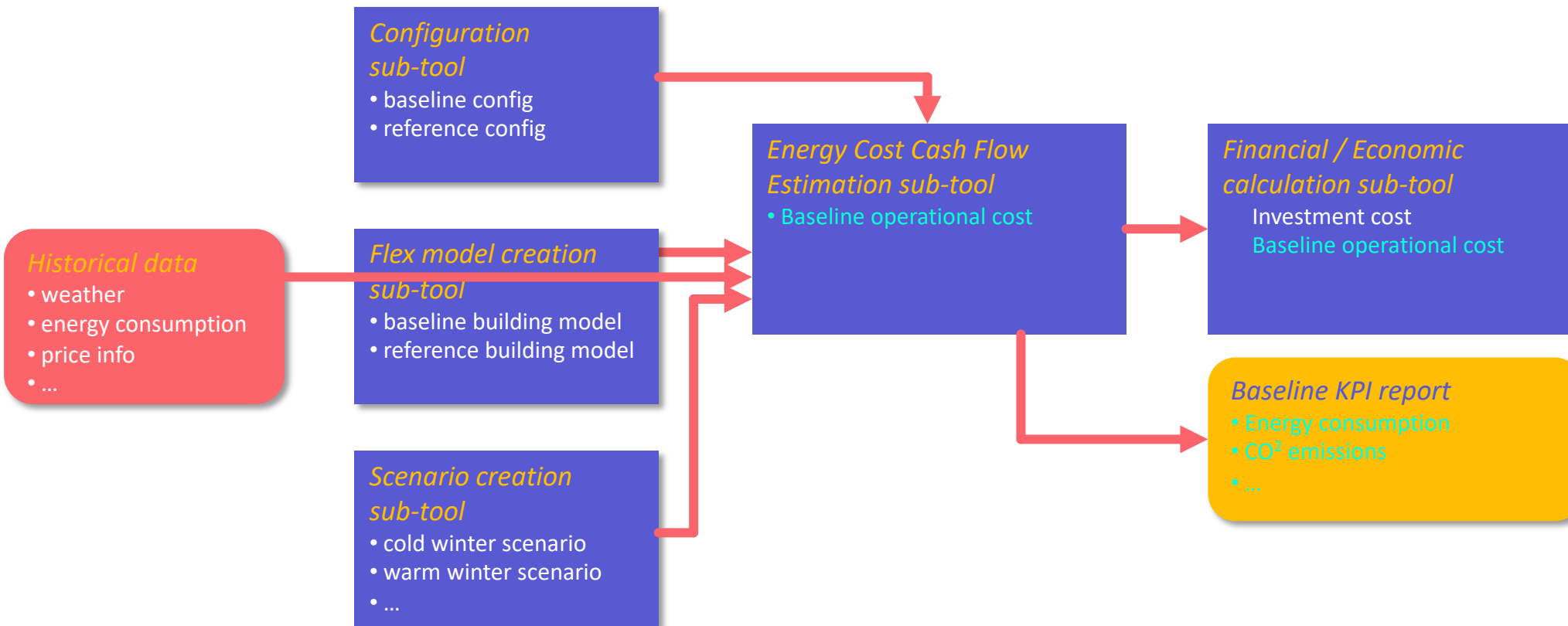
ABEPeM during the contracting phase

Step 4: calculate investment cost



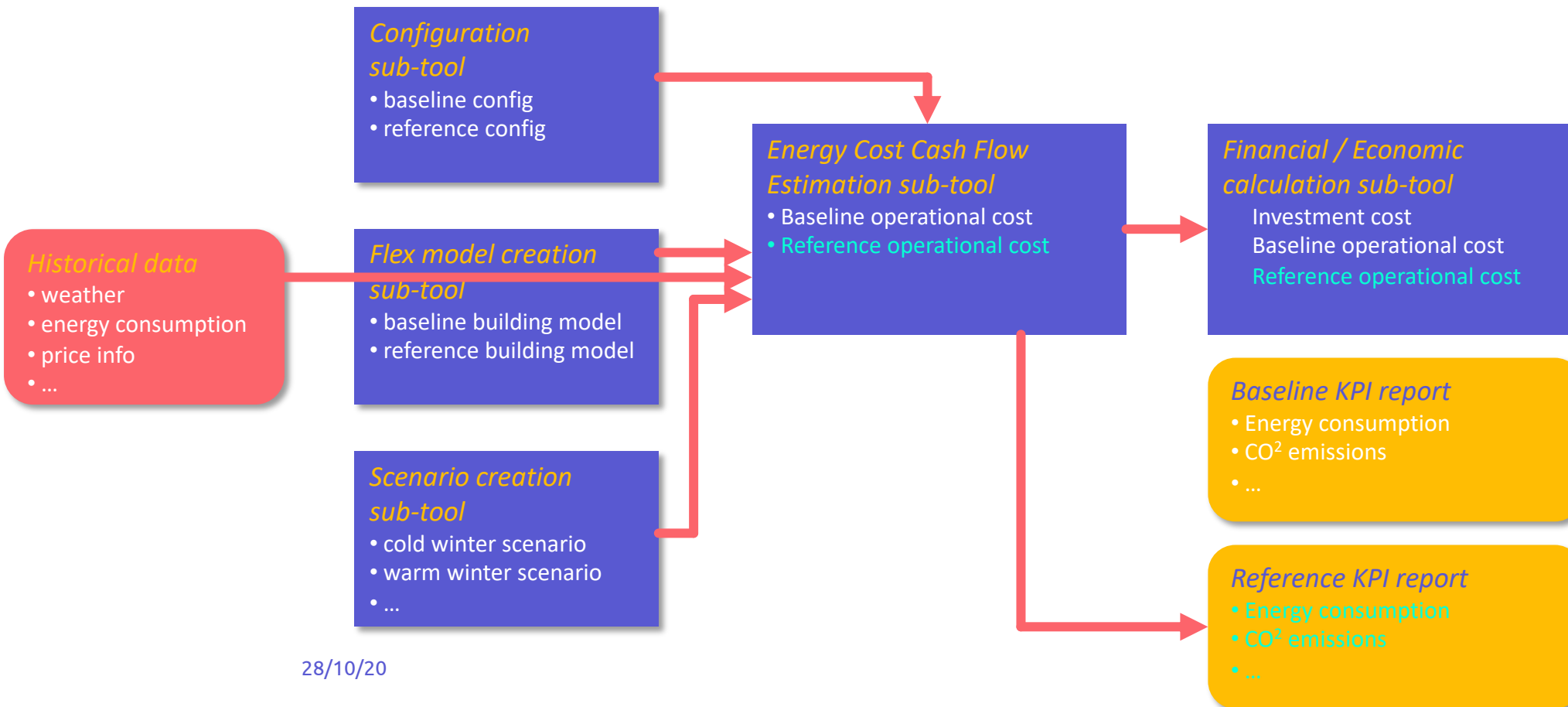
ABEPeM during the contracting phase

Step 5: calculate baseline operational cost



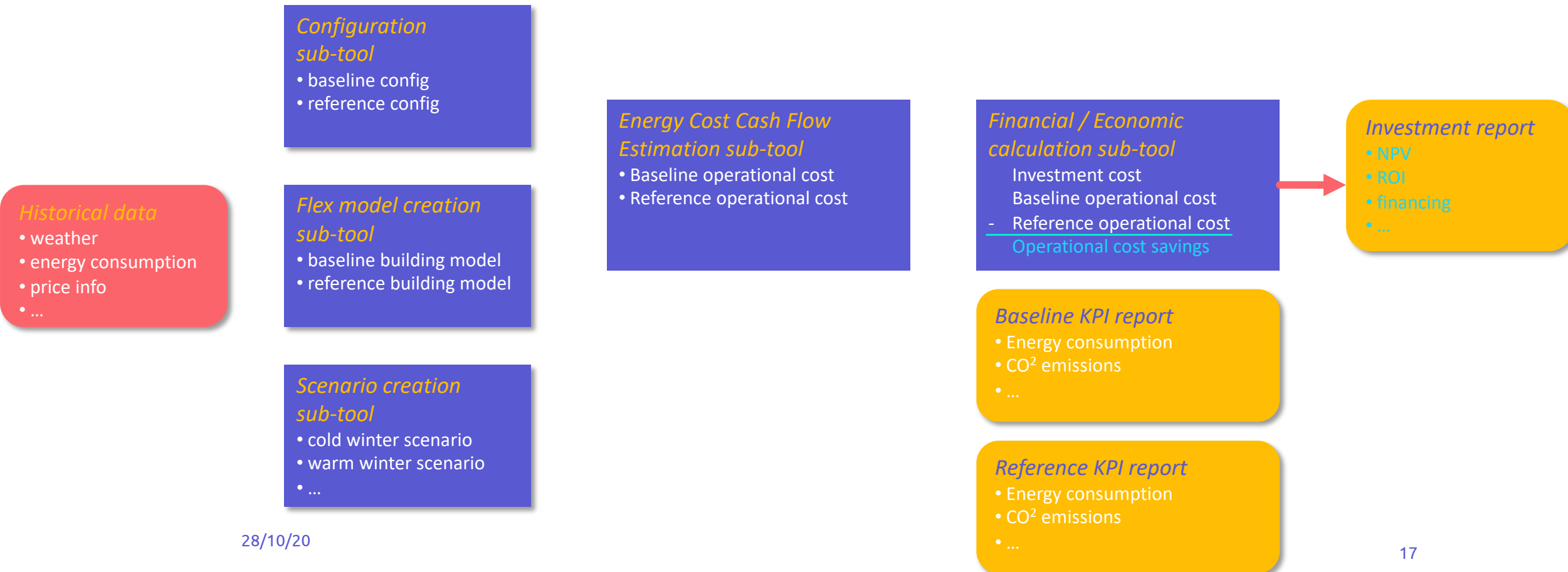
ABEPeM during the contracting phase

Step 6: calculate reference operational cost

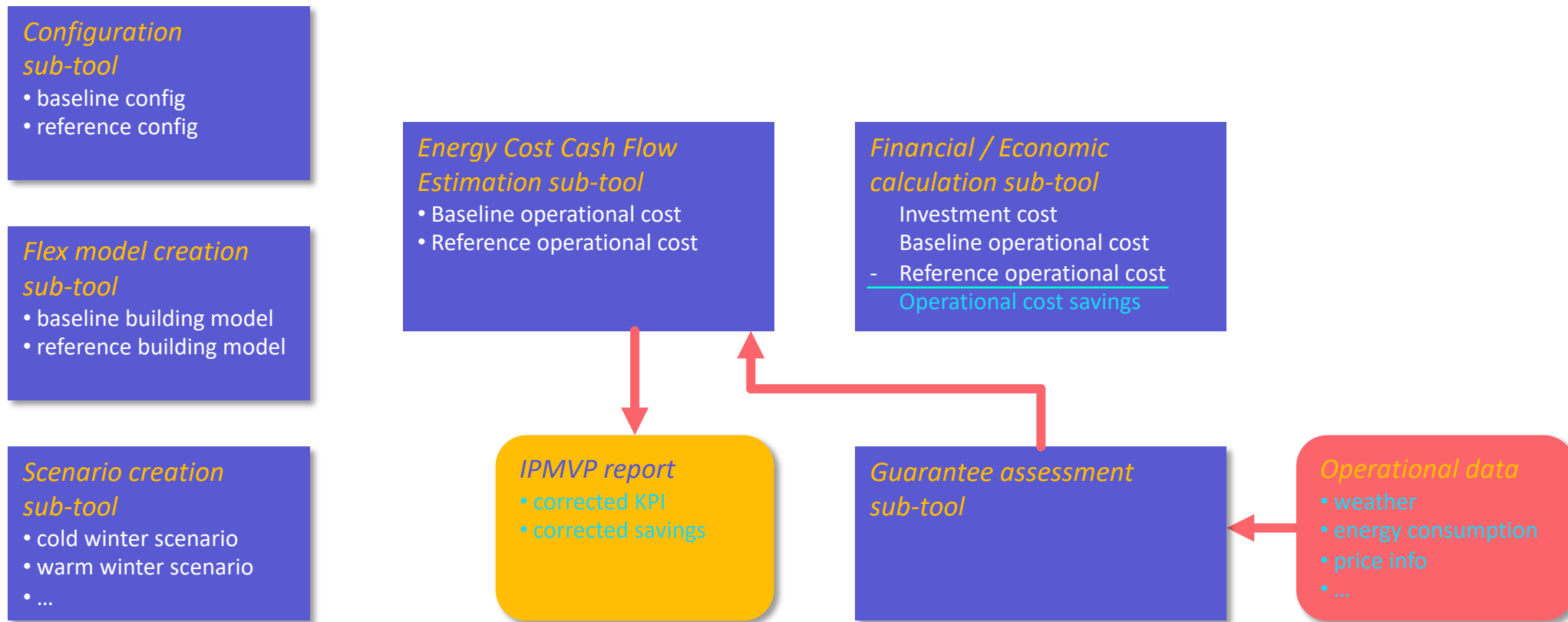


ABEPeM during the contracting phase

Step 7: generate investment report



ABEPeM during the performance phase



what is **ABEPeM** ?

building blocks of **ABEPeM**

energy cost cash flow estimation sub-tool

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Multiple commodity collector concept

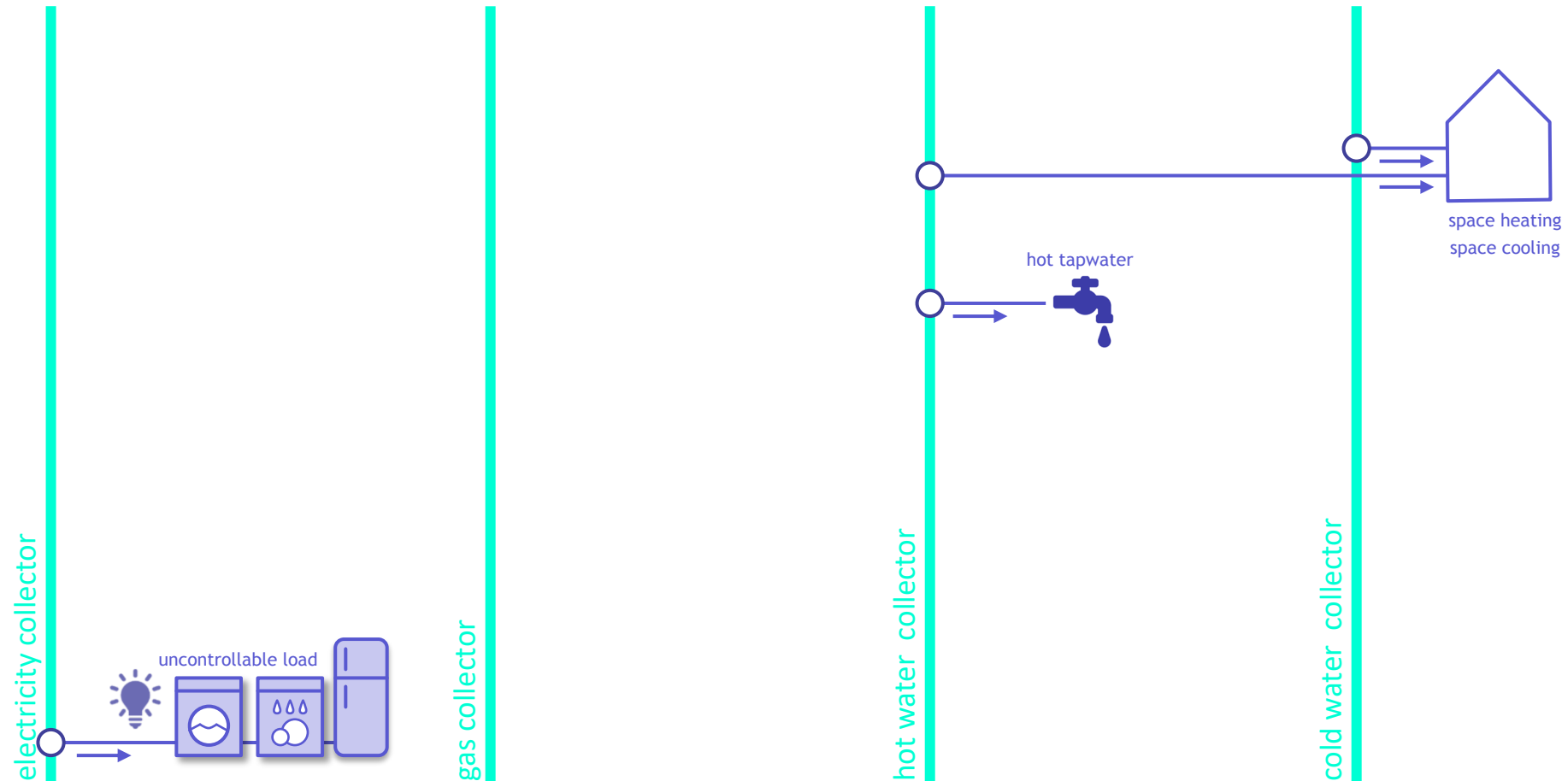
electricity collector

gas collector

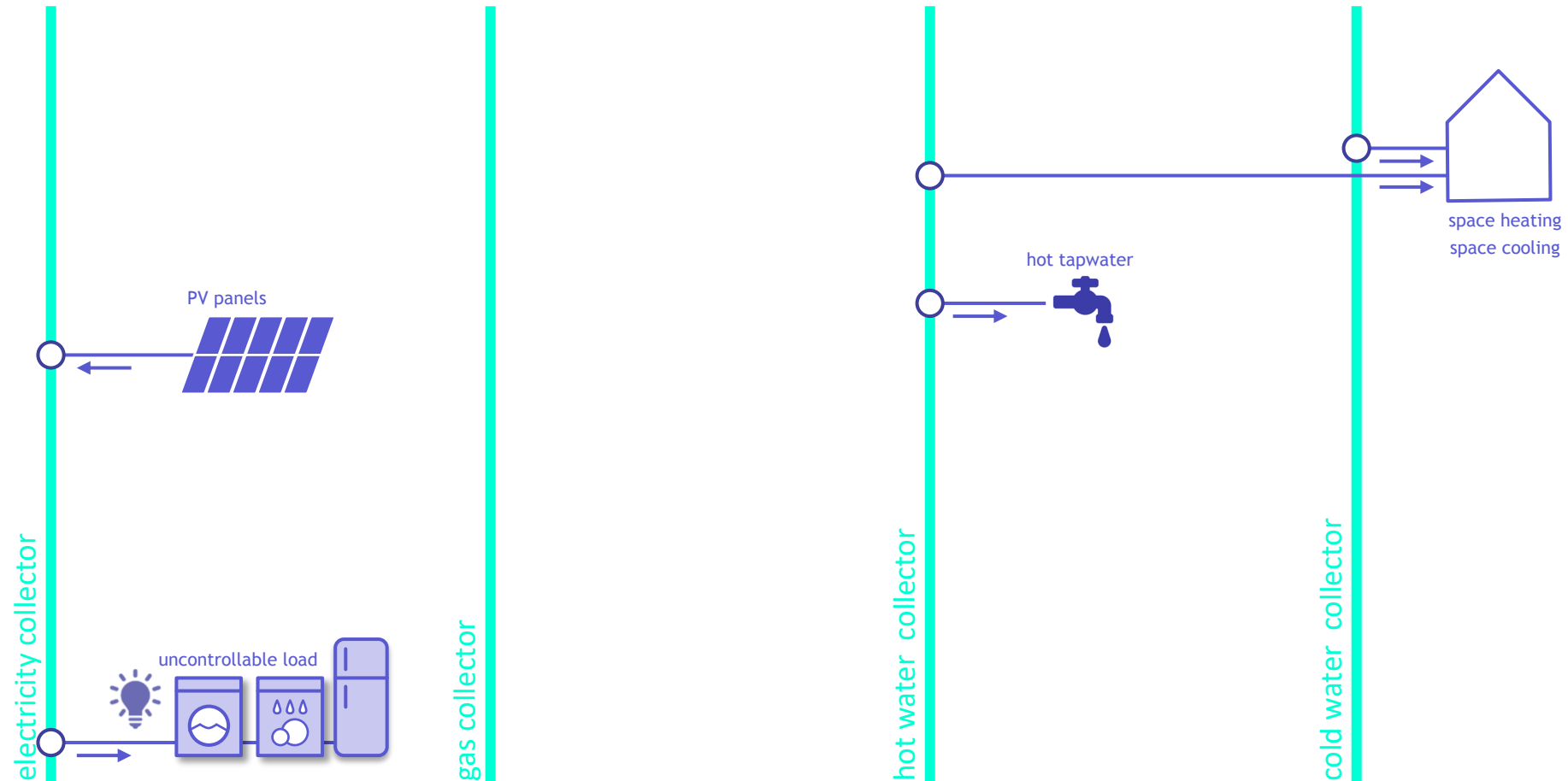
hot water collector

cold water collector

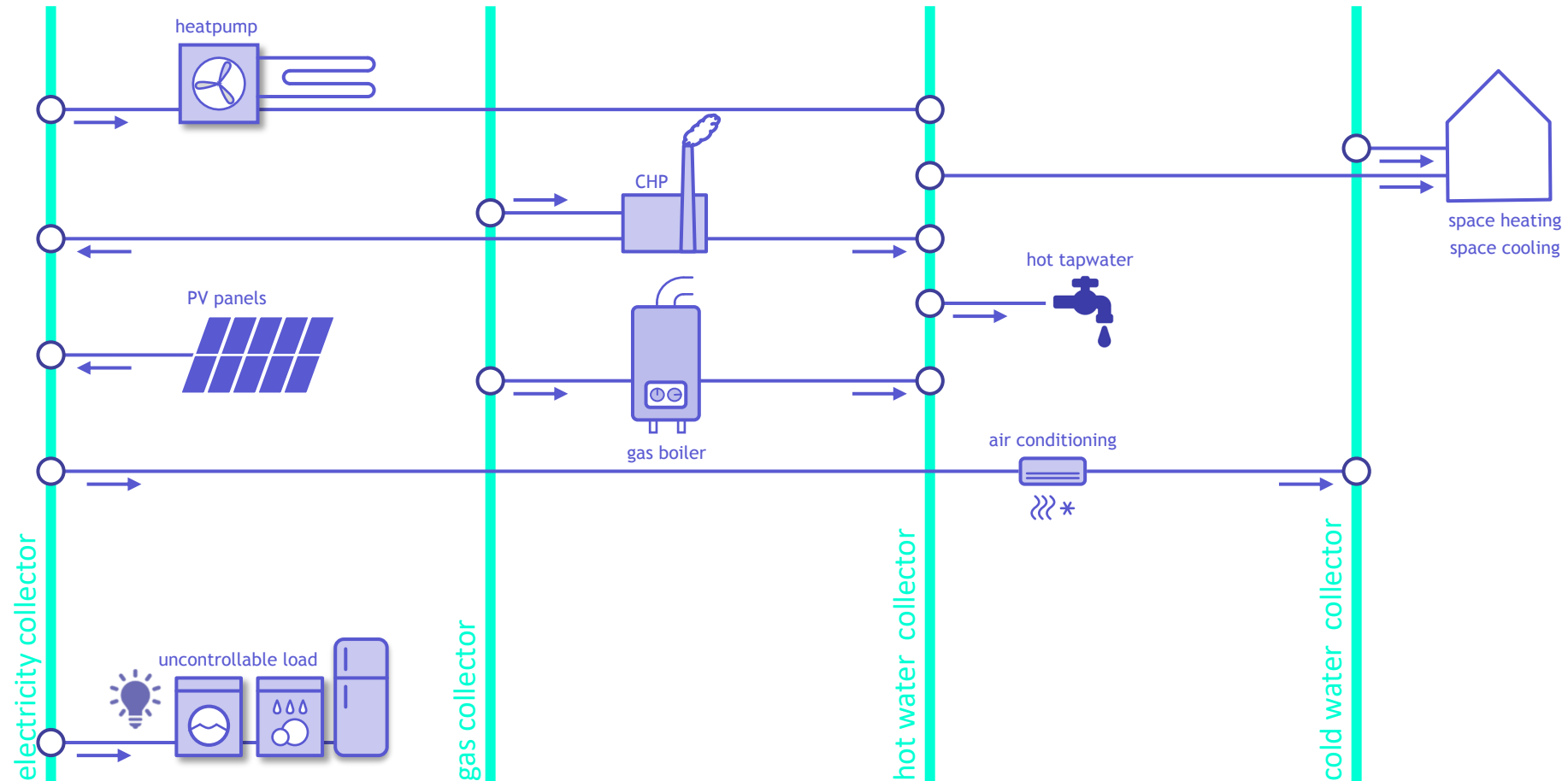
Commodity consuming devices



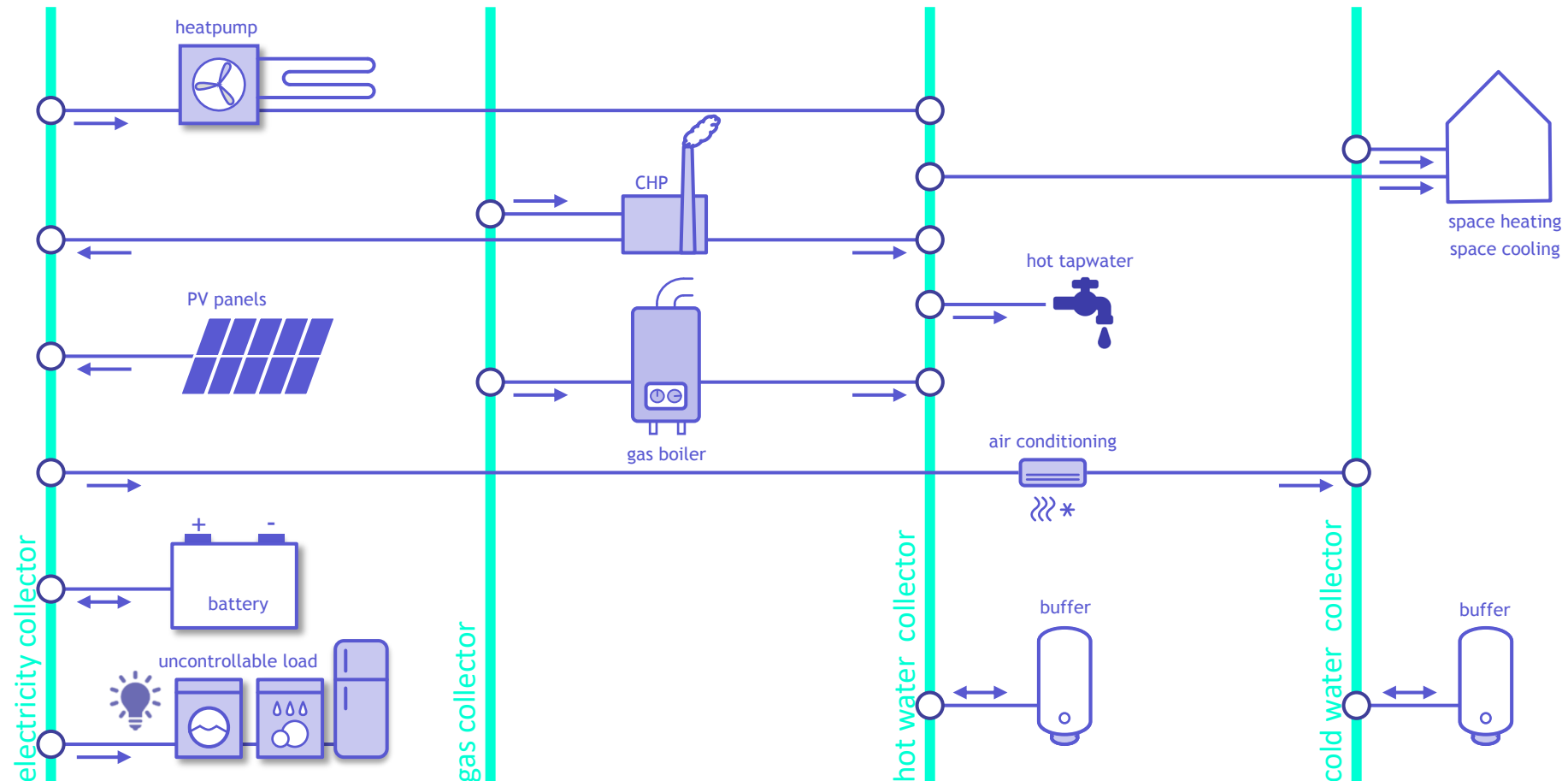
Commodity producing devices



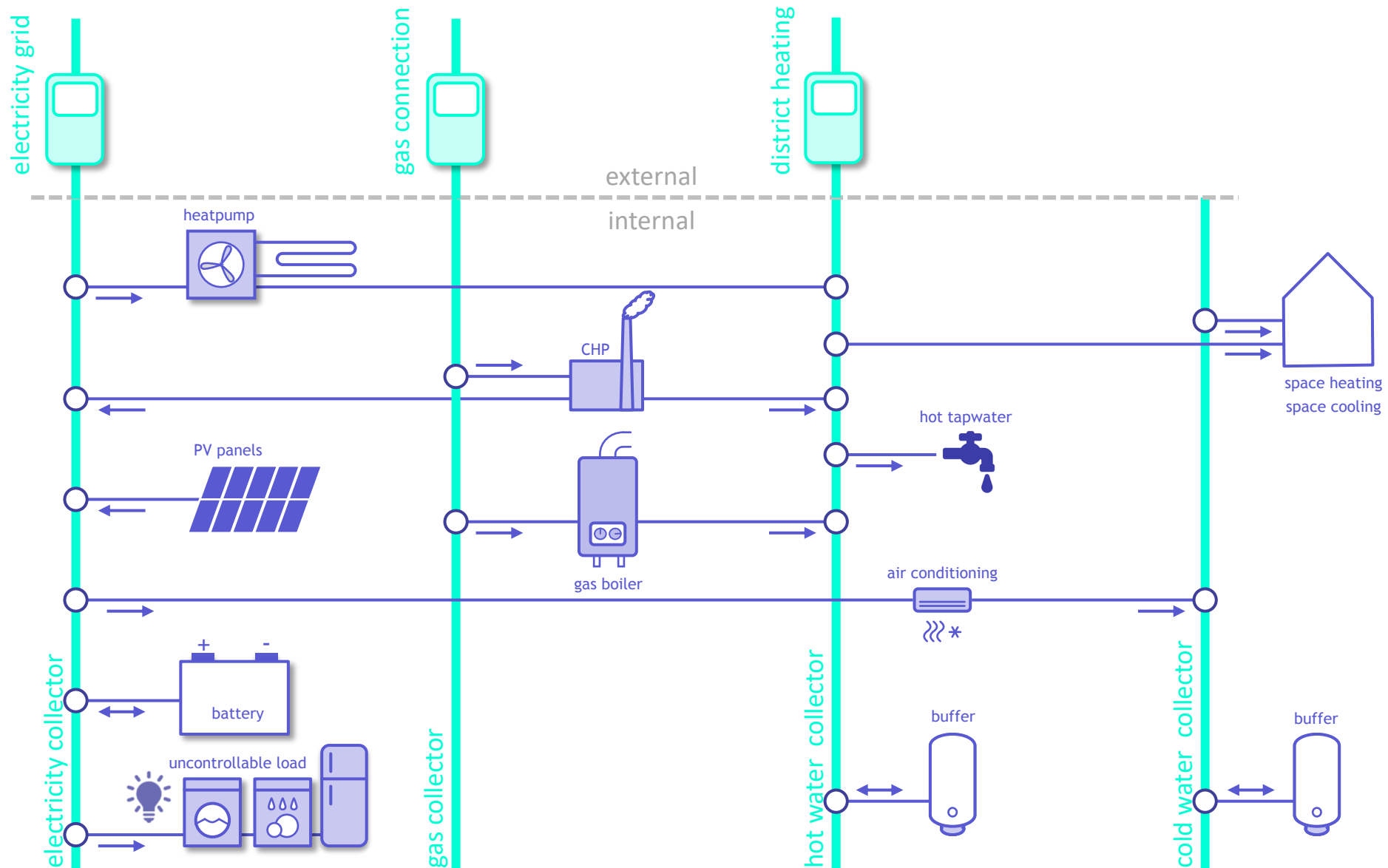
Commodity converting devices



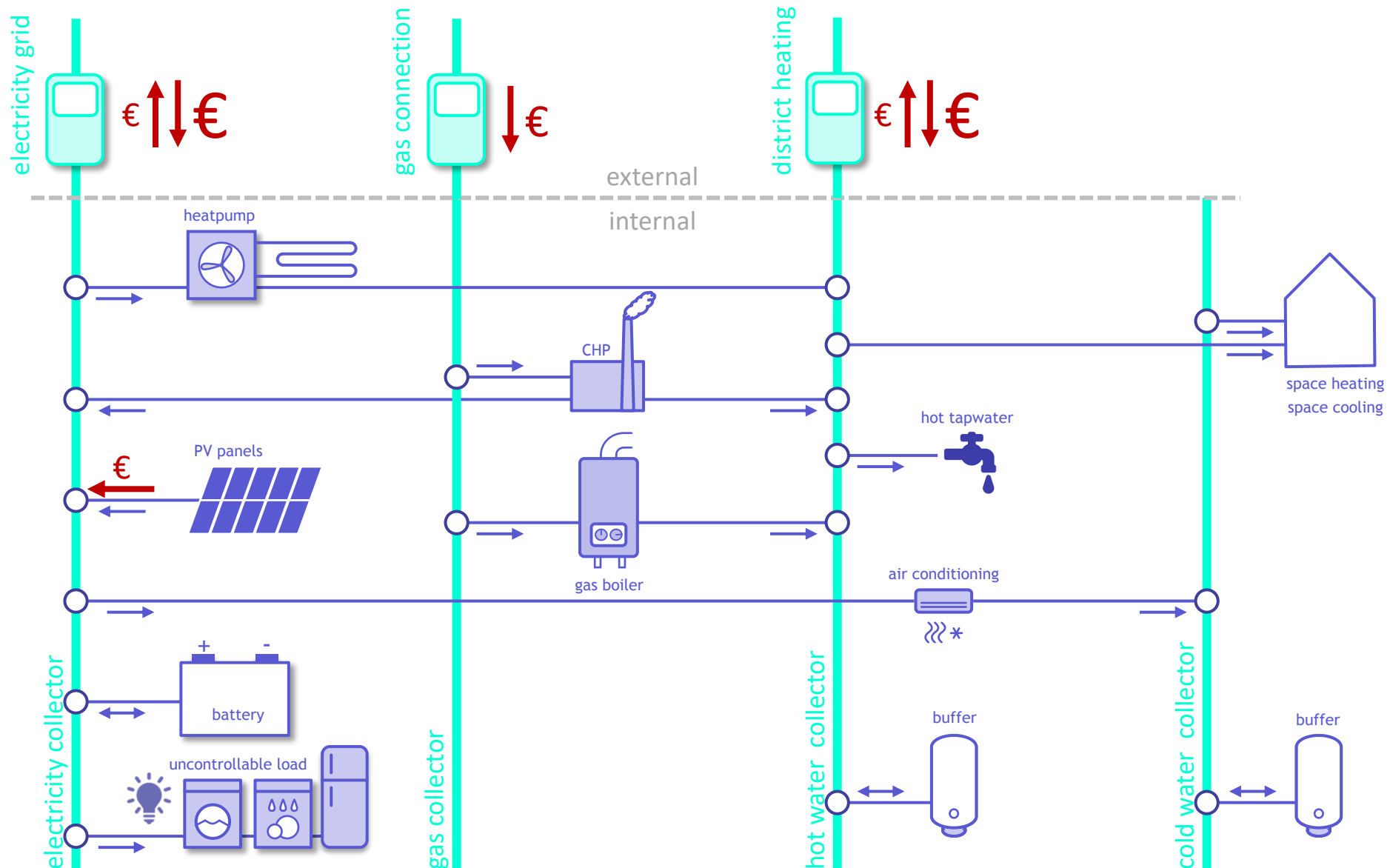
Commodity storage devices



Commodity exchange with the outside

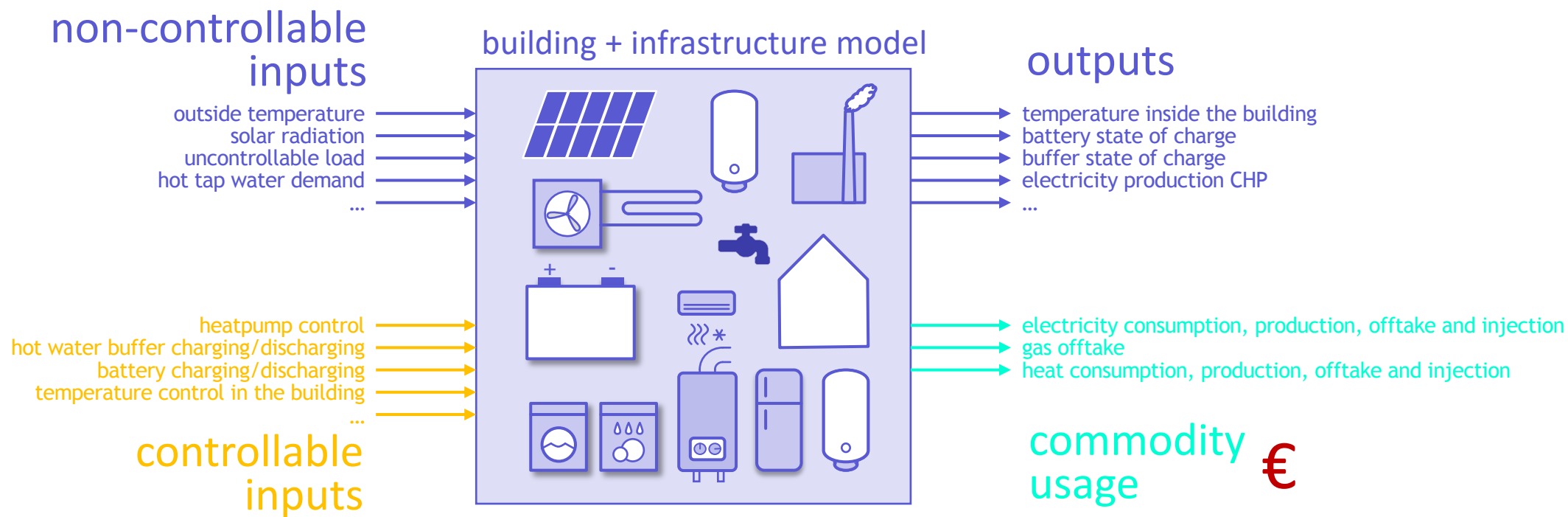


Operational cost coupling to commodity flows

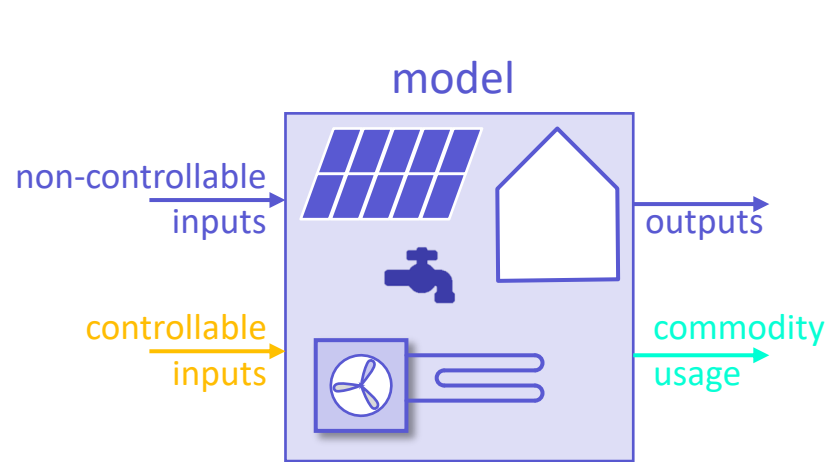


Building + infrastructure simulation model

a_g **ambience**

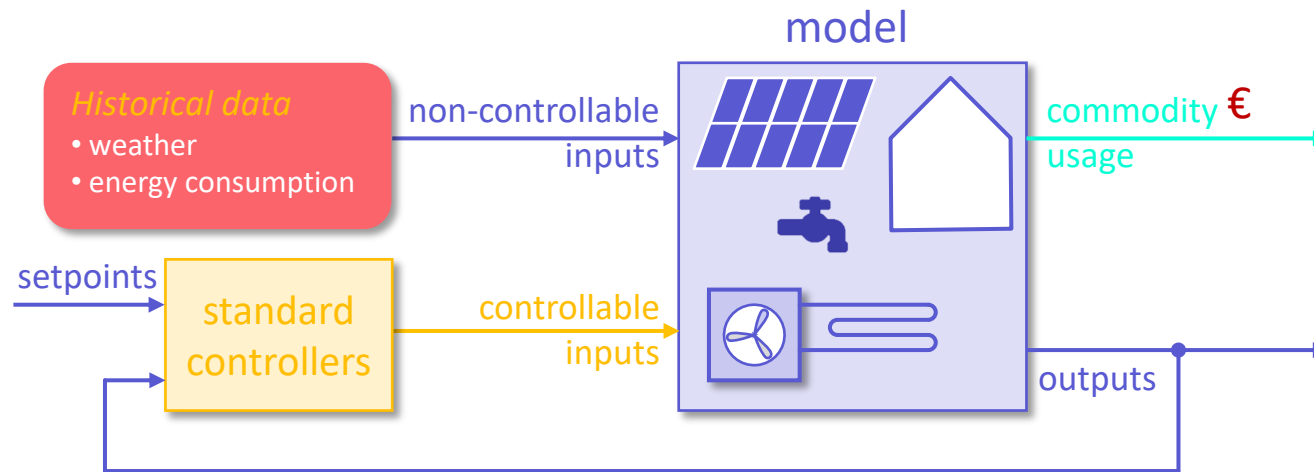


Model reuse in the Ambience approach



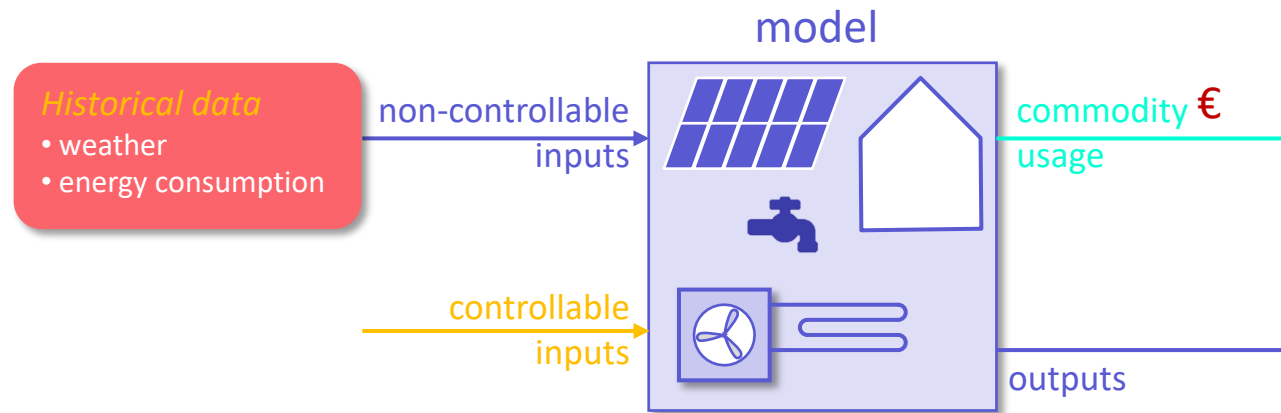
- 1** *Contracting phase:
Energy Cost Cash Flow Estimation sub-tool*
- 2** *Operational phase:
Model used for the “model predictive control”*
- 3** *Measurement & monitoring phase:
Guarantee Assessment sub-tool (IPMVP)*

Calculation in simple SIMULATION mode



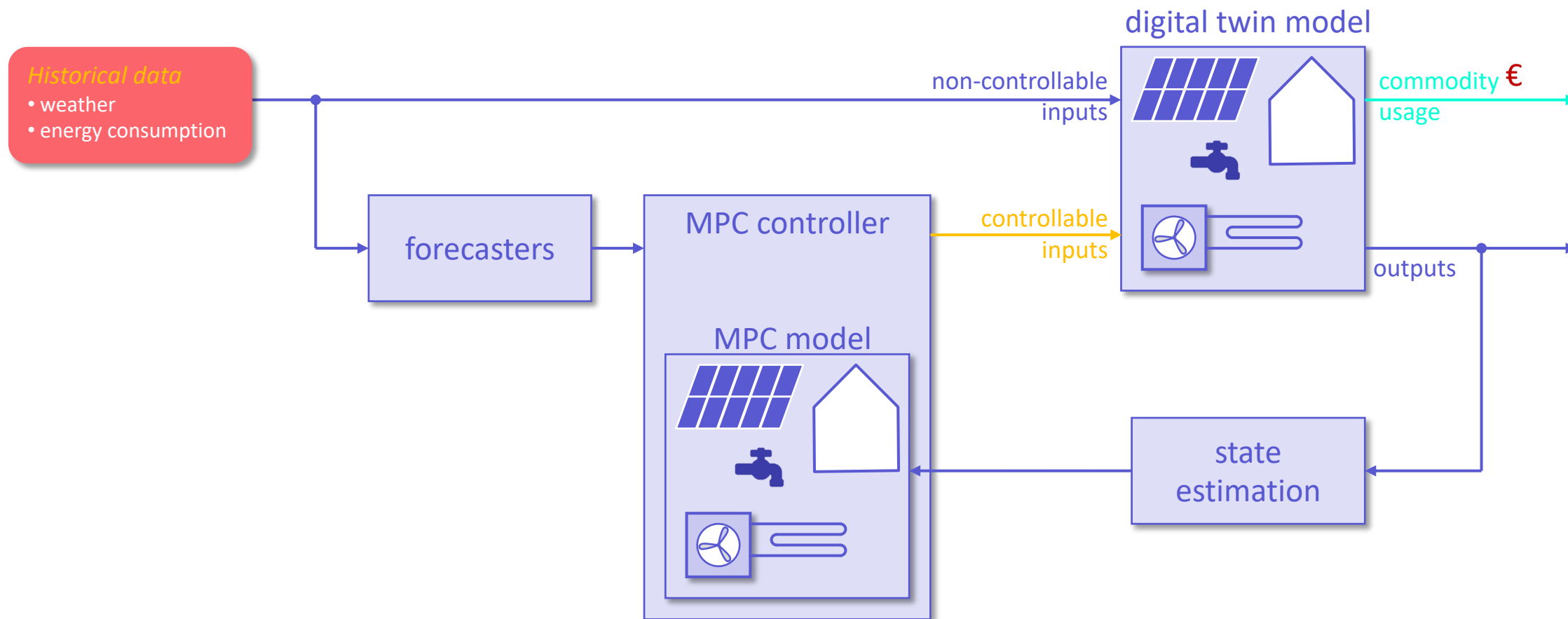
➔ Suitable for **baseline calculations** without smart control

Calculation in OPTIMIZATION mode



➔ Suitable for calculation of the **upper bound** of the value with smart control

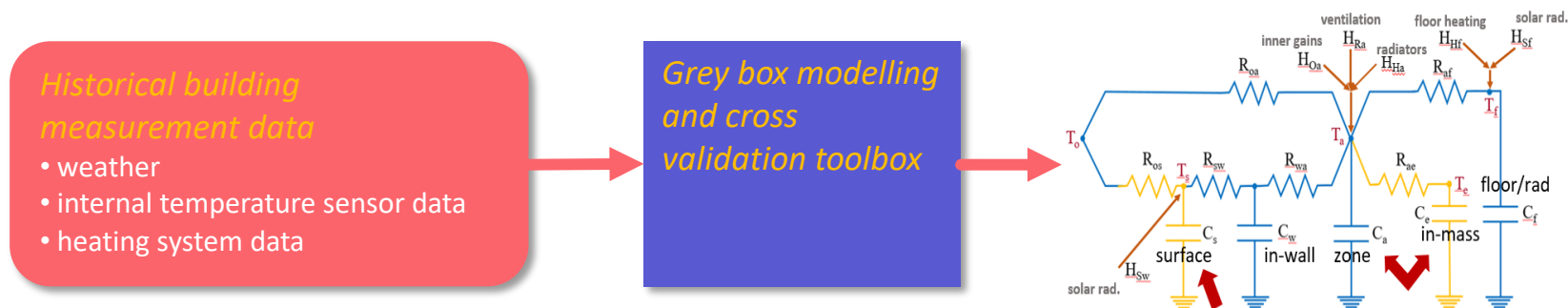
Calculation in MPC mode



➔ Getting the value of flexibility *as realistic as possible* with smart control³¹

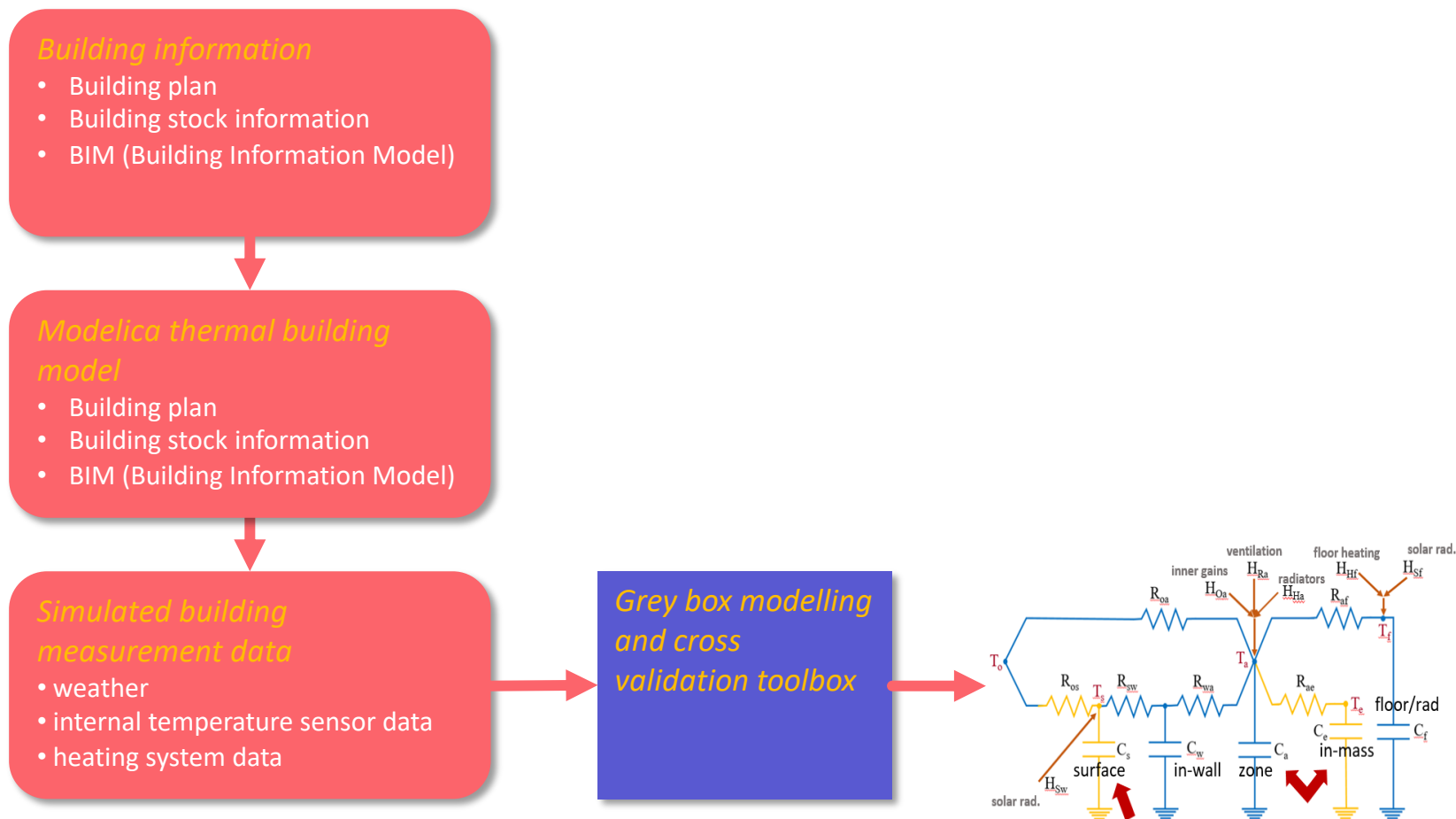
Flex model creation for building models

The preferred scenario



Flex model creation for building models

The alternative scenario



what is **ABEPeM** ?

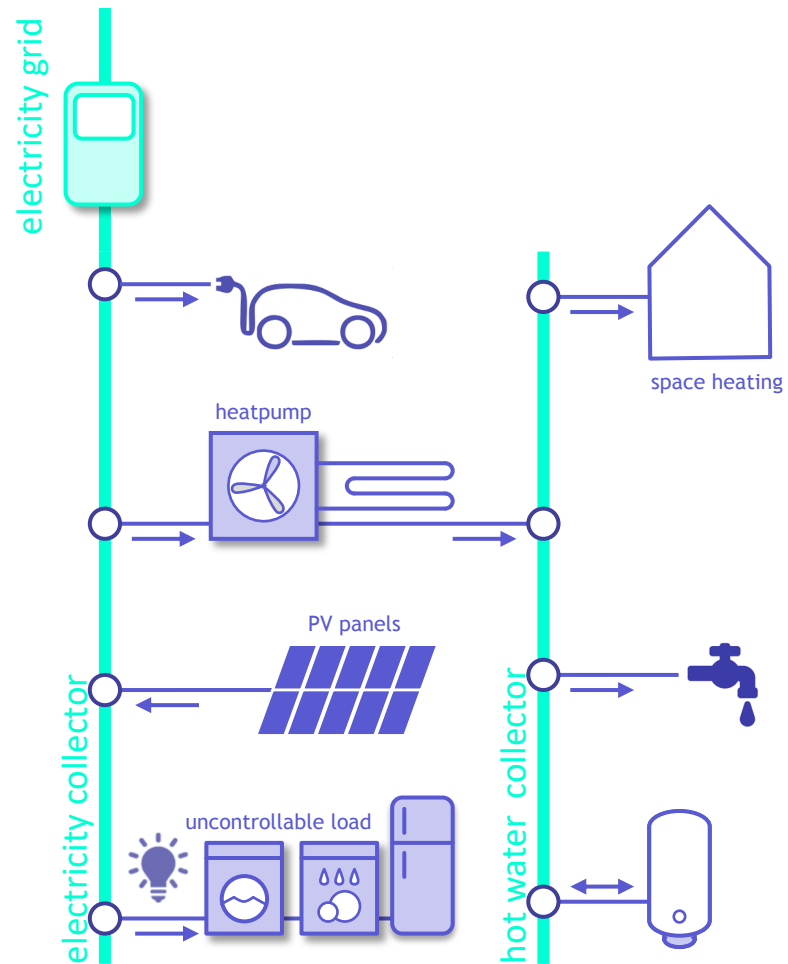
building blocks of **ABEPeM**

energy cost cash flow estimation sub-tool

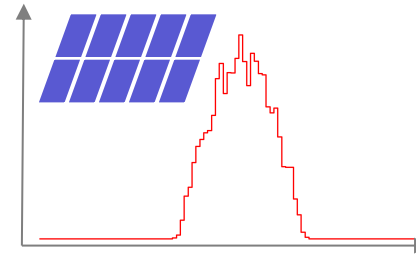
some examples

final remarks

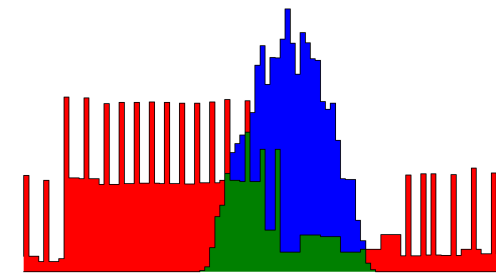
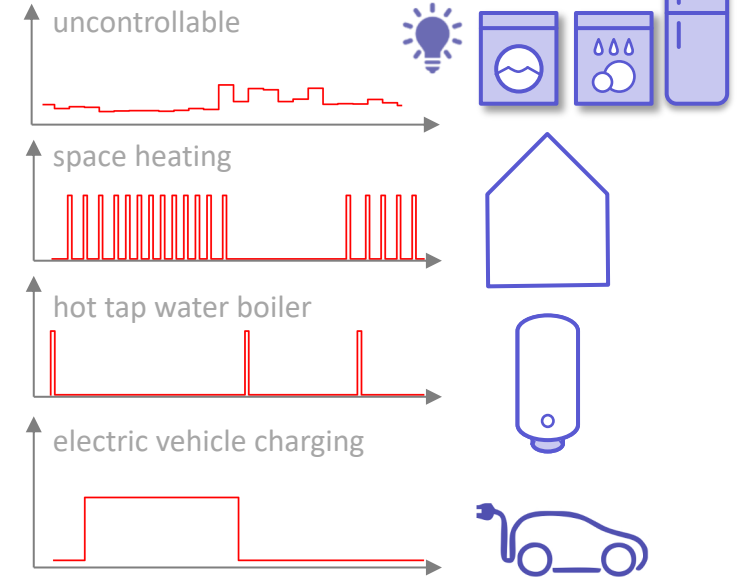
Simple example, simple control



production (29,61kWh)



consumption (40,79kWh)

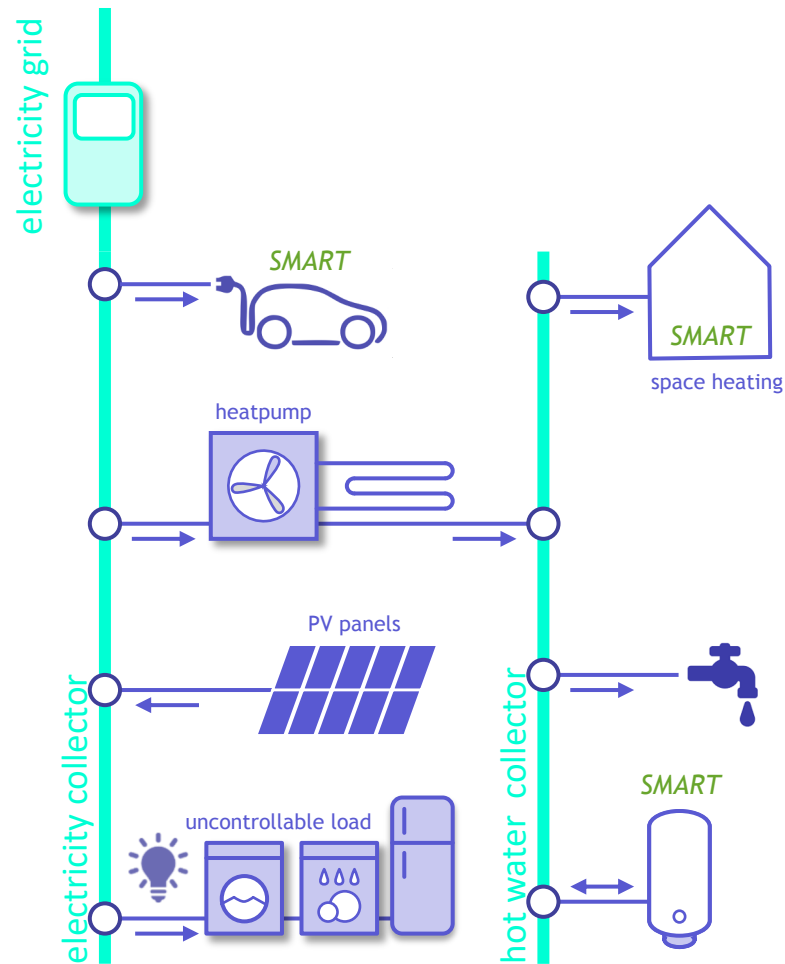


offtake (30,62kWh)

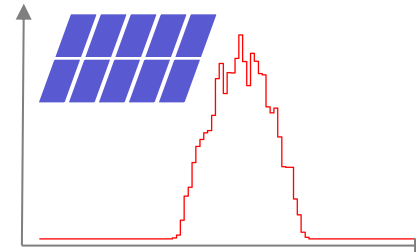
injection (19,53kWh)

self consumption (10,08kWh)

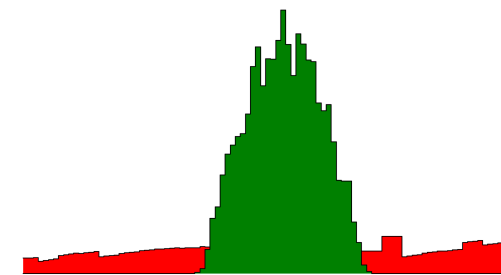
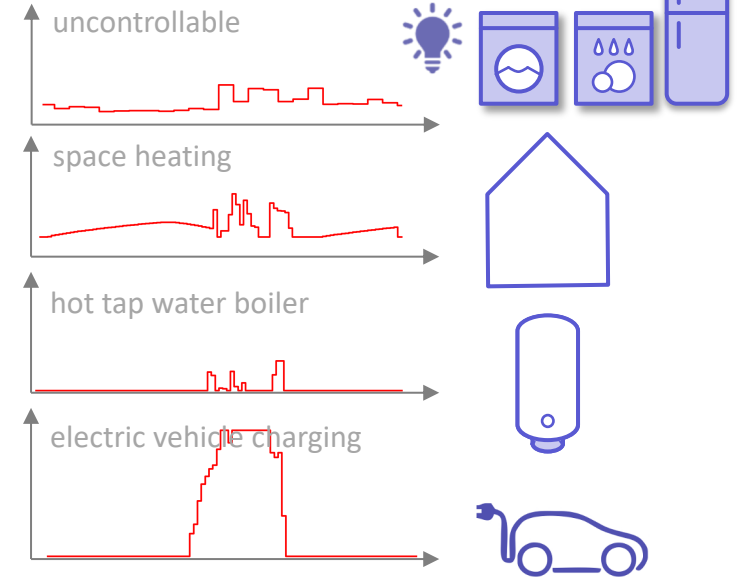
Simple example, optimal control



production (29,61kWh)



consumption (40,79kWh)



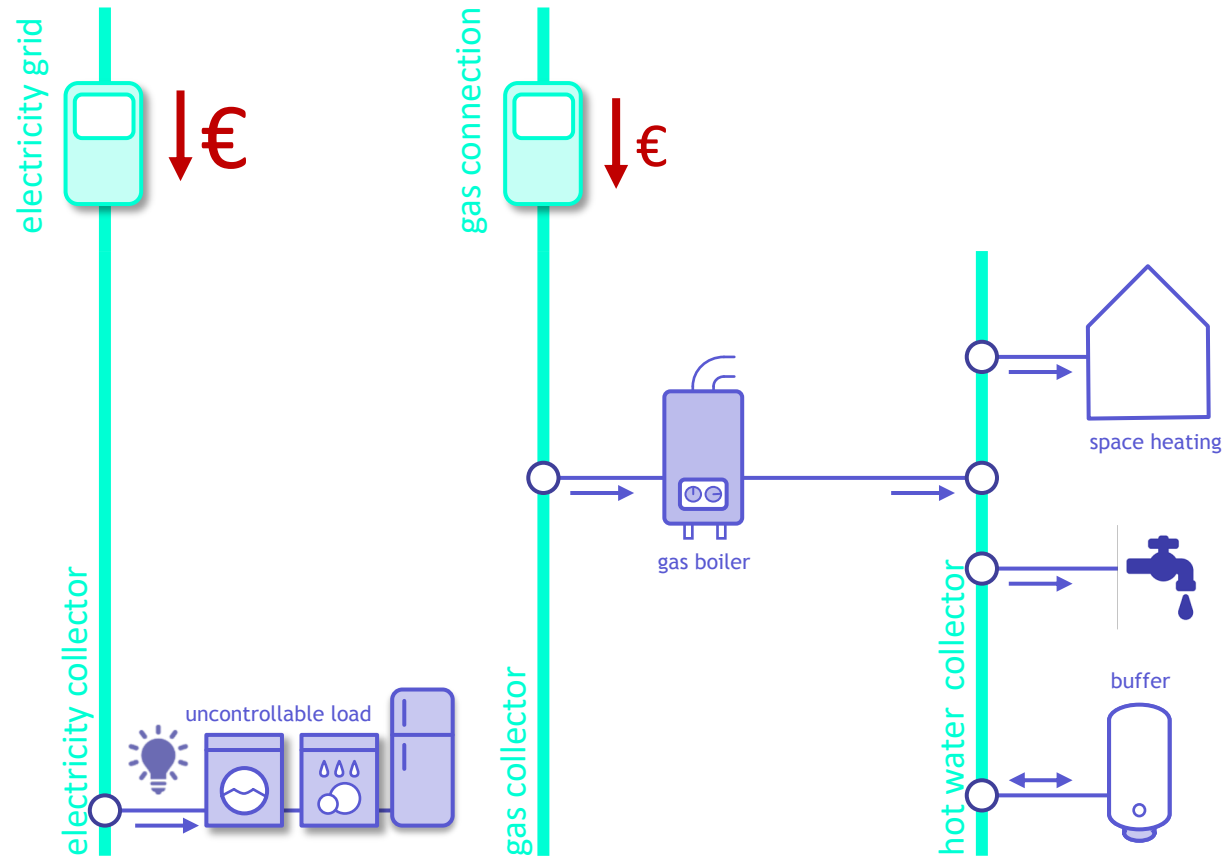
offtake (9,17kWh)

injection (0,0kWh)

self consumption (29,61kWh)

Example renovation family house

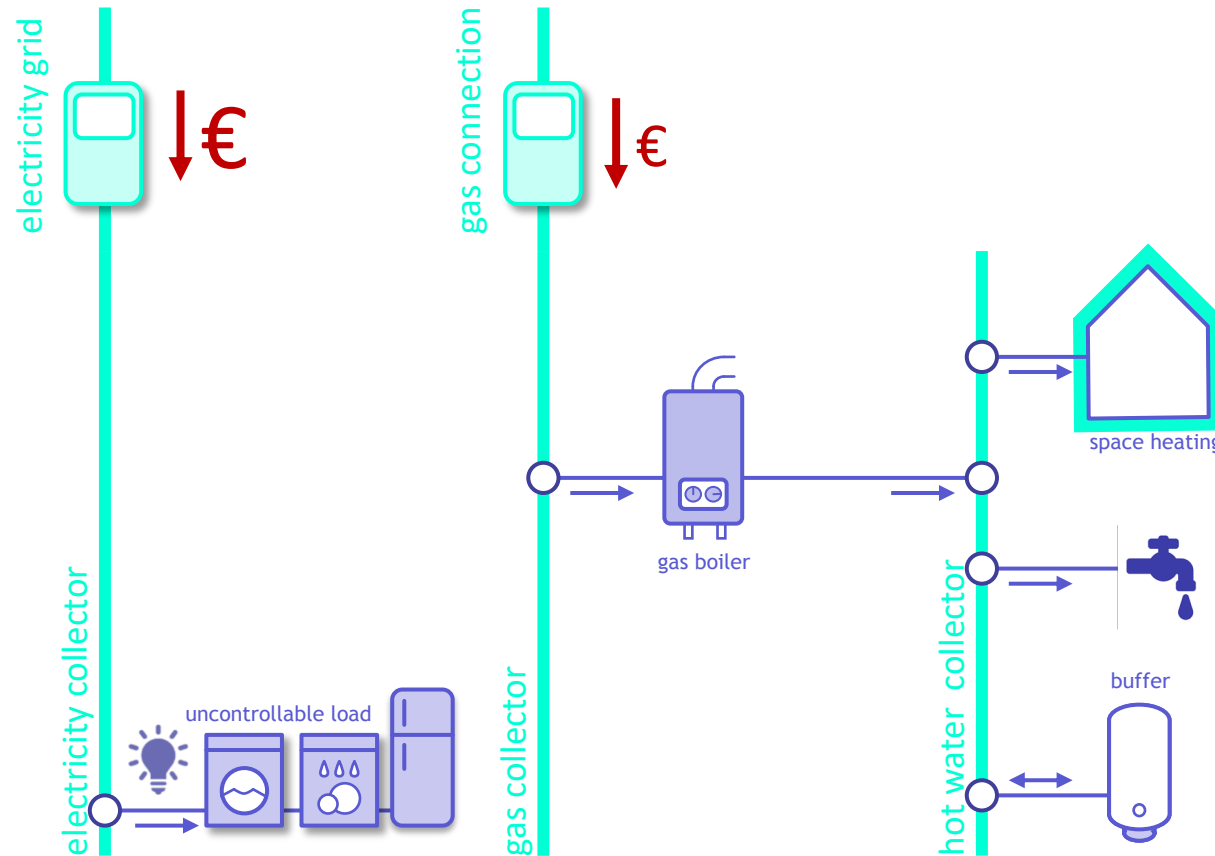
Case 1: before renovation (baseline)



- Electricity cost: 0,266 €/kWh
- Gas cost: 0,0535 €/kWh
- Heating and hot water with gas boiler
- Gas: 1.662 €/year
- Electricity: 960 €/year
- Total: **2.622** €/year
- CO₂ emission: 6.825kg/year

Example renovation family house

Case 2: envelope renovation

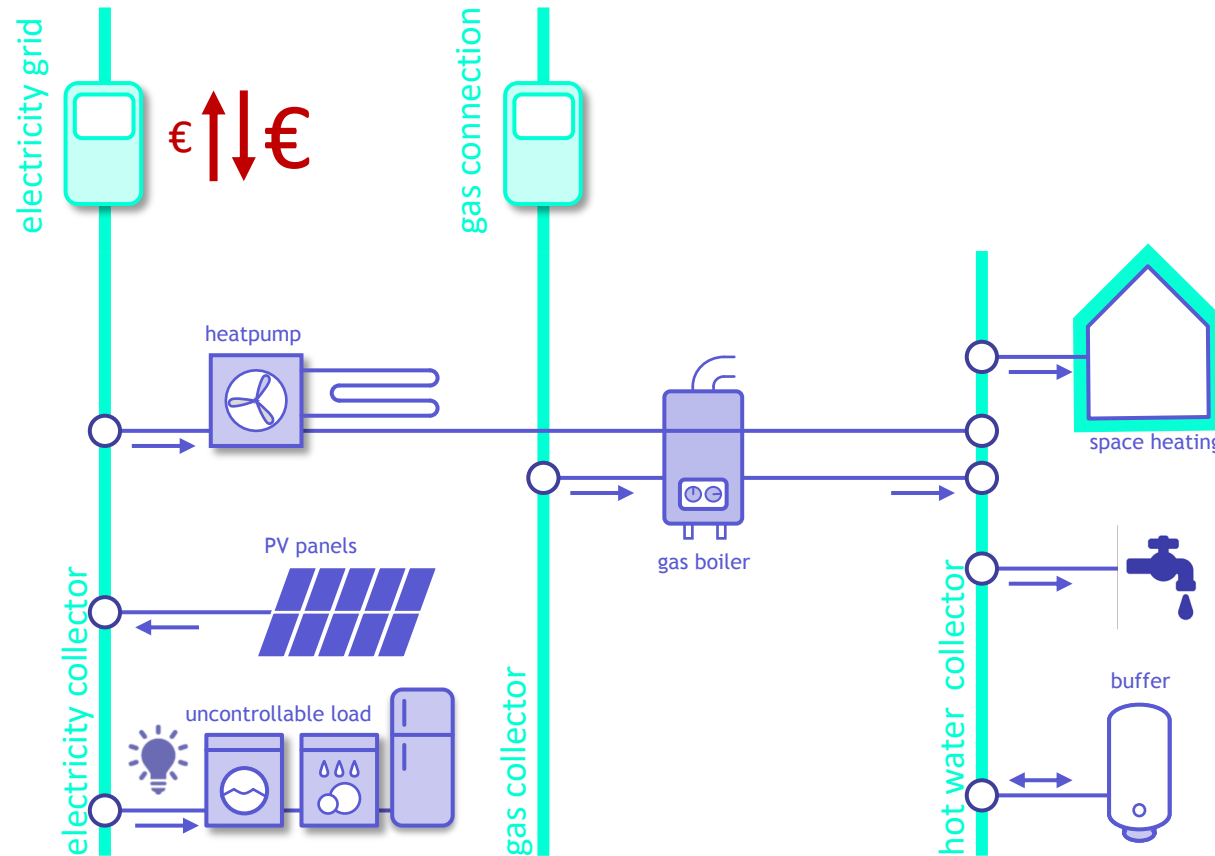


- Electricity cost: 0,266 €/kWh
- Gas cost: 0,0535 €/kWh
- Heating and hot water with gas boiler
- Gas: 635 €/year
- Electricity: 960 €/year
- Total: **1.595 €/year**
- CO₂ emission: 2.987kg/year

➔ **Cost saving of 39%**

Example renovation family house

Case 3: Electrification + PV (6kWp)

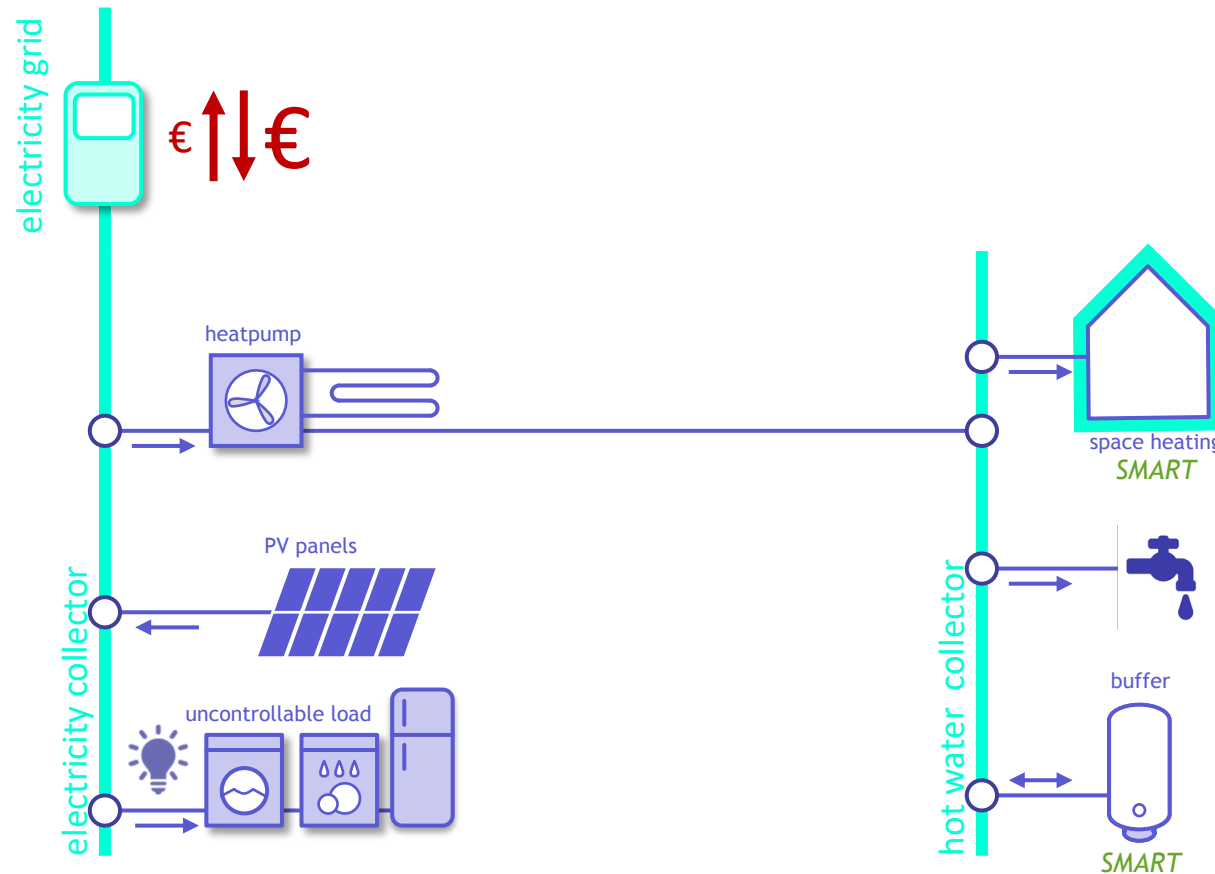


- Offtake: 0,266 €/kWh
- Injection: 0,089 €/kWh
- Heating and hot water with gas boiler
- Electricity: 1.150 €/year
- Total: **1.150 €/year**
- CO₂ emission: 968 kg/year

➔ **Cost saving of 28%**

Example renovation family house

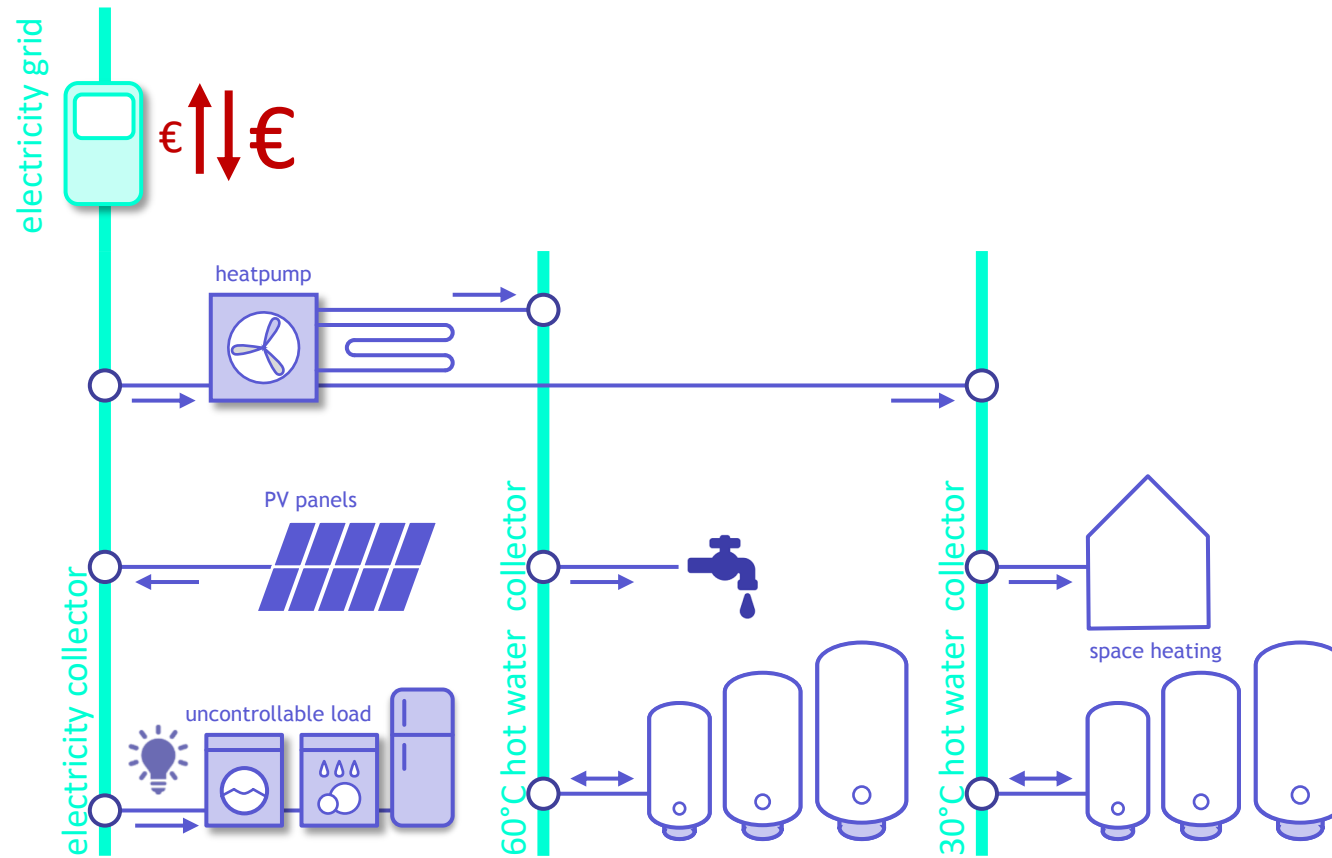
Case 4: Active (smart) control on heating and buffer



- Offtake: 0,266 €/kWh
- Injection: 0,089 €/kWh
- Heating and hot water with gas boiler
- Electricity: 933 €/year
- Total: **933 €/year**
- CO₂ emission: 657 kg/year

➔ **Cost saving of 19%**

Buffer dimensioning family house



- Offtake: 0,25 €/kWh
- Injection: 0,05 €/kWh

Buffer dimensioning family house

Case 1: without smart control

		Domestic hot water buffer size							
		no buffer		100l		200l		400l	
Space heating buffer size	no buffer	consumption	7.439,53	consumption	7539,07	consumption	7591,07	consumption	7676,07
		injection	4038,77	injection	4123,69	injection	4145,44	injection	4106,12
		offtake	5305,11	offtake	5489,56	offtake	5563,31	offtake	5608,99
		cost	€ 1.124,34	cost	€ 1.166,20	cost	€ 1.183,55	cost	€ 1.196,94
	100l	consumption	7463,03	consumption	7562,57	consumption	7614,57	consumption	7691,57
		injection	4020,81	injection	4106,45	injection	4126,63	injection	4075,33
		offtake	5310,65	offtake	5495,82	offtake	5568	offtake	5593,71
		cost	€ 1.126,62	cost	€ 1.168,63	cost	€ 1.185,66	cost	€ 1.194,66
	200l	consumption	7472,53	consumption	7572,07	consumption	7624,07	consumption	7709,07
		injection	4016,86	injection	4101,74	injection	4122,92	injection	4082,63
		offtake	5316,2	offtake	5500,61	offtake	5573,79	offtake	5618,5
		cost	€ 1.128,20	cost	€ 1.170,06	cost	€ 1.187,30	cost	€ 1.200,49
	400l	consumption	7491,53	consumption	7591,07	consumption	7643,07	consumption	7728,07
		injection	4011,62	injection	4095,88	injection	4119,03	injection	4081,78
		offtake	5329,95	offtake	5513,75	offtake	5588,9	offtake	5636,65
		cost	€ 1.131,90	cost	€ 1.173,64	cost	€ 1.191,27	cost	€ 1.205,07

Buffer dimensioning family house

Case 2: with smart control

		Domestic hot water buffer size							
		no buffer		100l		200l		400l	
Space heating buffer size	no buffer	consumption	7368,48	consumption	7407,48	consumption	7427,52	consumption	7455,78
		injection	3474,91	injection	3177,6	injection	3138,24	injection	3107,73
		offtake	4670,2	offtake	4411,88	offtake	4392,57	offtake	4390,32
		cost	€ 993,80	cost	€ 944,09	cost	€ 941,23	cost	€ 942,19
	100l	consumption	7381,06	consumption	7419,21	consumption	7438,31	consumption	7464,05
		injection	3409,11	injection	3128,53	injection	3092,49	injection	3066,11
		offtake	4616,97	offtake	1093,63	offtake	4357,6	offtake	4356,96
		cost	€ 983,78	cost	€ 937,21	cost	€ 934,77	cost	€ 935,93
	200l	consumption	7385,47	consumption	7422,3	consumption	7439,3	consumption	7466,66
		injection	3370,86	injection	3102,49	injection	3072,47	injection	3047,29
		offtake	4583,14	offtake	4351,6	offtake	4338,58	offtake	4340,75
		cost	€ 977,24	cost	€ 932,77	cost	€ 931,02	cost	€ 932,82
	400l	consumption	7376,29	consumption	7412,58	consumption	7429,55	consumption	7456,91
		injection	3350,87	injection	3094,84	injection	3069,22	injection	3045,99
		offtake	4553,96	offtake	4334,23	offtake	4325,57	offtake	4329,7
		cost	€ 970,94	cost	€ 928,81	cost	€ 927,93	cost	€ 930,12

what is **ABEPeM** ?

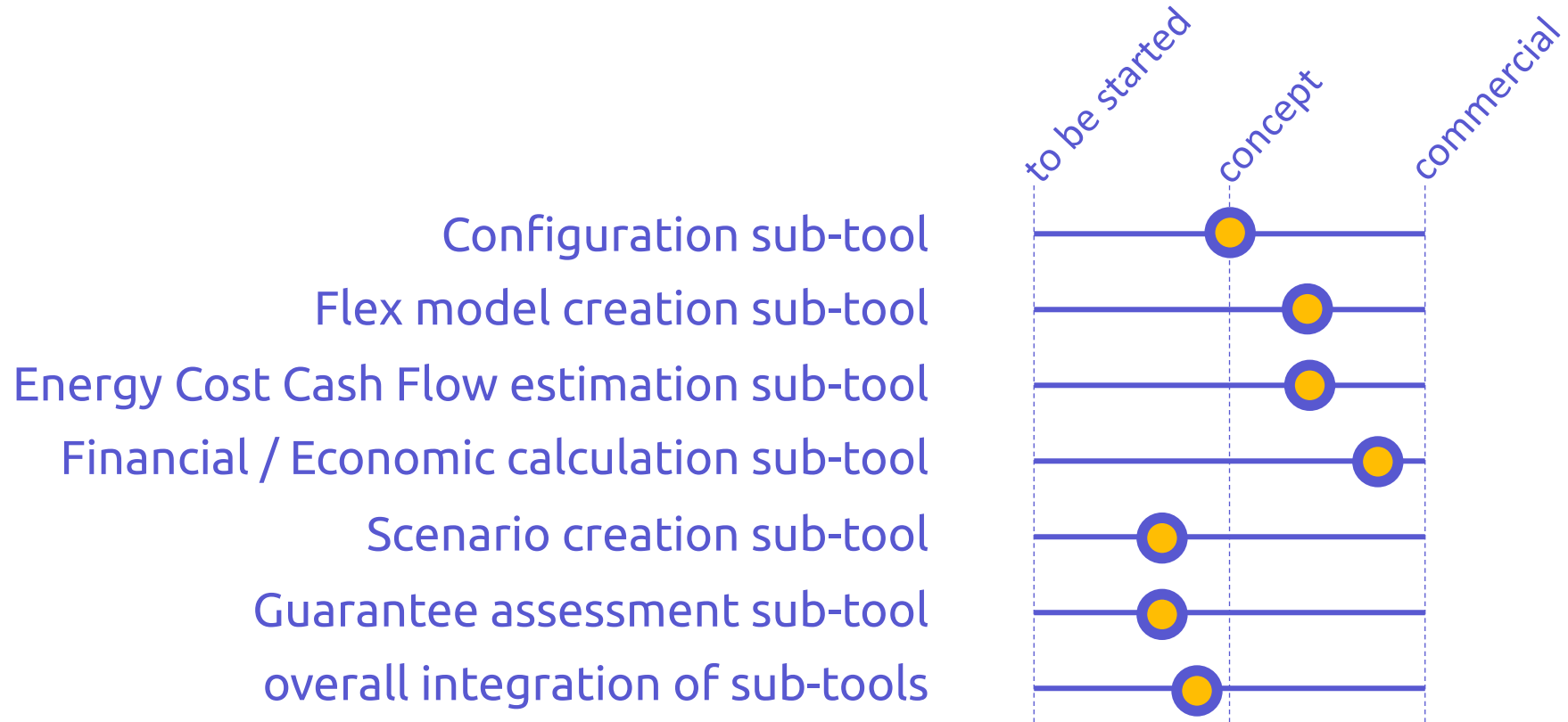
building blocks of **ABEPeM**

energy cost cash flow estimation sub-tool

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Status of the ABEPeM platform



➔ *Keep in mind ... we are developing a concept.*

Test **ABEPeM** in pilot projects

Portuguese pilot:



Belgian pilot:





Questions?

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