

LOW CO2 EMISSION HVAC SYSTEM

**New headquarter of BNP Paribas Fortis
Seasonal Thermal Energy Storage (STES)**

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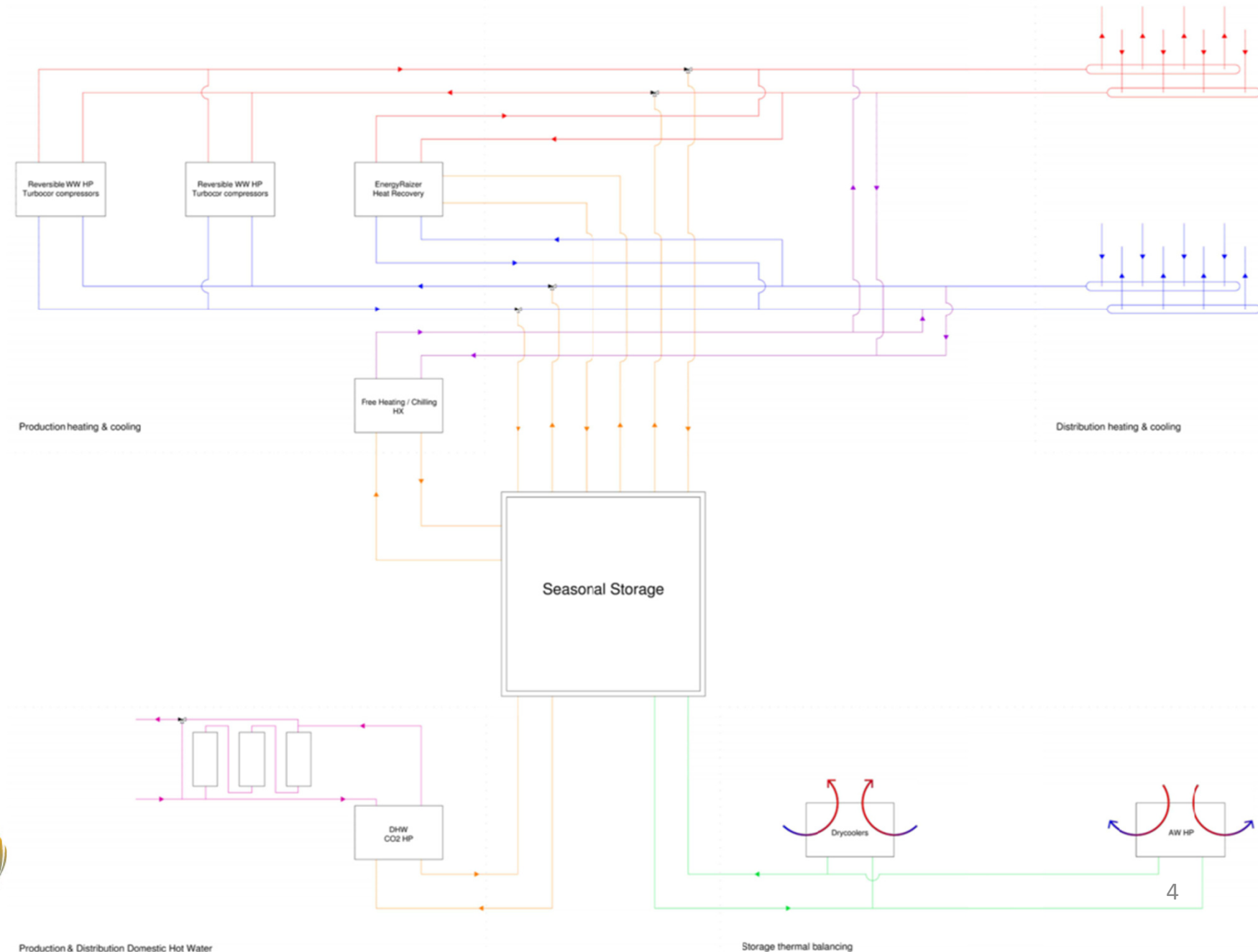
Summary

1. Presentation of the project
2. Schematic
3. Why STES ?
4. Diagrams
5. Dynamic Simulations
6. Risk Analysis
7. First results

1. Presentation of the project

- New BNP Paribas Fortis Headquarter in Brussels
- MIPIM AWARDS 2022
- +- 100.000 m² gross area - 4500 Work Places
- Commercial areas on base floor
- Industrial Kitchen, restaurants
- Atrium
- Parking for 250 vehicules
- 150 kWp PV-Panels
- Climatic Ceilings – Heating and cooling
- AHU's with wheel recovery – CO₂-Controls
- Seasonal Thermal Energy Storage of 13.200 m³ of water

2. STES – SCHEMATIC DIAGRAM



3. Why STES ?

BNP Paribas Fortis sets high ambitions

Standards :

- EPB : Brussels 2015
- PHPP : Passive House standard
- BREEAM : Excellent label

Comfort :

- Number of people per m²
- Very high climate comfort
- Daylight

Sustainability:

- Energy consumption in line with 2020
- CO₂ - emissions

=> Search for a very performant system

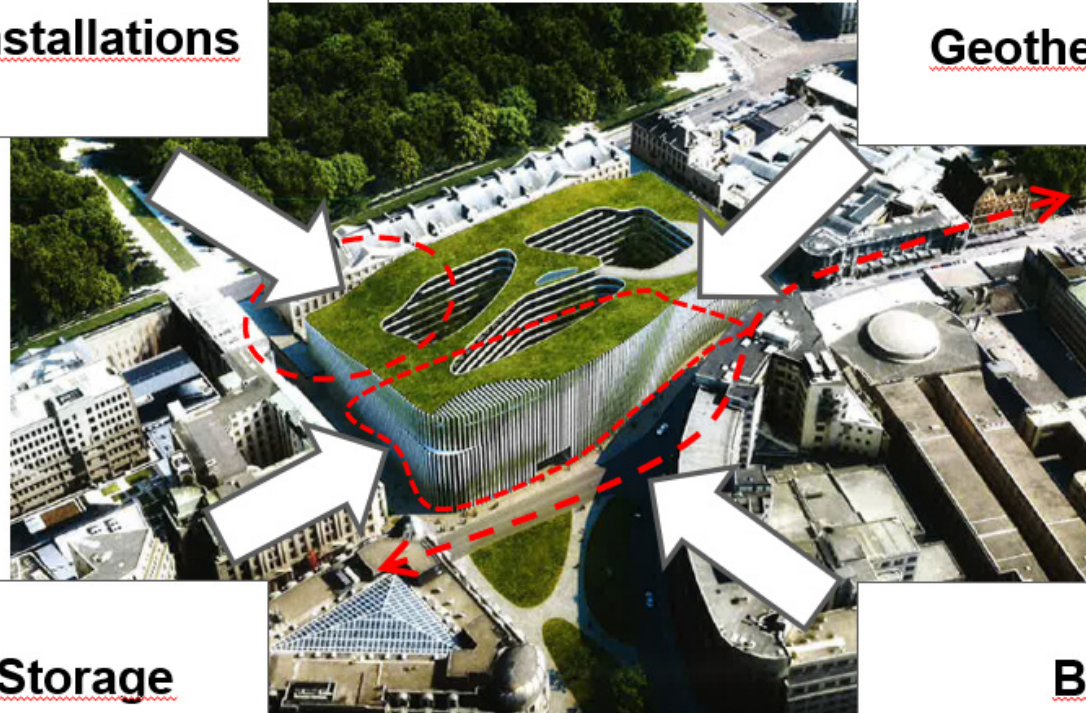


3. Why STES ?

Overview options for primary installations providing heating & cooling

Traditional installations

Geothermal system



Seasonal Storage

Biomass

3. Why STES ?

Elimination of geothermal energy & biomass



Geothermal system

Very cost intensive

Very planning intensive

Requires still 80% of top floor office space for roof installations, compared to traditional systems

Only 25% renewable energy share

...



Biomass

Cost intensive

Burner outside project perimeter

Requires still 50% of top floor office space for roof installations, compared to traditional systems

High particle emission in urban environment

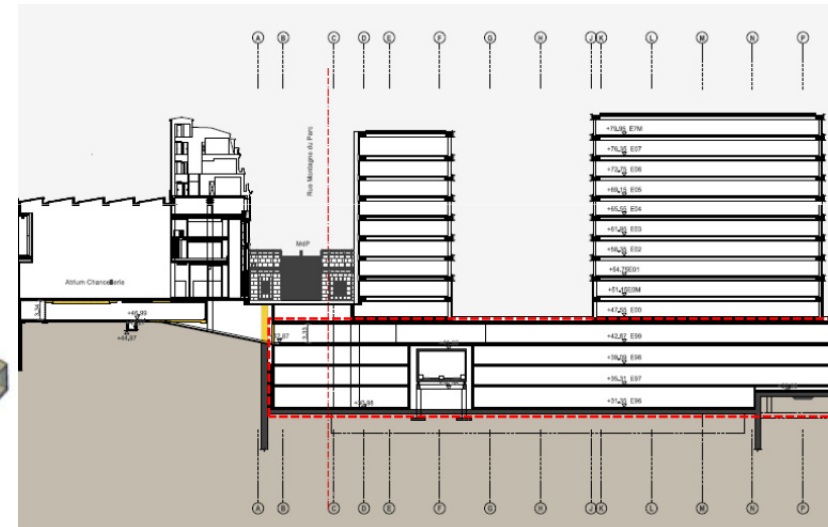
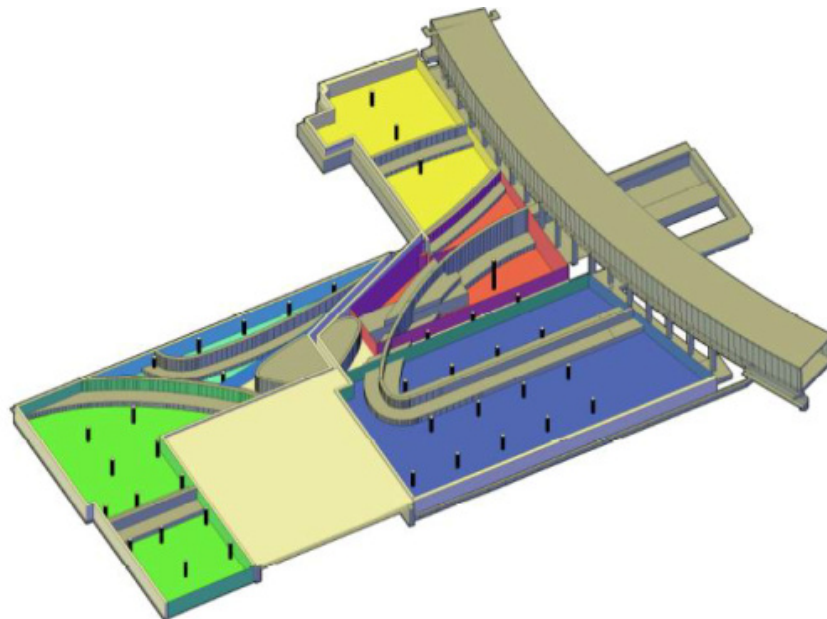
High burden on surrounding roads due to supply

...

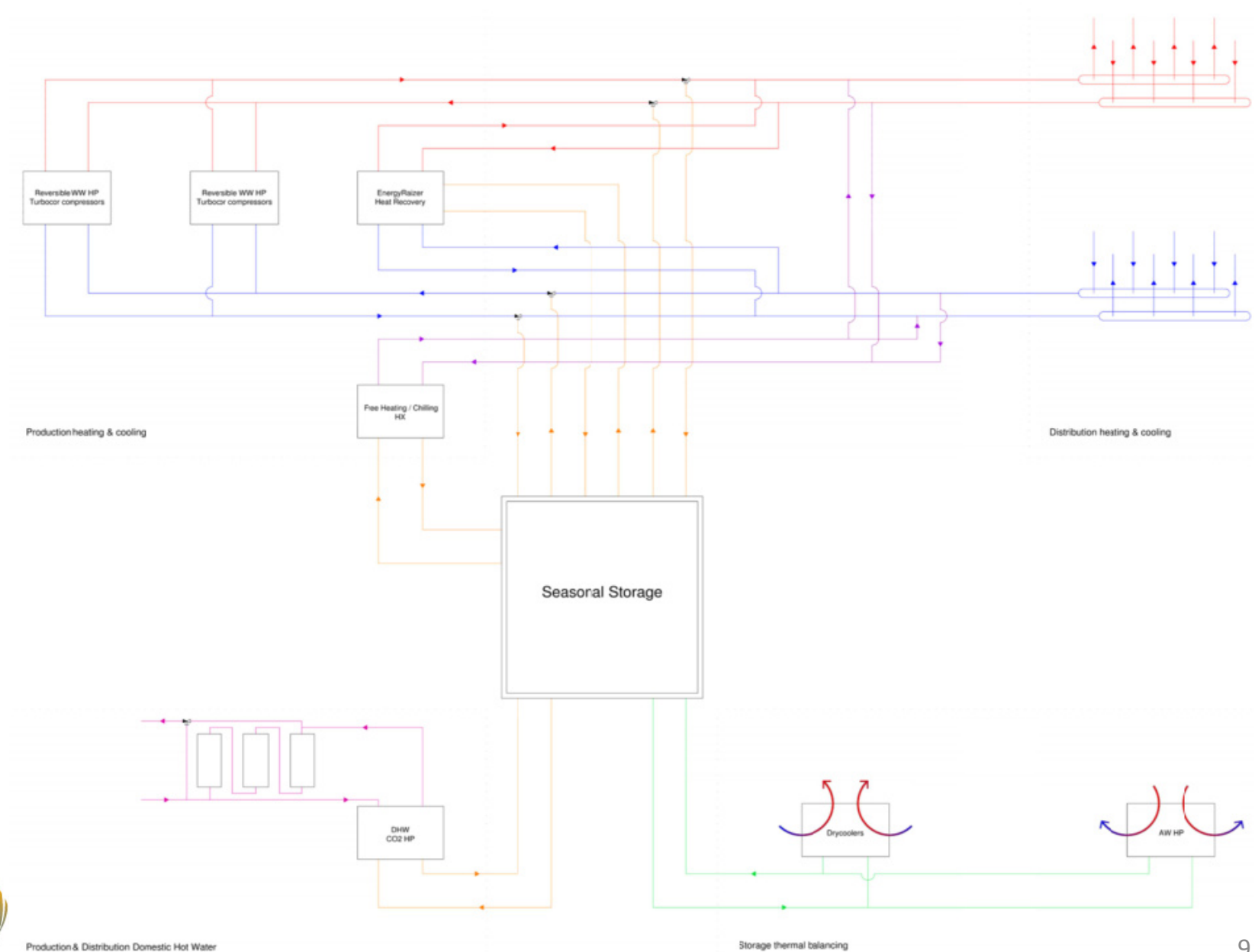
3. Why STES ?

Seasonal Storage = Total solution + opportunity for the project :

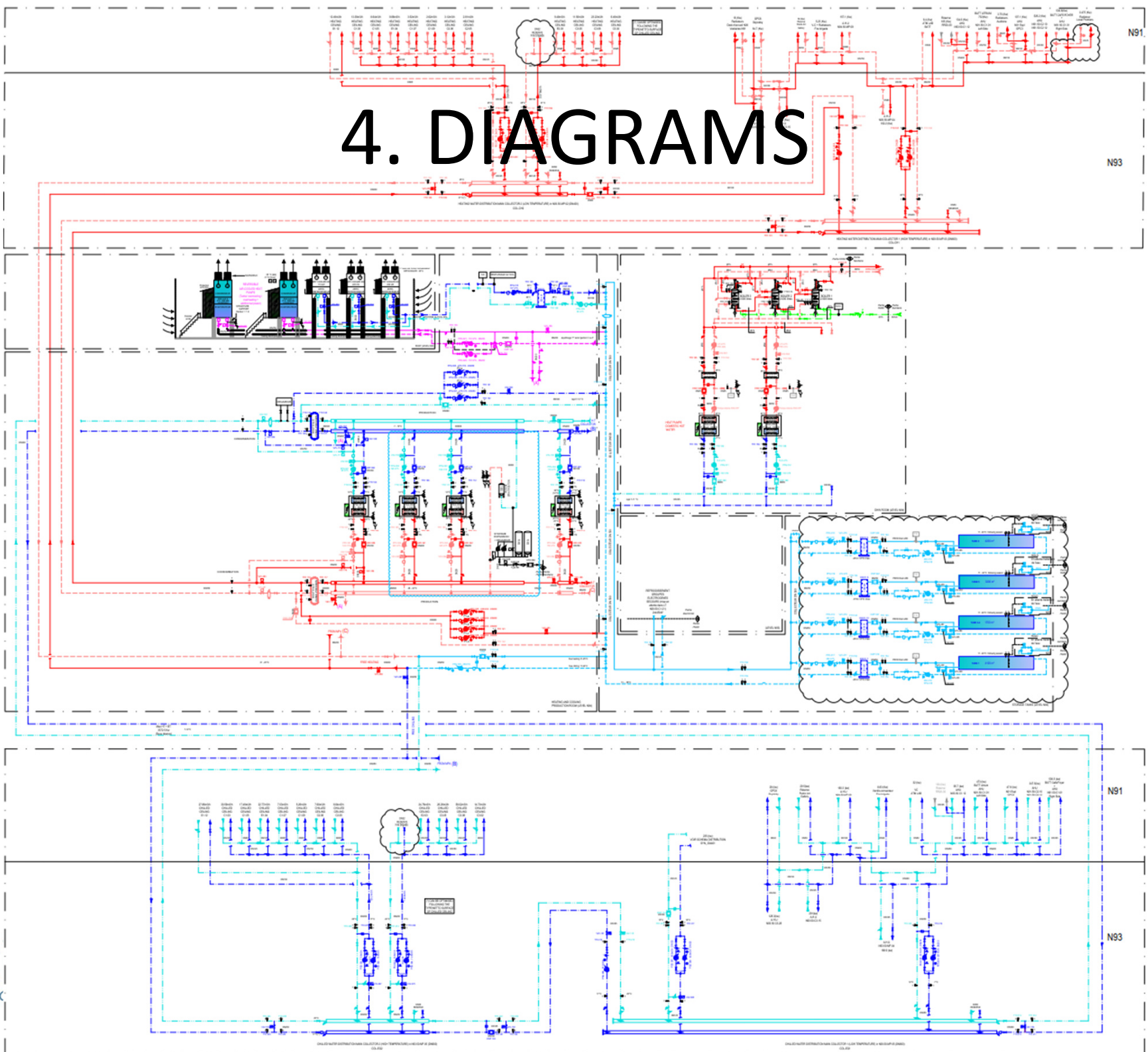
- Existing underground space is present = major cost impact
- Limited valuable alternatives present on site
- Sustainable front-runner = green image
- ...



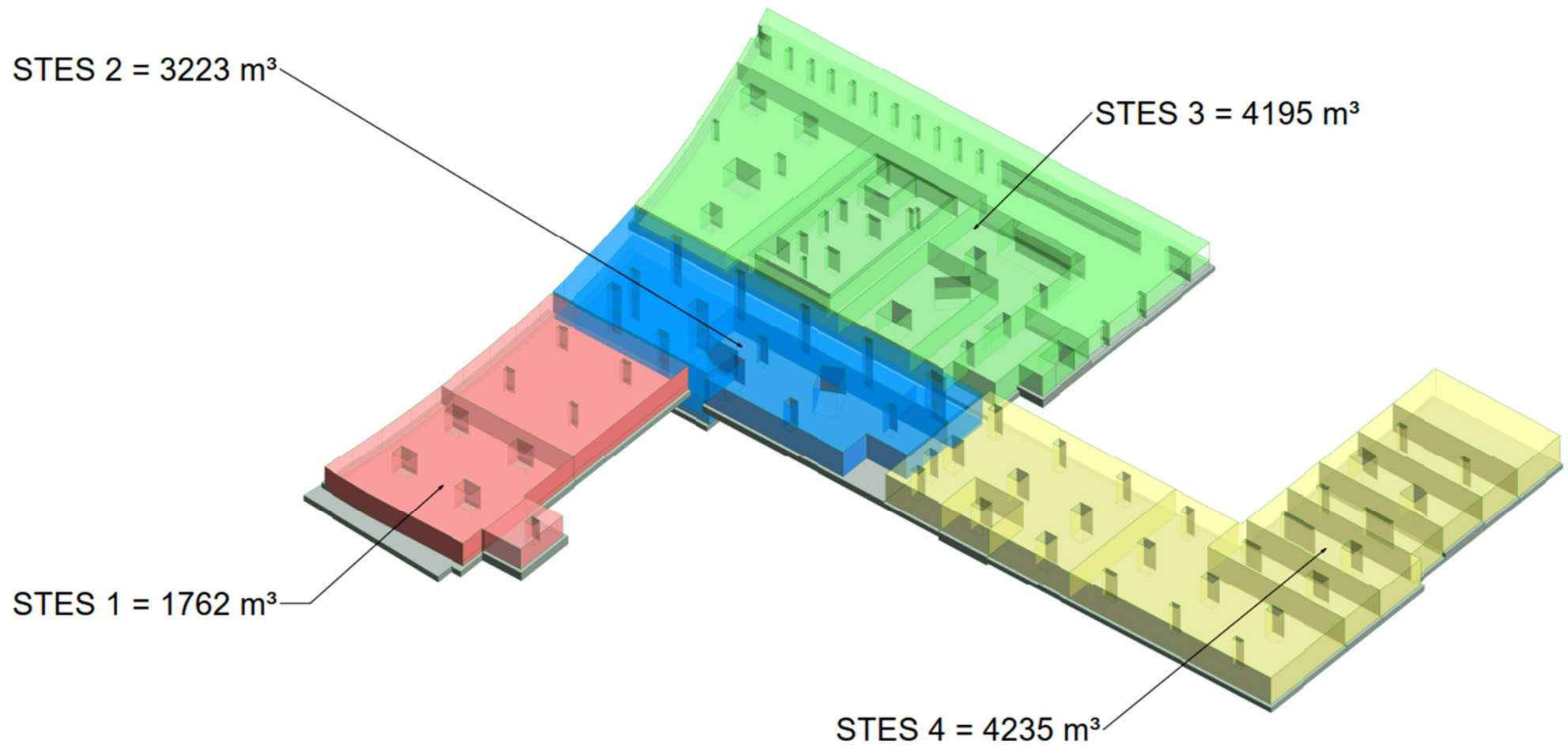
4. DIAGRAMS



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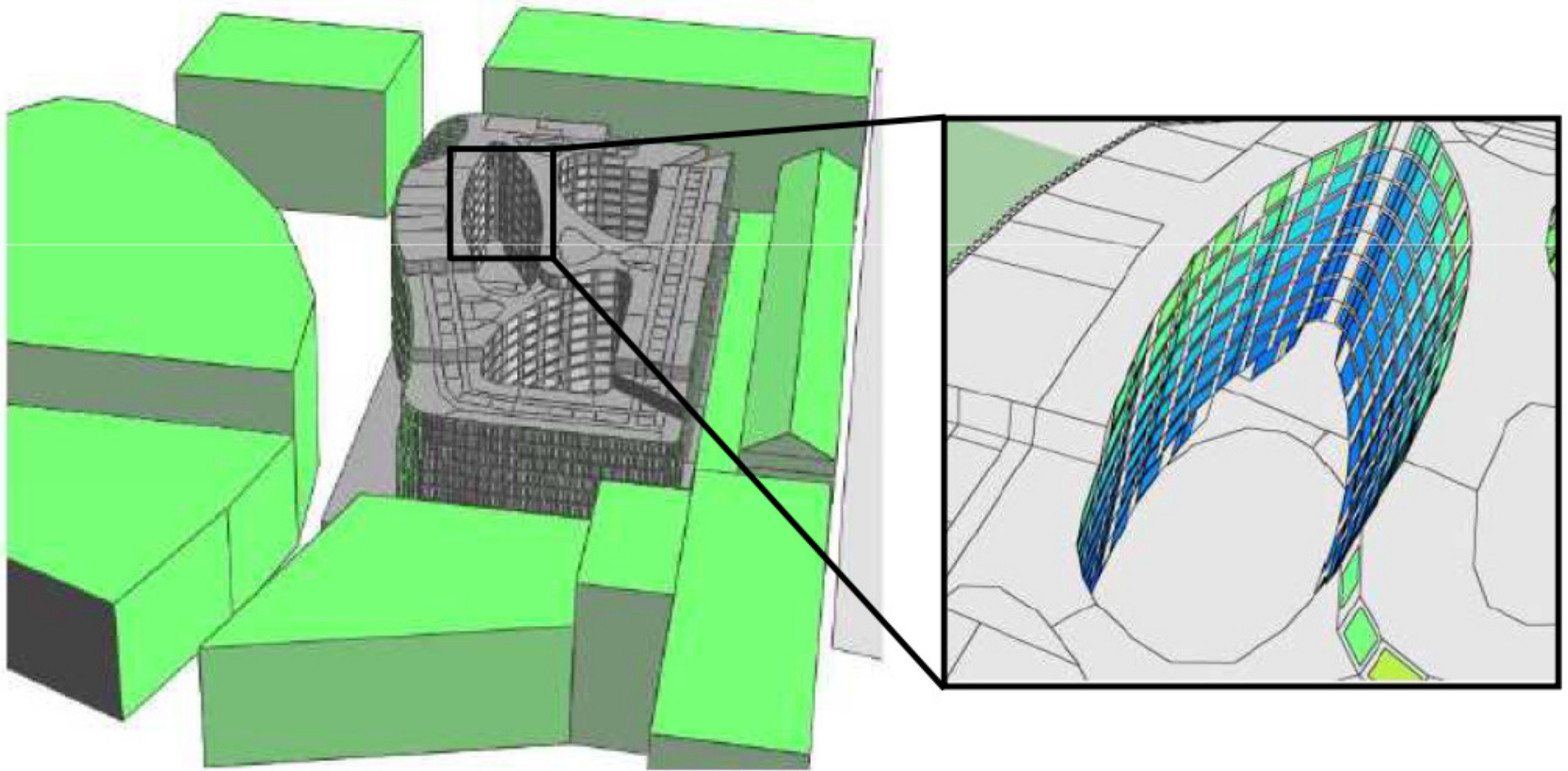


4. DIAGRAMS



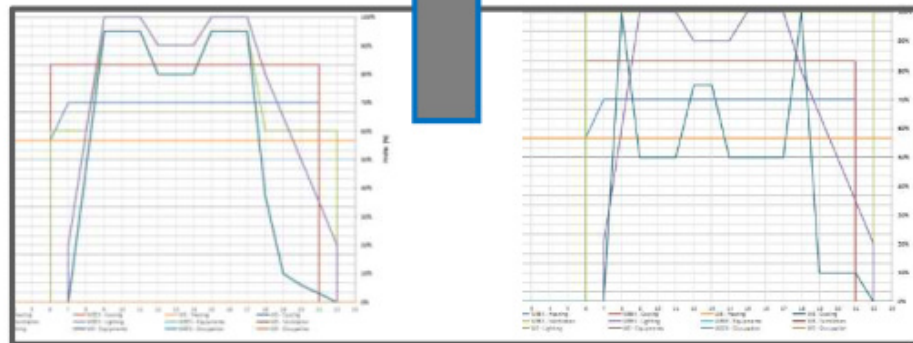
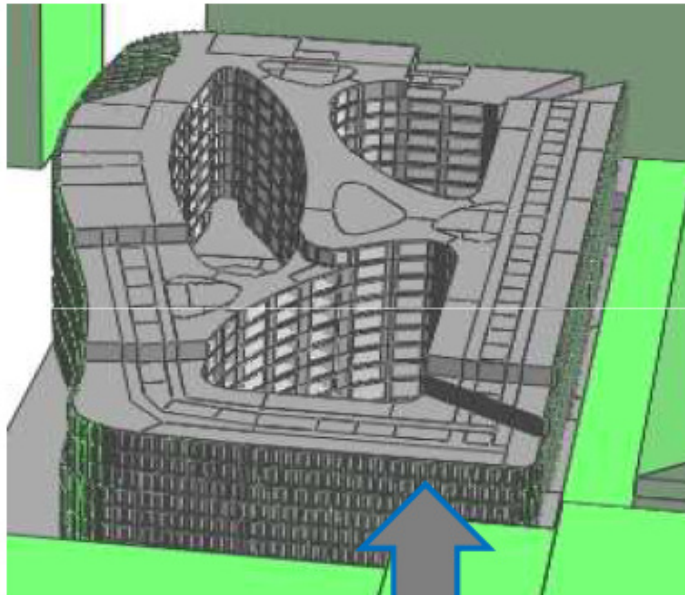
5. Dynamic Simulations

Starting point: dynamic simulation model



5. Dynamic Simulations

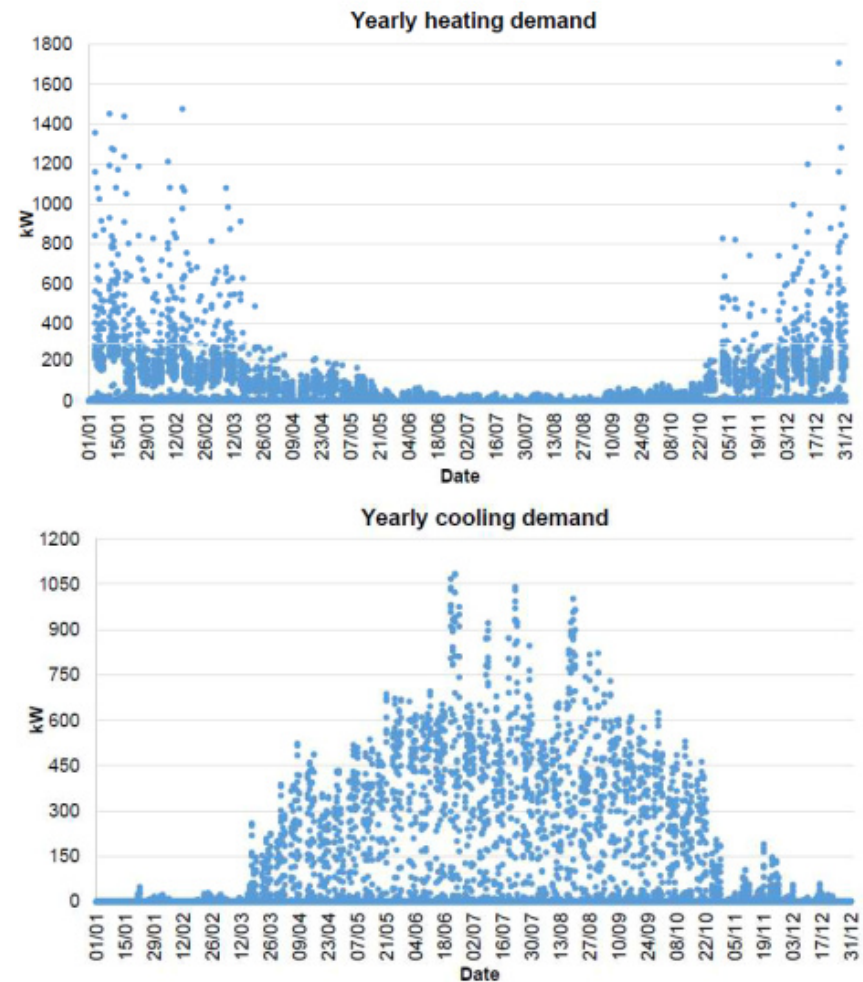
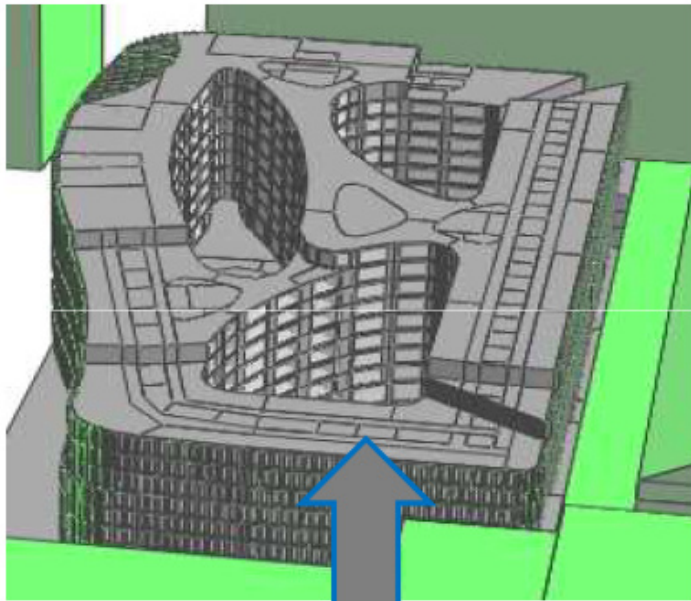
Starting point: dynamic simulation model



Exterior walls with windows also covered by the passive volume making the SPB-values less important as they are less strict	Uwall 4.0-24 W/m ² K Uw ≤ 1.8 W/m ² K Ug ≤ 1.1 W/m ² K	Function in the building	Lighting power density (W/m ²)	Lighting power density (code)	Light luminance (Pst)	Light luminance (code)
Exterior walls with windows not covered by the passive volume making the SPB-values important to follow	Uwall 4.0-24 W/m ² K Uw ≤ 1.8 W/m ² K Ug ≤ 1.1 W/m ² K	Open spaces	8 W/m ²	8 W/m ²	500 lx	500 lx
Halls between 'offices' and unheated spaces (parking, technical rooms, ...)	U ≤ 0.24 W/m ² K	Closed room	8 W/m ²	8 W/m ²	300 lx	300 lx
Halls between 'diverse functions' and unheated spaces (parking, technical rooms, ...)	U ≤ 0.24 W/m ² K	Archives	3 W/m ²	3 W/m ²	150 lx	150 lx
Halls between two heated spaces of different protected volumes	U ≤ 1 W/m ² K	General storage	3 W/m ²	3 W/m ²	150 lx	150 lx
Halls in contact with ground	Resin ≥ 1.5 m ² /K/W	Polysulfone room	8 W/m ²	8 W/m ²	300 lx	300 lx
Floor above unheated spaces (parking, technical rooms, ...)	(no section was added)	Training room	8 W/m ²	8 W/m ²	300 lx	300 lx
Floor between two heated spaces of different protected volumes	(no section was added)	Commercial	-	12 W/m ²	-	750 lx
Roof	U ≤ 0.24 W/m ² K	Restoration	-	-	-	-
		Bank service	-	6 W/m ²	-	300 lx
		Copy room	3 W/m ²	3 W/m ²	500 lx	500 lx
		Dressing facilities	5 W/m ²	5 W/m ²	-	300 lx
		Equipment room	3 W/m ²	3 W/m ²	-	150 lx
		Industrial kitchen	-	8 W/m ²	-	500 lx
		Kitchenette	-	6 W/m ²	-	300 lx

5. Dynamic Simulations

Starting point: dynamic simulation model

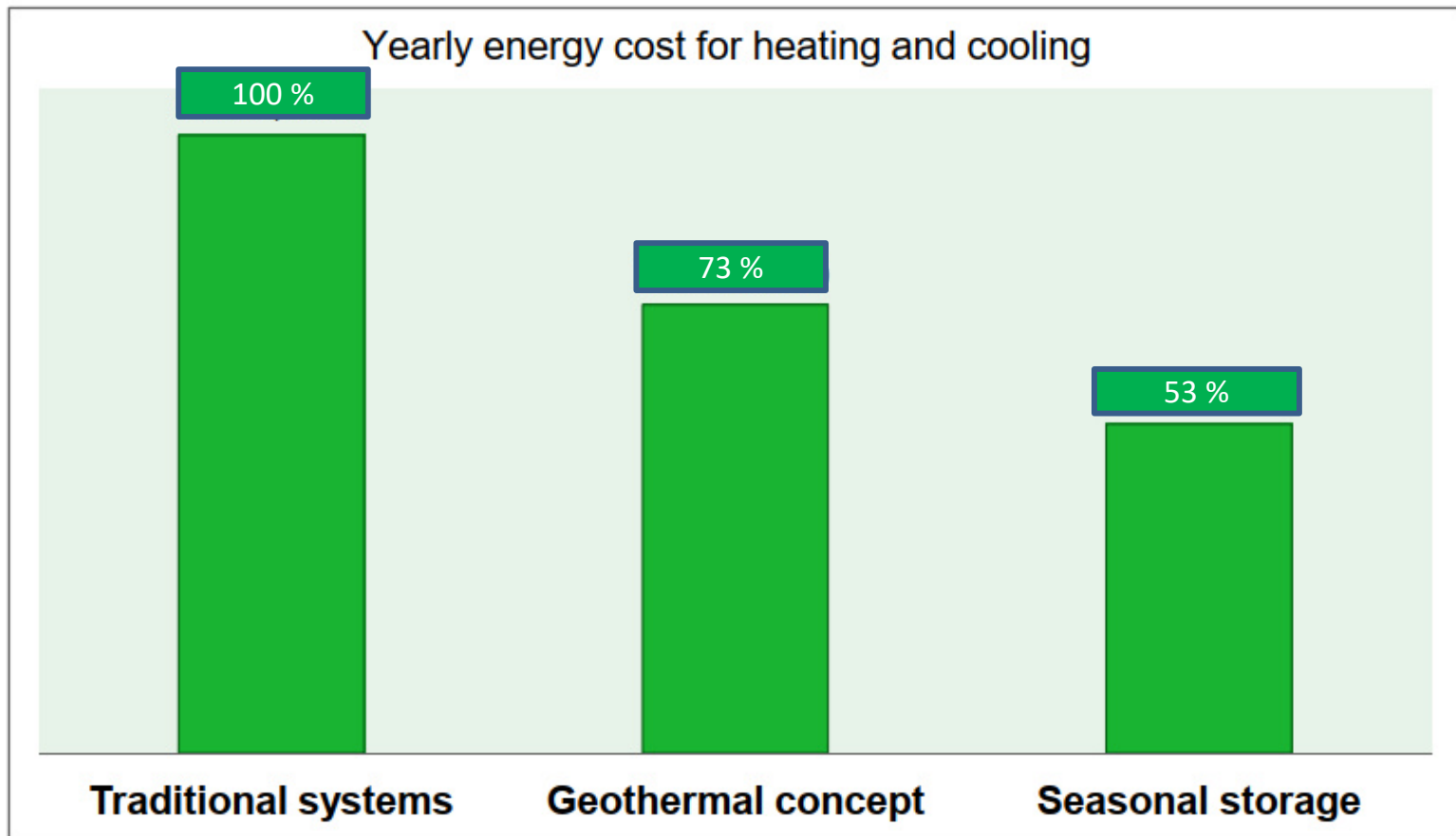


Meteodata:

- Ussel moderate (see Comfort standard)
- Brussel extreme (see Energy Concept)
- IPCC A1B – 2020 (see Energy Concept)
- IPCC A2 – 2060 (see Energy Concept)

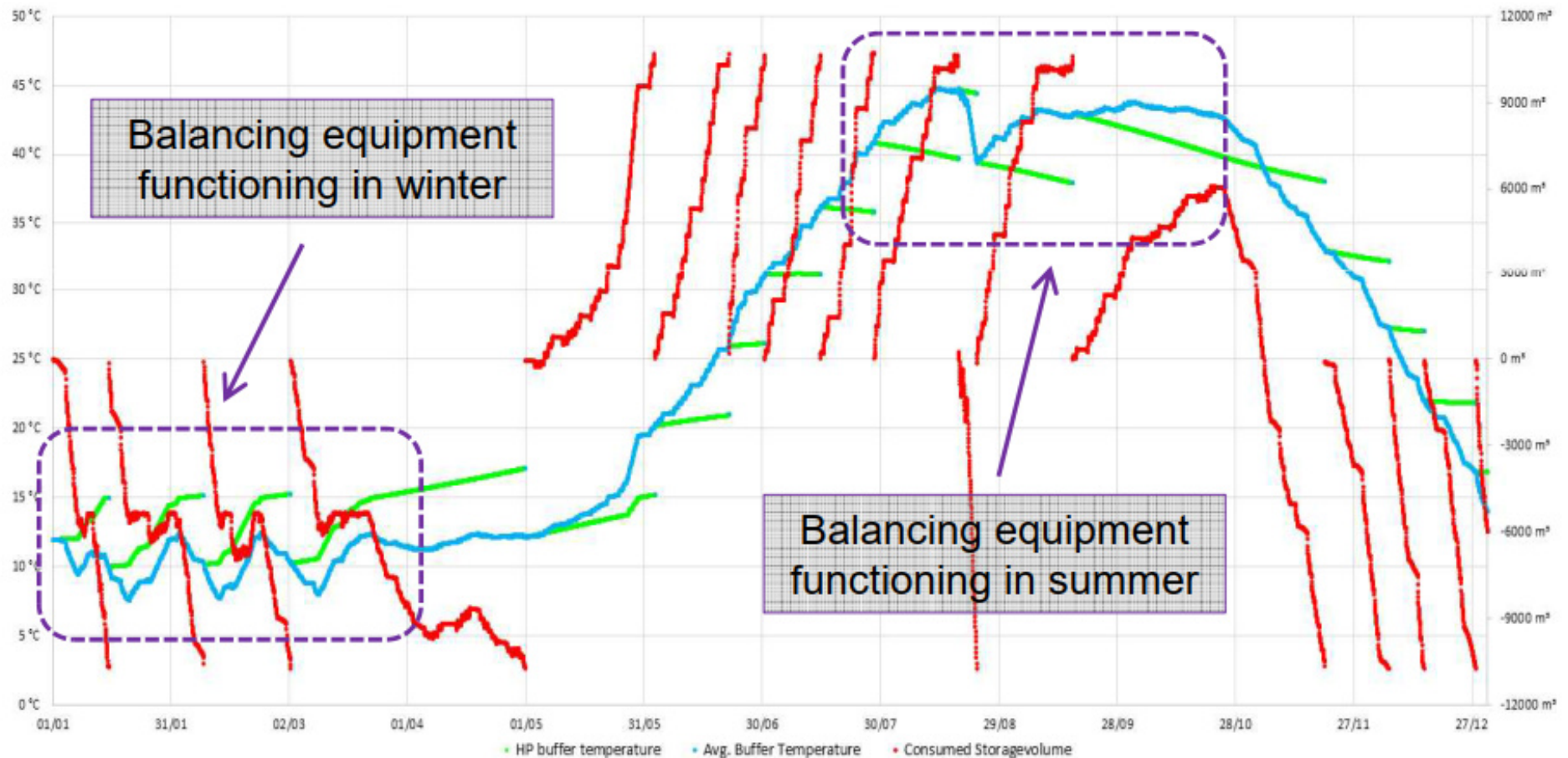
5. Dynamic Simulations

Results simulation model



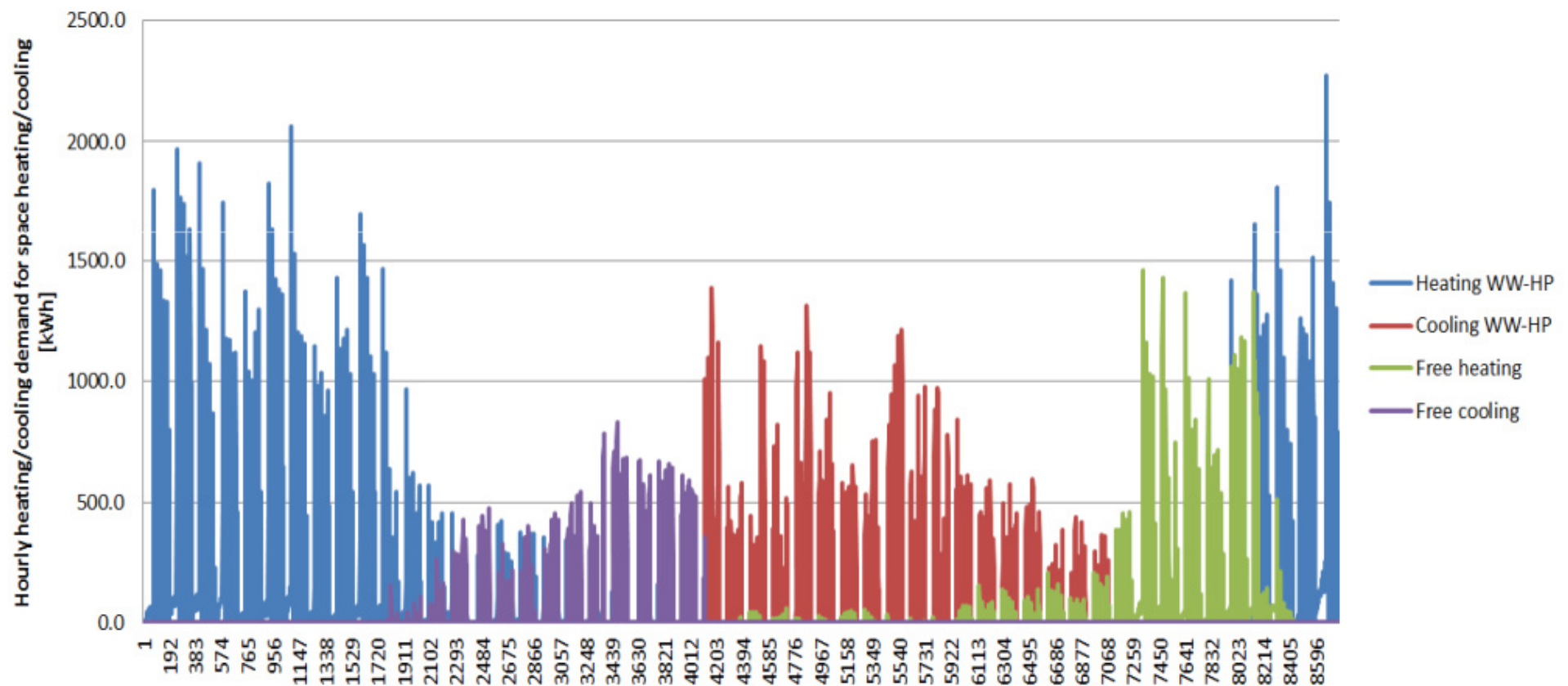
5. Dynamic Simulations

Visualisation of STES-functioning



5. Dynamic Simulations

Visualisation of STES-performance



5. Dynamic Simulations

Numerical data of STES-performance

- Performances of proposed equipment:
 - Heating - Water-water heat pump: SCOP = 6.37
 - Cooling - Water-water heat pump: ESEER = 5.80
 - Simultaneous heating and cooling: SCUE = 5.76
 - Balancing equipment heating: SCOP = 4.64
 - Balancing equipment cooling: SCOP = 37.6



Traditional equipment: PER = 0.98
Geothermal concept: PER = 0.67
STES-concept: PER = 0.40

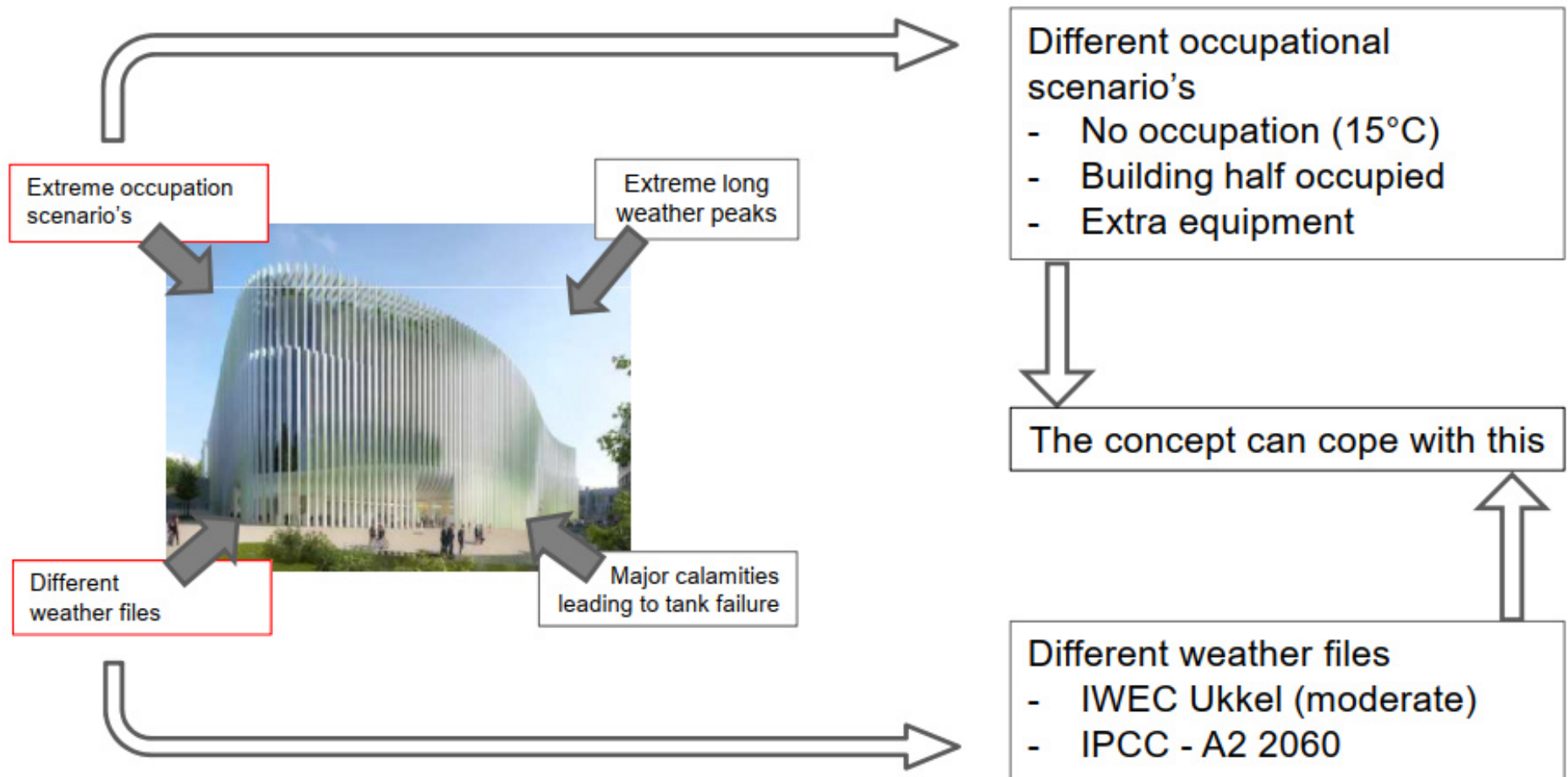
6. Risk Analysis

Risk Analysis achieved on many factors :

- Energy : Stratification Effect in the storage tanks
- Change of hypotheses (internal Loads, ...)
- Sealing of the storage tanks
- Weather changes
- Robustness of the simulations
- Closed System \gg Open system

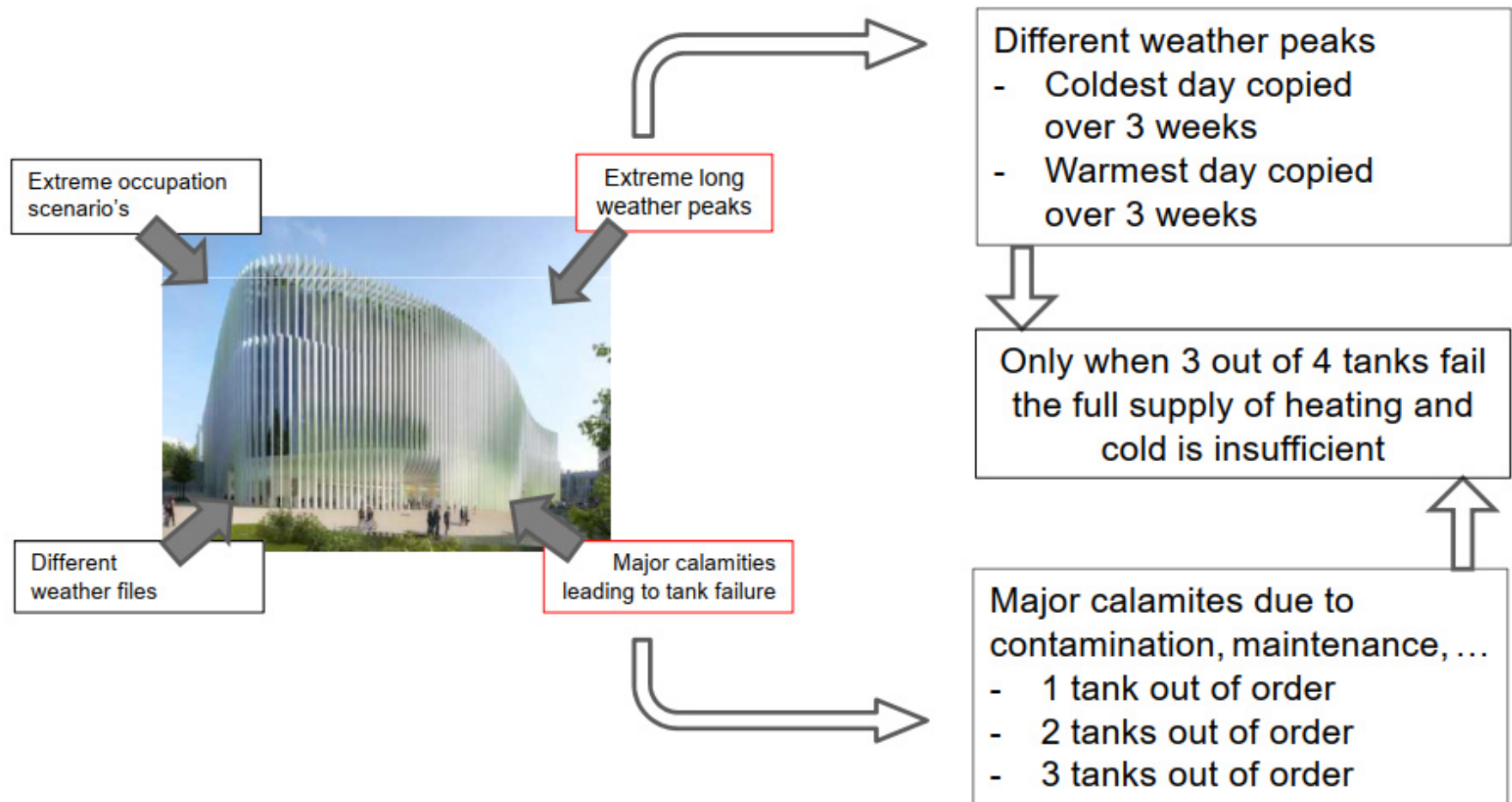
6. Risk Analysis – Robustness of the simulations

Robustness system dimensioning



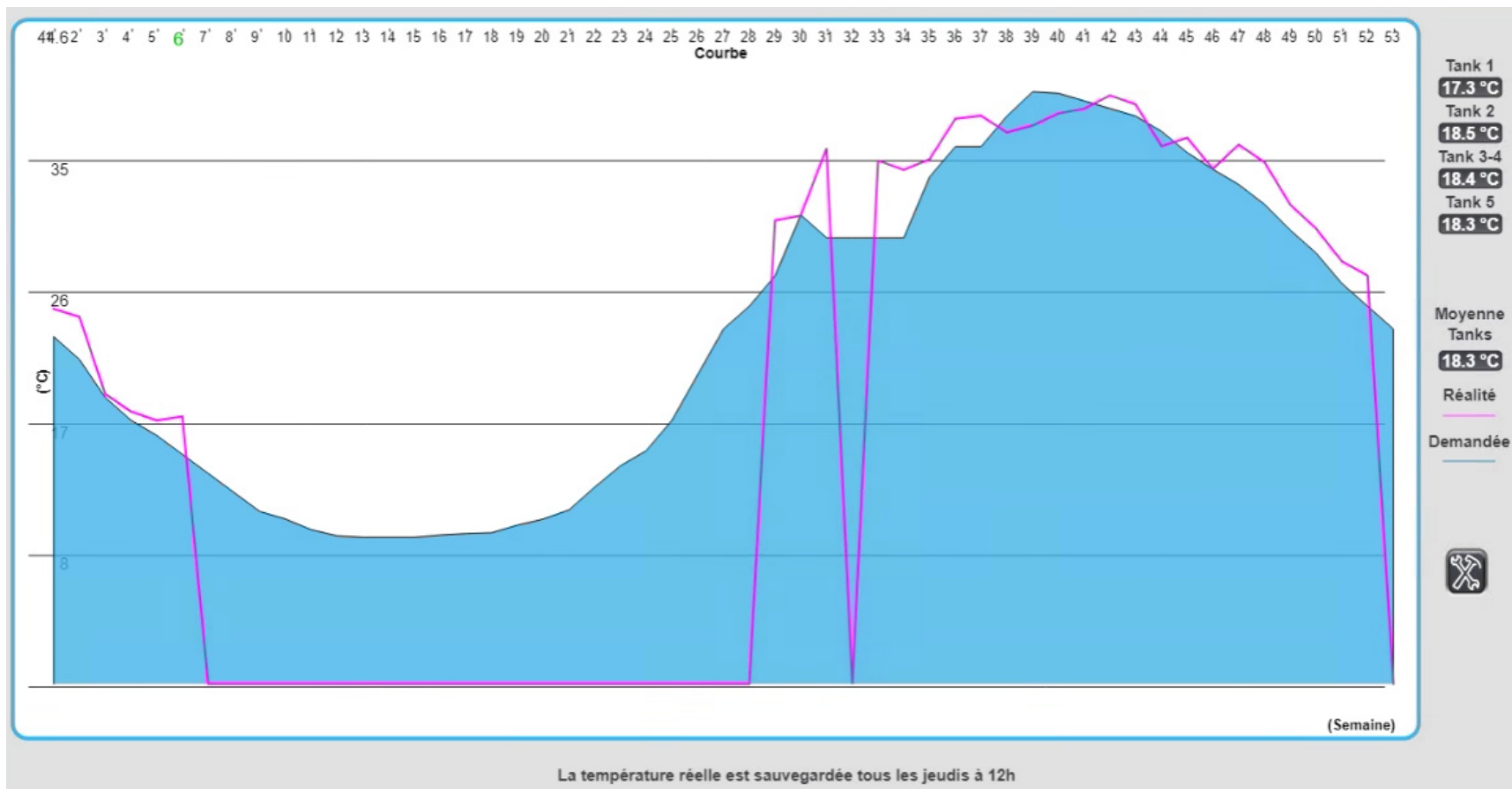
6. Risk Analysis – Robustness of the simulations

Robustness system dimensioning



7. Firsts Returns on experience

- Building occupied since more than 1 year
- Seasonal commissioning still in performance
- Temperature of the STES : No bad surprises :



7. Firsts Returns on experience

- CO2 Heat pumps for DHW : seems to be a good system but be careful with the return of DHW which needs to be $< 25^{\circ}\text{C}$ (need to stratification, +- constants demands, ...)
- Good confort achieved
- Buildings in cooling demand since 14/02/2023
- Energy bills not yet available
- Importance of saisonnal commissionning (need to be planified and ... remunerated...)

THANKS FOR ATTENTION **SWECO**



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