H2020 - EEB - 2017 - 766464 – SCORES

Self Consumption Of Renewable Energy by hybrid Storage systems

D8.1 Characteristics of the existing multifamily building with electric space heating, using as the demo site B, and its climate conditions

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Approved by	Coordinator (on behalf of General Assembly)	23/5/18

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1 Background

"The SCORES project aim is to develop and demonstrate in the field a building energy system including new compact hybrid storage technologies, that optimizes supply, storage and demand of electricity and heat in residential buildings, increasing self-consumption of local renewable energy in residential buildings at the lowest cost. Combination and optimization of multi-energy generation, storage and consumption of local renewable energy (electricity and heat) brings new sources of flexibility to the grid and gives options for tradability and economic benefits, enabling reliable operation with a positive business case in Europe's building stock. SCORES optimizes self-consumption of renewable energy and defers investments in the energy grid."

This deliverable (D8.1) gives the main characteristics of the multifamily building, selected as demonstrator B of the SCORES project. Exchanges are coordinated with the technical partners of the consortium and with the owner of the demonstration site, in order to best anticipate the requirements for the demonstration.

This document was compiled by Heliopac, whereas with the support of EDF's expertise on demonstrators' follow-up and monitoring. This document has also been reviewed by the partners within the SCORES program before publication.

2 References

2.1 Applicable Documents

	Document	Reference	Issue
AD-01	EDF-SCORES-ECM-008-i2_DemoB-Building characteristics	EDF-SCORES-ECM-008	2

2.2 Reference Documents

	Document	Reference	
RD-01	DoA: EeB-06-2017-SCORES-PartB		
RD-02	Thermal regulation for new buildings in France (RT2012)	Arrêté du 26 octobre 2010 Arrêté du 20 juillet 2011	

3 Terms, definitions and abbreviated terms

RP	Report
RT2012	Règlementation Thermique 2012 French Thermal regulation for new buildings since 2012
SRT	Surface règlementaire thermique Thermal Regulation Surface
Cep	Consommation en énergie primaire Primary energy consumption of the building
Cepmax	Coefficient d'efficacité énergétique maximal de l'enveloppe du bâtiment Maximum value of the building thermal efficiency coefficient
Bbio	Besoin bioclimatique Building thermal losses coefficient
Bbiomax	Besoin bioclimatique maximal de l'enveloppe du bâtiment Maximum value of the building thermal losses coefficient
DHW	Domestic hot water

4 Executive summary

This document presents the characteristics of the demonstration site B located in South of France. A general description of the building including its size, usage, location and climate is given first. Then all details of the building as the configurations, energy needs and technical equipment installed are described. The last part of the report specifies the location of the SCORES technologies in the building. Technical specifications related to the building, connections between the technologies and the existing equipment are also identified here.

General description

The building selected for Demonstrator B (Figure 1) is a multi-family residence for seniors.

Figure 1: 3D view of the building (Source: Domitys)

It is located in the Eco-district “Le Parc du Canal” in Agen (France). It is a part of the ZAC Donnefort, a urbanistic area created in 2012 by the city of Agen. Close to the city center, this sustainable district is planned to integrate housing but also to be a technologic center.

Urban development works started in 2013 with a road improvement with bike path and sidewalks, creation of parking, a walkway and the Donnefort square.

The construction of the building selected for Demonstrator B along with other housing buildings comes with the second part of the urbanistic program. The end of the construction work is expected for the end of 2018.

Finally the new district is planned to host economic activities for the new building construction sector.

5 Location

The building is located in the city of Agen which is the prefecture of the Lot-et-Garonne department in Nouvelle-Aquitaine in southwestern France (Figure 2). It lies on the river Garonne, approximately halfway between Bordeaux (132 km) and Toulouse (107 km).

Geographical coordinates	44°12′18″N 0°37′16″E
Population (2017)	34 126
Area	11.49 km²

Agen is 1h30 far from Toulouse and Bordeaux by car. It takes 1 hour by train from this two cities and 4h from Paris. The city has also an airport with direct flights to Paris.

Figure 2: Location of the city of Agen (left) and the residence (right) (Source: Google maps)

6 Actors involved

Project ownership	AEGIDE DOMITYS SCI Agen Les verges d'Ebène
Project management	BAKELITE ARCHI CONSEIL
Condominium syndicate	not defined yet

7 Timeline of the building's construction

- March 2015 : Building permit
- March 2017 : Start of construction work
- December 2018: Expected end of work

8 Building's environment

8.1 Climate conditions

Agen features an oceanic climate (Cfb), in the Köppen climate classification. Winters are mild and feature cool to cold temperatures while summers are mild and warm. Rainfall is spread equally throughout the year, however, most sunshine hours are from March–September.

Climate data for Agen, France (altitude 59 m, 1981–2010) [hide]													
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Record high °C (°F)	20.1 (68.2)	22.3 (72.1)	26.3 (79.3)	30.2 (86.4)	34.0 (93.2)	38.8 (101.8)	40.6 (105.1)	41.0 (105.8)	36.7 (98.1)	32.0 (89.6)	25.4 (77.7)	21.6 (70.9)	41.0 (105.8)
Average high °C (°F)	9.2 (48.6)	11.3 (52.3)	15.0 (59)	17.5 (63.5)	21.5 (70.7)	25.0 (77)	27.6 (81.7)	27.6 (81.7)	24.5 (76.1)	19.6 (67.3)	13.2 (55.8)	9.5 (49.1)	18.5 (65.3)
Average low °C (°F)	2.1 (35.8)	2.4 (36.3)	4.4 (39.9)	6.6 (43.9)	10.3 (50.5)	13.6 (56.5)	15.4 (59.7)	15.3 (59.5)	12.3 (54.1)	9.7 (49.5)	5.4 (41.7)	2.8 (37)	8.4 (47.1)
Record low °C (°F)	−17.4 (0.7)	−21.9 (−7.4)	−10.5 (13.1)	−3.9 (25)	−1.6 (29.1)	2.5 (36.5)	5.9 (42.6)	4.7 (40.5)	1.0 (33.8)	−5.0 (23)	−8.8 (16.2)	−12.1 (10.2)	−21.9 (−7.4)
Average precipitation mm (inches)	55.1 (2.169)	52.1 (2.051)	49.8 (1.961)	67.6 (2.661)	76.1 (2.996)	58.4 (2.299)	51.3 (2.02)	55.0 (2.165)	59.3 (2.335)	64.3 (2.531)	63.4 (2.496)	59.8 (2.354)	712.2 (28.039)
Average precipitation days (≥ 1.0 mm)	9.9	8.3	9.0	10.8	10.6	8.1	6.3	7.1	7.9	9.5	10.0	9.8	107.1
Average snowy days	1.3	1.2	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.1	4.8
Average relative humidity (%)	89	85	79	77	77	75	73	76	79	86	90	91	81.4
Mean monthly sunshine hours	77.5	110.1	172.6	182.3	213.6	232.1	255.4	242.3	204.9	138.2	84.0	69.4	1,982.4
Source #1: Météo France[2][3]													
Source #2: Infoclimat.fr (humidity and snowy days, 1961–1990)[4]													

Figure 3: Weather data for the city of Agen (Source: Wikipedia)

Direct normal solar irradiation range: [1100; 1400] kWh/m²/year

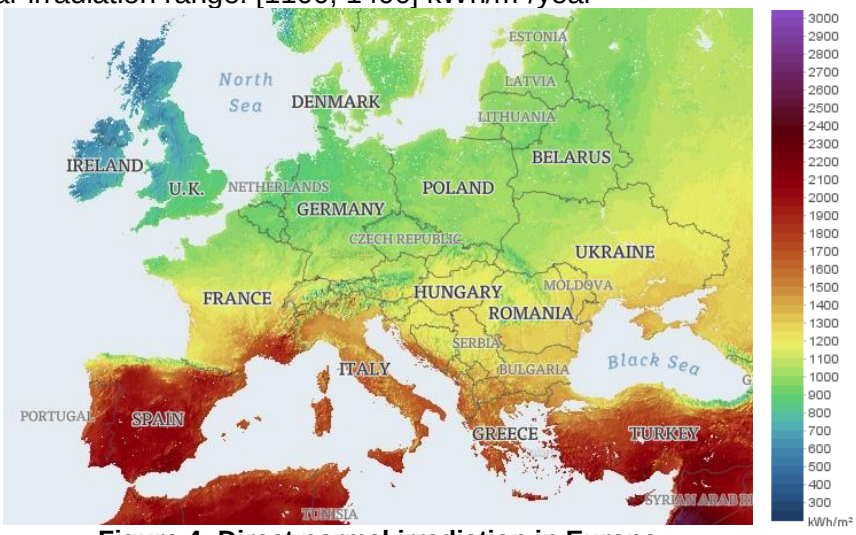

Figure 4: Direct normal irradiation in Europe (Source: Global Solar Atlas by the World Bank Group)

8.2 Surroundings

Called "Les Vergers d'Ebène" (litt. “ebony orchards”), the residence will be located in the heart of a brand new eco-district, "Le Parc du Canal", offering a pleasant environment on the banks of the Canal Lateral, branch of the Garonne river. The city, located on the right bank of the Garonne, offers its inhabitants a pleasant setting for walks along the banks. In the heart of the city center, young and old alike will appreciate the Jayan Garden. Green lung of the city, this garden offers a real haven of peace and relaxation around its fountain and its centenary trees.

Figure 5: Aerial view of the building (Source Domitys)

9 Usage

9.1 Residential apartments

The building has 115 apartments in total. The table below shows the breakdown of apartments by size:

Type 1	16
Type 2	71
Type 3	28
Total	**115**

Figure 6: Preview of a Type 2 apartment (Source: Domitys)

9.2 Services

The residence includes services for its occupants located on the ground floor of the building.

Figure 7: Services (Source: Domitys)

1	Swimming pool
2	Gym
3	Beauty institute
4	Art studio
5	Lobby
6	Bar lounge
7	Media room
8	Restaurant
9	Kitchen

9.3 Gardens

Green spaces and car parks surround the building. The northern part of the building overlooks a public park.

Figure 8: Gardens around the residence (Source: Domitys)

9.4 Utility rooms

A laundry and storage spaces are located on the ground floor of the residence.

10 Building's dimensions

10.1 General characteristics

Characteristics	Value
Surface area	6 552 m²
Volume	16 380 m3
Number of wings	2 wings (North and South) linked at the ground floor
Number of floors	ground floor + 5 floors

10.2 Ground floor

Dimensions : 1614 m²

North wing	
Apartments	1x T1 5x T2 1x T3
Services	Swimming pool Gym Relaxation Hairdresser Beauty institute Art room Office
Utility rooms	
Technical rooms	Swimming pool technical room DHW technical room
South wing	
Apartments	1x T1 2x T2 2x T3
Services	Media room Restaurant Kitchen Bar
Utility rooms	Storage Laundry
Technical rooms	

10.3 Upper floors

1st floor

North wing	
Apartments	2x T1

	6x T2 3x T3
Services	
Utility rooms	
Technical rooms	Terrace (CLC container)
South wing	
Apartments	1x T1 8x T2 2x T3
Services	
Utility rooms	
Technical rooms	

2nd floor

North wing	
Apartments	2x T1 6x T2 3x T3
Services	
Utility rooms	
Technical rooms	
South wing	
Apartments	1x T1 8x T2 2x T3
Services	
Utility rooms	
Technical rooms	

3rd floor

North wing	
Apartments	2x T1 6x T2 3x T3
Services	
Utility rooms	
Technical rooms	
South wing	
Apartments	1x T1 8x T2 2x T3
Services	
Utility rooms	
Technical rooms	

4th floor

North wing	
Apartments	1x T1 5x T2 3x T3
Services	
Utility rooms	
Technical rooms	
South wing	
Apartments	2x T1 6x T2 2x T3
Services	
Utility rooms	
Technical rooms	

5th floor

North wing	
Apartments	1x T1 5x T2 3x T3
Services	
Utility rooms	
Technical rooms	PV inverter + electrical batteries room
South wing	
Apartments	2x T1 6x T2 2x T3
Services	
Utility rooms	
Technical rooms	

10.4 Roof

Type	Terrace roof
Dimensions	1 204 m²
Height	17 m

11 Building's envelope

11.1 Glazed surface

- Glazed surface covers 39% of the walls surface.
- Orientations: North : 26.97, South : 37.85 %, East : 13.28, West : 21.56 %, Horizontal : 0.34%
- Expected Ug = 1.1 W/m²K

11.2 Insulation

Walls

- Interior insulation
- 20cm concrete + 12cm of glass whool
- Expected Ug = 0.244 W/m²K

Roofs

- 20cm concrete + 12cm of rigid insulation
- Expected Ug = 0.16 W/m²K

12 Energy consumption forecast

The French thermal regulation called RT2012 is related to new buildings construction in France. It aims to set a maximum limit (Cepmax) for the primary energy consumption of new buildings for heating, ventilation, air conditioning, domestic hot water and lighting. It also set a limit of the buildings thermal losses (Bbiomax). In order to validate the compliance to the RT2012, a calculation of new building thermal and energetic performances is done according to the regulation method.

Results of RT2012 for the demo-site building are presented below. As the construction work is not finished yet, these results are temporary. They could slightly evolve until the end of the construction work if some component material implemented in the building are different from those planned.

Résults (not final)

SRT	8880.60	*m²*
Cepmax	88.8	*kWhep/m²/year*
Bbio max	62.94	/
Cep	69.34	*kWhep/m²/year*
Bbio	46.7	/

Detail of Cep :

Space heating	22.60	*kWhep/m²/year*
Space cooling	13.40	*kWhep/m²/year*
DHW	20.04	*kWhep/m²/year*

Lighting	5.90	*kWhep/m²/year*
Auxiliary equipment	7.3	*kWhep/m²/year*

Meaning of acronyms:

RT2012 (Règlementation Thermique 2012): French Thermal regulation for new buildings since 2012

SRT (Surface règlementaire thermique): Thermal Regulation Surface

Cepmax (Consommation maximale en énergie primaire): Maximum primary energy consumption of the building

Bbiomax (Besoin bioclimatique maximal du bâtiment) = Maximum value of the building thermal thermal losses coefficient

Cep (Consommation en énergie primaire) : Primary energy consumption of the building

Bbio (Besoin bioclimatique du bâtiment) = Building thermal losses coefficient

13 Original energy system installed

13.1 Space heating

Overall heating capacity of the building is 85 590 kWh per year. The building will be heated by thermodynamic air/air units and electrical heaters.

	System	Power	Setpoints	Control / monitoring
Apartments	Air to air heat pump : Ceiling concealed ducted in each apartment (bedrooms and living room) with centralized outdoor units	Indoor units : 3.2 kW Outdoor units : 4x 113kW	22°C (+-2°C) Min 16°C / Max 28°C	No centralized control or monitoring
Services	Air to air heat pump : Ceiling concealed ducted in each apartment (bedrooms and living room) with centralized outdoor units	Indoor units : 3.2 kW Outdoor units : 4x 88kW	22°C (+-2°C)	No centralized control or monitoring
Circulation	Electric radiators	150 kW		No centralized control or monitoring
Laundry, locker room, toilets	Radiant ceiling			No centralized control or monitoring

13.2 Domestic hot water

Overall heating capacity for DHW is 213 837 kWh per year. A centralized thermodynamic system will heat the water for the apartments and electric water heaters will provide DHW for Services parts of the building.

	System	Power / storage	Control / monitoring
Apartments	Water-to-water heat pumps coupled to unglazed solar collector	3x 12kW 7 000 L	Touchscreen, internet connection
Services	Electric water heater	75 to 300 L	

At any time, the temperature of the water leaving the storage needs to higher than 55°C according to sanitary regulation. The temperature of the distribution loop has to be higher than 50°C everywhere in the circuit.

13.3 Ventilation

	System
Apartments	hygro-thermal ventilation
Services (except restaurant, lobby, lounge)	simple flow ventilation
Restaurant, lobby, lounge	dual-flow ventilation

13.4 Air-conditioning

Overall air-conditioning capacity of the building is 76 732 kWh per year. The building will be refreshed by the same thermodynamic air/air units used for the space heating.

	System	Power	Setpoints	Control / monitoring
Apartments	Air to air heat pump : Ceiling concealed ducted in each apartment (bedrooms and living room) with centralized outdoor units	Indoor units : 3.2 kW Outdoor units : 4x 113kW	22°C (+-2°C)	/
Services	Air to air heat pump : Ceiling concealed ducted in each apartment (bedrooms and living room) with centralized outdoor units	Indoor units : 3.2 kW Outdoor units : 4x 88kW	22°C (+-2°C)	/

13.5 BEMS

No BEMS are planned to be installed in the building.

14 Integration of the SCORES technologies

The building has two technical rooms at the ground floor: the first for the collective domestic hot water production and the second one for the swimming pool technical equipment.

For the need of the SCORE project, two other places are identified to install technical devices. The CLC storage will be installed in container on terrace of the 1st floor. The PV inverter and electrical batteries will be implemented in a room at the 5th floor.

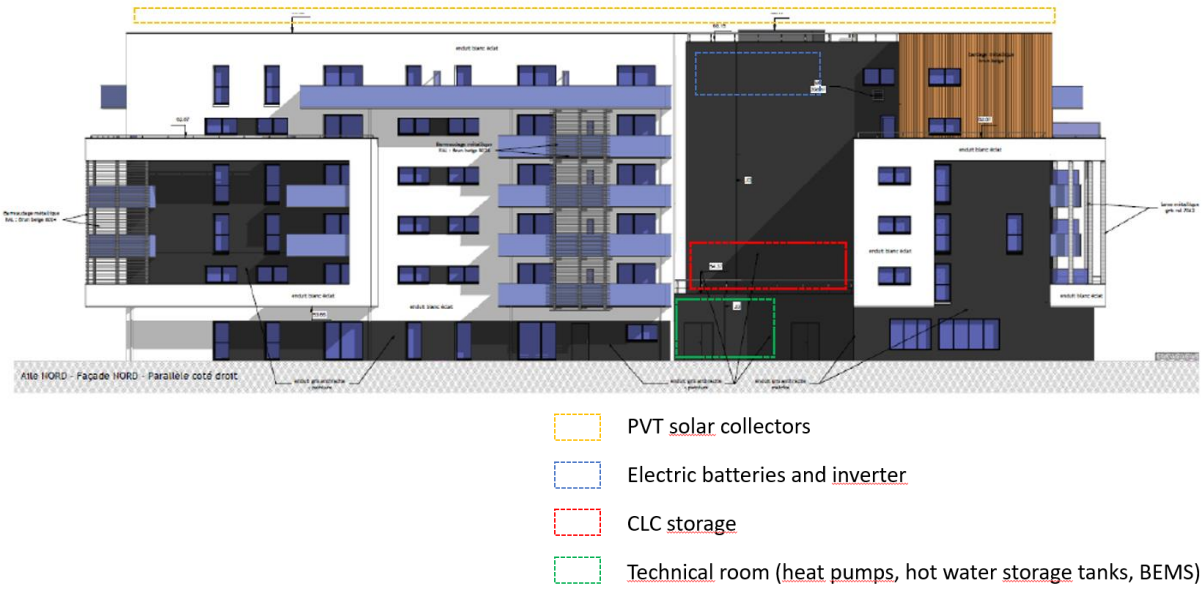

Figure 9 - North façade of the building with identification of technical equipment location

14.1 Domestic hot water system technical room

Located at the ground floor of the building, the technical room includes all components of the collective domestic hot water system: water to water heat pumps, water storage tanks and electrical cabinets.

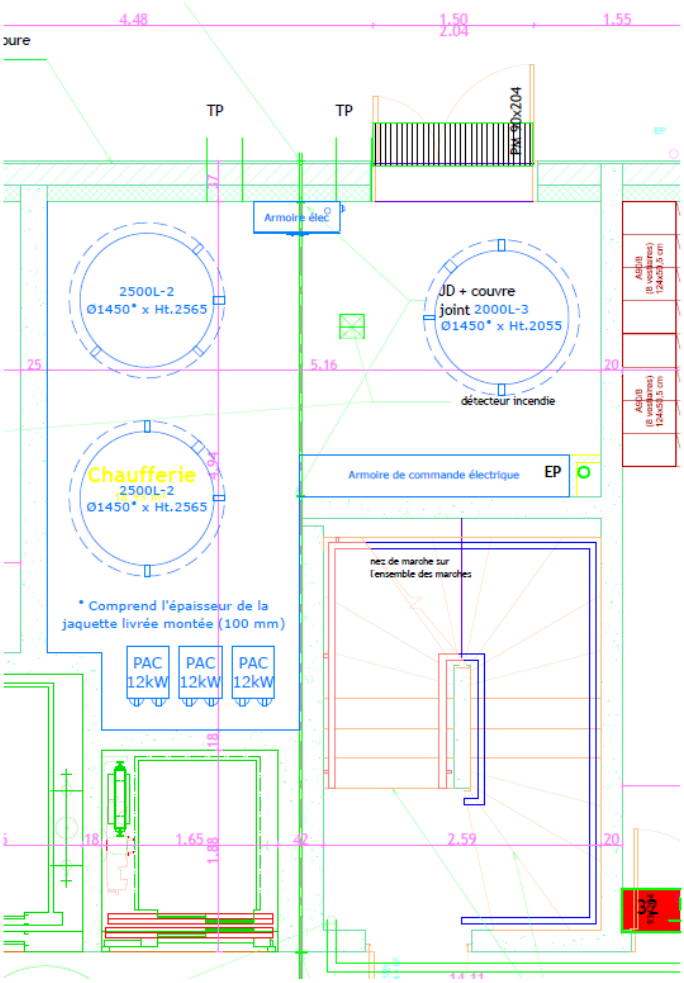

Figure 10 - DHW technical room (Ground floor)

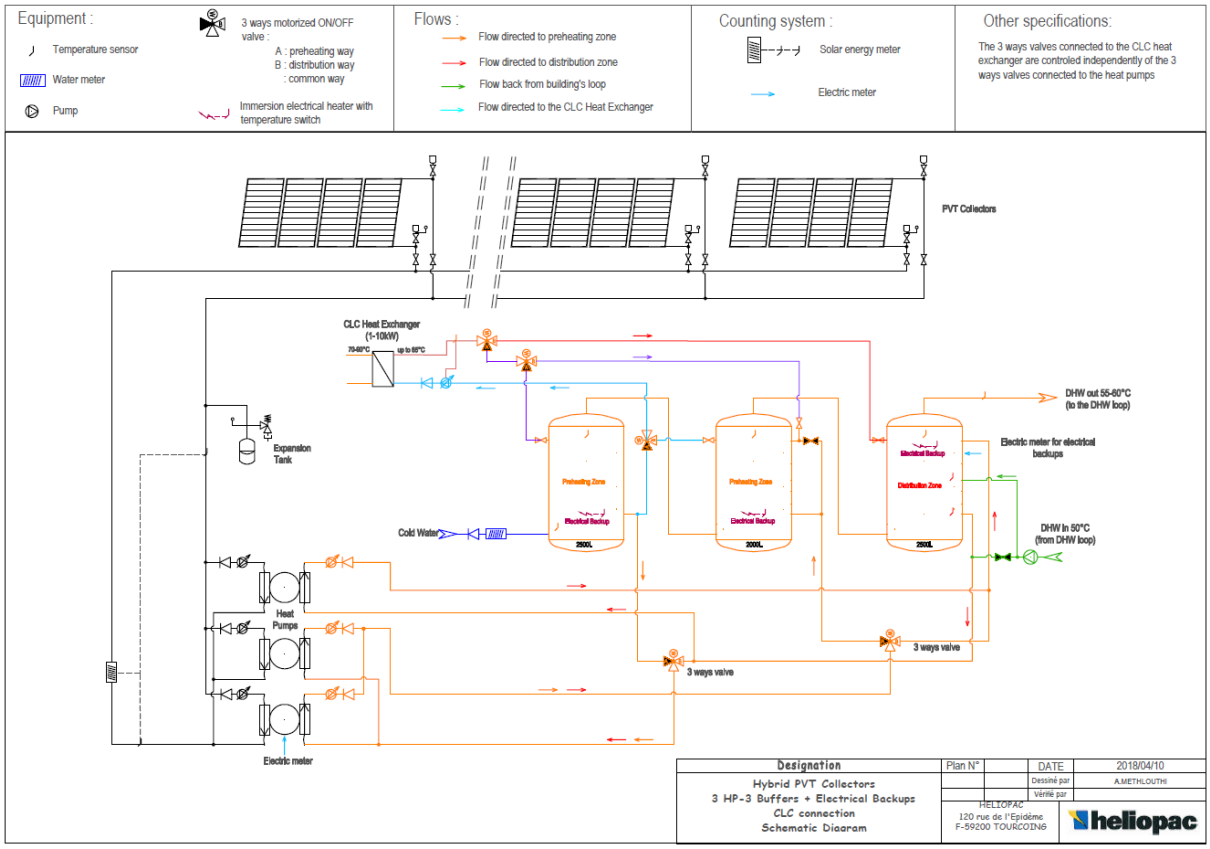

Figure 11 - Hydraulic diagrams of DHW system

14.2 CLC storage location

The CLC storage will be implemented in a container located on a terrace just above the DHW system technical room. The CLC container will be connected (hydraulic and electricity) to the technical room on the DHW system electrical cabinet.

Electric connections planned:

- 380V 32A
- several standard 220V connections

The maximal admissible weight of the container and its material is 6 tons.

1

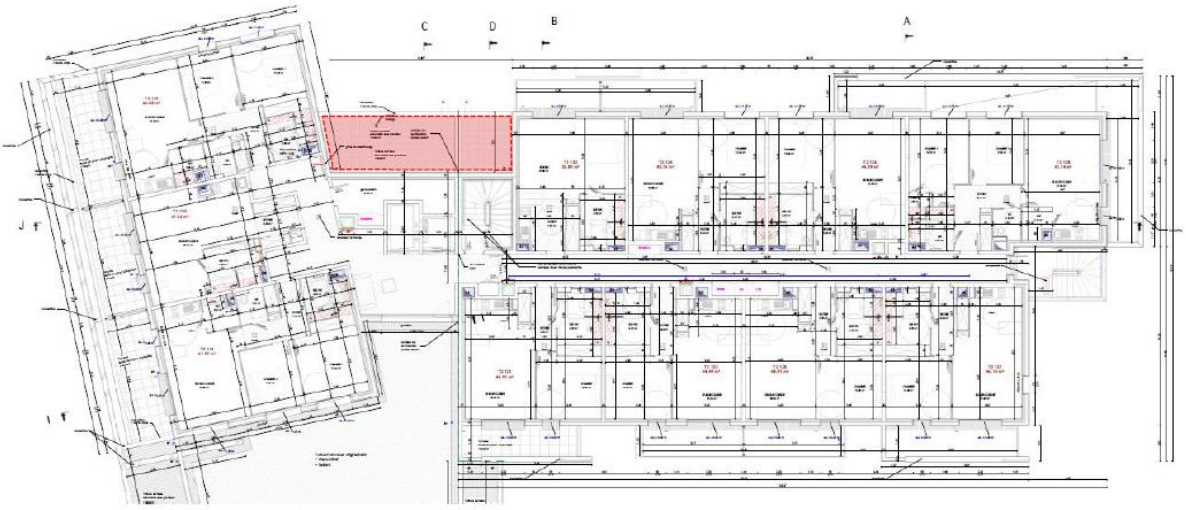

Figure 12 - First floor plan with location of the CLC storage

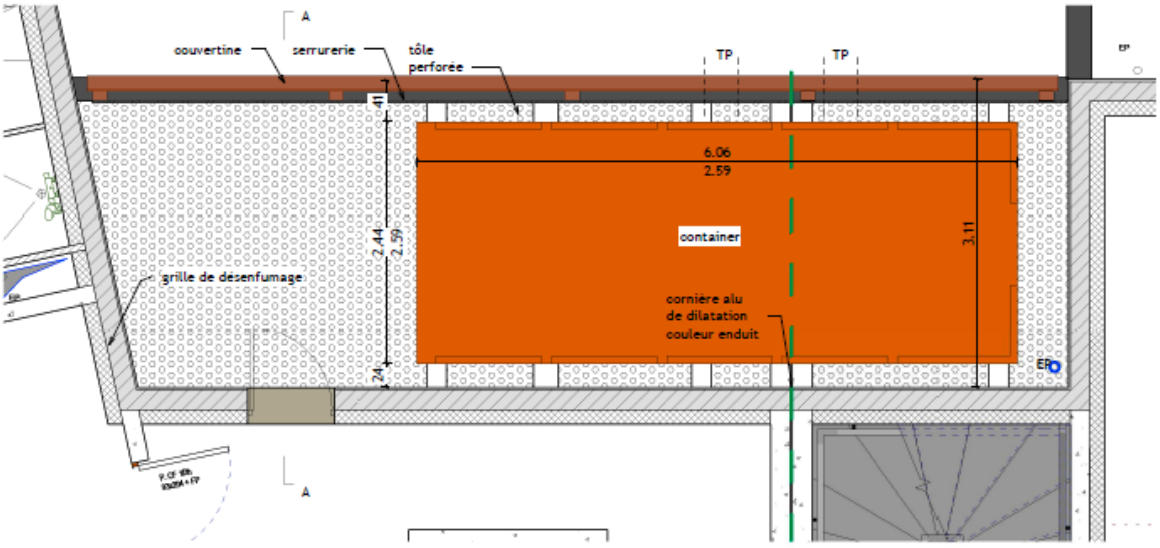

Figure 13 - Plan of CLC container (Source Bakelite)

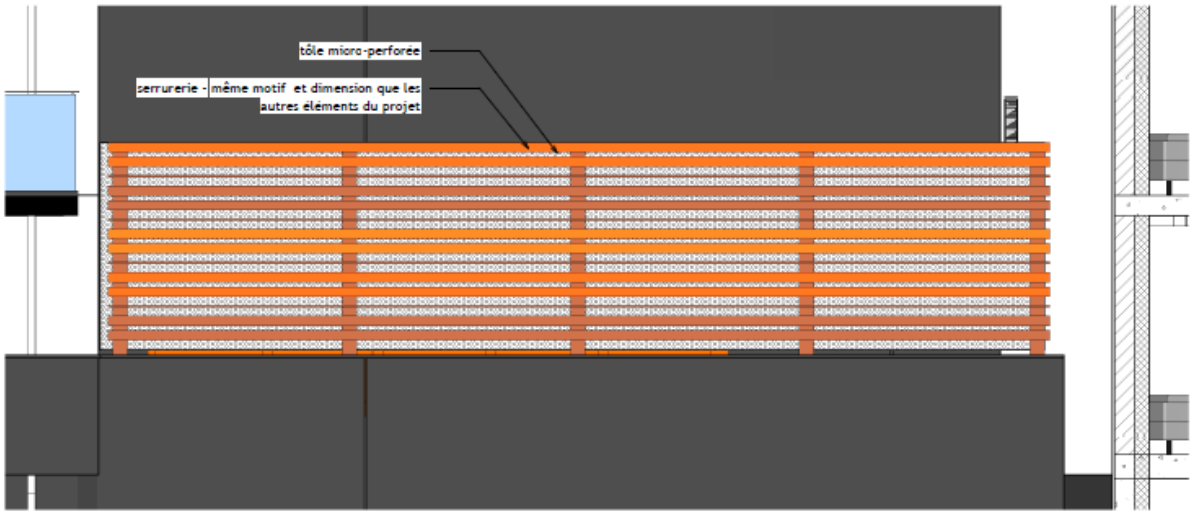

Figure 14 - Elevation view of CLC container (Source Bakelite)

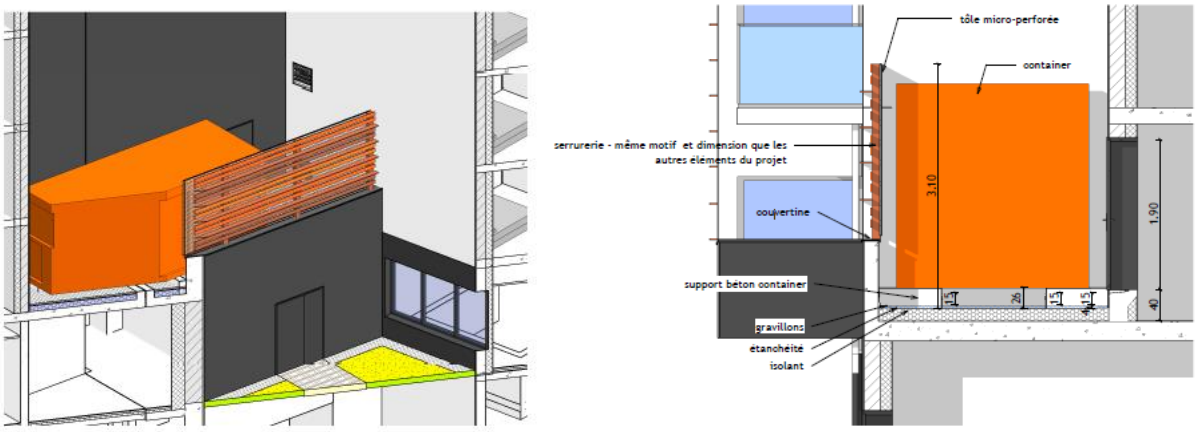

Figure 15 - 3D and sectional view of CLC container (Source Bakelite)

14.3 Electrical batteries technical room

Electrical batteries and the converter will be located in a room at the 5th floor of the building. The room will be equipped with an air conditioning system and a door with an anti-panic bar opening from the inside.
The maximal admissible weight for the material implemented in this room is 1500kg.

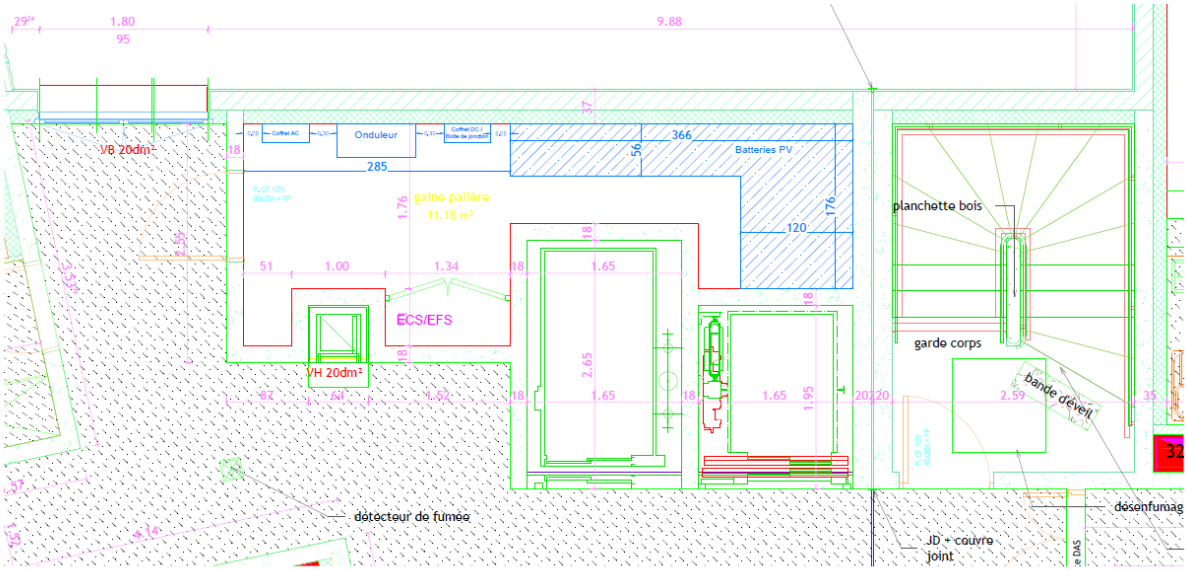

Figure 16 - Inverter and electrical batteries technical room (5th floor)

14.4 PVT solar collectors location

A total of 129 PVT panels will be implemented on the roof of the North wing of the building. They will be oriented to the south with a slope of 15° and they will be fixed on a metallic support to the roof slab.
The PVT panels will be connected electrically to the main electric distribution of the building. Electricity that will not be consumed by the building will be injected into the grid.

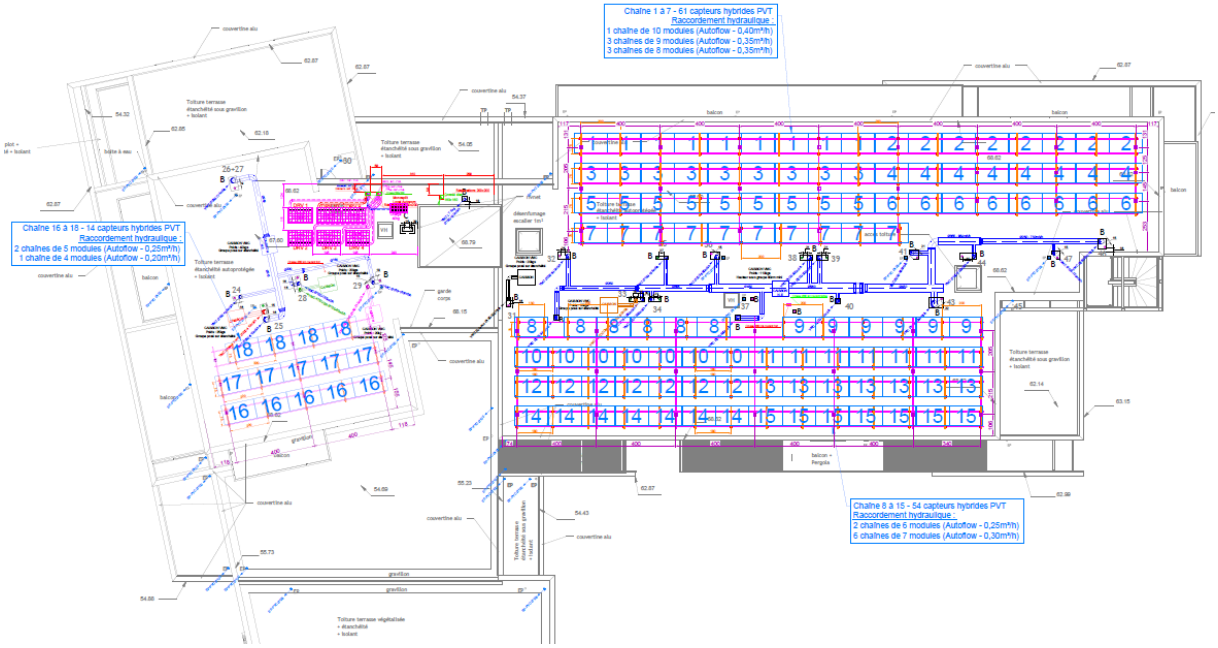

Figure 17 – North wing roof plan with PVT solar collectors implementation

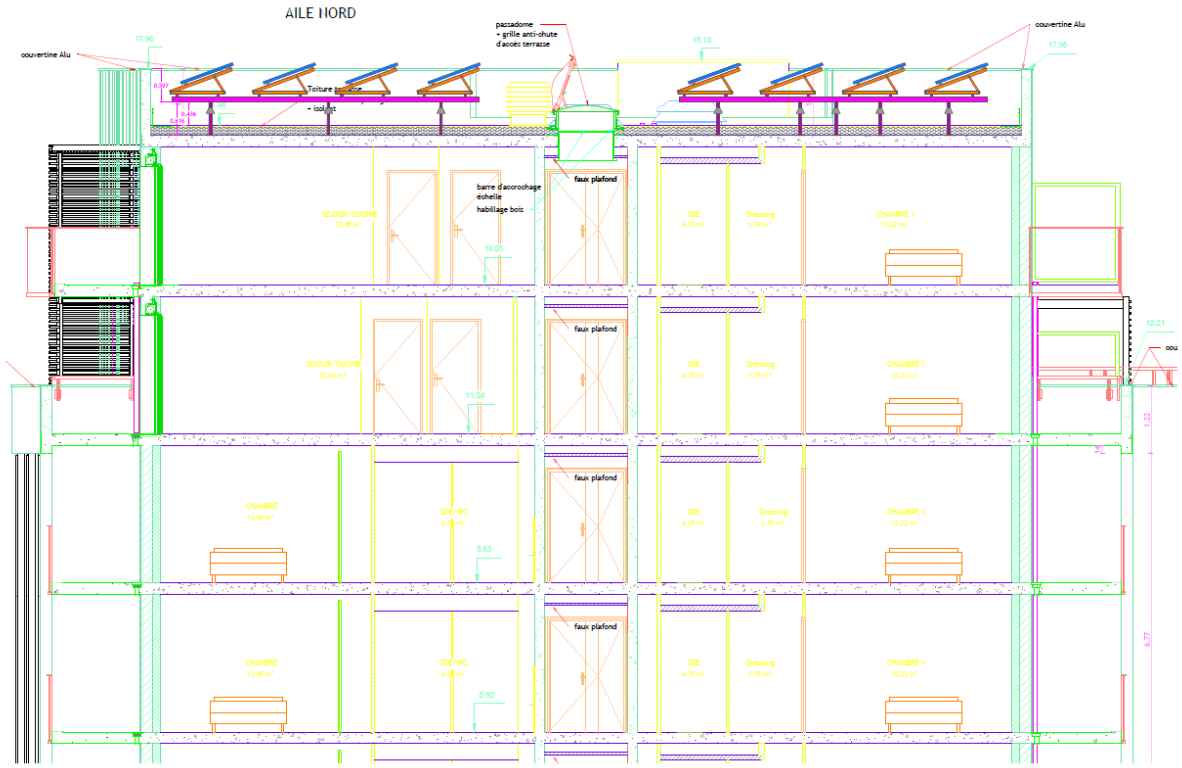

Figure 18 - Sectional view of the North wing of the building with PVT implementation

14.5 Electrical heaters with PCM locations

Electrical heaters with PCM (EHP) will be tested in two apartments located at the ground floor of the building. One unit will be located in a Type 1 apartment and 3 other units will heat a Type 3 apartment. The heating system of origin will be set off during all the test phase of the project.

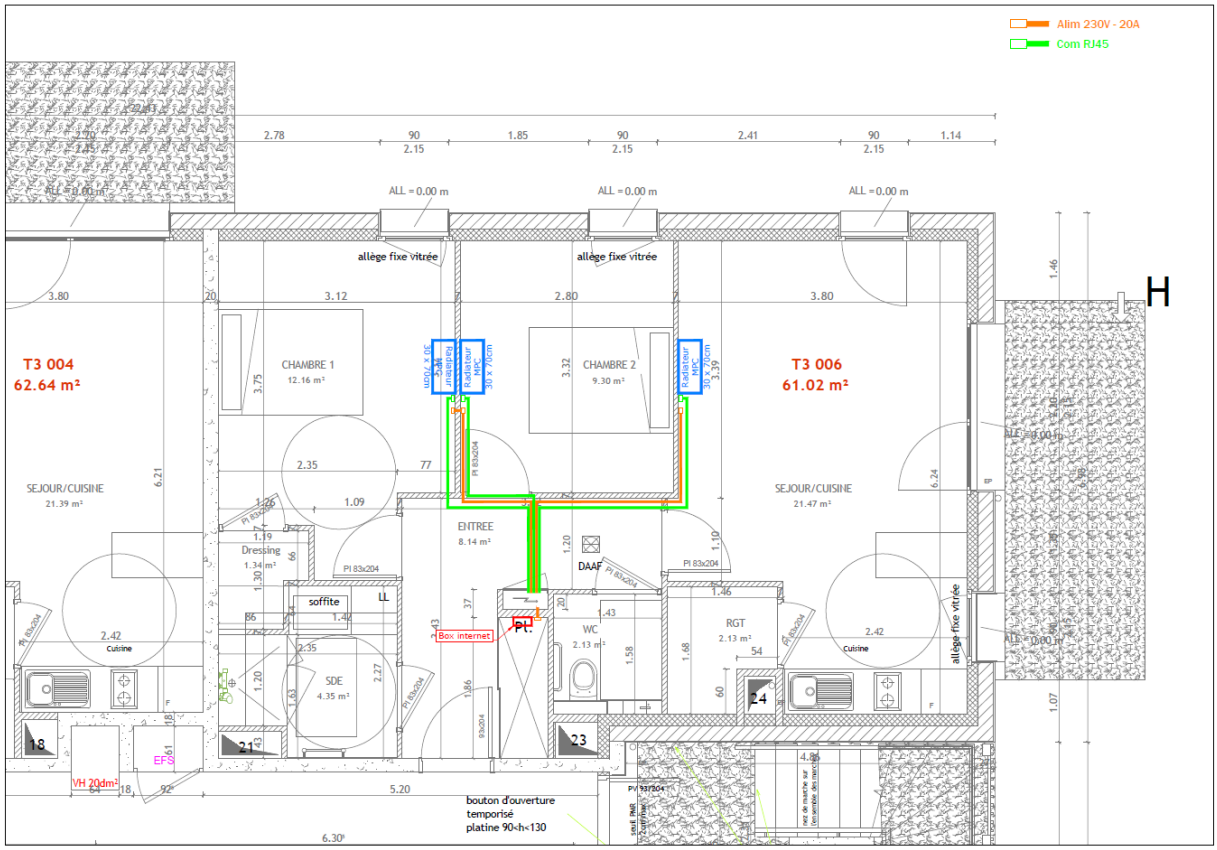

Figure 19 – Implementation and connections of EHP in the Type 3 apartment (Ground floor South wing)

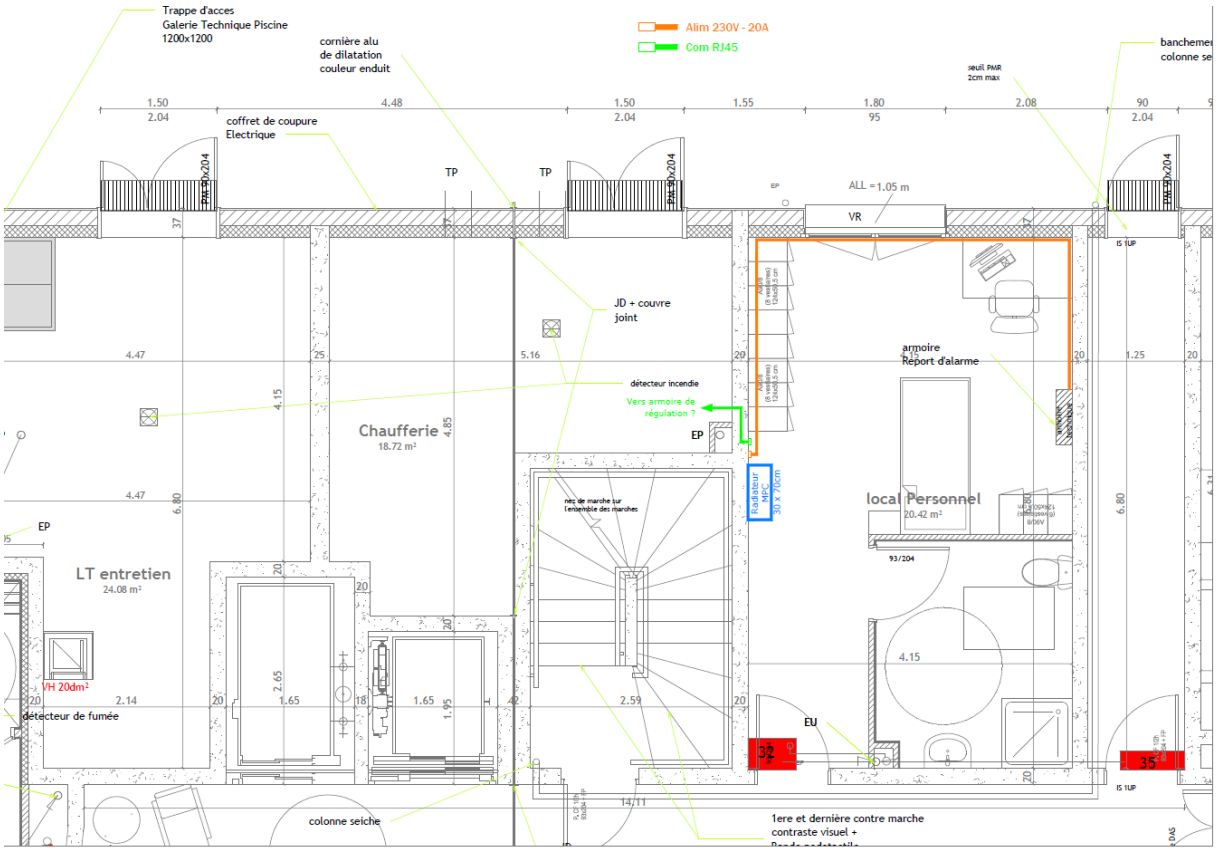

Figure 20 - Implementation of EHP in the Type 1 apartment (ground floor North wing)