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1 Executive Summary

This deliverable aims at offering an inspection solution to any user of the E-DYCE method. This inspection form should allow the expert user to add a building to the E-DYCE method. In addition, some monitoring solutions will be explored and classified depending on different factors (measured KPI, frequency and spatial resolution)

Its filling might be tedious, but there is a need for a centralisation of the building information. The correct filling of the sheet allows for precision in the simulations. It allows the good introduction of the building in the E-DYCE platform.

The inspection sheet allows a standard EPC calculation, an adapted conditions EPC calculation and a description of the zones for dynamic simulation (see D3.5 and simplification model for zones definition).

Link to the Building inspection sheet

2 Context

Currently, only static Energy Performance Certifications (EPC) are performed in the EU countries as an assessment of the building's energy needs. It has been observed that a great part of the buildings are showing a performance gap. The performance gap is defined as the difference between the real and theoretical consumptions of a building. The theoretical consumption is given by the static EPC. This doesn't allow for dynamic behaviours to be considered in the calculation. To perform a dynamic assessment of the energy needs of a building, additional parameters must be defined. This inspection sheet will allow an expert to fill the needed parameters in the given excel sheet, to build a static model as well as a dynamic one. It is the first step of the introduction of a building in the E-DYCE process.

The E-DYCE method aims at anticipating and eliminating the performance gap for renovated and new buildings. The inspection allows to build a numerical model and analyse its potential for renovation. This report and the building inspection sheet offer a solution for the building inspection.

2.1 Objectives

Multiple simulations must be performed with the building model to accurately identify the reasons for a performance gap. First, a static simulation with the national standard is mandatory, in order to give the energy performance certification (EPC). This simulation result is the one from which a performance gap is usually computed. It is the reference for theoretical energy consumption.

The second calculation is a static one with adapted parameters such as the indoor temperature, the window solar protection percentage, the heating efficiency and the DHW production efficiency. This gives a range of possible causes of consumption drift.

A third and fourth calculations must be computed according to the E-DYCE method. Both are dynamic simulations. The third is a dynamic simulation of the building and some zones (the needed zones will be described in further deliverables – D3.5) with the EU standard. Finally, the fourth calculation is dynamic, with the same zoning as the third but with adapted parameters. Some of these adapted parameters will

be the same as the second calculation, but additional ones (dynamic ones) will either be taken from national standards or the inspection or the monitoring.

Table 1 : Different calculation steps

N°	Title of calculation	Static/ Dynamic	Standard	Where to take parameters	Zoning
1	Static EPC – Standard	Static	National	Standard	Building
2	Static EPC – actual	Static	Adapted	Inspection/monitoring	Building
3	DEPC – Standard	Dynamic	EU	EN 16798	Specific (output D3.5)
4	DEPC – Adapted	Dynamic	Adapted	Same as 2 + National standard or inspection/monitoring for dynamic	Specific (output D3.5)

The building inspection sheet contains all the necessary information for the calculation of a standard EPC, as all the envelope's elements are listed. In addition, several sheets contain dynamic parameters that either must be filled by the inspector or read from the EU standard. This allows all four calculations to be performed with one inspection sheet.

Additional elements must be inspected in order to perform a dynamic simulation of the building. If some of the elements cannot be identified through the inspection, these data may be retrieved from the EU standard.

The objective of the inspection sheet is to guide the user of the E-DYCE method to build the four simulation models mentioned above to finally identify the reasons for the performance gap.

3 Building Inspection sheet

The inspection sheet is an excel spreadsheet. It contains multiple sheets describing different elements of the building, its surfaces and zones. Each sheet is described in the following sub-sections.

3.1 Instruction of use

The table is designed to be filled during and after an inspection of the building. There are very few optional parameters, except in the zone dynamic sheet (sheet number 5). All the parameters must be filled in order to get a complete building model for both static and dynamic EPC. Link to the building inspection sheet

3.1.1 Sheet 1: General Information

This sheet gathers all the administrative information about the building and inspection. It is meant to collect the general information about the building (address, owner, etc…) and the expert.

	A	B	C	D	E
1	**General information**				
2	Project name	Loex 17-23		**Inspection date**	27.05.21 00:00
3					
4	**Client**				
5	Title	Company			
6	Name 1	CPEG			
7	Name 2				
8	Adress				
9	Postal box				
10	ZIP				
11	City				
12	Country				
13	E-mail				
14	Phone 1				
15	Phone 2				
16					
17	**Building informations**				
18	ZIP	1213			
19	City	Onex			
20	Commune	Onex			
21	Road	Route de Loëx			
22	Number	17-23			
23	Building's name	Loex 17-23			
24	Construction date	1963			
25	Parcel number				
26	Meteo station	Genève			
27	Meteo station nearby	Genève-Cointrin			
28	Elevation	500			
29	Energy reference surface [m²]	2005.0			
30	Mean floor height [m]	2.7			
31	Number of full floor	1			
32	Building's width [m]	0.1			
33					
34	**Building's state description**				
35	Building's description				
36					
37	**Building's shell**				
38	Shell's description				
39					
40	**Technical infrastructure**				
	Description of the technical infrastructure				

Building identification		
National identification number	Building's adress	ZIP/Location
1021764	Route de Loëx 17	1213 Onex
1021765	Route de Loëx 19	1213 Onex
1021766	Route de Loëx 21	1213 Onex
1021767	Route de Loëx 23	1213 Onex

Figure 1 : Screenshot of Sheet 1 : General information

3.1.2 Sheet 2: Building's assignment

This sheet defines the category of use of the building. There are 3 columns for a possibility of 3 different assignments for the building use. The first assignment is the main one. Each building's assignment must be filled with its own floor surface. The total building surface is computed on the right of the table. The possible assignments for the E-DYCE project are:

Table 2 : Possible assignments

Assignment
Collective Housing
Individual Housing
Administration
Office
School

The second table of the sheet allows modifying the standard conditions of use for each assignment. This is destined for the calculation step N°2 (static EPC with adapted conditions).

	A	B	C	D	E
1	**Building's assignment**				
2					
3					
4		**Use 1**	**Use 2**	**Use 3**	
5	Assignment type	Collective_housing			**Total**
6	Surface [m²]	2005			2005
7	Surface [%]	100%			100%
8	Construction date	1963			
9					
10	**Adapt the standard conditions of use**				
11	Room temperature [°C]	21.5			
12	Supplement for room temperature control [K]				
13	Surface per person [m²/P]				
14	Heating emission per person [W/P]				
15	Daily presence time [h/d]				
16	Annual energy needs [kWh/m²]				
17	Electricity reduction factor				
18	Energy needs for DHW [kWh/m²]				

Figure 2 : Screenshot of Sheet 2: Building's assignment

3.1.3 Sheet 3: Global surfaces

This sheet aims at giving an overview of the building's floor surface area for the different categories. It allows for a good intuitive understanding of the building's site.

The cells to fill are underlined in light orange. Other cells (light green) are computed automatically from the inputs.

	Surfaces and volumes according to SIA 416:2003 and DIN 277					
				to fill		
				calculated		
	LAND SURFACE AREA SL					
	EN abrev.					
1	**LA**	**Land surface area**	**3206.0**	**m2**	**100%**	
1.1	BA	Built area	680.0	m2	21%	
1.2	SuA	Surrounding area	2526.0	m2	79%	
1.2.1	SALS	surface area of landscaped surroundings	2526.0	m2	79%	
1.2.2	SAUS	surface area of undeveloped surroundings	0.0	m2	0%	
	FLOOR AREA SP					
2	**FA**	**Floor area**	**2566.0**	**m2**	**100%**	
2.1	NFA	Net floor area	2312.0	m2	90%	
2.1.1	UA	Usable area	2002.0	m2	78%	
2.1.1.1	MUA	Main usable area	1616.0	m2	63%	
2.1.1.1.I		Collective housing	1616.0			
2.1.1.1.II		Individual housing	0.0			
2.1.1.1.III		Office/administration	0.0			
2.1.1.1.IV		Schools	0.0			
2.1.1.1.V		Others	0.0			
2.1.1.2	SUA	Secondary usable area	386.0	m2	15%	
2.1.2	CA	Clearance surface area	271.0	m2	11%	
2.1.3	SA	Technical area	39.0	m2	2%	
2.2	BSA	Building surface area	254.0	m2	10%	

Figure 3: Screenshot of Sheet 3: Global surfaces

3.1.4 Sheet 4: Energy surfaces and envelope

This sheet aims at giving an overview of the floor and envelope surfaces useful for the energy consumption calculation. Again, only the light orange cells are to be filled (in the energy reference surface table). The cells in light green in the envelope surfaces tables are automatically computed from the inputs in sheets 8-11.

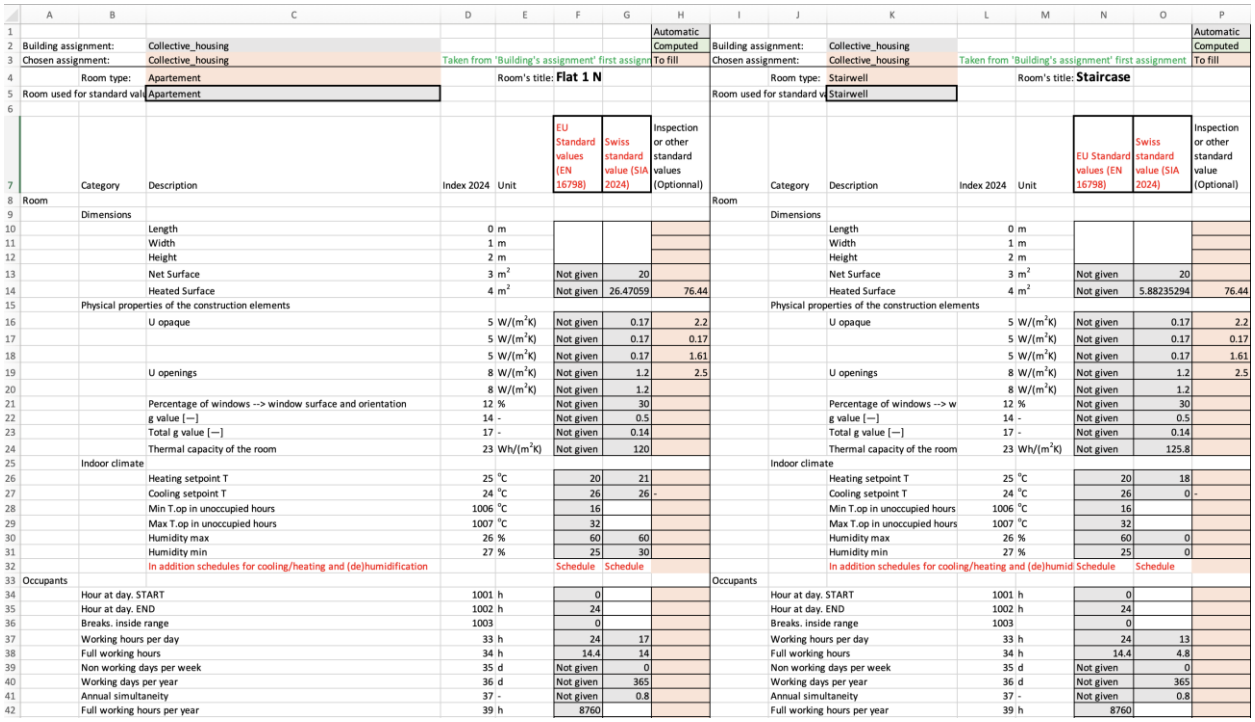
Row	Label	Code	Value	Unit	%	U Value	Unit	g Value
3	**Surfaces and thermal values according to SIA 380/1**							
4								
5			To fill					
6			Computed or extracted from the inspection sheets					
7	**ENERGY REFERENCE SURFACE ERS**							
8								
9	**Energy reference surface**	**ERS**	**2005.0**	**m2**	**100%**			
10								
11	Per floor	ERS	2005.0	m2	100%			
12	basement -2	ERS	0.0	m2	0%			
13	basement -1	ERS	100.0	m2	5%			
14	ground floor	ERS	635.0	m2	32%			
15	floor 1	ERS	635.0	m2	32%			
16	floor 2	ERS	635.0	m2	32%			
17	floor 3	ERS		m2	0%			
18	floor 4	ERS		m2	0%			
19	floor 5	ERS		m2	0%			
20	floor 6	ERS		m2	0%	you can add floors by inserting lines		
21								
22	By assignment	ERS	2005.0	m2	100%			
23	I collective housing	ERS	2005.0	m2	100%			
24	II individual housing	ERS	0.0	m2	0%			
25	III administration	ERS	0.0	m2	0%			
26	IV schools	ERS	0.0	m2	0%			
27	V Others	ERS	0.0	m2	0%			
28								
29	**Surface area of the envelope Ath**							
30								
31	**Surface area of the envelope**	**Ath**	**2978.4**	**m2**	**100%**			
32								
33	floor area	AF	651.7	m2	100%	U Value		
34	floor area against the outside	AFe	19.7	m2	3%	1.53	W/m2.K	
35	floor area against unheated floors	AFu	532.0	m2	82%	1.34	W/m2.K	
36	floor area against the ground	AFG	100.0	m2	15%	4.14	W/m2.K	
37								
38	roof area	AR	640.5	m2	100%	U Value		
39	roof area against the outside	ARe	640.5	m2	100%	0.20	W/m2.K	
40	roof area against unheated floor	ARu	0.0	m2	0%	0.00	W/m2.K	
41								
42	Wall area	AW	1283.8	m2	100%	U Value		
43	wall area against unheated volume	AWu	176.3	m2	14%	2.90	W/m2.K	
44	wall against the ground	AWG	0.0	m2	0%	0.00	W/m2.K	
45	wall area against other heated building	AWn	0.0	m2	0%	0.00	W/m2.K	
46	Wall area against the outside	AWe	1107.5	m2	86%	2.24	W/m2.K	
47								
48	*wall area against the outside by orientation*	*Awe*	*1107.5*	*m2*	*100%*	U Value		
49	*south orientation*	*AweS*	*0.0*	*m2*	*0%*	0.00	W/m2.K	
50	*south-east orientation*	*AweSE*	*141.6*	*m2*	*11%*	2.60	W/m2.K	
51	*east orientation*	*AweE*	*0.0*	*m2*	*0%*	0.00	W/m2.K	
52	*north-east orientation*	*AweNE*	*416.0*	*m2*	*32%*	2.20	W/m2.K	
53	*north orientation*	*AweN*	*0.0*	*m2*	*0%*	0.00	W/m2.K	
54	*north-west orientation*	*AweNO*	*143.1*	*m2*	*11%*	2.58	W/m2.K	
55	*west orientation*	*AweO*	*0.0*	*m2*	*0%*	0.00	W/m2.K	
56	*south-west orientation*	*AweSO*	*406.8*	*m2*	*32%*	2.04	W/m2.K	
57								
58	*window area by orientation*	*Aw*	*402.4*	*m2*	*100%*	U Value		g Value
59	*zenith window area*	*AwH*	*0.0*	*m2*	*0%*	0.00	W/m2.K	0.00 -
60	*area of south-facing windows*	*AwS*	*0.0*	*m2*	*0%*	0.00	W/m2.K	0.00 -
61	*area of windows facing south-east*	*AwSE*	*11.7*	*m2*	*3%*	2.75	W/m2.K	0.60 -
62	*area of east-facing windows*	*AwE*	*0.0*	*m2*	*0%*	0.00	W/m2.K	0.00 -
63	*area of windows facing north-east*	*AwNE*	*189.1*	*m2*	*47%*	3.20	W/m2.K	0.62 -
64	*area of north-facing windows*	*AwN*	*0.0*	*m2*	*0%*	0.00	W/m2.K	0.00 -
65	*area of windows facing northwest*	*AwNO*	*0.0*	*m2*	*0%*	0.00	W/m2.K	0.00 -
66	*area of west-facing windows*	*AwO*	*0.0*	*m2*	*0%*	0.00	W/m2.K	0.00 -
67	*area of windows facing southwest*	*AwSO*	*201.6*	*m2*	*50%*	2.74	W/m2.K	0.60 -

Figure 4: Screenshot of Sheet 4: Energy surfaces and envelope

This allows for a general understanding of the building's conditioned spaces (energy envelope and surface area). With this sheet only, a simplistic (static) version of the building model can be built.

3.1.5 Sheet 5: Zones dynamic

This sheet gathers the information needed for the basic dynamic simulation of the described zone.



							Automatic										Automatic
Building assignment:		Collective_housing					Computed	Building assignment:		Collective_housing							Computed
Chosen assignment:		Collective_housing	Taken from 'Building's assignment' first assignm				To fill	Chosen assignment:		Collective_housing	Taken from 'Building's assignment' first assignment						To fill
	Room type:	Apartement		Room's title:	**Flat 1 N**				Room type:	Stairwell		Room's title:	**Staircase**				
Room used for standard val		Apartement						Room used for standard v		Stairwell							
					EU Standard values (EN 16798)	Swiss standard value (SIA 2024)	Inspection or other standard values (Optionnal)						EU Standard values (EN 16798)	Swiss standard value (SIA 2024)	Inspection or other standard value (Optional)		
	Category	Description	Index 2024	Unit					Category	Description	Index 2024	Unit					
Room								Room									
	Dimensions								Dimensions								
		Length	0	m						Length	0	m					
		Width	1	m						Width	1	m					
		Height	2	m						Height	2	m					
		Net Surface	3	m^2	Not given	20				Net Surface	3	m^2	Not given	20			
		Heated Surface	4	m^2	Not given	26.47059	76.44			Heated Surface	4	m^2	Not given	5.88235294	76.44		
	Physical properties of the construction elements								Physical properties of the construction elements								
		U opaque	5	$W/(m^2K)$	Not given	0.17	2.2			U opaque	5	$W/(m^2K)$	Not given	0.17	2.2		
			5	$W/(m^2K)$	Not given	0.17	0.17				5	$W/(m^2K)$	Not given	0.17	0.17		
			5	$W/(m^2K)$	Not given	0.17	1.61				5	$W/(m^2K)$	Not given	0.17	1.61		
		U openings	8	$W/(m^2K)$	Not given	1.2	2.5			U openings	8	$W/(m^2K)$	Not given	1.2	2.5		
			8	$W/(m^2K)$	Not given	1.2					8	$W/(m^2K)$	Not given	1.2			
		Percentage of windows --> window surface and orientation	12	%	Not given	30				Percentage of windows --> w	12	%	Not given	30			
		g value [—]	14	-	Not given	0.5				g value [—]	14	-	Not given	0.5			
		Total g value [—]	17	-	Not given	0.14				Total g value [—]	17	-	Not given	0.14			
		Thermal capacity of the room	23	$Wh/(m^2K)$	Not given	120				Thermal capacity of the room	23	$Wh/(m^2K)$	Not given	125.8			
	Indoor climate								Indoor climate								
		Heating setpoint T	25	°C	20	21				Heating setpoint T	25	°C	20	18			
		Cooling setpoint T	24	°C	26	26	-			Cooling setpoint T	24	°C	26	0	-		
		Min T.op in unoccupied hours	1006	°C	16					Min T.op in unoccupied hours	1006	°C	16				
		Max T.op in unoccupied hours	1007	°C	32					Max T.op in unoccupied hours	1007	°C	32				
		Humidity max	26	%	60	60				Humidity max	26	%	60	0			
		Humidity min	27	%	25	30				Humidity min	27	%	25	0			
		In addition schedules for cooling/heating and (de)humidification			Schedule	Schedule				In addition schedules for cooling/heating and (de)humid			Schedule	Schedule			
Occupants								Occupants									
	Hour at day. START		1001	h	0				Hour at day. START		1001	h	0				
	Hour at day. END		1002	h	24				Hour at day. END		1002	h	24				
	Breaks. inside range		1003		0				Breaks. inside range		1003		0				
	Working hours per day		33	h	24	17			Working hours per day		33	h	24	13			
	Full working hours		34	h	14.4	14			Full working hours		34	h	14.4	4.8			
	Non working days per week		35	d	Not given	0			Non working days per week		35	d	Not given	0			
	Working days per year		36	d	Not given	365			Working days per year		36	d	Not given	365			
	Annual simultaneity		37	-	Not given	0.8			Annual simultaneity		37	-	Not given	0.8			
	Full working hours per year		39	h	8760				Full working hours per year		39	h	8760				

Figure 5: Screenshot of part of Sheet 5: Zones dynamic. Two different zones are described: an apartment and a staircase

At the top of the sheet (C2), we can see the building's assignment which is taken from Sheet 2. The actual assignment of the zone can be selected in the line below (C3) if modification is needed. For the SIA 2024 (Swiss standard for dynamic simulations), the zone type must be chosen in the list in the cell below (C4). European standard (EN16798) doesn't require zone type specification.

The template chosen is a list coming from the Swiss standard SIA 2024 describing the dynamic simulation of building. Several lines were added to introduce the EN 16798 standard values. Both values can be found under two different columns (EN 16798 and SIA 2024 columns). A third column allows the inspector to enter values specific to the building. The values entered in the third column can come from observations during the visit or monitoring data. They are of interest for the 4th step of simulation (i.e. DEPC adapted).

Column values are found in the tables at the end of the excel sheets. This explains the restriction for buildings assignment and room type selection.

New zones can be described by copy-pasting the first columns (A-H) and adding them on the right side (See Figure 5). This can be done as much as desired to describe each desired zone in the building. Each zone can be described individually

3.1.6 Sheet 6: Zones description

This sheet is dedicated to the description of the zone's envelope and its constructions. This would allow building a model in the dynamic simulation tool. Constructions and geometry play an important role in the dynamic tools and this sheet aims at fulfilling this need. A built-in catalogue of typical constructions is given in this form to aid the inspector.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	Zone 1	Computed														
2	Apartement	To fill														
3																
4	_Exterior_Wall	Wall 1					Wall 2					Wall 3				
5	Type	Intermediate					Heavy					Intermediate				
6	Construction	Construction	Capacity [J/k	Lambda[W/r	Rho [kg/m3]	Thickness [m]	Construction	Capacity [J/k	Lambda[W/r	Rho [kg/m3]	Thickness [m]	Construction	Capacity [J/k	Lambda[W/r	Rho [kg/m3]	Thickness [m]
7	1	Masonry	1000	0.18	700		Concrete	1000	2.5	2400		Masonry	1000	0.18	700	
8	2	0					0					0				
9	3	0					0					0				
10	4	0					0					0				
11	other 1															
12	other 2															
13	other 3															
14	other 4															
15																
16	_Interior_Wall	Int. Wall 1					Int. Wall 2					Int. Wall 3				
17	Type	Light					Other									
18		Construction	Capacity [J/k	Lambda[W/r	Rho [kg/m3]	Thickness [m]	Construction	Capacity [J/k	Lambda[W/r	Rho [kg/m3]	Thickness [m]	Construction	Capacity [J/k	Lambda[W/r	Rho [kg/m3]	Thickness [m]
19	1	Plaster	1000	0.43	1200		to fill below					to fill below				
20	2	Insulation	800	0.04	50		to fill below					to fill below				
21	3	Plaster	1000	0.43	1200		to fill below					to fill below				
22	4	0					to fill below					to fill below				
23	other 1															
24	other 2															
25	other 3															
26	other 4															
27																
28	_Roof	Roof 1					Roof 2									
29		Light_Metal					Light_Metal									
30		Construction	Capacity [J/k	Lambda[W/r	Rho [kg/m3]	Thickness [m]	Construction	Capacity [J/k	Lambda[W/r	Rho [kg/m3]	Thickness [m]					
31	1	Wood	1600	0.13	500		Wood	1600	0.13	500						
32	2	InsulationM	1000	0.05	100		InsulationM	1000	0.05	100						
33	3	Iron	450	17	7900		Iron	450	17	7900						
34	4	0					0									
35	other 1															
36	other 2															
37	other 3															
38	other 4															
39																
40	_Interior_Floor	Int. Floor 1														
41		Light_Wood														
42		Construction	Capacity [J/k	Lambda[W/r	Rho [kg/m3]	Thickness [m]										
43	1	Wood	1600	0.13	500											
44	2	InsulationW	1000	0.045	100											
45	3	Wood	1600	0.13	500											
46	4	0														
47	other 1															
48	other 2															
49	other 3															
50	other 4															
51																
52	_Exterior_Floor	Ext. Floor 1														
53		Heavy														
54		Construction	Capacity [J/k	Lambda[W/r	Rho [kg/m3]	Thickness [m]										
55	1	Cement	850	1.4	2000											
56	2	Concrete	1000	2.5	2400											
57	3	0														
58	4	0														
59	other 1															

Figure 6: Screenshot of Sheet 6: Zones description

If the construction of a wall, roof of floor is uncertain, the type can be described (typically light, intermediate or heavy construction). If a specific type is selected, the green cells will be filled automatically. Thickness should always be filled by the inspector. The standard constructions are similar to the ones used in the Dial+ software.

If the construction is not "standard" (not fitting the available options), 4 lines (others 1 to 4, See Figure 6) are available to describe each layer present in the construction with the required characteristics.

3.1.7 Sheet 7: Monitoring

This sheet refers to the description of the monitoring solutions available on site. This sheet is concise in order to gather the essential information. Additional descriptions can be added if necessary.

			Frequency						
			Yearly	Weekly	Daily	Hourly	type of sensors	Quantity	remarks
Type of sens	Energy		Building				Energy	1	Oil counter
	Comfort / quality					Appartement	comfort	37	Measuring Temperature, CO2, humidity
							total	38	

Figure 7: Screenshot of Sheet 7: Monitoring

3.1.8 Sheet 8: Roof and ceilings

This sheet is dedicated to report all the envelope's roofs and ceilings. The first table (lines 5-8) allows writing a general description and observations about the category on envelope elements. It is designed for reading purposes but is not mandatory for the inspection and introduction on the E-DYCE platform.

Roof and ceilings									
Roof type		Flat Roof							
		Roof/ ceilings < 2m under ground level				**Other ceilings/roof**			
General state		intacts							
Refurbishment priority level		Long term - 5 to 10 years							
Description									
Possible upgrades									
Abrév.	Denomination	Type	Orientation	Surface [m²]	U value [W/(m²K)]	b factor [—]	Number [—]	Construction type	Insulation position
T1	T010-X	Flat roof / terrace	Horiz	640.5	0.20	1.00	1	Heavy	Exterior

Figure 8: Screenshot of Sheet 8: Roof and ceilings

Each column must be filled for each roof/ceiling element of the envelope. If information is missing, the cell will appear in yellow.

3.1.9 Sheet 9: Walls

Same as sheet 8 but for the envelope walls.

Walls

Walls structure	Normally structured walls	
	Walls against outdoor/ buried with < 2m	**Other walls**
General state	intacts	intacts
Refurbishment priority level	Medium-term - 1 to 5 years	
Description		
Possible upgrades		

Abrév.	Denomination	Type	Orientation	Surface [m²]	U value [W/(m²K)]	b factor [—]	Number [—]	Construction type	Insulation position
M1	NE-M010-R	Exterior Wall	NE	346.5	2.01	1.00	1	Heavy	None
S1	NE-M070-R	Blind box	NE	46.5	1.02	1.00	1		
M2	NE-M050-R	Exterior Wall	NE	27.6	2.01	1.00	1	Heavy	None
M3	NE-M080-R	Exterior Wall	NE	41.9	3.92	1.00	1	Intermediate	None
M4	NO-M030-R	Exterior Wall	NO	42.6	3.92	1.00	1	Intermediate	None
M5	NO-M040-R	Exterior Wall	NO	100.5	2.01	1.00	1	Heavy	None
M6	NO-M080-R	against unheated	NO	67.2	2.90	0.48	1	Heavy	None
M7	SE-M010-R	Exterior Wall	SE	24.6	2.01	1.00	1	Heavy	None
S2	SE-070-R	Blind box	SE	2.7	1.02	1.00	1		
M8	SE-M030-R	Exterior Wall	SE	43.8	3.92	1.00	1	Intermediate	None
M9	SE-M040-R	Exterior Wall	SE	73.2	2.01	1.00	1	Heavy	None
M10	SE-M080-R	against unheated	SE	67.2	2.90	0.48	1	Heavy	None
M11	SO-M010-R	Exterior Wall	SO	349.8	2.01	1.00	1	Heavy	None
S3	SO-M070-R	Blind box	SO	46.2	1.02	1.00	1		
M12	SO-M020-R	Exterior Wall	SO	57.0	2.23	1.00	1	Light	None
M13	SO-M080	against unheated	SO	41.9	2.90	0.48	1	Heavy	None

Figure 9: Screenshot of Sheet 9: Walls

3.1.10 Sheet 10: Windows and doors

As windows and doors are necessary for the energy models of the buildings, in this sheet are listed all envelope's openings. They must be linked with their respective walls or roof using the 'Included in' Column. Use the walls or roof abbreviations for this purpose (see column L in Figure 10).

Windows and doors

General state	intacts
Refurbishment priority level	Long term - 5 to 10 years
Description	
Possible upgrades	

Abrev.	Denomination	Type	Orientation	Surface [m²]	U value [W/(m²K)]	g value [—]	b factor [—]	Proportion of glass [—]	Shadow proportion [—]	Number [—]	Included in
F1	NE-FE020	Window	NE	3.5	2.75	0.60	1	0.77	0.14	45	M1
F2	NE-P010-R	Door	NE	7.6	5.54	0.70	1	0.86	0.4	4	M3
F3	NO-FE080	Window	NE	0.4	2.76	0.60	1	0.4	0.34	3	M5
F4	SE-FE020	Window	SE	3.5	2.75	0.60	1	0.77	0.13	3	M7
F5	SE-FE080	Window	SE	0.4	2.76	0.60	1	0.4	0.46	3	M9
F6	SO-FE010	Window	SO	2.8	2.72	0.60	1	0.75	0.61	12	M11
F7	SO-FE030	Window	SO	2.8	2.72	0.60	1	0.75	0.61	12	M11
F8	SO-FE050	Window	SO	3.2	2.76	0.60	1	0.78	0.42	12	M11
F9	SO-FE060	Window	SO	2.4	2.72	0.60	1	0.75	0.16	24	M11
F10	SO-FE090	Window	SO	3.2	2.76	0.60	1	0.78	0.42	12	M11

Figure 10: Screenshot of Sheet 10: Windows and doors

3.1.11 Sheet 11: Floors and basements

Similarly, as in sheets 8 and 9, in this sheet, information related to the envelope's floors must be filled in the sheet. General description in the lines 5-8 and listing from line 11 (see Figure 11).

	A	B	C	D	E	F	G	H	I	J
1	**Floors and basements**									
2										
3	Proportion of heated basement		0							
4			**Floors facing outside / buried ≤ 2 m**				**Other Floors**			
5	General state		intacts				intacts			
6	Refurbishment priority level		Long term - 5 to 10 years							
7	Description									
8	Possible upgrades									
9										
10	Abrév.	Denomination	Type	Surface [m²]	U value [W/(m²K)]	b factor [—]	Number [—]	Construction	Insulation position	
11	P1	D010-R	Against unheated (partia	532.0	1.34	0.48	1	Heavy	None	
12	P2	D020-X	Against ground ≤ 2 m	100.0	4.14	0.25	1	Heavy	None	
13	P3	D030-R	Against outside	19.7	1.53	1.00	1	heavy	None	

Figure 11: Screenshot of Sheet 11: Floors and basements

3.1.12 Sheet 12: Thermal bridges

The thermal bridges of the building envelope can be listed here. The abbreviations must be differentiated between punctual thermal bridges (TBp) and linear thermal bridges (TBl).

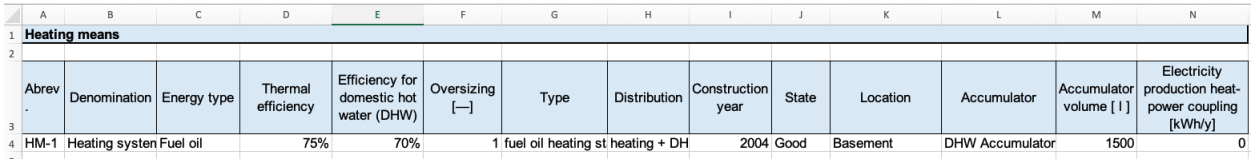
	A	B	C	D	E	F	G	H
1	**Thermal bridges**							
2								
3	Priority level							
4	Description							
5	Possible upgrades **Example:** TBl-1 for linear thermal bridges TBp-1 for ponctual thermal bridges							
6								
7	Abrev.	Denomination	Type	Length [m]	Psi Ψ value [W/(mK)]	Chi X value [W/K]	Number [—]	b factor [—]
8								
9								

Figure 12: Screenshot of Sheet 12: Thermal bridges

3.1.13 Sheet 13: Heating means

This sheet is designed to list the different heating means present in the building. Important parameters are the efficiency of heating and DHW production.

Each heat producer should be described in this table, even if they are only meant for DHW (electric boiler, for example).



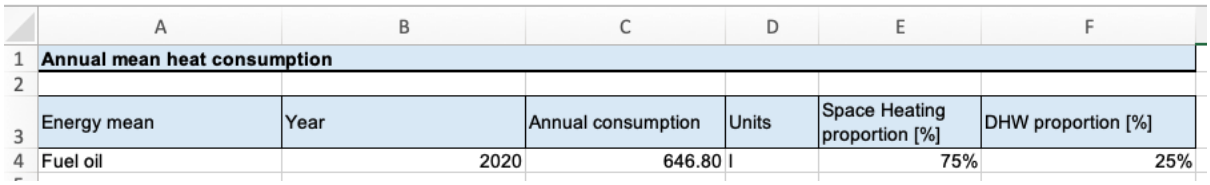
Heating means

Abrev.	Denomination	Energy type	Thermal efficiency	Efficiency for domestic hot water (DHW)	Oversizing [—]	Type	Distribution	Construction year	State	Location	Accumulator	Accumulator volume [l]	Electricity production heat-power coupling [kWh/y]
HM-1	Heating systen	Fuel oil	75%	70%	1	fuel oil heating st	heating + DH	2004	Good	Basement	DHW Accumulator	1500	0

Figure 13: Screenshot of Sheet 13: Heating means

3.1.14 Sheet 14: Annual heat consumption

This sheet allows entering the annual consumption for heating. Each known consumption can be entered in the table. The two “proportion” columns (E and F , see Figure 14) are there to know the distribution between space heating and DHW for each entry.



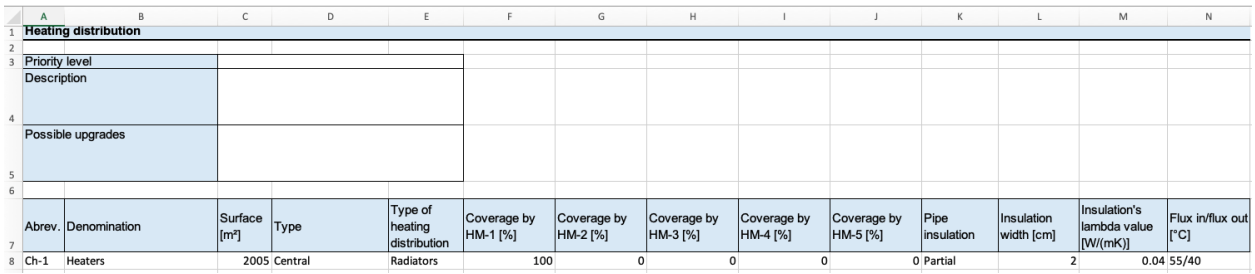
Annual mean heat consumption

Energy mean	Year	Annual consumption	Units	Space Heating proportion [%]	DHW proportion [%]
Fuel oil	2020	646.80	l	75%	25%

Figure 14: Screenshot of Sheet 14: Annual heat consumption

3.1.15 Sheet 15: Heating distribution

This sheet allows describing the heating distribution means. It can be linked to the heating means in the columns F-I by indicating the percentage of covering by the specific mean. Each heating mean is represented by its abbreviation (HM-1, HM-2, etc…). The table isn’t dynamically showing the available heating means, therefore the user should report to the “Sheet 13 : Heating means” to remember the abbreviation of each entered heating mean.



Heating distribution

Priority level	
Description	
Possible upgrades	

Abrev.	Denomination	Surface [m²]	Type	Type of heating distribution	Coverage by HM-1 [%]	Coverage by HM-2 [%]	Coverage by HM-3 [%]	Coverage by HM-4 [%]	Coverage by HM-5 [%]	Pipe insulation	Insulation width [cm]	Insulation's lambda value [W/(mK)]	Flux in/flux out [°C]
Ch-1	Heaters	2005	Central	Radiators	100	0	0	0	0	Partial	2	0.04	55/40

Figure 15: Screenshot of Sheet 15: Heating distribution

3.1.16 Sheet 16: DHW distribution

This sheet is the same as the 15 but for the DHW distribution. The link to the heating means is like Sheet 15.

Domestic hot water distribution

Priority level	
Description	
Possible upgrades	

Abrev.	Denomination	Surface [m²]	Type	Coverage by HM-1 [%]	Coverage by HM-2 [%]	Coverage by HM-3 [%]	Coverage by HM-4 [%]	Coverage by HM-5 [%]	Pipe insulation	Insulation width [cm]	Insulation's lambda value [W/(mK)]	Temp. maintaining mean
DHW-1	Domestic hot water	2005	Central	1	0	0	0	0	Partial	2	0.04	Circulation

Figure 16: Screenshot of Sheet 16: DHW distribution

3.1.17 Sheet 17: Lighting

This sheet allows entering the lighting type and the power generated from their use (from the column "Quality").

Lighting

							Proportion of electricity tariffs		
Abrev.	Denomination	Assigment	Type	Area [m²]	Layout	Quality	High tariffs	Standard tariffs	Low tariffs
Ec-1	Energy saving lamps	Collective_housing	Flat	1444	Standard	25-75 % energy-saving lamps	0%	100%	0%
Ec-2	Energy saving lamps	Collective_housing	Staircase	160	Standard	25-75 % energy-saving lamps	0%	100%	0%

Figure 17: Screenshot of Sheet 17: Lighting

3.1.18 Sheet 18: Ventilation

This sheet allows entering the different ventilation types used in the building. Important information is the fresh air flow rate.

Ventilation

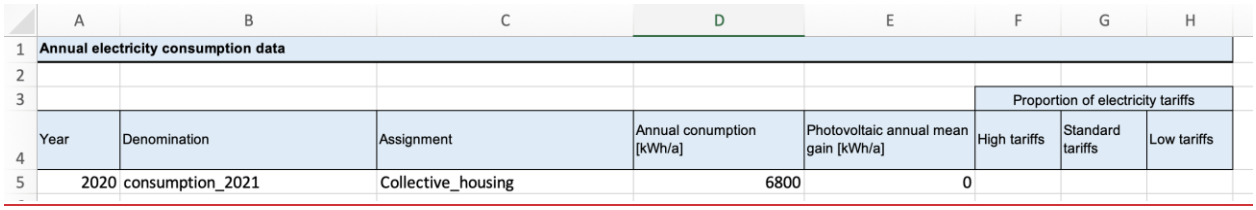
Priority level	
Description	
Possible upgrades	

				Proportion of electricity tariffs								
Abrev.	Denomination	Assigment	Type of standard ventilation system	High tariffs	Standard tariffs	Low tariffs	Number [-]	fresh air flow rate [m³/h]	Heat recovery efficiency [-]	Electricity needs for ventilation and antifreeze [kWh]	Electricity needs for cold transportation [kWh]	Electricity needs for cooling and humidification [kWh]
V1	Ventilation Loex	Collective_housing	Installation without heat recovery	0%	100%	0%	1	0.70	0.00	?	0.00	0.00

Figure 18: Screenshot of Sheet 18: Ventilation

3.1.19 Sheet 19: Annual electricity use

This sheet allows reporting the annual electric consumption of the building.



	A	B	C	D	E	F	G	H
1	**Annual electricity consumption data**							
2								
3						Proportion of electricity tariffs		
4	Year	Denomination	Assignment	Annual conumption [kWh/a]	Photovoltaic annual mean gain [kWh/a]	High tariffs	Standard tariffs	Low tariffs
5	2020	consumption_2021	Collective_housing	6800	0			

Figure 19: Screenshot of Sheet 19: Annual electricity use

3.1.20 Appendix: Plan

Here the user can upload the building's plan.

3.1.21 Appendix: Quick energy check

This sheet gives typical constructions and typologies for building. It can be used for a quick energy assessment of a building.

3.1.22 Catalogue: SIA 2024 schedules

This sheet gives different schedules of occupancy and device power use for different room types. It is a table with different zones type for lines as columns represent occupancy and device power use level at each hour of the day. The main zones of interest would be "1.1 Apartment", "3.1 Individual or collective office" and "4.1 Classroom". However, a finer definition of the zone model could push a user to describe different zones, "12.3 Stairwell" for example.

3.1.23 Catalogue: SIA 2024 Standard

Here are gathered the standard values from SIA 2024 (Switzerland) for the dynamic simulations. It is from this table that the values are taken in "Sheet 5: Zones Dynamic". The important values are therefore found in the Sheet 5. This catalogue is there for consultation and possible future modification if standards evolve.

3.1.24 Catalogue: EN16798

Here are gathered the standard values for EN 16798. Values in Sheet 5: Zones Dynamic are taken from here. Schedules are also available for different building uses. The schedules are here described by building assignments and not by zones assignment. It is less precise than the Swiss standards.

3.1.25 Catalogue: Constructions

Here are listed some typical materials used in the constructions in "Sheet 6: Zones Description". The characteristics of the materials are the same as in DIAL+.

3.1.26 Catalogue: Lists

Here are all the lists used for validation in the Excel spreadsheet.

4 Monitoring Plan

Monitoring a building is essential to detect a performance gap. The monitoring can take multiple forms, going from reading the heating bills to installing sensors in each apartment. The monitoring will help identifying which KPI is drifting, causing the performance gap, and help the decision making about the possible actions.

In the E-DYCE project, we identified four classes of KPI's that need to be assessed. They are:

- Energy operation
- Energy signature
- Comfort/quality
- Free-running operation

The 4 classes are linked by cause-to-effect dynamics, but they allow to separate the information according to the certification template.

The first step for a monitoring plan definition is to look at the already available counting technologies and sensors. For example, the energy bills are a convenient way to follow the energy operation KPI's as well as the energy signature ones without any additional cost except for the data collection time. Some buildings might also have ambient sensors for optimisation purposes. These are examples of exploitable "free" monitoring services.

Then, the budget and needs for monitoring must be assessed. Most of the time, sensors are too expensive for building owners or tenants, therefore their need must be motivated. The needs for precise monitoring arise if one or more KPI is not behaving as expected and its behaviour cannot be trivially explained. Expected behaviours are given by the energy certificate for the Energy consumption and energy signature KPI's and the European standards (En 16798-1) for Comfort/quality KPI's.

When the needs are defined according to the budget, a list of installed and desired elements must be described. This list should contain all the available information about the sensors or counters. More precisely, each element should be described with at least: measured quantity/KPI, sensor type/brand, measurement frequency, communication type, sensitivity and installation date. Any additional information can be relevant and could benefit the analysis.

Table 3: Example of a list of monitoring elements for the air quality and comfort

Probe's type	Number	Date of installation	Measured data	Acquisition frequency	Communication mean	Sensitivity	Comment
Elsys ERS CO2	12	22.12.2021	T, Rh, CO2, Lum	15 min	LoRaWAN	unknown	Acquisition frequency can be modified
Elsys ELT-2	6	22.12.2021	T, Rh, P, movement	15 min	LoRaWAN	unknown	Same as above
Elsys VOC	8	22.12.2021	T ,Rh, Lum, VOC level	15 min	LoRaWAN	unknown	Same as above
Class'Air2	6	8.11.21 to 22.12.21	T, Rh, P	10 min	Datalogger	unknown	Were picked on 22.12 when dropping Elsys

For energy consumption counters, a counting diagram must be drawn. The diagram allows to understand relations between counters, identify the missing information and allow for good data analysis (see example on Figure 20).

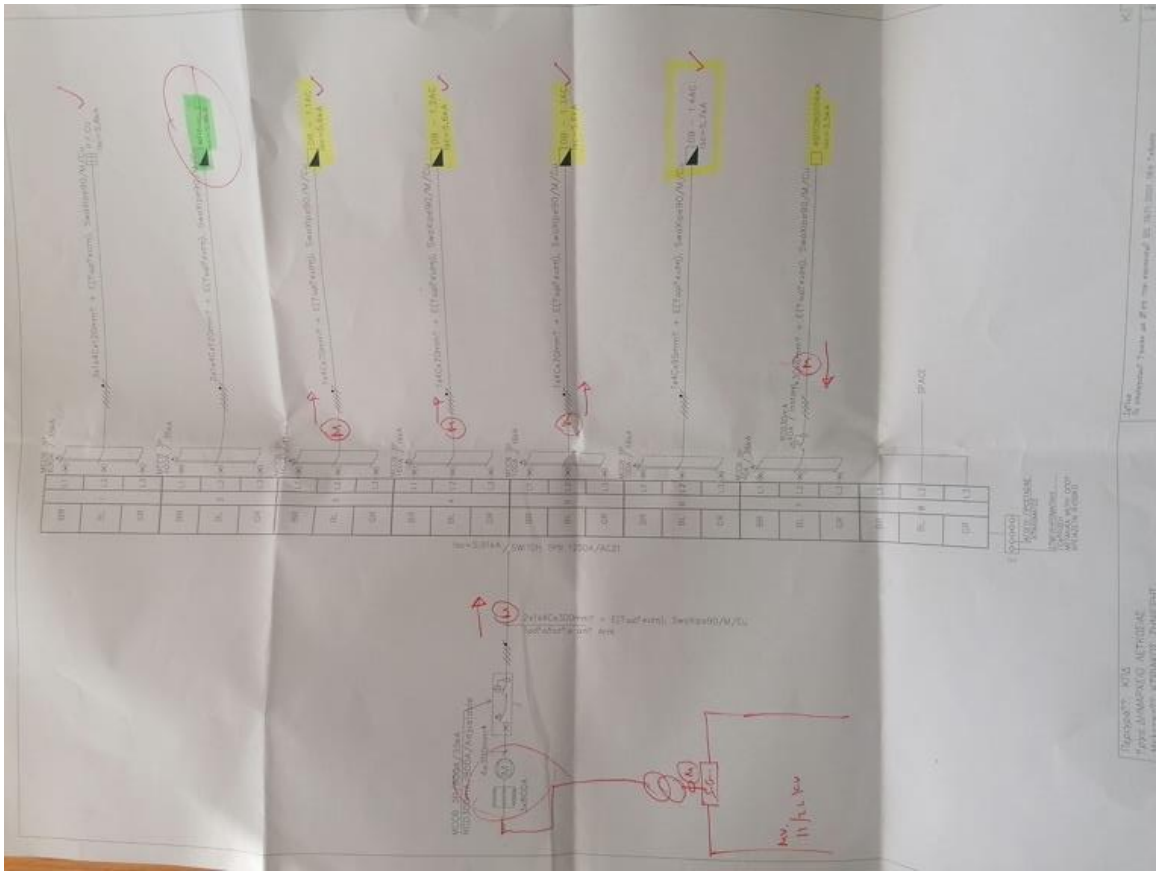


Figure 20: Counting diagram example for the Cyprus case study. The counters are drawn in red on the electrical diagram

For the air quality and comfort sensors, a map of the building with their positions can be drawn (see Figure 21). This helps identifying the considered zones and hypothesis when analysing the data.

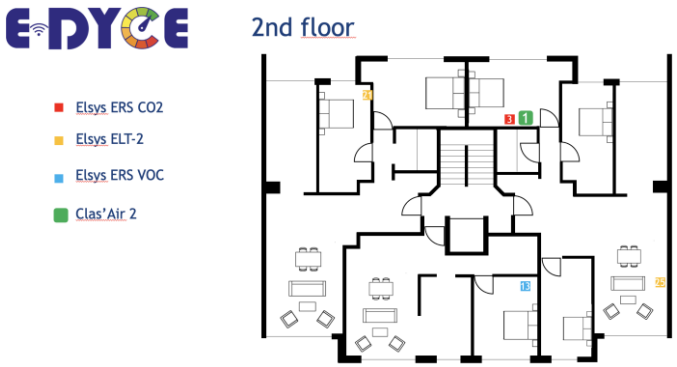


Figure 21: Example of a floor map with sensors location for a Swiss case study

Generally, the objective of a monitoring diagram is to easily understand the components and the links between each of them as well as the measured quantity. The final form taken by the diagram will depend on the building's characteristics and the already available drawings from the technicians or others (see Figure 22).

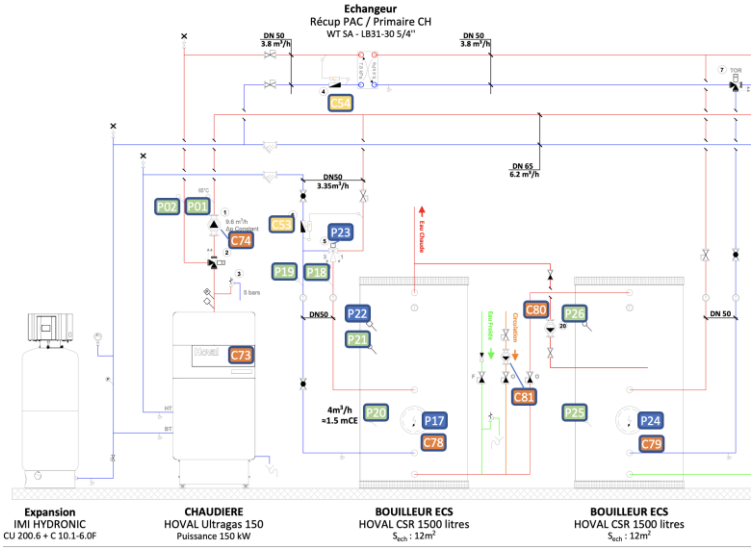


Figure 22: Example of a monitoring design for a complex heating setup with different probes and counters

When the monitoring is well defined, it becomes clear to the analyst where the relevant information is located and which sensor to analyse.

The following steps of the monitoring procedures are the data collection and analysis that should both follow a standardised procedure and are not described in this work.

5 Conclusions and Outlook

The presented solutions represent the status of the work done until now. We have defined an inspection method that is extremely rigorous and precise but can allow for an adequate representation of the building envelope and dynamic simulation. A description of each sheet is done in this document so that users can understand the purpose of each table. With the outputs of the ongoing studies about model simplifications, the inspection form will evolve to a simpler version, allowing only relevant information to be collected and reducing the inspection work.

In a second part, a guideline for a monitoring plan definition is proposed. The guideline might also evolve along with the project when facing various issues or improvement possibilities with the case studies. The proposed guideline allows to carefully inspect the monitoring needs and list the installed equipment. It also gives insight on how to facilitate the creation of monitoring diagrams.

Link to the Building inspection sheet