D3.9_Overall Refurbishment Plan

DRAFT

CS15

André Tournon-sur-Rhône

INTELLIGENT ENERGY – EUROPE II

Energy efficiency and renewable energy in buildings

IEE/12/070

EuroPHit

[Improving the energy performance of step-by-step refurbishment and integration of renewable energies]

Contract N°: SI2.645928

Co-funded by the Intelligent Energy Europe Programme of the European Union

Technical References

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Project Title	Improving the energy performance of step-by-step refurbishment and integration of renewable energies
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Abstract

This overall refurbishment plan provides an overview of the retrofit steps of a step-by-step refurbishment to EnerPHit standard to be undertaken for the project André in Tournon-sur-Rhône.

First, the existing building will shortly be described, including building component and component conditions. In addition, the existing energy efficiency performance of the building will be described.

In a second step, the overall refurbishment plan will describe the retrofit steps to be undertaken until the refurbishment will finally be completed.

The first step consists in airtightness of walls and roofs coupled to installation of centralised MVHR units. In the second step, walls will be insulated from the outside and windows will be changed with passive house quality components. Following steps to reach the EnerPHit standard will comprise insulation of roofs on top of existing rafters and insulation under slab on unheated basement.

Include a pictures or drawings typical for the project.

1 General Project description

1.1 Motivation

The owner of this single family house is the André family, who has made built this house in 1985. As manufacturers of passive house quality windows, they are very proactive for energy efficiency and see their own house as a demonstrator of EnerPHit retrofits.

The intented retrofit pace is quick, as most of the work is to be finished by 2016. Additional integration of renewable energy sources can be foreseen between 2018 and 2025.

1.2 Existing Building

The André house is located chemin des Trousses in Tournon-sur-Rhône, close to the Rhone river and the Vivarais mountain, where high sun resource and high wind speeds coming from the Rhone valley indicate the beginning of Mediterranean climate. The house was built in 1985 and is occupied by a family of 5 persons.

The house is located on the edge of a valley, to South facing a hill with an elevation of 100 m above house level. This hill prevents the house from receiving significant direct solar radiation between December and February.

The building follows the terrain slope with stepwise floors in contact with a non-heated basement. The existing walls are made of concrete hollow bricks with a 6 cm interior insulation of extruded polystyrene (XPS). The slabs are based on a concrete beam and block structure, partially interior insulated by a 6 cm XPS layer where an electric floor heating system has been installed. The roofs are made of a traditional wooden frame, partially insulated with mineral wool and XPS.

Airtightness is poor as accounted by the owners, although it has not been evaluated by a blower-door test. We will consider a conservative value for envelope permeability of n50 = 5 air change rate / hour at 50 Pascals.

Windows are composed of double glazing 4-6-4 without filling gas and 48 mm wooden frames not insulated.

A Mechanical Ventilation with Heat Recovery has been installed at the time the building was erected, but is not functioning anymore and shall be replaced.

Heating demand is covered by the afore-mentioned electric floor heating plus a wood stove. Domestic Hot Water demand is covered by an electric storage hot water heater of 300 L.

Electricity meter indicates an average yearly consumption of 17 000 kWh.

1.3 Refurbishment steps

1.3.1 Retrofit steps within EuroPHit

Short description of the works to be carried out until March 2016.

At first step, an airtightness layer will be created on walls, preferably applying a new cement render to the exterior surface of the existing concrete hollow block structure. The existing ventilation unit will be replaced by a new ventilation unit with heat recovery, placed in the unheated attic. After due inspection, ducts can be partially reused. New windows will be placed in the new insulation layer of 25 cm, outside the existing structure.

In the second step, roofs will be insulated: pitched roofs will be elevated with an additional insulation layer between counter battens over a new vapour barrier film. Ceilings on the unheated attic will receive an additional insulation layer on the existing rafters and a new vapour barrier will be placed on the warm side of the existing insulation.

In the final third step the slab on the unheated ceiling will be insulated from below with thickness of 100mm to 150 mm, and the staircase walls will be insulated from the inside with a maximal thickness of 100mm.

1.3.2 Further retrofit steps

Short description of the works to be carried out in the future.

Given the important shading in winter, an important winter gap will remain between the energy load and the renewable solar production of the refurbished building, be it solar thermal or PV. A 5 kWp PV system south oriented integrated to the refurbished roof will produce around 6 MWh/a electricity, closed to the 7 MWh/a yearly electricity consumption, but only one third of the electricity load in January and December.

According to the regional geothermal potential atlas realised by BRGM in 2012, the granite soil could be adequate to vertical geothermal wells (Figure 11). Additional drillings and measurements are required to get a more reliable assessment of the heat production potential via a heat pump.

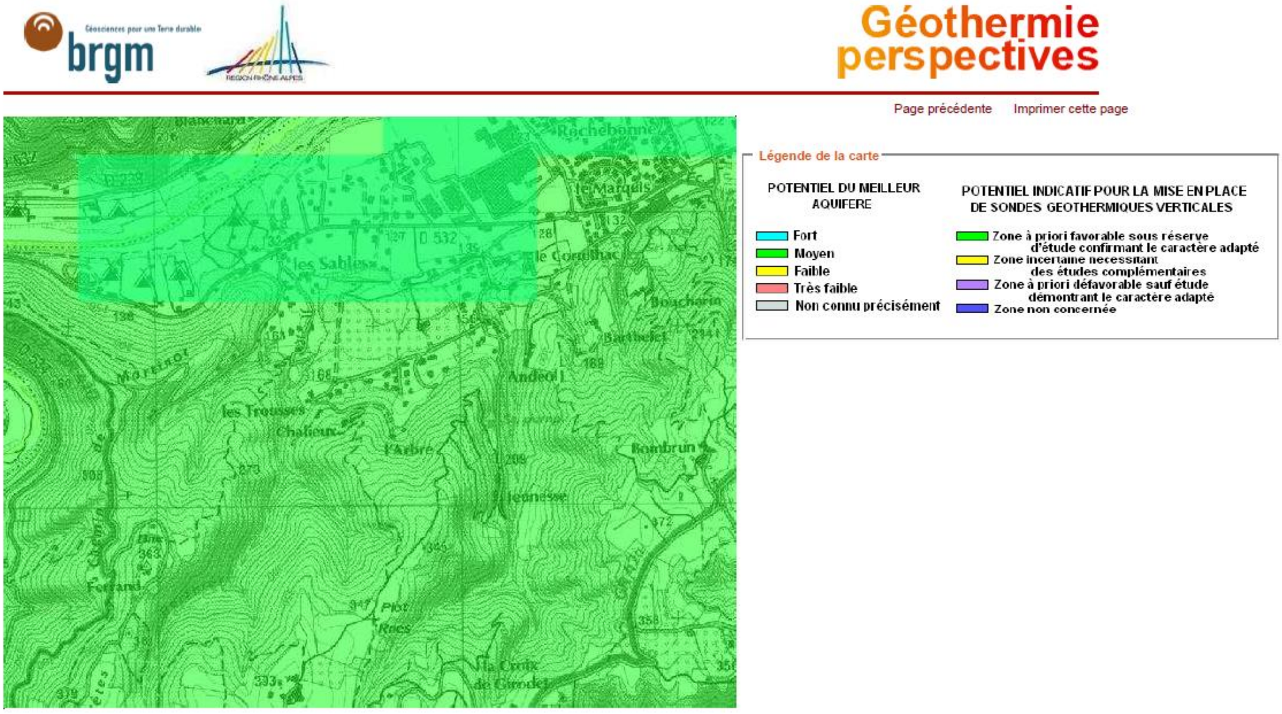

Figure 1 : Geothermal potential resource in les Trousses, Tournon sur Rhône. Green indicates possible resource for vertical geothermal wells, to be confirmed by drillings on site.

1.4 EnerPHit standard

Short description of the final retrofit step to EnerPHit standard

The EnerPHit standard will be reached after the envelope has been completely refurbished, so after the slab on unheated basement has been insulated.

1.5 Pictures

Figure 2 : Pictures of Existing Buildings, Source: André

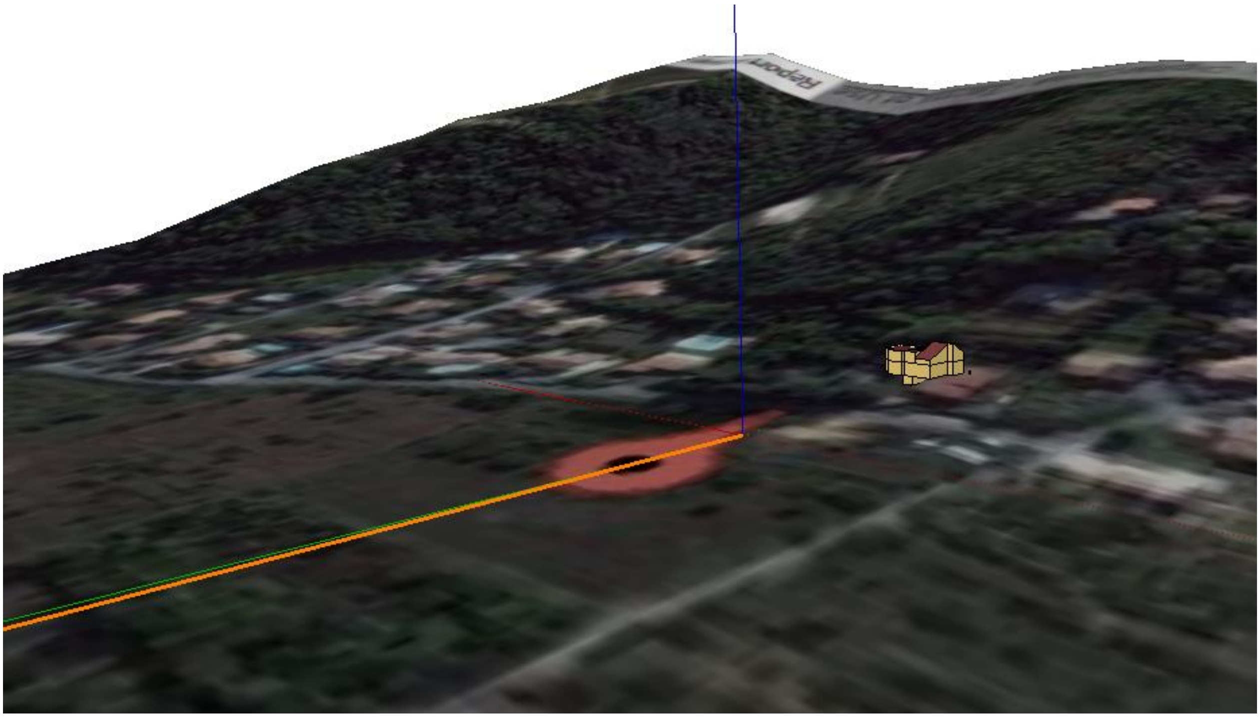

Figure 3 : OpenStudio model of Andre House with terrain integration using Trimble Sketchup and Google Earth data. Orange indicates solar North

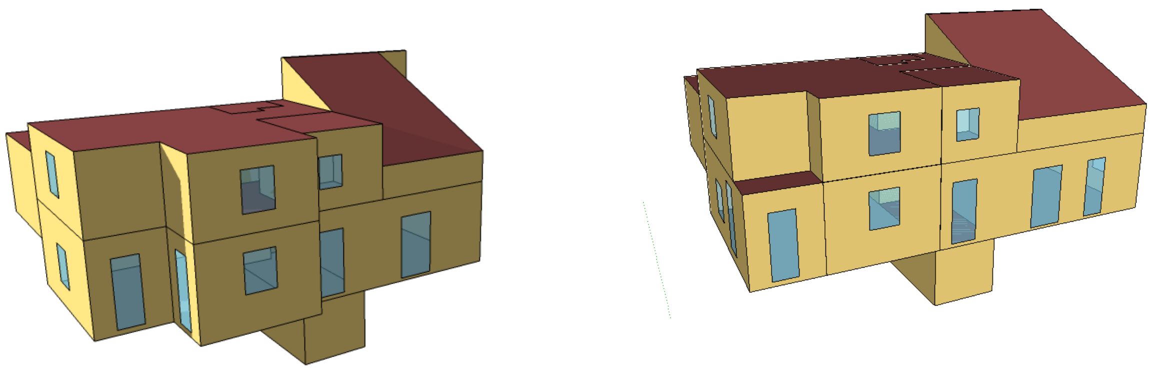

Figure 4: 3D OpenStudio model for shading analysis. Source: LAMP

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2 Existing building

2.1 General description

Add a more detailed description of the existing building including specific properties (building geometry, general quality, temporary use), challenges (balconies, foundations, basement walls, ecc) or building regulation and monument protection issues.

2.1.1 Building data

- Construction Time: 1985
- Last retrofit: 1985
- Building use: Residential
- General condition: No major structural disorder, winter discomfort due to poor airtightness
- Occupancy: 1 family
- Treated floor Area: 155 m²
- Other:

2.1.2 Client

- Name / Company Family André
- Address Chemin des Trousses, Tournon sur Rhône
- Email andrejeanlouis@wanadoo.fr

2.2 Existing Building components

2.2.1 Floor slab

- Description Concrete beam and block floor 20 cm, partially insulated with 6 cm XPS where an electric radiant floor has been installed
- U-Value 1.81 W/(m²K) (no insulation) – 0.44 W/(m².K) (insulation)
- Installation date: 1985
- Condition: No disorder noted
- Next replacement: Insulation under floor before 2016
- Other:

2.2.2 External walls

- Description Concrete hollow blocks walls 20 cm with 6 cm interior insulation XPS + 4 cm interior hollow brick layer
- U-Value 0.45 W/(m²K)
- Installation date: 1985
- Condition: No disorder noted

- Next replacement: Airtightness and insulation before 2016
- Other:

2.2.3 Windows

- Description Double glazing 4/6/4 + Timber frame 68 mm
- U-Value 2.70 W/(m²K)
- Installation date: 1985
- Condition: near to end of service life
- Next replacement: 2015
- Other:

2.2.4 Roof / Top floor ceiling

- Description Ceiling under attic: 6 cm XPS + 12 cm mineral wool between rafters
- U-Value 0.25 W/(m²K)
- Installation date: 1985
- Condition: no specific disorder observed
- Next replacement: airtightness and exterior insulation 2016
- Other:

2.2.5 Heating

- Description Electric radiant floor 115 m² + Wood stove first floor
- Efficiency: average
- Installation date: 1985
- Condition: no specific disorder observed
- Next replacement: 2020
- Other:

2.3 Energy efficiency of the existing building

Short description of the energy efficiency properties of the existing building.

- Modelled specific heating demand: 170-180
- Modelled specific cooling demand / overheating frequency: 0/0%
- Modelled specific primary energy demand: 460-470

Average annual Gas/Oil bills (if available):

Average annual Electricity bills (if available): 17 000 kWh/a

For an overview of the energy efficiency of the existing building, see the verification spreadsheet of the PHPP 9 beta version [PHI 2013] on the next page.

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EnerPHit verification

Building:	House Andre Tournon Sur Rhone
Street:	
Postcode/City:	Tournon sur Rhone
Country:	France
Building type:	Single Family House
Climate:	Tournon avec masque LAMP Temp 1960-1990
Altitude of building site (in [m] above sea level):	168
Home owner/client:	Andre
Street:	
Postcode/City:	

Architecture:		Mechanical System:	
Street:		Street:	
Postcode/City:		Postcode/City:	
Energy consulting:		Certification:	
Street:		Street:	
Postcode/City:		Postcode/City:	

Year of Construction:	2014	Interior temperature winter [C°]	20,0	Interior temp. summer [C°]	25,0
Number of dwelling units:	1	Internal heat gains winter [W/m²]	2,1	IHG summer [W/m²]	2,1
Number of Occupants:	4,4			Spec. capacity [Wh/K per m² TFA]	180
Exterior vol. V_e:	731,7 m³			Mechanical cooling:	

Specific building demands with reference to the treated floor area

				Requirements	Fulfilled?*
	Treated floor area	155,0	m²		
Space heating	Annual heating demand	173	kWh/(m²a)	25 kWh/(m²a)	no
	Heating load	71	W/m²	-	-
Space cooling	Overall specific space cooling demand		kWh/(m²a)	-	-
	Cooling load		W/m²	-	-
	Frequency of overheating (> 25 °C)	0,0	%	-	-
Primary Energy	Heating, cooling, dehumidifying, DHW,	463	kWh/(m²a)	310 kWh/(m²a)	no
	DHW, space heating and auxiliary electricity	422	kWh/(m²a)	-	-
	Specific primary energy reduction through solar electricity		kWh/(m²a)	-	-
Airtightness	Pressurization test result n_{50}	5,0	1/h	1 1/h	no

EnerPHit (Modernisierung): Bauteilkennwerte

Building envelope	Exterior insulation to ambient air	0,25	W/(m²K)	-	-
Average U-Values	Exterior insulation underground	1,96	W/(m²K)	-	-
	Interior insulation to ambient air	0,45	W/(m²K)	-	-
	Interior insulation underground	0,44	W/(m²K)	-	-
	Thermal bridges ΔU	0,03	W/(m²K)	-	-
	Windows	2,67	W/(m²K)	-	-
	External doors	2,50	W/(m²K)	-	-
Ventilation system	Effective heat recovery efficiency	0	%	-	-

* empty field: data missing; '-': no requirement

Figure 5: Specific energy efficiency values of the existing building modelled with PHPP 9 Beta

2.4 Pictures / Drawings

These pictures and drawings illustrate the existing building.

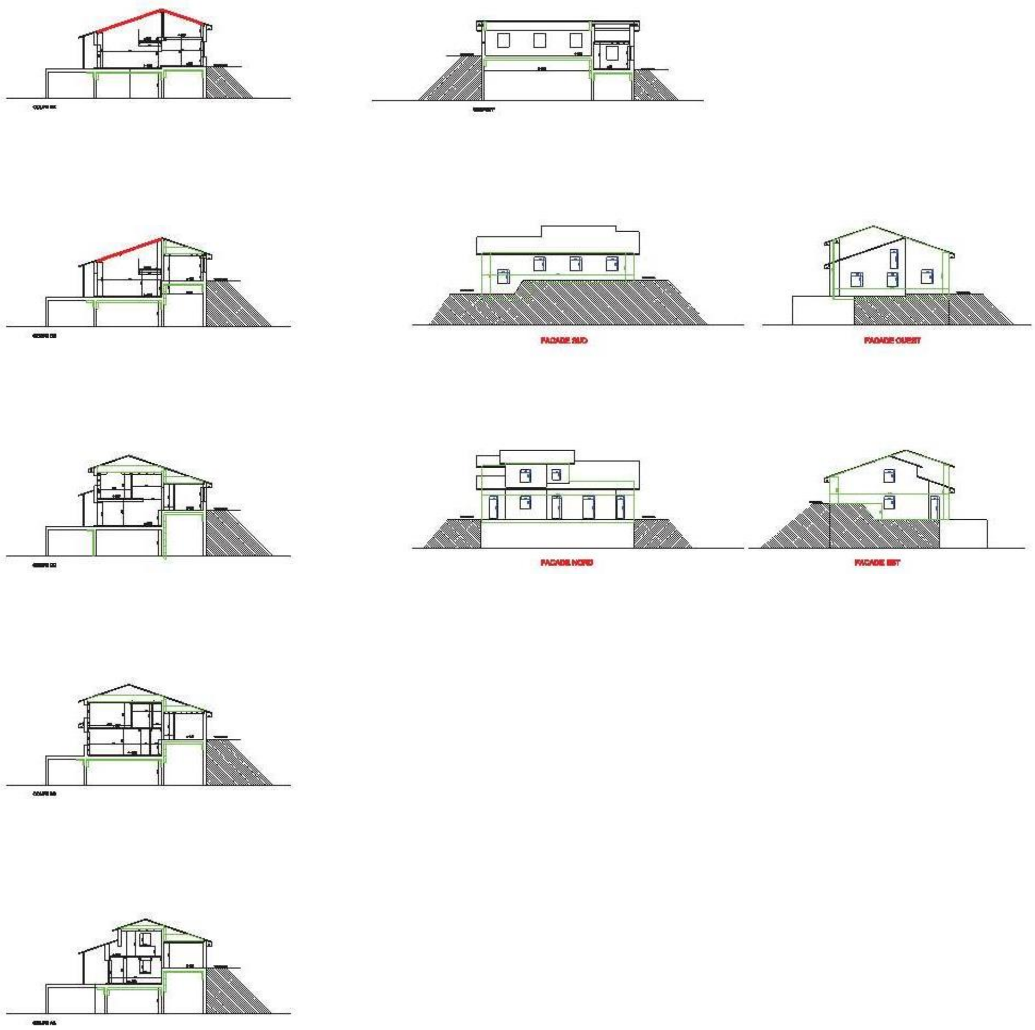

Figure 6: Elevations and Sections of the building. Source: André

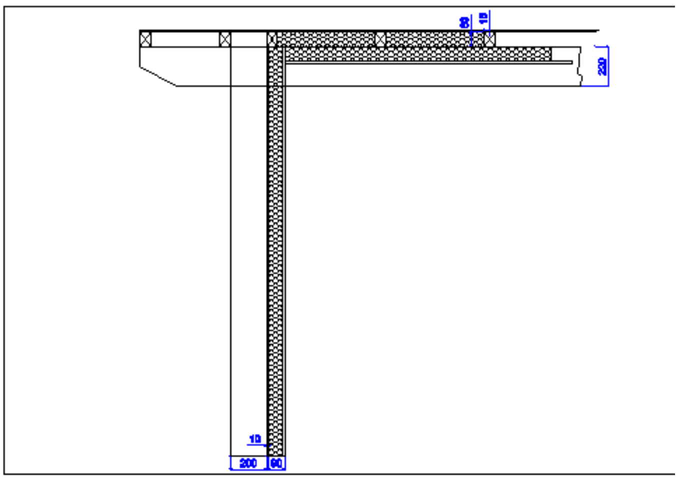

Figure 7 : Gable wall to pitched roof connection for existing building. Source: André

3 Retrofit steps

3.1 Overall refurbishment Plan

3.1.1 Retrofit steps:

Short description of the overall refurbishment plan. Include information of the components to be exchanged or the building parts to be retrofitted and the estimated dates for the measures according to the plan.

The first step is chosen as to create the largest energy reduction upfront: retrofit of walls, windows and installation of a new MVHR unit can reduce the heating demand by 55%. An average n50 of 3.5 h-1 is assumed after realisation of this first step.

After the second step with installation of a new roof, the reduction in energy demand is less visible as the roof is already relatively well insulated. An average n50 of 2.5 is assumed at the end of this second step.

The final third step will bring another significant gain on energy efficiency as slabs will be insulated from the basement, and the staircase will be insulated from the inside with an airtight door between the staircase and the basement.The required EnerPHit airtightness level n50=1 h-1 will be obtained at this stage.

Step	Year	Measure	Specific Heating Demand	Specific Primary Energy Demand	Specific Useful Energy from Renewable Sources
1	2013	Existing Building	173	463	0
2	2015	Walls + Windows + MVHR	78	215	0
3	2016	Roofs	70	190	0
4	2017	Slabs	22	114	0
5	2020	5 kW PV	22	114	37
6 (instead of 5)	2025	6 kW Brine heat pump with ground probes	22	86	48

Figure 8: Overview refurbishment steps

3.1.2 Efficiency Improvements

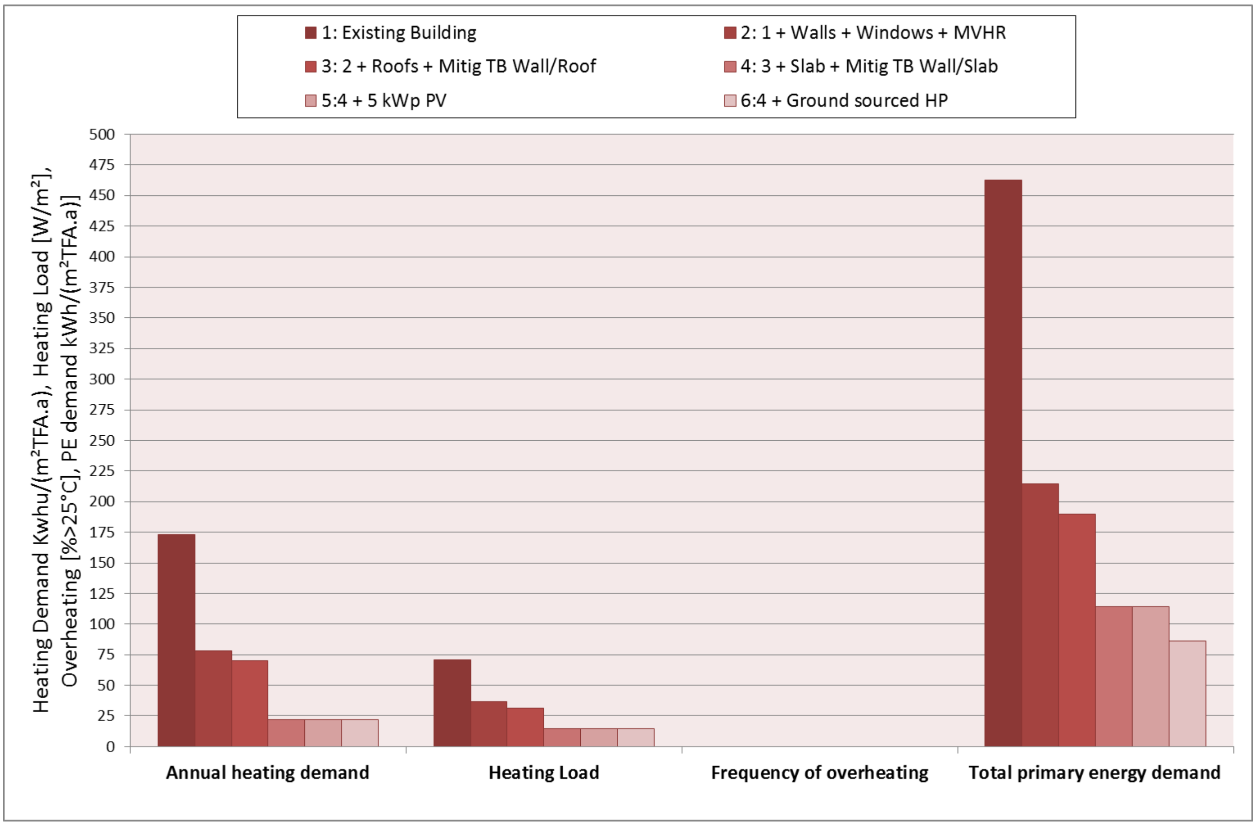

Figure 9: Overview energy efficiency improvement according to the overall refurbishment plan

3.2 Retrofit steps within EuroPHit

3.2.1 Retrofit step 1:

Airtightness and insulation of walls, new windows, new MVHR.

- Start date: 09/2014
- Completion date: 12/2014
- Budget: 80 k€
- Specific heating demand reduction: 100
- Specific cooling demand / overheating frequency reduction/increase: 0
- Specific primary energy demand reduction: 250

3.2.1.1 New Envelope component

- Description: Airtightness layer on walls, 25 cm external insulation,.
- n50 : 3.5 h^{-1} U wall : 0,10
- Installation date: 09/2014
- Next replacement: 09/2064
- Other: Airtightness layer on the outer face of the existing structure to avoid penetrating beams from intermediate floors and ceilings. Still problems with protruding rafters on the outer face of the eave.

3.2.1.2 New building equipment component

- Description: Installation of a centralised MVHR unit in the unheated attic
- Efficiency: 90% effective heat recovery
- Installation date: 09/2014
- Next replacement: 09/2044
- Other:

3.2.2 Retrofit step 2:

Roof top insulation + airtightness + Mitigation Thermal Bridges Walls / Roofs

- Start date: 06/2015
- Completion date: 08/2015
- Budget: 20 k€
- Specific heating demand reduction: 8
- Specific cooling demand / overheating frequency reduction: 0
- Specific primary energy demand reduction: 25

3.2.2.1 New Envelope component

- Description : 20 cm insulation on the ceiling + 20 cm insulation on top of existing rafters for pitched roofs
- U-Value : 0,10 n50 : 2.5
- Installation date: 08/2015
- Next replacement: 08/2065
- Other: Airtight layer of pitched roof placed on top of existing rafters. Airtight layer of ceilings placed below existing insulation, from the inside.

EnerPHit verification

Building:	House Andre Tournon Sur Rhone
Street:	
Postcode/City:	Tournon sur Rhone
Country:	France
Building type:	Single Family House
Climate:	Tournon avec masque LAMP Temp 1960-1990
Altitude of building site (in [m] above sea level):	168
Home owner/client:	Andre
Street:	
Postcode/City:	

Architecture:		Mechanical System:	
Street:		Street:	
Postcode/City:		Postcode/City:	
Energy consulting:		Certification:	
Street:		Street:	
Postcode/City:		Postcode/City:	

Year of Construction:	2014	Interior temperature winter [C°]	20,0	Interior temp. summer [C°]	25,0
Number of dwelling units:	1	Internal heat gains winter [W/m²]	2,1	IHG summer [W/m²]	2,1
Number of Occupants:	4,4			Spec. capacity [Wh/K per m² TFA]	180
Exterior vol. V_e:	731,7 m³			Mechanical cooling:	

Specific building demands with reference to the treated floor area

		Value	Unit	Requirements	Fulfilled?*
	Treated floor area	155,0	m²		
Space heating	Annual heating demand	70	kWh/(m²a)	25 kWh/(m²a)	no
	Heating load	32	W/m²	-	-
Space cooling	Overall specific space cooling demand		kWh/(m²a)	-	-
	Cooling load		W/m²	-	-
	Frequency of overheating (> 25 °C)	0,0	%	-	-
Primary Energy	Heating, cooling, dehumidifying, DHW,	190	kWh/(m²a)	186 kWh/(m²a)	no
	DHW, space heating and auxiliary electricity	150	kWh/(m²a)	-	-
	Specific primary energy reduction through solar electricity		kWh/(m²a)	-	-
Airtightness	Pressurization test result n_{50}	2,5	1/h	1 1/h	no

EnerPHit (Modernisierung): Bauteilkennwerte

		Value	Unit	Requirements	Fulfilled?*
Building envelope	Exterior insulation to ambient air	0,25	W/(m²K)	-	-
Average U-Values	Exterior insulation underground	1,47	W/(m²K)	-	-
	Interior insulation to ambient air	0,10	W/(m²K)	-	-
	Interior insulation underground	0,41	W/(m²K)	-	-
	Thermal bridges ΔU	0,01	W/(m²K)	-	-
	Windows	0,87	W/(m²K)	-	-
	External doors	0,80	W/(m²K)	-	-
Ventilation system	Effective heat recovery efficiency	88	%	-	-

* empty field: data missing; '-': no requirement

Figure 10: Specific energy efficiency values after measures within EuroPHit

3.3 Future retrofit Steps

3.3.1 Retrofit step 3:

Slab airtightness and insulation

- Start date: 06/2017
- Completion date: 08/2017
- Budget: 12 k€
- Specific heating demand reduction: 50
- Specific cooling demand / overheating frequency reduction: 0
- Specific primary energy demand reduction: 75

3.3.1.1 New Envelope component

- Description: 20 cm 0,025 W/m.K insulation under slabs, 10 cm on staircase walls

- U-Value 0,12 – 0,22
- Installation date: 06/2017
- Next replacement: 06/2067
- Other: n50 1h-1

3.3.2 Retrofit step 4:

5 kWp PV south oriented

- Start date: 06/2020
- Completion date: 08/2020
- Budget: 20 k€
- Specific primary energy demand reduction through PV: 89

3.3.2.1 New building equipment component

- Description: 5 kWp Poly-Si System grid-connected south oriented roof integrated
- Efficiency: Poly-Si standard
- Installation date: 08/2020
- Next replacement: 08/2045
- Other:

3.4 Pictures / Drawings

These pictures or drawings illustrate the retrofit process.

4 Completion of step-by-step refurbishment to EnerPHit standard including RES

4.1 General description

4.2 Retrofit steps carried out

The steps carried out are the following:

	select active variants >>	5-5:4 + 5 kWp PV	1: Existing Building	2: 1 + Walls + Windows + MVHR	3: 2 + Roofs + Mitig TB Wall/Roof	4: 3 + Slab + Mitig TB Wall/Slab	5: 4 + 5 kWp PV	6: 4 + Ground sourced HP
Results	**Units**	5	**1**	**2**	**3**	**4**	**5**	**6**
Annual heating demand	kwh/(m²a)	21,8	173,2	78,0	70,2	21,8	21,8	21,8
Heating Load	W/m²	14,6	70,8	36,6	31,5	14,6	14,6	14,6
Frequency of overheating	%	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Total primary energy demand	kwh/(m²a)	114,3	462,6	214,5	190,0	114,3	114,3	86,4
Certifiable as EnerPHit building retrofit (acc. to heating demand)?	yes / no	yes	no	no	no	yes	yes	yes

Figure 11: PHPP9 beta [PHI 2013] Variant sheet with the retrofit steps carried out

4.3 Description of Building components

4.3.1 Floor slab

- Description
- U-Value
- Installation date:
- Condition:
- Next replacement:
- Other:

4.3.2 External walls

- Description
- U-Value
- Installation date:
- Condition:
- Next replacement:
- Other:

4.3.3 Windows

- Description
- U-Value
- Installation date:

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- Condition:
- Next replacement:
- Other:

4.3.4 Roof / Top floor ceiling

- Description
- U-Value
- Installation date:
- Condition:
- Next replacement:
- Other:

4.3.5 Heating

- Description
- Efficiency:
- Installation date:
- Condition:
- Next replacement:
- Other:

4.4 Energy efficiency of the refurbished building

Short description of the energy efficiency properties of the completed retrofit.

- Modelled specific heating demand: 22
- Modelled specific cooling demand / overheating frequency: 0/0-6%
- Modelled specific primary energy demand: 110-120

For an overview of the energy efficiency of the completed step-by-step refurbishment, see the verification spreadsheet of the PHPP 9 beta version [PHI 2013] on the next page.

EnerPHit verification

Building:	House Andre Tournon Sur Rhone
Street:	
Postcode/City:	Tournon sur Rhone
Country:	France
Building type:	Single Family House
Climate:	Tournon avec masque LAMP Temp 1960-1990
Altitude of building site (in [m] above sea level):	168
Home owner/client:	Andre
Street:	
Postcode/City:	

Architecture:		Mechanical System:	
Street:		Street:	
Postcode/City:		Postcode/City:	
Energy consulting:		Certification:	
Street:		Street:	
Postcode/City:		Postcode/City:	

Year of Construction:	2014	Interior temperature winter [C°]	20,0	Interior temp. summer [C°]	25,0
Number of dwelling units:	1	Internal heat gains winter [W/m²]	2,1	IHG summer [W/m²]	2,1
Number of Occupants:	4,4			Spec. capacity [Wh/K per m² TFA]	180
Exterior vol. V_e:	731,7 m³			Mechanical cooling:	

Specific building demands with reference to the treated floor area

		Value	Unit	Requirements	Fulfilled?*
	Treated floor area	155,0	m²		
Space heating	Annual heating demand	**22**	**kWh/(m²a)**	25 kWh/(m²a)	**yes**
	Heating load	**15**	**W/m²**	-	**-**
Space cooling	Overall specific space cooling demand		**kWh/(m²a)**	-	**-**
	Cooling load		**W/m²**	-	**-**
	Frequency of overheating (> 25 °C)	0,0	%	-	**-**
Primary Energy	Heating, cooling, dehumidifying, DHW,	**114**	**kWh/(m²a)**	128 kWh/(m²a)	**yes**
	DHW, space heating and auxiliary electricity	74	kWh/(m²a)	-	**-**
	Specific primary energy reduction through solar electricity	89	kWh/(m²a)	-	**-**
Airtightness	Pressurization test result n_{50}	**1,0**	**1/h**	1 1/h	**yes**

Figure 12: Specific energy efficiency values of the completed project modelled with PHPP 9 Beta

4.5 Pictures / Drawings

These pictures or drawings illustrate the final status of the retrofit.

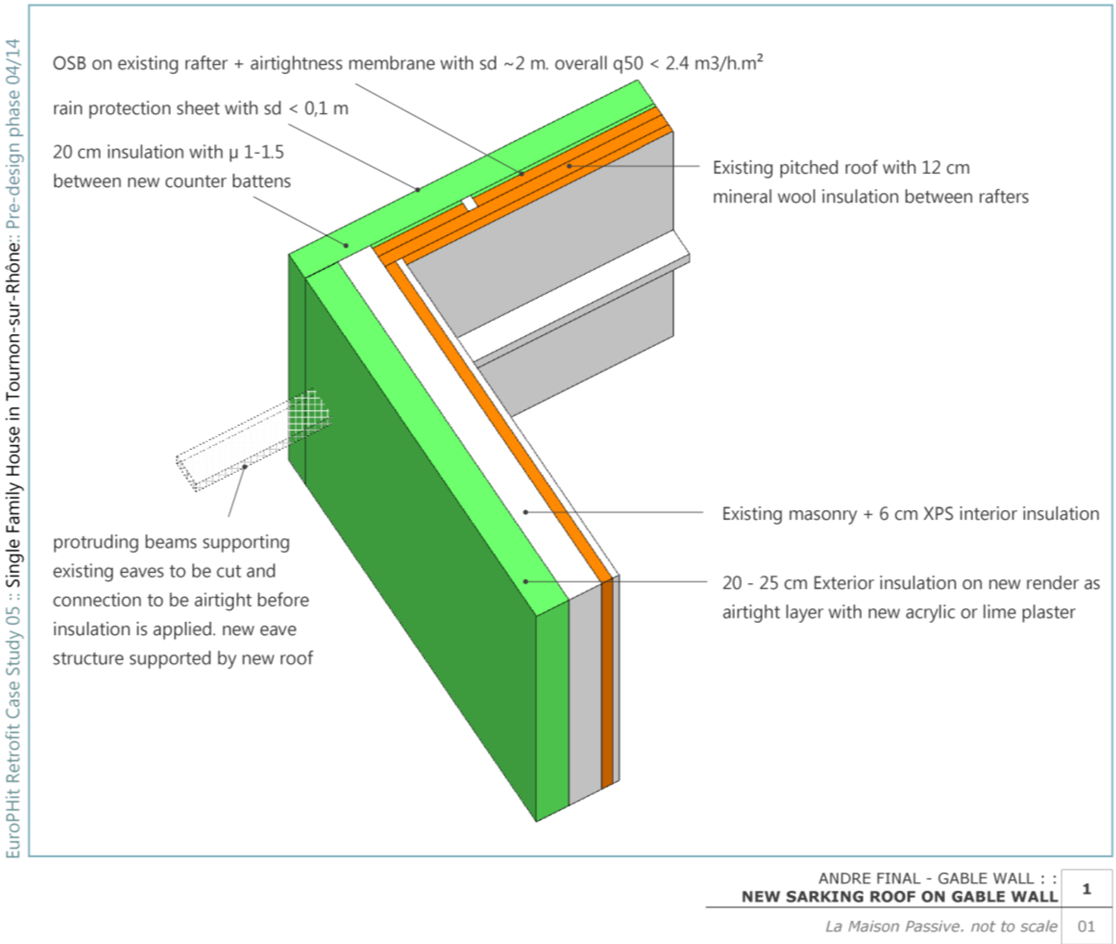


Figure 13: Possible final sill connection gable wall to pitched roof

5 RES Strategy / PV potential Evaluation

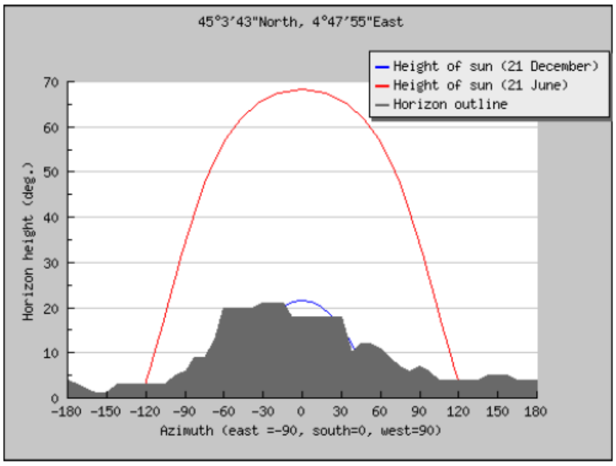
5.1 Inhabitant's comfort and location concept

5.2 Evaluation of potential BIPV systems

5.3 Production estimation

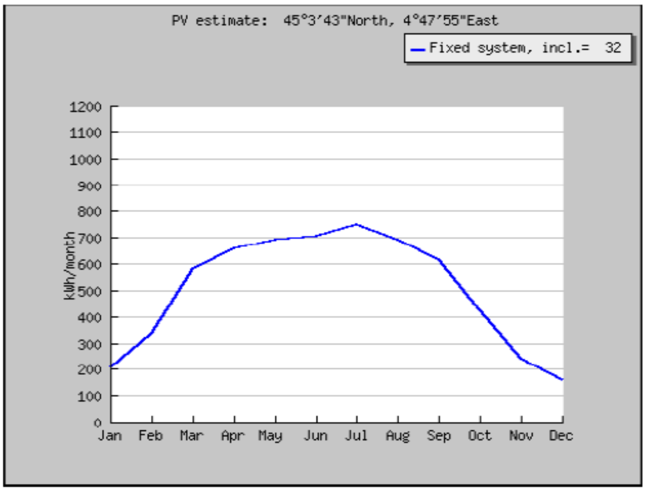
According to the PV assessment software PVGIS, a 5 kWp polycrystalline silicon grid-connected PV system, with optimal orientation (South, fixed slope 32°) could produce around

6000 kWh per year (Figure 9). Due to low resource and high site shading (Figure 8), the electricity will be produced mostly outside the heating period so with a relatively poor overall match with the energy load of the refurbished building. The PV sheet of the PHPP 9.0 gives a similar result at 5800 kWh per year (Figure 10). A substantial solar fraction can still be obtained given difficult orientation, and the solar fraction could be enhanced by investigating storage solutions.



Outline of horizon with sun path for winter and summer solstice

Figure 14 : Horizon and sun path for Tournon-sur-Rhône, PVGIS



Monthly energy output from fixed-angle PV system

Figure 15 : Monthly PV Energy output 5kWp, PVGIS

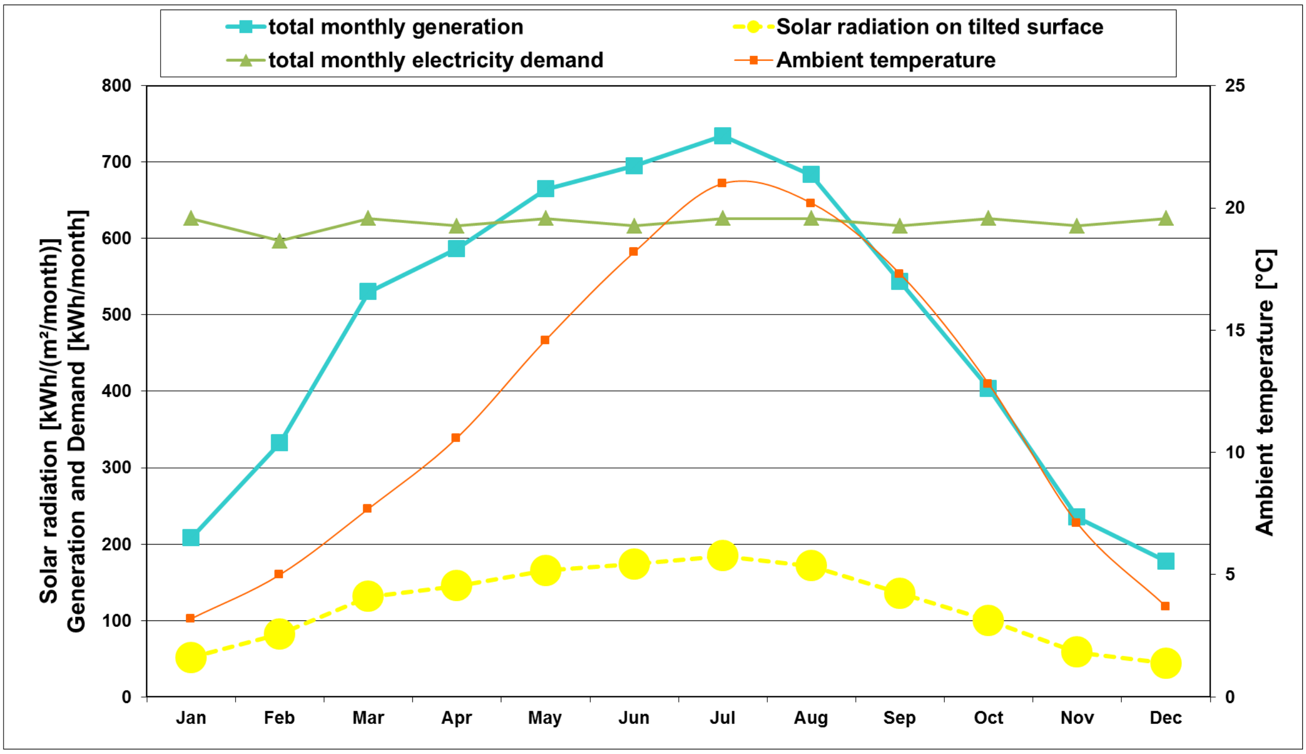


Figure 16: Monthly PV Energy output 5kWp and monthly total electricity demand refurbished building, PHPP9.0

Solar thermal solutions could also be an interesting option to cover most of the DHW demand in summer and cover a part of heat demand if seasonal storage can be implemented.

PV type	:	Poly-Si
Location	:	On the roof, South oriented
Installed PV area [m²]	:	50
Installed peak power [Wp]	:	5000
Annual RES gains [kWh]	:	5800
Other	:	

5.4 Multifunctional behaviour of the BIPV systems: passive properties

5.5 Financial evaluation & taxes and incentives assessment

For simple roof integrated solutions, a feed-in tariff of 14 c€/kWh can be granted. With a price of 3.5 €/Wp plus 0.5 €/Wp every 10 years to replace the inverter, the electricity from PV would cost 14 c€/kWh averaged on 20 years. That is equal to the average electricity price from the grid in France in 2014.

5.6 Conclusion

6 Refurbishment to the current National Standards

6.1 General Description

Add a more detailed description of the main differences between the building retrofitted according to national regulations and EnerPHit standard.

The French national regulation [RT-Ex 2007], in case of a building less than 1000 m²TFA, ask for minimal R-values of opaque components and windows:

- Walls : R > 2 m²K/W
- Roofs: R > 4 – 4.5 m²K/W
- Slabs: R > 2 m²K/W
- Windows : R > 2.3 m²K/W

6.2 Efficiency results comparison table

	Existing building	National regulations	EnerPHit standard	Differences [%]
Space heat demand [kWh/(m²/a)]	170	146	23	16%
Primary energydemand [kWh/(m²/a)]	452	407	115	28%
Heat Load [W/m²]	70	63	15	24%

Figure 17:Comparison of efficiency results

6.3 Building envelope comparison table

	Existing building	National regulations	EnerPHit standard	Differences [%]
Airtightness Pressure test n50 [1/h]	5.0	5.0	1.0	20%
Building envelope				
Floor Slab [W/(m²K)]	1.10	0.57	0.14	
Walls to ground [W/(m²K)]	0.45	0.41	0.10	
Walls [W/(m²K)]	0.45	0.41	0.10	
Roof / Attic ceilings [W/(m²K)]	0.25	0.28	0.10	
Windows [W/(m²K)]	2.7	2.3	0.87	

Doors [W/(m²K)]	2.7	2.3	0.80	
Thermal bridging ΔU[W/(m²K)]	0.04	0.03	0.02	

Figure 18:Comparison of building envelope components

6.4 Building equipment comparison table

	Existing building	National regulations	EnerPHit standard	Differences [%]
Ventilation	**Mechanical**	**Mechanical**	**MVHR**	
HR Efficiency [%]	0	0	92	
Electric efficiency [Wh/m³]	0.25	0.25	0,24	
Ducting				
Heating	**Electric radiators+floor heating**	**Electric radiators+floor heating**	**Electric radiators**	
Energy source	Electricity	Electricity	Electricity	
Performance ratio of heat generation [%]	100	100	100	
Thermal output kW	10	10	2.5	
Insulation of pipes				
Domestic hot water	**Electric hot water storage**	**Electric hot water storage**	**Electric hot water storage**	
Energy source	Electricity	Electricity	Electricity	
Performance ratio of heat generation [%]	100	100	100	
Thermal output kW	3	3	3	
Insulation of pipes				
Cooling				
Energy source				

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Performance ratio of cooling generation [%]				
Thermal output kW				
Insulation of pipes				

Figure 19:Comparison of building envelope components

6.5 RES implementation comparison table

	Existing building	National regulations	EnerPHit standard	Differences [%]
Renewables	None	None	None	

Figure 20: Comparison of building envelope components

6.6 Conclusions

Add some general comments, observations on the comparison of the project according to national regulations and EnerPHit standard…