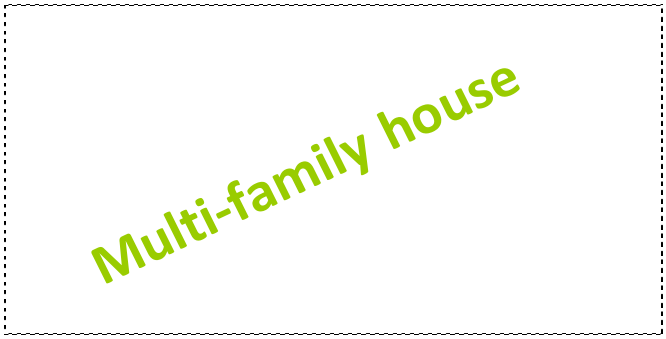
EnerPHit Retrofit Plan

Target standard: EnerPHit Classic

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



Object:	**Multi-family house**		
	Passivhaus street 1		
	12345	Innsbruck	
			AT-Austria
	residential building		
Climate data set:	AT0032b-Innsbruck		
Climate zone:	3: Cool, temperate	Altitude of location:	578

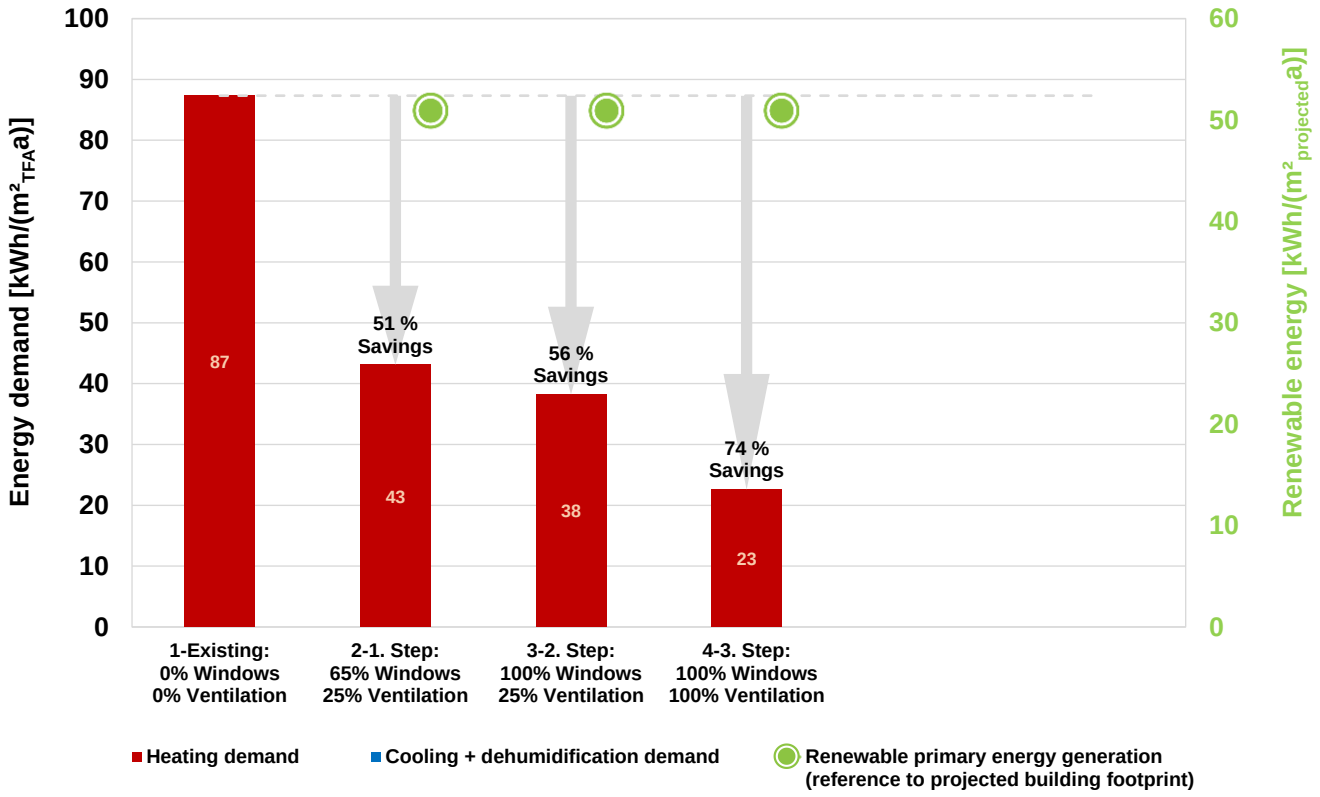
Owner:	**Owner**		
	Street 2		
	12345	Passive City	
			DE-Germany

Energy consulting:	**Passivhaus Certification**		
	Passive street 12		
	12345	Passive City	
			DE-Germany

Pre-Certification:	**Passivhaus Certification**		
	Passive street 12		
	12345	Passive City	
			DE-Germany

Year of construction:	1945/2018	Interior temp. winter [°C]:	20.0	Interior temp. summer [°C]:	25.0
No. of dwelling units:	49	Treated floor area:	3500.3	No. of occupants:	107.8

Energy demand and generation over the retrofit steps



I confirm that the values given herein have been determined following the PHPP methodology and based on the characteristic values of the building. The PHPP calculations are attached to this verification.

First name	Last name	Signature
John	Smith	

Company	Issued (date)	City
Passive House Certification	21.07.2021	Passive city

Passive city, 21.7.2021

Dear building owner,

in the next few years you intend to modernise your building and to improve stepwise its level of thermal protection. This "EnerPHit Retrofit Plan" will help you to make the right decisions at each step.

EnerPHit Standard
In the case of refurbishments of existing buildings, it is not always possible to fully achieve the Passive House Standard with reasonable effort. The reasons for this lie e.g. in the unavoidable thermal bridges due to existing basement walls. For such buildings, the Passive House Institute has developed the EnerPHit Standard. With the use of Passive House components, EnerPHit retrofitted buildings offer almost all the advantages of a Passive House building with optimum cost-effectiveness at the same time:
• Comfortable living with uniformly warm walls, floors and windows
• Draughts, condensation and mould growth are no longer a problem
• Permanent supply of fresh air with a pleasant temperature
• Independence from energy price fluctuations
• Financial profits from the very first year on due to up to 90 % reduced heating costs
• Climate protection due to decreased CO2 emissions of the same scale

EnerPHit Retrofit Plan
Most buildings are modernised in a step-by-step way when the respective building component needs to be renewed. Advantage can be taken of such opportunities to carry out future-oriented improvements to the thermal protection of the building. For example, if the façade already needs to be renewed anyway, the extra effort for thermal protection of the exterior wall to the Passive House quality at the same time will be manageable. Nevertheless, many interdependencies exist between individual energy efficiency measures, so that a good standard of thermal protection can only be achieved cost-effectively if an overall concept is prepared for the entire building prior to the first modernisation step. With the modernisation route planner, such an overall concept will be worked out for you by your Passive House Designer or energy consultant. This offers you the following advantages:
• Preparing for future steps already with today's measures will save costs on the whole and will ensure an optimal final outcome.
• An excellent final outcome can only be achieved if each individual step is implemented with the appropriate quality (EnerPHit-Standard).
• Once the overall concept has been prepared, it is available for every further step and thus facilitates the planning process (you don't have to start from the beginning every time).
• The energy demand is stated for each step.
• The approximate time points for upcoming refurbishment measures are stated in the general plan. This serves as a valuable aid for personal finance planning.

Pre-certification
The modernisation route planner as well as other relevant documents can be checked by a PHI accredited certifier for additional quality assurance. If the examination shows that the EnerPHit Standard will be achieved with the implementation of all planned measures, then the first step can be carried out. After this a preliminary EnerPHit certificate can then be issued for the building. If quality assurance is continued accordingly for each step, then the full EnerPHit certificate will be issued for the building upon completion of the last step. A preliminary certificate increases the value of your building because its potential is clearly demonstrated. It also increases the credibility of the refurbishment concept in the context of talks with the bank e.g. because the achievable cost saving is available in a reliably calculated way. Apart from that, you can demonstrate to the outside world that you are committed to climate protection.

I wish you every success with your retrofit project!

John Smith (Passive House Certification)

Scheduler

Source file: 'PHPP_V9.7_MFH_PRE-CERTIFICATE.xlsm' (PHPP version: 9.7)

EnerPHit Retrofit Plan: Multi-family house, Passive City, AT-Austria

Retrofit steps:		1										2		3		4										
Assemblies	Last renewal	1945	1950	1960	1970	1980	1990	2000	2004	2010	2015	2018	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070	2075	2080	2085
Plastering facade	1980											x													
Balconies/loggias	1945											x													
Exterior door	1990											x													
Pitched roofing	1980											x													
Roof ends	1980											x													
Basement ceiling	1980											x													
Windows 2004	2004													x											
Windows 2018	1980											x													
Ventilation (25% of dwellings)	2018											x													
Ventilation (50% of dwellings)	2030													x											
Ventilation (100% of dwellings)	2040															x									
Photovoltaics	2018											x													
Airtightn. test: X, Leakage search: (X)												(X)		(X)		X									

Initial condition

Main-tenance

Extensive repairs

X Retrofit dates

Smaller repairs

Immediate replacement

Overview of measures

Source file: 'PHPP_V9.7_MFH_PRE-CERTIFICATE.xlsm' (PHPP version: 9.7)

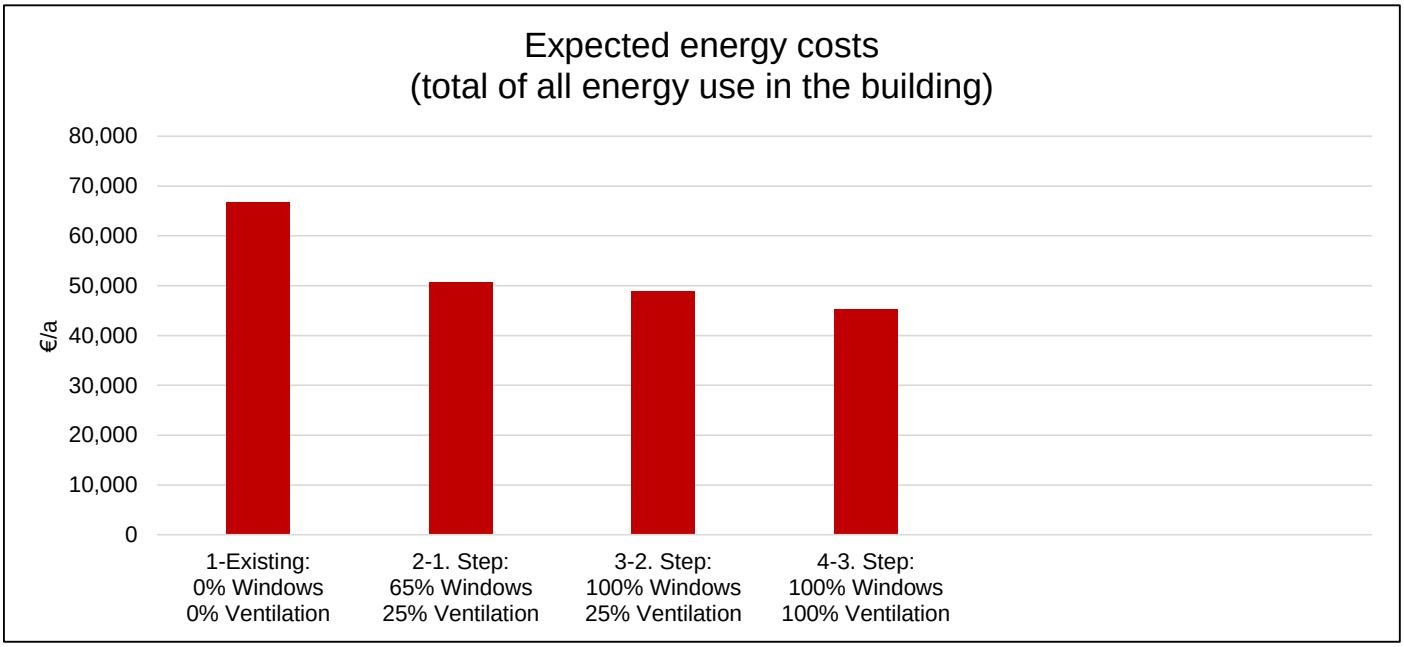
EnerPHit Retrofit Plan: Multi-family house, Passive City, AT-Austria

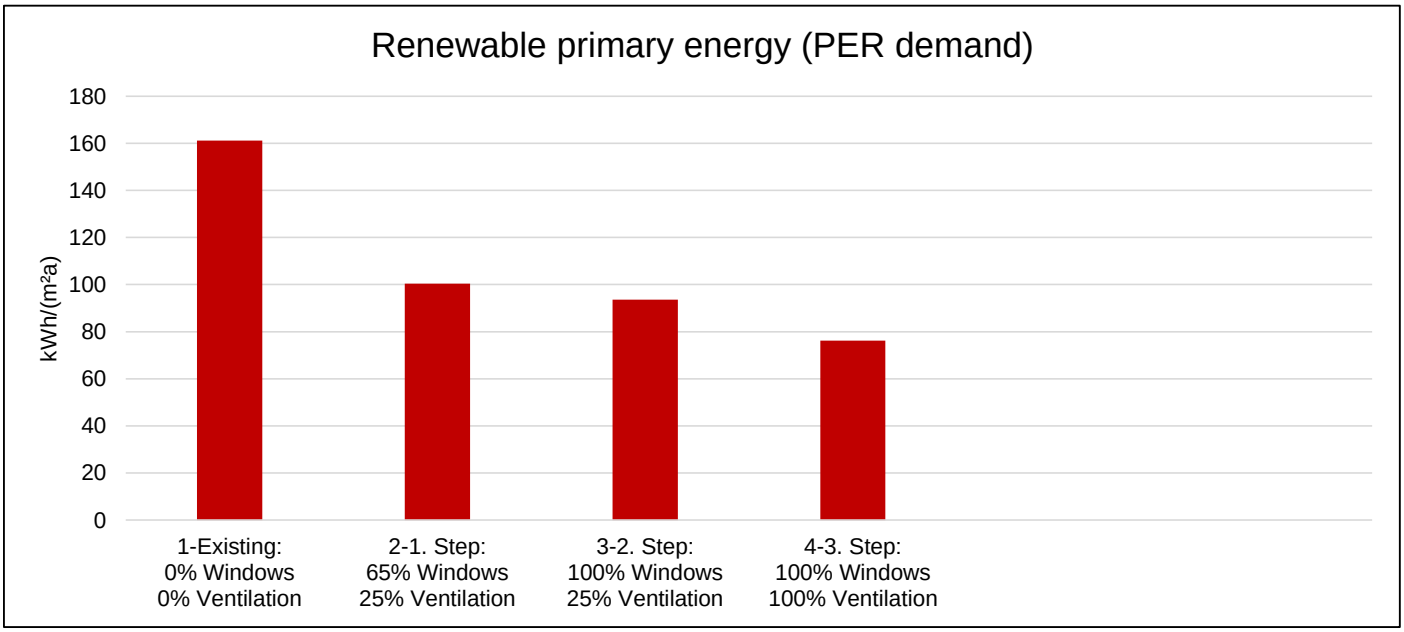
								Criteria	Alternative criteria
Retrofit step No.		1-Existing: 0% Windows 0% Ventilation	2-1. Step: 65% Windows 25% Ventilation	3-2. Step: 100% Windows 25% Ventilation	4-3. Step: 100% Windows 100% Ventilation				
Year		1945	2018	2030	2040				
Measures									
Occasion ("anyway measure")	a		Window replacement	Window replacement					
Energy-saving measure			65% Passive House Windows	100% Passive House Windows					
Occasion ("anyway measure")	b		Plaster renewal						
Energy-saving measure			External wall insulation						
Occasion ("anyway measure")	c		Insulation eligible for approval						
Energy-saving measure			Insulation EnerPHit top floor ceiling						
Occasion ("anyway measure")	d		Front door replacement						
Energy-saving measure			Passive house door						
Occasion ("anyway measure")	e		Mould prevention	Mould prevention	Mould prevention				
Energy-saving measure			25% ventilation system with heat recovery	25% ventilation system with heat recovery	100% ventilation system with heat recovery				
Occasion ("anyway measure")	f		no						
Energy-saving measure			Photovoltaic system						
Occasion ("anyway measure")	g								
Energy-saving measure									
Occasion ("anyway measure")	h								
Energy-saving measure									
Component characteristics									
Wall to ambient air, ext. insulation (U-value)	[W/(m²K)]	0.42	0.15	0.15	0.15				
Roof (U-value)	[W/(m²K)]	0.27	0.12	0.12	0.12				
Building envelope to ambient (U value)	[W/(m²K)]	0.39	0.14	0.14	0.14			-	-
Wall to ground, ext. insulation (U-value)	[W/(m²K)]								
Basement ceiling / floor slab (U-value)	[W/(m²K)]	0.96	0.96	0.96	0.96				
Building envelope to ground (U-value)	[W/(m²K)]	0.96	0.96	0.96	0.96			-	-
Wall, int. insulation to ambient air (U-Value)	[W/(m²K)]	-	-	-	-			-	-
Wall, int. insulation to ground (U-Value)	[W/(m²K)]	-	-	-	-			-	-
Flat roof (solar reflection index, SRI)	[W/(m²K)]	45.20	45.20	45.20	45.20			-	-
Inclined and vertical external surface (SRI)	[W/(m²K)]	45	45	45	45			-	-
Windows / doors ($U_{installed}$)	[W/(m²K)]	1.63	1.14	0.95	0.95			-	-
Windows ($U_{W,installed}$)	[W/(m²K)]	-	-	-	-			-	-
Windows ($U_{W,installed}$)	[W/(m²K)]	-	-	-	-			-	-
Glazing (g-value)	[]	0.60	0.53	0.50	0.50			-	-
Glazing/sun protection (max. solar load)	[kWh/(m²a)]	82	60	55	55			-	-
Ventilation (effective heat recovery efficiency)	[%]		15	15	73			-	-
Ventilation (effective humidity recovery efficiency)	[%]		0	0	0			-	-
Airchange at press. test n_{50}	[1/h]	3.5	1.2	0.8	0.8			1.0	-
Building characteristics									
Heating demand	[kWh/(m²a)]	87	43	38	23			25	-
Heating load	[W/m²]	51	27	24	17			-	-
Cooling + dehumidification demand	[kWh/(m²a)]	-	-	-	-			-	-
Cooling load	[kWh/(m²a)]	-	-	-	-			-	-
Frequency of overheating (> 25 °C)	[%]	0	0	0	0			10	-
Frequency of exc. high humidity (> 12 g/kg)	[%]	0	0	0	0			20	-
Non-renewable primary energy (PE demand)	[kWh/(m²a)]	158	117	112	102			-	-
Renewable primary energy (PER demand)	[kWh/(m²a)]	161	100	94	76			67	76
Renewable primary energy generation (reference to projected building footprint)	[kWh/(m²a)]	0	51	51	51			-	44
Criteria fulfilled for EnerPHit Classic?		no	no	no	yes				

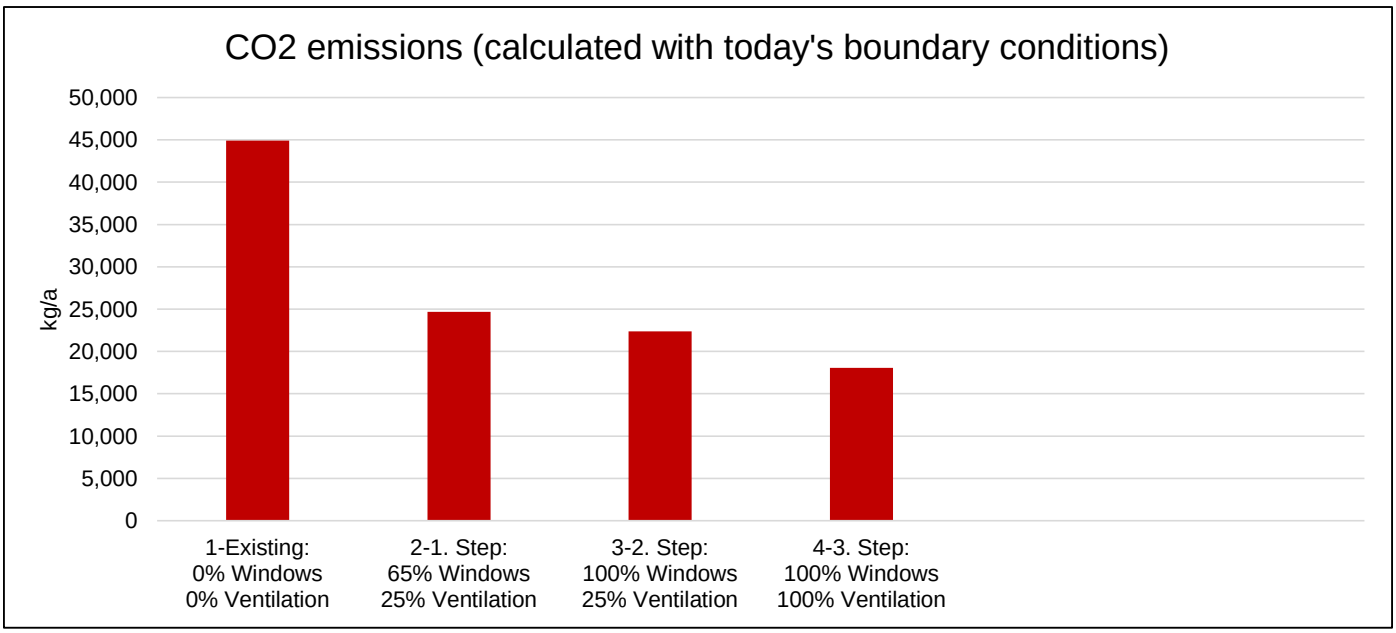
Diagrams

Source file: 'PHPP_V9.7_MFH_PRE-CERTIFICATE.xlsm' (PHPP version: 9.7)

EnerPHit Retrofit Plan: Multi-family house, Passive City, AT-Austria







Building assemblies (U-values)

Source file: 'PHPP_V9.7_MFH_PRE-CERTIFICATE.xlsm' (PHPP version: 9.7)

EnerPHit Retrofit Plan: Multi-family house, Passive City, AT-Austria

Assembly: **01ud-AW01 Exterior wall - existing renovated** Area: 0.0 m²

Areas with this assembly: **Wall_052_W, Wall_053_N, Wall_054_E,**

Retrofit step: **1-Existing: 0% Windows 0% Ventilation**

Subarea 1	λ [W/(mK)]	Subarea 2 (optional)	λ [W/(mK)]	Subarea 3 (optional)	λ [W/(mK)]	Thickness [mm]
Interior plaster	0.470					15
Wall stone	0.324					250
Exterior render	0.700					30
Mineral wool	0.040					60
Exterior render	0.700					30
Mineral wool	0.034					0
Exterior render	0.700					7

Fraction subarea 1	Fraction subarea 2	Fraction subarea 3	Total	
100%	0%	0%	**39.2**	cm

U-value supplement: 0 W/(m²K) **U-value:** **0.389** W/(m²K)

Retrofit step: **2-1. Step: 65% Windows 25% Ventilation**

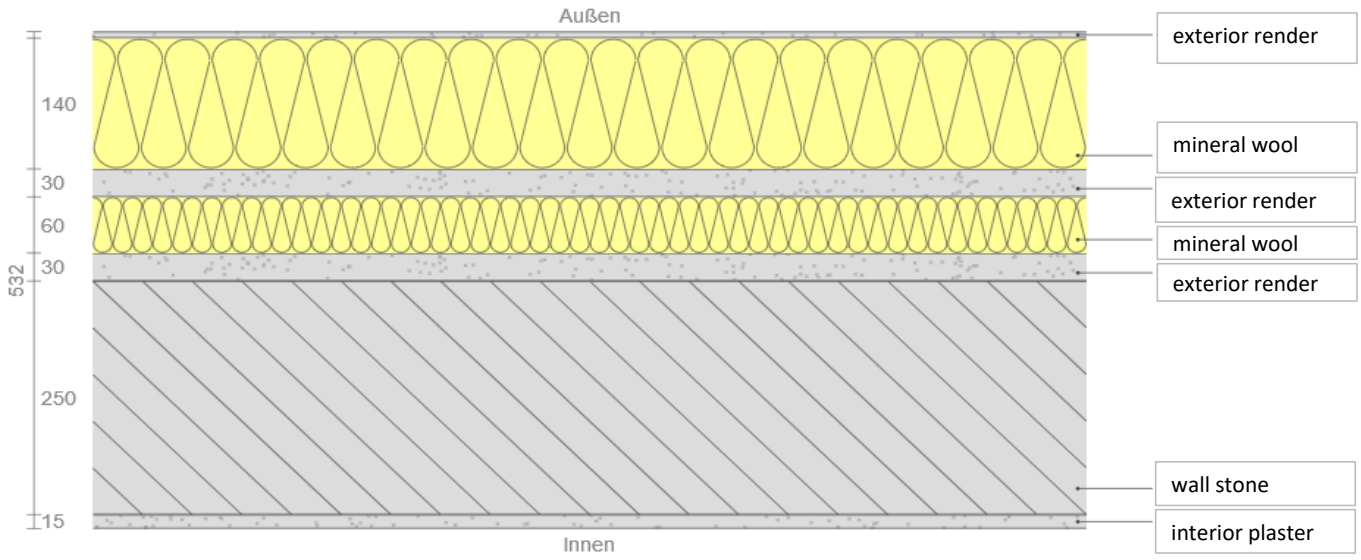
Subarea 1	λ [W/(mK)]	Subarea 2 (optional)	λ [W/(mK)]	Subarea 3 (optional)	λ [W/(mK)]	Thickness [mm]
Interior plaster	0.470					15
Wall stone	0.324					250
Exterior render	0.700					30
Mineral wool	0.040					60
Exterior render	0.700					30
Mineral wool	0.034					140
Exterior render	0.700					7

Fraction subarea 1	Fraction subarea 2	Fraction subarea 3	Total	
100%	0%	0%	**53.2**	cm

U-value supplement: 0 W/(m²K) **U-value:** **0.150** W/(m²K)

Assembly: **01ud-AW01 Exterior wall - existing renovated**

Advice



Within the scope of the 1st retrofit step of the EnerPHit renovation an additional thermal insulation composite system with 140mm mineral wool (λ= 0,034[W/(mK)) insulation to the already existing 6cm mineral wool insulation was mounted. With this measure the facade is suited for Passive House Standard (U-value= 0.15 W/(m²K)). In addition, sufficient measures were taken for minimized thermal bridges from perimeter to the facade insulation (perimeter: ψ≤ 0,045 W/mK).

Building assemblies (U-values)

Source file: 'PHPP_V9.7_MFH_PRE-CERTIFICATE.xlsm' (PHPP version: 9.7)

EnerPHit Retrofit Plan: Multi-family house, Passive City, AT-Austria

Assembly: **05ud-FD01 + FD02 Inverted roof** Area: 0.0 m²

Areas with this assembly: **Roof_067_H, Roof_073_H, Roof_074_H**

Retrofit step: **1-Existing: 0% Windows 0% Ventilation**

Subarea 1	λ [W/(mK)]	Subarea 2 (optional)	λ [W/(mK)]	Subarea 3 (optional)	λ [W/(mK)]	Thickness [mm]
Interior plaster	0.830					15
STB ceiling	2.300					260
Aerated concrete	0.180					180
XPS Existing	0.040					100
XPS SL-A 036	0.036					0

Fraction subarea 1	Fraction subarea 2	Fraction subarea 3	Total	
100%	0%	0%	**55.5**	cm

U-value supplement: 0 W/(m²K) **U-value: 0.261** W/(m²K)

Retrofit step: **2-1. Step: 65% Windows 25% Ventilation**

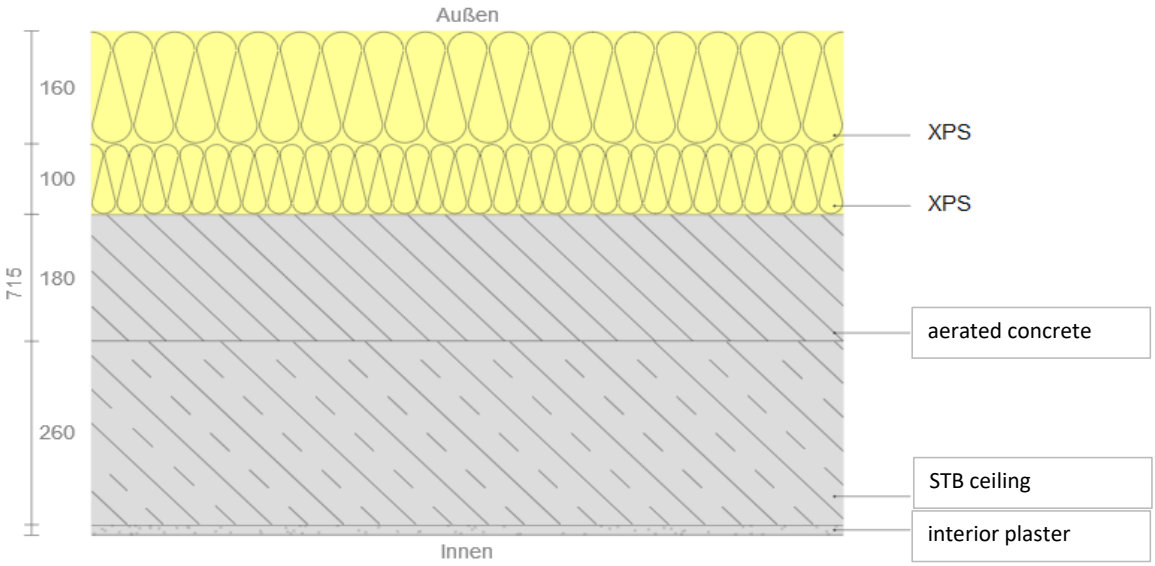
Subarea 1	λ [W/(mK)]	Subarea 2 (optional)	λ [W/(mK)]	Subarea 3 (optional)	λ [W/(mK)]	Thickness [mm]
Interior plaster	0.830					15
STB ceiling	2.300					260
Aerated concrete	0.180					180
XPS Existing	0.040					100
XPS SL-A 036	0.036					160

Fraction subarea 1	Fraction subarea 2	Fraction subarea 3	Total	
100%	0%	0%	**71.5**	cm

U-value supplement: 0 W/(m²K) **U-value: 0.121** W/(m²K)

Assembly: **05ud-FD01 + FD02 Inverted roof**

Advice



Within the scope of the 1st renovation step of the EnerPHit renovation an insulation of 160mm XPS (λ= 0,036[W/(mK)) layer to the already existing 10cm XPS insulation was mounted. With this measure a suitable Passive House Standard assembly could be created (U-value= 0.121 W/(m²K)). In addition, sufficient measures were taken for minimized thermal bridge at eaves of sloped roof (ψ≤ 0,060 W/mK).

Building assemblies (U-values)

Source file: 'PHPP_V9.7_MFH_PRE-CERTIFICATE.xlsm' (PHPP version: 9.7)

EnerPHit Retrofit Plan: Multi-family house, Passive City, AT-Austria

Assembly: **08ud-DD01 Ceiling under flats**

Area: 0.0 m²

Areas with this assembly: **Floor slab_042_D**

Retrofit step: **1-Existing: 0% Windows 0% Ventilation**

Subarea 1	λ [W/(mK)]	Subarea 2 (optional)	λ [W/(mK)]	Subarea 3 (optional)	λ [W/(mK)]	Thickness [mm]
Existing false ceiling	0.352					300

Fraction subarea 1	Fraction subarea 2	Fraction subarea 3	Total	
100%	0%	0%	**30.0**	cm

U-value supplement: 0 W/(m²K) — **U-value:** **0.839** W/(m²K)

Retrofit step: **2-1. Step: 65% Windows 25% Ventilation**

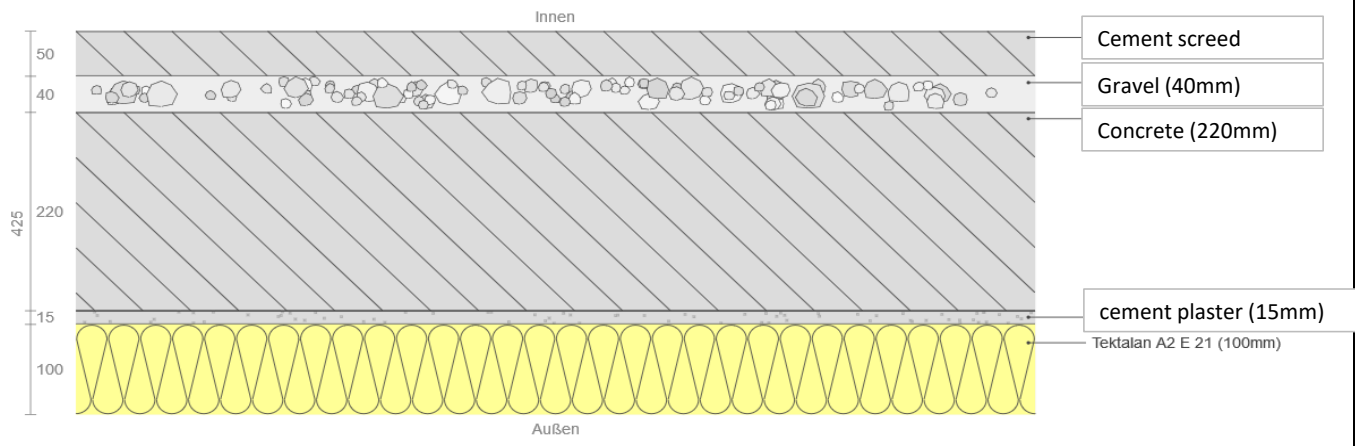
Subarea 1	λ [W/(mK)]	Subarea 2 (optional)	λ [W/(mK)]	Subarea 3 (optional)	λ [W/(mK)]	Thickness [mm]
Existing false ceiling	0.352					300

Fraction subarea 1	Fraction subarea 2	Fraction subarea 3	Total	
100%	0%	0%	**30.0**	cm

U-value supplement: 0 W/(m²K) — **U-value:** **0.839** W/(m²K)

Assembly: **08ud-DD01 Ceiling under flats**

Advice



A fire-restraining insulation with the strength of 100 mm (λ= 0,036[W/(mK)) already exists. Because of the local building legislation concerning too low space height no other insulation can be raised here.
The commercial units in ground floor is heated --> no heat losses.

Window (glazing and frame)

Source file: 'PHPP_V9.7_MFH_PRE-CERTIFICATE.xlsm' (PHPP version: 9.7)

EnerPHit Retrofit Plan: Multi-family house, Passive City, AT-Austria

Window type:	**a-Window big 2004**	Fläche: 0 m²

Retrofit step	Year	Glazing	U_g	Frame	U_f
1-Existing: **0% Windows** **0% Ventilation**	1945	02ud-Glazing 2004	1.20	03ud-Window frame big 2004	1.50

Retrofit step	Year	Glazing	U_g	Frame	U_f
3-2. Step: **100% Windows** **25% Ventilation**	2030	01ud-PH Glazing	0.64	01ud-PH-FRAMES: average thermal quality	1.00

Advice

Plan / sketch / image

These windows were already renewed in 2004. Large windows have been chosen here without division. In the second retrofit step the existing windows (old double glazing) became replaced by window frame constructions and glazings suitable for Passive House Standard. Special attention was placed on minimized thermal bridges concerning window installation situation and the improvement of the daylight situation by sloping lateral reveal.
Frames: highly insulated window frame (Uf value= 1 W/(m²K); ψ glass= 0,04 W/mK)
Glazing: triple low-e glazing (Ug value= 0,64 W/(m²K); g value= 0,50)

Window (glazing and frame)

Source file: 'PHPP_V9.7_MFH_PRE-CERTIFICATE.xlsm' (PHPP version: 9.7)

EnerPHit Retrofit Plan: Multi-family house, Passive City, AT-Austria

Window type:	**b-Window divided 2004**	Fläche: 0 m²

Retrofit step	Year	Glazing	U_g	Frame	U_f
1-Exisitng **0% Windows** **0% Ventilation**	1945	02ud-Glazing 2004	1.20	02ud-window frame divided 2004	1.50

Retrofit step	Year	Glazing	U_g	Frame	U_f
3-2. Step: **100% Windows** **25% Ventilation**	2030	01ud-PH Glazing	0.64	01ud-PH-FRAMES: average thermal quality	1.00

Advice

Plan / sketch / image

These windows were already renewed in 2004. Small windows have been chosen here with division. In the second retrofit step the existing windows (old double glazing) became replaced by window frame constructions and glazings suitable for Passive House Standard. Special attention was placed on minimized thermal bridges concerning window installation situation and the improvement of the daylight situation by sloping lateral reveal.
Frames: highly insulated window frame (Uf value= 1 W/(m²K); ψ glass= 0,04 W/mK)
Glazing: triple low-e glazing (Ug value= 0,64 W/(m²K); g value= 0,50)

Window (glazing and frame)

Source file: 'PHPP_V9.7_MFH_PRE-CERTIFICATE.xlsm' (PHPP version: 9.7)

EnerPHit Retrofit Plan: Multi-family house, Passive City, AT-Austria

Window type:	c-Window 2018	Fläche: 0 m²

Retrofit step	Year	Glazing	U_g	Frame	U_f
1-Exisitng 0% Windows 0% Ventilation	1945	02ud-Glazing 2004	1.20	02ud-window frame divided 2004	1.50

Retrofit step	Year	Glazing	U_g	Frame	U_f
2-1. Step: 65% Windows 25% Ventilation	2018	01ud-PH Glazing	0.64	01ud-PH-FRAMES: average thermal quality	1.00

Advice

Plan / sketch / image

In the 1st retrofit step the existing windows (old double glazing) became replaced by window frame constructions and glazings suitable for Passive House Standard. Special attention was placed on minimized thermal bridges concerning window installation situation and the improvement of the daylight situation by sloping lateral reveal.
Frames: highly insulated window frame (Uf value= 1 W/(m²K); ψ glass= 0,04 W/mK)
Glazing: triple low-e glazing (Ug value= 0,64 W/(m²K); g value= 0,50)

Ventilation systems

Source file: 'PHPP_V9.7_MFH_PRE-CERTIFICATE.xlsm' (PHPP version: 9.7)

EnerPHit Retrofit Plan: Multi-family house, Passive City, AT-Austria

Retrofit step	Year	Ventilation type	Ventilation unit	Heat recovery efficiency	Humidity recovery efficiency	Electric efficiency
1-Exisitng 0% Windows 0% Ventilation	1945	3-nur Fensterlüftung	-	-	-	-

Retrofit step	Year	Ventilation type	Ventilation unit	Heat recovery efficiency	Humidity recovery efficiency	Electric efficiency
2-1. Step: 65% Windows 25% Ventilation	2018	1-Balancierte PH-Lüftung mit WRG	01ud-PICHLER - LG 150 A	0.86	0	0.30

Retrofit step	Year	Ventilation type	Ventilation unit	Heat recovery efficiency	Humidity recovery efficiency	Electric efficiency
4-3. Step: 100% Windows 100% Ventilation	2040	1-Balancierte PH-Lüftung mit WRG	01ud-PICHLER - LG 150 A	0.86	0	0.30

Advice

By means of core drillings the connections installed on the outside wall.

Photovoltaics

Source file: 'PHPP_V9.7_MFH_PRE-CERTIFICATE.xlsm' (PHPP version: 9.7)

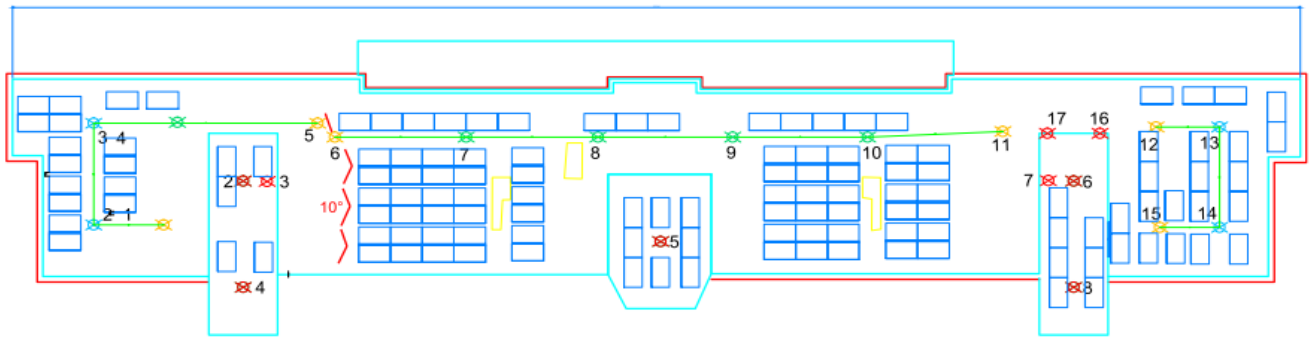
EnerPHit Retrofit Plan: Multi-family house, Passive City, AT-Austria

Step	Technology	Module area [m²]	Location	Annual electricity yield after inverter	
				absolute [kWh/a]	related to projected building footprint area [kWh/(m²projecteda)]
1-Exisitng 0% Windows 0% Ventilation	**Mono-Si**	**221.70**	**Roof**	**36344**	**50.8**

Step	Technology	Module area [m²]	Location	Annual electricity yield after inverter	
				absolute [kWh/a]	related to projected building footprint area [kWh/(m²projecteda)]
2-1. Step: 65% Windows 25% Ventilation	**Mono-Si**	**221.70**	**Roof**	**36344**	**50.8**

Advice Photovoltaics

Plan / sketch / image



The photovoltaik equipment was established according to current state of technology by the local energy supplier and is also pursued by this.

Heating & cooling

Source file: 'PHPP_V9.7_MFH_PRE-CERTIFICATE.xlsm' (PHPP version: 9.7)

EnerPHit Retrofit Plan: Multi-family house, Passive City, AT-Austria

	Retrofit step:	**1-Exisitng 0% Windows 0% Ventilation**		1945	
Heating		**Type**	**Type**	**Heating fraction**	**DHW fraction**
	Primary heat generator	3-District heating, CGS	40-User determined: 90% CHP	100%	0%
	Secondary heat generator	5-Strom direkt	-	0%	100%
Cooling		**used?**	**Seasonal performance factor**		
	Supply air cooling	-	-		
	Recirculatio cooling	-	-		
	Additional dehumidification	-	-		
	Panel Cooling	-	-		

	Retrofit step:	**3-2. Step: 100% Windows 25% Ventilation**		2030	
Heating		**Type**	**Type**	**Heating fraction**	**DHW fraction**
	Primary heat generator	3-District heating, CGS	40-User determined: 90% CHP	100%	0%
	Secondary heat generator	5-Direct electricity	-	0%	100%
Cooling		**used?**	**Seasonal performance factor**		
	Supply air cooling	-	-		
	Recirculatio cooling	-	-		
	Additional dehumidification	-	-		
	Panel Cooling	-	-		

Advice Heating & cooling
Plan / sketch / image
The supply of space heating is provided by district heating. No plans to change the heating system in the near future.