EuroPHit

Built examples and project certification

Zeno Bastian, Passive House Institute

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Passive House Standard for Retrofits?

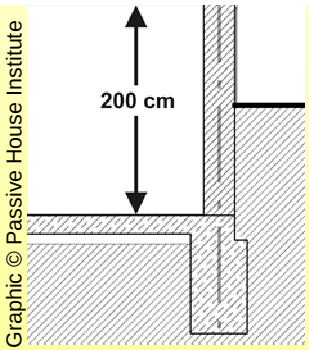
EuroPHit

Shape

Thermal Bridges

Airtightness

Window orientation



Not enough space for insulation

Cultural heritage protection

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Retrofit: Component Requirements

EuroPHit

Economics

Building physics

CO_2 reduction

Thermal comfort

Health

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Advantages

- Thermal comfort ✓ warm surfaces, no drafts
- No mould growth ✓ warm surfaces, secure moisture removal
- Constantly fresh air ✓ reliable air exchange
- CO_2 emission reduction ✓ up to 90 % reduction in heating demand

AND

- **Financial profit** ✓ **1 m² wall insulation**

⇒ 5 - 10 € net profit per year

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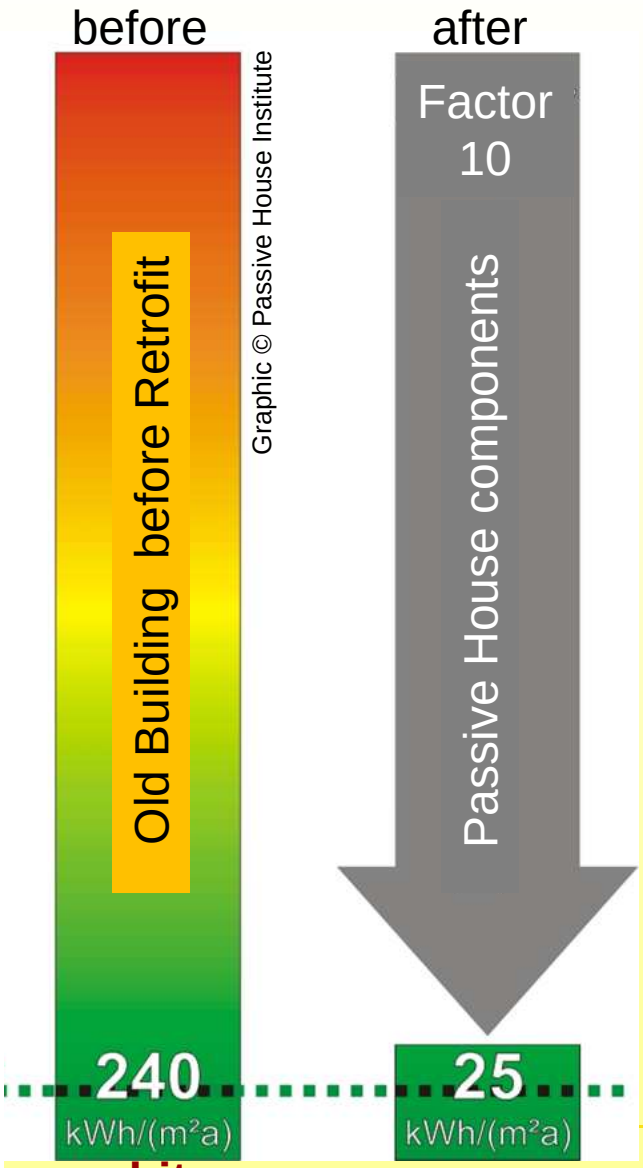
Retrofit with Passive House Components

EuroPHit

Typical heating demand in Central-European climate



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EnerPHit

Certified Retrofit

Passive House Institute

| classic | plus | premium |

EnerPHit Standard

- Guideline and incentive for an optimal efficiency standard for retrofits
- Certification as quality assurance for building owners

„Energy Retrofit with Passive House Components“

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Energy standards in PHI's certification scheme:

Passive House buildings are characterised by especially high levels of indoor comfort with minimum energy consumption. The Passive House Standard offers excellent economic efficiency especially for new builds.

The Passive House Classes Classic, Plus or Premium can be achieved depending on the use of renewable energy sources

EnerPHit is the established Standard for refurbishment of existing buildings using Passive House components. Despite the slightly higher energy demand, it offers virtually all the advantages of the Passive House Standard.

The EnerPHit Classes Classic, Plus or Premium can be achieved depending on the use of renewable energy sources

The PHI Low Energy Building Standard is suitable for new builds which for various reasons do not fully comply with the more ambitious Passive House criteria.

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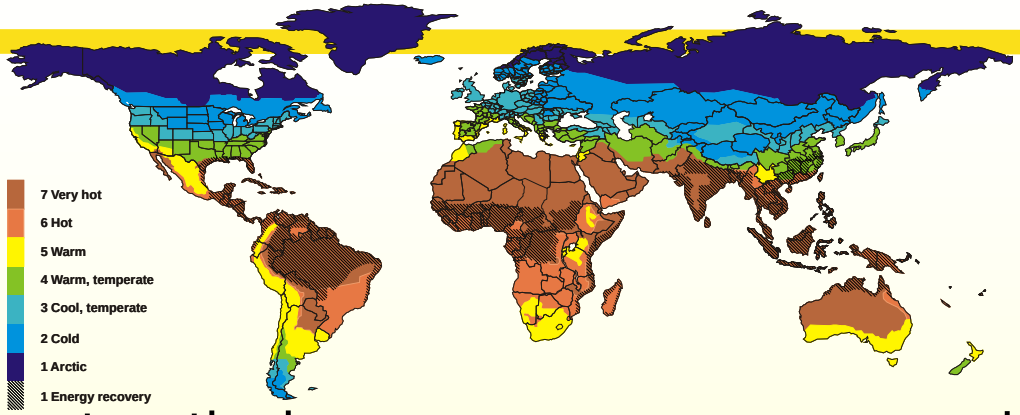
International EnerPHit criteria

EuroPHit



building component method:

Climate Zone according to PHPP	Opaque envelope[1] against...				Windows (including exterior doors)					Ventilation	
	...ground	...ambient air			Overall[4]			Glazing	Solar load[5]		
	Insu-lation	Exterior insulation	Interior in-sulation[2]	Exterior paint[3]	Max. heat transfer coefficient ($U_{D/W,installed}$)			Solar heat gain coefficient (g-value), only if active heating present	Max. specific solar load during cooling period	Min. heat reco-very rate[6]	Min. hu-midity re covery rate[7]
	Max. heat transfer coefficient (U-value)			Cool colours							
	[W/(m²K)]			-	[W/(m²K)]			-	[kWh/m²a]	%	
											
Arctic	Deter-mined in PHPP from project specific heating and cooling degree days against ground.	0.09	0.25	-	0,45	0,50	0,60	U_g - g*0.7 ≤ 0	100	80%	-
Cold		0.12	0.30	-	0,65	0,70	0,80	U_g - g*1.0 ≤ 0		80%	-
Cool-temperate		0.15	0.35	-	0,85	1,00	1,10	U_g - g*1.6 ≤ 0		75%	-
Warm-temperate		0,30	0,50	-	1,05	1,10	1,20	U_g - g*2.8 ≤ -1		75%	-
Warm		0.50	0.75	-	1,25	1,30	1,40	-		-	-
Hot		0.50	0.75	Yes	1,25	1,30	1,40	-		-	60 % (humid climate)
Very hot		0.25	0.45	Yes	1,05	1,10	1,20	-		-	60 % (humid climate)

or alternatively, energy demand method:

Climate Zone according to PHPP	Heating	Cooling
	Max. heating demand	Max. cooling + dehumidification demand
	[kWh/(m²a)]	[kWh/(m²a)]
Arctic	35	equal to Passive House requirement
Cold	30	
Cool-temperate	25	
Warm-temperate	20	
Warm	15	
Hot	-	
Very hot	-	

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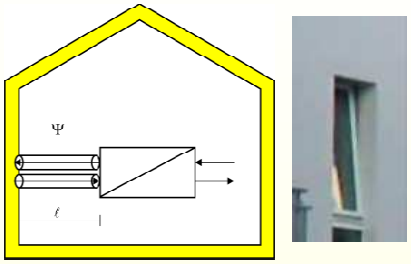
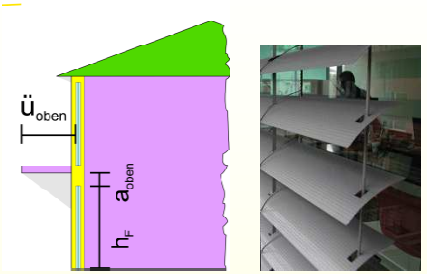
Component requirements for cost optimal buildings

EuroPHit

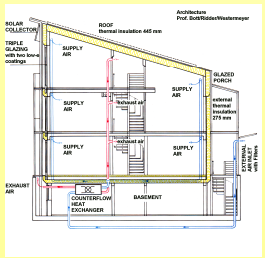




4 x **10 x** **5 x**

Degree Days
HGT/KGT

⇒



⇒

⇒

Cost-optimized building

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EnerPHit-certified house in New York City

EuroPHit

Listed building renovated to EnerPHit standard

- From the early 1900s in Brooklyn
- Interior insulation at the front wall

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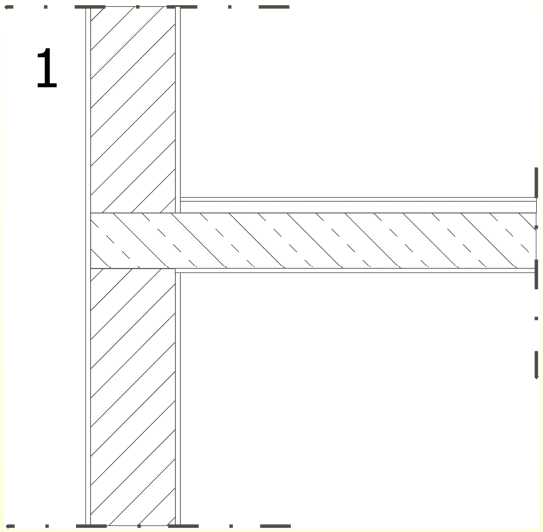
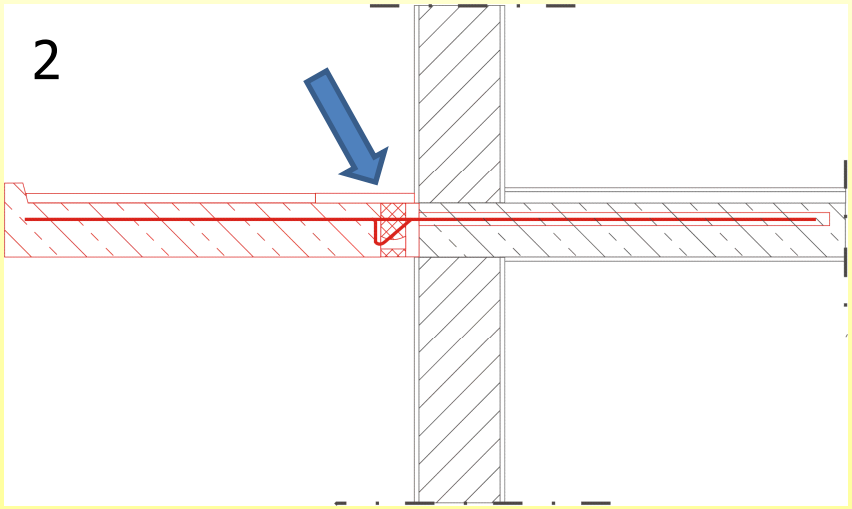
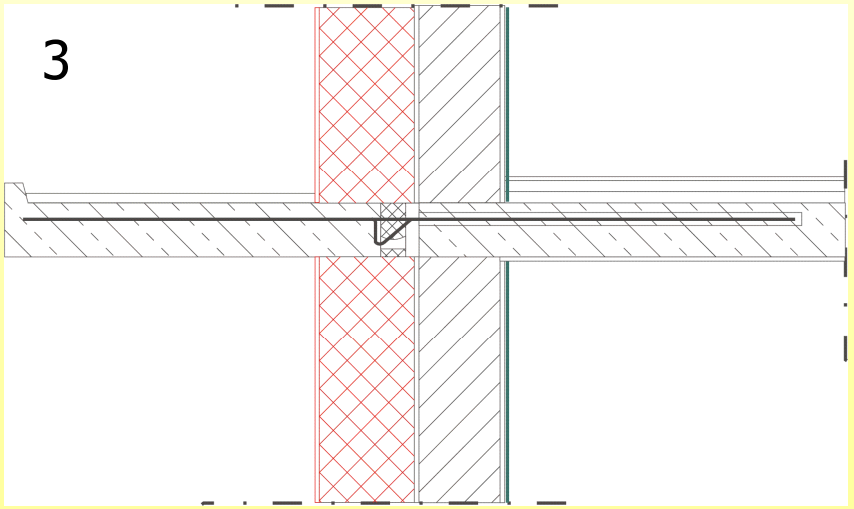
Special issues in stepwise retrofits

EuroPHit



When doing one step, you sometimes should already think of the next one.





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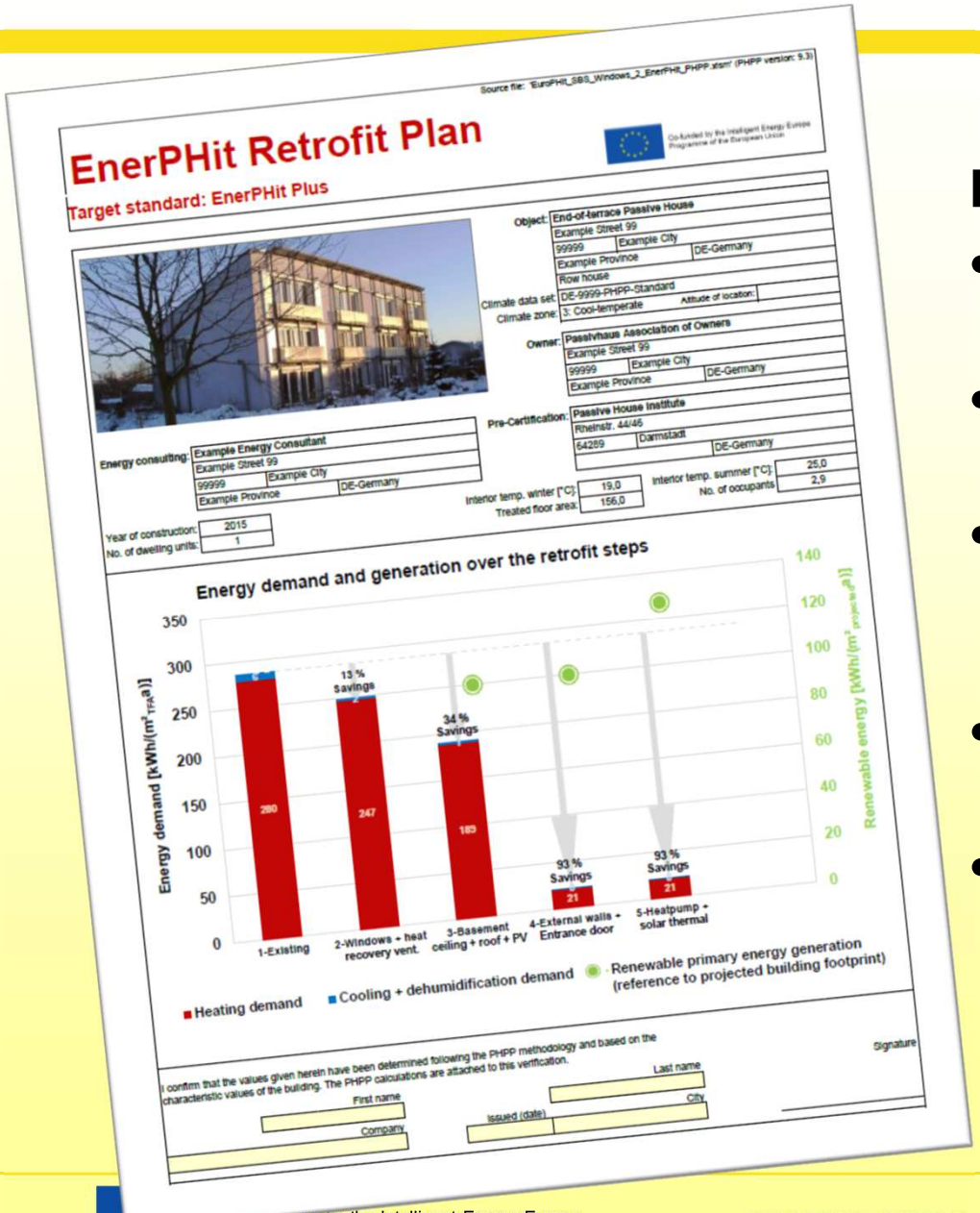
Stepwise Retrofit with EnerPHit Retrofit Plan

EuroPHit



EnerPHit Retrofit Plan clarifies:

- Order of energy efficiency measures
- Energy efficiency level of all measures
- Basic principles for airtightness and thermal bridge reduced insulation
- Interdependencies between different measures
- Investment costs and cost effectiveness

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Defining packages of retrofit measures

EuroPHit

Scheduler

Source file: 'EuroPHit_SBS_Windows_2_EnerPHit_PHPP.xlsm' (PHPP version: 9.3)

EnerPHit Retrofit Plan: End-of-terrace Passive House, Example City, DE-Germany

Retrofit steps:														1	2		3			4		5			
Assemblies	Last renewal	1960	1965	1970	1975	1980	1985	1990	1995	2000	2005	2010	2015	2016	2017	2020	2022	2025	2030	2032	2035	2037	2040	2045	2050
Render facade	1966																			X					
Facade decoration	1966																			X					
Balconies/Loggias	1966																			X					
Exterior door	1987																			X					
Pitched roof covering	1966																X								
Flat roof																									
Roof weatherings	1987																X								
Windows	1966														X										
Blinds / sun screens	1966														X										
Basement ceiling	2022																X								
Boiler	2015																					X			
Ventilation	2017														X										
Solar thermal system	2035																					X			
Airtightn. test: X, Leakage search: (X)															(X)		(X)		X						

Initial condition | Main-tenance | Extensive Repairs

X Retrofit dates | Smaller Repairs | Immediate replacement

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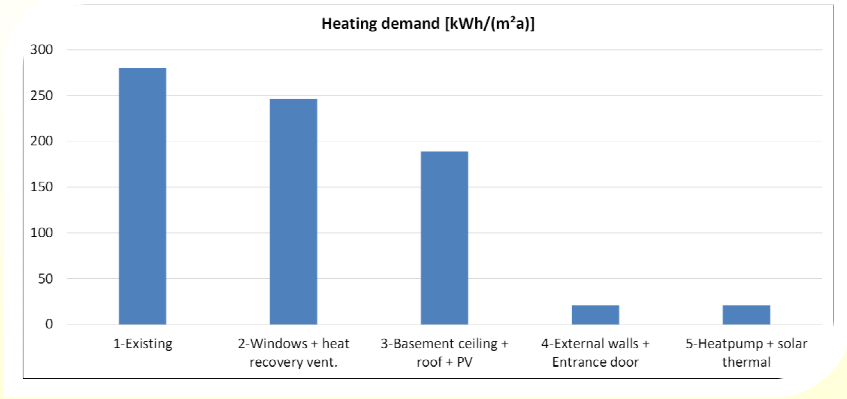
Entering all steps in the Passive House Planning Package (PHPP)

EuroPHit



Select the active variant here >>>>>>>		Active: 1-Existing	Existing	Windows + heat recovery vent.	Basement ceiling + roof + PV	External walls + Entrance door	Heatpump + solar thermal
	Units	1	1	2	3	4	5
Heating demand	kWh/(m²a)	246,7	279,7	246,7	189,0	20,6	20,6
Heating load	W/m²	100,0	129,2	100,0	79,8	15,6	15,6
Cooling & dehum. demand	kWh/(m²a)	2,3	6,2	2,3	1,1	0,3	0,1
Cooling load	W/m²	18,2	31,9	18,2	12,8	5,8	4,0
Frequency of overheating (> 25 °C)	%						
PER demand	kWh/(m²a)	770,4	855,8	770,4	624,9	203,0	36,7
EnerPHit Plus?	yes / no	no	no	no	no	no	yes

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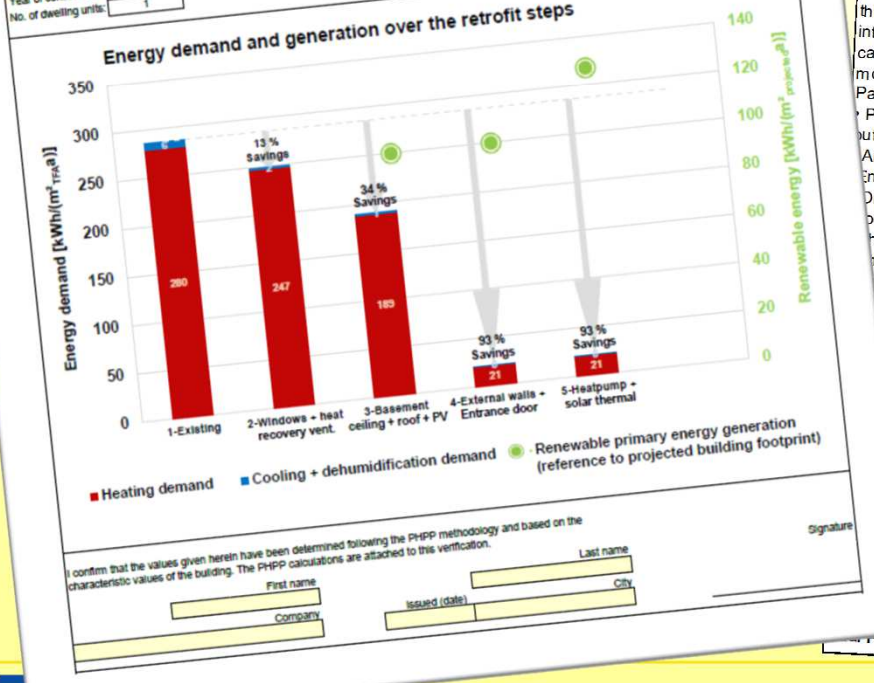
EnerPHit Retrofit Plan as output of PHPP

EuroPHit

EnerPHit Retrofit Plan

Target standard: EnerPHit Plus

Object: End-of-terrace Passive House
Example Street 99
99999 Example City
Example Province DE-Germany
Row house
Climate data set: DE-9999-PHPP-Standard
Climate zone: 3: Cool-temperate Altitude of location:
Owner: Passivhaus Association of Owners
Example Street 99
99999 Example City
Example Province DE-Germany
Pre-Certification: Passive House Institute
Rheinstr. 44/46
64289 Darmstadt
DE-Germany
Energy consulting: Example Energy Consultant
Example Street 99
99999 Example City
Example Province DE-Germany
Year of construction: 2015
No. of dwelling units: 1
Interior temp. winter [°C]: 19,0
Treated floor area: 156,0
Interior temp. summer [°C]: 25,0
No. of occupants: 2,9



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
Company City
Issued (date) Signature

Dear building owner,

31.6.2016

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 reliable aid for personal finance planning.

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 well calculated way. Apart from that, you can demonstrate to the outside world that you are committed to climate protection.

We wish you every success with your retrofit project!

Your Passive House Institute

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Overview of all measures and costs

EuroPHit

Overview of measures

Source file: 'EuroPHit_SBS_Windows_2_EnerPHit_PHPP.xlsm' (PHPP version: 9.3)

EnerPHit Retrofit Plan: End-of-terrace Passive House, Example City, DE-Germany

								Criteria	Alternative criteria
Retrofit step No.		1-Existing	2-Windows + heat recovery vent.	3-Basement ceiling + roof + PV	4-External walls + Entrance door	5-Heatpump + solar thermal			
Year		until 2016	2017	2022	ca 2027	ca 2037			
Measures									
Occasion ("anyway measure")	a		Window replacement	none	Exterior wall - new render	Boiler - replacement			
Energy-saving measure			Passive House windows	Basement ceiling: Insulation	Exterior wall - insulation	Heat pump			
Occasion ("anyway measure")	b		Extract air system	Roof - new covering	Ext. door - replacement	Hot water storage tank replacement			
Energy-saving measure			Heat recovery ventilation	Roof - insulation + PV system	Passive House door	Solar thermal system + stratified storage tank			
Component characteristics									
Wall to ambient air, ext. insulation (U-value)	[W/(m²K)]	1,87	1,87	1,87	0,15	0,15			
Roof (U-value)	[W/(m²K)]	1,27	1,27	0,13	0,14	0,14			
Building envelope to ambient (U value)	[W/(m²K)]	1,68	1,68	1,33	0,15	0,15		0,15	-
Basement ceiling / floor slab (U-value)	[W/(m²K)]	0,72	0,72	0,26	0,26	0,26			
Building envelope to ground (U-value)	[W/(m²K)]	0,72	0,72	0,26	0,26	0,26		0,29	-
Windows / doors ($U_{installed}$)	[W/(m²K)]	2,71	1,09	1,09	0,82	0,82		0,85	-
Glazing (g-value)	[]	0,75	0,55	0,55	0,52	0,52		0,39	-
Glazing/sun protection (max. solar load)	[kWh/(m²a)]	404	216	197	85	23		-	-
Ventilation (effective heat recovery efficiency)	[%]	0	77	77	77	77		75	-
Airchange at press. test n_{50}	[1/h]	5,0	1,0	1,0	1,0	1,0		1,0	-
Building characteristics									
Heating demand	[kWh/(m²a)]	280	247	189	21	21		-	-
Heating load	[W/m²]	129	100	80	16	16		-	-
Cooling + dehumidification demand	[kWh/(m²a)]	6	2	1	0	0		-	-
Cooling load	[kWh/(m²a)]	32	18	13	6	4		-	-
Non-renewable primary energy (PE demand)	[kWh/(m²a)]	451	408	337	132	65		-	-
Renewable primary energy (PER demand)	[kWh/(m²a)]	856	770	625	203	37		51	37
Renewable primary energy generation (reference to projected building footprint)	[kWh/(m²a)]	0	0	100	100	127		60	33
Criteria fulfilled for EnerPHit Plus?		no	no	no	no	yes			
Annual energy-related costs									
Energy-related invest. (interest+repayment)	[€/year]	0	310	502	976	1284			
Expected energy costs (total of all energy use in the building)	[€/year]	5900	5360	4440	1810	1060			
Total costs	**[€/year]**	**5900**	**5670**	**4942**	**2786**	**2344**			

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Detailed overview of all investment costs and annuities

EuroPHit

Investment and maintenance costs

Source file: 'EuroPHit_SBS_Windows_2_EnerPHit_PHPP.xlsm' (PHPP version: 9.3)

EnerPHit Retrofit Plan: End-of-terrace Passive House, Example City, DE-Germany

	Retrofit step No.	1-Existing	2-Windows + heat recovery vent.	3-Basement ceiling + roof + PV	4-External walls + Entrance door	5-Heatpump + solar thermal	
	Year	until 2016	2017	2022	ca 2027	ca 2037	
a	**Occasion ("anyway measure")**		**Window replacement**	**none**	**Exterior wall - new render**	**Boiler - replacement**	
	Investment costs		**11.180 €**	**0 €**	**6.440 €**	**12.000 €**	
	Maintenance costs		**0 €**	**0 €**	**0 €**	**320 €**	
	Energy-saving measure		**Passive House windows**	**Basement ceiling: Insulation**	**Exterior wall - insulation**	**Heat pump**	
	Investment costs		**16.770 €**	**2.160 €**	**23.920 €**	**16.000 €**	
	Financial support (present value)		**2.000 €**	**400 €**	**3.000 €**	**2.000 €**	
	Maintenance costs		**0 €**	**0 €**	**0 €**	**100 €**	
	Service life [years]		**40**	**50**	**50**	**20**	
	Annuity (energy related only)	**0 €**	**131 €**	**56 €**	**459 €**	**-98 €**	**0 €**
b	**Occasion ("anyway measure")**		**Extract air system**	**Roof - new covering**	**Ext. door - replacement**	**Hot water storage tank replacement**	
	Investment costs		**4.680 €**	**5.810 €**	**1.000 €**	**1.000 €**	
	Maintenance costs		**50 €**	**0 €**	**0 €**	**0 €**	
	Energy-saving measure		**Heat recovery ventilation**	**Roof - insulation + PV system**	**Passive House door**	**Solar thermal system + stratified storage tank**	
	Investment costs		**8.580 €**	**11.620 €**	**1.600 €**	**7.500 €**	
	Financial support (present value)		**1.000 €**	**1.500 €**	**200 €**	**1.000 €**	
	Maintenance costs		**100 €**	**0 €**	**0 €**	**70 €**	
	Service life [years]		**30**	**50**	**40**	**20**	
	Annuity (energy related only)	**0 €**	**179 €**	**137 €**	**15 €**	**406 €**	**0 €**
	Total Invest. costs (annual interest+repayment) [€/a]						
	Total (incl. previous steps)	**0 €**	**976 €**	**1.352 €**	**2.066 €**	**3.487 €**	**3.487 €**
	Energy related (incl. previous steps)	**0 €**	**310 €**	**502 €**	**976 €**	**1.284 €**	**1.284 €**

dary conditions	Interest rate and inflation:	Nominal interest rate	3,0%	Inflation	1,0%	Real interest rate	2,0%
	average energy price (during service life):	Electricity	0,25 €	Natural gas / Oil	0,09 €	Wood	0,07 €

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Description an advice for all components

EuroPHit

Window (glazing and frame)

Source file: 'EuroPHit_SBS_Windows_2_EnerPHit_PHPP.xlsm' (PHPP version: 9.3)

EnerPHit Retrofit Plan: End-of-terrace Passive House, Example City, DE-Germany

Window type:	a-Opening casement 1	Fläche: 30,4192 m²

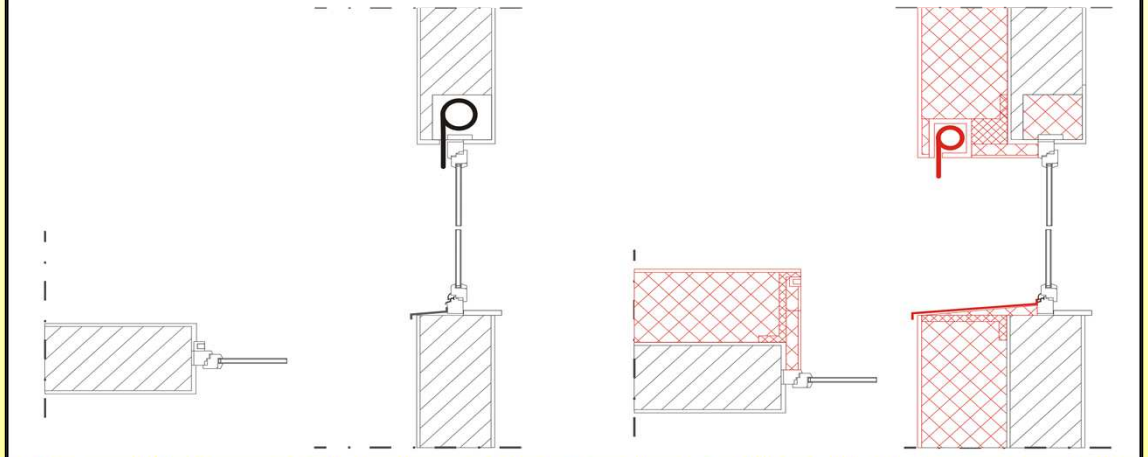
Retrofit step	Year	Glazing	U_g	Frame	U_f
1-Existing	until 2016	93ud-Double glazing 4/12mm air /4	2,9	53ud-EXISTING: timber 45 mm	2,5

Retrofit step	Year	Glazing	U_g	Frame	U_f
2-Windows + heat recovery vent.	2017	09ud-EnerPHit window	0,63	09ud-EnerPHit window	0,9

preparation for subsequent steps:

1-THERMAL INSULATION ON THE OUTSIDE	Prepare for subsequent thermal bridge minimised connection of the wall insulation
6-ROOF TERRACE INSULATION	Set the French window threshold high enough so that later insulation of the roof terrace will be possible
7-BASEMENT CEILING/FLOOR SLAB INSULATION	The installation position of casement windows and doors in the basement should leave enough head room to allow for opening the window/door, even if insulation under the basement ceiling is installed later on -- or thresholds of french windows should be high enough to allow for subsequent installation of insulation above the basement ceiling
8-PERIMETER INSULATION	In case of a "heated" basement, prepare for subsequent thermal bridge minimised connection to perimeter insulation
10-BOILER	If necessary, decrease the forward flow temperature
11-RADIATORS AND DISTRIBUTION	With Passive House suitable windows, the heaters can be placed anywhere (e.g. next to interior walls).
12-VENTILATION SYSTEM	To avoid mould formation, a ventilation system should be installed at the same time, in case sufficient ventilation (4 times a day) via windows is not possible

Advice



Vor Anbringung der Wanddämmung wird ein Montagerahmen aus hochfestem Dämmstoff vor der Fensterleibung installiert. Die Dämmung wird von außen bis an den Rahmen geführt. Fensterseitig wird ein zweiteiliger Dämmstoffstreifen an den Montagerahmen geklebt, der die Außenleibung bedeckt und den vorhandenen Rahmen überdämmt. Am Stoß der zwei Dämmstoffstreifen-Teile wird schon ein Anputzprofil eingearbeitet. Für den Zwischenzustand gewährleistet das Detail eine schimmelfreie Innenleibung. Die ungünstige Fensterposition verursacht aber noch relativ hohe Wärmeverluste. Neben der unschönen Optik beeinträchtigt die tiefe Außenleibung auch die winterliche Nutzung der Sonneneinstrahlung.

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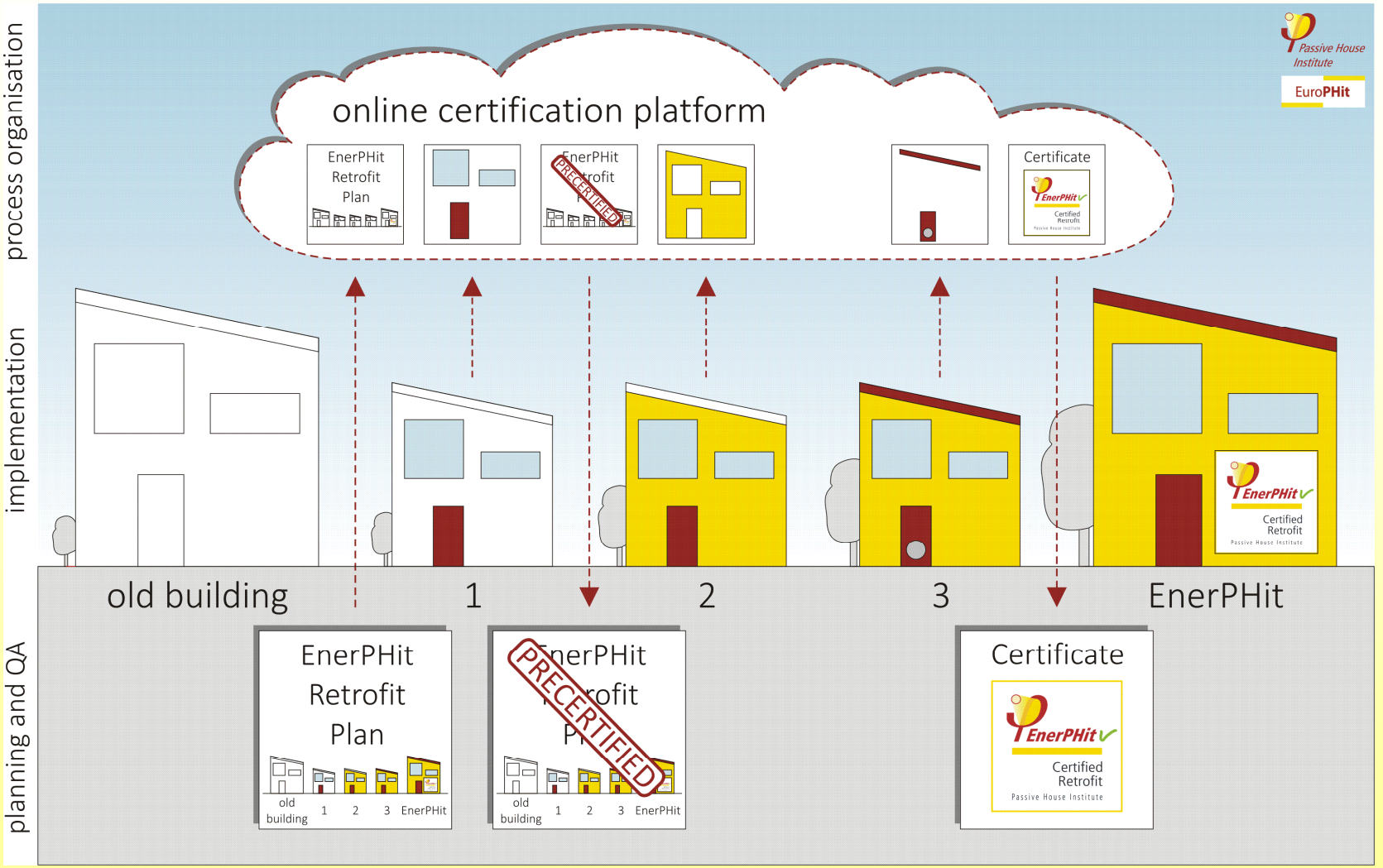
Pre-certification for stepwise retrofit

EuroPHit



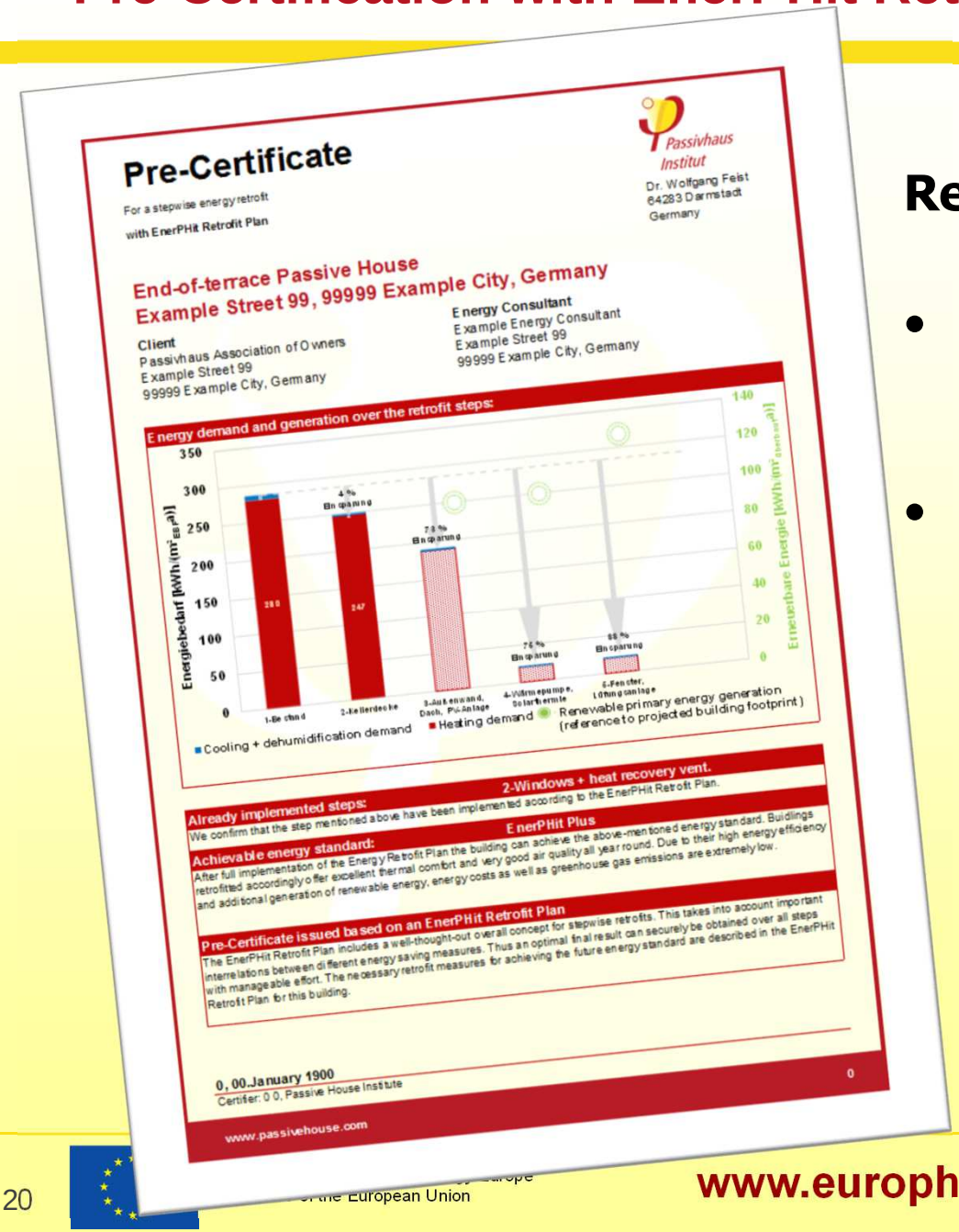
Co-funded by the Intelligent Energy Europe Programme of the European Union

www.europhit.eu

Passive House Institute

Pre-Certification with EnerPHit Retrofit Plan

EuroPHit



Pre-Certificate

For a stepwise energy retrofit
with EnerPHit Retrofit Plan

Passivhaus Institut
Dr. Wolfgang Feist
64283 Darmstadt
Germany

End-of-terrace Passive House
Example Street 99, 99999 Example City, Germany

Client
Passivhaus Association of Owners
Example Street 99
99999 Example City, Germany

Energy Consultant
Example Energy Consultant
Example Street 99
99999 Example City, Germany

Energy demand and generation over the retrofit steps:

Already implemented steps:
2-Windows + heat recovery vent.
We confirm that the step mentioned above have been implemented according to the EnerPHit Retrofit Plan.

Achievable energy standard:
EnerPHit Plus
After full implementation of the Energy Retrofit Plan the building can achieve the above-mentioned energy standard. Buildings retrofitted accordingly offer excellent thermal comfort and very good air quality all year round. Due to their high energy efficiency and additional generation of renewable energy, energy costs as well as greenhouse gas emissions are extremely low.

Pre-Certificate issued based on an EnerPHit Retrofit Plan
The EnerPHit Retrofit Plan includes a well-thought-out overall concept for stepwise retrofits. This takes into account important interrelations between different energy saving measures. Thus an optimal final result can securely be obtained over all steps with manageable effort. The necessary retrofit measures for achieving the future energy standard are described in the EnerPHit Retrofit Plan for this building.

0, 00.January 1900
Certifier: 0 0, Passive House Institute

www.passivehouse.com

Requirements for pre-certification:

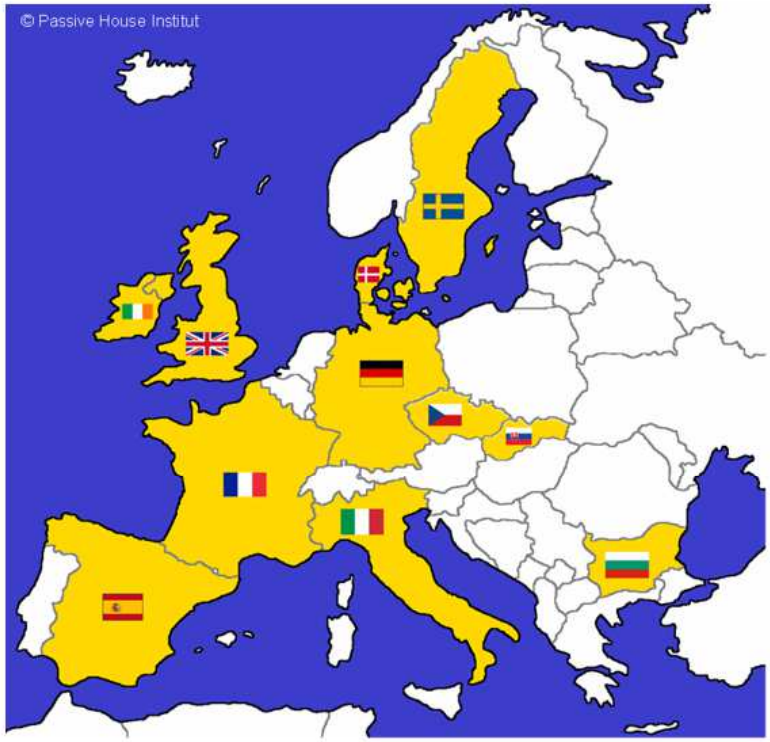
- Complete EnerPHit Retrofit Plan shows that EnerPHit standard can be achieved
- First step is implemented according to the plan

Passive House Institute

EuroPHit

Thank you for your attention

www.europhit.eu



Coordinator:

Passive House Institute

Project Partners:

La Maison Passive France

Passivhus.dk

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Plataforma Edificación Passivhaus

International Passive House Association

IG PH Passivhus

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