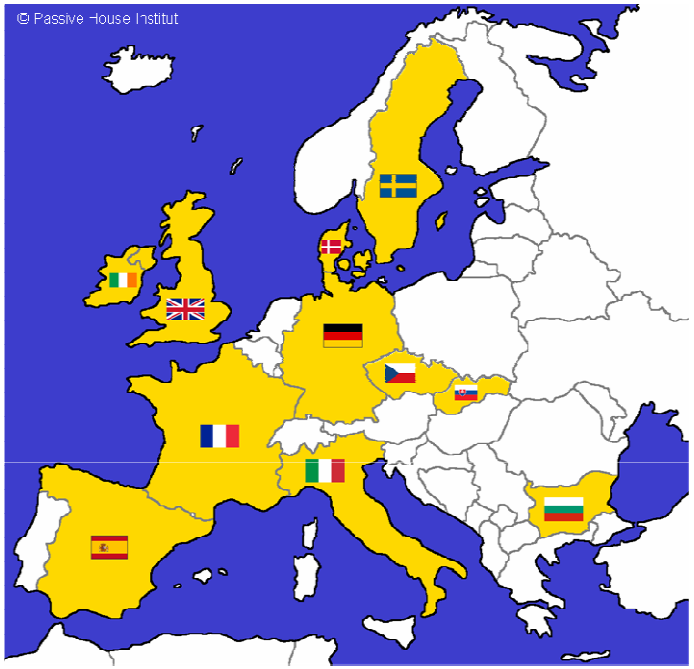
EuroPHit

Trans-European EnerPHit Case Studies Lead the Way

Tomás O'Leary and
Mariana Moreira

MosArt and Passive House Academy

www.europhit.eu



Coordinator:

Project Partners:

Supporters:

Reduce Energy Consumption!

EuroPHit

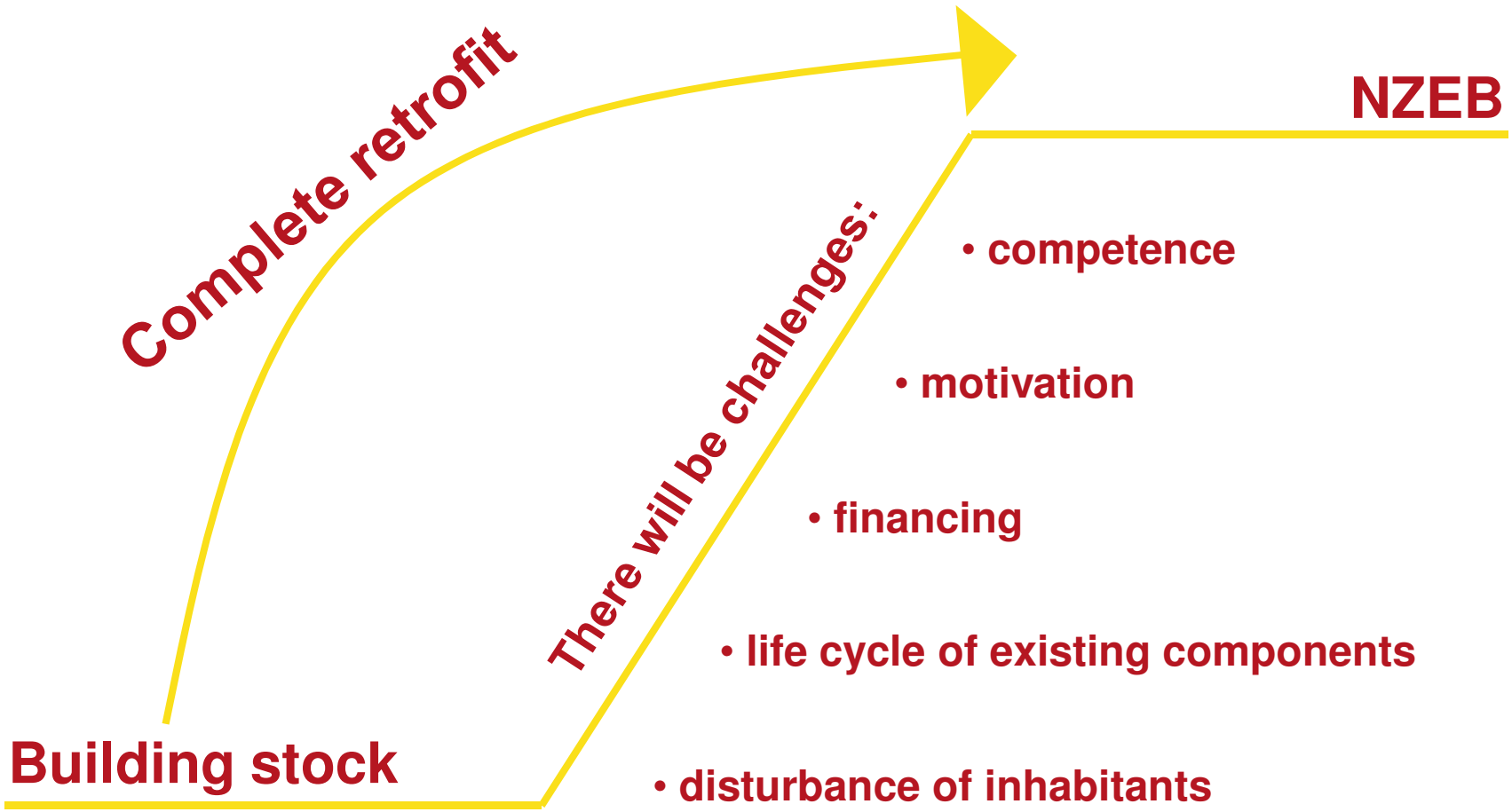
EU's 2020 objective:

All new/refurbished buildings as NZEBs (Nearly Zero Energy Buildings)

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

All At Once?

EuroPHit



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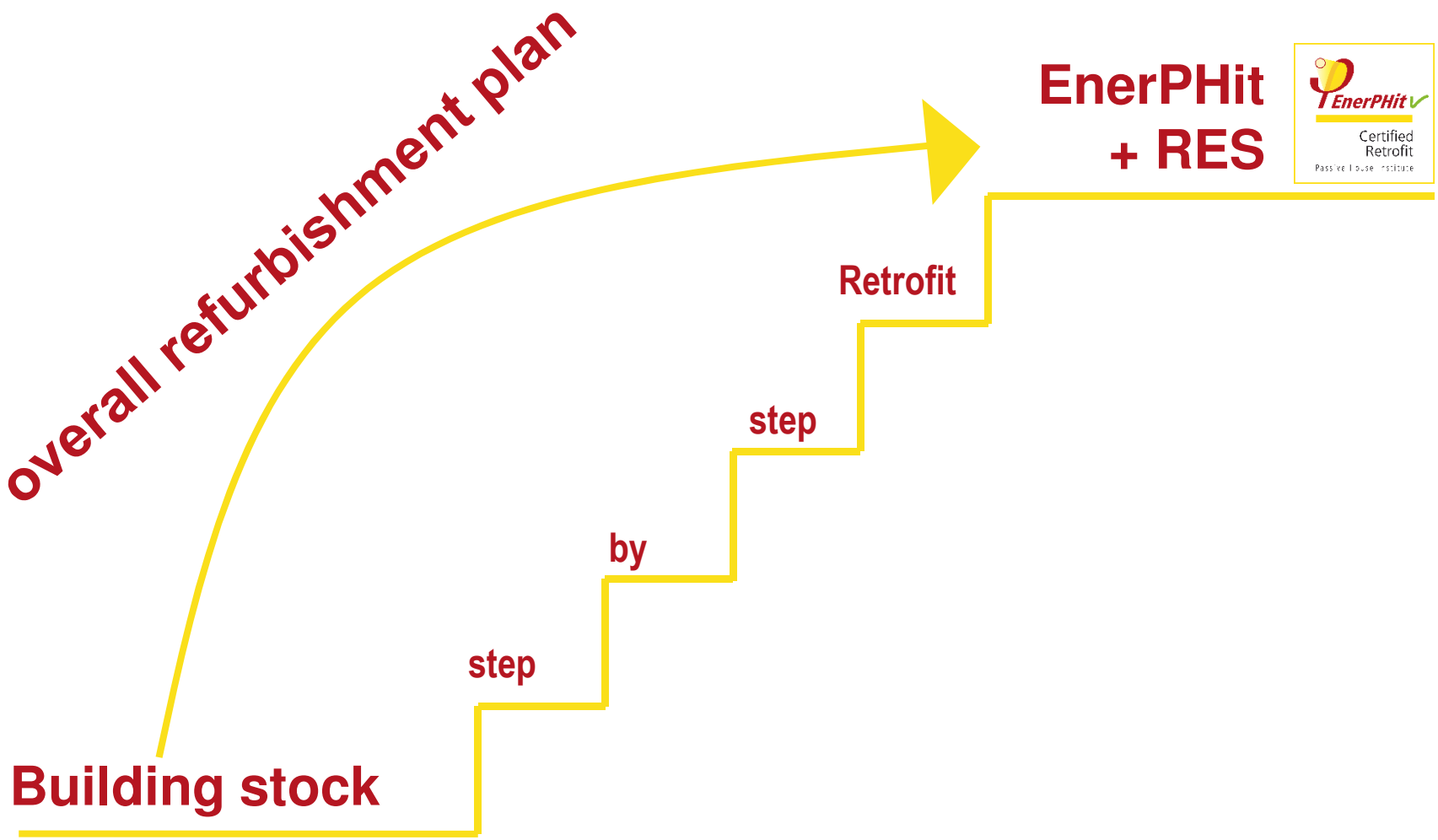
...Or Step By Step

EuroPHit



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Programme of the European Union

We Have Been Warned!

EuroPHit

Diana Ürge-Vorsatz

Lead Author, IPCC, Central European University

- ***Shallow retrofits** need to be **avoided***
- ***"Wait out"** for deep, systemic retrofit*
- *Need to **revisit support schemes** around shallow retrofits!*

Way too thin!

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Typical Retrofitter Questions:

EuroPHit

- **How far** should I go?
- What should I do **first**?
- Does it make **financial** sense?
- Where can I get expert **know-how**?
- Is there step by step **guidance**?
- Latest innovative **products**?

EuroPHit aims to provide the answers!

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The 9-Step EnerPHit Journey

EuroPHit

Design

1. Model existing and retrofit steps in PHPP → 2. Determine Economic Feasibility in PHPP → 3. Prepare Phased Refurbishment Plan and Source Finance

Detail

4. Select Suitable Products → 5. Develop Step-by-Step Construction Details → 6. Prepare Tendering Documents

Deliver

7. Select Trained Builders → 8. Implement retrofit – step by step if needed → 9. Certify or Pre-certify Project to EnerPHit

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Case Study Projects

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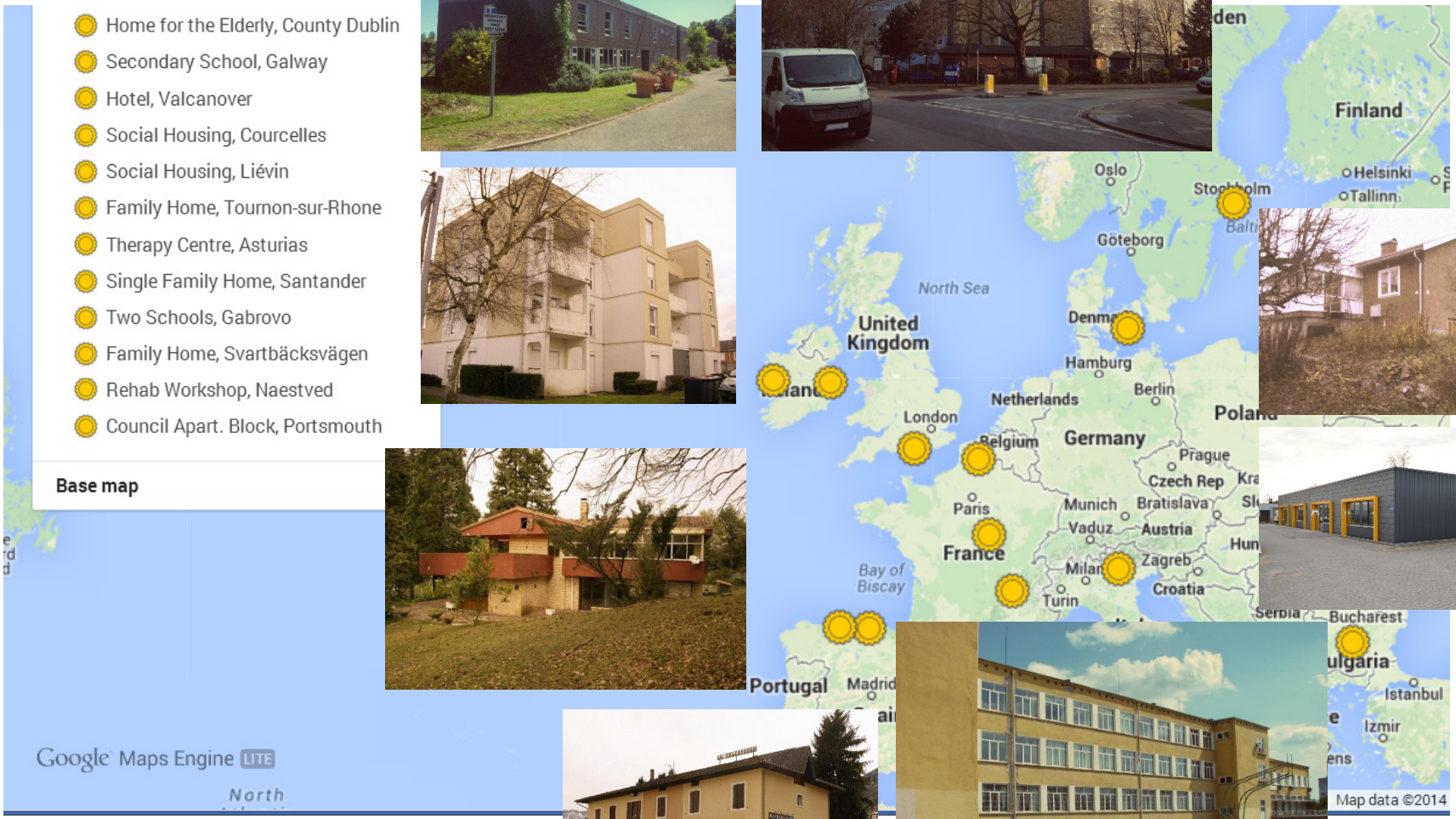

www.europhit.eu/projects

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Case Study Overview

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Total floor area = 25,000 m²

Committed budget = €18.5 m

Residential

- 3 single family homes
- 4 multi-unit social housing

Non-Domestic

- 3 schools
- 1 hotel & restaurant
- 2 therapy and rehab

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1.Model Retrofit in PHPP Version 9

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Test all kinds of combinations to see what works for your project

Seriously Cool Tool

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Compare Individual Retrofit Measures

EuroPHit

CALCULATION OF VARIANTS

			2013
		Active	
		1-1: Existant	Existing
select active variants >>			
Results	**Units**	1	1
Annual Heating Demand	kwh/(m²a)	**92**	92
Heating Load	W/m²	**38.6**	38.6
Overall specific space cooling demand	kwh/(m²a)		
Cooling load	W/m²		
Frequency of overheating	%	**0.0**	0.0
Primary energy demand	kwh/(m²a)	**396**	396
Certifiable as EnerPHit?	yes / no	**non**	no

EnerPHit Certified Retrofit Passive House Institute

LAMP

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PHA Passive House Academy

MosArt

Step by Step towards EnerPHit

EuroPHit

LAMP

EnerPHit Certified Retrofit

Future = 12 kWh/m².yr

3.8 kBTU/ft².yr

Retrofit

step

by

step

Existing = 92 kWh/m².yr

291 kBTU/ft².yr

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www.europhit.eu

PHA Passive House Academy

MosArt

Heating Demand & Heat Load Reduction

EuroPHit

EnerPHit verification

Building: Hotel Restaurant Valcanover
Street:
Postcode/City:
Country: Italy
Building type: Masonry construction
Climate: Pergine
Altitude of building site (in [m] above sea level): 459
Home owner/client:
Street:
Postcode/City:
Architecture:
Street:
Postcode/City:
Mechanical System:
Street:
Postcode/City:
Energy consulting: ZEPHIR
Street:
Postcode/City: Pergine Valsugana
Certification:
Street:
Postcode/City:
Year of Construction: 1928
Number of dwelling units: 1
Number of Occupants: 37.0
Exterior vol. V_e: 2948.8 m³
Interior temperature winter [C°]: 20.0
Internal heat gains winter [W/m²]: 9.4
Interior temp. summer [C°]: 25.0
IHG summer [W/m²]: 9.9
Spec. capacity [Wh/K per m² TFA]: 204
Mechanical cooling: x

Specific building demands with reference to the treated floor area

Treated floor area: 584.6 m²

			Requirements	Fulfilled?*
Space heating	Annual heating demand	269 kWh/(m²a)	25 kWh/(m²a)	no
	Heating load	128 W/m²	-	-
Space cooling	Overall specific space cooling demand	4 kWh/(m²a)	-	-
	Cooling load	13 W/m²	-	-
	Frequency of overheating (> 25 °C)	%	-	-
Primary Energy	Heating, cooling, dehumidifying, DHW,	868 kWh/(m²a)	425 kWh/(m²a)	no
	DHW, space heating and auxiliary electricity	445 kWh/(m²a)	-	-
	Specific primary energy reduction through solar electricity	kWh/(m²a)	-	-
Airtightness	Pressurization test result n_{50}	10.0 1/h	1 1/h	no

* empty field: data missing; - no requirement

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

EnerPHit building retrofit (acc. to heating demand)? no

Name: Company: Registration number PHPP:
Surname: Issued on:
Signature

EnerPHit verification

Building: Hotel Restaurant Valcanover
Street:
Postcode/City:
Country: Italy
Building type: Masonry construction
Climate: Pergine
Altitude of building site (in [m] above sea level): 459
Home owner/client:
Street:
Postcode/City:
Architecture:
Street:
Postcode/City:
Mechanical System:
Street:
Postcode/City:
Energy consulting: ZEPHIR
Street:
Postcode/City: Pergine Valsugana
Certification:
Street:
Postcode/City:
Year of Construction: 1928
Number of dwelling units: 1
Number of Occupants: 37.0
Exterior vol. V_e: 3281.5 m³
Interior temperature winter [C°]: 20.0
Internal heat gains winter [W/m²]: 9.4
Interior temp. summer [C°]: 25.0
IHG summer [W/m²]: 9.9
Spec. capacity [Wh/K per m² TFA]: 204
Mechanical cooling: x

Specific building demands with reference to the treated floor area

Treated floor area: 723.4 m²

			Requirements	Fulfilled?*
Space heating	Annual heating demand	18 kWh/(m²a)	25 kWh/(m²a)	yes
	Heating load	22 W/m²	-	-
Space cooling	Overall specific space cooling demand	5 kWh/(m²a)	-	-
	Cooling load	13 W/m²	-	-
	Frequency of overheating (> 25 °C)	%	-	-
Primary Energy	Heating, cooling, dehumidifying, DHW,	kWh/(m²a)	123 kWh/(m²a)	
	DHW, space heating and auxiliary electricity	kWh/(m²a)	-	-
	Specific primary energy reduction through solar electricity	kWh/(m²a)	-	-
Airtightness	Pressurization test result n_{50}	1.0 1/h	1 1/h	yes

* empty field: data missing; - no requirement

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

EnerPHit building retrofit (acc. to heating demand)?

Name: Company: Registration number PHPP:
Surname: Issued on:
Signature

© PEP

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2. Determine Economic Feasibility

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Option A:

Cost to Save 1 kWh

of Energy

Option B:

Cost to Buy 1 kWh

of Energy

If A < B, A is a 'No Brainer'

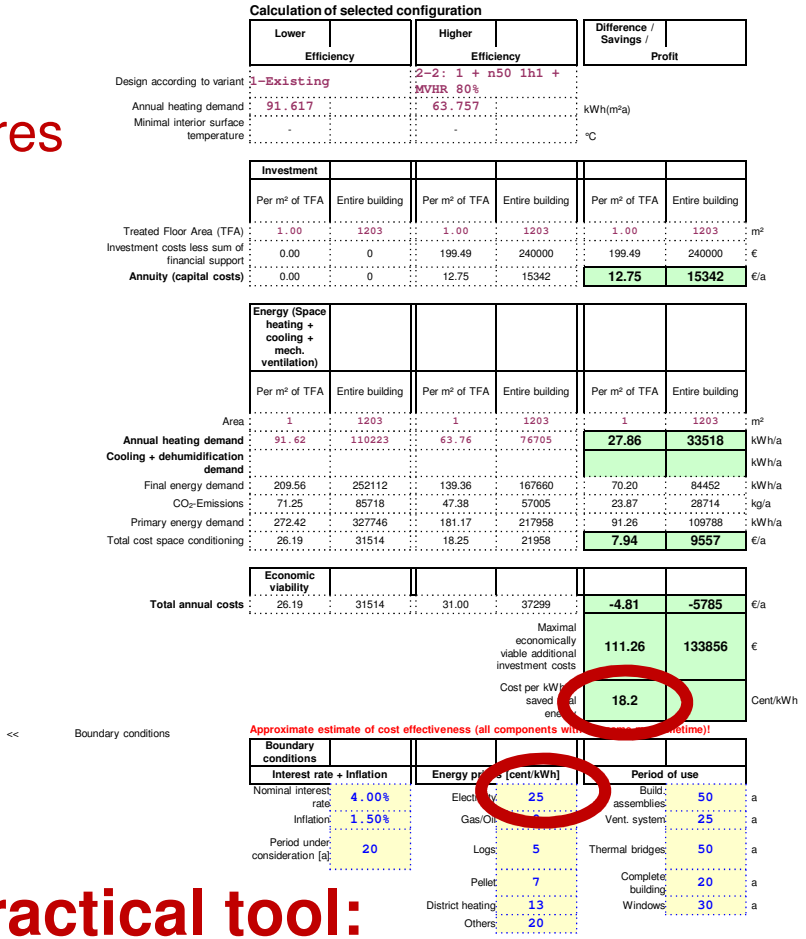
Typically people still chose B ('No-Brain')

Calculating Cost to Save 1 kWh of Energy

EuroPHit

Calculation Factors:

- Retrofit cost for individual measures
- Annual maintenance cost
- Subsidies and supports (if any)
- Product life
- Energy saved
- Interest rate, inflation rate
- Duration of borrowing
- Energy Price



Calculation of selected configuration

	Lower Efficiency		Higher Efficiency		Difference / Savings / Profit		
Design according to variant	1-Existing		2-2: 1 + n50 1h1 + MVHR 80%				
Annual heating demand	91.617		63.757				kWh(m²a)
Minimal interior surface temperature	-		-				°C
	Investment						
	Per m² of TFA	Entire building	Per m² of TFA	Entire building	Per m² of TFA	Entire building	
Treated Floor Area (TFA)	1.00	1203	1.00	1203	1.00	1203	m²
Investment costs less sum of financial support	0.00	0	199.49	240000	199.49	240000	€
Annuity (capital costs)	0.00	0	12.75	15342	**12.75**	**15342**	€/a
	Energy (Space heating + cooling + mech. ventilation)						
	Per m² of TFA	Entire building	Per m² of TFA	Entire building	Per m² of TFA	Entire building	
Area	1	1203	1	1203	1	1203	m²
Annual heating demand	91.62	110223	63.76	76705	**27.86**	**33518**	kWh/a
Cooling + dehumidification demand							kWh/a
Final energy demand	209.56	252112	139.36	167660	70.20	84452	kWh/a
CO_2-Emissions	71.25	85718	47.38	57005	23.87	28714	kg/a
Primary energy demand	272.42	327746	181.17	217958	91.26	109788	kWh/a
Total cost space conditioning	26.19	31514	18.25	21958	**7.94**	**9557**	€/a
	Economic viability						
Total annual costs	26.19	31514	31.00	37299	**-4.81**	**-5785**	€/a
Maximal economically viable additional investment costs					**111.26**	**133856**	€
Cost per kWh saved [illegible]					**18.2**		Cent/kWh

<< Boundary conditions

Approximate estimate of cost effectiveness (all components wi[illegible] lifetime)!

Boundary conditions		Energy p[illegible] [cent/kWh]		Period of use		
Interest rate + Inflation						
Nominal interest rate	4.00%	Elect[illegible]	25	Build. assemblies	50	a
Inflation	1.50%	Gas/Oi[illegible]		Vent. system	25	a
Period under consideration [a]	20	Logs	5	Thermal bridges	50	a
		Pellet	7	Complete building	20	a
		District heating	13	Windows	30	a
		Others	20			

Revolutionary and Highly practical tool:

Enables real-time comparison of cost efficiency

LAMP

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Determine Economic Feasibility

EuroPHit

Option A:

Cost to Save 1 kWh

of Energy

= €0.18

Option B:

Cost to Buy 1 kWh

of Energy

= €0.25

Choose Option A, it's a 'No Brainer'

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If you do it...

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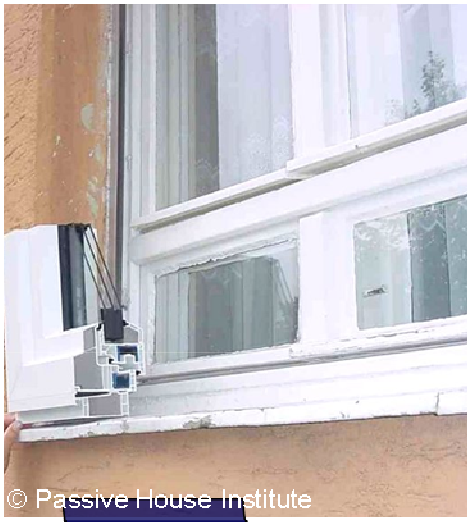
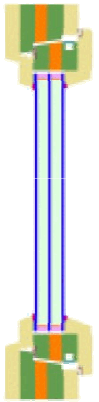
Initial investment in PH windows may be a bit higher

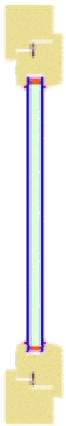


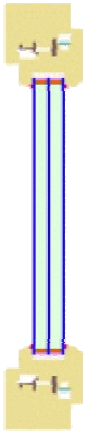
€411

+ €111



€300





€320/m²

+ €20

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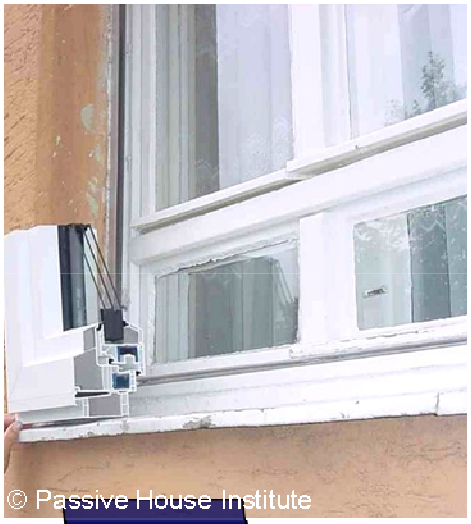
...do it right.

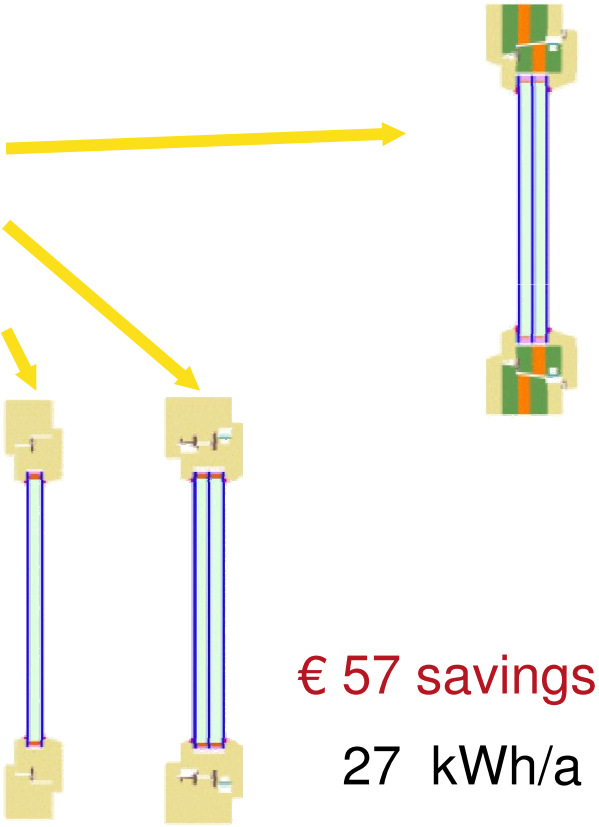
EuroPHit

...but they saves twice the money !

€ 211 savings

101 kWh/a





no savings

€ 57 savings

27 kWh/a

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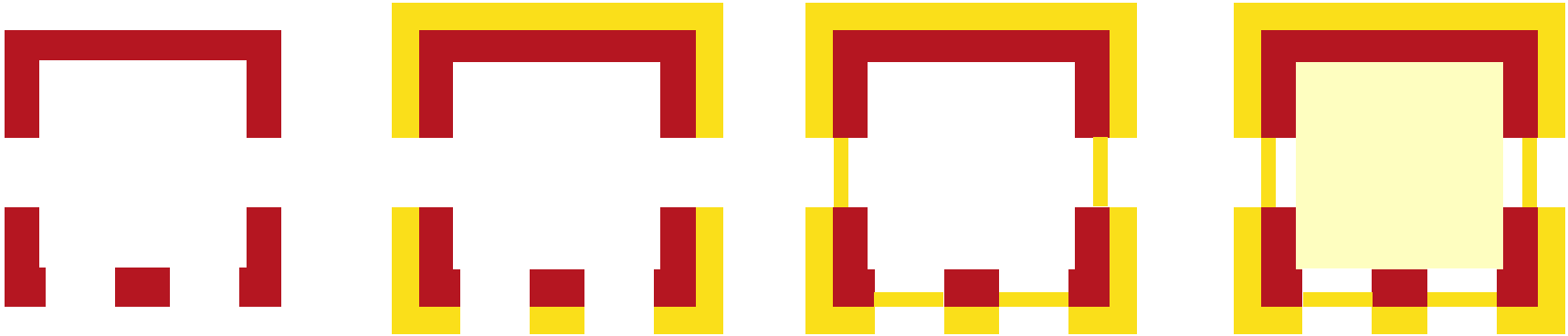
3. Prepare A Refurbishment Plan

EuroPHit

Option 1: Components step-by-step



Existing Building stock

Insulation

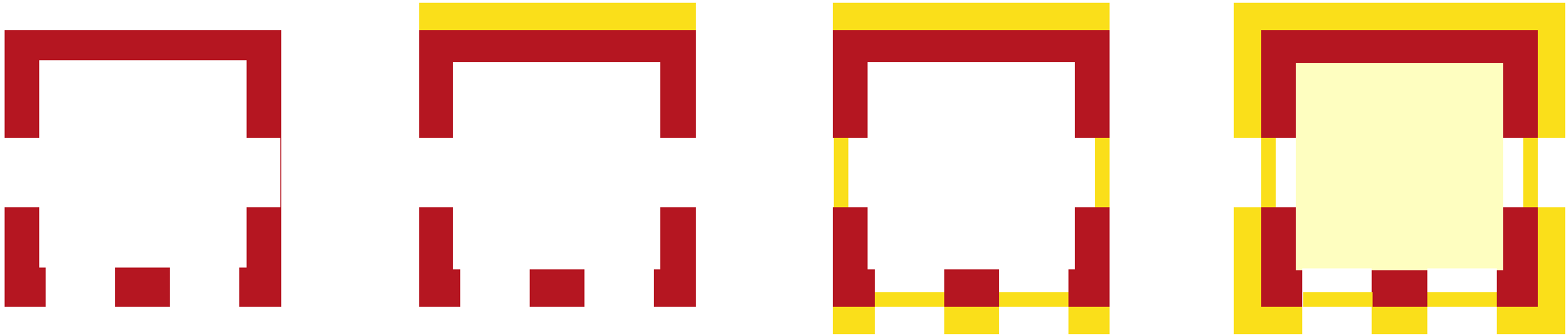
Windows

Airtightness + Ventilation + Renewables

What is step-by-step retrofit?

EuroPHit

Option 2: Facades / Parts step-by-step



Existing Building stock

North side

South side+ Windows+

Rest+ Airthightness+ Ventilation+ Renewables

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What to tackle first…

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Windows?

Airtightness and ventilation?

External insulation?

Beijing

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Scale of Refurbishment Plans

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Part or whole facade?

Part or whole building?

Part or whole block?

New York City

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Step by step façade insulation

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Replacing windows only?

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Then put them in the right place!

(awaiting future external insulation)

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Keeping occupants in situ?

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France:

- Start with issues that improve comfort (windows)
- Use existing ducts for MVHR
- Scaffolding avoided in 1st phase

UK:

- 20% of building unoccupied
- Phased approach preferred by residents
- Temp. partitioning of living rooms

Bulgaria:

- Tried to schedule works in school holidays
- 1st step involves external roof refurb
- Health and safety a high concern

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Occupier liaison: show flat, UK

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Financial workshops – options available

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PHA Passive House Academy

MosArt

4. Select New Products for Old Buildings

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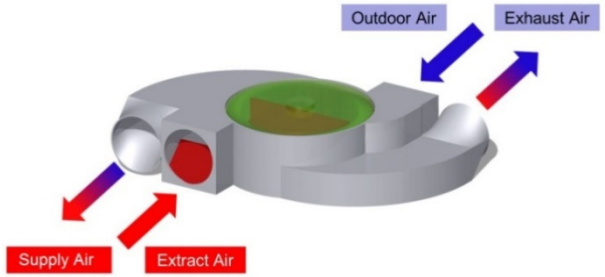
Façade Integrated MVHR with flow rates > 100m³/h (*60 CFM*)

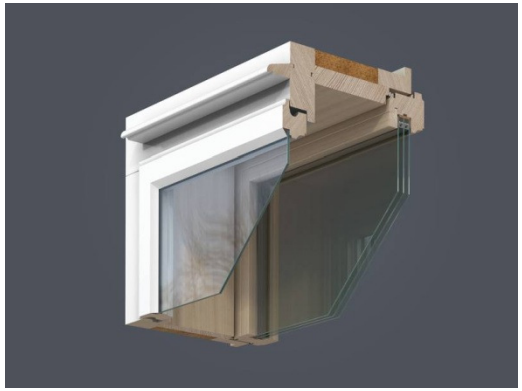


Example, © Vent4reno

Decorative easy-mount ducting

Example, © Helios

High performance windows for historical retrofits



Example, © SmartWin

COMPONENT AWARD 2015
Passive House Institute

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PHA Passive House Academy

MosArt

Flexible framing for uneven walls

EuroPHit

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5. Step by Step Construction Details

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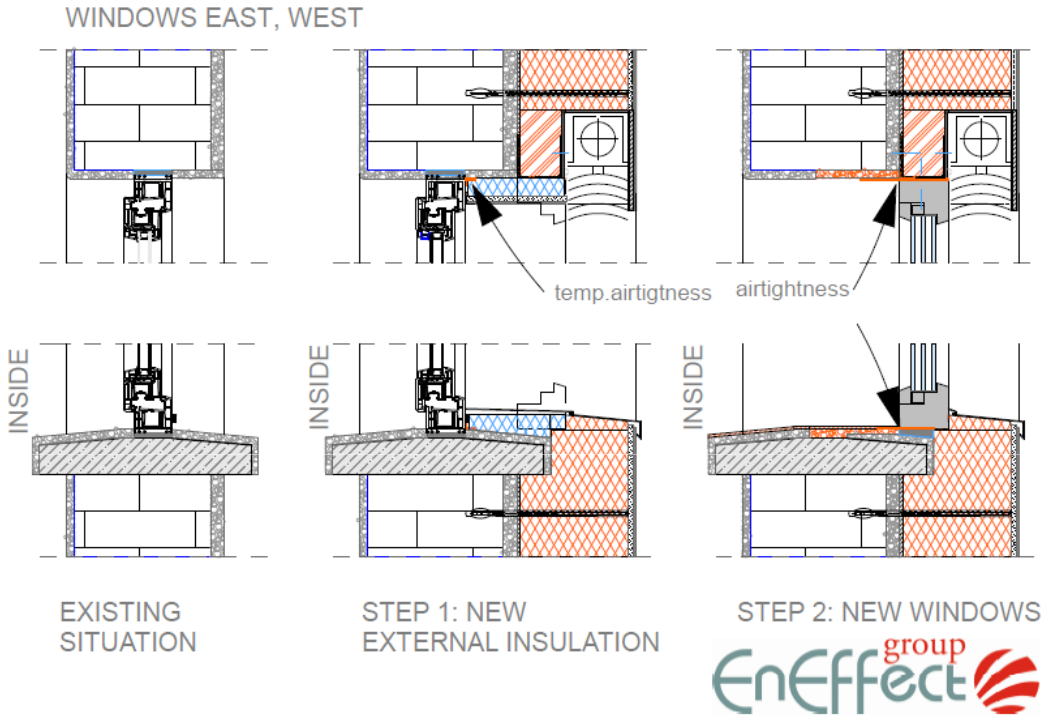

School retrofit project in Bulgaria

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Database of step by step details

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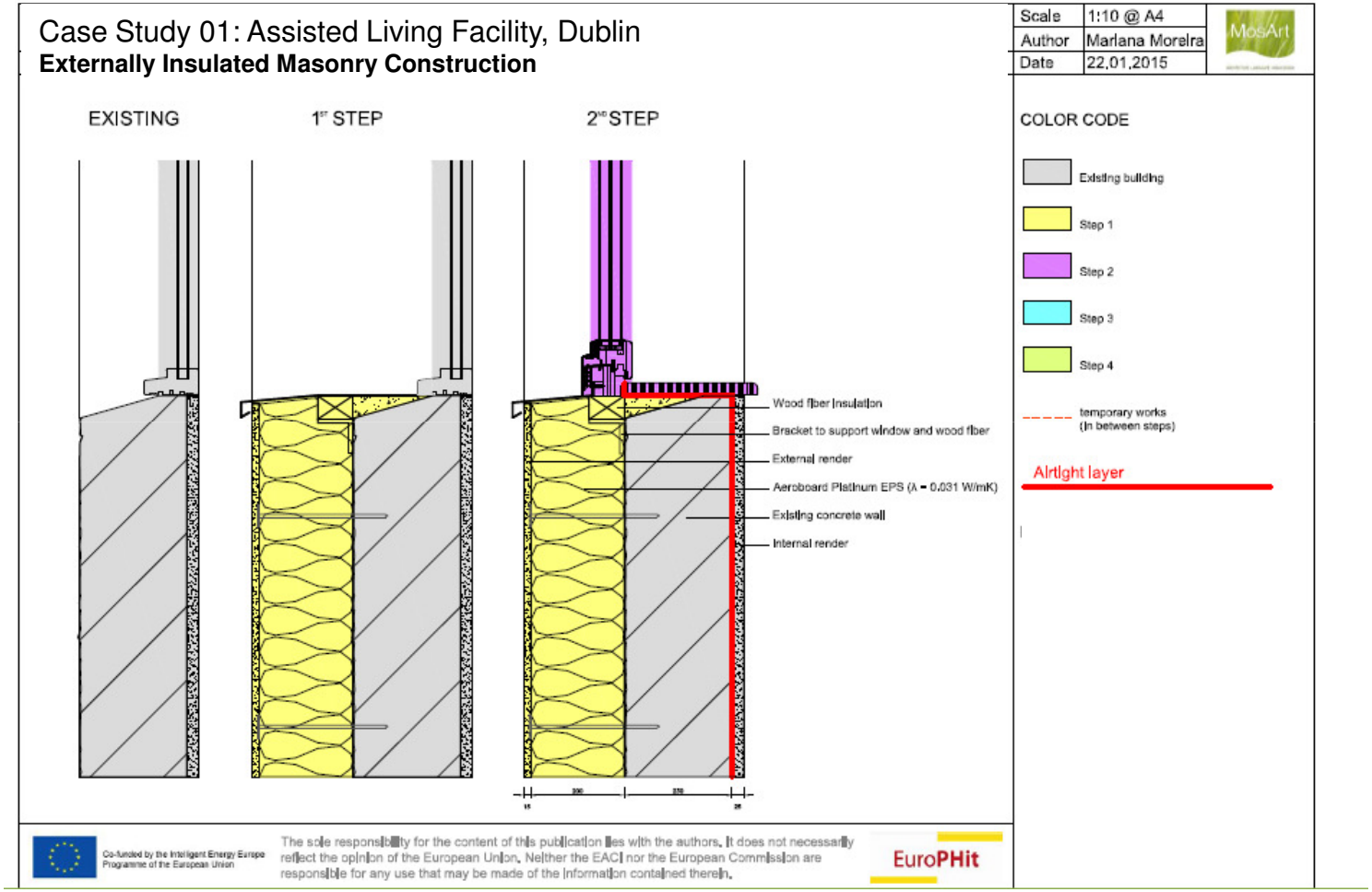


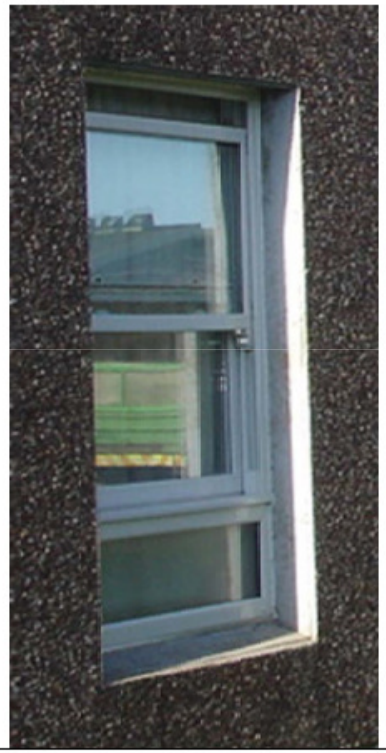
Step by step visual guide

EuroPHit

Case Study 01: Assisted Living Facility, Dublin

Externally Insulated Masonry Construction

BEFORE



AFTER

Scale	-
Author	Marlana Morelra
Date	22.01.2015

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Analysis of thermal performance

EuroPHit

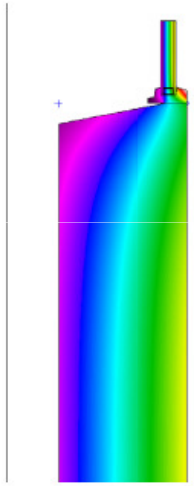
Case Study 01: Assisted Living Facility, Dublin

Externally Insulated Masonry Construction

Scale	1:10 @ A4
Author	Marlana Morelra
Date	22.01.2015

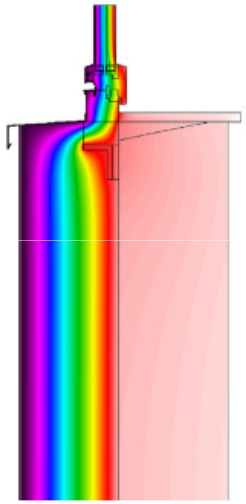
MosArt

EXISTING



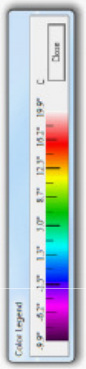
Ψ - value [W/mK] = 0.244 W/mK

Final Step



Ψ - value [W/mK] = 0.031 W/mK

COLOR CODE



DESCRIPTION/CHALLENGES

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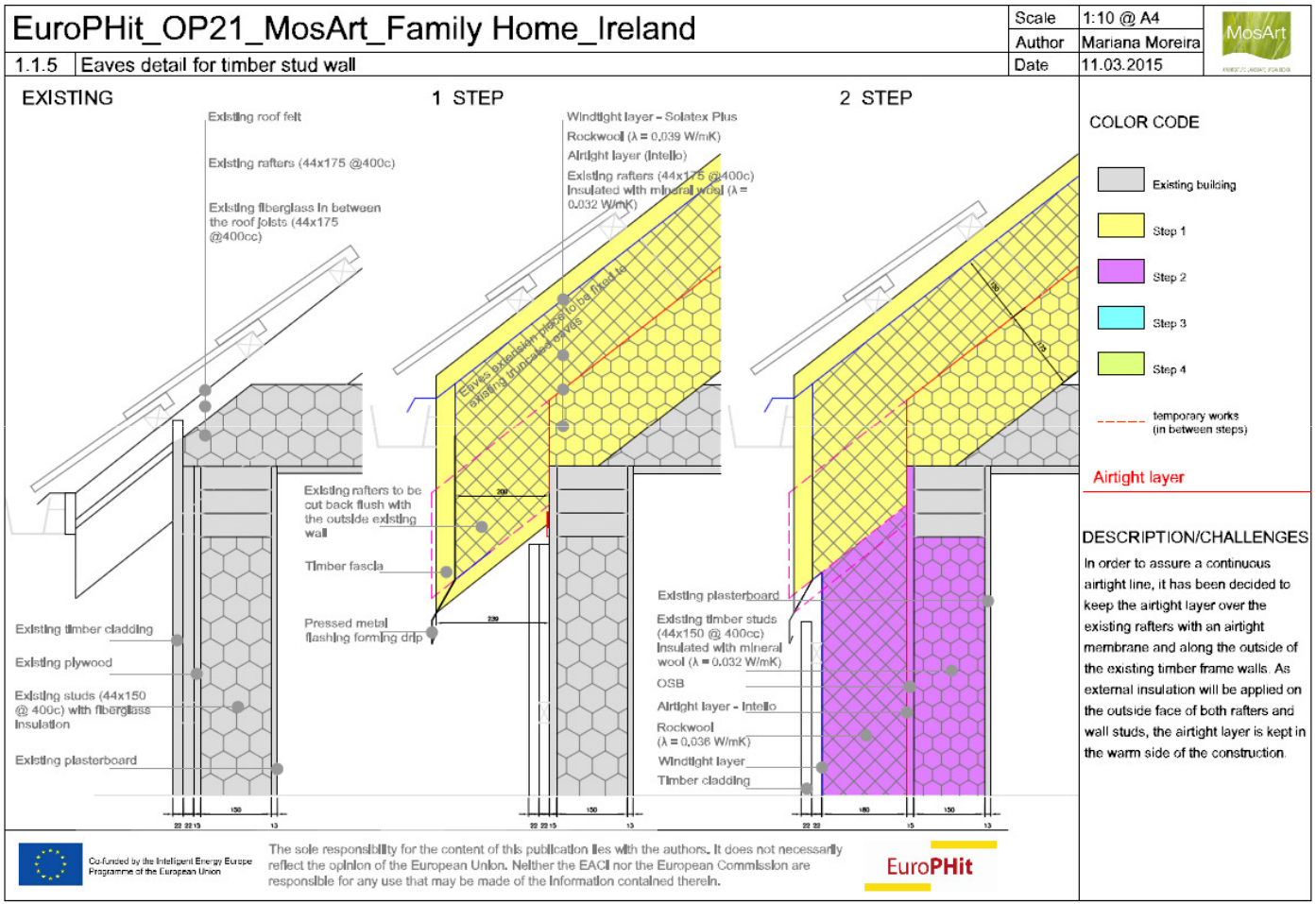
EuroPHit

Insulate eaves detail in 2 phases

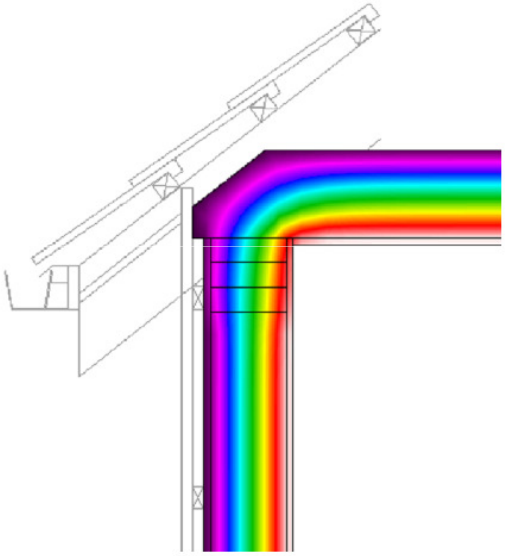
EuroPHit



EuroPHit_OP21_MosArt_Family Home_Ireland

1.1.5	Eaves detail for timber stud wall - THERM	Scale	1:10 @ A4
		Author	Mariana Moreira
		Date	22.01.2015

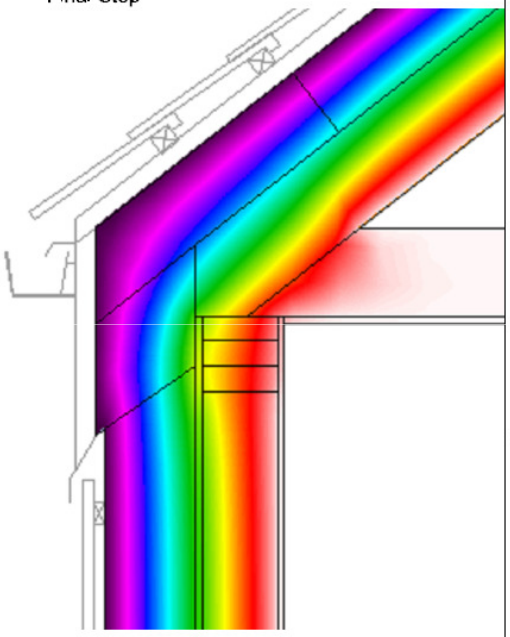
EXISTING



Losses = 20.4 W/m

Ψ - value [W/mK] = - 0.017

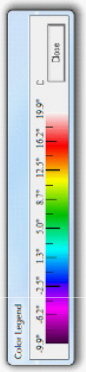
Final Step



Losses = 10.3 W/m

Ψ - value [W/mK] = - 0.016

COLOR CODE



DESCRIPTION/CHALLENGES

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6. Prepare Tendering Documents

EuroPHit

ArchitectureMNP

Avoid Costly Unforseen Extras

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Tender Clauses Specific to Passive House

EuroPHit

- Define Passive House certification criteria
- **Attendance at project briefing and training**
- **Adherence to PHPP models**
- Performance specification for materials and products
- ISO Standards for glass, frames, spacer bars and SHGC
- Certification of MVHR?
- MVHR efficiency, filter types, power consumption, duct testing
- MVHR commissioning and air flow balancing
- Blower door test protocols
- Allowance for thermal imaging
- Signed declaration by construction supervisor

Pre-Tendering Training Requirement

EuroPHit

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7. Select Trained Builders

EuroPHit

Three EuroPHit Training Programmes

Project Design Team:
Certified Passive House **Designer**:
7 days, 80 trainees

Project Contractor:
Certified Passive House **Tradesperson**:
3 days, 224 trainees

Airtightness, Installation and Measurement:
3 days, 224 trainees

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Hands-on Training in Tradesperson Labs

EuroPHit

Certified Passive House Tradesperson Training Lab in Dublin

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www.europhit.eu

PHA Passive House Academy

MosArt

Overlap of envelope and mechanicals

EuroPHit

Internal airtightness solutions

www.europhit.eu/events

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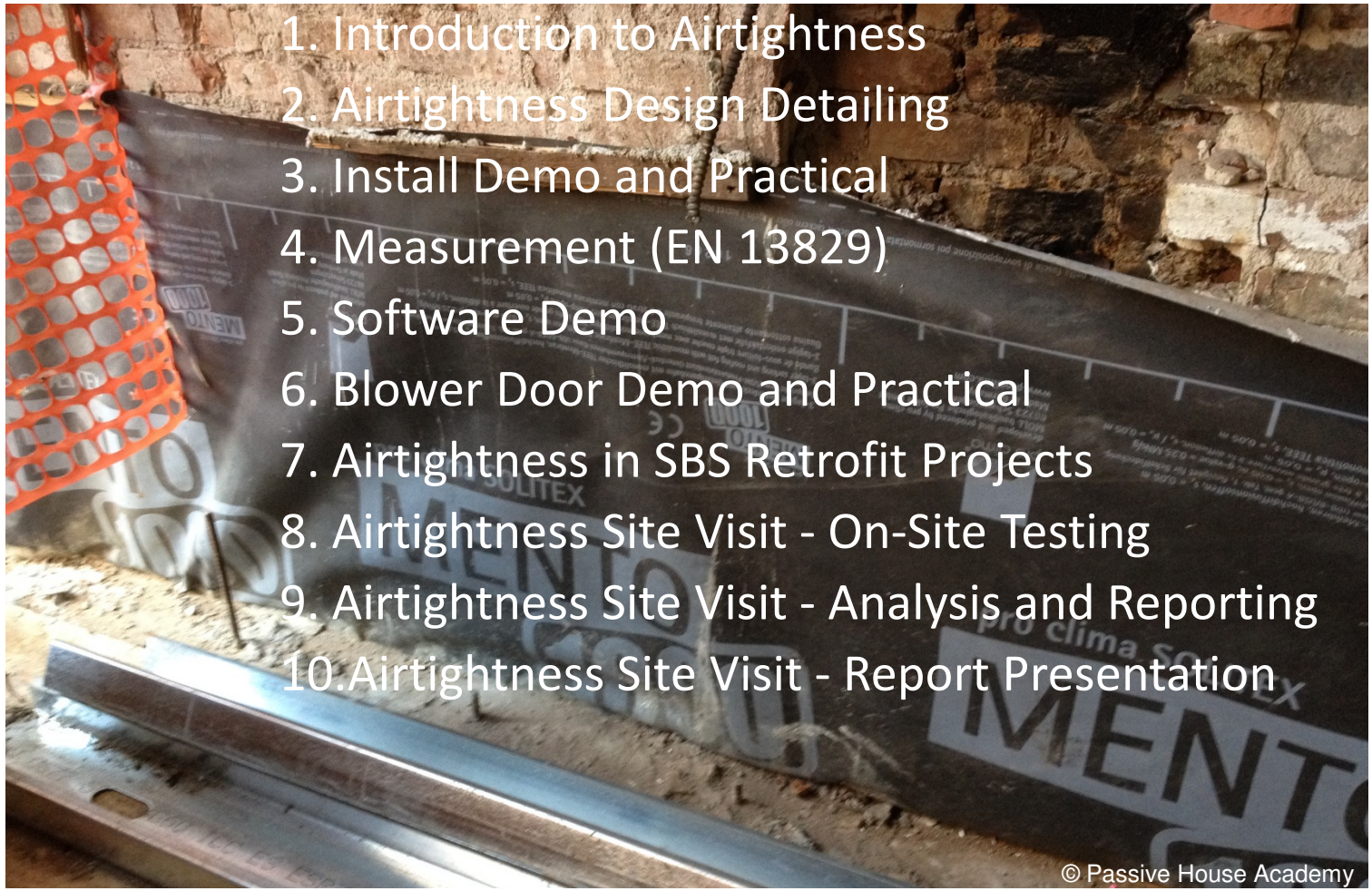
Airtightness Learning Objectives

EuroPHit



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8. Start On-Site – Reality Bites

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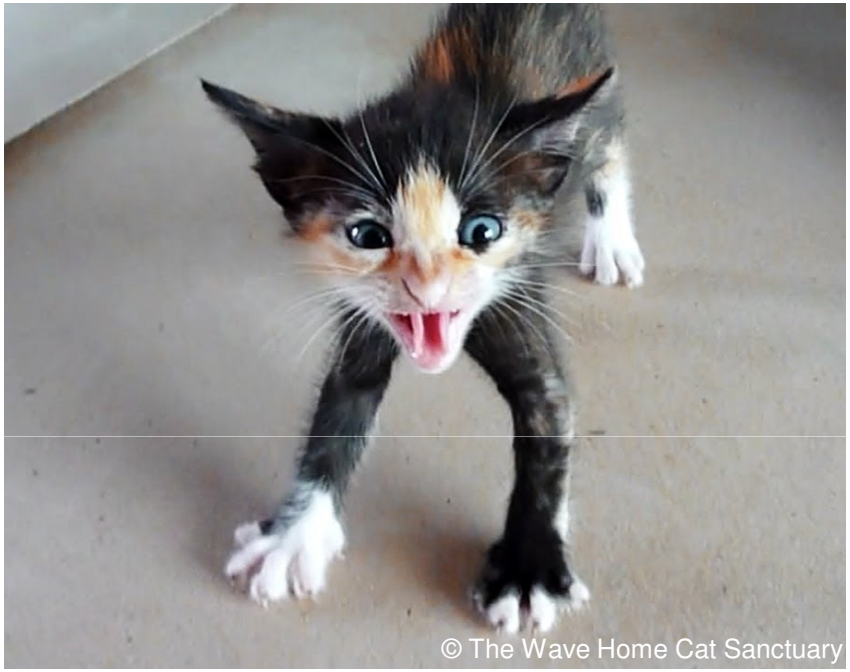
Retrofit in theory



Retrofit in practice

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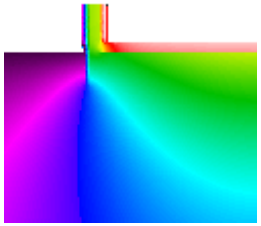
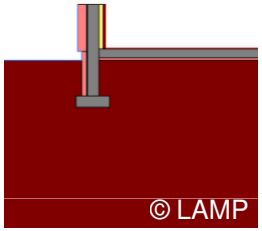
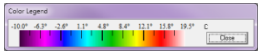
Wall to foundation detail, France

EuroPHit







Perimeter insulation XPS 120mm x 800mm
PSI-Value reduced from 0.50 W/mk to 0.15 W/mK

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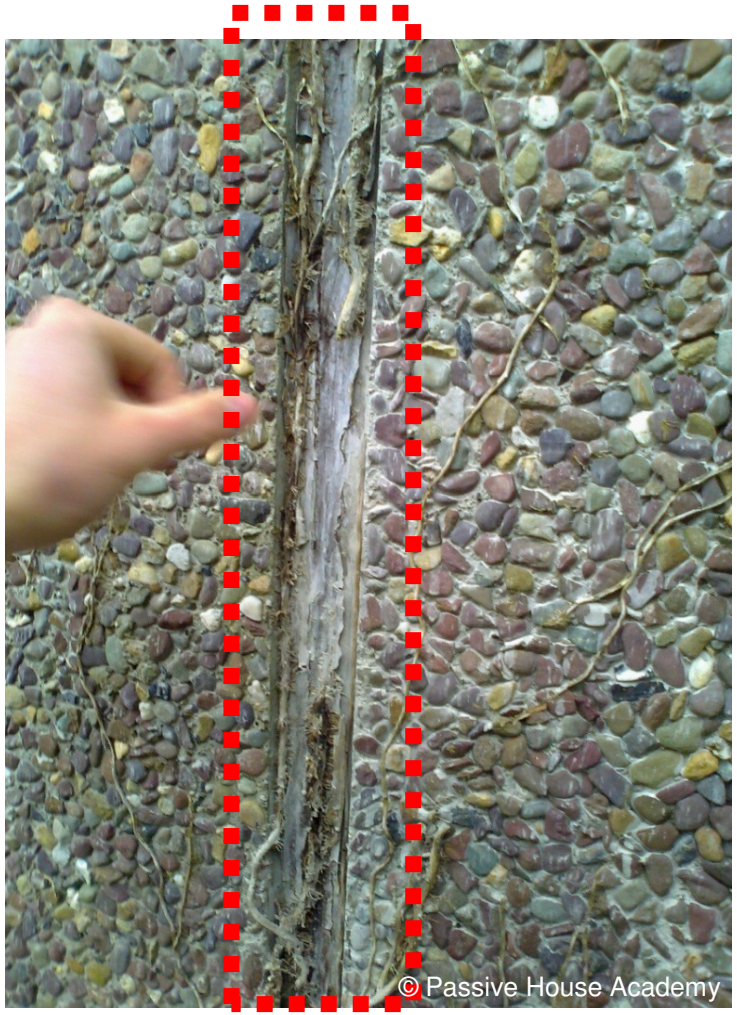
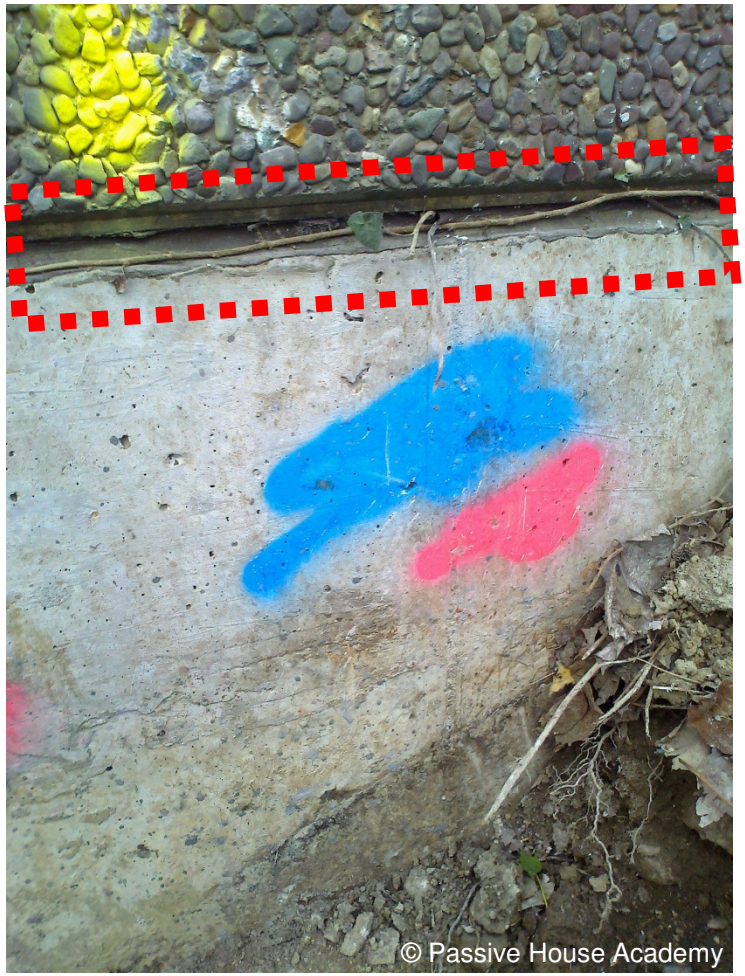
“remove vegetation before applying tape”

EuroPHit





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The Project Architect's Perspective

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Sarah Clifford - Executive Architect, Architecture and Cultural Department, Dun Laoghaire Rathdown Co Co

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Thinking on-site - airtight line - options

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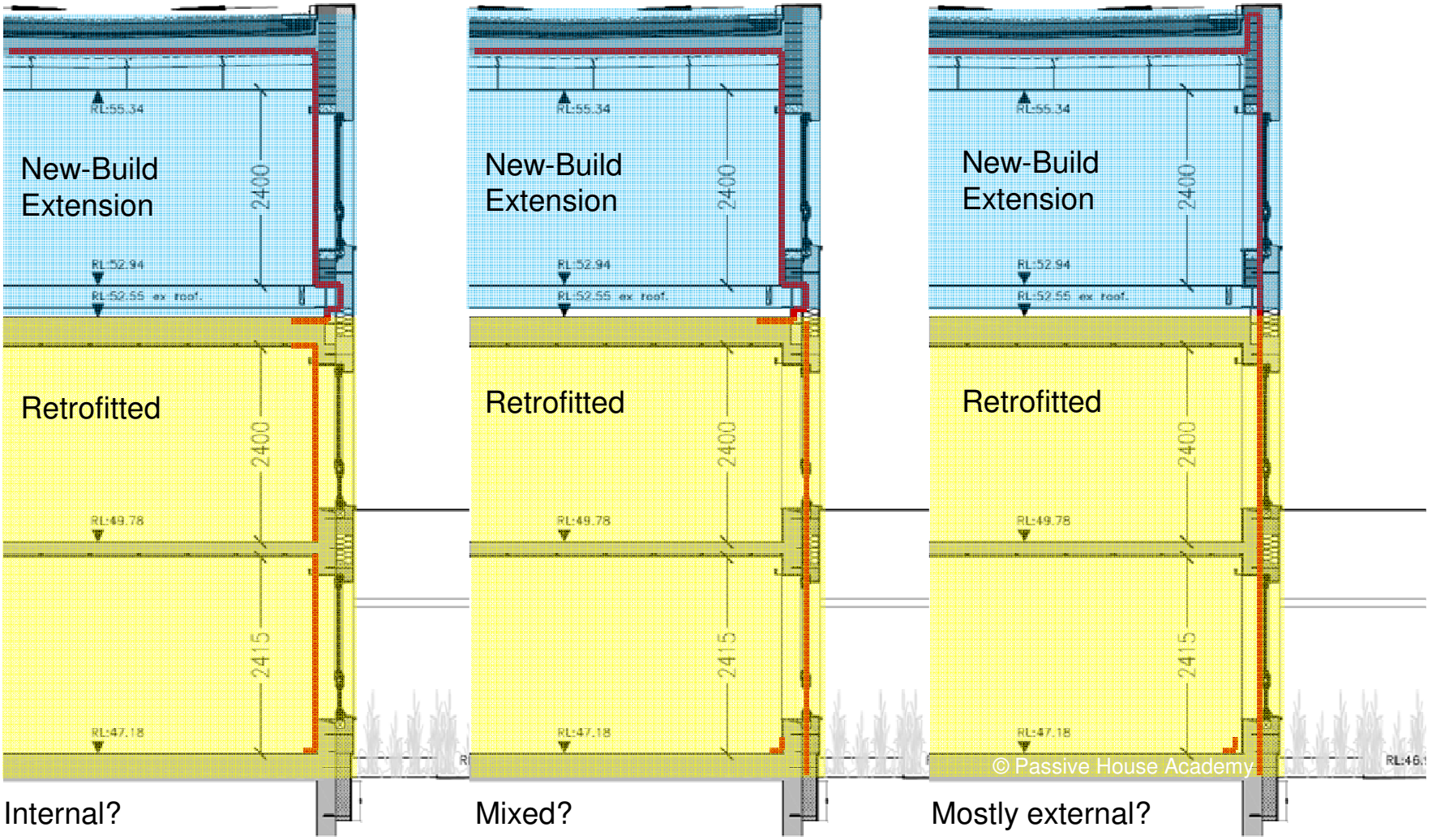

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www.europhit.eu

The Contractor's Perspective

EuroPHit

Pat O'Connor – Manley Construction, Main Contractor

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9. Certification: criteria and scheme

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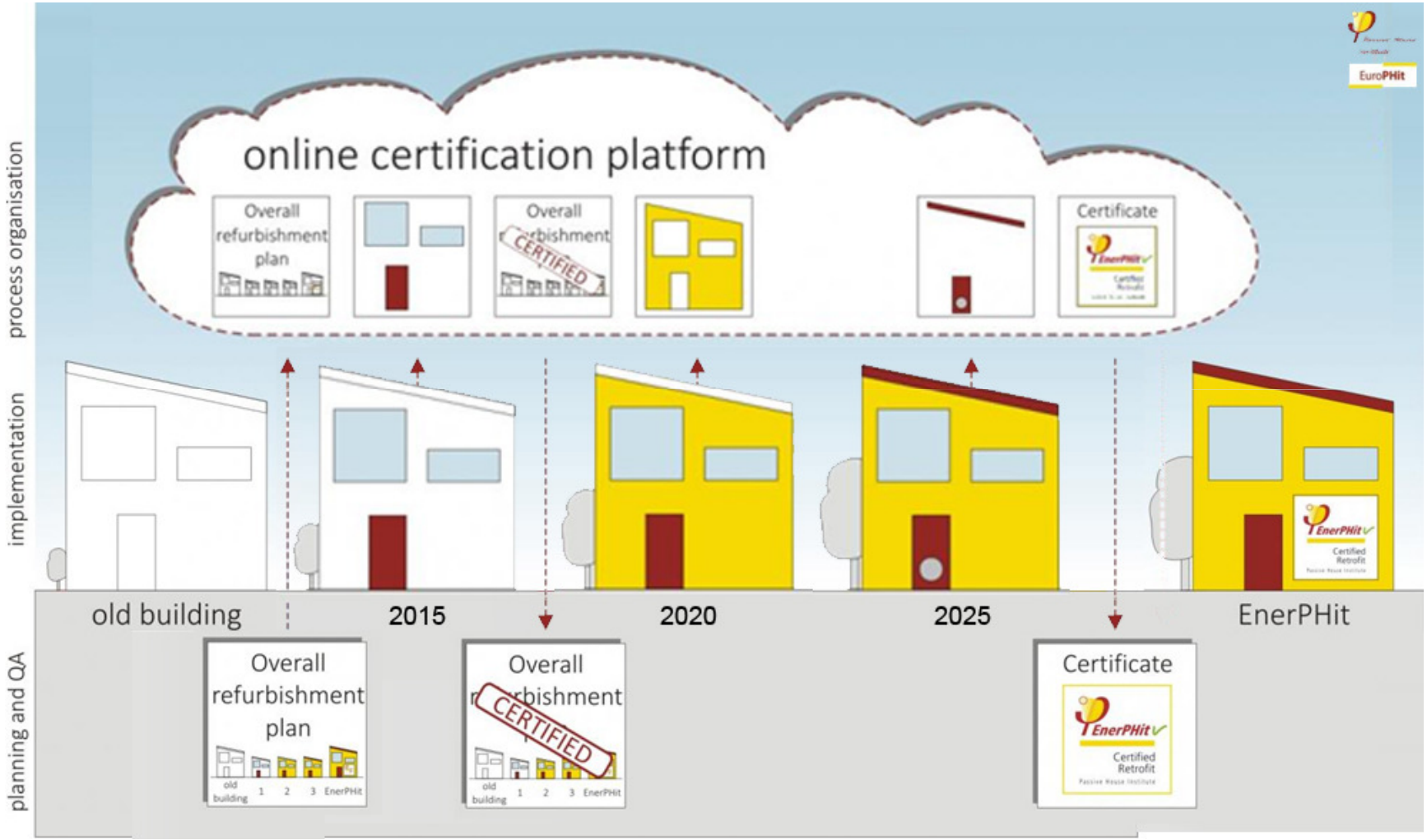

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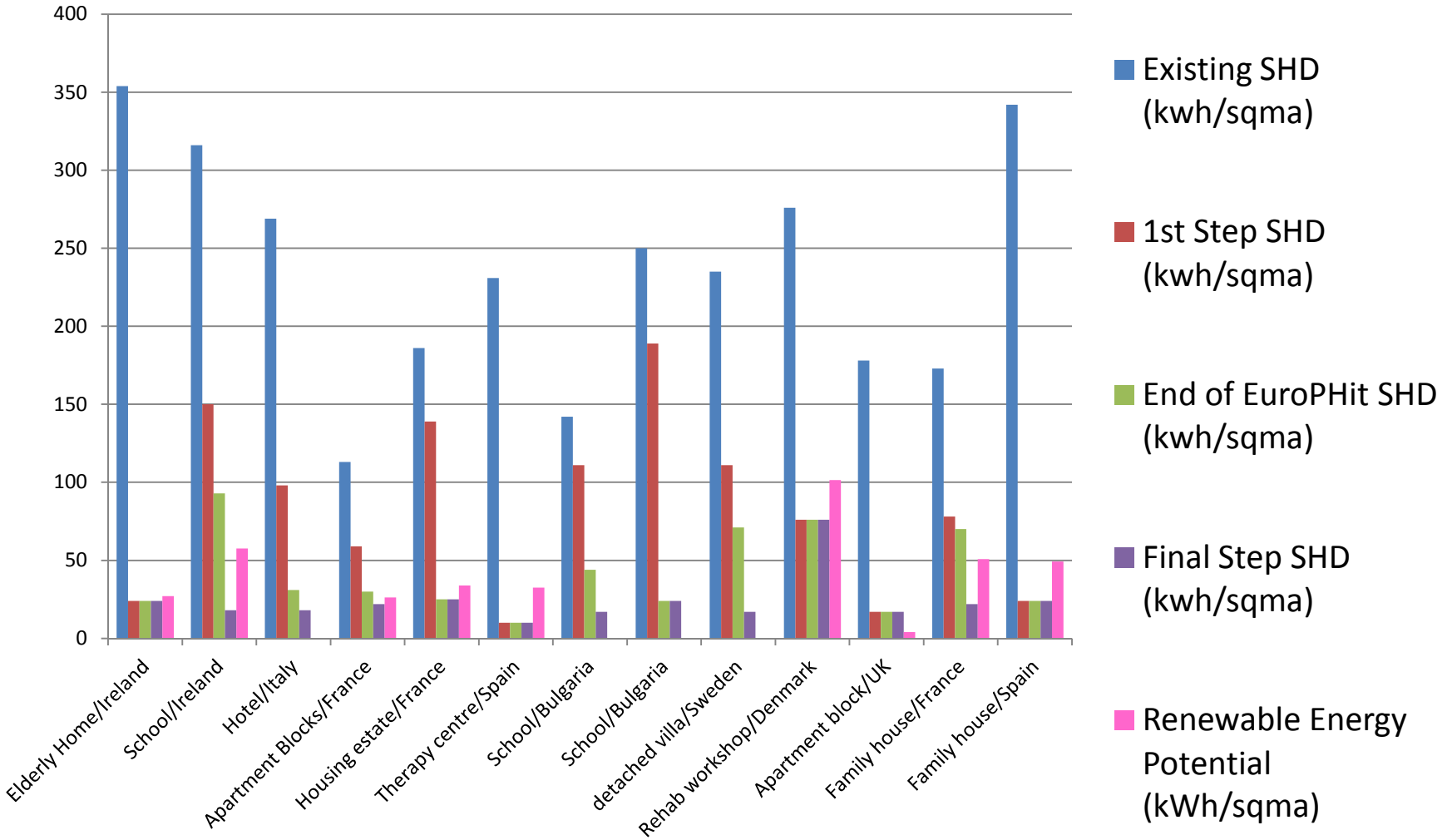
EuroPHit case study performance

EuroPHit



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Observer projects welcome

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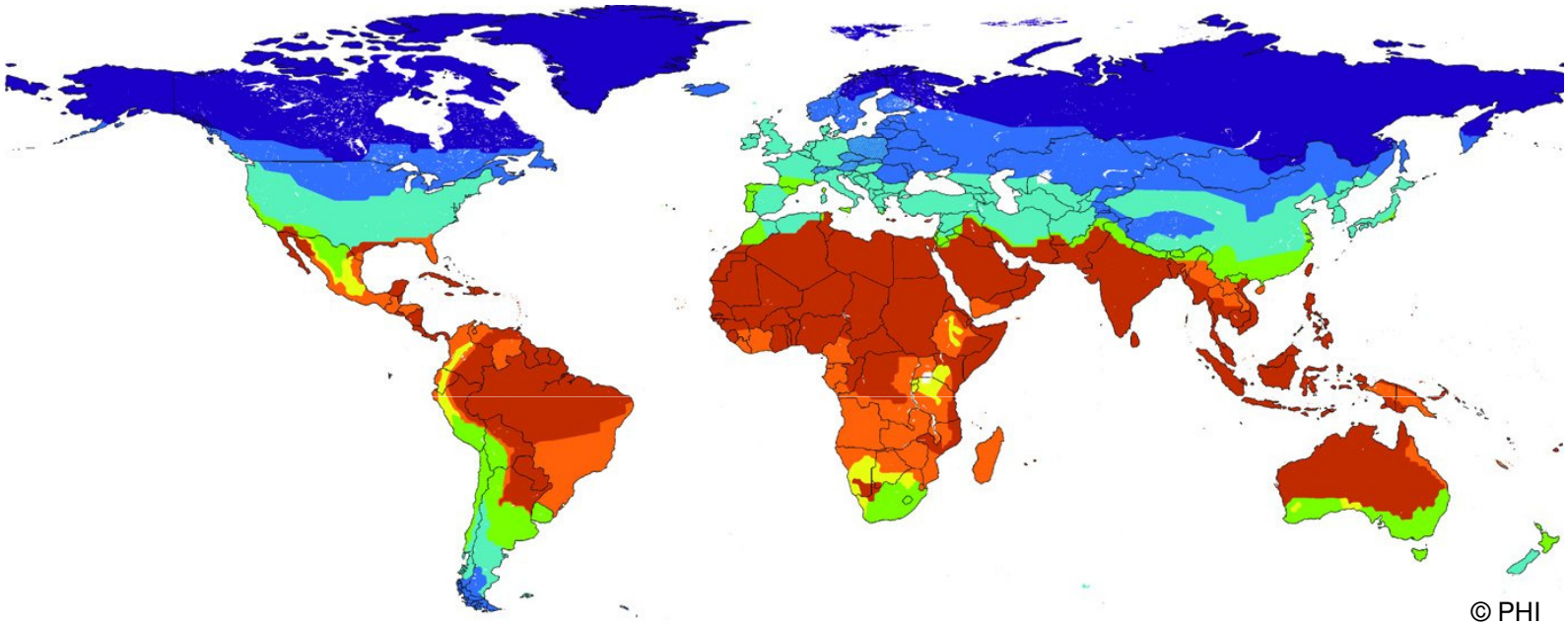

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From ‘EuroPHit’ to ‘Planet-PHit’

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Thank you for your attention

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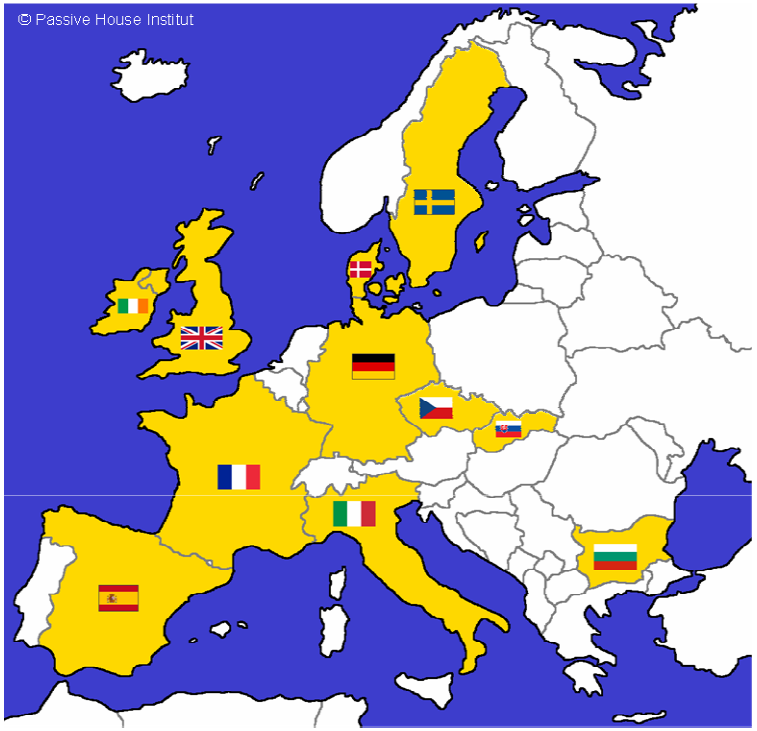

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