

## Passive House: Definition and Basic Principles

South Dublin County Council Forum  
Sustainability Through Innovation:  
Passive Solar Design

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Patxi Hernandez  
UCD Energy Research Group  
School of Architecture,  
Landscape & Civil Engineering



## What is a 'passive house' ?

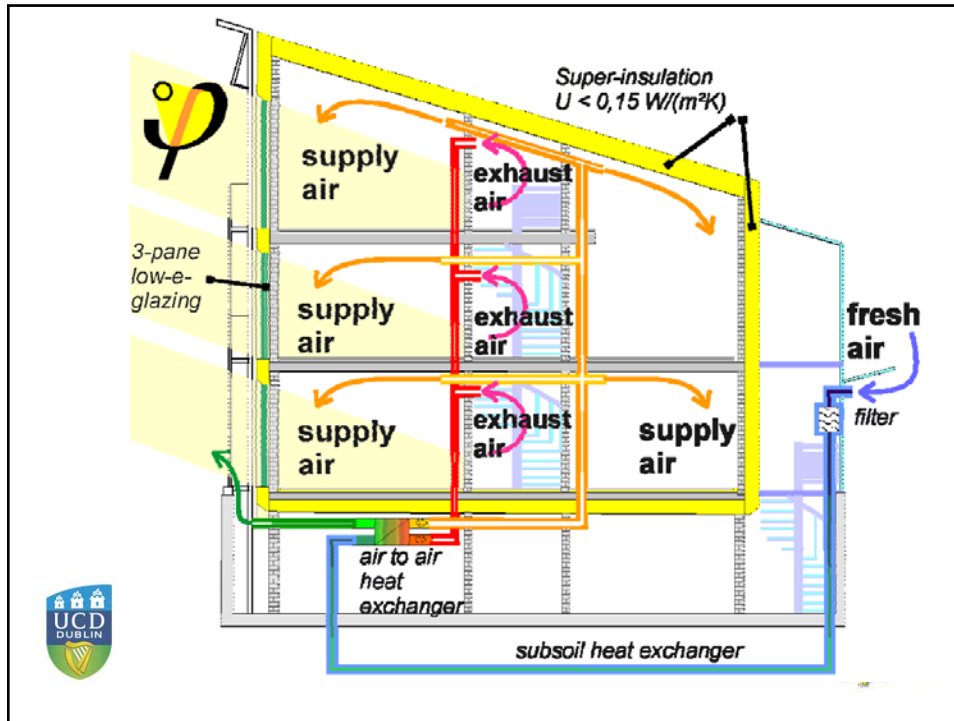
The term 'passive house' refers to a specific construction standard for buildings with good comfort conditions during winter and summer, without the need for a traditional heating system.

- Maximum specific heat demand for heating  
< 15 kWh/m<sup>2</sup>.a
- Total energy demand  
< 120 kWh<sub>prim</sub>/m<sup>2</sup>.a

Typically includes:

- High insulation levels
- Low infiltration, low thermal bridging
- Mechanical ventilation system with heat recovery





## Passive House Solutions

| Measure/ solution   | Passive House standard   |
|---|--|
| <b>1. Super Insulation</b>                                |  |
| Insulation walls  | $U \leq 0,15 \text{ W/m}^2\text{K}$  |
| Insulation roof   | $U \leq 0,15 \text{ W/m}^2\text{K}$  |
| Insulation floor  | $U \leq 0,15 \text{ W/m}^2\text{K}$  |
| Window casing   | $U \leq 0,8 \text{ W/m}^2\text{K}$   |
| Window glazing  | $U \leq 0,8 \text{ W/m}^2\text{K}$   |
| Doors   |  |
| Thermal bridges   | linear heat coeff. $\psi \leq 0,01 \text{ W/mK}$   |
| Air tightness   | $n_{20} \leq 0,6 \text{ h}^{-1}$   |
| Minimal Shape Factor (Area TFA/ Volume TV)                |  |
| <b>2. Heat Recovery/ IAQ</b>                              |  |
| Ventilation counter flow air to air heat exchanger        | heat recovery $\eta_{HR} \geq 75 \%$   |
| Ventilation air subsoil heat exchanger                    | Fresh air $\geq 8 \text{ }^\circ\text{C}$  |
| Ventilation ducts insulated                               |  |
| Other heat recovery (e.g. ventilation & DHW return pipes) |  |
| DHW heat recovery   |  |
| DHW pipes insulated                                       |  |
| Minimal space heating                                     | Post heater ventilation air, low temperature heating   |
| Efficient small capacity heating system                   | Biomass, heat pump, gas, co - generation (e.g. district heating), etc.                         |
| Air Quality through ventilation rate                      | min. $0,4 \text{ ach}^{-1}$ or $30 \text{ m}^3/\text{pers/h}$ or national regulation if higher |
| <b>3. Passive (Solar) Gain</b>                            |  |
| Window glazing  | solar energy transmittance $g \geq 50 \%$  |
| DHW (solar) heater  |  |
| Thermal mass within envelope                              |  |
| Solar orientation   |  |
| Night-time shutters                                       |  |
| Shading factor [%] (East & West)                          |  |

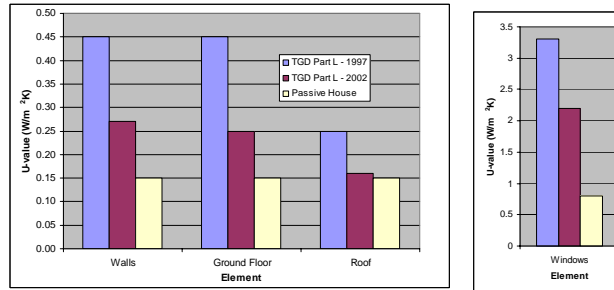
| Measure/ solution                                    | Passive House standard                                |
|--|---|
| <b>4. Electric Efficiency</b>                        |   |
| Energy labeled household appliances [Labeling A - G] |   |
| Hot water connections washing machines/ dishwashers  | Energy reduction 50% of common practice               |
| Compact Fluorescent lighting                         |   |
| Regular maintenance ventilation filters              |   |
| <b>Direct Current motor ventilation</b>              |   |
| Efficient fans: SFP (Specific Fan Power)             | $\leq 0,45 \text{ W/(m}^3\text{h)}$ (transported air) |
| <b>5. On-site Renewables</b>                         |   |
| Wind turbine   |   |
| Photo Voltaics                                       |   |
| Solar thermal energy                                 |   |
| Biomass system                                       |   |
| Other  |   |
| <b>6. Cost reduction</b>                             |   |
| Building team  |   |
| Commissioning  |   |
| Building systems                                     |   |



= basic measure/ solution  
 = often applied optional measure/ solution  
 = other optional measure/ solution

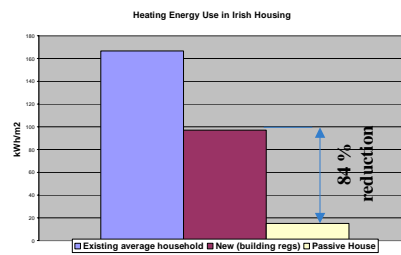


## Irish Construction and the Passive House Standard



### Passive House:

- Low infiltration
- Minimal Thermal Bridges
- Heat recovery ventilation



## IAQ in Passive Houses

Requirements of fresh air for good IAQ:  
(humidity, VOC, CO<sub>2</sub>, radon)

- minimum ventilation 30 m<sup>3</sup>/h/pers
- minimum ventilation rate of 0.4 ac/h

Infiltration and natural ventilation techniques used for housing are often difficult to control and with high thermal losses

### Passive House Solution:

Very airtight house:  $n_{50} < 0.6$  ach



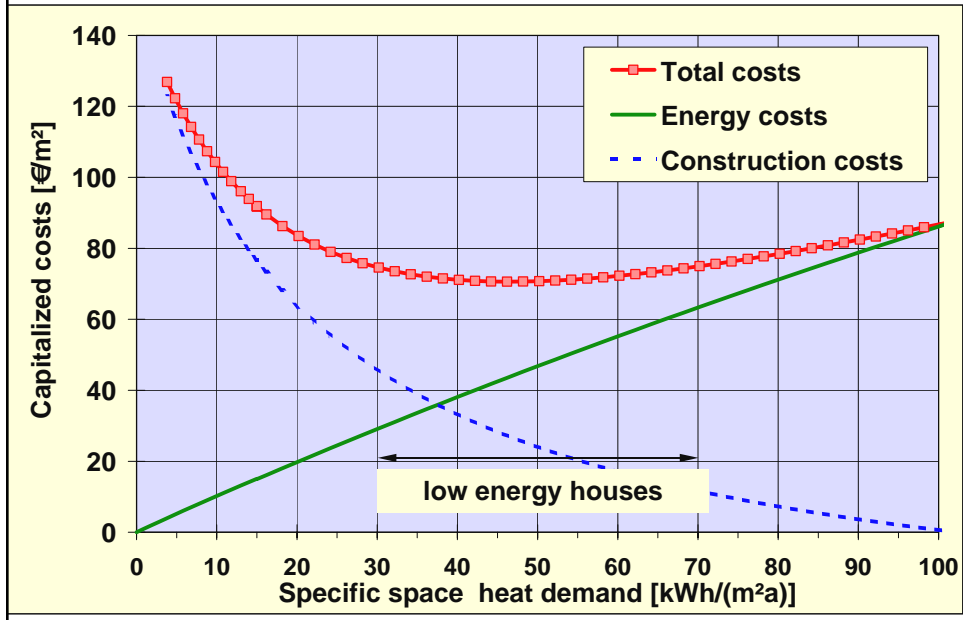
### Heat Recovery Ventilation

(High recovery efficiency and low energy motors)



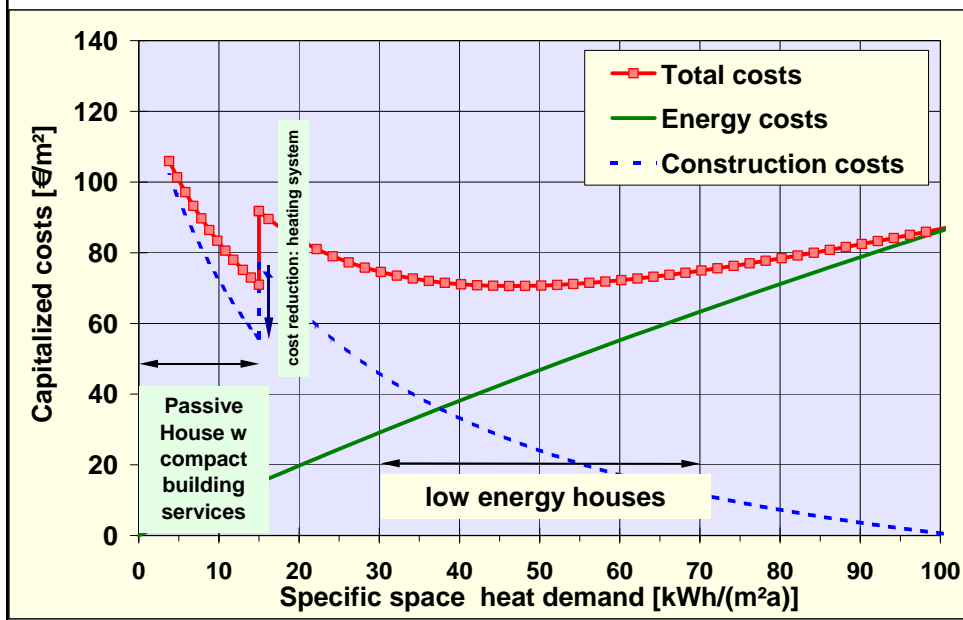
## Rationale of the Passive House:

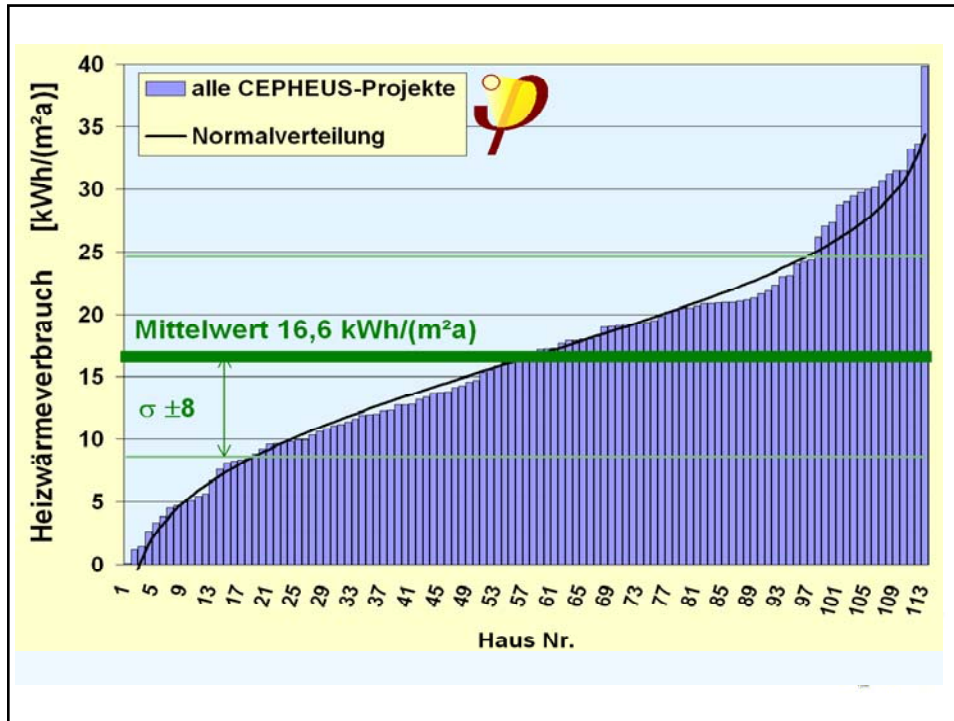
Source: Passive House Institute (www.passiv.de)



## Rationale of the Passive House:

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Passivhaus geeignete Außenwandkonstruktionen  $U < 0,15 \text{ W/(m}^2\text{K)}$

a) Mauerwerk mit Wärmeverbundsystem (über 25 cm dick)

b) Schalungselement aus Polystyrol-Hartschaum (24cm)

c) Leichtbauelement: Holz-Boxträger oder Doppel-T-Träger voll gedämmt (20-40 cm)

d) Fertigbauteil aus Polyurethan-Sandwich-Elementen (20 cm)

e) Leichtbeton-Fertigteil-Element

f) Blockbohlenwand

g) low-tech: Strohballenwand (60 cm)

h) high-tech: Vakuumisolierung (2,5 cm)

Deck- und Bodenblech (Stahl)

Glasboard/Spacer  $\lambda$  um 0,0022 W/(mK)

Passivhaus geeignete Fenster und Türen 2002

Einfamilienhaus / residential house in Celle, Fa. wa-bau



Deutschland / Germany



Deutschland / Germany



Einfamilienhaus / residential house in Laatzen, Architekt Wildmann



Mehrfamilienhaus / residential building in Hannover, Architekt Grubert



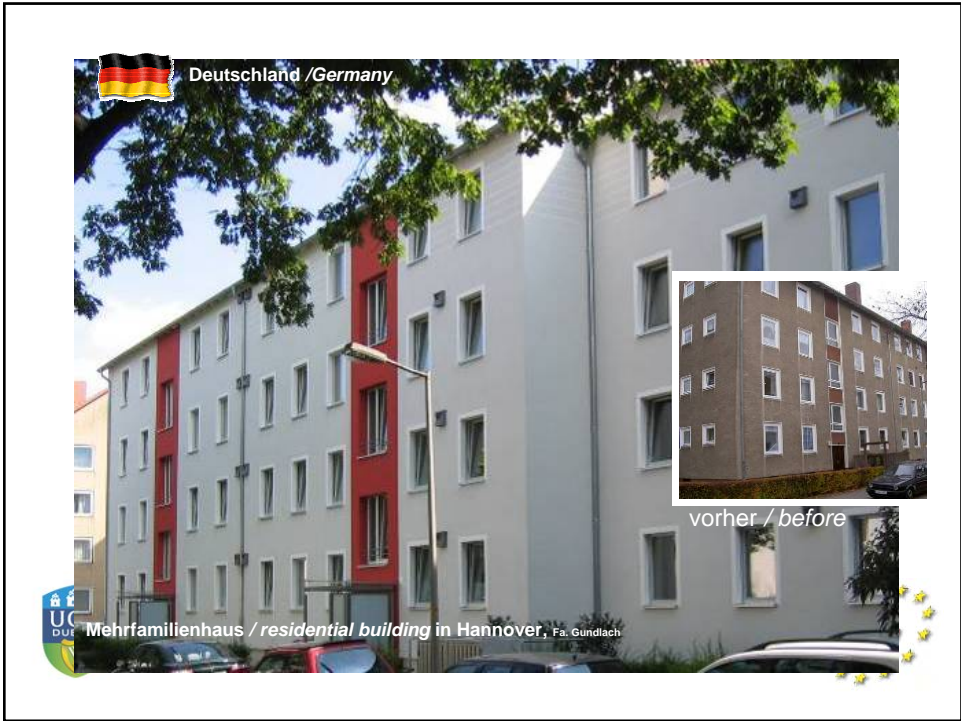
Deutschland / Germany



vorher / before

Mehrfamilienhaus / residential building in Hannover, Nicole von Oesen





Bürogebäude / office building in Stadl Paura Architekten Frohnwieser, Böhm



Österreich / Austria



Kindergarten in Ziersdorf, Kislinger Architekten



Österreich / Austria



Kindergarten in Ziersdorf, Kislinger Architekten



Österreich / Austria



Deutschland / Germany



Sporthalle / gymnasium in Laatzen, Architekten ART-plan





Thanks for the attention!

Various documents and contact list available at:

[www.europeanpassivehouses.org](http://www.europeanpassivehouses.org)

Patxi Hernandez

[hernandez@erg.ucd.ie](mailto:hernandez@erg.ucd.ie)

Vivienne Brophy

[brophy@erg.ucd.ie](mailto:brophy@erg.ucd.ie)

Irena Kondratenko

[irena.kondratenko@ucd.ie](mailto:irena.kondratenko@ucd.ie)

