Passivhaus and EnerPHit retrofits: a comparison

A comparison of completed certified projects designed by greentomatoenergy

Marine Sanchez ñ Building Physics Engineer & Passivhaus Designer

ukpassivhaus conference 2014

1. Introduction

greentomatoenergy, its projects and its domestic clients

The Company

- Building physics engineers based in London
- Consultancy and support to deliver low energy buildings
- Design of many retrofits and new-builds to varying standards
- Passivhaus design of the first 2 Passivhaus retrofits in the UK

Our Clients

- In-depth renovation of family homes
- **Comfort** is a key driver (along with low energy bills)

1. Introduction

Our Projects

Lena Gardens

- 1st PH residential retrofits (UK)
- Private retrofit
- CIBSE Retrofit Award 2013

Princedale Road

- 1st PH residential retrofits (UK)
- Social housing
- TSB ìRetrofit for the Futureî

Barmouth Road

- 1st EnerPHit in London

2. Monitoring Results

Results & monitoring data of certified PH & EnerPHit refurbishments

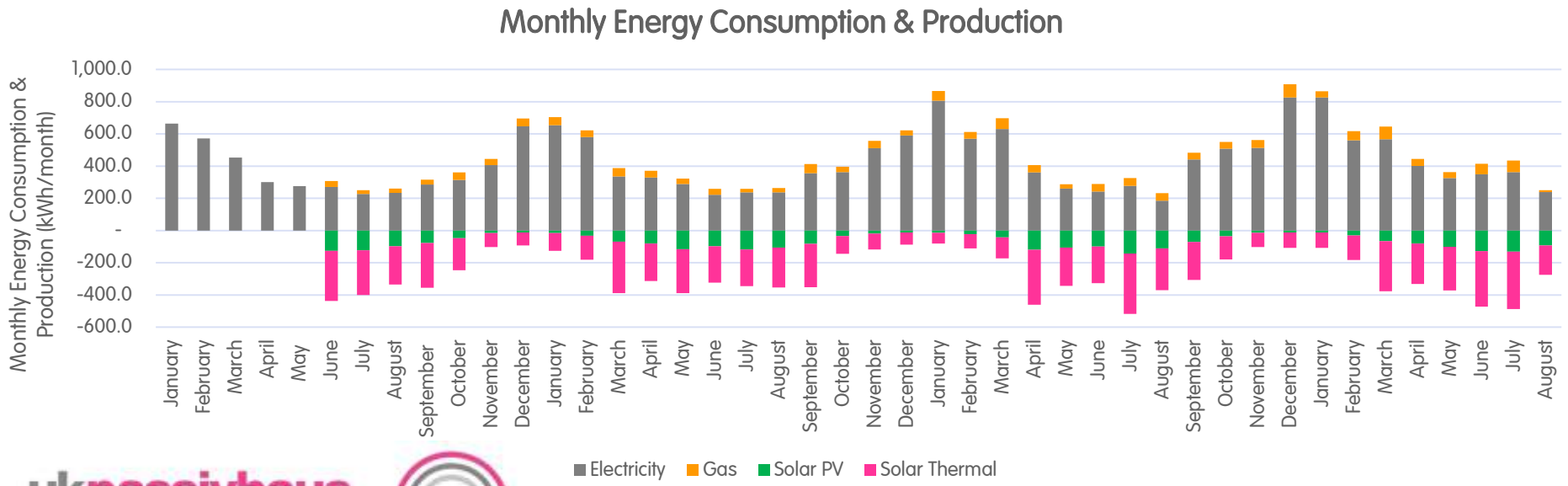
Lena Gardens (PH)

- Ongoing monitoring (April 2011)
- Good monitored energy performance
- Soft feedback = good in terms of comfort and IAQ

Barmouth Road (EnerPHit)

- Ongoing monitoring (April 2014)
- No overheating (Summer 2014)
- Anecdotes

Year	Pre Retrofit	2011	2012	2013
Grid Energy Consumption	252.6 kWh/m².year	25.2 kWh/m².year	26.6 kWh/m².year	31.9 kWh/m².year



3. EnerPHit / PH Standards

Key differences between Passivhaus & EnerPHit standards

PASSIVHAUS

ENERPHIT

Criteria	Based on PHPP heating demand	Based on PHPP heating demand	Based on certified components
Space Heating Demand Q_H	≤ 15 kWh/m2.year	≤ 25 kWh/m2.year	Component Criteria
Primary Energy Demand	≤ 120 kWh/m2.year	≤ 120 + (Q_H-15) * 1.2 kWh/m2.year	
Airtightness	≤ 0.6 ach @50Pa	≤ 1.0 ach @50Pa	
Overheating	≤ 10% (T > 25°C)	≤ 10% (T > 25°C)	

3. EnerPHit / PH Standards

EnerPHit with a ìCertified Componentî approach

Criteria

- Opaque building envelope (floor, external walls & roof)
  - ï $f_T * U \leq 0.15$ W/m².K for exterior insulation
  - ï $f_T * U \leq 0.35$ W/m².K for interior insulation

- Windows
  - ï $U_{W,\ installed} \leq 0.85$ W/m².K
  - ï g *1.6 W/m².K $\geq U_g$

- External Doors
  - ï $f_T * U_{D,\ installed} \leq 0.80$ W/m².K

- Ventilation
  - ï $\eta_{HR,\ eff} \geq 75\%$
  - ï SFP ≤ 0.45 Wh/m³

4. EnerPHit Challenges

Context of greentomatoenergyís retrofit projects

- Typically Victorian / Edwardian solid wall homes in conservation areas
- FaÁade appearance (windows and walls) to be retained
- Non-ideal orientation & compactness (canít be changed!)
- Space limitation

EnerPHit is nearly as difficult to achieve as Passivhaus in these retrofit conditions !!! *

** We believe there are many occasions where EnerPHit is significantly easier, but these occasions donít represent our typical projects.*

Difficult Conditions → Component Approach → Lack of Certified Components → Space Heating Demand Approach

5. EnerPHit vs Passivhaus

greentomatoenergy

5.1 Insulation Approach & Materials

- Same approach to materials (performance / space / cost)
- Similar moisture issues
- Insulation thickness EnerPHit ≤ Passivhaus
- Challenge to achieve consistent U-values of the whole envelope

(costs & space limits → underpinning / room height / room width Ö)

ª Compensation in other areas

Barmouth Road
¡ upgraded solid wall U-values [0.17 to 0.25 W/m2.K]
¡ upgraded existing roof U-value [0.19 W/m2.K]
→ other U-values pushed ≤ 0.10 W/m2.K

5. EnerPHit vs Passivhaus

greentomatoenergy

5.2 Windows & Doors

No certified components that meet exactly planning/heritage conditions

→ **Need to use bespoke products**

- Additional modelling (to assess performance)
- Limited Performance (Uw ≈ 1.0 W/m².K ≠ Uw ≤ 0.80 W/m².K for PH windows)
  [a] Compensation in other areas

Lack of certified ìtraditional lookî retrofit products (entrance doors, windows, Ö)
→ ìCertified Componentî approach made impossible

5. EnerPHit vs Passivhaus

greentomatoenergy

5.3 Airtightness

New airtightness layer in Passivhaus project

To lower EnerPHit project costs:

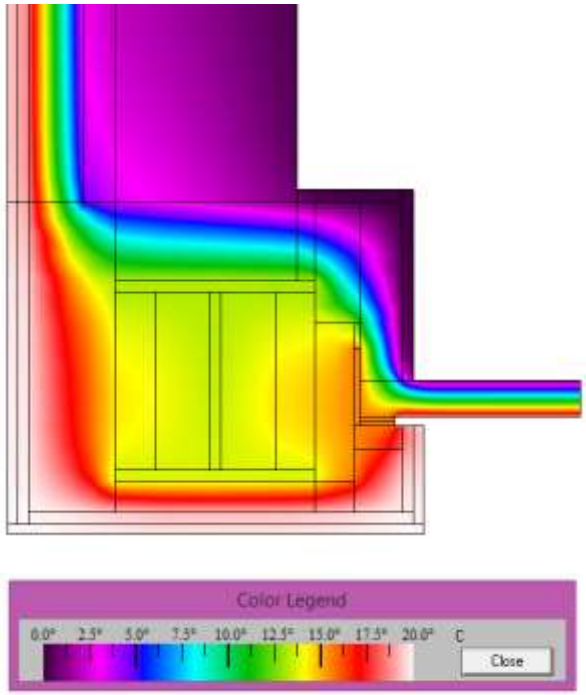
- Retained existing components (staircases, chimney breasts, timber joists Ö) ª more difficult to achieve low n50

- Used non-certified products (rooflights)

ª difficult airtight installation

5. EnerPHit vs Passivhaus

greentomatoenergy



5.4 Thermal Bridging

Challenges with junctions + structure related to modern extensions

- Retrofit ≠ fully thermal bridge free
- Main aim = surface temperature to avoid mould / condensation risks
- Early involvement in design to keep costs / complications manageable

Challenges with timber joists crossing the insulation layer

- Additional modelling (moisture transfer analysis)
- In-situ monitoring

≠ Rehanging of joists within thermal envelope (PH)

ukpassivhaus conference 2014

bre

5. EnerPHit vs Passivhaus

greentomatoenergy

5.5 Ventilation System

- Similar approach to ventilation (MVHR)
- MVHR design not as challenging as people thought when taken into account from early design stage (use of floor voids, stud walls, Ö)

5.6 Heating System

- Heating and ventilation systems separated on EnerPHit projects (as heat load > 10 W/m^2)

6. Retrofit at scale

EnerPHit is unlikely, currently, to be the appropriate standard for mass-scale solid wall retrofit in the UKÖ

Key constraints

- Health and comfort benefits not fully accounted for
- 1.2 million UK dwellings in conservation areas (≥ 50% located in London)
- Use of IWI (with associated moisture risks, thermal bridging and loss of floor space)
  Technological innovation to help?
- Cost of certification higher on domestic retrofit (% of total project cost)
  Possibility for cost reduction?
- UK ìtraditionalî buildings with varied shapes
  Less compact than Central Europe?
- Availability and cost of certified components
  Certified product availability to increase so cost to come down?

6. Retrofit at scale

Öbut the framework provided by EnerPHit is right

Possibilities

- Use of PHPP (whole house performance-based model) to identify reasonable kWh/m^2.year
  - → *based on age and risks (German model)?*
  - → *based on research pilots (TSB)?*
  - → *AECB standards (Silver)?*
- Need for more certified products & product innovation
- Need for readily available low-cost finance / incentives to support deep retrofits (and avoid lock-in risk due to light / medium retrofits)

7. Conclusion

- EnerPHit nearly as difficult as Passivhaus for retrofit of ìtraditionalî UK solid wall homes, mainly due to the lack of aesthetically appropriate and cost-effective certified components
  → *EnerPHit project chosen with care*
  → *Focus on ìCertified Componentî approach*
  → *Certified component market to be developed*

- EnerPHit still unlikely to be appropriate standard for mass-scale retrofit of solid wall houses in the UK
  Öbut the framework provided by EnerPHit is right

Questions