

ENERGY EFFICIENCY IN BUILDINGS

GREEN BUILDING CERTIFICATION

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BUILDING SUSTAINABILITY ASSESSMENT

There are systems for assessing the building sustainability in different aspects.

Some measurable aspects are:

- ☐ Energy consumption in materials production
- ☐ Energy efficiency
- ☐ Use of non-pollutant materials
- ☐ Possibilities for recycling and recovery
- ☐ Use of recycled materials
- ☐ Building use
- ☐ Energy consumption during use stage
- ☐ Use of surrounding resources
- ☐ Water consumption
- ☐ Access to natural light
- ☐ Heating and cooling systems
- ☐ Indoor air quality



BUILDING SUSTAINABILITY ASSESSMENT

Certification developed by an accredited assessor

Why is it useful?

- market recognition for low environmental impact buildings
- confidence in tested environmental practice
- innovative solutions to minimise environmental impact
- a standard for progress towards environmental objectives



BREEAM at a glance

1st

FOUNDED IN 1990, THE WORLD'S
FIRST
SUSTAINABILITY ASSESSMENT METHOD FOR
BUILDINGS



HOLISTIC MEASUREMENT ACROSS
9
CATEGORIES



APPLIED IN OVER
70
COUNTRIES WORLDWIDE



80%
EUROPEAN MARKET SHARE



ADAPTABLE
TO LOCAL AND CLIMATIC CONDITIONS



1000'S
OF LICENSED ASSESSORS WORLDWIDE



BRE SCIENTIFICALLY BACKED
STANDARDS



DRIVING BUILDING SECTORS TO
INNOVATE



INCREASED
FINANCIAL
RETURNS FOR INVESTORS



Primary aim?

- *“....to mitigate the impacts of buildings on the environment; to enable buildings to be recognised according to their environmental benefits; to provide a credible, environmental label for buildings; [and finally] to stimulate demand for sustainable buildings.”*
- Does BREEAM achieve this?



BREEAM in numbers

BREEAM in numbers worldwide

550,929

Certificates

2,252,672

Registered Buildings

77

Countries





Categories



Energy



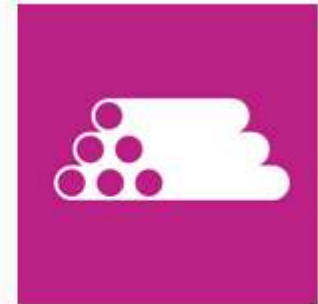
Health and
Wellbeing



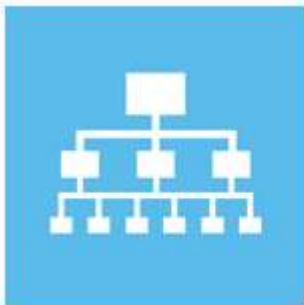
Innovation



Land Use



Materials



Management



Pollution



Transport



Waste



Water

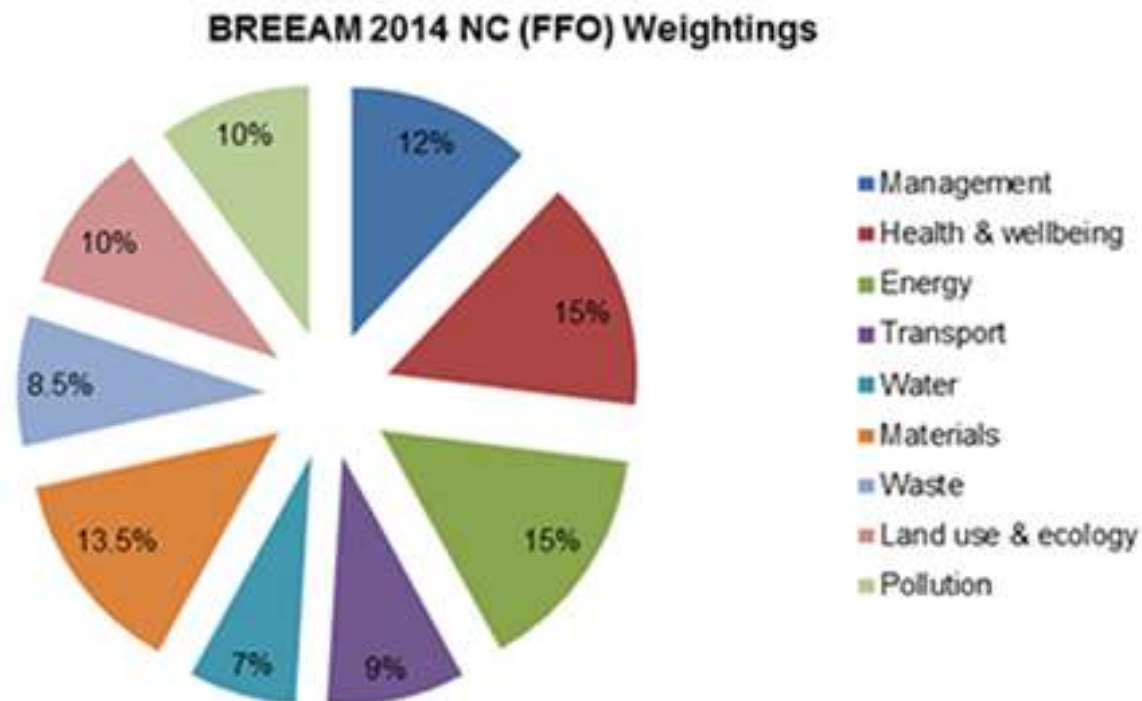


BRE Global Limited

Based in the UK

One of the most extended in the world

VIDEO





National Scheme Operators



International



United Kingdom



Germany



Netherlands



Norway



Spain



Sweden



Austria



BREEAM New Construction

BREEAM International New Construction

BREEAM In-Use

BREEAM Refurbishment

BREEAM Communities



Strengths?

- Allows comparison & benchmarking of different buildings
- Independently audited
- Adjusted to UK legislation and culture
- Backed by UK Government
 - Require BREEAM ratings on public buildings
- Can assess any building with Bespoke version
 - Can also adapt to local contexts
- Based on carbon dioxide
- More academic & rigorous



Weaknesses?

- Very exacting requirements
 - ‘Paper chase’
- Complex weighting system
- Market profile
- Cost of compliance
- No “one size fits all”
- Based on carbon dioxide?



Source: www.stvincentplaza.com



Sources of information

- Planning Portal (www.planningportal.gov.uk)
- BREEAM (www.breeam.com)
- UK Government (www.gov.uk)
- Journal papers (on moodle)
 - Also try Science Direct (www.sciencedirect.com)
 - UWTSD library catalogue
(<http://librarycatalogue.uwtsd.ac.uk/>)



CSH – background

- Building a Greener Future: Towards Zero Carbon Development
- Assessment stages:
 - Registration of site
 - Formal assessments at design & post-construction stage
- Credit rating
 - Categories broken down into ‘issues’
 - Weightings applied
 - Final code score
- Six Code levels



Code for Sustainable Homes

Primary aim?

- *“..the national standard for the sustainable design and construction of new homes, aiming to reduce carbon emissions and create homes that are more sustainable.”*
- *“...environmental assessment method for rating & certifying the performance of new homes.”*

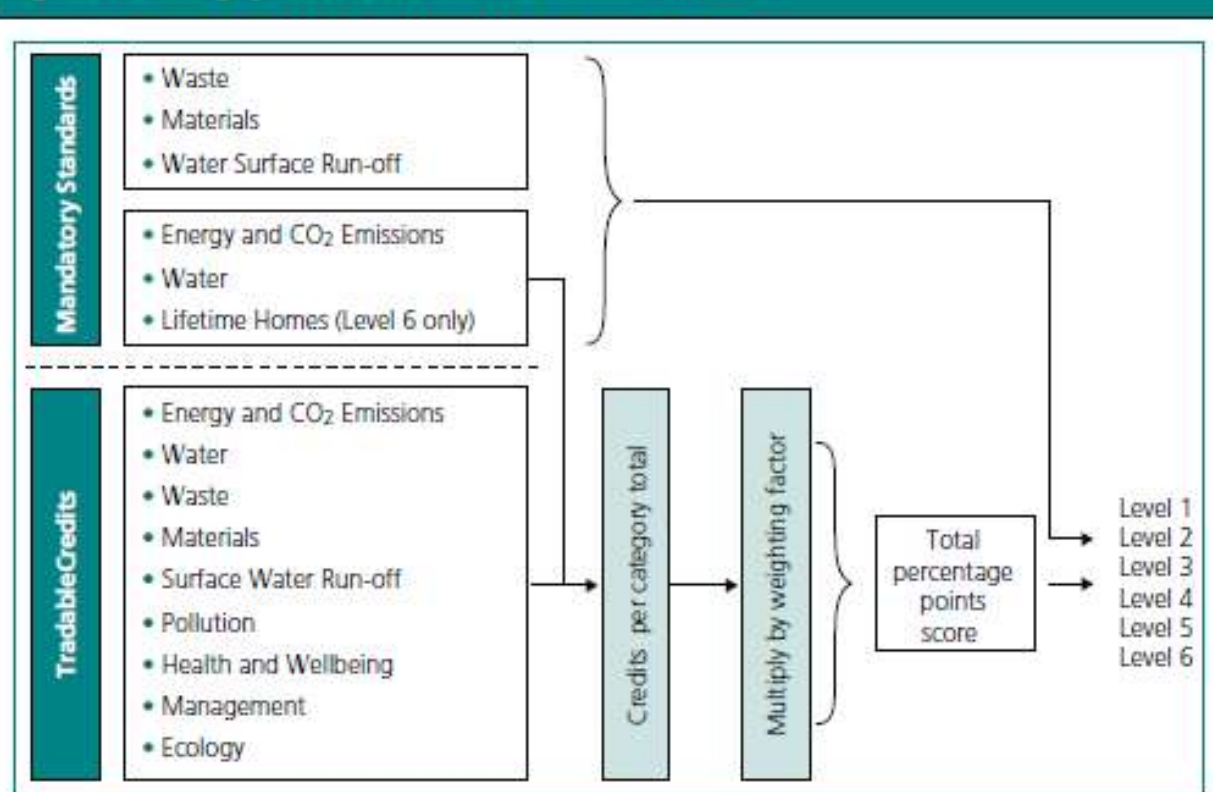


Environmental impact categories

Code categories	Available credits	Weighting factor
Energy & CO ₂ emissions	31	36.4
Water	6	9
Materials	24	7.2
Surface water run-off	4	2.2
Waste	8	6.4
Pollution	4	2.8
Health & well-being	12	14
Management	9	10
Ecology	9	12
TOTAL	107	100

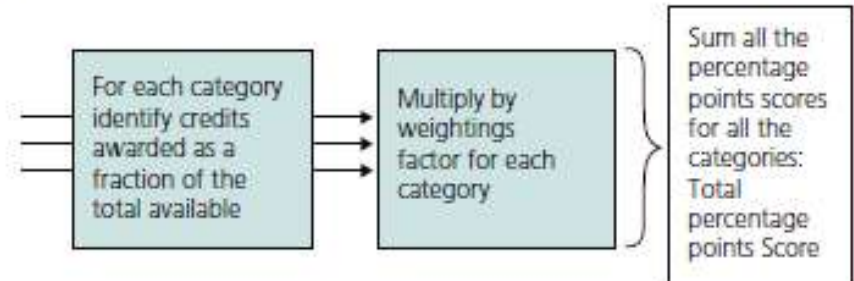
Scoring system

Figure 1.3: Scoring System for the Code for Sustainable Homes



Categories

- Energy and CO₂ Emissions
- Water
- Materials
- Surface Water Run-off
- Materials
- Waste
- Health and Wellbeing
- Management
- Ecology



Source: Code for Sustainable Homes, Technical Guidance, 2010, p16



Code levels

Code levels	Description	Total score
Level 1 (★)	Above regulatory standards, similar to EcoHomes PASS and EST Good Practice Standard for energy efficiency	36 points
Level 2 (★★)	Similar to EcoHomes GOOD standard	48 points
Level 3 (★★★)	Similar to EcoHomes Very GOOD / EST Best Practice standard	57 points
Level 4 (★★★★)	44% improvement above Part L 2006 / 25% above Part L 2010	68 points
Level 5 (★★★★★)	Exemplary performance with high standards of energy & water efficiency	84 points
Level 6 (★★★★★★)	Aspirational, based on zero carbon emissions & high performance across all environmental categories	90 points

Level 6 to be achieved on homes by 2016



Design stage assessment

- Aims:
 - To assess the design specifications for each individual dwelling
→ interim / design stage rating
 - Award interim / design stage certificate
- RIBA Plan of Work stage 0-4
- At this stage:
 - Demonstrate performance requirements for credited mandatory issues are met
 - Choose remaining tradeable issues required to achieve overall rating
 - Evaluate performance of each dwelling against the chosen issues
 - Assemble and check evidence



Post-construction stage assessment

- Aim:
 - To assess each individual dwelling as built to determine the final score and Code level
 - Can use design stage assessment as starting point
 - Otherwise completed against as-built dwelling
- At this stage:
 - Appropriate number of site visits (min. 1 per site)
 - Review each specification, collect evidence
 - For phased releases, assessments must show the same specifications have been incorporated OR dwellings will be reassessed
- Phased development – some exceptions for first dwelling



CSH in numbers

- Up to 31st March 2012:
 - 64,664 PC stage certificates
 - 113,236 DS certificates
- Largest proportion of certificates are 3-star rating
 - 77% at design stage
 - 85% at post construction stage
- Largest proportion with PC certificates built for public sector (84%)
- Dwellings achieving 6-star rating (PC) - 142



Strengths?

- Voluntary scheme
- Drove down environmental impact of new homes
- Made residential renewables more affordable
- Exceeds other international standards wrt self generation
- Phased development i.e. zero carbon by 2016
 - Achievable?
- Provide long term benefits for whole economy
 - Reducing energy bills, skill creation, less impact on environment
- Government incentives
 - Stamp duty, land tax relief



Weaknesses?

- Voluntary scheme
- Why not legislated for?
- Additional building costs
- Technical & design barriers
- Integration of renewables
- Only applicable in England?
- Zero carbon definition





Right to withdraw?

- Cut housebuilding regulation by 90%
- Allows councils to adopt own sustainability levels
- Elements will be included within Building Regulations
 - Set at equivalent of Code level 4
 - Ignores localism?
- Did have ambiguities within the system
 - E.g. zero carbon definition
- Will continue with certain contractual arrangements
 - E.g. Affordable Funding Programme for RSL 2015-2018
 - Legacy sites may still build to the Code



Home Quality Mark (HQM)

- BRE
- Voluntary certificate
- BETA version 2016
- HOME ONE launched in August 2018





Home Quality Mark (HQM)

- Our Surroundings
 - Transport and movement
 - Outdoors
 - Safety and resilience
- My Home
 - Comfort
 - Energy
 - Materials
 - Space
 - Water
- Delivery
 - Quality assurance
 - Construction impact
 - Customer experience



Standard

(<http://www.homequalitymark.com/standard>)



LEED – a little history

- 1993 – Natural Resources Defence Council
- 1994 – 2006: one standard for new construction to six standards covering development & construction processes
- 1998 – launched
 - LEED NCv1.0 – pilot version
 - LEED NCv2.2 – released 2005
 - Now at LEED v4
- 2003 – LEED Canada-NC v1.0
- Today – suite of rating systems



Primary aim?

- *“..helps a building be environmentally responsible and use resources efficiently.”*
- *“...reduces the carbon footprint by saving energy, water and other resources; increases productivity from fresher air, good lighting and access to views, and access to daylight; helps to boost performance and productivity.”*



LEED credit categories



Five credit categories

LEED for
Neighbourhood
development

LEED for Homes

Bonus credit



LEED rating levels





BUILDING SUSTAINABILITY CERTIFICATION

THIS is

LEED®

LEED® for

BUILDING DESIGN + CONSTRUCTION

LEED® for

BUILDING OPERATIONS + MAINTENANCE

LEED® for

INTERIOR DESIGN + CONSTRUCTION

LEED® for

HOMES

LEED® for

NEIGHBORHOOD DEVELOPMENT



LEED in numbers

56,000
LEED PROJECTS





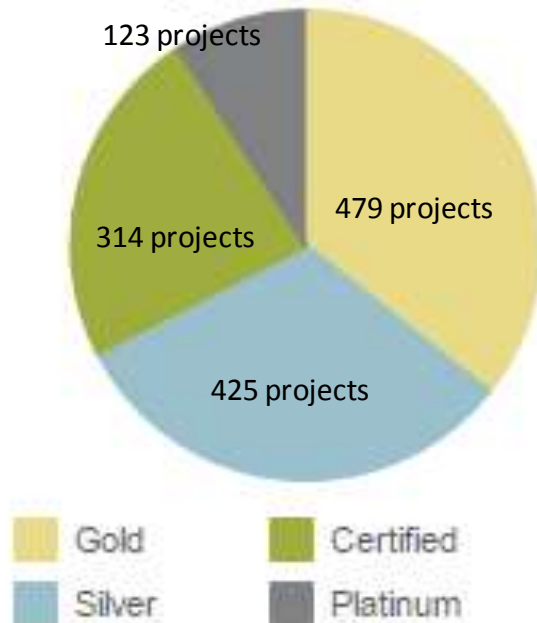
LEED in numbers



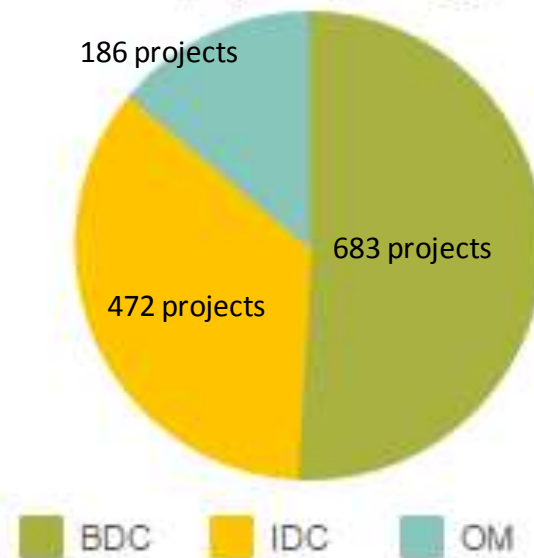


LEED in numbers

Certified projects by achievement



Certified projects by rating system





LEED SYSTEM

Green Building Council Network

GBCs are member-based organisations

- Prospective
- Emerging
- Established

Regions:

- Africa
- Americas
- Europe
- Asia Pacific
- MENA (Middle East and North Africa)



WORLD
GREEN
BUILDING
COUNCIL

VIDEO

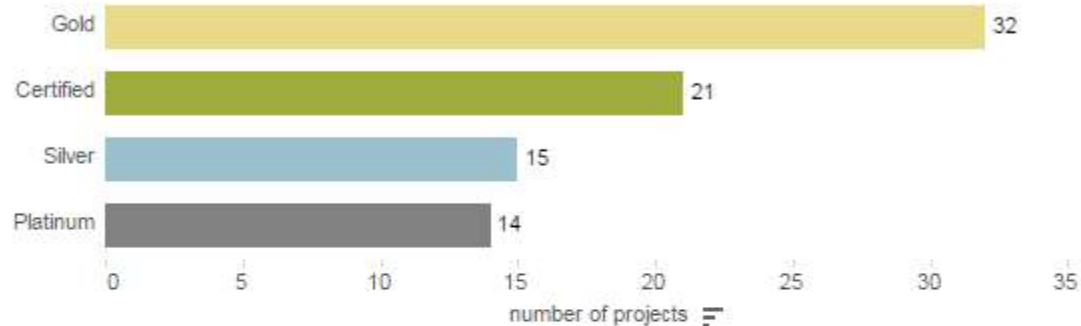


LEED in the UK

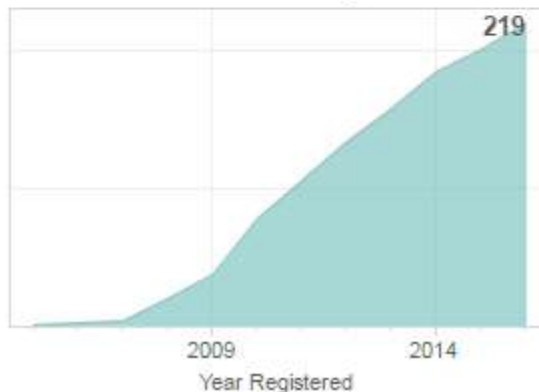


Country Market Brief: United Kingdom ..

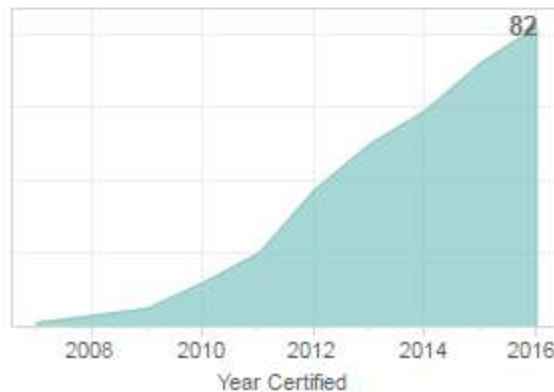
LEED® Achievement



Cumulative LEED® Registrations



Cumulative LEED® Certifications



Summary

(last updated 10/11/2016 10:42:32 AM)

Project Status	number of projects	gross square meters
Certified	82	396,808
Registered	137	2,018,784
Grand Total	219	2,415,593

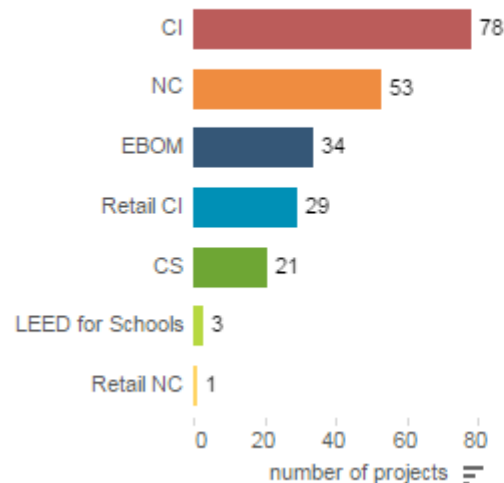
Certified square meters equivalent to Taipei 101.





LEED in the UK (contd)

LEED® Rating Systems*



Space Type*

Office	122
Retail	35
Lodging	28
Datacenter	11
Higher Ed	3
Industrial Manufacturing	3
K-12	3
Public Assembly	3
Laboratory	2
Other	2
Warehouse and Distribution	2
Office: Mixed Use	1
Service	1

Owner Sector*

Corporate	168
Investor	34
Federal Government	4
Higher Ed	4
Local Government	2



Strengths?

- Credits awarded by 3rd party technical reviewers
- Certificate issued by US-GBC
- Credits developed through public comments & expert interpretation
- Comparable across the globe
- Regional bonus credits (US ONLY)
- National versions being developed
- Does not require trained assessors
- Mandatory post-construction review



Weaknesses?

- Voluntary?
- Time consuming
- Cost (esp. consultants)
- Based on US system
- Does not recognise innovation
- Based on US dollars
- Lots of documentation
- Does not adapt to local contexts



Source: Columbia University Facilities



Comparison to BREEAM?

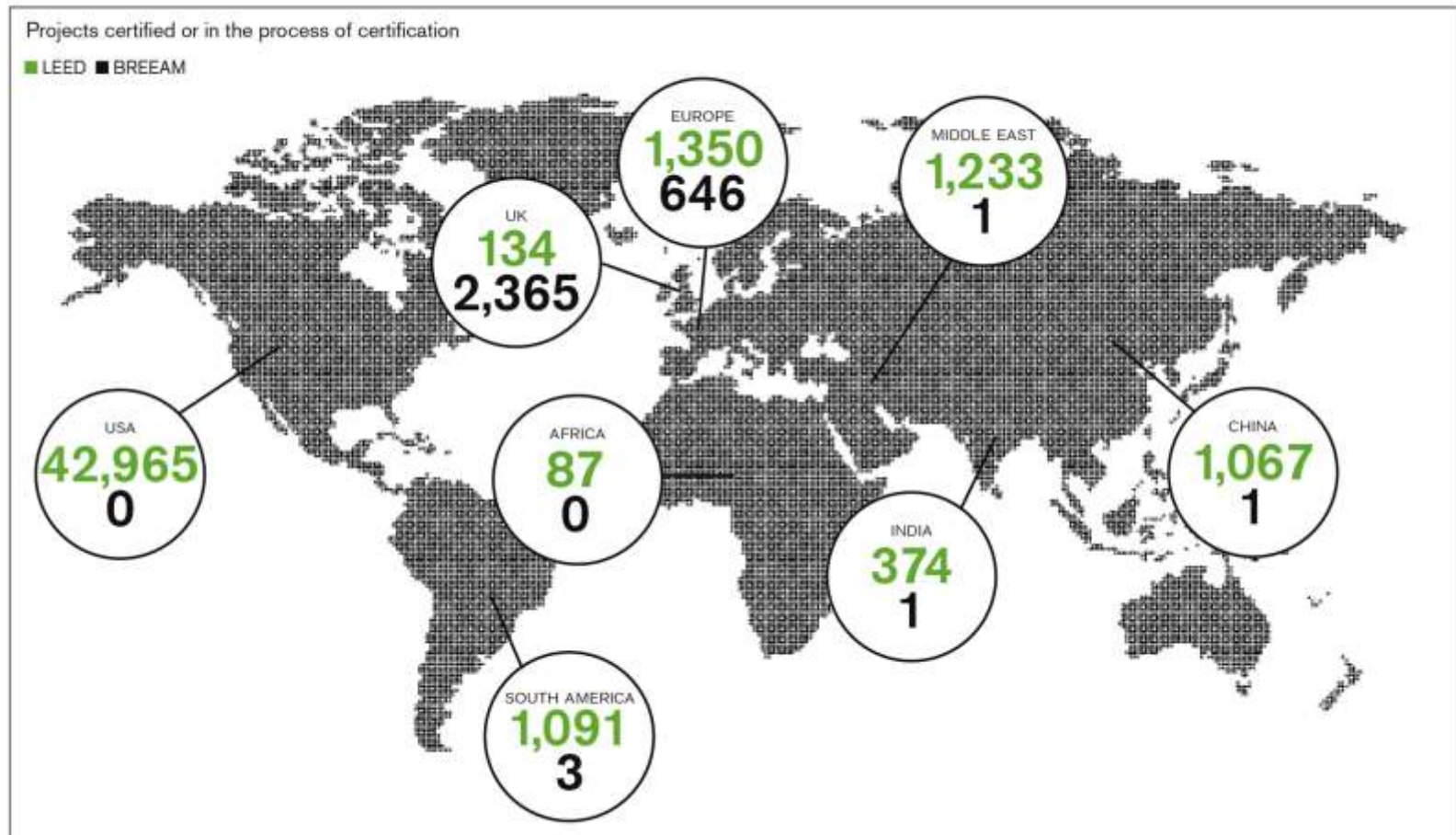
- **In common:**
 - Do share common components
 - Early involvement of assessor / AP benefits project & rating
 - Drive the market to improve building design
 - Criteria keep to pace with legislation / best practice
 - Global corporate policy

- **Differences:**

BREEAM	LEED
Legislation / best practice	Optional standards
Quantitative thresholds	Percentage thresholds
Based on CO ₂	Based on US Dollars
Main application in UK	Niche application in UK
Assessor involvement	Team involvement



Comparison to BREEAM





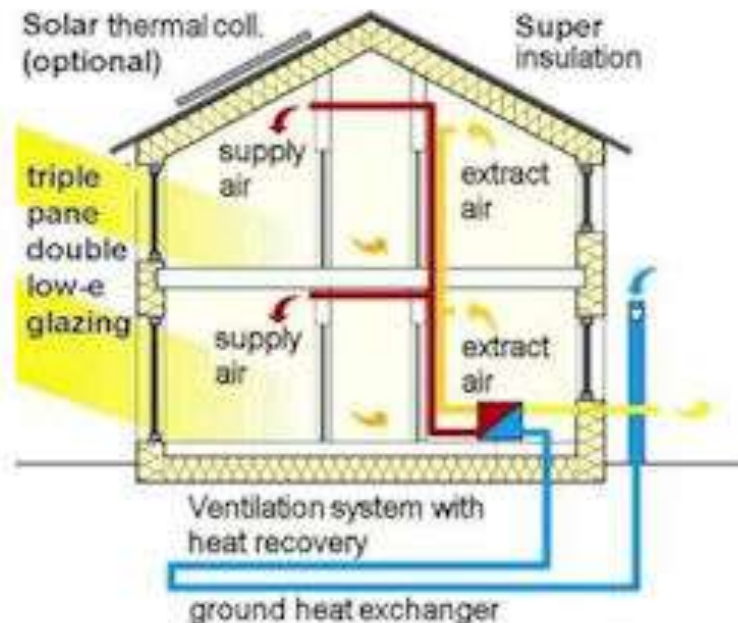
Passivhaus - Definition

- *“A Passivhaus is a building, for which thermal comfort can be achieved solely by post-heating or post-cooling of the fresh air mass, which is required to achieve sufficient indoor air quality conditions – without the need for additional recirculation of air”. (www.passivhaus.org.uk)*



Passivhaus – background

- Performance standard



- Video https://www.youtube.com/watch?v=_oRUs7p5mMM



Primary aim?

- *“..world leading fabric first approach to low energy buildings.”*
- *“...reduces the requirement for space heating / cooling by use of passive measures, and maintains indoor air quality through mechanical ventilation.”*



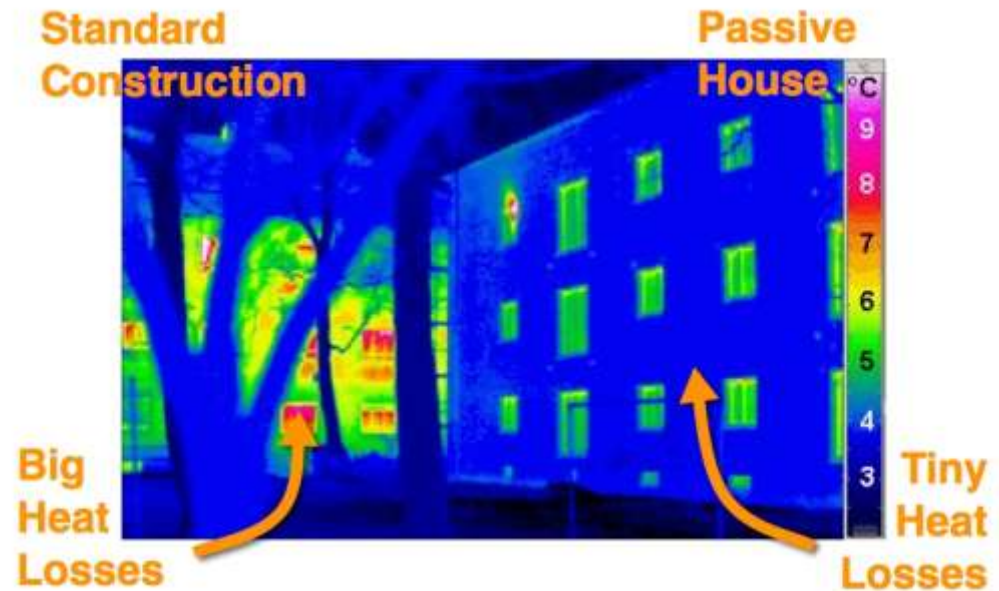
PASSIVHAUS

Looking for 3 main outputs:

- Comfort
- Energy efficiency
- Quality Assurance

5 Basics:

- Integrated design
- Location
- Orientation
- Form
- Construction system



**PASSIVE HOUSE IS
FUNDAMENTALLY
ABOUT DESIGN**

VIDEO



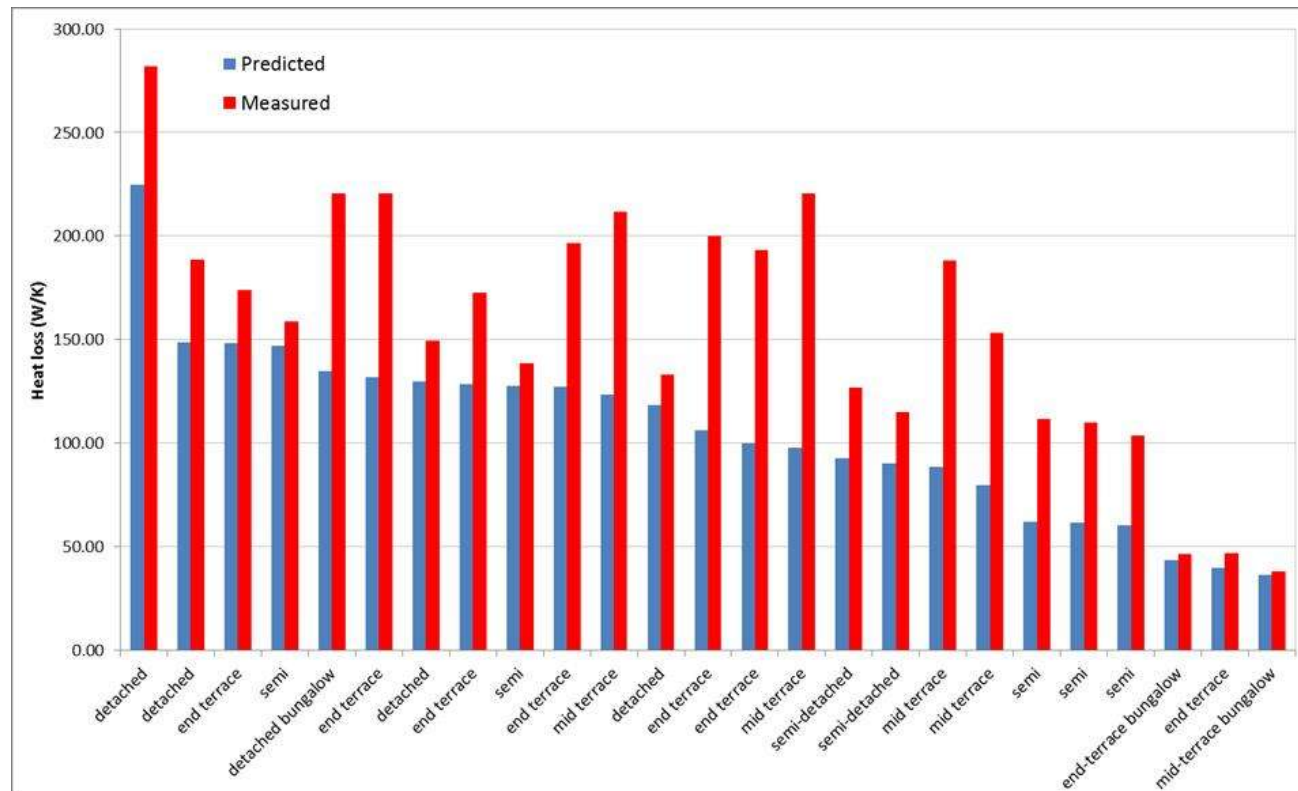
Outline specification

Energy Performance Targets and air changes per hour	
Specific heating demand	$\leq 15 \text{ kWh/m}^2 \text{ per yr}$
Specific cooling demand	$\leq 15 \text{ kWh/m}^2 \text{ per yr}$
Specific heating load	$\leq 10 \text{ W/m}^2$
Specific primary energy demand	$\leq 120 \text{ kWh/m}^2 \text{ per yr}$
Air changes per hour	$\leq 0.6 @ n50$



PASSIVHAUS

The performance gap – Passive House value





PASSIVHAUS

Passive House Institute

Independent research institute lead by Dr Wolfgang Feist
First pilot project (Kranichstein Passive House, Darmstadt, Germany, 1990)



iPHA Affiliate Organisations

Austria	Hungary	Sweden
Australia	Ireland	Turkey
Canada	Italy	United Kingdom
Germany	New Zealand	United States
Estonia	Portugal	
Spain	Greece	





Strengths?

- Voluntary standard
- Simple approach
- Performance-based
- Clear & economic model
- Assumes internal temp of 21 °C
- Healthy living
- Reduces sources of internal air pollution
- Buildings perform as modelled
- Simple for users
- Efficiency savings
- Amount of direct sunlight



Weaknesses?

- Limits of energy demand / ach warmer climates
- MVHR – additional capital & maintenance costs
- Health implications if not maintained
- Requires behaviour change
- Is 21 ° C comfortable for all?
- Renewables optional
- Not adaptable
- NOT zero carbon
- Increased construction costs



Source: www.passivhaustrust.org.uk



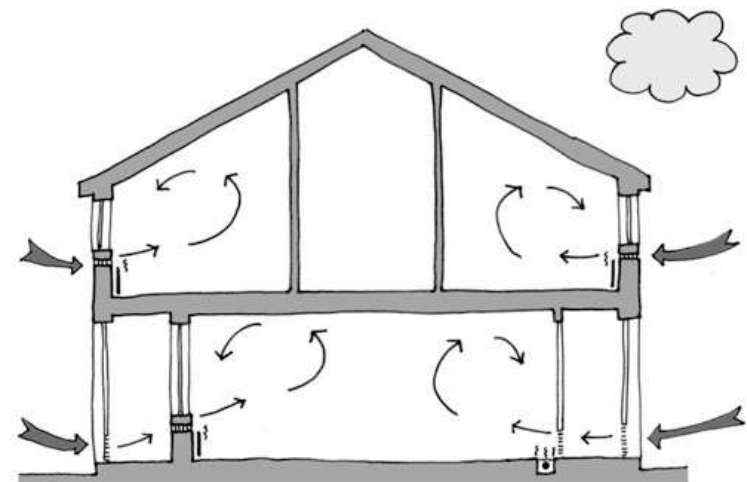
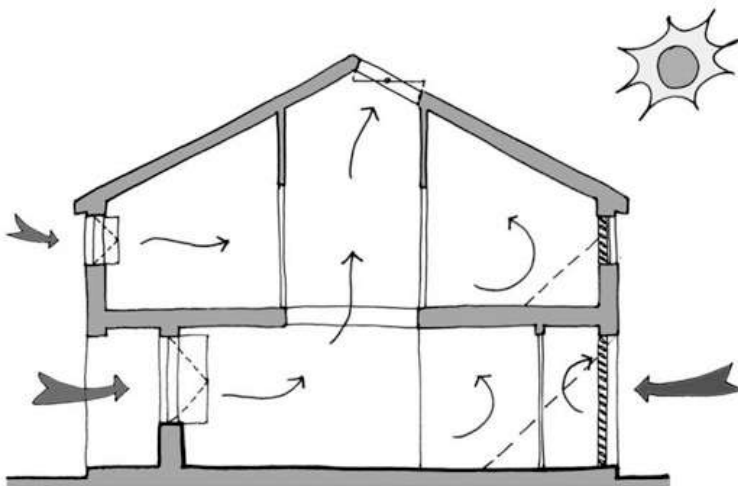
Misconceptions

- “Its too expensive to build to Passivhaus standard”
- “But you can’t open a window” / “The air will be too stuffy”
- “The walls are too thick”
- “It will be too cold / too hot”
- “It doesn’t look traditional”
- “It has to be built with sustainable materials”
- “The ventilation system costs too much to run / has to run all the time / too complicated to use”
- “We can’t have a woodburner”
- “Its only for domestic use, right?”



Application in the UK?

- Shown to suit climatic conditions
- MVHR may not deliver low energy performance in UK
 - Use more passive methods?
- UK construction standards
 - Airtightness? Use of triple glazing?
- UK lifestyle



Source: The Passivhaus Standard in the UK: Is it desirable? Is it achievable?



Map of Passivhaus buildings in the UK & Ireland

Source:
www.peterwarm.co.uk



Some concepts to compare

- Passive design
- Performance gap
- Use of renewable energies
- Materials
- Insulation
- Ventilation
- Transport