



LESSONS

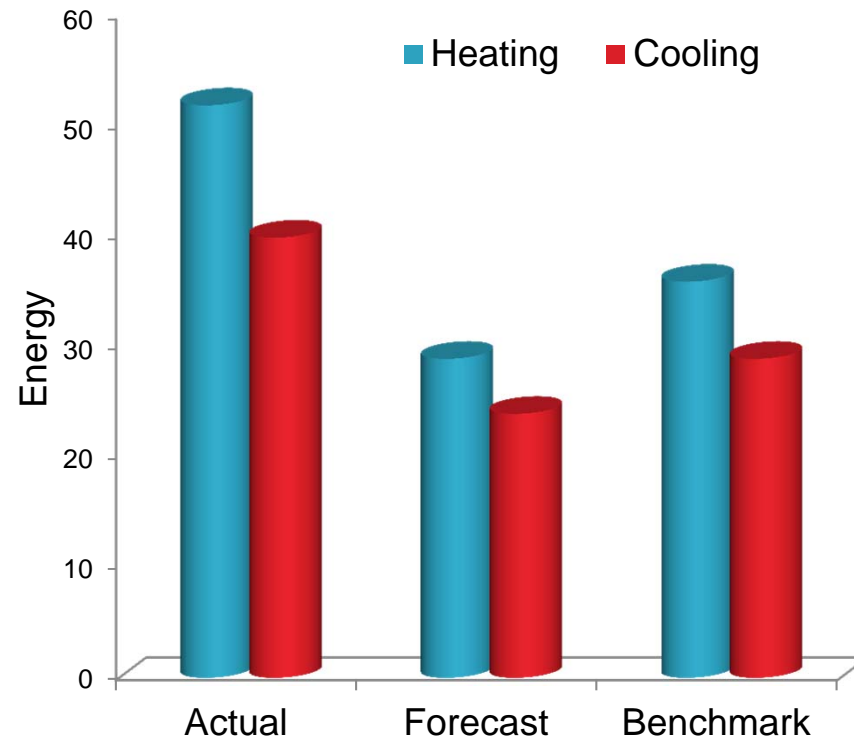
Presented by
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Institute of Energy
and
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De MontFort University
ICEBO Conference
Manchester Hilton
24th October 2012

Introduction



- There is high confidence that human activity is warming the climate – IPCC 4AR
- We need to limit stabilise carbon dioxide in atmosphere to 450 ppm.
- Buildings account for 40% of carbon emissions.
- Massive gaps between building design and actual building performance.
- Key step – Base new designs on lessons learnt from previous building designs.

Actual vs Forecast energy use



EPC vs. DEC!!



Energy Performance Certificate

15, Spring Lane
Horbling
SLEAFORD
NG34 0PF

Dwelling type: Detached bungalow
Date of assessment: 22 July 2011
Date of certificate: 25 July 2011
Reference number: 8439-6723-8570-3862-5926
Type of assessment: RdSAP, existing dwelling
Total floor area: 157 m²

This home's performance is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on carbon dioxide (CO₂) emissions.

Energy Efficiency Rating		Environment Impact (CO ₂) Rating	
	Current	Potential	
Very energy efficient - lower running costs			Very environmentally friendly - lower CO ₂ emissions
(92 plus) A			(92 plus) A
(81-91) B			(81-91) B
(69-80) C	70	77	(69-80) C
(55-68) D			(55-68) D
(39-54) E			(39-54) E
(21-38) F			(21-38) F
(1-20) G			(1-20) G
Not energy efficient - higher running costs			Not environmentally friendly - higher CO ₂ emissions
England & Wales EU Directive 2002/91/EC		England & Wales EU Directive 2002/91/EC	

The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO₂) emissions. The higher the rating the less impact it has on the environment.

Estimated energy use, carbon dioxide (CO ₂) emissions and fuel costs of this home		
	Current	Potential
Energy use	125 kWh/m ² per year	118 kWh/m ² per year
Carbon dioxide emissions	4.8 tonnes per year	4.6 tonnes per year
Lighting	£85 per year	£85 per year
Heating	£603 per year	£568 per year
Hot water	£132 per year	£121 per year

Energy Performance Operational Rating

This tells you how efficiently energy has been used in the building. The numbers on and around represent actual costs of energy consumed. They represent comparable energy efficiency. 100 would be typical for this class of building.

Total CO₂ Emissions

This tells you how much carbon dioxide the building emits. It shows tonnes per year of CO₂.

More energy efficient

A 0-25
B 26-50
C 51-75
D 76-100
E 101-125
F 126-150
G Over 150

100 would be typical

← 108

Less energy efficient

Previous Operational Ratings

This tells you how efficiently energy has been used in this building over the last three accounting periods.

LESSONS



- LESSONS – New Web based design tool providing knowledge gained from previous designs.
- Closing the gap between forecast and actual building performance.
- Supported by industry.
- Key stakeholders – Architects, Engineers, Manufacturers and Group organisations

Aims of LESSONS



- Design tool containing quantitative, explicit knowledge and qualitative, tacit knowledge.
- Data presented in simple accessible manner.
- Applicable to new build and retrofit/refurbishment.
- Initially for housing and school design.
- Offices, retail, courts etc....future additions
- Also addition of other environmental features..water

Objectives of LESSONS



- Existing tools provide means of calculation and have no lessons. Designers have to independently gather information.
- Make case studies central to the DB.
- Database providing previous design information and 'rules of thumb' guidance.
- Early stage design information available for novice to expert level.
- Integrate DB with established dynamic simulation modelling tool. IES VE

Methodology

- Surveys, questionnaires and workshops.
- 100 contemporary case studies identified.
- Case study codification and content analysis.
- Inform User interface



Welcome


LESSONS

Home Page

Login - Register



Building Build Type Sector Construction	Location Country Region City Rural	Energy Target <u>Passivhaus</u> <u>Blg Regs</u> <u>CfSH</u>	Assessment All LEED BREEAM	Performance CO2 All High to Low Low to High Specified



Lessons
Design and decision tool for low impact buildings

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 ▶ Code for Sustainable Homes
 ▶ EPC
 ▶ BREEAM
 ▶ Passivhaus
 ▶ CO2 Performance
 ▶ Cost By Area

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- CO2 Performance
- Cost By Area

Building Sector

Domestic

- Detached (27)
- Semi-Detached (21)
- Terraced (18)
- Apartments (10)
- Other Domestic (1)

Educational

- Early Years (1)
- Primary (3)
- Secondary (18)
- Further Education (2)
- Higher Education (1)
- Other Educational (0)

Other

- Offices (2)
- Healthcare (0)

107

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LESSONS		
Category	Sub-Category	Lesson
Construction Process	Design	The walls of the building are constructed from pre-fabricated timber frame panels which contain insulation manufactured from recycled newspaper. In addition to offering insulation in excess of the levels required under current legislation, the panels fit neatly together with air-tight joints and so reduce uncomfortable and energy wasting draughts. These prefabricated panels accelerated the build process and reduced the generation of on-site waste during construction.
Construction Process	Manufacture	
Construction Process	Construction	
Technology Types	Insulation	
Construction Process	Design	An underfloor heating system has been installed in most areas of the building. Underfloor heating is an efficient means of providing warmth evenly across a whole room and improves comfort levels by avoiding the creation of hot and cold spots. The heating system is supplied by highly efficient gas condensing boilers.
Construction Process	Design	The school was designed to maximise the availability and use of natural lighting. The classrooms have sloped ceilings and are glazed at occupant level on both outer facing walls. On the opposing walls, which face into the courtyard, windows are mounted at a higher level. The classrooms are thus provided with ample daylight. Glazing on the Northern elevation of the building is minimised to prevent heat loss. Inevitably, however, some artificial lighting was required in the school. To provide this without excessive energy consumption, the design team opted for highly efficient fluorescent lighting with automatic controls. These controls, which monitor both occupancy and level of natural light in the room, minimise energy use by ensuring that lights are only switched on when the room is occupied and by automatically dimming the lights in relation to the amount of daylight available.
Construction Process	Glazing	
Construction Process	Design	Control Lighting to Save Energy No matter how efficient the light, it will waste energy if left on whilst the room is empty. Also, using natural light will only save energy when electric lights are controlled in relation to the amount of daylight available (i.e. dimming or switching off when there is sufficient daylight to support the activity being undertaken in the room). For new buildings, or refurbishment of lighting systems in existing buildings, select automatic lighting controls
Wider	Management	www.buildinglessons.com/casestudy/view?casestudyid=139 - Google Chro

Currently No Image Available

Windygoul Primary School

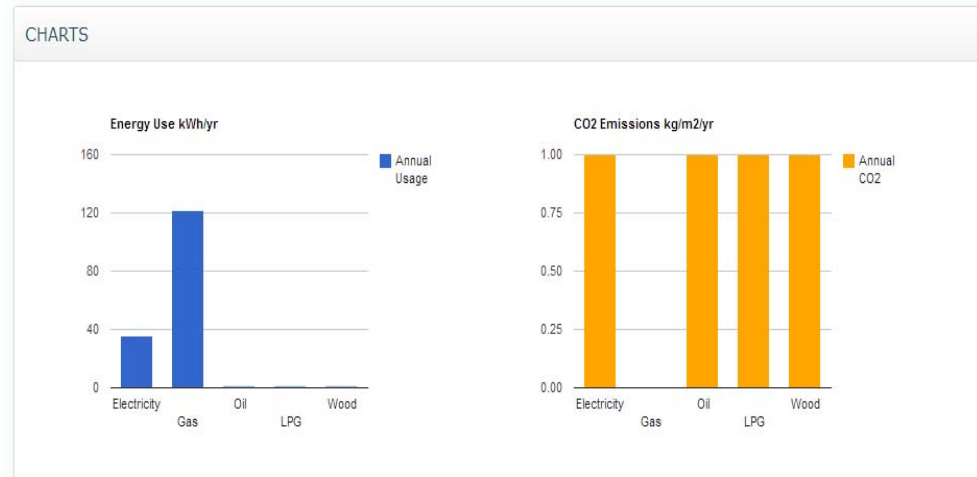
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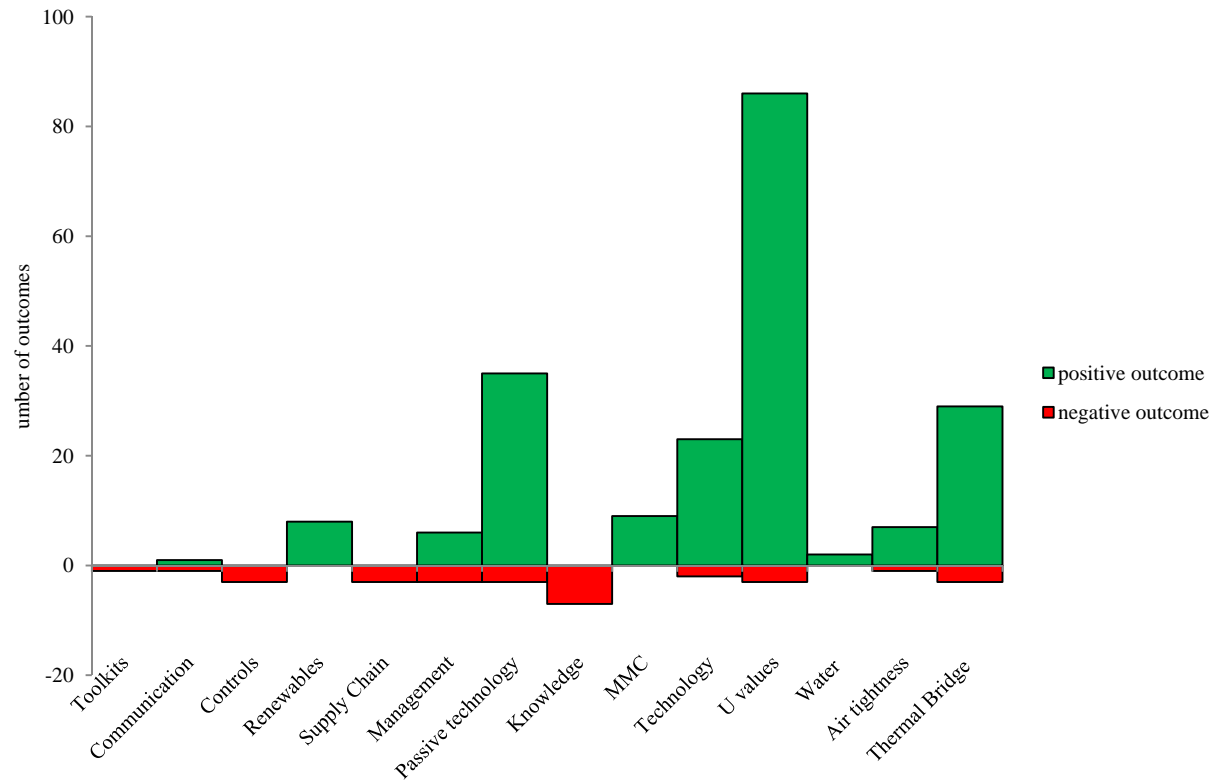
GENERAL

Energy codification education/domestic sectors combined

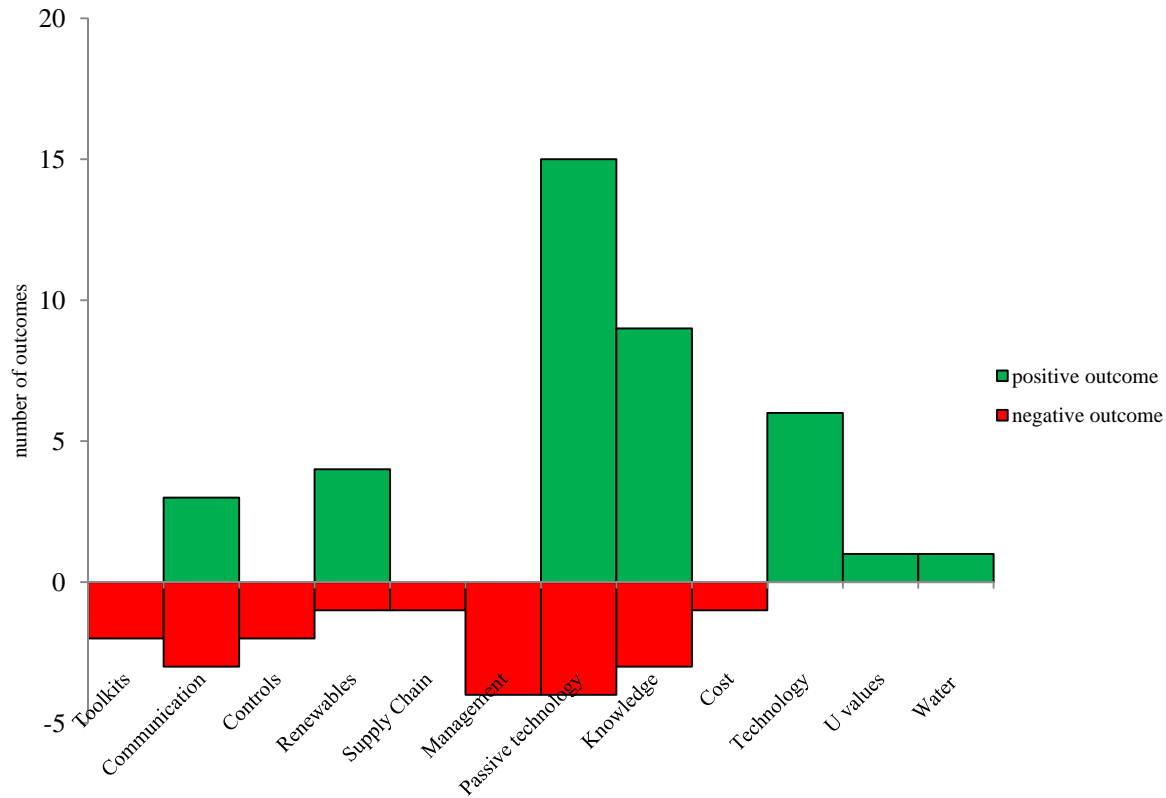


Theme	-ve outcome	+ve outcome	Total
Fabric performance	7	123	130
Passive technology	7	50	57
Technology	2	29	31
Renewable energy	1	12	13
Management	7	6	13
Off site construction	0	9	9

Energy Outcomes in the Domestic Sector



Energy Outcomes in the Education Sector



Example – Elm Tree Mews York (JRF)



- New Build Housing, >AD Part L 1B 2006, CfSH Level 4





Insights

- Thermal bridging leads to heat loss.
- Elm Tree Mews, TB responsible for 25% whole heat loss.
- Lessons
 - Energy failure due to incorrect U- values
 - Tacit knowledge gap, reliance on SAP standard details
 - Tacit knowledge gap, poor design detailing



Insights

- Air tightness – cause of heat loss up to 50%
- Elm Tree Mews, High levels of infiltration
- Lessons
 - Energy failure due to difficult junction details
 - Target not made explicit in design brief
 - Tacit knowledge gap, poor design detailing

Example – Cottesmore Road Leicester (EMHA)



- Refurbishment, Retrofit for the future, improved infiltration and insulation





Insights

- Loss of floor area due to new internal insulation
- Lessons
 - Pod installation in attic to address floor area loss
 - MMC solution
 - Requires good communication between contractor and client

Example – Meden Vale Notts (Nottingham University)



- Whole house retrofit solution





Insights

- Thermal bridging reduced
- Passive solar strategy

- Lessons
 - Specialist knowledge sought for correct detailing
 - Openings must be the same on all properties
 - Prevents problems with different planning permissions
 - Helps to make project repeatable

Example – Northampton Academy



- New build secondary school





Insights

- Night time cooling
- Estimate unregulated loads
- Allow for growth in IT loads

- Lessons
 - Energy consumption through night cooling seek expert knowledge for design, better use of BMS
 - Explain impact of unregulated loads to client – No shocks /manage expectation
 - Future proof design by allowing for growth in IT loads



Next Steps

- Beta test tool November 2012.
- Addition of new building sectors - commercial property.
- Populate tool with international case studies and lessons.
- Marketing of tool.



Conclusions

- The 6 themes that emerged from this study where energy performance can be improved are:
 - Fabric performance,
 - Use of passive technology,
 - Technology (such as MVHR),
 - Renewable energy,
 - Management, and
 - Off site construction techniques.



Conclusions

- The 3 interventions that will have the biggest impact on energy reduction are:
 - The provision of insulation,
 - The reduction in thermal bridging, and
 - The use of passive technology.
- Throughout the study the importance of attention to detail in the initial design stage has frequently been mentioned. Failure to do so has led to some apparently fairly trivial decisions and design changes resulting in large impacts on the energy performance of buildings.



Try LESSONS
www.buildinglessons.com

Thank you

Acknowledgements



The LESSONS project is funded by the Technology Strategy Board.
(TSB)

Collaborators



PICK EVERARD



Case study data fields domestic sector



Ref	Lesson	Building	Location	Energy target	Environmental assessment	Performance
P001	Underestimation of timber fraction resulted in significant heat loss – 23%	Terraced Timber frame	York	> AD1B 2006	CfSH 4	Low carbon 20 kg/m ² /yr

Lesson classification domestic sector



Approach	Process	Technology	Wider subject area
Aspirational	Design	Natural vent	Management
Regulation	Manufacture	Thermal mass	Infrastructure
Best practice	Construction	GSHP	Transport
Innovation	Commissioning	PV	Waste
Pioneering	Refurbishment	Solar thermal	Water
Other	New build	Wind	Biodiversity
	Other	Insulation	Other
		Glazing	
		Other	