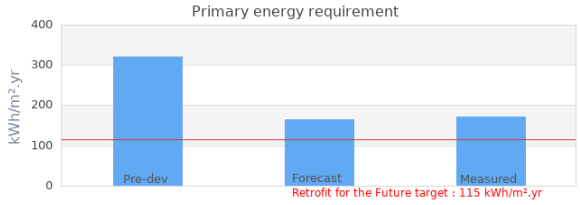
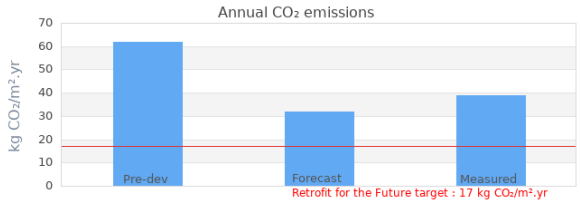
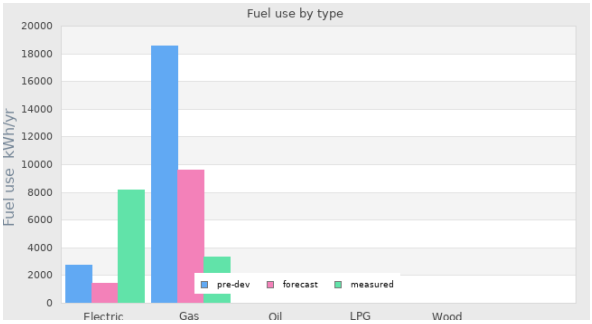
https://www.lowenergybuildings.org.uk/

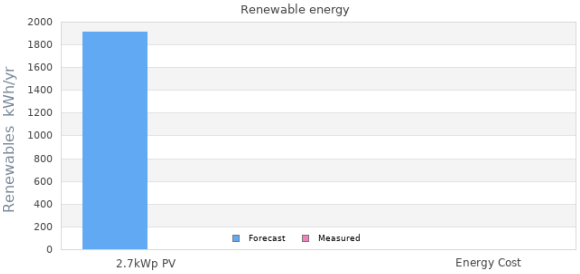
Project name BISF Steel Frame House - 80% Carbon Dioxide emmision reduction through whole house upgrade approach including innovative technologies

Project summary Existing: Steel frame with render and steel cladding; Blockwork and timber frame side extension; Steel shingle roof. Proposed: Existing render and steel cladding removed; New sheathing board, insulation & render cladding; Wall, roof & floor insulation to side extension; Main roof insulation increased to 350mm; Triple glazed uPVC windows; High efficiency gas boiler serving radiators; Flue gas heat recovery; LED lights with 50k hours guaranteed max light output; Decentralised whole house ventilation; 2.7kWp PV and 3.0m2 solar thermal panels; AA++ appliances; Smart metering with display; Shower water heat recovery; Reduced water consumption









Project Description

Projected build start date	01 Mar 2010
Projected date of occupation	16 Apr 2010
Project stage	Occupied
Project location	Cambridge, Cambridgeshire, England
Energy target	Retrofit for the Future
Build type	Refurbishment

Building sector	Public Residential
Property type	Semi-Detached
Existing external wall construction	Steel frame
Existing external wall additional information	Render and steel cladding
Existing party wall construction	250mm block / block cavity
Floor area	88 m²
Floor area calculation method	SAP

Project team

Organisation	Cambridge City Council
Project lead	Cambridge City Council
Client	Cambridge City Council
Architect	PRP Architects
Mechanical & electrical consultant(s)	N/A
Energy consultant(s)	PRP Environmental
Structural engineer	Scott Wilson
Quantity surveyor	
Other consultant	CDM Coordinator: PRP Project Services
Contractor	Hill Partnerships ltd

Design strategies

Planned occupancy	Currently one elderly resident, but potential for family with three children
Space heating strategy	Gas fired boiler with flue gas heat recovery feeding radiators
Water heating strategy	Solar hot water with gas condensing boiler back up
Fuel strategy	Solar thermal hot water with mains gas back up, PV panels and mains electricity
Renewable energy generation strategy	2.7kWp polycrystaline photovoltaic array; 22.5sq.m, 3.0sq.m solar thermal panels
Passive solar strategy	The house faces almost exactly due west and has some large windows on the west side. Fenestration patterns will remain as existing and adjustments have been made to glazing g-value to compensate for potential overheating on the west facing elevation.
Space cooling strategy	Natural ventilation via openable windows; room layouts allow for cross ventilation and cooling. Adjustments to glazing g-value to guard against overheating.

Daylighting strategy	The house already has good natural daylight through large windows. It was designed at a time when daylight and fresh air where important aspects of new beginings in post war housing development.
Ventilation strategy	Natural ventilation via openable windows, plus a decentralised whole house system using continuously running low energy fans drawing air out through wet rooms.
Airtightness strategy	Sheathing board with foam / render overcladding and careful detailing around windows and doors to minimise air leakage. High performance seals to windows and doors. Draught sealing around the loft hatch. Ventilation equipment checked for air leakage prior to commissioning and careful detailing around sockets and all other penetrations. Instruction to operatives on best practice at contract stage.
Strategy for minimising thermal bridges	Minimisation of thermal bridges at design stage by careful detailing of all material and component junctions to ensure continuity of insulation and thermal performance. House steel frame adjusted locally to allow new windows to be supported in line with overcladding. Continuation of overcladding to below ground level to protect the concrete slab edge. Instruction to operatives on best practice and careful monitoring on site during construction.
Modelling strategy	Whole house modelling was undertaken using SAP (with NHER Plan Assessor software) in conjunction with the Extended SAP worksheet. EDSL TAS was used to undertake an overheating analysis. AutoCAD produced plans and elevations were used to assist with visualisation and detailed design.

Insulation strategy	Ground floor - new timber suspended in living room, 25mm nanogel blanket Resultant U-value 0.43 W/m2K Exposed front, rear and gable walls - 200mm Permarock external insulation Resultant U value 0.11 W/m2K Sheltered house wall in lean-to lobby & store - 50mm Spacetherm 0.21 W/m2K Stud external wall - 50mm phenolic board plus 50mm Spacetherm 0.17 W/m2K Pitched roofs with flat ceiling - Top up to 350mm mineral fibre quilt Resultant U value 0.12 W/m2K Windows - Replacement uPVC triple glazed low-e Resultant U-value 1.1 W/m2K Doors - Replacement uPVC with triple glazed low-e Resultant U-value 1.5 W/m2K
Other relevant retrofit strategies	Our proposals are designed to be carried out with residents remaining in occupation. Considering the wider application of Retrofit it will not be practical or economically viable on a large scale to decant residents while the work is in progress. Pre commencement discussion and engagement with residents, plus regular monitoring during and after the works, will help to minimise the degree of inevitable inconvenience.
Other information (constraints or opportunities influencing project design or outcomes)	The particular form of steel frame construction of this house and the well documented defects that have affected other similar homes have influenced our decision to remove the detriorating and unstable external finishes and substitute a structurally sound and thermally efficient envelope. The poor quality of original internal linings have also influenced the choice of a robust and stable cladding.

Energy use

Fuel use by type (kWh/yr)

Fuel	previous	forecast	measured
Electric	2751	1406	4913
Gas	18587	9593	2509
Oil			
LPG			
Wood			

Primary energy requirement & CO2 emissions

	previous	forecast	measured
Annual CO2 emissions (kg CO2/m².yr)	62	32	39
Primary energy requirement (kWh/m².yr)	321	165	172

Renewable energy (kWh/yr)

Renewables technology	forecast	measured
2.7kWp PV	1914	
-		
Energy consumed by generation		

Airtightness (m³/m².hr @ 50 Pascals)

	Date of test	**Test result**
Pre-development airtightness	-	15.82
Final airtightness	-	12.51

Annual space heat demand (kWh/m².yr)

	Pre-development	forecast	measured
Space heat demand	-	79	-

Whole house energy calculation method	SAP Extension for Whole House
Other energy calculation method	
Predicted annual heating load	-
Other energy target(s)	

Building services

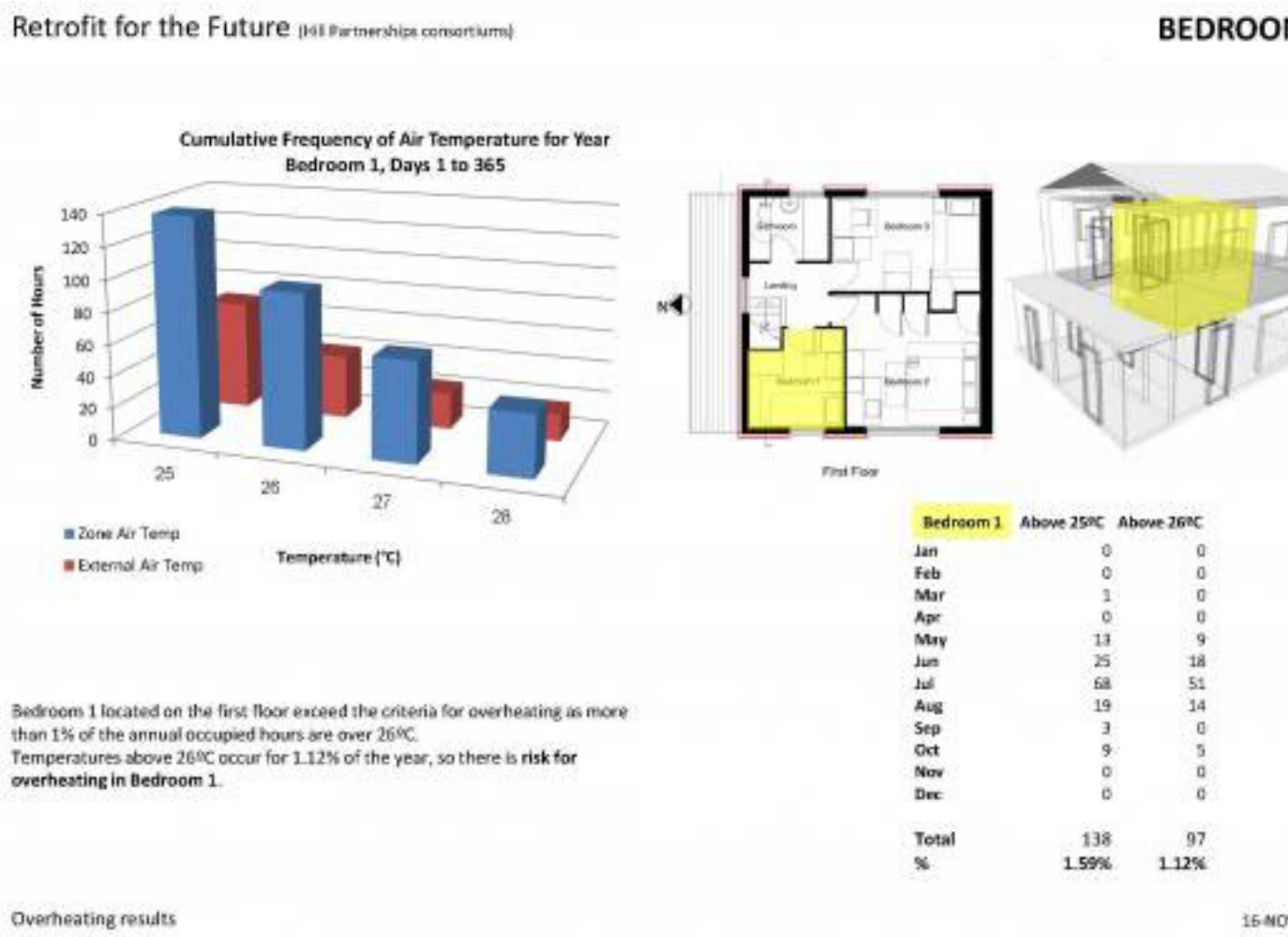
Occupancy	NULL
Space heating	NULL
Hot water	NULL
Ventilation	NULL
Controls	NULL
Cooking	NULL
Lighting	NULL
Appliances	NULL
Renewables	NULL
Strategy for minimising thermal bridges	NULL

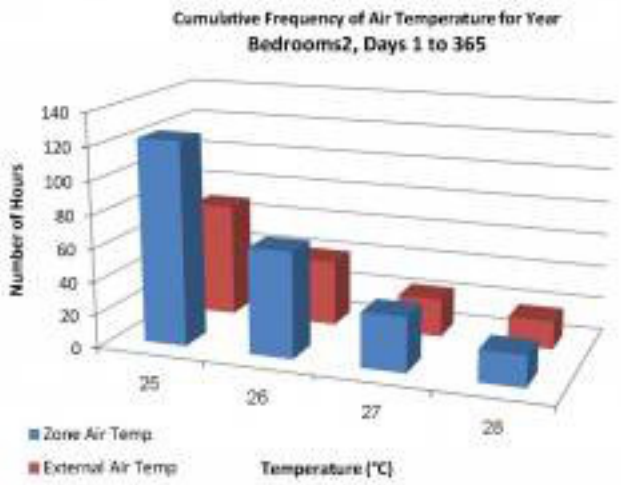
Building construction

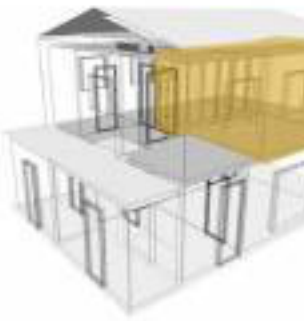
Storeys

Volume	
Thermal fabric area	
Roof description	NULL
Roof U-value	0.00W/m² K
Walls description	NULL
Walls U-value	0.00W/m² K
Party walls description	NULL
Party walls U-value	0.00W/m² K
Floor description	NULL
Floor U-value	0.00W/m² K
Glazed doors description	NULL
Glazed doors U-value	0.00W/m² K
Opaque doors description	NULL
Opaque doors U-value	0.00W/m² K
Windows description	NULL
Windows U-value	0.00W/m² K
Windows energy transmittance (G-value)	
Windows light transmittance	
Rooflights description	NULL
Rooflights light transmittance	
Rooflights U-value	0.00W/m² K

Project images







Bedroom 2	25ºC	26ºC
Jan	0	0
Feb	0	0
Mar	0	0
Apr	0	0
May	6	4
Jun	29	11
Jul	76	47
Aug	12	2
Sep	0	0
Oct	0	0
Nov	0	0
Dec	0	0
Total	123	64
%	1.42%	0.74%

The temperatures in Room 2 do not exceed 1% of the time above 25ºC, as just 64 hours exceed this criteria. Therefore, this room **does not have risk of overheating.**

Overheating results

16-NO

Dwelling Airtightness Testing Report

BSRIA Airtightness
Old Bracknell Lane West
Bracknell, Berkshire RG12 7AH
Phone: 0800 5871000
Fax: 01344 465691

BSRIA Airtightness & Acoustics

Report N°: DAT-CAM01-NA01 -1-PL1-T1

Date:	14/09/2009	**Airtightness Engineer:**	C Knights
Accreditation Body:	ATTMA	**Registration Number:**	0005

Client: Cambridge City Council
Region: N/A
Address: The Guildhall
Market Square
Cambridge
Cambridgeshire
CB2 3QJ
Telephone: 01223 457000
Facsimile:

Plot N°: 1
Developers Type: N/A
Development Name:
Development Address:

Test Results at 50 Pascals

		Q_{50}: Airflow (m³/h):	2888
Measured Air Permeability (m³/(h.m²)):	13.58	**Design Air Permeability (m³/(h.m²)):**	

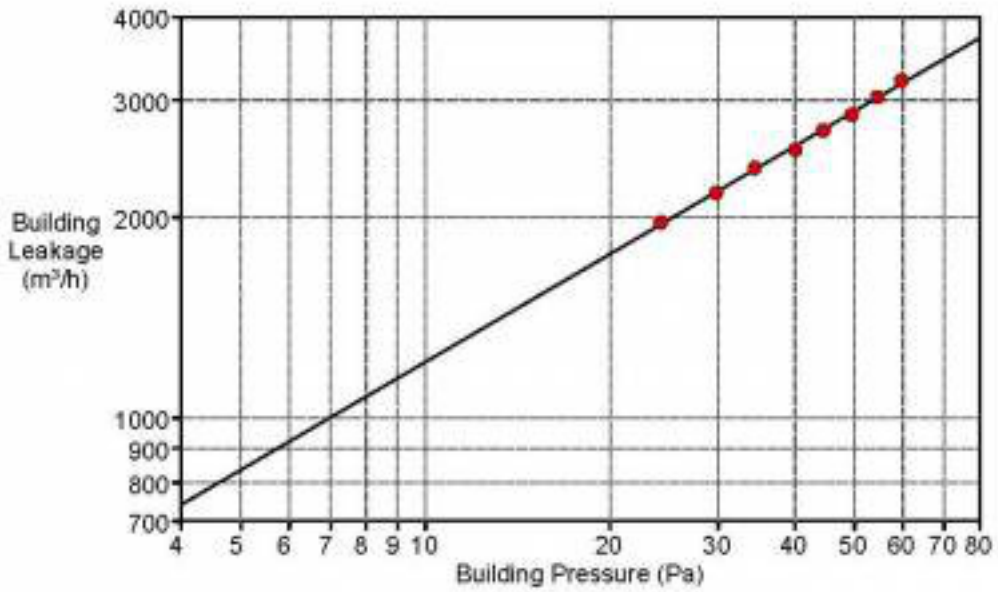
Did the dwelling achieve the required air permeability as specified in the SAP calculations?	

Building Leakage Curve

Air Flow Coefficient (C_{env}):	345.1	**Air Leakage Coefficient (C_L):**	351.3
Exponent (n):	0.54	**Correlation Coefficient (r^2):**	0.9989

Test Information

		TS1 Leakage Area (m²):	0.144
Type of Test:	Depressurisation	**Test Method:**	B
Test Standard:	TS1	**Regulation Complied With:**	N/A

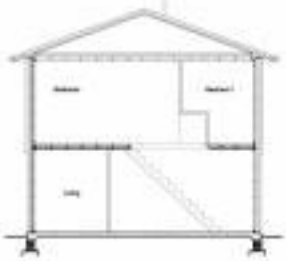


Ground Floor

First Floor

Front Elevation (South Facing)

Rear Elevation (North Facing)



Section AA


Ground Floor
First Floor


Front Elevation (South Facing)
Rear Elevation (North Facing)
Section AA

Front view

Rear view

Side view