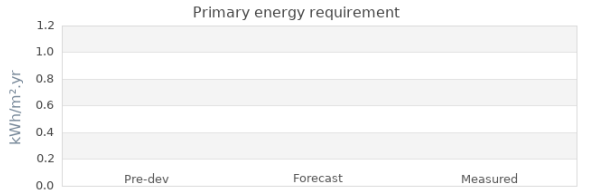
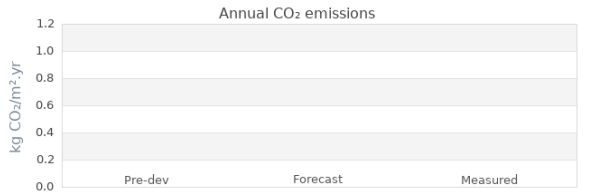
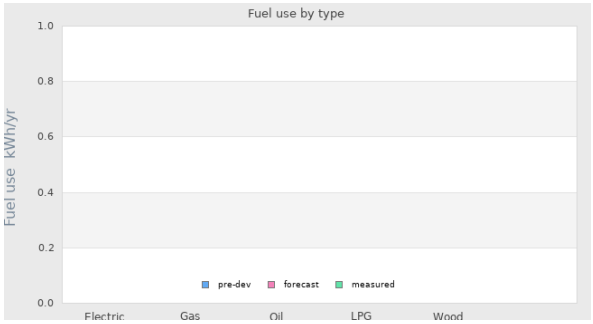
https://www.lowenergybuildings.org.uk/

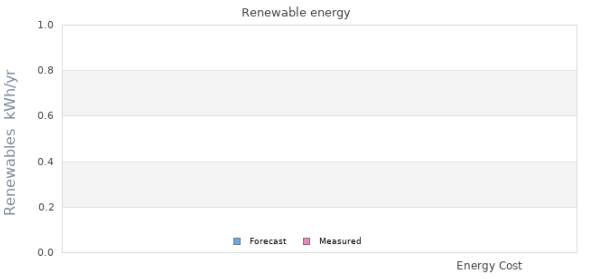
Project name Harpenden EnerPHit Plus

Project summary Deep retrofit of a 1960s detached house in Harpenden and the addition of a small rear extension. This project was constructed to meet the EnerPHit Plus criteria as well as going gas free; by using an air source heat pump and harnessing renewable energy with an entire roof pitch dedicated to solar pv. The existing brickwork walls were externally insulated using wood fibreboard and finished with a painted render and the curtain walls were removed and replaced with new highly insulated timber I beam walls with cellulose insulation and clad in western red cedar. The rear single storey extension was also constructed in this way and finished with either render or timber cladding. The existing ground floor was removed and replaced with a new highly insulated slab with underfloor heating.









Project Description

Projected build start date	13 Jan 2020
Projected date of occupation	13 Feb 2021
Project stage	Occupied
Project location	Harpenden, Hertfordshire, England
Energy target	EnerPHit
Build type	Refurbishment

Building sector	Private Residential
Property type	Detached
Existing external wall construction	Other
Existing external wall additional information	Two types: retrofitted cavity wall and new infill curtain wall
Existing party wall construction	
Floor area	151 m²
Floor area calculation method	PHPP
Building certification	Passivhaus certified

Project team

Organisation	
Project lead	Heather McNeill, A D Practice Ltd
Client	Private - carried out own BMS/home automation design
Architect	Heather McNeill, A D Practice Ltd
Mechanical & electrical consultant(s)	M&E Spec & MVHR: Enhabit Ltd; Solar PV: GB-Sol Ltd; ASHP: Solid Renewables
Energy consultant(s)	Heather McNeill, A D Practice Ltd and Guy-Pitts Crick, Heatflux
Structural engineer	
Quantity surveyor	
Other consultant	Certifier: Kym Mead, Mead: Energy & Architectural Design Ltd
Contractor	Jigsaw Design & Construction Ltd

Design strategies

Planned occupancy	Two people (and two cats) working from home or office-based
Space heating strategy	Air source heat pump with underfloor heating downstairs and dual fuel radiators in bathrooms.
Water heating strategy	Air source heat pump heating hot water tank with extra immersion element powered by solar pv. Waste water heat recovery from showers.
Fuel strategy	Gas free. Electricity, as much as possible generated on site
Renewable energy generation strategy	Full front roof pitch of solar pv (8.10kW) array helping to run ASHP and heat hot water as well as powering the house and charging cars.
Passive solar strategy	Southern-facing rooms with large windows to maximise solar gain.

Space cooling strategy	Fan coil unit with ducted cooling into upstairs rooms. *Continuous use of MVHR with night purging in hot weather. *Electrically opening rooflights in rear extension and above stairs for stack effect purge ventilation linked to building management system.
Daylighting strategy	Large windows providing lots of natural daylighting as well as rooflights over the dining/garden room area and skylight over stair void, flooding staircase, hallway and landing with light (previously very dark).
Ventilation strategy	Comfort ventilation with heat recovery (winter) *Openable windows (summer) *Electrically opening rooflights in rear extension and above stairs for stack effect purge ventilation linked to building management system.
Airtightness strategy	SmartPly over existing masonry structure linked to SmartPly layer in new curtain walls. *Intello Plus membrane to underside of roof.Membrane under concrete screed. *All taped together and into windows/doors
Strategy for minimising thermal bridges	Thermal bridging analysis undertaken for all primary junctions interfaces. *Continuous insulation maintained throughout. *Geometric thermal bridges minimised. *External insulation wrap maintained as far as possible and compensatory insulation overrun at junctions where this is not possible. *External insulation below ground to top of foundations to prevent thermal bridging to floor/existing cavity walls.
Modelling strategy	Whole house modelling was undertaken in PHPP with thermal bridges modelled by consultant in Therm

Insulation strategy	Natural insulations as far as possible (not below floor slab) *External woodfibre insulation to retained cavity walls (to achieve U-value of 0.13 W/mK) *Blown Warmcel insulation in between I-studs in new curtain walls (to achieve U-value of 0.12 W/mK) *Existing floor slab renewed with 160mm PIR insulation below slab (to achieve U-value of 0.13 W/mK) *Extension floor slab with 260mm PIR PIR insulation below slab (to achieve U-value of 0.11 W/mK) *Retrofitted pitched roof with 30mm woodfibre sheathing, 240mm woodfibre insulation between rafters, 60mm woodfibre insulation below rafters (to achieve U-value of 0.135 W/mK) *Flat roof to extension with 300mm woodfibre insulation over joists (to achieve U-value of 0.12 W/mK) *EPS insulation used below ground to insulate base of walls to top of foundation level
Other relevant retrofit strategies	
Other information (constraints or opportunities influencing project design or outcomes)	Conservation area

Energy use

Fuel use by type (kWh/yr)

Fuel	previous	forecast	measured
Electric			
Gas			
Oil			
LPG			
Wood			

Primary energy requirement & CO2 emissions

	previous	forecast	measured
Annual CO2 emissions (kg CO2/m².yr)	-	-	-
Primary energy requirement (kWh/m².yr)	-	-	-

Renewable energy (kWh/yr)

Renewables technology	forecast	measured
-		
-		
Energy consumed by generation		

Airtightness ($m^3/m^2.hr$ @ 50 Pascals)

	Date of test	Test result
Pre-development airtightness	10 Dec 2019	8.39
Final airtightness	08 Nov 2021	0.59

Annual space heat demand (kWh/m^2.yr)

	Pre-development	forecast	measured
Space heat demand	-	-	-

Whole house energy calculation method	PHPP
Other energy calculation method	
Predicted annual heating load	-
Other energy target(s)	

Building services

Occupancy	Two people (and two cats) working from home or office-based
Space heating	Air source heat pump with underfloor heating downstairs and dual fuel radiators in bathrooms
Hot water	Air source heat pump heating hot water tank with extra immersion element powered by solar pv. Waste water heat recovery from showers.
Ventilation	Balanced ventilation system with heat recovery, enthalpy heat exchanger; heat recovery efficiency 86%
Controls	Loxone system providing whole building management system
Cooking	Induction hob with electric oven
Lighting	100% LED
Appliances	A+ rated appliances as minimum
Renewables	Full front roof pitch of solar pv (8.10kW) array helping to run ASHP and heat hot water as well as powering the house and charging cars with capacity for future battery installation.
Strategy for minimising thermal bridges	Thermal bridging analysis undertaken for all primary junctions interfaces. *Continuous insulation maintained throughout.*Geometric thermal bridges minimised.*External insulation wrap maintained as far as possible and compensatory insulation overrun at junctions where this is not possible. *External insulation below ground to top of foundations to prevent thermal bridging to floor/existing cavity walls.

Building construction

Storeys	2
Volume	375m³
Thermal fabric area	503m²
Roof description	There are two types:1) Retrofitted pitched roof:30mm woodfibre sheathing; 240mm woodfibre insulation between rafters; 60mm rigid woodfibre board; Airtight membrane; Service void; Plasterboard and skim 0.135W/m2K. 2) Flat roof to extension:100mm rigid woodfibre insulation; 200mm rigid woodfibre insulation over joists; Smartply; Service void; Plasterboard and skim 0.103W/m2K
Roof U-value	0.12W/m² K
Walls description	There are two types: 1) Retrofitted cavity wall:200mm woodfibre EWI; Existing insulated brick and block cavity wall; SmartPly; Service Void; Plasterboard and skim 0.129W/m2K. 2) New infill curtain wall: 80mm woodfibre sheathing; 300mm blown cellulose insulation between I studs; SmartPly; Service void; Plasterboard and skim.0.109W/m2K
Walls U-value	0.12W/m² K
Party walls description	N/A
Party walls U-value	
Floor description	There are two types: 1) New floor slab in main house: Concrete slab; 160mm PIR insulation; Concrete screed with UFH; Floor finish. 0.127W/m2K. 2) New floor slab to rear extension: Concrete slab; 260mm PIR insulation; Concrete screed with UFH; Floor finish 0.080W/m2K
Floor U-value	0.11W/m² K
Glazed doors description	Internorm HF310 inward opening. g: 0.50; Ug: 0.53
Glazed doors U-value	0.86W/m² K installed
Opaque doors description	Internorm front door. Moralt Passiv Ferro
Opaque doors U-value	0.85W/m² K installed
Windows description	Internorm HF310 and HV450 (front and rear bedroom windows)
Windows U-value	0.86W/m² K installed
Windows energy transmittance (G-value)	
Windows light transmittance	
Rooflights description	Fakro DEF DU8 (flat roof extension) and Fakro FTT U8: g: 0.38; Ug: 0.40. Fakro FTT U8: g. 0.35; Ug: 0.30
Rooflights light transmittance	
Rooflights U-value	0.80W/m² K installed

Project images