Energy House

The very fabric of
whole house retrofit

SAINT-GOBAIN

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Introduction from Mark Weaver, Sector Marketing Director – Retrofit, Saint-Gobain UK.

Saint-Gobain worked closely with Salford University, Leeds Metropolitan University and Saint-Gobain Recherché on what is **believed to be the most in-depth study into whole house retrofit.**

Saint-Gobain was delighted to carry out a substantial retrofit of the Energy House, a full-scale typical 1919 end-of-terrace house, built in the environmentally controlled chamber of Salford University's Energy Hub. What attracted us was the opportunity to work in a facility where climatic conditions could be maintained, varied and repeated and the results accurately monitored, providing us with the confidence that the results were due to our interventions with no extraneous factors obscuring performance. The UK has seven million hard-to-treat houses in urgent need of improvement, the Energy House represents 21% of this housing stock.

Our approach to the project was based upon a multi-comfort and fabric-first approach, key components of Saint-Gobain's strategy. Multi-comfort is about careful teamwork, preparation, detailing and workmanship to achieve best practice, and a significantly more comfortable and healthy internal living space for occupants. A fabric-first approach determines that performance of the building fabric should be addressed before improvements to heating and renewables are considered.

However, we also wanted to understand the performance that can be achieved from a conventional whole-house retrofit – this was not about trying to achieve utopian performance levels. Standard systems were installed and designed to achieve insulation levels required by Building Regulations. Areas that are often seen as difficult to insulate, such as loft eaves and external window reveals, were left untreated as might commonly occur in typical refurbishments, providing us with data to understand the dynamics of thermal performance and airtightness at these junctions in controlled conditions.

The project team, led by Simon Gibson, R&D Manager, Saint-Gobain UK spent three months at the Energy House and the close collaboration between Leeds Metropolitan University, Salford University and Saint-Gobain Recherché resulted in measurements being taken by 414 sensors to compare pre- and post installation energy performance, air leakage and comfort. The sensors each took a reading at approximately one minute intervals – providing us with over fifty-four million items of data. This data was supplemented with video, time-lapse and conventional photography as well as thermography to create the most in-depth retrofit study to date.

We decided to set the 'baseline' at a level representative of the majority of UK housing. So, instead of starting with the single-glazed windows of the Energy House, we installed typical 1990's double-glazing – reflective of windows found in many properties but which would benefit from improved glazing unit upgrades. The old loft insulation was retained and topped up to today's standards. Finally, in order to test multiple solid wall insulation measures and to reflect the 'hybrid' approach we chose to install internal wall insulation on the front elevation and external wall insulation on the side and rear elevations.

Four Saint-Gobain brands participated in the Energy House retrofit:

- Internal Wall Insulation from British Gypsum
- External Wall Insulation from Weber
- Loft and Floor Insulation from Isover
- Window Glazing from Glassolutions

Technical, training and on-site support teams worked together on the project, alongside installers from our customer networks, to ensure that the work carried out met our specifications but also reflected workmanship expected from competent teams trained and supported by Saint-Gobain and the Saint-Gobain Technical Academy network.

We were delighted to find that the whole-house results were as calculated and the Saint-Gobain systems installed, in combination, reduced the heating demand of the property by 63%.

Taking an average gas fuel price for Manchester in 2012, this house could be heated for less than £4 per week – a tremendous saving of almost £350 per year to the energy costs of a small dwelling. The CO_2 saving of 1.45 tonnes pa is equally important in contributing to climate change targets. It was also notable that a 50% reduction in air-leakage resulted from the interventions made and this, in combination with the thermal improvements, resulted in a more comfortable internal environment where more of the house could be used with no impact on energy costs, showing the value in a whole-house, holistic approach to retrofit.

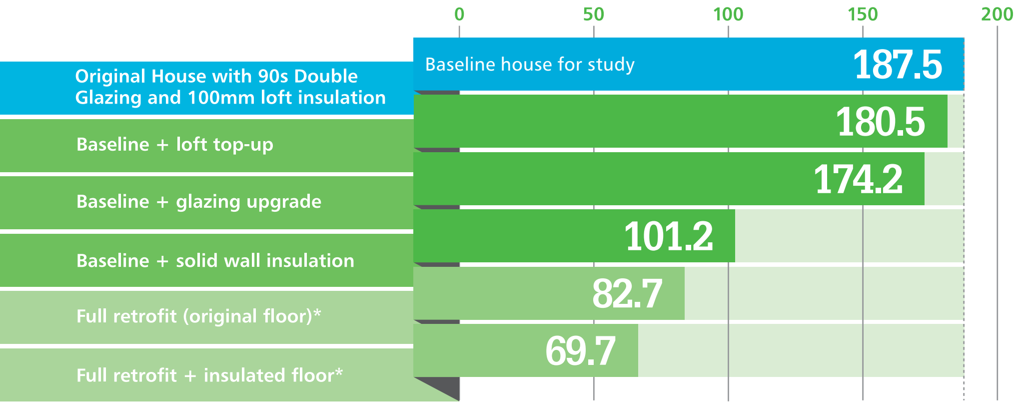
It is going to take us some time to fully work through the data we've collected from the Energy House project but I look forward to sharing more as it becomes available over the coming months.

Mark Weaver
Sector Marketing
Director – Retrofit

Si Gibson
Research and
Development Manager

Heat loss through the building

Heat Loss Coefficient (HLC) measured in W/K. The smaller the number the lower the heat loss.



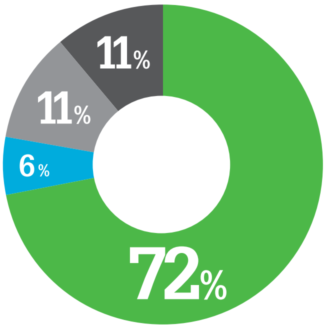
*Multiple measures installed

Chart shows whole house heat loss value of the test house at each stage of the programme. The full retrofit measures resulted in a heat loss coefficient reduction of 63%.

63%

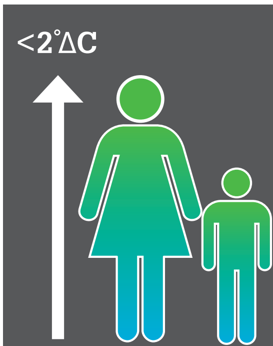
Reduction in heat lost from the building following full Saint-Gobain retrofit

Contribution to Reduction



- Solid wall insulation
- Loft insulation (top up)
- Floor upgrade (suspended timber)
- Replacement glazing

Contribution of each thermal upgrade measure to the reduction in whole house heat loss of the fully retrofitted test house.



Thermal Comfort

The measurements taken from the whole-house retrofit showed a less than 2 degree centigrade difference between head and foot levels – a recognised measure of comfort. The floor upgrade accounted for most of this improvement.

Reduction in energy cost (£)

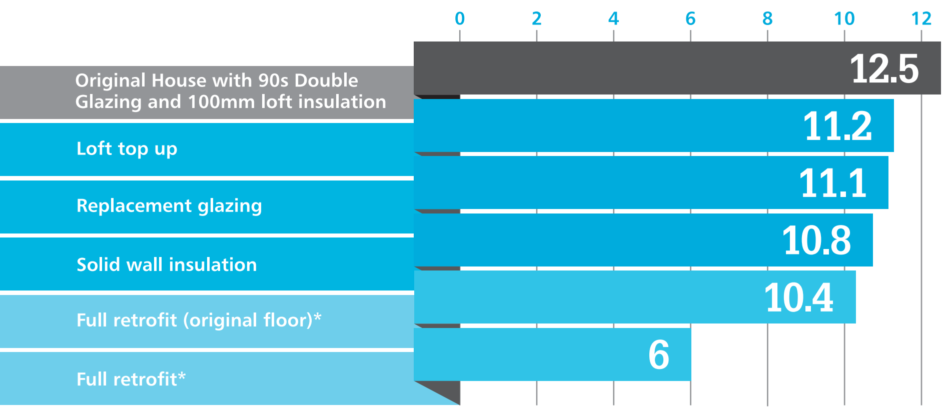
Based upon a notional property with similar heat loss characteristics, installing these Saint-Gobain measures saves significant energy costs.

Initial figures indicate the payback against Green Deal assessments could be shorter than predicted if Saint-Gobain whole-house retrofit solutions are competently installed.

The improved heat loss coefficient and improved air permeability reduces heating bills in the property from £554 to £206 per year, or put another way, down to less than £4 per week.

All values calculated for reduction in annual heat demand are based on the previous 5 years (2008-12) mean annual heating degree day value of 2297 measured at Manchester Airport (base temperature 15.5°C. Monetary savings based on average gas price for Manchester during 2012 of 4.42p per kWh.

Air leakage (m³/(h·m²) @ 50 Pa)



*Multiple measures installed

The full retrofit of the test house resulted in a 50% reduction in air leakage from the base condition. The greatest improvement, 42%, came from the inclusion of an airtightness membrane. Less air-leakage will result in a more comfortable home.

50%

Reduction in air leakage

What was measured

Temperature sensors 230
Heat flux sensors 96
Relative humidity sensors 23
CO_2 sensors 10
Power measurement 52
Gas/Boiler 7

Total

418 measurements taken every minute

601,920 measurements per day

54,172,800 items of data collected

Internal Wall Insulation

British Gypsum SAINT-GOBAIN

An Internal Wall Insulation (IWI) system was installed to the inside of the front elevation.

Gyproc ThermaLine PIR 93mm incorporating a 12.5mm Gyproc WallBoard and finished with 10.5mm Thistle Hardwall and 2mm Thistle Multi-Finish.

Window Glazing

GLASSOLUTIONS SAINT-GOBAIN

1990's specification frames were installed with standard double glazed units with no glass coatings – typical of the time period. These windows were then upgraded with a high specification double glazed unit containing Planitherm low-e glass – moving the windows from an indicative "G" window energy rating to an "A" rating.

Loft and Floor Insulation

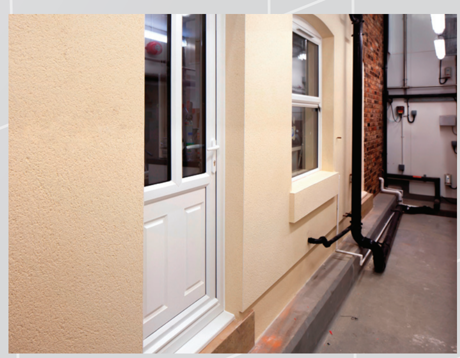
170mm of Isover's Spacesaver mineral wool quilt (0.043W/mK) was installed over the existing 100mm of insulation that was in the loft. The loft hatch was replaced with a Gyproc Profilex FR1.

The ground floor was insulated with 200mm Isover Renovation Roll Thermal fitted between the floor joists and was overlaid with Isover Vario KM Duplex Climate membrane.

External Wall Insulation

Weber's External Wall Insulation (EWI) system weber.therm XP was fixed to the gable and rear of the house and incorporated 90mm weber.therm EPS with a scraped finish of machine applied one coat weber.therm M1 render.

The weber.therm XP system was also installed below the damp proofing membrane.



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weber SAINT-GOBAIN

Formulator and manufacturer of building materials for the facade, construction mortars, flooring systems and tile fixing markets, Weber's well established product range includes monocouche renders, external wall insulation systems, tile adhesives/grouts, leveling compounds and specialist construction products.

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