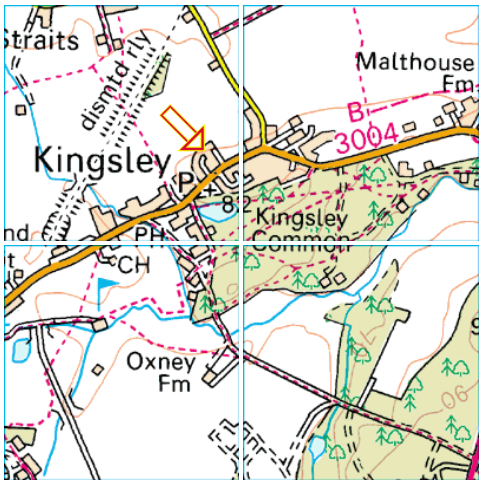
Case study

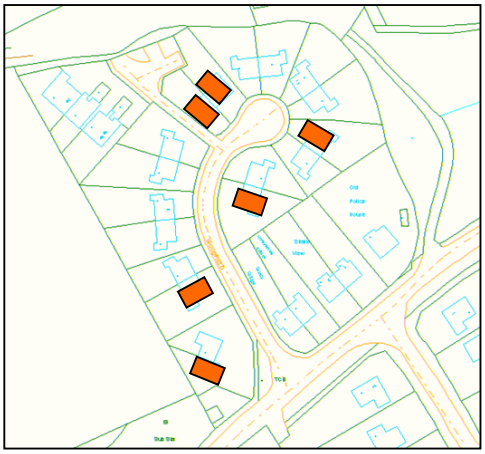
Woodfields, Kingsley, Hampshire
Drum Housing Association

Context:
Drum Housing Association (a part of the Radian Group) put forward six properties for a major energy performance upgrade through the Generation Homes programme. The scheme comprises three 3-bedroom semi-detached houses and three 2-bedroom bungalows, built in the 1950s. All are cavity wall construction with pitched roofs and loft spaces.



The scheme is located in a rural area of Hampshire and the properties are clustered in a cul-de-sac. There is no mains gas supply and therefore heating and hot water were originally provided by a combination of a solid fuel-fired boilers and electrical storage heaters. A survey of residents' running costs prior to the works being undertaken revealed annual energy costs of the order of £1,000-£1,250 on average per household.

The housing association had already planned some energy-focused refurbishment, when in spring 2006 they teamed up with the Generation Homes programme and extended the scope of low-carbon solutions.



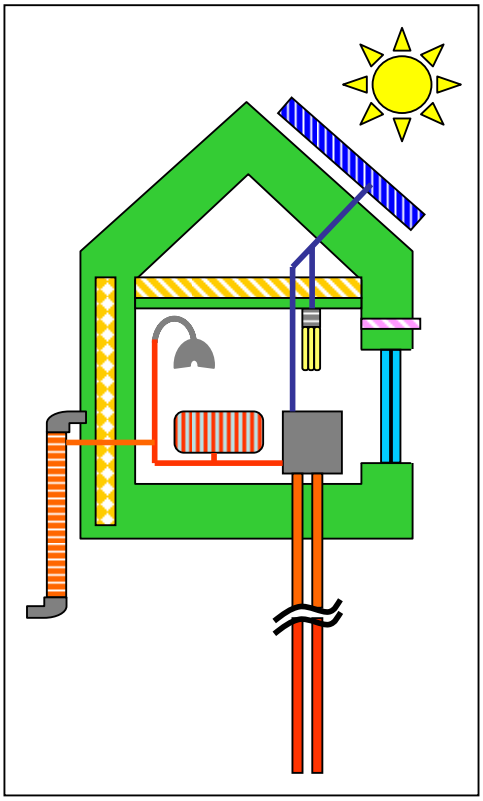
Approach:
Generation Homes aims to reduce carbon emissions from dwellings by at least 60% against their baseline. This is achieved by applying an integrated package of low-carbon measures including energy efficiency and renewable energy.

Drum HA's objectives were to provide new and affordable heating options to the tenants, which are easily controllable and also environmentally friendly. Also, the properties would be monitored and assessed using the EcoHomes XB methodology to establish the actual effect of the improvements.

Finance:
Funding was secured through a number of routes:

- The housing association allocated resources through internal budgets for projects delivering sustainability and innovation totalling about £90,000;
- Generation Homes contributed £30,000 to the scheme across a variety of energy efficiency and renewable energy technologies;
- A successful application to the Low Carbon Buildings Programme resulted in a 50% grant for installing Solar Photovoltaic (PV) systems;
- A subsidy was secured through Powergen for installing Ground Source Heat Pumps.

Specification:
A comprehensive low-carbon package was specified and implemented. The technical approach targeted to save carbon emissions resulting from: a) heat losses through the building fabric, b) reducing energy use through equipment and appliances and c) offsetting residual energy demand through renewables. The following range of energy efficiency measures and renewable energy systems feature on-site:



Energy efficiency:

- Cavity wall insulation (CWI)
- Loft insulation (LI) (300mm)
- Full double glazing (DG)
- Drought-proofing
- Mechanical ventilation with heat recovery
- Waste water heat recovery (WWHR)
- Low-energy light bulbs
- Shower fittings

Renewable energy:

- Ground source heat pumps – 3.5 and 5 kW systems
- Solar Photovoltaics (PV) – 1 kWp systems

Outcomes:
Drum HA managed the project overall with support from ESD on technical specification, supply and finance. A number of suppliers and contractors were involved at different stages of the process.

The scheme was successfully completed in March 2007. Early estimates show that 75% of the carbon emissions are being saved (baseline emissions were calculated as 9.8 tCO_2/year and post-installation emissions are expected to be 2.5 tCO_2/year).

Heating:
New heating systems were installed in the form of Ground Source Heat Pumps (GSHP), replacing the original solid fuel boilers. Depending on the property size, 3.5 kW systems were used for the bungalows and 5 kW ones for the houses. GSHP provide the entire demand for heating and hot water. Their coefficient of performance (COP[1]) is 3.0-3.5 for space heating and about 2.5 for hot water. Low-

[1] GSHP use electricity to increase the temperature of the water already preheated in the ground loop. The coefficient of performance indicates how many units of heat are generated for each unit of electricity consumed by the plant (measured in kWh).

temperature radiators were fitted throughout. A two-part hot water cylinder was installed in each dwelling (for storing heat and providing hot water on demand).

The GSHP require a liquid-filled loop buried in the ground to pick up the stored heat. Ground temperature is constant at about 10^0C. For the Woodfields scheme, a pair of 40m deep boreholes were used for each property (initially a single 80m deep borehole was specified, but due to unvourable ground conditions drilling below 40m proved technically difficult). The GSHP plant is placed externally in a weatherproof box.

Solar electricity:

Each property was equipped with a roof-mounted array of 1 kWp (peak) Photovoltaic panels. The system generates DC electricity from solar radiation which is transformed into AC current using an inverter. This power is used directly in the household for lights and appliances, but also to power the heat pump, thus further reducing its carbon impact. Up to 800 kWh per annum will be generated from each array and none of it will be wasted as the systems are connected to the grid. Some tenants even chose to have export meters enabling any surplus power to be sold to the energy utility (subject to contract).

Waste water heat recovery:

This innovative measure can recover up to 60% of the heat still embodied in bathroom water going down the drain. The product applied was the Canadian-made Power-Pipe, which requires vertical installation. Therefore, only the three houses with bathrooms on the first floor were suitable. The devise is a copper pipe which replaces a section of the soil stack; there is a thinner copper coil wrapped around the main pipe carrying cold mains water.

As waste water falls down the stack, it clings to the inside of the stack and heat is transferred to the cold supply in the coil and on to the shower thus delivering preheated water. Power-Pipe was installed externally replacing the existing waste pipe and boxed-in for security and thermal insulation.

Energy efficiency upgrades:

Apart from the main improvements (CWI, LI & DG), further internal features were added. The properties without showers were fitted with those, thus saving water and energy (for hot water). The bathrooms were fitted with humidity sensors and mechanical ventilation with heat recovery. To improve air-tightness, the original air bricks and redundant flues were also filled.

Monitoring:
A key objective of this scheme is to establish the actual performance of the low-carbon features applied, both individually and as a package. Appropriate monitoring equipment was installed to this end consisting of:

- GSHP – electricity consumption meter and heat & flow meter
- Solar PV – electricity generation meter
- Electricity (general) – standard domestic electrical meter
- WWHR – heat & flow meter
- Internal temperature – single point temperature logger per dwelling
- External temperature – single point temperature logged for the site

Additionally a pressure test was carried out to establish the level of air tightness. The results showed that at 50 Pa pressure the average air leakage for the bungalows was 4.5 $m^3/m^2/h$ and for the houses 5.5 4.5 $m^3/m^2/h$. This is well below the Building Regulations requirement of 10 $m^3/m^2/h$, but further improvements to the properties were identified that could reduce leakage to 3.0-3.5 $m^3/m^2/h$. These recommendations will be implemented in the near future.

Costs:
Woodfields was implemented as an innovative exemplar ultra low-carbon refurbishment project. As such the cost could be regarded as high, due to the extensive range of measures and technologies used, as well as the complex supply chain, consultant input and specialist contractors involved. The cost per dwelling was about £23,000 and the total project value reached nearly £150,000 (including grants and subsidies).

Planning:
The housing association consulted the planning authority on all aspects of the project and no significant hurdles were encountered. Permissions were granted for all relevant components of the scheme.

Lessons learned:
Key to project success was a strong and committed partnership between the main participants – Drum HA and Generation Homes – as well as a wide spectrum of relevant stakeholders – residents, suppliers, contractors, funders, etc. Effective project management and good communication ensured that all players buy into the objectives and contribute to the process. Tenants in particular were very responsive and keen to see the project through, despite certain delays with implementation and some domestic inconveniences.

A co-ordinated supply chain was crucial to the successful outcome – the schedule of work was well communicated and roles were properly assigned. Products and services were provided in a well-defined sequence, however, a high degree of flexibility was also maintained. An important factor was a parallel GSHP implementation scheme on an adjacent site, which on the one hand ensured critical mass but also posed certain time constraints (GSHP at Woodfields had to wait before the other site was completed).

For more information on this scheme contact:

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