CE306

Essex Energy Village, Colchester: a case study

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Contents

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1. Introduction

Home energy use is responsible for over a quarter of UK carbon dioxide (CO_2) emissions which contribute to climate change. To help mitigate the effects of climate change, the Energy Saving Trust has a range of technical solutions to help UK professionals build to higher levels of energy efficiency.

This case study focuses on a development on the site of the former Colchester Barracks by Lexden Restoration Ltd in partnership with thegreenedge. The development, known as the Essex Energy Village, consists of nine terraced houses, eight with two bedrooms and one with three bedrooms. The site is in a conservation area and adjacent to several historic buildings, so a traditional design has been used.

The primary driver for the development was to test a range of different mass market renewable technologies to gain experience of the practical implications associated with their installation, their benefits during operation, and to create a marketing platform for thegreenedge to enter the renewable energy market. The homes were also designed to incorporate other sustainability features such as low energy appliances, energy efficient lighting in 95% of fittings, low water-use sanitaryware and, within four of the dwellings, rainwater harvesting systems.

A range of renewable energy technologies were included in the development: solar water heating (SWH), photovoltaics (PV), ground source heat pumps (GSHP), air source heat pumps (ASHP) and a wind turbine. Biomass heating was also proposed, for an adjacent phase of apartments, but not taken forward because of planning, cost and energy

Figure 1: Four houses at the Essex Energy Village, north elevation

Table 1: As built specifications

	Essex Energy Village specification	Energy Saving Trust guidance for Code level 3 design backstops
Floor U-value (W/m²,K)	0.22	0.20
Roof U-value (W/m²,K)	0.13	0.13
Wall U-value (W/m²,K)	0.26	0.25
Window U-value (W/m²,K)	1.90	1.50
Door U-value (W/m²,K)	3.00	1.00
Air permeability (m³/m²,h)	As built values ranged from 5.89 – 7.70	3.00

Source: Essex Energy Village and Energy Saving Trust guidance Energy efficiency and the Code for Sustainable Homes Level 3 (June 2008) [CE290]. See www.energysavingtrust.org.uk/housing/publications metering difficulties. The technologies were chosen primarily because their marketing and installation could be replicated. The developers also considered capital costs, performance and ability to install without compromising the aesthetic character of the dwellings or location.

2. Development details

2.1 Building fabric

Because the project focused mainly on the incorporation of renewable technology, building fabric efficiency measures were not pursued beyond current typical practice. The as built specifications are shown in table 1, alongside the minimum design performance requirements recommended by the Energy Saving Trust for achieving the Code level 3 energy standard.

2.2 Renewable energy

All houses were fitted with a solar water heating system. Three were fitted with heat pumps (one ground source and two air source) located within Energy Sheds in the back garden. Photovoltaic panels were fitted to the roof of 1 Stable Road and the roofs of each of the Energy Sheds.

Figure 2: Ground source heat pump inside Energy Shed

The concept behind the Energy Sheds was to create a plug-and-play renewable energy system which could be installed on any house type with sufficient external space. As well as reducing the impacts of

Figure 3: Rear of houses showing Energy Sheds in two of the gardens

noise and not taking up space within the dwelling, this approach aimed to minimise disruption between trades working on the same plot.

A 20kWp Quiet Revolution turbine was also installed in the parking area at the back of the houses. The turbine was not connected to the dwellings but is currently exporting power directly to the grid, although there are plans to connect the power output of the turbine to a nearby historic building when this is converted into a commercial unit.

Figure 4: Vertical axis wind turbine with the Essex Energy Village

The results of the as built SAP assessments, showing the Dwelling Emission Rates (DER) and Target Emission Rates (TER), for the nine houses on the site are shown in table 2.

As table 2 shows, the improvements in the DER relative to the TER are relatively small for the properties where only a solar water heating system is installed. This reflects the level of fabric efficiency measures specified. A combination of solar water heating and improved building fabric measures would have provided more significant CO_2 savings.

The properties on Stable Road perform slightly better than those on Crimea Walk because of their orientation, which results in greater solar gains and therefore reduced space heating requirements.

More marked improvements are realised in those dwellings that include heat pumps. However, because these homes are electrically heated, their TERs are higher than those of the other properties, which are gas heated. As a result, the improvements in the DER relative to the TER are more significant than the comparative CO_2 emissions savings.

Table 2: Results of the as built SAP assessments

Dwelling	Type	Floor area (m²)	Renewable technologies	TER ($kgCO_2$ /m²)	DER ($kgCO_2$ /m²)	Improvement in DER relative to TER	As-built air permeability (m³/m².h@50Pa)
1 Stable Road	Three bed end-terrace	119.5	SWH, GSHP, PV	33.56	9.59	71%	5.89
3 Stable Road	Two bed mid-terrace	75.6	SWH, ASHP, PV	31.88	19.27	40%	7.58
5 Stable Road	Two bed mid-terrace	75.6	SWH	22.64	20.64	9%	7.58
7 Stable Road	Two bed end-terrace	75.6	SWH	26.20	23.66	10%	7.70
2 Crimea Walk	Two bed end-terrace	75.6	SWH, ASHP, PV	37.11	22.71	39%	7.70
4 Crimea Walk	Two bed mid-terrace	75.6	SWH	22.64	22.00	3%	7.59
6 Crimea Walk	Two bed end-terrace	75.6	SWH	22.64	21.94	3%	7.58
8 Crimea Walk	Two bed mid-terrace	75.6	SWH	22.64	22.00	3%	7.59
10 Crimea Walk	Two bed end-terrace	75.6	SWH	26.06	25.39	3%	7.70

Figure 5: Plan of the Essex Energy Village development (the Energy Sheds are shown as brown rectangles in the gardens)

Figure 6: Energy Sheds being installed at Essex Energy Village

2.3 Costs

Additional costs associated with the renewable technologies varied from £6,000 to £45,000 per unit (including fees) depending on the technologies specified. Some unexpected costs were experienced, most notably for the wind turbine which required a substantial reinforced foundation, a plant room and three-phase supply, all of which combined to double the overall price.

Where possible, thegreenedge plans to collect information on the performance of the dwellings during occupation. By developing good relationships with the occupiers, they hope to obtain information that will allow them to assess the performance of the renewable energy technologies, running costs, reliability and user experiences. In addition to the knowledge already gained during installation, this information will help to direct their future choices of technology. Refer to the technical data sheet (table 3) in the appendix for further information on specific products selected, predicted annual CO_2 savings and costs.

3. Lessons learned

Because they were easy to install and use, the solar water heating systems have been deemed extremely successful. Initial views on the photovoltaics have also been positive, although their future use by thegreenedge is likely to depend on capital costs and the potential returns for consumers. Experience of the heat pumps has been mixed. There were a number of problems during installation and setup, and feedback on their operational performance has been limited so far. The team said that if heat pump technologies are to be incorporated in similar schemes (terraced housing and/or small groups of flats) in the future, they are likely to favour communal systems.

Figure 7: Heat pump and solar hot water controllers

The dwellings in which solar hot water and heat pumps were combined needed significant additional commissioning in order for the systems to work together effectively. It is hoped that analysis of the units performance over time will show whether or not this arrangement has been successful.

Another key lesson was the added complexity resulting from the need to manage renewable energy suppliers and installers alongside the standard contractors. thegreenedge commissioned many of the renewables suppliers directly and despite best endeavours, the responsibilities of the different contractors on site was sometimes unclear. This led to difficulties during construction. It has therefore been suggested by the team that for future projects, a single overriding contractor would be commissioned to organise all of the subcontractors and suppliers, including the renewable energy systems. For this to succeed, the contractor would need to understand the systems being installed, so previous experience in this area is likely to become a selection requirement when tendering contracts.

Figure 8: Energy Shed with ground source heat pump 600w array on roof and 3.4kW array on house

Although the primary goal of this development was to gain experience of working with renewable technologies, there is an acknowledgement that the fabric specifications should be improved in future projects to achieve reductions in overall energy consumption. On this subject, the Energy Saving Trust recommends maximising long-lasting energy efficiency improvements to the fabric of a dwelling before adding the optimum renewables solution.

For more guidance on combining fabric measures and renewable technologies the Energy Saving Trust's 'Energy efficiency and the Code for Sustainable Homes' guidance documents (CE290, CE291 and CE292) provide potential solutions relating to Code levels 3, 4 and 5&6 respectively. These publications are available from the Energy Saving Trust website at www.energysavingtrust.org.uk/housing/thecode

Appendix 1

Table 3: Technical data sheet – Essex Energy Village, Colchester

Technology	Dwelling	Manufacturer and model	Performance and outputs	Predicted CO_2 savings ($kgCO_2$/year)	Cost
Ground source heat pump	1 Stable Road	Econic Dimplex SI 7 ME 6.4kW	6122kWh/year	490	£14,620
Air source heat pump	2 Crimea Walk 3 Stable Road	Econic Dimplex LI 8 MEK 9.2kW	6090kWh/year 4658kWh/year	505 390	£10,370 £10,370
Wind turbine	-	XCO2 Quiet Revolution 6kW vertical axis turbine	Manufacturers suggested output 7,300kWh/year	4,150	£25,000 for turbine & c£25,000 for mast, controls, foundations & installation
Solar water heating	2 & 10 Crimea Walk and 1 & 7 Stable Road	Genersys 1000-10 2m² Flat Panel	792kWh/year per installation	155 per installation	£3,000 per installation
	4,6 & 8 Crimea Walk and 3 & 5 Stable Road	Genersys 1000-10 4m² Flat Panel	1,584kWh/year per installation	155 per installation	£3,780 per installation
	2 Crimea Walk	2m² Evacuated Tube	1,040kWh/year	202	£3,839
PV panels	1 Stable Walk	Sanyo Hybrid 2.52kWp	2016kWh/year	1,145	£13,530
	3 Stable Road	Sharp Mono 0.18kWp	144kWh/year	82	not available
	2 Crimea Walk	Sharp Mono 0.36kWp	288kWh/year	164	not available

Assumptions:

Ground source heat pump – outputs derived from SAP Worksheets. Coefficient of performance based on manufacturer’s quoted figure of 3.7.

Air source heat pump – outputs derived from SAP Worksheets. Coefficient of performance based on manufacturer’s quoted figure of 3.8.

PV – outputs based on SAP figure of 800kWh/kWp.

Solar water heating – outputs based on OFGEM figures of 396kWh/m²/year for flat panels and 520kWh/m²/year for evacuated tubes.

Predicted CO_2 savings based on SAP figures for the emissions from the use of gas (0.194$kgCO_2$/kWh), grid electricity (0.422$kgCO_2$/kWh) and grid displaced (generated) electricity (0.568$kgCO_2$/kWh).

Further reading

The Energy Saving Trust provides free technical guidance and solutions to help UK housing professionals design, build and refurbish to high levels of energy efficiency. These cover all aspects of energy efficiency in domestic new build and renovation. They are made available through the provision of training seminars, downloadable guides, online tools and a dedicated helpline.

A complete list of guidance categorised by subject area can be found in our publications index 'Energy Efficiency is best practice' (CE279). To download this, and to browse all available Energy Saving Trust publications, please visit www.energysavingtrust.org.uk/housing

Guides

- Energy efficiency and the Code for Sustainable Homes – Level 3 (CE290)
- Energy efficiency and the Code for Sustainable Homes – Level 4 (CE291)
- Energy efficiency and the Code for Sustainable Homes – Levels 5 & 6 (CE292)
- Enhanced Construction Details: introduction and use (CE297)
- Enhanced Construction Details: Thermal bridging and airtightness (CE302)
- Monitoring energy and carbon performance in new homes (CE298)

To obtain these publications or for more information, call 0845 120 7799, email bestpractice@est.org.uk or visit www.energysavingtrust.org.uk/housing

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