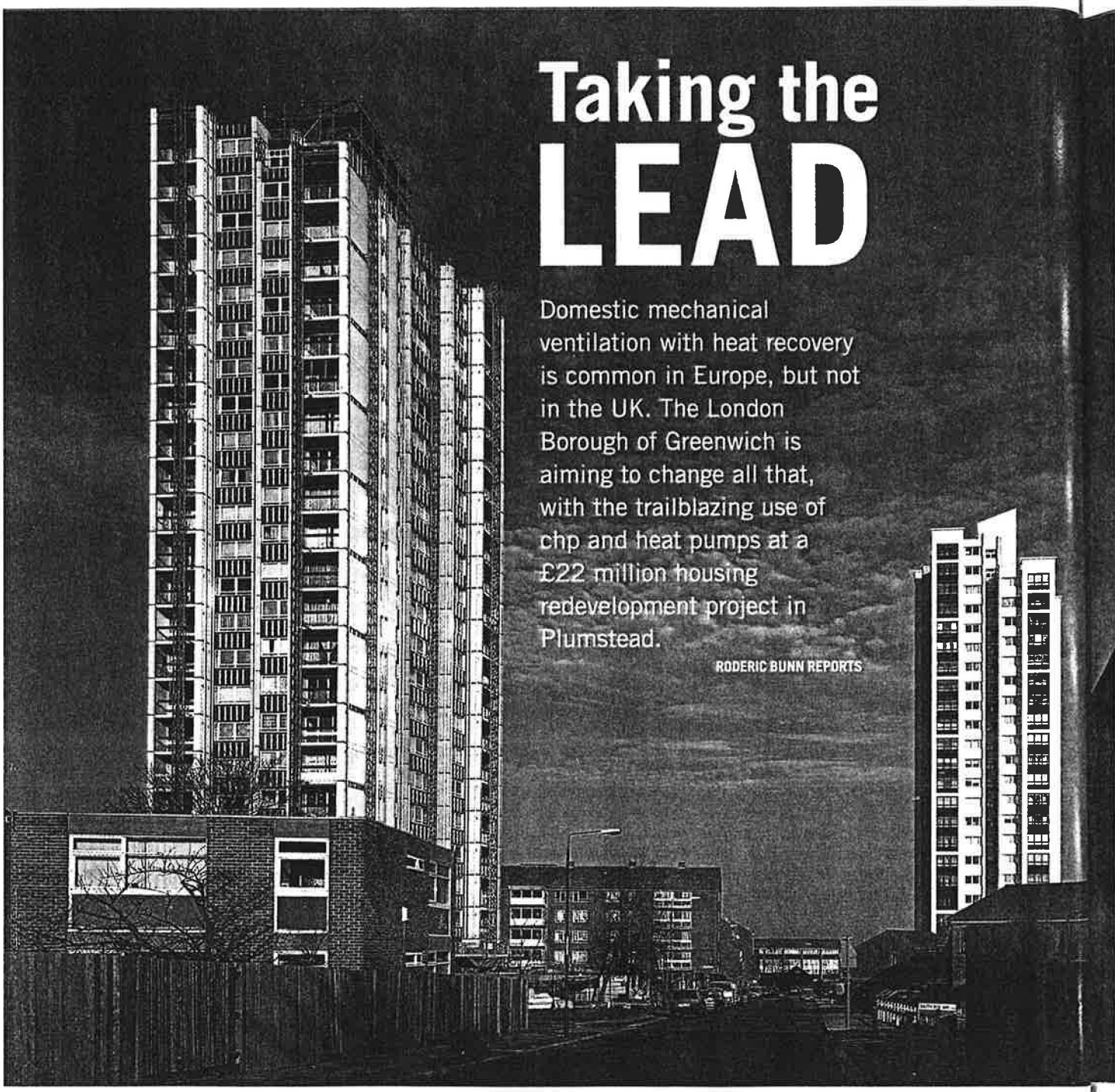


Taking the LEAD

Domestic mechanical ventilation with heat recovery is common in Europe, but not in the UK. The London Borough of Greenwich is aiming to change all that, with the trailblazing use of chp and heat pumps at a £22 million housing redevelopment project in Plumstead.

RODERIC BUNN REPORTS

Co-generation and heat pumps is not the sort of technology one would associate with local authority housing. Yet this is precisely what Greenwich Council has used in the refurbishment of three crumbling 1960s tower blocks on its Plumstead estate.

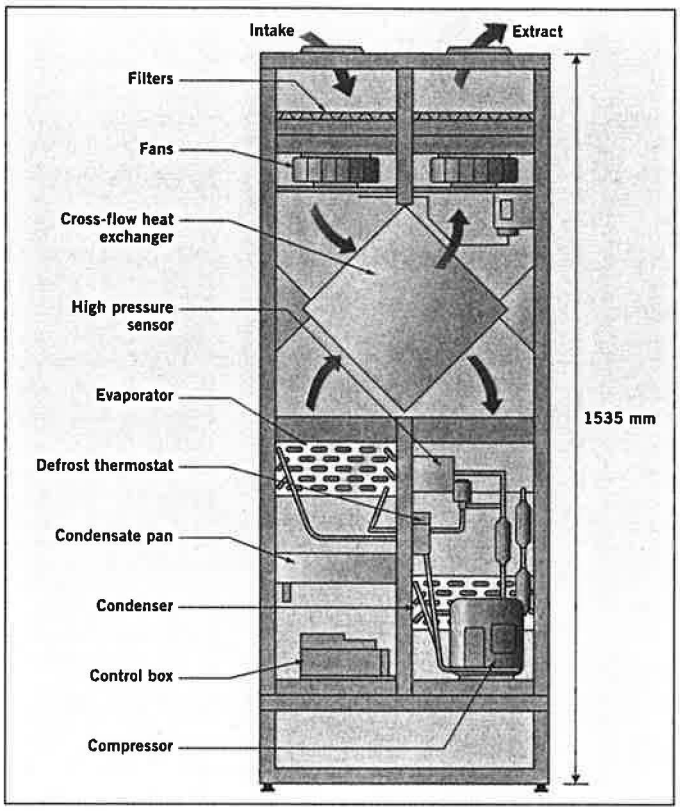
Like many local authorities, Greenwich Council is responsible for vast swathes of council flats and maisonettes. In total, the authority maintains some 35 000 such dwellings, 25% of which are over six storeys high.

Years of cash-strapped care and maintenance had reduced many of the properties to a state where, in some cases, demolition was the only answer. They leaked, they were cold and the aged and inefficient heating systems cost over £1000/ y to run. Hardly the kind of property to run on state benefit payments...

One such estate at Glyndon Road in Plumstead has long been a target ripe for renewal. Greenwich Council made two bids under central Government's Estate Action Programme, but for a variety of reasons failed to win the required funds. Greenwich looked elsewhere for money, and finally won an EU Thermie grant in 1993 to renovate one particular property, Claymill House.

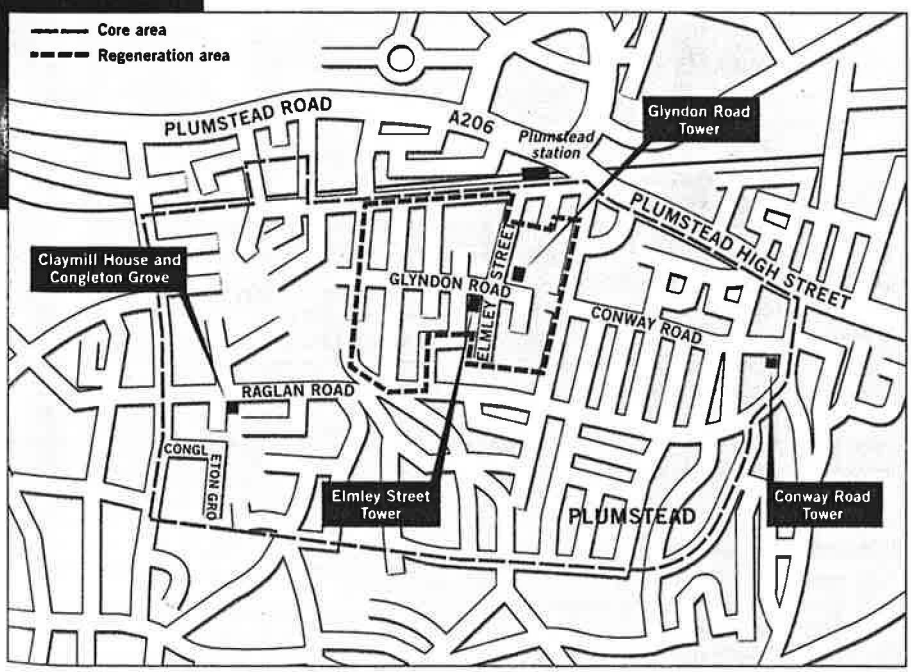
Claymill displayed all the shortcomings of 1960's uninsulated Bison construction: no insulation, cold bridging, condensation and high infiltration. To solve these problems, Greenwich Council planned to thermally overclad Claymill and replace its inferior electric underfloor heating with mechanical ventilation and heat recovery (mvhr) heat pumps, power and heat coming from two gas-fired combined heat and power (chp) engines.

The innovative nature of this proposal, called the Low Energy Application in Dwellings (LEAD) programme, served to open the financial floodgates. In addition to the £600 000 Thermie grant, Greenwich Council subsequently secured £19 million from the government's Single Regeneration Grant Budget (which subsumed Estates Action), £52 000 from the Combined Heat and Power Association and £35 000 from the LEB. The latter has paid for energy-efficient lighting right across



ABOVE, FIGURE 2: The Genvex units consist of a large heat pump unit and two fans – supply and extract – at the top. For the two-bedroom flats, the Genvex mvhr units were located on enclosed balconies, LEFT. This reduced the length of the inlet and extract ductwork, and simplified the disposal of condensate waste.

BELOW, FIGURE 1: The extent of the Plumstead housing redevelopment scheme, annotated with the LEAD tower blocks. Greenwich Council is experimenting with a variety of heating systems – only time will tell which system works best.



the Glyndon Road estate (figure 1). With this kind of support Greenwich Council has been able to instigate a wholesale refurbishment of 1190 properties, with chp being used on two more 24 storey towers, Glyndon House and Elmley Street.

Work started in December 1995 and, two years into the seven-year project, Claymill House and Elmley Street are already demonstrating massive savings in heating energy.

Project architect Hunt Thompson Associates designed thermal overcladding to reduce U-values from around 2·0 W/m²/K to 0·45 W/m²/K (6·5 kW per flat to 2·5 kW per one bed flat). Where once the annual heating bill for a two-bedroom flat at Claymill House was £1255/y, this has been slashed to just £387/y, a 69% saving. Cuts in CO_2 emissions have been similarly dramatic, down by 77%.

The chp installation

Only Glyndon House and Claymill House are equipped with dedicated heat co-generation plant, while Elmley Street shares the output from Glyndon's 280 kW Petbow chp engines.

The chp plants in both locations are run continuously between 07.00 h and 23.00 h. Outside these hours heat demand is met by gas-fired Strebel atmospheric boilers, with the electrical load satisfied by off-peak power from the grid at 2 p/kW, marginally better than the co-generation cost of 2·25 p/kW.

Although the Glyndon House chp station is a virtual carbon copy of that at Claymill House, the two installations differ in their use of the chp output. The units at Glyndon Road supply over 280 kW of heating for 182 one and two bedroom flats, as well as generating 180 kW of electricity. This is only used for communal lighting, lifts and the concierge-based cctv security systems at each block, rather than for tenants' use. Any generating surplus is sold back to the grid under an export agreement.

The heat from the chp's cooling system is used to heat traditional wet radiator systems in both the Gyndon Road and Elmley Street towers, small heat exchangers located in the corridors connecting each flat's low pressure circuit to the high pressure primary circuit.

At Claymill House the opposite applies. By virtue of the LEAD funds, electrical energy from the 175 kW chp plant is used to power the mvhr heat pumps and ancillary convector heaters, while the thermal output is used for space heating and domestic hot water in 90 adjacent flats at Congleton Grove.

Heat pump technology

Genvex heat pumps at Claymill House are sized to provide each dwelling's heating needs above external temperatures of 5°C. Below 5°C, extra heating will normally be required to maintain internal temperatures at 21°C (figure 2). This is achieved by electric convector heaters in each room, totalling 600 W.

The heat pumps are rated at a co-efficient of performance of between 2-4, depending on the conditions. They can operate in cooling mode, but have not been applied in this way at Claymill House.

THE BIGGER PICTURE

Finding the funds for the LEAD project was monumentally difficult, but Greenwich proved that money is available for projects which include social improvements as well as physical refurbishment.

This holistic approach captivated European funding mechanisms like Thermie, which is keen to disseminate good practice in the energy-efficient renewal of high-rise dwellings, particularly into Eastern Europe.

The sustainability of the whole refurbishment was also a key issue, as many such projects have failed to bring lasting improvements in a community's social conditions and employment figures.

During the early 1990s, central Government put the various funds for education, health and social services into a single pot. In simple terms, this meant that any grant application had to reflect benefits in each of those departments and not just physical refurbishment.

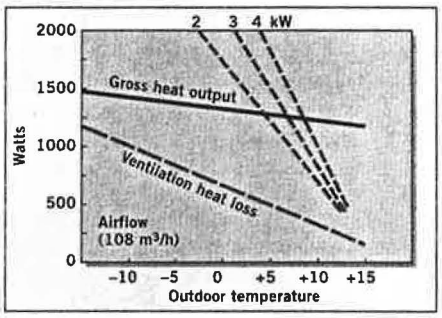
Although favouring local labour and suppliers can contravene European law, the UK construction industry has observed voluntary agreements on such matters.

At Plumstead, Greenwich hoped for 10% additional employment by virtue of these agreements, but in practice local employment on the project has reached a creditable 40%.

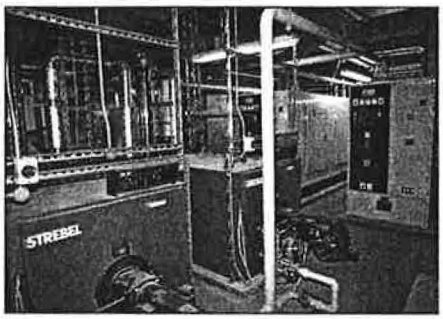
This is testament to the even-handedness of the construction industry, given that this was outside tender evaluations and contract awards.

Greenwich Council also set up GLLIC (Greenwich Local Labour Into Construction) to assist construction labour to move between other construction projects in the area, such as the Millennium Dome and the Bluewater Retail Park project at Dartford.

The ultimate benefit of GLLIC has been to extend the skills and training for construction labour, which would otherwise be confined to short periods of work primarily carried out on purely local projects.



The heating capacity of the Genvex GE210 mvhr heat pump at three power ratings.



The chp units and gas-fired boilers. Spare power is sold back to the grid at between 2-8 p/kWh.

The thermal output from the Genvex GE 210 heat pumps in each flat is supplemented by an air-to-air heat recovery device which can recover up to 70% of the latent heat from the waste air, pulled from the bathroom and kitchen. Incoming fresh air is then warmed through the heat exchanger before being injected into the living room areas.

The essential criteria is to maintain a balance between the electrical and thermal sides. At Claymill House and Congleton Road, the balance is extremely close. At Glyndon/Elmley the balance is slightly less. Thermal energy that provides space heating and domestic hot water is counter-balanced by electrical loadings tied to services maintained 24 h/day (eg communal lighting, lifts and cctv systems). Imbalances result in small amounts of electricity being sold back to the grid.

A Trend energy management system monitors temperature and humidity levels within each flat and the fault condition of the Genvex units, also possible remotely via a modem link. A Trend intelligent controller in each dwelling watches over the state of each hot water cylinder, which allows some mild load shedding of the chp engines if needs be.

These either cut in automatically when internal temperature falls, or are brought on by the tenant by raising the set-point via a room controller. A setback programmer also allows the tenant to lower the heating by 3°C. The cost to install the equipment compared to other forms of central heating was estimated at the design stage to be £1 675 000, excluding professional fees. This will be recouped over 10·7 y through anticipated energy, management and maintenance savings.

This may seem inordinately long, and indeed it is by central Government standards, but Greenwich Council is also anticipating some additional health benefits from using mvhr technology. When Greenwich undertook prototype tests of the Genvex units in some now-demolished maisonettes, one tenant reported a significant drop in asthmatic attacks. This suggests that mvhr units can help reduce dust mite populations.

Where tenants were once paying over £1000/y for heating and hot water, this is now down to £275/y including the maintenance charge. Such massive cuts in fuel costs serve to put less pressure on precious housing benefits, and have the added value of increasing tenants' disposable income.

Key design lessons

Retrofitting the mvhr systems into occupied flats was not easy. The major problem was the drilling of holes in walls to accommodate the ductwork. The reinforced concrete walls of Bison towers are 200 mm thick, and the two-bed flats at Claymill House required eight 159 mm-diameter holes. Diamond-tipped drills did the trick. Once the contractors learnt how to do it, they found they could drill a flat in a day.

The current design of the Genvex unit does not facilitate handed applications, the fixed position of the supply and extract terminations causing problems for ductwork arrangements. This has led to some unsightly installations, especially when the units are located in the storerooms. At least the architects and engineers have been able to demonstrate that the technology can work given the worst-case conditions typical of council tower blocks.

To deter roosting pigeons, external air boxes for the inlet and extract terminals have been amended to have a more steeply sloping top surface. Finally, tenants expressed concerns about the complexity of controls. This prompted Greenwich Housing Department to issue a set of simplified user instructions.

Conscious of the replication potential for similar high rise towers across Europe, the EC funders are keeping a close watch on the progress of the Genvex installation. Dissemination of the project's results will be handled by the technical arm of the Dutch housing authority (National Woningraad) and via the UK's own Building Research Establishment, managers of the Thermie project.

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Greenwich Housing Engineering Services (Graham Saunders, David Turner)
CHP scheme design consultant
Waltham Forest
Structural engineer
Ellis & Moore
Main contractor
Walter Llewellyn & Sons

Main engineering suppliers
Mechanical ventilation heat recovery units: Genvex
Controls: Trend
Boilers: Strebel
CHP Engines: Petbow Co-Generation
Windows: Swedish H
Cladding: Cape External
Insulation: Rockwool

Claymill House engineering services costs*
Overcladding: £866 000
Windows: £402 000
Enclosed balconies: £228 100
Lift shafts: £6 400
Security and energy management system: £11 300
Genvex mvhr systems: £427 000
Total cost analysis of innovative package: £1 941 400
(*Tender only: subject to final accounts)

Funding arrangements
Single Regeneration Grant Budget: £19 million
Housing Association investment: £10 million
Greenwich Council Housing: £10 million
Total investment in Glyndon Estate: £39 million

Total cost of refurbishment
Claymill House: £4.5 million
Glyndon Road: £4.0 million