#3412

Energy Efficiency Demonstration Scheme

Report

Energy Efficiency Office

DEPARTMENT OF ENERGY

ENERGY EFFICIENCY DEMONSTRATION SCHEME

ENERGY EFFICIENT

REFURBISHMENT OF

VICTORIAN TERRACED HOUSING

A Demonstration for
Merseyside Improved Houses,
Liverpool

BDP Ener
PO Box 85
Manchester
M60 3JA

Building Use Studies Ltd
14-16 Stephenson Way
Euston
London NW1 2HD

Prepared for
Building Research Energy
Conservation Support Unit (BRECSU)
Building Research Establishment
Garston
Watford
Herts WD2 7JR

FINAL REPORT No ED 227/209

HOST ORGANISATION	Merseyside Improved Houses Liverpool North Area Office 25 County Road Walton Liverpool L4 3QA
EQUIPMENT MANUFACTURERS	INSULATION BOARD Fibreglass Ltd Insulation Division Prescot Road St Helens Merseyside WA10 3TR
	DOUBLE GLAZING Pilkington Glass Ltd Lynnfield House Church Street Altrincham Cheshire WA14 4DZ
INSTALLATION CONTRACTORS	Frank Rogers (Building Contractors) Ltd 93 Oakfield Road Anfield Liverpool L4 0UE
	Laytondale Ltd 59 Linacre Road Litherland Merseyside L21 8NW
	Meadway Building & Electrical Contractors Ltd 21 Lynnbank Road Liverpool L18 3HE
	Bleasdale Building Contractors Ltd 193A Altway Liverpool L10 6LB
MONITORING CONTRACTORS (for BRECSU)	Building Design Partnership Sunlight House PO Box 85 Quay Street Manchester M60 3JA
	Building Use Studies Ltd 14-16 Stephenson Way Euston London NW1 2HD

MANAGEMENT SUMMARY

Energy savings worth an average of £41/year, together with improved comfort levels and reduced maintenance requirements, have been achieved in this demonstration by Merseyside Improved Houses.

The demonstration, which was supported under the Energy Efficiency Office's Energy Efficiency Demonstration Scheme, involved the installation of a package of energy-saving measures in 24 solid-walled terraced houses in an inner-city area of Merseyside. These were in addition to the normal energy-related measures (central heating and roof insulation) installed during refurbishment of houses to the standard level for 1985. The additional measures comprised:

- internal insulation of external walls;
- draught-stripping of external doors and windows;
- double glazing of downstairs living rooms;
- extract fans in kitchens and bathrooms;

The measures were successfully installed during a major refurbishment of the properties. Their effectiveness was determined during independent monitoring when energy use and comfort levels in those houses in which the measures had been installed were compared with 20 control houses which had only been refurbished to the standard level.

Tenants in the control group spent, on average, only £120 per year on space heating. Even so, the insulated houses showed savings averaging 34% (£41 per year) and were found to be 6% warmer than the control houses. Potentially damaging condensation was eliminated, even in kitchens and bathrooms. The cost of installing the additional measures amounted to £1,142 and represented only a 7% increase on the standard refurbishment cost of £16,858.

The application of the internal wall insulation and the reduced heat loss through these solid walls appears to have had no adverse effect on the outer brickwork: no frost damage or spalling was observed, even after the low temperatures experienced in January 1987. Furthermore, there is no evidence so far of interstitial condensation occurring between the dry lining and the brickwork.

The monitoring included a social survey. This indicated that tenants in the insulated houses achieved greater levels of comfort than those in the control houses. The trial group houses were heated for fewer hours per day (10 compared with 14 for the control group), and overall spending on energy by trial group households was less than for the control group. However, neither group experienced the full benefits of central heating either for financial reasons or because of an inability to control it effectively due to lack of understanding of the controls. In addition it was found that some tenants were using energy wastefully.

The educational programme carried out during Phase 2 of the project was designed to help tenants understand their heating system and controls better and to reduce the wasteful use of energy. The programme was well received, led to some degree of behavioural change and resulted in further savings on total fuel consumption of about 10%, worth about £25 per year.

CONTENTS

1. INTRODUCTION

Merseyside Improved Houses (MIH) is a charitable housing association which was set up in 1928 to provide rented homes for people in serious housing need in the inner city areas of Merseyside. The Association is currently managing almost 11,000 dwellings and a major part of its work is the refurbishment of older, mainly pre-1919 houses.

The normal rehabilitation package is designed to make the structure of a dwelling sound and to install full or partial central heating, based on a gas-fired back boiler. Loft insulation (100 mm) is also provided. However, MIH have found that, even after the installation of these measures, the dwellings have continued to suffer both from condensation with its associated problem of mould growth and from inadequate winter temperatures. These problems are particularly characteristic of low-income households who cannot afford to make full use of the central heating.

In 1985 MIH decided to improve a trial sample of pre-1919 inner-city terraced houses to a higher standard of energy efficiency. The selected houses were all of solid-wall construction and each had the following package of additional energy-saving measures installed:

- internal insulation applied to external walls;
- double glazing of main downstairs rooms;
- draught stripping of doors and windows;
- extract fans, controlled by humidistat, in kitchens and bathrooms.

The aim was to assess whether the installation of these measures was practical and cost-effective in reducing fuel consumption, in improving comfort levels for tenants and in reducing maintenance costs by eliminating much of the damage normally associated with condensation. This was done by comparing the sample group of houses with a control group which had been refurbished to the normal standards of the housing association.

The project was selected in 1985 as a demonstration project under the Government's Energy Efficiency Demonstration Scheme, and a 25% grant was made towards the installed cost of the energy-saving measures. Mr Tony Russell of the Building Research Energy Conservation Support Unit (BRECSU) was appointed to represent the interests of the Energy Efficiency Office (EEO) of the Department of Energy.

The costs of independent monitoring of the project were also met by the EEO. Building Design Partnership were contracted to carry out physical monitoring and Building Use Studies Ltd were sub-contracted to undertake the sociological surveys and the energy advice and education scheme. This report summarises the results.

The measures installed are suitable for most solid-walled dwellings, and the national stock of pre-1919 dwellings, most of which are solid-walled, has been assessed at 4.75 million. The replication potential for these measures is therefore high.

2. DESCRIPTION OF PROJECT

The work was undertaken in two phases. The first of these involved the selection of 24 houses and their refurbishment to the higher standards of energy efficiency outlined in the Introduction. This trial group was then monitored and compared with a control group of 20 houses which had already been refurbished but had received only the standard central heating and roof-insulation package. During the Phase 1 social survey it became evident that levels of understanding in relation to heating systems were low and that many households were wasting energy. A second phase was therefore devised involving the implementation and monitoring of an educational campaign to encourage tenants to use their heating systems efficiently and to reduce energy waste.

2.1 Characteristics of houses selected for Phase 1

Location and dimensions

The 44 houses selected for the demonstration are all pre-1919 terraced houses, constructed of brick and with large windows. They are located in typical inner-city streets in Kirkdale and Linacre, and experience little exposure. Although the houses were chosen to be as similar as possible, the need for tenant co-operation resulted in the inclusion of three end-of-terrace houses in the sample. The average floor area of houses in the trial group was 78 m^2 compared with 79 m^2 for the control group.

Space and water heating systems

Some variation existed between houses in the types of space-heating system installed. No central heating was installed in three of the trial houses at the request of the tenants concerned: two of these houses had gas fires downstairs and the third had all-electric heating. In general the standard of heating installation in the trial group was higher than in the control group: although each house in the control group had central heating installed, there were fewer radiators per house, fewer radiators in bedrooms and fewer gas fires.

All except one of the houses in the trial group had an immersion heater for water heating. The exception had a gas multi-point boiler. In addition, those houses in the trial group which had central heating installed could use the gas boiler to heat water. Each house in the control group had both a gas boiler and an immersion heater.

2.2 Additional measures installed in the trial houses

Internal wall insulation

Internal wall insulation can be applied either during a major refurbishment when a house has been gutted, or during the upgrading of insulation standards of otherwise acceptable walls.

In this demonstration a major refurbishment was being undertaken and the existing, failing plasterwork was replaced by Crown Dry Liner, a laminate of plasterboard, vapour barrier and rigid glassfibre slab. This was applied to bare brickwork using a combination of mechanical fixings and plaster dabs. In some houses the walls were rendered beforehand to take up irregularities in the surface of the brickwork and to provide a truer final surface. A final skim of plaster was applied to the drylining boards to take up any inaccuracies in their alignment.

Draught stripping

All external doors and windows were draught stripped. New doors were supplied to fit existing frames and were draught stripped on site. The windows were supplied in sets of casements and frames which had already been draught stripped by the manufacturers. An additional draught-proofing measure was the replacement of rotten timber floors by solid floors. To ensure that sufficient air was then available for heating appliances, ducts were installed in the solid floors to bring air to gas fires.

Double glazing

Windows in the two main downstairs living rooms were double glazed using sealed units supplied in casements and frames which had been draught-stripped by the manufacturers. The remaining windows were single glazed and drainage channels were installed to remove the products of condensation. All windows were fitted with trickle ventilators.

Extract fans controlled by humidistat

Extract fans were installed in each trial house kitchen and bathroom and were controlled by a humidistat.

2.3 Characteristics of households involved in Phase 1

For various reasons no exact match was possible between the trial group and the control group in terms of household type and size. The effect of these differences was to dispose the control group to consume slightly more energy, and analysis of the monitoring results allows for this.

Most of the trial group had always lived in rented accommodation and were a settled group. Those who were sitting tenants when MIH bought their houses had been longstanding occupants of their homes - many for over 20 years. The others in the trial sample, who were rehoused by MIH, had come mainly from local authority or privately rented accommodation, and most had been in their previous tenancy for more than five years.

Only one of the trial group tenants had had prior experience of central heating. The remainder had relied on coal and gas fires or (in three cases) electric fires. Although nearly half the group had accepted these conditions as satisfactory, there was some dissatisfaction expressed, mainly of cold bedrooms and inadequate heat from electric fires. Several of the 'new' tenants said that their previous houses had been cold and damp.

Five of the tenants in the trial group had previously had no water heating and had had to rely on friends and relatives for baths. Three households had relied on back boilers (reported as being very efficient in winter, but an unsatisfactory method of heating water in the summer); two had relied on geysers and the remainder on immersion heaters.

Those tenants in the trial group who were interviewed before the refurbishment took place were looking forward to fewer draughts and increased warmth throughout the house, to less mess from coal fires and, in half the cases, to better facilities for heating water, especially for baths.

The control group was similarly split between longstanding, sitting tenants and those rehoused by MIH. Many of this group had experienced modernisation of their homes quite recently - half of them in the year preceding the start of this demonstration. A few modernisations had, however, been completed up to five years previously.

Nearly all the houses in both groups were occupied by low-income families, many of them unwaged and in receipt of state income support. The average reported income per household for the trial group was £67/week; that for the control group £74/week. These figures should only be regarded as a guide for two reasons:

- some tenants may not have been aware of benefits received in terms of direct payment for rent etc;
- some tenants gave only rough estimates of income.

2.4 Characteristics of the sample households involved in Phase 2

At the conclusion of Phase 1 of the project, tenants in both trial and control groups were asked to continue into Phase 2. Ten of the trial group and three of the control group decided to withdraw at this point: this was mainly on the grounds that they wanted the monitoring equipment removed in order to redecorate.

A second trial and control group was therefore recruited using, as an incentive, the offer of draught-stripping for their houses. The new trial group was given advice and instruction: the new control group was not. The four groups and their level of involvement are shown in Table 2.1.

Table 2.1 Tenant involvement in Phase 2

Group	Group Size	Insulation	Advice	Draught Stripping	Interviewed
Phase 1 Trial	14	Yes	Yes	Yes	Phase 1 & 2
Phase 1 Control	17	No	Yes	No	Phase 1 & 2
Phase 2 Trial	25	No	Yes	Yes	Phase 2
Phase 2 Control	20	No	No	Yes	No

Despite the reduced numbers, the household characteristics of both Phase 1 groups remained similar with a higher proportion of families with school-age children and a lower proportion of adult-only households in the control group. Both groups recruited for Phase 2 had similar characteristics and were distinguished from the Phase 1 groups by the very high proportion of small households and elderly tenants.

Only 24 of the 58 tenants interviewed before the start of the educational campaign could recall receiving any instruction on how to use their heating and hot water systems. Of these, only 13 had been given this instruction by staff from the housing association. Although MIH aims to visit all new tenants, its housing assistants have an increasing administrative load and, in any case, may be limited in their own understanding of the heating systems installed. Very few tenants possessed a proper instruction book.

Although only 13 tenants said that lack of instruction had caused problems, either of greater than necessary energy use or of worry and confusion, the danger is that lack of understanding and instruction leads to bad and costly habits which could be avoided if tackled when tenants first move in.

2.5 The Phase 2 educational campaign

The educational campaign had four components.

- Fieldworker advice: as well as reading meters and downloading monitoring equipment, the fieldworker was trained to provide energy advice and instruction.

- Energy advice sheets: these dealt with such issues as hypothermia, use of controls and condensation control, and were issued free to tenants during three separate visits in January 1987.

- Energy calendar for 1987: a cartoon-style calender was designed to stimulate interest in energy efficiency. Each month had an energy efficiency tip and space was provided at the end of each week to record the units of gas and electricity used (Fig 2.1).

- A questionnaire survey: this was carried out in March and April 1987 to evaluate the education campaign and to measure tenants' reaction to it.

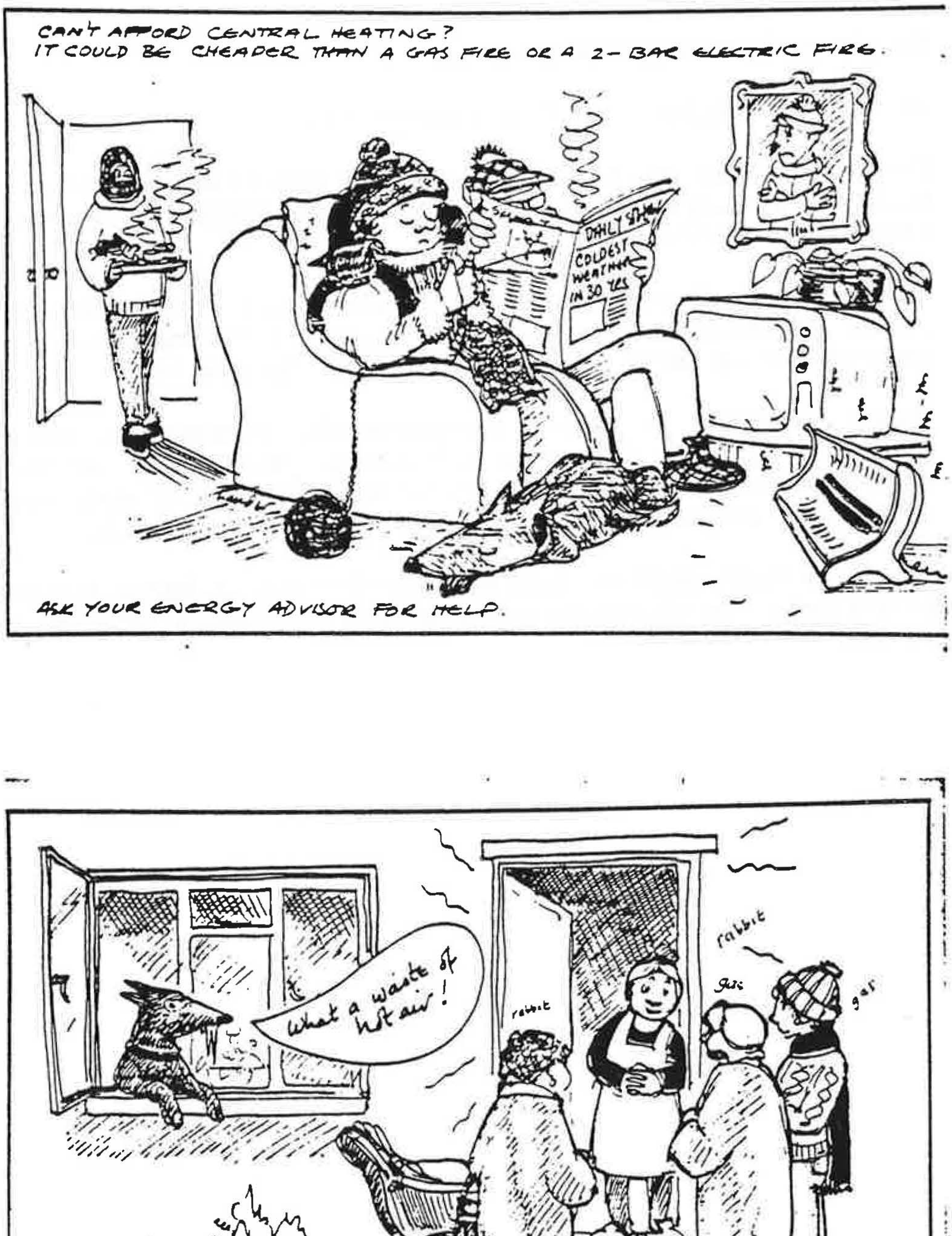


Fig 2.1 Energy calendar for 1987: sample months

3. THE MONITORING PROGRAMME

3.1 Aims and objectives

The overall aim of the monitoring programme was to provide information which would assist other organisations considering large-scale refurbishment in deciding whether to install a similar package of energy-saving measures.

More specifically the aims were:

- to determine the energy savings achieved by the measures being demonstrated;
- to determine the corresponding cost savings;
- to assess any consequential benefits or disadvantages;
- to assess the ease with which the measures were installed;
- to assess the influence on energy consumption of the behaviour and demographic characteristics of building occupants;
- to determine, in qualitative terms, the benefits of the trial measures to householders;
- to assess the effects of an energy-saving educational campaign.

3.2 Methodology

Monitoring was divided into

- monitoring during the installation of the energy-saving measures;
- detailed physical monitoring of occupied houses in the original trial and control groups;
- monitoring of energy consumption in the additional trial and control houses involved in Phase 2;
- social monitoring during both phases of the project.

3.3 Installation monitoring

Monitoring of the installation of the energy-saving measures took place during refurbishment of the trial houses. Four houses were examined by staff from the Building Research Establishment; two of the houses inspected were ready for dry lining and two had already been lined.

3.4 Physical monitoring during occupation: Phase 1 houses

Although the initial plan had been to monitor the houses during the entire 1985/86 heating season, a large number of the trial properties were not available for occupation until after the summer of 1985. Energy monitoring for the control group and for part of the trial group commenced in July 1985 with temperature monitoring starting in November 1985. Full monitoring of the 19 control houses and 23 trial houses involved occurred only between January and June 1986, and this shortage of data resulted in the monitoring being extended for a further year. However, not all the tenants agreed to the continuation of monitoring in their houses and the samples were reduced to 17 control and 14 trial houses.

Total fuel consumption

Energy use was established by recording the gas and electricity consumption in each house on a fortnightly basis. The frequency of these readings offered two advantages:

- fluctuations in consumption and atypical readings could readily be observed;

- tenants were more likely to be able to offer reasons for these fluctuations, thus allowing them to be related to the occupancy and activities in each house.

Base load estimation

Because no sub-metering was used, the base load (consumption for water heating, cooking, lights and other electrical appliances) was estimated from readings during the summer period. The space-heating load was then calculated from the fortnightly readings minus the estimated base load.

Internal and external temperature measurements

The success of a demonstration of this type depends on obtaining two samples which are alike in all aspects except those being tested. The highly variable nature of both the building stock and its occupants made this very difficult to achieve and so both internal and external temperatures were measured to help to explain the undesirable variation between the samples.

Inside air temperatures were recorded in the four main rooms of each house (two upstairs and two downstairs) using sensors mounted in patress boxes and wired back to Squirrel data loggers. These were downloaded at the same time as the fortnightly meter readings.

Measurements were also made, using an infra-red thermometer, of the internal wall surface temperatures in a sample of the houses.

Outside air temperatures were measured at three locations using in each case a single-channel recorder located in an enclosure on a garden wall. These were downloaded fortnightly when the houses concerned were visited.

Pressure testing

A sample of both trial and control houses were subjected to pressure testing to establish the benefit of draught-stripping.

3.5 Energy consumption monitoring: Phase 2 houses

During the second phase of the Project, energy consumption was monitored for the 45 additional households recruited. This information was then used to compare consumption by the new trial group households (which received energy information and advice as part of the educational campaign) with consumption by the new control group households (not involved in the campaign).

3.6 Social monitoring

The survey during Phase 1 of the project comprised two interviews with tenants of the trial and control properties. The first interview was scheduled for the 1984/85 heating season, prior to the completion of the trial modernisations; the second was for the 1985/86 heating season.

Additional information was collected fortnightly during the monitoring period in the form of an 'energy diary' for each household. This was completed by the fieldworker during visits to read meters and download monitoring equipment. The variables surveyed were as follows:

- household size - number of adults, children, elderly;
- employment status of adults;
- self-reported income level;
- previous method of space heating;
- satisfaction with space and water heating;
- use of central heating, and methods of control if used;
- demand for water heating (on scale 1-5).

During Phase 2 of the project, a second social survey was carried out to detect changes in the tenants' attitudes and perceptions. The questionnaire aimed to assess

- attitudes to the presentation of the energy literature;
- the number of advice notes read;
- the advice recalled and the spread of information to peers;
- the behavioural response;
- the value of feedback on consumption;
- the changes in energy consciousness;
- the impact of the campaign on consumption.

4. RESULTS FROM MONITORING

4.1 Installation of the energy-saving measures

Internal wall insulation

Houses of this age are unlikely to have walls in good condition and the houses in the trial group were no exception. Nevertheless, the dry-lining boards were installed successfully and with only a few minor problems. Local variations resulting from brick misalignments were accommodated because of the thickness of the insulation.

The high quality boards used in this project were heavy: they required two men to lift them and this slowed down the speed of the installation. Lighter and cheaper products with a similar thermal performance are available, although consideration needs to be given to the fire resistance of the insulating material and the likelihood of delamination occurring.

The use of mechanical fixings led to depressions in the surface of the insulation; plaster dabs should normally be sufficient and these have the advantage that the boards can be aligned by being pressed home with a batten.

Excessive bonding plaster was sometimes used to make good a joint between boards: this resulted in a temperature drop at the joint, though with no discernible effect in use.

No impact damage to the surface of the insulation was noted and none of the tenants had attempted to hang anything on the insulated walls. However, it should be noted that specialised fixing devices are required for this purpose, and there is a slightly greater danger of damage occurring with this type of wall finish than with traditional plasterwork.

The only problem which did arise was that, in one house after two years, the plasterboard delaminated from the backing at a door reveal. This probably resulted from a failure to follow the manufacturer's recommendations (a reinforcing scrim) for corner details.

So far there is no evidence that the outer surface of any of the trial houses has been affected by frost damage and spalling as a result of reduced heat loss. The extreme temperatures experienced in January 1987 appear to have had no effect on the brickwork, and it is estimated that the area's climate is unlikely to give rise to problems of this nature.

The vapour barrier incorporated in the dry liner to prevent the build-up of condensation at the cold interstitial surface had to be pierced at every light switch and wall socket. However, no problems resulting from interstitial condensation have been noted in the two years since the insulation was installed. If condensation is occurring, it must be escaping at a rate faster than it can build up.

Tenants' reactions to the insulation were positive. They were pleased both with the wall finish and the significant increase in comfort levels.

Draught stripping

Although tenants needed to take care to avoid damaging the draught stripping when opening or closing doors and windows, the measure proved very acceptable. A little accidental damage was observed in some cases and warping of some of the new doors has necessitated the replacement or adjustment of the draught-proofing strip.

The main non-energy related benefit is the increased level of comfort experienced by tenants. No problems of condensation were experienced in the trial houses (even in those most likely to experience them), probably because of the combination of extract fans and wall insulation. However, making a house more air tight and reducing the air change rate was found to cause condensation problems during Phase 2 of the project when the additional sample houses were draught-stripped only. Eight of these households complained of increased problems of condensation. In six cases, this occurred on windows where it could be mopped up and in two cases it resulted in mould growth on walls.

Double glazing

No complaints about either the double glazing or the new single glazing have been received from tenants, and the benefits of the measures in eliminating condensation on windows were welcomed.

Extract fans controlled by humidistat

The installation of these fans appears to have been successful as no complaints relating to condensation have been received from tenants in the trial houses. However, condensation-related problems have been recorded in the control houses (no fans fitted), for instance mould growth under a window.

The fans themselves, although very reliable, are subject to the failures associated with any electro-mechanical device. The humidistats have proved rather less reliable to date.

4.2 Results of physical monitoring

Energy consumption

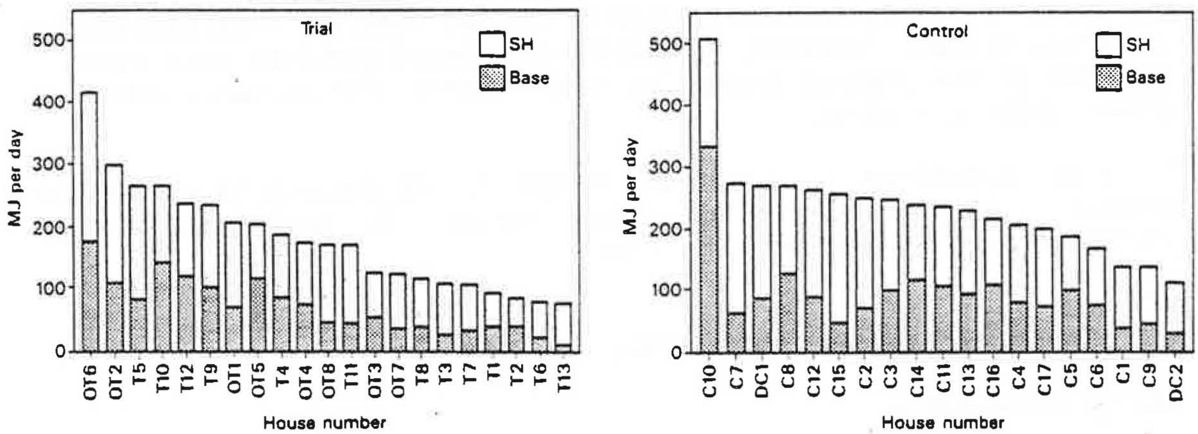
The calculations for energy consumption have made allowance for the fact that the period of monitoring varied considerably from house to house. A complete set of data was available for the control houses, but data for the trial group varied from those which were monitored for only part of the first heating season to those for which monitoring continued during a second heating season.

The average energy consumption in GJ for those houses which completed a full year of monitoring is given in Table 4.1.

Base loads covering cooking, lighting, small power and water heating were calculated from graphs of metered consumption on which the heating and non-heating seasons could be identified. Calculations have been adjusted to accommodate those households which used electricity for heating water in the summer only and whose electricity consumption was therefore higher in the summer than in the winter. Annual base and space-heating loads for both trial and control groups are shown in Figs 4.1 and 4.2.

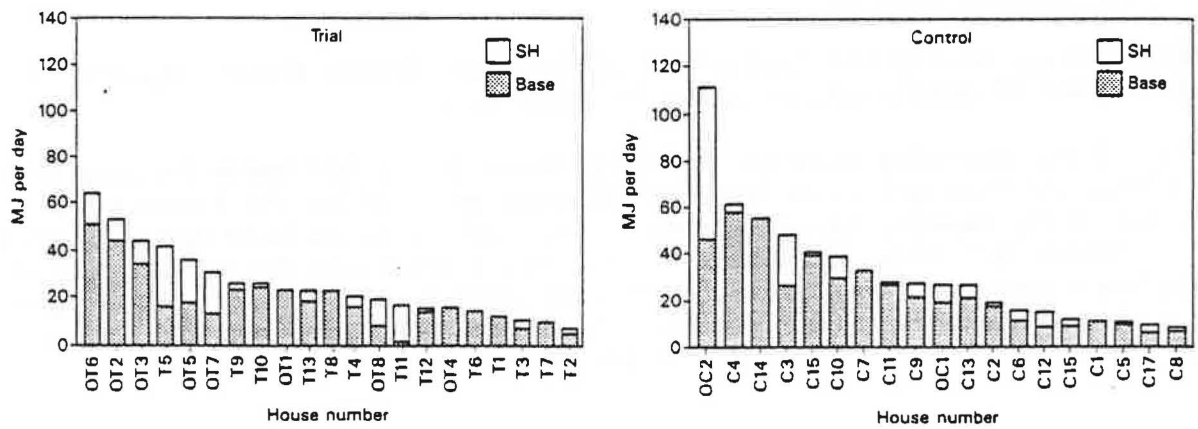
Table 4.1 Average energy consumption for houses completing a full year of monitoring (GJ)

		Energy consumption Trial houses GJ	Energy consumption Control houses GJ
Base load:	Gas	22.5	35.8
	Electricity	5.4	8.6
	Total	27.9	44.4
Space heating:	Gas	19.4	29.7
	Electricity	0.9	0.9
	Total	20.4	30.6
Total energy:	Gas	41.9	65.4
	Electricity	6.3	9.5
	Total	**48.2**	**74.9**



Trial houses **Control houses**

Fig 4.1 Annual base and space-heating loads: gas



Trial houses **Control houses**

Fig 4.2 Annual base and space-heating loads: electricity

House temperatures

In most of the houses monitored the main heated room was either the front or the back room downstairs. In one house one of the bedrooms was the warmest room, presumably because the elderly occupant was bedridden for much of the time.

Table 4.2 details the average temperatures recorded in both trial and control houses. Temperatures are low by current design standards. Although the trial houses appear to be marginally warmer than the control houses in the main occupied rooms but colder in whole-house averages, and although the trial houses appear to be more uniform in temperature with a smaller average temperature difference between rooms, the differences are not significant. There is, however a significant difference between the two groups in the average internal/external temperature difference: the trial houses are warmer by 0.5°C. This is further evidenced in the calculation of degree days for each house. These figures are derived by measuring the difference between the average house temperature and the outside air temperature for each hour of the day, producing an average temperature difference for that day and then totalling the temperature differences for the period of monitoring. As can be seen from the figures, the trial houses are warmer than the control houses by some 6%.

Measurements were also made, using an infra-red thermometer, of the internal wall surface temperatures in a sample of houses. These measurements were taken on a cold, windy day with the outside air temperature between 0 and 3°C. The main conclusions to be drawn are outlined below.

- Those houses with insulation show an evening out of the temperature difference between the top and bottom of the wall (3.3°C compared with 4.6°C in the control houses). This must lead to an increase in the levels of comfort experienced by the occupants in the trial houses.

- There is a lack of heating in many rooms in both groups of houses.

- The temperature of the party wall is much affected by the temperature next door.

Table 4.2 Average temperatures in the trial and control houses (°C)

		Trial houses	Control houses
Average temperature in house	1985	15.6	N/A
	1986	15.8	15.9
Average temperature in principal heated room	1985	18.7	18.5
	1986	18.6	18.4
Average temperature difference between rooms	1985	5.6	6.0
	1986	5.6	6.2
Average internal/external temperature difference	1986/7	7.1	6.6
Average degree days per house	1986/7	1602	1505

The relationship between energy consumption and temperatures achieved has also been studied. In Fig 4.3, the average temperature of the warmest room for each house has been plotted against its energy consumption. A direct relationship between temperature and energy consumption has been assumed, and the graph indicates a good degree of correlation. The fit for the control group is marginally better than for the trial group, which may be a result of the different sample sizes. On average, the households in the trial group used one third less energy than those in the control group to achieve the same level of temperatures in the warmest room of each house. The graph clearly shows the benefit of the insulation measures installed.

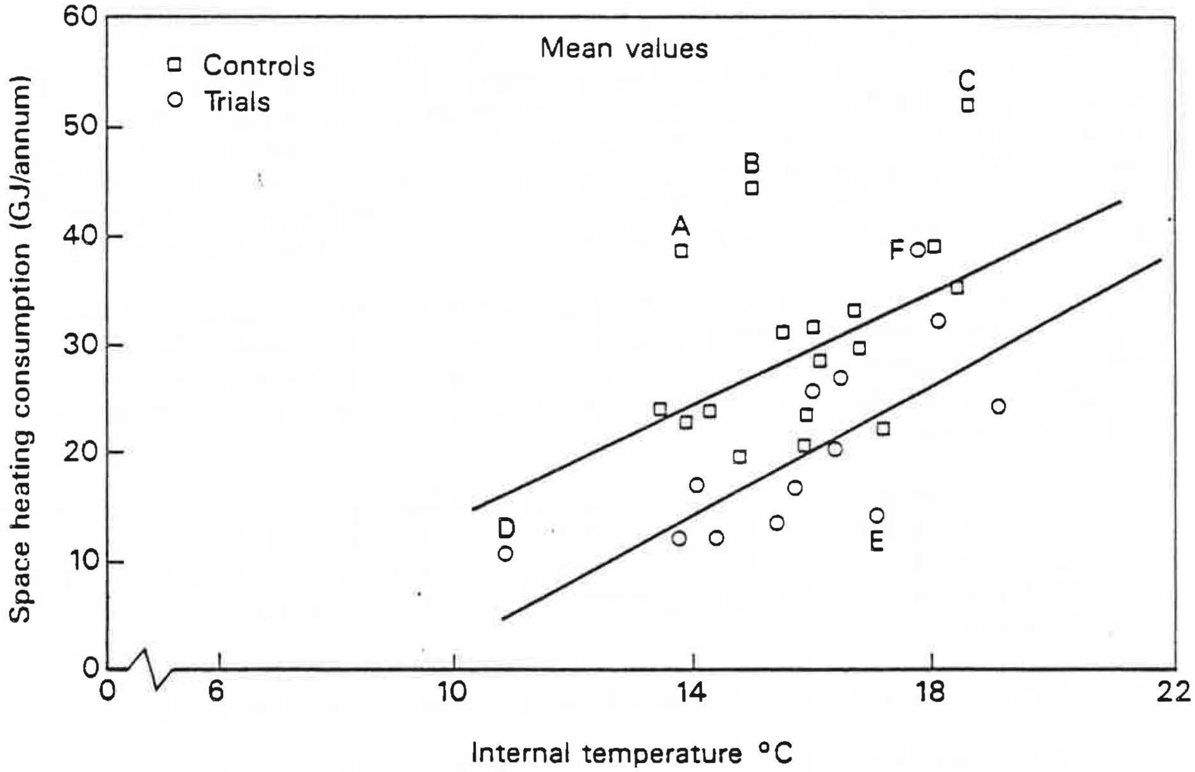


Fig 4.3 A comparison of average internal temperature in the warmest room with annual energy consumption for space heating

The graph also indicates a number of households which are well outside the main scatter for the two groups (A, B and C for the control group; D, E and F for the trial group).

Household A has a high energy consumption, but the occupant, a single elderly person, complained that the house is cold and difficult to heat - a conclusion borne out by the facts. House B contains a family household which has louvre windows and which leaves the front door open; while House C contains a family which tends to heat both downstairs rooms. In the trial group, house D is occupied by a single male: it feels cold on entry and so both the low temperature and the low value for energy consumption are likely to be correct. House E contains an adult family who are careful with heating, while F has a confused record with changes in the occupancy during the monitoring period.

It is not possible from the results to predict likely energy consumption for specific types of household, although general observations can be made. Highest temperatures tend to be in family households while, apart from D, lowest temperatures occur among the single elderly. Energy consumption, however, varies widely and reflects both the differing behaviour of households with respect to window and door opening, and the number of people and other heat gains to the occupied space. From the temperature and energy records it was, however, clear that individual households maintained consistent patterns.

Pressure testing of houses

The results of pressure testing indicated that the trial houses are, on average, more air tight than the controls. Both groups of houses, however, proved to be relatively 'leaky' and this helps to explain both the lack of condensation experienced and also the low temperatures recorded in unoccupied rooms. The results also suggest that there are other leakage paths from these houses apart from the cracks around doors and windows which, in the case of the trial houses, had been draughtproofed.

4.3 Results of social monitoring: Phase 1

Householders' use of space-heating systems

It became clear during the monitoring period that only half the households used the central heating regularly. The remainder either never used the system or used it in the coldest weather to 'top up' the heat provided by gas fires. This was characteristic of both trial and control groups with the latter making slightly greater use of central heating, probably a result of their greater experience of and confidence in this more complex heating system.

The main reason for low overall use of central heating was financial. Fear of large gas bills was particularly characteristic of elderly households and families with young children. The fear was reinforced by a poor understanding of the controls. One tenant, on receiving a large gas bill after using the central heating over Christmas, subsequently stopped using the system altogether.

Because many of the houses in both trial and control groups were continuously occupied, the demand for space heating was high. One third of the trial group and half the control group reportedly heated their living rooms for more than 12 hours per day. The average heating period for the trial group was 10 hours per day compared with 14 for the control group.

Bedroom heating showed a similar pattern. Over 50% of the trial group elected not to heat their bedrooms (although radiators were fitted in at least one bedroom in each house), while 60% of the control group used some bedroom heating (either radiators or electric fires), and two families with young babies kept the heating going all night.

Householders' use of central heating controls

A comparison was made, in terms of understanding of the system, between the trial group (to whom central heating was a novelty) and the control group (all of whom had had experience of central heating for at least one year prior to the start of this demonstration).

All heating systems in the trial properties had time clocks and thermostatic radiator valves (TRVs). In the control group only 11 had clocks, the remainder having a simple ON/OFF switch. Two control houses had TRVs; the others had ordinary valves but no room thermostats.

Of the 14 trial households who used the central heating, only nine used the time clock. Of the control group only four used the time clock. All remaining households whose systems incorporated a clock ignored it and used the 'CONSTANT' setting as an ON/OFF switch. This wide use of manual switching can be explained partly by unfamiliarity with the system and partly by a desire to avoid large heating bills. The central heating was used in all nine control houses with a simple ON/OFF switch, and this confirms the preference for simple heating controls.

Of the trial group tenants who used their time clock, half appeared to do so with full understanding. The remainder encountered difficulties and were often helped by friends, relatives or housing officers. A similar pattern was encountered among tenants in the control group.

Only one tenant in the trial group used the TRVs. In the control group again only one tenant used the TRVs while another used the radiator valves to provide heating in the kitchen only. This lack of use of valves is a further example of inadequate understanding of the system's flexibility.

Householders' use of water-heating systems

The majority of households in both groups relied on gas boilers for their hot water. One householder in the trial group used the immersion heater to 'top-up' the supply compared with four in the control group: this probably reflects the more established pattern of supply for the latter group, a pattern which was fine-tuned to meet their requirements.

Variations also occurred in the levels of hot water use. The trial group had a slightly lower level of consumption (based on baths taken and washing machine loads), and this may reflect

- the modest habits of those in that group, some of whom had never had hot water before;
- the greater number of families with children in the control group.

Householders' use of water-heating controls

Of the 17 tenants in the trial group who used the gas boiler to supply hot water, seven used the time clock for a regular, automatic supply; eight used the 'CONSTANT' setting as an ON/OFF switch, and two used both methods. The five remaining tenants in the trial group obtained hot water by using an immersion heater: two did not have gas boilers and the other three made no use of their central heating system. There was some understanding of the principles of a time clock, but there was little comprehension of the costs that might be incurred with a regular and automatic supply of hot water in these cases. In only five households in the trial group were both heating and hot water controlled with the time clock. In several cases, the method used for controlling hot water differed from that used to control heat supply.

Of the 11 control group households with a time clock, five used it for water heating, five used the 'CONSTANT' setting and one used the immersion only. The method of control, with one exception, was the same as their method of control for central heating. The remaining households in the control group had simple ON/OFF switches and were automatically provided with hot water whenever the heating was on. Two also used the immersion heater - one probably in a wasteful manner.

There was little change in the method of heating hot water during the first year of monitoring, even as the weather improved: only one tenant stopped using the boiler and changed to the immersion heater. In the summer of 1986 more tenants switched to using the immersion heater.

Satisfaction with space-heating and control systems

The trial tenants' reactions to space heating were almost universally complimentary and reflected their general appreciation both of the modernised houses and of a more up-to-date heating system than they had hitherto enjoyed. The only complaint of draughts came from a tenant whose house lacked carpets. Of the three households who found the bedrooms cold, two were unable to use the central heating for economic reasons.

Considerably more dissatisfaction was expressed by tenants in the control group. Three tenants complained generally about draughts and cold. The first, a mother with two children, had only the minimum number of radiators; the second had the maximum number of radiators but no longer used the central heating system having experienced high bills in the past (the house in this case did seem draughty). The third tenant was an elderly single person suffering continuous illness and therefore sensitive to cold.

Half of the control group tenants criticised the inadequacy of heating in bedrooms and, in several cases, supplemented this with electric fires. In seven of these cases the house had only one upstairs radiator.

All tenants of houses with a 'through' lounge reported no difficulty in maintaining comfort: their heating systems were of sufficient capacity to allow them to warm the space.

As regards satisfaction with the controls, the trial group were almost universally satisfied with facilities for controlling the time of heat supply. People were, in general, choosing a method they felt comfortable with and that suited their particular lifestyle. In two cases only, it was felt that a failure to understand the time clock was resulting in reliance on the 'CONSTANT' setting, although in both cases the heating was used only occasionally.

The control group tenants expressed similar levels of satisfaction with the controls. Three households would have preferred a time clock instead of an ON/OFF system, and those using a time clock were pleased with this facility even when they relied on others to set it.

Satisfaction with water heating and control systems

Most tenants were satisfied with their level of control over the hot water supply. As with space heating, they controlled this in a way they felt suited them, and almost all were happy with the facilities available. The tenant with the gas multi-point boiler was particularly satisfied.

Only one householder in each group expressed dissatisfaction with the quantity of hot water available and the time it took to heat. Both had high levels of consumption. In the trial group case, the supply was controlled using the 'CONSTANT' setting and not the clock. In the control group instance, an immersion heater was being used. In the latter case, the heater developed a fault during the monitoring period, and this may have been the cause of the dissatisfaction.

Three tenants did stipulate that they would have preferred a time clock to control both heating and hot water.

4.4 Results of the educational campaign: Phase 2

Tenants were questioned on various aspects of the educational campaign, and the response is summarised below.

Number of advice notes read

Forty-three (77%) of the tenants had read all the notes (Appendix 1) and kept them for future reference. There were four requests for more information (some of it already provided). Over half of those who did not read the leaflets in their entirety were elderly, often ill or relying on relatives and friends to manage their heating for them. Only one tenant expressed a total lack of interest in the educational campaign - and also lacked an understanding of the heating system.

Presentation

The presentation and legibility of the information was commented on favourably.

Advice recalled

There was quite a good rate of recall among those who had read the notes provided, although it was those who had been settled longest in their homes who remembered most. There are two possible explanations for this:

- those who are settled have fewer worries and are more receptive of new ideas and information;

- the longest-settled group occupy largely uninsulated houses, improved to a lower standard than those more recently refurbished. The incentive to improve energy efficiency and comfort is therefore greater.

The type of advice most commonly recalled was the running cost of various domestic appliances. This was of interest to many tenants and could provide them with the opportunity for choosing between the options in a low-income situation.

Spread of information to relatives and friends

Fifteen tenants said that their advice notes had been read by others. There is therefore some spread of information within the community. The significance of this should not be ignored: previous studies of educational campaigns have emphasised that information passed between peers often has greater penetration and influence than information from an official source.

Behavioural response of tenants

Eighteen of the tenants questioned reported that they had taken action as a result of the campaign. The most frequently mentioned actions were using the gas boiler or kettle for hot water rather than the immersion heater (six people) and reduced room temperatures (five people). In all groups, actions were taken by a cross-section of household types -

elderly, single parents and families. In view of the fact that more advice had been recalled than had yet been acted upon, it is possible that further actions may have been taken since the survey was conducted.

Consumption feedback

Over half of those interviewed said that they had found the feedback on consumption of interest, and eleven said that it had helped them to anticipate their fuel bills. However, little behavioural change appears to have resulted.

Changes in energy consciousness

Although two tenants who had habitually left windows and doors open were doing this less frequently after the advice campaign, one other had not altered habits of this type which are obviously deeply ingrained. In ten instances, an improvement in the general understanding of energy issues was noted, and there was an increase in efficiency of energy use. Four of the households concerned comprised elderly tenants.

Impact of the educational campaign on consumption

Thirty houses from the Phase I trial and control groups provided data on consumption. The overall pattern showed that energy consumption fell in the trial group houses by an average of 25 MJ (7 kWh)/house/day and in the control group houses by an average of 46 MJ (13 kWh)/house/day. In 24 households consumption in the second heating season was lower than in the first, and in 14 of these cases, the reduction was by more than 10%. In several cases tenants had made a direct attempt to respond to the advice given and reduce consumption. In other cases, reductions had been achieved, either deliberately because consumption had previously been high, or as a result of a change in habits. Although these particular households were not responding directly to the educational campaign, they did acknowledge the help it had given them.

Half of those who reduced their consumption by more than 10% were elderly tenants who were already using energy frugally. This shows that there is scope for savings even amongst those with a very low initial energy consumption.

Table 4.3 Daily energy consumption: first and second heating seasons (MJ)

	Control houses				**Trial houses**		
House	**Heating season**			**House**	**Heating season**		
No	**1**	**2**	**Diff.**	**No**	**1**	**2**	**Diff**
Ave	318.0	271.7	46.3	Ave	202.7	177.2	25.5

Increases in consumption were noted in several houses, but there were usually good reasons for this such as changes in tenancy with larger families moving in.

Comparison of the new trial and control group tenants enlisted for Phase 2 again showed that the educational campaign had had an impact. The average difference in consumption between the two groups was 36 MJ (10 kWh)/house/day, or 13%, a difference that was found to be statistically significant. This figure was confirmed by an analysis of Gas Board readings.

5. ENERGY SAVINGS AND ECONOMIC ANALYSIS

5.1 Energy savings

Energy savings were estimated by comparing the space-heating energy consumption for houses in the trial group with that for houses in the control group.

For all the houses studied during Phase 1 of the project, including those for which only six months of monitoring was completed, the average saving was 5.8 GJ/year.

However, this figure for energy savings depends on a number of factors:

- Energy use: it has been estimated from records (extending over two heating seasons) for the three families maintaining the highest individual room temperatures in each group that savings were as high as 16.5 GJ/year. For single elderly households on the other hand, with lower average temperatures and different patterns of heating use, the average energy saving by the trial group (who did not use their central heating) amounted to 9.6 GJ/year. Although these results are not statistically significant because of the sample sizes, the general premise holds good that the social mix will affect the level of saving achieved in any replication.

- Variations between the trial group and the control group: the control group houses were about 6% colder than the trial group houses and their energy consumption per degree day was higher. If the basic figures are corrected for these two factors, the estimated energy saving by the trial group households amounts to 12.2 GJ/year.

These energy savings are summarised in Table 5.1.

Table 5.1 Average annual space heating savings (GJ)

	Total space heating		
	Trial GJ	**Control GJ**	**Saving GJ**
All houses	25.6	31.3	5.7
Houses completing two heating seasons	20.4	30.6	10.2
Three warmest houses occuped by families	25.9	42.4	16.5
Houses occuped by single elderly people	18.6	28.2	9.6
Houses completing two heating seasons (corrected for temperature)	20.3	32.5	**12.2**

5.2 Economic analysis

Costs of installation

The quantity surveyors involved in this MIH scheme have recorded the costs of the measures for each house. These have been calculated as the **additional** cost which can be attributed to the measures and include both materials and labour costs. Because the installation of some measures was done as a package involving a number of houses, the figures for these measures are a simple average. Other measures were contracted for at a fixed rate per house although the amount of work done per house differed in each case.

The total cost per house averaged £1,142. This can be sub-divided as follows:

Wall insulation	712
Draught stripping	140
Double glazing	170
Extract fans	90
Additional roof insulation	30
Total	**1,142**

The cost of the dry lining varied from £440 to £897 per house (excluding the end-of-terrace houses) and was probably determined more by the complexity of the fitting than by the limited variation in the area covered. The materials cost was approximately £300 per house.

The average total expenditure for refurbishing a house, including the energy efficiency measures, was £18,000. Had the measures not been incorporated, the refurbishment would have cost £16,858. The additional cost of the energy saving measures therefore represents a 7% increase.

Cost savings

Expenditure on energy was low in both groups. During the winter, trial houses spent £9 per week on average, while the control group spent £13 per week.

The cost savings have been calculated using values of £3.33/GJ (1.2p/kWh) for gas and £15.56/GJ (5.6p/kWh) for electricity. Although standing charges of £40 per annum for gas and £30 per annum for electricity are incurred, these have been ignored in Table 5.2 as it is the difference in consumption that is of interest. The ranking of cost savings differs from the ranking of energy savings derived from Table 5.1 because of the variation in gas and electricity consumption. For example, the elderly in the trial houses used electric heating less than did the same group in the control houses, and this led the former to show higher cost savings than the average household.

The best estimate of the average savings, for houses monitored over two heating seasons and adjusted for temperature, is £41, or about 34%. For higher energy consumers the cost savings are greater. The calculation does not take into account other benefits of improved levels of comfort and reduced maintenance.

Table 5.2 Average annual space-heating cost savings (£)

	Total space heating Trial £	Control £	Savings £
All houses	105.9	124.8	18.9
Houses completing two heating seasons	79.8	113.6	33.8
Three warmest houses occupied by families	107.9	162.1	54.2
Houses occupied by single elderly people	65.0	101.6	36.6
Houses completing two heating seasons (corrected for temperature)	79.8	120.4	40.6

5.3 Additional costs and benefits of the measures installed

Extract fans

The use of the extract fans installed represents an increased cost to the householders concerned. This has been estimated at between £4 and £5 per year but has not been included in the cost-savings analysis.

Maintenance costs

Installation of the energy-saving measures will result in maintenance cost savings which are difficult to quantify. The main conclusions are that the risk of damage by condensation to the decorations of the house has been reduced and that the danger of wet rot in the bottom of window frames and cills has been eliminated by the installation of double glazing and of drainage channels in the single glazing. The full extent of the maintenance savings will only become clear over a longer timescale.

Additional costs may occur in relation to boilers and central heating systems. It is apparent from Section 4.3 that many tenants do not make full use of the heating systems installed in their houses. Apart from a lack of understanding of the system, the main reason is that tenants often do not need whole-house heating. Yet the efficiency of gas boilers drops off as the heating load is reduced, and the boiler cycling load becomes a more significant loss at low loads. Furthermore, in a wet central heating system the distribution losses are almost constant and therefore achieve a greater significance at low loads. In addition the rate of corrosion of the complete system increases if it is not regularly used. In view of this and of the low load levels achieved in this demonstration, it is obvious that individual room heaters and instantaneous water heaters would have suited many of the tenants better and would have had the additional advantages of being more easily controlled.

Comfort levels

There was a significant increase in comfort levels in the trial group houses as a result of the measures installed, and tenants' satisfaction with the refurbished houses has already been discussed in Section 4.3.

6. CONCLUSIONS AND RECOMMENDATIONS

The measures selected by Merseyside Improved Housing to improve the comfort levels and energy efficiency of the 24 trial group properties were all successfully installed during a major refurbishment while the houses were unoccupied. The measures are suitable for any type of dwelling, although dry lining is particularly suitable for solid-wall houses as it is the cheapest way of improving the 'U' value of walls of this type.

Only one problem arose with the dry lining. In one house the plasterboard delaminated from the backing at a door reveal and this appears to be the result of failure to follow manufacturers' recommendations.

In this demonstration there was no evidence of interstitial condensation two years after the lining had been installed; neither was there any evidence of frost damage to the surface of the facing or common bricks on the outside of the houses - even after the extreme temperatures experienced during January 1987.

This dry lining installation was undertaken while the houses concerned were empty. If, however, insulation can be applied over an acceptable existing plaster finish and the room concerned can be sealed off, there is less disruption and the house can continue to be occupied. The main disadvantage in such a case would be the extra costs of replastering, additional joinery and electrical work required to make good. The cost-effectiveness of the measure would be reduced by comparison with this demonstration where much of the refinishing work was necessary with or without the insulation.

The draught-stripping measures proved satisfactory in the trial houses although some of the new doors warped, necessitating replacement or adjustment of the draught-proofing strip. However, when draught-stripping was installed on its own (and not as part of a package of measures) in the additional sample of houses monitored during Phase 2 of this project, condensation problems did occur and resulted, in two instances, in mould growth on a wall.

Draught-stripping is a measure which is frequently installed while a house is occupied and is appropriate to almost any scale of refurbishment. Furthermore, the installation can be undertaken by operatives after only a brief training period.

The new glazing has proved to be entirely satisfactory. The double glazing with its trickle ventilators has eliminated condensation on the main living room windows, while the incorporation of both drainage channels and trickle ventilators in the new single glazing has helped to control any problems of condensation elsewhere. Again the measures are appropriate to almost any level of refurbishment. There is considerable experience in the installation of double glazing; it can be fitted to either new or existing frames; and it has a number of non-energy-related benefits such as greater strength, noise-proofing and increased levels of comfort.

The extract fans have also proved successful in reducing condensation, although a number of problems have been experienced with the humidistats. Again, the measure is appropriate to any level of refurbishment. The disruption of knocking a hole through the wall is confined to one room only, and this can be sealed off while work is in progress.

The package of measures together reduced condensation in the trial houses, even in those households expected to generate condensation problems. This in turn eliminated certain maintenance costs normally attributed to condensation: damage to decorations and soft furnishings and rotting of window frames.

Comparison of the trial houses with the 20 control houses indicated that average energy consumption in the trial houses was significantly less than in the control houses which had only been refurbished to the standard level for 1985. For space heating, the average cost saving amounted to 34% or £41 per year (figures corrected for temperature). The additional costs incurred for the installation were £1,142. Tenants consuming more energy for space-heating than the average achieved higher savings, but even tenants using very limited heating (mainly the single elderly) achieved cost savings in excess of £36 per year out of a total expenditure on space heating of £101.

There is a strong correlation between energy consumption and average temperature in the houses, and the significantly different relationships between the two samples shows the benefit of the measures installed in reducing the rate of heat loss. When average temperatures inside the houses were compared with the outside air temperature, it was evident that the treated houses were warmer than the control houses by 6%.

The social survey revealed that many householders made only limited use of their central heating, either through fear of large bills or because of unfamiliarity with the controls. There was a definite preference for simple controls. However, tenants in the trial houses were very satisfied with the measures installed. They rated their homes more comfortable and used their heating for an average of 10 hours per day compared with the 14 hours per day of the control group. There were fewer complaints about cold bedrooms among tenants in the trial group and their overall spending on energy was less (£9.38 or 14% of their income for a typical week in winter, compared with £13.32 or 18% of their income for the control group).

Phase 2 of the project was devised to improve the apparently very poor level of understanding among tenants of energy issues. Much of this appeared to be the result of lack of instruction when tenants moved into their houses and while in many cases this lack of information did not matter, for some it resulted in inefficient use of heating systems or higher than expected bills.

Over 75% of the tenants read the advice leaflets distributed as part of the educational campaign, and the level of advice recall was quite good particularly among those who had been settled longest in their homes. The main type of advice recalled concerned the running costs of various domestic appliances.

Just over 30% of the tenants took action or changed their behaviour as a result of the campaign and, in other cases, there was an improved understanding of energy issues which could, in time, lead to more efficient use of energy. In certain other cases, wasteful behaviour persisted.

6.2 Recommendations

Because the installation of a single measure can exacerbate problems (as did the draught-stripping in Phase 2 of the project) groups of related energy-saving measures should be applied to maintain the balance between the conflicting requirements of a household. The two groups of measures which should be addressed concern ventilation and fabric loss.

Ventilation should be controlled by attending to the following:

- draught-stripping of doors, windows and loft hatches;

- sealing gaps in the fabric at, for example, chimneys, window frames and floor edges;

- providing trickle ventilators and extract fans.

Fabric losses should be reduced by attending to the following:

- insulating the ceiling or roof;

- insulating the walls;

- double glazing: a minimum for this would be those rooms which are frequently-heated rooms.

Condensation should be counteracted by such methods as

- using extract fans to improve ventilation in kitchens and bathrooms, if needed;

- employing drainage channels on single glazing.

Heating systems should be selected and sized to meet the needs of the household and the building loads. Wet central heating systems are not necessarily the most appropriate, and alternatives should be investigated.

Heating equipment should be easy to use. Designers of heating controls should address the problems of the elderly and those without experience of heating systems. A method which allows the addition or removal of features so that the complexity can be matched to the abilities of users should be sought.

Landlords should establish links with local neighbourhood energy action groups to advise their tenants. For example, MIH have decided to draught proof all their houses over the next three years using 'Keep Warm', the local MSC-funded energy action group. It is planned that tenants in need of advice will receive this on request from 'Keep Warm'.

The way in which advice is given to tenants is very important. As most landlords cannot afford to employ advisers full time, housing assistants should be trained to identify tenants who need energy advice and to provide much of this advice to new tenants at the takeover stage. Also, when tenants' houses are upgraded, the appropriate advice should be provided to prevent tenants' actions eliminating the benefits intended.

APPENDIX 1

ENERGY ADVICE MATERIAL

Heating Controls

Improved heating systems are always put in when your landlord, Merseyside Improved Homes, modernise their houses. Normally central heating is installed with a gas fire in the living room. Some houses have electric fires because the tenants don't like having gas in the house.

Being able to control your heating system means that you get warmth when you want it without wasting gas and electricity which you then have to pay for.

Gas fires

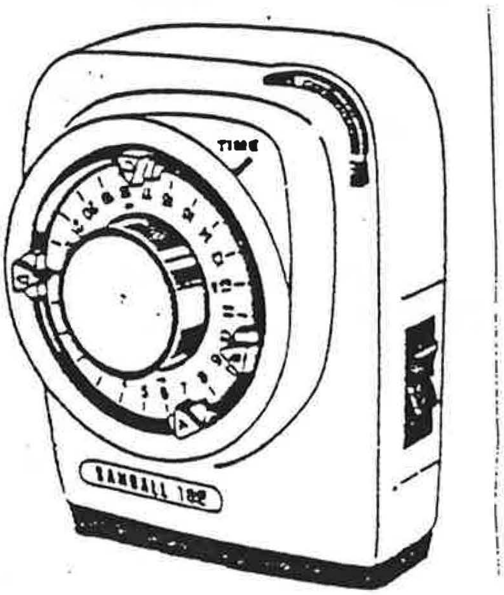
These are easy to control. You just turn the switch and the gas fire starts giving out heat.

Central heating

On/off switch - Like the gas fire - some central heating systems have an 'on/off' switch. If you use the switch the radiarors will stay on until you switch it off.

Time clock - More modern central heating systems don't have an 'on/off' switch, they use a clock to automatically switch the heating on and off.

The Time Clock



The clock can be set to put the heating on at, say 7 o'clock in the morning so the radiators are on for half an hour or so before you get up.

Setting the clock

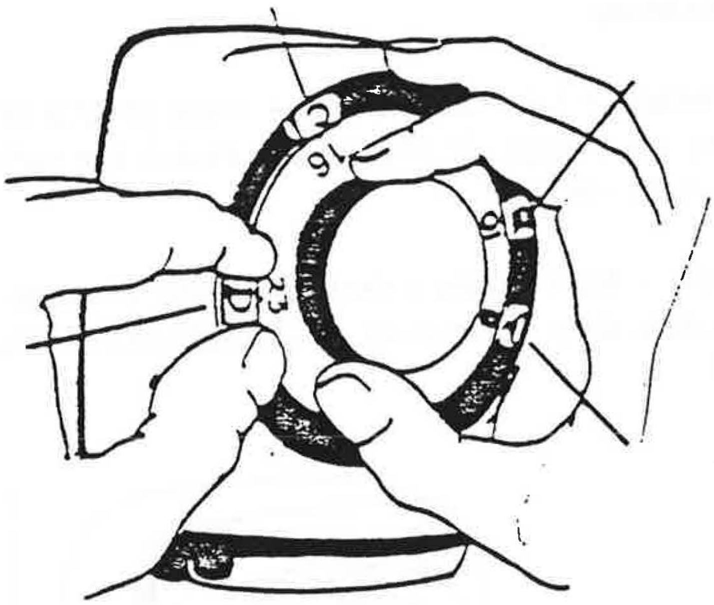
The clock covers the 24 hours in each day - from midnight, which is no. 24 to midday which is no. 12. on the clock.

The clock has red and blue markers on it. These can be moved around. The red markers set the heating to come on - the blue markers will switch it off. So ...

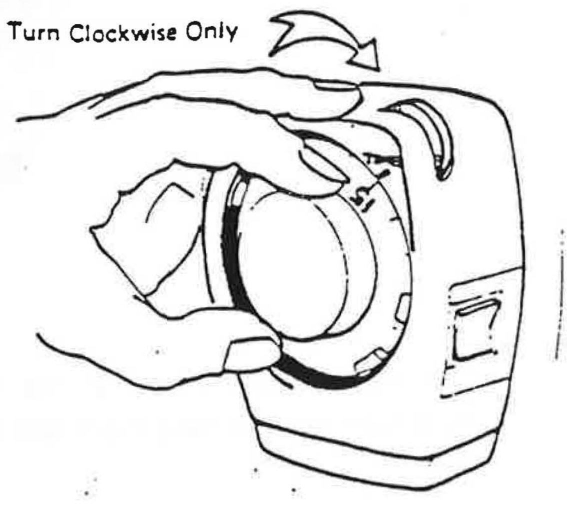
- decide when you want the heating to come on and move one red marker to this time on the clock

- decide when you want the heating to go off and move one blue marker to this time

Because there are two red and two blue markers you can set the heating to come on and off twice a day.



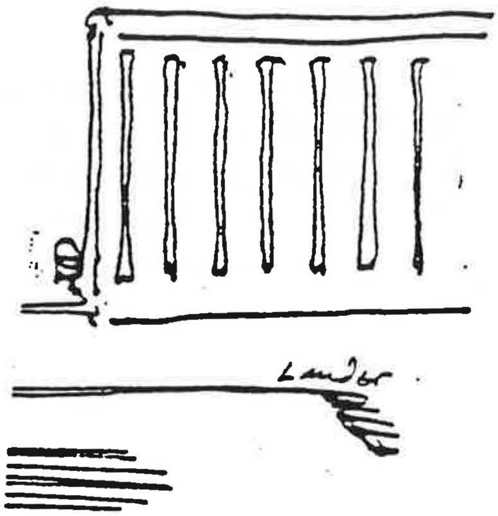
When you have set the markers you must make sure the "time" pointer is pointing at the correct time.



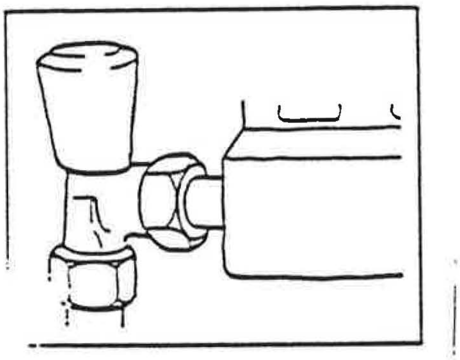
Temperature control - It is radiators which give out the heat from a central heating system. If you want the heating on but you don't want it on 'full blast' there are several ways you can do this

For example...

Some people want the heating on downstairs but do not want heat in the bedrooms. This can easily be dealt with, since each radiator can be switched off.



If you don't want heat in your bedroom just turn the radiator off using the valve on the radiator.

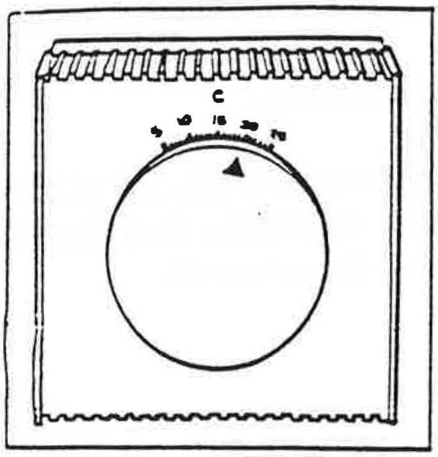


On the most modern radiators the valves are different - they have numbers on them. These valves are thermostats - in other words even if you have set the heating to be on for 2 hours if the room temperature reaches the temperature set by the valve (using the numbers) the radiators will go off.

If you want your room very warm set the valve on a high number - say 5 or 6. If you don't want the room so warm you can turn the valve to a low number - this means the radiator will go off when the room reaches a certain temperature. It will come on again if the temperature of the room becomes cool again.

Older central heating systems don't have radiators with these modern types of valves. However, some systems are fitted with a dial called a room thermostat.

Room
thermostat



A room thermostat is usually fitted in the hall or living room. You can turn it so that you set different temperatures on it. When the temperature in the room reaches the temperature on the thermostat the radiators will go off and will only come on again when the temperature becomes cool again.

For the elderly

Financial Help

----

insert Steve Jennings -

Hypothermia

Hypothermia occurs in cold weather. It is sickness which affects old people. If you are getting on in years or have a neighbour who is you should read the following notes.

How to recognise Hypothermia

- General slowing down of speech, breathing, pulse and responses.
- Drowsiness and mental confusion.
- Body cold to touch: face puffy and pale.
- Increasing disability as body temperature falls.

What to do about Hypothermia

- Warm up the room, but don't apply direct heat to the skin, eg. hot water bottle or electric blanket.
- Wrap up the person well, but don't make bedcovers too heavy.
- Give warm drinks, but no alcohol.
- Keep the person warm in bed and discourage movement and exercise.
- Call the doctor.

How to prevent Hypothermia

- Keep one room well heated and, if necessary, sleep in it during a cold spell.
- Take regular meals and hot drinks.
- Move around as much as possible.

- Wear several light layers of clothing.

- Always wear a hat.

- Make sure that all appropriate welfare benefits are claimed. (The Social Work Department can advise on this, or dial 100 and ask for Freefone Social Security).

The good neighbour code

- Neighbours drop in sometimes during very cold weather.

- If something is seriously wrong, tell somebody about it - Doctor, Social Worker, Policeman.

Hot water - Get it Cheap

You can get hot water by using either

- the electric immersion heater
- or the gas boiler

If you want hot water every morning and night for baths, showers, laundry, doing the washing up and so on, it is cheaper to use the gas boiler.

If you live on your own and only want hot water for a bath say, once a week, it is better just to put the immersion on just for the short time you need it. This is because it heats water more quickly than the gas boiler.

An electric kettle is the cheapest way to heat your water if you only want to do the washing-up

To cut down on the amount of hot water you need, take a shower rather than a bath. A bath uses about a four times as much water as a shower so if you take a shower you needn't heat the water for so long.

It might be worth buying a cheap shower attachment if you don't have one.

If you use a medium amount of hot water it is difficult to say whether the immersion heater or the gas boiler is cheaper. You have to check your meter readings to work this out. However, the gas boiler may be less wasteful because you can use it on the time clock. Just set the time you want hot water then forget about it - the boiler is switched off automatically at the time you set.

In the summer you don't need central heating **but** it is important to remember that you can still use the gas boiler for hot water.

Also if you don't use the central heating in the winter you can still use the gas boiler and the time clock for hot water.

YOU CAN HAVE HOT WATER READY SIMPLY BY SETTING THE TIME CLOCK.

How to work out what you are spending on fuel

Over the next few months David Bird will visit you and read your gas and electricity meters. From the meter readings he will work out how much you are spending on gas and electricity each month. This can then be recorded on your special energy calendar.

Why not check your gas and electricity consumption yourself? Ask David if you want help on how to read the meters.

If you have difficulty paying gas and electricity bills, ask David - there may be financial help available from the DHSS, or a better method of paying the bills.

If you want to keep a check on gas and electricity consumption the following list of running costs will be of help. You may be surprised to find out how much certain appliances cost to run.

Electricity	**Cost for 1 hour**
Cooker (1 ring)	8p
Cooker (oven)	12p
Kettle	12p
Fridge	1p
Washing machine	up to 17p
Immersion heater	17p
Electric Overblanket - per night	3p
Electric fire (1 bar)	6p
Gas	
Cooker (1 burner)	3p
Cooker (oven)	4p
Central heating and hot water	18p
Gas fire (high setting)	7p

If you are elderly or have young children (under 12 months) do **not** try so hard to save energy that you do not keep yourself and your family warm. It is important, in the coldest weather, to keep at least one room warm. If you sit in your living room for long periods watching TV, you might not notice how cold it is getting and this can be dangerous to your health.

Hypothermia

Hypothermia, a medical term which literally means low body temperature, occurs in cold weather. It is a sickness which affects old people and infants under 12 months. If you are getting on in years or have a neighbour who is you should read the following notes.

How to recognise Hypothermia

- General slowing down of speech, breathing, pulse and responses.
- Drowsiness and mental confusion.
- Body cold to touch: face puffy and pale.
- Increasing disability as body temperature falls.

What to do about Hypothermia

- Warm up the room, but don't apply direct heat to the skin, eg. hot water bottle or electric blanket.
- Wrap yourself, or the person suffering from hypothermia, up well, in several layers of light clothing, but don't make bedcovers too heavy.
- Give warm drinks, but no alcohol.

- Keep warm in bed and discourage movement.
- Call the doctor.

How to prevent Hypothermia

- Keep one room well heated and, if necessary, sleep in it during a cold spell.

IT'S IMPORTANT TO KEEP AT LEAST ONE ROOM WARM

OVER 65'S MAY GET HELP FROM THE D.H.S.S

- Take regular meals and hot drinks.
- Move around as much as possible.
- Wear several light layers of clothing.
- Always wear a hat.
- Make sure that all appropriate welfare benefits are claimed. (The Social Work Department can advise on this, or dial 100 and ask for Freefone Social Security).

The good neighbour code

- Drop in sometimes during very cold weather.
- If something is seriously wrong, tell somebody about it - Doctor, Social Worker, Policeman.

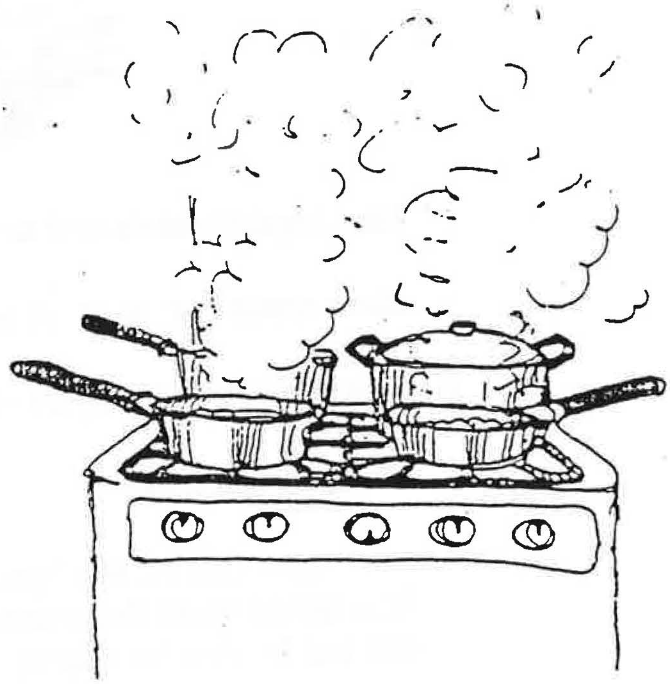
Good energy sense: in the kitchen & bathroom

Think about the way you do everyday things like washing and cooking. Are there simple steps you can take to save energy ?

Cooking

Saucepans: Match the size of saucepans to gas flames or the electric ring, otherwise heat is wasted. Use lids to keep the heat in. Use small amounts of water because steam cooks just as well as boiling water.

Another idea is to put more than one vegetable in the pan, in fact specially divided pans are made to do this.

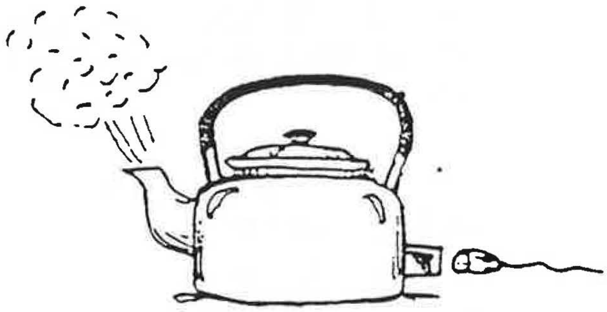


Ovens: Cook several things at once. Try not to use the oven for cooking one small item.

Fridges: Position your fridge away from cookers and radiators. Allow plenty of ventilation behind the fridge. Don't put warm food into the fridge, let it cool first.

Bathing, Washing & Laundry

Use your kettle if you only use <u>small</u> quantities of hot water. It is more economical to use a kettle rather than the boiler or immersion heater if, for example, you only want to do the washing - up.



Use your gas boiler with the time clock if you want hot water every day. For regular baths, the washing machine etc. its cheaper than the immersion heater, even if you don't use the central heating radiators. Use the time clock - it switches the boiler off automatically so you don't waste money by forgetting to switch the boiler off.

Taps

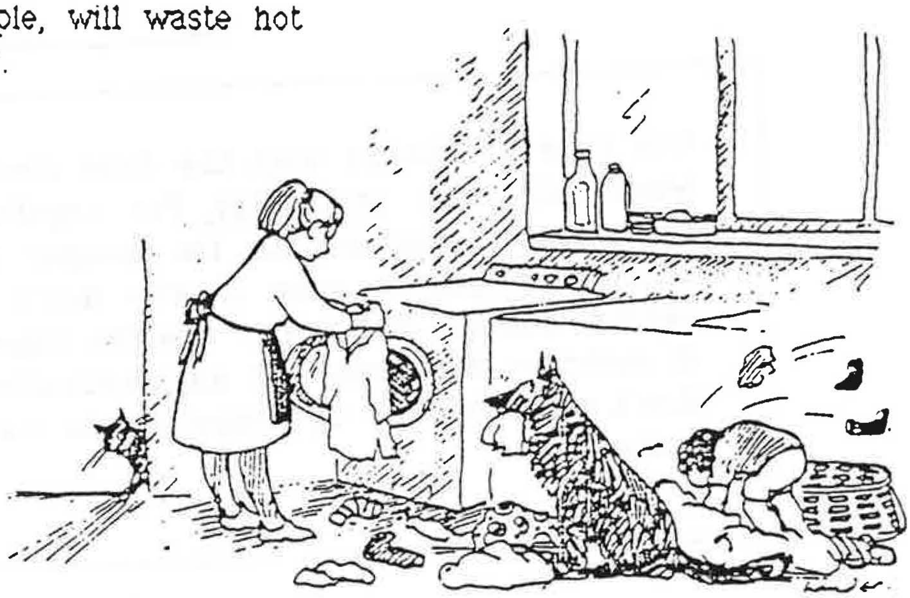
Never leave taps running. When you're washing up put the plug in the sink or use a bowl.

Fix dripping taps.

Washing machine. This is the most expensive appliance that you use in terms of the energy it uses.

Take advantage of heated water when you do a wash. If you have already heated some water it makes sense not to fill the washing machine with cold water. Apart from very dirty clothes regular washes using cooler, shorter programmes clean clothes just as well.

Use a full load. Only washing a few shirts, for example, will waste hot water.



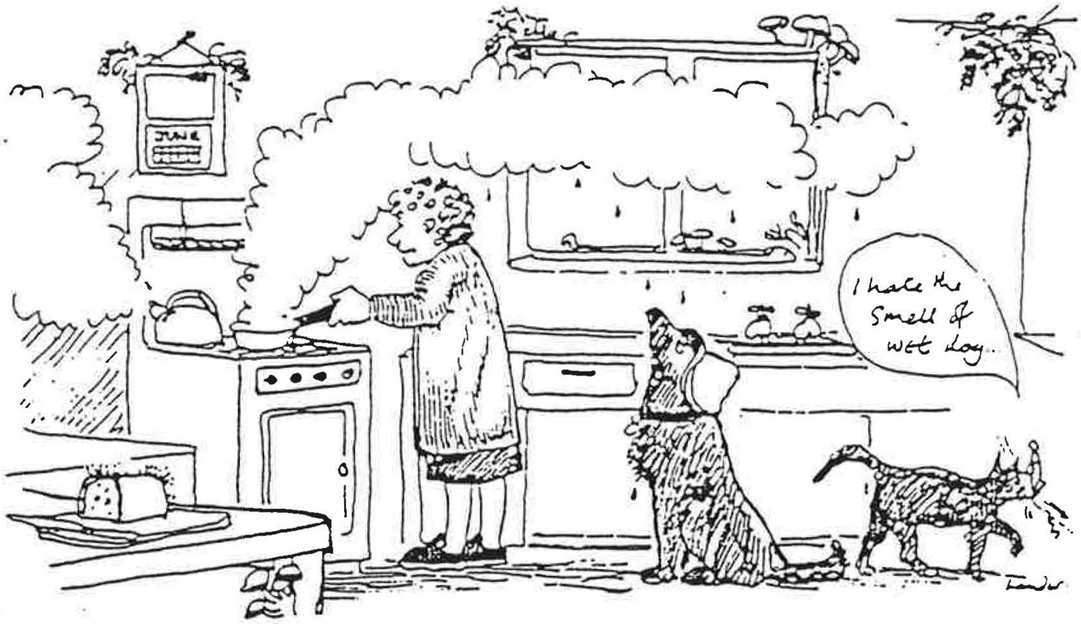
Rinsing. Use cold water, it rinses just as well as hot.

Drying. Spin the washing before drying.

If you can't hang clothes out to dry use a clothes horse. Do not drape them over the radiator. This lets more heat into the room and stops the radiator from rusting.

Stopping damp and mould

If you get damp patches and black mould on your kitchen or bathroom walls the chances are that it is caused by condensation. When steamy air meets cold surfaces such as windows and cold walls it forms mist or small drops of water - this is condensation. Cooking and washing and bathing are the most common sources of the steamy air which causes condensation.



CONDENSATION LEADS TO MOULD GROWING ON YOUR WALLS. - OPEN THE WINDOWS AND LET THE STEAM OUT.

Heating to stop damp

If you heat your kitchen and bathroom the walls stay warmer and so are less likely to attract condensation.

Ventilation to stop damp

- extractor fans in the kitchen will get rid of moist air as soon as it is produced;

- open a window to let the steam out, then close it to keep the heat in;
- close doors so the steam goes out of the window not into your hall or onto the landing;
- when drying clothes indoors, make sure there is plenty of ventilation;
- do not block up air bricks or ventilation grilles.

Good energy sense: in the living room and bedrooms

Doors and windows - All rooms need airing regularly and some people like to sleep with a window open for fresh air - this is fine - but in general keep windows shut to keep heat in.

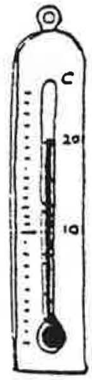
If you are visited by friends or neighbours try not to talk to them on the doorstep with the door wide open. All the heat in the front of the house will be lost that way.

If you feel too warm in any room turn down the room thermostat, or turn the radiator and the gas fire off. Do not open doors or windows as you will soon have to heat the room again which costs money.

If you have an empty or a spare room, have the radiator valve only partly open to keep the chill off the room and condensation and mould away. Some people also turn down radiators in bedrooms as too much heat gives them a headache.

Temperature: A room is comfortable if it is kept at a temperature of between 64°F. and 70°F. (18°c. and 21°c.). Set your thermostat between these settings. A reduction of 1°c can save £15 - £20 of gas or electricity over the winter.

If you do not have a thermostat in the room it is worth keeping a check on the temperature with a thermometer.

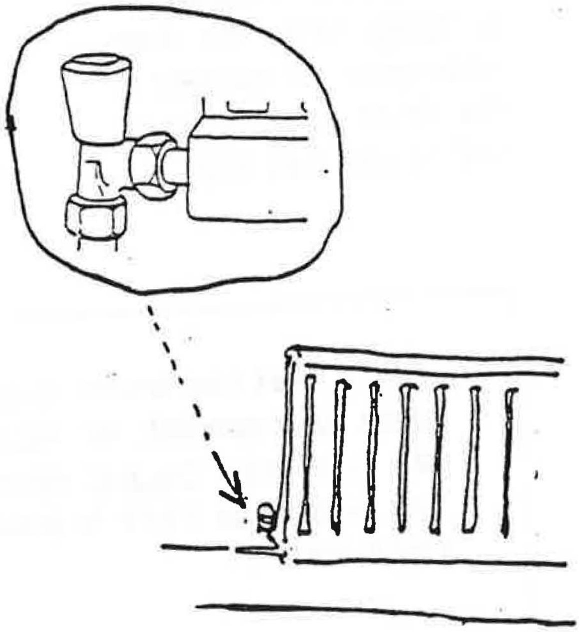


Curtains: Keep curtains closed at night. If you can afford to - line them.

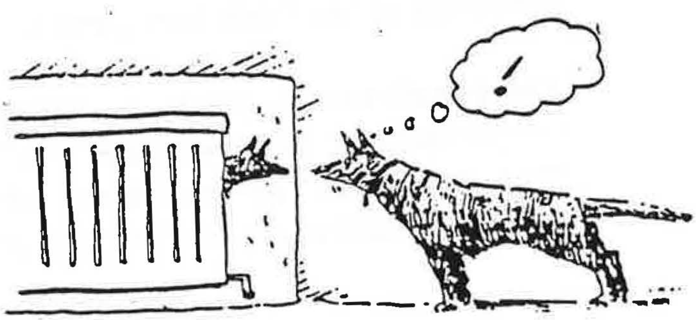
Do not drape curtains in front of radiators - this traps the heat behind curtains.

Radiators:

Use valves to turn down radiators in rooms you do not use. If your radiator valves have numbers, these indicate the amount of heat they are giving out - do not leave them at the highest setting.



Silver cooking foil behind a radiator stops heat going straight out through the wall.



Furniture. Do not put furniture right up against radiators as the heat goes into the furniture not the room. Central heating can also warp the furniture.

Clothing. Use warm clothes, especially underclothes made from wool or cotton. Rooms obviously need less heating if you are warmly dressed. In spring and autumn, when the weather changes, we are often lazy and put a fire on rather than a pullover.

CHANGE WITH THE WEATHER – WEAR WARMER CLOTHES!