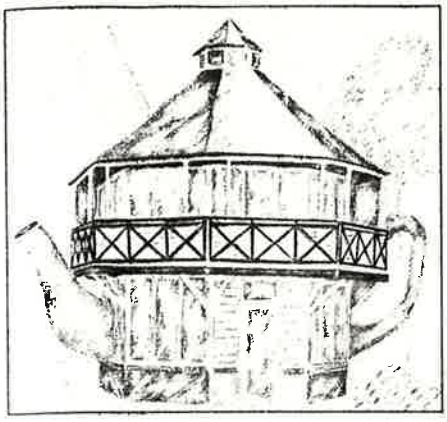
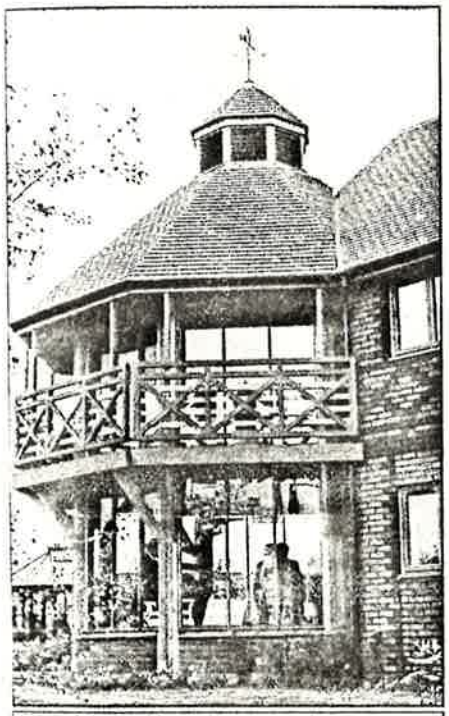




Above: Salvesen Homes' inspiration for our cover. Four bedrooms, three reception rooms plus conservatory. Floor area 150 m², MKECI of 68.

Energy World

Milton Keynes can be relied upon to excite interesting experiments in construction. *Mark Bowman* looks at the best houses in the Energy World exhibition.

The exhibition is the first part of a new £100 million scheme attempting to develop the "world's most energy efficient community" the Energy Park. The park itself is contained within an area of 125 hectares (300 acres) and will hold 1000 houses and provide jobs for 2000 at the end of its seven year development; the first 50 are already built.

So far the only development is for housing, but later there will be a commercial site and a continual exhibition in an energy centre.

Three areas of energy policy have been followed, produced in collaboration with the energy utilities:

- ☐ reducing levels of demand;
- ☐ providing efficient and secure energy supplies;
- ☐ providing energy management services.

This has led to savings in excess of 30% in energy consumption compared with areas built to normal standards.

The greatest saving is obviously from reducing energy demand. This was achieved in three main ways:

- ☐ planning road layouts to maximise solar access;
- ☐ producing favourable microclimates through careful attention to the relationship between landscaping, and buildings to create shelter belts and reduce wind speeds;
- ☐ most importantly, building design to achieve standards of energy performance better than anywhere in Europe with the exception of Scandinavia.

To measure the performance in the last area, building design, a performance standard called the Milton Keynes Energy Cost Index (MKECI) has been developed. The index is based on total annual energy running cost under certain standard conditions of occupancy and use. It is presented as a figure which typically varies between 80 and 250. The lower the figure the better the house's likely performance. For Energy Park the figure which must be reached is 120; approximately 30% better than current building regulations demand.

The index takes into account most of the factors which affect a house's energy performance, such as the heating system, the building's orientation and type of glazing used. Assessment takes place using a microcomputer program. This has been evaluated against field trial data and is endorsed by the BRE.

The cost index does not give a direct prediction of fuel consumption. Analogous to the fuel efficiency figures for cars, the actual energy consumed will depend on how the home is used. The energy cost index for commerce and industry will be a similar measure of energy running costs of environmental services.

Most of the houses look fairly normal. The argument runs that they build them to look normal because that's what people buy.

However, some of the more interesting buildings have features which could be generally applied. We will now look at these, in no particular order.

On plot 24 Haslam Homes has built a bungalow designed by Feilden Clegg Design with energy consultants EDG and the Polytechnic of Central London.

The structure is a traditionally-built bungalow, the main feature of which is the fully glazed south facing wall area which is designed to make use of passive solar gain. The highly insulated fabric with a high efficiency heating system and the passive solar input with other features gives an

Houses as they should be

The energy performance of new housing in the UK is becoming increasingly scandalous when compared with what can be achieved, technically and cost effectively, in the UK and when compared with what is being achieved in the rest of Northern Europe and in the equivalent climatic regions of North America.

Once again, Milton Keynes has pointed an accusing finger by building commercial energy efficient houses, the worst of which smashes current ideas of domestic expenditure on fuel.

In this feature we look at what we consider to be the most interesting of the Milton Keynes houses and support this with articles on the emerging necessity for mechanical ventilation of houses, and Dutch and Danish work on low energy houses in masonry rather than in timber frame.

MKECI of 72·75 and a projected annual heating cost of around £60/70.

Solar glazing on the south face gives a passive solar gain to the living area. This large area of full height glazing does give the building a rather unusual appearance but after seeing the inside and looking round, it isn't as off putting as one first thinks.

This glazing comprises triple-glazed sealed units with an additional outer pane of low emissivity glass giving quadruple glazing. Automatic blinds are fitted between the triple glazing and the outer pane. These are normal Hunter-Douglas Luxaflex with motor controls — the same sort of blinds as were used on the Sainsbury centre.

Temperature and lighting sensors are used to control the movement, the temperature sensor has been given the priority. The low level blinds are all manually controlled

Clerestory glazing is used throughout; the light then goes to the back of the room. This allows more room space to be used without the drawbacks of direct sunlight and puts heat into the blockwork wall for storage.

A conventional wet central heating system is used but with a Tri-save fully condensing room sealed gas-fired boiler. High output panel convector radiators are used in all rooms. Each radiator has a thermostatic valve and three zone control with seven day programming is installed in one house and in the other a Danfoss boiler energy manager does the job. The fuel costs in the two similar houses can then be compared and analysed.

In the kitchen, a Bahco ventilation system with heat recovery is installed with the unit mounted above the cooker hood. This arrangement has advantages over ventilation systems mounted in the roof space as there is very little noise transmission, and what noise there is comes from the kitchen and so has very little nuisance value when included with normal kitchen noises.

The ventilation system distributes heat from the living wing into the bedroom wing and additionally provides ventilation to areas of high condensation and risk.

In addition there is a phase-change heat storage material built into the kitchen/dining area. This stores unwanted heat during the day for retrieval later.

As an architectural feature for the living room, a high efficiency solid-fuel fire was built. This may, at first, seem an odd idea but apparently the double dampered fire doesn't leak. The trouble is the brickwork chimney does; tests revealed faulty building was the cause of leakage not the dampers or fire itself. So if properly installed the possibility of air leakage is low.

The desirability of this dwelling even at the high price of £90 000 was ably demonstrated when it was bought within five hours of the exhibition opening, one of the first houses to be sold.

For the British market local developer Erostin Homes of Newport Pagnell, with architects the Wigfall group practice, have adapted a heating idea from USA.

The houses are called limited addition homes because the basic two bedroom units are extendable to three and four bedrooms by adding extra floors.

The heating system is an unusual American type with warm air ducted under the suspended floors and through the walls. It is a gas-fired Johnson and Starley system with warm air ducted through the floor and walls giving a large area for radiant transmission. This arrangement gives good comfort for a low running cost. The walls have holes cut in them at the top corner with the ceiling to let the warm air out; these are covered by linear grilles which are, unfortunately, rather unsightly.

The return air grille is at the highest point of the house. The houses have the great majority of their windows facing south, so any incidental solar gain is captured by the space heating system. This extensive glazing on the south collects any solar energy in the warm air which is entrained and circulated along with the air from the furnace. It simply rises to the top of the house and joins the ducted air being pumped to the underfloor plenum. This convenient exploitation of the passive solar element is one of the factors contributing to the effectiveness and low running cost.

The upper air is expelled from the blockwork channels at window level and ceiling level. On the ground floor, grilles under the windows take air from the plenum under the suspended floor and send it into the rooms. If there is a localised need for an increase in temperature a hole can easily be cut in the floor with another grille placed on top.

Under the floor, beneath the air flow, there has to be insulation so the walls and roof have 75 mm and 150 mm of Rockwool respectively.

This radiant warm wall system uses hollow blockwork walls as a radiant-surface space heating system with the walls acting as the radiant heating elements and giving some thermal storage effect. The warm air additionally passes through the vents releasing heat.

This system is new to this country but tested in the United States. In America, savings of between 10 and 23% have been monitored using the plenum method of heating. As this is the first such house in the UK, no figures are yet available but the architects are expecting the modified system to work well for the UK climate.

The MKECI is 97·3.

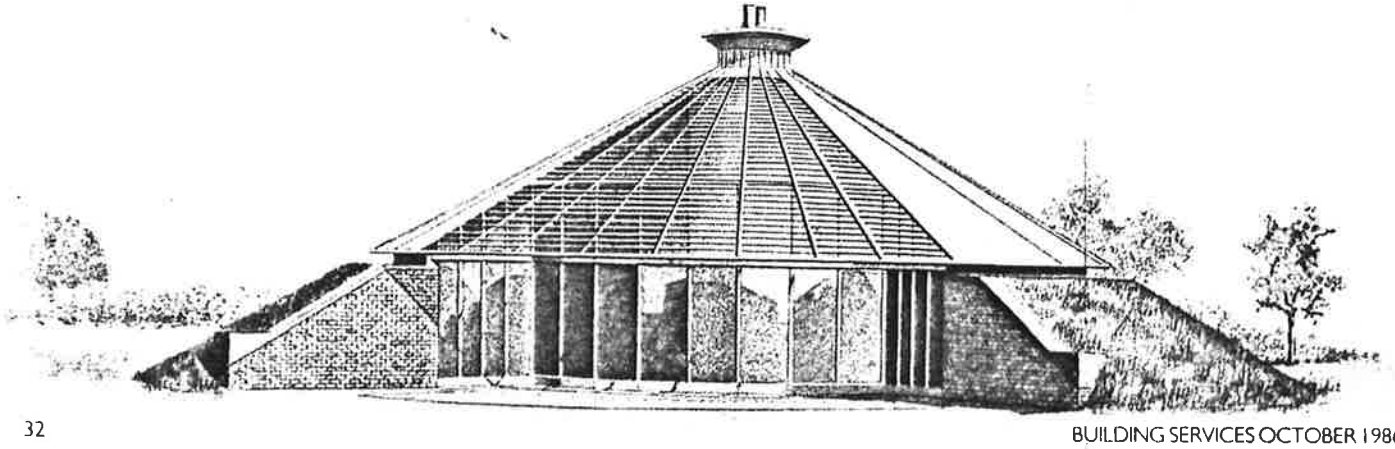
Persimmon Homes of Northampton and architects David Tuckley Associates have two houses on the Energy World plot. The two houses in the exhibition are show houses for an adjacent development of eight houses. They are highly insulated, traditionally constructed dwellings with small windows to the north and large glazing areas to the south. They also have a conservatory for passive solar gains and heat storage.

The structure is brick and tile faced with 75 mm of insulation in the wall, 150 mm in the roof space, 125 mm block inner leaf and 50mm insulation for the ground floor. The windows are high performance timber double glazed and weather stripped.

The heating system is supplied by a Cormorant gas boiler in which the heat generator is separated from the heat transmitters by a thermal store. This will produce instant hot water and run radiators at a lower cost and with less maintenance than usual.

The principle of the heating design is to even out the fluctuating demand for heating and hot water by utilising a thermal store which thus allows the use of a smaller appliance.

Not particularly inspiring stuff, although the really unusual feature of houses is the electricity generation; a demonstration scheme of combined solar/



wind generation. The company installing the system, Solapak of High Wycombe, normally specialises in providing power for remote areas. With funding from the EEC, a situation in which this kind of generation would normally be uneconomic is a pilot scheme for electrification of isolated villages in the developing world. In that case, solar power can often be competitive with diesel generator sets.

The solar array on the house conservatory is supplemented by an area, half the size of a tennis court, of polycrystalline silicon cells on the battery/control building. The total photovoltaic output capacity is 5 kW.

The house also benefits from solar activated extraction to control excessive heat gains.

The horizontal axis wind generator with 12 m dia blades and installed on an 18 m tower, is rated at 22 kW. The start up wind speed is 2 m/s but maximum power is reached at 10 m/s.

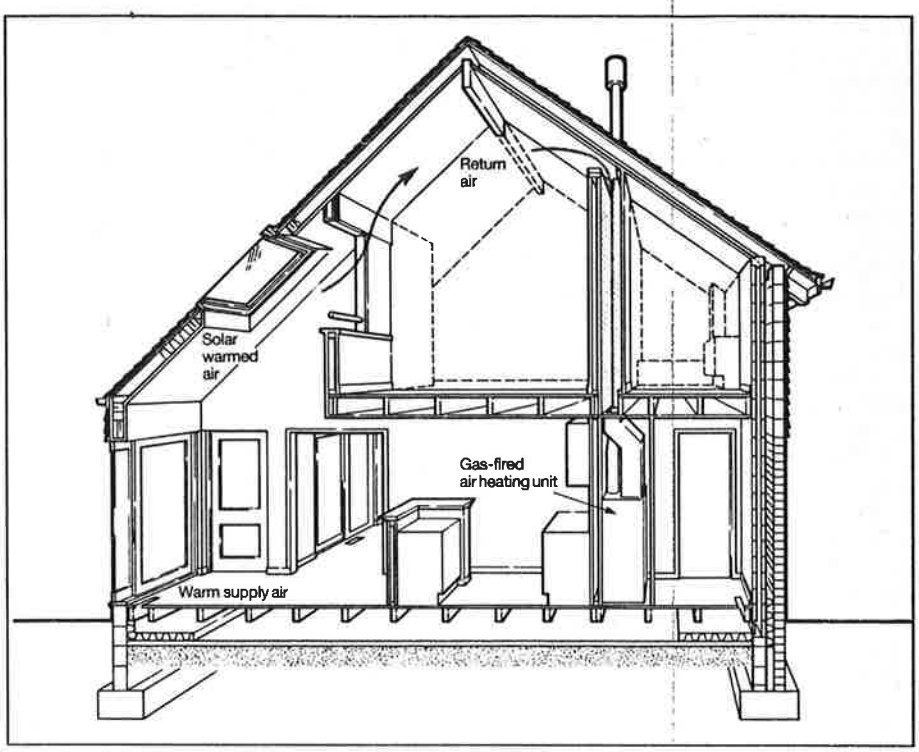
With an average wind speed of only 3·6 m/s, the Energy World site is not really suited to wind generation but for pure demonstration purposes it impresses the punters. The battery house holds 110 cells of 600 Ah at 220 V for storage of the electrical energy.

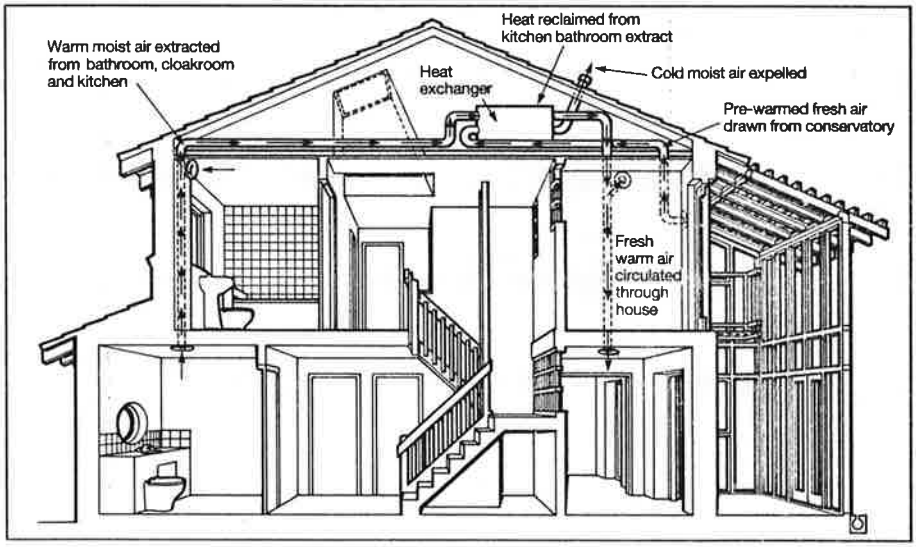
A control system which uses the energy from the solar/wind source and the storage can make-up any shortfall. The battery energy can then be used in the houses after rectification all controlled by a thyristor system in the control building; if necessary, electricity from the grid can be used. The scheme is being monitored by the Open University. The householders will not know of the control system but an indicator in each house will show when electricity is being used from natural sources.

The idea of a pilot cogeneration scheme was Solapak's. The system was designed taking account of the higher proportion of sun in summer and wind in winter. The output of wind and solar together closely match the seasonal electrical demand.

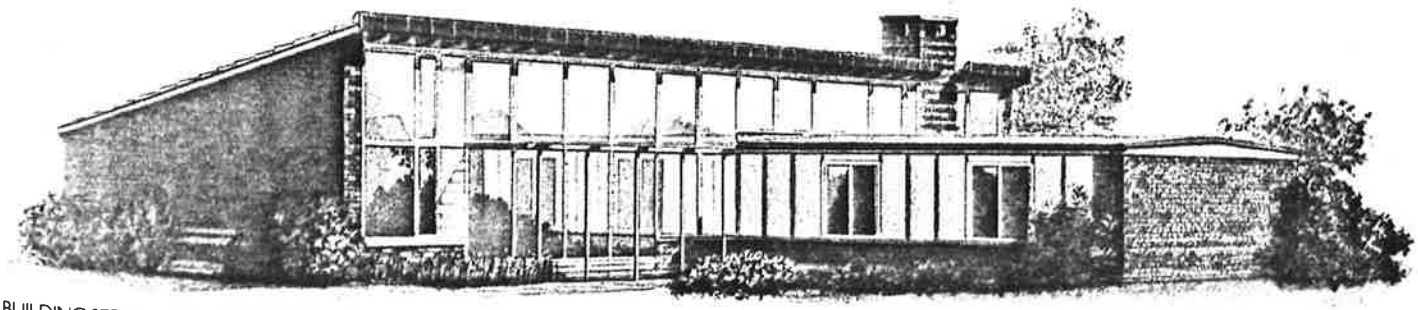
The cost of the project is £½ million. 40% of this was met by an EEC grant and a smaller percentage is promised from the UK Department of Trade and Industry.

The pathfinder project for cogeneration is built with a view to future large scale rural electrification in developing coun-





Top: Erostin Homes' houses, three bedrooms, two reception rooms. 95 m². MKECI of 97·3. Use is made of the voids in the walls and floors to distribute and recover heat. *Above:* John Mowlem's Soltice house, four bedrooms, three reception rooms. 159 m². MKECI of 100·1. One of the mechanically ventilated plus heat recovery houses. Low air filtration is achieved through the use of poured concrete walls. *Below:* Haslam Homes plus EDG and the Polytechnic of Central London. MKECI of 72·75. *Below left:* Roundhouse from K C Developments. MKECI of 84·5.



tries. Solapak's main business is in supplying professional electrical systems powering telephone networks in remote areas and corrosion protection of desert pipelines.

International Research and Development, the aero-generator company and part of NEI, has already put up a number of wind generators on islands around the British coast.

On the Fair Isles a big 55 kW machine provides 90% of the islands' requirements, so the average wind speed of 11 m/s does give the islanders a bit of an advantage over Milton Keynes. The cost of their old diesel generated electricity was 18p per kWh. The wind turbine generator and a back up diesel cost 3.3p per kWh: a large saving. As the canny islanders got all the costs covered with a grant they don't have to worry about paying back loans either!

The only really unconventional looking house in the exhibition is the Round House, designed and built by Keith Horn of KC Developments.

The design is intrinsically energy efficient by means of the shape, thermal capacity and the heating and ventilating systems.

The circular plan and conical shape minimise external surfaces. The sloping earth berms protect and insulate the external walls. The slope also combines with the roof profile to minimise wind impact.

The south facing glazing provides a passive solar gain and the construction of concrete and brick give a large thermal mass to store the heat. High levels of insulation in the floor and walls help maintain the energy gain.

The south facing conservatory provides increased solar heat gain to adjoining living spaces. preheats the ventilation air for distribution to the living spaces and heats the thermal store. It is also a draught excluding space in the winter and additional living space in the spring, summer and autumn. The conservatory is double glazed throughout and protected from overheating by adjustable external louvres.

A zoned underfloor heating system using low temperature hot water is used at ground floor and first floor levels. A gas-fired boiler linked to a pressurised water heat store is the heat source. The use of the thermal store in this particular scheme allows for a minimal size of boiler.

A high efficiency solid fuel fireplace is incorporated as an alternative heating method in the winter. The fireplace uses air ducted directly from the exterior to avoid draughts and can be used to duct warm air to adjacent rooms.

Mechanical ventilation with heat recovery is used in the house. This ducted system distributes preheated air, extracts waste heat from the kitchen, bathrooms and utility spaces, passes it through a heat exchanger where it is mixed with fresh air and redistributes it to the living area. This is efficient and also helps prevent condensation.

The system provides for the extraction of preheated warm air in the summer from the conservatory and the heat bank during the winter and fresh ambient air during the summer.

It has an MKECI of 84·5.

Laing Homes has two houses on its Energy World plot both of them being modified versions of the standard Laing designs. The interesting one is the three bedroomed detached house with the lowest MKECI in the exhibition of 41·9. This means an estimated annual heating and hot water cost of £80.

It is constructed with the Laing timber and brick "Superhome" package upgraded by 50 mm of extruded polystyrene in the floor and double glazing throughout. Such a thing does make one wonder why they don't take simple measures like this to start with.

A passive buoyancy ventilation system ensures that each house has continuous ventilation rates and a humidistat controlled mechanical extract fan in the kitchen area removes water vapour generated by cooking and washing.

The heating system is unusual in that it is powered by electricity but distributed by a wet system with radiators. The heat is supplied by an air-to-water heat pump using off peak electricity and thermal storage. There are radiators in the dining room, bedrooms and hallway.

Control is by conventional programmer and a wall mounted temperature sensor. The heat pump is a TI Creda 4 kW model for the central heating and hot water uses the TI computerised heat pump control system.

Another energy efficient housing scheme at Milton Keynes went up last year at Two Mile Ash, a site off the Energy Park grid. This particular development is not connected to the energy world exhibition but there are some highly insulated houses.

This project was started in 1985. The timber framed superinsulated houses arrived in crates from Finland and were erected at the rate of about two a day on prepared sites. The insulation standards are three to four times higher than those currently required by the Building Regulations.

The houses have a MKECI of about 60-70, ie as good as the best on the energy world site.

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The panels arrive from the factory with doors and windows fitted. The roof trusses are assembled first and then are craned away. Then the panels are joined together at the corners. The roof is then craned back on top and the whole thing is completed. The houses have an MKECI of about 60-70, ie as good as the best on the Energy World exhibition site.

The project was conceived by the PCL and Fielden Clegg Design. The aim was to show that superinsulation was a viable proposition in the UK and demonstrate that the level of technology was attainable for house builders in this country. The mechanical ventilation system and underfloor insulation were also on trial. The timber framed system was supplied by a Milton Keynes-based company imaginatively named Finlandia. All the joints in the kit were filled on site with expanding uf foam. The vapour barrier 40 mm into the frame is factory installed.