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Architecture between ecology and the market: the Homeworld, Energy World and Futureworld exhibits in Milton Keynes

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Architecture between ecology and the market: the Homeworld, Energy World and Futureworld exhibits in Milton Keynes

This article explores the ecological architecture showcased in three exhibitions in Milton Keynes: 'Homeworld '81' (1981), 'Energy World' (1986), and 'Future World' (1994). Drawing on archival documents, press reviews, post-occupancy evaluations, and interviews with key participants, it offers a multilayered historical assessment of these buildings and their socio-political context. The three exhibitions displayed houses, many of them with conspicuously postmodern, neo-historical, and neo-vernacular forms, which at the same time responded to the two most important and yet somewhat contradictory themes — on the one hand, an increasing concern with energy saving and environmentally friendly construction, and, on the other, a move towards privatisation and market-oriented housing provision. Reflecting the spirit of both environmentalism and neoliberalism, the exhibitions promoted low-energy and non-toxic construction along with entrepreneurialism and market-oriented policies. The article shows why the attempt to marry ecology and economy proved unsuccessful in the long run. To a certain extent, it failed due to the inherent contradiction between resource-saving environmentalism and growth-oriented market economics, but even more so because falling prices for oil and gas from the mid-1980s onwards made energy saving economically unattractive. The article also demonstrates that the three exhibits nonetheless generated an influential legacy, including postmodern or neo-vernacular design innovations and 'green' technological features that soon became widespread. They also facilitated the development of a new metrics for sustainability, the Milton Keynes Energy Cost Index (MKECI), which in a different form is used to date. Finally, comparing ecological metrics in the long run for different buildings in and around the Energyworld exhibit, the article shows that certain ecological design features did not necessarily translate into high environmental or energy-saving performance.

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Ecological architecture and the market

The 1980s in Britain were characterised by a contradictory approach to the built environment — on the one hand, state responsibility for housing and public spaces was diminishing as part of market-oriented policies under Margaret Thatcher, and, on the other, attempts at ecological change were often supported by state institutions. This article presents Milton Keynes as a focal point of these policies and a clue to the limited success of marrying ecological goals with market capitalism. Based on archival documents, press reviews, post-occupancy evaluations, and interviews with former protagonists, the article also discusses the influential heritage of the experimental buildings constructed at the time. Many of them were designed in a postmodern or neo-traditional vocabulary and included 'green' features that later became mainstream. They also contributed to the development of metrics for sustainability, which in an altered form are used to date.

Milton Keynes, incorporated in 1967 as a car-centric, resource-hungry new town, in the 1980s and 90s, became the testing ground for a type of architecture that sharply diverged from the modernist principles of growth and resource intensity. In the architectural exhibits, 'Homeworld '81' (1981), 'Energy World' (1986), and 'Future World' (1994), innovative architects explored resource-economical and non-polluting designs, reflecting similar trends in Western European countries. The exhibits were organised and funded by welfare state institutions, but at the same time heralded a new emphasis on market forces, entrepreneurialism, and private homeownership.

'Ecological', 'environmentalist', or 'green' approaches to architecture evolved as a response to mid-twentieth-century design deemed wasteful or unhealthy. As shown in recent publications, they received significant input from a transatlantic high-tech-related discourse on ecology, as well as from the development of cybernetics and systems theory.[1] The architectural experiments of the time relied on a heterogeneous social and political movement whose supporters aimed at a wholesome life in harmony with nature and sought an alternative to the modern Western lifestyle, whose inherent unsustainability was powerfully exposed in Rachel Carson's 1962 book, *The Silent Spring*, the Club of Rome's 1972 report, 'Limits to Growth', the Oil Crises of 1973 and 1979, and later in the UN's Brundtland Report on the state of ecological destruction (1987).[2]

Implementing such approaches in a capitalist economy was much more challenging, as was powerfully exposed by Ernst Schumacher. In his much-read 1973 book, *Small is Beautiful*, he promoted the idea of a self-sufficient economy based on small-scale technology and directed towards development that he called 'sustainable' — an early use of a concept that only from the 1990s onwards entered mainstream discourse.[3] At the same time, he pointed to the contradiction between ecology and the market that would later riddle the exhibits in Milton Keynes — that on a planet with finite resources, growth-oriented economics is in the long run unsustainable, and hence the underlying principle of a market-based housing industry is incompatible with the long-term preservation of our livelihood.

As a scholarly subject, the three architectural exhibits in Milton Keynes so far have been hiding in plain sight. They were well publicised and at the time, received extensive press coverage.[4] They were also remembered in a number of commemorative articles, most prominently in the context of the fortieth anniversary of the start of 'Homeworld' in 2019.[5] Scholarly treatment of these exhibits, as well as of 1980s ecological design in general, is much scarcer.[6] This is partially related to the difficult definition. As James Steele put it in one of the first histories of ecological architecture, 'ecology […] gets murky when applied to buildings'.[7] His three themes — a concern with the traditional, a focus on technological solutions, and a search for sustainable urbanisation — are thus accordingly broad and would not only fit most examples in Milton Keynes (which are not discussed in his book) but also the work of architects as diverse as Enric Miralles, Norman Foster, and Hassan Fathy which he discusses.

Similarly broad are the categories published in 1995 by Sim van der Ryn, the long-term president of the Ecological Design Collaborative and a steadfast promoter of ecological design based on mimicking nature.[8] The diversity of design solutions is also evidenced in Peder Anker's history of ecological currents in architecture, which focuses on famous architects such as Walter Gropius, Ian McHarg, and Christopher Alexander, emphasise American projects, and puts a strong effort on the connection between the ecological theme and the space exploration movement.[9] Lydia Kallipoliti, in her recent 'cyclopedia of ecological design', therefore speaks of histories rather than history.[10] The fact that some of the designs discussed in these publications results from genuine ecological innovations while others merely engage in ecological rhetoric is a further complication. None of these publications historicise the experiments Milton Keynes or the contemporaneous model estates in other European countries.

An unusual new town

The three architectural exhibits were developed in a very specific location. Milton Keynes, situated 80 kilometres northwest of London, is currently home to about 260,000 residents. It was designated in 1967 as part of the third and final wave of new towns, two decades after Stevenage (1946), Harlow (1947), Welwyn (1948), and East Kilbride (1947). It is thus a late example of the British new town programme, somewhat removed from the spirit of the early-twentieth-century Garden City movement that still inspired the first wave, but still firmly rooted in the modernist principles of comprehensive top-down planning and strong local authorities. Built Milton Keynes eventually extended beyond the modernist principles of car orientation and cheap oil economy that underpinned its first plan. 'Peak Milton Keynes', when most central areas were built up, happened in the 1980s, overshadowing earlier construction phases and in terms of building activity and media attention.

Like other new towns, Milton Keynes was also built by a development corporation — Milton Keynes Development Corporation (MKDC) — which acquired agricultural land through compulsory purchase and eventually became a powerful landlord comparable to a Scandinavian or Eastern European local authority, as it developed, managed, and rented out houses and flats, (even if the target from the beginning was a 50:50 public/private split). Under Margaret Thatcher's Conservative government since 1979, it became increasingly clear that public housing provision would soon belong to the past and that the future was private homeownership and entrepreneurialism. MKDC began selling land to housing developers, thus gradually shifting housing responsibilities to private actors and establishing homeownership as a model. During this transition period, however, by picking the buyers and setting the conditions for the sale, MKDC assumed a strong role and actively promoted policy goals, such as energy-saving design and technology. The attempts to marry environmentalist goals with market-centred approaches were thus an outcome of this specific constellation.

Ecological architecture and the Open University

Milton Keynes' position as a hub of technological innovation was bolstered by the Open University, established in 1969.[11] The Open University aimed to provide a more democratic model of higher education compared to the traditional, class-based system of British elite universities. It had no lecture halls, but rather practiced remote learning before the computer age, teaching students across the UK through posted materials, televised lectures, travelling tutors, and occasional meetings in Milton Keynes. The innovative method was complemented by a curriculum that embraced concerns such as energy saving and environmental protection.

The search for technological solutions to ecological challenges in architecture can be traced back to the mid-twentieth century, with key figures including Walter Gropius, Julian Huxley, Serge Chermayeff, Maxwell Fry, and Ian McHarg.[12] At the Open University, impulses for ecological design came, for example, from the Alternative Technology Group (later Environmental Research Unit). It was founded in 1976 by Godfrey Boyle (1945–2019), co-author of the book *Radical Technologies*, that promoted technology geared towards preserving the environment.[13] The group drew significant input from the work of the Cambridge Research Group around Alexander Pike, John Frazer, and their colleagues, including Brenda and Robert Vale. Their most famous project, the Autonomous House (built in 1974, renamed Autarkic House in 1975, later dismantled), was a prototype for ecological design aiming at self-sufficiency, producing all energy and two-thirds of the food consumed by a family of four on the premises.[14] A similar environmentalist agenda was pushed by the Energy Research Group, founded in 1974 by Peter Chapman, whose book, *Fuel's Paradise*, predicted the depletion of oil in the near future.[15] Since 1978, the group was part of the Technology Faculty, and at the time, had about 30 members. An interest in ecological principles, systems theory, and cybernetics were key elements in their work.

Calls for action fell on fertile grounds with MKDC's general manager Fred Lloyd Roche, who was described as being particularly receptive to the Energy Research Group's concerns and supported a productive collaboration.[16] Also Frank Henshaw, who succeeded Roche in 1980, continued to support joint projects. An important partner at MKDC was John Doggart (born 1941), a Cam-

Figure 1.
The Bradville Solar House, 1972, designed by Steven Szokolay, Jiri Skopek, and John Doggart, a restrained modern design that nonetheless anticipates postmodern concerns, courtesy of MKCDC collections, Prof. Brian Cudmore, 1980, CUD/017

bridge-educated English architect and engineer, who joined MKDC in 1971 after working for Richard Rogers. Doggart remembers working in an environment 'like NASA', with enthusiastic young professionals eager to apply the latest scientific findings to practical, future-oriented projects.[17]

These included researchers-practitioners such as Steven Szokolay (1927–2024), a Hungarian-born engineer and founder of the Built Environment Research Group at the Polytechnic of Central London,(later University of Westminster), and Jiri Skopek (born 1949), a Czech-born architect. Facilitated by MKDC and in collaboration with Doggart, they designed the energy-saving Bradville Solar Heated House on the street Harrowden, in the Bradville neighbourhood, a rental building owned by MKDC and completed in 1972 (Fig. 1).[18] The three-bedroom house with 84 m^2 floor space features a restrained modern design with a box-shaped form, unadorned façade, and monopitch roof.[19] Post-occupancy evaluations showed that the house could provide 71% of hot water requirement and 47% of the space heating load through solar energy.[20] The south-facing terrace with big windows contributed to a good heating balance. The building was catapulted to the centre of public attention with the first Oil Crisis a year later, and Milton Keynes came to be connected with the challenges posed by rising prices for fossil fuel. It hence can be interpreted as a precursor to the designs in the 'world' exhibits, even if its exterior form owes to high-modernist austerity rather than the postmodern playfulness that can be read in some of the houses in the exhibits.

Both the first Oil Crisis during the Yom Kippur War of 1973 and the second one following the Iranian Revolution of 1979 were provoked by geo-political tensions rather than depleting resources. They nonetheless made excessive energy consumption the most obvious aspect of the unsustainable Western lifestyle, and, given the sudden financial impact, the one environmentalist concern that both designers and users were most willing to address. Applying money-saving ecological features to buildings that in the Thatcherite spirit of market capitalism were designed for bolstering the transition from state-provided housing to private homeownership seemed to be the perfect match.

Proposed ecological devices were, on the one hand, high-tech 'active' solutions based on solar water panels, heat pumps, or glazed sunspaces connected to ventilation systems, and, on the other, low-tech 'passive' solutions such as south-facing windows and enhanced insulation. Szokolay's 1975 book, *World Solar Architecture*, outlines both methods, but his focus, like that of many of his colleagues at London Polytechnic, was on active systems.[21] The fact that technologically sophisticated active systems tended to be more expensive than, let's say, thicker insulation seemed to have been largely absent in the discussion, and only came to the front in the 1980s. In a 1982 study, Doggart and his colleagues David Hodges and Alan Horton at the Polytechnic of Central London concluded that 'active solar heating systems for houses are not cost-effective'.[22] Or, as a journalist put it, 'good insulation is the single most effective measure to be taken to reduce fuel consumption'.[23] The gradual shift from active to passive systems reflects the impact of market forces on ecological design.

'Homeworld': balancing ecology and economy

The 'Homeworld' exhibit, next to presenting the latest advancements in design and technology, aimed to promote Milton Keynes and stimulate private housing construction during a period of economic crisis. In the UK, high inflation and high unemployment rates by 1980 had brought house construction to the lowest level since the Second World War.[24] At the same time, energy prices reached an all-time high of over 30 US$ per barrel, having doubled in less than a year.[25] The ecological goals were thus closely connected to the promise of monetary savings due to energy conservation. The framing of ecological architecture as a means to protect customers' finances rather their living environment is noticeable in articles and promotional publications, and it was a consequential move that would haunt ecological architecture for years to come.

'Homeworld' was held from 1 May to 1 June 1981 on Coleshill Place in the Bradley Commons area, one of the town's numerous grid squares framed by four-lane thoroughfares and sheltered from through-traffic through large green spaces (Fig. 2). The exhibit was organised and sponsored by MKDC. The initiator may have been David Parker, an American consultant working for MKDC general manager Fred Roche, or David Lock, MKCD's planning manager.[26] It attracted about 150,000 visitors. The event was promoted through an official catalogue and numerous leaflets.[27] Critics praised the non-standard design of many buildings and the involvement of private actors and foreign companies, particularly Scandinavian house builders like the Danish Marchesi company and the Swedish Aneby Hus company.[28] Trendsetting energy-saving elements included enhanced insulation, draught proofing, double

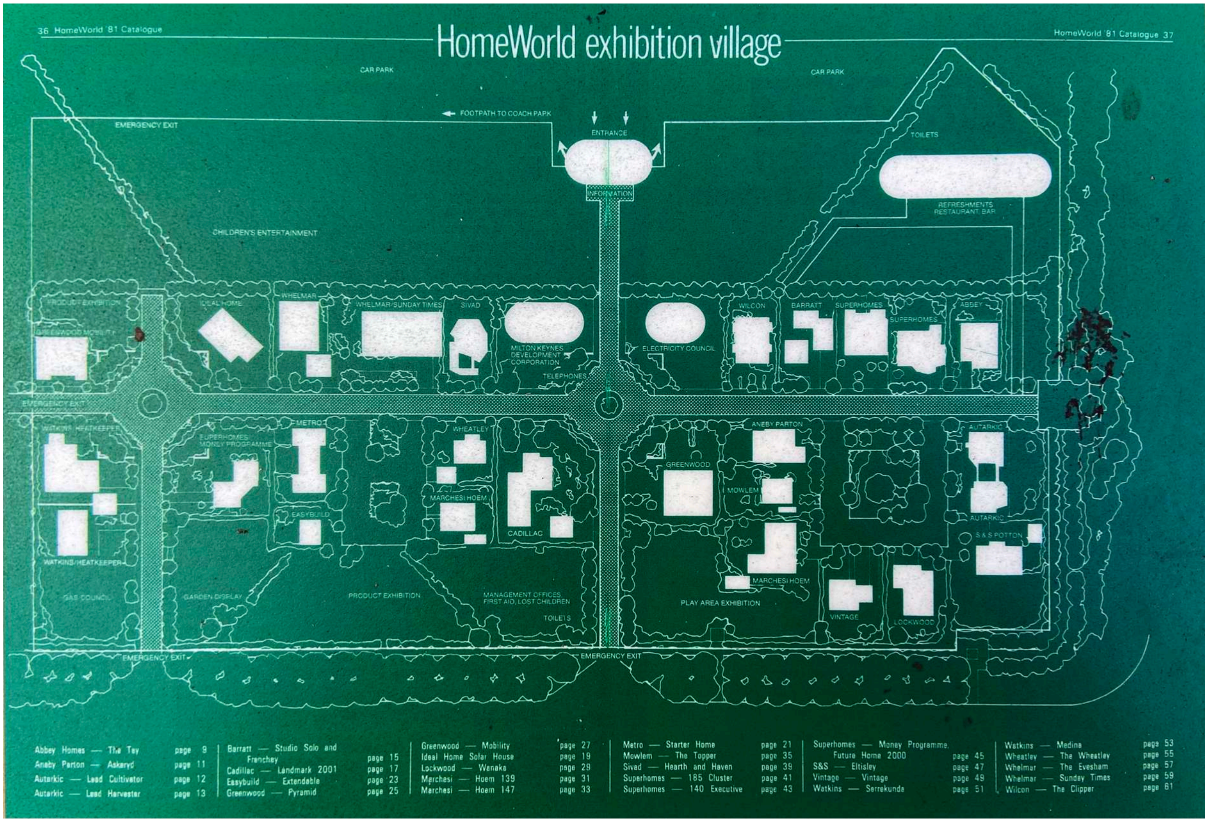


Figure 2.
Plaque of the 'Homeworld' plan, Coleshill Place, Milton Keynes, photographed by the author, 2024

glazing, thermostats, and, to some extent, heat recovery and photovoltaic panels, all of which homeowners were persuaded to incorporate in their houses.[29]

A prime example is the Solar House. It was designed by Dominic Michaelis and built by the firm Ideal Homes, a subsidiary of Trafalgar House. The building was widely discussed at the time and featured a unique design that combined high-tech and postmodern neo-vernacular elements on opposite sides. The south-facing front was a glazed slanted surface with a futuristic look, acting as a sun collector and conservatory. The rear featured a garage, a pitched roof, and a brick-faced gable. A 1981 description attempted to wed the two, pointing to the connectedness of the building's high-tech structure with the natural environment: a trellis in front of the glazing was designed to be grown over with deciduous creepers, providing shade in summer and sunlight in winter (Figs 3 and 4).[30]

Heat storage was achieved by both active and passive means. The active system included solar water panels in the upper portion of the glazed surface that heat water, which was then to be stored through liquifying sodium sulphates. The fluid stored heat through a combination between melting and de-crystallisation, and later released heat by reversing the process. This relied on a rather basic electronic controller, which nonetheless at the time was considered sophisticated.[31] Developed by the Calor Group, the system cost £3,000, a significant expense considering a two-bedroom 'starter home' at 'Homeworld' sold for £20,000. Supplementary heating was provided by a solid fuel (coal or wood) burner.[32]

The passive system included the heated space behind the glass and what was then considered 'high-insulation standard': 50 mm Dritherm fibreglass insulation in the cavity and further 25 mm behind the plasterboard lining, along with triple-glazing.[33] The Solar Home is one of the few 'Homeworld' buildings on which insulation figures were published: the exterior walls had a *U*-value of 0.35 W/m^2K, superior to the legal maximum of 0.6 W/m^2K at the time (the lower the *U*-value, the better the insulation).[34] But they were inferior than the regulatory minimum for new builds today which stand at a u-value of 0.18 W/m^2K, typically achieved by 90–150 mm thick mineral wool. [35]

The Futurehome 2000 across the street showcased similar advanced technology behind postmodern volumes (Figs 5 and 6). It was designed by David Turrent, Jes Mainwaring and John Doggart at the office Energy Conscious Design for Superhomes, a subsidiary of the volume builder John Laing Group. The two-storey brick-faced house with a shed roof was built on an L-shaped plan. A glazed, south-facing with a butterfly roof in the angle of the L, originally with red-painted iron frames, gives the building a distinctive post-modern look. Noteworthy technical features included water-heating solar panels and double glazing — at the time a rarity in England — and windows were covered with a heat-reflecting gold coating on the interior. But there was no heat pump and no photovoltaics.

The building was also referred to as the 'Computerized Home', as it included computer-controlled technology produced by the American firm Texas Instruments that, at the time, was considered pioneering enough to be featured in the BBC's business affairs series, 'The Money Programme'. The main feature was a push-button controller for the heating, which could switch between hot water panels, a gas boiler, and a natural-gas-powered 500 ccm Fiat engine with a heat recovery system named 'Total Energy Module' (Totem).[36] This set-up reflected a 'Jack the Lad' approach that MKDC architect John Doggart remembers as being typical for many ecological projects at the time. The engine produced enough electricity to make the building independent from the grid and could be run on liquified gas canisters to provide complete autarky. At the same time — this was the main energy-saving feature — it used the engine's waste heat for heating the building. A journalist celebrated the house as a 'den of energy saving devices'.[37] Also, the mere possibility of calculating energy use, facilitated by the first, rather unwieldy desktop computers, at the time, was considerable progress and, as will be discussed below, was a step towards energy metrics first developed during the 'Energy World' exhibit six years later.[38]

The 'Totem' small-scale generator also stood for another important aspect of the 1980s discourse — the goal of autarky or independence from the grid, which had inspired the Cambridge Research Group around Alexander Pike, the designer of the famous Autonomous/Autarkic House and a pioneer of eco-

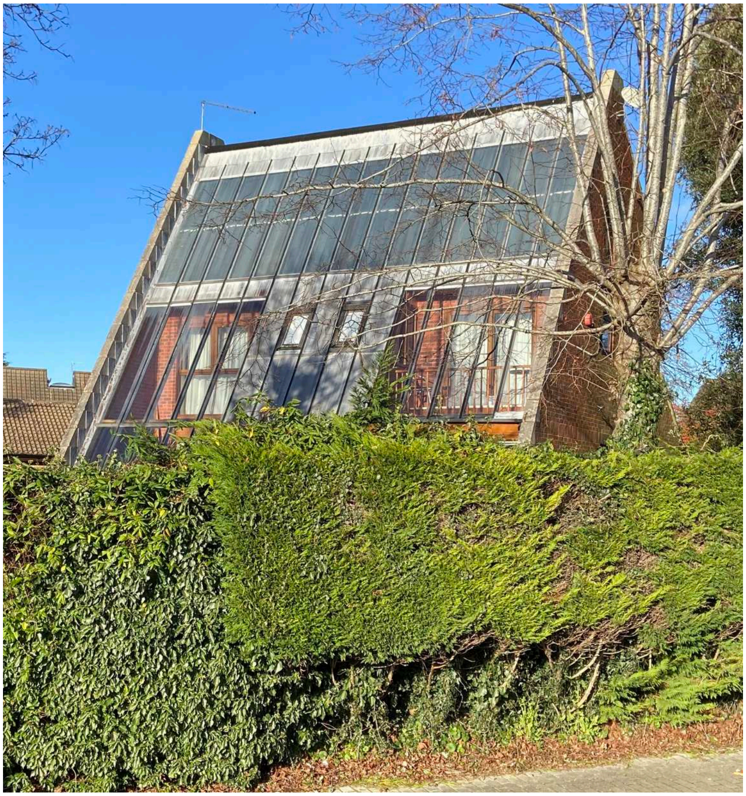


Figure 3.
Solar House, front and rear views, 1981, designed by Dominic Michaelis, photographed by the author, 2024

Figure 4.
Solar House, front and rear views, 1981, designed by Dominic Michaelis, photographed by the author, 2024

Figure 5.
'Futurehome 2000', 1981, designed by Superhomes/Laing Group, portrayed in the BBC's 'Money Programme', photographed by the author, 2024

logical architecture. While this did not necessarily come with energy or money savings, it pointed to an important and somewhat unexpected aspect of 1980s attitudes to housing — the mistrust in (welfare) state institutions — and the goal of increased self-reliance were shared by both progressive environmentalists and conservative Thatcherites. While for the former they were part of an alternative and more sustainable lifestyle, for the latter they implied entrepreneurialism and individual responsibility in light of an increasingly volatile energy market.

The ambivalent goal of autarky was also programmatic for the Autarkic Houses about a hundred metres down the road (Figs 7 and 8). The two adjacent buildings were called LEAD Harvester and LEAD Cultivator, with the confusing acronym standing for Low Energy Adaptable Dwelling and supposedly pronounced as in 'leading' and not as in 'lead poisoning'. Low energy consumption was to be achieved by enhanced insulation as well as glazed sunspaces on the southern side. They also featured an active heat storage system using eutectic salts. 'Adaptable' referred to a certain structural flexibility that allowed for extension according to the inhabitants' needs, as well as to certain unfinished parts 'for the do-it-yourself enthusiast'.[39] Following the market logic, the timber frame in the Lead Cultivator was not praised for being a renewable material, but for the cost-saving speed of construction that allowed it to be erected in only three days.[40]

The London-based company Autarkic Potentials, headed by the architect Donald Forrest, was established to provide homes for a self-sufficient lifestyle based on sustainable materials, spaces to raise livestock, and gardens for growing crops.[41] Forrest in the 1970s had worked with Alexander Pike. Forrest's Autarkic Houses at 'Homeworld' were less ambitious. Their approach nonetheless lies at the core of anti-modernist criticism, as they rejected mass-produced housing and modernist one-size-fits-all architecture.

A more extreme step towards possible autarky was 'The Pyramid', designed by Wigley Fox Architects for Greenwood Homes (Fig. 9). The wood-clad, 214 m^2 building featured a slated, pyramid-shaped roof that almost reached the ground and was topped by a four-sided skylight, re-calling both vernacular peasant abodes and futuristic visions. Like the previous 'Homeworld' buildings, it included 'high insulation' and a flexible plan for interior room division based on the inhabitants' needs. The basement was designed to be used as a fall-out shelter — another reminder that the fear of nuclear war was just as much a part of the period's apocalyptic visions than that of ecological disaster.[42]

The theme of individualism and autarky at the interstices of hippie culture, apocalyptic visions, and market capitalism was also present in the World House, designed by New Zealand architect Roger Walker and his firm Vintage Homes (Fig. 10). It was a three-storey timber-frame building that resembled a medieval wooden fort from a distance, with timber-clad geometric volumes topped by a pitch-roofed tower. It was advertised as 'typical colonial-style architecture' from New Zealand (intended as a positive label), as the building was expandable through lean-to structures. It connoted not only the long-standing harmony and trustworthiness of vernacular forms but just as much the self-reliance of new settlers and their strategies of bottom-up incremental growth.[43]

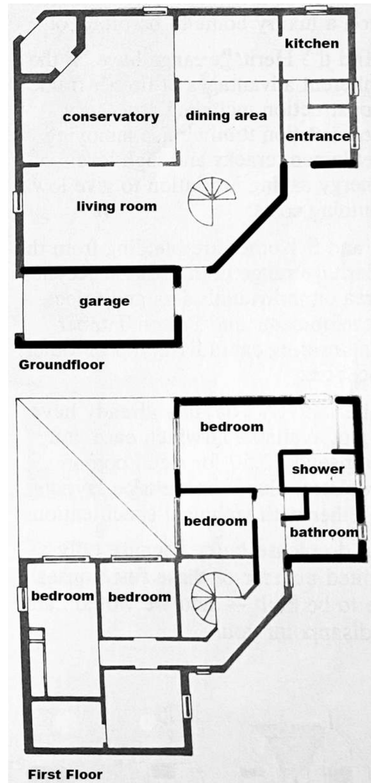


Figure 6.
Plan of 'Futurehome 2000', 1981, author's drawing based on MKDC, *Homeworld 81 – Official Catalogue* (1981), p. 45

Technologically, 'Homeworld' promoted higher standards of insulation and, in light of all-time-high energy prices, increasing acceptance for the associated extra cost. This is evidenced by the comprehensive use of glass fibre insulated exterior walls and double-glazed windows, which were not common for new builds at the time. In this respect, 'Homeworld' was not only widely praised in the press at the time but still considered a success by residents decades later.[44] At the same time, economic factors also contributed to the limitations of 'high-tech' and 'computerised' ecological technology, which was rather basic by today's standards and mainly consisted of thermostats and electrically controlled ventilation. A heat pump, now considered one of the most effective means of providing climate-neutral heating, was a much rarer feature, as it was priced at £1,200, a considerable sum, compared to the aforementioned £20,000 price tag for a two-bedroom 'starter home'.[45] One featured in the Superhomes 140 Executive building, an otherwise unspectacular pitched-roof structure with a timber-clad first floor and a protruding gable on the long side. In this context, British builders still saw heat pumps as 'a product of the future' and, despite energy-saving potentials, not compatible under the market conditions at the time.[46]

In terms of design, the sunspace or 'unheated solar buffer zone' was the most widespread ecological innovation. It was a south-facing glazed veranda that heats up during the day when doors or ventilation shafts between the veranda and the rest of the building are closed and releases warm air into the building at night when they are open. Such sunspaces often featured post-modern design with volumetric forms and brightly coloured metal frames and were not based on expensive technology. The cost effectiveness is likely to have contributed to their widespread application. They became central to the

Figure 7.
Autarkic House, with (left) the LEAD Harvester and (right) the LEAD Cultivator, 1981, designed by Donald Forrest, where both buildings have extensive glazed sunspaces on the back, not visible on the picture, photographed by the author, 2024

'Energy World' exhibit, which explicitly mandated the inclusion of 'passive solar design, conservatories and sunspaces'.[47] They also featured prominently in the Solar House, the Futurehome 2000, the Autarkic Houses, and many similar buildings in the UK and beyond.

In 1981, a journalist praised the sunspace of Futurehome 2000 as providing 'as much as a quarter of the house's space heating'.[48] Additionally, engineer Paul Flello, who owned the building from 1982 to 1996 and inhabited it with his wife Carol and three children, remembered the comfortable hot air that the fan would draw into the living room from the sunspace.[49] Yet neither Flello nor anyone else cut down the trees on Coleshill Place that, over the years, effectively overshaded it, and few architects designed sunspaces a few decades later.

Their popularity at the time notwithstanding, sunspaces nonetheless quickly came out of fashion. A 1995 study from Glasgow concludes that, while they were effective in reducing heating costs, their effectiveness was often significantly diminished by user intervention.[50] Such intervention included heating a sunspace in winter directly or opening it up as a heated part of the dwelling, practices common among space-strapped families. If a sunspace was badly designed, such unintended use could be even more detrimental. These issues made sunspaces controversial and contributed to their decline. There may have also been an element of taste; at some point, sunspaces were seen as outdated, and their workability no longer improved by architects and technicians.[51]

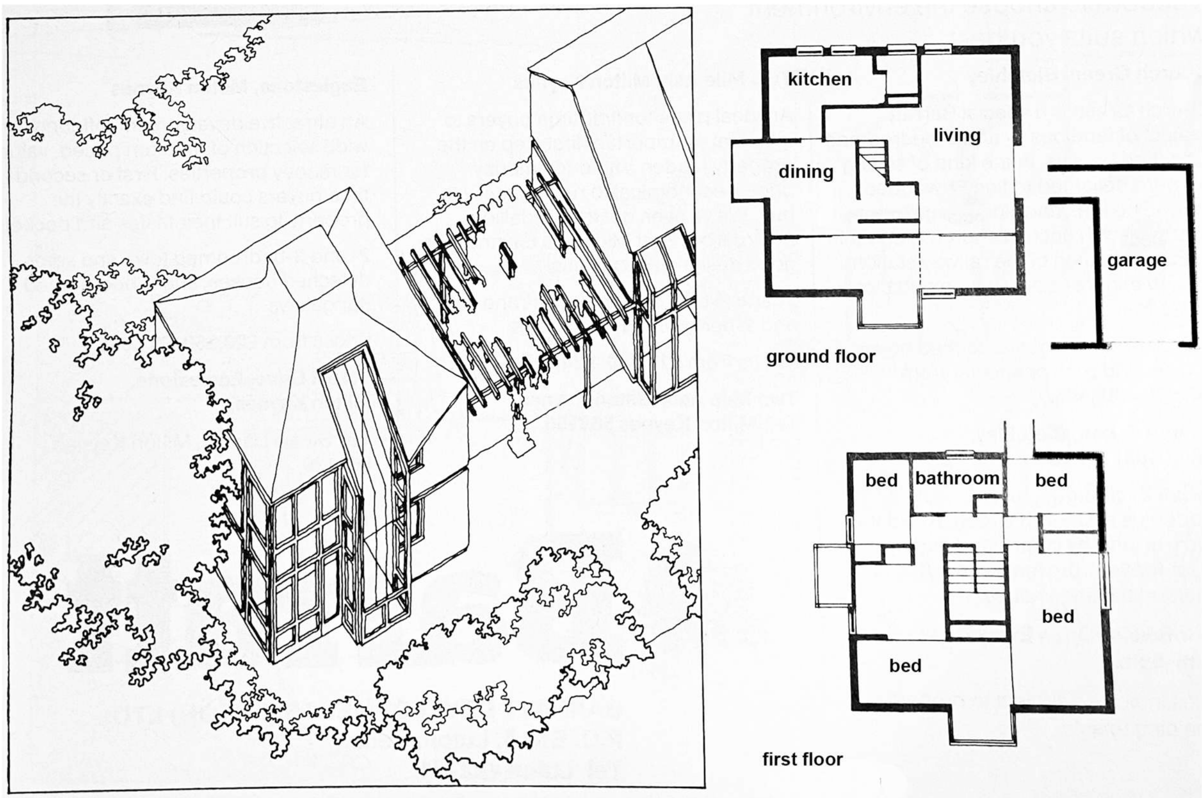


Figure 8.
Autarkic LEAD Cultivator, plan and drawing, author's drawing based on MKDC, *Homeworld 81 – Official Catalogue* (1981), p. 12

Energy World: 'management' rather than saving

Energy World elevated the energy theme to a new level that seemed to be even more compatible with entrepreneurial strategies (Fig. 11). The exhibit took place from 23 August to 21 September 1986 around Cadman Square and Faraday Drive in the Shenley Lodge grid square, featuring approximately 50 energy-efficient houses, most of which are still standing (Fig. 12). At the time, these buildings were part of a larger area that was promoted as 'Energy Park', which included portions of the adjacent Knowlhill and North Furzton grid squares. 'Energy Park' was envisioned as a comprehensively planned urban area with volume housing, greenery, and shops, as well as energy supply in the form of a wind park. While some of the housing was built and remains today, the wind park was later dismantled.[52] Additionally, this exhibit was organised by MKDC in collaboration with private home builders and was designed to promote Milton Keynes in the context of the national 'Energy Efficiency Year' 1986 declared by the UK Secretary of State for Energy Peter Walker. The exhibit also included a 'Business Week' in September 1986 for businesses engaged in energy-efficient construction. In contrast to 'Homeworld', claims for energy efficiency now had to be substantiated with hard data. To be selected for the exhibit, buildings had to be 30 per cent more energy efficient than required by the building regulations at the time.[53] The goal was to establish principles of energy economy in the private housing market, which at the time was widely regarded as the future.

Energy World promoted strategies different from the focus on energy saving and renewables demanded by climate action 40 years later. The goal was not energy saving, but rather 'energy management'. The distinction may appear subtle, but it had significant consequences for building-related approaches. Energy management aimed not predominantly at reducing consumption (even if this was mostly achieved), but rather, in the sense of a well-managed business, at achieving maximum output from any given input and a more efficient use of increasingly expensive resources. This approach was also evidenced by the repeated celebration of quickly built houses — a perspective that was not necessarily a plus for customers expecting longevity. Thus, a focus on limitation and constraint to preserve the planet's resources was never in the foreground. Instead, energy efficiency was promoted as a capitalist operation summarised in the term 'monergy' that was frequently used in promotional materials.[54]

This shift aligned with the political move away from state-controlled rental housing towards entrepreneurialism, homeownership, and financialisation of the housing market. 'In pursuit of a property-owning democracy', as a 1986 leaflet put it, the housing market was being pushed into overdrive.[55] The Thatcher government had recently crushed the coal miners' strike of 1984–1985, sealing the fate of both Britain's ailing coal industry and large state-managed companies. Energy supply at the time was still largely in public hands, but it was already moving towards privatisation. Since 1979, the Thatcher government had gradually sold its shares of the British Petroleum Company (now BP), but British Gas was only privatised in 1986 and at the time still a vertically integrated firm that also acted as a housing developer. The privatisation of the electricity supply companies began in the 1990s. However, a move away from fossil fuel was not considered, as the potentially catastrophic consequences of climate change at the time were only known to a small minority, with the distribution of this knowledge severely hampered by the fossil fuel industry.[56]

The British government still had good reasons to propagate innovation. The country was only slowly recovering from the early 1980s recession, and high energy bills were a major concern for the population. Computerisation was on the rise and Building Management Systems (BMS) were an emerging technology. The focus on 'energy management' or 'energy efficiency' must be understood against this backdrop.

Low energy houses in neo-traditional cladding

Energy World promoted 'low-energy houses' mostly in neo-traditional cladding. Traditional forms, it seems, suggest safety and reliability, but pitched roofs and wooden cladding do not automatically translate into a better ecologi-

Figure 9.
The Pyramid, 1981, designed by Wigley Fox, photographed by the author, 2024

Figure 10.
World House, 1981, designed by Roger Walker, photographed by the author, 2024

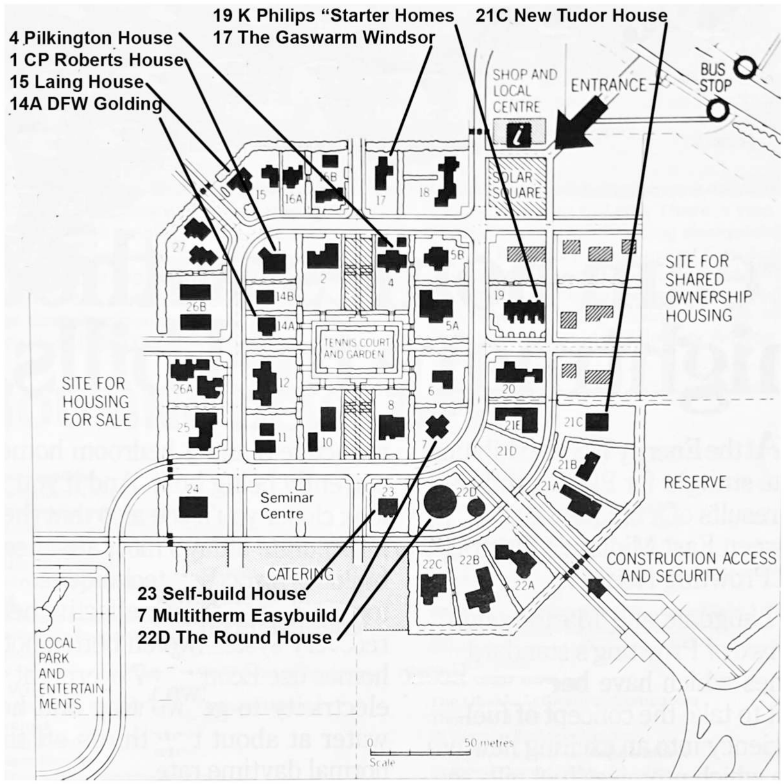


Figure 11.
'Energy World' plan, 1986, author's drawing based on MKDC, *Energy World – Official Guide* (1986), p. 18

cal performance. The C. P. Roberts House, designed by Hertfordshire-based architect John Bonnington, merges postmodern neo-traditionalism with energy-managing technology (Figs 13 and 14). The two-storey, 155 m^2 four-bedroom house sits on a roughly quadrangular plan, with the southeast corner cut out to form a glazed, double-height sunspace referred to as 'Solar Court', which opens into the living room, kitchen, and central dining area — all lit through a small glass pyramid on the roof. The north and west façades display a split aesthetics; the northwest corner is brick-faced, while the northeast and southwest corners feature a neo-Tudor style. The Tudor look does not derive from half-timbered construction, but rather from glasal cladding with dark vertical stripes (Figs 15 and 16). These fibre cement panels with mineral enamel coating provided good insulation. At 0.25 W/m^2K, the *U*-value of these exterior walls was not only significantly lower than that of real seventeenth-century half-timbered walls (2.2–4 W/m^2K) but also better than the brick portions of the house (0.36 W/m^2K) and close to the previously mentioned 2021 standards of 0.18 W/m^2K.[57]

The Pilkington House was designed by Derek Walker, MKDC's chief architect and planner from 1970 to 1976, and thus a key figure in the genesis of Milton Keynes as a modern, spread-out town immersed in the landscape (Figs 17 and

Figure 12.
Shenley Lodge Meeting Place, central building for the ‘Energy World’ exhibit, originally with a wind turbine on the roof and was adorned with the Energy World Wise Owl mascot, now a shop, photographed by the author, 2024

18).[58] This building somewhat takes a different approach, combining neo-traditionalist forms and ecological technology. The two-storey, four-bedroom house with 150 m^2 floor area on a symmetrical cruciform plan is designed around a double-storey-height central living area. The north façade displays a full gamut of postmodern vocabulary: an ornamented porch resting on white columns, a triangular gable with a bi-parted round window, a slated pitched roof in the middle, hip roofs on the sides, and neo-historical brick ornaments recalling a crow-stepped below the roofline. The south side features an extensively glazed sunspace with structural shading. The building also has a gas-fired boiler. Windows are double-glazed and the cavity walls are similarly well insulated as in other Energy World designs.[59] An efficient ‘energy management’ is proudly announced through measures that a few decades later were standard: thermostatic control in each room, ‘low-energy lamps’, and trickle ventilators in the main windows.[60] *U*-Values are low, even by today’s standards: 0.26 W/m^2K for the external walls and 0.18 W/m^2K for the roof.[61] The ecological capitalist message is summarised under the motto, ‘get more for your monergy’ — the house is ‘reassuringly traditional, but its Energy Index is astonishingly low’.[62]

The Gaswarm Windsor, built by the developer department of British Gas, follows this similar approach (Fig. 19). The building has a brick-faced façade with restrained ornaments and a south-facing sunspace with a conspicuously ornamented postmodern gable. At times, neo-vernacular design was explicitly used to support an ecological message. The Multitherm Easybuild House with 308 m^2 and three bedrooms was designed by Milton Keynes-based architect David Sim (not to be confused with the eponymous Copenhagen-based architect). Sim experienced low-energy design while working in West Germany.[63]

The house was proudly promoted as containing wall, floor, roof, and even bricks from West Germany and referred to as 'traditional German style' (Fig. 20).[64]

With its large gable-side balcony under a protruding pitched roof and its partial wooden cladding, the building indeed appears to be loosely modelled on an eighteenth-century Upper Bavarian farmstead. In contrast to its model, however, it was not built from brick and timber, but rather with a cavity wall whose inner leaf (140 mm) is from in-situ concrete poured into permanent polystyrene formers, while the outer leaf is from brick work (115 mm). The building also has German-style tilt-and-turn oak windows with triple glazing, at the time, highly unusual in both West Germany and the UK. Other features boasted about were 'thermostatically controlled radiators' and draught proofing of doors and windows. *U*-values are even lower than in the Pilkington House: 0.22 W/m^2K for the walls, 0.17 W/m^2K for the roof, and 1.9 W/m^2K for the windows.[65]

Possibly the most-photographed house was a remarkable design, but at the same time not pioneering in energy-saving features — the Round House — designed by London architect Keith Horn and built by KC Developments, which provided spacious rooms behind brick walls, arranged around a central brick core (Figs 21 and 22). There were four bedrooms, two bathrooms, and a two-storey conservatory. The roof was made from copper sheet on a timber panel frame. The main energy-saving device was the conservatory, combined with heat storage in the south facing core wall, distributed through a ducted heat recovery system. Other features are rather energy intensive; the building includes a swimming pool and is heated through a gas-fired boiler and a wood/coal burner. Energy-saving devices such as heat pumps or photo-

Figure 13.
C. P. Roberts House front view, 1986, designed by John Bonnington, front view photographed by the author, 2024

voltaic panels are merely 'to be examined for future schemes' — an indication that the commitment with energy saving was never unambiguous. [66]

State-sponsored ecological design in the 1980s Milton Keynes was not limited to the 'world' exhibits, but manifested in various other projects before and after, which were all supported by MKDC. Notable examples include: Solar Court (1979–1980, nine free-standing houses) and Pennyland estate (1980–1981, 177 terraced houses, monitored by the Open University), both featuring unspectacular traditional design; Giffard Park Housing on Hainault Ave, (1984, 36 flats and 'starter houses'); and the Calewen estate on the street Calewen (1985, Feilden Clegg) (Fig. 23). All these projects featured pitched roofs and traditional designs with restrained postmodern and neo-historical elements, including sunspaces.

The Calewen estate in the Two Mile Ash grid square was one of the most ambitious at the time. It featured 12 timber-frame semi-detached houses with triple-glazed windows. Wall panels of up to 10×2.4 metres were delivered as a kit by a Finnish supplier, with the insulation and internal finishes already fitted on. Walls and floors were insulated with fibre glass; the floors also contained Styrofoam layer. At the first-floor level the buildings are clad in white glasal fibre cement panels with brown frames, which give them a similar neo-Tudor aesthetic like the C. P. Roberts House in the 'Energy World' exhibit. The Tudor-style ornamentation is also repeated in the garages. The most innovative feature of these 'superinsulated houses', as they were celebrated at the time, is simply two layers of fibre glass insulation on the inside, 40mm and 145 mm thick, divided by a vapour barrier, as well as an air-filled cavity between timber frame and the 103 mm thick brick outer skin.[67] Unlike 'The Solaire' with its conspicuous glazed south façade, the Calewen buildings do not contain any sun spaces, and, given the north–south-direction of the street, south faces are overshadowed by the adjacent building. Given the thick insulation the Calewen estate had a very low *U*-value of 0.17 W/ m^2K for both walls and floor, compared to 0.6/1.0 required in 1981 and 0.18/ 0.13 required in 2023 (see also Table 1).[68]

In retrospect, the strategies promoted by the exhibit seem rather mundane and common sense, although many are still not universally practiced: draught proofing, wall insulation, and double glazing. The occasional use of photovoltaic panel and the extensively applied sunspaces were also notable. Among the more time-specific features that did not gain widespread adoption were trombe walls that heat up during the day and give off heat during the night, solar water heating panels, and active ventilation systems. Other types of environmental impact were not considered problematic: non-recyclable materials like fibreglass, the use of fossil fuel (with natural gas being encouraged rather than criticised), and wasteful space planning in subdivisions of single-family homes that favoured individual car traffic.

The functioning of these features was intensely researched. Most buildings included a computer-controlled 'building interface unit' in the phone box outside the building — technologically advanced by the standards of the time.[69] The unit measured and transmitted data on temperature and humidity

Figure 14.
C. P. Roberts House plan, 1986, designed by John Bonnington, author's drawing based on MKDC, *Energy World – Official Guide* (1986), p. 19

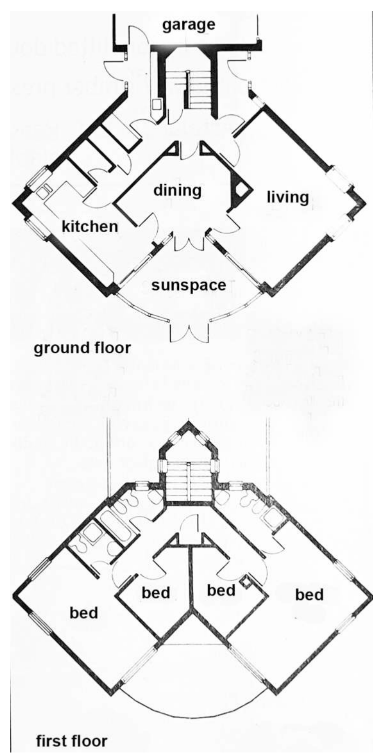


Figure 15.
'Self-build house', 1986, designed by Phil Bixby, photographed by the author, 2024

as well as fuel and water consumption to a central monitoring office, allowing for the monitoring of 1,200 dwellings in the area.[70] While the measurement of energy consumption was groundbreaking and certainly raised awareness, there is no evidence that any specific figures were widely discussed. It seems that the most important aspect was that research was conducted and distributed rather than the findings themselves. In the UK, as in most European countries, energy standards slowly increased, but as Doggart pointed out, it took over 20 years for the regulations to keep up with the level that had been provided at Energy World.[71] It is safe to say that this was mostly economically motivated and related to the narrow focus on 'monergy' rather than resource awareness. With energy prices decreasing throughout the mid-1980s, the interest in energy efficiency was soon gone.

'Futureworld': energy management sponsored by the fossil fuel industry

'Futureworld', the last of the three exhibits, stands for the ultimate failure of advancing an ecological agenda by market forces and entrepreneurialism. Unlike 'Homeworld' and 'Energy World', it did not achieve comparable success or generate a significant output of architecture. And yet, it is telling for the decline of energy-saving design in light of sinking energy prices, receding state responsibility for housing, and increasing market influences. 'Futureworld' was built on Crowborough Lane between Hartfield Close and Southbridge Grove, in the Kents Hill grid square, about 7 km east of the city centre (Fig. 24). The exhibition took place from 11 June to 10 July 1994. The show was organised by the private company Cunningham Associates and commissioned by the Commission for New Towns, the successor organisation of MKDC, which was dissolved in 1992. It was later renamed Homes and Communities Agencies, later English Partnership, and later Homes England. None of these successors were architecturally as influential as MKDC.

The exhibit was about half the size of 'Energy World' and comprised only 25 homes. The buildings were advertised as 'some of the most energy-efficient designs available today'.[72] Given that the exhibit was sponsored by the privatised electricity companies gathered in the Electricity Association and by oil firms such as Shell, the motto was clearly at odds with the sponsors' interests.[73] Unlike in 'Energy World', energy saving figures were not published in the catalogue, and the energy saving goal was largely rhetorical. The lack of vision was also noted by contemporaneous critics who described the exhibit as 'well built, well insulated, well-mannered and, well, a bit ordinary',[74] or, less polite, 'a bit of a damp squib [that] never worked and never got off the ground'.[75]

In design terms, 'ordinary' mostly meant neo-historical, as by the 1990s a postmodern pastiche of historical styles — Tudor, Georgian, Edwardian — was well established among average homebuyers. The Yeoman Cottage, designed by the firm Medina Gimson, exemplifies this trend. The stately two-storey building with four bedrooms and 181 m^2 dwelling space was designed in a neo-Tudor style with a half-timbered aesthetics. However, it is anything but a cottage, and, in terms of space per person, far too large to correspond to the medieval Wealden hall houses it claims to have been inspired by.[76] The building is made from a softwood timber frame structure and clad with bricks. With a *U*-value of 0.23 W/m^2K the walls are well insulated. Unlike most 'Homeworld' or 'Energy World' buildings, it does not contain a sunspace or any energy-saving technological devices.

The limited ambition of fuel-industry sponsored eco-architecture is embodied by the Future House, one of the most discussed contributions. It resulted from a Royal Institute of British Architects (RIBA) competition won by University of Brighton students Ian McKay and Duncan Baker Brown (Fig. 25). Both later founded BBM architects and specialise in low-carbon architecture and retrofit. The two-storey cottage with a zinc shed roof has a charming, individualistic aesthetic and includes popular energy saving features of the time: a south-facing glazed sunspace, solar water heating, and photovoltaic panels. The building also features well- insulated walls — concrete block and brick at the ground-floor level and block and timber cladding on the first floor, and a south-facing 'solar-control trellis' of deciduous vines providing shade only in summer, and adding a hippie aesthetic.

In contradiction to the architects' focus on solar gains and energetic sustainability, the RIBA Future House was instrumentalised to promote fossil oil. The Future House contained an oil heating system, and oil, given the large number of fossil-fuel related sponsors of the exhibit, was widely praised in the catalogue. A half-page article next to Future House description, commended oil for its 'economy, efficiency and versatility', and low running costs, noting that 'in real terms oil is back to its low price of 1972' (Fig. 26). This was complemented by a two-page advert that promoted the Future

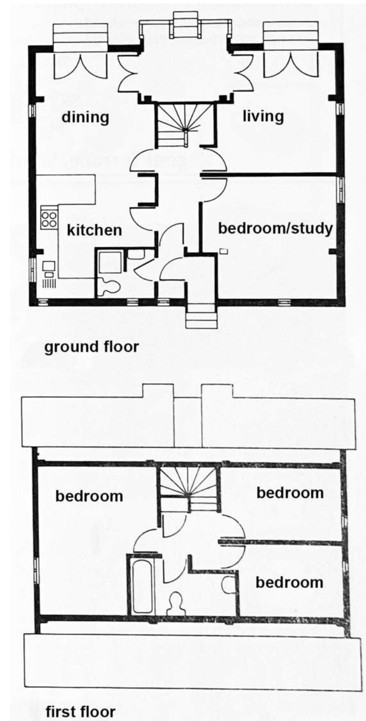
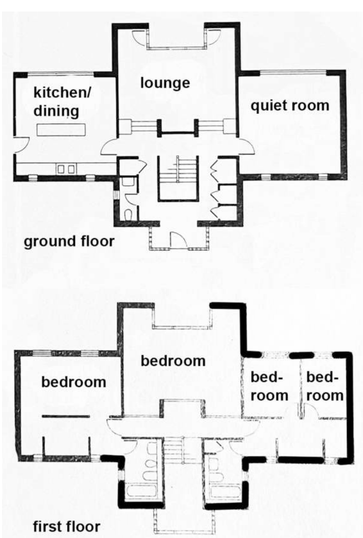


Figure 16.
'Self-build house' plan, 1986, author's drawing based on MKDC, *Energy World – Official Guide* (1986), p. 81

Figure 17.
Pilkington House, 1986, designed by Derek Walker, photographed by the author, 2024

Figure 18.
Pilkington House plan, 1986, author's drawing based on MKDC, *Energy World – Official Guide* (1986), p. 25



House under the title, 'Open your Eyes to Oil'.[77] In this respect, the 'Future World' exhibit became a precursor of greenwashing rhetoric that was to influence the discourse on 'ecological architecture' to date.

Towards a metrics for ecological design

Perhaps the most long-lasting outcome of the attempts to marry ecology and economy in Milton Keynes was the move towards a metric for ecological design. 'Energy World' introduced the Milton Keynes Energy Cost Index (MKECI), a computer-generated index to determine energy use of all houses in the exhibit — not actual fuel use, but fuel efficiency along the lines of the 'miles per gallon' measure for cars. This informed the UK's National Home Energy Rating scheme (introduced in 1990) and the Standard Assessment Procedure (introduced in 1995) used to date in building regulations and for Energy Performance Certificates (introduced in 2007).[78] The parameters, calculation of delivered energy in kWh/m^2 as well as primary energy use, are still in use to date.

MKECI was vetted and supported by the Hertfordshire-based Building Research Establishment (BRE), at the time a national laboratory (privatised in 1997). It thus informed the Building Research Establishment Environmental Assessment Method (BREEAM), one of the oldest and most popular methods of assessing sustainability in the construction industry. The Milton Keynes experience was a major input for the establishment of BREEAM in 1990.[79] The MKECI was calculated based on standard occupancy, heating temperature of 21°C in living areas, and insulation figures for floor, walls, roof, and

Figure 19.
The Gaswarm Windsor, 1986, designed by Hutchinson, Locke and Monk for British Gas, photographed by the author, 2024

Figure 20.
The Multitherm Easybuild House, 1986 photographed by the author, 2024

windows, as well as parameters such as solar orientation/overshadowing, draught proofing, and heating system.[80] The index measures the total annual fuel cost per square metre of floor area (heating, hot water, and electricity) in British pounds, although it was mostly used as an abstract figure to compare different designs rather than an indication of actual cost.

An index figure of 120 was considered good, corresponding to that achieved by the recently completed Pennyland houses monitored by the Open University. UK building regulations at the time corresponded to an index figure of slightly over 170, while those in other countries were significantly stricter: West Germany 140, and Norway, Sweden, and Finland below 100.[81] Particularly interesting in that respect is the comparison of MKECIs and *U*-values for the 'Energy World' buildings (Table 1). While all *U*-values are significantly better than those mandated by the building regulations at the time — this was mandated in the design brief — there were significant differences. This suggests that few designers and developers had a systematic approach to energy economy, and that for many of them energy saving was not the first priority. There was also no clear correlation between construction technique (timber frame vs cavity wall) and effectiveness of insulation — possibly the thickness of the fibreglass pads was all that counted. And there was no particular correlation between sunspaces and low index values; the buildings with conspicuous, south-facing conservatories did not per se score lower than the average of 83; for example, the DFW Golding House at 86, the Laing House at 81, or The Eclipse 2 at 85.

Most houses had a MKECI between 70 and 100, see Table 1. The most energy inefficient houses with the highest MKECI, not entirely surprisingly, were two buildings designed by an energy provider that also acted as a developer, East Midlands Electricity: 'The Langdale' at MKECI 119 and 'The Marlborough' at MKECI 117. In contrast to most other 'Energy World' buildings, the two unspectacular pitched-roof houses were not heated by gas but by an all-electric system with the evocative name 'Economy 7'.[82] As the *U*-values for wall and roof are about average and only that of the floor in the high range, it is likely that the electric heating accounts for the high energy price; *honi soit qui mal y pense*.

Conclusion

With over four decades of historical distance, the ecological houses in Milton Keynes presents a mixed legacy. The three architectural exhibits still stand out as high-profile events that brought the discourse on ecological architecture to public attention. They raised awareness about the importance of quantifying and publicising energy data such as *U*-values and consumption indexes. They also popularised neo-historical and neo-vernacular design, which remained continuously fashionable among volume-built houses, even though it is not per se more ecological than modernist design. All buildings are still standing and serve their original purposes, and some ecological features have been upgraded to match technological development. However, its impact on a

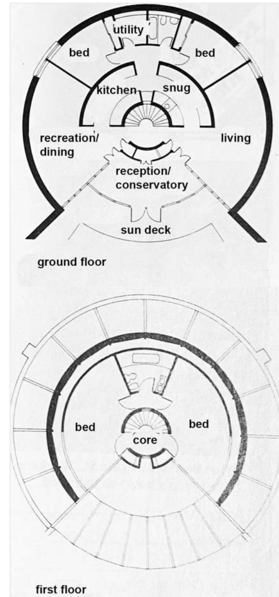


Figure 21.
Round House, 1986, designed by Keith Horn, photographed by the author, 2024

Figure 22.
Round House plan, 1986, author's drawing based on MKDC, *Energy World – Official Guide* (1986), p. 79

more sustainable lifestyle was limited. MKECI accelerated the introduction of the National Home Energy Rating scheme, and helped to set the energy standards in BREEAM. The exhibits also supported a network of academics and practitioners that raised energy awareness. But the projects did not spearhead a swift ecological restructuring of the construction industry.

Several factors contributed to this outcome. The most significant was the fluctuation in global oil prices. As mentioned earlier, oil prices hit an all-time high of over 30 US$ in 1980, but plummeted in the following years due to increasing oil drilling, famously in the North Sea. When 'Energy World' opened in 1986, prices had dropped to less than half that amount. For market-oriented policy makers and homeowners, this reduced the urgency for restructuring and diverted the focus away from ecological themes, particularly in 'Futureworld'. As a result, increased insulation and solar heating provided only marginal financial relief, and the 'monergy' argument did no longer catch. Despite ongoing ecological rhetoric, developers and designers did no longer systematically include energy-saving devices into their design.

The three exhibits show that, for single-family home builders and their clients, financial considerations were the primary driver of energy-saving construction rather than ecological consciousness or a commitment to preserving the earth for future generations. This is openly acknowledged in the reviews, as well as in the calculations, which focused on quick amortisation of energy-saving devices and were quick in dismissing certain measures for being too expensive.[83] This financial focus also led to an almost exclusive emphasis on energy saving rather than, for example, non-polluting materials or renewable resources that were promoted by theorists of ecological architecture at the time. The postmodern and neo-traditional dimensions, very simplified, meant that pitched-roof house with small windows were easier to insulate than modernist glass structures. However, more sophisticated design elements like sunspaces in the long run proved to be too expensive, too complex, and too prone to design faults or inappropriate use by the inhabitants. Once the financial incentive disappeared, so did the focus on energy saving, despite ongoing environmental damage and resource depletion.

Possibly equally significant was the fossil fuel industry's disinformation campaign which misled public opinion, weakened the environmentalist cause, and hindered energy-saving legislation. The industry's concerted effort to undermine energy saving and ecological legislation through misinformation about science and scientists is well documented.[84] The fact that fossil fuel companies sponsored the three exhibits and featured prominently in catalogues and promotional materials certainly did not help the ecological cause. Not only was gas promoted as an 'energy-saving' fuel of the future,[85] but also coal. While the use of coal for domestic heating had been severely restricted in the Clean Air Acts of 1956 and 1968, it continued to be promoted as an atmospheric home-making device (see the advert 'real fires start with British coal' in the *Energy World Catalogue*, Fig. 27). Effectively, coal was only banned in 2020.[86]

A comparison of the three exhibits shows that the influence of fossil fuel companies increased as welfare state institutions declined and energy providers were privatised. In 'Homeworld' and 'Energy World', MKDC still to a

Figure 23.
Super-insulated Neo-Tudor homes on Calewen, 1985, designed by Feilden Clegg, photographed by the author, 2024

Table 1. Energy World Houses, sorted by quality of insulation (worst to best), compiled by the author based on MKDC, *Energy World – Official Guide* (Milton Keynes: MKDC, 1986).

Plot No	Name/ Builder	Architect	m^2	bed-rooms	Structure cw= cavity wall from concrete blockwork/ brick	*U*-value wall (W/ m^2K)	*U*-value floor (W/ m^2K)	*U*-value roof (W/ m^2K)	MKECI
26B	Studio 21/AG Denson/ W Watson Builders	Trevor Denton Wayland Tunley	45	1	cw	0.40	0.45	0.25	110
14B	CP Roberts	John Bonnington Partnership	65	2	cw	0.36	0.24	0.25	104
15	Laing Homes	Lang Homes Design Dpt, with Charter Partnership Bedford	110	4	cavity wall with brick outer leaf, concrete block inner leaf	0.35	0.37	0.26	80
15	Laing Homes	Charter Partnership	74	3	cw	0.35	0.37	0.26	42
21B	Roan House/ Wimpey	Wimpey	143	4	brickwork, timber frame	0.35	0.45	0.28	94
22A	The Yorkshire Salvesen Homes	Nick Lloyd of Michaelis Brandon, London	150	4	cw	0.35	0.38	0.23	68
22A	Salvesen	Nick Lloyd			cw	0.35	0.38	0.23	68
23	'Self-Built House'/ Constructive Individuals	Phil Bixby, London	120	3	timber frame	0.34	not specified	0.29	68
14A	DFW Golding	Andrew Ogorzalek/ PCKO Architects	116	4	timber frame	0.32	0.53	0.23	86
21E	Scan Select	Trevor Denton Wayland Tunley	165	4	brickwork, timber frame	0.32	0.65	0.25	98
26A	Limited Addition Home/ Erostin Homes	Wigfall Group Practice	85	2	cw	0.31	0.44	0.22	95
26A	Limited Addition Home/ Erostin Homes	Wigfall Group Practice	95	3	cw	0.31	0.44	0.22	97
26A	Limited Addition Home/ Erostin Homes	Wigfall Group Practice	105	4	cw	0.31	0.44	0.22	89
2	Hughes Homes	ECD Partnership	188	4	cw	0.30	0.20	0.25	76
6	Scan Select	Trevor Denton Wayland Tunley	148	4	cw	0.30	0.37	0.25	81

(*Table continued*)

Table 1. Continued

Plot No	Name/ Builder	Architect	m^2	bed-rooms	Structure cw= cavity wall from concrete blockwork/ brick	*U*-value wall (W/ m^2K)	*U*-value floor (W/ m^2K)	*U*-value roof (W/ m^2K)	MKECI
8	Broseley CDA Low Energy House/ Broseley Homes with Copper Development Association	ECD Partnership	130	4	cw	0.30	0.25	0.24	70
22B	The Cherwell/ Countryside	Countrsyde Porperties/ Solid Fuel Advisory Service	151	4	cw	0.29	0.23	0.23	99
5A	The Thorncraft Bungalow/ AR Wise	David Gabriel	131	3	cw	0.29	0.33	0.15	73
27	S&S Homes	Max Lock Easton Perlston & King	109.4	3	cw	0.29	0.47	0.23	80
19	Starter Home 2 Bedrooms K Philips Limited	David Tuckley, Buckinghamshire	57	2	cw	0.28	0.43	0.21	80
19	Starter Home 3 Bedrooms/ K Philips Limited	David Tuckley, Buckinghamshire	85	3	cw	0.28	0.43	0.21	80
16B	Eclipse II 2 Bedrooms/ Persimmon	David Tuckley Associates	55	2	cw	0.28	0.49	0.23	85
16B	Eclipse III 3 Bedrooms/ Persimmon	David Tuckley Associates	55	3	cw	0.28	0.49	0.23	98
22D	The Round House/ KC Developments	Keith Horn, London	200	4	cavity wall with two brick leaves	0.28	0.42	0.22	85
5B	Solstice/ John Mowlem	Phippen Randall & Parks	159	4	cw	0.28	0.32	0.25	100
10	Hosby House	The Generation House/ Hosby House	215	4	brickwork, timber frame	0.27	0.19	0.20	79

Plot No	Name/ Builder	Architect	m^2	bed-rooms	Structure cw= cavity wall from concrete blockwork/ brick	*U*-value wall (W/ m^2K)	*U*-value floor (W/ m^2K)	*U*-value roof (W/ m^2K)	MKECI
22C	The Senator/ Barrat	Peter Farmer	154	4	cw	0.27	0.48	0.25	94
25	The Langdale/ East Midlands Electricity	Prowting Homes	100	3	cw	0.27	0.49	0.25	119
26	The Marlborough/ East Midlands Electricity	Prowting Homes	130	4	cw	0.27	0.49	0.25	117
4	Pilkington	Derek Walker, MK	150	3	cw	0.26	0.43	0.18	82
1	C.*P*. Roberts	John Bonnington, St Alban	155	4	cw	0.25	0.24	not specified	102
21C	The New Tudor/ Buildform Ltd	ASPP John Bailey, Surrey	125	4	timber frame	0.23	0.28	?	92
7	Multitherm Easibuild	David Sim, MK	308	3	cavity wall with brick outer leaf and in-situ inner leaf	0.22	0.18	0.17	62
11	The Pailton/ Stepnell Ltd with SIAB Sweden	Nilsson Associates	142	3	cw	0.22	0.21	0.18	61
17	The Gaswarm Windsor/ British Gas/ Erostin Homes	Hutchinson, Locke and Monk, Sheffield	137	4	cw	0.22	0.39	0.17	96
18	The Gaswarm Sandringham/ British Gas/ Erostin Homes	Hutchinson Locke and Monk	126	3	cw	0.22	0.37	0.17	83
16A	Llewellyn Group	Llewellyn Group	90	3	brickwork, timber frame panel	0.22	0.25	0.23	60
24	The Solaire/ Haslam Homes	Feilden Clegg	112	3	cw	0.22	0.29	0.24	73
12	Hedlund Swedish Houses	Hedlund Swedish Houses	140	3	timber frame (prefabricated), bitumen impregnated fibreboard	0.20	0.20	0.20	94
20	The Abbey National House	Hobbs Architects	150	4	timber frame and cavity from brick/blockwork	0.20	0.22	0.18	62
21A	Dow Construction/ Guildway/ Robinson&White	TRADA			timber frame and cavity from brick/blockwork	0.20	0.23	0.19	69
19	The Gaswarm Balmoral/ British Gas/ Erostin Homes	Hutchinson Locke and Monk	104	3	cw	0.17	0.37	0.17	72.7

(*Table continued*)

Table 1. Continued

Plot No	Name/ Builder	Architect	m^2	bed-rooms	Structure cw= cavity wall from concrete blockwork/ brick	*U*-value wall (W/ m^2K)	*U*-value floor (W/ m^2K)	*U*-value roof (W/ m^2K)	MKECI
	Calewen Estate (not part of Energy World)	Feilden Clegg			Cw	0.17	0.17		
	Average of all Energy World Buildings					**0.28**	**0.36**	**0.22**	**84**
	thermal requirements of 1981 building regulations					0.60	1.00	0.35	172
	thermal requirements of 2023 building regulations					0.18	0.13	0.13	

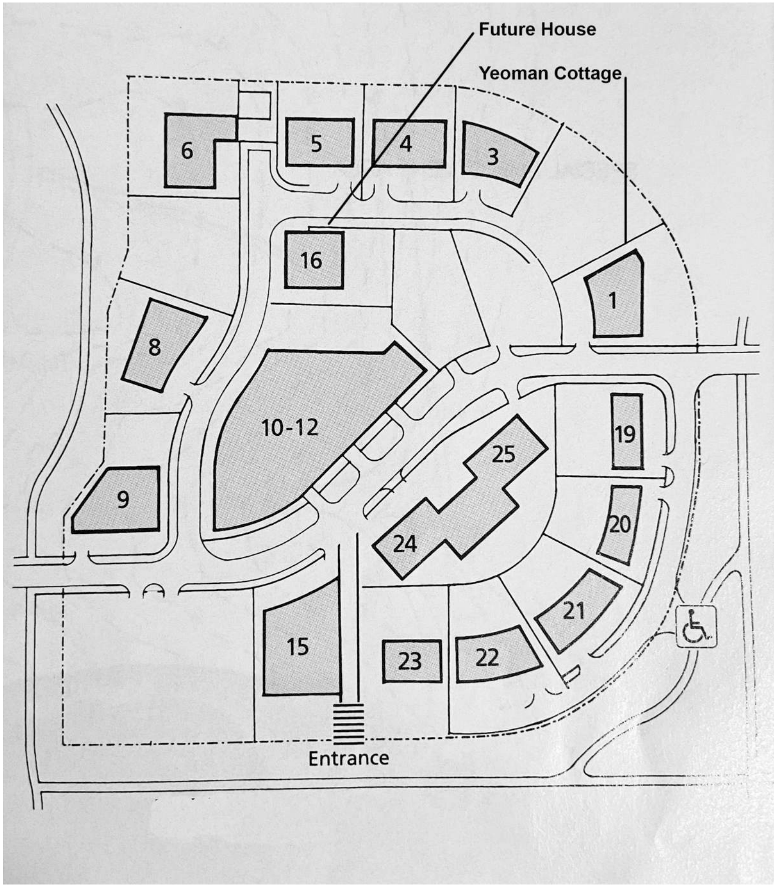


Figure 24.
'Futureworld' plan, author's drawing based on FutureWorld Leaflet, MKCDC Collections, B060:62:01:03

certain extent managed to balance the interests of homebuyers with those of developers and energy firms. Such a balance was less evident in 'Futureworld', which was proudly sponsored by the Electricity Association and featured numerous adverts for the privatised electricity company and oil firms like Shell. From a historical perspective, it is obvious that the main argument used to justify these projects at the time — that environmentalism is compatible with capitalism — was flawed from the beginning. Energy-saving homes held their competitive advantage only for a brief period of rising energy prices around 1980. This spike was an anomaly in a 300-year trend of nearly continuous energy price declines since the start of systematic fossil-fuel exploitation in seventeenth-century Britain.[87] Over these three centuries, the 'invisible hand of the market' consistently sought cheap energy rather than expensive energy-saving technology, except when restricted by protective legislation. It was thus not unexpected that this pattern resumed from the mid-1980s onwards, especially as state institutions that could restrict the market were progressively weakened.

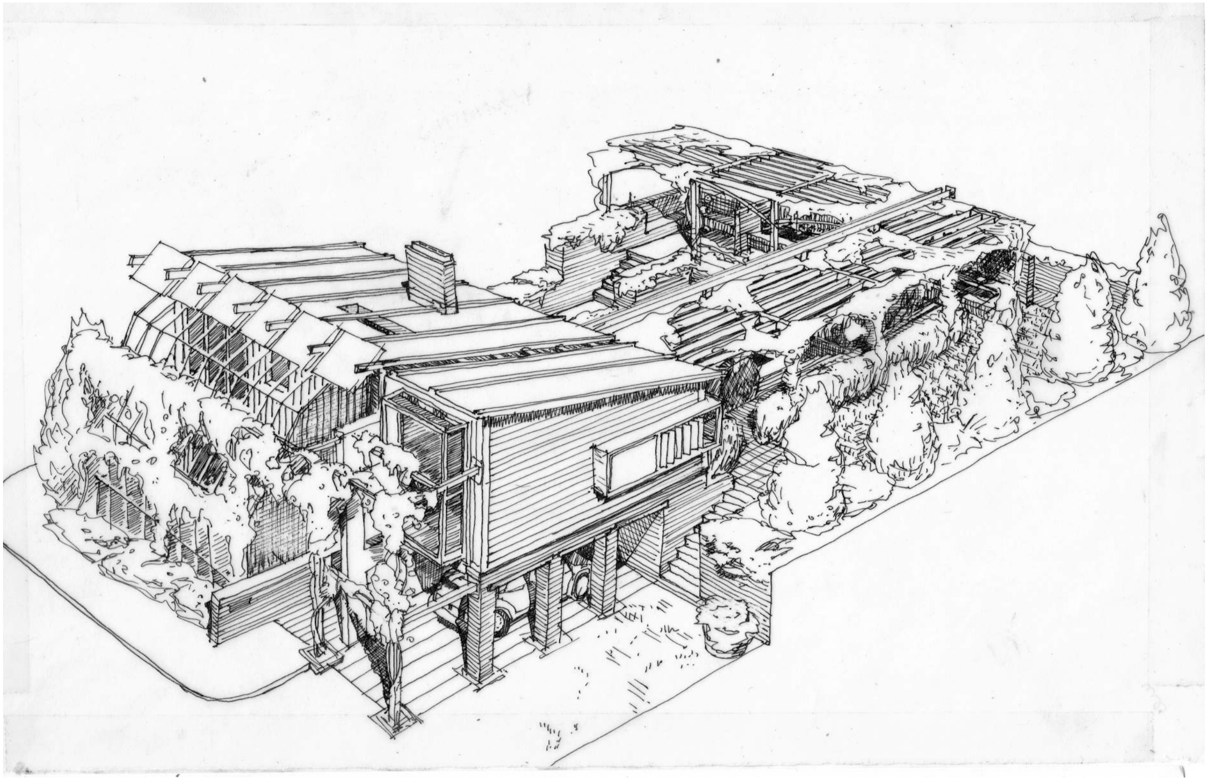


Figure 25.
Future House, designed by students Duncan Baker-Brown and Ian McKay for the ‘Future World’ exhibit, 1994, courtesy of Ian McKay

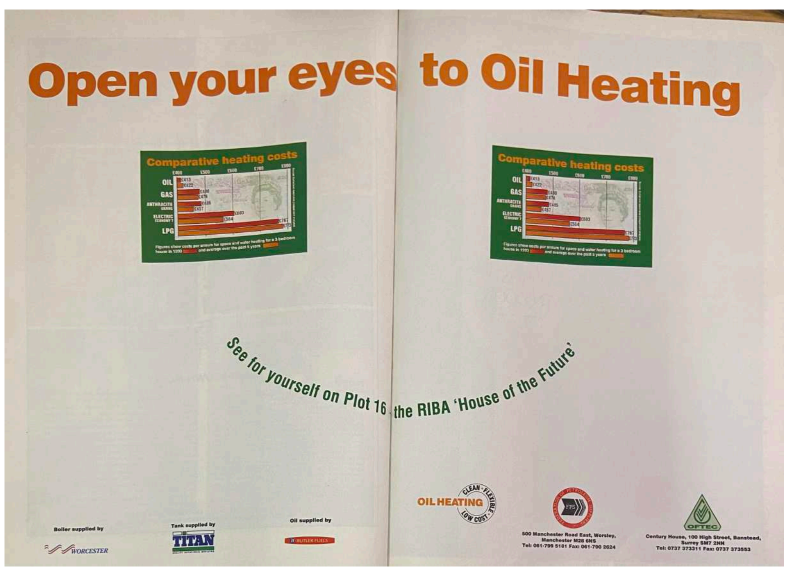


Figure 26.
Double page advert for oil heating in the context of the RIBA competition, ‘House of the Future’, 1994, in *The Futureworld International Housing Exhibit: Official Catalogue*, ed. by Cunningham Associates (Milton Keynes: MKDC, 1994), courtesy of MKCDC Collections, B060:62:01:03MIL

Figure 27.
Advert by Solid Fuel Advisory Service, in *Milton Keynes Energy World*, a special supplement published by What House? Home Finder, courtesy of MKCDC Collections, B060:62:01:01 MIL

Nevertheless, some of the technical standards did become mainstream over time possibly because the cost–benefit balance and the rise in living comfort were favourable even with low energy prices. These were not the sophisticated electronic or computerised devices celebrated as high-tech at the time, which in retrospect appear rather clumsy. Rather, it was double glazing and thick insulation, as well as a general awareness that the form of a building has an effect on its energy efficiency — basic insights, but far from generally shared at the time. The Milton Keynes exhibits thus demonstrate the long and tortuous journey towards establishing minimum environmental standards and creating minimum energy awareness. Milton Keynes ecological architecture therefore has to be seen as an important step in the on-going path towards an architecture that does not endanger the means of livelihood for future generations.

Disclosure statement

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