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New Image and Lower Energy Bills in Manchester Inner-City Neighbourhood

Summary

The Manchester Project involved the energy-efficient rehabilitation and retrofitting of existing housing units plus the construction on vacant lots of new dwellings incorporating energy conservation measures. This project, in the Manchester neighbourhood of Pittsburgh, Pennsylvania, began in the late 1970s and was completed in 1983. Energy use and air quality monitoring were carried out for one year after the completion of the project. It was found that in comparison to detached single-family houses using standard construction, energy savings of 75 to 80% were being realized. Monitoring of air quality showed that in most apartments the indoor air quality was better than standards. This project has set a standard of construction for energy savings in Pittsburgh which people recognize and have used in part in various, subsequent construction projects; however, the project has not been replicated at the same level. A major lesson learned is that a project of this nature requires cooperation at all levels of government.

After innovative revitalization, Manchester has a new image and a new future.

Highlights

- **75 - 80% energy savings over detached standard-construction homes**
- **Reduced fuel subsidies**
- **Renewed use of urban infrastructure**

Aim of the Project

The Manhattan Project, initiated by Carnegie-Mellon University's Institute of Building Sciences and the Manchester Citizens' Corporation, demonstrates and promotes the benefits of inner-city revitalization using energy efficient retrofits for existing housing units and energy-conscious new construction. These benefits include decreased national energy dependence, decreased fuel subsidies, and lower energy costs for low- and moderate-income householders. Movement back to cities not only saves energy for the homeowner or renter through energy-efficient construction but also lowers personal transportation costs due to the close proximity of jobs, services, and entertainment;

improves the urban tax base; increases utilization of urban infrastructure and services; and reduces the need for alternative low- to moderate-income housing and housing subsidies.

The Principle

The Manchester project included rehabilitating abandoned houses, retrofitting existing houses, and constructing new dwellings on vacant land using existing technologies and materials. As a result of energy studies and design guidelines, criteria were established which are aimed at the four critical decisionmaking groups – designers, builders, users, and politicians and financiers.

Designers, by following a few critical guidelines, can add energy efficiency to a home with little additional cost. Homes should be clustered to reduce exterior exposure, thereby saving on heating bills and lowering construction costs. Higher thermal quality of walls, R-25 (U=0,23 W/m^2K), roofs, R-35 (U=0,16 W/m^2K) and windows should be applied. The home should be oriented so that the living areas take advantage of the sun's free source of heat and light.

Builders can ensure the continuing energy efficiency of the home by constructing unbroken thermal, moisture, and wind barriers. Since much of a home's heat loss occurs at the connections between ceilings, walls, floors, and foundation, insulation material should be carefully packed around all such connections. Moist-air barrier continuity is ensured by installing a continuous polyethelene wrapper on the heated side of the insulation with careful overlapping at openings and corners. Wind barrier continuity is provided by wrapping the house in a vapor- porous windbreaker outside the insulated framing and just under the final exterior cladding.

The user must carry out a few activities on a daily basis to benefit from both thermal comfort and cost savings. Close off doors to cold spaces and live in rooms that take advantage of the sun's warmth and light. Invest in a setback thermometer. Choose energy efficient appliances based on the Energy Guide which is attached to new appliances.

Politicians and financiers can contribute to energy conservation, too. Instead of creating suburban housing with public amenities, the provision of innovative financial support will encourage and reward the revitalization of inner-city neighbourhoods. Investment in energy efficient housing helps to protect low and moderate income families from rising energy costs which eat up much of their disposable income.

Workbooks targeted at these four decision-making groups were developed by the project team. These workbooks, which illustrate and quantify the costs and benefits of the revitalization project, contain relevant guidelines and are intended to promote widespread continuation of energy-efficient inner-city revitalization.

The Situation

A declining inner-city neighbourhood in Pittsburgh, could only look forward to being demolished to make way for revenue-producing businesses. In this Manchester area, rising energy and housing costs had caused as much as a 50% reduction in the disposable income of residents. A situation such as this would inevitably lead to higher fuel subsidies and an increase in everyone's tax burden.
Now, after the completion of the Manchester project, the neighbourhood has a new future and is successfully demonstrating the benefits of energy-conscious inner-city revitalization. Homeowners are guaranteed low energy bills, thus making more of their income available for food, clothing and other needs.

Monitoring of energy usage for one year after completion of the project showed energy savings of 75 to 80% compared to detached single-family standard construction houses. Typical energy usage is less than 113.6 MJ/m^2, year (10,000 BTUs $/ft^2$, year) for these homes. Air quality monitoring for this period showed an air infiltration rate of 0.19 air changes per hour (ACH) with a 15 mile per-hour wind. In homes with normal usage and no smoking, the indoor air quality was better than standards. In homes with numerous guests, above-average cooking activities, and smoking, indoor air quality approached unacceptable levels.

The Organization

Carnegie-Mellon University is a privately supported, coeducational university in Pittsburgh, Pennsylvania. It has about 6,700 students and a faculty of about 500 plus a research faculty of approximately 500. The Center for Building Performance and Diagnostics performs research activities in the fields of energy conservation, housing in developing countries, computer-aided design, expert systems, design sciences, building climatology, building performance and diagnostics.

The Economics

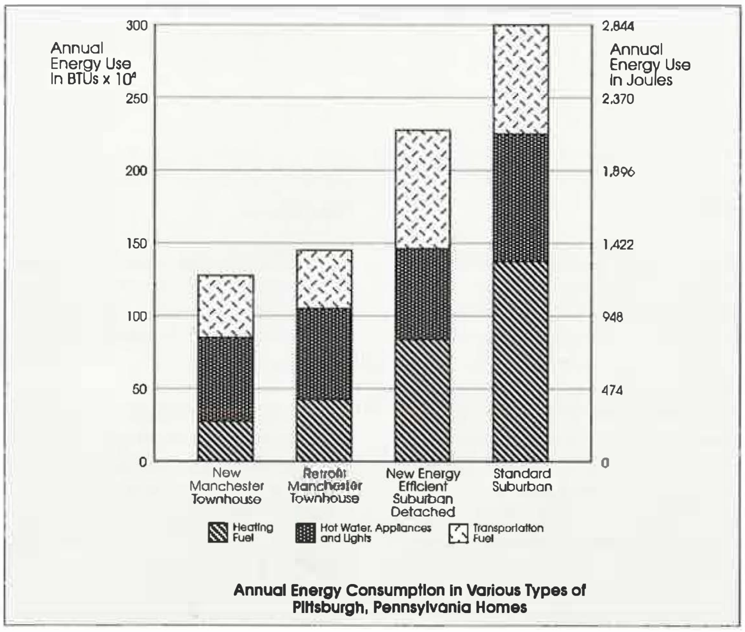
The studies by Carnegie-Mellon show that the greatest long-term energy savings occurs within high-density urban neighbourhoods rather than in existing or future suburban development.

Energy costs for an energy-conserving row house in the inner city with efficient appliances, improved energy-operating practices, and a short commute to work can be as little as one-fourth of those for a standard-construction, single-family home in the suburbs with standard appliances, moderate energy saving practices, and a longer commute to work.
Figure 1 shows the energy savings for a new or retrofit Manchester townhouse as compared to a new energy-efficient suburban detached house and a standard suburban detached house.

Monitoring of gas usage in Manchester Project homes showed that in homes where occupants were away during the day and setback thermostats were used to control temperatures, gas bills averaged USD 10 per month. For homes that were occupied around the clock and had numerous guests in and out during day and evening hours, the highest gas bills were about USD 30 per month.

Without energy-saving construction, each unit would have cost USD 70,000. The energy-saving features added USD 5,000 to USD 6,000 per unit, less than 10% of the total cost. Energy saving features and their costs were: a sun porch, USD 3,000; additional insulation to double standard construction

Figure 1. A comparison of one year of energy bills in various types of homes.



requirements, USD 2,000; Tyvek wrap to cut down on air infiltration, USD 1,000; and solar collectors, USD 2,500. Shared walls between homes saved approximately USD 2,000 per home.

The sun porch had no reasonable payback in monetary savings (10 year payback) but it did add quality living space and home value. The doubling of the thermal insulation of walls, ceilings, and roofs, plus the detailed attention to reducing air infiltration, produced energy savings of approximately 50%. The insulation measures had a payback of three to five years and the Tyvek wind barrier a payback of about two years. The solar collectors provided minimal energy savings, with a payback of about 15 years. Clustering, which cut building costs per unit by over USD 2,000, produced a 25 to 30% energy savings through the warmth of shared walls.
In addition to the monetary savings, other benefits of the construction used in the Manchester Project are increased: liveability, improved quality of life, and improved efficiency of energy use.

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* IEA: International Energy Agency
OECD: Organisation for Economic Co-operation and Development

IEA

The IEA was established in 1974 within the framework of the OECD to implement an International Energy Programme. A basic aim of the IEA is to foster co-operation among the twenty-one IEA Participating Countries to increase energy security through energy conservation, development of alternative energy sources and energy research development and demonstration (RD&D). This is achieved, in part, through a programme of collaborative RD&D, consisting of forty-two Implementing Agreements, containing a total of over eighty separate energy RD&D projects.

The Scheme

CADDET functions as the IEA Centre for Dissemination of Information on End-Use Technology Demonstration projects for all IEA CADDET member countries.

This project can now be rpeated in CADDET member countrires. Parties intereseted in addopting this process can contact National Team or CADDET. Demonstrations are a vital link between R&D or pilot studies and the end-use market. Projects are published as a CADDET 'Demo' or 'Result' respectively, for on-going and finalised projects.

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