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SIGNS of RECOVERY

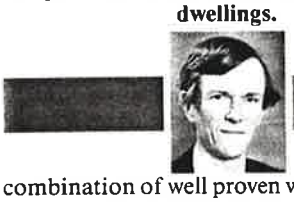
While mechanical ventilation systems with heat recovery for dwellings are well established in some countries on the Continent, they are still rare in the UK. Why is this? One reason is the relatively high cost of the systems. In the UK this leads to long pay-back periods when heat is recovered only from the ventilation air. Another reason is that natural ventilation has traditionally been considered adequate in UK dwellings. Together, these two factors make the prospects for mechanical ventilation look unpromising. But Dave Etheridge of Housing Development explains that the situation might be more favourable in the future because of the increased importance of ventilation to the design of dwellings.

Ideally, while the ventilation rate of a dwelling should be sufficient to produce a comfortable indoor environment and to prevent condensation problems, it should not give rise to excessive heat losses. From a purely technical viewpoint, whole-house mechanical ventilation offers the best solution to this problem. This fact, together with the potential benefits to be gained with gas systems, makes the future look more promising and has led to work at Watson House on the evaluation of two novel integrated types of system.

The potential benefits with Gas

There are several potential benefits to be gained by combined gas heating with mechanical ventilation and heat recovery. The first and probably the most important is the potential for significantly reduced pay-back periods. This potential stems directly from the relatively large amount of additional heat which can be recovered from the flue products compared to heat recovered from the ventilation air alone. In addition, the capital cost of the system can be reduced by adopting a warm-air space heating system where the same ductwork distributes the ventilation air as well as the heating air. Thus pay-back periods can be reduced in two ways.

Another benefit is that the



combination of well proven warm air and mechanical ventilation systems offers a route to high-efficiency (condensing) heating systems with relatively little development effort. Warm air systems are ideally suited for mechanical ventilation and offer other advantages in modern, well-insulated dwellings. One of the systems under evaluation is, quite simply, two commercially available systems joined together.

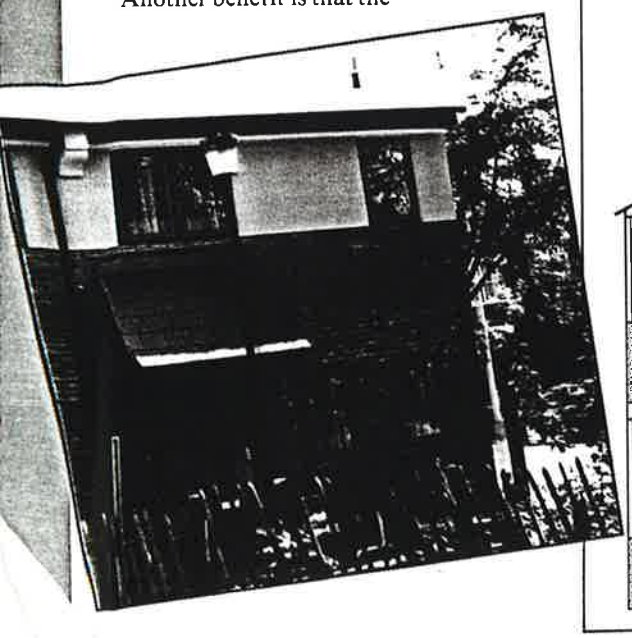
There are also benefits to be gained from the installation aspect. Flue heat recovery means that the flue is fan-powered with consequently increased freedom of appliance siting.

As far as the customer is concerned the main benefits will be those normally associated with mechanical ventilation plus the reduced space heating costs. The benefits of controlled ventilation might be sufficient to justify a greater initial outlay on a heat recovery system in much the same way that double glazing is popular because there are additional benefits to energy conservation.

In view of the above, evaluation of heat recovery systems was accomplished by carrying out tests on systems that were considered likely to be most suitable for possible future development.

Integrated Gas Heating and Ventilating Systems

Two systems are currently under evaluation. One is a modified warm air system and the other is a modified mechanical ventilation



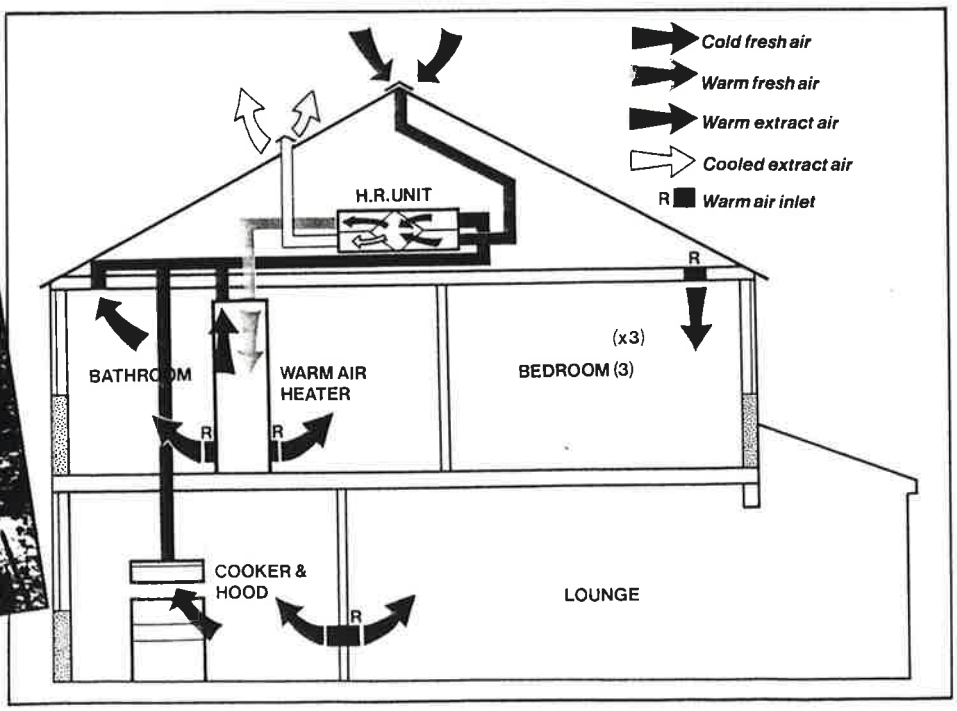


Fig. 1: Left: Test house at Sydenham, S.E. London. Right: Schematic layout of modified warm-air system installed in the test house.

system. These represent two likely routes to obtaining integrated heating and ventilating systems. Both adopt the principle of reducing the pay-back period by maximising heat recovery and combining the roles of distributing heat and ventilation air.

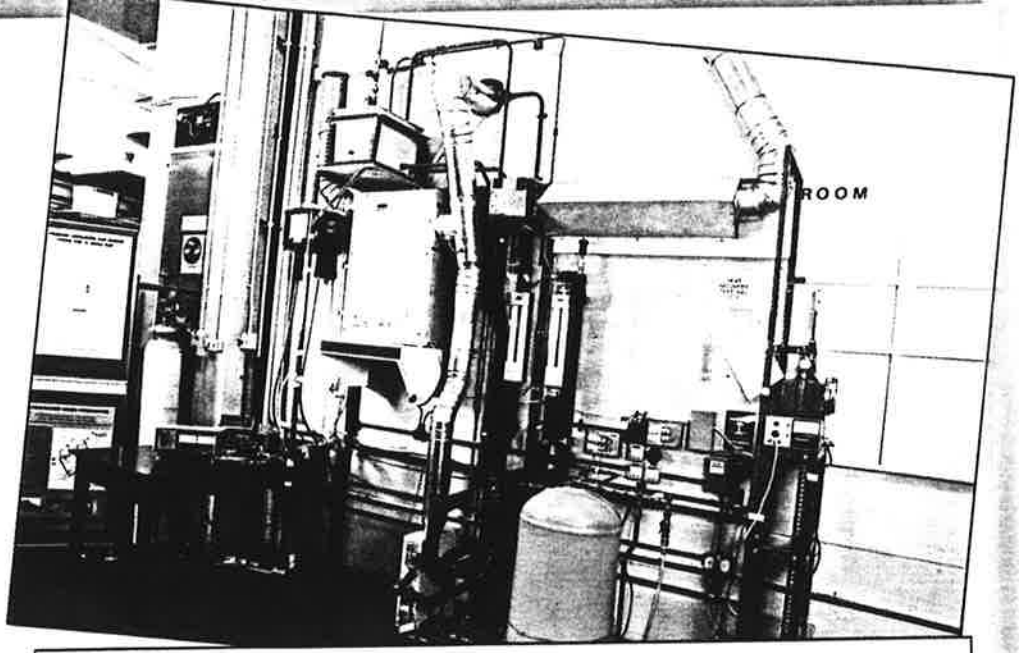
The modified warm air system is shown in Figs. 1 and 6. It consists of a J & S Modairflow Maf/V1 system and a Flakt Rexovent heat recovery unit and cooker hood. Normally the warm air system would take in air from the loft through a short duct; to combine the two systems only requires the connection of this duct to the supply duct of the heat recovery unit. The heated fresh air is then distributed throughout the house by the existing warm air ducts. Two extra ducts are, however, required for the cooker hood and bathroom extract. Other points to note are the need for a condensate drain (the heat recovery unit effectively turns the air heater into a condensing appliance) and a safety device in the flue. For the current system a pressure-sensitive device based on standard practice was developed.

The modified mechanical ventilation system is shown in Fig. 2. It is based on a very compact ventilation/heat recovery unit (Flakt Rexonet) which incorporates a cooker hood and occupies the space of a kitchen cupboard. Space heating is provided by a water coil in the supply air duct. A circulator powers the coil and the domestic hot water cylinder. An important point to note about this system is that it is only suitable for dwellings with design heat losses below about 2.5 kW. The reason for this is simply that a limit to the heat supply is set by the flow rate of the supply air. The system is therefore primarily intended for small flats and needs to be compact. It is actually not far removed from a 'heat centre' as it provides all the heating requirements, eg space heating, hot water, cooking.

Modified warm air system

The performance of the system has been investigated in an unoccupied house in South London. Fig. 3 shows examples of heat recovery rates obtained with a low extract rate and how they vary with outdoor temperature. The heater's effective space heating efficiency is shown by the right hand axis which shows that values above 90% can be achieved; this is partly due to the latent heat recovery from the flue products. An interesting feature is that the heat recovery rate increases in colder weather because the outdoor air is used directly as the heat transfer medium. With a condensing boiler the situation is not so straightforward because an intermediate heat transfer medium is used (ie water) and the heat recovery rate is not necessarily at its maximum when it is most needed.

One problem which is often found with energy conservation is ensuring that a theoretical saving actually materialises in practice. For example, the heat released during cooking will not necessarily lead to a reduction in the space heating load. To do this it has to be sensed by the control system (thermostat). One advantage of the present system is that this problem is automatically accounted for. All heat recovered is distributed through the house in the same way as the heat supplied directly by the heater. It is possible to demonstrate energy



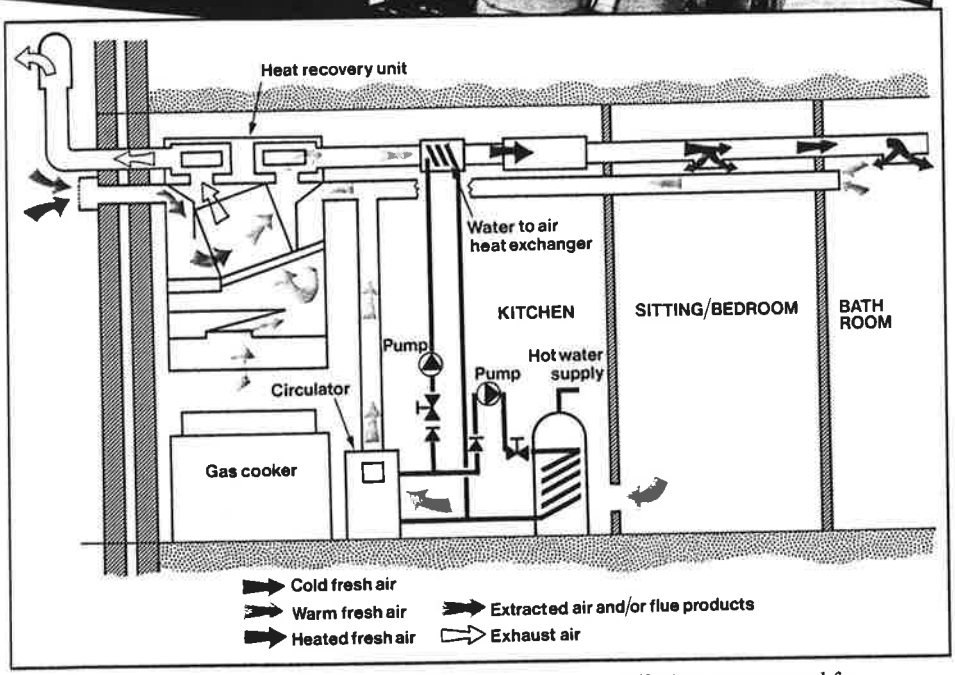


Fig. 2: Top: Laboratory rig showing modified mechanical ventilation system used for technical evaluation. Above: Schematic diagram of laboratory rig.

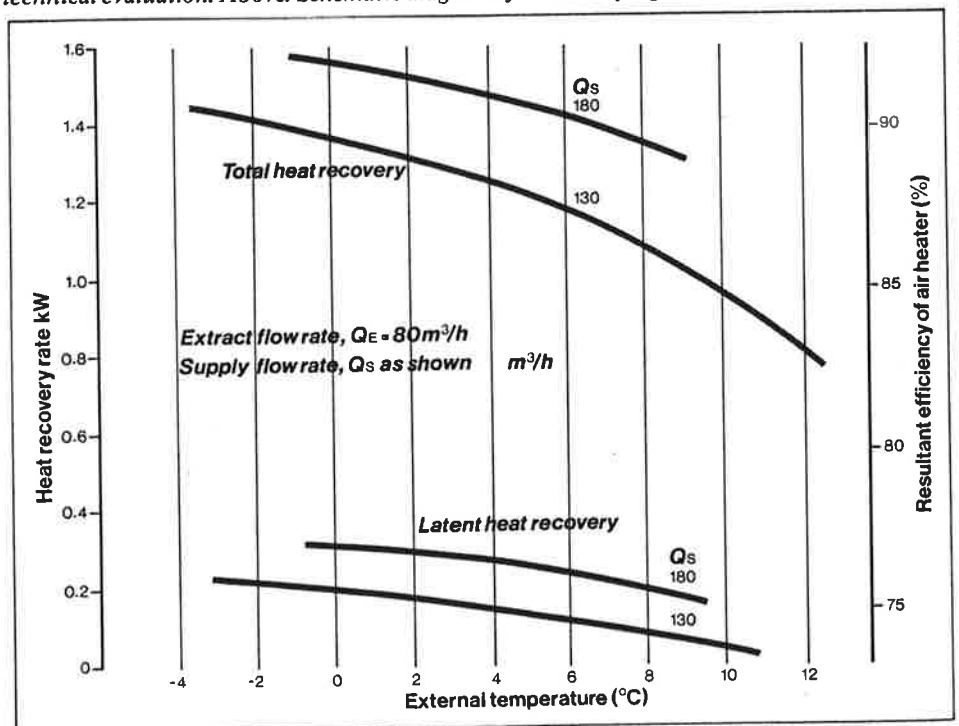


Fig. 3: Experimental results from modified warm-air system showing how heat recovery rates increase in colder weather.

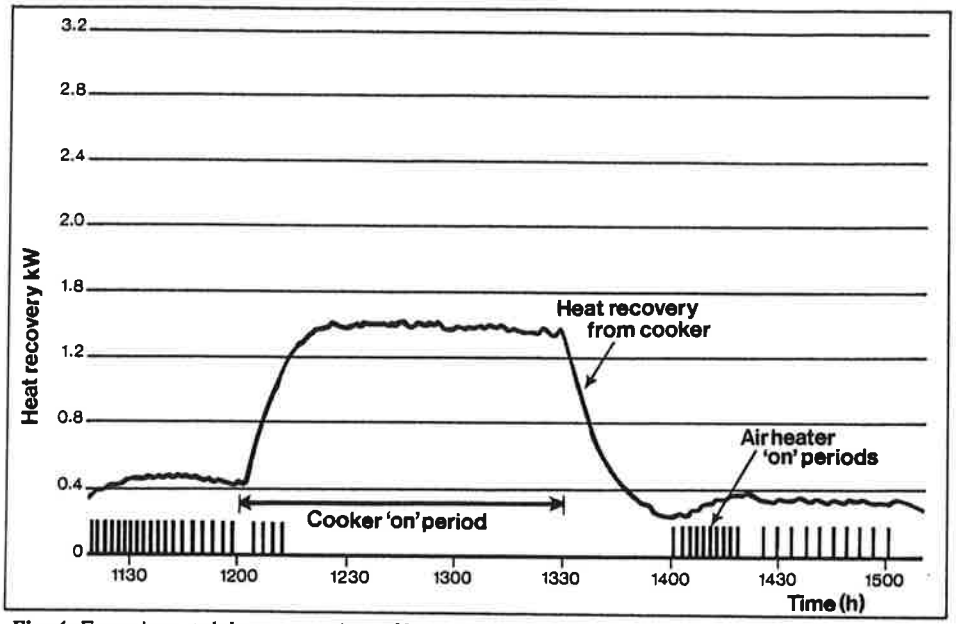


Fig. 4: Experimental demonstration of heat recovery from cooking, reducing air heater gas consumption.

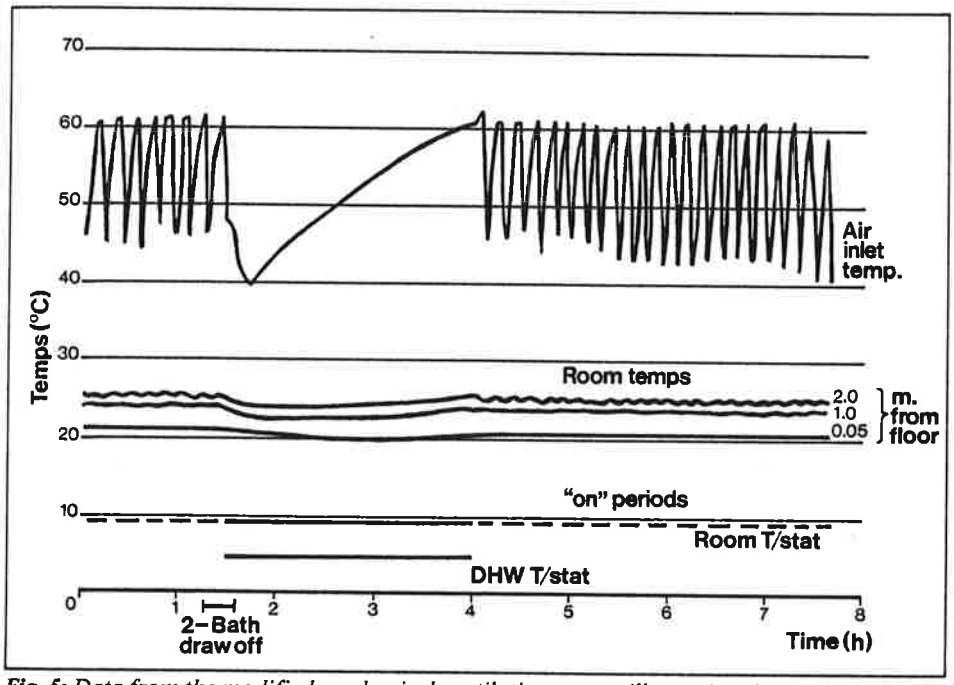


Fig. 5: Data from the modified mechanical ventilation system illustrating the good room temperature control which can be achieved and the small effect of a two-bath draw-off.

conservation in action and this is shown in Fig. 4. It shows the effect of heat recovery from the cooker on the operation of the warm air heater. The effect is rather dramatic as the heater switches off completely. Normally the heater would continue to cycle with reduced 'on' periods but for this demonstration somewhat artificial conditions were used to emphasise the point.

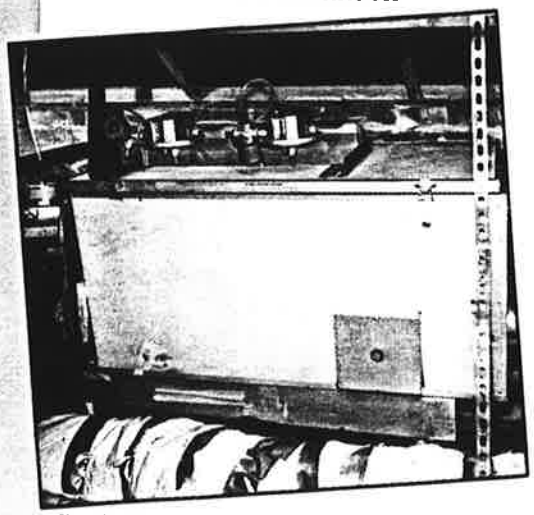


Fig. 6: Heat recovery unit in the attic in the test house.

Modified system

Tests on this system have been carried out in the laboratory using a controlled temperature room to simulate the heating load and to investigate the thermal environment produced by the system. The latter investigation is very important because the system delivers air at high temperatures and low velocities compared to a conventional warm air system. Attention has also been paid to different strategies for control.

Very encouraging results have been obtained. The system should be suitable for design heat losses up to 2.5 kW and could produce an acceptable thermal environment. A very close room temperature control is possible, similar to the Modairflow system (see Fig. 5).

Fig. 5 also shows the effect of a double bath draw-off. Although there is a consequent reduction in room temperature, it is not likely to be significant, especially, as with the present rig, the additional recoverable heat in the air extracted from the bathroom is not included.

Economics of the systems

From a purely technical viewpoint the tests outlined above have been very encouraging. Of course technical performance is not the sole criterion for judging market potential, an economic assessment is equally important, and this will form the next stage of our evaluation.

Several factors have to be considered which are not easy to estimate with confidence, eg total energy savings, incidental cost savings, running costs, manufacturing and installation costs, costs of competing systems. For example, it is very difficult to estimate the energy savings (if any) which result simply from heat recovery from the ventilation air. This depends on the ventilation heat loss which would occur in the absence of the mechanical system and this is not easy to predict. If the dwelling were made "airtight" at the same time as the mechanical system was installed, then savings of this type are highly probable, but the cost of sealing the dwelling would have to be taken into account. Fortunately with gas systems this difficulty is less important because the large savings from flue heat recovery are easier to estimate. In fact, it can be argued that moderate air leakage is preferable so the system need not be operated continuously, thus reducing running costs.

Incidental savings estimation is even harder, but it could be significant in some cases. Maintenance bills arising from condensation damage are a potential source of savings which could be an important factor for local authorities.

A recent economic assessment* by the Building Research Establishment indicated that mechanical ventilation/heat recovery systems are not financially attractive in the UK. However, flue heat recovery was not included in that assessment and it remains to be seen whether systems of the type described above can be justified in economic terms.

Conclusions

There seems little doubt that mechanical ventilation and heat recovery integrated with warm air space heating has much to offer from the technical standpoint. Whether this promise can be realised in commercial terms is still unclear — but it is certainly worth investigating.

Looking further ahead, the customer acceptability of such systems will have to be considered because whole-house mechanical ventilation is a fairly radical departure from the UK tradition of natural ventilation. The fact that the mechanical system is part of the heating system might, however, be beneficial in this respect — and there could be much to learn from experience on the Continent.

* *An Economic Assessment of some Energy Conservation Measures in Houses and other Buildings. BRE, 1985, by J. Pezzey.*

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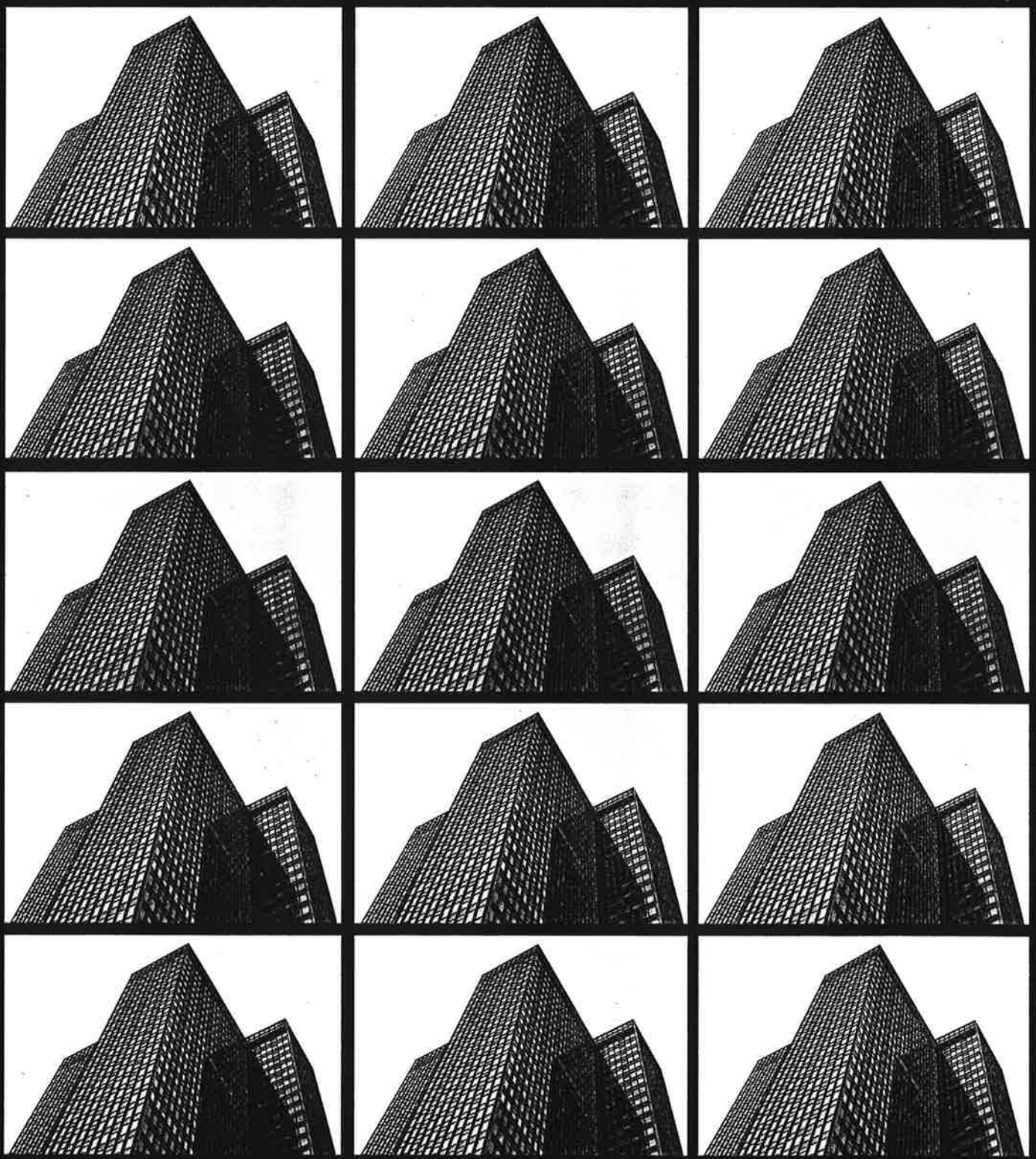

The Energy Squeeze