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Energy Saving and CO_2 Reduction.

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Synopsis

The greenhouse effect is one of those topics in environmental politics which are currently worldwide at stake. There are several national concepts aiming at the diminution of CO_2-emission in order to lessen the greenhouse effect. One of these concepts is the CO_2-reduction programme of the Federal Republic of Germany.

With this resolution, passed on November 7th, 1990, Germany's Federal Government aims high: national carbondioxide emission is to be cut back by 25 per cent by the year 2005. The programme contains new requirements to be met by the building equipment technologies, where mainly modifications of residential heating and ventilation systems are to be considered.

This lecture presents the Federal Government's suggestions and discusses them critically in view of the lack of capacity among the building equipment and construction companies. Besides, it gives the amount of CO_2 that can ce prevented from emitting into the atmosphere through the installation of ventilation systems with heat recovery.

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1. Introduction

With the resolution on CO_2-reduction, passed on November 7th, 1990, Germany's Federal Government aims high: as a step towards the protection of the global atmosphere, an extensive national CO_2-reduction programme is supposed to cut back the carbondioxide emissions in Germany by 25 per cent by the year 2005. These values are based on the 1987 figures so that 25 per cent are the equivalent of 300 million tons of CO_2. The following industries are directly concerned: agriculture and forestry, traffic, new technologies and building and construction. As for the latter, an even higher percentage is to be achieved.

2. CO_2 reduction in the building and construction industry

In 1987 – the basic year of the programme in case – carbondioxide emission resulting from heating systems in housing was roughly 130 tons. Hot-water supply caused an additional 20 tons. These figures show that heating and hot-water supply of residential buildings cause 30 per cent (5 per cent respectively) of the total CO_2 emission load (716 t) originating from the consumption of fossile energy sources. The reason for this relatively high percentage are chiefly the average heating load requirements of residential buildings being higher than 220 kWh/m²a. Peak values of 350 kWh/m²a are not unusual.

Given the environmental problems as well as the energy problems known so far or still to become apparent, this fact is definitely unjustifiable and requires, therefore, efficient and immediate measures.

The implementation of the „heat transfer barrier act", an energy conservation code, was – no doubt – a good and important decision in so far as single family dwellings which were built in accordance with this new resolution produce heating load requirements between 130 and 180 kWh/m²a only. Thanks to this considerable improvement it seems feasible to limit additional CO_2 emission from those residential buildings which are to be built before the end of 2005 to 50 per cent at around 10 million tons CO_2. It is much more difficult, however, to achieve similar results with older buildings. In this area, a potential diminution by 60 up to 65 per cent can only be realized through compre-

hensive measures aiming at the efficient use of energy as well as at the substitution of energy sources.

The heating load requirements of so-called *Niedrigenergiehäuser* („low-energy houses") are again much lower: single- and two-familiy dwellings of that type require only between 50 and 90 kWh/m²a, apartment buildings even less. The typical features of such buildings are clearly improved heat transfer barriers on the one hand and highly heat insulated windows on the other hand. The constant diminution of heat transmission losses comes along with important hygienic problems yet: these airtight windows can function properly only if they are kept closed during the heating season. Since this is hardly practicable, it is indispensable to equip the building with a ventilation system in combination with heat recovery in order to prevent high ventilation heat losses.

Qualified calculations showed that CO_2 emission from such highly thermal insulated buildings, which are equipped with that kind of ventilation system, has decreased by 1 to 2 tons per year. In this context further positive effects can be achieved through small heat pumps. These are capable of substituting fossile energy sources in room air-conditioning systems by means of heat recovery.

3. Energy conservation and CO_2 reduction through mechanical ventilation combined with heat recovery

Since, as described above, the building sector has an enormous share in the total CO_2 emissions, as a consequence, many decisive reduction measures will focus on this sector. Here, heat insulation and corresponding insulating measures are of high importance. However, any further steps towards the reduction of the transmission heat losses alone will not lead to the desired result (see figure 1). Hence, in future calculations,the ventilation heat requirements will have to be taken into account more systematically.

Several studies proved that the ventilation heat requirements of an average 70 - 90 m² apartment lies around 5000 kWh/a, depending considerably on the occupant behaviour with respect to ventilating, of course. Yet already for construction and hygienic reasons, this value (5000 kWh/a) can hardly be de-

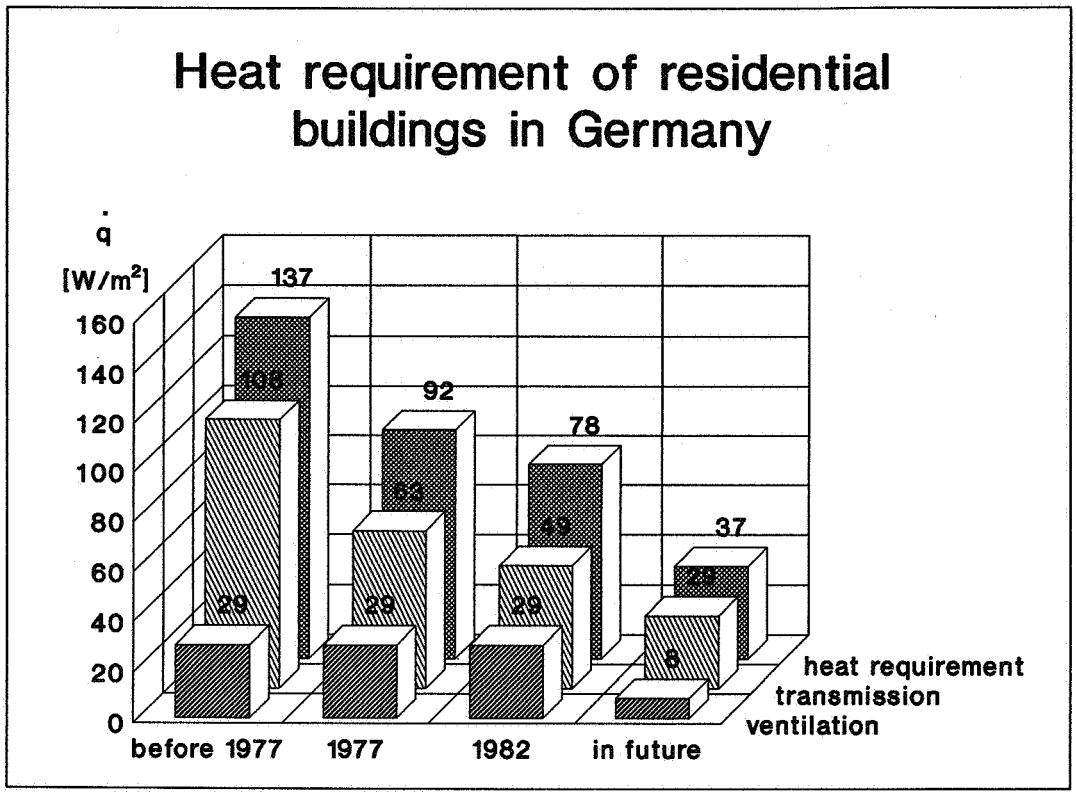

Fig. 1

creased. Such apartments and buildings, however, which are equipped with mechanical ventilation combined with heat recovery and whose heat insulation values correspond to the standard of low energy houses, allow energy saving potentials up to 50 per cent.

Calculations of the HEA* work group *„Wohnungslüftung mit Wärmerückgewinnung"* (building ventilation with heat recovery) show how much CO_2 can be saved with these new standards. (* HEA = *Hauptberatungsstelle für Elektrizitätsanwendung* = Advice Centre for Electricity Application)

The HEA calculations suppose that a 70 - 90 m² apartment shows heat requirements around 15,000 kWh/a including ventilation heat requirements around 5,000 kWh/a. Furthermore they distinguish between

(1) heating systems with natural ventilation

(2) ventilation systems combined with heat recovery through heat exchangers

(3) ventilation systems combined with heat recovery through heat exchangers and heat pump devices.

Oil-fired apartments produce 6094 kg/a CO_2 emissions with system (1), 5243 kg/a with system (2) and 4396 kg/a with system (3), whereas gas-fired apartments show the following numbers: 3854 kg/a (1), 3377 kg/a (2) and 2550 kg/a (3).

The calculations take into account the varying CO_2 emissions of different power stations and imply the amount of CO_2 caused by the ventilator.

As can be seen from these numbers, it is possible to reduce CO_2 emission by 46 per cent with oil-fired apartments and by 34 per cent with gas-fired apartments.

4. CO_2 reduction and investment costs

The Federal Building Ministry starts from the assumption that two thirds of all existing residential buildings dispose of – at least partly – considerable energy saving potentials. With the help of intensified measures to save energy, CO_2 emission from housing could be reduced by approximately 50 million tons per year by 2005.

By substituting oil by gas and replacing the heat generator, CO_2 emission could be reduced by an extra load of 10 to 15 million tons per year.

According to estimations of several Federal Ministries, this saving potential is confronted with investments ranking between 250,000 to 350,000 million marks (US: 250 to 350 billion) though. Suppose out of this volume of investment 90,000 million marks can be covered by the saving of energy costs, 160,000 to 210,000 million marks will still be remaining, i. e. roughly 11,000 to 15,000 million marks per year. The specific investment cost to carry through the reduction programme is estimated to be between 3 and 4 marks/kg CO_2. This means that the houseowner has to be offered considerable incentives to make him invest in the renovation of his heating system.

Here, it should be stressed that the amount to be raised is a one-off investment whereas the CO_2 reduction effect will occur every year.

But not only financing represents a problem on the way to realization of the CO_2 reduction programme. A basic question is whether or not the building and construction industry as well as technical building equipment companies are capable at all to satisfy the immense demand potential resulting from the programme. This branch of industry is already booming as an acute shortage in

housing led to the promotion of corresponding aid programmes. At the same time this branch of industry faces a significant shortage of construction workers, so that at the short term an increase in construction capacity seems out of question.

5. International aspects

In view of the current and future environmental dangers resulting from the greenhouse effect, any effort to reduce CO_2 emission must be supported. The concentration on national programmes seems to be little promising nonetheless. Even if the CO_2 reduction programme of the Federal Government turns out successful in 2005, the 25-%-reduction of CO_2 emission in Germany represents a worldwide diminution of 1,25 per cent only. And if – as is supposed – CO_2 contributes only 50 per cent to the greenhouse effect, this figure is reduced to 0.675 per cent even.

The sole possible and obvious consequence out of these numbers is that only joint international efforts can combat the greenhouse effect efficiently – sooner or later all nations will be concerned.

6. References

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