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FIRST PERIODICAL REPORT ON THE COMMUNITY
ACTION PROGRAMME FOR THE RATIONAL USE OF ENERGY

AND

DRAFT RECOMMENDATIONS OF THE COUNCIL

(Submitted by the Commission to the Council)

RATIONAL USE OF ENERGY

INTERIM REPORT OF SUB-GROUP A.

" THERMAL INSULATION OF BUILDINGS "

CHAIRMAN : R. MOURAREAU

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The Rational Use of Energy

Interim Report of Working Group A
Thermal Insulation of Buildings

1. Introduction

1.1. The terms of reference of the Working Group were to study measures to reduce heat losses from space heating in all buildings, including industrial buildings.

1.2. This subject was tackled the first time at the 4th plenary meeting of the Working Group "Construction Materials" (DG XI), which took place in Brussels on the 19th, 20th and 21st February 1975. However energy experts were only present for a limited number of countries. These countries were Belgium, France, Ireland and the United Kingdom.

1.3. The first full meeting of Working Group 'A' was held on the 2nd and 3rd June 1975 at Brussels.

1.4. Between February and June, there were bilateral contacts between the Chairman and Secretary of Working Group 'A' on the one hand, and the experts in thermal insulation for the following Member States on the other hand : West Germany, Belgium, France, the United Kingdom. For practical reasons, it was not possible to extend these contacts to other Member States.

1.5. From these discussions emerged the following points :

1.5.1. That the principal parameters which affect the thermal performance of buildings are the following three :

- the degree of insulation
- the ventilation
- the heating system.

These three variables are not independent of one another, and the distinction between "insulation" (Group A) and "heating systems" (Group B) is artificial, and in contradiction with the overall approach adopted by all the Member States.

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1.5.2. That the experts in Working Group 'A' see themselves as experts in technical matters alone, who are not competent to propose financial or fiscal measures. However such measures are indispensable if tangible results are to be obtained, particularly in the sector of existing buildings, though they have to be considered in the wider context of overall national economic policy.

1.5.3. That the sector of existing buildings is that in which the potential savings are the largest between now and 1985. However because of technical and economic difficulties which arise when a certain minimum is exceeded, the majority of experts were of the opinion, at the meeting on the 2nd and 3rd June, that it was by dealing with the problem of buildings yet to be constructed that concrete results could be achieved most rapidly. This should provide a feedback into the sector of existing buildings which will enable progress there also.

2. Analysis of the present situation

2.1. It is above all since September 1973 that national administrations have decided upon, or begun studying statutory instruments related to the thermal insulation of buildings.

2.2. Where theyexistedalready, the principal objective of statutory instruments applying to the insulation of buildings was to ensure comfort and hygiene in buildings. The levels fixed were minimum levels. The energy problem has led to a raising of these levels. However it must be noted that even if these new or complementary statutory instruments are at the heart of the effort to achieve savings in the heating of the buildings, they are of a very variable character depending upon the country in question.

2.3. In some cases the standards are advisory, in others compulsory. It goes without saying that the standards are respected when the buildings in question belong to the public sector, or are partly financed or aided by public funds.

2.4. It should be added that these statutory instruments, while they all have the same objective, often have a very different formulation as between one country and another. In addition, if in some cases all types of buildings are covered, in others, only dwellings are affected.

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2.5. In principle, the scientific knowledge and the technical means available as of now, if applied on a grand scale, will allow substantial savings of energy to be achieved in the heating of buildings between now and 1985.

2.6. But from a practical point of view, the implementation of this knowledge and these means is obstructed by a great many difficulties.

2.7. First of all, difficulties related to the buildings themselves. Since the rate of renewal of the existing stock of buildings is of the order of 2% per annum, in 1985 the majority of the stock will consist of the stock already in existence today.
It has even been estimated that, in the year 2000, these buildings will still comprise around 50% of the stock.

2.8. If we consider existing buildings, they can be divided into three large categories :

- buildings used as dwellings
- buildings used by tertiary activities
- buildings used for industrial purposes.

2.8.1. Buildings used as dwellings consist, on the one hand, of individual houses, and, on the other hand, of a wide variety of appartments of different sizes. Each Member State's stock consists of tens of millions of units and the distribution by type is very different between countries
If we consider one case, that of individual houses for example, given the historical and climatic circumstances, the differences in traditional construction techniques and in the economic and social context, the variations in circumstances and in opportunities for action are wide indeed, and thereby lies the problem to be tackled.

2.8.2. Buildings for tertiary uses are also very varied. They include administrative buildings, commercial buildings, buildings used for cultural activities, hospitals, educational establishments, etc. They are classified in different ways in different countries, and have their own distinct properties depending upon their function. For those which can be considered public sector buildings, whether national, regional or local, the possibilities for action vary as a function of the requirements laid down by, and means available to the authority responsible for them.

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2.8.3. Finally, as regards industrial buildings, virtually every case must be the subject of specific study.

2.9. At this point we can already say that in the case of existing buildings, except in the case of individual houses and small appartment blocks, significant results cannot be expected other than by the implementation of measures affecting heating systems and the ventilation.

2.10. Now if we examine dwellings in more detail, another difficulty emerges. Whether concerning existing buildings or those yet to be constructed, an opinion generally put forward is that the investment in better insulation (which could result in a reduction in that for the heating system) should be amortised within a period of five years.

2.11. If we consider the private sector, where buildings are yet to be constructed for rent, the owner can expect to make a bigger profit where the construction is of a higher standard. If we consider existing buildings, the tenant has no interest in undertaking expenditure except where he can be sure of benefitting well beyond the period of amortisation. If, on the other hand, we consider the owner, where as is often the case, rents are controlled, he will have difficulty in passing on the expenditure he incurs to his tenant. It must also be remembered that a significant number of people do not have sufficient resources available to them to envisage undertaking expenditure of this kind.

2.12. To try to overcome these problems, various measures are envisaged by the Member States and some of them applied, but none of them seems to give complete satisfaction, and in any case, they are subject to the wider considerations of national economic policy.

2.13. Thus it is clear that achieving energy savings by improving the thermal insulation of buildings is a very complex problem when examined at the Community-level, because :

- conditions vary from country to country
- the field of application is enormous whether by virtue of its scope or its diversity
- the whole affair is closely linked with other aspects of national policies - economic, social, health policies, etc

3. Actions which can be undertaken, and ways of implementing them

3.1. Actions which can be undertaken can be grouped in three large categories :

- general actions
- actions concerning buildings yet to be constructed
- actions concerning existing buildings.

3.2. General actions

3.2.1. Fixing national objectives

3.2.1.1. As a first stage, each Member State must fix a national objective for reducing energy consumption for the heating of dwellings by improving thermal insulation.

3.2.1.2. This objective should be revised as and when further statistical information, particularly as regards existing buildings, becomes available.

3.2.2. Exchange of information between national administrations

3.2.2.1. So that the Community as a whole can profit from the experience obtained by each Member State, the channels of information should be improved.

3.2.2.2. At the level of the Working Group, the Commission's services are preparing an inventory of measures and actions underway.

3.2.2.3. At the Community-level, the experts have suggested the creation of an office or agency for Community exchanges of information.

3.2.3. Information for the general public

3.2.3.1. At the national level, most Member States have set up an office or an agency for the information of the public. These organisations have sponsored press and television campaigns and film displays.

3.2.3.2. These actions should be put on a permanent basis and followed up. Their impact should be assessed to increase their efficacity.

3.2.3.3. These same organisations should be in a position to give advice to individuals who request it.

3.2.4. Finance

3.2.4.1. An important obstacle is the financing of the necessary expenses to improve the thermal insulation of existing buildings.

3.2.4.2. This is not a problem specific to Group 'A', whose experts in any case, see themselves solely as technical experts. They have suggested that this problem be examined in the context of the overall policy for the Rational Use of Energy.

3.3. Actions concerning buildings yet to be constructed

3.3.1. Technical requirements

3.3.1.1. The national standards or statutory instruments, even if following the same objective, are expressed in different ways and with a greater or lesser field of application.

3.3.1.2. A common language at the Community level is necessary. This has already been the subject of work outside Community institutions. This work should be taken up and completed.

3.3.2. To go beyond existing levels, a certain number of questions must be examined in greater depth. Five points in particular have been identified during the discussions of the Working Group. They are :

3.3.2.1. The establishing of more efficient monitoring and control systems, and the problem of consumer protection.

3.3.2.2. The improvement of building practice and techniques.

3.3.2.3. The problems related to ventilation.

3.3.2.4. Training programmes for building operatives and specialists in the field of thermal insulation, both in the design phase and in the construction phase.

3.3.2.5. Problems related to construction materials.

3.3.3. For each of these topics, a rapporteur has been chosen, who has the task of summarizing the situation in such a way as to permit the Working Group to make proposals for action.

3.4. Actions concerning existing buildings

3.4.1. The modifications which can be made to existing buildings concern :

- the insulation of roof spaces
- the insulation of windows
- the insulation of basement floors or other under-floor spaces
- the insulation of walls either
  - by internal insulation
  - by external insulation
  - by filling cavity wall spaces where they exist.

3.4.1.1. However care must be taken to avoid secondary effects such as :

- condensation
- fire risk (choice of materials)
- reduced sound insulation
- rising damp in the walls (after filling cavity spaces).

3.4.1.2. Research programmes are underway. The communication of the results will be part of the mutual exchange of information between national administrations.

3.4.1.3. In the case of the external insulation of the wall of existing buildings, town planning regulations can be an obstacle.

3.4.2. To evaluate the need for action, surveys have been undertaken, particularly in France, on several thousand existing dwellings. Their purpose was to establish how far these buildings conformed to the standards laid down (for new buildings).
This type of action should be developed and extended to all Member States.

3.4.3. In Germany, a competition along the lines of a "suggestions' box" was launched, to obtain the suggestions of builders themselves on how to improve the thermal insulation of existing buildings, and the costs associated. Again, actions of this type should be undertaken in the other Member States.

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4. Recommendations

4.1. First phase (between now and end 1975)

Based on what has been said so far, the following recommendations should be implemented by the Member States, in the first phase :

4.1.1. - fix national objectives for energy saving in the heating of dwellings,

4.1.2. - create or reactivate agencies or offices for information or advice to the general public, and organise publicity campaigns through the various media,

4.1.3. - undertake surveys to establish the level of thermal insulation in existing dwellings,

4.1.4. - launch a competition along the lines of a "suggestions' box" for the improvement of thermal insulation in existing dwellings, and for the evaluation of the associated costs,

4.2. Second phase (between now and end 1976)

4.2.1. - Apply progressively the standards and/or statutory instruments to tertiary sector buildings in industrial areas.

4.2.2. - Define appropriate actions to increase the levels of thermal insulation above present levels, for buildings yet to be constructed, based upon the results of the terms of reference given to the rapporteurs.

4.2.3. - For existing buildings, define appropriate actions to implement the results of the research, of the surveys, and of the "suggestions' box" competition.

4.2.4. - Establish a Community information agency.

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5. Future work

5.1. Develop a directive to harmonize national regulations for the thermal insulation of buildings.

5.2. Develop directives to harmonize national standards and statutory instruments concerning insulating materials and construction elements, including such aspects as standard testing methods, quality control and their use in construction.

In this area, it should be noted that

- a proposed directive on double windows is being developed by the ad hoc group "glass in construction".
- the secretariat general of the 'CEN' has established an inventory of all the standards now in existence, at the request of DG XI.

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17.6.1975

ANNEX 3 - B

RATIONAL USE OF ENERGY

INTERIM REPORT OF SUB-GROUP B.

" HEATING SYSTEMS "

CHAIRMAN : O. MOROCUTTI

SECRETARY : G. GERINI

RATIONAL UTILIZATION OF ENERGY

Interim Report by sub-Group B on Heating Systems

1. Sub-Group B has the task of examining ways of improving the efficiency of heating systems, with reference to control, maintenance, water heating and combustion. Following the numbering used in the RUE programme, the areas being examined by the sub-Group are as follows:

   1.3. Better regulation of heating and installation of heat meters;

   1.4. Improved burners and maintenance of heating systems;

   1.5. More efficient hot water production;

   3.1. Improved combustion efficiency.

2. The sub-Group met in March and June. At these meetings, the experts agreed to examine first of all the improvements that can be made to existing buildings and systems, in view of the need to act swiftly and the possibility of making a certain amount of progress even in the short and medium term. Accordingly, in the first phase of the sub-Group's work, possible measures relating to points 1.3, 1.4, 1.5 were examined with reference to existing buildings and systems, but it was agreed that the plan of action for point 3.1 would be drawn up at the sub-Group's next meeting in October.

   For new buildings and systems, a start will be made on the examination of measures relating to all four points in the second half of the year. Electric heating systems will be examined separately, also in the second half of the year.

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3. The measures proposed by the sub-Group in connection with points 1.3, 1.4 and 1.5 are set out in the plan of action annexed.

4. The first of these measures concerns the regulation of heating in existing office buildings, public buildings and buildings in general which are occupied for only part of the time.

On average, offices are occupied for one-third of the day (24 hours) and even less over a period of one month (occupied one quarter of the time).

To avoid unnecessary heating of unoccupied premises it would be necessary to adopt a directive requiring Member States to fit heat-generating plant (burners - boilers) with an automatic programming and regulating system to implement the required temperature curve. Maximum and minimum levels on the curve, as well as the time required for raising or lowering the temperature, should be assessed by the Member States. However, it is recommended that the maximum temperature should not exceed 20°C and that the temperature when the building is empty should be the lowest possible compatible with the requirement not to damage internal structures and fittings (water-pipes, calculating machines, etc.) and the need to be able to raise the temperature to the desired level once the premises are occupied.

Present heat distribution systems are not sufficiently stable and, depending on the direction which the rooms face, the size of the windows and so on, there is often a wide range of temperatures inside a building served by a collective central heating system. Furthermore, the occupant of an office where the temperature goes above the maximum recommended level will either open the windows in order to improve ventilation or accept the higher temperature. For all these reasons each room should be fitted with an independent and automatic heat control device. For example, where heating is by radiators, a thermostat valve should be fitted in each room to reduce the flow of water automatically if the maximum recommended temperature is exceeded.

This measure would certainly produce savings. While it is difficult to generalize, since existing buildings are involved and the capital investment costs vary from case to case, it has none the less been estimated that energy savings would be between 10 and 30%. As a result, the capital invested would be covered in as little as one year's operation.

5. Separate action is required in connection with the regulation of heating in existing residential buildings which should be subdivided into buildings with individual, centralized or room-heating systems and buildings with collective central heating systems.

They must be considered in two different groups according to whether they are heated by collective or individual systems because with individual ones the user, knowing what a high price he pays for fuel, can take steps to make the most efficient use of the heating. By contrast, where dwellings are heated by a collective central heating system, the user cannot intervene in this way. It was necessary therefore to examine special systems with a view to reducing energy wastage.

For dwellings with individual heating systems (central or room-heating) the fitting of a thermostat is recommended in a room typical of the dwelling in order to ensure automatic heat control as a function of outside and/or inside temperatures. Examples of such systems are:

- a central regulating device to vary the outflow temperature by means of a two-point thermostat system (which measures the outside temperature and regulates the water outflow temperature, for example by means of a three-way mixing valve, fitted at the installation outlet);

- a regulating device in the form of a room thermostat, or central regulation supplemented by one or more thermostat valves fitted on radiators in the rooms with the most windows.

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For dwellings with a collective central heating system, the quantity of heat delivered into the network must be controlled automatically. To do this, the heat output of the heat-carrying fluid delivered to the network must be adjusted to suit the outside temperature. In addition, considerable savings can be obtained by requiring the installation of individual meters or heat distributors to ensure that each user pays only for what he has consumed. In any event, the meter system adopted must be such as to permit rapid installation at the lowest possible cost.

As a number of variables must be allowed for, it is difficult to estimate the potential energy savings. It is clear that as far as individual heating systems are concerned, everything hinges on the consumer's awareness of the amount of money that he spends on fuel. It should be possible to increase his awareness through a suitable information campaign, the results of which could be quite considerable - potential fuel savings in the region of 20%. For collective central heating systems, capital investment costs and especially the running costs of a meter system (reading, filling, etc.) must be taken into consideration. Consequently, although the economics of the operation are certainly sound, potential savings are likely to lie within a rather broad range, estimated at between 10 and 30%.

6. In accordance with the sub-Group's opinion, it is proposed that the title of point 1.4 be amended to read: "Maintenance and monitoring of heat generators, excluding electrical installations".

The sub-Group has recognized that it would be desirable to require the regular maintenance of heating systems, even though in several Member States not enough is known at present about the range of existing installations (capacity, type, year of manufacture, etc.) and that on economic grounds an enquiry into this will have to be postponed until the periodic surveys are carried out. But, even without the results of such surveys - which will obviously be highly useful in the formulation of each Member State's line of action - provision can be made now for drawing up a plan for inspecting heating systems and overhauling them in order to ensure that existing installations are used as efficiently as possible.

Member States must therefore make arrangements for the progressive creation of teams of trained personnel to carry out the standard operations required to increase plant efficiency. The method to be adopted should be left to the discretion of the Member States.

The plan would have to provide for progressive and balanced inspection of the different installations according to the means and staff progressively available. In any event, it is highly desirable to protect the owner or user of the installation against the risk of malpractice in respect of the cost of compulsory inspection. It is recommended that this matter be looked into and that rules be defined for inspection tariffs.

In any case, heating plant should be inspected and overhauled at least once every three years, beginning for example with the more powerful installations and progressively working down to the less powerful ones. The lower power rating should be fixed at 35 kW[1]. It should be pointed out in any case that there is more likelihood of energy losses being reduced in small and medium-sized installations than in the larger ones since, in the case of the latter, more maintenance and overhaul work has been done with a view to saving fuel.

However, surveys carried out recently in certain Member States have shown that the efficiency of heat-generating plant is in the region of 60% on average. Efficiency can be increased to 80% if the plant (boiler, burner or chimney) operates under the best possible conditions. A considerable amount of fuel would then be saved and the cost of plant maintenance and inspection would easily be covered.

7. The most promising aspects as regards improving the efficiency of hot water production concern the distribution system and the ways in which the hot water is used.

Instantaneous hot-water-production systems must be examined separately for multi-household and single-household dwellings.

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[1] The power of heating plant is defined in this proposal as the product of the amount of fuel consumed each hour in maximum continuous operation and the accepted lower calorific value of the fuel.

The essential difference is that for multi-household dwellings, it is necessary for charges to be worked out on the basis of individual consumption i.e. a hot-water meter ought to enable each consumer to be charged only for what he consumes. In contrast to what happens in most cases at present - where the lump-sum system does not give consumers an incentive to save energy - charging each user for the hot water which he has consumed encourages him to cooperate in energy conservation.

Although for obvious reasons, it is not easy to assess the economics of the operation, it is likely to be worthwhile as meters are comparatively inexpensive.

In addition, although it is impossible to lay down the temperature at which hot water should leave the tap it must be recommended that this temperature be as low as possible, according to what it is used for. In any event, it should not exceed 60°C and an average figure of 50°C would be desirable. This would apply to both multi-household and single-household dwellings.

8. Sub-Group B has had a preliminary exchange of views on point 3.1 but has not gone into any aspect of the problem in detail. Moreover, it was thought necessary to propose that the title of point 3.1 be amended in order to pinpoint the sub-Group's role in the RUE programme. The amended title would read: "Improving the operation and utilization of heating units (boilers)".

9. In general, the sub-Group thinks it necessary for the Member States to prepare an information programme on the proposed measures in order to back up the recommendations and directives which will be adopted in the different areas. This programme should be designed to increase the awareness of technicians and the general public by giving them the degree

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of conviction required to accept the provisions adopted, especially if these provisions are not backed up by financial measures.

Furthermore, this programme should highlight the close relationship between the advantage gained and the costs involved and, lastly, indicate acceptable solutions, avoiding inappropriate ones which while complying with the provisions could produce unfavourable results.

It is recommended that there be an exchange of information and a pooling of the results of action by the Member States.

RATIONAL UTILIZATION OF ENERGY

Sub-Group B on heating systems

Draft action programme

I. Existing buildings

1.3. Better regulation of heating systems

1.3.1. Office buildings, public buildings and partially occupied premises in general

- Calorie-producing installations should be equipped with automatic programming systems capable of achieving and maintaining the temperature curve designed for the building.

- The setting of the maximum temperature, both when the building is occupied and when not occupied, is left to the discretion of the Member States.
  However, it is recommended that the temperature should not exceed 20°C when the buildings are occupied and that, when they are not occupied, the temperature should be kept as low as possible but remain high enough not to damage structures and internal fittings, and to ensure that, as soon as the building is occupied again, the temperature can be raised to an acceptable recommended level.

- All premises should be provided with independent and automatic regulating devices for the heating system. For instance, where a building is heated by a system of radiators, at least one radiator in each room should be fitted with a thermostatic valve capable of automatically reducing the flow of water and thereby ensuring that the maximum recommended temperature is not exceeded.

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1.3.2. Residential buildings

1.3.2.1. Dwelling units with individual heating systems (centralized or separate for each unit)

It is recommended that calorie-producing installations should be controlled by one or more fittings which permit the automatic regulation of the supply of heat in the dwellings as a function of the external and internal temperatures, or either one of these temperatures.

1.3.2.2. Buildings with a centralized heating system

The thermal content of the heat-conducting liquid fed into the heating system should be subject to the outside temperature. Where the technique permits, each individual dwelling unit should be fitted with a heat meter or distributor by means of which the quantity consumed by each user can be determined, so that heating costs can be calculated on the basis of individual consumption.

1.4. Maintenance and control of heat generators other than electric installations

The Member States should draw up a programme for inspecting and bringing up to standard all existing calorie-producing installations having a capacity* of $\geqslant 35$ kW (about 30 000 Kcal/hr), at least once every three years. A lower capacity limit could be set in the event by the Member States. With this aim in view they should immediately promote the establishment of bodies or the training of suitably qualified persons to be responsible for carrying out the specific details of a plan of action.

This proposal is intended to ensure that the inspection and servicing of the heating installations is carried out in an organized manner, in relation to the services available. It is also suggested that the maximum charges for such inspection and servicing should be controlled.

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* The capacity of a heating installation is defined in this proposal as the product of the hourly fuel consumption, under steady conditions, and the lower calorific value of the fuel.

The ways and means by which public authorities could contribute to the cost of modifying installations should be determined by each Member State.

1.5. Increasing the efficiency of water heating systems

1.5.1. Blocks of flats with instant hot water systems

Where the technique permits, each individual dwelling unit should be fitted with a device for metering the amount of hot water consumed by each user so that heating charges can be calculated on the basis of individual consumption.
It is recommended that the water outflow temperature (at the valve) should be kept as low as is compatible with the specific characteristics of the installation and the requirements of the application.

1.5.2. Detached dwellings with instant hot water systems

It is recommended that Member States organize a campaign to inform users of the desirability of keeping the water temperature at the boiler outflow as low as possible, and having the installation serviced regularly.

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Measures in support of the action programme

Member States should establish a specific information programme in order to support the recommendations or directives which will be taken in the different sectors so as to permit each user to know the motives for the action as well as the means available to achieve a reduction in loss and waste of energy.

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ANNEX 3 - C

RATIONAL USE OF ENERGY

INTERIM REPORT OF SUB-GROUP C.

" ROAD TRANSPORT VEHICLES "

CHAIRMAN : G. BRONDEL

SECRETARY : J. EDSBERG

INTERIM REPORT OF SUB-GROUP C "ROAD TRANSPORT VEHICLES"

1. INTRODUCTION

Sub-Group C's main task is to seek energy economies from the improved design and use of motor vehicles. The possibility of more economic space heating for road and rail vehicles is also being considered. The Group is concentrating on the economic and technical aspects of vehicle and engine design, on the rational use of fuels and on some of the factors which influence people's behaviour when purchasing or driving a motor car. The wider aspects of vehicle use and traffic management are being examined by Sub-Group D. Our original terms of reference have been expanded with the approval of the Steering Group to the following six points:

1. Promotion of changes in driver behaviour
2. Better ignition timing and carburettor setting
3. Improvement in design for conventional vehicles and engines
4. Promotion of more advanced types of internal combustion engine
5. Promotion of diesel engines where energy savings justify their wider use
6. Improved thermal insulation and better use of heat in public transport (including rail) vehicles

The Group's membership includes representatives of Government departments, of research agencies and of the motor industry. Our initial efforts have been directed principally to the points most likely to yield useful energy economies in the short term.

2. SUMMARY OF INTERIM RESULTS

A large reduction in energy consumption could be achieved immediately through drastic increases in vehicle or fuel taxation, or by restrictions on vehicle use. Measures such as these, which can impair the quality of life and damage the motor industry, are only likely to be applied during an acute energy crisis.

The recent substantial increase in fuel prices has already aroused public interest in fuel economy which has been reflected in the motoring press and in the increased use of thermostatic fans, improved carburation and other economy features into some recent production models. The Group feels that the most promising way to encourage the rational use of energy in motor vehicles is to inform and exploit this newly awakened public interest.

As far as private motoring is concerned, the consumer should be encouraged to drive his car more economically, to keep it properly tuned and serviced and to choose his next car with economy very much in mind. For economy measures to be adopted rapidly, they must be attractive and financially worthwhile to the ordinary car owner. Fiscal and pricing policies can therefore play an important part in encouraging economy measures and economical cars.

Apart from improvements in driver behaviour, economy measures include:

- those which can be applied to existing vehicles, such as regular tuning and servicing and some energy saving devices;
- those which could be applied to new production models, including improved streamlining, reduced weight, optimized engine and transmission design, and use of certain alternative fuels;
- long-term measures including the introduction of other types of propulsion and the use of unconventional fuels.

A balance must also be struck between improved economy, safety and environmental factors such as noise and pollution. Where safety features in line with US standards have been adopted by American and some European manufacturers, the weight of cars has increased with some corresponding increase in energy consumption. The noisy diesel engine is more economical than the quieterpetrol engine. On the other hand, improved tuning of petrol engines would have important advantages from the point of view both of economy and of reduced pollution.

It will also be necessary to ensure that energy economies on the road are not offset by additional energy consumption in the manufacturing and fuel refining processes.

2.1. Driver behaviour

Uneconomical driving, with violent acceleration and braking, can waste more energy than faulty engine tuning. It has been proved that driving styles affect consumption to a considerable degree; when tests were carried out on one vehicle covering a specific route at a given average speed, it was found that consumption differed depending on the driver, and that such differences could amount to several litres per 100 km, the differences between one driver and another being as much as 50 % in some cases. Drivers would almost certainly improve their economy driving skills if they could measure their own performance. The following methods by which manufacturers could help to improve economy driving performance are being discussed:

2.1.1. Information in the drivers handbook

- standard fuel consumption figures for each make of vehicle based on the test cycle being developped at the ECE in Geneva;
- most economic speed range in each gear;

- other economy advice, such as to have the car tuned and serviced regularly, to use equipment such as choke and heaters correctly, and to keep the tyres properly inflated.

2.1.2. Information in the vehicle

- optimum speed range in each gear marked on the speedometer
- optimum engine speed for economy marked on the revolution counter if fitted
- an economy driving indicator such as a vacuum gauge

The Group hopes that car manufacturers would adopt these or similar measures on a voluntary basis.

2.2. Improved Tuning

Less than half the cars on the road are properly tuned. If the ignition and carburettor on every car were properly adjusted twice a year, an average energy saving of some 5 % would result. Furthermore, emissions of Hydrocarbon and Carbon monoxide would be considerably reduced, giving a major environmental benefit. Regular tuning could save the motorist more per year in fuel costs than the extra charge for tuning, particularly if this were to become a regular part of vehicle servicing. Unfortunately, rapid and efficient engine tuning requires a skill and diligence not always available at ordinary garages . The problem of giving effect to these measures in practice will receive further attention from the Group.

Other features contributing to fuel economy are:

- correct plugs in good condition
- clean air filters
- properly fitting valves
- suitable lubricating oils
- correct engine working temperature
- properly inflated tyres
- brakes which are not binding
- correct compression
- no fuel leakage

How to keep petrol engines properly tuned is one of the most challenging problems facing the Group. There is at present no simple, cheap and reliable test to detect badly tuned engines, but measures suggested are:

2.2.1. Wider use of electronically controlled ignition

2.2.2. Including checks on tuning in the periodic roadworthiness tests in countries which apply them

2.2.3. Including engine tuning in periodic servicing

2.3. Improvements in design for conventional vehicles and engines

Important opportunities for improving vehicle economy will come in the next generation of production cars and it is essential that the consumer's interest in economical design should be stimulated. Without trying to lay down standards for individual factors such as weight, streamlining or engine economy, the Group has indicated how these factors could contribute to the design of a car which would be more economical and not less attractive to the consumer. Equipment such as electronic ignition systems and thermostatically controlled fans which are rather expensive to fit to existing cars can be incorporated in new models at a more acceptable initial cost.

Some factors, such as reduced weight, have most effect on economy in town driving, others such as reduced cross-sectional area and improved streamlining make their most important contribution on the open road. The split between town and open road driving in the Community as a whole is about 50/50 although the ratio varies slightly from one Member Country to another. The Group has not yet attempted to calculate the combined effect of the measures discussed below on energy consumption, although a general figure of 25 % has been mentioned.

2.3.1. Weight

Additional weight contributes to fuel consumption, particularly in town traffic, but more stringent safety requirements have tended slightly to increase weight. Increased interest in economy should encourage manufacturers to make and consumers to buy the lightest car which provides the necessary space, comfort and performance and meets the safety requirements. A 10 % reduction in weight can result in a 5 % energy saving in town and about 2 % on the open road, giving an average figure of about 2 - 4 % for normal use.

2.3.2. Streamlining

The cross-sectional area and the coefficient of drag Cx of a vehicle have an important effect on fuel economy at speeds of 60 kph and over. At present, many production cars are simply "styled" and not rationally designed for minimum drag. Road tests on over 100 makes of small and medium sized production cars have shown that:

- the air resistance absorbs roughly half the energy output at 60 kph and generally more than two thirds at 100 kph, depending on the quality of the aerodynamic design

- the Cx values for ordinary production cars cover a wide range from good streamlining (Cx value 0.35) to very poor streamlining (Cx value 0.69)
- some small compact family saloons are well streamlined, whereas some larger, more powerful cars are poorly streamlined
- the idea that well streamlined cars need a greater weight of metal than poorly streamlined ones is not supported

Clearly, there is scope for substantial improvement in aerodynamic design for many makes of production cars and on average figures of 0.35 - 0.40 rather than 0.40 - 0.50 should be easily achievable.

The estimated energy saving for open road driving due to a 10 % improvement in Cx value 5 % at 60 kph and 8 % at 100 kph, giving a mean figure of 2 - 4 % for normal mixed town and open road driving. Substantially greater savings than these would be possible in some cases. Streamlining could also bring substantial savings for heavy vehicles used on motorways.

2.3.3. Engine and Transmission

High compression ratio engines give increased efficiency but require more expensive high octane fuels, particularly now that the use of lead additives is being more strictly controlled. An economic balance has to be achieved between the energy saved by a high compression ratio and the energy cost of producing high octane fuel.

A petrol engine is most efficient at moderate engine speeds and with a high load factor. Substantial energy savings can be achieved by designing the engine, gears and transmission to keep the engine speed in the most economical mode over a wide range of road speeds and loads.

In view of the speed restrictions currently in force, the reduction of the differences between the ratios of the lower gears and the raising of the fourth gear ratio would enable consumption to be reduced and correct ratios to be achieved both in town traffic and on the open road. A fifth, high speed gear with a suitable driving-axle ratio can reduce consumption by up to 10 % on clearways and motorways.

Existing automatic transmission systems can help to optimise engine speed but are themselves generally wasteful from the energy point of view. However, in the longer term, variable transmission offers possibilities for even closer engine speed control and substantially greater energy savings. The Group intends to study possible energy savings from improved engine and transmission design in greater depth.

2.3.4. Tyres

Radial tyres can save 5 % - 10 % in energy consumption compared with the conventional cross-ply type and are already fitted to most modern cars, but not as yet to many commercial vehicles.

2.4. More advanced engines

Conventional petrol and diesel engines are unlikely to be challenged by other forms of engine for at least 15 years.

2.4.1. Electric motors

The electric motor is seriously handicapped by the weight and bulk of the lead acid accumulator and severely restricted in range and performance. Electrically driven vehicles are substantially less efficient in terms of total energy consumption than petrol or diesel vehicles. The commercial development of an economical fuel cell or accumulator which would overcome these problems is probably many years off.

2.4.2. Other types of heat engine

The Group has discussed the possibilities for energy saving offered by other types of internal combustion and heat engines and from petrol/diesel, electric combinations. Our rapporteur is preparing a more detailed paper.

The Group has observed that conventional oil fuels are so convenient for road transport that the unconventional types of fuel such as hydrogen, methanol etc. might be burned more conveniently and economically in stationary installations.

2.5. Diesel engines

The fuel economy of diesel vehicles (volume of fuel consumed) is related to the driving pattern used and the thermal efficiency of the engine. In an urban environment with frequent stops and starts the saving in fuel consumed may be as high as 50 % of that of an equivalent spark ignition engined vehicle whilst in average mixed traffic a saving of between 20 and 35 % could be expected. High speed use produces less benefit for the diesel car and on motorway journeys (maximum speed 112 kph in UK) the consumption of both spark ignition and diesel vehicles is of similar order. It would

therefore seem reasonable to expect a saving overall of between 25 and 30 % in favour of the diesel vehicle. The main disadvantages of the diesel engine are:

- higher initial cost
- increased noise
- increased weight
- rather sluggish performance.

Speed restrictions have reduced the relative importance of the poor performance, but the cost differential would always exist, even if production were increased to numbers comparable with the petrol engine. Very few types of small diesel engine are available on the market at present, and big improvements in performance or noise reduction are unlikely in the near future.

The promising vehicle types for further conversion to diesel are, firstly, the lighter industrial and commercial vehicles and taxis and secondly, medium-sized family cars in the non-luxury class. The Group is seeking more precise information on how much growth would be available in these sectors.

Favourable publicity could help to draw the consumers' attention to the diesel engine, but his choice is likely to be based on:

- whether the particular car that suits him is available with a diesel engine
- how many miles/kilometres he will have to drive before he can recover the higher initial cost (the pay-back period)
- whether he can fuel and service a diesel car easily.

To encourage the increased use of diesel engines, manufacturers will have to offer a wider range of diesel cars and Governments will have to apply a satisfactory and stable tax policy as between petrol and diesel fuel. If the Community seriously wishes to promote diesel cars, an artificial incentive such as reduced VAT on the purchase price may have to be given.

The Group has discussed the ability of refineries to respond to increased demand for diesel fuel for road transport. The change from the refineries' point of view is probably marginal, would be phased over several years and might easily be absorbed in changes in the use of gas oil for other purposes, such as domestic heating. On the other hand, there is a surplus of petrol at present in most Community countries and as long as petrol is used for road transport, the search for economies in the use of the petrol engine must continue.

2.6. Thermal insulation for vehicles

Thermal insulation is already an important factor in the design of railway stock, particularly in countries with a severe climate, such as West Germany. The Group is examining the scope for further improvement in this field and the possibility of transferring some of the lessons of railway practice to road vehicles, particularly public transport vehicles and to underground railways and tramways.

3. INTERIM RECOMMENDATIONS

In the limited time available for the production of this first report, it has not been possible for the Group to analyse in depth all the information collected from studies in the various Member States and elsewhere.

However, some qualitative judgements can already be made and have led the Group to a limited number of firm recommendations.

3.1. Promotion of changes in driver behaviour

Economy measures must be designed to be attractive and financially worthwhile to the consumer, or they will not be readily adopted.

3.1.1. Car manufacturers should be asked to include more factual information in their vehicle handbooks on how to economise on fuel, presented so as to attract the car-owner's attention and stimulate his interest.

3.1.2. Private cars should be equipped to give the driver a feedback on the quality of his driving from the economy point of view. Two suggested methods are:

- to mark the optimum speed in each gear on the speedometer or on the revolution counter if fitted
- to fit a device, for instance a vacuum gauge to record the driver's performance quite simply as either good, indifferent or poor.

The views of manufacturers should be sought on the most suitable equipment for this purpose. A device to record the actual rate of fuel consumption would be costly and unsuitable for comparing the drivers' performance with optimum fuel consumption over a wide range of driving conditions.

3.2. Ignition maintenance and carburettor setting

3.2.1. The vehicle handbook should contain clearly presented information encouraging car owners to have their vehicles serviced and tuned regularly.

3.2.2. A major effort should be made as soon as possible to develop an economical, quick and reliable standard test to establish whether a petrol engined vehicle is correctly tuned or not.

3.2.3. A major effort should also be made to develop an accurate and economical method for tuning engines which can be adopted by ordinary service stations.

3.3. Improvements in Design for Conventional Vehicles and Engines

The Group is not at present recommending that separate standards should be adopted for the various factors, such as weight, streamlining, engine power and transmission efficiency in the design of a motor car.

3.3.1. However, the Group strongly recommends that all types of vehicle on the market should be submitted to a standard test of fuel consumption and that the results of this test should be shown in the vehicle handbook and be available to prospective purchasers.

The group of experts on the construction of vehicles at the Economic Commission for Europe of the UN at Geneva has agreed such a test in principle and hopes to reach a firm conclusion at the end of 1975. It is proposed that the test should include an urban driving cycle and open road cycles at 90 and 120 kph.

3.3.2. The adoption of radial tyres should be encouraged for all types of vehicle, including commercial vehicles.

3.4. Other Topics

Progress on the other topics in the Group's terms of reference has been outlined in this report but it would be premature to make firm recommendations at this stage.

3.5. Environmental, safety and energy requirements

It will be necessary to resolve the sometimes conflicting requirements of these factors in future vehicle design and road traffic legislation.

4. FUTURE PROGRAMME

In the second half of 1975, the Group proposes to

- study the subjects on which interim recommendations have been made in greater detail,
- develop the other subjects with a view making firm recommendations in a further report before the end of the year,
- consult the motor and oil industries on the implementation of our recommendations.

The Group also proposes to study the complete fuel-engine cycle in order to assess the most rational means of consuming energy in road vehicles. The latter study is expected to continue into 1976.

ANNEX 3 - D

RATIONAL USE OF ENERGY

INTERIM REPORT OF SUB-GROUP D.

" TRANSPORT STRUCTURES "

CHAIRMAN : J. PEARSON

SECRETARY : R. VAN CAMPENHOUT

Rational Use of Energy

Interim Report of Sub-group D: Transport structures

Introduction

1. The sub-group's task is to examine the scope for saving energy within the next ten years by using it more rationally in transport, with special reference to passenger movement in urban areas. The sub-group was also invited to examine energy saving possibilities in urban freight movement, as well as to consider extending its work to include inter-urban transport. But this interim report considers only the question of passenger movement in urban areas. The sub-group's concern is with how vehicles are used rather than with their physical characteristics, which is the field of interest of sub-group C.

2. Before discussing specific energy-saving possibilities in more detail, the sub-group wishes to make a number of more general remarks.

3. By definition, the measures to be examined should consist only of those which would have no significant adverse effect on the economy or on personal welfare. Some of the measures we discuss might be thought by some to involve a reduction in personal freedom inconsistent with the principle of not adversely affecting personal welfare. But this is largely a matter of judgment, and it seemed to us only realistic to discuss these possible measures here.

4. Measures to promote energy-saving often involve costs and may be accompanied by desirable or undesirable consequences in other fields. To take two examples: it might be energy-saving if bus operators ran smaller buses off-peak than during peak periods. But such a policy would involve operators in a number of cost, operating and maintenance problems. On the other hand energy-saving car driving techniques would probably also be safer and slightly reduce noise and fumes. There may be a tendency, in work with a particular objective, in this case energy-saving, to underestimate the importance of the accompanying effects in other fields of the policies advocated- a kind of professional distorsion. We have tried to guard against this, but we are conscious that these effects have not been fully explored.

5. In the field of urban passenger transport the general policies which were being pursued before the new energy situation arose tended already, as it happens, to be of an energy-saving nature, although this was not normally deliberately intended. This applies, for example, to the major related aims of improving public transport and reducing road traffic congestion. What is required from the viewpoint of a more rational use of energy may therefore often be little more than an acceleration or reinforcement of existing lines of action.

6. It is particularly difficult to estimate the likely energy-savings from measures proposed or adopted in our field. This makes it difficult in turn to decide the order of priority of measures, since while it may be possible to estimate their cost it may be most unclear what energy saving they would permit. While it may be possible to estimate how much less energy in total is being consumed in town transport compared with what would probably have been consumed without a whole package of measures, it is much more difficult to distinguish the particular contribution of individual measures and the effect of external factors (e.g. the general state of the economy). The sub-group is assembling what information it can on the savings offered by various individual measures and will then examine the scope for improving knowledge here.

7. At all events, rapid change is not to be expected in the way passenger movement in towns is organised. While the present situation of urban transport is no doubt unsatisfactory from the energy-saving viewpoint as well as from many others, experience has shown that significant improvement can only take place gradually, and often at considerable cost in money terms or in terms of obliging people to change their habits. In particular, it is difficult to cause people to transfer from private to public transport without suffering a sense of personal loss at abandoning the advantage of private transport: public transport is only regarded as a superior alternative in rather special circumstances. In any case, it often has only limited spare capacity available for those transferring to it from private transport. Generally, energy-saving measures will only work if

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they are reasonably acceptable to the majority of the people affected.

8. Responsibility for urban transport is exercised in the main at local level (local and regional authorities and public transport operators) within a general policy and financial framework set at national level. There is in our view little scope for formal Community-level legislative action in relation to the rational use of energy in urban transport. We hope however that our report will be useful to those at local and national level who must decide what package of energy-saving measures is most appropriate to their particular circumstances.

9. We should like to consult the Steering and Co-ordinating Committee about the extension of our work to the fields of urban freight transport and of inter-urban transport (cf. para. 1 above). Such an extension would require modification of the composition of the Group. We are also inclined to think that there is considerably less scope for saving energy in these two areas than there is in the field of urban passenger movement which we have examined so far.

10. We now go on to discuss energy-saving possibilities in urban passenger movement in five main fields. This sub-division is, however, in no sense rigid and several measures discussed would have beneficial effects in more than one field.

Ways of using private vehicles with less consumption of non-useful energy

11. Since with their many attractions private vehicles will inevitably continue to be used on a large scale in urban areas, it seemed to us important to consider ways of reducing the energy consumption involved without reducing the number of journeys. Three main kinds of action seem available in this context:

a) reduce the incidence of stop-go driving situations

12. A wide range of actions can be considered here, most of which can be categorised as traffic management measures: more careful phasing of traffic

lights, including "green wave" arrangements ; better signposting of routes, destinations and parking areas ; reductions in on-street parking ; and staggering of working hours. There is the danger here that these arrangements could tend to increase the relative attractiveness of the private car unless bus services benefited from them at least equally. Moreover, the staggering of working hours could reduce the scope for such energy-saving measures as car-pooling, though it might help the economics of public transport operations by spreading demand.

13. Stop-go situations can of course also be reduced, at a price, by improved road infrastructure, though this is clearly a dangerous tool in the energy-saving context.

14. Deleted

b) speed limits

15. Speed limits in towns are for the most part no doubt already at or below the optimum energy-saving level. There may however be some limited scope for reducing speed limits on urban motorways for energy-saving purposes.

Ways of rationalising the use of private vehicles
(measures of restriction, investment etc ..)

16. In considering here, inter alia, measures involving restrictions on the use of the private car we are conscious of coming close to the category of measures involving a reduction of personal welfare or freedom. We feel justified, however, in examining this aspect of the matter both by the probably limited scope for reducing energy consumption in urban transport by purely voluntary measures, and by the fact that the public authorities have anyway been trying for years now to control private transport in towns by measures involving the actual discouragement in various ways of its use. The new energy situation has increased the need to do this.

17. Here a number of related measures could be considered. The first is to increase the average occupancy of private vehicles, an energy-saving measure provided that it actually reduces the volume of private car traffic below the level it would otherwise reach. Car-pooling arrangements need to be facilitated in this context. This would involve examining existing legal and other disincentives to such arrangements. For example, in several member states there are problems about passengers contributing to the driver's costs, which may cause insurance difficulties of infringe bus licensing law. While accepting that the contribution of voluntary car-pooling to energy-saving would probably be only marginal, we think member states should examine the case for removing these impediments so far as possible. (In at least one member state they were in fact removed during the acute stage of the energy crisis.) There may also be scope for the encouragement by employers of car-pooling by their staff (e.g. through privileged parking arrangements) ; and it might be advantageous to allow full cars to use bus lanes, provided that enforcement could be carried out easily and that bus movements were not unduly impeded.

18. Turning now to measures involving restraint on the use of the private car, two kinds of action have classically commended themselves. The first has been to reduce the scope for using private cars by restricting parking possibilities, especially for all-day parking. The restriction can be effected through the price mechanism of by physically reducing the quantity of parking available. The latter approach could involve controlling not only on-street but also off-street parking and, in the latter category, non only publicly- but also (though this presents obvious difficulties) privately-owned parking, including parking in office buildings.

19. The second classic method of restraining private car use has been to bring home to drivers the cost of their presence in town. In this context the Commission has proposed - and the member states have been inclined to agree in principle - that all users of transport infrastructure should meet the marginal social costs of their use of it. These costs are no doubt considerable in many urban situations. While this proposal has not been implemented in a wholesale way, and presents special problems in urban areas, member state authorities are tending to move in that direction, and the need to do so is increasedby the new energy situation.

Among the tools available here are increased parking charges, supplementary licensing and road pricing. It would, however, be wrong to overestimate the likely impact on private car use of even major increases in its perceived cost to the user. The relatively slight effect of increased petrol prices on the volume of private car use in towns confirms that the price elasticity of demand for private transport is low, at least in the urban situation. Increased petrol prices constitute nevertheless a significant weapon in the hands of the public authorities.

20. Other possible measures in this field might include propaganda in favour of voluntary restraint in the use of private cars for short distance journeys, related possibly to the health benefits available here. They might also include the extension of pedestrian - only areas and streets (which may be costly to institute but bring substantial environmental and safety benefits as well as saving some energy). Deliberate failure to improve road infrastructure also restrains the volume of car use, but is a double-edged weapon in the energy context because of the willingness of many drivers to accept high levels of energy-wasting congestion before abandoning their cars. It is probably better (though difficult) to restrain the use of private transport while at the same time improving conditions for the vehicles which remain in use.

Ways of using public transport vehicles with less consumption of non-useful energy

21. A number of measures are possible here, most of them requiring cautious use in order to minimise undesirable side-effects in other fields. The main possibility in the field of bus transport may be to reduce the incidence of stop-go situations, for example by providing bus-only lanes, privileges for buses at traffic lights and elsewhere and on-street parking control. Here it is clearly necessary to avoid hampering private vehicles to such an extent that total energy consumption increases. Careful scheduling may reduce the amount of empty-running.

22. At the operating level, there may remain some scope in some urban areas for reducing unnecessary competition between bus operators on the same or similar routes.

Ways of making public transport more attractive to the user

23. The qualities which make public transport attractive are frequency and convenience, regularity and reliability, speed, comfort and cheapness - possibly in descending order of importance. Those responsible for public transport naturally try to make their services correspond as closely as possible to these ideals, quite apart from the new energy situation. That situation simply strengthens the case for making public transport as attractive as possible, and here again the measures available are those which have been classically employed in the past : increasing frequency and comfort by investment in new stock; increasing regularity and reliability by traffic management, including bus lanes and parking control; increasing convenience by seeking to give to public transport, e.g. through "dial-a-bus" systems, some of the characteristics of the private car or the taxi. Effective "park and ride" arrangements may allow the different advantages of both public and private transport to be brought to bear for the same journey; in this context it may well be justified to depart from the general rule that car-parks should not be provided on a subsidised basis.

24. Public transport operators will no doubt consider the scope for giving more publicity to the stronger points of public transport.

25. While not wishing to exaggerate the importance of the price of public transport as a factor affecting users'choice between public and private transport, we would expect the responsible authorities to have in mind the new energy situation in making the financial and fiscal decisions which in practice decide the fares which public transport operators must charge.

26. Convenience may also be improved by various kinds of co-ordination between different public transport operators in the same area, which might go as far as the setting-up of single conurbation or regional traffic and trans-

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port authorities. The co-ordination may be physical (better interchange arrangements) or organisational (for example co-ordinated timetables, and charging arrangements allowing a single payment to be made for travel on both bus and underground railway).

27. It may be admitted that some measures here - for example those aimed at providing a more convenient service by such means as "dial-a-ride" buses - may not always directly save much energy. However, they are doubtless justified in a more general way in the interests of the long-term preservation and improvement of public transport, the use of which instead of private transport is certainly energy-saving in general.

Ways of reducing the need for urban passenger movement in powered vehicles

28. The two main ways of reducing the need for people to move in urban areas are no doubt changes in urban land use and developments in telecommunications. But there is limited scope for action here within the ten-year timescale with which we are concerned and it does not seem possible to do more than draw planners' attention to the increased importance of the energy factor here. There may, however, be scope for action of a more limited kind by encouraging cycling and walking through propaganda and through minor infrastructure changes designed to make them pleasanter and safer.

Recapitulation of certain Main Points

29. The general urban transport policies which were being pursued before the new energy situation arose tended already, as it happens, to be of an energy-saving nature. So the requirement from the viewpoint of a more rational use of energy may often be little more than an acceleration or reinforcement of existing lines of action.

30. There are serious difficulties in estimating the likely energy savings from individual measures in the field of urban passenger movement. The sub-group is collecting what information it can on this and will examine the scope for improving knowledge here.

31. Responsibility for urban transport policies lies at local or regional level, within a framework set at national level. In these circumstances we see little scope for formal Community-level legislative action in this field. But we hope that our report will be useful to those directly responsible for choosing, from the range of possibilities, the energy-saving measures best suited to their circumstances.

32. We recommend Member states to examine the case for removing any legal impediments to remunerating the driver in car-pooling arrangements.

33. We should like the Steering and Co-ordinating Committee to examine again whether the Sub-group should extend its work to the fields of urban freight transport and inter-urban transport. This would require changes in the composition of the Sub-group, and we think that these further areas offer considerably less scope for saving energy than our main field of study.

16.6.1975

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ANNEX 3 - E

RATIONAL USE OF ENERGY

INTERIM REPORT OF SUB-GROUP E

" INDUSTRIAL PROCESSES - HEAT "

CHAIRMAN : C. FRIZ

SECRETARY : M. ALLION

Interim Report of Sub-Group E

Industrial Processes - Heat

I. Introduction

Sub-group E is responsible for studying three of the 22 projects of the Community Action Programme on the Rational Utilization of Energy. These are :

3.2 Recovery of residual heat

3.5 Use of continuous production processes and other manufacturing methods

3.7 Recycling and recovery of materials

According to estimates submitted by the Member States in spring 1974 the industrial sector would account for 541 million toe in 1985 (about 34 % of the total energy and non-energy consumption 1 600 million toe), disregarding any rational utilization of energy projects.

This sector is the largest single consumer of energy of the four sectors usually considered. The three projects which are being studied by the sub-group should help save more than 30 million toe of the 84 million toe which could be saved in 1985 by means of rational utilization of energy projects.

II. State of progress

The sub-group decided at its meetings on 18 February and 3 April 1975 to concentrate its work successively on three main aspects :

(1) Savings in energy which would not involve costly alterations to industrial structures, plant and equipment and current processes (action 3.5. of the mandate) ;

(2) savings in energy which would involve costly alterations to industrial structures, plant and equipment and current processes (actions 3.2. then 3.7. of the mandate) ;

(3) research and development work on new economical processes (long-term projects).

The group observed that industry has, by its very nature, always tried to utilise energy as rationally as possible, at least in sectors where energy is an important element of the cost price.

Since the increase in energy prices, industry has tried to adapt to the changed situation and schemes and methods which were not economic before have now become so and have been put into operation.

The group also noted that, although industry as a whole has taken steps to use energy more efficiently, small and medium-sized firms have not always been able to do so, mainly because of a lack of qualified staff and technical facilities. Furthermore, the cost of energy often represents only a small percentage of the cost price of manufactured goods and there may be little economic

incentive for them to take steps to utilise energy more rationally. Nevertheless, even a minimal saving by every small firm takes on a much greater importance at national or Community level in view of the large number of small and medium-sized firms.

This can be seen in the attitude of public authorities in the Member States towards industry.

The main kind of mandatory legislation introduced by the Member States has been the obligatory approval and/or inspection of industrial fuel combustion plants to ensure a certain minimum efficiency of performance. Other legislation has not been introduced to enforce a reduction in energy consumption as this would only aggravate the problems of industrialists faced with higher energy prices and inflation.

Some Member States have given financial incentives (freeing credit from restrictions, for instance) to firms which are willing to invest in projects which would save energy.

Several Member States have set up information services to provide technical aid and advice to industry in general and small and medium sized firms in particular. Trade associations have taken similar initiatives.

III. Timetable

1. Economy measures

As can be seen from the foregoing, in addition to the restrictions and incentives introduced by the national governments, industry itself has taken a number of economy measures.

The experts are gathering information at present from as many source as possible on the steps taken by industry since 1973 to save energy.

They vary considerably, from drawing up codes of good conduct and introducing systems for the periodic and systematic monitoring of every energy -consuming operation, to appointing special members of staff responsible for energy questions.

It should be possible to compile an information "brochure" which will be as exhaustive as possible on the basis of the data collected. This would contain :

(1) national measures by country (type of measures taken - public, private, combination ; mandatory legislation, incentives),

(2) the means used (analytical list),

(3) the actual or planned effects for each type of firm (large, small, medium-sized, old, new) in relation to local conditions.

2. In-depth sectoral study

The group has decided to make a horizontal study of one industrial sector and a study of three particular industrial categories.

(a) High temperature furnaces

This horizontal sector, which covers very different industrial branches (brickworks, cement works, glass and ceramics, heat treatment, smelting and refining processes, etc) includes all processes requiring high temperatures (of 1 000°C and over), with, as a corollary, the utilization of residual energy in the form of heat and power, of high specific thermal content.

(b) Industrial sectors

With regard to the following three sectors :

the sugar industry,
the pulp industry and
the textile and clothing industry (excluding synthetic fibres)

the experts will study known expensive and inexpensive techniques and processes which have brought considerable savings, new processes and techniques which have been introduced since 1973 to reduce energy consumption and processes and technical know-how which are perhaps not generally known but which would enable industry to make a rational utilization of energy even if their dissemination had to be paid for (selling, licences, etc).

(c) Energy consumption per unit of production.

Finally, the experts decided to make a general comparison of energy consumption per unit of production. This would enable them to see what techniques could be developed to achieve the foreseen objectives for energy saving.

ANNEX 3 - F

RATIONAL USE OF ENERGY

INTERIM REPORT OF SUB-GROUP F

" POWER "

CHAIRMAN : M. GODELLE

SECRETARY : R. VAN CAMPENHOUT

Rational Utilization of Energy
Interim Report of Sub-Group F "Power"

Within the framework of the Community Action Programme for the Rational Utilization of Energy (URE), Sub-group F has received a mandate to elaborate the measures suited to the reduction of energy consumption (as compared to its forecasted level for 1985), and to submit such actions and the means suited for their implementation in both the following sectors :

- Appliances and equipment in the domestic and tertiary sectors with a given economy objective of 8% on half the estimated consumption for 1985 at 50 Mtoe (i.e. a saving of 2 Mtoe).

- Power and lighting in industry with a given energy economy objective of 10% on 75% of the estimated consumption for 1985 at 54 Mtoe (i.e. a saving of 4 Mtoe).

During the two meetings of the Sub-group, held respectively on the 4th and 5th March and 10th and 11th April 1975, the experts agreed to deal first with the medium term problems, i.e. at the 1980 level and then with the longer term problems by allowing information exchanges and discussions if circumstances render it possible.

It follows that some measures have to be initiated immediately in order to meet the deadlines: the elaboration of harmonizing standards detailing the performance of certain electric domestic appliances and of certain lighting equipment and motive power as well as methods for measuring such performance; information labelling concerning, among others, energy efficiency in the use of electric domestic appliances. In addition to these

measures which are considered the most urgent and which will be thoroughly examined during the third meeting of Sub-group F on June 30th and July 1st 1975, this report summarizes the results of the activities of Sub-group F.

1. ANALYSIS OF THE CURRENT SITUATION

1.1 Some global considerations have been expressed and several delegations showed their concern about the lack of evaluation methods to show the impact of the planned measures on energy consumption and about the absence of the necessary statistical equipment.

The Sub-group reached a decision concerning the unit in which the energy quantities will be expressed : the KWh and its multiples were chosen. However, a table showing the conversion rate from KWh to toe will be provided every time this varies from the standard rate of 4.5 KWh = 1 toe.

1.2 Each expert produced an inventory of the measures already taken or envisaged for his country. These measures can generally be grouped into two large categories :

- measures for drawing the public's attention to the proper utilization of existing equipment (publicity folders, advisory booklets, publicity bombardement on T.V. and radio, etc.);

- restrictive measures especially in the field of public and commercial lighting;

examples need not be quoted as these measures are sufficiently familiar. Some delegations will transmit reports to the Sub-group of the results of the publicity campaigns established by their governments. In the light of the results of these reports, the possibility of publicity campaigns on a Community level could be envisaged although their usefullness is, at present, not great, considering the efforts already taken at national levels.

The Danish government is financing about 200 equipment improvement projects and has volunteered to provide a list of these projects along with the names of the organizations in charge of them.

The French delegation drew attention to the existence of a procedure for the granting of energy consumption label for electric domestic appliances and heating units, conforming to minimum requirements set by AFNOR. This label would carry information on the consumption and economic utilization of the device. The Sub-group's Secretariat expressed its concern about the compatibility of such a procedure with the Articles of the Treaty of Rome in the event of it causing any restrictions.

2. POSSIBLE SHORT AND LONG TERM MEASURES

2.1 It has been necessary to systematically examine the problems in view of the deadlines set by the mandate. The Sub-group set about the examination of measures not requiring design modifications for appliances and equipment already on the market. Such measures would be the most efficient and necessary in the field of electric-domestic appliances. As far as power in industry is concerned, the Sub-group considers that the increase in energy prices has created a sufficiently strong motivation for the management of large- and medium-sized firms to render urgent measures less necessary.

For smaller firms and craftsmen, a more important effort has to be made and measures through which the largest savings can be achieved by a more rational utilization of energy are :

- lighting
- control of wastage in motors, machines and processing;
- better information for craftsmen and small manufacturers on the equipment best suited for their present and future needs.

2.2 The URE-F Sub-group hopes to avoid hasty measures in the field of appliance design. It has, indeed, been put forward by the constructors that present appliances are the result of a balance achieved between the energy necessary for their utilization and the energy necessary for their construction. Hence, any increase in efficiency would

therefore require an increase in raw materials and energy for their construction. The construction costs of these appliances would of course increase, and provoke heavy competition upsets at the expense of the Community industries.

3. MEANS FOR THE IMPLEMENTATION OF SUCH MEASURES

In addition to the financial and budgetary means common to all URE sectors, the implementation of the following measures is foreseen for Sub-group F (Power) :

3.1 Information campaign on behalf of the Administration directed at craftsmen and small industries, (see 2.1 above)

3.2 Information campaign by the constructors directed at the users of domestic electric appliances in order to encourage a rational utilization of these appliances (see 2.1 and Annex 2). The CECED (European Federation of Constructors of Electric Domestic Appliances) have offered their technological backing for the elaboration of information documents for such a campaign with the collaboration of the Directorate-General for Information.

3.3 Standardization of performance measurement methods (of electrical apparatus) necessary for the rational utilization of energy. The CENELEC (European Committee for Electrotechnical Standardization) is ready to elaborate European standards to which Community measures could refer.

3.4 Community measures to be implemented gradually :

possible national measures risk having a direct effect on the design of electrical equipment for which free circulation has been guaranteed by the Council Directive of the 19th February 1973 (73/23/CCE; J.O. L77 of 26th March 1973).

In order to comply with the clauses of the Treaty, one should

3.4.1 avoid national measures which are obligatory concerning design, approval, labelling or marking of appliances;

3.4.2 elaborate proposals of Community acts concerning the harmonization of planned URE measures whose application in each member state could be only optional.

A first proposal should be drafted as soon as 1975 (see 4.1).

4. PROPOSALS FORMULATED DURING THE FIRST STAGE

4.1 It appeared that a platform could be reached for the elaboration of a proposal for the labelling of electric domestic appliances. This proposal would enable constructors to affix on the most visible part of each appliance intended for the Community market, a label informing would-be buyers of the energy consumption of each appliance and a break-down of how the measurements were obtained. This label would, moreover, indicate the most efficient methods of utilization to economize energy and product consumption. The label would, at a later stage have a European symbol which would replace any national symbols introduced earlier. Furthermore, there should be at least one organization per member state entitled to control the content of the label. The Sub-group is aware of the complexity of the problems in establishing the measurement criteria such a system involves.

4.2 To prepare the procedures concerning the above and in order to create a basis for discussion, on the basis of the german statistics the Sub-group has drawn up a list of electric domestic appliances in deacreasing order of their combined energy consumption. Moreover, it has been established that the efficiency of these appliances can be improved, either through a change in their method of utilization or through a change in their design, or even in both these cases. This list is included in Annex 1.

5. PROPOSED FUTURE PROGRAMME

The Sub-group has drawn up a programme comprising a series of guidelines designed to commence and direct the procedures rather than to be used as a rigid work-plan. This programme is included in Annex 2.

The actions of the URE programme aim at measures directly affecting the design or marketing of electric appliances and machines. They should be implemented through measures similar to those used for the harmonization procedures started in the general programme aimed at removing technical barriers to trade. This last programme is already at an advanced stage(*) and a coordination of action on the goods concerned can only facilitate their enforcement on a Community level.

Indeed, the legislative, regulatory and administrative measures necessary for the implementation of the URE programme could thus be more quickly enforced on the whole of the Community so favouring the realization of the energy savings objectives and ensuring the proper functioning of the Common Market.

(*) The Council adopted on the 19th February 1973, the directive 73/23/CCE concerning the electric appliances to be used within certain limits of voltage (J.O. L77 of 26th March 1973) and other directives in the same "electricity" fields are in the process of being adopted.

ANNEX 1

UTILISATION RATIONNELLE de l'ENERGIE - FORCE MOTRICE

RATIONELLE ENERGIE NUTZUNG - KRAFT

RATIONAL USE OF ENERGY - POWER

Liste des appareils électro-domestiques modifiables
Liste der zu verändernden elektro haushaltsgeräte
List of improvable electric domestic appliances

Appareil	Geräte	Appliance	Modification de l'utilisation	Modification de la construction
Chauffe eau	Heisswassergeräte	Water heater	X	X
Cuisinière	Herd	Cooking stove	X	X
Frigo	Kühlgeräte	Refrigerator	X	X
Eclairage	Licht	Lighting	X	X
Machines à laver	Waschmaschine	Washing machines	X	X
Air chaud	Heisslüfter	Air heaters	X	-
Congélateur	Gefriergeräte	Freezer	X	X
T.V. couleurs	Fernseher - Farben	Colour T.V.	-	X
T.V. noir et blanc	Fernseher - schw. und w.	Black & white T.V.	-	X
Sechoir de linge	Wäschetrockner	Dryer	X	X
Lave-vaisselle	Geschirrspüler	Dishwasher	X	X
Aspirateur	Staubsauger	Vacuum cleaner	-	X
Grill	Grillgeräte	Grill	-	X
Fer à repasser	Bügeleisen	Iron	X	-
Machine à repasser	Bügelmaschine	Ironing machine	X	-
Essoreuse	Wäscheschleuder	Spindryer	X	-

ANNEX 2

URE - F Sub-Group " Power "

This Sub-Group's programme, laid out in its mandate on the one hand, and the actions 1.6. and 3.4 of the URE programme on the other, could be elaborated upon along the following guidelines if the agreement of the Orientation and Coordination Group for the URE is obtained :

- a better internal information of Sub-group F
- an exchange of information, by way of publication of current or envisaged national measures
- a breakdown of Community actions into three categories according to their period of implementation : short-term (8 months : duration of the mandate), medium-term (2 years) and long-term (1985).

Action 1.6 : Improvement in efficiency of electrical domestic appliances

(foreseen savings : 2 millions tpe)

1.6.1 Group classification of domestic appliances according to their capacity for energy economy :

a) appliances needing an alteration in design in particular;

b) appliances needing an alteration of practice and use;

c) appliances for which the energy balance-sheet cannot be improved noticeably and thus not necessitating any action.

1.6.2 Promotion of energy saving appliances : european " Energy label " following criteria to be established.

1.6.3 Implementation of European standards for electric domestic appliances according to standardized methods.

1.6.4 European information campaign for appliances in group 1.6.1 b) : mass-media, schools, instruction for use, etc.

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1.6.5 For each new construction standard implemented, information campaign on the corresponding " Energy label ".

1.6.6 For each appliance in group 1.6.1 a) and b), enquiry about financial benefit and cost/energy benefit.

1.6.7 Determination of the source of finance : consumer, producer, Member State, Community.

Action 3.4 : Improvement in efficiency of power and lighting equipment in industry

(foreseen savings : 4 millions tpe)

3.4.1 Means of action foreseen in the mandate.

3.4.2 Information campaign on lighting intensities and proper choice of light sources.

3.4.3 Breakdown of installed electrical motors according to their usage : continuous, discontinuous, reduced, in order to differentiate between the actions to be taken at construction level from those at utilisation level.

3.4.4 Efficiency analysis in industrial processes by standardized methods.

3.4.5 Standardization of characteristics of the elements controlling better energy efficiency in industrial processes : mandate to CENELEC.

3.4.6 Study of compulsory measures to be set up for the enforcement of above mentioned standards.

3.4.7 Different financing systems for these measures through tariffs and/or taxes depending on whether the consumer or the producer is to be the beneficiary.

3.4.8 For each recommendation or proposed modification of design : enquiry about financial benefit and cost/energy benefit.

3.4.9 Determination of the source of finance : user, producer, Member State, Community.

CONCLUSION

The following measures could be considered taking account of the various deadlines already mentioned (as from March 6, 1975) :

Short-term (8 months)	Medium-term (2 years)	Long-term (1985)
1.6.1	1.6.2	
decision 1.6.3	start 1.6.3	end 1.6.3
1.6.4	end 1.6.4	
	start 1.6.5	end 1.6.5
start 1.6.6	end 1.6.6	
	start 1.6.7	end 1.6.7
3.4.2		
3.4.3		
	3.4.4	
decision 3.4.5	start 3.4.5	end 3.4.5
	3.4.6	
	3.4.7	
start 3.4.8	end 3.4.8	
	start 3.4.9	end 3.4.9

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ANNEX 3

DRAFT PROVISION

This provision would permit constructors to affix a label on the most visible part of each electric domestic appliance which is destined for the Community market, informing would-be buyers of the consumption level of the appliance as well as the methods by which these measurements were obtained. The labels would also indicate the most efficient method of utilization for energy and material consumption. These labels could have a European symbol which would replace any national symbols used previously. Moreoever, at least one organization per member state should be qualified to control the content of the labels. The Sub-group is well aware of the problems for forming criteria for these measures, involved in such a system.

The abovementioned provision would serve only as a framework and would be complemented by supplementary provisions indicating the format of the labels, their precise content and labelling and measurement methods.

These provisions would apply to a restricted number of appliances, especially those which have the highest energy consumption levels at the present time. A temporary list has been drawn up in decreasing order of consumption levels. The first five appliances are :

- water heaters
- electric cookers
- refrigerators
- lighting
- washing machines

Other appliances which are less important from the energy consumption point of view are also proposed to be included in the application of this provision :

- televisions
- dishwashers

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ANNEX 3 - G

RATIONAL USE OF ENERGY

INTERIM REPORT OF SUB-GROUP G.

" CONVERSION IN POWER STATIONS "

CHAIRMAN : M. DAVIS - A. COLLING

SECRETARY : H . DALDRUP

RATIONAL UTILIZATION OF ENERGY

Interim report by sub-Group G - Conversion in power stations

I. Introduction

Sub-Group G has the task of investigating appropriate ways of improving the efficiency of power stations, of developing combined production of heat and electricity and of utilizing waste heat. It is estimated that at least 11 million toe of primary energy - 6% of estimated total consumption by the energy generating industry (186 million toe) - can already be saved in 1985. More substantial savings could be achieved in the years to follow.

Of the three subjects under consideration, combined heat/electricity production permits the greatest savings of primary energy. It both improves power station efficiency and reduces the amount of waste heat released. For example it is possible, under certain conditions, to obtain from a given primary energy input twice the useful energy (electricity and heat) output from combined production compared with the production of electricity alone. At the same time the amount of residual heat rejected to the environment is reduced to about one third.

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At its first meeting held on 20 March 1975 the Group adopted its programme of work and discussed certain points in greater detail. During the second meeting held on 27 May 1975 a number of papers were submitted and others were read. This interim report was drafted on the basis of this information. The report was submitted to the members of the Working Group for approval; their remarks have as far as possible been included.

II. Programme of the sub-Group on conversion in power stations

The three parts of the programme are defined as follows:

- The efficiency of power stations, meaning the relationship between useful energy and the energy consumed; in the first part of the work programme the improvement in efficiency, achievable by the use of combined heat and power production, will not be taken into account;
- The combined production of heat and power, meaning the combined production of heat and electrical power in thermal power stations (back-pressure turbines and extraction condensing units, gas turbines with exhaust heat boilers, use of exhaust heat from Diesel engines);
- Residual heat, meaning the heat inevitably lost through the cooling system during the production process in a power station (condensing turbines and closed-cycle gas turbines).

II.1. Improving power station efficiency

Power station efficiency cannot be examined in itself. As regards measures to improve efficiency, the following considerations must be particularly noted:

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- the extra capital costs which must be offset by a reduction in the total consumption of primary energy,

- the dynamic behaviour of the plant, typified by such factors as rapid start-up and load pick-up,

- the reduction in reliability and thus in availability consequent upon the use of complex technology,

- the choice of fuels according to price and security of supply.

II.1.1. Technical and economic possibilities for improving the efficiency of existing power stations

The only way to bring about any significant improvement in the efficiency of existing power stations is through partial plant replacement; e.g. by

- adding a topping unit (high pressure boiler and back-pressure steam turbine, or gas turbine with exhaust heat boiler) to an existing, relatively low-pressure unit,

- using gas turbines for preheating the air for boilers,

- fitting recuperators to gas turbine plant.

As this can have a major effect on plant availability, owing particularly to the juxtaposition of components with different lifespans and added plant complication, preference is generally given to new, and even more efficient plant rather than alterations.

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Certain improvements can be made in the efficiency of industrial plants especially if a decrease in the exhaust-steam pressure of the back-pressure turbines can be achieved through better thermal insulation of the heat distribution piping.

With smaller plants it is often possible to save fuel simply by
(1) making minor modifications (e.g. better insulation and control systems, checking of burners, better operation procedures etc.). This aim could be
(6) attained by systematically questioning and advising their owners.

II.1.2. Technologies available for improving the efficiency of thermal power stations to be built in future

The main possibilities for improvement are:

- higher steam pressures and temperatures,
- double reheat,
- feedwater preheating to higher temperatures,
- steam turbine driven feed-water pumps,
- combined cycles (gas and steam turbine),
- nuclear power stations equipped with a light-water reactor and a tailing conventional superheater.

It now seems clear that significant improvements in efficiency are not possible using the first three methods without penalties in terms of reliability, and considerable capital cost. Turbine-driven feed pumps - which have been in use for many years - become particularly attractive with increasing unit capacity.

Efficiency can be increased several percentage points using the combined gas and steam turbine cycle instead of conventional plant and there is also a reduction in capital cost, particularly if the gas turbine inlet temperature is increased still further and the steam-generator is of pressurized furnace design.

A major disadvantage, however, is that gas turbines require clean fuel so that the systematic application of this process depends on the availability and cost of natural gas or power gas produced by gasifying coal, or alternatively light fuel oil with a low salt and vanadium content or scrubbed heavy fuel oil. The operation over many years of the few nuclear power stations with light water reactors and fossil-fired superheat has shown that they compare badly in terms of both economics and availability.

II.1.3. Improvement in the overall economy and efficiency of electricity production by optimum management of integrated power systems

The main areas for improvement are as follows:

a) Classification of power stations in the load diagram according to their economic merit with the inclusion of the greatest possible number of stations, including industrial power stations;

b) Cooperation between public and private producers

- in the planning of equipment in general and in particular of the mix of machines,
- in the common use of stand-by and energy storage plants,
- with a view to coordination of overhaul periods,
- by mutual assistance in the event of unforeseen station outages;

c) Trans-frontier management of power stations (public and private) and interconnecting systems;

d) The improvement of the availability of base-load power stations by appropriate maintenance procedures;

e) The optimum use of high merit base load plants and nuclear stations by an increased use of storage plants.

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With reference to point (a), utilities generally run their generating capacity with an eye to maximum economic efficiency. With some exceptions, e.g. in Belgium, private producers have not so far been included in the load diagram. Elsewhere in certain cases cooperation between neighbouring utilities could also be improved.

So far there are only a few examples of the type of cooperation referred to in point (b). In addition to the obvious advantages of joint planning of equipment and overhaul periods and of mutual assistance, problems concerning the maintenance of reserve capacity could also be eased.

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Accordingly in certain cases, the private producer could be capable of supplying peak load to the public network if, for example, he has combined back-pressure/condensing plant or steam-storage capacity.

Widespread trans-frontier management of power stations and systems at Community level does not seem appropriate at present since, despite the advantages of increased installed generating capacity and network size, increasing transmission losses make additional savings insignificant once the grid area exceeds a certain size. On the other hand, trans-frontier networking on a regional basis can produce considerable improvements.

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General improvements in power station economics can also be achieved by plant optimization and better operational flexibility, taking into account all relevant parameters. Fuel can also be saved by going over from periodic to "condition" maintenance. Before all this can be achieved comparable data are needed on the availability and reliability of all power stations in operation and their components. The data published by UNIPEDE[1] and UCPTE[2] for Europe and EEI[3] for the USA are not adequate for this purpose as they extend to only main components. For various reasons, including commercial, they contain no precise analyses (causes and magnitude) of the breakdowns. The collection of more detailed statistics is generally carried out at national level.

(3) Increasing the capacity of storage plant does not only improve the return on the high capital investment in nuclear stations, but leads also to a reduced number of start-ups and a decrease of annual utilization of old, low efficiency power stations. The development of storage plant should therefore be favoured.

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[1] UNIPEDE = Union Internationale des Producteurs et Distributeurs d'Energie Electrique

[2] UCPTE = Union pour la Coordination de la Production et du Transport de l'Electricité

[3] E.E.I. = Edison Electric Institute.

II.2. Combined production of heat and electricity

II.2.1. Current state of development of combined production of heat and electricity in the various Member States

Currently almost 15% of the electricity produced in the Community comes from combined power stations which produce both electricity and heat for industrial or domestic heating (see table 2.1). The exact quantities of heat produced by these plants are often unknown and are not always indicated in the statistics available.

It is difficult to work out the state of development of combined production because of the lack of adequate statistics. Sub-Group G is therefore proposing:

- to collect the information which the various members might have,
- to lay down the measures to be taken with a view to producing a (4) systematic set of statistics on heat production (as is currently done in the case of electricity production).

The principal methods used for combined production of electricity and heat are:

- the removal of steam by back-pressure (approximately 43% of the electricity produced by the combined power stations comes from such plants) (see table 2.2),
- the removal of steam by bleeding off (approximately 55%),
- the recovery of exhaust heat from gas turbines and gas engines (approximately 2%),
- the recovery of heat from Diesel engines.

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Power stations equipped with gas turbines with exhaust-heat recovery equipment have developed fast during recent years. This is due partly to the flexibility with which such plants can be operated and partly to the relatively low investment costs involved and the short time required to build them.

Information on the operators of combined plants is fragmentary and is obtained mainly from the electricity production statistics. The most important categories are:

- public producers/distributors of heat,
- the chemical and electro-chemical industry (approximately one-half of the electricity produced in the combined plants comes from power stations belonging to the chemical industry),
- the paper industry (approximately 15%),
- mines and collieries (approximately 12%).

II. 2.2. Analysis of the reasons why combined production has developed differently in the various countries

In the industrial sector combined production is practised in all the Community countries. It has reached the most advanced stage of development in Italy, France, Germany and the Netherland

Public distribution of heat from combined power stations has been developed to a certain level only in Germany and Denmark. Limited heat distribution networks also exist in Belgium, France, the Netherlands, Italy and the United Kingdom.

No exhaustive analysis has yet been made of the reasons why combined production has developed differently in the various countries.

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In the industrial sector mention could be made of

- the historical reasons, bound up with the nature and size of the industry's production and with the availability of waste fuel;

- the industrial scales of charges applied by public electricity producers, including those for the supply of auxiliary and reserve energy and the purchase of excess energy from private producers;

- national legislation on self-production and the private transport of electricity;

- taxation.

In the case of public heat distribution from combined power stations, the reasons are mainly historic (economy measures taken at the time of the second world war, ability to install distribution networks when towns were rebuilt after the war), climatic (relatively cold continental climates) and demographic (very densely populated areas and high concentration of industries) The structure of the electricity sector (private, public or nationalized) has certainly not been without its effects on the development of heat distribution networks.

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TABLE 2.1

NET AMOUNT OF ELECTRICITY PRODUCED IN COMBINED THERMAL POWER STATIONS IN 1972

Country	A. Industrial producers		B. Public producers		Total A + B	
	TWh	% of national production	TWh	% of national production	TWh	% of national production
B	2.054	5.9				
DK	0.3	1.5	6.6	34	6.9	35.5
D	40.018	15.3	13.0	5.0	53.018	20.3
F	18.685	16.3	0.429	0.4	19.114	16.7
IRL	0.16	2.2	0	0	0.16	2.2
I	15.619	17.9				
L	0	0	0	0	0	0
NL	4.79	10.1				
UK	14	7,0	0,135	0,07	14,135	7,07
Community						

TABLE 2.2

NET AMOUNT OF ELECTRICITY PRODUCED IN THE VARIOUS TYPES OF COMBINED POWER STATIONS IN 1972

Country	Back-pressure		Bleeding off		Recovery from gas turbines		Recovery from Diesel engines	
	TWh private and public	% of the national combined production	TWh private and public	% of the national combined production	TWh private and public	% of the national combined production	TWh private and public	% of the national combined production
B	1.367 +		0.407 +		0.200 +		0	0
DK	0.3 + 0.4	10	0 + 6.2	90	0	0	0	0
D	22.870 + 2.400	47.6	16.719 + 10.100	50,6	0.424 + 0.500	1.7	0.005 + 0	0.1
F	5.682 +							
IRL								
I	6.675 +		8.930 +		0.014 +		0	0
L	0	0	0	0	0	0	0	0
NL	2.093 +							
UK								
Community								

II.2.3. Rationalization of combined production in the industrial sector

There are approximately 120 000 to 150 000 industrial boilers in service in the Community countries. Only a small proportion of these boilers are installed in combined heat/electricity plant. Economic studies made since the recent increase in the prices of fossil fuels indicate that the break-even point of a combined plant is, depending on local conditions, between 500 and 5000 kW. Consequently a large number of these boilers could gradually be replaced on economically satisfactory terms by combined plants and thus play a part in the effort to achieve substantial reductions in the consumption of fossil fuels.

In order to assess the savings which could be achieved by rationalizing the use of industrial boilers, and especially by encouraging combined production, a list of such plants, indicating
(5) their principal features, must be drawn up. Appropriate measures have been taken in various Member States, and they should be extended to all the Community countries.

Small and medium-sized industrial undertakings using boilers often lack information on the technical and economic aspects of combined production. An information brochure summarizing in a few pages and in simple language the advantages of combined production should be drawn
(1) up and sent to these undertakings. The advisability of drawing up a list of technical advisers who could give additional information to
(6) undertakings requesting it will be examined.

However, even if industries are convinced of the fact that combined production will lead to savings, both for their company and for the community, they may hesitate in the face of difficulties such as

- the extra investment required for a combined power station as against a simple boiler;
- negotiations with public electricity producers with regard to the terms for the supply of reserve and emergency quantities of energy as well as the purchase of any surplus energy produced; the obtaining of equitable tariffs for these supplies and services;
- less flexibility as regards the operation of a boiler as a result of the addition of a generating unit.

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(7) An effort must be made to find suitable ways of overcoming these difficulties.

It might prove beneficial if, instead of building several small industrial boilers, several industrial undertakings situated in the same region were to build one or two joint boilers which would be more efficient and on which even greater savings could be made if a generating set were added. Undertakings can decide to adopt such a solution, which is certainly rational from the point of view of energy savings, only if national laws do not prohibit them from sharing the heat and electricity produced by their joint power station. Where it is not possible for public electricity producers to supply that group of industries with heat on the terms stipulated, the legal obstacles should

(8) be abolished in order to enable joint industrial power stations to be built, designed primarily to produce heat on economic terms.

The considerable increase in the prices of fossil fuels during the past two years has led to a reexamination of the possibility of optimizing the use of combined power stations. It is often found that the temperature of the process steam is too high, that the thermal insulation of the pipes through which the heat is distributed is inadequate and that a lesser degree of interdependence between electricity

(9) production (particularly to cope with peak demand) and heat production would be desirable. These points will be examined in detail and the conclusions reached could be included in the information brochure on

(1) combined heat/power production mentioned above.

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II. 2.4. Cooperation between public electricity producers and industrial consumers of heat

The Community has laid down, as the target of its energy policy, the reduction of its dependence on imported energy from the current figure of 60% to 40 - 50% in 1985. This target can be achieved only if nuclear energy is used on a large scale for the production of both electricity and industrial heat. Except in the case of some large industrial companies, industry will generally not have access to nuclear energy supplies unless it enters into close cooperation with the electricity producers. The latter, for their part, will find that they have an associate in industry capable of solving the difficult problem of distance between nuclear power stations and the centres of consumption which are generally found in densely-populated regions. The increase in the use of primary energy, which is relatively limited in the case of pure electric power stations equipped with light-water reactors, and the reduction in thermal waste, which is particularly high in the case of the nuclear power stations currently in service, constitute other arguments in favour of combined heat/electricity production in nuclear power stations. Stress should be laid on developing this technique.

Because of the difficulties involved in the transportation of heat, the nuclear power station and the industry using the heat must not be situated very far from each other. In order to guarantee the industry a continuous supply of steam, the power station must have at least two or three interconnected units. The construction on one site of a large nuclear power station and a large industrial complex gives rise to planning and regional development problems which cannot be solved without the active participation of the public authorities. If the industrial complex is to have at its disposal the necessary manpower for its construction and operation, it must necessarily be situated close to a population centre of some size. The regional development authorities would have to begin the necessary prospection

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work already in order to find sites - and there certainly will not be very many - suitable for the building of both large industrial complexes and nuclear power stations, and take the necessary measures to see that
(10) they are reserved for that purpose. A recommendation in this connection should be sent to the Member States.

In order to supply the competent authorities with information, advisory bodies should be set up composed of experts from the electricity-producing industry and the heat-consuming industries. Such bodies have already been set up in various Member States. The other Community
(11) countries should be encouraged to set up similar bodies.

The task of such advisory bodies would be to undertake or to continue technico-economic studies - taking into account the particular conditions prevailing in each country - of the various possibilities of introducing combined production in nuclear power stations. To enable such studies to be carried out successfully, preliminary investigations should be made to determine:

a) the principal temperature and steam-pressure levels required for industrial processes as well as the possibilities of reducing them to a limited number of levels;

b) the approximate quantities of heat necessary for the manufacture of the principal industrial products;

c) the daily, weekly and seasonal variations in the demand for heat from the various industries;

d) the cost to various industries of an untimely interruption of heat supplies;

e) the technical means of reducing the interdependence of the production of heat and the production of electricity in nuclear power stations and the costs of such methods;

f) the implications of the combined production of heat and power for the safety of nuclear power stations;

g) the most suitable forms of cooperation between electricity producers and industry in those power stations where combined production is carried out (e.g. joint financing and operation).

These investigations, certain of which have already been started, could be carried out in conjunction with the industrial federations (a, b,
(12) c, d, g), the manufacturers of electro-nuclear equipment (e), the national authorities responsible for the safety of nuclear power stations (f) and the electricity producers or their federations (a, b, c, d, e, f, g).

(13) A Community framework should be created to enable the national advisory bodies to meet and discuss their experiences.

The combined production of heat and electricity in nuclear power stations is in line with both objectives set out by the Member States on national as well as on Community level: energy savings and rational use of energy on one hand and the reduction of the dependence on oil imports on the other. In order to achieve certain targets of their energy policy, Member States have in the past often granted concessions to one or the other industrial sector (e.g. coal mines). A deliberate implementation of a Community energy policy can most probably not be brought about without
(14) similar measures. It is therefore proposed to examine measures to encourage combined production, such as tax relief and non-linear or accelerated depreciation of investments.

II.2.5. Assessment of the prospects for using power station heat for district heating

In the case of district heating, the liquid used to transport the heat is hot water (80 - 130°C). This temperature level is suitable for only a small number of industrial uses. Consequently, the number of industrial consumers will be relatively limited. The main task of district heating networks will therefore be to heat buildings in cold weather and to provide hot water for domestic uses. The amount of heat required for the latter remains relatively constant throughout the year, but it generally represents no more than 10% of the maximum power used. The total installed thermal power used to heat buildings is used for only 2000 to 3000 hours, depending on the climatic conditions.

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Compared with supplies of process steam to industry, district heating is characterized by:

- the small annual utilization of the installed capacity;

- considerable investments in a highly ramified distribution network;

- the long time required to develop a network.

When assessing the merits of district heating bearing in mind the general economic position of a town or region, account should be taken not only of the savings which could be made by the abolition of individual heating plants but also of the reduction in atmospheric pollution and the increase in the comfort of the user. However, account should also be taken of the quantities of other forms of energy which could be used for heating buildings, such as natural or synthetic gas or electricity, which will be available in future in the area in question.

The development of district heating will depend to a large extent on the possibility of making use of nuclear power stations for the provision of heat. To this end it will be essential to site the nuclear power stations nearer the centres of heat consumption, i.e. the towns. If the present state of development of safety techniques is considered inadequate to allow the siting of nuclear power stations in areas of high population density, a special effort should be made to develop these techniques. A recommendation to this effect should be made to the Member States.

District heating networks can be fed from combined power stations in the long term only if the interdependence of heat and electricity production can be decreased on economically satisfactory conditions. Because of the high investment costs involved, a new nuclear power station cannot be incorporated economically into an electricity network unless it is operated at the base of the load diagram. This implies that when the nuclear power station enters into service, other conventional power stations, including combined power stations, must be moved towards the middle of the load diagram. During the winter period this is possible only if the

combined power station can alter the amount of electricity which it produces while maintaining a base load level for heat production. Because of the low annual rate of utilization of the installed power of a district heating network, the problem of the economic separation of the two processes becomes even more acute than in the case of combined power stations supply-
(16) ing industry. A special effort will therefore be required to work out separation methods. An increase in the thermal inertia of the heat distribution networks by incorporating daytime accumulators could provide a partial solution to the problem.

In view of the complexity of the economic problems involved in district heating, the only possible remedy is to increase the number of detailed studies which must be undertaken to take into account the particular conditions prevailing in each area. Studies should be carried out to indicate, for the various climatic conditions found in Europe, the specific problems involved in the use of nuclear power stations in this context. To stimulate and coordinate these studies, similar advisory bodies to those already in existence or to be set up for the industrial
(17) sector (see point II.2.4.) should be set up in the Member States. A Community framework in which the members of these bodies can discuss their
(18) experiences should also be created.

II.2.6. The development of links between heat distribution networks

The question of links arises only in the case of heat distribution networks which have been adequately developed and are relatively close to each other. This situation currently persists only in certain regions of Germany, where detailed studies are in progress. It is on the results of these studies that the advisability of embarking on similar studies of other regions in the Community will depend.

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II.3. Waste heat utilization

The low level of cooling water temperature limits the utilization of waste heat from condensing steam power stations. For most central heating applications the temperature would have to be raised by centrally or locally sited heat pumps. The economics of such applications is dependent upon the conditions of each case. Waste-heat utilization has certain advantages in comparison with combined heat/power stations as no changes in equipment are needed in the power station, electricity generation is independent of heat requirements and substantial quantities of waste heat can be utilized without affecting station operation. On the other hand, a major disadvantage is that in view of the far smaller temperature difference than with district heating by hot water, pipes of very large cross-section are needed with correspondingly high cost, particularly for burying them. Consequently, waste heat from condensing steam power stations cannot be used for district heating except perhaps if there is a sufficiently large centre of consumption near the power station. But even in this case the production of heat in a combined heat/power station at a temperature directly applicable to central heating purposes might be more economic than the use of waste heat from a conventional station with the use of heat pumps to provide the necessary temperature.

The utilization of waste heat for fish farming and agricultural purposes is outside the scope of this project. A special working group in the Environment Service is examining it.

III. Proposal for measures to be worked out in detail at future meetings of sub-Group G

II.1.1 and II.2.3

(1) Preparation of an information brochure, designed primarily for small and medium-sized industrial undertakings, on the advantages offered by a greater concentration of energy production, by combined production of heat and electricity and on ways of saving fuel in low-power industrial power stations.

II.1.3

(2) Examination of ways of increasing cooperation between public electricity producers and industrial self-producers, with a view to optimizing the investments to be made by each and to improving the management of the power station systems.

(3) Examination of ways of increasing the total efficiency of electricity production by introducing measures such as increasing the capacity of power stations as far as possible, improving the flexibility with which they can be operated, reducing the number of maintenance shut-downs and using more storage power stations.

II.2.1

(4) Measures to be implemented to increase the amount of statistical data available on heat production by industry and on heat distributors.

II.2.3

(5) Drawing up of a list of industrial boilers, above a certain capacity, in service in the various Community countries.

(6) Measures to be taken to encourage small and medium-sized industrial undertakings without specialized staff to ask for advice when drawing up projects and when operating and servicing their heat and electricity production plants.

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(7) Search for ways and means of enabling undertakings to overcome the difficulties encountered during the construction and operation of combined heat/power production plants.

(8) Elimination of the legal problems and obstacles preventing the transport of heat and electricity produced in a combined power station to the industries which are the co-proprietors of the plant.

(9) Examination of technical ways of increasing the efficiency and flexibility with which combined industrial power stations are operated.

II.2.4

(10) Recommendation to be sent to the regional development authorities in the Member States proposing that they should look for and reserve suitable sites where industrial heat-consuming complexes can be set up near nuclear power stations.

(11) Encourage those Member States which have not already done so to set up advisory bodies to deal with combined electricity/heat production in nuclear power stations for industrial use.

(12) Complete the necessary preliminary studies to enable the advisory bodies on combined production in nuclear power stations to begin their work. Carry out these studies in a Community framework as far as possible.

(13) Create a Community framework in which the national advisory bodies on combined production in nuclear power stations can collaborate and discuss their experiences.

(14) Propose to the Member States measures encouraging the combined production of heat and electricity, mainly of nuclear origin, such as tax relief and accelerated or non-linear depreciation of investments.

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II.2.5

(15) To recommend to the Member States the acceleration and intensification of the studies and developments necessary to allow the siting of nuclear power stations close to towns.

(16) Encourage the development of methods allowing the economic reduction of interdependence of heat and electricity production in combined power stations.

(17) Encourage those Member States which have not yet done so to set up advisory bodies on district heating.

(18) Create a Community framework in which the national advisory bodies on district heating can collaborate and discuss their experiences.

ANNEX 3 - H

RATIONAL USE OF ENERGY

INTERIM REPORT OF SUB-GROUP H

"TRANSFORMATION IN REFINERIES"

Chairman : J. SIRCHIS

Secretary : J. MARRIOTT

RATIONAL USE OF ENERGY

Interim report of Sub-group H
"Transformation in refineries"

The second meeting of sub-group H was held on 17 and 18 June 1975. The Irish and Netherlands delegations took part for the first time in the work of the sub-group. The Belgian representative has still not been named.

Participants confirmed that own use in refineries had already been reduced by between 10 and 20%, according to plant, since the months immediately following the crisis in 1973. These results have been obtained, above all, by the strengthening of instructions given to personnel and a stricter control of operations. Generally speaking, during this period, only minor modifications have been made to plant intended to reduce own-use. Since that time, the majority of refineries have worked out and/or initiated major investment programmes covering several years aimed at reducing still further own-use in refineries. These programmes could lead, for the most modern refineries, to gains of 25 to 30% with respect to 1973 as is already the case for certain plants in the USA.

These findings point to two courses of action within the mandate of the sub-group:

1. To encourage the exchange of information and experience in order to extend to the whole of the refining sector the positive results achieved at plant level in the various Community refineries. Action should be taken by means of a standard list of operating instructions which will be forwarded to all the refineries of the Community. The sub-group has collected the necessary data from several refineries, has standardised and completed existing instructions and prepared the document whose distribution should begin in July.

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2. To ascertain the actual situation in the refining sector as regards the economies already achieved and new measures which are being taken. For this purpose, a questionnaire is in preparation which will be addressed to the governments of the Member States in September at the latest. The delegates realise that problems will arise in distinguishing own use in refining from the consumption of petrochemical plants when the two activities are integrated. In this connection, they wish to see the problem of the petrochemical industry studied jointly with sub-group E. In order to guarantee the confidential nature of the information, the replies to the questionnaire will be processed by the same method as the documents relating to Regulations 1055 regarding imports and 1056 regarding investments.

INVESTIGATION OF ENERGY CONSUMPTION BY REFINERIES

GENERAL DATA

Company :

Address of Refinery : telephone :

telex :

Commissioning date :

Crude processed :

1973.....tonnes

1974.....tonnes

Yield :

1973.....tonnes

1974.....tonnes

Type of refinery* :

AD	VD	CC	HC	CR	TR	V	H		

* Underline units installed. (AD - atmospheric distillation ;
VD - vacuum distillation ;
CC - catalytic cracking ;
HC - hydrocracking ;
CR - catalytic reforming ;
TR - thermal reforming ;
V - visbreaking ; H - Hydrotreating)

If there are any other units installed at the refinery, please give details.

GENERAL DATA
(cont^{d})

Heat and oil losses incurred during treatment

If possible, give estimates of the breakdown of heat and oil losses arising during treatment

Heat losses	% of total energy consumed
a) To atmosphere b) In exhaust gases c) In cooling water	
Total heat losses	

Oil losses	% of total fuel consumed
a) Water in crude oil b) By evaporation c) Oil in effluent water and spillage, if any d) Flares	
Total oil losses	

I. DIFFERENCE BETWEEN REFINERIES OWN CONSUMPTION IN 1973 and 1974

Please give the relevant figures for the two years in question

Year	Fuel consumed (t.o.e.)	Electricity consumed	
		Own production (t.o.e.)	Mains electricity (t.o.e.)
1973			
1974			

II. INCREASE IF ANY IN OWN CONSUMPTION

If appropriate, indicate the increase in own consumption noted between 1973 and 1974 that could be ascribed to :

a) the commissioning of new units ;

b) a change in the quality of crude ;

c) an increase in the severity in processing ;

d) a modification in the range of products ;

e) the under-employment of the capacity of any plant ;

f) the implementing of environmental protection standards.

Year	Fuel consumed (t.o.e.)	Electricity consumed	
		Own production (t.o.e.)	Mains electricity (t.o.e.)
1973			
1974			

III. MEASURES FOR REDUCING OWN CONSUMPTION

A. Measures already applied since 1973 up to the present time

Where a saving of energy has been obtained indicate the reduction in own consumption obtained as a result of each of the following kinds of measures.(1)

1) Stricter operating practices

Year	Fuel savings (t.o.e.)	Electricity savings	
		Own production (t.o.e.)	Mains electricity (t.o.e.)

2) Modification of plant

Year	Fuel savings (t.o.e.)	Electricity savings	
		Own production (t.o.e.)	Mains electricity (t.o.e.)

(1) Using Annex 1, please indicate principal points of application of these measures.

B. Programmes being introduced in 1975 and 1976

If any programmes are being introduced or are due for introduction shortly, indicate the additional reduction in own consumption to be aimed at.(1)

Year	Fuel savings (t.o.e.)	Electricity savings	
		Own production (t.o.e.)	Mains electricity (t.o.e.)

Note : If appropriate, indicate the foreseeable increase in fuel consumption which is related to the introduction of measures for the protection of the environment (i.e. reducing lead in gasoline, and sulphur in fuels)

.....t.o.e.

C. Programmes to be introduced from 1977 to 1980

If medium-term programmes are being considered, give the additional savings in own consumption to be aimed at.(2)

Year	Fuel savings (t.o.e.)	Electricity savings	
		Own production (t.o.e.)	Mains electricity (t.o.e.)

Note : If appropriate, indicate the foreseeable increase in fuel consumption related to the introduction of measures for the protection of the environment

.....t.o.e.

(1) Give details of the programme using Annex 2.

(2) Give details of the programme using

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III.A. MEASURES ALREADY APPLIED SINCE 1973 UP TO THE PRESENT TIME

	Tightening up of operating instructions(1)	Modification of installations	
		(1)	Total invested(2)
Furnaces and boilers			
Heat exchangers			
Waste heat recovery			
Insulation			
Steam systems			
Flares			
Electricity			
Storage and handling			
Fractionation			
Other processes			
Miscellaneous			

(1) Mark with a cross, those operations which have resulted in a reduction in own consumption and if sizeable savings have been made, please indicate the amounts.

(2) If applicable.

III.B. Programme being introduced in 1975 and 1976

	Estimated savings			Estimated date of commissioning	Forecast of Estimated Total Investment (2)
	Fuel (1)	Electricity (1)	Steam (1)		
Furnaces and boilers					
Heat exchangers					
Waste heat recovery					
Insulation					
Steam systems					
Flares					
Electricity					
Storage and handling					
Fractionation					
Other processes					
Miscellaneous					

(1) Expressed as t.o.e.

(2) If no investment is involved, please indicate the expected operational savings (if applicable)

III.C. Programmes to be introduced from 1977 to 1980

	Estimated savings			Estimated date of commissioning	Forecast of Estimated Total Investment (2)
	Fuel (1)	Electricity (1)	Steam (1)		
Furnaces and boilers					
Heat exchangers					
Waste heat recovery					
Insulation					
Steam systems					
Flares					
Electricity					
Storage and handling					
Fractionation					
Other processes					
Miscellaneous					

(1) Expressed as t.o.e.

(2) If no investment to be involved, please indicate the expected operational savings (if applicable)