COMMISSION OF THE EUROPEAN COMMUNITIES

COM(84) 614 final

Brussels, 13 November 1984

TOWARDS A EUROPEAN POLICY FOR THE RATIONAL USE OF ENERGY IN THE BUILDING SECTOR

(Communication from the Commission to the Council)

COM 614

TOWARDS A EUROPEAN POLICY FOR THE RATIONAL USE OF ENERGY IN THE BUILDING SECTOR

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BACKGROUND STATEMENT

Re : "For a European policy of rational use of energy in the building sector" (Communication from the Commission to the Council)

1. On 9 June 1980, the Council of the European Communities adopted a resolution [1] concerning new lines of common action regarding the energy saving. This resolution defined the guidelines of an outline programme and recommended all Member States to take a series of measures to encourage the rational use of energy in the building sector.
2. The activities carried out by the Member States in the field of energy have been recently analysed by the Commission [2]. Several actions have also been carried out at the Community level in the same field.
3. From the energy point of view, the building sector, domestic and tertiary, is the most significant, regarding its energy consumption (38% of the total consumption of the Community) as well as saving potential (approximately 50% of the total saving potential of all sectors).
4. The Commission believes that the exploitation of this savings potential in the building sector (potential estimated to 75 Mio TOE/year of primary energy saving at the horizon 1995) is possible by way of rational use of energy, itself encouraged by the general extension of on-going activities and the communion of efforts at the private, public, national and Community levels.
5. After having recorded the economic importance of the building sector in the EEC and the objectives and gains that such a European policy implies, this Communication lays down some guidelines for action based upon the forecast programmes of the Member States or of the Community :
   - promotion of the thermal auditing of buildings;
   - technical improvements and regulations;
   - optimal usage of financial resources;
   - information and users' behaviour.
6. The objectives and the energy saving potential are described in Annex A. The present situation in the sector (energy consumption; prices policy; regulations and actions at the Community and at the Member States level) is described in Annex B. A methodology for the thermal diagnosis is described in Annex C. The actions already carried out by the Community are detailed in Annexes D to H.

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[1] OJEC C.149 of 18 June 1980
[2] COM(84)87; COM(84)88; COM(84)36 (Communications from the Commission to the Council)

INTRODUCTION

The building sector in the EEC

1. Together with manufacturing industry, agriculture and transport, the building sector (combined with civil engineering) is one of the basic branches of the economy in industrialized countries.
The economic ramifications of this sector, residential and tertiary, are extremely widespread, ranging from component manufacture (materials, equipment and systems) upstream to use and operation by occupants and managers downstream, through design (engineering) and construction proper.
A few statistics will put the building industry into context in the Community economy :

- contribution to total Community added value (building and civil engineering): 7%
- directly employed workforce: 8 million
- annual investment (building): 210 thousand million ECU, broken down as follows:

new dwellings:	90	components:	65
other new buildings:	60	engineering:	15
maintenance and renovation:	60	construction:	130
	210		210

Objectives and challenges of a European policy for the rational use of energy in the building sector (domestic and tertiary)

2. With a final energy consumption of 248.5 million t.o.e. in 1982 (i.e. 0.9 t.o.e. per capita) the domestic and tertiary sector accounts for over 38% of the Community's total energy consumption. Of even greater significance is the fact that there is considerable potential for saving energy in this sector - a potential which so far has hardly been tapped. The Commission

estimates the possible savings at 75 million t.o.e. (of primary energy) per annum [1]; it believes that a reduction in energy use on such a scale can be achieved by 1995 at reasonable cost to the economy.

The economic viability of the investments required is discussed in Annex A. By way of illustration, it is roughly true to say that the economically acceptable worst case is a ten-year gross payback time, corresponding to an investment of 3 500 to 4 000 ECU per t.o.e. saved annually. The average is about four years, corresponding to an investment of about 1 500 ECU per t.o.e. saved annually.

3. Above and beyond the objective of reducing energy consumption by 75 million t.o.e. annually, the proposed action should contribute to:

- reducing the Community's dependence on energy imports and improving its trade balance [2];
- promoting the investment of 8 000 to 9 000 million ECU per annum in the building sector [3];
- galvanizing the economic operators (manufacturers; distributors; contractors; consulting and other engineers). A total of 3 million jobs might be affected by the programme, 400 000 [4] of them being new;
- reducing expenditure on energy by consumers in the domestic and tertiary sector by 25 000 to 30 000 million ECU per annum in 1995.

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[1] About 30% of the sector's total energy consumption. See Annex A.

[2] In 1982 the Community's energy bill was 3.6% of its gross domestic product.

[3] See Annex A.

[4] Equivalent to 20 000 - 23 000 ECU for each job created, a relatively low figure owing to the non-mechanized nature of much of the work of the building trades, in which labour still accounts for a large share of costs. These figures must be treated with caution, however, for they depend to a great extent on the ability of the industry to expand and on its scope for increasing productivity.

4. The last ten years have seen a variety of policies in operation at both Member State and Community levels. There have been results, but partial and inadequate ones. Simply to continue present programmes without substantial change would be to fail to take full advantage of the potential for energy saving in the building sector.

The Commission is aware of the recession in the building industry as a sector of the economy and of the general scarcity of public resources. But what is at stake and in prospect for the future:
- reduction of dependence on imported energy,
- the generation of investment,
- galvanizing of the economic operators concerned,
- and a big reduction in spending on energy by many classes of user,

is such that it is worth making an overall effort at national and Community levels to realize the potential for energy saving. Previous efforts are worth amplifying and optimizing, and only by combining those efforts - private and public, national and Community, and regional and local especially - will make it possible to capitalize on past progress and experience.

The challenge is undoubtedly a difficult one, so diverse and dispersed are the decision-makers and users in this sector of the economy; the complexity of the matter is reflected in its many dimensions :

- **the institutional dimension:** central-government agencies; regional authorities; local authorities; national, regional and Community financial institutions, both public and private;
- **the socio-professional dimension:** private domestic-sector users (sometimes formed into interest groupings), landlords, property management companies (the investor/user dichotomy, the diverging interests of landlords and tenants), private tertiary-sector companies (commercial, office and hotel businesses), public services (education and health-care establishments, offices, leisure centres), housing associations and companies formed to build and let controlled-rent housing;
- **the economic dimension:** large and small employers in the building trade and independent craftsmen;
- **the physical dimension:** the nature and variety of types of buildings, climate and geographical environment.

In this context the Member States (central-government, regional and local authorities) and the European Economic Community have an important part to play in catalysing endeavours, rationalizing and expanding the most effective schemes of action and identifying guidelines for action in order to achieve a European policy for the rational use of energy in this sector.

5. The guidelines for action proposed by the Commission are based on earlier programmes already put into operation in the Member States or by the Community [5]. A detailed review of the present situation in the sector is set out in Annex B [6].

The primary aim is to take maximum advantage of previous experience by systematizing and rationalizing endeavours and by a general raising of requirements for energy performance.

The Commission intends particular emphasis to be placed upon:

- promotion of thermal auditing as an essential prerequisite to the extensive upgrading of the energy efficiency of the existing building stock;
- the dissemination of successful experience and preparation of a "reference code";
- placarding the nominal energy consumption of buildings;
- an attempt to make financing procedures more effective.

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[5] The background to this communication is chiefly made up of :
a) A Council Resolution of 9 June 1980 (O.J. of the European Communities No C 149, 18.6.1980) recommending that all Member States take steps to promote the rational use of energy, particularly in the building sector;
b) Two communications from the Commission to the Council (COM(84)87 final and COM(84)88 final) which analyse and compare the Member States' energy policies;
c) A communication from the Commission to the Council (COM(84)36 final) comparing the Member States' Energy-Saving Programmes.

[6] Energy consumption - Pricing Policy - Programmes at Community and Member State levels.

GUIDELINES FOR ACTION

Promoting the thermal auditing of buildings

6. A major obstacle to the execution of alterations to improve the energy efficiency of existing buildings lies in the difficulty that owners and occupants have in determining which forms of action are most effective in reducing their energy consumption.
Thermal auditing of buildings is an essential decision-making aid, for it provides the decision-makers concerned (local authorities, owners of controlled-rent housing, private individuals, etc.) with all the information needed to select which improvements to make to their buildings: the thermal characteristics of the building and its equipment, possible forms of action (energy saving and/or alternative energy sources), cost, energy savings and return on investment provided by each of the alterations envisaged. Thermal auditing can achieve its purpose (namely, to lead to decisions on alterations) only if it is complete and objective. Training schemes and strict rules for those carrying out thermal auditings are essential to ensure that they are of high quality (reliability of methods, compliance with specifications, etc.) [7]

Thermal auditing is common practice in two Member States, Denmark and France; Annex C provides a good description of the methods developed in France.

The Commission is of the opinion that the widespread practice of thermal auditing is an essential prerequisite to the extensive upgrading of the energy performance of the existing building stock. At present it is common practice in only a minority of Member States. An effective way of promoting it might be to make it compulsory on the occasion of every property transaction [8].

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[7] The approximate costs of thermal auditings are as follows:

. Detached house :	250 ECU
. Apartment block, fewer than 50 dwellings:	1 500 to 3 000 ECU
. Apartment block, more than 50 dwellings:	3 000 to 5 000 ECU
. Tertiary-sector premises, less than 1 000 m2:	500 to 1 000 ECU
. Tertiary-sector premises, 1 000 to 5 000 m2:	1 000 to 3 000 ECU
. Tertiary-sector premises, over 5 000 m2:	3 000 to 5 000 ECU

[8] Since this point also has regulatory implications it is taken up again in paragraph 16.

7. In order to promote the procedure whereby a thermal auditing of a building is conducted before a coherent work programme is formulated, the Commission proposes to put in hand an **illustrative programme for upgrading the energy performance** of the public buildings in several towns in the Community [9]:

(a) selection of one or two towns with 10 000 to 40 000 inhabitants in each Member State; a list of buildings to be thermal-audited of each of them to be drawn up: public administrative offices, school and university buildings, sports centres, health-care establishments, etc.;

(b) thermal auditing of these buildings;

(c) assessment of the thermal auditings carried out, comparison of the methods employed, monitoring of illustrative projects in order to refine our understanding of these building categories and work out dissemination action which might be undertaken following the illustrative programme;

(d) public-awareness and information campaign on the methods used and the results of thermal auditings and illustrative projects in order to provide an incentive for all those responsible to take similar action on buildings managed by them.

After defining the technical requirements for thermal-auditing and the scope for it (i.e. the building categories to which it will apply), the Commission intends to finance expenditure relating to points (b), (c), and (d) above (Article 704 of the Budget). The estimated total cost of this programme is as follows:

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[9] Projects selected from those put forward for thermal auditing will be carried out by the Local Authorities concerned with specific aids from the Member States if necessary.

	(MECU)
(b) Thermal auditings	1.8
(c) Assessment and follow-up	0.3
(d) Information campaign	0.4
Total	2.5

The Commission will subsequently consider the desirability of embarking upon further programmes on other categories of buildings: low-cost housing (flats), offices, large trading establishments, hotels, etc.

Technical improvements and Regulations

8. This second guideline takes many forms and affects both new and existing buildings. There are two sets of aspects:
   - **technical:**
     - specifications and harmonized methods of calculation
     - research, development and demonstration
     - reference code
   - **regulatory:**
     - energy performance of new buildings
     - incentive schemes
     - illustrative action by the authorities in respect of public building construction
     - energy performance of existing buildings
     - energy consumption placarding.

9. There are important needs in terms of **technical specifications** and **harmonized methods of calculating the energy performance of energy-saving products**, in particular to provide a guarantee of the quality and energy performance of components.

As regards products intended for buildings (materials, components, equipment and systems to promote the rational use of energy) the Commission will set priorities to accord with the formulation of the European Code for Energy Saving in Building (see paragraph 11).

The ways and means used by the Commission will include in particular the facilities provided by international bodies operating in this field (ISO, European Committee for Standardization, etc.).

10. The first Framework Programme for Community Scientific and Technical Activities for the period 1984 to 1987 (COM(83) 260 final), which was the subject of the Council Resolution of 25 July 1983 [10], points out in the introduction that among the desired objectives special importance should be attached to Community **Research - Development** and **Demonstration** activities; regard will be had to this policy in implementing the proposed projects.

With regard to **Research and Development**, techniques to be developed will be reviewed in order to identify priorities for the Community programme fully coherent with national programmes.

As regards **Demonstration**, major programmes are already in progress in the building sector, at both national and Community levels. The Commission intends in future to give priority to the most promising fields, e.g.:

- upgrading the energy performance of large dwelling blocks, low-cost housing in particular;
- upgrading the energy performance of public buildings (administrative and office premises, school and university buildings, sports centres, hospitals, etc.);
- procedures and methods which produce a substantial change in user behaviour (regulation and control, programming, individual billing, etc.).

With a view to ensuring that national and Community action are better coordinated, the Commission will continue to use the Advisory Committee for the Management of Demonstration Projects (ACMDP) as a standing means

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[10] OJ No C 208, 4.8.1983.

of joint consultation and coordination to improve the exchange of information on the assessment of results from the various programmes, the dissemination of the results and the direction to be imparted to the programmes.

11. The Commission will draw up a code on energy saving in building which will be used as a "**reference code**" for the entire Community. The reference code will bring together the technical rules, qualitative and quantitative, and the procedures required to achieve the optimum level of energy consumption possible in the building sector.

This scheme of action is justified by the wide margin between measures adopted by Member States and what is technically feasible and economically warranted; moreover, though major endeavours have been mounted in research, development and demonstration and great successes have been chalked up by national and Community programmes, not all have found practical applications - though this is their intended purpose.

A reference code, with its objectives set at the highest level that is technically and economically feasible would therefore constitute:

- a standard for the effort that could still be put in by each Member State (having regard in particular to diversity of climate);
- a target for the convergence of national policies;
- a means of supporting the translation of research results into practical applications;
- a valuable guide for the work of the professions, trade and industry in orientating their activities.

For drafting the reference code the Commission will make use of the feasibility study of a model European code for energy saving in space heating (see Annex B, paragraph 5). Once published by the Commission, the European Code, if it is to remain operative, will need to be updated and revised periodically.

12. Regulatory action is an appropriate means of **improving the energy performance of new buildings**, since every construction project is already subject regulations with regard to town planning, safety, etc. Furthermore, at very little extra cost (about 3-5% of the total cost of the building), energy consumption can be reduced by at least 30%. It is therefore economically warranted to make such investments mandatory, since the return on expenditure is much better than with equivalentaction on existing buildings. [11]
Most Member States [12] have **laws and regulations on the heat performance of new buildings**. There is great variation in these regulations, however, in terms both of methods and of the levels of energy performance required. The Commission will examine all appropriate measures designed for the formulation of regulations relating to minimum requirements for insulation, the control of heating, ventilation and air conditioning systems; the overall aim will be to make mandatory a high but economically warranted [13] level of energy performance.

The European Code on Energy Saving in Building (see paragraph 11) will provide a yardstick for the strenthening of national regulations relating to new buildings. In addition, the comparative survey of heat insulation requirements in EEC countries published in 1978 and 1980 (see Annex E, paragraph 2) will be regularly updated.

13. Schemes to **encourage the construction of new buildings with improved energy performance** should also be undertaken. Regulations on heating should be strengthened in stages, having regard to changes in energy tariffs and progress with energy-saving techniques. In the Commission's opinion the Member States should:

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[11] Insulation, on walls and windows in particular, is between 2 and 4 times less expensive during construction than when applied retrospectively. This would also be a forward-looking policy: 20% of buildings which will be standing in the year 2000 have not yet been built; most of the buildings now standing will still be in use at that time - and will still be using energy several decades from now.

[12] See COM(84)36, Annex I, page 4, table 1.

[13] Account will also be taken, however, of possible adverse effects: for example, excessive additional building costs might further aggravate the position of this industry, which is already in a state of crisis; hence the attraction of giving several years' advance notice of tighter regulations (see paragraph 13).

- give several years' notice of the coming strengthening of the regulations, with quantitative objectives;
- use a "method of calculation" [14] for determining the energy saving achieved by a new building with a high energy performance compared with a reference design built in accordance with the existing regulations, and to make provisions for the "labelling" of new buildings with the best levels of performance, (e.g. buildings at least 20% more economical than is required by the regulations);
- run schemes vocational training for trades and professions engaged in construction (architects, engineering, contractors and craftsmen). [15]

Arrangements along these lines would foster the development of techniques and processes with the highest levels of performance and open up markets for them, and have the effect of preparing building-industry professionals and the manufacturers for the introduction of strengthened regulations on heating and insulation.

14. The Commission is of the opinion that national, regional and local authorities should **incorporate high levels of energy performance in specifications drawn up for public invitations to tender**: new public buildings should set an example of the rational use of energy. The Commission accordingly calls on the Member States, if they do not already do so, to lay down requirements for energy performance in specifications for invitations to tender for the construction of public buildings. These measures could either be confined to buildings put up by the State or be extended to those put up by public establishments, local authorities and para-public bodies responsible for low-cost housing.

Should there already be regulations relating to heat performance for the buildings in question (residential or non-residential) requirements exceeding the existing rules should be brought in. Otherwise, specific rules for public buildings should be laid down.

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[14] This would be developed at the Commission's initiative.

[15] Action is also needed at the initial training stage (technical schools, universities, etc.) to teach specific aspects of energy-saving techniques and the use of renewable energy sources.

15. Schemes for **improving the energy performance of existing buildings** are based primarily on incentive measures, since any form of regulation is difficult to frame, implement and enforce in this field. However, standards similar to those for new buildings (see paragraph 12) should be laid down and heat-performance upgrading work should be carried out whenever a major refurbishment programme is carried out on existing buildings. The Commission will examine all special measures in this field (requirements for thermal auditing or even specific regulations which make certain energy-saving modifications mandatory) in order that it may send the Council a proposal for a directive or recommendation along these lines. Furthermore, the Member States should ensure that there is better inspection of heating, air conditioning and ventilation systems.

16. The last field in which the Commission considers regulations to be of benefit relates to **market transparency** through the **placarding of nominal energy consumption**. The requirement for a thermal auditing prior to any property transaction was mentioned earlier (see paragraph 6).

This measure might also be extended to new buildings and include the mandatory production of a certificate: either the building meets the regulatory standards or it does not, in which case the certificate gives an itemized, quantitative list of the work needed. The certificate should in any case state the building's nominal energy consumption.

The Commission will examine whether a proposal for a directive along these lines could be sent to the Council, on the basis of experience with similar schemes run by the Government in some Member States.

Optimum use of funds

17. A large number of programmes of financial assistance for investment in energy saving or substitution have been instituted by national, regional or local authorities under their energy policies;

Schemes of this kind are a matter for the Member States; they can identify the forms of action best suited to the various categories of investor (local authorities, businesses, private individuals, institutional landlords).

18. The Commission believes that it is necessary to seek greater effectiveness for public aids for these national programmes and that this could be done by:

- examining the various financial incentives now available, so that the most effective measures taken by certain Member States can serve as models;
- confining aids to investments most effective in saving energy, i.e. those with a ratio of cost per t.o.e. saved below a stated limit (which will be variable according to the country and sometimes to the form of energy or type of investment [16]) and by taking account as well of the total energy saving over the lifetime of the equipment;
- seeking to put some driving force behind the widespread dissemination of high-performance techniques or the development of work programmes: the Commission is of the opinion that the Member States should, at least in some cases, provide financial assistance for "high energy-performance construction projects"; such financial assistance seems to be a useful means of encouraging owners and promoters to incur additional building costs, especially in the early stages as a way of initiating the process which will lead to the future regulations (the amount of assistance can be reduced progressively with the approach of the date on which the new regulations come into force);
- giving preference to those types of work of greatest benefit to society at large;

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[16] In this connection see Annex A, para. 3. Logically, "high-return" work (e.g. with a payback period less than two years) should not attract official aids. Experience shows that these jobs are generally on a small scale compared with those with a payback period between e.g. two and ten years. Moreover, the dividing line between "high-return" and "medium-return" is difficult to draw with any precision. A further point is that many jobs, particularly those with the lowest return (wall insulation, for example), may be regarded as meeting many criteria, i.e. they contribute not only to improving thermal performance but also to improving noise levels and draught proofing, the creation of improved social conditions in dwellings, etc. It must therefore be borne in mind that energy-saving programmes affecting the existing housing stock may also be overall modernization programmes for run-down buildings.

- providing certain classes of building owner or manager with strong motives by fulfilling objectives over and above the rational use of energy (improved comfort, refurbishment of run-down buildings, etc.) and by introducing machinery for guaranteeing the results and controlling the quality and cost of work;
- taking account of the specific problems affecting the trades and professions concerned (level of activity in the building industry, etc.) and of the impact on employment of action taken;
- adopting the necessary supporting measures: training for various trades and professions (particularly in new techniques), information and publicity schemes, etc.;
- using organizations or bodies to act as relays to provide local support and promotion for these aid programmes, thus considerably enhancing the impact of financial assistance, particularly for private individuals, small traders, etc.

19. The amount of funding required makes borrowing a necessity. The Commission intends accordingly:

- to reaffirm the availability of loan instruments with a view to extending the financial assistance given by them; and
- to study with the European Investment Bank and the Member States' relevant organizations what changes could be made to present lending procedures for them to become better suited to the proposed guidelines for action.

Furthermore, action such as that conducted under the "Fonds Spécial de Grands Travaux" (FSGT, Special Fund for Major Projects), where the Agence Française pour la Maîtrise de l'Energie acts in some sense as a transmission belt between the European Investment Bank and local authorities, would appear to set an example which should be more widely followed [17].

Energy producers and distributors, and certain financial institutions, might also offer contracts under which investments costs are paid back by the yields from the savings made.

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[17] The Commission will make a detailed study of this scheme and consider the form in which similar action could be taken in the other Member States.

User information and behaviour

20. It is essential to collect, analyse and compare all available data, evaluate action taken and design and propose the most appropriate methods for the full dissemination of information.

With this in view the Commission proposes to set up a panel of experts with the following main tasks:

- to collect, analyse and compare all information on national programmes;
- to design and implement schemes for disseminating the resulting information, results of evaluations and analyses;
- to collect detailed macroeconomic statistics on energy consumption;
- to follow up Community objectives, directives and recommendations;
- to spell out policy guidelines for Community action, ensure that they are coordinated with national programmes and formulate fresh proposals to be put to the Council.

The Commission calls on the Member States to make the assessment of their own actions standard procedure, and to send it full information on their programmes and the results from them; since such exchanges of information should make it possible to raise the technical standards of many of those taking part, to expedite the development of certain schemes, improve the effectiveness of various programmes and reproduce successful experiments on a wide scale.

Regarding existing Community programmes (research, development and demonstration), results and findings will need to be widely disseminated. The Commission has begun to hold conferences and publish papers and brochures on such undertakings. This form of action is being expanded in view of progress made with these programmes, notably by means of computerized data sheets (SESAME sheets) which will shortly be made available to the general public through EURONET.

21. Action to change user behaviour takes a variety of forms under national programmes: it may be through laws, regulations, etc. (limiting temperature in heated buildings, limiting night lighting, etc.); but the chief form is that of awareness-creation and information campaigns. Action such as this is inexpensive and may be highly effective: France, for example, saves an estimated 10 million t.o.e. annually in buildings as a result of changes in behaviour since 1974. The Commission is of the opinion that Member States must continue to inform the public - particularly during periods when real energy prices are stable or falling.

For large property-managers in both public and private sectors a number of forms of action could be stepped up in the Member States to promote more economical behaviour patterns: appointment of specially trained energy officers, issue of guides to energy management [18], introduction of energy accounting systems (manual or computerized) individual invoicing of energy expenditure, etc.

The Commission will also endeavour to improve our understanding of the behaviour and aspirations of energy consumers and to get a better insight into the likely results of various measures envisaged in order to enhance the effectiveness of certain forms of action taken at Community or national level by making them better adapted to the psychological and social character of the population groups in question.

22. Manufacturers of **domestic appliances** generally make a big effort to design more energy-efficient appliances. It would be logical for this effort to be acknowledged in information terms by energy-consumption labelling. The aim here is both to afford due importance to the energy-consumption impact of domestic appliances [19] and to encourage the producers to push ahead with their efforts along these lines.

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[18] The Commission is now preparing energy-management guides for health-care establishments and the centralized energy management of communal buildings. A survey of private initiatives in this field (the Commission is aware that an energy-management guide has been produced for supermarkets and large stores) should be carried out and the Commission should help to promote such publications at the European level.

[19] And, hence, to improve user awareness.

Framework directive and an implementing directive relating to electric stoves [20] have already been adopted by the Council. The Commission intends to give fresh impetus to the examination of other implementing directives with a view to achieving a successful outcome.

CONCLUSIONS

23. In conclusion the Commission would like to emphasize :

- the importance of what is at stake regarding an economically safe exploitation of the energy saving reserves in the building sector;

- the indispensable nature of thermal diagnosis, a preferred aid to decision making for the energy rehabilitation of existing buildings; this approach should be employed on a large scale in particular by the institution of an illustrative programme of thermal rehabilitation of the public buildings in several towns in the Community, to which the Member States should lend their support;

- the necessity of following a programme of Research, Development and Demonstration carried out at Community level, based either on the existing legal framework of that which is currently being drawn up;

- the importance of a statutary approach for the improvement in the thermal performance of buildings to be constructed and those existing buildings to be renovated.

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[20] See Annex D, page D.2.

TOWARDS A EUROPEAN POLICY FOR THE RATIONAL USE OF ENERGY IN THE BUILDING SECTOR

ANNEXES

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ANNEX A

TARGETS FOR 1995 - ENERGY SAVING POTENTIAL

NEW BUILDINGS

1. Approximately 2 million new housing equivalents are built in the Community every year - some 1 400 000 of them new homes and the others 600 000 premises in the tertiary sector [1].

   Combined, the measures concerning new buildings (the legislation on insulation and settings in particular, though also the incentives to encourage more energy-efficient heating systems and so forth) should yield a primary energy saving of one tonne of oil equivalent (toe) per housing equivalent per year [2], giving a total of 2 million toe per year.

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[1] The number of housing equivalents in non-residential buildings is calculated from either the floor surface or the energy consumption of the buildings.

[2] This is the average energy saving compared with the (pre-1974) reference figure and includes the savings produced by the legislation on heating in new buildings since 1974 plus those expected from the new measures to be introduced over the next few years.

2. By 1995 the Community could therefore save 20 million toe by improving the energy efficiency of new buildings and of their heating systems.

HEATING IMPROVEMENTS IN EXISTING BUILDINGS

3. The energy saving potential of existing buildings is generally defined as the total energy saving made if all possible heating improvements are made apart from those which give no "reasonable return".

"Reasonable return" is difficult to define; so many criteria enter into play that no investment in heating improvements can be assessed purely and simply in terms of the energy savings attained.
For example,

(i) external insulation also resurfaces the façade, brightening up the neighbourhood in the process and, in some cases, stopping the ingress of water and correcting imbalances;

(ii) insulating glass also helps to reduce the noise from outside;

(iii) insulation of balconies can also stop seepage;

(iv) very often installation of new more energy-efficient boilers also reduces pollution or is in any case inevitable when the existing boilers are no longer serviceable.

Similarly, calculations of the return on the investment in energy saving must take due account of the life expectancy of the equipment or materials used (which ranges from a year or two in the case of lighting to several decades for insulation) and of the related recurrent costs (for maintenance, etc.) and define other specific economic parameters such as the discount rate, the consumer and import prices for different forms of energy and so forth.

A rough definition of "reasonable return" - should it still be deemed necessary despite all these reservations - would be a gross payback time [3] of less than 10 years or so or a maximum investment of between 3 500 and 4 000 [4] for each toe saved per year.

4. The Ispra Joint Research Centre has already advanced a tentative estimate of the potential for energy savings in existing buildings by constructing a mathematical model of housing stock in the Community in a model which it subsequently adapted to conditions in Italy. Climatic region, environmental features, and the heating performance and type of buildings are the main parameters included. A series of assumptions were made to simplify the model, for instance, the accent was placed on insulation and the model assumed uniform labour costs in every Member State. Nonetheless in essence the initial estimate agrees with the assessments made by the Agence Française pour la Maîtrise de l'Energie (AFME) in France.

To give an initial idea of the cumulative investment needed to produce a given energy saving, the results obtained at Ispra can be extrapolated to cover the housing stock in the Community.

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[3] Ratio, in years, between:

$$\frac{\text{investment cost}}{\text{reduction in energy costs compared with the first year}}$$

[4] This figure is likely to fluctuate appreciably, depending on how much energy is saved and on the country concerned.

Annual energy saving (in million toe)	Investment needed to achieve this energy saving (in thousand million ECU)
7	2 - 5
15	7 - 15
20	12 - 21
30	30 - 39
40	58 - 67
45	80 - 90

Table 1: Energy saving potential and the requisite cumulative investments.

5. Needless to say each successive "instalment" of energy saving is more expensive and harder to achieve than the one before. Table 1 provides a starting-point for assessing the average investment cost per toe saved per year for each instalment and, hence, for assessing the real potential for energy saving, bearing in mind the foregoing comments on the need for a "reasonable return".

Aggregate energy saving (in million toe per year)	Energy saving in this instalment (in million toe per year)	Average investment in this instalment (in million ECU)	Average investment to save one toe per year (in ECU)
7	7	3 500	500
15	8	7 500	950
20	5	5 500	1 100
30	10	18 000	1 800
40	10	28 000	2 800
45	5	22 500	4 500

Table 2: Investments to modernize existing buildings, by instalment.

6. The comments made on the need for a reasonable return automatically rule out the final instalment in Table 2 (the one raising the saving from 40 million toe to up to 45 million toe a year in return for an investment of 4 500 ECU per toe saved each year).

   Theoretically, however, it is therefore feasible, and "reasonable" to expect, to save around 40 million toe a year in existing buildings in return for a total investment of between 58 000 million and 67 000 million ECU - an average investment of around 1 600 ECU per toe saved per year, the minimum being around 500 ECU per toe and the maximum 4 500 ECU.

7. A similar figure emerges too if a different method of calculation is adopted:

   The Community's housing stock totals around 140 million housing equivalents (counting both the domestic and tertiary sectors), roughly 95% of which were built before the recent legislation on insulation came into force. This existing stock, with its mediocre average energy performance, holds considerable potential for energy saving.

   One possible target would be to modernize the heating arrangements in five or six million housing equivalents (4% of the stock) each year. Assuming an average primary energy saving of 0.6 toe per housing equivalent, this would give a total saving of roughly 3.5 million toe per year and, in all, of 35 million toe by 1995.

8. In the final analysis, this figure, slightly lower than the first estimate, seems the more realistic one - in other words, improvements to existing buildings can be expected to save 35 million toe a year from 1995 on.

CHANGES IN WAY OF LIFE

9. Lowering room temperatures by 0.5°C throughout the Community alone would save at least 6 million toe.

   Other changes of way of life (for instance, energy management in larger housing developments and more energy-efficient use of domestic electrical appliances and lighting) could also produce significant energy savings.

10. A primary energy saving of 9 million toe a year is a realistic target to strive for by more frugal energy use by 1995.

MORE ENERGY-EFFICIENT DOMESTIC ELECTRICAL APPLIANCES AND LIGHTING

11. On average, new appliances (domestic electrical appliances, lighting, kitchen appliances ans so forth) should be some 20% more energy-efficient by 1995. This in turn will allow a saving of roughly 11 million toe by that date.

SUMMARY AND 1995 TARGETS

12. The foregoing gives an idea of the potential for energy savings by 1995.

	Target (in million toe)
- New buildings (2 million housing equivalents per year)	20
- Heating improvements to between 5 and 6 million housing equivalents per year ..	35
- Changes in way of life	9
- Appliances and lighting with greater energy efficiency	11
T O T A L	75

The targets outlined above would thus yield a total primary energy saving in the domestic and tertiary sectors of 75 million toe a year from 1995 on.

ESTIMATED INVESTMENT

13. Paragraph 6 put the average investment cost per toe saved each year for existing housing at around 1 600 ECU. Energy-saving investments will also add to the cost of newly-built housing, albeit by less than the existing stock. Taking both categories of stock together, a figure of 1 500 ECU for each toe saved per year can be assumed.

14. No investment, in the strict sense of the word, is needed to change the way of life. On the other hand, industry will have to invest in the research, trials and new production processes and so forth required to improve the energy-efficiency of domestic electrical appliances and lighting systems. However, there appears to be no reason for including this outlay in this calculation in so far as industry has to invest in any case to cope with the constant rapid expansion of the market, even without making improvements to the energy-efficiency of its appliances.

15. Accordingly, this programme would call for an aggregate cumulative investment of between 80 000 million and 85 000 million ECU spread between 1985 and 1995 - in other words of approximately 8 000 million or 9 000 million ECU a year.

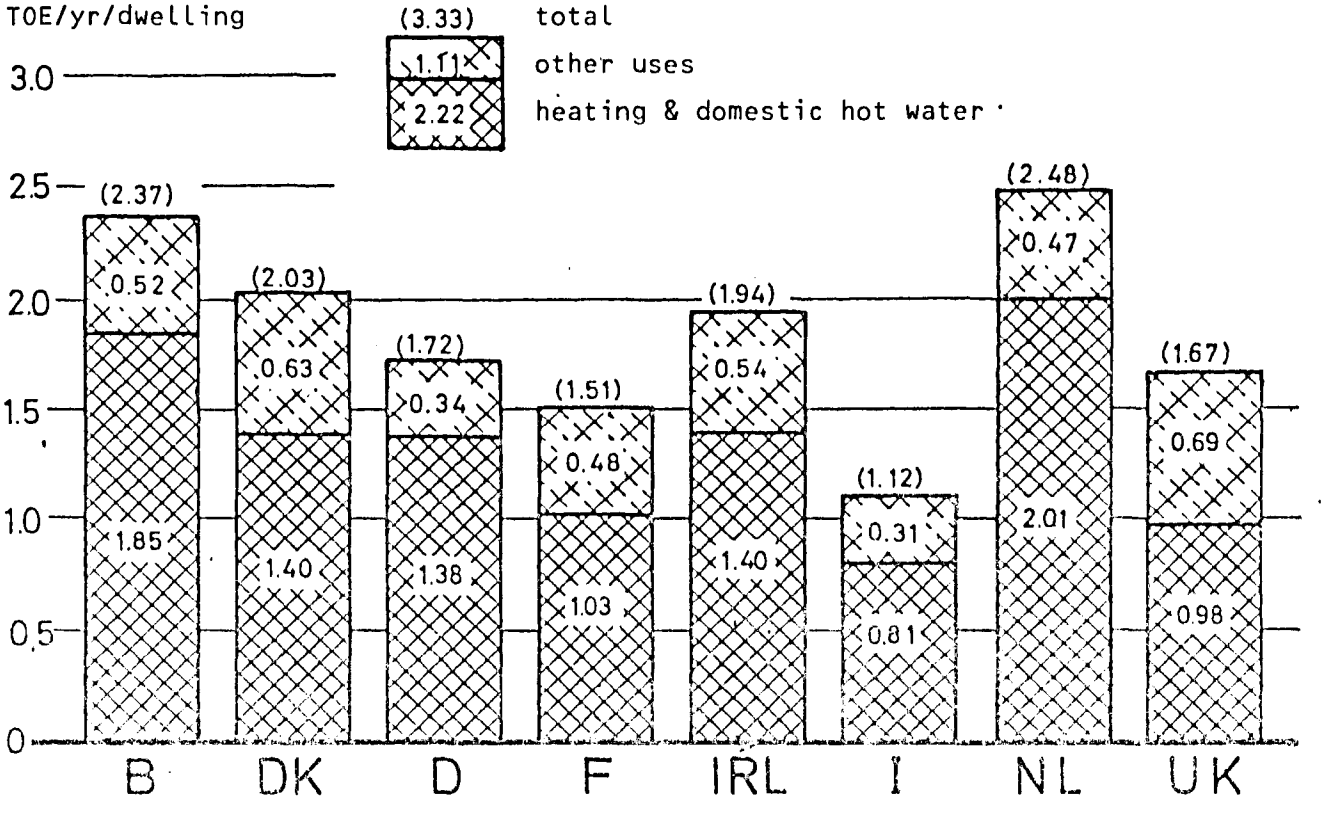
ANNEX B

CURRENT SITUATION IN THIS SECTOR

ENERGY CONSUMPTION

1. The domestic and tertiary sector has a wide variety of uses for energy : heating, ventilation, air-conditioning, production of domestic hot water, lithting, cooking, domestic appliances, office equipment, lifts, etc. In the domestic sector alone, the average annual consumption per dwelling tended to increase up to 1979 but has fallen since then. The differences between the Member States are considerable. This is illustrated by Figure 1 below.

Figure 1 - Domestic consumption per dwelling (1982)



2. The amount of energy consumed purely in order to heat dwellings is closely linked with (essentially climatic) external parameters, which partly explains the differences noted. Calculation of specific consumption per head of population and degree/day tends to compensate for the effects of climatic variations (see Table 1 below). Nevertheless it has been found that the Member States fall into three distinct groups :

- Member States with a low specific consumption (United Kingdom, Ireland) where, however, has been a regular increase in consumption. This can be explained by the spread of central heating, which is still in its infancy in those Member States;

- Member States with a high specific consumption (Belgium and the Netherlands), which is much higher than that of the other Member States of the Community;

- Member States whose specific consumption is falling below the average (Germany, Italy, France, Denmark). So far the efforts made by the last-mentioned Member State have yielded the most remarkable results.

Country	B	DK	D	F	IRL	I	NL	UK
Consumption	11.4	7.7	7.9	7.1	6.5	6.4	10.6	6.0

Table 1 : Annual domestic consumption for heating, expressed in MJ per person and per degree/day

PRICING POLICY

3. The policies governing the final consumer prices of the various energy sectors constitutes a major component of the rational energy use policy.

An analysis of the prices, inclusive of tax, of fuel supplied to customers in early 1983 identifies major differences. Thus Denmark charges energy prices which are much higher than the Community average. This applies to a lesser extent to France and Italy. On the other hand, the United Kingdom and Ireland charge distinctly lower prices than the Community average (in the latter case for coal).

Figure 2 below shows changes in energy prices in six Member States since 1970 in the form of a graph.

Figure 3 below enables the price of each energy product to be situated in relation to the Community average (for each country).

As shown in Table 2 below the proportion of spending on domestic heating/hot water production/lighting has changed in different ways compared with final consumption owing to the effect of price rises and differences in energy consumption patterns per dwelling.

Year	B	DK	D	F	IRL	I	NL	UK
1970	5.3%	4.6%	3.5%	3.1%	4.2%	3.3%	3.9%	4.7%
1974	5.4%	5.9%	3.8%	3.7%	4.9%	3.3%	4.2%	4.3%
1980	7.2%	8.2%	4.5%	4.6%	6.2%	4.0%	5.3%	4.7%

Table 2 : Houseld energy spending as a proportion of overall consumption (Source : SOEC-ESA).

The heavy energy spending by households can be explained by various factors) :

- high prices (Denmark);

- level of energy consumption higher than the Community average (Belgium, Netherlands);

- purchasing power lower than the Community average (Ireland).

The very moderate increase in household energy spending in Ireland and the United Kingdom can be explained by the virtual stagnation - at constant prices - of final consumer energy prices (including taxes).

4. As shown in Table 3 below, the structure of energy-product consumption in this sector has changed considerably owing to the effect of differences in price patterns, changes in the way of life (increasing use of central heating) and increases in purchasing power.

	1973	1981
Coal	13.4%	7.6%
Domestic heating oil	56.1%	42.2%
Gas	16.3%	30.5%
Electricity	14.2%	19.7%
Total	100.0%	100.0%

Table 3 : Consumption of energy products in the domestic and tertiary sector. Changes in distribution per energy source.

Figure 2

Small consumers. Energy price indicators.
Constant prices in national currency
(base 100 : 1970)

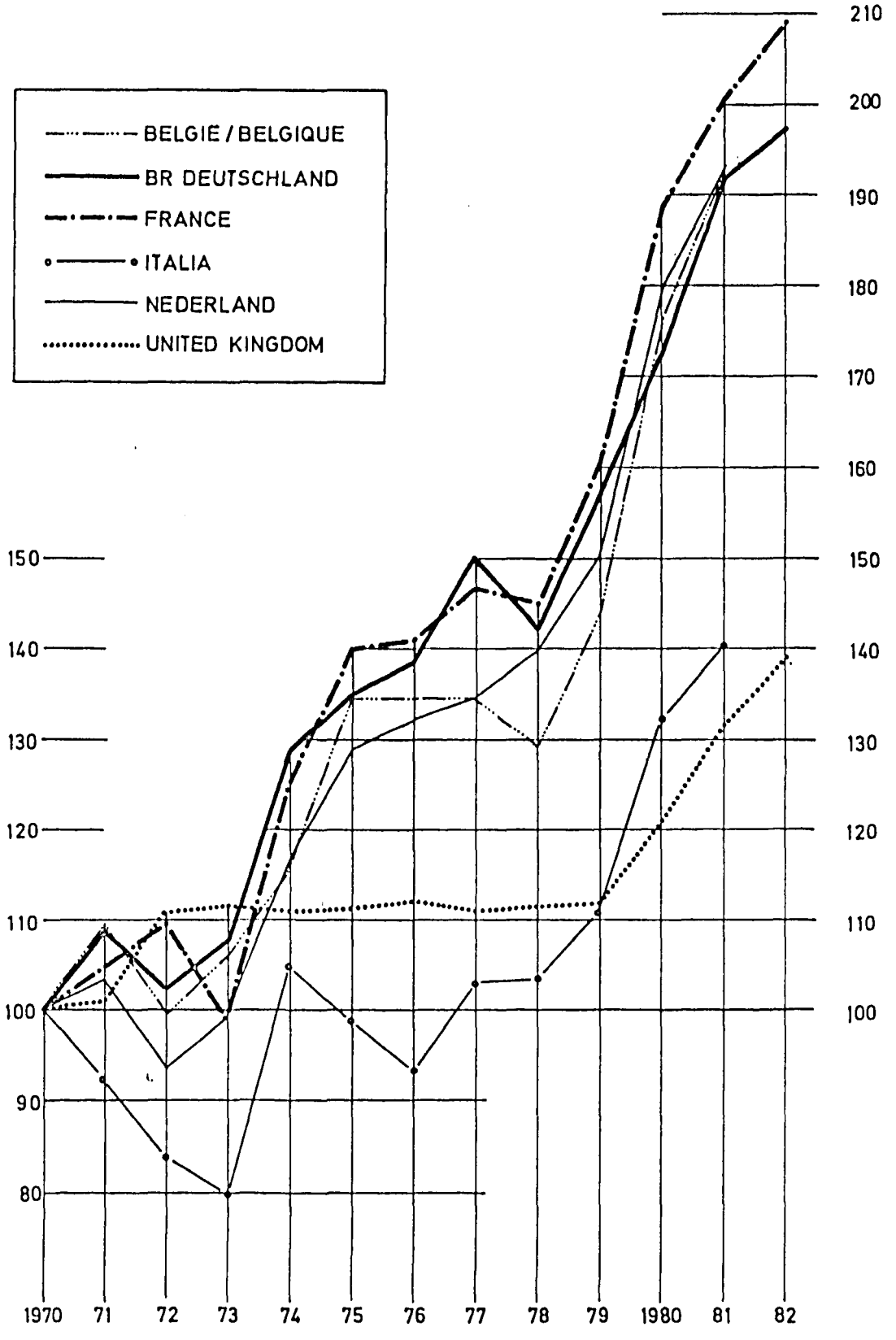
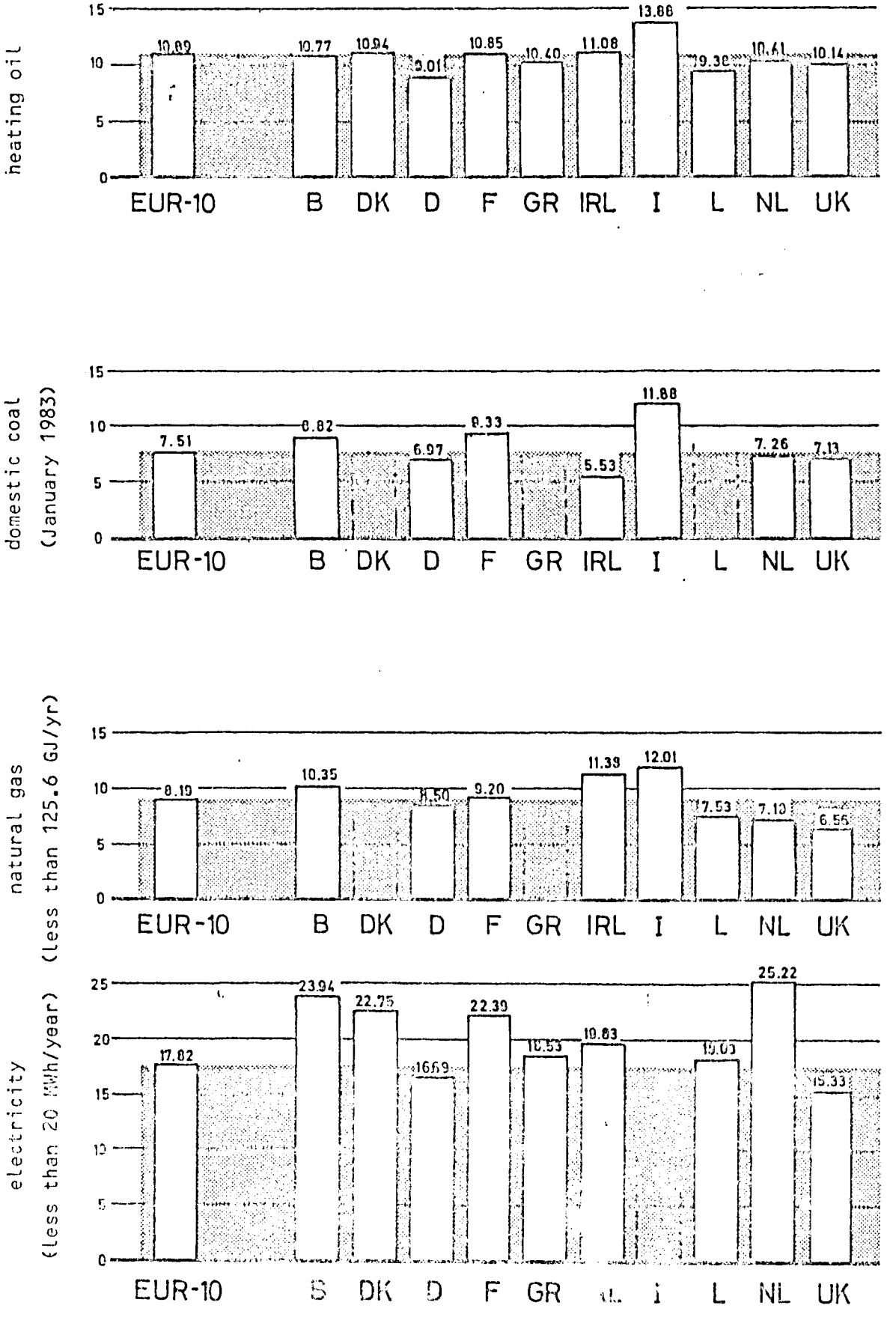


Figure 3 - Energy prices, inclusive of tax, for domestic consumers, expressed in PPS (Purchasing Power Standard) per Giga Joule. January 1984



REGULATIONS AND OTHER ACTIVITIES AT COMMUNITY LEVEL

Recommendations and Directives

5. In the field of rational use of energy in buildings the Council, since 1976, has adopted several recommendations on the heat insulation of buildings and on heating plant, the regulation of heating systems and heat measurement.

In addition, Community directives have been adopted in two areas : that of heat generator performance, and that of the energy (consumption) labelling of domestic appliances (outline directive and implementing directive on electric ovens).

Details of these directives and recommendations can be found in Annex D.

They are implemented in various ways with various deadlines, depending upon the Member States and areas concerned. However, it may be felt in general terms that these Community instruments have helped to speed up the adoption of national measures promoting rational use of energy in buildings.

Studies

6. Several studies have been recently carried out on the Commission's prompting. They are particularly interesting starting points for the line to be followed by future work. More details are given in Annex E.

Harmonization

7. Several activities concerning both building design and the design of products intended for the building industry are under way as part of the harmonization of national measures (see Annex F).

These activities relate to the building trade overall. In an energy context they are more specifically concerned with insulating materials, insulation glazing and solar collectors.

Research and Development

8. Two R&D programmes in the energy field were approved by the Council in 1975 and 1979. The second programme, the budget for which is 105 million ECU, ended in June 1983.

The work on reducing the energy consumption of buildings was carried out in two sub-programmes : energy saving and solar energy. The third four-year programme is in preparation.

Basically these programmes aim at providing the technical means for obtaining a long-term reduction in the consumption of energy by buildings of 50%.

Sixty contracts concentrating on the following topics were concluded under the sub-programme on energy saving (1979-1983) :

- development of heat pumps, particularly of the absorption type;

- improvements to conventional heating systems and to regulators;

- improvements to wall and roof insulation; development of reflective films for existing glazing;

- reduction of air ingress;

- computer simulation for low-energy building design calculations.

The solar R&D subprogramme deals with the development of passive and active solar systems and with the preparation of guidelines for solar-system design.
Council is examining the third programme (1984-1987).
The list of available reports on these activities is contained in Annex G.

9. In addition the Joint Research Centre, Ispra, is working in several areas under the solar energy subprogramme and especially on passive technologies in the building sector and on heat storage.

Two projects have also been launched : one on information acquisition and the other on energy diagnostics in relation to existing buildings (cf. Annex H).

Demonstration

10. In order to promote the full-size application of the techniques developed at the R&D stage the Council adopted a four-year Community demonstration programme in 1978 which enables financial support to be granted to demonstration projects in both the energy saving and alternative energy source fields.[1]

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[1] Regulations (EEC) Nos 1302/78 and 1303/78, published in the OJ of the EC No L 158 of 16.6.1978. See "Evaluation of the Community demonstration programmes in the energy sector" (COM(82) 324).

On 11 July 1983 the Council adopted a new demonstration programme for 1983.[2] It was decided on 23 July 1984 [3] to continue the programme through 1984 and 1985.

From the start of the programme on 31 December 1983 124 million ECU have been committed to support 232 demonstration projects in the energy saving field; of this total 5.9 million ECU have been devoted to buildings (30 projects in all, disregarding the projects withdrawn after acceptance) and above all to the following techniques :

- building of low-energy dwellings;

- energy saving techniques in tertiary-sector buildings;

- new types of heat pump;

- high-output boilers.

The demonstrations of alternative energy sources dealt hot water production by solar means and heating both buildings and swimming pools.

There have already been several demonstration projects at both national and Community level in the building sector. All of the projects must be assessed in order to identify the areas to receive priority treatment in the new Community programme.

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[2] Regulation (EEC) No 1972/83, published in the OJ of the EC No L 195 of 19.7.1983.

[3] Regulation (EEC) No 2126/84, published in the OJ of the EC No L 196 of 26.7.1984.

REGULATIONS, INCENTIVES AND ACTIVITIES WITHIN THE MEMBER STATES [4]

Regulation [5]

11. Although rules governing the insulation of new buildings have been generally introduced and improved in almost all of the Member States, insulation standards for existing buildings are still rare.

Many Member States have also adopted rules for heating systems and require minimum insulation of hot water pipes, but some countries still require no regulation of heating systems.

Individual assignment of heating costs is only obligatory in a minority of Member States, while the majority provide for temperature limits, at least in public buildings.

The labelling of domestic appliances in accordance with the Community directives is still not very widespread within the Community.

Financial incentives [6]

12. Almost all of the Member States have provided specific aid for the building sector. Generally speaking more importance should be placed

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[4] The Commission has sent the Council a report on the Member States' energy saving programmes which, inter alia, examines in detail the measures taken in support of the building sector (COM(84) 36).

[5] See document COM(84) 36 already referred to, Annex I(1).

[6] See document COM(84) 36 already referred to, Annex I(2).

on collective dwellings which, in most countries, have still benefited too little from this aid to realize their energy saving potential.[7]

Three types of intervention may be noted : direct subsidy, taxation measures, loans variously made within the Community countries or by the Community itself. Direct subsidies have been favoured by many Community countries, but were clearly declining in 1983 owing to the major costs involved - abolition in Germany, sharp drop in Denmark. Overall the aid granted in all of its forms (subsidies, taxation, low-interest loans) varies significantly from country to country. Thus in the UK and in Belgium aid was limited in 1982 to 1.4 ECU/per capita/year and 2 ECU per capita/year respectively as opposed to 5.9 ECU/per capita/year in France, 6 ECU/per capita/year in Germany and 7.7 ECU/per capita/year in the Netherlands.

Research

13. The various Member-State R&D strategies in the energy field arise from the differences between the resources available (gas in the Netherlands, oil in the United Kingdom), climatic conditions or energy policy (nuclear electricity in France). Hence the differing priorities of the R&D projects : electric heat pumps in France, gas-engined heat pumps in the Netherlands, steps by Denmark to lower heating bills in buildings and particular stress on solar heating in the southern countries such as Italy and Greece.

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[7] More generally in the case of rented buildings the owners' interests conflict with those of the tenants. This constitutes a fundamental obstacle to the proper functioning of market forces.

Demonstration

14. Most of the Member States have demonstration programmes which also cover the building sector. The "Evaluation of the Community demonstration projects in the field of energy saving and of alternative energy sources" (COM(82) 324) and also the communication from the Commission to the Council on "Demonstration projects in the energy sector" (COM(83) 381) list the main features of these national demonstration projects.

ANNEX C

THERMAL AUDITING METHODOLOGY

Extract from a leaflet entitled "Le diagnostic thermique des bâtiments existants" (Thermal auditing in existing buildings) published in November 1983 by Agence Française pour la Maîtrise de l'Energie for use by surveyors.

MODEL THERMAL AUDITING

The "model thermal auditing" described in what follows is clearly not a model to be followed blindly. It should not be regarded as a "recipe" but as a check list of tasks to be completed. Anyone carrying out a survey must take into consideration the various points dealt with in this paper and each point must necessarily be adapted to the individual building or zone surveyed.

I - DESCRIPTION AND INVESTIGATION

Every building must be subjected to a detailed survey in order to provide - by means of calculation, measurement or estimate [1] - the data required for Stage II (exploitation and processing of data) and Stage III

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[1] So far there are no plans to single out one method rather than another but it is essential that the method used to obtain the various pieces of information is noted at each stage. For instance, when obtaining details by calculation, the calculation method as well as the results must be given. Similarly, in the case of estimates, the basis on which they were made must be given.

(summary) of the heat survey. For this purpose reference should be made to all available documents (e.g. as-completed drawings of the building and installations, operating manuals for heating systems, etc.) relating to the structure, shell, walls, equipment and conditions of use of the premises.

1. Specific characteristics of the premises depending on their intended use, site, zoning and actual conditions of use.

11. Use for which the buildings are intended.

Nature, general activity (public, private, etc.).

12. Site, climatic data and local resources.

Type of site, harshness of climate, orientation, insolation, wind factors, shape of the building, etc.

Site characteristics such as insolation and whether the orientation of the building is favourable or unfavourable to the installation of solar powered equipment (solar collectors, etc.) should be particularly noted.

A particular effort should also be made to note the availability of local resources such as wood, charcoal and waste.

13. Zoning and actual conditions of use

Zoning will depend on the following factors :

- whether buildings are used permanently or intermittently;
- the premises (janitor's accommodation, etc.);
- any particular free inputs (kitchens, etc.);
- unheated premises (garages);
- special areas (cinemas).

The following must be described for any given zone : inputs, volumes, operating temperatures, times, etc.

2. Description of the buildings (building by building)

21. Construction

- Data of construction - methods used (traditional, industrial, facade panels, etc.). Photographs and survey map indicating orientation. Perimeters, surfaces, height, number of zones, number of levels, number of dwellings, unheated units, heated units.
- Any recent studies and works completed or under way (e.g. installation of solar collectors for domestic hot water, refurbishing of a flat roof after a thermal shock, etc.). Any other work planned or agreed on (e.g. a vote by the General Assembly of Owners to alter the external joinery etc.).
- Various documents made available by the builder (e.g. drawings and papers relating to checks made when the outside of the building was last refurbished, etc.).

22. Examination of the structure (nature, state and characteristics, etc., to be described in II - 1).

Per building.

General weatherproofing, ageing, leaks, damp, condensation, etc.

Openings : type, weatherproofing of openings (type of joinery, appearance, operability, air and waterproofing, etc.), dimensions, orientation, screening (various kinds of shutters, coffering, etc.), type and state of walls (give thickness, composition, etc.), surface per opaque wall (simple, composite, prefabricated units, etc.), breast-walls, transparent or translucent walls, lower level floors (over solid earth, over spaces containing plumbing installations, over unheated areas, etc.), roofing - flat roofs, sloping roofs, etc.

Method of dealing with heat bridges, ventilation, natural or mechanical draught (measurement flows, etc.), ventilation of the plumbing, etc. renewal of air [2], K and G coefficients.

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[2] Provision will be made for the specific examination of the tertiary sector buildings by giving precise indication of : zones, volume treated, humidity, temperature, etc. and the methods used in this part of the study (type of exposure, type of window, leaks, air renewal, etc.).

3. **Description and examination of heating installations** (type, state, features to be described in II - 1)

31. Layout

32. Heating - Air-conditioning

321. Siting of the heating installation (underground, on a terrace), surface, maintenance, whether there is room for further units.

322. Energy storage (volume, age, maintenance) metering.

323. Generator(s) :

- Type of energy.
  Number of generators - whether used for domestic hot water.
  Dates of commissioning, repairs and any recent modifications.
  Condition (deterioration, corrosion, etc.).
  Make, type, capacity, dimensioning, lagging.
  Burners (age, type, date when last regulated or changed).
  Losses when turned off.
  Removal of products of combustion, related devices.
- Regulation of output.
  Hours operated per year.
  Description of operation.
  Disconnection during periods of shutdown.
- On-site measurements; spacing of measurements (smoke, CO2, etc., smoke losses, related losses) based on the maintenance manual for the heating installation or on regular checks. Where this important data is unavailable, the efficiency is to be measured on the spot on the date of the inspection (to be specified in I - 713).
- Efficiency (determination thereof).

324. Distribution :

For each distribution zone

- Installation layout.
  Type of fluid used to distribute heat.
  Actual outlet and return temperatures as compared with outside temperatures.
- Method of distribution - horizontal zone, facade, etc.
  - vertical zone, facade, etc.
  - diameter and length of piping, etc.
- Characteristics of the circulating unit, flow rate, etc.

- Lagging : present or not, type, thickness, length, etc.,
  passage through heated and unheated areas (cellar, attics, etc.).
  Courses for cables, piping, etc., drains, etc.
- Substations (condition of the valves, etc.).
  State of the piping network (furring, deposits, etc.).
  Losses from the network (measuring, etc.).
- Efficiency of distribution (basis of calculation or estimates, etc.).
- Suitability of the distribution network for conditions of use and heat requirements of the various premises.
- Equilibration
  Regulating devices (type, number, siting, ease of operation, etc.).

325. Radiators :

Type (floor, radiators), dimensions, number, regulating devices (single control, dual control, etc.), output, suitability vis-à-vis requirements.

- Temperature distribution plan.
- Radiation efficiency (basis of determination : difference between the most highly heated and the least heated room, etc.).

326. Regulation :

By zone

- Age and description of the installation.
  Type (internal thermostat, external sensor mounted on a valve, burner, etc.).
  Placing of sensors (in relation to climatic conditions, the orientation of the building, etc.).
- Regulation (at outlet....).
- Thermostatic valves - zones, number .... where installed.
- Regulation gradient - comments, etc.
- Efficiency of regulation (basis of estimate or calculation).

327. Programming by zone :

- Description of the installation.
  Type.
  Reduced heating and/or heating switched off.
  Period, temperature during unheated period, degree-days TNC or degree-hours as a function of temperatures during the non-heating period.

328. Optimizers

329. Overall efficiency :

- Method of calculation.
- Calculation.

33. Domestic hot water.

Daily volume of water consumed (by metering, estimate, etc.).

Cold water temperature.

331. Siting.

332. Generator.

Generator solely for the centralized production of domestic hot water.

- Instant heating.
- Heating by individual units.
- Type of energy.
- Number of generators - commissioning date.
- Make, type, rating - whether appropriate for the various uses.
- Production temperature.
- Efficiency of production (measurements made, basis of estimate where estimates are made).

Generator for the centralized dual production of heat and hot water.

- Investigation of the operation of the generator for the production of domestic hot water (summer output, etc.).

Miscellaneous

333. Storage (capacity, whether appropriate to requirements).

- Storage temperature, insulation, losses, etc.
- Metering (whether present, condition).
- Comparison between the volume stored and the volume consumed.

Efficiency of storage (storage volume/consumption/losses).

334. Distribution.

- Method of distribution.
- Whether there is any lagging, type of lagging, etc.
- Take-off temperature.
- Whether the temperature is geared to the different uses (cooking, bath water, shower, washing, etc.).
- Network losses, whether temperature level is constant.
- Whether meters are installed.

Efficiency of distribution (how determined ?).

335. Regulation.
- Type.
- Condition.

336. Programming.
- Operation of the loop - periods when system is shut down.
- Whether on/off times are appropriate to the different uses.

337. Overall efficiency.
- Method of calculation.
- Calculation.

4. Operating the heating installations.

- Running the installation, monitoring and intervals between maintenance.
- How administrated (by the owner, someone paid by the party that awarded the building contract, a manager, etc.).
- Type of contract.
- Heating manual - interval between measurements.

5. Specific electricity uses (lighting, motors, pumps, lifts, etc.).

- Lighting by zone.
- Light-switch timers in communal spaces.
- Lighting of the surrounding area.
- Programming.
- Condition and type of lights - whether suited to requirements.
- Etc.

6. Examination of special equipment.

For special equipment (e.g. in kitchens, swimming pools, laundries, computer rooms, etc.), special studies should be made using methods specifically adapted to the individual cases concerned (e.g. steam production, air-conditioning, etc.).

7. Energy consumption (in invoiced units, SI units, toe, and giving an energy equivalence table).

71. Consumption in respect of heating.

711. Readings.

Where made.

Summary of readings for the preceding three years, making sure that the selected reference period is representative, and adding any relevant comments on the readings (whether the establishment operated normally, exceptional climatic variations, etc.).

712. Calculating theoretical consumption.

State the method used, give the source of the climatic data and specify what basis is used for calculating standard degree-days or degree-hours and, in particular, making allowance for any free contributions.

Where tertiary sector buildings are concerned, the calculating method will become more detailed as the complexity and particular uses of a building become more specific (e.g. different outlet temperatures, etc.).

713. Comparisons and observations.

The above data will be used to draw up a comparison between theoretical and actual consumption. The observations will concern the anomalies noted during the above procedures. Correlation methods must be explained, e.g. with regard to modifications in efficiency, any reduction in degree-days and the consumption of dual-use domestic hot water.

72. Other consumption (domestic hot water, electricity, other energy consumption) under each item of consumption.

721. Readings.

722. Calculation.

723. Comparison.

N.B. : For instance, in the case of domestic hot water, consumption will as far as possible be based on measurements.

II - EXPLOITATION AND PROCESSING OF DATA

1. Critical analysis of the present situation

The readings made in the earlier part of the procedure and any anomalies or deficiencies observed on site should enable the surveyor to make a detailed critical analysis covering the following points :

- Conditions of use and operation.
- The quality of the structure :
  This will highlight the strengths and weaknesses of the building as regards heating and hot water and will cover both the walls and all factors involved in air renewal (excessive or insufficient). It will also take into account any foreseeable plans for work on the fabric, the leak-proofing or the pathology of the building, etc.
- Analysis of the standard of the thermal installations : This will show the owner the sensitive and defective points of all or part of his thermal installations (heating, domestic hot water, other specific installations and equipment, etc.).
- The suitability of the building and its installations from the point of view of energy management (e.g. the inertia of the building vis-à-vis regulation, etc.).
- Immediate or long-term possibilities of energy diversification and the application of new techniques. (Here a detailed analysis of the possibilities of the on-site provision of supplies should be made).

2. Testing and exploitation.

The following will then be done for each building or piece of equipment :

- a table will be drawn up summarizing the main parameters in respect of which improvement is possible e.g. degree-days, output, G, consumption, efficiency, etc;
- List of improvements that could be made at operating level (running of the installation, maintenance, keeping to recommended temperatures, switching off the night loop for domestic hot water, etc.);

- The result of the test of any improvements envisaged (improvement in the structure and thermal installations, use of renewable forms of energy and efficient techniques). This could include :
  . insulation and lagging
  . air renewal
  . changing to a different ype of equipment
  . installing regulatory and programming devices
  . specific electricity
  . revamping the heating installation
  . revamping the domestic hot water production system (centralizing or decentralizing it)
  . installing solar powered equipment for the production of domestic hot water
  . transforming the heating system with a view to using coal, wood, or waste
  . installing a heat pump (using the outside air or groundwater as a cold source etc.)
  . recovering heat from extracted air
  . the efficient use of steam, thermal waste, etc.
- The following information will be given <u>for every alteration tested</u>:
  . a detailed description of the work done (surface, length, thickness, equipment, etc.).
  . a calculation of the amount of energy saved (state the calculating method used)
  . costs (unit and quantitative)
  . a calculation of profitability geared to the owner's circumstances.

  Similarly, the total time required for a return on investment as compared with the estimated lifetime of the equipment must be given. For every variation in processes or techniques considered, separate studies must be made, e.g. for the production of domestic hot water or the dehumidification of the air in enclosed swimming pools.

III - SUMMARY

This study will be used as a basis for one or more proposals for comprehensive programmes to improve the conditions of use and exploitation of the building (heating temperature, reduction of temperatures at night, possibly a modification in the operating contract, reviewing the length of time the automatic time switches stay on, etc.), to carry out technically feasible work on the structure and thermal installations (whilst taking into account all the interactions between the proposed improvements such as equilibration and recalibration of the regulating systems in the event of work being done on insulation, etc.), and to :

- prepare a description of the work to be done;
- work out a financial package;
- draw up a comparison between actual consumption as obtained from readings and calculated consumption, whilst taking into account the proposed programme (plus the calculation and the rules used for cumulating energy savings);
- calculate profitability, geared to the owner's circumstances;
- where necessary draft a proposal for more detailed studies on more complicated work or particularly expensive techniques.

The report of the survey submitted to the contractor must include :

- a description of the examination carried out in stage I;
- the analyses and results for stage II; and
- the summary (stage III) to enable the customer to assess the technical and economic desirability of carrying out the improvements (operating conditions, comprehensive work programme).

Having read the report the customer must be in a position to decide, on the basis of the best possible information, what improvements to carry out on the building or in operating conditions.

ANNEX D

Community Recommendations and Directives

The Council has adopted a series of Recommendations and Directives on the rational use of energy in buildings:

1. Recommendation 76/492/EEC of 4 May 1976 on the rational use of energy by promoting the thermal insulation of buildings [1] calls for information and promotional campaigns, for competitions to obtain original ideas and for the adoption of reference standards for thermal insulation, harmonized at Community level, as a means of monitoring the implementation of the standards laid down in the regulations;

2. Recommendation 76/493/EEC of 4 May 1976 on the rational use of energy in the heating systems of existing buildings; [2]

3. Recommendation 76/496/EEC of 4 May 1976 on the rational use of energy for electrical household appliances; [3]

4. Recommendation 77/712/EEC of 25 October 1977 on the regulating of space heating, the production of domestic hot water and the metering of heat in new buildings; [4]

5. Recommendation 79/167/ECSC, EEC, Euratom of 5 February 1979, [5] which calls

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[1] OJ L 140, 28.5.1976.
[2] OJ L 140, 28.5.1976.
[3] OJ L 140, 28.5.1976.
[4] OJ L 295, 18.11.1977.
[5] OJ L 037, 13.2.1979.

on the Member States to adopt a four-year programme to reduce energy requirements by improving the thermal efficiency of buildings;

6. Resolution of 9 June 1980 concerning new lines of action by the Community in the field of energy saving, [6] which suggests that the Member States should conduct a programme to measure energy consumption in various sectors;

7. Recommendation 82/604/EEC of 28 July 1982, [7] which recommends the Member States to provide substantial financial aid towards the renovation of buildings, wherever this is sufficiently cost-effective;

8. Directive 78/170/EEC of 13 February 1972, [8] as supplemented by Directive 82/885/EEC of 10 December 1982, [9] which calls for type approval for heat generators to be limited to appliances satisfying the minimum performance requirements laid down by the Member States and for generators to be inspected during manufacture or at the time of installation to ensure that they are in conformity;

9. Finally, Directive 79/530/EEC of 14 May 1979 on the indication by labelling of the energy consumption of household appliances. [10] The plan is to follow up this framework Directive with a series of Directives implementing it for each of the appliances concerned. Directive 79/531/EEC was adopted at the same time [11] as the framework Directive to apply the framework Directive to electric ovens; now proposals concerning washing machines, dishwashers and refrigerators and freezers are being discussed by the Council. Further proposals covering water heaters, gas ovens and tumbler dryers have also been drafted.

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6 OJ C 149, 18.6.1980.
7 OJ L 247, 23.8.1982.
8 OJ L 052, 23.2.1978.
9 OJ L 378, 31.12.1982.
10 OJ L 145, 13.6.1979.
11 OJ L 145, 13.6.1979.

ANNEX E

Recent studies conducted at the Commission's request

1. "Heating, ventilating and cooling systems in buildings" by the Building Services Research and Information Association, Bracknell, United Kingdom

   The first of these studies concludes with four recommendations covering all three types of system concerned:

   (i) a system design code;
   (ii) data bases containing the performance and efficiency standards for each component in the systems;
   (iii) standards for measuring the performance of existing systems; and
   (iv) a European code for audits and improvements to existing systems.

2. "Thermal insulation requirements in the EEC countries" by Uyttenbroeck and Carpentier from the Centre Scientifique et Technique de la Construction, Brussels

   The second study reviews the requirements imposed in this field in 1980 country by country and expresses them in comparable terms. It concludes by proposing a simple method of expressing insulation requirements leaving architects complete freedom in their designs yet at the same time providing them with an easy means of calculating whether their plans are in line with the existing legislation.

3. "Analyse comparative des coûts/avantages de l'isolation thermique pour deux bâtiments-types dans les Pys Membres" by EXPERTEC, Paris (available only in French)

This study comes to the conclusion that the cost of improving thermal insulation in existing or newly-built buildings varies substantially from one country to another and that insulation of the external walls and of the roof yields no more than a mediocre return and has little attraction in the Mediterranean countries. It concludes that thermal insulation of the external walls and roof alone is not enough to achieve superinsulation values in the order of 0.6 W/m3/K for private homes or of 0.3 W/m3/K for office blocks. Changes must also be made in the heating system design and in the architecture of the buildings in order to achieve such values.

4. "Consommation des secteurs résidentiel et tertiaire" by SEMA, Paris (available only in French)

This analysis, compiled with the assistance of correspondents from each Member State, is divided into three parts:

(i) data on energy consumption in the domestic sector in the Member States;
(ii) comparison of the Member States' legislation on heating;
(iii) analysis of specific cases in the domestic and tertiary sectors, and in particular assessments of the impact of conversion work on existing buildings and on buildings using certain basic techniques.

5. "Feasibility of a European model code for saving energy in space heating", Association pour l'initiation à la recherche dans le bâtiment, Paris (available in English, French, German and Italian)

The final study systematically reviews possible ways of saving energy in buildings and proposes a model code for measuring energy savings in space heating.

A N N E X F

Harmonization measures

1. Building design

1.1. Current work concerns the preparation of EUROCODES for the design, calculation and erection of stable, reliable structures.

In all, 8 EUROCODES are contemplated:

EC 1	Uniform common rules
EC 2	Concrete structures Reinforced and pre-stressed concrete
EC 3	Steel structures
EC 4	Mixed steel and concrete structures
EC 5	Timber structures
EC 6	Masonry
EC 7	Foundations
EC 8	Rules for building in seismic areas.

ECs 2 to 6 each deal with one type of structural material and can thus be called specific codes, whereas EC 7 and, in particular, EC 8 are more general in application.

In terms of technical content ECs 1, 2, 3 and 8 are the most advanced and have in fact been practically completed.

1.2. In principle, the Eurocodes will be introduced in special directives coming under a framework directive laying down the drafting and amending procedures.

Consideration is being given to disseminating those in the form of a pre-publication Commission report pending the solution of the political and legal questions that normally arise when directives are sent to the Council for adoption.

1.3. In addition to the work on structural stability, a start has also been made on the fire protection of buildings. Whilst the former is concerned essentially with mechanical aspects, fire protection involves physical aspects and brings into play a number of systems such as those for fire detection and extinction and smoke extraction. Like the rules for buildings in seismic areas, those for fire protection apply horizontally to all buildings, the safety measures adopted depending of course on the risk incurred.

From the construction point of view, fire protection is not neutral and will influence a building's very design with regard to both structural and other parts and its performance value as a whole.

1.4. Exactly the same applies as regards energy saving, when considered from the angle of a building's thermal performance. For this reason one should always regard a building as a single system, not one of whose elements can be completely isolated from the rest.

This approach - regarding a building's energy consumption as part of a "multifunctional" system rather than as a separate aspect - has also been adopted by the international organizations working in this field.

The International Council for Building Research, Studies and Documentation (CIB), for instance, takes this line, especially within the CIB 67 Working Group on Energy Conservation, and so too do the working groups of the UN Economic Commission for Europe's Committee on Housing, Building and Planning in Geneva.

2. Products

2.1. As regards products intended for the building industry, work on harmonization has involved :

(i) sending to the Council a proposal for a framework directive laying down detailed rules for the various procedures governing the launch and use of such products, and

(ii) starting to draft special directives in cooperation with industrial organizations and international standards authorities or similar bodies.

2.2. Energy-related questions have loomed particularly large in these preparations, as witness the work done by:

(i) ISO/TC 163 on thermal insulation (preparation of terminology; measuring and calculation methods);

(ii) CEN/TC 88 on the classification of building materials according to their thermal insulation properties (N.B. this was defined in outline, if not in detail, by DG III (ex-DG XI) in concert with the CEN back in 1976), and

(iii) the European Union for Technical Approval in the Construction industry (UEATC) on insulating glass, and its projected work on solar collectors.

The current work on insulating glass concerns the preparation of rules for evaluating the suitability of insulating glass from the angles of:

- safety
- hability, especially thermal comfort, and
- durability.

ANNEX G

FINAL REPORTS UNDER THE R & D

Heat pump heat sources

Investigation on using the earth as a heat storage medium and as a heat source for heat pumps	EUR 6835 EN EUR 7414 EN
Analysis of the factors which determine the COP of the heat pump	EUR 7048 EN
The use of soil with and without artificial heat regeneration as a heat source for heat pumps	EUR 6968 FR
Recovery of waste heat in sewers by heat pumps	EUR 7061 DE

Conventional heat pumps and components

Development of domestic heat pumps	EUR 7098 EN
Air source heat pumps under Northern European climatic conditions	EUR 7388 EN
Frosting and defrosting behaviour of outdoor coils of air source heat pumps	EUR 7281 EN
Microprocessor based control system for heat pumps	EUR 7283 EN
Heat pump models for microprocessor based control systems	EUR 7046 FR
Analysis of the factors which determine the COP of a heat pump	
Heat pumps for individual rooms	EUR 7007 EN

Advanced heat pumps

Development of an absorption heat pump fired by primary energy for domestic heating	EUR 6326 EN

Design construction and testing of a prototype absorption heat pump fired with primary fuel	EUR 7064 DE
Directly fired heat pump for domestic and light commercial application	EUR 7063 EN
The design and development of an absorption heat pump for domestic heating	EUR 7129 EN
Heat pump operating with a fluid mixture	EUR 6848 FR
Feasibility and design study of a gas engine driven high temperature industrial heat pump	EUR 7657 EN EUR 6262 EN

Heat pump applications

A gas engine driven heat pump using air as heat source for an apartment building	EUR 7133 EN
Diesel heat pump for district heating plants and for the heating of large housing blocks	EUR 6740 EN
Air source electrical heat pumps for 56 apartments	

Insulation (windows and walls)

Production of infrared reflective layers on glass	EUR 6804 FR EUR 6806 FR
Infrared reflective coatings on plastic film	EUR 6741 EN
Heat and sound insulation with coated glass	EUR 6811 DE
Energy savings by infrared reflective finishing	EUR 6323 EN
Development and optimization of polyurea foam	EUR 6737 EN
The detection and classification of heat leaks with the help of infrared thermography	

Energy saving and heat recovery

Energy savings in low cost houses	EUR 7385 EN
Building characteristics and gratuitious energy	EUR 7875 FR
Natural ventilation and energy consumption	
The performance of a heating control system in experimental houses	EUR 8506 EN

Comparison of the efficiencies of space and water heating appliances	EUR 6851 EN
Electric hot water heaters	EUR 6598 DE
Heat recovery in buildings	
Heat recovery in air conditioning systems	EUR 7377 EN

THE COMMUNITY'S ENERGY R & D PROGRAMME - ENERGY CONSERVATION

Survey of results and Compilation of New Projects - 1975/79	EUR 7389 EN
Survey of results and compilation of New Projets - 1979/83	EUR 8861 EN

SYSTEM SIMULATION IN BUILDINGS

Proceedings of the International Conference in Liège 6-8/12/1982	XII/425/83 EN

HEAT PUMPS

Proceedings of four contractors meetings held in Brussels on 28, 29 April and 13 and 14 May 1982	EUR 8077 EN

ENERGY CONSERVATION IN BUILDINGS - Heating, ventilation and insulation

Proceedings of eight contractors meetings in 1982	EUR 8463 EN

PUBLICATIONS ON SOLAR ENERGY IN THE HOME

Solar Houses in Europe, 1981 (Pergamon)

Solar Energy Applications in Houses, 1981 (Pergamon)

Passive Solar Architecture in Europe, 1981 (The Architectural Press, London)

Monitoring Solar Heating Systems, 1983 (Pergamon)

Series A, Reidel, Solar Energy Applications to Dwellings

Vol. 1 1982 Contractors' meeting

Vol. 2 1982 Contractors' meeting

Vol. 3 1983 Solar Thermal Energy in Europe, An assessment

Forthcoming in 1983

Vol. 4 Passive Solar Handbook

Vol. 5 Contractors' meeting

Vol. 6 European Experience with Solar Collectors

ANNEX H

Work in progress at the Ispra Joint Research Centre

The Ispra Joint Research Centre is working on the following problems as part of the Solar Energy Programme approved by the Council:

(i) formulation and testing of recommendations concerning methods of measuring the performance of individual components;

(ii) study of problems connected with equipment age and of the reliability of the technologies and materials used in solar systems;

(iii) assessment of the performance of active and hybrid systems of different types, including full-scale trials and modelling;

(iv) measurements and comparisons concerning passive technologies.

Two other projects have also been started - one on data acquisition, the other on energy audits.

The first is designed to determine the type ad volume of data which must yet be collected before the national or regional authorities can devise a suitable campaign to promote the rational use of energy.

All the available data on the housing stock are being collated to determine, above all, the highest energy saving possible in return for a given total investment at regional or national level. At the same time the different energy-saving measures which might be taken are being ranked in order of preference.
The next stage will be to assess the impact of the economic incentives and rules already in existence.
Finally, studies are in progress to determine the minimum degree of detail and accuracy required of the method of calculation and of the data input.

The second project is to outline an "energy auditing" programme.
Energy audits serve two purposes:

(i) to provide a decision-making aid to property-owners; and

(ii) to add to the abovementioned data on the housing stock.

Another part of the programme will also be looking into the measurement methods to be employed and into the models to be used to interpret the results.
Finally, design work is continuing on a data base to conduct the assessments outlined above and, little by little, to make the audits simpler and reduce the amount of equipment required.
