

Evaluation of Energy Conservation Programmes in the EC Countries

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Study

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Preface

Since 1973 the ten EC member countries have been very successful in improving overall energy efficiency (by more than 17 % between 1973 and 1981) and in substituting oil by replacing it with other types of energy (between 1973 and 1981: 20 %). This success and the present stagnation of oil prices, however, should not detract the attention from the need to use energy more efficiently, that is from energy demand management. With regard to the high energy price levels reached in 1981/1982, the need for further structural changes in energy consumption is obvious. Self-complacency now would jeopardize the achievements of the past few years and put at risk those within sight for the next few years.

Naturally, full impact of energy conservation policies will only become apparent over time. Although the energy problem is a long-term issue, policy-making in most countries is, unfortunately, oriented towards short-term measures. Energy conservation policies, however, need both long-term continuity and stamina for the following reasons:

- the life span of most capital goods and durables is long, seen in terms of possible further increases of energy price levels (especially buildings with lifetimes of more than 50 years),
- producers of energy-saving equipment and new products have to invest in production equipment, facilities, etc. and require a continuous market to ensure acceptable returns on their investment.

Finally, as energy conservation substitutes energy consumption by services or capital goods which are mostly produced within the Member countries, energy conservation has a positive net employment impact and alleviates the employment problem which will be a continuing burden for all Member countries in this decade. The argument is often heard that energy conservation contributes to environmental protection; social benefits stemming from reduced energy consumption and hence reduced emissions today are underestimated because of the difficulty in quantifying the costs of emissions in quantitative economic terms.

It is hoped that this study contributes to improving the level of information on present energy conservation policies in the Member countries, and

that it will initiate discussion and encourage evaluation research focused on understanding the actual programmes and on improving energy conservation policy in future.

Acknowledgements

The collected data of energy conservation programmes in force (see Annex) as well as their comparative description and the overview on national evaluation efforts in this volume could not have been presented without the ready cooperation of many colleagues in various governmental bodies and institutes in the Member countries. They provided data and related studies, helped to establish contacts in their countries, and reviewed information in this study. Those who deserve particular mention in this regard are D. Barnes, R. Becker, W. Danner, K. Egan, M. W. Horning, G. McInnes, H.-D. Karl, P. Le Vaillant, C. Putman, P. Rammner, J. E. Sakellarios, O. Smith-Hansen, H. E. Swarre, and L. Zampilli. We are grateful to H. Hilbrecht for his thorough review of the manuscript.

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- Denmark (DK)
- France (F)
- Greece (GR)
- Italy (I)
- Ireland (IRL)
- Luxembourg (LUX)
- Netherlands (NL)
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Summary

The scope and budgets of national energy conservation policies of the EC countries have increased greatly in the past few years. In most Member countries, ex ante assessments of the effectiveness of energy conservation programmes are carried out before taking action. But there is a wide-spread lack of evaluation after implementation of programmes. Little is known about energy savings actually achieved or their causal links to one or several programmes. There is even less information about indirect and intended or non-intended effects of a programme (e. g. employment, increase of rents, price changes of energy-saving goods).

Energy-saving programmes and policies implemented in the EC countries differ from country to country with respect to specific programme design, programme acceptance and success. National differences notwithstanding, a country's experience with implemented programmes could provide useful information for other Member countries. Given this context, the European Commission is concerned to provide an overview of current energy-saving programmes so as to disseminate results of evaluation studies among the Member countries and to recommend further energy-saving activities.

The main objectives of this study therefore include

- a review of three types of measures of national energy conservation policies (regulations, subsidies as well as information and consultation),
- collection and analysis of evaluation studies of particular programmes with regard to assessed impact, methodology and data,
- preliminary comparative analysis of implemented energy-saving programmes,
- recommendations for further activities of the European Community and the Member countries in the field of programme design and impact analysis.

The results of this study are based on three types of investigation: review of literature and reports, personal and telephone interviews with experts in administration and research institutes in all EC countries, and comparative political analysis.

Development of the energy situation in the EC countries

There are many arguments that energy conservation programmes (as far as regulations, subsidies, and information are concerned) contributed only little to the improvement of overall energy efficiency in almost all EC countries up to 1981:

- large energy price increases in 1979 - 1981 resulted in energy-saving investments and changes of consumption patterns;
- structural changes within industry (especially cuts in iron and steel production) and between industry and the other economic sectors contributed to smaller growth or even a stagnation of energy consumption in contrast to the economic growth in the 1970's;
- energy-saving programmes require a couple of years before full implementation or effectiveness is reached.

In some sectors and Member countries, however, energy savings achieved in 1980 and 1981 cannot be fully explained by price reactions and structural changes; here, the first positive results of energy conservation programmes can be observed (see Tables 3.1, 3.2, 3.3 and Figures 3.1, 3.2).

The study briefly reviews the general framework of energy and economic policies in order to clarify the framework for energy conservation policy of each EC country.

Review of the three measures: regulations, subsidies, information

International comparison of implemented programmes is difficult because specific national factors have to be considered. They determine the scope of actions to be taken in a country. These factors refer to climatic and socio-economic conditions, technical endowment, economic structure and level of development, overall policy goals, and the attained level of information (see p. 75 - 78).

Climatic conditions often explain national construction methods and most of the differences of building standards. In addition, technical and socio-economic conditions differ widely:

- the energy efficiency of existing heating systems and of the building stock,
- the extent of saving measures already taken,
- types of new buildings, share of owner-occupied and rented dwellings.

Economic factors clearly influence energy conservation policy: Income per capita and, hence, purchasing power, income distribution, taxable income and public deficits as well as industrial development play an important role in determining to what extent and how specific measures are introduced, maintained or terminated (regulations, subsidies).

Furthermore, overall policy goals with regard to employment, foreign trade, industrial development and environmental protection may influence the design of particular programmes. The set of programmes planned or implemented by a country is determined by whether the economic policy is demand or supply-oriented, market-oriented or intervening.

Finally, the level of information in the residential and commercial sectors varies to some extent from country to country, just as existing legislation in closely-related fields such as building laws, tenant laws, or environmental laws do. Public information and consulting programmes may also be influenced by existing communication networks.

Some of these factors have been considered in the study, but the results of this report have to be interpreted and used very cautiously when used for international comparison. In many cases, more detailed analysis needs to be made before final conclusions can be drawn and detailed programmes recommended.

Regulations

Energy-saving related laws and administrative regulations are focused on space heat, process heat generation, and energy labelling for domestic appliances (see Tables 3.19 to 3.22 and Fig. 3.4).

The above mentioned national differences notwithstanding, there are deficits: The importance of control equipment for central heating and hot-water systems is underestimated, especially in the case of existing buildings (see p. 86 f). Enforcement of individual heat metering in apartment and rented office buildings is, as yet, the exception (see p. 88).

Standards seldom require best possible performance or investments with minimum total expenses. They do not adequately consider the long lifetimes of buildings or equipment nor further energy price increases in the next two decades. Consequently, a target setting regulation policy should be considered which would announce standards several years ahead of enforcement and leave time for research, development, product design, and training of personnel.

Subsidies for investments

In many countries, subsidies for energy-saving investments pursue several additional objectives (employment, regional development) which makes international comparisons difficult. Most of the subsidies are given in the form of grants; data on loans and tax relief are not available. Grants per capita stand in close correlation to gross domestic product per capita with the exception of Belgium, Italy, and Luxembourg (mean value of all EC countries in 1982: 6.8 ECU/cap; see Table 3.23).

Some countries pursue a subsidy policy promoting premature replacement, i. e., a reinvestment which is made several years before the end of the usual technical life-time. This type of funding will have increasing importance in the next few years, a period of stagnating or even falling energy prices and high unemployment. Premature replacements, however, may also produce negative effects such as economic distortions of particular markets (see p. 99 f).

If energy consumers have little technical, energy-related know-how or market knowledge (home owners, small and medium-sized firms), subsidies tend to mis-channel investments. Mandatory consultation with external consultants before either application for subsidy or investment seems to be a solution to these problems. The success of this measure, however, depends on the consultant's competence. In certain cases, grants given on the basis of expected energy savings may also contribute to better priority setting (see p. 206 f).

The proportion of subsidized investments which would have been made by the investor independent of a grant, called the "free-rider effect", is estimated to be very high (50 - 90 %). Factors contributing to free-rider effects are, for example, the subsidy rate of investment, profitability of investment, and running time of the programme. Free-rider effects can be reduced

by careful programme design (selection of subsidizable technologies, minimum pay-back time, minimum amount of investment). These specifications, however, set narrower limits to energy-saving potentials and increase administration costs (see p. 97 f and Table 3.24).

In principle, subsidies reduce energy costs for the consumer. The main purpose of subsidies, however, is to help the investor intensify the input of capital and to overcome financial bottle-necks and credit limits. Low-income groups and small and medium-sized firms are particularly affected by these financial barriers. Technologies with long-term profitability expectations and inherent economic risks are also vulnerable, an example being district heating. Here, a warranty programme should be introduced or banks should be enabled to reduce reserve limits by the amount of credits given for energy-saving investments. Warranty programmes do not distort energy cost signals and help to limit public subsidies. Loans with low interest rates and repayable a few years after investment should be concentrated on technologies with rather low profitability and on small and medium-sized firms in order to reduce the number of free-riders (see p. 216 f).

Financial aid tends to be designed in a rather isolated manner; non-financial factors in decisions to purchase residential heating equipment or new energy-saving technologies are under-estimated by the administration. Such non-financial factors are, for instance, system reliability, warranty protection, adequate information about system costs and performance, confidence in system suppliers and installers, environmental concerns, and administrative barriers (see p. 216).

Information and consulting

All governments implemented information campaigns by means of mass media channels, advertisements, and leaflets and considered them important aids in changing attitudes towards energy consumption (see Table 3.25). Broad public information campaigns, however, often fail to promote energy-saving investments.

The investor or energy consumer needs detailed technical information about technological and organizational measures. Programmes were especially successful where information was based on personal communication (i. e., external advice by telephone or through personal contact or in-house advice on

the basis of energy audits and on-the-spot consulting). In several Member countries, these measures could be intensified even further (see p. 103 f, p. 217 - 219).

Small and medium-sized firms and private households - especially those of low-income groups - without or with only inadequate information on matters related to energy conservation have most need of energy-saving measures. Consequently, public measures should concentrate particularly on these groups (see p. 108 f).

It is difficult for a Government to support the multi-step flow of informal communication between various actors in societal groups directly. But there is no doubt that opinion leaders and gate-keepers of social groups exert a strong influence on the information level, attitudes, and decisions of individuals. There is no general answer to the question of how to address opinion leaders, but public information policy using existing formal communication structures (consumer associations, house and landowner associations, chambers of commerce, crafts and architects, etc.) is cost-effective and may contribute to fast implementation. Typical examples of using communication structures effectively are organized visits to firms, workshops, local and regional advisory services, and information centres (see p. 217 - 219).

Evaluation studies

Although there is widespread interest in the assessment of the impact of energy conservation policies, reliable results from empirical evaluation studies are not yet generally available. There are several reasons for this. Most of the energy conservation programmes were started in the last three or four years. Since many factors such as energy prices, structural changes in industry or in the energy transformation sector influence energy consumption, tracing the influence of a particular programme on an actually achieved change of energy efficiency is often a difficult task. In many cases, the data basis is poor for various reasons, such as no available data before the programme was introduced, bias effects of surveys, and expensive technical measurements (see p. 202 f).

Many evaluations of the impact of financial support programmes completely neglected the problem of free-rider identification, thus (implicitly) assum-

ing that all the investments funded by the programme would not have been made without the programme. Even where the evaluation studies examined the question of free-riders, the survey results did not discuss the problem of how to identify interviewer-oriented answers in which respondents pretended a sufficient level of energy-related knowledge or wanted to avoid being considered a free-rider. It is interesting to note that no study discussed premature replacements, a measure now receiving increasing attention because of high unemployment and stagnating energy price levels. Little attention was paid to the tendency of subsidy programmes to mis-channel investments (see p. 206 f).

Studies assessing the impact of information and consulting programmes are usually based on surveys. In almost all cases, control groups had either not been integrated in the survey at all or had not been sufficiently analysed with respect to the influence on informal communication by opinion leaders or gate-keepers. Surveys assessing the impact of public information campaigns scarcely touch on the question of durability of energy awareness and energy-saving behaviour (e. g. reduction of room temperature).

There is considerable evidence that private consumers and firms well informed and already interested in energy matters want more information and consultation. On the other hand, those who ignored energy matters before the information programme started will often not be influenced at all by the programme. The reasons for this behaviour have not been studied in detail (see p. 208, p. 217 - 219).

Recommendations for further research activities

There are several fields of evaluation which require in-depth research. The results which could be expected would be of great value for the energy conservation policy of the European Commission and the Member countries. The proposals below are tentative and intended to stimulate discussion.

The first proposal takes up the problem of how to distinguish from a macro point of view energy savings induced by energy conservation policy from many other factors such as yearly climatic variations, market fluctuations, structural changes in the economy and in the energy transformation sector, price fluctuations, etc. We recommend developing a fully implemented instrument

which analyses the importance of these factors from a macro point of view (see p. 221 f). It is worth considering to what extent the present EC energy model might serve for this purpose.

The second proposal is aimed at improving comparability of selected regulation policies (see p. 222 f). The discussion whether differences of national standards are to be explained by a country's specific factors (climatic conditions, proportion of rented dwellings, etc.) or whether the differences reveal weaknesses in regulation policy, presupposes extensive knowledge of each country's legal context. On the basis of a comparison of energy-saving potentials of certain regulatory measures and their present enforcement a number of regulations are recommended for in-depth analysis and international comparison (these are: control equipment for central heating and hot-water systems, individual heat metering, and boiler-operation standards).

In addition, a study of the possibility of a target setting regulation policy is recommended (boiler and boiler-operation standards, minimum performance of air-conditioning equipment and cars).

The third proposal is aimed at focusing empirical research on two promising measures and their national context (see p. 223 f):

- Mandatory consultation in connection with grant schemes for insufficiently informed investors and
- warranty programmes which are intended to achieve better cost-effectiveness and faster market-penetration than pure subsidies because free-rider effects are reduced and liquidity of firms is improved.

1. Background and objectives of the study

Since the first oil price increase in 1973, most EC countries have developed energy conservation programmes as a supplemental element of their national energy policy. In recent years, especially after the second oil price increase in 1979/80, the governments have increased their promotion activities. By now all EC countries have a more or less comprehensive energy conservation and oil substitution policy.

Both the scope and the budgets assigned to governmental programmes have increased greatly during the past few years. At the same time a remarkable cut in specific energy consumption can be observed in most countries. There is, however, a variety of influences which have contributed to this: Above all, the energy price increase itself, the reduced economic and hence expected energy growth as well as structural changes in the economy had a strong impact on energy consumption and conservation activities.

In view of the need for energy conservation policies, many essential questions arise for the decision makers such as:

- In which areas do market forces not suffice to promote energy conservation?
- How can public funds be used in a cost-effective way (financial incentives, information programmes)?
- In what areas can energy savings be achieved by regulations only?
- How should various programmes be combined so as to be optimally effective?

Such questions could be answered more easily if evaluations were available for measures already taken. In some Member countries emphasis is laid on the assessment of effectiveness of energy conservation programmes by governmental or other public institutions before taking action to suggest measures likely to be successful. But there is a widespread lack of evaluation after implementation of the programmes. Empirical research of this kind can provide important inputs to improve future conservation policies. Firstly, evaluation would help to assess the cost-effectiveness of actual programmes and to decide how programmes should be modified in order to improve their efficiency. Secondly, effects of programmes other than energy savings, such as initiated investment and running costs, oil substitution and employment on the one

hand, and non-intended, unfavourable effects (i. e., rent increases, price increases of energy-saving goods) on the other, can be observed and taken into account in further programme design.

There is, above all, little exchange of information among countries. National differences notwithstanding, one country's experiences with programmes could be useful for other countries. Some countries have empirically measured the effects of programmes already implemented and are aware of some effects and methodological difficulties. Other studies only cover some aspects of evaluation. Thus the European Commission is concerned to have a comprehensive survey of conservation policies developed in the Member countries as well as the results of evaluation research.

In OECD countries the policy responses to the energy challenge are mainly based on six types of measures:

- regulations such as building codes, standards for boilers, individual heat metering, temperature limits, energy labelling, speed limits
- financial incentives such as grants, subsidized loans and tax relief
- information programmes or communicative measures in a broader sense such as publicity campaigns, advisory services, energy audits, education and training
- energy pricing (taxes, tariffs)
- energy research, development and demonstration
- institutional measures such as establishment of energy agencies, change of laws and regulations to overcome barriers for energy conservation efforts.

The first three types of measures have been selected for more detailed investigation because they represent concrete governmental action which is directly addressed to the final energy consumer. In most countries energy pricing is only applied in specific sectors such as transportation or for specific types of final energy such as electricity or oil products. If R, D & D has any impact on energy conservation at all, it will be long-term and a result of intensive trade between the EC countries.

As a first step, the International Energy Agency has presented for several years now a yearly review of national energy conservation policies in the

IEA countries (for example see IEA, 1982). Since 1980, the European Commission has also provided an overview on current programmes in EC countries which also covers governmental budgets as far as data are available. There was a need for a comprehensive study in order to update existing listings and to provide indepth and comparable information on current energy conservation programmes. Moreover, existing evaluation studies and data on results of programmes needed to be gathered and analysed as a basis for further steps to be taken by the European Communities.

The main objectives of this study therefore include:

- (1) A review of national energy conservation policies and characteristics of programmes such as
 - regulations,
 - subsidies, and
 - information measureswith special attention to budgets, initiated investment costs, and total national energy savings as far as data are available (see Chapter 3.4 and Annex).
- (2) The gathering and analysis of evaluation studies with regard to methods, concepts and results which have been conducted in the Member countries or by international institutions, particularly with regard to national energy savings achieved either calculated or based on empirical findings (see Chapter 4.2).
- (3) A preliminary comparative evaluation of energy conservation policies in EC countries on the basis of available data and the results of existing studies; in addition, a rough overview of each country's background with regard to its energy situation and the political framework for energy conservation programmes (see Chapters 3. and 4.2.3).
- (4) Recommendations for further activities of the European Communities as a body and for the Member countries, as far as possible both in the fields of impact analyses and energy saving policy (see Chapter 5).

2. Scope and Methodology

From the methodological point of view the present study is based on three types of investigation:

- review of literature,
- interviews with experts in EC countries (administrations, research institutes), and
- some steps towards a comparative political analysis.

First of all the scope of the study was established with regard to several aspects:

- All the Member countries of the EC were to be included in the study. Other countries would only be included if evaluation studies could be found providing additional information on the impact of energy conservation programmes in these countries. The most important results from non-EC countries have come from Sweden and the United States.
- Three types of political programmes have been considered: regulations, financial support, and information. Not included are financial measures such as taxation, pricing, funds for research, development and demonstration, changes in regulations which prevented energy savings, and other institutional strategies.
- The study is only concerned with nation-wide programmes in each country, not with regional or local measures. In most EC countries the main responsibility for energy conservation programmes lies with the national or federal ministries or with institutions working for them. In some countries, however, many private activities are carried out on a national, regional or local level (e. g. industrial standards, providing consulting facilities, education and training). These activities are not dealt with in the study.
- With regard to evaluations, only those studies are included which are based on empirical research or on technical calculations using empirical

data and which both are ex post analyses after programmes have been implemented. For the programme descriptions, however, ex ante assessments are mentioned where these are used as official documents of governments and empirical data are not available. Ongoing studies will only be mentioned but not analysed if final results are not yet published.

The working programme of the present study can be broken down into six main steps.

(1) Formulating the concept for analyses

As a first step the main parameters for the description of energy conservation programmes were worked out and were used as guidelines for further search for information in the EC countries. The categories were

- for regulations: period of effectiveness, technical description and range of application, controlling authority
- for financial measures: period of availability, budget, amount of participation, eligibility, authorizing institution, total grants approved, average grant per case, use of grants
- for information policies: time period, public funds, amount of participation.

In addition, for all types of measures, the impact in terms of initiated investments, national energy savings and non-intended effects have been included as further categories (see Annex).

A similar framework has been developed for the description of evaluation studies so as to present their content as briefly and clearly as possible. The main emphasis was placed on two aspects:

- the methodological approach of the study, especially with regard to the data base (calculation, measurement, survey, statistical data), the representativeness, and the type of evaluation (impact analysis, goal attainment)
- the results on performance of the measure (acceptance, types of groups

addressed, programme network) as well as on impact, special attention was to be given to the discussion of "free-riders" in the case of financial support.

(2) Search for information sources

First of all, the following steps were taken:

- listings of existing political programmes provided by national governments or other institutions
- policy or programme comparisons made by the European Commission, the International Energy Agency or other institutions (e. g., a comparative study made by the French Agency AFME, Agence Francaise pour la Maitrise de l'Energie)
- telephone interviews with contact persons named by the European Commission or the International Energy Agency and institutions already cooperating with ISI. The aim was to contact people in ministries, energy agencies, and other bodies who are responsible for implementing and monitoring national energy conservation programmes. These contact persons would also be able to provide information and suggestions about existing evaluation studies. In some countries ministries, commissions, agencies and research institutes were contacted directly.

On this basis preliminary programme descriptions were made which were then to be updated through personal interviews with responsible persons in each country.

(3) Visits to EC countries

The information required to fulfill the goals outlined in step (1) cannot be obtained solely by analysing written material or making telephone calls, especially in cases where no official data are available and preliminary figures or expert assessments have to be used.

The interviews, therefore, had four main objectives:

- completing and updating of programme descriptions
- information on the general philosophy of energy conservation policies within the national context

- collecting expert assessments on the success of programmes, reasons for failure, expectations for the success of only recently introduced measures
- suggestions for existing or ongoing evaluation studies.

In some cases (as in France, Ireland) the institutions which carried out evaluation studies were also visited.

(4) Comparative analysis

On the basis of the programme descriptions completed after the visits the EC countries have been compared as far as possible. Since the three types of measures - regulations, financial support, information - are embedded in a broader political framework some important aspects of the general energy situation and of the development of the energy policy have been investigated briefly.

It should be pointed out, however, that the comparisons are descriptive rather than explanatory. Due to the short time assigned to the present project, too many factors had to be left aside which account for success or failure of programmes implemented by the governments.

(5) Description of evaluations

With regard to evaluations three types of sources were considered:

- evaluation studies with a scientific claim
- data collected by experts or expert groups
- expert assessments.

Results of the second and third type are for the most part included in the programme description in the annex. The evaluation studies are described according to the parameters which have been worked out in step (1). Some conclusions are drawn dealing with a critical assessment of deficits, problems, and topics excluded from discussion as well as the present state of the art of impact analyses in the field of energy conservation, together with some general remarks on possibilities and difficulties of evaluation.

(6) Concluding hypotheses and suggestions

The need for further indepth studies of important national characteristics notwithstanding, some preliminary conclusions can be drawn with respect to the most important issues of energy conservation policies in the EC countries and to their effects. Special attention is given to the success of financial support in terms of minimizing free-rider effects and achieving high cost-effectiveness. In the case of regulations the standards are compared with the actual technical level. In addition, successful combinations of measures are considered.

3. Energy conservation policies in the EC countries

One part of this chapter describes the energy conservation policies in the EC countries since the first oil price increase in 1973. So as to allow a rough overview the national activities have been made comparable as far as possible. It is necessary, however, to consider first the general background of conservation efforts in terms of the national energy situation. In addition, with regard to the assessment of success of energy conservation programmes, an often held argument will be briefly discussed so as to clarify that a policy cannot be considered as successful only because energy consumption has dropped. Instead the extent to which other influences - such as climatic and economic changes or structural changes in industry - have produced changes in total or specific energy consumption has to be analysed. Such factors are considered in chapter 3.1. It presents a rough outline of the following topics:

- major factors affecting energy consumption
- changes in specific energy consumption during the past years
- changes in energy efficiency
- sectoral structure of energy consumption
- net energy imports
- prices for industrial and residential energy.

As is the case for all types of comparative political analyses, comparisons between countries become more difficult if there are basic differences in institutional background, major national problems and even in political culture. This subject must be studied more closely in the future. For the present purpose the general remarks in chapter 3.2 are confined to the most important topics with regard to the history of national energy conservation policies in the field of regulations, financial measures, and information.

Chapter 3.3 is concerned with some methodological remarks on possibilities and difficulties of the comparisons presented. Chapter 3.4 includes the comparative descriptions of programmes for all the EC countries.

3.1 Development of the energy situation in the EC countries

Some remarks on major factors affecting energy consumption

Overall energy efficiency measured as relation of total primary energy required (TPE) and gross domestic product (GDP) improved in all EC countries between 1973 and 1981, except for Greece. However, this improvement has changed drastically in some countries (i. e. France, Ireland) for the two periods of 1973 - 1977 (post-embargo) and of 1978 - 1981 (energy conservation policy) (see Table 3.1). The absence of complete data so far for 1982 has restricted the analysis to the year 1981.

There are many factors which influence overall energy efficiency (structural changes, energy prices, energy saving measures, substitution and changing imports of final energy etc.) and which may influence each other. With regard to energy policy evaluation, the question arises whether energy conservation policies of the EC countries contributed to energy savings realised between 1973 and 1981, and if so to what extent. Two recent papers come to the conclusion that national energy conservation policies contributed substantially to the achieved savings of the Community (40 Mtoe between 1973 and 1980; EC, XVII/73/82- EN) and that energy conservation policies in some countries were more successful than in others (LeVaillant, 1982). On the basis of some preliminary analysis, however, we come to the conclusion that

- the impact of energy conservation policies on the overall development cannot have been substantial as most of the programmes started at the end of the seventies (see Chapter 3.2) and need some time for broader implementation and application,
- and hence, significant influence of energy conservation programmes on energy consumption can be expected in the eighties only.

Analysts working in this field emphasize how difficult it is for purpose of analysis to separate the various factors affecting overall energy efficiency (Schipper, 1981). To support the above conclusion, the results of this preliminary analysis are summarized below, covering five factors which may have influenced energy consumption, but which cannot be attributed to improvements of "energy efficiency" (in the strict sense of a more rational use of energy):

Table 3.1: Changes in overall energy efficiency and per capita final energy consumption in the residential/commercial and transportation sectors, EC countries, 1973 - 1977, 1977 - 1980 and 1977 - 1981

	B	D	DK	F	GR	I	IRL	LUX	NL	UK	EUR 10
Total Primary Energy per Gross Domestic Product Changes in %											
1973 - 1977	-11.3	-8.5	-6.1	-14.9	+2.6	-4.4	-13.9	-15.6	-10.9	-8.4	-9.7
1977 - 1980	-4.6	-4.5	-6.5	+2.8	+0.7	-6.8	+7.9	-12.6	-2.6	-7.7	-4.3
1977 - 1981	-8.1	-8.9	-17.6	+0.2	-2.0	-7.7	+0.9	-21.8	-8.2	-8.4	-7.2
Total Final Consumption per capita Changes in %											
o Residential/Commercial											
1973 - 1977	-2.3	-1.2	-4.6	-10.3	-0.7	-1.1	+2.4	+9.6	-5.4	+1.2	-3.3
1977 - 1980	+3.4	-2.1	-15.1	+2.7	+7.9	+6.5	+32.0	-0.7	+4.4	+2.6	+1.3
1977 - 1981	-5.3	-6.5	-24.4	-0.4	+3.8	+4.0	+13.6	-6.4	-4.7	+1.9	-2.7
o Transportation											
1973 - 1977	+9.4	+11.8	+8.6	+9.2	+11.0	+7.3	-9.1	+20.1	+14.4	+2.6	+7.9
1977 - 1980	+5.4	+10.2	-11.5	+8.5	+19.9	+13.4	+7.4	+31.9	-0.7	+8.1	+8.8
1977 - 1981	+2.9	+6.9	-14.0	+9.7	+19.9	+16.6	+3.8	+44.9	-1.3	+4.4	+7.7

Source: Eurostat, 1982 b

- The relative decrease of iron and steel production contributed to a significant decrease of energy consumption in several EC countries, notably Luxembourg and the United Kingdom (see Chapt. 3.2.8 and 3.2.10).
- Furthermore, structural changes within industry (especially the chemical industry) and within the economy (industrialization/de-industrialization) contributed to changes in the specific energy consumption in several countries, especially in France, Greece, Ireland, Italy, and the United Kingdom (see Table 3.2).

- Increasing motorization in all EC countries caused additional consumption of energy, thus diminishing the overall energy efficiency notably in Greece, Italy, and Luxembourg (see Table 3.1 and 3.4).
- Increasing areas of space heating in the commercial, public, and residential sectors induced additional energy consumption which in several countries, notably Greece and Ireland could not be compensated for by energy saving measures (see Table 3.1).
- Finally, substitution of final energies, different energy consumption structures as a result of energy saving efforts as well as changed import and export shares influenced the energy transformation sector (power generation, refineries, district heating etc.). In some cases this led to a markedly higher primary energy consumption (Belgium, France) and, in an exceptional case, to a slightly better relation of final energy to primary energy consumption (1973 - 81: Luxembourg) (see Table 3.3). This effect is expressed by the overall energy transformation factor, the relation of total final energy consumption (TFC) to total primary energy required (TPE).

The following results give some evidence for the argument that the impact of energy conservation policies between 1974 und 1980 should not be considered to have been very high. First positive results, however, can be observed in individual sectors in a few member countries in 1980/1981. It was not the task of this study to analyse the contribution of all above mentioned factors to the energy savings achieved.

Between 1973 and 1977, energy efficiency improved in all EC countries by 9.7 % (i.e. 2.3 % per year) and in the following four year period by 7.2 % (i. e. 1.8 % per year) (see Table 3.1). In most countries, degree-days of the year 1977 were 5 to 8 per cent less than the value for 1973, i.e., taking the relative warm climate of 1977 into consideration, real savings were fairly constant over the two periods. In the first period, four countries were very successful in relation to the EUR 10 figure:

Table 3.2: Population, changes in gross domestic product and industrial production, EC countries, 1973 - 1977, 1977 - 1980/81

	B	D	DK	F	GR	I	IRL	LUX	NL	UK	EUR 10	
Population (Mill.)												1) 2)
1973	9.742	61.976	5.022	52.118	8.970	54.913	3.072	0.353	13.438	56.000	265.604	
1977	9.830	61.400	5.089	53.078	9.284	56.461	3.272	0.362	13.856	55.919	268.551	
1980	9.859	61.567	5.123	53.713	9.599	57.070	3.428	0.365	14.149	56.010	270.883	
1981	9.867	61.682	5.123	53.947	9.695	57.214	3.455	0.365	14.247	56.055	271.650	
Gross Domestic Product (GDP) (Prices in 1975)	Bill. FB	Bill. DM	Bill. Dkr	Bill. FF	Bill. Dr	Bill. Lire	Mill. IR £	Mill. FLX	Bill. Hfl	Bill. £	Bill. ECU	3) 5)
1973	2216.75	1043.15	220.05	1404.23	657.84	124935	3501.6	88941	204.37	106.31	1119.62	
1977	2416.27	1118.69	235.54	1571.37	739.53	135259	4063.4	88706	237.47	109.78	1214.91	
1980	2614.73	1230.19	245.44	1696.31	832.50	151423	4527.0	97227	249.57	113.36	1314.27	
1981	2570	1231	245	1701	827	151120	4577	94895	247	111	1306	6)
Changes (%)												3)
1973 - 1977	+9.0	+7.2	+7.0	+11.0	+12.4	+8.3	+16.0	-0.3	+16.2	+3.3	+8.5	
1977 - 1980	+8.2	+10.0	+4.2	+8.0	+12.6	+12.0	+11.4	+9.6	+5.1	+3.3	+8.2	
1977 - 1981	+6.4	+10.0	+4.0	+8.2	+11.8	+11.7	+12.6	+7.0	+4.0	+1.1	+7.5	
Changes of Industrial Production (%)											EUR 9	4)
1973 - 1977	+0.9	+2.8	+2.8	+5.7	+16.5	+5.7	+13.5	-16.1	+7.0	0	+2.8	
1977 - 1980	+5.5	+7.2	+6.4	+5.4	+14.2	+14.3	+12.6	+3.8	+3.7	-0.9	+6.4	

Sources: 1) Deutscher Bundestag (Drucksachen 9/1061 and 9/2118), 1981 and 1982; 2) Statistisches Bundesamt Wiesbaden, 1975, 1979, 1982; 3) Eurostat, 1982a; 4) Eurostat, 1980a and 1981 (basis: indices); 5) ECU: prices and conversion rates 1975; 6) Commission of the European Communities, 1982 (GR, F and I: prices in 1970; D: 1976; NL: 1977); preliminary

- Belgium and Luxembourg, however, "saved" most of their energy because of a drastic drop of the iron and steel production (2 Mtoe and 1 Mtoe respectively); in addition, the overall energy transformation factor of Luxembourg improved slightly by 1.1 %.
- France and Ireland seem to be the best savers in the post-embargo period (but the least successful countries in the period from 1977 - 1981). In France, a reduction of 4 Mtoe can be explained by the drop in the iron and steel production. The energy transformation factor of France shows a slight improvement. France was also one of the three countries who reduced per capita final consumption of the commercial/residential sector more than the average of EUR 10 during this period (France: - 10,3 %; the Netherlands: - 5.4 %; Denmark: - 4.5 %).

Two countries improved overall energy efficiency only little as compared to the average of EUR 10:

- In Greece, high growth of industrial production (16.5 %) and of the transportation sector (11 %) contributed to the slight increase of specific total primary energy consumption. 50 % of the additional final energy consumption in industry, however, one would have expected on the basis of constant specific energy consumption, was saved. Finally, 0.6 Mtoe additional primary energy consumption, were related to diminishing overall efficiency in the transformation sector stemming from increased power generation (+ 28.6 %).
- In Italy, at least 1.6 Mtoe can be attributed to further industrialization, especially to increased steel production (+ 2.33 Mio t).

Considering these factors, both countries were more successful in reducing specific energy consumption than the global figures make believe.

Table 3.3: Primary and final energy consumption, structure of final energy consumption, overall energy transformation factor, EC countries, 1973 - 1981

	B	D	DK	F	GR	I	IRL	LUX	NL	UK	EUR 10
Total Primary Energy Required (TPE, Mtoe)											
1973	45.8	262.2	19.5	174.7	11.7	122.2	7.02	4.50	61.4	221.7	930.7
1977	44.3	257.2	19.6	166.4	13.5	126.5	7.01	3.79	63.6	209.8	911.8
1980	45.7	270.1	19.1	184.6	15.3	132.0	8.43	3.63	65.1	199.9	943.8
1981	43.3	257.8	16.8	180.5	14.8	130.4	7.97	3.17	60.7	194.4	909.9
Total Final Consumpt. (TFC, Mtoe) incl. Non-Energy Consumption											
1973	36.7	200.9	16.4	137.7	8.8	98.1	5.5	4.1	49.5	153.6	711.4
1977	34.2	193.0	16.0	134.0	9.7	101.4	5.3	3.5	50.7	145.6	693.4
1980	34.7	200.7	14.9	140.2	11.2	104.6	6.5	3.4	51.9	138.0	706.0
1981	32.3	189.9	13.5	133.2	10.7	102.9	6.1	3.0	48.4	135.0	675.0
Sectoral Energy Use (% of TFC)											
o Residential/Commercial											
1973	35.0	39.2	56.1	39.5	27.4	31.4	33.2	12.7	40.8	35.1	37.2
1977	37.1	40.0	55.4	37.0	25.5	30.9	36.9	16.9	38.8	37.5	37.4
1980	37.9	37.8	50.8	36.8	24.6	32.3	41.7	17.4	40.5	40.6	37.5
1981	37.5	38.1	50.0	37.7	24.9	32.1	38.5	18.8	39.9	41.3	37.8
o Industry											
1973	41.4	34.1	20.6	33.5	35.8	36.4	33.0	79.3	26.5	37.5	34.9
1977	38.6	32.0	18.9	32.7	36.8	37.6	32.0	71.4	23.4	32.1	32.6
1980	37.3	32.4	25.4	32.0	35.3	35.7	29.7	66.9	26.8	30.0	32.2
1981	36.5	31.8	24.5	28.6	33.8	35.0	31.4	61.5	27.5	29.1	31.1
o Transport											
1973	13.5	16.5	19.5	18.8	31.4	19.8	29.2	7.3	14.5	19.4	18.0
1977	16.1	19.0	22.0	21.6	32.8	21.2	28.8	10.7	16.7	21.0	20.2
1980	16.7	20.1	21.1	22.6	35.2	23.5	26.6	14.6	16.6	24.0	21.8
1981	17.5	20.7	22.6	24.2	37.1	24.6	27.6	18.4	17.8	23.7	22.6
o Non Energy Consumption											
1973	10.1	10.2	3.8	8.2	5.4	12.4	4.6	0.7	18.2	8.0	9.9
1977	8.2	9.0	3.7	8.7	4.9	10.3	2.3	1.0	21.1	9.4	9.8
1980	8.1	9.7	2.7	8.6	4.9	8.5	2.0	1.1	16.1	5.4	8.5
1981	8.5	9.4	2.9	9.5	4.2	8.3	2.5	1.3	14.8	5.9	8.5
TFC/TPE, overall energy transf. factor											
1973	0.801	0.766	0.841	0.788	0.752	0.803	0.783	0.911	0.806	0.693	0.764
1977	0.772	0.750	0.816	0.805	0.719	0.802	0.756	0.923	0.797	0.694	0.760
1980	0.759	0.743	0.780	0.759	0.732	0.792	0.771	0.937	0.797	0.690	0.748
1981	0.746	0.737	0.804	0.738	0.723	0.789	0.765	0.946	0.797	0.694	0.742

During the period of 1977 - 1981 the picture changes drastically for a few countries (see Table 3.1). But again, separating the factors which influence energy consumption from those which reduce specific energy consumption by way of more rational use of energy, the differences are not as significant in most cases as might first appear.

- The United Kingdom and Luxembourg underwent a period of de-industrialization; especially the iron and steel industry in both countries is responsible for a drop of more than 2.5 Mtoe in the United Kingdom and 0.6 Mtoe for Luxembourg because of reduced production. In addition, Luxembourg improved the overall energy transformation factor owing to its reduced power generation in 1981.
- In Denmark, however, the reduction of per capita residential/commercial and transportation figures is surprisingly high (see Table 3.1). As compared to the average of the Member countries, the changes between 1980 and 1981 cannot be solely attributed to the sharp price increase of energy or climatic variations. Here in the residential sector, a significant impact of energy conservation programmes has to be attributed to achieved savings.

Three countries improved overall energy efficiency much less than the average of EUR 10, two of which had been leaders in the post embargo period.

- France increased drastically power generation which led to a drop of the overall transformation factor (see table 3.3) and, consequently, to 15 Mtoe additional primary energy consumption.
- Greece and Ireland underwent high increases of the per capita residential/commercial energy consumption (Ireland: 13.6 %; Greece: 3.8 %; EUR 10: - 2.7 %). This can be explained mainly by higher economic activity in the commercial and public sectors and also in both the increased living area and the standard of living in the residential sector. In Greece, per capita fuel consumption in the transportation sector increased by almost 20 %. In spite of the fact that both countries are in an industrialization phase, industrial energy consumption increased less than industrial production.

Taking these structural changes in economy and in the transformation sector into consideration, there seem to be only a few unexplained variations of energy consumption trends of EUR 10. Perhaps only a few energy saving programmes had significant effects in limited sectors until 1980/81.

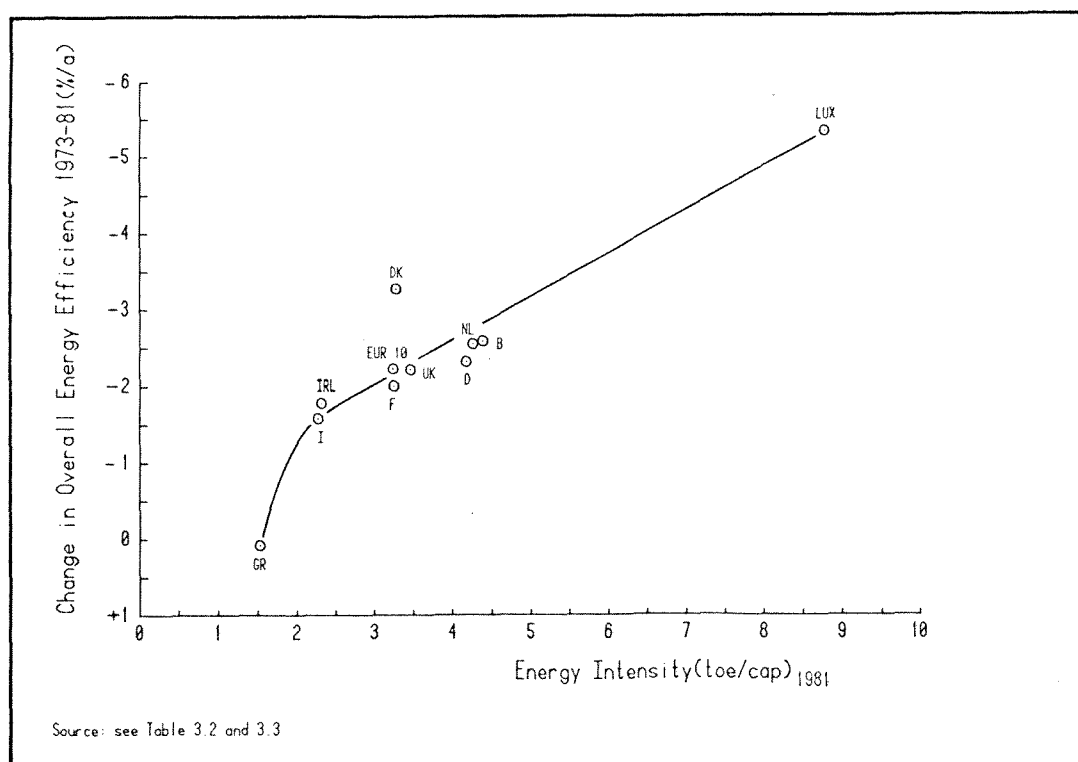
Even if this preliminary analysis had been carried out in more detail, the task of distinguishing between the following three factors influencing "real" energy savings would remain:

- Autonomous energy saving improvements which are incorporated in most reinvested capital goods or come about as upscaling effects; such effects were predominant in the sixties with falling energy price levels (Garnreiter/Legler, 1980).
- Increasing energy prices induce energy savings achieved by investments or organizational measures (e. g. maintenance, temperature control); this effect may have been predominant after 1973.
- Energy savings induced by energy conservation policies may play an increasingly important role in the eighties.

One could try to separate these three factors by regression analyses for the industrial, transportation, and residential sector. But this seems impossible for the commercial sector because of a lack of necessary data. In order to get some insight into the success of energy conservation policies we suggest detailed evaluations of individual programmes. It seems far too difficult to trace their influence from the development of global figures.

From global figures, however, we can conclude that there seem to be important factors which reduce overall energy efficiency with increasing energy intensity, i.e., total primary energy consumption per capita (see Figure 3.1).

Figure 3.1: Changes in overall energy efficiency between 1973 and 1981 and energy intensity in 1981, EC countries



These factors may be adjustment of national energy price levels, saturation of energy intensive industries, adjustment of production, transportation and consumption patterns among most of the EC countries, gradual adjustment of energy supply structures and - in the future - of conservation policies. This development may lead to a saturation value of energy intensity in the order of 4 toe per capita and year even if per capita gross national product increases in the next ten years (see Figure 3.2).

Still fast expanding energy consumption is observed in the transportation sector in eight member countries (exceptions since 1977: Denmark - 14 % and the Netherlands - 1.3 %, see Table 3.1). The major reason for this development was further motorization (see Table 3.4), but interestingly enough: there is an almost complete lack of energy conservation programmes for this sector in most member countries, although this sector is highly dependent on oil products. Actual fuel price policy seems to have very weak impact.

Figure 3.2: Energy intensity, change in overall energy efficiency 1973 - 1981 and per capita gross domestic product 1981, EC countries

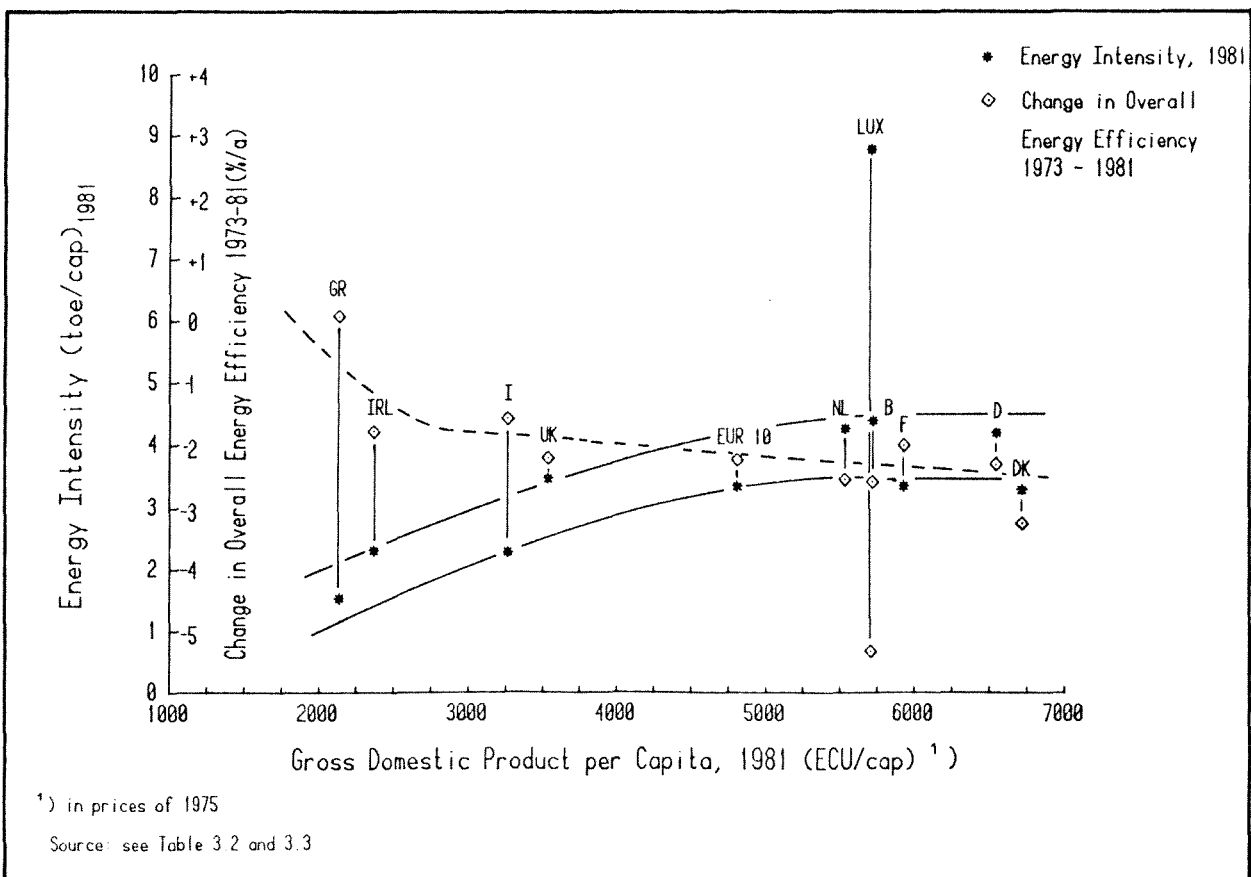


Table 3.4: Motorization in the EC countries, 1977 - 1980

	B	D	DK	F	GR	I	IRL	LUX	NL	UK	EUR 10
Change of car stock	+ 10,0	+ 22,6	+ 1,1	+ 12,6	+ 41,8	+ 5,7	+ 28,1	+ 34,1 ^x	+ 10,1 ^x	+ 5,4	+ 10,1
Change of lorry and bus stock	+ 9,9	+ 11,6	- 0,7	+ 13,1	+ 51,8	+ 5,1	+ 21,4	+ 18,0	+ 22,9	- 0,2	+ 9,5

x 1978 - 80

Source: Statistisches Bundesamt, 1982

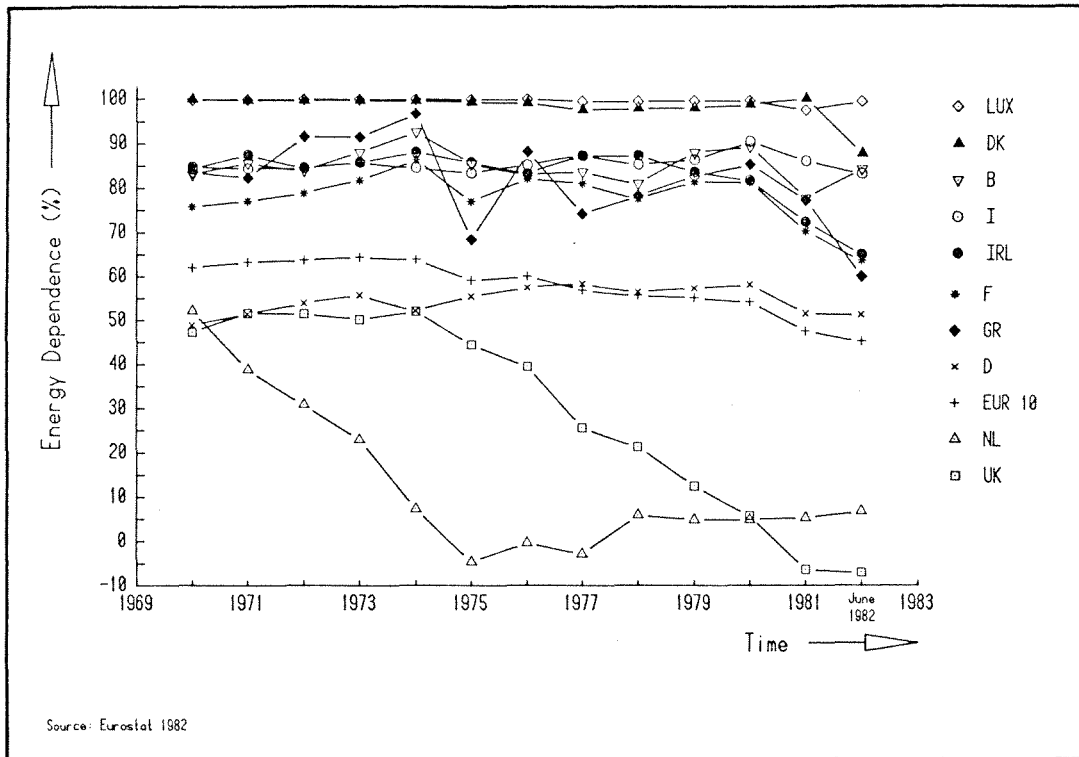
Net energy imports

The decreased dependency on energy imports of EUR 10 between 1973 and the first half year of 1982 is mainly due to a drastic increase in domestic energy production in the United Kingdom and the Netherlands and to some extent to the decreased dependency of Greece, France, and Denmark (see Figure 3.3). The dependence on energy imports in 1981 was

- over 97 % in Luxembourg and Denmark which dropped below 90 % until June 1982,
- still very high in Italy, Belgium, Greece, Ireland, and France with more than 70 %; the last three countries have been very successful in reducing dependency below 70 % until June 1982,
- still of great importance in Germany with more than 50 %,
- negligible in only two countries, namely the Netherlands and the United Kingdom.

As a high dependency on energy imports puts a heavy burden on the foreign trade balance, especially with increasing energy prices, energy conservation, seen from this aspect too, is a central concern of energy policies.

Figure 3.3: Dependency on energy net-imports, EC countries, 1970 - 1981



Energy Prices

Energy prices in the EC countries published by the European Commission (1982) may be used for international comparison or for international interfuel comparison. The first has its own particular problems as purchasing power differs in the various EC countries. Consequently comments on existing price levels will be restricted here to interfuel comparison.

As far as the price incentives within industry to substitute natural gas for residual fuel oil are concerned, the price relation of residual fuel oil to natural gas is most favourable in France with 92 % and in Italy with 86 % (see Table 3.5). In the United Kingdom and the Netherlands, the two countries with high percentages of domestic natural gas production, the relation is 85 % and 75 % respectively. The price incentives for substitution of residual fuel oil are low in Belgium (69 %) and Germany (68 %).

Table 3.5: Energy prices and price relations of industrial and residential fuels in EC countries, January 1982

EC Country	Residual Fuel Oil (ECU/GJ) ¹⁾ (1)	Industrial Gas 42,000 GJ/a (ECU/GJ) ¹⁾ (2)	Ind. Electricity 10 GWh/a (ECU/GJ) ¹⁾ (2)	Relation (1)/(2)	Gas oil (ECU/GJ) (3)	Residential Gas 16.7 GJ/a (ECU/GJ) (4)	Residential Electricity 1.2 MWh/a (ECU/100 kWh) (3)	Electricity 20 MWh/a (4)	Relation (3)/(4)
B	4.1	5.9	21.2	0.19	11.8	13.1	14.5	7.2	2.01
D	4.7	6.8	22.0	0.21	12.0	13.3	13.6	5.5	2.47
DK	4.8 ²⁾	-	23.8	0.20	15.1	17.9	10.2	7.2	1.41
F	4.5	4.9	16.9	0.27	12.8	12.7	11.1	6.7	1.65
GR	-	-	17.6	-	-	-	9.1	5.7	1.59
I	4.3	5.0	23.8	0.18	12.0	8.2	6.3	-	-
IRL	5.6	-	28.1	0.20	11.6	-	11.0	6.7	1.64
LUX	4.3	5.9	16.9	0.25	11.1	14.4	10.2	5.0	2.04
NL	4.7	6.2	27.7	0.17	12.6	7.1	12.5	8.5	1.47
UK	5.2	6.1	23.0	0.23	12.5	7.9	13.0	5.1	2.55

1) VAT excluded 2) VAT and energy tax (10 Dkr/GJ) excluded
Source: EC, DG Energy, 1982; calculations by FhG/ISI

Prices for industrial electricity (10 GWh consumption per year) are four times as high as for residual fuel oil in France and Luxembourg, as a result of relatively low electricity prices in these countries. The price relation is a factor 5 to 5.9 in Denmark, Ireland, Belgium, Italy, and the Netherlands, caused by relatively low residual fuel prices in Belgium and Italy and relatively high electricity prices in Ireland and the Netherlands.

Regarding the price incentives within the residential sector to substitute gas oil by natural gas the latter fuel is significantly less expensive for the Dutch, British and Italian consumer. Price incentives to encourage substitution are especially low in Luxembourg and Denmark; this situation may well change in the near future as a result of natural gas imports from Germany and domestic production in Denmark.

There are significant differences as far as the linear increase in residential electricity tariffs is concerned: British and German consumers are clearly urged to consume a lot electricity, as low electricity consumption is two and a half times more expensive than high consumption (see Table 3.5). On the other hand, Dutch and Danish consumers are forced by a rather linear tariff structure to think about additional electricity consumption. Greece, Ireland, and France have also adopted a rather moderate price-consumption depression of 1.59 to 1.65.

3.2 Main issues of national energy conservation policies

This chapter will give a brief overview on the general political framework for energy conservation in each EC country. It concentrates on the role of the three types of measures considered: regulations, financial support, and information. In addition, other applied measures of energy demand and supply policy as well as overall governmental objectives in the field of energy will be mentioned.

On the basis of the present study there is, of course, no possibility for a general judgement of the national energy policies because measures other than the ones mentioned above have not been analysed.

The statements made in this chapter are primarily based on the interviews performed in national ministries and energy agencies. They will cover the following aspects:

- implementation of energy conservation policies after the first oil price crisis in 1973
- general framework for energy conservation programmes (e. g. national energy plans)
- political priorities for types of measures (regulations, financial incentives, information) for energy conservation in the different sectors
- distribution of responsibilities for planning, performing, and monitoring energy conservation programmes
- governmental objectives for energy savings to be reached
- important measures other than regulation, financial support, and information.

Each part of this chapter will be concluded by a table showing the development of regulations, financial, and informational measures and the 1982 budgets. Table 3.6 shows a brief overview on some aspects of the energy conservation policy in the Member countries.

Some countries have started a comprehensive energy conservation strategy soon after the first oil price crisis (especially France, the Netherlands and the Federal Republic of Germany) whereas other countries have started only recently (Ireland, Italy) or have not yet adopted a comprehensive

demand and supply policy (Belgium, Greece, Luxembourg). By 1978, however, each country had introduced at least singular measures towards energy conservation.

Table 3.6: Energy conservation policies in the EC countries

	B	D	DK	F	GR	I	IRL	LUX	NL	UK
Dependency on energy imports	high	medium	very high	high	high	high	high	very high	in balance	in balance
First energy conservation programmes started in	1975	1973	1974	1974	1975	1977	1974	1978	1974	1975
Comprehensive energy supply and demand policy since	-	1974	1976	1974	-	1982	1980	-	1974	1978
Quantitative governmental objectives for energy savings	-	-	detailed goal setting: e.g. improve energy efficiency by 20 % (1990) 30 % (2000)	60 Mtoe (1990)	res. 10 % public 15 % ind. 5% by 1987 no oil-based electricity production	15 Mtoe (1985) 20 Mtoe 1990	-	-	improve energy efficiency 10 % (1985) 20 % (1990) 30 % (2000)	-
Most important national energy conservation policies	space heat (all measures)	space heat (all measures) financial incentives	oil pricing space heat (all measures) district heating	Energy Agency space heat (all measures) industry (consulting)	regulations (all sectors)	space heat (regulations) pricing	information and advice (all sectors) pricing	information (all sectors) residential (subsidies)	space heat (all measures) process heat (subsidies)	pricing information (all sectors) industry, residential (subsid.)
RD&D budget for energy conservation and renewable energy sources 1981										
- Mill. ECU	14.2	97.8	12.7	85.1	9.0	44.4	6.0	no data	36.1	55.9
- ECU per capita	1.4	1.6	2.5	1.6	0.9	0.8	1.8	available	2.6	1.0

Sources: IEA, 1982b; AFME, 1982

Regarding national priorities for certain energy conservation strategies, most countries concentrate on space heating. Very few activities can be found in the transportation sector. Only several countries clearly show priorities for one of the three measures studied:

- regulations: Greece, Italy, France
- financial incentives: Federal Republic of Germany, Denmark (district heating), Luxembourg (residential), the Netherlands (process heat), United Kingdom (industry, residential)
- information: Ireland, France (consulting in industry).

Denmark, the United Kingdom, Ireland, and Italy focus on pricing strategies as a main activity towards energy conservation.

3.2.1 Belgium

The energy situation in Belgium is characterized by a relatively high total primary energy consumption per capita, due to the high proportion of energy-intensive industry. Half of the Belgian energy consumption depends on imported oil and approximately 80 % of total primary energy is imported. The exploitation of domestic energy sources, mainly coal, has become rather expensive, similar to the neighbouring countries.

The ratio of total primary energy per gross domestic product (TPE/GDP) has declined since 1973 (see Table 3.1). These changes do not only reflect more efficient use of energy but also structural changes within industry; for instance, steel production dropped by more than 20 % between 1973 and 1981.

The Belgian energy policy can be characterized as strongly market-oriented, the Government taking responsibility primarily for the supply side, especially through the implementation of a "significant nuclear programme, the present phase of which will be completed by 1985, when 51 % of electricity is expected to be generated from nuclear power" (IEA, 1982).

First measures have been taken since 1975 when a "calory man" was installed for information about a more rational use of energy. In 1976 first financial subsidies for energy investments were granted. Governmental White Papers on energy conservation have been presented since 1975; and a "National Programme for Reorientation and Rational Use of Energy" has been adopted in 1980.

The appointment of a "Secretary of State for Energy" at the Ministry of Economic Affairs is supposed to give more importance to energy problems and especially to a more rational use of energy.

Among the number of measures for energy conservation taken in the last years, the Government established the Belgian Energy Conservation Service at the Ministry of Economic Affairs (SCE, Service pour la Conservation des Energies) in October 1979. It is responsible for

- directing education campaigns,
- circulating information on conservation techniques,

- preparing governmental measures towards energy conservation.

With a budget of 0.6 Mill. ECU (1979) and 1.7 Mill. ECU (1980) it has largely taken publicity measures in order to acquaint consumers with the need for energy conservation.

At present, Belgium's energy conservation policy is integrated in a wider political framework, in particular that of the economic redeployment policy.

Besides intensifying financial aids, government took a new action called "Energy = new industry", which aims at industrial redeployment towards these key technologies and to set out a framework for cooperation between enterprises, universities and Government.

The Belgian energy conservation programmes include all three types of measures under study. Compared to other EG countries, regulations and tax relief receive pronounced attention by the Belgian energy conversation policy.

Regulations

- Building codes for public buildings (since 1980)
- Maintenance of heating equipment (since 1978)
- Temperature limits in public buildings (since 1979, enforced 1981)
- Labelling of household appliances (law 1981, but not yet implemented)
- Public lighting limits (since 1979)
- Delivery limits for fuel oil (1979 - 1982)
- Speed limits (since 1975)

Financial support

- Grants for insulation of houses (since 1976; regional grants: Wallonia since 1979, Flanders 1980 - 1982)
- Grants for energy-saving investments in agriculture (since 1981)
- Tax relief for insulation investments in houses (since 1981)
- Reduction of V.A.T. for energy-saving investments in houses (since 1982)
- Tax relief for energy-saving investments in industry (since 1981, enforced 1982)

Information

- Information campaigns (since 1975)
- Energy audits (since 1981)

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Table 3.7: Energy conservation programmes in Belgium and budgets 1982

	1974	1975	1976	1977	1978	1979	1980	1981	1982 (Mill. ECU)
1. Building codes for public buildings									
2. Temperature limits for public buildings									
3. Control systems and maintenance of heating equipment									
4. Energy labelling for household appliances +)									
5. Lighting limits									
6. Delivering limits for fuel oil									
7. Speed limits									
8. Grants for insulation of houses									
Wallonia									2
Flanders									
9. Grants for agriculture									
10. Tax relief for households									
11. Reduction of V.A.T. for energy saving investments									
12. Tax relief for industry									
13. Information campaigns									
14. Energy audits									

+) not yet implemented

3.2.2 Federal Republic of Germany

The Federal Republic of Germany, because of its comparably high proportion of nationally produced primary energy, is relatively less affected by energy problems than other EC member countries (see Chapter 3.1). Furthermore, an overall concept of energy policy has been available in published form since 1973. It is based on detailed reports by renowned institutes and revised at intervals. The most recent revision from November 1981 contains the political guidelines, elements of energy supply and demand, and research and development for energy.

Judging by the financial volume of the governmental measures, the emphasis continues to be laid on the supply side (promotion of coal and nuclear energy), although it must be taken into consideration that these measures also incorporate other aims such as national supplies security and labour market considerations. The weight given to energy demand policies, has, however, increased successively: from aiming originally at the "introduction and application" of rational use of energy (Energy Programme, 1973) to then aiming at "restricting the growth of energy consumption by an economical and rational use of energy" (2nd Revision of Energy Programme, 1977), and finally expressing the postulate that policies for energy conservation would continue to take priority (3rd Revision of Energy Programme, 1981).

This increasing shift of accent in favour of a rational use of energy can be attributed to three reasons:

- the drastic increase of world market prices for energy,
- the experience of the last eight years, namely, that despite a 17 % increase of gross domestic product the consumption of primary energy remained at the level of 1973. Apart from structural effects, the possibilities for energy conservation have thus been convincingly demonstrated,
- furthermore, the topic has been made a political issue by community action groups, influencing the administration via the established political parties and causing major changes in priority.

According to assessments by the Federal Government "the fundamental regulation of energy supplies on the basis of market forces has proved its worth"

(Deutscher Bundestag, 1982) and will therefore be continued. This is also felt to be the case in the energy conservation policy too. The various governmental measures therefore do not consist of hard-hitting interventions into existing market structures such as changing the tariff autonomy to abolish degressive tariffs, or restricting private transport in favour of public transport. Likewise, taxes on certain energies are levied exclusively as part of the fiscal policy, not as part of an energy conservation policy. Thus the energy conservation policy, apart from promoting research and development, is based on measures such as information, subsidies, and regulation.

Regulations:

- thermal insulation codes for new buildings (since 1977, revised in 1981)
- standards for new boilers and hot water production (since 1978, revised in 1982)
- standards of operation for space heating and hot water production (since 1978)
- mandatory individual heat metering in apartment buildings (since 1981)
- speed limit on roads (since 1975).

Financial incentives:

- DM 4.35 Bill. grant programme for energy saving in dwellings (1978-1983)
- § 4a Investment Allowance Act which provides grants on 7.5 % of investment costs (since 1975)
- programme "Investment for the Future" (ZIP) since 1977 to promote district heating systems and energy conservation in federally owned buildings (finished 1981, followed up in 1982 by two separate programmes: grant scheme for coal-fired heating and power plants and district heating, programme for energy saving investments in federally-owned buildings)
- investment loan programme with subsidized interest rate for energy-saving and oil substitution investments (1981-1982)
- programme to promote accelerated introduction of energy saving technologies and products (1978 - 1982)
- subsidies for consultation for small and medium-sized firms (since 1978)

Information:

- information campaigns for consumers: several campaigns of the Federal Government (since 1977) and governmental support for the Stiftung Waren-test (since 1979)
- advisory service for consumers: support for the Consumer's Association (since 1978).

The majority of the measures are aimed at private households and the commercial sector. For industry, mainly financial incentives and advisory services are employed.

None of the measures used (except moderate speed limits) is directly aimed at the transport sector. There are voluntary agreements instead, like the voluntary commitment of industry to reduce the specific energy consumption of motor cars by 15 % between 1979 and 1985 and the establishment of a DIN norm by which the specific energy consumption of cars is registered for three different speeds.

In keeping with Germany's federal structure, both the Länder and the municipalities also contribute to energy policy; the federal authorities, however, have the final conceptual and financial say.

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Table 3.8: Energy conservation programmes in the Federal Republic of Germany and budgets 1982

	1974	1975	1976	1977	1978	1979	1980	1981	1982 (Mill. ECU)
1. Building Codes									
2. Standards for new boilers									
3. Operation standards for boilers									
4. Individual heat metering									
5. Speed limits									
6. DM 4.35 Bill. Grant Programme for energy savings in dwellings									370
7. Investment Allowance Act § 4 a									50
8. Programme for energy saving investments in federally-owned buildings									200
9. Grant scheme for coal-fired heating and power plants, district heating									130
10. Investment loan programme									10
11. Accelerated introduction of energy saving technologies and products									ca.5
12. Grants for investments in greenhouses									
13. Grants for consultations									2
14. Information campaigns for consumers: Federal Ministry of Economics									8.5
15. Information for consumers: Stiftung Warentest									1.5
16. Advisory service for consumers: Consumers' Association									1.5

3.2.3 Denmark

Denmark, dependent on energy imports up to 1980 for more than 97 % of its primary energy requirements, has moved somewhat faster and more consistently than most European countries since 1973 to conserve energy and to substitute oil. The dependency on oil imports is still very high, and the former Danish Government's Energy Plan (1981) took this into account in defining its targets:

- little growth in energy consumption during the eighties (7 to 14 %),
- further large drops in oil use (from 62 % in 1981 to around 45 to 47 % in 1990)
- big increases in the use of coal (from 33 % today to 39 % in 1990) and of natural gas (from 1 % in 1981 to 11 % in 1990), and finally
- a rising contribution from domestic fuels (North Sea oil and natural gas, garbage, straw, and other renewables). The degree of dependency on energy imports could drop to almost 50 % by 1990 as a result of North Sea oil and gas development (Fedler, 1981).

Denmark's first Energy Plan was published in 1976 and formed the basis for energy policy and important decisions until 1981, when the last plan was worked out.

The target of the Government's energy conservation policy - calculated from the forecasts of the "Energy Plan '81" - is to improve the overall energy efficiency by 20 % between 1980 and 1990 and by 30 % by 2000. The projections assume the highest energy savings in the space heating sector (30 % to 40 % between 1980 and 1990) and in the transportation sector (25 % to 35 % until 1990). Surprisingly low expected savings are projected in the industrial, agricultural, fishing, and construction sector (6 % to 24 % between 1980 and 1990).

The "Energy Plan 81" will intensify information, consulting, and regulation measures. High public deficits, the fact that high energy prices and additional taxes enforce additional energy conservation, and insufficient knowledge and maintenance in the residential, commercial and public sector seem to be main reasons for this policy. Whether the new Government shares these opinions as far as regulations are concerned is an open question. The Energy Plan 81 included

- tightening existing building codes and extending of the control schemes for technical installations,
- the grant scheme for houses and the programme for public buildings which have to be in an "acceptable state of thermal efficiency" before the end of 1987.

Energy pricing plays an important role for energy conservation as well as diversification. Residual fuel oil and gas oil prices are by far the highest in the EC (see Table 3.4). Future district heat and gas prices will be determined by costs and supervised by the Gas and Heat Pricing Committee.

The annual energy conservation subsidies in 1982 were around 600 Mill. DKr (75 Mill. ECU), i. e. almost 15 ECU per capita. Public authorities may spend additional 40 Mill. ECU per year for public buildings (National Building Agency, 1982). High public financial deficits may make it difficult to continue these grant schemes in the near future. The fact that the grant scheme for renewables is as large as those for energy conservation in industry or for utilization of excess heat is an indication of the importance so far placed on developing domestic energy resources in the Danish energy policy.

The regulations apply for the most part to the space heating sector. In particular building codes, first set up in 1961, are the strictest of all EC countries (see Chapter 3.3).

Information programmes are mainly coordinated by the Danish Energy Conservation Committee. The National Building Agency runs a special information programme for energy conservation in buildings with a yearly budget of 0.15 ECU/cap, the EUR 10-average of information programmes for all sectors. The total annual information budget is, compared to most EC countries, relatively high (0.41 ECU/cap). In 1983, however, it will possibly be reduced to 0.27 ECU/cap (National Building Agency, 1982).

Denmark is one of the first countries to have made voluntary consultation fully subsidized before home-owners or tenants may apply for a grant. This seems to be very important to reduce low-return investments as a result of insufficient technical knowledge on the part of the investor.

Four out of thirteen programmes of energy conservation started before or in 1975. Five programmes started in the period of 1977-79 and four programmes after the second oil price crisis (see Table 3.5). Although the Danish energy intensity is relatively low (see Figure 3.2) changes in overall energy efficiency have been surprisingly high since 1973. Denmark seems to be a good candidate to trace significant shares of realized savings to energy conservation policy and not only to other factors mentioned in Chapter 3.1.

Denmark has a Ministry of Energy responsible for overall energy policy, including energy conservation. Conservation policy is implemented and coordinated with other main policy issues by several ministries (Housing, Agriculture and Fishery) and their subordinate institutions (Building Agency, Agency of Technology, Energy Agency).

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Table 3.9: Energy conservation programmes in Denmark and budgets 1982

	1974	1975	1976	1977	1978	1979	1980	1981	1982 (Mill.ECU)
1. Building codes for new buildings									
2. Maintenance control of oil burners									
3. Individual heat metering, law of rent (on behalf of majority of tenants)									
4. Law of energy labelling for domestic appliances, boilers, and cars									
5. Act on Reduction of Energy Consumption in Public Buildings									
6. Speed limits for passenger cars									
7. Grant for home owners and tenants									30
8. Grant for utilisation of excess heat									10
9. Grant for renewables									11
10. Grant for energy saving investments									10
11. Grant for new energy technology									4
12. Energy Conservation Committee									1.3
13. Information campaigns for households									0.8

3.2.4 France

For historical reasons France always paid considerable attention to energy self-sufficiency. Prior to the first oil crisis in 1973, the French energy policy was part of the general framework of economic policy. In 1974/75 a coherent concept for an energy policy was developed in a concise form, setting quantitative goals and covering all sectors of the economy.

Because of the great importance of nationalized industries (energy supply is almost completely nationalized) there is a tendency in France to solve energy problems primarily from the supply side. Thus, in the 1974 Energy Programme substituting nuclear energy for oil had high priority. However, equal importance was given to defining a comprehensive energy conservation policy; the goal to be reached by 1982 was 40 to 45 Mtoe energy savings. In addition, 55 % of electricity should be supplied by nuclear energy (40 to 45 Mtoe).

The French Energy Conservation Agency (AFME) points out that the overall energy efficiency in France was already high in 1973 compared with EUR 10. While the Gross Domestic Product (GDP) increased by 21.1 % between 1973 and 1981, energy consumption increased by only 3.3 %. AFME argues that one main reason for this improvement is a structural shift in industry accompanied by investments for modernization and innovation. For the future, however, AFME expects that the attainment of energy conservation goals will require more investments which cannot solely be realized without governmental aid.

In October 1981 a new energy programme "Plan d'indépendance énergétique" was adopted by Parliament which gave particular emphasis to the topics of national independence in energy supply and economic and social improvements. The main goal is oil substitution by (goals for 1990):

- production of domestic forms of energy (nuclear, coal, and renewable energy): 85 Mtoe
- energy conservation: 60 Mtoe.

The goal of 60 Mtoe annual energy savings (1990) is expected to be achieved through investments and behavioural changes as follows (Table 3.10).

Table 3.10 Expected annual energy savings in France by 1990

	through invest- ments (Mtoe)	through behav- iour (Mtoe)
Industry	1.2	0.2
Residential and Commercial	1.2	0.2
Transport	0.6	0.1
Total	3.0	0.5

Source: AFME, 1981

This would represent a volume of investments of 215 Bill. FF (32.8 Bill. ECU) in a ten-year period.

Until recently, the main bodies responsible for energy conservation programmes were: AEE (Agence pour les Economies d'Energie) and COMES (Commissariat pour l'Energie Solaire). To improve the prerequisites for realizing energy conservation policies these bodies were amalgamated to a large agency AFME (Agence Francaise pour la Maitrise de l'Energie) with regional offices.

The AEE was set up in 1974; its main tasks were to gather information on efficient use of energy and to define and coordinate governmental measures, especially advisory services and publicity campaigns. The AFME, established in 1982, has a yearly budget of 1.250 Mill. FF/191 Mill. ECU (1982) which covers personnel cost, expenses for information campaigns, advisory services, and some of the grants.

The 1980 AEE budget provides predominantly grants for industry (53 % of total budget, 62 Mill. ECU). 11 % of the budget (13 Mill. ECU) were spent on research and development, 16 % (19 Mill. ECU) on information and training. 1.3 Mill. ECU were spent on monitoring the programmes and reviewing the results.

In the industrial and agricultural sector, the Government is taking the following actions: Credit and fiscal facilities for the firms investing in energy saving: The banking restrictions concerning credit are not applicable

for energy saving investments; specialized regional institutions for financing and leasing or rent of energy-saving equipment have been created; low interest loans and tax relief are granted. In addition, the Government promotes intensive consulting. Different actions are taken for small and medium-sized firms (with an annual energy consumption of less than 5,000 toe) and large-scale firms, which are incited to negotiate agreements directly with the AFME.

The wide range of measures taken in the residential and commercial sector is due to the variety of energy consumers in this sector. Half of the public funds spent in this sector come from the AFME and half from the Ministry of Housing and Construction and other institutions owning public buildings.

The AFME now concentrates its activities on free diagnosis, approval of consulting firms, training of consultants, and information campaigns.

In the transport sector the AFME spends about the same funds on research and development programmes as on information and training of the public. Free consulting services are offered for transport firms with high energy consumption. A special programme is implemented for the fishing fleet.

To develop the French energy conservation policy further, the Government tries to improve the energy consciousness by means of information campaigns and to reach a better cost-effectiveness by allocating financial incentives to intermediaries rather than direct to consumers.

Summing up, the French Government has been very active both with regard to the great variety of measures and their comprehensiveness. Some of the more than 150 regulations, approximately 40 financial support measures and extensive information programmes are listed below and summarized in table 3.11.

With respect to a definition of "governmental measures" it has to be kept in mind that the public sector of economy is extremely large in France: 60 % of industry (by turnover) and most of the banking sector are state-owned enterprises. Although the French government emphasizes the integration of these enterprises in its policies, we have not included measures taken by these enterprises as governmental measures if there are no additional governmental funds allocated to them.

<u>Regulations</u>	<u>since</u>
1. Standards for calculation of energy demand in new buildings	1982
2. Insulation standards for new buildings 1974 (residential), 1976 (commercial), 1977 (electricity-heated buildings), 1977 (agricultural)	
3. Standards for heating systems 1974 (residential), 1978 (commercial)	
4. Mandatory inspection of heating systems	1977
5. Mandatory individual metering of heating and hot water costs - in new buildings: 1975 (residential), 1976 (commercial) - in existing buildings: 1979	
6. Temperature limits	1974, 1979
7. Approval and labelling of domestic appliances	1976, 1977
8. Restrictions for commercial lighting	1974, 1979
9. Restrictions for the delivery of fuel oil	1974, 1980, 1982
10. Limited advertisement for energy-consuming appliances	1974, 1979
11. Operating standards for boilers	1975
12. Speed limits	1974
13. Standards for testing and publication of gasoline consumption in new cars	1975
14. Standards for testing energy-saving devices in private cars	1976

Financial support

15. Tax relief for energy-saving investments	1974, 1982
16. Grants for energy-saving investments in existing buildings (AEE)	1976 to 1982
17. Grants for energy-saving investments in existing buildings (ANAH, PALULOS, DDE)	1975, 1979, 1982
18. Grants for investments in public buildings	1982
19. Low-interest loan (CREDIT FONCIER)	1981 to 1982
20. Special loan for new buildings with higher standards for "energy performance"	1980, 1982
21. Special loan for solar use	1979, 1980
22. Grants for installation of heat pumps	1981 to 1983
23. Grants for district heating projects	1982
24. Financial scheme for reconversion to coal	1981, 1982

since

- | | |
|---|--------------|
| 25. Financial framework to promote energy-saving investments
in the industry | 1980 |
| 26. Accelerated tax depreciation | 1978 |
| 27. Special loans for industry and agriculture | 1977 to 1982 |
| 28. Grants for investments in industry and agriculture (AEE) | 1976 to 1980 |
| 29. Grants for small and medium-sized firms | 1981 |
| 30. Grants for fishing boats | 1981 to 1982 |
| 31. Grants for energy audits and studies | 1981, 1982 |
| 32. Grants for thermal diagnosis in social housing | 1982 |
| 33. Grants for engineering studies not leading to investments | 1979 |

Information

- | | |
|---|------------|
| 34. Information campaigns for energy saving in existing buildings | 1979 |
| 35. Campaigns for the reduction of the heating period and the
compliance to temperature limits | 1979 |
| 36. Information campaigns for industry | 1976 |
| 37. Information on economic driving and gasoline-saving
devices for private cars | 1979 |
| 38. Information and training for specialized firms | 1979, 1981 |

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Table 3.11: Energy conservation programmes in France (I)

	1974	1975	1976	1977	1978	1979	1980	1981	1982
1. Building codes									
2. Insulation and standards for heating systems									
3. Individual heat metering									
4. Temperature limits									
5. Labelling and approval of household appliances									
6. Lighting restrictions									
7. Delivery limits for fuel oil									
8. Advertisement restrictions									
9. Operating standards for boilers									
10. Speed limits									
11. Loans for improved insulation in new buildings									
<u>Aids to investments in existing buildings:</u>									
12. Tax relief									
13. Grants									
14. Loans									
15. Consulting									
16. Promotion of new energies									
17. Special programme for public buildings									
<u>Aids to industry and agriculture:</u>									
18. Accelerated depreciation									
19. Tax deduction									

Table 3.11: Energy conservation programmes in France (II)

	1974	1975	1976	1977	1978	1979	1980	1981	1982
20. Loans									
21. Leasing or rent									
22. Grants									
<u>Publicity campaigns:</u>									
23. Insulation in new buildings									
24. Investments in existing buildings									
25. Behavioural change									
26. New energies									
27. Economical driving									
28. Information and training of experts									
29. Information for industry									

3.2.5 Greece

The Greek energy situation is characterized by heavy dependence on energy imports (77.2 % in 1981). The country has only limited indigenous resources: lignite and, to a lesser extent, hydro power. Total primary energy requirements as well as final consumption have grown rapidly between 1973 and 1980. A preliminary energy balance sheet of 1981 shows a stagnation for the first time.

Until the end of 1980 the Greek economy was expanding rapidly. Since then, however, investments decreased considerably in general. Despite the fact that most new industries use energy more efficiently than older ones, the overall ratio of TPE/GDP (Total Primary Energy/Gross Domestic Product) did not decline between 1973 and 1981. Because of the low consumption base in the residential/commercial sector, consumption is increasing noticeably in this area; the same holds for the transport sector with regard to increasing private motorization (see Table 3.1). The main emphasis of Greek policy still lies in encouraging continuing economic growth, but reducing the TPE/GDP elasticity ratio.

The Greek government is now trying to achieve at least the following objective: to limit the country's dependence on imported energy, mainly by using only lignite and hydro power for the PPC (Public Power Corporation) electricity production by 1987. The Government has introduced a number of measures in order to achieve this goal, such as switching from oil to natural gas imports, support of indigenous oil production, coal mining, hydroelectricity production, and use of alternative energy sources (solar, wind).

As far as overall energy savings are concerned, the National Energy Council (NEC) points out that some isolated measures to conserve energy are existing, but a comprehensive energy conservation policy covering all types of measures including financial incentives is lacking. The overall weakness of the Greek energy conservation policy can basically be traced back to two factors: inadequate public funding and staffing on the one hand and on the other a lack of information and insufficient institutional backing for existing regulations (lack of monitoring to ensure standards are met, lack of information about why standards should be met and how to meet them).

For the three types of programmes considered - regulations, financial support, information - the following measures have been taken (National Energy Council, 1982):

- In the residential sector mainly two regulations are in force: building codes for new houses and limits on room temperatures. Financial incentives are only available for the installation of solar heaters (the Government promotes the provision of loans and allows longer repayment periods, but does not subsidize the interest rates).
- Energy consumption in industry has been given more attention by the Government as reflected in measures such as mandatory energy auditing in energy-intensive industries and mandatory 3 % investments of the capital for machinery installed for energy-saving measures both in new and expanding old industries. One main problem here, however, is the Government's inadequate facilities (lack of staffing) to ensure that regulations are observed. In addition some information activities are being pursued by the Committee for Energy Conservation in Industry (CECI) which also suffers from insufficient public funding. Financial incentives have been offered to industries since 1978. Until recently (1982), grants covered both energy saving investments and general restructuring and expansion of industries (Law No. 1116). The same applies to the new Development Law No. 1262/82 which is in force now.
- The transport sector in Greece consumes the highest percentage of the final energy consumption compared with all other EC countries (see Table 3.3). Severe problems are the rapid increase in private motorization and the inadequacy of public transport facilities (especially the lack of adequate railway systems, bus priority tracks, etc.) together with the concentration of working places in the cities. In addition to measures such as progressive taxation on cars and improvements in public transport (electrification) as well as relatively high gasoline prices there are some regulations affecting private car use such as speed limits and driving restrictions: however, these are not too effective. One reason is that high prices of new cars due to high taxation does not encourage people to replace the old, low-efficient cars by new ones.

Until recently, one of the main purposes in awarding grants was to support investments in less developed regions, whereas saving energy was considered of only secondary importance. Another measure which has more impact on environment protection than on energy saving is the prohibition of heavy oil for heating purposes (all new boilers; old boilers only in the cities of Athens, Saloniki and Patras; in force since 1975).

The overall responsibility for energy conservation policy is in the hands of the Ministry of Energy and Physical Resources. The body principally involved in planning energy programmes is the National Energy Council (NEC) which advises the Government with regard to current programmes and suggests new energy conservation policies to the Ministries. The National Energy Council, established in 1975 (and also suffering financial constraints), has put forward many recommendations for an improved and more comprehensive energy conservation policy, but these have never been fully adopted by the Government. In particular, measures such as mandatory thermostats, individual heat metering, and grants for retrofitting have been suggested for the residential sector but have not been realized (National Energy Council, 1982).

A Ministerial Decision (237/1980) says that the following energy-saving goals should be reached:

- in old residential buildings, 10 % of oil used for space heating per year has to be saved
 - in the public sector 15 % per year
 - in the industrial sector 5 % per year
- compared to the 1978 consumption.

There are, however, no concrete proposals as to how to realize these objectives.

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Ministry of Energy and Physical Resources: personal communication, 1982

Table 3.12: Energy conservation programmes in Greece and budgets 1982

	1974	1975	1976	1977	1978	1979	1980	1981	1982 (Mill.ECU)
1. Building codes									
2. Operation standards for boilers									
3. 3 % investments for energy saving									
4. Mandatory auditing									
5. Lighting limits and closing hours									
6. Temperature limits									
7. Speed limits and driving limits									
8. Loans for solar heaters									-
9. Grants for investments									17
10. Loans for solar heaters in hotels									-
11. Advisory service for industry									
12. Publicity campaign									

3.2.6 Italy

Italy is one of the EC countries heavily dependent on energy imports: in 1981, Italy imported 86 % of its primary energy requirements (Eurostat, 1982). Some indigenous energy production is based on natural gas and hydroelectric power.

As far as energy conservation is concerned, the main activity of the Italian government after the first oil crisis of 1973 was the preparation of a first National Energy Plan. This was proposed in 1975 but not fully implemented. As a result, some information activities were started, and a law (No. 373/1976) was passed regulating the insulation of buildings and installation and operation of heating systems. The law has been in force since 1977.

In answer to the overall economic crisis which began in 1975, the Restructuring and Reconversion of Industry Law (No. 675/1977) was approved. It provided funds for industrial investments including improvements in energy efficiency. No findings are available as to the extent of energy saved through this measure.

A revised version of the National Energy Plan appeared in 1977. Its main emphasis was on three topics:

- energy conservation (regulations and information)
- pricing
- development of indigenous energy sources and nuclear power.

The plan does not include financial incentives to encourage energy saving investments, the assumption being that increasing energy prices were sufficient economic incentive to take energy saving measures. In addition, it is argued that in Italy the overall energy consumption level is quite low compared with other EC countries, even considering climatic differences (Ministry of Industry and Commerce, 1982).

At the end of 1981, a new and comprehensive National Energy Plan has been approved. The main objectives were:

- to cut down the increase in energy demand by adopting a firm energy saving policy in all sectors,

- reduction of dependence on imports by reducing the oil share of energy supply and developing alternative energy sources, above all coal,
- improvement of the international competitiveness of Italian industry.

As far as energy conservation is concerned, the plan has led to the approval of Law No. 308 (1982) which, for the first time, provides financial incentives to promote energy saving investments in all sectors.

With the exception of the energy transformation sector (district heating and industrial heat/power production), the effectiveness of this law, however, still depends on regulations governing implementation which have not yet been formulated. The responsibility lies with the Ministry of Industry and Commerce and CIPE (Interministerial Committee for Economic Programmes) which also awards the grants.

The goals for savings through the National Energy Plan are 15 Mtoe per year by 1985 and 20 Mtoe per year by 1990 (ENI, 1982) which represent approximately 12 % / 15 % of the primary energy consumption of 1982.

In sum, the following programmes for energy conservation in Italy should be mentioned:

Regulations

- building codes for new and essentially modernized buildings (since 1977)
- standards for boilers for heating and hot water production (since 1977)
- operation limits for boilers (since 1980)
- efficiency standards for boilers (since 1981)
- energy labelling (since 1982)
- appointment of energy managers in industry (since 1982)
- temperature limits in buildings (since 1977)
- speed limits (since 1977)

Financial Support (since 1982)

- grants for energy saving investments in all sectors*
- loans or grants for energy saving investments in industry and agriculture*
- grants and loans for use of renewable energy sources in agriculture*

- grants for combined heat and power production
- retrofitting and installation of small hydroelectric plants
- incentives for the purchase of electric or gasoline-alcohol driven cars in communities*

* not yet implemented because of lacking decrees

Information

- publicity campaigns (1976)
- energy authorities' campaigns (1975)

The governmental information campaigns were not continued in 1981 or 1982. The main responsibility for information programmes has been delegated to the National Electricity Board (ENEL, Ente Nazionale per l'Energia Elettrica) which supplies about 90 % of electricity in Italy. The ENEL philosophy is not to sell electricity but to sell a service. With Law No. 308, ENEL's responsibilities have been extended to the active promotion of energy saving and increased use of renewable sources. From 1983 on, the public will be able to purchase solar equipment and heat pumps from ENEL and pay for them with their regular electricity bill.

Additional information programmes are carried out by Agip Petroli, a subsidiary of ENI (Ente Nazionale Idrocarburi) which offers local energy advice services in all sectors, and ENEA (Ente Nazionale per la Ricerca e lo Sviluppo dell' Energia Nucleare e delle Energie Alternative) which provides technical and scientific advice to public authorities.

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National Energy Plan, 1981

Table 3.13: Energy conservation programmes in Italy and budgets 1982

	1974	1975	1976	1977	1978	1979	1980	1981	1982 (Mill. ECU)
1. Building codes									
2. Standards for new Boilers									
3. Operation limits for boilers									
4. Efficiency standards for boilers									
5. Energy labelling									
6. Appointment of energy managers in industry									
7. Temperature limits									
8. Speed limits									
9. Grants for energy saving investments ⁺)									119
10. Loans or grants for investments ⁺)									25
11. Grants and loans for using renewables ⁺)									68
12. Grants for combined heat and power production									109
13. Grants for hydroelectric plants									15
14. Incentives for the purchase of electric cars ⁺)									1.5
15. Publicity campaigns									
16. Energy authorities' campaigns									

+) not yet implemented

3.2.7 Ireland

Ireland is highly dependent on imported energy. In 1981, 72.3 % of total primary energy requirements were covered by oil which depends entirely on imports. Other energy sources are solid fuels, mainly peat (used in the domestic sector), and natural gas.

Even more important than energy supply is the improvement of the country's balance of payments. The energy import bill (1981 estimated 900 Mill. IR £/ 1.3 Bill. ECU) weakens the national economy and hurts the job creation effort. Ireland is one of the EC member countries with the highest unemployment rate. Energy demand and final consumption have increased during the last years (except 1980 due to reduced economic growth) and are expected to increase furthermore. Energy consumption per Gross Domestic Product (GDP), however, has declined by 13 % between 1973 and 1981.

The level of GDP per capita in Ireland is still below the European average, although industry has strongly developed during the last years (economic growth rate lies above the European average). There are two different types of industries now: a quite new one, well equipped and very energy efficient (mostly American, European and Japanese companies) and an old, indigenous one (mainly textile) which is rather inefficient and short of closing down in many cases.

The Irish energy conservation policy is characterized by two main issues:

- achieving cost-effective energy savings
- switching away from heavy dependence on oil and switching to solid fuels whenever possible.

Conservation programmes commenced in 1974 and are in place for all sectors. The emphasis lies on voluntary cooperation rather than mandatory measures. The crucial point is to provide information to industry, especially small firms, public sector and to households. In the public sector area conservation measures are being taken in Government Buildings, Health Board Buildings, schools and by Local Authorities.

The Department of Industry and Energy, set up in September 1981 as a combination of the Department of Energy (established in 1980) and the Department of Industry, is responsible for all actions taken and receives cooperation where appropriate from other Departments (Transport, Environment) and State Agencies.

Governmental energy conservation activities focus on information and advice

- publicity campaigns for all sectors: broad information for households, a series of 15 technical booklets on energy conservation for industry (since 1974)
- Energy Conservation Hotline: telephone service for all sectors, especially households (since 1980)
- National Boiler Testing Service, free for all firms/institutions having boilers > 50 kW (1980 - 1982)
- Energy Management Programmes: establishment of the Energy Management Association and of Regional Energy Conservation Officers in 1979
- programmes for public buildings (since 1980)

financial support

- grant scheme for the insulation of dwellings (1980 - 1982)
- Home Improvement Grant Scheme (since 1981)
- tax relief on labour cost of insulation in dwellings (since 1979)
- Fuel Efficiency Survey Grant Scheme for fuel efficiency and oil substitution surveys carried out by consultants (since 1980; offered but little used since 1959)
- Energy Conservation Loan Scheme with subsidized interest rates (1980 - 1982)
- incentives for energy intensive industries (since 1981)
- grants for manufacturing industry for energy saving equipment and insulation (1980 - 1981; now under review; former programme since 1969)

and only to a small degree regulations

- thermal insulation standards (since 1979, revised in 1981)
- speed limits (since 1973).

In addition, the Dublin Transportation Authority has been set up which shall improve the public transportation services. In the transport sector, energy saving activities are rather limited for many reasons.

In the residential sector, the main constraint for energy conservation efforts is shortage of disposable income. Above all, households should preferably burn solid fuels in closed rather than open fires (90 % of dwellings are still heated by open fire with coal, peat or wood).

The financial resources for energy conservation programmes were

- 1.1 Mill. IR £ (1.65 Mill. ECU) in 1980 and
- 4.76 Mill. IR £ (6.9 Mill. ECU) in 1981.

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Table 3.14: Energy conservation programmes in Ireland and budgets 1982

	1974	1975	1976	1977	1978	1979	1980	1981	1982 (Mill.ECU)
1. Thermal insulation standards									
2. Speed limits									
3. Grant scheme for the insulation of domestic dwellings									0.7
4. Home Improvement Grant Scheme									
5. Tax relief on labour cost of insulation									
6. Fuel Efficiency Survey Grant Scheme									0.07
7. Energy Conservation Loan Scheme									ca. 0.13
8. Incentive scheme for energy intensive industries									0.9
9. Grant for manufacturing industry									
10. Publicity campaigns (including transport)									0.43
11. Energy Conservation Hotline									0.04
12. National Boiler Testing Service									0.2
13. Energy Management Association and Regional Energy Conservation Officers									0.14
14. Energy conservation programmes for public buildings									0.04

3.2.8 Luxembourg

Luxembourg, a small country with only 365,000 inhabitants is strongly dependent on energy imports which cover 99 % of its primary energy requirements: coal and coke (47.6 % of net imports), oil products (32.5 %), gas (10.2 %), and electricity (8.2 %). Less than 1 % of its primary energy consumption is based on indigenous hydropower, refuse and organic wastes (figures for 1981).

The Government of Luxembourg has not yet set any quantitative objective for energy conservation. One reason for this delay is the economic structure of Luxembourg, especially characterized by the energy intensive iron and steel industry which alone consumed 88 % of the total final industrial energy in 1980. The rapidly increasing energy prices have led to strong efforts in the iron and steel industry to improve its energy efficiency, and with some success:

	1970	1974	1977	1979	1980	1981
Steel production (Mt)	5.5	6.4	4.3	4.9	4.6	3.8
Energy consumption (Mtoe)	4.4	4.9	3.1	3.5	3.2	2.5
Toe/t steel ratio	0.80	0.75	0.73	0.71	0.70	0.66

Source: Ministry of Energy, 1982

Because of the improved energy efficiency but also due to reduced steel production (-28,3 %), energy consumption in the iron and steel industry dropped between 1973 and 1980 by 5.3 % per year. Over the same period oil substitution was also carried out without political measures: the oil share of industrial energy consumption decreased by 17 % per year on an average, mainly due to substitution by natural gas and coal.

The Government believes in the effectiveness of market forces to control consumption. This can also be observed in the energy pricing policy: energy taxes like most other indirect taxes are rather low compared to other countries. Diesel, gasoline and electricity prices have significant lower prices as in most other EG countries.

Since 1979 the Luxembourg Government has taken steps to promote energy conservation and substitution. The Ministry of Energy aims at the following objectives:

- more rational use of energy,
- diversification of energy sources, especially oil product substitution,
- improvement of distribution networks.

In 1981, public funds for energy conservation purposes were four times as high as they were in 1979 (1981: 38.7 Mill. FLX / 0.9 Mill. ECU). Measures provided by the Government are relatively few compared to average practice of the EC countries. They concern information campaigns and some financial support. Regulations are only in force for public buildings and for the transport sector; besides mandatory checking of boilers there is no regulation in the residential, commercial, or industrial areas.

The following measures have been implemented in Luxembourg:

Regulations

- thermal insulation standards for all new public buildings (1979)
- temperature limit of 20 °C in public buildings (1979)
- mandatory checking and maintenance of heating installations using fuel oil (1979)
- speed limits (1974)

Financial support

- grants for energy saving investments in private houses (1979)
- grants for thermovision of houses (1979)

Information

- publicity campaigns for all sectors (1978)
- recommended thermal insulation standards for all new buildings (1979)

Total energy consumption decreased by 12.7 % in 1981, where again a 0.5 Mtoe reduction was caused by decreased steel production. It has not been analysed yet to what extent achieved energy savings result from governmental energy conservation policy.

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Table 3.15: Energy conservation programmes in Luxembourg and budgets 1982

	1974	1975	1976	1977	1978	1979	1980	1981	1982 (Mill.ECU)
1. Building codes for public buildings									
2. Controls of heating equipment									
3. Temperature limits									
4. Speed limits									
5. Grants for energy saving investments in private houses									1
6. Grants for Thermovision of private houses									0.01
7. Information campaign									0.02
8. Recommended insulation standards for private houses									

3.2.9 Netherlands

The energy situation in the Netherlands differs from most of the EC countries through the ample availability of natural gas. The Dutch energy dependence which was more than 50 % in 1970 has declined to a negligible percentage since 1974 (see Fig. 3.3). About 50 % of the annual natural gas production is exported, thus compensating for the Dutch imports of oil and coal. As the natural gas reserves will dwindle rapidly in the next 20 to 30 years, the government stressed the importance of energy conservation in its first Energy Memorandum issued in September 1974 and, more insistently, in its second Memorandum of September 1979.

This document describes the overall concept of the energy policy which has been scarcely modified in the last two years (see IEA, 1981, 1982). There are two major objectives: conservation and diversification of energy sources to be achieved by a set of programmes and measures:

- an overall energy conservation policy, particularly in the space heating and industrial sector,
- limiting the quota of gas contracted for electricity production,
- introduction of substitute products of oil derivatives such as LPG and methanol,
- long-term policy for renewables, especially waste, wind and solar energy,
- reintroduction of coal for electricity production and the heavy industries in the early 1990ies.

Gas pricing policy plays an important role for both conservation and diversification. Although the government intends to price natural gas at a premium over relevant oil product prices, there are still considerable differences between gas prices and comparable oil product prices, especially in the residential and horticultural sectors (see Table 3.4). The price differences, however, declined in 1982 and in January 1983.

In the Memorandum of 1979, the energy conservation policy sets targets that by 1985 energy efficiency would improve 10 % compared to 1977, by 1990 20 % and until 2000 by more than 30 %. These targets are broken down for several sectors of consumption (see Table 3.10).

The targets are supported by an energy conservation policy which focuses on information and subsidies (mainly grants for investments), but also promotes

research and development and uses regulation and energy pricing to some extent. The annual energy conservation budget for subsidies for 1981 and 1982 was around 750 Mill. Hfl (280 Mill. ECU), i.e. 20 ECU per capita. Specific energy savings required as a minimum achievement or estimated range from 0.6 toe per 1,000 ECU (central government programme) to 2.1 toe per 1,000 ECU (energy grant programme for industrial sectors).

Table 3.16: Energy-saving targets of the Dutch Government broken down by sector of consumption, 1985 - 2000

Sector	Share of TFC 1) 1977	Efficiency improvement, targets on the basis of 1977		
		1985	1990	2000
Residential heating	15 %	20 %	33 %	45 %
Other residential consumption	7 %	5 %	10 %	20 %
Commercial and Public Sectors	18 %	15 %	20 %	35 %
Transportation	13 %	10 %	15 %	25 %
Industry, incl. building trade	47 %	10 %	15 %	30 %
1) Total Final Consumption	100 %	10 %	20 %	30 %

Source: Ministry of Economic Affairs, 1979

Information programmes are coordinated by the Netherlands Energy Saving Information Foundation (SVEN) which also carries out energy audits, 50 % of which are financed by industry; the annual information budget is 0.85 Hfl/cap (0.32 ECU/cap).

At present, regulations exist only in four cases (building codes for newly built houses and for office buildings, efficiency standards for gas boilers, and speed limits). Further spheres in which regulations are currently being considered are individual heat metering, efficiency standards, energy labels.

Four programmes started immediately after the first oil price increase, a further three started in 1977/78, and another seven programmes (five of them subsidies) have started since 1980 during or after the second oil price increase (see Table 3.11).

Most of the programmes are implemented by the Dutch Ministry of Economic Affairs or local and governmental institutions. Municipalities are empowered to set their own building regulations.

As many of the subsidies are awarded on the condition of a minimum energy conservation effect, the national energy savings of most of the subsidy programmes may be estimated on the basis of total investment figures. Although there is no in-depth evaluation of any Dutch energy conservation programme, the General Energy Council (Algemene Energieraad) published an assessment in 1982 which comments on most of the programmes. It served as one of the main sources of information for this study.

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Table 3.17: Energy conservation programmes in the Netherlands and budgets 1982

	1974	1975	1976	1977	1978	1979	1980	1981	1982 (Mill.ECU)
1. Building codes for new houses									
2. Building codes for office buildings									
3. Minimum efficiency standards for gas boilers									
4. Speed limits									
5. Subsidy scheme for insulation in dwellings									105
6. Subsidies for district heating									15
7. Energy grant - Law of Investment									130
8. Grant for conservation consulting									0.5
9. Grant for economizers high-efficiency boilers									5
10. Subsidies for the non-profit sector									15
11. Energy conservation by the central government									20
12. Grant for energy conservation in greenhouses									26
13. Information campaigns									4
14. Energy audits for industry and commercials									

3.2.10 United Kingdom

Since 1980 the United Kingdom is in the position of energy self-sufficiency. Indigenous energy production covers now more than total primary energy requirements (TPE) (1981: 6.4 %). Total primary oil consumption declined between 1979 and 1981 by 20 %; the oil share of TPE is now 35 %. In 1981, the United Kingdom continued to make progress in energy conservation and domestic energy production and has thus become a net exporter of energy. The Department of Energy points out that the overall energy policy objective is to establish a framework for energy production and conservation which will allow the market in the energy sector to operate as freely as possible.

The United Kingdom has the lowest overall energy transformation factor of 0.694 (see Table 3.3). The achieved energy savings are partly caused by a sharp decrease of iron and steel production in the 1970ies (Eurostat, 1982; OECD, 1976; 1982):

	1973	1977	1980	1981
Iron production (Mt)	15.3	12.2	6.3	9.6
Steel production (Mt)	26.6	20.4	11.3	15.4
Energy consumption in iron and steel industry (Mtoe)	14.5	10.6	6.5	n.a.

Initial energy conservation activities were started in 1975, soon after the first oil price crisis. Financial support has been available since 1976. Between 1976 and 1978 increasing expenditure for publicity, information and financial support have been provided for energy conservation, especially for investments in the public sector which owns a "large proportion of building stock and, therefore, is subject directly or indirectly to governmental control" (Select Committee on Energy, 1982). Some changes in energy policy can be observed in 1979 due to the new Government which concentrates less on financial intervention than was the case before and pays more attention to energy pricing as well as the provision of a wide range of information and advice. Between 1979 and 1981 there still was a further increase in expenditure for information and financial help. The major emphasis is now on the

economic pricing of fuels. Another main emphasis of the governmental energy policy is making the state fuel industries more responsive to market forces.

The British energy conservation policy includes four major elements now:

"Economic pricing" of energy is considered the most important measure. It is central to the market-oriented approach of the Government that energy should be priced realistically (Department of Energy, October 1982), i.e. the policy aims to have energy prices reflect long-term costs of supply and underline the true value of resources.

Information and advice

- publicity campaigns: the campaign "Save it" was started in 1975 but since the main emphasis now lies on improving the economic efficiency of energy use rather than purely energy saving, the new campaign is therefore titled "Make the most of energy"
- advisory telephone service (stopped 1982)
- energy managers are strongly supported by the Government (Regional Energy Conservation Officers, Energy Manager Groups, National Energy Management Conferences, and publicity including free newspapers)

Financial incentives

- combined with information: Energy Survey Scheme, Industrial Energy Thrift Scheme
- Coal Firing Scheme for promotion of switching to coal
- Tax allowance for insulation in industries
- Home Insulation Scheme

A first principle of the British incentive policy is to promote cost-effective saving measures.

Regulations are rarely used:

- thermal insulation codes for new buildings
- temperature limit for new domestic buildings
- energy efficiency standards for new heat generating appliances
- mandatory fuel consumption testing and labelling for new cars

In addition, great attention is paid to energy conservation in Government buildings. As a preliminary result, total energy savings of 40 % have been achieved in this sector over the past nine years.

The British Government spend a total of around 125 Mill. £ (226 Mill. ECU) in 1981/82 on energy conservation programmes, broken down as follows:

Information	3.9 Mill. £	(7 Mill. ECU)
Industry and Commerce	6.9 Mill. £	(12 Mill. ECU)
Domestic Sector	37.45 Mill. £	(68 Mill. ECU)
Transport	0.57 Mill. £	(1 Mill. ECU)
Public Sector	75.1 Mill. £	(136 Mill. ECU)

The best available estimates on impact of political programmes suggest that pricing, backed by conservation measures, has been responsible for a reduction of 5.9 % in energy demand over the period 1973 - 1980.

The House of Commons' Select Committee on Energy, appointed to examine expenditure, administration and policy of the Department of Energy and associated public bodies, critically reviewed the governmental energy conservation policy (Select Committee on Energy, 1982). The Committee argued that the Government still pays too much attention to the supply side; this is also reflected by budget figures: In 1981/82, 240 Mill. £ (434 Mill. ECU) have been spent on fuel subsidies, 149 Mill. £ (270 Mill ECU) on energy conservation. Investments in energy efficiency is often considered more cost-effective than investment in energy supply and both should at least be taken to the point of economic equivalence.

The situation described by the Select Committee is not caused by lack of interest in the Department of Energy's Conservation Division. It is rather that the efforts of this Division are often not supported enough by the overall governmental policy because of powerful pressure groups on the supply side and because the Supply Division is backed up by the financial resources of nationalized supply industries whereas the Conservation Division is understaffed.

In addition, the responsibility for energy conservation programmes is fragmented through several bodies: the Department of Energy, the Department of the Environment (buildings), the Department of Industry, the Property Services Agency (public buildings). The recommendations of the Select Committee on Energy (1982) include therefore the establishment of an Energy Conservation Agency as an institutional framework for energy conservation policy.

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Table 3.18: Energy conservation programmes in the United Kingdom and budgets 1981/1982

	1974	1975	1976	1977	1978	1979	1980	1981	1982 (Mill.ECU)
1. Building codes									
2. Controls on new heating systems									
3. Insulation of pipes, ducts and storage vessels									
4. Heating limit in non-domestic buildings									
5. Energy labelling for cars									
6. Speed limits									
7. Energy Conservation Scheme									
8. Coal Firing Scheme									45
9. Energy Survey Scheme									3
10. Tax allowance for insulation of ind. buildings									
11. Homes Insulation Scheme									69
12. Energy saving in the Public Sector									8
13. Industrial Energy Thrift and Audit Schemes									1
14. Energy saving in the Government's estate									
15. Promoting and preparing home insulation projects									0.1
16. Publicity campaigns, education and training									6
17. Information campaign for the transport sector									0.1
18. Energy Quick Advice Service									0.2

3.3 Difficulties of comparative analyses

Before presenting a comparison of existing energy conservation measures in the EC countries the difficulties of this kind of analysis should be mentioned briefly. Reasons why particular measures were taken by governments and others were not depend on a great variety of factors which although not dealt with in this study have to be taken into account for an in-depth comparative analysis, especially with regard to suggestions for additional or modified programmes in the Member countries.

The most important influences are summarized below. Some of them will be illustrated more clearly in the comparative Chapter 3.4.

The combination of all these factors mentioned in this chapter, together with the countries' general philosophy and predominant problems, would be needed to explain the relative importance of regulations, financial aid and information programmes seen against each other and against measures such as pricing, taxation, supporting certain areas of research, development and demonstration, promotion of nuclear energy use or the belief in the effectiveness of voluntary agreements with industry.

(1) Climatic conditions

Climatic differences between the countries can explain part of the attention paid by governments to space heating. High insulation standards and other measures for energy saving are much more important for colder regions than for others. Warmer countries, on the other hand, should have standards which also include energy-saving measures with regard to air-conditioning in the summer period.

(2) Technical conditions

A fundamental basis for the assessment of main energy-saving potentials and hence the selection of adequate policies to tap these potentials are technical conditions which may vary from country to country such as energy efficiency of existing heating systems, thermal quality of the building stock, construction methods, and extent of saving measures already taken.

In addition, structural differences among the Member countries such as the share of different types of new buildings, the share of owner-occupied and rented dwellings, the share of grant-aided housing, the share of leased industrial or commercial premises, etc., become relevant in this context.

(3) Policy goals

As was mentioned in chapter 3.2, the overall policy goals and the need for particular policies vary greatly from country to country. Thus the energy conservation policy depends on factors such as

- whether the philosophy of economic policy is demand or supply-oriented, market-oriented or intervening,
- on major national problems such as environmental pollution, unemployment, balance of foreign trade.

(4) Economic factors

Not only do prices for different kinds of energy vary in different EC countries (see Table 3.5) but also building and installation costs, as well as prices for energy-saving equipment. These factors determine the cost-effectiveness of energy-saving investments.

Furthermore, structural effects have to be taken into account such as

- income per capita and resultant purchasing power,
- income distribution (e.g. proportion of low-income groups suffering most from increasing energy prices),
- gross domestic product per capita which determines the government funds available for energy conservation programmes (see Chapt. 3.4.2),
- structural conditions within industry, as mentioned in Chapter 3.1.

(5) Information level

A very important factor is closely related to the economic and social structure, namely the information level of energy consumers with regard to energy items. Not only may the general level of information vary from country to country and hence the need for general information programmes,

but also differences within a country influencing the types of target groups to be reached.

(6) Legislation and administration

Energy conservation programmes are highly dependent on the institutional background of each country: legislative elements such as existing regulations obstructing a more efficient use of energy, building laws, tenant laws, environmental laws on the one hand and on the other, the administrative practice (e. g. approval procedures etc.).

Within this framework the institutional or organizational set-up for controls to ensure that standards are met ought to be considered.

(7) Private activities and communication networks

Governmental energy conservation programmes, particularly information programmes, concentrate on areas where private activities do not suffice. For efficiency reasons, existing communication channels are used to spread information. For an in-depth comparison between countries the functioning of these networks would have to be studied. However, the informal multi-step flow of communication and persuasion is one of the most difficult factors about which to gain precise information.

More easily analysed are the more institutionalized networks of regional, local and private activities such as

- regional and local information campaigns, advisory services, education and training, financial support provided by regional or local authorities,
- internal education and training in firms,
- training and advisory services offered by private companies and associations.

(8) Norms, values and behaviour

A comparative analysis of different countries must also take into account cultural differences with regard to factors such as

- general energy awareness,
- general preparedness for investments, planning for the future,
- extent to which standards are met,
- desired comfort levels,
- behavioural patterns (e. g. use of energy-consuming equipment, maintenance of boilers, driving behaviour, use of public transport facilities).

(9) The political culture

The energy conservation policy is one result of the overall political decision-making. The political process can be described as a balance of power among overlapping political and economic groupings based on a plurality of private and public ends. It is not the government alone which contributes to a certain policy, but rather many groups shape the final decision.

Thus the government's policy has to take into account aspects such as legitimization of ruling parties, voting power and pressure groups. In addition, decisions depend on public pressure on the Government on the one hand and acceptance of measures by the public on the other.

3.4 Comparative description of existing energy conservation programmes

Keeping the various factors in mind which influence the EC countries' energy conservation policies, the three measures selected for this study will be analysed in a preliminary and rough comparison. These are:

- the kind of existing regulations (building codes, installation and operating standards for boilers, individual heat metering, labelling of household appliances and cars, temperature, lighting and speed limits),
- the type of financial support (grant, tax relief, subsidized loans) broken down by sectors,
- the type of informational or communicative measures (publicity campaigns, advisory services, energy audits, training).

For grants and information, public expenditure per capita and year was compared as far as was possible. More sophisticated comparisons, however, such as of funds spent per toe saved or per ECU investment are not presented here because of the lack of available evaluation data in most cases.

The present study is only concerned with government measures. Efforts to promote energy conservation, however, are also made through regional and local, public and private initiatives. The more non-governmental action there is, the less important a centralized government energy conservation policy is. Thus is that a country which at first glance appears to have an insufficient policy may be just as efficient as a country with a strong policy, but lacking private initiatives.

3.4.1 Regulations

Energy conservation policies mostly turn to mandatory measures in cases such as rented apartment houses, financial bottle-necks of builders, lack of technical and economic energy-related knowledge in the residential and commercial sectors. The regulations actually enforced in the EC countries can be classified into four different types:

- mandatory requirements for new buildings, heating equipment or specified goods which are met by investments,

- mandatory maintenance requirements such as periodic inspections of boilers, control systems, or air-conditioning plants,
- behavioural prescriptions which have to be observed in everyday life, such as temperature limits, speed limits, or individual heat metering, and finally
- energy labelling to improve market transparency for the consumer or investor (electricity consumption of household appliances, fuel consumption of cars).

Building codes

The importance of building codes relating to the limitation of transmission losses as well as ventilation losses cannot be emphasized enough:

- During the relatively long life-times of newly built houses and buildings it is very likely that further energy price increases will put a heavy burden of heating costs onto the next generation, while the present generation saved only minimal additional investment costs because of insufficient insulation.
- Once buildings have been constructed, additive insulation measures can be very costly and often only cost-effective in cases of modernization.

In several countries thermal requirements for buildings were adopted long before 1973 for reasons other than oil price increases. In some countries, for instance, the main purpose was to ensure sufficient overall thermal comfort, to avoid the risk of condensation on the inside of walls or to avoid structural damage to walls. In addition, climate, energy prices, local insulation costs, traditional modes of construction and costs, as well as heating habits may influence building codes.

These various factors explain traditional differences in countries' regulations with regard to both calculation methods and values. Since 1974, building codes have been adopted or modified to attain a more rational use of energy. A preliminary comparative study of the thermal requirements for buildings in the EC countries was made in 1975 and updated in 1981 (Carpentier/Uyttenbroeck, 1975, 1981).

The values of the mean transmission coefficient U_m required by the national building codes for newly-built houses and shown in Table 3.19 are taken from this study. As several countries developed different approaches to define minimum thermal requirements, the authors translated the national thermal regulations into the maximum permitted mean U-values of several types of buildings as a function of the ratio between the volume of the building (V) and the heat loss area of the building (A). In a few cases where building codes changed in 1981 or 1982, the FhG/ISI calculated or estimated the new mean U-values respectively.

Table 3.19: Building codes in EC countries, situation 1982

	B	D	DK	F	GR	I	IRL	LUX	NL	UK
Residential buildings										
- present standard in force since:	-	1981	1979	1977 ⁵⁾	1979	1977	1982	-	1982	1982
- newly constructed		+	+	+	+	+	+		+	+
- modernized		+	+	-	-	-			-	-
- U_m -value ¹⁾		>19 °C	>18 °C	>14 °C	>19 °C	>19 °C	>19 °C		>19 °C	>19 °C
o detached house		0.69	0.49	1.24 ²⁾	0.71 ²⁾	0.98 ²⁾	0.85		0.94	0.85
o blocks of flats		1.01	0.79	2.07 ²⁾	0.92 ²⁾	1.44 ²⁾	2.0 ³⁾		1.48	1.41
Non-residential buildings										
- present standard in force since:	1982	1981	1979	1977 ⁵⁾	-	1977	1982	1979	1982	1979
o public buildings ⁶⁾	1.6	1.01	0.75	3.53 ⁴⁾		1.44	2.0 ³⁾	~1.0	1.38	1.27
o office buildings ⁶⁾	-	1.01	0.75	3.53 ⁴⁾		1.44	-	-	1.38	1.27
- buildings <19 °C	-	>12 °C	>10 °C	>14 °C		-	-	-	-	- ⁷⁾
1) detached house 864 m ³ , detached block 12.000 m ³ 2) coldest climatic zone 3) estimated by ISI 4) depends on glazed area of the building 5) revised in 1982, new figures are estimated, see text 6) 12 000 m ³ ; V/Atot: 3.53 7) estimated heating requirement less than 50 W/m ²										

Sources: Carpentier/Uyttenbroeck, 1981; calculations by ISI

In Belgium, a standard (NBN B 62-301) has been discussed since 1979 which at present is enforced for public buildings and, although not compulsory, for social dwellings (K 80). The standard is said to be generally met in new buildings.

The Danish requirements of 1979 are the strictest of all EC countries, a further version revised in a few minor points, but not in the U-values, comes into force in April 1983.

New regulations were set up by the West German Government in 1982 to replace the standards of 1977 in January 1984. Mean heat transmission losses will be reduced by 20 to 25 %. An additional change introduced by the new building code is that existing buildings are included where significant modernization is involved as well as for the replacement or addition of building parts.

In France, global heat losses of dwellings and buildings are limited by a maximum permitted G-coefficient taking transmission and ventilation losses into account. The new regulations of March 1982 include the aspects of energy gains by internal heat sources and passive solar energy use (F) in dwellings by introducing the B-coefficient. The value of the B-coefficient expressed in $\text{W/m}^2\text{K}$ is calculated by

$$B = (G - \frac{1.5}{t}) \cdot (1 - F)$$

and is 25 % to 30 % smaller than the former G-coefficient (t = difference of outdoor to indoor temperature). Supposing that the energy gains are in the order of 10 % and ventilation losses are not reduced, the U_m -values in Table 3.19 would drop to around $1.0 \text{ W/m}^2\text{K}$ and $1.6 \text{ W/m}^2\text{K}$ for the coldest climatic zone. These are still rather high when compared to other EC countries with similar climates (see Figure 3.4).

Greece introduced relatively strict building codes for new residential and public buildings in 1979. For three climatic zones depending on minimum outside temperature during two successive days, the regulation stipulates maximum U-values for building elements and for facades as well as maximum mean heat transmission.

Ireland adopted 32 % stricter standards in 1982. The mean U-value, which did not depend on the shape of the building in the 1979 regulation, is still kept invariant from the volume/area relation.

The Italian building codes in force since 1977 are defined in maximum permitted volumetric heat losses of the building (G), similar to the French regulations. Six climatic zones specified on a degree days basis take into account the large differences in climate between Northern Italy and Sicily. The building codes also include existing buildings where significant modernization is involved.

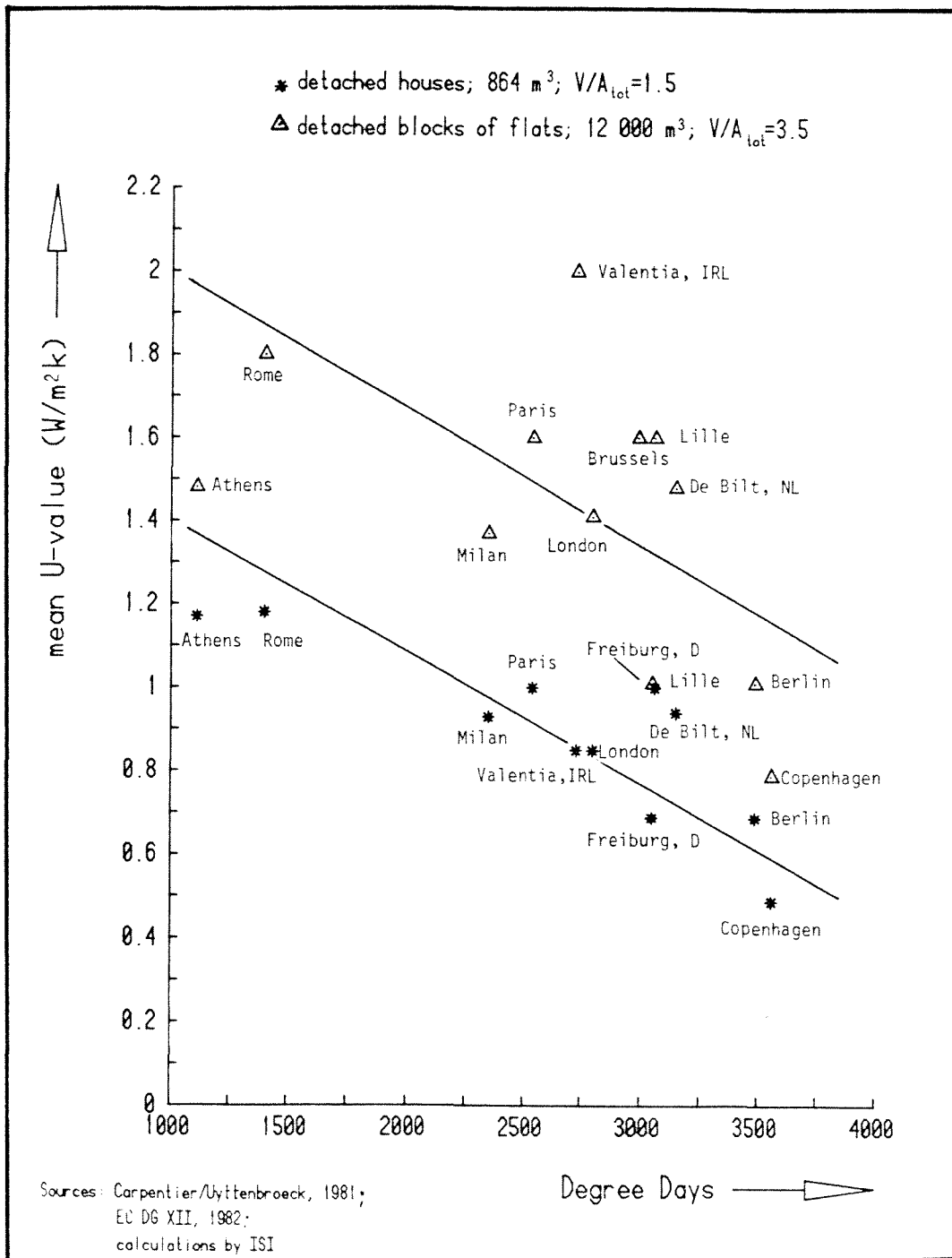
Luxembourg only has building standards for public buildings. However, foreign standards are applied (German DIN, French AFNOR, and Belgian NBN). Building standards, similar to those of West Germany, are in preparation.

In the Netherlands, building codes from 1978 were again revised in 1982 for individual building elements with direct outdoor exposure such as ceiling and floors.

The United Kingdom also adopted 35 to 40 % stricter building codes, which now are in line with the common practice of EC countries if degree days are taken as the predominant influencing factor (see Figure 3.4).

During the last two years, there has been a significant harmonization of building codes. The actual permitted values, however, appear to be still too high for most European countries if additional costs for additional insulation of new buildings are compared with additional benefits from saved energy costs during the life-time of these buildings (Meyer, 1981). This argument most probably holds for all EC countries (see Figure 3.4). The two Member countries with highest and lowest degree day values (Denmark and Greece) have actually enforced the strictest building codes, especially for large buildings with a high volume-to-area relation.

Figure 3.4: U_m -values of specified buildings and mean degree days of EC countries, situation 1982



Considerable evidence suggests that stricter building codes induce negative non-intended effects such as

- additional obstacles to financing the construction of new houses,
- reduced sales of heating and air-conditioning equipment because of smaller boiler and heating capacity needed,
- large market losses of particular construction materials such as bricks, lime sandstone, and pumice stone, because these materials have rather high heat transmission coefficients.

Specific measures have to be taken to minimize these negative impacts. One important aspect is the time-span between the obligatory introduction of the stricter regulations and their time of enforcement. This time-span should cover several years in order to give enough time for structural changes within the construction materials sector and for producers to adapt their heating equipment and train construction workers.

In the EC countries construction methods, the costs for insulation and heating habits vary greatly. Consequently, it is not possible to make a general recommendation for the design of economically optimal building codes. Local climatic conditions, local or regional construction and installation costs, national purchasing power, regional or national markets of housing space, and national energy prices must be taken into consideration.

On the other hand, however, this reference to nationally distinct considerations should not dissuade

- those countries which have not yet enforced any regulations for particular types of buildings (i. e. office buildings or industrial buildings with less than 19 °C) from introducing building codes,
- the EC countries from examining the costs and benefits of stricter standards, especially for large buildings, and extension of these standards to cases such as significant modernization of buildings or the replacement or addition of building parts.

Requirements for heating systems and new boilers

If space heat is provided by a central heating system, there are two areas of major possible heat losses which could be largely avoided by economical technical means:

- heat losses during heat transport from the central boiler to individual

rooms because of the lack or inadequacy of insulation of pipes, ducts, etc., or unnecessarily high temperature of the heat carrier,

- avoidable heat losses of the boiler (stand-by losses, exhaust gas losses because of too high temperatures) and poor combustion efficiency.

Good insulation of pipes, ducts, etc., may improve energy efficiency by 5 % to 10 % depending on the layout of the piping system and heating habits. Around 10 % savings or more can be expected from introducing time switches (day/night, absence) and indoor temperature control. This type of control cannot prevent transportation losses and short term overheating in rooms during warm periods of the day. Outdoor temperature control systems avoid these losses and contribute at least 15 % savings in relation to a constant temperature of the heat carrier (Angerer et al., 1982). Reduction of stand-by losses of the boiler and a good combustion efficiency in burners may contribute a further 10 % saving.

Home-owners are usually unaware of the existence of these energy saving investments and the fact that their pay-back periods are much shorter than their life-times. Moreover, landlords may not invest in this additional equipment as additional capital costs cannot entirely be covered by a higher rent, and tenants still have to pay high heating costs in the end. For these reasons many EC countries have introduced regulations for heating systems and new boilers.

Comparing the actual situation of enforced regulations (see Table 3.20) we found that

- almost all countries demand minimum insulation of pipes, ducts, etc.
- a few countries do not demand any kind of control installations for central heating systems (Belgium, Greece, Ireland, Luxembourg) or only for non-domestic buildings (United Kingdom). This situation can partly be explained by the fact that in these countries central heating systems are less wide-spread than in the other EC countries;
- there is no country that requests outdoor temperature control for one-family houses. If the pay-back time of outdoor temperature control is compared to that of double or triple glazing, outdoor temperature control is much more cost-effective in the northern countries or the northern regions of EC countries.

Table 3.20: Requirements for heating systems and new boilers, situation 1982
in the EC countries

	B	D	DK	F	GR	I	IRL	LUX	NL	UK
<u>Requirements for heating systems</u>										
- present standards in force since:	-	1981	1981	1978	-	1976	-	-	1980	1981
- range of application (residential, commercial, public)	-	all	all	all	-	all	-	-	all	all
- minimum insulation of pipes, ducts etc.	-	+	+	+	-	+	-	-	+	+
- control installations for central boilers										
o time switches, indoor temperature	-	1 fam. houses	1 fam. houses	1 fam. houses	-	-	-	-	-	non-domestic build-ings
o outdoor temperature	-	other build-ings	other build-ings	other build-ings	-	>58 kW boilers	-	-	-	-
<u>Requirements for new boilers</u>										
- in force since:	-1)	1981	-1)	1975	1982	1976	-	1979	1980	1983 ³⁾
- range of application (fuel capacity limits)	oil, coal	all	oil	all fuels	domestic boilers	all	-	gas oil	gas <35kW	all
- minimum boiler performance	-	+2)	-	+2)	80 %	+2)	-	+	83.3 %	+2)
1) indirect minimum requirements through boiler-operation standards										
2) depends on type of fuel and capacity										
3) refers to implementing act of 1981; first regulations in 1983										

Sources: see Annex

Considering the actual regulations and the techno-economic facts, the contribution of control installations to energy conservation seems to be underestimated, especially in regions with degree day values of more than 2,500 (on the basis of 18 °C).

Stricter building codes reduce the annual energy requirement of new buildings and hence increase the pay-back time of control installations. But the predominant area of requirements for control installations are buildings already constructed and which are often limited by additional cost-effective insulation of the outer shell of the building.

Only very few countries demand a minimum boiler performance without any capacity limits and for all types of fuel. This is partly explained by the fact that several countries enforced operating standards and periodic maintenance controls, thus indirectly introducing minimum performance standards for new boilers.

In general, the minimum standard requirements can easily be met by the boiler or burner producers. Here one might question why no EC country introduces a high combustion efficiency standard announced some years prior to its enforcement so as to give producers enough time for research and development. This would spur technical innovation and is already common practice in environmental legislation, especially in the United States.

Operating standards of boilers

Design and installation of heating systems in buildings can be excellent, but poor maintenance of the boiler and incompetent handling of control installations may cause very low heat generation efficiencies. Two surveys in the residential, commercial, public and industrial sectors in the Federal Republic of Germany, for instance, concluded that 10 % to 30 % of the boilers examined did not comply with existing standards for operation (Ifo, 1982; Holler, 1981). Compliance of gas-fired boilers was better than of oil-fired boilers.

Table 3.21: Operating standards for boilers and individual heat metering in apartment buildings, situation 1982 in the EC countries

Six of the EC countries introduced operating standards for boilers and mandatory periodic control by independent persons (chimney-sweeps) or approved firms (see Table 3.21). Denmark and Luxembourg restricted the regulations to oil boilers. The German regulations lowered the maximum permitted exhaust losses stepwise over several years. Again, standards can easily be met if maintenance is carried out by technically trained personnel and/or new high-efficiency boilers are installed.

Individual heat metering in apartment buildings

Energy savings by individual heat metering have been estimated in Germany on the basis of empirical findings in the range between 10 and 20 %. Even if only a 10 % saving is assumed - because of influences of increasing energy prices during the period of empirical research - individual heat metering is still to be judged as a very cost-effective measure. But only in two countries, France and Germany, has this measure been enforced and will have to be complied to by 1985 in all existing buildings (see Table 3.21).

This regulation is certainly less important and cost-effective in countries with a very small part of the population living in apartment buildings (e. g. Ireland) or in areas with lower yearly heating costs (i. e. in the southern parts of Italy and Greece).

Temperature limits in buildings

The convenience of centrally heated buildings and relatively cheap energy in the 1960ies changed heating and dressing patterns in many countries: The buildings were kept at summer indoor temperatures even in winter. As energy savings per degree centigrade reduction are circa 5 % to 7 %, almost all EC countries enforced temperature limits for at least public buildings (see Table 3.22). In three countries, France, Italy, and the United Kingdom, the regulations include all non-domestic buildings.

In Italy the regulations also include centrally heated buildings in the residential sector; and France, with a limit of 19 °C makes no exception even in the residential sector.

The control of temperature limits may be easy in the case of public buildings. Sporadic control in the commercial sector could be one answer, limitation of heating oil delivery to the consumers in the commercial and residential sectors another answer (Belgium, France).

Table 3.22: Temperature limits in buildings, energy labelling, and speed limits, situation 1982 in the EC countries

	B	D	DK	F	GR	I	IRL	LUX	NL	UK
<u>Temperature limits in buildings</u>										
- in force since:	1981	1979	1981	1979	1979	1977	-	1979	1981	1980
- public buildings	19 °C	20 °C	20 °C	19 °C	18 °C	20 °C	-	20 °C	20 °C ¹⁾	19 °C
- private homes	-	-	-	19 °C	-	20 °C ²⁾	-	-	-	-
- commercial buildings	-	-	-	19 °C	-	20 °C	-	-	-	19 °C
<u>Energy labelling</u>										
- in force since:	1981 ⁷⁾	-	1982 ⁶⁾	1977	-	1982 ⁶⁾	-	-	- ⁴⁾	1977
- major domestic appliances	+	-	+	+	-	+	-	-	-	-
- cars	+ ³⁾	+ ³⁾	+	+ ³⁾	-	-	-	+ ³⁾	+ ³⁾	+
<u>Speed limits</u>										
- in force since:	1975	1972	1979	1974	1975	1977	1979	1974	1974	1974
- motorways/roads	120/90	-/100	100/80	130/90	100/100	80/90 ⁵⁾ 110/140	88/88	120/90	100/80	110/100
1) regulation was converted into a recommendation 2) centrally heated buildings 3) voluntary widely applied 4) in preparation 5) for small cars (600 cm ³) and big cars (1300 cm ³) respectively 6) additional regulations for electrical ovens 7) existing law not yet implemented										

Energy labelling

This measure has been designed to increase market transparency by mandatory information of the consumer about the energy consumption of major domestic appliances or cars. Although this measure has been called for by the EC since 1979 there are only four countries which have enforced energy labelling for domestic appliances (Belgium, Denmark, France, and Italy). Energy labelling for cars is only mandatory in the United Kingdom since 1977. In a few other countries, energy labelling for cars is widely applied voluntarily by meeting the EC norm (see Table 3.22).

Speed limits

Although speed limits can hardly be justified in terms of energy saving but are relevant for road safety aspects, the enforcement of speed limits took place in or after the year of drastic energy price increases in almost all EC countries (see Table 3.22).

Other regulations

In some countries additional regulations are in force but not mentioned in Tables 3.19 to 3.22. These regulations are implemented in only one or two EC countries, some were designed to deal with specific national conditions such as balance of foreign trade, oil dependence, power generation capacity. Some other regulations may be cost-effective for most of the EC countries but have not yet been considered by national legislative bodies and/or administrations.

- Industry and commercials

Except for boiler operation standards, most EC countries have no specific energy conservation regulations for industry. However, there are a few exceptions:

In Italy all firms with more than 1,000 employees or an energy consumption of more than 10,000 toe per year have to appoint an energy manager who is responsible for energy conservation.

Greek firms consuming high or medium voltage electricity or certain yearly quantities of oil products have to undertake energy auditing and report to the Ministry. In addition, new or expanding firms with more than 50 employees have to set aside 3 % of their total investment for energy conservation purposes.

- Rational use and saving of electricity

There are only very few regulations concerning a more rational use or saving of electricity although the importance of electricity in relation to primary energy consumption is high because of its high generation losses of more than 60 % and transmission losses of around 6 % to 8 %.

Daylight-saving time has been introduced in all EC countries; the electricity savings, however, are estimated to be less than 0.3 % so that positive effects on leisure seem to be more important than on energy conservation (see Annex).

- Belgium, France, and Greece enforced regulations for commercial lighting including technical prescriptions (ionized gas or fluorescent tubes) or time limits for illuminated advertisements. Belgium restricted highway lighting.

The French Government tries to limit advertisements which would promote energy consumption.

- Ventilation and air-conditioning

There is almost no information available on heat losses by mechanical ventilation and electricity consumption for air-conditioning. Although the share of additional energy necessary for ventilation and air-conditioning may vary greatly among the EC countries, technical energy saving potentials are extremely high (20 % to 80 %).

It was this factor which led Denmark and Italy to introduce regulations for buildings with mechanical ventilation. In Italy, buildings have to be equipped with an energy recuperation plant to recover the waste heat in certain cases. In Denmark, a former standard (heat content of outside air 50 MWh per year, yearly operation time 2,000 hours) was withdrawn and replaced by a general recommendation for heat recovery in mechanical ventilation. The decision is left to the investor.

- Space heating

Italy restricted operating time of all boilers producing space heat to a maximum permitted operation time during the heating season and to maximum permitted daily operation hours. The regulation distinguishes six climatic zones (the same as for building codes).

No information about further regulations in other areas has been collected because of fund and time restrictions. These areas do not contribute very much to absolute energy savings; they are, however, in many cases very cost-effective: e.g. separated piping of central heating systems according to

whether the building faces principally South or North, separate piping to the secretariat or the caretaker's apartment in schools or public buildings, time switches for pumps in central heating and hot-water systems.

3.4.2 Financial support

Quantitative comparison

A comparison of the financial aid with regard to the funds per year and capita has to take into account some restrictions:

- In some countries, in particular France but also Belgium and Greece, data on programme budgets are not available for all programmes.
- Some programmes cover several sectors. Since the total budget cannot be attributed to each sector separately, it is subsumed to the sector considered most affected.
- In addition, some countries have programmes intended not only to support energy saving but include other goals such as environmental protection, employment, etc. (especially Denmark, France and the Netherlands). These expenditures are also intended to promote a more rational use of energy; they will therefore be included here.

Table 3.23 summarizes the results of the comparison of the financial aid programmes. All programmes are considered whose funds are available for applicants in 1982. Support for research, development and demonstration is, according to the general framework of the study, outside of the scope of this Table. When differences arise between total budget (available funds) and grants actually approved (this is not very often the case and mostly not too relevant), the figures for grants approved are used. Some programmes cover more than one item of Table 3.23 (e. g. include grants and loans or include grants both for the residential and the industrial sector). In these cases we could mostly disaggregate the whole volume and separate the single shares. The number of programmes is therefore the number of homogeneous parts of programmes. Moreover, it should be noted that the figures for France are certainly overestimated - compared with the correspondent figures for the other countries - because in France budget figures are often available only for the most recent year, while for other countries it was possible to cal-

culate the average of several years. Especially the French expenditures for energy saving have been strongly increased over the past years (see Chapt. 3.2.4).

In the following analysis the figures will be used very cautiously keeping in mind the various restrictions mentioned above.

The grants play by far the most important role. In Table 3.23 the loans seem to be nearly as important as the grants as far as the total loan sum is considered. However, the actual support is the subsidized interest rate. This figure is largely unknown but it certainly amounts to only a few percent of the total loan sum. A considerably high figure in the Federal Republic of Germany results from one loan programme (the 6.3 Billion DM Loan Programme). Its voluminous funds were available for applicants over a period of only 14 month. Funds per year and capita would be much smaller if the programme would have been in operation for a longer time. The low amount of loans is surprising because they are considered adequate for improving the financial situation of investors and thus for overcoming a main constraint on energy saving.

Of the three financial measures, tax relief has the lowest relevance as far as the available data are concerned. The data are only available for the Federal Republic of Germany. Some kinds of tax relief such as the reduction of V.A.T. (Value Added Tax) have a very similar effect to that of grants. It is effective in a different way compared to income-tax relief. But the prevailing type of tax relief in the EC countries is income-tax relief.

The average amount spent on grants in the ten countries in 1982 is 6.8 ECU per year and capita. Denmark and the Netherlands have the highest figures, about three times the average. The Federal Republic of Germany, France, and Italy are about average (it should be noted, however, that most of the implementing decrees have not been passed in Italy yet and thus the real amount of grants is not known). All other countries offer grants per year and capita far below the EC average.

A presupposed relationship between the amount of subsidies and the gross domestic product per capita is confirmed by a correlation coefficient of

0.6 (Belgium, Luxembourg, and Denmark deviate slightly from this line). The approval of subsidies thus obviously depends on total national income and hence the Government's total available budget. Countries with lower income per capita have to implement different measures, such as regulations, if they want to compensate for their disadvantaged position in comparison to more wealthy countries.

A further assumption, namely a close relationship between the amount of subsidies and the dependency on energy imports (which means, in a sense, an urgent need to save energy) could not be confirmed: The correlation coefficient amounts to -0.2 (excluding the Netherlands; this value climbs up to 0.2 which is not a significant value at all). Besides the lack of reliability of the subsidy data, one reason for the weak correlation may be that the countries with high energy imports rely more often on mandatory or other low-cost measures than other countries do.

As far as countries with low dependency on energy imports are concerned, such as the Netherlands and the United Kingdom, the Governments turn to considerable efforts to maintain energy self-sufficiency through increasing efforts of energy conservation to prevent oil dependency in the future.

Broken down by sectors, Table 3.23 shows that in most countries both the amount of programme funds and the variety of programmes concentrate on the residential and industrial/commercial sectors. Separate programmes for agriculture have been implemented only scarcely; the subsidies offered to agriculture are sometimes included in the programmes for the industrial/commercial sector. Considerable amounts are spent on the public sector in only three countries: Denmark, the Netherlands and the Federal Republic of Germany. The total subsidies of these countries are above average.

Qualitative comparison

The comparison presented below has the following objectives:

- to classify the countries with regard to their goals and their promotion of certain energy-saving techniques,
- to compare the design of programmes regarding criteria relevant for the extent of free-riders and hence the effectiveness of programmes,

Table. 3.23: Current financial support programmes for energy conservation
1982 in the EC countries and subsidies per capita and year
(average over the duration of programmes)

	B	D	DK ^{k)}	FR ^{l)}	GR	I ⁱ⁾	IRL	LUX	NL ^{k)}	UK	EUR 10
1. Grants											
1.1 Residential sector											
- First programme	1975	1978	1975	1975			1980	1979	1974	1978	
- Funds ^{a)}	0.1(1) ^{b)}	3.4	9.0	4.0(4)			0.4(1)	5.6	5.7	1.3	2.3
- Number of programmes	2	1	2	6			2	2	2	3	
1.2 Industrial/commercial											
- First programme		1975	1977	1976	1981	1981	1980		1977	1976	
- Funds		0.5	2.2	1.1	1.5	4.2 ^{f)}	0.3(2)		6.6	0.2 ^{g)}	
- Number of programmes		3	1	5	1	3	3		2	3	1.7
1.3 Agriculture											
- First programme	1981	1973	1977	1981		1981			1981		
- Funds	0.8		0.4			0.6			2.1		0.3
- Number of programmes	1	1	1	1		1			1		
1.4 Public sector											
- First programme		1982	1975	1982		1982			1980	1972	
- Funds		2.6 ^{d)}	5.3	2.2		0.04			2.6	1.8	1.6
- Number of programmes		1	1	1		1			2	2	
1.5 District heating and combined heat and power production											
- First programme		1981	1977	1982		1981			1978		
- Funds		2.1	1.3	1.3		1.9			1.0		
- Number of programmes		1	1(CHP only)	2		1			1		1.2
Grants, total sum	0.9	8.6	18.3	8.5	1.5	6.7	0.6	5.6	18.0	3.3	7.1
2. Loans											
2.1 Residential sector											
- First programme			1978	1979	1980						m)
- Loan sum			h)	0.1(1)							
- Number of programmes			1	3	1						
2.2 Industrial/commercial											
- First programme		1981		1977	1980		1980				
- Loan sum		21.9 ^{e)}		4.0(2)			0.6				
- Number of programmes		1		3	1		1				
2.3 Agriculture											
- First programme						1981					
- Loan sum						0.1					
- Number of programmes						1					
3. Tax reliefs											
3.1 Residential sector											
- First programme	1981	1978		1974	1980		1979				m)
- Funds		2.6									
- Number of programmes	2	1		1	1		1				
3.2 Industrial/commercial											
- First programme	1975									1974	
- Funds	0.1 ^{c)}										
- Number of programmes	1									1	

a) in parenthesis: number of programmes for which data on budgets are available

c) including agriculture

e) subsidized interest rates: 1.8 ECU per cap., partly used for investments others than for energy saving

h) made by municipal councils according to § 17,18 Act on the Reduction of Energy Consumption in Buildings

i) only two programmes are already implemented

k) these countries combine energy saving policy with efforts in employment policy

l) for most programmes only 1982 budgets available; yearly average would be somewhat lower

m) availability of data too limited for calculations

b) including the commercial sector

d) little used for modernization

f) two programmes include agriculture, residential and public sector

g) one programme includes the public sector

- an assessment of the relationship between the programmes and the overall economic policy.

Due to the above-mentioned incomplete data, the criteria for comparison have been selected in accordance with available data. The results are summarized in Table 3.24.

Table 3.24: Qualitative comparison of financial programmes between the EC countries

	B	D	DK	F	GR	I	IRL	LUX	NL	UK
Goals and main objects of fin. support										
- General energy savings	+	++		++	+		+			
- Insulation	+	++	+				+	++	++	+
- Renewable energy sources and new technologies ¹⁾		+	++	+		++			+	
- District heating, combined heat and power production			+	+		+				
- Consulting, feasibility studies		+		++			+			++
- Oil or gas substitution		+	++			++	+		++	+
Further criteria										
- Support dependent on savings expected			+	++		+			++	
- Social aspects taken into account			+	++						+
Financial support particularly embedded in the overall economic policy		+	+	++					+	+

+ above average ++ most salient characteristics

1) excluding demonstration projects

As far as political goal setting is concerned in terms of the allocation of subsidies, two main strategies were found: One is primarily to substitute oil, the other one is to save energy in general. Denmark and Italy seem to be examples for the first strategy. Both countries are highly dependent on oil imports. Oil substitution is achieved through further development of district heating and, in particular, through promoting the use of renewable energy sources. For climatic reasons solar energy use is highly suitable in Italy whereas Denmark benefits from its advanced technical know-how (on district heating, straw incinerators, wind energy) and the possibilities it has of producing oil and gas from the North Sea in the future. A similar situa-

tion arises in the Netherlands: There the Government promotes insulation and the use of new energy-saving techniques to conserve the indigenous gas resources as far as possible for the future.

The Federal Republic of Germany and France, in particular, favour the second strategy. They also promote oil substitution but the main emphasis lies on overall energy saving. All energy-saving techniques are supported to a similar extent, with insulation measures being given priority in Germany and consulting in France. Similar strategies have been adopted in the Netherlands and to some extent in Belgium and Ireland.

Concerning information and advice programmes, it should be noted that Tables 3.23 and 3.24 only include these programmes if they offer grants for consulting, audits, etc. (for further information see Chapter 3.4.3). The financial aid includes grants for consulting, feasibility studies for energy saving in individual companies, energy audits, and, on the production side, support for the introduction of energy-saving R & D results into the market. The Irish information policy covers a general monitoring and control programme for public, and in particular state-owned buildings. The activities include continuous checking of room temperature and control facilities, energy audits, and providing manuals for caretakers and other persons responsible for heat control.

Free-rider effects

Given that many investments in energy saving equipment pay back in a reasonable time period one might question if any financial aid meant as incentive to invest should be necessary at all. A well-informed, rationally deciding investor would be expected to invest without any public incentive. Assuming this type of investor, grants or any other financial subsidy seem to be cost-effective only for technologies for which pay-back times are too long or for investors that have more urgent needs on which to spend their money. A very important issue in this context is the free-rider effect. Free-riders take advantage of financial aid although they would have made the planned investment without aid too. Data on this effect, however, are still scarce (see Chapter 4.2). The free-riders lower the cost-effectiveness of subsidies. Furthermore, a distortion of the income distribution arises because high-in-

come households and large-scale companies claim for subsidies more often than others. Some of the evaluation studies mentioned in Chapter 4.2 show a proportion of free-riders of up to 70 % or even more. Thus, there is a clear need to reduce free-rider effects in order to improve the cost-effectiveness of programmes considerably.

Denmark and France have made efforts to increase cost-effectiveness of the subsidies. In France, a number of subsidies concentrate on economically disadvantaged people or companies with scarce financial resources. The Danish Government not only makes the approval of subsidies in the residential sector dependent on achieved energy savings but also tries to take into account different motivation of building owners to increase the capital stock and, hence, to alleviate the conflict of interest between tenants and landlords (landlords pay for energy-saving investments, tenants pay for heating costs): Owners of rented dwellings receive a higher percentage of subsidies than owner-occupiers (a similar procedure was found in the Netherlands). In addition, expected increases of energy prices are taken into account by reducing the percentage of subsidies each year. Resulting effects such as premature replacements are favoured for overall economic reasons.

In some countries, subsidies are limited to certain technologies with rather low profitability (renewables, combined heat and power generation, district heating). Exclusion of highly profitable technologies lowers the proportion of free-riders of subsidies, but it also limits the investor's energy conservation options and it increases competing labour saving investments and also administration costs for approving subsidies.

Of course, these measures cannot help to avoid free-rider effects completely. However, compared to other countries with comprehensive subsidizing policies Denmark and France are shown to have made the most effort to allocate public funds in a cost-effective way with regard to the overall financial restrictions of the public budget. Because of lacking evaluation studies covering this aspects, however, conclusive statements on the proportion of free-riders in the EC countries cannot be made and further evaluation is necessary (see Chapt. 4 and 6).

Premature replacements

Some Member countries (e. g. Denmark) pursue a grant policy promoting pre-mature replacement, i. e. reinvestments in energy-saving technologies several years before the end of the usual technical life time. Although this effect is rather similar to free-rider effects, this policy may have some advantages in cases of reducing mid-term unemployment or of periods of stagnating energy prices. During this period, reinvestments can be made more profitable by the subsidy which may influence the investor's decision. Premature replacements dampen the impact on the balance of foreign trade in the event of price jumps for imported energy. Premature replacements, however, may also produce negative effects such as economic distortions of particular markets and high inflation rates of particular products and services.

Two major problems: information and availability of capital to the investor

When discussing financial support measures two problems remain to be solved: insufficient information and insufficient liquidity of the investor in the residential sector and in small and medium-sized firms.

As the assumption of a well-informed, rationally deciding investor often is wrong in practice, in some countries a great deal of attention is paid to providing information and practical know-how, as is the case, for example, in the Federal Republic of Germany, the United Kingdom, Denmark and, above all, in France. France even has stopped a grant programme for the residential sector in 1982, and replaced it by subsidized consultation to promote better decisions on investments.

On the other hand the availability of capital is a bottle-neck of energy conservation investments. For investors - especially in small and medium sized firms - working along their credit lines it may be impossible to obtain a further loan for energy saving investments. The energy saving investments generally would pay for themselves because of their high profitability, but the investor could only surmount his credit lines in case of a warranty given by the government or an equivalent institution. Furthermore, significant energy savings may be achieved by a change in production processes, also incorporating new production possibilities and enabling rationali-

zation and/or economies of scale. Such investments often constitute major barriers especially for small and medium-sized enterprises, by far exceeding their normal level of financing ("take-off investments").

To our knowledge, France is the only country providing a warranty programme especially designed for energy saving investments and has furthermore enabled banks to reduce reserve limits and to raise the amount of credits given for these investments, thus raising the amount of capital available. (This does not exclude such investments being implicitly eligible in warranty programmes of other countries).

A close relationship between energy conservation programmes and the overall objectives of the economic policy seems to be drawn mainly by the Governments of large or more wealthy EC countries, depending on the general philosophy of the economic policy. For example, the United Kingdom emphasizes the proper functioning of the market, both in production and consumption of fuels. Thus, a key element of the Government's approach is energy pricing, reflecting long-term costs of supply. The present Government has cut some of the former financial programmes, particularly for private households and companies. The energy conservation policy is designed to supplement their price message given to consumers by focusing on providing information, advisory services, subsidies for consultation and the like.

France tries to solve both the problem of saving energy and of unemployment with a combined policy: Financial incentives and activities in the public sector are partly directed at creating jobs in the field of energy conservation, through, for example, modernization of grant-aided dwellings. Similar efforts were found in the Netherlands, Denmark and the Federal Republic of Germany. These countries' energy conservation programmes are particularly embedded in their overall economic policy.

In sum, the French energy conservation policy, as far as financial support is concerned, must be seen as the best thought-out and most consistent policy in the EC.

3.4.3 Information programmes

A solid basis of information is a prerequisite for any voluntary energy conservation activities. The consumer should at least be sufficiently aware of and informed about

- the necessity of making more efficient use of energy, either for cost-saving or political and economic reasons,
- their present energy consumption and saving potentials,
- concrete actions to be taken or investments to be made and expected savings as a result of these activities.

Prior to the first oil price crisis in 1973, after many years of considerable economic growth and of carelessly consumed low-priced energy in households and less energy-intensive industries, little need was felt for energy conservation. Consequently, energy awareness and energy-related knowledge were often lacking.

In view of this background, one of the first activities of the Governments in almost all EC countries (except Greece) to promoting energy conservation was to implement a general information and publicity campaign. In recent years, however, it has been realized that this kind of information does not suffice, especially as a means of encouraging energy-saving investments. It leads to avoiding energy waste more than promoting investments.

In the past nine years the EC countries' central Governments have developed several information strategies which will be classified into four categories below. As far as information policies are concerned it is very important to keep in mind that the amount of activities based on private, local or regional initiatives (industrial associations, chambers of commerce, local and regional authorities, associations of engineers, architects, etc.) and coordinated programmes by governments and other institutions strongly influence the need for centralized information strategies.

(1) Information campaigns

Besides initial publicity campaigns which aim at encouraging a different attitude towards energy consumption through the mass media, advertisements or

leaflets, a comparison between the EC countries revealed the following types of campaigns:

- special campaigns about individual topics which also provide comprehensive technical information or even a form of checklist for energy conservation for households, especially on the following topics:
 - o Belgium: insulation of dwellings
 - o Federal Republic of Germany: insulation, use of household appliances, driving behaviour
 - o France: energy saving in dwellings, weather information to help achieve optimal switch-on/off time of heating systems, economical driving and installing energy-saving devices in cars
 - o Italy: "Agenda for Space Heating Plants Operation"
 - o Ireland: manuals on energy conservation options in buildings
 - o Luxembourg: recommendation of insulation standards for new dwellings
 - o United Kingdom: insulation, use of central heating controls, checklist for motorists
- detailed information and checklists for industries, especially in Belgium, Italy (provided by national energy and electricity companies), Ireland, United Kingdom (partly included in topic 4: education and training). In France and especially in Ireland industrial managers responsible for energy are personally contacted by the National Energy Agency or the Ministry respectively. The United Kingdom actively supports energy managers, with among other activities, an annual conference, and a free "Energy Management" newspaper
- special information for local authorities or other public administrations (France, Ireland)
- accompanying campaigns for other governmental measures, especially
 - o regulations: 19 °C temperature limit in France
 - o financial support: leaflets on financial aid in several countries
- campaigns addressed to specific groups who function as intermediaries such as building experts, driving schools, associations (see topic 4: education and training)

- government funds for information campaigns are also spent on subsidizing institutions who test energy-consuming and energy-saving appliances (Federal Republic of Germany) and consumers associations (Germany, Netherlands, United Kingdom).

(2) External advisory services

In addition most EC countries have implemented advisory services. There are two types of services:

- an external service which offers advice by telephone, replies to inquiries or maintains information centres and
- an "on-the-spot" advisory service consisting of concrete technical instructions.

As far as external services are concerned, all ministries or agencies responsible for energy conservation programmes answer consumer inquiries regarding energy saving. The present study includes only the services offered by governments as a special programme with expert personnel etc.

All external advisory services of this kind are free for the user. The following types of services are available:

- telephone advice for households in Belgium, Netherlands and especially in Ireland ("Energy Conservation Hotline"); similar service in Denmark on experimental basis
- telephone advice for firms, especially in Belgium (Energy Conservation Agency), Netherlands (National Foundation for Energy Information) and the United Kingdom ("Energy Quick Advice Service")
- support for voluntary consumer organisations which offer advice in their energy information centres (e. g. Federal Republic of Germany: Arbeitsgemeinschaft der Verbraucher).

(3) Energy audits

A further informational measure in the field of information even more directly aimed at concrete action is the provision of advice for people "on-the-spot". There are four main types of measure which can be subsumed under this heading:

- free advice from national institutions given by trained personnel for boiler tests in industry (Ireland), inspection of heat equipment and buildings in the residential sector (Denmark), inspection of energy-consuming production equipment in energy-intensive industries (Greece)
- financing of well-equipped energy busses for comprehensive technical measuring in industrial sectors in Belgium and in the Netherlands (two energy busses each); subsidized development of busses in the Federal Republic of Germany and in Italy, but services are provided by private enterprises
- free energy audits carried out by government approved consultants (France, Netherlands) and subsidized energy advice given by private consultants (Federal Republic of Germany, United Kingdom).
- "Regional Energy Conservation Officers" in Ireland provide on-the-spot advice to energy users in industry and public buildings.

(4) Education and training

This measure aims at middle and long-term effects on energy conservation rather than at immediate investments or behavioural changes. Four principal types of activities were found in the EC countries:

- establishment of energy conservation agencies or other information centres which organize seminars, courses etc. on request (Denmark, France, Netherlands)
- central or regional organization of seminars, meetings, visits to firms which are well equipped with energy-saving devices; establishment of formal energy management systems, appointment of regional officers, etc., who organize educational and training workshops and distribute information materials to specific categories of users (Denmark, France, Ireland, United Kingdom)
- publishing handbooks and energy guides for energy conservation in specific areas, especially for industrial and commercial sectors with high total energy consumption (Denmark, Federal Republic of Germany, France, Ireland, Netherlands, United Kingdom)
- adaptation of energy conservation aspects to existing educational institutions and procedures such as high schools, universities, vocational

training driving schools and others (to varying degrees implemented in all EC countries).

A tentative comparison between the EC countries

Table 3.25 shows which type of information programme was implemented for all EC countries. It also includes data of total funds per year and capita over the past two years. It must be pointed out, however, that great caution must be used in comparing these figures for the following reasons:

- First, in some countries with a central institution responsible for energy conservation, the funds for information activities are included either partially or completely in the total budget of this institution (France, Greece, to some extent in Belgium, Denmark, and the Netherlands). In addition, education and training measures are sometimes part of the information campaigns where, for example, they are addressed to specific groups such as managers or school teachers.
- Secondly, blank categories in Table 3.25 do not necessarily mean that no activities exist in the countries but rather that there are no centralized and government financed programmes.

Informational initiatives to promote energy conservation often take place with no or only indirect governmental actions. For instance, in some countries institutions or companies providing information are traditionally state-owned and hence more or less controlled by the Government anyway (e. g. fuel and electricity companies in Italy, banks in France and Greece). The funds spent on information on energy conservation, however, are not budgeted separately.

The most important factor to be taken into account is the traditional structure of information and communication channels. Roughly speaking, there are two types of structures:

- In France, for example, all types of information and advice are concentrated in the Energy Conservation Agency, AFME. This institution not only prepares the implementation of programmes but also monitors and carries

Table 3.25: Information programmes for energy conservation in the EC countries
(funds per year and 1,000 cap. over the past two years, ECU)

	B	D	DK	F
(1) <u>Information campaigns</u>				
Sectors	all	residential transport	residential	all
Started in	1975	1977	1974	1974
Main activities	mass media, leaflets, advertisements, specific groups	mass media, leaflets, advertisements, support for testing institute	mass media, leaflets, advertisements, energy guides	mass media, leaflets, advertisements, campaigns for special topics
Funds	152	147	400 ^{a)}	included in the AFME budget
(2) <u>External advisory services</u>				
Sectors	residential, industry	residential, transport		all sectors
Started in	1979	1978		1974
Type of services	free tel. service for firms, free advisory service for households	support for 120 advisory services, of the Consumers Association		telephone advice written answers
Funds	included in (1)	24		included in the AFME budget
(3) <u>Energy audits</u>				
Sectors	industry	commercial industry	residential	residential comm., industry
Started in	1981	1978	1975	1979
Type of services	2 busses, trained personal, 2-days free audits	grants for consulting	inspection of heat equipment and buildings	free audits for small consumers and firms < 5,000 toe/a
Funds	27	(see table 3.23)	2	
(4) <u>Education and training</u>				
Sectors			all	industry
Started in				1977
Main activities			information centre organizes seminars etc. on request	information and training for managers
Funds		(regional and private activities)	included in (1)	included in the AFME budget
Total funds spent for information	179	171	402	AFME ^{b)} budget for information: 657

a) Budgets of the Ministry of Housing and the Danish Energy Conservation Committee

b) AFME: Agence Française pour la Maîtrise de l'Energie

c) NEC: National Energy Council

d) Indirect Government activity

e) SVEN: National Foundation for Energy Information

GR	I	IRL	LUX	NL	UK
residential 1979 only leaflets, booklet, TV, films -	residential, comm., transport 1976 - 1980 mass media, leaflets advertisements, checklists -	all, mainly residential 1974 mass media, leaflets manuals 112	all 1978 leaflets advertisements, specific groups 80	all 1974 mass media, leaflets advertisements, specific groups 283	all 1975 mass media, leaflets, advertisements 115
industry 1976 - 1980 telephone advice included in the NEC budget	all 1975 assistance, advice by the National Electricity Board (21 incl. campaigns)d)	all, mainly residential 1980 telephone advice 11		residential, industry 1977 telephone service of SVENE) no information available	all non-domestic 1977 - 1982 telephone advice 2
industry 1976 - 1980 visits in energy- intensive industry included in the NEC budget		industry, commerce 1980 - 1981 all boilers tested by trained staff 63		energy-intensive industries 1981 2 energy busses (28) included in (1) see table 3.23	industry, commerce 1976 grants for consulting
		industry, commerce 1979 "Energy management Association", seminars, Regional officers 20		all 1974, 1979 - SVEN organizes seminars etc. - brochures and study day for industries included in (1) + 30 (ind.)	Energy Management Programmes, schools programme included in (1)
included in the NEC budgetc)	(21)	206	80	313	117

out the measures. Local and regional activities also take place under the directive of AFME.

- The situation in the Federal Republic of Germany, for example, is quite different. The Federal Government provides information only on a very broad level. Responsibility for detailed information, i. e., campaigns for special groups, external advisory services, energy audits, education and training traditionally belong to other bodies (such as Länder, chambers of commerce, local authorities) or private institutions and companies such as private associations, organizations and vocational federations (Engineers' Association and others).

Such differences partly explain why the funds spent on information programmes are so different. France, for example, has by far the highest budget of all EC countries.

Activities on the local level could not be dealt with here when not coordinated by the central governments. Especially in the field of information this kind of activity, however, is commonly considered very important, in particular for the residential sector.

Information programmes are intended to overcome some of the main constraints for taking energy-saving measures. National differences notwithstanding, in the industrial and commercial sectors particular attention has been paid to small and medium-sized firms. Many of them do not have their own engineer concerned with energy questions; the owners are overburdened with day-to-day problems of production and sales and are consequently often not well enough informed about the main sources of energy consumption, energy flows, and heat losses (see Angerer/Gruber, 1982). In addition there is, what might be called a general information "overload", in the field of energy conservation in particular. In all EC countries, therefore, programmes for the industrial and commercial sectors focus on advisory help rather than offering information on a more general level.

In some countries, especially in Belgium, France, Greece and Ireland, particular attention has been paid to advisory services for energy-intensive industries.

With regard to all types of advisory services and grants provided for using private consulting, the governments should make an effort to assure that consultants are qualified enough. The market for energy consultation has rapidly increased over recent years due to the high demand of firms for practical advice. Consultants need very broad knowledge in many fields such as architecture, engineering, management and know-how on the technical processing in the industries concerned. Some countries now award grants only if consultants are government approved so as to improve the general qualification of consultants. The problem, however, will become less important in the long run.

As far as private households are concerned, little effort is made to reach specific consumer groups through information programmes, in particular the low-income groups who need them most. Obviously, amongst the higher social classes awareness of the energy problem, energy-saving potentials and of measures to be taken is higher than amongst less literate groups in the community (Mettler-Meibohm, 1982; Phillips et al., 1977). Special assistance should, therefore, be given to low-income and other disadvantaged households who, on the one hand, could adopt saving measures which are very economical or install them themselves, and on the other hand, could encourage their landlords to make investments.

Particularly for households, personal contact is considered important. Special attention is paid to this aspect in Denmark (home energy checks) and in the Federal Republic of Germany (support for energy information centres). It should be pointed out here again, however, that private or decentralized local activities exist in many countries, but are not included in this report.

There is a noticeable lack of one type of information, namely feed-back strategies. For example, heat metering takes place "in the dark corner" and only once a year, and heat cost accounts or electricity bills are not clear enough. In general, there are no programmes for immediate, clear feedback to people on how much energy they have used or saved.

4. Evaluation of energy conservation programmes

Following the comparative description of energy conservation policies in the EC countries in Chapt. 3.4, this chapter is concerned with a general framework for research in the field of evaluation of energy conservation programmes and presents short descriptions of available studies.

It begins with a brief discussion of methodological problems of evaluation studies with regard to regulations, financial support, and information programmes (Chapt 4.1.1). On the basis of these considerations a frame of analysis will be presented in Chapt. 4.1.2 used for a concise description of impact analyses.

Chapt. 4.2 reviews the available evaluations in the EC countries as well as experiences made in Sweden and in the United States. To give an impression of the scope of assessment efforts, some studies or reports which are not to be considered comprehensive impact analyses have also been included. A comparative chapter (4.2.3) identifies problems and limitations of impact analyses and leads to some generalizing remarks.

4.1 Concepts and tools of evaluation

This chapter gives a short methodological overview (4.1.1) on the main issues to be considered with regard to impact analyses in the field of governmental energy conservation measures. It is not intended to be fully comprehensive with regard to basic questions of evaluation but rather points to some critical problems, considering especially the policy measures dealt with in this study, i. e. regulations, financial support, and information programmes. Derived from these considerations a screen is presented (4.1.2) that aims at making the available impact analyses comparable and enabling a concise description of their contents with respect to methodology, performance, and impact.

4.1.1 Some methodological remarks

A look at energy policies in the EC countries has revealed a widespread interest of political decision-makers, administrative organizations and research institutions in the assessment of energy policy impact. But there are three main reasons why many impact analyses have only limited validity.

- Most of the energy conservation programmes were only started in the last three or four years. As a result, empirical findings on the effectiveness of these programmes are often not yet available.
- There are many factors influencing energy consumption behaviour and energy conservation efforts which can overlay or even dominate the effects of political programmes. Influences such as increased energy prices, structural changes in industry, economic growth, introduction of new energy-saving technologies, and climatic factors have to be taken into account when studying the impact of programmes. Furthermore, there are autonomous developments such as learning processes which result in energy saving inherent in the introduction of new machines, plants, or household appliances. These factors influence decisions of companies' management or private households. Lastly, there are also internal circumstances like investment cycles and concepts or changes in consuming behaviour which influence the propensity to energy savings. The crucial question is therefore: How can a causal link be drawn between a particular political programme on the one hand and a certain amount of energy savings on the other?
- Finally, yet another difficulty arises with respect to the data basis. Three different approaches can be used - aside from the ex ante calculation: analysis of official statistics (applications approved, etc.), survey studies, and technical measuring. Official statistics are often not available, the survey method produces a lot of bias effects, and technical measuring is quite expensive.

Measuring problems can be overcome by careful planning and execution of personal interviews. For example, facts rather than opinions or attitudes should be solicited. Two approaches would be appropriate strategies: the "before vs. after" strategy which provides a comparison between the energy behaviour before the programme was started and the behavioural changes in the course of or after running the programme. This strategy entails the disadvantage that the data are provided by the clients who received public support of some kind. An even better strategy, but one more difficult to adopt, is the control group approach, in which supported and non-supported firms or households are compared.

These problems are discussed below with respect to the three kinds of measures dealt with in this report: regulations, financial support, and information programmes.

Regulations

At the first glance, the effectiveness of regulative measures seem to be easily calculated in advance because of well-defined technical figures. Most analyses are therefore concerned with technically feasible energy savings rather than with an empirically proved impact. It should be pointed out, however, that there is a considerable uncertainty about the validity of assessments due to a lack of data on

- the extent to which objects remain below the requested standard (through poor insulation, insufficient maintenance of heating equipment, non-observance of behavioural prescriptions) and
- the extent to which higher standards than those laid down in the regulations are achieved (because of expected increase of energy prices, further improvements of available technologies, or sub-optimal mandatory operating standards).

The most important question is whether people would also meet the standards if no mandatory norm existed. Factors like energy awareness, profitability of investments or maintenance efforts, expected increase of energy prices, improved information level could also increase the share of energy consumers who would meet those standards.

With regard to the three methods proposed earlier in this chapter the following situation arises:

- There is a lack of official or empirical statistics, in particular, the prior state of affairs has not been recorded.
- Survey studies are sure to underestimate the effects of regulation measures because people often pretend to meet standards even if there would be no regulations.
- Technical measurements are only valid when compared with prior data. In addition, other influences such as linked behavioural changes or energy price increases would have to be excluded.

In general, as far as regulations are concerned the uncertainties relate to all possible regulatory instruments (e.g. temperature and speed limits, standards for energy consumption, building codes). Thus, for impact analyses of these instruments, too, empirical surveys are indispensable. These uncertainties are, however, not as severe as in the case of financial support and information programmes but are not at all negligible.

Financial subsidies

Financial support is provided by the Government to overcome financial barriers to energy-saving investments. One of the most important criteria for assessing the impact of financial programmes is their efficiency in terms of the cost-benefit relation between governmental expenses on the one hand and achieved national energy savings on the other. Additional effects, particularly non-intended effects, such as those concerning income or competition patterns and prices, are scarcely dealt with.

With regard to the efficiency of financial measures, several questions should be discussed:

- How many persons addressed by the measure register its existence and what is the degree of participation?
- To what extent are energy-saving investments made earlier than was planned previously (premature replacements)?
- What is the public cost of total funds allocated by the financial programmes compared with achievable or achieved national energy savings?
- To what extent do "free-riders" take advantage of the measures, i. e., people who would have made energy-saving investments in any case without getting financial support from the Government? And to what extent are energy savings achieved specifically by a certain programme rather than by some other factor?
- How many investments have been initiated by financial support that do not optimize energy-saving possibilities with regard to profitability by, for example, replacing windows instead of installing improved heating control systems (unused energy-saving potentials)?
- In the case of private households it is often assumed that the consumer behaves like a "homo oeconomicus". In reality, reducing energy cost is

not a household's most important objective, the aim of private households is to realize a combined benefit of quality of life, economic wealth, social recognition and reward.

These questions make it obvious that impact analyses of financial subsidies cannot be restricted to an evaluation of application forms and a survey of applicants.

Interviewing those promoted, one has to rely on

- statements about problems which often are not familiar to the interviewee such as energy consumption and possibilities of energy saving
- statements about problems which might possibly make the respondent uncomfortable such as questions about information on governmental programmes or about free-rider effects.

In particular the extent of free-riders - the rate of subsidies that did not have any effect on the decisions of the beneficiaries - can hardly be analysed by interviews, because of methodological considerations: It has to be assumed that many respondents will not admit to being free-riders because that might be felt immoral. Furthermore, they expect political calculations such as the following: The higher the free-rider effect (i.e. the lower the actual effectiveness of a subsidy programme), the more likely the government might not continue the programme. In general, therefore, free-rider effects will in reality be higher than identified in surveys of beneficiaries.

Furthermore, investigations often do not clearly differentiate between free-rider effects and premature replacement effects. While free-riders do not have any additional economic impact, energy-saving effects of investments that have been made some time earlier than originally planned may result in a useful cost/benefit ratio of a financial subsidy programme. In this context it must also be taken into account that governmental actions often are multi-goal programmes, incorporating economic performance goals and job creation policy for which premature replacement effects alone may be considered a success.

A further problem which, however, does not cause such grave methodological difficulties, is posed by selective structural effects which occur in particular with programmes that require active application efforts. Such structural effects relate to a higher rate of promotion of high-income households or large-scale companies respectively (see Chapt. 4.2.2.9, evaluation No. 4) due to their higher information level, more transparency relative to technical possibilities, more experience in dealing with administering institutions and with application forms. Moreover, a greater amount of available financial resources also explains a higher general investment activity which results in a higher share of public subsidies for high-income households and financially well-off firms.

In a survey made by the Koblenz Chamber of Industry and Commerce (IHK Koblenz, 1981) a main reason for non-participation in a subsidy programme is mentioned: 31 % of the small and medium-sized companies consider their potential for energy saving to be exhausted. For many of them this is probably a false conclusion; a comparison with large companies shows that these firms constantly introduce successful energy-saving measures and continue to find considerable new potential for saving energy. Besides the lack of information, a further reason for structural effects is certainly that application costs for small projects may well be higher than the expected subsidy.

All these factors point to the necessity for a comprehensive approach to assessing the impact of financial support measures to be able to judge the efficiency within the general political framework. Thus it will in most cases be necessary to include a control group in the investigation.

Information programmes

Impact analyses of information programmes have to solve two main problems:

- The effects of certain information measures are often overlaid by the impact of energy price increases or other factors.
- Even if other influences can be isolated by studying control groups the question arises whether a causal relationship between information and behaviour exists. Selective exposure accounts for a part of the resulting energy-saving behaviour: People who are interested in energy matters and already well informed will listen to and read further information more

often than those who ignore the communication because they are not interested and will thus not be influenced by it. In cases where people would have taken energy-saving measures even without the information programme, we propose to call this phenomenon a free-rider effect of information.

Another important question is the duration of energy awareness and technical know-how. An improved information level either leads to energy-saving investment which continues to be effective after information impact has faded or the information is a permanent prerequisite for energy-saving behaviour (e.g. reduction of room temperature).

Two further questions have to be considered:

- Do information programmes reach those who need the information most rather than those who are already well informed?
- To what extent is actual behaviour and not only attitude changed by information?

It cannot be expected that information programmes have very directly measurable impacts. One has instead to take into account that behaviour towards energy consumption changes only in the course of longer time periods. This has, of course, to be considered for the design of impact analyses in this field.

As broad information campaigns do not usually lead directly to concrete actions and investments it is especially important to investigate accompanying measures and the programme network (other information measures, financial support programmes) within which the information programmes operate.

4.1.2 Screen used for surveying impact analyses

Based on the foregoing methodological remarks we have drawn up a screen in order to make the available impact analyses comparable and to enable a concise description of their contents. The categories used refer to methodology, performance and impacts.

METHODOLOGY

The range of an impact analysis and the value of its findings are largely determined by the method used. Thus information about the methodology is a first indication of the results that can be expected from the analysis. In particular, information refers to the items

- type of evaluation (ex ante, ex post, monitoring, accompanying evaluation)
- data basis (calculations on given assumptions, technical measurement, survey, official statistics)
- sampling method
- number of cases investigated
- time period (the period of the programme that was chosen to be analysed)
- representativeness (is the analysis statistically representative, does it allow trends to be indicated, does it only give punctual indications; for which set of statements does this apply?).

PERFORMANCE

Under this heading we present all the information on the range of application of the programme reviewed. Some of the information on these items can be taken from application forms so that it should normally be available for all programmes under consideration.

The items described here include:

Acceptance

refers to the rate of participation of all units eligible to the programme; shows the broadness of effects to be expected as well as possible distortions caused by the programme in branches of industry, groups of consumers, regions etc.

Description of groups addressed

gives explanation why a programme may prove to be selective, although not intended to be; participation in a measure may depend on the information level, on the financial situation, etc. of the participating groups;

detailed information on these items allow a first judgement of the effectiveness of the measure

Reasons for non-participation

partially complementary to description of groups addressed; but the explicit investigation into these reasons, put forward by those who are eligible under the conditions of the programme, should reveal barriers to participation more clearly as well as possibly provide indications about how to increase the effectiveness of the measure; reasons for non-participation very often can be due to

- lack of information: potential beneficiaries do not know that governmental programmes exist;
- opportunity costs: the existence of programmes is known but the time that has to be spent for the application procedure can be spent with higher returns on different purposes;
- an unfavourable relation between costs of application and expected grant;
- financial restrictions that lead to alternative spending of money even though an expected grant would contribute substantially to improve the financial situation

Programme network

normally, a certain programme is embedded in a network of other energy policy measures - there may be synergisms or contradictory effects; the network is sometimes studied in order to isolate the effects of the specific programme under consideration; effects on subgoals of a programme or on other political areas are dealt with under "other effects" (below)

Grants approved (in the case of information programmes: funds spent)

the most obvious quantitative indicator of acceptance of a measure; a basic indicator for judging the effectiveness of a measure (compared to savings achieved)

Use of grants/use of service

indicates qualitative effects of a programme

Extent of free-riders

the extent of free-riders is a crucial point for all governmental measures because it influences the cost-effectiveness of subsidies. Free-riders are beneficiaries who take advantage of financial aid although they would have made the subsidized investments without aid too. Thus statements about the extent of free-riders is one of the most meaningful indicators for the effectiveness of governmental measures and one of the most necessary items of impact analyses.

Concerning regulations, most of these categories do not apply. There are, however, corresponding categories that are used instead:

Range of application

indicates the scope of energy-saving potentials to be expected

Programme network

synergisms or contradictory effects to other measures may occur

Controlling

if an effective system of control is lacking, the theoretically expected effects may not be achieved

Meeting standards

indicates efficiency of regulations; either displays the rate of diffusion initiated by the measure or illuminates the fact that the standards are over-fulfilled in practice.

IMPACT

The identification of impact should permit final effectiveness to be measured and the overall value of a government measure to be assessed:

Functioning as incentive

only applies for financial support; refers to the net benefit for the consumer when application costs have been subtracted from the grant approved; should also take into account whether a major or only a minor part of all costs is eligible; generally the pure cost/benefit ratio cannot be regard-

ed the only measure to identify the incentiveness of a government programme, as consumers' actions may be taken without strict economic considerations, and also general awareness may have been stimulated

Initiated investment costs

gives volume of investments in connection with the measure; in most cases rather giving the affected investment costs when free-rider effects cannot be isolated; depending on the measure analysed, total affected running costs may be given

Achieved national energy savings

information on quantitative savings as well as qualitative aspects such as kind of energy saved, especially oil substitution; mostly, free-riders are not excluded

Other intended or non-intended effects

very often, analysis has to deal with multi-goal measures that are also supposed to promote employment, technical innovation, environment protection etc.; the achievements towards these goals have to be taken into account for an overall assessment of the measure; this also applies for non-intended economic or social effects such as:

- impact on markets; certain energy conservation measures may lead to a shrinking of conventional markets (for example, with regard to heating equipment, types of boilers etc.); on the other, to the creation of new markets (e. g. energy consultants)
- increasing demand may lead to price increases
- directiveness towards certain investments may lead consumers to make wrong decisions if they lack technical and/or economic transparency
- financial support may improve general energy awareness and provides information on the existence of certain energy-saving possibilities.

The application of such a screen has, of course, some inherent limitations. The content of available studies cannot be described here in detail. The type of presentation chosen for this study, however, allows to give a brief and clear overview on available evaluation studies. Some final conclusions from comparative analysis are discussed in Chapter 4.2.3.

4.2 Review of existing impact analyses

This chapter is concerned with the description of available evaluation studies which have been collected between April and November 1982. First of all, the types of data sources for reviewing the impact of energy conservation programmes will be discussed briefly.

4.2.1 Sources

One of the most interesting issues to be dealt with in this study is to answer the following questions:

- How much energy has been saved through a certain energy conservation programme?
- To what extent are data available that can be used as a basis for assessing the impact of a programme such as use of grant or service, meeting standards, characteristics of groups addressed etc.?

Most of the data gathered for this report are included in the programme descriptions (see Annex). The present chapter is concerned only with ex post evaluation studies which deal with items such as

- achieved national energy savings,
- actually resulting investment costs and
- free-riders.

To present a brief overview on evaluation studies or basical data respectively in the above mentioned sense, Table 4.1 shows sources for information and amount of data obtained on the programmes in each Member country.

From the methodological point of view valid results on the impact of programmes, i. e. evaluation studies in a strict sense are scarce (see also the listing in Chapter 4.2.2). Available studies were made either by research institutes or governmental bodies responsible for the programmes themselves.

In two countries, the Netherlands and the United Kingdom, an expert group was established which is concerned specifically with the assessment of the impact of energy conservation programmes.

In some countries the performance of programmes is well monitored, documented and analysed, especially in Denmark, Ireland, the Netherlands, and the United Kingdom. Most of these data are internal statistics which were accessible in most cases and used for the programme descriptions.

A further source of information on estimated energy savings and the success or failing of programmes were the interviews in the responsible ministries and agencies.

Lacking information sources in Greece, Italy, and Luxembourg become understandable considering the fact that the energy conservation policy is not as comprehensive as in the other countries.

Table 4.1: Sources for information on programme impact

Country Type of sources	B	D	DK	F	GR	I	IRL	LUX	NL	UK
Research studies (number)	1	3 ^{x)}	2	6	-	-	1	-	2	3
Governmental expert groups for evaluation of energy conservation programmes	-	-	-	AFME	-	-	-	-	Allgemeene Energie-raad	Select Committee
International documentation and analysis of programme performance (comprehensiveness)	-	+	++	+	-	-	++	-	+	++
Interviews (estimates on savings)	+	+	+	+	+	+	+	+	+	+

x) one of the studies covers 11 programmes

4.2.2 Overview on national evaluation efforts

The present chapter summarizes the contents of evaluation studies available by the end of November 1982. Some difficulties arise with regard to these studies:

- For some studies only summaries were available which do not allow to present a complete description in accordance with the issues listed in Chapter 4.1.2.
- Some studies were only available in the original language and have not been translated for time and budgetary reasons (e.g. Denmark).

- Most of the studies would deserve more attention than was possible in the context of this report. A concluding judgement of each study, therefore, will not be presented.

The following studies will be described below:

Belgium: one evaluation study of information campaigns

Federal Republic of Germany: a study including 11 programmes and three studies concerning one grant programme each

Denmark: four studies, two of which deal with a regulation, one with information/consulting, one with grants for industry

France: six studies, three of which are dealing with information or advice programmes, two with grants and one with a regulation

Ireland: one study on an energy audit service

Netherlands: important assessments made by the Dutch expert group and two studies on a regulation and an information programme respectively

United Kingdom: three studies, one concerned with an information campaign, two others with grant schemes

Furthermore, a Swedish study as well as some results from evaluation efforts made in the United States are included.

4.2.2.1 Belgium

The Belgian energy conservation agency (Service pour la Conservation des Energies, SCE) has just completed an evaluation study which will be available in 1983. This study analyses the parameters which influence the energy consumption of households and tries to assess the impact of information campaigns through regression analysis.

A summary of this study is analysed below.

EVALUATION STUDY

Country	Belgium, 1982
Evaluated programme	Information campaigns on energy saving
For detailed description see Annex p. 20	

Title of the study	La mesure de l'impact de la campagne d'information en faveur des économies d'énergie (Impact analysis of the information campaign on energy saving) (only summary available)
Institution	Service pour la Conservation des Energies (SCE), Institut Interuniversitaire de Sondage d'Opinion Publique (INUSOP)
Type of evaluation	Ex post impact analysis

METHODOLOGY

Data basis	- empirical - statistics of gas companies (over 2 years), survey of households with gas-fired heating systems, living in the same dwelling since 1979
Sampling	random
Number of cases	- 1350 of all concerned households - 350 of concerned households who asked for a SCE-booklet
Time period	01.07.1982 - 15.08.1982

Representativeness representative for all households concerned

PERFORMANCE

Description of groups addressed	29 % of all households have a gas-fired heating system. Parameters for energy consumption: number of days of occupation of the dwelling, number of occupants, time period since completion of energy saving investments, reduction of living space, number of gas boilers. These parameters account for 89 % of the energy saving in one year (total energy savings 2.9 % compared to recent years)												
Acceptance	4.8 % of concerned households asked for the booklets												
Reasons for non-participation	not mentioned in the summary												
Programme network	not mentioned in the summary												
Funds spent	total funds for the information campaigns												
	<table border="0" style="margin-left: 100px;"> <tr> <td></td> <td>1979</td> <td>1980</td> <td>1981</td> </tr> <tr> <td>Mill. FB</td> <td>24</td> <td>69</td> <td>62</td> </tr> <tr> <td>Mill. ECU</td> <td>0.6</td> <td>1.7</td> <td>1.5</td> </tr> </table>		1979	1980	1981	Mill. FB	24	69	62	Mill. ECU	0.6	1.7	1.5
	1979	1980	1981										
Mill. FB	24	69	62										
Mill. ECU	0.6	1.7	1.5										
Use of service	not mentioned in the summary												
Extent of free-riders	not mentioned in the summary												

IMPACT

Functioning as incentive	3 parameters were analysed: - recalling statements of the publicity campaign - talking about energy saving - asking for the booklet. Only one parameter: "asking for the booklet and reading it thoroughly" was significant for behavioural change. While all households concerned saved an average of 2.9 % gas in one year, this population saved an average of 8.7 %.
Initiated investment costs	not mentioned in the summary
Achieved national energy savings	11,400 toe per year for users of gas-fired heating systems
Other intended or non-intended effects	not mentioned in the summary

4.2.2.2 Federal Republic of Germany

A comprehensive evaluation study made by Ifo - Institut für Wirtschaftsforschung (Ifo Institute for Economic Research) covers most of the energy saving measures implemented in the Federal Republic of Germany. The content of this study will be described below, for each evaluated programme separately (EVALUATION STUDY 1 - 11). First of all, however, some general remarks, especially on methodology, will be presented.

In addition to the Ifo evaluations three further studies deserve attention: study (12) deals with indepth evaluation of the DM 4.35 Billion Grant Programme; study (13) is concerned with the Investment Loan Programme as is study (14) entailing an ex ante assessment the results of which will be mentioned briefly.

EVALUATION STUDY (1) - (11)

Country	D, 1982
Evaluated programme	Most of the energy saving measures implemented in the Federal Republic of Germany
For detailed description see Annex p. 23 - 26, 28 - 31, 36 - 39, 42 - 46	
Title of the study	Abschätzung der quantitativen Wirkung von Energiesparmaßnahmen - Möglichkeiten und Grenzen. München, July 1982 (Assessment of quantitative impact of energy conservation measures - Possibilities and limits)
Institution	Ifo - Institut für Wirtschaftsforschung (Ifo - Institute for Economic Research) Karl, H.-D., Rammner, P., et al.
Type of evaluation	Impact analysis: ex post analysis from the beginning of the programme and ex ante assessment up to 1985 including a prognosis of the further programme development. In the following description of each programme evaluation we try to separate the prognosis from the ex post analysis and to describe only Ifo's results on the effects of the actual programme volume, programme acceptance, and programme characteristics.

METHODOLOGY

Data basis

Most of the surveys are based on four different kinds of data sources: global representative surveys (carried out by Infratest - Institute for Social Research), application forms, technical calculations, and (non-representative) expert assessments, and inquiries of users. On the basis of surveys or applications received by authorizing institutions the overall potential of programme impact has been found out (e. g. heating equipment affected by regulations, knowledge and relevance of information offered, groups or conservation measures eligible for subsidies). The energy savings have mostly been calculated for each investment separately. With regard to the total amount of applying a certain energy conservation measure, the total impact of the programme can be calculated. These assessments were backed up by interviews with experts.

A different method was applied in the field of information programmes. On the basis of indepth interviews with experts a highly disaggregated review of the saving possibilities and saving areas was used in order to find out the amount of savings which can be attributed to the information programme, e. g. the amount of energy savings which would not have been achieved without the information offered.

Sampling
Number of cases
Time period
Representativeness

} see descriptions of evaluated programmes below

PERFORMANCE

Range of application

Description of groups addressed

} mostly not investigated

Programme network

mostly briefly discussed, but not investigated in detail

Extent of free-riders

Free-rider effects have been assessed only roughly. Total savings were broken down by impacts induced by increasing energy prices on the one hand and by the combined effect of energy prices and energy conservation programmes on the other. The first type of data will be used in the evaluation descriptions below.

IMPACT

Functioning as incentives	mostly not investigated
Initiated investment costs	} results do not exclude free-riders
Achieved national energy savings	

EVALUATION STUDY (1)

Country	D, 1982 (Ifo)
Evaluated programme	Building Codes (Wärmeschutzverordnung) since 1977, for all new buildings
For detailed description see Annex p. 23	

METHODOLOGY

(see general remarks)

Data basis	technical calculation of heat losses as a difference between - case a): technical standard of heating equipment 1977 and 1969 - case b): like case a) including the difference between double and single-glazed windows
Sampling Number of cases Time period	} all new buildings included (694,000) which have been built between 1978 and 1980
Representativeness	24 different types of buildings

PERFORMANCE

Range of application	all heated new buildings 1978 - 1980: 638,000 residential buildings 56,000 non-residential buildings
Programme network	related to Standards for Boilers, mandatory individual heat metering Building codes are very important for further energy saving measures

Controlling Insulation data are part of the building plan which has to be approved by local building administrations.

Meeting standards - This regulation corresponds with the trend of technical development.
 - Standards are exceeded by 10 to 20 % on average.
 - Therefore low impact of this conservation measure.

IMPACT

Initiated investment costs Increase of building costs by 3 %

Achieved national energy savings Primary energy saved:

	Energy required due to heat losses per building per year in toe	Energy savings per building per year in toe		Energy savings in all buildings per year 1978 - 1980 Mtoe	
		case a)	case b)	case a)	case b)
Detached one-family-houses	2.0	0.5	0.7	0.12	0.16
Serial houses	1.3	0.3	0.4	0.06	0.09
Two-family houses	3.0	0.9	1.2	0.11	0.16
Multi-occupied houses	16.7	1.9	3.6	0.07	0.13
Heated non-residential buildings	19.1	1.9	2.9	0.11	0.16
Total				0.47	0.69

Other intended or non-intended effects High oil savings: 51 % of total energy savings.

EVALUATION STUDY (2)

Country	D, 1982 (Ifo)
Evaluated programme	Standards for new boilers and hot water production (Heizanlagenverordnung) since 1978, for all new buildings and for replaced boilers or heating systems in existing buildings

For detailed description see Annex p. 24

<u>METHODOLOGY</u>	(see general remarks)
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Data basis	technical calculation of the difference of consumption between old and new standards
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Sampling Number of cases Time period	} all new oil and gas-fired central heating systems have been included (4.9 Mill. 1979 - 1985)
--	--

Representativeness	four types of boilers
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PERFORMANCE

Range of application	1979 - 1985: 3.5 Mill. new oil-fired boilers 1.4 Mill. new gas-fired boilers
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Programme network	related to Building Codes
-------------------	---------------------------

Controlling	Part of the building plan which has to be approved by local building authorities; installation firms have to comply with regulations.
-------------	---

Meeting standards	- This regulation corresponds with the trend of technical development. - Therefore low impact of this conservation measure.
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IMPACT

Initiated investment costs	not investigated
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Achieved national energy savings	yearly average 1979 - 1985: - primary energy savings per central heating system and year: 0.46 toe
----------------------------------	--

- total primary energy savings per year:
2.26 Mtoe

Other intended or not investigated
non-intended effects

EVALUATION STUDY (3)

Country	D, 1982 (Ifo)
Evaluated programme	Standards of operation for space heating and hot water production (Heizbetriebsverordnung) since 1978, includes maximum exhaust losses of boilers for space heating and hot water supply; monthly control and maintenance for boilers > 50 kW by trained personnel

For detailed description see Annex p. 25

METHODOLOGY (see general remarks)

Data basis	- measurements of emissions by chimney-sweeps - technical calculation of energy savings through improved efficiency of boilers
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Sampling Number of cases Time period Representativeness	} all oil and gas-fired central heating systems included (ca. 6.5 Mill.) which exist on the yearly average 1980 - 1985
--	--

PERFORMANCE

Range of application	existing oil and gas-fired central heating systems: - 1980: 6.21 Mill. - 1982: 6.56 Mill. - 1985: 7.10 Mill.
----------------------	--

Programme network	related to: information programmes provided by the Federal Ministry of Economics, Stiftung Warentest, Consumers' Association
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Controlling	- local chimney sweep for boilers < 1 MW - state and municipal authorities decide on the controlling authority for boilers > 1 MW
-------------	--

Meeting standards	- mandatory standards exceeded by about 30 % on an average - therefore low impact of this conservation measure
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IMPACT

Initiated investment costs	not investigated
Achieved national energy savings	primary energy savings per central heating system and year: 0.05 toe total primary energy savings per year: 0.31 Mtoe
Other intended or non-intended effects	not investigated

EVALUATION STUDY (4)

Country	D, 1982 (Ifo)
Evaluated programme	Mandatory individual metering of heating costs (Heizkostenverordnung) New multi-occupied buildings must be equipped with measuring instruments since 1981; existing buildings must be equipped by 1984

For detailed description see Annex p. 26

METHODOLOGY (see general remarks)

Data basis	1. representative surveys of households 2. documents obtained from building administrations, firms calculating heating costs, etc.
Sampling Number of cases Time period	} 1. random sampling 2. include a large portion of consumption (not quantified)
Representativeness	all existing dwellings which have to be equipped by 1984 (3.28 Mill.) and all new buildings constructed up to 1984 (0.62 Mill.) were included

PERFORMANCE

Range of application	0.62 Mill. new dwellings 3.28 Mill. existing dwellings according to assumptions made by Ifo 1979: 5 % 1980: 10 % 1981: 25 % 1982-84: 20 % each
Programme network	- related to information programmes provided by the Federal Ministry of Economics, Stiftung Warentest, Consumers' Association, Building Codes - measure promotes energy saving investments
Controlling	none
Meeting standards	by 1984 about 40 % would apply to individual heat metering anyway

IMPACT

Functioning as incentive	- Consumers are motivated to compensate the running costs for measuring (about 20 DM / 8 ECU) by increasing energy saving efforts. - The account identifies successful savers and allows people to prove their energy consciousness.
Initiated investment costs	initiated running costs: about 15 - 25 DM (6 - 10 ECU) per dwelling and year for 3.9 Mill. dwellings: about 60 - 100 Mill. DM (25 - 40 Mill. ECU) per year
Achieved national energy savings	primary energy saved by 1984: - about 13 % of requirements - about 0.38 toe per dwelling per year - about 1.5 Mtoe per year
Other intended or non-intended effects	- 60 % of total primary energy savings are oil savings - central heating systems will be substituted partially by electrical heating - unfavourable impact such as high costs for large families could be avoided by other measures such as higher rent subsidies - relatively low transparency of calculations for the consumers

EVALUATION STUDY (5)

Country	D, 1982 (Ifo)
Evaluated programme	DM 4.35 Bill. Grant Programme to conserve heating energy in dwellings from 1978 to 1983; grants or tax relief available for investments in insulation, improvements of heating systems, solar appliances, heat pumps, and others

For detailed description see Annex p. 28f

METHODOLOGY

Data basis	- statistics of grants awarded made by the Länder - experts' assessments of the House-owner and Land-owner Association and non-profit building companies - technical calculations of the effects of typical investments
Sampling Number of cases Time period	} 2.43 Mill. dwellings included, which are supported by the subsidy between 1978 and 1983
Representativeness	20 types of buildings and 6 groups of energy-saving investments were considered

PERFORMANCE

Acceptance	not investigated (2.42 Mill. dwellings $\cong$ ca. 10 % of total number of dwellings)						
Reasons for non-participation	not investigated						
Programme network	related to information programmes, consulting for small and medium-sized firms						
Grants approved	budget for grants	1978	1979	1980	1981	1982	total
	Mill. ECU	164	191	190	190	203	939
	Mill. DM	420	480	480	480	480	2,340

tax reliefs (expected)	total
Mill. ECU	810
Mill. DM	2,010

Use of grants no information available

Extent of free-
riders ca. 50 %

IMPACTS

Functioning as incentive	}	not investigated
Initiated invest- ment costs		

Achieved national energy savings	primary energy savings per year		
		per unit	total
	in % of demand	toe	(Mtoe)
- one and two family houses	29		
- multi-occupied houses	23		
- all houses	28	1.46	2.42
- all dwellings	28	1.00	2.42

Other intended or
non-intended
effects not investigated

EVALUATION STUDY (6)

Country	D, 1982 (Ifo)
Evaluated programme	§ 4a Investment Allowance Act (grants for energy conservation investments and use of alternative energy sources) since 1975; grants of 7.5 % of total investment costs of heating plants, hydro-electric plants, heat recovery, waste incineration, heating pumps

For detailed description see Annex p. 30f

METHODOLOGY

Data basis	application forms
Sampling Number of cases Time period	} total number of 5,028 applications approved from 1975 to the end of 1980
Representativeness	total number of cases included

PERFORMANCE

Acceptance	not investigated
Reasons for non-participation	not investigated
Programme network	related to consulting of small and medium-sized firms and district heating programme ("Investment for the Future")
Grants approved	grants awarded (estimates):
	1978 1979 1980 1981 1982
Mill. ECU	55 28 28 48 51
Mill. DM	140 70 70 120 120

Use of grants

	number of applications	grants approved	
	up to 1980	Mill. ECU	Mill. DM
heat and power plants	218	102	259
waste incineration	798	49	124
others	4,012	124	314
- hydroelectric plants	41	27	68
- solar collectors	69	0.2	0.4
- heat recovery	3,168	28	72
total	5,028	274	697

Extent of free-riders

more than 75 %

IMPACT

Functioning as incentive

not investigated

Initiated investment costs

according to applications approved 1975 - 1980:
9,300 Mill. DM (3,650 Mill. ECU)

Achieved national energy savings

	primary energy savings per application	savings per year
	(toe)	total (Mtoe)
heat and power plants	6,800	1.48
waste incineration	2,100	1.67
others	1,200	4.85
- hydroelectric plants	5,800	0.24
- solar collectors	15	0.001
- heat recovery	1,100	3.47
total	1,600	7.99

Other intended or non-intended effects

not investigated

EVALUATION STUDY (7)

Country	D, 1982
Evaluated programme	grants for providing consultation facilities for small and medium sized firms since 1978; support for energy consultations up to 75 % of consultation costs; public funds for seminars, meetings, training centres, handbooks

For detailed description see Annex p. 42f

METHODOLOGY

Data basis	1) application forms 2) supplementary survey of consultants and firms being consulted
Sampling Number of cases Time period	} total number of 1,473 applications approved from 1978 to 1980
Representativeness	1) total number of cases included 2) not representative

PERFORMANCE

Acceptance	- 50 % know the programme - number of applications 1978 - 1980: <table> <tr><td>consulting</td><td>397</td></tr> <tr><td>first visits</td><td>1,014</td></tr> <tr><td>seminars</td><td>55</td></tr> <tr><td>others</td><td>7</td></tr> <tr><td>total</td><td>1,473</td></tr> </table> - partly low qualifications of consultants and insufficient controlling of consultants' activities so far	consulting	397	first visits	1,014	seminars	55	others	7	total	1,473
consulting	397										
first visits	1,014										
seminars	55										
others	7										
total	1,473										
Reasons for non-participation	high expenditure for application compared with amount of subsidies										
Programme network	related to information campaigns of the Federal Ministry of Economics, § 4 Investment Allowance Act, accelerated introduction of energy-saving technologies and products										

Grants approved	1979	1980
ECU	240,000	520,000
DM	600,000	1.300,000

Use of grants grants 1978 - 1980

	DM	ECU
consulting	890,000	353,000
first visits	399,000	158,000
seminars	151,000	62,000
others	557,000	221,000
total	2.001,000	794,000

Extent of free-riders circa 30 % of the savings achieved

IMPACT

Functioning as incentive not investigated

Initiated investment costs not investigated

Achieved national energy savings	primary energy savings per year	
	per case (toe)	total (toe)
consulting	43	16,700
first visits	1	960
seminars	77	4,300
others	235	1,700
total	16	23,700

Other intended or non-intended effects oil share of primary energy savings: 74 %

Use of grants	household appliances	25
	projects in the commercial sector	7
	projects in industry	<u>21</u>
		53

Extent of free-riders circa 25 %

IMPACT

- stimulation of product supply by means of reduced business risks because production machinery is subsidized
- activation of product demand by means of increased information (subsidized marketing costs) and lower product prices

Initiated invest- ment costs	not investigated
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Achieved national energy savings	primary energy savings per year and project: 4,830 toe
	total primary energy savings per year: 0.26 Mtoe

Other intended or non-intended effects oil share of primary energy savings: 73 %

EVALUATION STUDY (9)

Country	D, 1982 (Ifo)
Evaluated programme	Information campaigns for consumers (Federal Ministry of Economics) since 1977; leaflets, TV and radio spots, advertisements

For detailed description see Annex p. 44

METHODOLOGY

Data basis	}	1) representative survey of 2.000 households
Sampling		
Number of cases		2) experts' assessments (60 experts)

Time period	1980/81
-------------	---------

Representativeness	1) representative for all households
--------------------	--------------------------------------

PERFORMANCE

Acceptance	- 16 Mill. leaflets mailed or distributed so far, i. e. 4 Mill. per year
	- 20 % - 35 % know the leaflets

Reasons for non-participation	not investigated
----------------------------------	------------------

Programme network	related to consulting of small and medium-sized firms, DM 4.35 Billion grant programme
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Funds spent	1979	1980	1981	1982
Mill. ECU	8.0	6.2	6.7	8.5
Mill. DM	20.0	15.7	17.0	20.0

Use of service	not investigated
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Extent of free- riders	circa 70 %
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IMPACT

Functioning as incentive	this measure has changed the attitude towards energy consumption with the result of energy saving due to better knowledge of the various possibilities
Initiated investment costs	not investigated
Achieved national energy savings	1.1 Mtoe primary energy savings per year (including savings resulting from the activities of Stiftung Warentest and the Consumers' Association)
Other intended or non-intended effects	not investigated

EVALUATION STUDY (10)

Country	D, 1982 (Ifo)
Evaluated programme	Information campaigns for consumers (Stiftung Warentest) since 1979; the Federal Ministry of Economics provides funds for testing energy-consuming and energy-saving appliances; comparisons are published

For detailed description see Annex p. 45

METHODOLOGY

Data basis	}	1) representative survey of 2,000 households
Sampling		
Number of cases	}	2) experts' assessments (60 experts)
Time period		1980/81
Representativeness		1) representative for all households

PERFORMANCE

Acceptance	- monthly magazine "test": 700,000 issues per month (circa 3 % of all households) - yearbook "test": 350.000 issues - more than 50 % know the activities of Stiftung Waren-test			
Reasons for non-participation	not investigated			
Programme network	related to energy-consumption labelling of cars (a voluntary agreement with industry), DM 4.35 Billion Grant Programme			
Funds spent	1979	1980	1981	1982
Mill. DM	2.3	3.0	3.5	3.5
Mill. ECU	0.9	1.2	1.4	1.5
(additional funds for the budget of Stiftung Warentest)				
Use of service	not investigated			
Extent of "free-riders"	circa 70 %			

IMPACT

Functioning as incentive	This measure has changed the attitude towards energy consumption with the result of energy saving due to better knowledge of the various possibilities.
Initiated investment costs	not investigated
Achieved national energy savings	1.1 Mtoe primary energy savings per year (including savings resulting from the activities of the Ministry's information campaigns and the activities of the Consumers' Association)
Other intended or non-intended effects	not investigated

EVALUATION STUDY (11)

Country	D, 1982 (Ifo)
Evaluated programme	Advisory service for consumers (Arbeitsgemeinschaft der Verbraucher, AgV) since 1978; the Federal Ministry of Economics provides funds for local advisory services of the AgV

For detailed description see Annex p. 46

METHODOLOGY

Data basis	} 1) representative survey of 2,000 households
Sampling	
Number of cases	
	2) experts' assessments (60 experts)

Time period	1980/81
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Representativeness	1) representative for all households
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PERFORMANCE

Acceptance	- hours spent on energy advisory service: 1978: 2,161 1979: 19,473 1980: 23,060
	- almost 50 % know about the advisory service
	- almost 30 % know the AgV publications

Reasons for non-participation	information centre too far away
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Programme network	related to DM 4.35 Bill. Grant Programme
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Funds spent	1979	1980	1981	1982
Mill. DM	1.9	2.2	3.5	3.5
Mill. ECU	0.8	0.9	1.4	1.5

Use of service	not investigated
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Extent of "free-
riders" circa 70 %

IMPACT

Functioning as
incentive This measure, in addition to other promotion activities,
makes the consumer aware of the problem and gives
practical know-how.

Initiated in-
vestment costs not investigated

Achieved national
energy savings 1.1 Mtoe primary energy savings per year (including
savings resulting from the activities of the Ministry's
information campaigns and the activities of Stiftung
Warentest)

Other intended or
non-intended
effects not investigated

EVALUATION STUDY (12)

Country D, 1981

Evaluated programme DM 4.35 Billion Grant Programme for
energy saving in dwellings

1978 - 1983; grant or tax relief for
insulation, improvement of heating
systems, solar appliances, heat pumps
and others

For detailed description see Annex p. 28f

Title of the study Auswertung der Energiesparprogramme auf Energie und
insbesondere Heizöleinsparung. IKE K-63, Stuttgart 1981

(Analysis of energy conservation programmes with respect
to energy savings and oil savings in particular)

Institution Institut für Kernenergie und Energiesysteme (IKE)
Scheirle, N., E. Wartmann

(Institute for Nuclear Energy and Energy Systems)

Type of evaluation ex post impact analysis

METHODOLOGY

Data basis

- application forms for grants
- calculation of savings through investments supported

Sampling	sample of applications approved in 1978 and 1979 (total number of applications was 29,595)
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Number of cases 1.139

Time period 1978/79

Representativeness	not mentioned in the study
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PERFORMANCE

Description of of groups addressed	not investigated

Acceptance	total number of applications:	
	- insulation	26,664
	- heating equipment	4,608
	- solar appliances, heat pumps	1,028
	total (incl. cases with more than one measure)	29,595

Reasons for non-participation	not investigated
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Programme network	not investigated
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Grants approved	sample: 3.82 Mill. DM (1.51 Mill. ECU)
	total: 98.9 Mill. DM (39.2 Mill. ECU)

Use of grants	insulation	78.5 %
	- roof	9.6 %
	- cellar	0.5 %
	- walls	25.8 %
	- windows	38.4 %
	- shutters	4.5 %
	heating equipment	5.1 %
	both insulation and heating	11.4 %
	connection to district heating	0.4 %
	solar appliances, heat pumps	4.8 %

Extent of free-riders not investigated

IMPACT

Functioning as incentive not investigated

Initiated investment costs calculated for the total number of applications:

insulation	76.0 %
heating equipment	4.8 %
both insulation and heating	14.7 %
connection to district heating	0.5 %
solar appliances, heat pumps	4.0 %

total investment costs: 436.0 Mill. DM
(172.6 Mill. ECU)

Achieved national energy savings

	per measure (toe)	final energy saved total number of applications (toe)
insulation	0.34	9,000
heating	0.76	3,470
solar, heat pumps	0.58	890
total	0.47	13,970
(free-riders not excluded)		

Other intended or non-intended effects not investigated

EVALUATION STUDY (13)

Country	D, 1982
Evaluated programme	Investment Loan Programme from 20.5.1981 to 30.6.1982; loans with subsidized investment rates (ca. 2 % below market rates) which cover up to 50 % of the investment costs up to 8 Mill. DM (3.2 Mill. ECU)

For detailed description see Annex p. 36f

Title of the study	1) Geschäftsbericht 1981, Frankfurt 1982 (Annual Report 1981) 2) Das Sonderprogramm 1981/82 der Kreditanstalt für Wiederaufbau, Frankfurt (KfW) (The Special Programme 1981/82 of the Loan Bank for Reconstruction)
Institution	1) Kreditanstalt für Wiederaufbau, Frankfurt (KfW) (Loan Bank for Reconstruction) 2) Irsch, N., Müller-Kästner, B. (employees of the KfW)
Type of evaluation	ex post goal attainment

METHODOLOGY

Data basis	documentation of subsidies approved, made by the Loan Bank
Sampling	all applications from the beginning up to the end of the programme
Number of cases	circa 10,400
Time period	20. May 1981 up to 30. June 1982
Representativeness	total number of cases included

PERFORMANCE

Description of groups addressed	not investigated
Acceptance	8,000 applications received during the first 6 months (1981) 2,500 applications received during the second 6 months (1982)

Reasons for non-participation	participation high in the beginning, later decreasing because of								
	- lower general interest rate for loans								
	- it became generally easier to get loans								
Programme network	not investigated								
Grants approved	loans approved by the end of the programme: 3.95 Bill. DM (1.6 Bill. ECU)								
Use of grants	<table> <tr> <td>- energy saving</td><td>53 %</td></tr> <tr> <td>- oil substitution</td><td>23 %</td></tr> <tr> <td>- innovation (products)</td><td>36 %</td></tr> <tr> <td>- innovation (processing)</td><td>49 %</td></tr> </table>	- energy saving	53 %	- oil substitution	23 %	- innovation (products)	36 %	- innovation (processing)	49 %
- energy saving	53 %								
- oil substitution	23 %								
- innovation (products)	36 %								
- innovation (processing)	49 %								
Extent of free-riders	not investigated in detail; supposed to be relatively small								

IMPACT

Functioning as incentive	programme was important for small firms to improve their competitiveness and to bridge over the period of high interest rates in 1981
Initiated investment costs	by the end of the programme: 8.9 Bill. DM (3.6 Bill. ECU)
Achieved national energy savings	20 % savings compared to prior consumption expected on average (free-riders not excluded)
Other intended effects	- promotion of competitiveness of small and medium-sized firms - promotion of raw-material saving - job creation to the order of 3.2 additional jobs per 1 Mill. DM investments (8,1 jobs per 1 Mill. ECU)
Non-intended effects	not investigated

A further study made by a regional Chamber of Commerce (Industrie- und Handelskammer Koblenz, IHK) is concerned with assessing the share of free-riders, which benefit from the Investment Loan Programme. From the methodological point of view it cannot be considered an evaluation, but rather an ex ante impact assessment. A brief description, however, may be interesting.

- (14) Industrie- und Handelskammer Koblenz: Strukturprogramm mit Webfehlern. Zinsverbilligung der Bundesregierung ohne Initialzündung, April 1982 (Restructuring programme with "flaws in waving". Subsidized interest rates provided by the Federal Government without stirring power)

Evaluated programme: Investment Loan Programme (see Annex p. 36f) from 1981 to 1982; loans with subsidized interest rates (ca. 2 % below market rates) which cover up to 50 % of the investment costs up to 8 Mill. DM (3.2 Mill. ECU)

Methodology: Telephone survey of 100 firms eligible for the loans, April 1981

Results:

- level of knowledge about the programme was high although the programme was not yet started: more than 60 % of firms knew the programme
- main reasons for non-participation were
 - o too little subsidy per firm to function as financial incentive
 - o too high expenditure for application procedure
- the share of free-riders amounts to more than 80 % (respondents stated that they would make the investment also without subsidy).

4.2.2.3 Denmark

In the Energy Plan 1981, the Danish Government discusses the measures of energy conservation policy in principle and sector by sector (space heating, other domestic energy consumption, process heat, and transportation). The performance of the implemented programmes is well documented although the data are scattered among several ministries and agencies. The Danish Government evaluated a few programmes to some extent and revised some of them according to the experience and insight gained in the past.

The problem of this study was that almost all of the documentation and evaluations is only available in Danish. Consequently, as time and financial resources of this study were restricted, the information presented will be limited and incomplete.

Government agencies published at least three short evaluation studies concerning

- the Act on Reduction of Energy Consumption in Buildings, including residential and public buildings and
- the grant scheme for energy-saving investments in industry and agriculture.

One regular evaluation concerning the impact of public information campaigns is actually going on and will be completed in mid 1983 (Held, The Middelfart Project).

EVALUATION STUDY (1)

Country	DK, 1982
Evaluated programme	Act on Reduction of Energy Consumption in Buildings (residential)

For detailed description see Annex p. 53

Title of the paper	Energy-conserving measures in buildings - A survey of the Danish energy-saving programme in the Ministry of Housing 1975 - 1987
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Institution	National Building Agency, Copenhagen
Type of evaluation	ex post evaluation on the basis of empirical data and assumptions

METHODOLOGY

Data basis	All applications of grants awarded for 11 different types of energy-saving technologies; estimated average energy saving of 1.8 to 2.1 MJ net heat per Dkr and year (0.34 to 0.38 toe per 1,000 ECU and year)
Sampling Number of cases Time period	} 24,300 dwellings have received the grant during the period of June 19, 1981 to June 25, 1982
Representativeness	100 % of the grants awarded; the representativeness of the estimated average energy savings per Dkr and year cannot be answered

PERFORMANCE

Acceptance	Until June 1982, 100,500 dwellings (approx. 4.8 % of the 2.1 Mill. dwellings in Denmark) had a heat inspection. About 1.2 % of the the total dwellings received the grant between June 1981 and June 1982.
Description of the groups addressed	one-family houses and apartment buildings, age of buildings (before 1940, 1940 - 1959, since 1960); social groups not investigated
Reasons for non-participation	not investigated
Programme network	not investigated
Grants approved	24,300 (June 1981 to June 1982)
Use of grants	11 types of energy-saving technologies
Extent of free-riders	not discussed

IMPACT

Initiated investment costs	450 Mill. Dkr (56 Mill. ECU)
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Achieved national energy savings	19,000 to 21,300 toe net heat per year (according to above estimates), i. e. 27,000 to 30,400 toe primary energy per year
Other intended or non-intended effects	employment effect of 3,000 man-years; net employment effects are not reported

EVALUATION STUDY (2)

Country	DK, 1981
Evaluated programme	The effects of information campaigns, technology and industry-oriented information brochures, and one to two days free consulting subsidized by the grant scheme for energy-saving investments in industry

For detailed description see Annex p.65 and p.61f

Title of the study	Undersøgelse af effekten af det udførte informations- og radgivingsarbejde om "Statstilskud til energibesparende foranstaltninger i forbindelse med industrielle processer m. v., hvor investeringen udgør mindre end 100,000 Kr"
	(Study of the impacts of the implemented information and consulting programmes on "State grant for energy saving measures concerning industrial production with investment of less than 100,000 Dkr")
Institution	IKO-Plan, Allerrød, Denmark
	The study is only available in Danish. It evaluates the performance of the information and funded consulting activities with regard to their impact on the grant scheme for energy-saving investments in industry and agriculture. The study suggests to improve information campaigns, to restrict the period of considering the applications to four weeks, to improve the consulting programme, to update the branch-oriented energy conservation brochures etc.
	The methodology used or the performance of the study was not mentioned in the summary which was the only chapter that has been translated into German.

EVALUATION STUDY (3)

Country	DK, 1980
Evaluated programme	Act of Reduction of Energy Consumption in Buildings - public buildings. The study did not explicitly evaluate the programme of 1976 to 1980, but could be used for this.

For detailed description see Annex p.53

Title of the study	Energiforbruget i større bygninger (Energy consumption in public buildings)
Institution	Statens Byggeforskningsinstitut (SBI) (National Research Institute of Construction) Nielsen, J. S. R., Juncker, K., Christophersen, E., Jensen, O. (SBI-Report 116)
Type of evaluation	technical and economic ex post analysis

METHODOLOGY

Data basis	actual measurements of energy consumption (1970 to 1979) of 53 buildings; actual investment costs of all 53 buildings (3.8 Mill. DKr)
Sampling	Danish text not translated
Number of cases	31 schools, 20 office buildings, 2 other types of buildings (265,000 m ²)
Time period	9 to 10 years
Representativeness	small with respect to number of cases .

PERFORMANCE/IMPACT

The study is only available in Danish. Two interesting items of the summary, which is translated into English, will be mentioned here:

- A computer model calculated expected energy consumption; in cases where these values differed from actually measured consumption values, the deviation was due to technical faults which were not noticed, or to poor instruction of the technical staff.
- The best results of energy-saving measures taken during the energy crises of 1973/74 were observed in buildings with high energy consumption.

EVALUATION STUDY (4)

Country DK, 1982

Evaluated programme Grant scheme for energy-saving investments in industry and agriculture

For detailed description see Annex p. 61f

Title of the study Statstilskud til energibesparende foranstaltninger i forbindelse med industrielle processer m. v. - Beretning for finansåret 1981

(State grant for energy-saving measures concerning industrial production - calculations for financial year 1981)

Institution Teknologistyrelsen (Technology Agency), Copenhagen

METHODOLOGY/ PERFORMANCE

The study is only available in Danish. It evaluates the grant programme (1977 - 1981) with several aspects

- applications, awards
- investment below or above 100,000 DKr (12,500 ECU)
- 9 industrial branches, agriculture, and other sectors
- 9 types of energy saving and fossil fuel substituting technologies
- regional distribution of awards and achieved energy savings (15 regions)

It does not discuss free-rider effects.

IMPACT

Initiated investment costs	They are reported according to several classifications (see above). Free-rider shares are included.
Achieved national energy savings	The study reports a continuous drop of average specific energy-saving effects per DKr since 1977. Besides inflation effects, this may be due to decreasing free-rider shares.
Other intended or non-intended effects	48 projects have been studied as far as employment impacts of the investment are concerned. Employment impacts related to service, maintenance, and repairs are excluded. The study takes into account the high rate of imports of the equipment and materials, but it does not consider any negative employment effects (e. g. in the heating oil sector).

4.2.2.4 France

The French agency for energy conservation (Agence Française pour la Maîtrise de l'Energie, AFME) has a department for economic studies and is presently setting up an "observatory of the energy" ("observatoire de l'énergie") and a data bank. Several macro-economic and evaluation studies have been made, and it can be expected that in the next years the statistical instruments will allow valuable analysis and evaluation.

Further evaluation studies were made by other organizations, i. e. the research institute for architecture and engineering (Centre Scientifique et Technique du Bâtiment, CSTB) and the research institute for transport (Institut de Recherche des Transports, IRT).

At present, six studies are available: one dealing with a regulation (effects of speed limits on energy consumption in urban areas); two studies on subsidy schemes which were cancelled after a period of one and a half or two years respectively (one in the residential sector, one in industry); four studies deal with information activities: three of them evaluate the impact of campaigns aiming at behavioural changes in heating and driving habits.

List of the studies

- (1) Impact of speed limits on gasoline consumption of private cars
- (2) Analysis of financial aids for solar hot water production in dwellings
- (3) Energy-saving investments in industry in 1980 and 1981
- (4) Analysis of a campaign to promote the reduction of the heating period
- (5) Impact analysis of an information campaign on temperature limits
- (6) Study on the campaign against gasoline waste

The following studies are not included in this report because they deal with global estimates on energy savings under consideration of economic and climatic parameters. The two studies are made by:

- Le Vaillant, P . McInnes, G.: Une comparaison des résultats des politiques d'économies d'énergie dans six pays industrialisés. Paris: Agence pour les Economies d'Energie 1982.

The study presents data on the national energy situation and descriptions of current or former energy conservation programmes in France, Germany, Italy, the United Kingdom, Japan, and the United States.

- Agence pour les Economies d'Energie: Comparaison des politiques d'économie d'énergie dans cinq pays industriels. Paris 1981.

The authors have collected information on existing energy conservation programmes in the Federal Republic of Germany, Spain, Italy, the United Kingdom, and the United States.

Two further studies are not included in this report:

- Agence pour les Economies d'Energie: Bilan de l'heure d'été.

The study is concerned with the effect of summertime on conservation of electricity in the evening. These savings can be calculated. Increasing consumption due to increasing traffic in the evenings was not observed (comparisons with past years).

- Agence Française pour la Maîtrise de l'Energie (AFME): Enquete sur la satisfaction du public aux réponses écrites données par l'AEE (AEE-CREDOC), 1982. The survey deals with the customers' satisfaction with written answers to their inquiries given by the AEE. The study was aimed at a better understanding of the customers' information needs and asked for follow-up actions taken by the customers after having received the answers.

Because of the limited scope of questions this study is not considered as an evaluation of energy saving policy.

EVALUATION STUDY (1)

Country	F, 1982
Evaluated programme	Speed Limits in Urban Areas
For detailed description see Annex p. 78	

Title of the study	Influence des limitations de vitesse sur la consommation de carburant des voitures particulières (Impact of speed limits on gasoline consumption of private cars)
Institution	Institut de Recherche des Transports. Centre d'évaluation et de recherche des nuisances et de l'énergie (IRT/CERNE) (Research Institute for Transport. Centre for environment and energy evaluation and research)
Type of evaluation	ex post impact analysis

METHODOLOGY

Data basis	empirical; checking if gasoline consumption has been reduced through various speed limits (50 km/h and 60 km/h) in urban areas
Sampling Number of cases	} 450
Time period	summer 1981
Representativeness	representativeness for type of car (3 types), type of driver (3 types), type of street, testing time

PERFORMANCE

Range of application	all drivers
Programme network	not mentioned in the study
Controlling	police
Meeting standards	Lyon (France): speed limit 60 km/h, exceeded in 50 % of the cases Genève (CH): speed limit 50 km/h, exceeded in 60 % of the cases

IMPACT

Functioning as incentive	Speed limits alone do not lead automatically to energy savings. The most important factor is the behaviour pattern of the drivers. The "nervous" type of driver uses more gasoline at 50 km/h than at 60 km/h. Most savings can be achieved at 60 km/h.
Achieved national energy savings	If 60 km/h limit was maintained: 45,000 toe/a.
Other intended or non-intended effects	not mentioned in the study

EVALUATION STUDY (2)

Country	F, 1980
Evaluated programme	Grants for solar hot water systems, 1977 - 1979
	- one family houses: 1,000 FF (172 ECU)
	- multi-occupied houses: per apartment 1,000 FF (172 ECU)
	or per m ² installed collector 500 FF (86 ECU)

For detailed description see Annex p. 94

Title of the study	Le Bilan de l'aide financière aux acquéreurs de chauffe- eau solaires individuels, un an après sa suppression (Analysis of financial aids for solar hot water produc- tion in dwellings - one year after being stopped)
Institution	Centre scientifique et technique du bâtiment (STB); Elias, P. (Research Institute for Architecture and Engineering)
Type of evaluation	ex post impact analysis

METHODOLOGY

Data basis	official documents (application forms)
Sampling	no information available
Number of cases	between 1250 and 1715
Time period	01.07.1978 - 31.12.1979 (complete programme)
Representativeness	no information available

PERFORMANCE

Acceptance 5,000 out of 21 Mill. dwellings in France

Description of groups addressed	participants	%	(average for France 1978)			
	owners	96			70	
	first residence	97			81	
	<u>socio-professional status</u>	<u>%</u>	<u>new buildings</u>	<u>existing buildings</u>	<u>both</u>	<u>Ø France</u>
	farmers		2	6	4	9
	workers		6	5	5	27
	employees		12	12	11	6
	executives (middle)		20	14	16	8
	executives (high)		18	14	16	14
	independant/free prof.		31	27	29	
	without profession		12	23	18	36
further information on						
- size of community						
- age of groups addressed						

Reasons for non-participation not investigated

Programme network not investigated

Grants approved (not stated in the study)
5 Mill. FF (0.86 Mill. ECU) estimated

Use of grants	<u>Age of buildings</u>	<u>participants</u>	<u>Ø of France 1978</u>
	new buildings	49 %	7 %
	existing buildings		
	- built later than 1948	25 %	32 %
	- built before 1948	26 %	61 %
	surface of installed collectors	average 3.5 m ² (new buildings 3.2 m ² , existing 3.4 m ²)	

Use of grants	<u>second energy source (%)</u>	<u>buildings</u>	
		<u>new</u>	<u>existing</u> <u>both</u>
	gas	9	10 10
	electricity	74	61 67
	fuel oil	16	27 21
	other	2	2 1

further information given on placing of collectors and on trade names of collectors

Extent of free-riders not investigated in depth
the study suggests

- many professionals in the building sector who wanted to test solar equipment
- similar average cost for existing and new buildings, i. e. old systems were replaced completely by new solar systems

IMPACT

Functioning as incentive not investigated

Initiated investment costs For the sample: 12.8 Mill. FF (2.19 Mill. ECU)
average costs per case:

- material only 6,200 FF (1,063 ECU)
- material and installation 10,300 FF (1,766 ECU)

Achieved national energy savings not investigated

Other intended or non-intended effects not investigated

EVALUATION STUDY (3)

Country	F, 1982
Evaluated programme	Grants from the AEE for industry (1979 - 1980) grants of 400 FF (69 ECU) per saved toe (20 - 60 % of costs)

For detailed description see Annex p. 107

Title of the study	Les investissements d'économie d'énergie dans l'industrie en 1980 et 1981 (Energy-saving investments in industries in 1980 and 1981) (only summary available)
Institution	Agence pour les Economies d'Energie (AEE)
Type of evaluation	ex post impact analysis

METHODOLOGY

Data basis	Empirical; comparison of the level of energy saving investments in the last year when the subsidy was granted (1980) and the year there after.
Sampling	Firms with energy consumption of > 1000 toe/a.
Number of cases	704
Time period	1980 - 1981
Representativeness	The 704 firms have a total energy consumption of 27 Mill. toe/a, i. e. 50 % of industrial consumption.

PERFORMANCE

Description of groups addressed	not mentioned in the summary
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Acceptance	180 firms invested in energy saving with grants of AEE 248 firms invested in energy saving without grants of AEE <u>276</u> firms did not invest in energy saving 704
Reasons for non-participation	not mentioned in the summary
Programme network	not investigated
Funds spent	not mentioned in the summary
Use of service	not mentioned in the summary
Extent of free-riders	not mentioned in the summary

IMPACT

Functioning as incentive	Important. After the subsidy was cancelled, the investments in energy saving dropped to about 1/3 (industry investments the same time period remain of the same level). In 3 sectors (glass, textile-leather, food) where subsidies were awarded by the end of 1980, the level of energy saving investments did not drop in 1981.		
Initiated investment costs	1.1.80 - 1.7.80	1.1.81 - 1.7.81	1.7.81 - 31.12.81
Mill. FF.	271.5	77.9	80.5
Mill. ECU	46.2	12.9	13.4
Achieved national energy savings	the programme stopped at the end of 1980, some investments under the grant scheme remained to be effected in 1981		
	1.1.80 - 1.7.80	1.1.81 - 1.7.81	1.7.81 - 31.12.81
1,000 toe	129.8	39.7	21
Other intended or non-intended effects	not mentioned in the summary		

EVALUATION STUDY (4)

Country	F, 1981
Evaluated programme	Reduction of the heating period through daily weather information fall and spring
For detailed description see Annex p. 120	

Title of the study	Analyse de la campagne visant à retarder le fonctionnement des chauffages centraux - Résultats de la campagne automne 1980 (Analysis of a campaign to promote the reduction of the heating period in centrally-heated buildings - results of the campaign in autumn 1980) (only summary available)
Institution	Agence pour les Economies d'Energie (AEE)
Type of evaluation	ex post impact analysis

METHODOLOGY

Data basis	Empirical; statistics for previous periods; calculations of climatic factors.
Sampling	Panel of private households; daily surveys.
Number of cases	all France 500 Paris 200 Southern France 200 Eastern France 200 1,100
Time period	13.10.1980 to 07.12.1980
Representativeness	Representativeness with regard to type of housing (one-family or multi-family-houses), type of heating system (individual or collective) and region.

EVALUATION STUDY (5)

Country	F, 1982
Evaluated programme	Information campaign "19 °C" to promote the compliance with temperature limit of 19 °C in buildings

For detailed description see Annex p. 120

Title of the study	Analyse d'impact de la campagne d'incitation au respect de la température maximum intérieure des locaux fixés à 19 °C (Impact analysis of an information campaign on the temperature limit of 19 °C in buildings) (only summary available)
Institution	Agence pour les Economies d'Energie (AEE)
Type of evaluation	ex post impact analysis

METHODOLOGY

Data basis	empirical; measurement of temperature in private dwellings. Survey of 2,104 households (25,000 measurements) in the winter 1980/81.
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PERFORMANCE

The groups addressed are households in apartment buildings and one-family houses with and without central heating. Other parameters are the climate and the characteristics of households, dwellings and heating systems.

89 % of the respondents saw the TV spots 3 times or more ("exposed group"), 11 % less than 3 times ("non-exposed group").

IMPACT

The campaign had no significant impact on energy savings in

- apartment buildings both with and without central heating
- one-family houses without central heating

In one-family houses with central heating, the "exposed group", had a temperature of 0.4 °C lower than the "non-exposed group" on an average. Calculated for all one-family houses, the total energy savings were 200,000 to 250,000

EVALUATION STUDY (6)

Country	F, 1981
Evaluated programme	Information on economic driving: advice for drivers (mass media, booklets, training), May - Sept. 1979

For detailed description see Annex p. 122

Title of the study	Les études de suivi des campagnes "Anti-Gaspi" dans les transports 1979 et 1980 (Study on the campaigns against gasoline waste) (only summary available)
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Institution	Agence pour les Economies d'Energie (AEE)
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Type of evaluation	ex post impact analysis
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METHODOLOGY

Data basis	empirical, calculations
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Sampling	1979 - Representative surveys: 10 telephone panels with 500 persons over 10 weeks, 2 interview panels with 300 persons, 1 survey of 1,000 persons - panel of 4,000 drivers observed over 3 months - calculations of gasoline consumption 1980 - survey of 1,600 drivers - panel with 1,500 drivers
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Number of cases	1979: 10,600 1980: 3,100
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Time period	summer 1979 summer 1980
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Representativeness	Representative for all drivers
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PERFORMANCE

Acceptance	1979 - 15 Mill. (out of 17.7 Mill.) drivers heard of the campaign. Information source: TV 66 %, radio 58 %, newspapers 17 %. - 77 % consider the campaign helpful. - 12,000 drivers participated in the training courses, mainly in the regions where radio spots were broadcasted The study includes details regarding advice on economic driving as recalled by the respondents. 1980 - 5.4 Mill. booklets were distributed to 3.6 Mill. drivers (out of 18.3 Mill.). More booklets were distributed in regions where radio spots were broadcasted. - 80 % of the drivers who received the booklets have read them thoroughly. - 1.5 Mill. drivers were better informed about energy saving devices after the campaign than before - the level of information about costs and energy saving possibilities was the same before and after the campaign - 16 % of all drivers and 62 % of the drivers who read the booklet intended to buy one or more devices (calculated for the total number of drivers: 1.5 Mill. drivers)
Description of groups addressed	all drivers
Reasons for non-participation	not mentioned in the summary
Programme network	not mentioned in the summary
Funds spent	22.7 Mill. FF (3.8 Mill. ECU)
Use of information	not mentioned in the summary

IMPACT

Functioning as incentive	- different results of 2 surveys made at the same time by different institutions: drivers stating that the campaign revealed new information to them and who changed their behaviour: survey DEMOSCOPIE 25 % survey SOFRES 42 % - the 4,000 drivers of the 1979 panel saved an average of 2.2 % of gasoline consumption, but this may have other reasons (no control group studied) - the 1,500 drivers of the 1980 panel did not achieve any significant saving in gasoline consumption - 725,000 drivers bought energy saving devices, but the energy saving was much less than expected
Initiated investment costs	not mentioned in the summary
Achieved national energy savings	calculated on the basis of gasoline sales on highways: - 6.76 % savings between June/July 1979 and June/July 1977 - 15 % savings through training courses on economic driving total (estimated): 1979: 300,000 toe 1980: 480,000 toe
Other intended or non-intended effects	not mentioned in the summary

4.2.2.5 Ireland

The Irish energy conservation programmes are in general well monitored because planning and performance of financial aids are concentrated in the energy conservation division of the Department of Industry and Energy, and the advisory services are in the hands of the Institute for Industrial Research and Standards (IIRS).

Most of the programmes were not implemented before 1980, and evaluation efforts, therefore, have started only recently. There is one detailed evaluation study on the effects of the National Boiler Testing Service (see description below). This study is concerned with actions taken by firms and institutions which have been visited by a consultant of IIRS and makes an assessment of achieved national energy savings. It will be continued in 1983 with a broader survey of firms and institutions with regard to their further actions taken on recommendations and their energy savings achieved.

A further evaluation study will be available during the next weeks. It is concerned with the impact of the activities undertaken by the Energy Management Association which has been established by Government in 1979. Its task is to improve the energy awareness and the know-how of industrial managers through participation in workshops, information exchange, and training by IIRS engineers.

In the consumer sector a representative survey has been carried out. Strictly spoken, it is not to be considered as an evaluation, but it covers some effects of programmes. In September/October 1980 and again in February 1981 the Department of Industry and Energy ran mass media energy conservation advertisement campaigns aimed specifically at the domestic sector. To monitor the effectiveness of these campaigns, a market survey was carried out in May 1981. The main results can be summarized as follows:

- 77 % of the respondents were aware of the advertising
- 50 % were aware of the insulation grant (attic insulation grant scheme introduced in October 1980)
- 38 % have taken steps to save energy since September 1980.

In addition, the survey showed significant variations between social classes and urban/rural areas. The results were used to determine further governmental activities, for example, in the direction of regional programmes.

Statistical data on several grant programmes are provided by the Department of Industry and Energy; further written material either on impacts or on assessments is available. The interviews with responsible persons at the Department and the IIRS, however, have shown the following experiences:

- The most important strategy is to improve the information level, especially in small old firms and in households.
- Local information networks and personal contacts either from IIRS to firms or between firms are considered most effective.

EVALUATION STUDY

Country	IRL, 1981
Evaluated programme	National boiler Testing Service (testing of non-domestic boilers > 50 kW by IIRS personal)
For detailed description see Annex p. 183	

Title of the study	Report on the assessment of the National Boiler Testing Service
Institution	Institute for Industrial Research and Standards (IIRS), Dublin
Type of evaluation	ex post impact analysis

METHODOLOGY

Data base	empirical study
Sampling	survey of contacted companies/institutions, random sampling (almost all of the existing 12.000 non-domestic boilers > 50 kW have been tested by IIRS)
Number of cases	100

Time period	April - June 1981
Representativeness	study includes regional (5 regions) and sectoral (industry, commerce, services) differentiation, also with regard to types of equipment (sectional boilers, steam boilers, air heaters) and number of employees

PERFORMANCE

Acceptance	high visibility (advertisement, each company/institution received a personal letter from IIRS), almost all firms had accepted the testing
Description of groups addressed	Service available for all industries, services, institutions. 87 % of participants were small and medium-sized companies (less than 100 employees) often characterized by lack of knowledge on energy questions and by financial problems.
Reasons for non-participation	not investigated
Programme network	related to Energy Management Programmes (not investigated)
Funds spent	free testing service by IIRS (0.5 - 1 hour per boiler) 150,000 IR £/a (219,000 ECU) (not mentioned in the report)
Use of service	Results of the survey: 71 % acted on all recommendations 8 % adopted some but not all recommendations 21 % took no action at all (because of lack of time or priority of other problems)
Extent of free-riders	not investigated

IMPACT

Functioning as incentive	79 % acted on recommendations of IIRS (not mentioned in the study but reported by IIRS experts: most companies would not have known otherwise which measures have to be taken)
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Initiated investment cost mainly improved operation and maintenance of heat production equipment by existing personnel

Achieved national energy savings calculated from the sample for all companies/institutions contacted:
57.000 toe: 71 % heavy fuel oil
 23 % gas oil
 5 % light fuel oil
 1 % medium fuel oil

Other intended or non-intended effects not investigated

4.2.2.6 Netherlands

Evaluation activities covering most of the Dutch energy conservation programmes were carried out by the Dutch General Energy Council (1982). This body has to report to the legislative body about development and progress of energy policy once a year. In 1977, the Council had reported on energy-saving in the residential sector, in 1978 on energy-saving in firms, and 1980 on waste heat use and energy conservation aspects of town and city planning.

Although the report on the national insulation programme cannot be called an evaluation study, it is mentioned here, because the Steering Committee of the programme gives some estimates of total savings achieved.

Two further studies by Meyer (1981) and by Midden et al. (1981), covering the residential sector as far as building codes and general information programmes are concerned, will be shortly described.

EVALUATION STUDY (1)

Country	NL, 1982
Evaluated programmes	essentially all programmes except information programmes - national insulation programme - building codes for new buildings - high efficiency boilers and economizers - subsidies for district heating - energy grant - law of investment - demonstration projects for new energy sources - energy conservation programme of the central government - grant schemes in the non-profit sector and in greenhouses

For detailed description see Annex p. 197 - 217

Title of the study	Evaluatie energiebesparing - Advies uitgebracht aan de Minister van Economische Zaken. (Evaluation of energy conservation - advice delivered to the Ministry of Economic Affairs)
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Institution	Algemeene Energieraad General Energy Council
Type of evaluation	estimations by expert group on the basis of available programme data, a few special studies, and estimates of achieved specific energy savings

METHODOLOGY/PERFORMANCE

	As the publication covers some 10 programmes within 50 pages, there is almost no information about the methodology used (data basis, sampling, number of cases, time period, representativeness).
Acceptance	in a few cases, some information is given by the Council (see programme descriptions in Annex NL).
Description of the groups addressed	none
Reasons for non-participation	not investigated
Programme network	not investigated
Grants approved	figures are mentioned in a few cases (see Annex, NL)
Use of grants	not investigated
Extent of free-riders	not investigated

IMPACT

Initiated investment costs	estimates are made in a few cases (see Annex, NL)
Achieved national energy savings	estimates are made in a few cases (see Annex, NL)
Other intended or non-intended effects	not investigated

PROGRESS REPORT (2)

Country: NL, 1982

Evaluated programme: National insulation programme
(grant scheme)

For detailed description see Annex p. 201f

Title of the study Rapportage over het tweede halfjaar 1981 inzake het nationaal isolatie programma van de stuurgroep NIP voor de bewindslieden van VRO en EZ

Report about the second half year of 1981 concerning the national insulation programme, submitted by the steering group NIP for the ministries of housing and of economic affairs.

Institution Steering group of the national insulation programme

Type of evaluation expert estimations based on available programme data

METHODOLOGY

Data basis grant applications; the information is classified in categories such as: home and apartment owners, rented dwellings; insulation of outer walls, roofs and ceiling, window replacement.

Sampling 100 % (because of application sheets)

number of cases and time period 1981: 340,000

Representativeness 100 % of grants awarded; the representativeness of estimated average specific energy savings per Hfl cannot be judged.

PERFORMANCE

Acceptance	}	see Annex, NL
Description of groups addressed		
Grants approved		

Reasons for non-participation	}	not investigated
Programme network		
Extent of free-riders		

IMPACT

Initiated investment costs	average investment costs of - apartment and house owners: 2,800 Hfl (1,080 ECU) per dwelling, - rented dwellings: 3,440 Hfl (1,320 ECU) per dwelling
Achieved national energy saving	1981: 240 Mill. m ³ gas, i. e. 180,000 toe
Other intended or non-intended effects	not investigated

EVALUATION STUDY (3)

Country	NL, 1981
Evaluated programme	Information strategies in influencing energy consumption patterns in the residential sector; except general information, the strategies studied are not implemented
Title of the study	Using feedback, reinforcement and information to reduce energy consumption in households: a field experiment
Institution	Midden, C. J. H., Energy Study Centre Meter, J. E., Weenig, M. A., Zievourk, H. J. A., Dept. of Social and Organisational Psychology, Univ. of Leyden
Type of evaluation	experiment

METHODOLOGY

Data basis	three-week measurements of electricity and consumption prior to the start of the experiment and 12-week measurements during the experiment; attitude tests and factor analysis
Sampling	} 91 identical dwellings spread over four apartment buildings located in Voorschoten, NL; gas was used for space heating, hot water production and cooking.
Number of cases	
Time period	December 1979 to April 1980
Representativeness	not representative; gas consumption data were connected by taking into account variations of climate and different position of the apartment.

PERFORMANCE

Description of groups addressed	not investigated
Acceptance	not applicable because of the experimental situation
Reasons for non-participation Programme network	} not applicable

IMPACT

Initiated investment costs	none; (gas and electricity meters were available)		
Achieved energy savings	type of measure	electricity	gas
	- general information about energy conservation possibilities	7.6 %	0.0 %
	- weekly feedback about actual energy consumption	18.8 %	18.4 %
	- weekly feedback about actual energy consumption as compared to consumption of the control group	18.4 %	5.4 %
	- weekly feedback and financial reward for energy savings	19.4 %	17.5 %
Other intended or non-intended effects	not investigated		

Programme network not investigated

Grants approved	}	not investigated
Use of grants		
Extent of free-riders		

IMPACT

Initiated investment costs not investigated (for the 250 dwellings where measurements had been made)

Achieved energy savings 400 to 1450 m³ gas per year, i. e. 18 % to 34 % of the normalised gas consumption for space heating before insulation. The author does not consider energy price changes between 1978 and 1980 and their influence on measured savings. The micro-economic analysis conducts that actual Dutch buildings codes are twice as high as they should be from the economic point of view (0.46 W/m²K instead of 1.0 W/m²K).

Other intended or non-intended effects not investigated

4.2.2.7 United Kingdom

In the United Kingdom the energy conservation programmes are well monitored in general which means that the Energy Conservation Division of the Department of Energy provides well updated statistics on the approval of grants, use of advisory services, etc. In some cases, rough assessments have been made with regard to energy savings to be expected from the programmes. These data are included in the programme forms in the annex.

Two studies deserve a more detailed description (see below). One is concerned with the impact of British information campaigns from summer 1974 up to 1977 on attitude change of consumers and energy savings. The second study was made by the Department of Energy and deals with findings from applications for grants under the Coal Firing Scheme.

EVALUATION STUDY (1)

Country	UK, 1977
Evaluated programme	publicity campaign "Save It" 1975/76

For detailed description see Annex p. 243

Title of the study	Energy saving in private households: An integrated research programme 1974 - 77
Institution	Central Office of Information (COI) and Taylor, Nelson + Associates Limited Phillips, N., P. Mills, E. Nelson
Type of evaluation	ex post impact analysis

METHODOLOGY

Data basis empirical

Sampling	}	1) 7 representative surveys	
Number of cases		(1,000 - 1,500 respondents each):	
		- before the campaign, August	1974
			January 1975
Time period		- during the campaign, March	1975
		July	1975
Representativeness		January	1976
		- 5 months after the last advertisement has appeared,	August 1976
			January 1977
		(667 respondents)	
	}	2) in addition:	
		- 50 indepth interviews	
		- purchase of data from other institutes (on home insulation etc.)	

PERFORMANCE

Description of groups addressed	- Discussion of sub-groups who are more energy saving-conscious such as owner-occupiers, middle class groups, those in modern houses, those with central heating. - Three types of segmentation were used: the first relates to the home itself (technical condition), the second to the household consumption (number of persons, presence of children), and the third to household circumstances (income, social status, age of persons, etc.)
Acceptance	The third survey (eight weeks after the campaign was started) revealed a very high level of advertising recall (90 % of respondents recalled some energy saving message).
Reasons for non-participation	not investigated
Programme network	energy conservation programmes since December 1974 (regulations, incentives, "economic pricing of energy")

Funds spent	1975 - 1980: 20 Mill. ECU (not mentioned in the study)
Use of information	- Before the campaign was started households tended to shift the responsibility for saving energy to industry and the public sector because they did not know how to save energy themselves. - First effects of the campaign were improved maintenance of boilers, planning loft insulation, tank lagging, draught excluders. - After the campaign was finished: less recall of advertisement, less investments made, but the level of claimed good housekeeping has risen still further.
Extent of "free-riders"	not investigated

IMPACT

The study describes the overall development of actions planned by private households in the years 1974 to 1976. It is not possible to separate the effects of the publicity campaign from other factors such as increasing energy prices and other advertisement campaigns (fuel industry, producers of double-glazed windows, etc.).

The most important findings can be summarized as follows:

- Plans for energy-saving installations showed a steady growth until the middle of the campaign.
Planning loft insulation, tank lagging, draught excluders, wall insulation, double glazing (%):

Aug. 74	Jan. 75	March 76	July 75	Jan. 76	Aug. 76	Jan. 77
17	30	33	58	54	47	44
 - The energy saving message was "self perpetuating" with regard to good housekeeping.
 - The consumers' prime interest is to save money and not necessarily energy. The households, therefore, have to be convinced that energy-saving devices are cost-effective. Otherwise households under financial pressure make savings on items others than energy, and the financial restrictions counteract investment expenditure.
 - If feed-back is received (e. g. gas or electricity bill just arrived), people more often stated that they plan energy saving measures.
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EVALUATION STUDY (2)

Country	UK, 1982
Evaluated programme	Coal Firing Scheme 50 Mill.£ grant scheme designed to encourage oil and gas substitution by coal (industry)
For detailed description see Annex p. 227f	

Title of the study	An appraisal of 105 proposed new coal fired firetube boiler projects. London, August 1982
Institution	Department of Energy; Schaffer, J. R.
Type of evaluation	impact assessment

METHODOLOGY

Data basis Sampling Number of cases	}	analysis of the first 105 applications submitted to the Department of Industry Coal Fired Boiler Unit which administers the grant scheme
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Time period	1981
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Representativeness	all cases included
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RESULTS

- The most important industries switching to coal are chemical and food and drink industries followed by textiles and engineering.
- The majority consists of small projects but a few large ones account for a high proportion of total coal burnt.
- Switching to coal reduces costs but will not save energy.
- New boiler capacity is 70 % of old capacity; the load factor will increase from 25 % to 38 %.
- Fuel flexibility is achieved through retaining old boilers as standby.

- The 105 projects will increase coal burn by 330,000 tonnes per year; capital cost is ca. 28 Mill. £, i. e. 85 £ per tonne of coal burn (including water boilers: 500,000 tonnes = 1.7 % of the 30 Mtoe industrial boiler fuel market).

One of the declared objectives of the scheme is to encourage firms to prematurely replace oil and gas plants. The study concludes "that in the absence of a grant, a substantial proportion of these schemes would have been postponed until capital was more readily available and less expensive and the outlook appeared less bleak" (p. 4).

EVALUATION STUDY (3)

Country	UK, 1980
Evaluated programme	Homes Insulation Scheme - Grants for basic loft, tank and pipe insulation; available for owners and tenants

For detailed description see Annex p. 233f

Title of the study	Paying for loft insulation A review of the Homes Insulation Scheme 1978
Institution	National Consumer Council
Type of evaluation	ex post impact analysis

METHODOLOGY

Data basis	empirical
Sampling	1) sample of nearly 2,000 households representative of all households in Great Britain in September 1979
Number of cases	2) sample of nearly 200 metropolitan authorities and district councils responsible for administering the scheme (August 1979)
Time period	
Representativeness	

PERFORMANCE

Description of groups addressed	The Scheme was especially aimed at helping disadvantaged households (low-income, elderly). But the low-income group, pensioners and tenants have the severest restrictions: - low level of knowledge: only 13 - 15 % (average 22 %) knew the right answer to a question concerning the recommended thickness for loft insulation - low awareness of the need for adequate insulation - lack of financial resources (availability of cash, elderly are often unable to carry out the work themselves) and lack of short-term financial savings (over 40 % do not heat their top floor at all, so they would not save money but get their top floor warmer)		
Acceptance	expected: insulation of 700,000 homes per year realized: 255,000 in 1978/79 over 375,770 in 1979/80 (estimated) high general awareness of the Scheme: 87 % of households had heard of the grants		
Reasons for non-participation	(1) Administration: Poor design of application forms (complicated, confusing) deter some people from applying; sometimes long delays between work being paid for and grants being received (2) Take-up: Low-income groups, elderly and tenants are least aware of the grants available; they have the lowest take-up rate, especially tenants, partly because they fear difficulties with the landlord (27 % of tenants)		
Programme network	- Insulation of local authority dwellings since 1978 - Insulation standards - Publicity campaigns in general and in particular to publicise the Scheme		
Grants approved	1978/79	1979/80	
	9.3	13.2	Mill. £
	14.4	22.1	Mill. ECU
Use of grants	not investigated		

Extent of free-riders	Households with high heating standards save the most energy by insulating their homes; the investment would be an attractive one also without a grant. Low-income or other disadvantaged households, on the contrary, would not invest in insulation without the grant.
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IMPACT

Initiated investment costs	not investigated directly
Achieved energy savings	Expectations were as follows: - insulation of 700,000 homes per year between 1978 and 1988 would save over 1 Mtoe per year after 1988 - this saving represents approximately 1/2 per cent of the 1978 primary energy consumption - investment cost about 60 £ per dwelling, i. e. 30 - 35 Mill. £ from public funds/a (54 - 63 Mill. ECU) The Scheme "has probably been quite effective". The study ends with concluding recommendations for improving the cost-effectiveness, i. e. to save more energy per public funds (which have been widely adopted by the Government).
Other intended or non-intended effects	Intended: social benefit for disadvantaged households (adequate warmth in their homes) Unintended: raising labour costs for insulation because contractors take advantage of the fact that grants are approved.

4.2.2.8 Sweden

EVALUATION STUDY

Country	Sweden, 1979
Evaluated programme	Energy-saving grants for industry. Total grants in the budget years July 1, 1974 to December 31, 1978: 468,2 Mill. Skr (94 Mill. ECU). Oil saving toe net per year: 592,6 (estimation). Number of measures: 5,912 Refusals: circa 1,000 (profitability was too high, the energy saving was too low, aim was other than energy saving)

Title of the study	Grants for Energy Saving Measures in Swedish Industry and Commerce 1974 - 1978, Stockholm 1979
Institution	The National Industrial Board, Stockholm
Type of evaluation	goal attainment (ex post)

METHODOLOGY

Data basis	}	a) Study in order to check the uncertainty in the savings figure: 144 projects receiving grants (autumn 1978)
Sampling		b) Questionnaire to all firms whose application for a grant for process measures has been rejected (281) and interview studies in 24 firms
Number of cases		
Time period		1974 - 1978
Representativeness		approximately representative

RESULTS

- a) For 123 of the 144 projects there exists a reliable figure: the "actual" energy saving for the process measures exceeds estimated saving by almost 37 %, the corresponding figure for the building measures being 95 %. In each item two projects diverge markedly. If they are removed, the actual energy saving will fall short of the calculated saving by 1 and 18 % respectively. The inaccuracy even in actual energy saving is so great that the estimated value is well covered within the area of uncertainty. In some cases the estimated value is more reliable than the measured value (building measures). The Board plans to make measurement of the energy saving a prerequisite for grants to a greater extent than is done at present.
- b) About 70 % of projects which are rejected are carried out notwithstanding. 20 - 25 % of projects receiving grants would have been carried out without a grant. The majority of the firms state that they are carrying out energy-saving investments even without applying for a government grant. A number of firms would like government grants for help by consultants as well as better information on measures for which they have received grants.

CONCLUSIONS

The evaluation supports the Board's belief that the grants system is working satisfactorily as a means of steering energy conservation in industry:

- from the applications it is possible to distinguish those projects which need grants if they are to be carried out from those which are executed mainly for other reasons than energy saving,
- the figures for energy saving stated in the applications can be used as a measure of the energy saving that will actually be achieved,
- the rules for the awarding of grants that are on the whole adequate.

Information, feedback, consultancy inputs and similar activities will become an increasingly important supplement to the grants.

4.2.2.9 United States of America

The past U.S. federal programmes for energy conservation can be generally characterized by one or more of the following strategies:

- disseminating information about the economic and technical feasibility of various energy conservation techniques to encourage firms and private energy consumers to make more informed decisions about implementing such techniques
- supporting research and development perceived as unlikely to be pursued by the private sector so as to increase and broaden the options available for increasing efficiency in the end-use of energy and substituting readily available energy sources for scarcer ones
- providing financial incentives to make conservation technologies more attractive and to accelerate their adoption by the market
- implementing standards and regulations where the market was believed to have failed to respond to other measures fast enough and where the potential benefits to the U.S. were felt to be large
- reducing some institutional and regulatory barriers to conservation, for example, the encouragement given to cogeneration through the implementation of the Public Utility Regulatory Policies Act of 1978.

Evaluation studies of energy conservation policy of the United States have been developed to quite a refined stage. Especially in the area of

- disseminating information (see study 6 below)
- providing financial incentives (see study 7)

some important studies were carried out. Based on broad empirical data collections and using differentiated methods, these studies offer detailed results for assessing information dissemination measures, loan programmes, and tax credits and provide recommendations for their improvement.

Two further aspects should be pointed out:

- Within the "Sunset-Report" the U.S. Department of Energy deals with a rather unusual approach to assess comprehensively all the energy policy programmes of the last five years. But the empirical basis often is small and mainly input indicators are presented. It can thus not be considered as evaluation study (U.S. Department of Energy, Office of Policy, Planning, and Analysis: Sunset Review. Programme by Programme Analysis, 3 volumes, Washington 1982, see also study 1 below).
- The U.S. General Accounting Office provides some analyses of the administration and implementation of energy conservation programmes (for two examples see studies 2 and 3 below). This type of work seems to be important, because a large body of evidence suggests that implementation has a major influence on the effectiveness and impact of government programmes. Nevertheless these aspects are still underdeveloped within evaluation research.

Finally it should be mentioned that in the United States the energy conservation budget was cut by the Reagan administration from 775 Mill. US \$/557 Mill. ECU (1980) to 385 Mill. US \$/406 Mill. ECU (1982); currently there is nearly no interest in evaluation studies in this field.

In the following we present brief descriptions of some analyses that cover some aspects of evaluations.

- (1) U.S. Department of Energy, Office of Policy, Planning, and Analysis:
Trends in Energy Use and Conservation, Washington 1982

This is an ex post estimation of U. S. energy use and conservation between 1972 and 1981 using an econometric model. Without investigating performance aspects and impacts on beneficiaries in detail, the study tries to identify the role of governmental measures in increased energy efficiency as compared to the role of energy price increase, time factors and other economic factors. It concludes that federal programmes and tax credits probably account for less than five percent of the overall increase in energy efficiency per unit of gross national product (GNP).

(2) U.S. General Accounting Office: Ineffective Management of the Appropriate Technology Small Grants Programme (ATSG), Washington 1981

The study deals with a programme started in 1977 in which grants of up to 50,000 US \$ (36,000 ECU) can be given to individuals, small companies, State and local agencies, and Indian tribes to develop and demonstrate energy-related appropriate technology. In 1980, more than 1,500 grants totalling about 18 Mill. US \$ (13 Mill. ECU) were awarded from this programme. The study is a review of the implementation and administration of the programme covering the time period 1980/81. On the basis of programme documents and literature concerning appropriate technology and that of interviews with U.S. Department of Energy headquarters and six of the ten regional offices, the General Accounting Office considers the management of the programme ineffective because of

- limited technical assistance available for grantees
- failure to coordinate the programme with related programmes
- lack of consistent application of criteria used to evaluate and select projects for funding.

(3) U.S. General Accounting Office: Uncertainties About the Effectiveness of Federal Programmes to Make New Buildings More Energy Efficient, Washington 1980

This is a review of the implementation and administration of the State Energy Conservation Programme and of Energy Performance Standards for new commercial and residential buildings. It covers the year 1979 and is based on a review of administrative reports of the Department of Energy and interviews with the administrations of ten states and 16 local jurisdictions. Its main findings are that, while 41 states had adopted some type of thermal efficiency standards, these had not been established for all building categories. Many of these states experienced delays in enacting and implementing the standards presently in effect as it takes up to one year or longer to revise building codes and train builders and inspectors before new standards are fully implemented and applied to new building designs. Thus the General Accounting Office concluded that about 34 percent of the projected 1980 savings could be lost due to delays in implementing the standards.

(4) Office of Technology Assessment: Energy Efficiency of Buildings in Cities, Washington 1982

This analysis deals with the federal programme of Residential Energy Tax Credits (started 1977) through which owners or occupants of buildings with up to four dwelling units may claim up to 15 percent tax credit on an energy efficiency retrofit, up to a ceiling of 2,000 US \$ (1979: 1,460 ECU); for renewable retrofits the ceiling is much higher. In the time period of 1977 - 1979 about six million tax payers took advantage of this programme, tax credits approved were 560 Mill. US \$ (1978: 440 Mill. ECU) (April 1977 - Dec. 1978) and 440 Mill. US \$ (321 Mill. ECU) in 1979. The analysis gives a description of groups reached and the extent of energy retrofit expenditures and tax credits. The tax credits have been used for

- insulation 66.7 %
- storm windows and doors 56.6 %
- draught excluders 24.4 %
- other uses 14.0 %.

It has been found that a fairly high proportion of middle and upper income tax payers respond while lower income tax payers hardly respond at all. The crucial questions of reasons for non-participation, extent of free riders, and impacts have, however, not been answered.

(5) Ch. Hill, J. Roessner; Center for Policy Alternatives, MIT:
Government Policy, Technological Innovation and Alternative Energy,
Cambridge 1980

The study deals with the "Pilot Energy Extension Service" which is operated by ten states; each supports three types of clients (home-owners, small companies, public institutions) by one or more of three kinds of services (hotlines, workshops, audits). In this ex post impact analysis empirical data for 1978 are used but data on the sampling method, number of cases and representativeness are not given. The main results of the study were to point out:

- Two aspects of programme design, personal contact with the client and recommendations of technical nature were identified statistically as having the greatest impact on actions taken.

- The residential target group have has less influence on their clients than programmes which served the other two target groups.
- Residential programmes had the lowest effect on total energy-savings the lowest average cost per client and served the largest number of clients.
- Public institution programmes had an energy-saving impact which falls between those of the residential and the small business programmes.

EVALUATION STUDY (6)

Country	USA, 1981
Evaluated programme	Federal Fuel Economy Information Programme (dissemination of Information Brochures since 1975, esp. of "Gas Mileage Guide"; printed numbers: 17 Mill. in 1981)
Title of the study	Impact of Fuel Economy Information on New Car and Light Truck Buyers, May 1981
Institution	J. D. Power and Ass.; Energy and Environmental Analysis, Inc.
Type of evaluation	ex post impact analysis

METHODOLOGY

Data basis	a) mail survey and interviews of car buyers, dealers, manufacturers, and advertising agencies b) review of information brochures c) review of advertising and media report d) control group
Sampling	see "Data basis"
Number of cases	5,000 car buyers
Time period	1978/79 and 1981 surveys
Representativeness	unknown

PERFORMANCE

Description of groups addressed	Detailed analysis with regard to - characteristics of car buyers (income, age, sex, education) - characteristics of type of car - regional distribution of buyers (large cities, rural areas, etc.)
Acceptance	17 Mill. copies of "Gasmileage guide" distributed to - consumers and consumers' agencies - dealers - media
Reasons for non-participation	a) fuel economy had decreasing importance for new car buyers (1978/79: rank 1; 1981 rank 3) b) other sources of information were more important: (1) friends, relatives, etc; (2) car dealers; (3) Federal Economy Label; rank of Gas Mileage Guide: 5
Programme network	not investigated
Funds spent	no information; 17 Mill. printed numbers (1981)
Use of service	awareness: 24 % of new car buyers use: 12 % of new car buyers
Extent of free-riders	not investigated

IMPACT

Functioning as incentive	for 12 % of new car buyers
Initiated investment costs	not investigated
Achieved national energy savings	Persons who use the Guide tend to buy cars which are three percent more efficient than the cars purchased by persons who do not use the information
Other intended or non-intended effects	unknown; especially learning effects (= change of use of information sources) were not investigated

EVALUATION STUDY (7)

Country	USA, 1982
Evaluated programme	Energy Conservation Loan Programme: Low interest loans of between 400 US \$ and 3,000 US \$ for the purchase and installation of insulation, solar heaters etc. in residential structures with one to four dwelling units

Title of the study	Evaluating State Energy Conservation Home Loan Programmes: The Case of Connecticut, Cambridge 1982
Institution	Warkov, S.; Tourigny, S.; Dept. of Sociology, University of Connecticut
Type of evaluation	ex post impact analysis

METHODOLOGY

Data basis	empirical
Sampling Number of cases	} a) 25 % sample of 10,179 requests for loan applications } b) 300 residents of owner-occupied, single family dwellings (control group) } c) mailed questionnaire and follow-up of telephone interviews
Time period	1979 - 1982
Representativeness	a) a state-wide random sample of residents of owner-occupied single family dwellings b) random sample of participants in the home loan programme

PERFORMANCE

Description of groups addressed	detailed description with regard to - socio-economic status - housing structure, density - family structure
---------------------------------	--

Acceptance	10,179 requests for applications 1980 in Connecticut
Reasons for non-participation	Rank 1 Income restrictions for loan-users 2 Programme required too much paper work
Programme network	not investigated
Grants approved	not mentioned in the study
Use of grants	43 % installed boiler/furnace 43 % solar 35 % storm doors/windows 31 % insulated attic/ceiling
Extent of free-riders	43 % would have taken energy conservation actions without a state loan

IMPACT

Functioning as incentive	Loan users were considerably more likely to effect major energy conservation measures than home-owners in general
Initiated investment costs	} not investigated
Achieved national energy savings	
Other intended or non-intended effects	

4.2.3 Concluding remarks on available evaluation studies

As we have shown in Chapters 3.2 and 3.3, comprehensive energy conservation policies were only introduced in most Member countries a few years ago. Consequently, evaluations of conservation programmes have only been able to be made in a few cases. As evaluation studies of public measures or programmes have in general many methodological problems, the analyst can only rely on plentiful and long-term empirical data to get valid results. This type of data base, however, was only available in a few exceptional cases (see Chapt. 4.2.2).

Limits of evaluation studies

The scope of the study was limited to a minimum in all assessments: only questions referring directly to the programme under study were considered. A thorough discussion of opportunity costs of the programmes, including the question what alternatives to the existing programme there might be, is left unbroached. Examples of unanswered questions are:

- What kind of alternative programme design with regard to prerequisites, additional specifications etc. would have been more cost-effective than that used? Was the implementation of the programme less cost-effective than expected because of unexpected investment behaviour as a result of inadequate information on the part of the investors or/and because of free-rider effects as a result of insufficient control of regulations or from neglecting formal or informal communication channels or the potential of feed-back information?
- What kind of programme or programme combination would have achieved higher energy savings?
- What are the long term indirect effects as far as economic and societal criteria are concerned (e. g. balance of trade, economic growth, inflation, employment structures, income distribution, technological progress, or environmental protection)? It has to be added, however, that this type of analysis assessing the intended and unintended impact in other fields than energy conservation considerably increases the evaluation costs.

One would have expected more details about the programmes' costs caused by administration and implementation of the programmes such as application costs of the applicant, costs for programmes' elaboration, examination of applications, and for control. These costs still play an important role in the public debate about energy conservation policy; for instance, regulations often are opposed with the argument that they would generate high administration and control costs.

Methods of evaluation studies

From a methodological standpoint, the evaluations studied can be classified into three categories: empirical surveys or polls addressing groups affected by the programme, technical calculations on the basis of technical causal relationships and empirical data (especially in the field of regulations enforcing technical standards), and thirdly, expert assessments on the basis of easily accessible programme data and estimates of achieved specific energy savings.

The empirical surveys and polls of private households (including control groups) carried out by Ifo (1982) can be mentioned as an example. These surveys were aimed at assessing the changes in behaviour of consumers and the programmes' contribution to achieved or potential energy savings, especially those of information programmes. Other evaluation studies like those made in France, Ireland and Sweden, base their conclusions on the results of surveys with more or less sufficient representativeness of groups to which the programme was addressed. Only very few surveys include control groups and no survey tries to tackle the general problem of how to eliminate the shortcomings resulting from wrong answers given deliberately or because of insufficient information or knowledge.

The studies carried out by Ifo (1982) and IKE (1981) are examples of technical calculations (see also Ifo summary sheet in Chapt. 4.2.2). In these two studies, the situation before and after the subsidized investment was known from the application forms (e. g. insulation measures). In fact, this approach is suitable for obtaining a first approximation of the impact of investments and of technical standards. Additional information is needed, however, to take into consideration free-rider effects and premature replace-

ment effects as well as over-compliance with or disregard of technical standards.

The third category of assessment studies, the estimations by experts on the basis of programme data and estimates of generally achieved specific energy savings, is represented in several countries. This type of evaluation is often applied to assess total energy-saving potentials of programmes or to cross-examine the estimates with results obtained by other methods. Danish and Dutch Government bodies, for instance, applied this method to several grant schemes which were well documented. The experts' assessments are the result of a discussion process in the case of the Dutch General Energy Council (1982). But again, uncertainties stemming from insufficient data or unreliable data from application forms make estimations difficult. In a few cases, estimations depend so much on assumptions with insufficient empirical evidence that the Council published majority and minority votes.

Energy savings and free-rider effects

The time period allotted to this study excluded the possibility of summarizing all the essential contents of the evaluation studies mentioned in Chapt.

4.2.2. Here, our concluding remarks will focus instead on two essential points to which evaluation activities should pay most attention: the achieved total energy savings and free-rider effects of subsidy programmes, also in a figurative sense of regulatory and information programmes. Those individuals or firms meeting a given standard even if the standard was not enforced or revoked can be considered as "free-riders" of regulatory programmes. Those who look for and get the necessary information independent of the presence or absence of information programmes can be considered as "free-riders" of information programmes.

The degree of specification and accuracy varies greatly among the studies. Almost all the studies present estimates about total achieved savings, but there are only a few which stress the uncertainties of the results. There is a great deal of evidence that the uncertainties are considerable because deviations in the results of different studies which carefully assess the same programme are quite considerable. Two examples are:

- When the study by Ifo (1982) and by IKE (1981) are compared, energy savings per ECU invested within the German 4.35 Bill. DM subsidy pro-

gramme - calculated from the studies data - are more than three times higher in the study of Ifo. Possible differences due to the different samples taken cannot explain the considerable deviations in the results.

- Similar deviations can be observed when total energy savings of two regulatory programmes (building codes and standards for new boilers and hot water production) are compared: the results of the Ifo study exceed an evaluation made by the FhG/ISI (1982) by several times.

Assumptions which have to be made because of missing data necessarily vary essentially and accumulate in the course of analysis to such large deviations.

Yearly energy savings per 1,000 ECU invested were estimated in several countries (see Table 4.2). They range between

- 0.25 and 1.3 toe/1,000 ECU per year in the residential and public sector
- 1.2 and 2.8 toe/1,000 ECU per year in the industrial, commercial and agricultural sectors.

Table 4.2: Estimated yearly energy savings per 1,000 ECU invested of subsidy programmes

Sector	Energy savings (toe) per year and 1,000 ECU investment			
	as prerequisite for support	programme number (Annex)	estimates of achieved savings	programme number (Annex)
Residential - dwellings		F (19) ¹⁾	0.94 0.47 0.25 1.3 1.2	D (6) DK (7) F (16) NL (5) IRL (3)
- high-efficiency boilers, economizers			0.48	NL (9)
Public buildings	> 0.6	NL (11)		
Commercial, non-profit institutions	> 1.03	NL (10)		
Industry and agriculture			2.2 1.37 2.8 1.5 2.1 1.5	D (7) DK (10) F (28) F (29) NL (7) UK (7)
	> 0.96	NL (7)		
Horticulture	> 0.4	NL (12)		
1) minimum energy savings per m ² : 0.004 to 0.01 toe/a (F) 3) small and medium-sized firms 2) assumed energy price 1981/82: 420 ECU/toe 4) primary energy savings				

Even if the different energy price levels in the sectors are taken into account, the profitability of the investments in industry and commerce is twice as high as in the residential and public sector.

The assessment of the free-rider effect is an important, but very difficult point of any evaluation. A clear statement about the proportion of free-riders was only found in two of the evaluations analysed: in the US study No. 7 (43 %) and in an telephone survey made by the Chamber of Commerce Koblenz (IHK Koblenz, 1981) about the impact of the German 6.3 Billion DM Loan Programme (more than 80 %). Unfortunately, the IHK findings seem to be based more on political grounds than on scientifically collected empirical evidence (e. g. type of questions, representativeness of the sample).

Some French evaluations comment in general terms on the free-rider effects as being important. The Swedish study (1979) calculated the proportion of free-riders to be 20 % to 25 %; the sample, however, was not representative at all. Ifo (1982) made a greater attempt to analyse free-riders accurately, but only differentiated between two types of energy savings, namely those

- which were initiated by both energy price and programme, and
- which were caused by the energy price increases alone.

Energy savings due to energy price increases were taken as an estimate of the free-rider proportion (see Chapt. 4.2.2). Free-rider effects estimated by Ifo are rather high; with regard to grant schemes, they vary between 30 % to more than 75 %. Considerable evidence suggests that free-rider effects may even be higher when Ifo's statements about the influence of energy prices are considered.

A similarly high assessment is made indirectly by Ifo (1982) as far as building codes and standards for new boilers and hot-water production is concerned: 10 % up to 30 % 'overcomply' with actual standards for economic reasons. On the other hand, around 10 % do not meet the standards.

Although several subsidy programmes were explicitly or implicitly designed to promote premature replacement effects, i. e. reinvestments which are made several years before usual reinvestment time, no evaluation study took up this topic or related mid-term effects such as economic fluctuations of markets concerned.

Lost energy conservation potentials as a result of misguided investment priorities

In many countries, window and door replacement are typical cases of premature reinvestments resulting from subsidy programmes in the residential sector. 23 % to 38 % of the cases of subsidized retrofitting are window and door replacements (see Table 4.3). This decision pattern is surprising because profitability of this type of investment is rather low when compared with other subsidizable alternatives such as new heating equipment (control equipment, boiler) or insulation of roofs and walls.

Table 4.3: Share of different types of energy saving investments in the residential sector subsidized by public programmes in some OECD countries, 1979 - 1982

	Country, (evaluation study number of Chapt. 4.2.2)				
	D (12)	DK (1)	F	USA (4)	USA (7)
Programme	4.35 Bill. Programme	Grant Scheme	AEE Grant Scheme	15 % tax credit	low interest loans
See Annex, page:	28	55	83	-	-
Evaluation period	1978/79	1981	1980	1977-79	1979-82
Type of investment					
Insulation	40.4	36.0	36.0	41.2	20.4
- roof, cellar	10.1	26.0	-	-	-
- walls	25.8	10.0	-	-	-
- shutters	4.5	-	-	-	-
Conventional heating equipment	5.1	12.0	17.0	-	28.2
Connection to district heating	0.4	n. a. ¹⁾	n. a. ¹⁾	n. a.	n. a.
Solar systems heat pumps	4.8	n. a. ¹⁾	6.0	n. a. ¹⁾	28.2
Both, insulation and heating equipment	11.4	-	-	-	-
Windows, doors	38.4	36.0	28.0	35.0	23.0
Draught excluders	-	5.0	-	15.1	-
Others	n. a.	11.0	13.0 ²⁾	8.7	-

n. a.: not applicable for the considered subsidy programme

1) separate subsidy programme exists 2) 12 % maintenance

As the subsidy programmes mentioned in Table 4.3 did not exclude these latter, relatively profitable investments, home and building owners obviously choose the wrong type of investment because of insufficient knowledge of profitability in many cases. This misguided ranking of investment into window and door replacement brought about an unintended and unnecessarily low benefit-cost ratio of the public subsidies involved.

There are two possibilities to reduce misguided choices of investment priorities and, hence, avoidable losses of possible energy savings:

- individual consultation prior to application or the actual investment decision by the owner; this measure has been in use in Denmark since 1981. Some 800 energy consultants suggest an investment plan to the homeowner on the basis of an individual heat inspection. This consulting is subsidized by the Danish government with 700 DKr (86 ECU) per dwelling. As the distinct decrease of per capita energy consumption in the Danish residential sector since 1980 (see Table 3.1) cannot entirely be explained by high energy price jumps, there seems to be some evidence that heat inspection prior to investments makes the subsidy programme much more cost-effective. Danish experts estimate that the consultation doubled the cost-effectiveness of the invested capital.

- A second possibility is a simple economic incentive: France, for instance, did not give the grant on the basis of a certain percentage of investment cost but on the basis of expected energy savings: 400 FF (61 ECU) per toe saved per year. This condition forced the owner to think about a proper ranking of his energy-saving investments. The French programme, however, was terminated in 1982 because the grant which amounted to around 2 % to 3 % of the investment produced a high percentage of free-riders and high administration costs. Furthermore, firms which made proposals and tenders were sometimes not qualified to estimate expected savings or their proposals were influenced by self-interest. Finally, investments were partly mis-channelled on the basis of short-term profitability considerations (new boiler) instead of long-term profitability (reduction of heat demand by insulation).

These measures would increase free-rider effects which again can be reduced by defining profitability limits or excluding highly profitable investments. Most of the Dutch grant schemes demand as prerequisite minimum energy savings per Hfl invested (see Table 4.2). This prerequisite also reduces misguided investment priorities but also increases free-rider effects, if highly profitable investments are not excluded.

International comparison of evaluation results - it's too early

Despite the fact that evaluation activities in seven Member countries were analysed by the project team, very few conclusions could be drawn from an

international comparison. First of all, the only evaluations covering the same programme and energy consuming sector and which simultaneously satisfy minimum scientific requirements were French and German. But even if sufficient evaluation studies on the same programme and consuming sector were available, comparison would still be a very cumbersome procedure because of the national factors described in Chapt. 3.3 and 3.4; they not only influence the design of a particular programme, but also its impact. For these reasons, an international comparison of evaluation results is not yet possible.

Principle conclusions on the impact of measures

Regulations: enforced standards very often lie below the point of profitability; therefore, consumers informed about energy-saving potentials and looking at energy costs tend to over-comply with actual standards. On the other hand consumers may not meet standards because they do not pay attention to energy costs and/or control is lacking.

Subsidies: high free-rider effects of 30 % to more than 80 % are important and question actual subsidy practice. The effects increase with the technological breadth of the programme determined by objectives other than energy conservation such as employment, regional development, etc.

Information and consulting: There is a great deal of evidence that advice is often asked for by firms or individuals who already have some knowledge. The advisory services scarcely reach those who need the information most. A final assessment on the effects of broad campaigns cannot be given because of the lack of control groups. Broad and general campaigns alone definitely do not lead to concrete energy saving actions. Information programmes using familiar and personal communication channels take into account the individual situation of the energy consumer and can give him practical advice.

5. Suggestions and selected hypotheses

General observations and remarks

1. The EC countries' programmes for energy conservation could have only limited impact on improved overall energy efficiency in the 1970ies as far as subsidies, regulation, and information are concerned. This is because these measures were mostly introduced in or after the year 1977 and measures of this kind generally need a few years for full implementation or effectiveness (in the case of building codes for new buildings, it takes several decades).

The successes in increasing overall energy efficiency and in substituting oil since 1973 can be attributed mainly to

- the large price increases for fossil fuels in 1973/74 and 1979/81, which induced investments and organizational measures for more efficient use of energy, especially in the space heating and process heat sectors;
- structural changes within industry (e. g. decreased steel production) and between industry and the other economic sectors (especially increased service sector).

2. The attempt to trace energy conservation successes in the last two or three years back to individual programmes of energy conservation is difficult because the second energy price increase in 1979 - 1981, it appears, caused stronger reactions in some consumption sectors than the first increase in 1973/74; the increase
 - induced a wave of energy-saving investments as these got significantly shorter pay-back times or surmounted the break-even point; in industry, energy-saving investments got higher rates than labour-saving investments. This may have contributed to a decrease in the labour productivity rate;
 - stimulated investors in some cases to "over-comply" with existing regulations because of economic considerations (e. g. building codes, operating standards for boilers);
 - stimulated many investors or consumers independent of public information programmes or financial aid to plan and decide on energy-saving investments or organizational and behavioural changes.

In a few sectors and Member countries, however, energy savings achieved in 1980 and 1981 seem to be significantly influenced by energy conservation programmes (e. g. Danish residential sector).

Concentration on space and process heat - omission of more efficient use of electricity

3. Analysis of the energy conservation policy of the EC countries reveals a concentration on space and process heat and the related types of energy. With regard to the relatively small share of electricity in total final consumption, this policy seems to concentrate on the right areas. But it neglects the fact that a more efficient use of electricity leads to three times higher savings of primary energy. Existing programmes are limited to electricity-saving potentials such as commercial advertisement illumination, daylight-saving time, and improvement of market transparency by energy labelling for domestic appliances.

More efficient use of electricity could be realized in many areas such as

- power-dependent control of electrically-driven engines with time-dependent characteristics such as pumps, ventilators, air-conditioning, compressors, agitators, conveyers or hauling plants in all sectors of electricity consumption (also in residential central heating or hot-water systems),
- by reducing degressive electricity tariffs promoting consumption, especially in Belgium, Germany, and Luxembourg (see Chapter 3.1). The degression of industrial electricity prices between 1.25 GWh and 10 GWh per year is most pronounced in Luxembourg and the United Kingdom; only Italy has no degression in the mentioned range of consumption.

Regulations

4. Energy-saving related laws and administrative regulations mainly focus on space and process heat and energy labelling for domestic products. This is felt to be an appropriate strategy because
 - building-owner and building-user may be different people (e. g. rented apartment houses),
 - market transparency is insufficient (e. g. domestic appliances, basic rent which excludes heating costs etc.), or

- technical and economic energy-related knowledge is poor, in particular in the residential sector and in small and medium-sized firms.

The huge variety of technological and organizational constellations in mills, factories, and workshops in industry often makes it difficult to design regulations without large-scale bureaucratic measures and to control regulations in a cost-effective way. In these sectors, specific information and individual consultation seem to be much more cost-effective than regulations.

5. Although there are many national factors which have to be considered in an international comparison of regulations (see Chapt. 3.3), there are obvious deficits when present energy-saving potentials and presently enforced regulations are compared:
 - The importance of control equipment for central-heating and hot-water systems is underestimated in several EC countries. For example, particularly in regions or countries with degree day values above 2,500 (on the basis of 18 °C) and marked changes in daily temperatures, outdoor temperature control is very cost-effective. This argument applies particularly in the case of existing buildings where energy consumption can only be reduced to a limited extent through insulation because of economic, aesthetic, or technical reasons.
 - Regulations promoting effective use of energy by mechanical ventilation and air-conditioning are in their infancy, although energy-saving potentials are estimated to the order of up to almost 1 % of total final energy consumption.
 - Individual heat metering in apartment and rented office buildings has scarcely begun to be enforced, although there is sufficient evidence that consumers will respond when they recognize their heating bill can be reduced.
6. In most cases, the actual technical standards of existing regulations represent actual average practice but very seldom require the best possible performance, nor are target standards set three or five years in advance of the time they are to be enforced, which would allow time for

research and development. This target setting policy, already common practice in other fields such as environmental policy (e. g. in the United States), was not implemented in any of the countries studied here. This is surprising because

- further increases in energy price levels are to be expected for several reasons, and technological innovation ought to take this into consideration,
- in many cases, technological possibilities or best performance potentials are not used or requested by actual standards (e. g. boiler performance standards).

This is especially true in the case of building standards for new buildings which, in terms of an economic analysis are not strict enough. With regard to the long lifetime of buildings, the burden of higher investment costs which would result from stricter insulation measures will be shifted to the next few decades.

Consequently, a target-setting regulation policy for selected areas allowing sufficient time for research, development, product design, and training of personnel clearly needs to be studied. The following technological areas are suggested for a study:

- boiler and operating standards,
- insulation and ventilation standards of new buildings,
- minimum performance of air-conditioning equipment,
- minimum performance of private cars.

7. Speed limits of road transportation are mainly based on safety considerations. They can hardly be considered an element of energy conservation policy although they were enforced in almost every EC country in or after a year of sharp oil price increases.

Financial aids for investments

8. Government intervention in the energy market through financial support may be justified on the grounds of market failures (e. g. failure to internalize external social costs in energy prices) or to overcome financial bottle-necks of potential investors.

In some cases financial aid cannot be seen solely in terms of its role in energy conservation but must also be seen as part of the national economic policy, concerned with diverse factors such as regional development, employment or improving foreign trade balance. In some cases, environmental aspects may play a certain role. These objectives, however, are seldom mentioned explicitly by the governments.

This multiple objective of programmes makes international comparisons difficult. Additional difficulties arise from

- lack of data or incomplete data on subsidized loans and tax relief,
- differences in running time of the compared programmes, or
- the unknown share of free-riders in a particular programme.

Because of these factors the following statements are mainly based on the experience gained from grant schemes.

9. The mean value of grants awarded for energy conservation in the ten EC countries in 1982 amounts to 6.8 ECU per capita and year. Denmark and the Netherlands are far ahead of this average (16 - 20 ECU/a), France, Germany, and Italy lie in the range of the mean value and the remaining EC countries far below. Grants per capita stand in slight correlation to gross domestic product per capita.
10. In several cases, broadly awarded grants are considered to have had important informational impacts. There is no empirical evidence for this claim. The benefit-cost relation of this impact is estimated to be very low when compared to the direct measures of information and consulting.
11. Some of the programmes are designed to promote premature replacements, i. e. a reinvestment which is made several years before the usual technical lifetime of equipment such as new control installations, windows or boilers expire. In some cases, the programme runs for a limited time and with yearly decreasing subsidy shares (e. g. Danish grant programme for home-owners and tenants).

In other cases the programme defines a minimum and maximum permitted pay-back time as a prerequisite for the grant. The minimum pay-back time tries to exclude free-riders whereas the upper limit is intended to ascertain that the mean benefit per capital invested does not drop to unacceptable figures and prevent investment in technologies operating below the break-even point.

This policy of premature replacements may have some advantages in cases of reducing unemployment or in periods when energy prices stagnate, but are expected to increase again. Thus, this aspect may presently gain increasing importance. Similar to the period of 1976 - 1978, the investors may tend to under-estimate the economic benefit of energy-saving investments on the basis of static economic analysis and may tend to postpone investment. Premature replacements, however, may also produce negative effects such as economic distortions of particular markets.

12. In the residential sector and among small and medium-sized firms, there is a lack of both technical energy-related know-how and market knowledge. As many grant schemes limit the subsidy to certain technologies, the deficiencies tend to mis-channel investments:

- As the investor is not aware of the causal links of individual energy-saving investments, he may choose the wrong sequence of investment (e. g. first a new boiler and then insulation of the outer shell of the building instead of vice versa).
- As investors can choose one of several alternatives, their decision may lead to less profitable investment because investors tends to decide on the basis of investment habits of their social environment rather than on the basis of economic analysis (one example is window replacement instead of many other more profitable investments).
- Finally, the grant may result in less profitable investments because the investor does not know the degree of profitability of each of the measures from which he is to choose (e. g., in many cases it is more profitable to invest first in non-subsidized control equipment than in other subsidized investments such as heat exchangers).

An excellent answer to these problems would seem to be mandatory consulting by external consultants who work on a recommended sequence of investment before grant application by the investor. Estimates in Denmark conclude that investments would have to be doubled to achieve the same savings without prior heat inspection. In some countries' programmes consulting prior to financial aid is mandatory. Good results, however, can only be expected if consultants are competent.

Another possibility is to give the grant on the basis of expected energy savings. But again, this measure has specific draw-backs such as increased free-rider effects.

13. The share of subsidized investments which would have been made even without subsidies because of changed energy price levels or on the basis of the expected profitability is called the "free-rider" effect. In most of the actual national subsidy programmes the percentage of free-riders is estimated to be very high (50 - 90 %). This means that the real contribution of financial aid to additional energy-saving investments may be in the order of 50 to 10 % of the total amount of initiated investment.

The share of free-riders increases when

- the subsidies cover only a small share of the costs; if they are below 15 % to 20 %, the increase in profitability they effect is minimal and the subsidy cannot be expected to have a specific promoting effect. Consequently, subsidy shares below 15 % should be avoided;
- profitability is high and can be expected from the investment even without subsidy; consequently some of the programmes exclude investments with short pay-back times;
- prerequisites of grant schemes do not consider the financial situation of the applicants; to counterbalance this some programmes are restricted to low-income households or small and medium-sized companies;
- the running period of the programme is short. There is some evidence that the free-riders invest more often in the first two or three years of the programme's running period. After this period the number of those investors with problems of financial origin seems to increase. Consequently, subsidy programmes should have a minimum running period of 4 to 5 years. Exceptions are programmes designed to promote rapid market introduction of a defined, marketable product or technology (e. g. economizer, high-efficiency gas boiler).

Free-rider effects are even more difficult to estimate in the case of loans and tax relief. There is some indication that these two forms of subsidy if awarded to well-informed consumer groups who have no financial restrictions have even more free-riders than grants.

14. Free-rider effects may be cut - but not eliminated - by a thoroughly designed programme which is restricted
- to selected technologies with profitabilities close to the break-even point,
 - to combinations of investments to be made at the same time for technical reasons (insulation and control equipment),
 - to a minimum amount of investment per dwelling or yearly energy consumption of a company or
 - to persons or companies with relatively small income or financial resources.

These possibilities to reduce free-rider effects have already been implemented or are planned by some countries after the failures and inefficiencies of subsidy programmes became evident.

If programmes are restricted to certain technologies or minimum pay-back times, however, the energy conservation potential will be sharply reduced either because the investor will be limited in his options or may prefer investments with other goals such as the reduction of labour cost.

A significant reduction of the proportion of free-riders through detailed specification of subsidizable investments always decreases the quantity and quality of the subsidized energy-saving options and the resulting national investment costs. And last, but not least, increased costs of administration have to be considered.

15. Planning of financial aid programmes tends to neglect the larger context: The importance of non-financial factors in decisions to purchase residential heating equipment is, it seems, underestimated by the administration. Factors such as system reliability, warranty protection, environmental aspects, adequate information about system costs and performance and confidence in system suppliers and installers are at least as important as initial system costs to purchasers.
16. Restricted availability of investor capital is one of the bottlenecks of energy conservation. Particularly small and medium-sized firms working along their credit lines may have difficulties getting further credit for energy-saving investments. Technologies with expected long-term profitability and inherent risks may be another case, e. g. district

heating, combined heat and power generation. In these cases, a warranty programme should be introduced or banks should be enabled to reduce reserve limits and raise the amount of loans given for energy-saving investments. These measures may have better results than grant schemes or subsidized interest rates on loans. The problem of restricted financial resources may also be alleviated by subsidized loans for investments which have surpassed the break-even point. If repayment starts several years after investment is made and if the interest rates are reduced by a two or four percent subsidy, this type of loan will still be economically attractive in the above mentioned cases. It strengthens the financial situation of the investor while putting less of a burden on public budgets than many grant schemes.

Information and consulting

17. Although there is a lack of empirical evidence as to what extent broad public information campaigns have to be considered as an important instrument of energy conservation policy compared to other measures such as energy pricing, all the EC governments implemented information campaigns and considered them important for the development of a general energy awareness in the public and for the consumers' further decisions.

Information campaigns, however, should be specifically designed to promote energy-saving behaviour (which has to be motivated from time to time) or to promote energy-saving investments to bring about improved energy efficiency without energy-saving behaviour patterns. In the case of investments, public campaigns are not considered to motivate potential investors sufficiently because they have to be informed about specific investment options relating to their particular situation.

Our findings suggest that publicity campaigns should now concentrate on specific topics rather than promoting general awareness. Implementation could take the form of leaflets or advertisements accompanying other types of measures such as regulations, pricing, and taxation and could thus help generate a broader understanding of the energy conservation policy.

18. Detailed information about technological and organizational measures is of particularly great importance for consumer groups and companies lack-

ing energy-related technical know-how and market knowledge. Here, information provided by governmental bodies does not necessarily need to be given direct to the individual investor as in the case of energy labelling. There are many situations where detailed information transfer through existing information or communication channels of intermediates (e. g. consumer associations, house and landowner associations, chambers of commerce, installers and architects) is more cost-effective and contributes to faster implementation because of the existing trust relationship.

19. Experience made with information programmes usually indicated that the programmes were especially successful when
 - information is based on personal communication either in cases where managers of companies or consumers seek advice on their own initiative and are already interested and well-informed, or in cases where energy agencies, ministries or other bodies concerned with energy conservation address themselves to firms and consumers directly;
 - technical advice takes place "on the spot" and concrete and practicable suggestions are made for energy-saving measures.

Governments should support or establish institutions which can effectively carry out energy conservation consulting on the one hand and inspire the trust of those they advise on the other.

20. A problem which is very difficult for a government to tackle is the multi-step flow of informal communication between the various actors in a society. As far as households are concerned, general information usually exerts influence through the mediation of opinion leaders and the so-called gate-keepers of social groups. These key persons have a strong influence on the information levels, attitudes, values and behaviour of individuals.

In the industrial and commercial sectors a similar pattern of informal communication and dissemination of messages exists, e. g., information exchange between managers of firms, influence of market leaders, etc.

There is no general strategy for governmental bodies on how to address opinion leaders. We recommend, however, that governments use the existing

formal communication structure as far as possible (e. g. organizing visits to firms, workshops, local and regional advisory services and information centres based on existing associations etc.).

It should be noticed for all types of information programmes that firms or consumers with insufficient knowledge need energy-saving measures most. At the same time, their financial constraints often are more severe than those of any other societal group. Governmental measures should, therefore, pay special attention to disadvantaged groups such as low-income households, small and medium-sized firms with heavy financial restrictions, etc.

Role of energy conservation policy in the 1980ies

21. The full impact of the EC countries' energy conservation policy will not be apparent before the mid 1980ies. Many programmes only started in 1979-81 and will need some time to reach full implementation (construction, reinvestments). Energy consumption patterns changed drastically in 1979-81 because of the large energy price increases. They are likely to revert to careless energy consumption in periods of stagnating or even short-term falling energy prices and of increasing income unless energy-conscious consumption patterns are maintained through consultation and regulations as well as by additional investments.

Considering the present large budget restrictions in almost all Member countries there is a tendency to reduce subsidies and public investments for energy conservation. If a reduction of public financial support cannot be avoided in the next few years, the authors recommend

- to allocate more funds to warranty programmes and loans rather than to grants in order to overcome financial bottlenecks among consumers as well as in small and medium-sized companies,
- to concentrate on the removal of informational barriers by running specific information and consulting programmes, the importance of consultation has been greatly underestimated so far;
- to implement strict controls of enforced regulations and to study possibilities of a target-setting regulation policy.

Energy conservation policy will play an important role in the 1980ies because energy-saving investments or services have a positive net employment impact and will thus alleviate the employment problem which will be a continuing burden for all Member countries in this decade. Energy conservation is one of the best environment-protection measures, an issue which will also gain increasing importance in the 1980ies because of damages from SO₂ and NO_x (corrosion, forest decease).

6. Recommendations for further research activities

As was mentioned in Chapter 5, there are several fields which require in-depth research. The results expected from the research activities proposed below would be very helpful for the energy conservation policy of the EC and the Member countries. On the basis of the information given in this study, we focus on the following three topics:

- the impact of energy conservation policy on energy consumption from the macro point of view,
- present practice and the future role of selected regulation programmes,
- empirical studies on promising measures and their programme context.

The following proposals are tentative: Their function is to stimulate discussion.

The impact of energy conservation policy on energy consumption from the macro point of view

In Chapter 3.1 we came to the conclusion that most of the differences in the Member countries' success in energy conservation in the 1970ies can be attributed to several factors such as structural changes, energy price increases, etc. Energy conservation policy seems to have had less influence in that period.

Some of the factors influencing energy consumption can be separated by means of technical or economic considerations: short-term influences such as yearly climatic variations and market fluctuations, structural changes in the economy and in the transformation sector. The influence of three further factors can be studied by means of regression analyses for the industrial, transportation, and residential sectors, namely:

- autonomous energy savings incorporated in most reinvested capital goods or come about as upscaling effect,
- energy price increases which influence energy-saving investments, organizational measures and behavioural changes, and
- energy savings induced by energy conservation policy.

We recommend developing a method for analysing the importance of the factors from a macro point of view. This method would give the EC or the Member coun-

tries a better insight into the causal relationship with regard to actual energy consumption and enable them to interpret the actual figures better than at present.

It is worth considering to what extent the present EC energy model might serve for this purpose.

Present practice and the future role of selected regulation programmes

The attempt to compare regulation programmes of the Member countries often leads to the question whether obvious differences of regulation practice can be explained by national differences of specific factors (e. g. climatic conditions, proportion of rented dwellings, construction methods), or whether differences show deficits of energy conservation policies in some Member countries.

This distinction presumes extensive knowledge of each country's regulation context which influences the development as well as the implementation and control of regulations (see Chapt. 3.3). When technical standards are to be compared, even in this quantitative field, standards are often not in a readily comparable form but have to be transformed to comparable figures. Finally, the question arises to what extent standards for a specific object and in a specific Member country are over-complied or not met to a certain extent.

Contrasting average energy-saving potentials of some regulatory measures and their actual enforcement in the Member countries, we would recommend a few regulations for in-depth analysis and international comparison:

- control equipment for central heating and hot water systems (including electricity consumption of systems' pumps, existing and newly constructed buildings),
- individual heat metering in apartment and rented office buildings, and
- boiler operating standards.

The target-setting regulation policy would be a further interesting subject of study. The authors of the this study found no example of this type of regulation policy in spite of the fact that this is common practice in environmental protection policy. The target-setting policy seems to be helpful

for technical standards and could thus encourage technological innovation during a period where the Member countries have to anticipate increasing energy price levels. The following technical standards should be considered:

- boiler and boiler-operating standards,
- minimum performance of air-conditioning equipment,
- minimum performance of cars.

Empirical studies on promising measures and their programme context

The conclusions of Chapters 3.4 and 4.2.3 suggest several measures or combinations of measures which seem to be very cost-effective or which seem to be suitable for improving cost-efficiency of measures already applied. But there are uncertainties as to what extent the observed successes or deficiencies of the running programmes depend on specifications of the programme or on the national context such as present information level or communication channels, energy price levels in particular sectors, etc. In some cases of financial aid programmes, other policy objectives, especially employment aspects, may have been of great importance in the programme design; consequently, achieved energy savings are only one part of the evaluation of the programme's efficiency.

Because of these uncertainties we suggest empirical studies on a few selected programmes. As it is often difficult to define control groups, a two-country study can be of some advantage (but can also have shortcomings because of different conditions from country to country).

One reason for an unnecessarily low cost-efficiency of subsidy programmes is their mis-channeling (see Chapter 5, item 12). This results either from too narrow technological specifications or a very broad technological range where the insufficiently informed investor cannot choose the best cost-effective investment. Therefore, we suggest mandatory consulting before subsidy application in selected sectors.

We recommend carrying out a comparative empirical study on a few subsidy programmes where consultation prior to grant application is mandatory in one country and not practiced in another one (e. g. energy audit prior to grant application in West German horticulture and similar grants in Denmark or the Netherlands without mandatory consultation).

A second proposal refers to item 16 of Chapt. 5, the hypothesis that repayable loans with subsidized interest rates achieve better cost-effectiveness than "lost" grants awarded to consumer groups and companies with no or insufficient energy-related knowledge and small financial resources, because both the free-rider effects and the burden on public budgets are reduced. Loans with subsidized interest rates improve the financial situation of potential investors and initiate considerable energy-saving investments. Here again, we recommend further comparative empirical studies on a few subsidy programmes (e. g. the Danish subsidy scheme on waste heat recovery).

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(References on the description of the political background for energy conservation policies are included in Chapter 3.2 for each country separately.)