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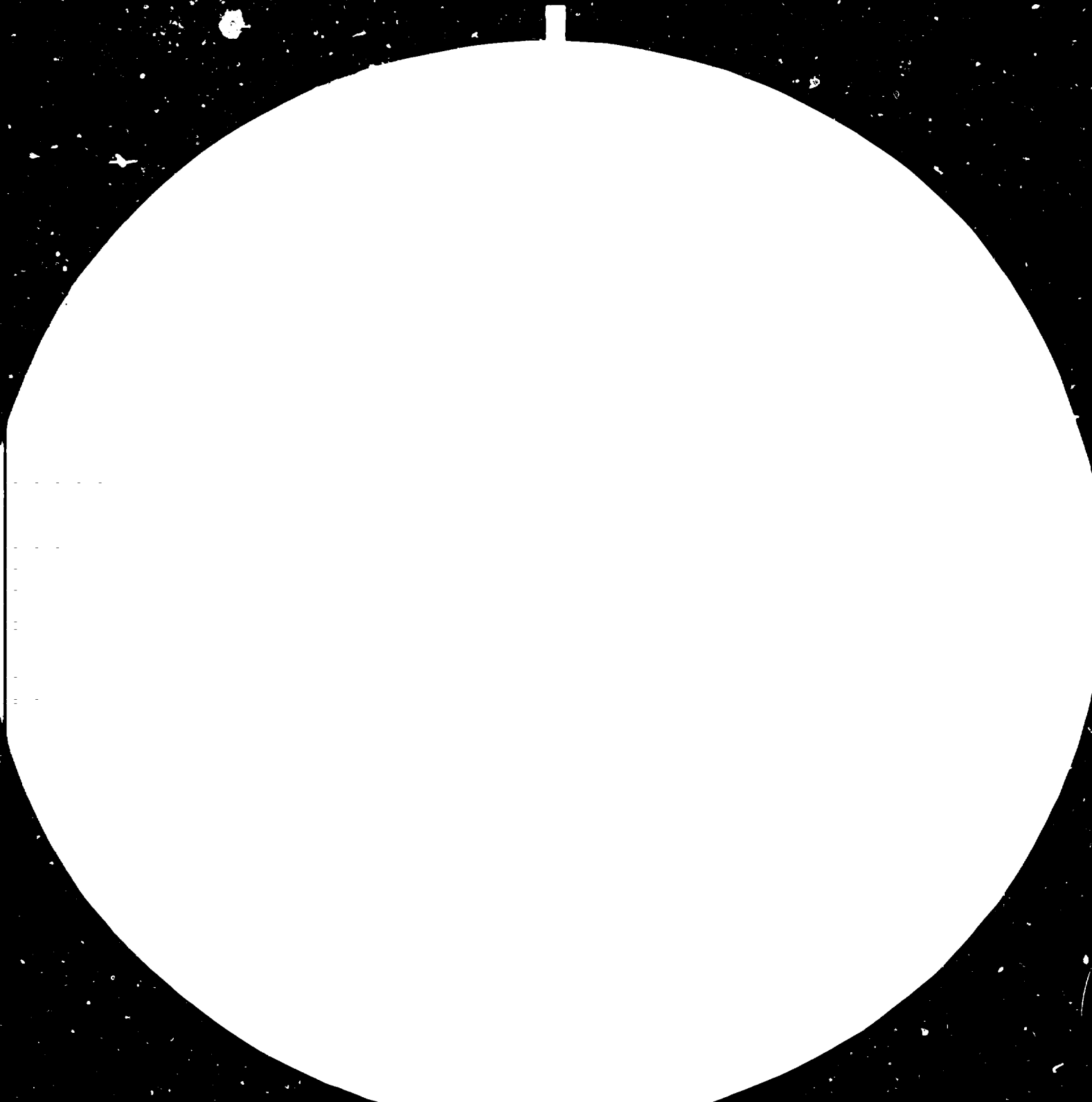

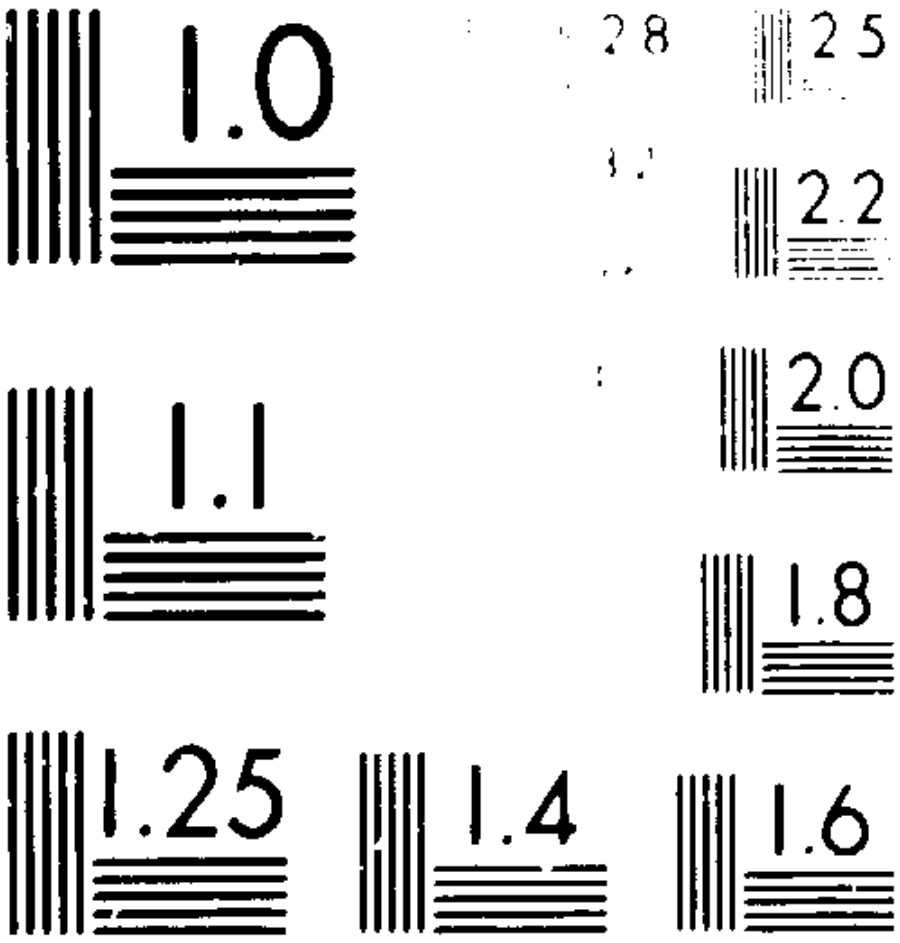
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PILOT PROJECT ON ENERGY CONSERVATION IN SELECTED SECTORS OF TURKISH INDUSTRY

SI/TUR/79/803

TURKEY

Technical report: Energy conservation and the rational use of energy resources *

Prepared for the Government of Turkey
by the United Nations Industrial Development Organization
acting as executing agency for the United Nations Development Programme

Based on the work of T.A. Kennedy,
adviser on energy conservation

United Nations Industrial Development Organization
Vienna

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FOREWORD

This assignment represents an intermediate stage between the completion of the technical studies of energy conservation in selected industries within the framework of UNIDO Project SI/TUR/79/803, and the implementation of a new series of work programmes and projects in the field of energy management and conservation to be carried out by the Turkish Electrical Power Resources Survey and Development Administration (hereafter referred to as EIE).

Although the assignment does not have a formal Project Document of its own its broad terms of reference are to assist and advise the EIE in the planning and development of activities related to surveys, feasibility studies, the study and development of new and renewable energy sources and carrying out research and development in energy conservation, especially in the industrial sector. The visiting expert is required to:

- assist in planning and formulating studies in the rational use of energy resources;
- advise on organisational and functional matters related to EIE's tasks in these fields of its work;
- advise on setting up an information system for the evaluation, analysis and monitoring of energy utilisation and conservation measures;
- assist in preparing a plan of activities for the Energy Resources Survey Department of EIE which is to be the centre of the new programme.

With an effective working time of less than one month it has only been possible to deal with some of these issues an a general and indicative way. In particular as in any project which involves the work of a number of agencies and institutions (and questions related to energy have particularly wide implications) a great deal depends on the nature of the working relationships and coordination between them. It has not been possible in the time available to form a view on how effective these links are in practice or where some action might be need to improve them. However, a good deal of what is said below depends on there being easy and informed channels of communication between the relevant parts of the Ministry, the State Planning Organisation, the EIE, the energy industries and the other agencies involved. It is therefore urged that these matters should be reviewed and that if necessary additional coordinating and consultative machinery should be set up.

At the time of writing this Report The Ministry of Energy and Natural Resources is undergoing internal management changes, and a little time will be needed for these to settle down. However, it seems to the writer that institutionally the energy sector is comprehensively covered by Government, semi-official and independent organisations and that a high priority is already attached to energy policy in general and to problems of the economic utilisation of energy. Moreover, the professional quality and motivation of the staff dealing with these questions is high.

The main purpose of this and future projects will therefore not be to recommend or create anything significantly new, but rather to suggest ways of making existing arrangements more effective or providing specific forms of support which are not readily available in Turkey at the present time.

Although it has been short the assignment has been very agreeable and constructive and the writer would wish to express his gratitude to all those concerned, especially within the EIE, for their kindness and cooperation.

SUMMARY

This one month assignment was designed to bridge the completion of the technical studies of the pilot project on energy conservation and the development of new programmes for conservation, the rational use of energy and new and renewable energy sources to be carried out by the Resources and Surveys Department of the Turkish Electrical Power Resources, Survey and Development Administration (EIE/RSD).

With per capita energy consumption of a little over 1 ton of coal equivalent annually and per capita incomes averaging about $ 1400 there can be no question of reducing energy consumption. The problem is to contain and optimise its growth, and especially that of imported oil, without damage to the economy.

The Report examines the present and planned organisation of EIE/RSD and makes suggestions for some changes in staffing and sturcture. It stresses the need to develop adequate statistical and other information systems relating to energy use and demand. Proposals are made for a number of areas of research and analysis in support of the Group's functions and for its operational activities in the fields of energy conservation and new and renewable energy sources.

The Report concludes with a suggestion for continued UNIDO assistance to be devoted to the setting up of a structured energy data system, for an extended programme of industrial audits and follow up studies and the introduction of a training scheme for energy managers. Longer term assistance, extending perhaps to industrial applications for new and renewable energy sources, will depend on the way in which the planned and current programmes develop.

Main Recommendations

(Figures in brackets refer to paragraph numbers)

1. Structure of EIE/RSD to be based on 3 functional and 1 common services branch. (22)
2. Specialist staff should be located in functional branches (22)
3. Present staffing levels of 25-30 are broadly adequate for present and foreseeable tasks, but later expansion could be necessary. (23)
4. Close links should be developed with the State Institute of Statistics, including the possibility of staff secondments. (27)
5. Regional energy centres should be set up using existing Government offices or the existing network of Chambers of Commerce, etc. (28)
6. Some additional staff will be needed with skills in economics, financial analysis, operations research and statistics. (31-32)
7. All energy utilisation studies and data should adopt the framework of the national industrial classification system. (41)
8. Studies should be undertaken (using the currently planned energy audits) to establish a structured system of energy data based on the end uses of energy. (43-47)
9. Studies should be undertaken on measuring the efficiency of energy using appliances in all sectors of the economy . (49)
10. Statistical matters to be reviewed should include: accounting units, treatment of non-commercial fuels, statistical publications on energy and statistics users' seminars. (53)
11. EIE should maintain data relating to energy costs and expenditure as well as physical quantities of energy. (50)
12. An adequate library of books and periodicals should be maintained. (56)

13. Studies of the capital stock of energy using equipment should be undertaken. (57)

14. Energy data contained in the annual production census should be assembled, processed and analysed. (58)

15. Energy modelling studies should be pursued with emphasis on simplicity and robustness; sectoral and single fuel models may be easier to manage and comprehend than fully integrated optimisation models. (59)

16. Performance indicators for monitoring progress should be developed. (63)

17. Prospects for structural change in industry and its potential impact on energy use should be examined. (64)

18. EIE counterpart staff participating in energy audits should develop techniques of data collection and analysis. (58)

19. Firms already using "best available practice" in energy consumption should be identified for publicity and demonstration purposes (71)

20. Possibilities for small scale industrial or agricultural enterprises using mini-hydro, solar or biogas techniques should be studied. (77)

I- INTRODUCTION

Energy Priorities

1) It is not necessary here to detail the development and current state of the energy problem in Turkey. This has been very adequately done elsewhere. There are some features however which are particularly relevant to the issues and proposals which will be discussed later and so a brief summary may be appropriate.

2) Total primary energy consumption in 1981 was about 52.5 mtce (30.5 mtoe) giving a total per capita consumption of a little over one ton of coal equivalent annually. Of this total some 12 mtce (7 mtoe) were traditional, non commercial, fuels such as wood and animal and vegetable wastes, used mainly in rural households. Thus the commercial energy supplies, which are most directly involved in the general economic and industrial development of the economy, amounted to 40.5 mtce (23.5 mtoe) and were made up as follows:

Solid fuels	11.3 mtce
Oil	23.5 "
Hydropower	5.1 "
Other	0.6 "

Net oil imports amounted to 20.1 mtce with a balance of payments costs of around US$ 2.5 billions. 58 per cent of commercial energy supplies were imported.

3) Total final energy consumption of commercial fuels totalled 32.4 mtce (18.6 mtoe) in 1981, with 11.3 mtce having been used in the energy conversion sector to produce some 4 mtce of secondary fuels, mostly electricity. Total final consumption was.

	Solids	Oil	Electricity	Total
Industry	4.6	6.9	3.3	14.8
Transport	0.2	7.0		7.2
Agriculture		1.4		1.4
Domestic other	3.0	4.8	1.2	9.0

4) Turkey is essentially a 3 fuel economy (excluding the traditional fuels), although there are small amounts of natural and manufactured gas, and this of course affects the opportunities for fuel substitution especially once the specific uses (oil transport and electricity for lighting and motive power) have been taken into account.

5) The basic national energy strategy is almost self evident: to maximise domestic production of coal and lignite, to press ahead with hydrocarbon exploration, to expand hydropower, to seek new energy sources, to restrain the growth of demand, and to seek wherever possible to limit the use of imported oil. The importance of oil is clear from the above figures; it accounts for

- 45 % of all energy
- 58 % of all commercial energy
- 27 % of electricity generation
- 47 % of industrial fuels
- 97 % of transport fuels
- 53 % of domestic commercial fuels.

6) While all energy, like other resources, must be used rationally and economically it is clear that the special focus of conservation programme should be on the use of oil and to substitute other fuels or it wherever possible.

7) The second relevant aspect of the energy scene is the way it has evolved and is likely to develop, in the future because conservation has to be seen as a continuing element in national policy. The Turkish economy has grown very rapidly in recent years, by between 5 and 6 per cent annually and up to the time of the 1973 oil crisis energy consumption grew twice as fast. Since then it has slowed down under the combined indluence of higher prices and slower economic growth in the past few years, but it has still been rising very much in line with GDP as a whole

8) It has not been possible to make a close or detailed assessment of the energy outlook, or to examine existing forecasts, but given the resumption of economic growth in line with past trends it would be unrealistic to assume that energy demand will grow by significantly less. In other words the energy coefficient ($\frac{\%\text{ change in energy}}{\%\text{ change in G D P}}$) is likely to be around 1 and it could well be somewhat higher for a time.

9) Official estimates have suggested a possible threefold increase in demand by 1990 to 160 mtce but these have almost certainly underestimated the effect on economic growth of the present world recession and the impact of higher prices on energy comsumption; but even an annual increase of 5 or 6 per cent in energy demand throughout the decade would point to a total commercial energyrequirement approaching 70 mtce, of which around half could well be imported oil at prices perhaps 50 per cent higher in real terms than they are at present. On any set of assumptions there is a large and worthwhile conservation target to be aimed at.

Conservation and the Rational Use of Energy

10) The programme of the EIE has to be considered against a background of the above broad structure of energy use and its prospects, but as will be discussed later that structure and those prospects require close and detailed definition and specification if the correct priorities are to be established. There are, however, a number of preliminary points:

- Energy conservation or the rational use of energy is only one aspect of the general objective of making the best use of all resources;
- Energy conservation may be achieved at all stages in the production, conversion, transportation, handling and storage of fuels as well as in their final consumption.

- Energy conservation will involve costs as well as benefits and in each specific case these need to be carefully balanced;
- Energy may be saved by avoiding unnecessary waste (switching off unused appliances) by technological or organisational changes (using more efficient machines), or by changing the pattern of output or demand (making less energy intensive products or doing less energy intensive things). In the longrun this may have the greatest potential.

Energy conservation has therefore positive as well as negative aspects, and it is economic and social as well as technical.

11) One of the characteristics of the energy system in all countries is that whereas the supply of fuels is generally controlled and organised by a small number of large organisations (in Turkey TEK for electricity, TPAO for petroleum and TKİ for coal) the consumption and use of fuels is undertaken by many millions of consumers: individual households, businesses, public authorities, transport undertakings, and other institutions. Moreover the energy is used in dozens of different ways even within a single enterprise or home: for lighting, cooking, riding in lifts, melting steel, heating, drying, refrigeration, and so on. Conservation involves changing or making decisions in all these areas, but to the individual consumer, whether it is a business or an individual, the decision may be a relatively unimportant one. For example, in much of manufacturing industry the cost of energy may be only 5 per cent of total costs or even less. It may be difficult to persuade a business in that position that a long term energy saving of 10 per cent is worth troubling about or ustifies any immediate expenditure.

12) Nevertheless it has to be stressed that while there is a national interest in energy conservation through benefits to the balance of payments and the better management of national resources,

the immediate gains accrue to the energy consumers themselves through lower fuel bills, and a conservation programme needs to stress this aspect of self interest.

Measurement of Conservation

13) It is always extremely difficult to measure the success of energy conservation, although there is rightly considerable interest in knowing how effective various measures and policies have been. Since it is not possible to measure directly consumption of energy which did not take place it is necessary to measure actual energy consumption and compare it with an estimate of what consumption would (or might) have been in the absence of the conservation measures.

14) On the national level this can only be very approximate because of the wide range of factors involved in the determination of consumption levels. In the case of the individual household, factory or institution however it is possible to make more accurate assessments, and although individual cases cannot be crudely grossed up to provide sectoral or national figures some general indications can be derived if the data is cautiously used and interpreted.

Conservation and Investment

15) While the initial stages of conservation fall into the "good housekeeping" category, the major long term gains in energy utilisation will come through changes in technology and the replacement of obsolete equipment. It follows that an essential climate for more economical energy utilisation lies in the maintenance of a high and steady level of capital investment in the economy as a whole.

16) The remainder of this report is divided into four parts which suggest the groups of activity on which specific recommendations are made and which it is believed could form the basis of an effective and coordinated work programme over the next three or four years. The proposals take account of existing structures and activities which are planned or in progress as well as suggesting a number of new and enlarged projects. The four parts are concerned with.

STRUCTURE AND ORGANISATION
INFORMATION SYSTEMS
RESEARCH AND ANALYSIS
OPERATIONAL PROJECTS

II- STRUCTURE AND ORGANISATION

17) The structure and the staffing of the Department will depend on the way in which the tasks which have been assigned to it are carried out. At this stage therefore some flexibility will be required and proposals should be regarded as provisional. Three main functions have been specified:

Rational Use of Energy
Conservation
New and Renewable Energy Sources.

Each of these will contain a mixture of the following activities:

Data and Information Systems
Research and Analysis
Operational Projects.

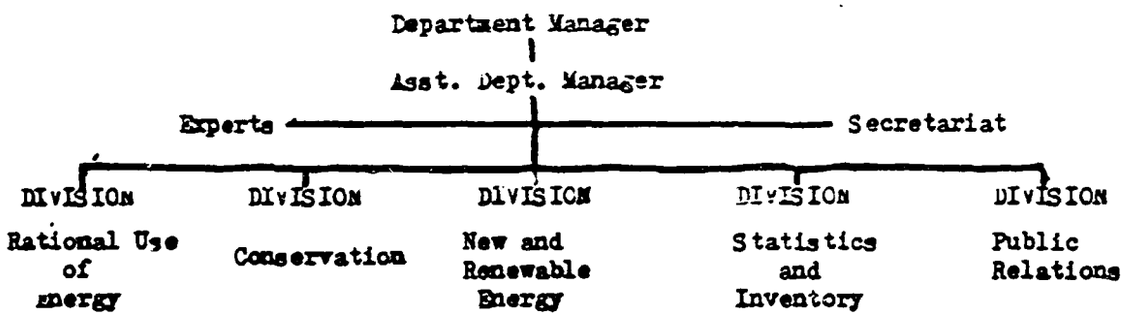
18) The content of each of these activities is discussed in later sections, but they may be outlined here as background to the consideration of organisation and staffing.

- Data and information systems involve establishment, maintenance and dissemination of statistical and other relevant technical information for working purposes within EIE and for distribution to other interested bodies inside and outside the Government
- Research and analysis consists of initiating and carrying out studies and surveys as required into those matters relevant to the Department's three functions. As a result new recommendations or projects may be identified for implementation.
- Operational projects will be concerned with a direct consultancy or management role in carrying out specific studies or schemes in individual firms or other institutions.

19) There are many ways in which these functions and activities could be organised within the existing practices and planned resources of the Department so as to ensure effective management and control without duplication of effort. What is suggested below is one way in which the advantages of specialisation and collective effort could be applied.

Present Structure and Work Programmes

20) The Resources Survey Department at present has a staff or about 26 of whom four or five are senior management or specialists with about 20 more junior engineers and technicians with a mixture of professional backgrounds in mechanical, electrical, chemical, engineering, metallurgy, etc. Since the new functions of the department have been only recently acquired its present structure is still flexible, but the provisional structure is broadly on the following lines:



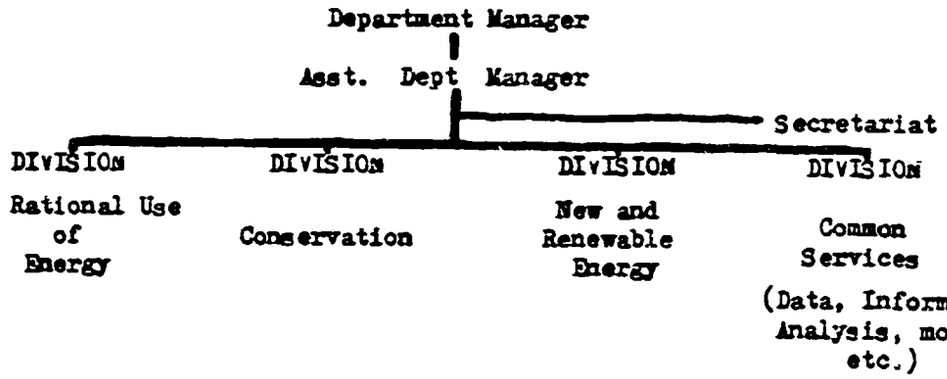
21) The EIE has an ongoing programme of activities related to its traditional responsibilities for the planning and development of the country's hydro-electric resources. The Research and Survey Department is responsible for the new energy ut lisation and conservation commitments and has already a number of activities in progress. These include:

- Collection of data and measurement of potential of solar and wind sources.
- Preliminary studies of energy resources and fuel substitution possibilities;
- Modelling of the electricity sector;
- Industrial survey of energy use in 600 firms;
- Energy conservation in selected industries, including consultancy studies now in hand (World Bank assisted)

Other projects are under consideration, but much of this work is of a continuing nature or will have longer term implications and it is therefore important that it should be integrated with any new activities and accommodated in any new organisational structure.

Suggested Organisaton (a) Internal

22) In order to carry out the present plans and future work programme it is suggested that the organisation of the Department might be slightly modified from the outline shown above. There would continue to be a central management and directing team with three functional branches, but the two rather smaller divisions for statistics and public relations would be replaced by a strong common services branch to provide Data and Information systems; forecasts and modelling, general energy analysis and facilities, public relations and information. It is also suggested that the specialist and expert staff should not be detached from the operational branches, unless a very small number are required to serve as personal advisers to the management team or are required for specific short term assignments. Otherwise the senior specialist should be part of the normal branch sturctures at the appropriate level. The central directing team would consist of the Department Manager, Deputy, and the four Division Heads. The structure proposed is as follows,



23) The actual allocation of staff between the branches should remain flexible while the work programme evolves. The present numbers of 25 - 30 are likely to be sufficient in the initial stages until procedures and priorities have been established and detailed industrial project work has been expanded.

(b) External

24) The question of relations between EIE/RSD and other governmental and non governmental bodies concerned with energy matters is an area where only very tentative suggestions can be made because it has not been possible in the time available to meet all the interests and agencies involved and to discuss their views. It has to be recognised that energy utilisation is a subject which has very widespread implications and it is most important that channels of information and public awareness should be kept freely open. Full coordination between the interests involved and especially in the role of EIE in the whole area of energy use and conservation is most important.

25) There is already a high level consultative body which meets from time to time under the chairmanship of the Ministry of Energy and drawing its membership from all the main energy agencies and from the private sector. Its effectiveness can be a valuable indication of the degree of political importance which the Government attaches to energy management problems. It is important that EIE should be actively involved in this work by initiating discussions and reports.

26) It would probably also be valuable for there to be a lower level official group drawn from the Ministry, EIE, the State Planning Organisation and the planning branches of the fuel industries which could meet rather more frequently and informally to review programmes, to facilitate the exchange of information and to deal with any inter agency problems.

27) In the early stages of the development of the new EIE programmes particular importance should be attached to the development of close working relationships with the State Institute of Statistics in the establishment of the appropriate conventions and procedures for the new data systems and information structures. Consideration should be given to the temporary secondment of one or more professional statisticians with experience in industrial statistics from the SIS to the EIE in order to set up the necessary structures.

28) A further area of external organisation which needs to be considered is the development of provincial or regional bodies who would (a) act as publicity and information agents for the dissemination of conservation and energy management matters, and (b) act as a channel through which relevant energy problems and information could be channelled back to the centre. Government offices of some Ministries, but not the Ministry of Energy, already exist for this purpose, and use could also be made of the industrial and trade associations and Chambers of commerce network who may have better direct access to the individual industrial concerns and enterprises.

29) The possibility of such centres is referred to in the Report of 24th November 1980 by the Hungarian consultants engaged in project SI/TUR/79/803, and who recommended the formation of energy consulting centres in a number of provincial cities. The purpose

of these centres would be to encourage awareness of energy conservation and the need for the rational use of energy among all consumers, but especially in the industrial sector. In particular such centres could identify local enterprises where energy consumption audits might be undertaken, or where particularly successful saving measures had been introduced and they could combine the resources of official agencies with those of independent industrial and commercial bodies.

Staffing

30) The problem of staffing for work in the energy sector is difficult because the subject is wide ranging and multi-disciplinary. Energy specialists range from accountants to geologists, and include engineers of all kinds, economists, pure and applied scientists, and (in the area of modelling) mathematicians.

31) The traditional background in EIE is in the engineering and physical sciences, and it is at present well equipped with the relevant expertise in these fields for work of an operational kind in industry and in the appraisal and monitoring of technological matters. The main gap is likely to reside in the "software" skills of economic and financial analysis, forecasting, operational research and statistics and these will be particularly needed to develop the common service functions and provide appropriate analysis and support in the operational branches. In these branches the need to assess costs and benefits, to engage in project appraisal studies, to assess the evolution of pricing policies and to examine possible changes in the balance of taxes and subsidies, will all call for a considerable strengthening of more economically orientated activities.

32) In the modelling and forecasting work skills in econometric analysis, linear programming, and other optimisation and resource management techniques will be a continuing requirement. It is therefore recommended that provision should be made for three or

four economists in the common services branch, at least one of whom should be at a senior level with industrial as well as macro-economic experience and interests.

33) The requirement for developing data systems appropriate to this area of work will also require at least two trained and well qualified statisticians to be capable not only of supervising the collection and processing of statistics, but also of designing surveys and questionnairs so as to ensure maximum coverage and effectiveness as well as consistency and compatibility with other related data systems. As was noted above the assistance of the State Institute of Statistics should be sought in filling these posts.

Training

34) Because of the nature of energy studies some special training is normally necessary to supplement the usual professional and academic qualifications. The EIE has recognised this and a special intensive one month course in energy studies was held for the new recruits to the Resources Survey Department covering various aspects of energy technology and systems analysis. The course was a very comprehensive one and it should certainly be repeated from time to time. However, because of its comprehensiveness many of the topics (which ranged from probability analysis and statistics to project management and modelling) could obviously only be dealt with at the familiarisation level while what is required for effective analysis is for specialists in these skills to be available for applied studies. A course of this kind needs to be supplemented with narrower and more intensive training. It is generally not possible to acquire a thorough working understanding of new concepts - eg for a scientist or an engineer to become familiar with the underlying concepts of economics (or vice versa)-through general briefing courses. The basic professional skills required in the Department have to come through recruitment policy

although these can be enhanced, refined, and broadened by appropriate on-the-job training and specialist courses.

35) Provision should be made avilable, however, for study tours to enable techniques and methodologies developed elsewhere to be compared, and in a small number of exceptional cases provision for higher level specialist studies overseas should also be made.

36) In the short term the most effective contribution to a training programme will come from on the job participation in the counterpart role and the possibility of follow up arrangements with the foreign contractors.

III- INFORMATION SYSTEMS

37) An up to date system of accurate statistics relating to all aspects of the consumption and use of fuels and their standardised conversion to comm energy units is an essential requirement for all energy/plan It must be internally consistent and compatible with national economic and industrial data. It has to cover all the processes of production, conversion and utilisation, and for the implementation of effective energy management programmes it needs to include information about what energy is used for-whether for heating, lighting, or motive power. It must also relate the energy system to the rest of the national economy.

38) At present in Turkey good statistics are available on the production and import of primary fuels as well as the secondary, manufactured fuels: solids, petroleum products, electricity and town gas. Much of the detailed information is, however, scattered among a variety of sources and regular reports issued by the fuel industries themselves. The figures often tend therefore to be the by-product of operational and managerial requirements and are not designed, processed or presented for analytical or policy purposes. In these circumstances the data may be based on definition and concepts which are relevant to the producing agency but which are not directly comparable with data and information arising elsewhere. (But mention should be made of the excellent summaries and analysis prepared each year by the Turkish National Committee of the World Energy Conference).

39) There are moreover a number of gaps which need to be filled and particular topics which need to be stressed for conservation policy purposes. For example, the electricity statistics produced by the Turkish Electricity Authority (TEK) are extremely comprehensive in respect of capacity and generation, but have little to say on the consumption of thermal fuels, stock levels,

the generating efficiency of stations - crucial data in the analysis of fuel utilisation and conservation - or on the pattern of electricity sales. Indeed it is generally in the area of sales, consumption and use of fuels that the statistical system is most in need of development.

40) In general the amount of new statistical work to be undertaken on the supply side is relatively small and will mainly consist of drawing out of existing sources, reporting procedures and publications those series which are mainly required, ensuring their consistence and standardisation and consolidating them in an accessible form.

41) It is in the area of energy demand, consumption and utilisation that the major new primary data collection, assembly and processing will be needed. There already exists some broad analysis of energy consumption in the main demand sectors (Industry, Transport, Households, etc) and some further division into main industrial subsectors and modes of transport is also available. There is however a need for energy data to be placed in a clear and standardised framework corresponding to that used for national production statistics. This is based on a four tier system of disaggregation beginning with broad activity sectors such as "Manufacturing" which is then subdivided into 20 main industriy groups (Food, Textiles, Machinery, etc), each of which is subsequently recommended that all studies of energy utilisation and conservation carried out by EIE should adopt and identify the standard national classification system and nomenclature.

42) An invaluable source of industrial energy data is to be found in the annual Censuses of Production carried out by the State Institute of Statistics. Unfortunately the sheer bulk of data involved in these surveys results in delays of two or three years between the survey and the publication of its results. But even the data for earlier years can provide a valuable guide to patterns of fuel use in industry.

Structuring Energy Demand

43) A statistical system needs to be designed for the purpose for which it will be used. It is not sufficient to know simply the main sectors of the economy (even if these are finely subdivided) in which energy, or individual fuels, are used even although it helps to provide a first approximation in identifying the sectors of greatest interest. It is also essential to know the end uses to which the energy is applied and the extent to which it is specific and essential in those uses or whether it is capable of substitution by other fuels being reduced in quantity without harm to the overall production process.

44) The basic structure into which consumption can be classified is in the form of a matrix which can refer to the whole energy economy or to all or any of its subsectors or components down to the individual household or business enterprise. The end uses are basically three in number (heat. light and motive power) but they can be subdivided as finely as is required or as the data will permit. Similarly fuels can be identified simply as solids, liquids, electricity, or broken down again as finely as is required or as the data permits into coal, lignite, wood, fuel oil, kerosene, motor spirit, etc.

END USES	FUELS					
	COAL	LIGNITE	OIL	ELEC.	..etc..	TOTAL
H E A T						
Space and Water Heating						
Processes: Burning						
Melting						
Drying						
Cooking etc						
M O T I V E P O W E R						
Stationary (eg Power tools)						
Mobile						
L I G H T I N G						
TOTAL Consumption in Each Use						

45) Analysis of this kind, if appropriately specified, can show for example how much of the process heat is for high temperature needs and how much for low temperature requirements thus pointing to opportunities for waste heat recovery or opportunities for switching to low grade fuels.

46) This approach is applicable to all sectors of the economy, domestic, commercial, transport and agriculture as well as to industry. The data required to complete the framework is of course not of the kind which is immediately available, but its collection does not have to be carried out more than once every two or three years (unless it is thought that very rapid technological changes are taking place). It is understood that a sample survey of energy use in the textile industry has been carried out along the lines of this conceptual framework to demonstrate its practicability. It is recommended that further studies be made and it may for example be possible for the planned audits of selected industries to construct matrices of this kind which would provide a basis for extending them to other sectors. It is recommended however that the survey should be very carefully prepared if it is to be effective and not impose unnecessary burdens on the recipients of the questionnaires.

47) In addition to the advantages which can flow from this structured approach and which have been mentioned above, such as identifying the potential for fuel substitution, it also helps to focus on areas where improved energy efficiency may be achieved through improvements in technology - boiler design, lighting, power appliances, etc.

Appliance Efficiencies

48) It is well known that just as the energy delivered to final consumers is a good deal less than that contained in the primary fuel supply because of losses in conversion, so the useful energy which is finally required is much less than the delivered energy because of inefficiency in appliances of all kinds.

49) It is recommended that surveys of the efficiency of energy using appliances should be undertaken (covering domestic as well an industrial equipment) with the collaboration of the fuel industries and appliance manufactures and importers. This could be developed in due course to lead to a system of efficiency labelling for approved products.

Financial Statistics

50) Since the implementation of rational utilisation and conservation policies will involve choices between various fuels, technologies and other resources it is important that adequate economic statistics relating to prices and costs should be maintained alongside those relating to physical quantites. This does not require that the EIE should be concerned with the detailed accounts of the fuel producing or using industries, although these may sometimes provide valuable indicators of performance, but rather with the costs of inputs and outputs and the relationship between those relating to energy and the total costs of the enterprise or activity.

51) It is particularly important to be able to identify the sectors where energy costs are large in relation to total costs and those where they are very small.

52) In terms of the social aspects of energy policy it is necessary that energy expenditure in the domestic and household sector should also be recorded and monitored.

Other statistical Matters

53) There are a number of other detailed statistical topics on which decisions will need to be taken at an early stage. It is not possible to discuss them in detail here, and many are of a technical nature, but the following are among the more important:

- Energy accounting units. At present Turkish statistics employ tons of coal equivalent (tce) as the basic presentational common energy unit. This is the UN practice but coal occupies a very minor place in the country's energy supply, and lignite has very different heating properties. It should be considered whether since oil is the key energy policy and conservation issue (and is the unit generally used by the IEA) it would not be advantageous to present national energy data in terms of tons of oil equivalent (toe). It is largely a matter of taste and convenience and provided that conversion factors are standardised and readily available it presents no statistical problem to move from one unit to the other. A related point is the need to establish an agreed standard scientifically accurate energy unit (coal and oil equivalents are inevitably approximations), which is particularly necessary for micro analysis of energy consumption as well as for national statistics. For this purpose multiples of the Joule, BTU or therm can be used and probably the Joule is the most universally acceptable.

- Commercial and Non-Commercial Fuels. Wood and agricultural wastes, most of which are not bought and sold for cash, constitute between a fifth and a quarter of the country's total energy supply. Most of it is used in the rural domestic sector, and the circumstances in which it is replaced by commercial fuels, mostly electricity or kerosine, are an important feature of energy utilisation policy which merits special analysis. The following points need to be taken into account:

  (a) the boundary between commercial and non-commercial fuels is not a precise one: some firewood is sold commercially.

(b) Non-commercial fuel consumption (and production) is extremely difficult to measure both in terms of physical quantities and thermal content. Special surveys and estimation are required.

(c) Direct conversion of thermal content to standard energy units is misleading because of the low efficiency with the fuels are used: about one quarter of the amount of oil in terms or thermal content can produce the same amount of heat or work as a given unit of wood or waste.

(d) Non commercial fuels have little or no role in industry - although biomass could have a role in relatively small scale enterprises.

It is recommended that in statistical tables and national energy balances non-commercial fuels should always be identified separately from the other solid fuels. Also regular surveys should be made of the production, use and thermal content of these fuels.

- Statistical Bulletin. It is strongly recommended that as a matter of some urgency, say by the end of 1982, a regular Summary bulletin of energy statistics should be produced. It should be produced quarterly and should contain data relating to the production, import, export, stocks and sales of all fuels (primary and manufactured). It should also include data relating to employment in the fuel industries, costs, prices, and consolidated enery statistics. This is a subject for discussion with the State Institute of Statistics and also with the National Committee of the World Energy Conference.

- Statistics Users' Seminar. Arrangements should be made for an annual seminar for the users and producers of energy statistics to discuss general presentational and methodological problems as well as techical and administrative issues involved in data collection, processing and dissemination.

IV- RESEARCH AND ANALYSIS

54) The research and analysis work which is proposed is geared to the broad function of the EIE of ensuring the rational use of energy in Turkey. It is concerned with providing the investigations, diagnosis and information on which effective energy policies can be based. It is moreover not only concerned with the effective use of energy in consumption but also with seeking ways whereby all the country's energy resources, actual and potential, may be optimised.

55) A great deal of valuable energy research and analysis is of course carried on continually both inside Government agencies and outside them. The energy problem is not new: the events of 1973-74 provided a major stimulus to study, the IXth World Energy Conference in Istanbul provided an extra focus and impetus for research, while the economic consequences of the second major oil price rise in 1979 gave work added u gency.

56) It is not possible to review the whole field of energy analysis, because in addition to their own work Turkey's analysts can draw on the massive resources of work done by the international community, and it is important that these links should be developed. It is essential therefore that the EIE should maintain a good energy library (coordinated with those of other institutions to avoid overlapping, unnecessary duplication and waste) of books and periodicals. Alongside the database the library should be a main support of the group's work.

57) EIE will however need to concentrate on specific areas of analysis directly geared to its official responsibilities in the fields of energy demand and utilisation and the behaviour and motivation of energy consumers of all kinds. Surveys will be required on the general scale, condition and efficiency of the capital stock of energy using equipment such as boilers, furnaces,

and machinery in order to provide a quantitative basis for decisions relating to financial assistance for replacement and similar projects to enhance the efficiency of the energy system. The beginnings of this work can emerge from the existing audit studies and surveys.

58) It has already been noted that data relating to fuel purchases by industry is available within the framework of the annual census of production. This data should be extracted and processed as an important component of the energy data bank.

59) Proposals are already in hand for the development of work in the field of energy modelling and forecasting. Some academic work has been done and EEC assistance may be forthcoming for further studies. This work is extremely important in providing a framework for policy studies and analysis, provided that it is firmly related to practical and operational requirements. The problem is that mathematics is a much more precise, sophisticated and developed art than energy analysis and it is easy for formal models to lose touch with reality because of data deficiencies and uncertainties which characterise the real world. It is often the case therefore that relatively simple and partial models are a more effective aid to decision making than attempts to construct large fully integrated simulations of the energy sector or the economy as a whole.

60) A particular area of economic modelling which is important in itself and as an input to more general models and which requires close analysis is the area of demand and substitution elasticities for individual fuels. With the Government's policy of ensuring that fuel prices are maintained at economic levels this should have a high priority in order to establish working conventions in EIE and also in drawing on the academic work which will have been done in Turkey on this subject.

61) The task of academic liaison is extremely important, because the universities provide the source of much valuable expertise (as well as possible future recruits) and can carry out specific research studies under contract. It is recommended that a member of the branch concerned with common services should be given the role of academic liaison officer to keep in touch with energy work being carried out in the universities and other academic institutes in Turkey.

62) Much of the analytical and research work which is carried out will need to be of an economic or techno-economic kind, and the staffing of the branches should reflect this by acquiring through recruitment or training the right kind of expertise. Projects and research proposals will need to be closely scrutinised to establish their viability and the balance of their costs and benefits to the nation.

63) It will be necessary to devise methods whereby the success or failure of particular policies or measures can be judged, and for this purpose appropriate performance indicators will need to be constructed. These can provide a basis for monitoring particular firms or enterprises. The indicators would be designed to relate energy inputs to output, to measure changes in the energy intensity of output, to measure energy losses as a proportion of output, and to measure energy costs in relation to total costs. The precise form of indicator or ratio might vary from one enterprise to another, but they would generally be designed to be interpreted in parallel with the progress of the national energy economy which can be monitored in a similar way by means of such indicators as the energy coefficient ($\frac{\%\text{ change in energy consumption}}{\%\text{ change in G D P}}$), the energy ratio (energy consumption per unit of G D P), or the oil ratio (oil consumption as % of all energy consumption).

64) In a country such as Turkey at an intermediate stage of economic development and having a relatively high rate of economic growth, industrial structures and the pattern of demand associated with them are liable to change fairly rapidly. It is particularly difficult to predict what these changes will be, but the implications of changes in the relative rates of growth between industries which are more or less energy intensive can be considerable and the sensitivity of the energy system to such changes needs careful appraisal.

V- OPERATIONAL ACTIVITIES

65) In addition to assembling statistical data and other information and carrying out research and analysis, the EIE will have a directly operational role in carrying out activities in its three main areas of responsibility: rational utilisation, conservation and renewables. It will be responsible for the management and implementation of projects, and for directly participating in their execution, either alone or as a part of consultancy teams. This aspect of the programme will principally determine its practical effectiveness.

66) Two main areas of work will predominate in the initial stages of the programme: first, the energy conservation projects in selected industries, and second, in the new and renewable resources programme, issues arising out of the acquisition by EIE of managerial responsibility for the Solar Research Institute and the development of firm programmes on other potential energy sources.

Industrial Conservation

67) One phase of this work has already been completed - the UNIDO project SI/TUR/79/803 in which four industrial enterprises, identified as large energy users, were surveyed by a Hungarian expert team to assess their conservation potential. The second phase, a further analysis of these sectors plus an electricity generation project has been planned and is close to implementation. The inclusion of electricity generation is of great importance as a reminder of the central role of the energy conversion industries in any programme concerned with the rational use of energy. The studies are funded by the World Bank and are being executed by teams of German, Japanese and British consultants who will be carrying out energy audits and surveys and making proposals for energy saving and for training. A later phase, which is still in an early stage of formulation, concerns the possible extension of this work and could include the provision of financial aid to specific firms for energy saving equipment.

68) EIE staff will have an important counterpart role in these areas of work and the maximum advantage should be derived from their participation in enhancing the technical know-how of the attached officials and in presenting them with the opportunity to acquire data and experience of energy use which can be banked for later application in other sectors. For example, in the scope and application for improved instrumentation and heat measurement in industry and the opportunities for the installation of control machanisms there is the opportunity to specify and formulate a general broadly based project for the introduction of improved heat control systems. Also they will gain experience in the collection of the kinds of data on final uses of energy which have been suggested earlier so that it is possible to identify the processes and operations as well as the sectors in which opportunities for conservation may arise.

69) Local counterpart staff should also be particularly aware of the need to identify opportunities for the introduction of new energy saving technologies or materials at all stages of energy use (including transport, storage and handling) and to be on the look out for opportunities where financial assistance towards early scrapping and replacement of old equipment would be cost-effective.

70) While the work that has been started and is being planned in the industrial sector will inevitably be of the greatest importance in the early stages of programme, the opportunities for energy saving in other sectors should not be neglected: the transport sector consumes as much oil as industry and the domestic sector too uses almost 3 million tons of oil annually. Trends towards smaller engined road vehicles should be encouraged and the prospects for electrification on the railways and other public transport should be examined Energy saving in the domestic sector is a very well documented area but at least one member of the staff of the Resources Survey Department should be responsible

for monitoring progress in this area,with particular attention being paid to the design of buildings and the heat properties of materials used in their construction.

71) It is recommended that the EIE/RSD should also assemble a register of best available practices in energy utilisation which are already adopted by individual firms and shoul d ensure that these receive maximum publicity and exposure.

New and Renewable Energy Sources

72) This is an area of great interest and activity world wide even although these sources are not expected to make a significant contribution to bulk energy supplies for many years. The main reason is that even at present high levels of energy prices they are not economically competitive with traditional energy supplied. However although this proposition is true in general terms and in relation to the provision of bulk energy this does not mean that in particular locations, for particular types of consumption or use new sources of energy cannot make a valuable contribution to supplies. If "mini-hydro" schemes are included in this category then these can very often be extremely cost effective and important.

73) Three of the renewable energy sources which are available in some other parts of the world, winds tides and wave power are not significantly present in Turkey. However the prospects for solar, geothermal and biomass are very promising. The Solar Energy Research Centre at Marmaris is now under the supervision of EIE and various studies and experiments are in progress. Few of these have direct industrial application in the near future (solar furnaces or photovoltaic energy for example) although in the provision of low temperature heat or direct solar drying of agricultural crops there is scope for development. (The form which energy conservation can take in these cases is to improve

traditional solar techniques so that the tendency for them to be replaced by manufactured fuels is held at bay).

74) Solar energy is a field which has attracted a great deal of low level experiment and research in universities and technical colleges throughout the world, but while it has educational value much of it is orthodox, familiar and repetitive. The EIE, through the SERC, should however take the lead in coordinating work and above all by keeping in touch with developments throughout the rest of the world where in some cases massive resources are being applied.

75) There are two interesting prospects for the development of geothermal energy, with which Turkey is relatively well endowed: low temperature supplies which may be of use to industry and horticulture, and electricity generation. A small experimental pilot plant has been in operation for some years, and larger installations are planned.

76) Biomass, including biogas from agricultural waste, is another promising source for the provision of electricity in rural areas and experiments are in progress.

77) In general work in the field of new and renewable energy is proceeding steadily and effectively in Turkey. Two points are important: first, Turkey can keep abreast of current technologies without the expenditure of large resources, and second since the economics of most forms of alternative energy is still marginal at current costs and prices there is no immediate pressure for action provided that general and steady progress can be maintained. Having said that, however, it is important that where results are promising demonstration projects should be mounted as quickly as possible with maximum publicity in areas likely to be responsive either in the adoption of new technologies or in their commercial development and production.

It would be particularly valuable if these could be linked to small scale agricultural or industrial enterprises to give a practical dimension to experiments and above all to provide a basis for realistic economic appraisal.

78) Although the study of new energy sources has tended to be associated with natural and renewable sources, it is important not to neglect study of the prospects of applying new and advanced technology in ways which can bring about the more economical use of existing conventional fuels. Many improvements in combustion technology are possible and the liquefaction of coal (and possibly lignite) as substitutes for imported oil should form a part of the research programme.

79) The whole area of nuclear power has deliberately not been touched on as it is likely to lie outside EIE terms of reference. It is possible however that comparative cost studies as between nuclear and hydropower as primary sources of electricity would be of value at a later stage.

VI- CONCLUSION

80) Turkey has a well defined structure and strategy for the organisation of its energy policy, and many projects and activities have been implemented or are being planned in the industrial sector. The present phase, however, is a transitional one with some internal reorganisations taking place and the role of other agencies being developed.

81) In EIE's forward programme there is abundant and continuing scope for energy audits and surveys in industry once the present group of projects has been completed, and increasingly it should be possible for these tasks to be undertaken with internal resources. What will then have to be worked out are the best ways of actually ensuring that those opportunities for improved energy use which have been identified are implemented. What resources will be needed? What organisation to supervise their allocation? How can the appropriate technologiecs be most effectively applied? These are the issues which will become

increasingly important after the first phase of the programme dominated by survey, research and analysis, has become established.

82) In the field of new and renewable resources the main opportunity for extency assistance and support could come in the application of solar energy to industrial purposes, or in opportunities for mini hydro schemes or biogas to be applied to small scale rural industries.

83) The most important and immediate project would be for assistance in the setting up of the industrial information and data system on which the effective implementation of the rest of the programmes will depend and to which those programmes themselves can make a substantial contribution as they develop.

84) The scope for longer term assistance on a larger scale could wait until the existing programmes have become firmly established and the operations of EIE/RSD and its staff have gained experience.

ANNEX

ERE

ENERGY RESOURCES SURVEY DEPT

The following outline framework illustrates a broad plan of activities which could be undertaken in following up the main objectives and functions of the new policy unit. The actual allocation of tasks is indicative only and there will need to be flexibility and cooperation between the Divisions in the carrying out of projects, some of which (such as the statistical, modelling and forecasting work) will be undertaken by the proposed common services Division

FUNCTIONS AND OBJECTIVES	ACTIVITIES		
	INFORMATION	ANALYSIS	OPERATIONS
Rational Use of Energy	Statistics Forecasts Balances End Use Surveys	Modelling Costs/Prices Non-commercial energy	Public relations Publications Academic liaison Library
Conservation	Consumption patterns Capital stock surveys	Performance indicators Monitoring Equipment evaluation	Audits Follow up surveys Energy management Industrial liaison
New and Renewable Energy	Resource potential	Evaluation of equ ipment Applications appraisal	Demonstration projects Admin of Solar Research Centre