

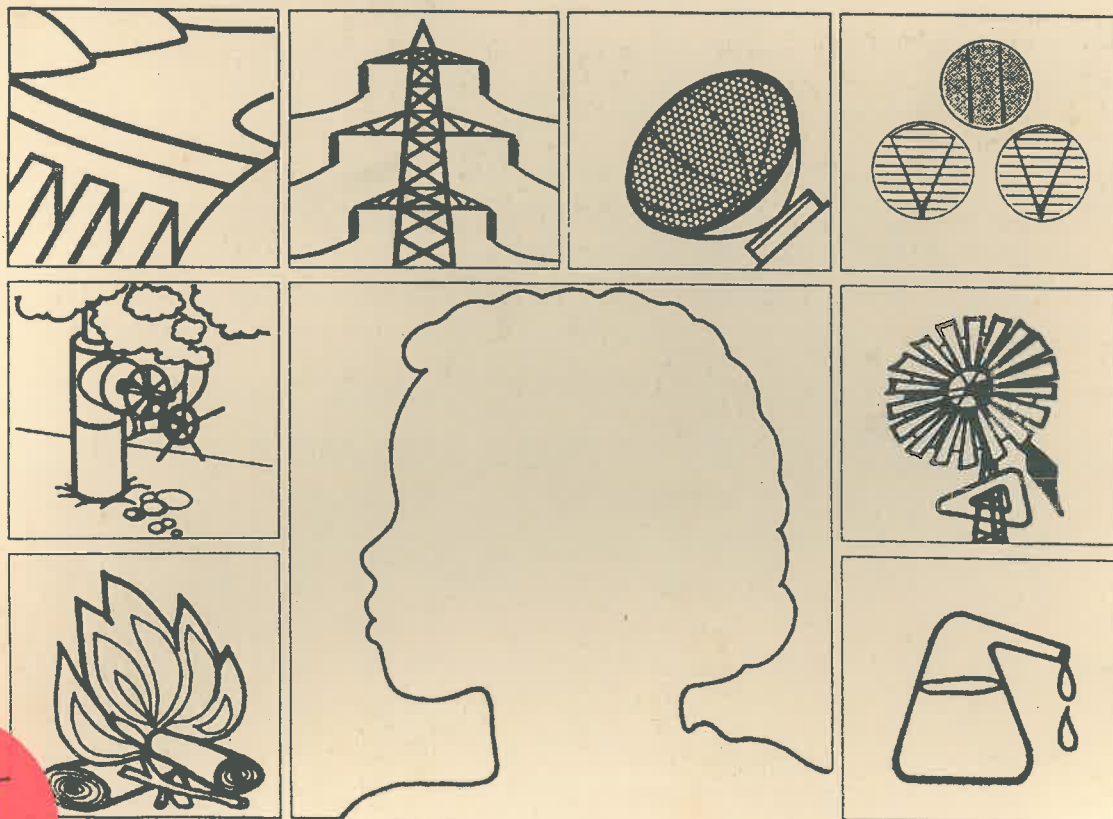
INSTRAW

United Nations International
Research and Training Institute
for the Advancement of Women



MEDITERRANEAN TRAINING SEMINAR ON WOMEN AND NEW AND RENEWABLE SOURCES OF ENERGY

Ljubljana, Yugoslavia
18 - 21 September 1990



1991 T
ENE-GLO

NOTE

This document has not been officially edited. The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations nor INSTRAW concerning the legal status of any country, territory, city or area of its authorities, or concerning the delimitation of its frontier or boundaries.

The responsibility for opinions expressed in signed articles, studies or other contributions rest solely with their authors, and publication does not constitute an endorsement by the Secretariat of the United Nations nor INSTRAW.

**INTERNATIONAL RESEARCH AND TRAINING
INSTITUTE FOR THE ADVANCEMENT OF WOMEN
INSTRAW**

**MEDITERRANEAN TRAINING SEMINAR
ON
WOMEN AND NEW AND RENEWABLE SOURCES OF ENERGY**

**Ljubljana, Yugoslavia
18-21 September 1990**

Table of Contents

Part One: Report of the Mediterranean Training Seminar on Women and New and Renewable Sources of Energy

Part Two: Adapted INSTRAW-ILO/TURIN Centre Training modules on "Women, New and Renewable Sources of Energy for the Mediterranean Region

1. Potential on Renewable Energy Sources in the Mediterranean Countries, Dr. Peter Novak.
2. The Role of Women in Energy-Intensive Economy: The Current Status and Advancement of the Co-operation of Women in the Energy-Intensive Economy, Dr. Marija Lap-Drozg.
3. Rational Energy Use and Environmental Protection in Slovenia, Dr. Peter Novak, Dr. Joze Zupancic, Dr. B. Suvorov.
4. New Energy Mixture for Domestic and Tertiary Use for Improved Environment in Slovenia-Yugoslavia, Dr. Joze Zupancic, Dr. P. Novak, Dr. B. Suvorov

Table of Contents

Part One: Report of the Mediterranean Training Seminar on Women and New and Renewable Sources of Energy

Part Two: Adapted INSTRAW-ILO/TURIN Centre Training modules on "Women, New and Renewable Sources of Energy for the Mediterranean Region

1. Potential on Renewable Energy Sources in the Mediterranean Countries, Dr. Peter Novak.
2. The Role of Women in Energy-Intensive Economy: The Current Status and Advancement of the Co-operation of Women in the Energy-Intensive Economy, Dr. Marija Lap-Drozg.
3. Rational Energy Use and Environmental Protection in Slovenia, Dr. Peter Novak, Dr. Joze Zupancic, Dr. B. Suvorov.
4. New Energy Mixture for Domestic and Tertiary Use for Improved Environment in Slovenia-Yugoslavia, Dr. Joze Zupancic, Dr. P. Novak, Dr. B. Suvorov

Part One

Centre for Management and Labour Research
and

The United Nations International Research and
Training Institute for the Advancement of Women

in co-operation with

The International Centre for Public Enterprises
in Developing Countries

Report

Mediterranean Training Seminar

on

Women and New and Renewable Sources of Energy

Ljubljana, Yugoslavia
18 - 21 September 1990

INTRODUCTION

The Mediterranean training seminar on "Women and New and Renewable Sources of Energy" was held in Ljubljana, Yugoslavia, from 18 to 21 September 1990 at the Centre for Management and Labour Research (CMLR) and was attended by 33 participants (see Annex I).

The seminar was organized by the Centre for Management and Labour Research (CMLR), INSTRAW focal point in Yugoslavia, and United Nations International Research and Training Institute for the Advancement of Women (INSTRAW) in co-operation with the International Centre for Public Enterprises in Developing Countries (ICPE). The aim of the training seminar was to adapt the multimedia modular training package on "Women and New and Renewable Sources of Energy" for the Mediterranean region by national experts. The training package was jointly prepared by INSTRAW and the International Centre for Advanced Technical and Vocational Training of the ILO/TURIN and financed by the Government of Italy.

I. ORGANIZATION OF THE SEMINAR

A. Opening Addresses

The opening of the seminar was co-ordinated by Mr. S. Jogan, Director of the Centre for Management and Labour Research, INSTRAW focal point in Yugoslavia. In his opening statement, Mr. Jogan welcomed the participants to the Mediterranean training seminar on "Women and NRSE" and stated that this training seminar also marks the celebration of INSTRAW's Tenth Anniversary in Yugoslavia as well as the first attempt of collaboration among INSTRAW focal points in Europe. He underlined the successful activities of INSTRAW during the past decade and reiterated hope for the continuation of fruitful collaboration between INSTRAW and its focal points.

Mr. Jogan said that in the field of women and NRSE the issues of accessibility, rational use, environmentally sound development, management of various technologies are a complex set of questions that most countries are facing today. He explained to participants that the integrated approach in the field of NRSE should be brought to the attention of the professional sector and wider public.

Finally, he wished the seminar success in its endeavours and thanked INSTRAW and ICPE for collaborating with the Research Centre for Management and Labour in organizing it. He thanked the participants from various organizations and INSTRAW focal points for participating and contributing to the success of the seminar.

Mr. Jogan then introduced the representative of the Slovenian Government, Minister for Energy, Mr. Miha Tomsic and thanked him for the support given in organizing the seminar.

Mr. Tomsic welcomed all the participants to the seminar and paid tribute to INSTRAW, its focal point in Yugoslavia and ICPE for organizing the first Mediterranean training seminar on "Women and NRSE". He said that the Government of Slovenia is preparing a new energy policy, with emphasis on soft energy and motivation of the general public on women's involvement. He pointed out that knowledge and information exchange in Yugoslavia influences continuous support to the energy transition and everyday life, in the extensive use of energy rather than value produced, as the increase of energy prices in the households is affecting daily lives. He concluded by wishing the success of the seminar and declared the seminar officially opened.

Mr. Jogan introduced Mr. Dar, Executive Director of the International Centre for Public Enterprises in Developing Countries (ICPE). He welcomed all participants and expressed satisfaction to co-operate with INSTRAW and the Yugoslav focal point of INSTRAW in co-organizing the training seminar as well as, the meeting of INSTRAW focal points from the Mediterranean region.

He pointed out that INSTRAW and ICPE had fruitful co-operation in pursuing programmes for the advancement of women. He informed the participants that ICPE shares with INSTRAW the trust that the human factor, with women having the crucial role in development, is of fundamental importance for pursuing sustainable development. ICPE, he stressed, has been promoting such an approach through different activities implemented through its programme on women in development.

On behalf of ICPE, Mr. Dar warmly congratulated INSTRAW for their tenth anniversary and the significant contribution made during the decade to promote the role of women in the developmental process.

Mr. Dar pointed out that ICPE - as a joint intergovernmental organization of 39 member states and 30 affiliate (enterprise) members is devoted to the promotion of contemporary management and performance of public enterprises specifically in developing countries, and is willing to further contribute towards achieving the common objectives in regard to the advancement of women. He stressed that new and renewable sources of energy is the subject of great importance today, as the active role of women in the management and utilization of energy can further contribute to making it more efficient and rational.

Finally, he wished success to the seminar and the subsequent INSTRAW focal point meeting and expressed the hope that the fruitful co-operation between INSTRAW and ICPE will continue in the future.

Mr. Jogan then introduced the representative of INSTRAW, Ms Borjana Bulajich.

Ms Bulajich thanked the INSTRAW focal point in Yugoslavia, Centre for Management and Labour Research (CMLR) and the International Centre for Public Enterprises in Developing Countries (ICPE) for organizing the

Mediterranean training seminar. She expressed INSTRAW's gratitude to Dr. Janez Drnovsek, Member of the Presidency of Yugoslavia, for his message on the occasion of the Tenth Anniversary of INSTRAW, which was delivered during his mandate as the President of Yugoslavia. She welcomed Mr. Tomsic, Minister of Energy, Member of Slovenian Government, participants and INSTRAW focal points representatives from the Mediterranean region. She also welcomed the representative of the International Centre for Advanced Technical and Vocational Training - ILO/TURIN Centre, Mr. Guilio Piva, Chief Training Operations, with whom INSTRAW produced jointly the training package on "Women, New and Renewable Sources of Energy".

Ms Bulajich paid special tribute to Ms Vida Tomsic, one of the founders of INSTRAW and one of its first Board Members for her tireless efforts to promote the Institute's work in research, training and commitment for the advancement of women at both national and international levels.

She pointed out that unfortunately, the first Director of INSTRAW, Ms Dunja Pastizzi-Ferencic was not present at the training seminar and stressed that during the past decade, through her tireless efforts she established INSTRAW and made it a well known institute world-wide for its work and commitment for the advancement of women.

She also thanked Ms Mara Rupena-Osolnik for initiating this training seminar and assisting in its preparation.

She stressed that INSTRAW has a very special role to play in the area of non-technological factors affecting the NRSE diffusion process. Many NRSE technologies have reached a state of "maturity" from a technical point of view, but their successful adoption is constrained by a variety of non-technological factors, such as social acceptability, economic feasibility, and environmental soundness. Women are central to this aspects of the diffusion process.

Ms Bulajich pointed out that in 1990, INSTRAW was given the mandate by the ACC Inter-Agency Group on New and Renewable Sources of Energy to be the lead agency for the theme "Women, New and Renewable Sources of Energy" within the United Nations system. The seminar represented one of the Institute's activities within this field.

She explained that there is a growing awareness that present choices of energy are not sustainable, neither ecologically, nor economically. Some energy sources and their use threaten massive changes in global climatic conditions with heavy consequences for sustainable development. She stressed that the question is how to develop a new approach to energy planning and policy formulation - an approach which takes into account the external environmental and social costs of energy, and which considers the full energy system from fuel source to end-user and at the same time enhances economic and human resource development, particularly that of women.

Ms Bulajich pointed out that the objective of this training seminar is to adapt and apply training packages formulated at the international level, to the Mediterranean region in order to upgrade women's needs and their participation in planning, technology development, design and implementation of NRSE programmes and projects.

She concluded her speech by extending her best wishes to the participants, resource personnel and observers for a fruitful and successful seminar, and thanked them in advance for their contributions.

B. Adoption of the Programme of Work and Election of Rapporteur

The Programme of Work of the seminar was then adopted by participants (see Annex II). The participants designated Ms Dragica Iskrenovic, the representative of INSTRAW focal point in Yugoslavia, as rapporteur of the seminar.

C. Adoption of the report

After the presentation of all modules and both general and working group discussions, the report of the seminar, including all recommendations made at the seminar, was adopted by consensus. The report was presented by the Rapporteur of the meeting.

D. Closing of the Seminar

The participants recommended that the final report of the Mediterranean training seminar should consist of two parts, namely: report of the seminar and full text of adapted modules for the Mediterranean region. They stressed that the report would enable them to adapt the modules further to national and local levels.

Following the adoption of the report, a closing ceremony was held. Concluding remarks were made as follows.

At the closing of the seminar, Mr. Jogan thanked INSTRAW for the substantive inputs and co-ordination of the seminar; Prof. Novak, Prof. Zupancic, Prof. Lap-Drozg for adapting and presenting the modules; ICPE for collaboration and support given during the seminar; participants and observers who had contributed to make the seminar a success. He said that this seminar also marked the celebration of INSTRAW Tenth Anniversary and was convened in conjunction with the meeting of INSTRAW focal points in the Mediterranean region. He expressed the hope that the follow-up will be seminars at the national level in the Mediterranean region.

Ms Borjana Bulajich, on behalf of INSTRAW, thanked the Centre for Management and Labour Research (CMLR), INSTRAW Focal Point in Yugoslavia and the International Centre for Public Enterprises in Developing Countries (ICPE) for organizing and hosting the seminar. She expressed her heartfelt gratitude to professors Novak, Zupancic, Lap-Drozg for adapting the modules for the Mediterranean region and other resource persons who contributed substantially during the seminar. She thanked INSTRAW Board Member and focal points for their valuable contributions and participants for sharing their experience in the field of women and NRSE. She expressed her gratitude to the Secretariat and support staff for their invaluable technical assistance.

Ms Bulajich expressed the hope that the participants would consider conducting national seminars using the modules.

II. PRESENTATION OF THE STRUCTURE AND METHODOLOGY OF THE MULTIMEDIA TRAINING PACKAGE

The representative of the ILO/TURIN Centre, Mr. Giulio Piva started his presentation by addressing two questions "Why Energy?", "Why women and NRSE"?, to which he answered by pointing out that energy is a key factor in the social and economic development success and consequently there is an increasing demand of energy all over the world.

This fact, he said, will inevitably increase the level of debts for all those countries which cannot rely on indigenous energy resources; in any case the burden of the energy bill will sensibly increase in all the Mediterranean countries with a consequent negative impact on the development process. The only option he said is to undertake actions for energy saving, using energy resources in a more rational way and inflating as much as possible the available indigenous resources. NRSE are obviously indigenous: a conscious inflation of their potential can contribute to the reduction of the energy bill. Since all human beings must contribute to the development process for which the energy resources and in particular NRSE play an important role, it is imperative that women must be able to contribute to the energy component of any development project.

For the above reasons Mr. Piva pointed out INSTRAW and ILO TURIN Centre prepared the multimedia training package on "WOMEN AND NRSE" aimed at

- contributing to a new approach in the organization and management on NRSE systems through the integration of women's needs as well as their participation in planning, technical operations and maintenance, assessment and implementation of NRSE programmes and projects;
- increasing the awareness and capability of planners, officials and experts in charge of the management of energy programmes and women's organizations and institutions of the need to involve women in energy planning and the development and implementation of NRSE projects.

He explained that the training package consists of 5 modular units, namely: An overview of UN activities in the field of NRSE; the role of women in NRSE; relevant NRSE systems: characteristics and technology; NRSE projects and programmes: design and implementation; education and training activities in NRSE, which could be used together in a predetermined sequence for the implementation of a one-week training seminar, or separately in other training seminars. He pointed out that each modular unit is complete in itself and can be easily adapted to different levels of target population. From a pedagogical point of view the structure of each modular unit consist of three main sections: input section - including identification of target population and definition of behavioural objectives; body of the module - including checklist on key issues for group evaluation questionnaire; and, output section - guides the trainees towards the next module or towards remedial activities. The unit is completed by an "Instructor Guide" designed to assist trainers to manage training activities based on the modular package content. Mr. Piva pointed out that the methodology used in preparing the modules was based on a participatory approach, and explained that the modules were conceived as a package containing the following: a trainer's guide, a text, additional reading material, a bibliography, audiovisual materials and evaluation questionnaires for trainees and trainers.

The training package is completed by a guide for the organization of seminars and an annotated bibliography. The modules, he said, addressed specific target groups: development planners and senior officials of the management of energy programmes; and senior officials of women's organizations and non-governmental institutions at national, regional and international levels.

He concluded by stating that the training package was validated during a series of seminars conducted in Ethiopia, Egypt, Tanzania, and a flexible course for training of trainers organized and conducted at the ILO Turin Centre in co-operation with INSTRAW.

III. PRESENTATION AND DISCUSSION OF THE MODULES

Module I "An Overview of the United Nations Activities in the Field of New and Renewable Sources of Energy" was presented by INSTRAW representative, Ms Borjana Bulajich.

In her presentation Ms Bulajich noted that one of the major initiatives of the United Nations system began in August 1981 with the United Nations Conference on New and Renewable Sources of Energy (UN NRSE) convened in Nairobi, Kenya. The Nairobi Programme of Action (NPA) was adapted for the Development Utilization of New and Renewable Sources of Energy which still represents the basic framework for the United Nations activities in NRSE. The NPA called for concerted international co-operation and identified the main areas for action to promote the development and utilization of NRSE.

She pointed out that it was agreed that the implementation of the Nairobi Programme of Action was to be carried out in a decentralized manner and that it required the participation of all concerned. With respect to concerted international action, the programme defined the following priority areas:

- a) Energy assessment and planning;
- b) Research, development and demonstration;
- c) Transfer, adaptation and application of mature technologies;
- d) Information flows;
- e) Education and training.

In 1987, she said, the United Nations convened a high-level meeting of experts to review and assess the implementation of the NPA. The experts recognized that the pace of implementation of the NPA was slower than anticipated, mainly because as the price of oil went down, interest in the development of NRSE decreased. Other constraints were identified in difficulties in promoting dissemination and inadequate attention to cultural, social and institutional aspects of energy development, including the insufficient involvement of women in the planning and implementation of NRSE projects and programmes. Ms Bulajich noted that there is renewed interest in NRSE because of the growing concern for the detrimental effects of deforestation and excessive combustion of hydrocarbons on the ecological balance of many regions of the world and of the entire planet.

She briefly illustrated the respective roles and activities of the United Nations organizations and bodies in the field of NRSE. She mentioned that an Inter-Agency Group on NRSE was created following the Nairobi Conference. A Special Co-ordinator on NRSE was appointed in the Office of the Director-General for Development and International Economic Co-operation of the United Nations.

She pointed out that women as agents in and beneficiaries of the development and utilization of NRSE must be fully integrated in the implementation of all activities in this field, within the United Nations system. The Nairobi Programme of Action, she said, recognized the special role women play in NRSE and that every effort should be made to ensure that actions in this field involve and benefit men and women equally.

Ms Bulajich stated that INSTRAW assists in ensuring that United Nations Agencies consider the impact their energy programmes and policy statements have on the status of women by improving the data base which the agencies may use and documents projects in which an effort has been made realistically to assess the position of women in the target community. INSTRAW provides as well important service by collecting existing information on how to involve women more effectively in NRSE projects, programmes and policies, analyses it and makes it available to all interested parties. This information is used as material in modular training programmes.

Ms Bulajich explained the various activities INSTRAW has undertaken in this area, such as: production of multi-media training package on "Women, New and Renewable Sources of Energy"; organizing and conducting training seminars at national, regional and international levels similar to the present one; establishing an international network of contacts to promote the technical cooperation among developing countries(TCDC) concept and the incorporation of women into activities to implement the Nairobi Programme of Action; preparing articles for periodicals and public information materials.

The following two key issues for discussion were then brought to the attention of the participants:

1. How can the activities of the United Nations in the field of NRSE be enhanced?
2. How can women's needs be better integrated into United Nations activities and the Mediterranean region in the field of NRSE?

The participants then divided into two working groups. The working groups presented their respective reports as follows:

Report of Group I

The participants expressed their interest in the activities of the United Nations on NRSE. The interlinkages of energy issues and women, as indispensable factors of development, were stressed as most crucial in order to achieve an integrated approach.

It was recommended that the information and knowledge gathered within the United Nations system on NRSE should be widely distributed at local, national and regional levels.

It was recommended that the exchange of data bases, various training materials should be strengthened within the national institutions and co-ordinated with institutions involved in this subject matter at regional and international levels.

The need to have better channels for information exchange (printed, visual) within the region was highlighted as one of the priorities.

It was also recommended that United Nations should provide adequate training materials, training seminars, consultancy assistance and exchange of information at national and regional levels on women and NRSE.

Report of Group II

The group recommended that the need for exchange of technical information and economic and technical efficiency of various energy technologies should be strengthened at national, regional and international levels.

The need for exchange of information, training materials, and training seminars should be co-ordinated among various institutions at the national level and with the counterpart agencies at Mediterranean, international levels as well as the United Nations system.

It was stressed that the organization of energy production is well co-ordinated, while more concerted strategies are needed in the field of energy consumption at various level. It was recommended that the economic incentives should be strengthened for energy conservation activities and efficiency use of household activities.

It was also stressed that more public information should be available to consumers and various pressure groups at all levels.

The group recommended that more education and training should be made available to different target groups at all levels. The need for human resource development, particularly of women and in certain instances children, was stressed as one of the prerequisites for sustainable development. Furthermore, through the formal education system and various training seminars, the information about the potentials of new and renewable sources of energy and the role of end-user's, specifically women, should be stressed at national and regional levels.

The participants recommended that INSTRAW through its focal points at the national level should continue to provide information and training within the field of women and new and renewable sources of energy, as well as in various subject matters related to the sustainable development.

Module II. The Role of Women in NRSE, was presented by Dr. Marija Lap-Drozg, Faculty of Education, Ljubljana

Dr. Lap-Drozg adapted the module for the national level and focussed on a current status and advancement of women in the energy intensive economy. She pointed out that the weekly amount of time dedicated to housekeeping in Slovenia takes into account the time allotted for food preparation, cleaning, washing, ironing, the mending, sewing, and other. She elaborated in detail on the role of women in energy sector with emphasis on the employment of women and housekeeping; time allotted weekly to housework; structural tendencies which include revenues, free time, budget and preferences of the household; reduced workload of women in domestic household; and statistics on household appliances in Slovenia. Each of the above subject matters was supplemented with data and statistics.

She pointed out that the inclusion of energy-oriented and technological content into the education, research and information areas should become one of the major objectives of the present and the future at national and international levels.

Dr. Lap-Drozg stressed that the conservation of human's environment and the use of renewable sources of energy should give rise to the responsibility for the protection and the advancement of the quality of life and should be integrated into the existing curriculum of the compulsory and vocational education and training.

She underlined that the goals are the following:

- presentation of the energy situation; the needs of the households and farming which can be met with renewable sources of energy; research of the local management of energy; study on the needs and energy supply with emphasis on renewable energy sources; analysis of the cost-effectiveness from the viewpoint of the work input and used energy; analysis and assessment of the use of local energy sources.

At the university level of education, she stressed that the following are the main areas for the technical, economic and organizational studies on the use of NRSE: specific problems, interdisciplinary orientations and selected orientations.

Dr. Lap-Drozg concluded by pointing out that the feasibility study of the involvement of women in NRSE technologies should be strengthened at national and regional levels.

Module III: NRSE Projects and Programmes: Design and Implementation was presented by Prof. Novak, Faculty of Mechanical Engineering, Ljubljana.

Mr. Novak adapted the module for the Mediterranean region and explained rational use of energy and renewable sources in Yugoslavia. In his presentation he elaborated on all sources of new and renewable energy and explained basic characteristics, use and applications of them. He provided statistics and data on the use of various sources of energy in the Mediterranean region as well as the future scenario of the energy demand.

He pointed out that there are two main reasons for the rational use of energy: conventional energy sources are limited due to the scarcity, price and availability and are also connected with political decisions and use of fossil fuels, such as: oil and coal. They have a serious environmental impact on health aspects and climate changes. He stressed that the analysis show that 39% of forest in Yugoslavia and over 52% in West Germany is deteriorating, and damage of ozone core is quite obvious.

Mr. Novak explained that in the Mediterranean region there are three basic energy demand projections for the future, namely; risk energy use (high scenario growth); low energy use (middle scenario growth); and, zero energy growth. The zero energy growth is most suitable due to the fact that it should reduce energy use in the developed countries, but is almost impossible to be achieved. The scientific community is advocating the low energy use which can provide ecological, economical and energy equilibrium worldwide.

He explained the definition of the newly proposed vertical/horizontal energy system with three main energy carriers: methane, methanol, and electricity and stated that this system will enable efficient use of renewable energy sources.

Mr. Novak described most important renewable energy sources: solar, wind, geothermal, hydro and biomass applicable for the Mediterranean region. He elaborated the weaknesses of these sources, which are: time dependant, low density, and presented the low efficiency of equipment.

Today, he pointed out, solar energy is being used for hot water, production of electricity and for passive solar heating. In Yugoslavia, he also explained that there are a number of geothermal baths and mini-hydro.

Finally, Mr. Novak concluded by explaining potentials of each energy source for each Mediterranean country.

Rational use of energy and environment protection in Slovenia, was presented by Prof. Jozе Zupancic, Faculty of Mechanical Engineering, Ljubljana.

Mr. Zupancic pointed out that the present fuel mix for domestic and tertiary use in Slovenia, populated mostly in basins, is substantially contributing to air pollution. Analysing the energy use trends of individual sources for about twenty-years and their effects on pollution in basins, he proposed ecologically and economically long-term concept of energy supply for domestic and tertiary use until the year 2020. In the ecological scenario, he said that earth gas in final energy supply for domestic and tertiary use has a growth of 4% to 29%, while renewed sources from 20 to 32% (hydro, solar, wood). The result is reduction of air emission for about 80%. The technological concept and the way of implementation has been discussed.

The participants then divided into two working groups. The following issues were discussed:

1. How to implement "radical" energy planning and assessment to achieve sustainable development?
2. How to join international efforts to establish unified methodology of data gathering needed for energy planning?

Report of Group I

The Group recommended the "radical" energy planning and assessment for sustainable development through three types of measures: behavioural change which can be achieved through mass media and creating public awareness; change of technology; and rational use of energy, such as: recycling waste material.

It was stressed that an essential component in the transition to realistic energy pricing will clearly be the promotion of public awareness of the true cost of energy, including costs to the environment.

The Group recommended that in order to achieve sustainable development and sustainable energy future, human resources development and energy issues should be planned in an integrated approach within the context of the national planning policies.

It was recommended that the energy policy must take into account the full environmental costs of energy production and use, and not simply be on supplying energy to meet a certain level of aggregated project demand, as well as cost-effectiveness of new technologies by optimizing the advanced technologies and sound indicators.

It was recommended that certain countries must include into energy policy development, strategies compatible with their traditions, sectoral structure and available resources. The need for closer regional and interaction co-ordination was stressed.

Report of Group II

The Group stressed that the lack of internationally comparable data makes it difficult to monitor growth prospects and assess the potential for new and renewable sources of energy. More data is particularly needed on the environmental impacts of new and renewable sources of energy.

The Group pointed out that the research, development and demonstration costs required for the widespread development and application of new and renewable sources of energy makes it imperative that the technological aspects be facilitated. Particular emphasis must be placed on international comparable data that can be used by various institutions at national and regional levels.

It was recommended that within the United Nations system and Committee on the Development and Utilization of New and Renewable Sources of Energy, the international efforts should be combined to provide comparable data on energy planning to institutions at local, national and regional levels.

They reiterated that UN/INSTRAW should continue not only to collect, and disseminate information on women and energy and to produce training materials on this subject but as well to assist in the international efforts in preparing statistics and data on women and energy.

It was recommended that the international initiatives must be supported by appropriate regional and national actions in preparing comparable data on energy planning and environmentally sound energy development.

The Group recommended that at the national level there is a need to establish comparable data on various sources of energy, energy planning and assessment for local and national levels. The data should be available through statistical institutes and/or national institutions on compatible basis.

It was recommended that INSTRAW focal point in Yugoslavia should continue to disseminate information of the United Nations activities in this development area at the national level.

Following the Group's presentation Ms Naidenova, representative from INSTRAW's focal point in Bulgaria gave an overall presentation on the situation of energy in Bulgaria and its impacts on economic development. She explained that high energy costs are affecting daily lives and emphasized the need to integrate women in all levels of energy projects, programmes and policies.

Module IV, Relevant NRSE systems: Characteristics and Technology,
was presented by Prof. Novak, Faculty of Mechanical Engineering, Ljubljana.

Prof. Novak elaborated on different systems and technologies for use of renewable sources. He said that some NRSE techniques are mature, others are still subject to major developments, not only technical and economical characteristics, but also environmental, infrastructural, social and human (users).

He elaborated on solar energy systems. He described all possibilities of technical use of solar energy for water heating and industry heating. He said that solar heating is also called passive solar system. Three basic types of passive heating elements are: window, trombwall and greenhouse. Furthermore, he pointed that there are possibilities to convert solar radiation directly into electricity by using solar cells.

In some parts of the world there are also possibilities to convert wind into electricity by using different types of turbines which is also applicable for irrigation purposes.

Mr. Novak explained various types of turbines and their usage. He continued his presentation by reiterating the importance of hydropower energy as a renewable source of energy which offers a number of advantages: non-polluting, reliable, multipurpose and easy to exploit.

Finally, he showed a slide presentation about existing solar projects worldwide with special aspects to the active and passive systems in Yugoslavia, which are composed of more than one hundred active solar systems on the Adriatic coast.

A study visit was organized for the participants to visit Commercial Passive Solar Heating Building SOP Krsko in Ljubljana, which is a pilot project for Passive Solar Heating.

Rational Use of Electricity in Households was presented by Ms Lilijana Stefancic, Electro-economic Institute of Ljubljana.

Ms Stefancic pointed out that women are the main users of electricity in households. She said that the general consumption of electricity is 260 kw per household, while the average consumption is 20% or 300 kw. Two tariff times are established for energy consumption. In Slovenia, consumption reduced for 1% during the last year for household use. One of the reasons for saving energy consumption and rational use was due to creating public awareness.

She explained that the two ways to achieve rational use of energy are: level of performance of household appliances and behavioural change in the household. As well, manufacturers have improved many household appliances, such as water boiler, washing machines, etc.

She stressed that in Slovenia there are two problems: new appliances are more expensive than traditional appliances, and user's have no information on various appliances but have to rely on manufacturers. Therefore, the label on the energy efficiency should be introduced in order to enable consumer to select rational appliances. Accordingly, the cost of energy saving appliances should be reduced in order to enable the user to apply rational use of energy.

Furthermore, she presented statistics of the yearly consumption of energy in households in Slovenia and elaborated in detail on the consumption of various appliances such as: boilers, washing machines, refrigerators, and other cooking appliances. She also explained various light-bulbs and lamps which are adapted for rational use of energy.

She underlined that the possibility of introducing more flexible two tariff system would enable low price, medium price and high price of energy consumption. As well, the attempt to create awareness among general public and education of various target groups for rational use of energy, should be continued through all media channels.

Ms Stefancic elaborated on the various TV and radio programmes prepared for different target groups and written documents for professionals in the sector on the rational use of energy. She stressed that multidisciplinary approach and further dissemination of information at all levels on the rational use of energy should be further strengthened.

The participants discussed various aspects of multidisciplinary approach to NRSE for involving women at national and regional levels. The need was felt that due to the fact of sectoral approach to energy, multidisciplinary approach would be necessary to combine compatible data which would consist of technical aspects, human resource development, policy aspects and financial aspects, into an integrated approach at national level.

It was therefore recommended that it would be useful to establish within INSTRAW focal point a group on energy and women at national level which would serve to this purpose, as well as for dissemination and exchange of information, preparing information, educational/training material and coordinating activities. It was suggested that INSTRAW focal points in their respective countries could also contribute to this aim.

Introduction of Integrated Energetic Systems in Agriculture was presented by Mr. Bertok and Integrated Energetic System on a Farm Specialized in Milk Production, was presented by Mr. Jecic.

Mr. Bertok pointed out that 'agriculture' is one of the main users as well as one of the main sources of energy. He said that there are possibilities of production of energy at the farm, such as: solar energy, hydro-energy, biomass, wind energy. The conventional source of energy is electricity. In agriculture, he said the problem is to co-ordinate and balance consumption and sources of energy and needs. He presented as example a statistical graph of sources of energy and needs at the farms.

He stated that there is a need to do research and prepare compatible data at national and international levels. In the United Nations system an integrated approach of energy and agriculture has been launched by FAO. The programme is computerized and methods of implementation and evaluation were elaborated. He pointed out that this model will be applied at regional, national and local levels.

Mr. Jecic presented the work in research for the integrated energetic system in agriculture. He explained a case study of a farm on how to replace existing energy sources with new energy sources and how to make integrated energy system for biomass. Another case study he presented is a Trebnje Project with integrated energy system for agriculture. This method is used in some parts of Slovenia especially in the region of Dolerijska. A similar project was initiated by the co-operative of Novo Mesto.

He explained that for a farm specialized in milk production with 40 LU, situated in the region of Gorenjska, an integrated energetic system with three alternative energy sources was programmed and an economic analysis of investment profitability in conversion facilities was made. The integrated energetic system includes: solar energy, biogas, and wood wastes. From the renewable sources the farm can cover all its requirements for thermal energy and approximately 50% of those for electrical energy, i.e. 77% of all the requirements for energy. Investment in the biogas production facilities and conversion in the electrical energy makes 88% of the total investment value of the programmed integrated energetic system. He said that economically justified investments in biogas production and cogeneration in the electrical energy will be acquired in Slovenia only at a relevant lowering of investment costs, and also with adequate price of electricity.

After general discussion, INSTRAW/ILO Turin Centre sound-slide package on "Women and New and Renewable Sources of Energy" was presented.

Education and Training Activities in NRSE Projects, was presented by INSTRAW representative, Ms Borjana Bulajich.

Ms Bulajich started her presentation by pointing out that education and training needs for NRSE cannot be considered independently from other needs, but must be approached in an inter-sectoral and inter-disciplinary approach. She explained INSTRAW's training programmes and innovative multi-media modular training methodologies. Education and training have to be seen as one element in an integrated programme for NRSE development and use. The energy-related training must be carefully planned in order to ensure that trainers, both women and men, are actually able to use their newly-acquired skills within the energy sector. The objective for training programmes must be the productive employment and engagement of the trainees and not simply the completion of another training course.

She stressed that the participation of women in the field of energy could be greatly increased through education, training and participation in NRSE projects. One of the most critically important factors affecting women's status is inadequate or non-existent education and training.

Furthermore, she elaborated on general guidelines and activities for training women in NRSE. She underlined that special efforts need to be made to:

1. identify women's needs and potential to train them accordingly, particularly in technical and managerial skills regarding project development, operation and maintenance;
2. encourage women's participation in post-graduate studies and training as engineers, scientific research workers and energy planners.

She pointed out that assessment and planning of training should be carried out in view of needs assessment which would include women's needs, and presented various training methodologies and approaches such as: training in situ; training of trainers; modular approach; learned-centred methods; mass media; traditional women's role as trainers; and training of extension workers. She presented an example of a training programme which could be used for different target groups, various training needs and different subject-matters, and adapted to different regions.

The representative of INSTRAW concluded by emphasizing the importance of monitoring and evaluation of training programmes and training methodologies. She underlined that there are different forms of evaluation, but each methodology has two distinct phases: the evaluation of the training process, and the evaluation of results on the impact of training on the acceptance level, and of the efficiency and effectiveness of the NRSE projects and programmes.

The discussion followed on how to use and apply different types of training methodologies for various aspects of energy policies, projects and programmes.

One of the participants explained that three groups of students made a research study of rural household including energy consumption in the commune of Trebnje. There is an on-going experimental FAO project "Integrated development of less developed parts" for Yugoslavia. She pointed out that special attention is paid to the education of women as they constitute 74% of population involved in agricultural production.

ANNEX I

LIST OF PARTICIPANTS

RESOURCE PERSONS

Mr. Giulio Piva
Chief Training Operations
ILO/Turin Centre
125 Corso Unita d'Italia
Torino
Italy

Ms Borjana Bulajich
Social Affairs Officer
United Nations International Research and Training
Institute for the Advancement of Women (INSTRAW)
P.O. Box 21747
Santo Domingo
Dominican Republic

Ms Marija Lap-Drozg
Professor
Faculty of Education
University of Ljubljana
Kardeljeva ploscad 16
61000 Ljubljana
Yugoslavia

Mr. Peter Novak
Full-time Professor
Faculty of Mechanical Engineering
Murnikova 2
61000 Ljubljana
Yugoslavia

Mr. Joze Zupancic
Associate Professor
Faculty of Mechanical Engineering
Murnikova 2
61000 Ljubljana
Yugoslavia

Ms Lilijana Perci Stefancic
Technical Advisor
Electro-Distribution Company
Hajdrihova 2
61000 Ljubljana
Yugoslavia

PARTICIPANTS

Mr. Ciril Arkar
Student/Faculty of Mechanical Engineering
University of Ljubljana
Murnikova 2
61000 Ljubljana
Yugoslavia

Mr. Borut Bartol
Student/Faculty of Mechanical Engineering
Funtkova 40
61000 Ljubljana
Yugoslavia

Dr. Katja Boh
Minister for Health and Social
Security of the Government of Slovenia
Ljubljana
Yugoslavia

Ms Cristina Pleite Jimenez
Technical Consultant
Ministry of Energy and Industry
Po. Castellana 160
Madrid, Spain

Mr. Ota Kazuo
Professor of Politics
91-2 Napporo Wakaba Cho
Ebetu Hokkaido
Japan

Mr. Igor Kulovec
Student/Faculty of Mechanical Engineering
Mirana Jarca 11
68000 Novo Mesto
Yugoslavia

Ms Sonja Lokar
Member of the Parliament
of the Republic of Slovenia
Vodnikova 44
61000 Ljubljana
Yugoslavia

Mr. Saso Marjanov
Student/Faculty of Mechanical Engineering
M. Velvscka 10
Nova Gorica
Yugoslavia

Ms Janja Markovic
Teaching Assistant
Pedagogic Academy
Zakotnikova 9
61000 Ljubljana
Yugoslavia

Mr. Saso Medved
Teaching Assistant
Faculty of Mechanical Engineering,
University of Ljubljana
Murnikova 2
61000 Ljubljana
Yugoslavia

Mr. Jurij Mlinsek
Student/Faculty of Mechanical Engineering
Slovenca 66
61000 Ljubljana
Yugoslavia

Ms Penka I. Naidenova
Vice-President of Pres Commission
Research Commission of Women
Presidium of the Bulgarian Academy of Science
INSTRAW Focal Point in Bulgaria
Arsavov St.
Sofia 10003
Bulgaria

Ms Mara Rupena-Osolnik
Co-operative Union
Gregorciceva 9a
61000 Ljubljana
Yugoslavia

Mr. Tomaz Poje
Agricultural Institute of Slovenia
Bacquetova 2
61000 Ljubljana
Yugoslavia

Ms Jelena N. Grasevska-Sekerinska
Engineer
Electro-Economic Institute of Macedonia
Ilinden 9
91000 Skoplje
Yugoslavia

Mr. Janko Ivan Seljak
Advisor for Statistics
Republic Institute for Statistics in Slovenia
Vozarski pot 12
61000 Ljubljana
Yugoslavia

Ms Milivoja Sircelj
Demographer
Republic Institute for Statistics
Reboljeva 8
61000 Ljubljana
Yugoslavia

Mr. Bojan Suvorov
Engineer
Faculty of Mechanical Engineering
Murnikova 2
61000 Ljubljana
Yugoslavia

Ms Vida Tomsic
INSTRAW ex-Board Member
INSTRAW Focal Point in Yugoslavia
Kardeljeva Ploščad 1
61000 Ljubljana
Yugoslavia

Mr. Lojze Zgajnar
Engineer of Forestry
Institute for Forestry and Wood Industry
Vecna pot 2
61000 Ljubljana
Yugoslavia

ORGANIZERS

Centre for Management and Labour Studies

Mr. Savin Jogan
Director
INSTRAW Focal Point in Yugoslavia
Kardeljeva ploscad 1
61000 Ljubljana
Yugoslavia

Ms Dragica Iskrenovic
Executive Advisor for International
Affairs and Co-operation
INSTRAW Focal Point in Yugoslavia
Kardeljeva ploscad 1
61000 Ljubljana
Yugoslavia

United Nations International Research and Training Institute for the Advancement of Women (INSTRAW)

Ms Borjana Bulajich
Associate Social Affairs Officer
César Nicolás Penson No. 102-A
P.O. Box 21747
Santo Domingo
Dominican Republic

International Centre for Public Enterprises in Developing Countries

Mr. V.K. Dar
Executive Director
Titova 104
61000 Ljubljana
Yugoslavia

Ms Gorana Sipic
Head - Programme on "Women in Development"
ICPE
Titova 104
61000 Ljubljana
Yugoslavia

Government

Mr. Miha Tomsic
Minister for Energy of the
Republic of Slovenia
61000 Ljubljana
Yugoslavia

Ms Marija Lazarevic
Head of Division for NRSE
Federal Secretariat for Energy
and Industry
Bulevar Avnoja 104
11070 Beograd
Yugoslavia

Ms Metka Mencin
President of Committee for Women Politics
Assembly of Republic of Slovenia
Subiceva 4
61000 Ljubljana
Yugoslavia

ANNEX II

PROGRAMME OF WORK

Tuesday September 18

Opening of the seminar

Presentation of methodology of the seminar and its objectives

Presentation of Module I: "An Overview of the United Nations Activities in New and Renewable Sources of Energy"

Group Work

Wednesday September 19

Presentation of Module II: "The Role of Women in NRSE"

Presentation of Module III: "NRSE Projects and Programmes: Design and Implementation"

Presentation of Rational Use of Energy and Environment Protection in Slovenia

Group work

Thursday September 20

Presentation of Module IV: "Relevant NRSE Systems: Characteristics and Technology"

Presentation of Rational Use of Electricity in Households

Group Work

Presentation of Integrated Energetic System in Agriculture and Integrated Energetic System on a Farm Specialized in Milk Production.

Presentation of Module V: "Education and Training activities in NRSE Projects and Programmes"

Group Work

Study visit to SOP Krsko

Friday September 21

Study visit - Health Centre in Litija.

Presentation and Discussion of Report

Closing of the Seminar

PART TWO

Adapted INSTRAW-ILO/Turin Centre multi-media training
package on "Women and New and Renewable
Sources of Energy" for the Mediterranean region

1. POTENTIAL OR RENEWABLE ENERGY SOURCES IN THE MEDITERRANEAN COUNTRIES

PETER NOVAK

- Phd in Mechanics
- Presently working at University of Ljubljana
Department of Mechanical Engineering
- Head of Laboratory for Heating, Solar and Sanitary Technique
- Chairman of Research Project: New Energy Technologies.
(Slovenia, YU)

POTENTIAL OR RENEWABLE ENERGY SOURCES IN THE MEDITERRANEAN COUNTRIES

Contents:

1. Introduction	6
2. Renewable Energy and the Running Out of Resources Myth	7
2.1. History of Energy Mix	7
2.2. Environmental Impact	8
2.3. Energy Outlook and Renewable Energy Sources	13
2.4. Energy System and Renewable Energy Sources	17
3. Fundamental Principles and Evaluation Methodology of Renewable Resources	21
3.1. Fundamental Principles	21
3.2. Evaluation Methodology	21
4. Potential of Renewable Energy Sources in the Mediterranean Countries (MC)	23
4.1. Solar Energy	25
Annex I.	29
4.2. Wind Energy	36
Annex I.	42
Annex II.	46
4.3. Hydro Energy	56
4.4. Biomass	58
4.5. Geothermal Energy	61
5. Conclusions	65
6. Nomenclatures	66
7. Bibliography	67

FIGURES

- Fig. 1 Economic growth and demand for energy in 2000 (2)
- Fig. 2 Global energy substitution (3)
- Fig. 3 Annual carbon dioxide emissions resulting from fossil fuel combustion, 1860-1949 (2)
- Fig. 4 Evolution of the hydrogen - to - carbon ratio in the world's fuel mix 1985-2030 (1)
- Fig. 5 Principles of transport and deposition of SO_2 and NO_x (2)
- Fig. 6 Effects of air pollution on a forest ecosystem (2)
- Fig. 7 Projections of the world primary energy consumption (2)
- Fig. 8 Projection of the capita world energy consumption (2)
- Fig. 9 Evolution of world supplies (scenario C) (2)
- Fig. 10 World Solid fuels (2)
- Fig. 11 World Natural gas (2)
- Fig. 12 World oil (2)
- Fig. 13 World Uranium (2)
- Fig. 14 IIASA Scenario: Global Primary Energy Consumption and Mix (2)
- Fig. 15 WEC Scenario: Global Primary Energy Consumption and Mix (1)
- Fig. 16 Energy consumption per capita and population (1985), (2)
- Fig. 17 Vertically Integrated Energy System (VIES), (8)
- Fig. 18 Horizontally Integrated Energy System (HIES), (8)
- Fig. 19 Vertically and Horizontally Integrated Energy System (WHIES), (9)
- Fig. 20 Energy use and economic growth, (GNP) between 1960-1980 in the Mediterranean Countries
- Fig. 21 The Mediterranean Countries Energy Mix 1960-1980
- Fig. 22 Mediterranean Countries Fossil Fuel Proven Reserves
- Fig. 23 Annual average global irradiation on a horizontal surface (10 years means, $\text{kWh/m}^2 \text{ day}$) (31)
- Fig. 24 Locations and members of the meteorological station and other towns for which the solar data are given (29)
- Fig. 25 Map I to XIII The daily mean sum of the solar global irradiation on a horizontal surface (in Wh/m^2) for each month in the year and yearly average (map XIII) (29)
- Fig. 26 Monthly mean values for the maximum available wind energy flux E_f (____) in W/m^2 and the mean wind speed m_v (---) in m/s for high (Naxos), medium (Kythira) and low (Heraklion) energy potential station (19)
- Fig. 27 Annual cumulative frequency distribution curves for the three stations (RA, MF and AQ) in Jordan (20)

- Fig. 28 Classes of wind speed and energy flux (14)
- Fig. 29 Plot of the area under study showing the location of the surface stations and the division of the area for simulation
- Fig. 30 to Fig. 41: Isovents (m/s) at 10m above surface for January to December
- Fig. 42 Subareas with the largest wind energy potential
- Fig. 43 The location of the stations utilized in the present study
- Fig. 44 Probability density distribution of the wind speed
- Fig. 45 Plot of the scaling weibull parameter c , k and mean wind speed m_v
- Fig. 46 Rivers in Mediterranean Region
- Fig. 47 Development of primary energy demand
- Fig. 48 Noncommercial energy use in the MC
- Fig. 49 Noncommercial energy-composition change in the MC
- Fig. 50 Locations of important geothermal fields in Yugoslavia
- Fig. 51 Region with geothermal hot water wells in Slovenia, YU

TABLES

Table 1: Environmental impact of various energy sources (2)

Table 2: Commercial energy use in the Mediterranean countries 1960-1980 (2)

Table 3: Yearly solar energy potential in the Mediterranean countries and Mediterranean sea

Table 4: Solar energy contribution to the energy demand in the Mediterranean countries

Table 5: Theoretical wind energy potential in MC

Table 5a: Wind energy contribution to the electric energy demand in the Mediterranean countries

Table 6: Identification of Resource, Site Selection and Evaluation

Table 7: Site Requirements: Relationship of Site-specific Characteristics to Design Parameters

Table 8: Environmental Impacts and Land-Use Considerations

Table 9: Characteristics of the different observatories used in the study

Table 10: Mean values of velocity and direction at the upper surface

Table 11: List of the stations in Fig. 45 along with some additional information on their operational duration and characteristics

Table 12: Daily mean with wind speed above 12 m/s (Period 1949-58)

Table 13: Wind energy data for Senj

Table 14: Hydro-power plants capacity and electricity production in year 1980 in the Mediterranean Countries

Table 15: Noncommercial energy use in the MC

Table 16: Possible Biomass Production in the MC

Table 17: Availability of Geothermal resources in the Mediterranean area (Ref. to 3.5 km depth)

Table 18: Estimation of Primary Reserves (to 50°C)

Table 19: The Characteristics of some Geothermal Locations

1. INTRODUCTION

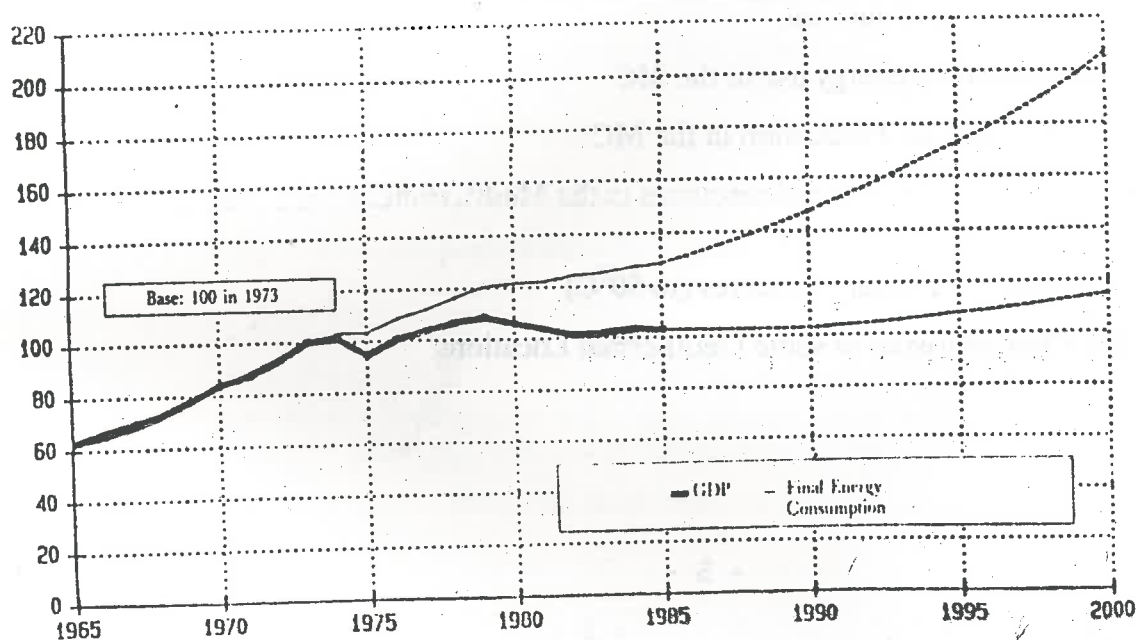
The most notable changes on the world energy scene since 1973 concerned the shift in OPEC's role from a base to a swing producer, the disruption of the fast market, penetration of nuclear power, and the impact caused by the technical advances at essentially all stages of the energy system. Further, several parts of the world witnessed a strong environmental movement which attracted public attention to the conduct of the energy industry and its social implications and environmental consequences (1). The future world energy outlook includes many different scenarios. Each scenario in itself appears internally consistent. The diverging projections of future energy demand and supply mixes in these scenarios are the results of the inclusion or omission of technical development dynamics in to the analyses.

The aforementioned changes on the world energy scene are commonly attributed to five major factors:

- the price response of consumers has led to efficiency improvements, conservation activities, behavioral adjustments and economic structural changes
- interfuel substitution
- sluggish performance of the world economy
- steep increase of non OPEC oil production
- the increasing weight of environmental concerns.

Energy efficiency improvements, less energy in intensive process designs and better energy management were the overall results of substituting capital for energy, the development of new technologies or both. The impact of energy equipment replacement process (or energy conservation) became increasingly evident as time elapsed. The energy intensity, i.e. the energy input per unit of economic output, fell by some 20% between 1973 and 1986 (Fig. 1). During the last decade, the industrialized countries (OECD) have achieved an objective, which appeared impossible in the early 1970's, namely the separation between the economic growth and the growth of energy use (2). Some studies suggest that these trends should continue and may even be intensified. Innovations in the field of energy use are far from finished.

Fig. 1 Economic growth and demand for energy in 2000 (2)



2. RENEWABLE ENERGY AND THE RUNNING OUT OF RESOURCES MYTH

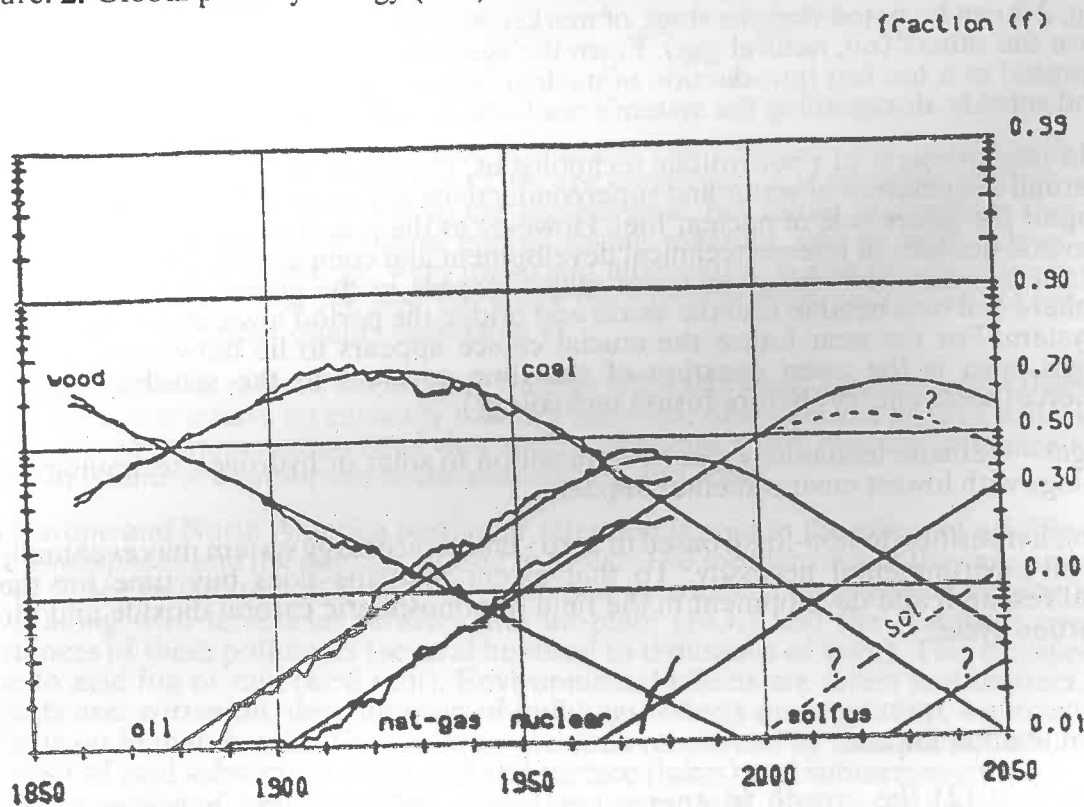
2.1 History of energy mix

Historically, between 1960 and 1973 the global primary energy use has been growing on the average by approximately 2.2% annually. In the period from 1973 to 1986 the growth was only 1.9% per annum. Future energy demand growth will be increasingly influenced by the economic and technical performance of the developing countries. The primary energy mix or the contribution of the different energy carriers to primary energy supply has also undergone some notable change. The choice of primary energy depends on a variety of factors such as resources and technology availability, level of development, government policy, price, and environmental regulation. An overview of the long-term estimates of economically available natural resources shows a universal constant reserve - to - production ratio of some 20 years (3). It appears that the world never shifted one resource to another because of running out of the old resource.

Indeed, the world does continuously shift from one resource to another, particularly in fuels. The fundamental driving force for doing so is that new and improved technology responding to changing demographic, economic, structural and cultural trends has made a new, better, and previously unimaginable resource available for new and improved services. The shift occurs because the new resource steadily becomes more available, and provides the marketplace with a new and/or better product or service, - and not because the old resource is exhausted.

In the past, the intensive use of each major resource was abandoned long before the world ran out of it (use of wood for heating, wind for windmills or water pumping etc.). Reason for these shifts is that technology makes the new resource much more available and acceptable than the old one and serves the old and the new marketplace demands alike. Fig. 2 (3) shows the global primary energy resources, starting in the middle of the last century and projected in the first half of the next century.

Figure 2: Global primary energy (fuel) substitution



On a market share basis, wood, once the dominant primary fuel, was replaced by coal. Then, that coal was replaced by oil. And now today, natural gas is seriously cutting into oil market leadership. Also nuclear fuel is rising rapidly. These transitions occurred despite the fact that resources of wood, coal and oil are still plentiful. In fact today, well over a century after wood lost its predominant position, the world's annual biomass production (70 Mtoe) exceeds the needs to fuel the world by a factor of ten (7.8 Mtoe), and is technically (not economically) realizable by a factor of 0.5 (cca 4.0 Mtoe).

Wood was abandoned because coal-mining and coal use technology developed to a point where coal evolved as a clearly superior energy source. Oil displaced coal simply because it was the focus of a set of new and vastly superior technologies, based on a superior primary fuel. On the end-use side, refined oil products are far superior to coal for powering trains, cars, aircraft, generating electricity, heating building, etc. By the 1960's oil displaced coal both on a market share and absolute basis. Again, the replacement occurred not because the world was running out of coal. For even today, conventional wisdom still holds that coal is by far our most abundant fossil resource.

The coal market has had its "ups and downs" around the generally losing trend, with the most recent up in 1970's. This recent growth spike is possibly a short lived aberration, because:

- the recently recognized environmental hazards and connected cost of using coal
- the rapidly growing market share of relatively cheap natural gas
- the long term (20 - 30 years) continuing availability of relatively "cheap oil"
- the dynamic improvement of gas technology for a combined cycle
- the introduction of second generation (several decades from now) nuclear technology, with much lower environmental impact
- the continued progress in the development of efficient low cost solar technology (thermal, photovoltaic).

From Fig. 2 it can be noted that the slope of market penetration of nuclear energy ranges well above the others (oil, natural gas). From the system's view this overshooting might be interpreted as a too fast introduction of nuclear technology advanced by government policy and subsidy, disregarding the system's readiness to adopt and accept it.

The rapid improvement of photovoltaic technologies, the latest advances in the field of photothermal dissociation of water and superconductivity are other critical variables that might impair the future role of nuclear fuel. However as the future will unfold, first there will be several decades of intense technical development and competition. Given the time constant for any new technology to make major inroads in the global primary energy market, there will be a need to fuel the world and bridge the period towards a sustainable energy system. For the near future the crucial choice appears to lie between coal and natural gas, also is the open question of the time constant to the sensible market penetration of solar energy (before fusion technology).

Natural gas - methane technology can be a transition to solar or hydrogen technology as a technology with lowest environmental impact.

Therefore, a transition to non-fossil based or zero - emission energy system may eventually become an environmental necessity. To that extent methane does buy time for the additional research and development in the field of atmospheric carbon dioxide and the global carbon cycle.

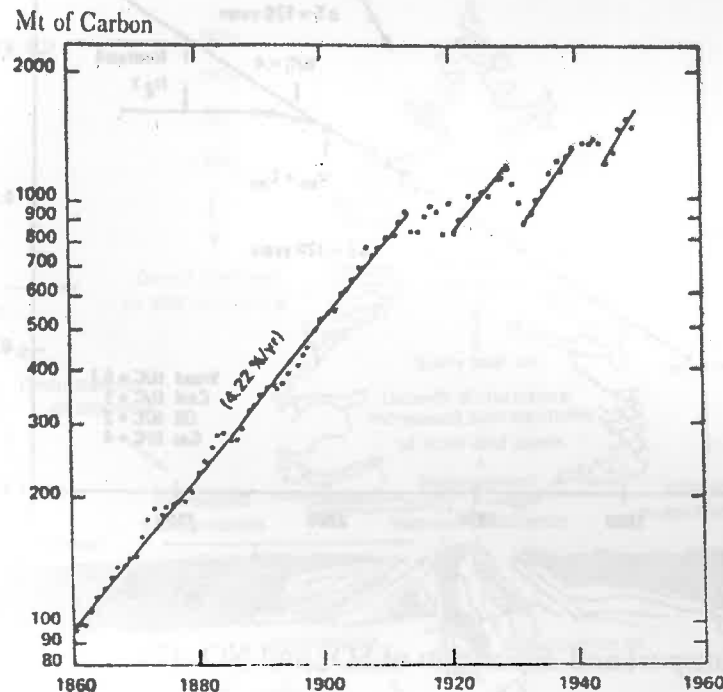
2.2 Environmental impact

As reported in (2) the growth in energy use largely influences the behavior of the atmosphere. The effect on the planet's climate due to CO₂ resulting from increasing

combustion of fuel containing a large amount of carbon is a very long - term preoccupation. It is estimated that there is a risk of the CO_2 concentration rising from 300 ppm before the industrial era to 600 ppm (to be reached in the next century by using coal in the same market share) causing the average temperature of the atmosphere to rise by 3°C ($\pm 1.5^\circ\text{C}$) because of the green house effect.

Since the Second World War, the exhaust rate has risen at an annual 4.5%, and is now 5 Gt of carbon per year coming from the combustion of all types of fossil fuels (Fig. 3).

Fig. 3 Annual carbon dioxide emissions resulting from fossil fuel combustion, 1860-1949
(2)



Today it would be desirable to reduce this rate to 1 or 1.5% per year. In fact, as far as the measures to be taken with regard to CO_2 are concerned, it is probably still too early to define solutions to the problems at the present time, but rather to conclude that CO_2 is an additional reason to continue energy saving measure and to push "clean" (solar, hydrogen, fusion) technology. Very important information is also the changing hydrogen to carbon ratio (4). Over the past 100 years, the global primary energy system has moved progressively to higher quality fuels (Fig. 4).

Hydrogen/carbon ratio of wood being roughly 0.1; 1.0 of coal; 2.0 of oil and 4.0 of natural gas. There is of course no certainty that this historical development pattern will continue. From the environmental point of view such a trend has a very positive influence to come back to a natural equilibrium in the atmosphere and soil.

In Europe and North America particular attention is paid to the effect of acidification of the atmosphere and the damage caused to forest. The mechanisms as they are understood (Fig. 5) see pollutants (SO_2 and NO_x) emitted by combustion plants as playing a major role along with terrestrial vehicles and air-plain (NO_x) and the transport over great distances of these pollutants (several hundred to thousands of km's). This transport gives rise to acid fog or rain (acid rain). Environmental effects are direct and indirect. Direct effects are: corrosion, deterioration of buildings, effects on vegetation, especially trees, effects on human health. These effects are then reinforced by the indirect effects of the deposit of acid substances in the soil and surface (lakes) and subterranean water, as well as the increased mobility of certain metals (cadmium, lead, mercury and even aluminium). The responsibility of SO_2 and NO_x (60 Mt of SO_2 and 20 Mt of NO_x per year currently

emitted in Europe) is therefore clearly stated. Two points remain to be clarified: the role of ozone, in combination or not with the previously mentioned pollutants, and the precise

Fig. 4 Evolution of the hydrogen - to - carbon ratio in the world's fuel mix 1985-2030 (1)

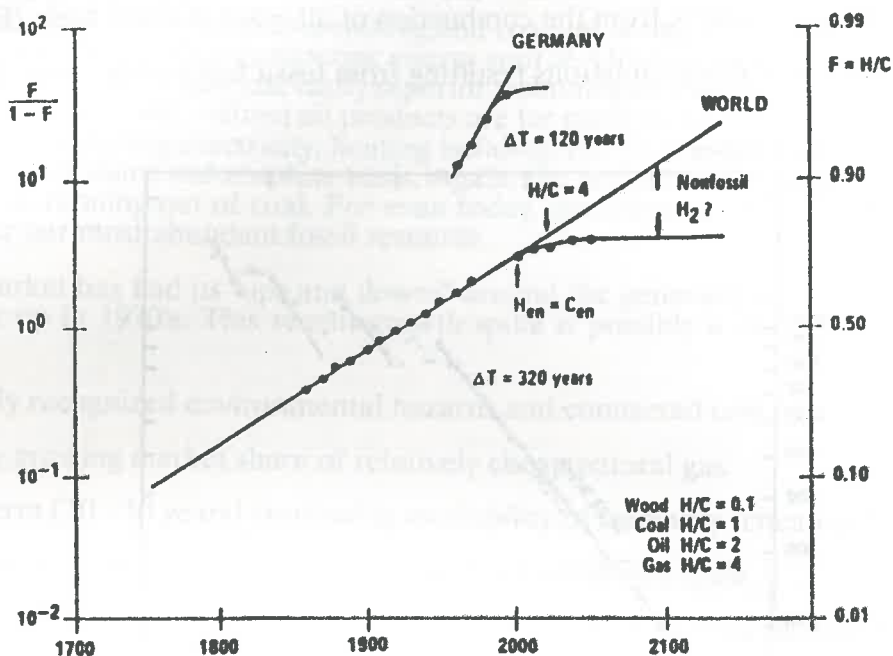
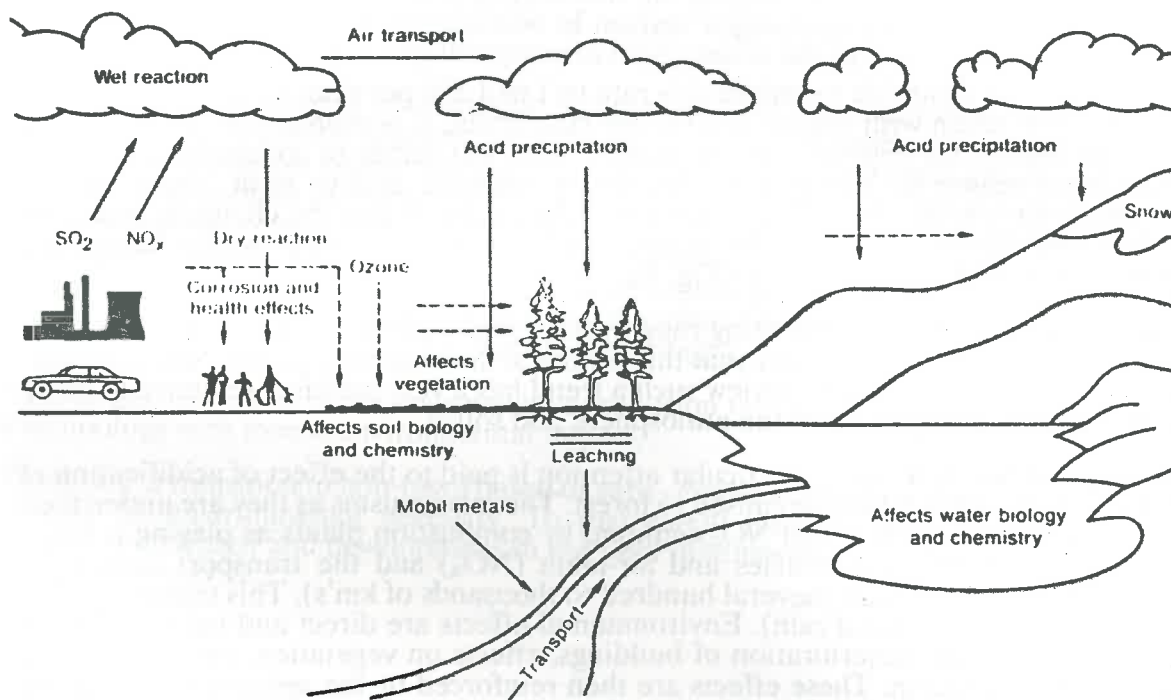
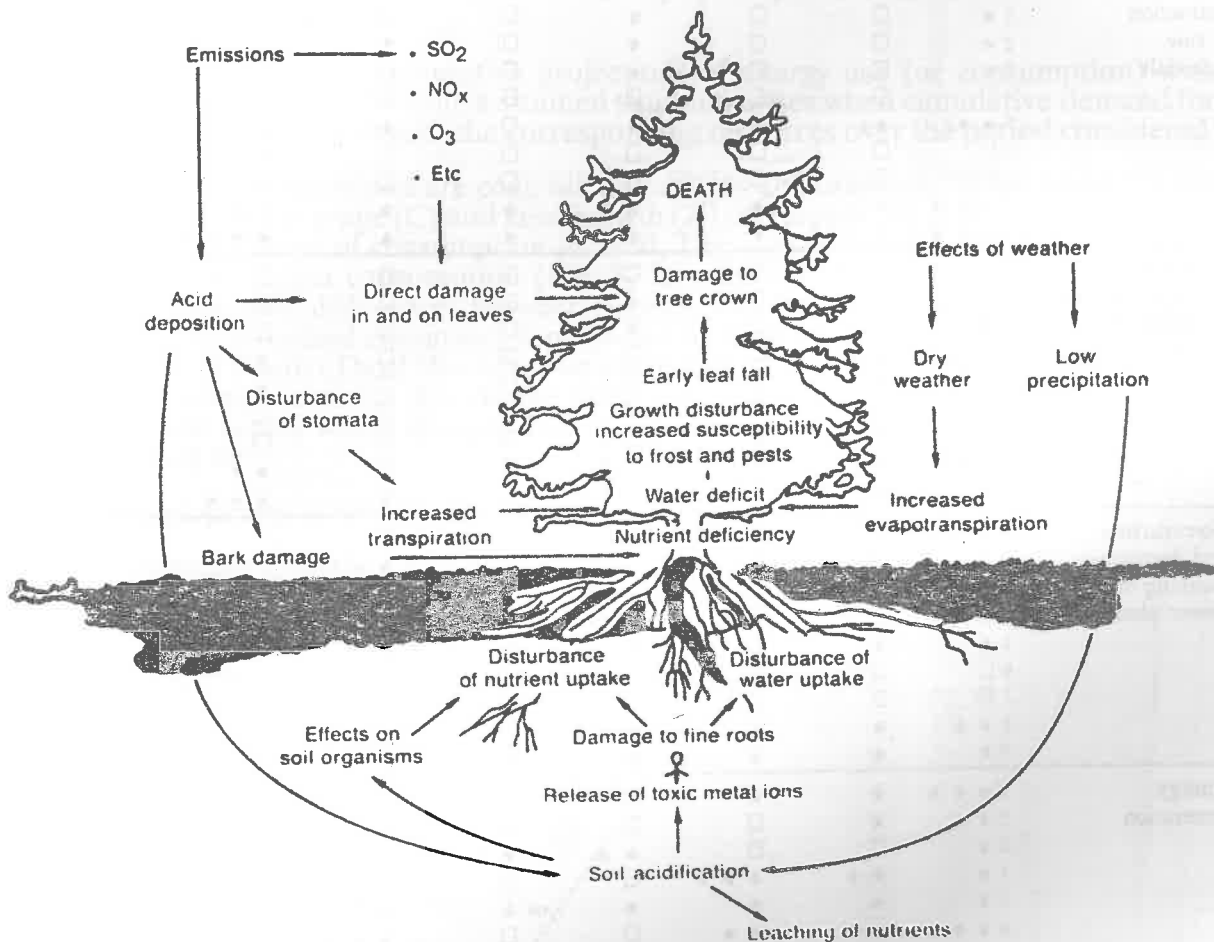


Fig. 5 Principles of transport and deposition of SO_2 and NO_x (2)



mechanism of acid rain deposits in the destruction of forests (10 Mha affected in Europe). Effects of air pollution on a forest ecosystem is presented in Fig. 6. As far as the vehicle is concerned, in acid rain and NO_x exhaust fumes, estimation vary: 48 to 60% of NO_x exhaust fumes. The contribution of NO_x is estimated to be 25% that of SO_2 , which therefore makes vehicles responsible for 10 to 30% of acid rain depending on the country. There is an urgent need for reducing the amount of SO_2 and NO_x fumes, released into the atmosphere together with other pollutants as lead, CO, hydrocarbons which are directly linked to the combustion cycle in vehicles.

Fig. 6 Effects of air pollution on a forest ecosystem (2)



Three types of solutions are possible to reduce environmental deterioration:

- the rational use of energy
- the use of "clean" technology (solar, hydrogen)
- implementation of technology involving the prevention or repair of damage or pollution created.

The cost of depollution technology or environmental impact of various energy sources (2).

Table 1 should be completed by some additional comments about nuclear and solar energy resources.

The problem of waste disposal has not been solved at all, therefore the mark of four asterisks should be used under the last point.

In addition, as concerns solar energy the negative effect of the terrestrial impact is overestimated, since the use of this source does not involve fertile land but built-up areas (roofs) or uninhabited areas. The same holds for climatic alterations which are negligible.

Table 1: Environmental impact of various energy sources (2)

Energy sources								
Different steps of production on cycle	Coal	Oil	Gas	Nuclear fission	Nuclear fusion	Solar photovoltaic	Methyl and Ethyl alcohol	Geothermal
Extraction of raw materials	1 ★	□	□	★	□	□	□	
	2 ★	□	□	★	□	★	□	
	3 ★	□	□	★	□	□	□	
	4 □	□	□	□	□	□	□	
	5 ★ ★	★	★	★	□	★	★ ★	
	6 □	□	□	□	□	□	★	
	7 □	□	□	□	□	□	□	
	8 ★ ★ ★	★	★	★ ★	★	★	★ ★	
	9 ★ ★ ★	★	★	★	★	★	★ ★ ★ ★	
Transportation and transformation of raw materials	1 ★ ★	□	□	□	□	□	□	
	2 ★	□	□	★	□	□	□	
	3 ★	□	□	★	□	□	□	
	4 □	★ ★	□	□	□	□	★ ★	
	5 ★ ★	★ ★	□	□	□	□	★	
	6 ★	★	□	□	□	□	□	
	7 □	★	□	□	□	□	□	
	8 ★ ★ ★	★ ★	★	★ ★	□	□	★ ★	
	9 ★	★	★	□	□	★	★ ★ ★	
Construction and decommissioning of power plants	1 ★	□	□	□	□	□		
	2 □	□	□	□	□	★ ★		
	3 □	□	□	★ ★	★			
	4 □	□	□	□	□	□		
	5 ★	★	□	★	★	★		
	6 □	□	□	□	□	□		
	7 □	□	□	□	□	□		
	8 ★ ★	★	★	★ ★	★	★ ★		
	9 ★	★	★	★	★	★ ★		
Energy generation	1 ★ ★ ★	★	★	□	□	□		□
	2 ★ ★	★	□	□	★	□		★ ★ ★
	3 ★	□	□	★ ★	★ ★	□		★ ★
	4 ★	★ ★	★ ★ ★	□	□	□		★ ★
	5 ★	★	★	★	★	★ +		★ ★
	6 ★ ★ ★	★ ★	★ ★	□	□	★ ★ +		★
	7 ★ ★ ★	★ ★ ★ ★	★	□	□	□		★
	8 ★ ★ ★	★ ★	★	★ ★	★ ★	★ (★ ★ ★)		★ ★ ★
	9 ★ ★	★	★	★	★	★ ★ +		★ ★
Waste disposal	1 ★ ★ ★	□	□	□	□	□	□	
	2 ★ ★	★	□	□	□	★	□	
	3 ★	□	□	★ (★ ★)	★ (★ ★)	□	□	
	4 ★	★	□	□ (★ ★ ★)	□ (★ ★ ★)	□	□	
	5 ★ ★	□	□	★ (★ ★)	□ (★ ★)	□	★	
	6 □	□	□	□	□	□	□	
	7 □	□	□	□	□	□	□	
	8 ★ ★ ★	□	□	★	□ (★)	□	□	
	9 ★	□	□	★ (★ ★)	★ (★ ★)	□	□	

Environmental effects:

1. Particulates
2. Stable toxic elements
3. Radioactive elements
4. Carcinogenic and toxic compounds
5. Water pollution and hydro-ecological alterations

6. Climatic alterations
7. Acid rain
8. Territorial impact
9. Connected risks

Extent of effects

- : Negligible
★: Small
★ ★: Substantial
★ ★ ★: Great
★ ★ ★ ★: Very great

2.3 Energy Outlook and Renewable Energy Sources

In the past decade questions regarding future energy demand and supply developments have received considerable attention. Because of the uncertainty inherently associated with such projections and the sociopolitical controversy surrounding the use of certain forms of primary energy technologies (nuclear, solar) there have been more answers offered than questions asked (1). Most long-term energy projections are based on technology performance profiles which are determined by the actual state-of-the-art performance of energy related technologies. From the point of view of renewable energy use two studies are of great interest. The first study, the World Energy Conference (5), uses a constant technology approach. The second study is an update of the IIASA '83 Scenario of Energy Development (6).

The first study compares cumulative projections of energy use (or consumption) with available resources. By definition, a strained situation arises when cumulative demand for a certain energy source exhausts the corresponding resources over the period considered.

The energy sources examined are coal, oil, natural gas and uranium. Three scenarios are analyzed: high (H), average (C) and zero growth (Z) corresponding to the preservation of the structure and level of consumption in 1980. The figures 7 and 8 illustrate aggregate (Fig. 7) and per capita consumption (Fig. 8) forecast for the world. The world values conceal considerable differences between regions. The mean per capita consumption in the North (industrialized countries) is projected to increase from 4.6 to 7.1 toe by 2060, whereas that of South (Third World) zone inhabitant would only increase from 0.6 to 1.1 toe in the average scenario (C). At the same time, the share of each individual energy source in total supply would change (Fig. 9). At a world scale, the salient features of this change would be:

- rapid development of solid fuel
- relatively steady growth of natural gas, nuclear and hydro-power
- emergence of new resources at the end of the period

Fig. 7 Projections of the world primary energy consumption (2)

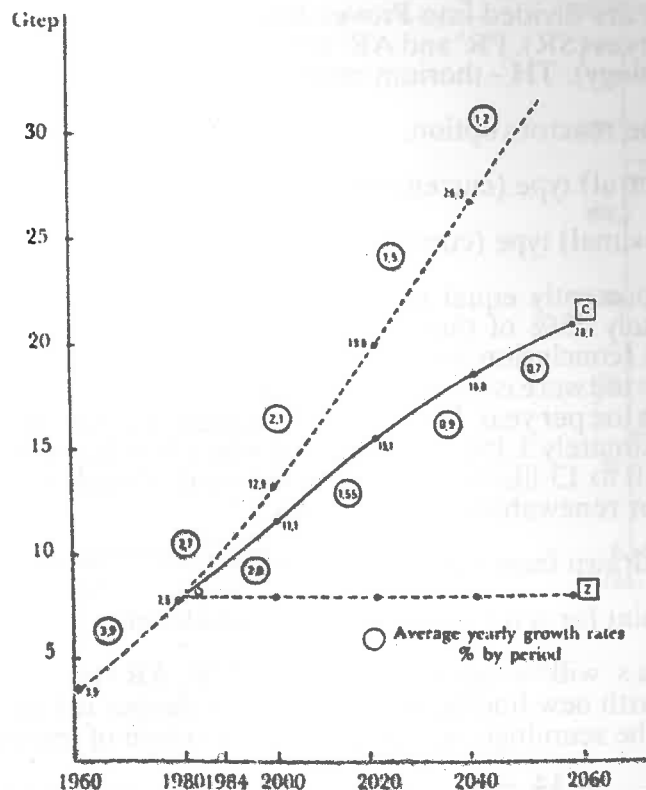
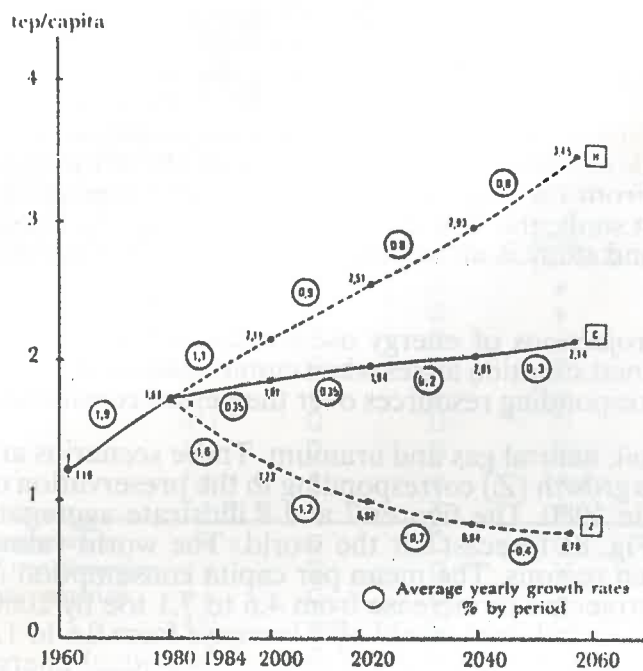


Fig. 8 Projection of the capita world energy consumption (2)



- declining resource to non commercial energy sources
- a continuous decrease in demand for oil from the level reached in the 1990's.

Comments: These results are not in accordance with depollution needs and sociopolitical controversy surrounding the use, or at least, the expansion of the nuclear technology.

Resources in this study were mostly assessed using the results of the 1986 enquiry of the WEC, but with some additions. They are divided into Proven Reserves (PR), Additional Reserves (AR) and Speculative Reserves (SR). PR' and AR' are proven non-conventional reserves (advanced extraction technology). TH - thorium reserves,

H₁, C₁ - two scenarios for current type reactors option,

H₂, C₂ - two scenarios for mixed (central) type (current+breeder),

H₃, C₃ - two scenarios for mixed (maximal) type (current+ maximal breeder reactors)

Total reserves (PR+AR+SR) are presently equal to almost 4500 billion toe. Proven Reserves only represent approximately 25% of this. Coal has an overwhelming share (78%), oil accounts for 14%, gas 5% (conclusion is very questionable) and uranium 3% of the total. Approximately 150 billion toe were consumed between 1960 and 1985; present consumption is of the order of 8 billion toe per year. In scenario C, cumulative consumption from now to 2060 could reach approximately 1.150 billion toe, of which 900 billion toe of non-renewable energy. The figures 10 to 13 illustrate the development of each scenario for each source, except new energy, or renewable energy sources.

The main conclusions, which can be drawn from this illustration are:

- there is no risk of a physical constraint for solid fuels at world level
- Proven Reserves of natural gas will be exhausted around 2020, AR shortly after 2060 (Results are in disagreement with new finding of natural gas in deeper off shore fields, tight sands etc. Reopened is the seemingly settled issue of the origin of terrestrial hydrocarbons (7)).

Fig. 9 Evolution of world supplies (scenario C) (2)

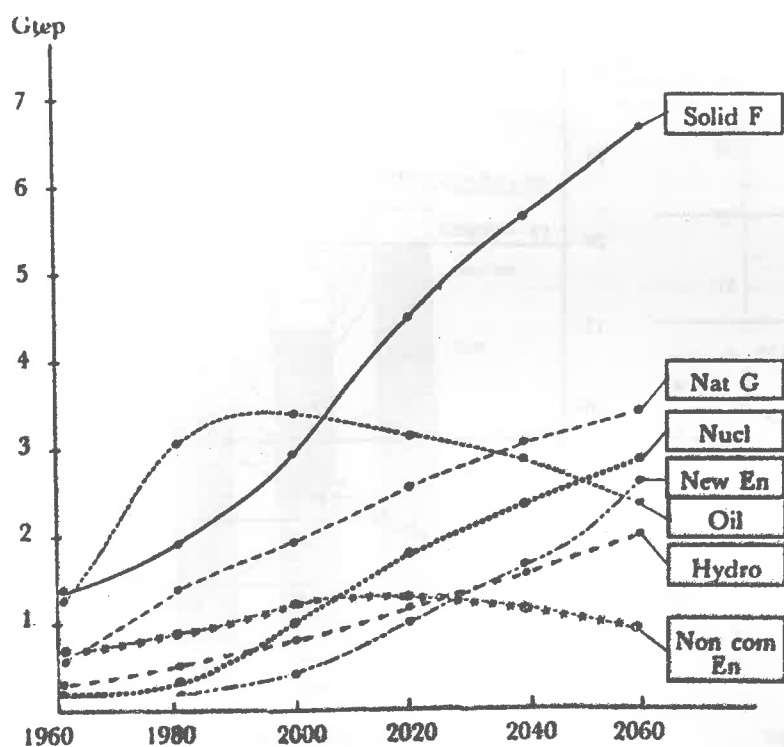


Fig. 10 World Solid fuels (2)

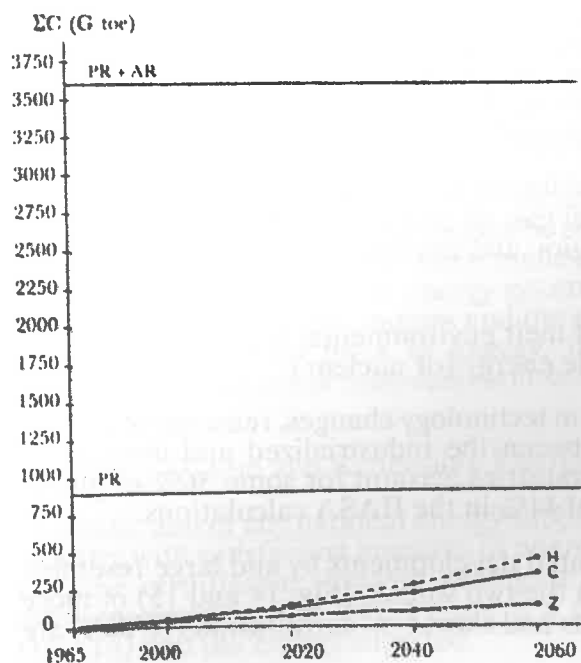


Fig. 11 World Natural gas (2)

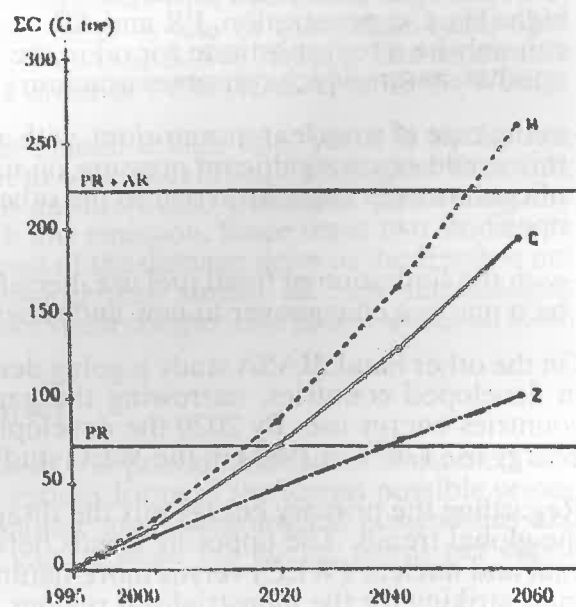


Fig. 12 World oil (2)

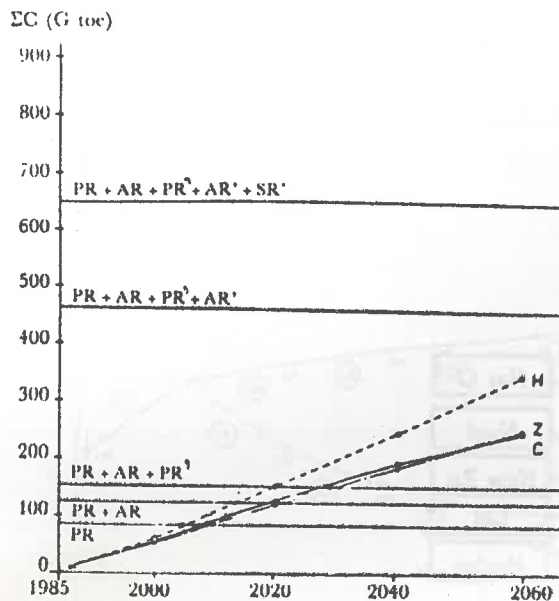
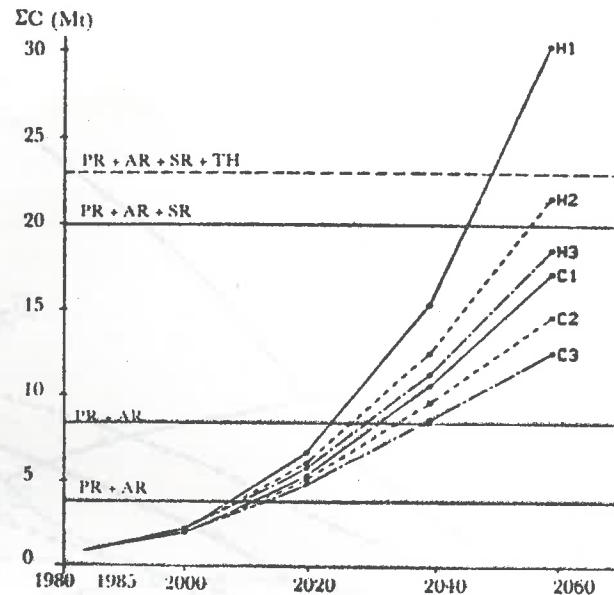


Fig. 13 World Uranium (2)



- PR of oil could be exhausted around 2010 - 2020 (PR + AR + PR') could be exhausted around 2030
- with the present nuclear technology (1 tone of U = 8000 toe) demand is such that constraints may arise (H₁, C₁) in 2010 affecting PR (assessing 4 million ton of U). With the introduction of fast breeder reactors (1 tone of U = 500000 toe) - following a sufficient initial stock of plutonium produced by conventional reactors - with average (H₂, C₂) and high (H₃, C₃) penetration. PR and AR could be exhausted around 2040. Nuclear energy can only be a real substitute for oil in the very long term if the fast breeder reactor or another system which consumes uranium very economically is introduced rapidly enough.
- in the case of a nuclear moratorium, with a total loss of nuclear output beyond year 2020, this would cause significant pressure on natural gas, oil and mainly coal. The questions of coal transfer costs from one to the other region and environmental effects remain open.
- with the limitation of fossil fuel use, because of their environmental impact, there would be a massive changeover to new and renewable energy (or nuclear).

On the other hand, IIASA study is going deeper in technology changes, reasonable growth in developed countries, narrowing the gap between the industrialized and developing countries energy use. By 2020 the developing countries account for some 36% of global energy use (26% in 1985) in the WEC study and 44% in the IIASA calculations.

Regarding the primary energy mix the disaggregated developments by and large resemble the global trends. The opposing trends between the two studies (Fig. 14 and 15) of more coal and nuclear (WEC) versus more natural gas and slower oil substitution (IIASA) are most striking for the industrialized regions.

The drastic changes in the future global and regional primary energy mixes as well as the notable growing share of the developing countries energy needs as compared to the industrialized countries will also have definite implications for global energy and energy technology trade.

Fig. 14 IIASA Scenario: Global Primary Energy Consumption and Mix (2)

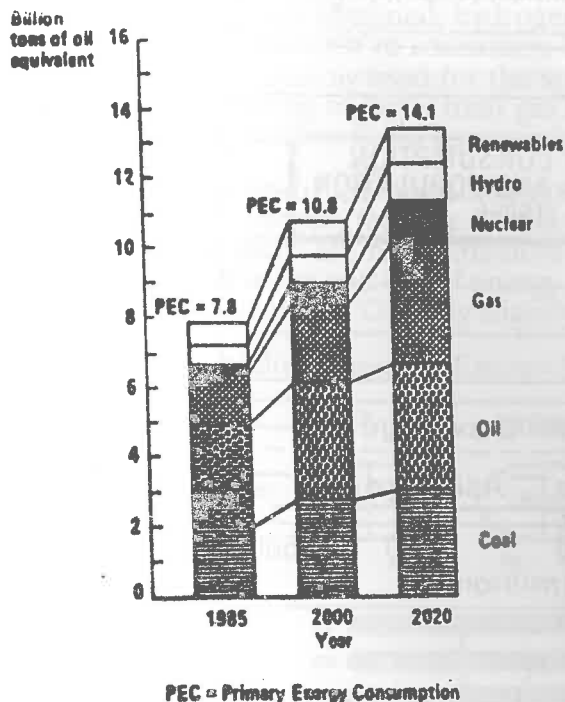
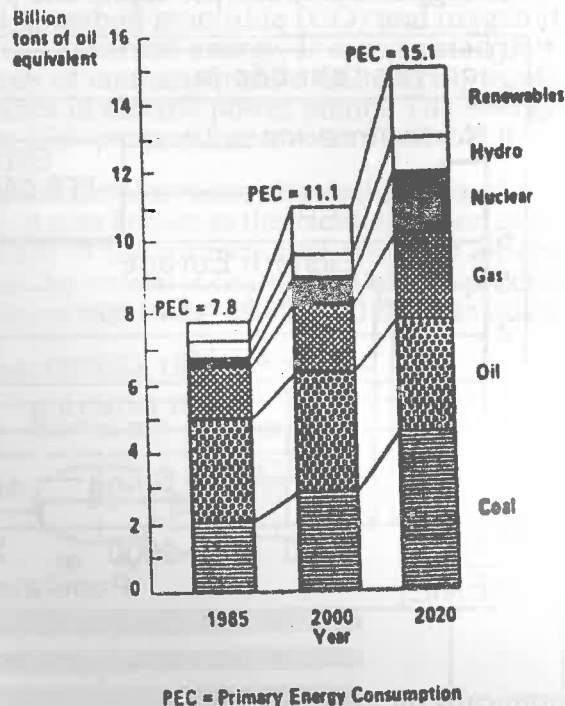


Fig. 15 WEC Scenario: Global Primary Energy Consumption and Mix (1)



Both studies take into account the possibility of a wider use of renewable sources, yet they remain strictly conservative. Comparing the primary energy mix in the year 2020 in figures 14 and 15, one can see that the renewable sources together with hydro sources, which are, inexplicably, presented separately (although the latter is one of the oldest renewable sources man has ever used), reach approx. 16% (IIASA) or 20.5% (WEC). The renewable sources or new sources by themselves are of the order of 7-8% (IIASA) or 13% (WEC).

Compared with the year 1985, this increase is indeed a high one, yet it is by far not answering the solutions which should be sought to solve the difficult ecological situation. Regrettably, no study has yet been made about an intensified transition (answering the ecological pressures) into an energy system with low emission. Since these two studies do not include any economic indices and the real cost of the damage done to the Earth is not recalculated into the price of energy, it is logical that almost all new technologies implementing the use of renewable sources do not seem competitive to conventional fossil fuels.

2.4 Energy System and Renewable Energy Sources

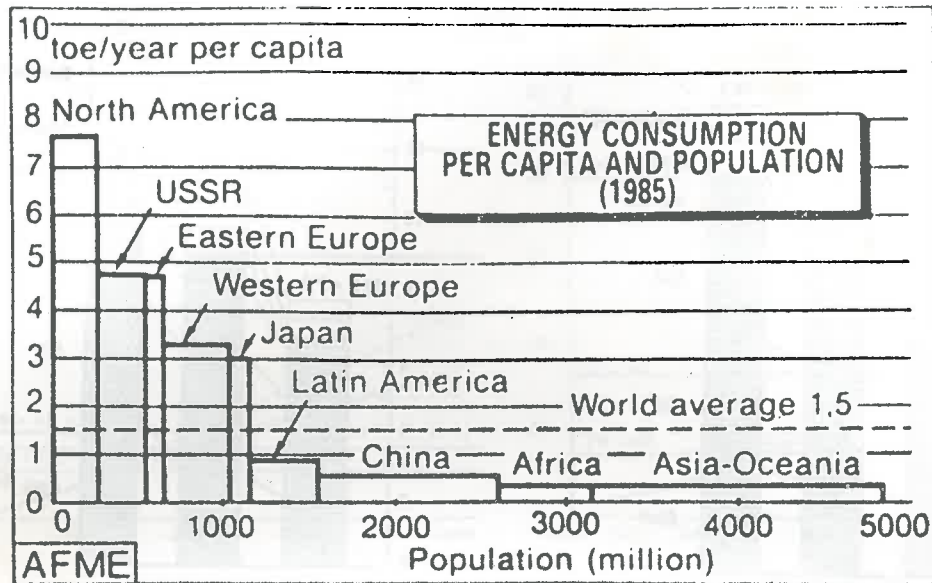
The basic aim of any national energy supply system is to provide individual consumers and industry with satisfying amounts of energy in various forms at the lowest possible prices. Because of different climatic, geological, economic and technological possibilities and different development stages there is a great gap between the energy needs per capita (Fig. 16) and the energy supplied.

There are some countries in which the renewable sources form the prevailing part of the energy needed (some developing countries) and other countries where the renewable sources, with the exception of hydro energy, do not appear in the energy balance at all.

The present energy supply can be called the period of use of fossil fuel in the vertical energy system, in which the individual energy carriers are practically unexchangeable. Oil

competes with coal, gas with oil and electric energy with all of them together. Since it is of highest quality (clean energy) it is ecologically, technologically and sometimes even

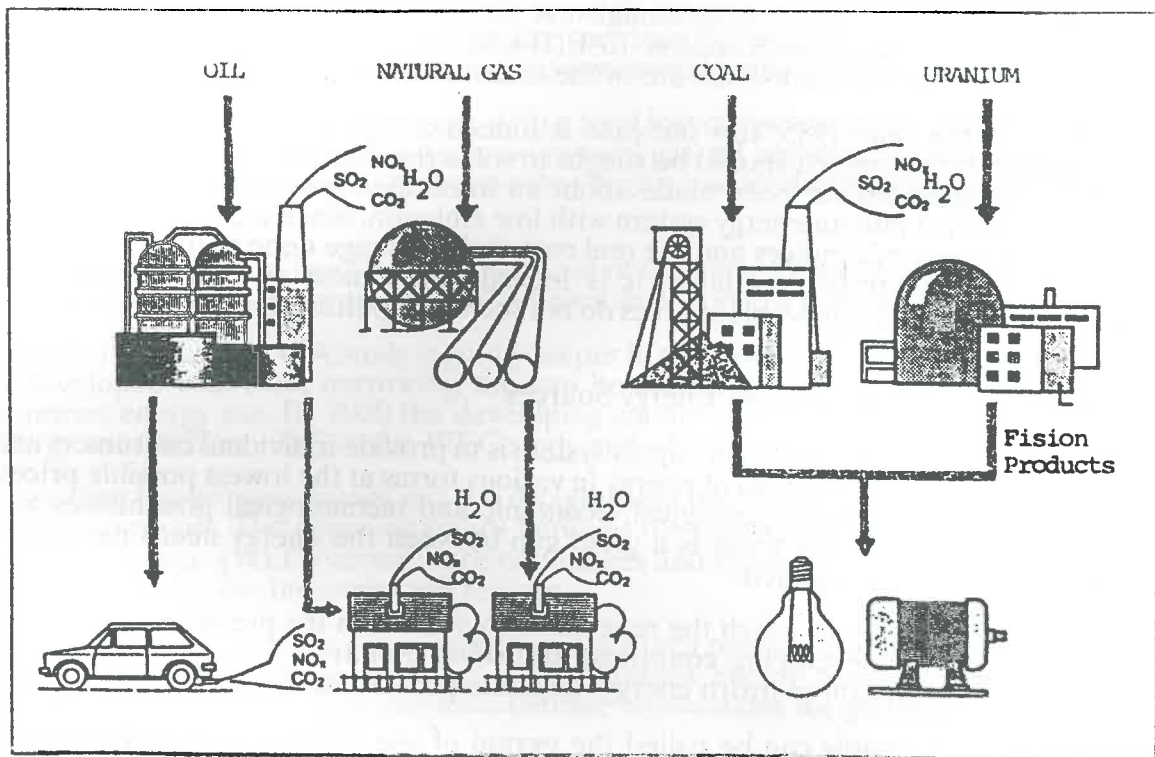
Fig. 16 Energy consumption per capita and population (1985), (2)



economically the optimal solution for the consumer. However, its production is connected with heavy losses (except hydro) and high emission. On the other hand, as regards the use of nuclear fuels the waste deposit problem remains unsolved.

In figure 17 the present vertically integrated energy system (VIES) is shown.

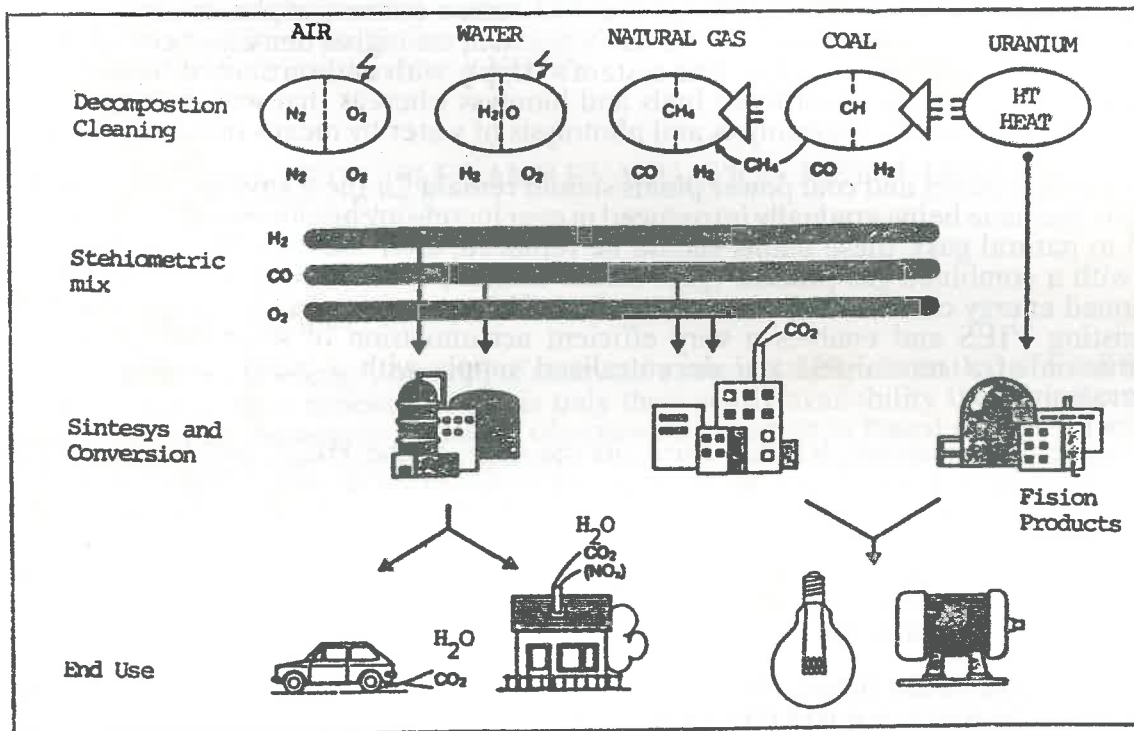
Fig. 17 Vertically Integrated Energy System (VIES), (8)



In the studies conducted at MIT, IIASA, KFA (8) it was suggested that a new, horizontally integrated energy system (HIES) would be introduced. Within this system all the energy carriers would be made equal (Figure 18). A characteristic of this system is that fossil fuels and uranium are converted by means of air and water so that three basic carriers of secondary energy are obtained: hydrogen (H_2), carbon monoxide (CO) and oxygen (O_2) which would be available to consumers besides electrical energy. It is suggested that H_2 and CO would be mainly used for the synthesis of methanol, while CO and O_2 would be used for the powering of isothermal gas turbines in electric power plants. The energy for the primary conversion would be provided by high temperature nuclear reactors.

With the prospects of the present technological development, the realization of such a system is almost entirely feasible. This system is also known as the "zero emission system". Unfortunately, there are high emissions present in the primary conversion of all energy forms as well as in the end use of energy. Thus the system is characterized by a practically unreduced emission of CO_2 , only slightly reduced emission of NO_x and nuclear wastes.

Fig. 18 Horizontally Integrated Energy System (HIES), (8)



Comparing the VIES to the HIES, one can find out that in the primary conversion it will be the crude oil refineries (due to shortage of oil) and the coal power plants that will be abandoned first. On the other hand, it will be necessary to build: power plants for the conversion of the remaining fossil fuels (coal, gas), high temperature reactors for the production of heat and electric power, gas thermal power plants and a transport system for H_2 , CO and O_2 . In addition, end consumers should start using engines and burners powered by methanol. The proposed HIES is without doubt more expensive than the VIES, especially if ecological costs are not taken into account.

However it is easy to find out that this kind of system is unacceptable for the developing countries. It is based on high technology, it is capital-intensive, and dependent on highly educated staff. It can only become the main core of the energy system in some of the highly developed industrialized countries.

The renewable energy sources are left out of the system and the problem of nuclear waste deposit is unsolved. In the system's balance a great shortage of hydrogen can be observed. Further the pipeline system for H_2 , CO and O_2 is far from being competitive to the transport system for natural gas or oil, and combination of CH_4 and O_2 .

The changes occurring in energy systems have never been revolutionary but gradual.

Therefore a reasonable concept of building a new energy system should be based on changes which are of gradual and organic nature. It should be equally acceptable for the developing and the developed countries. It should enable a reduction of harmful emissions conditioned by minimal investments into the old and the new power plants. This system should use the existing technology to its full and add new elements which in the course of time will become prevailing. The advantages of the old system should be preserved to the highest extent possible. A schematic presentation of such a system is shown in figure 19.

This system is termed as the vertically and horizontally integrated energy system (VHIES) (2, 3, 4). It is based on three main energy carriers: methane (CH_4), methanol (CH_3OH) and electric energy.

Considering their properties, methane and methanol are complementary energy carriers of which the former is more suitable for central distributions by pipelines whereas the latter, being in the liquefied state, is suitable for local distribution and long-term storage. Both these carriers can be applied to all the distribution systems of the existing vertical energy system. Another advantage over a HIES is also in the higher density of energy (CH_4 versus H_2 or CH_3OH versus CO). The system's supply with carbon should be obtained from the remaining sources of fossil fuels and biomass whereas that with hydrogen and oxygen from electrolysis, thermolysis and photolysis of water by means of solar energy.

Nuclear power plants and coal power plants should remain for the transition period. With synthetic methane being gradually introduced in ever increasing amounts (in the first phase added to natural gas), these plants should be replaced, after the expiration of their life time, with a combined gas process (gas+steam turbine) in which one of the two above mentioned energy carriers could be used as fuel. This system is entirely compatible with the existing VIES and enables a very efficient accumulation of solar energy. It is a combination of a centralized and decentralized supply with a trend towards greater decentralization.

In principle the combined VHIES obeys all the rules of the HIES, and is in addition distinguished by a more simple technology and lower environmental impact since the percentage of renewable sources will increase with the time. The number of chemical and thermodynamical conversions is smaller, which results in a higher exergy efficiency. The system can accept all alternative and existing fuels, as well as new technological solutions. There are only two conditions which have to be fulfilled: i.e. they should be ecologically acceptable and economically viable.

By a certain time in the future, the proposed energy system will have reached an energy & ecology equilibrium state on the Earth. With the carbon atom from the biomass being usefully applied, and with the dissociation of water by means of solar energy, the recycling will become a reality. According to first estimations, 38 to 44% of renewable sources (hydro energy and biomass inclusive) will join the system in the initial phase, and for the same proportion the emission and use of fossil fuels would be reduced.

The system also includes an additional season storage of heat obtained from wastes in cleaning flue gases in thermal power plants powered by fossil fuels. It concerns the useful application of SO_2 which would be synthesized into sulfuric acid H_2SO_4 . A concentrated H_2SO_4 (70%) is found to be a very good accumulator of waste heat (industrial and solar energy, since having been mixed with water to the concentration of 50% it emits approx. 1000 kWh per m^3 at the temperature of 60 - 80°C. Heat regeneration is a well known process. Thus sulfuric acid becomes out of a waste (SO_2) a useful energy carrier utilized for heating and sanitary water. Since it remains within the system's cycle, it thus reduces emission of CO_2 and other pollutants. Considering the fact that in industrialized countries as high as 25% of primary energy is used for low temperature heat, the proposed solution (with some technical improvements) could be a very efficient way towards rational energy utilization. This energy carrier has of course a 12-times lower efficiency per unit of volume than oil but a 12-times higher one than that of the existing systems for district heating.

The realization of a VHIES would require the development or gradual improvements of the following technologies:

- solar cells
- solar high temperature reactors
- methanol and methane synthesis
- hydration of coal and biomass
- converters for the synthesis of SO_2 into H_2SO_4 and mixing with H_2O
- alternatively isothermal turbines powered by CH_4

The proposed technological changes of the existing energy system inspires one with reasonable hope that renewable energy sources will offer the mankind at least equal or higher quality of life as that granted by today's fossil fuel and uranium utilization and enjoyed by only some parts of the world. Therefore, a thorough knowledge on renewable energy sources and their particular possibilities in different countries is one of the basic prerequisites for the transition into a VHIES.

3. FUNDAMENTAL PRINCIPLES AND EVALUATION METHODOLOGY OF RENEWABLE RESOURCES

3.1 Fundamental principles

The evaluation of the energy potential of renewable sources differs from that of fossil fuels since by virtue of their renewability, it is only their yearly availability that is important. The evaluation of the energy potential of renewable sources is based on the principles defining their availability and exploitability. There the following have to be known:

- availability in time
- availability in terms of power
- availability in terms of location

On the basis of these data, one can define the:

- theoretical potential
- technically exploitable potential (technical potential)
- economically exploitable potential (economic potential)

The theoretical potential should be understood as an integral of availabilities in terms of time, power and location.

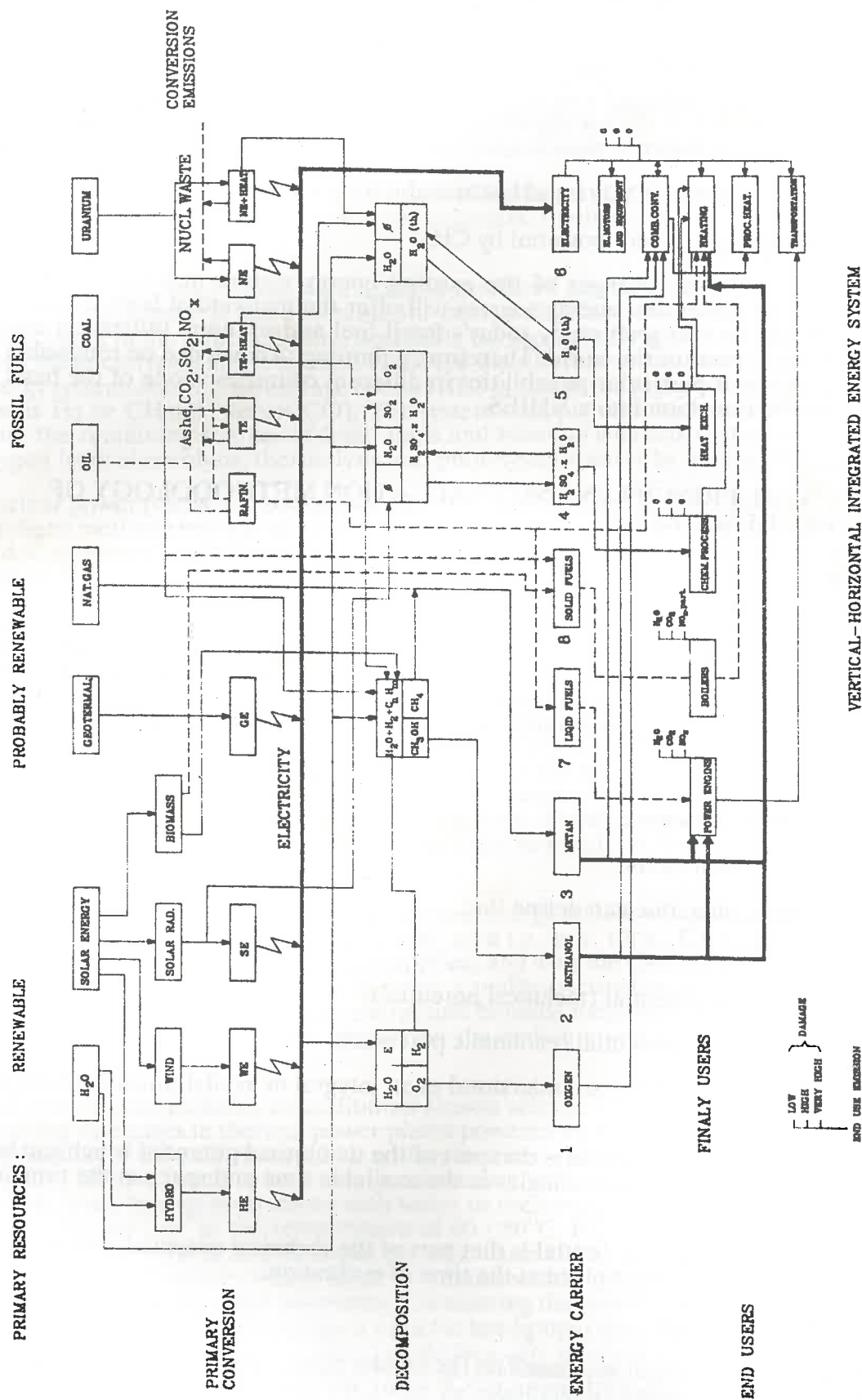
The technically exploitable potential is that part of the theoretical potential which can be utilized by means of available technologies in the available time and space at the time of evaluation.

The economically exploitable potential is that part of the technical potential which has a competitive price on the market place at the time of evaluation.

3.2 Evaluation Methodology

The evaluation of the potential was based on the known meteorological, hydrological and agronomic data. Since no standard methodology exists, the comparability of data is rather Fig. 19 Vertically and Horizontally Integrated Energy System (WHIES), (9)

Fig. 19 Vertically and horizontally integrated energy system (VHIES)



low. This is especially true in the case of technical potential which forms the basis for the evaluation of the real possibilities of utilizing renewable sources.

The evaluation of the availability and potential was worked out for the following renewable sources:

- solar radiation
- wind
- waves
- energy of rivers (hydro)
- biomass
- geothermal energy

In the evaluation of the theoretical potential no restrictions have been set as regards the area.

However, evaluating the technical potential, one has to exclude from:

- solar energy: the areas intended for agriculture, meadows and woodland in active exploitation, areas of transport routes and the littoral intended for tourism, areas 2000 m above sea level and north flanks
- wind: urban areas and transport routes
- waves: the littoral intended for tourism, ports and waterways
- energy of rivers: protected areas (national parks)
- biomass: "useful" part of biomass (for food, food processing etc.)
- geothermal energy:

These restrictions, which very probably did not exclude all the negative effects, can be taken into account only if very detailed data for each particular country are available. But since there are no such data known for each country there is a questionnaire added at the end of this study whose purpose is to help gather those data which would make the evaluation of the potential more reliable. In this way, the basis for implementation of renewable energy sources into the energy system would be obtained. Since large sums of money are spent on the search of fossil fuel reserves, some of this money should, by analogy, now be intended for the investigations of the potential of renewable sources, which at present receive but a very modest financial support not allowing any real presentation of renewable sources.

There is no doubt that also the energy of the environment belongs among the renewable energy sources. It is, however, not included in this analysis since the basic parameters of its conversion have not yet been defined. The amount of non-commercial energy is represented in the form of biomass which is already being used in the energy system of particular countries.

4. POTENTIAL OF RENEWABLE ENERGY SOURCES IN THE MEDITERRANEAN COUNTRIES (MC)

To compare the potential of renewable energy sources with present energy demand, we have prepared a short survey of time dependent consumption of the fossil fuels (Table 2) and the influence of economic growth on the energy use (Figure 20). Figure shows that there is no significant changes in the last 20 years (1960 - 1980) in the elasticity index. In most countries is larger than 1.

The composition of energy mix in the MC is presented on the figure 21. Growth of commercial and non-commercial energy is likely saturation curves, or curve which has had a maximum in the year 1979.

Fossil fuel resources (proven reserves) for MC are shown on figure 22. Only three countries, Algeria, Libya and Yugoslavia have some significant

Table 2: Commercial energy use in the Mediterranean countries 1960-1980 (2)

Année	Combustibles minéraux et solides		Produits pétroliers		Gaz naturel		Electricité primaire		Consommation totale énergie commerciale	
	en MTEP	%	en MTEP	%	en MTEP	%	en MTEP	%	en MTEP	%
1960	78,390	44,49	64,230	36,45	8,515	4,83	25,076	14,23	176,211	100
1964	84,582	35,52	115,470	48,49	12,402	5,21	25,664	10,78	238,118	100
1968	76,273	25,10	175,818	57,87	18,306	6,03	33,439	11,01	303,833	100
1972	69,472	17,39	260,369	65,18	30,434	7,62	39,211	9,82	399,437	100
1973	67,792	16,00	284,352	67,14	33,853	7,99	37,552	8,87	423,549	100
1974	70,118	16,15	284,223	65,48	36,873	8,50	42,825	9,87	434,039	100
1975	69,954	16,06	279,451	64,18	40,840	9,38	45,203	10,38	435,448	100
1976	74,218	15,85	303,059	64,71	49,470	10,56	41 579	8,88	468,320	100
1977	75,833	15,69	300,097	62,11	50,302	10,41	56,977	11,79	483,209	100
1978	75,674	15,44	305,870	62,39	52,234	10,65	56,468	11,52	490,246	100
1979	82,848	15,97	316,935	61,10	56,513	10,89	62,457	12,04	518,753	100
1980	87,560	17,00	306,318	59,46	57,184	11,10	64,081	12,44	515,143	100

Fig. 20 Energy use and economic growth, (GNP) between 1960-1980 in the Mediterranean Countries

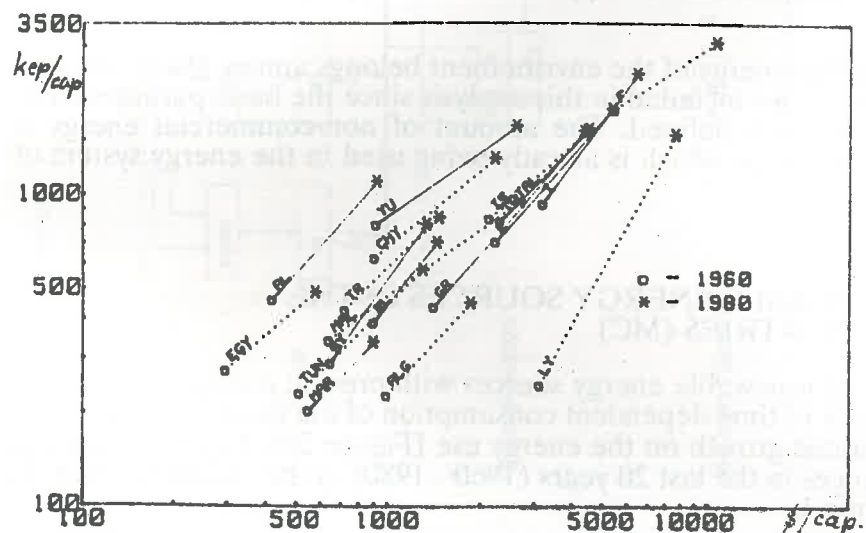


Fig. 21 The Mediterranean Countries Energy Mix 1960-1980

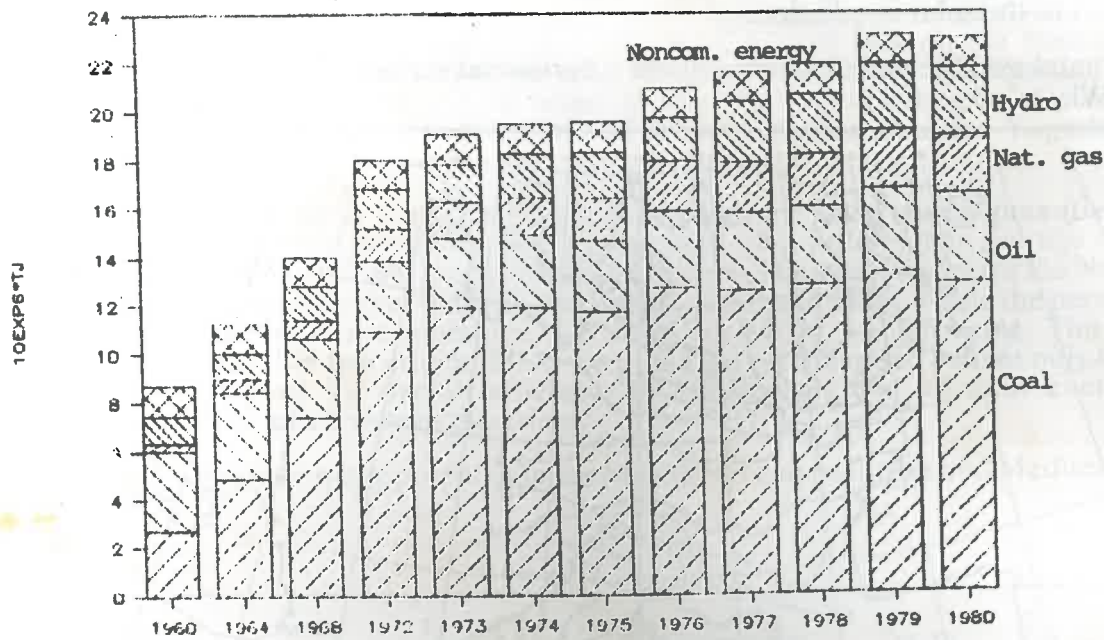
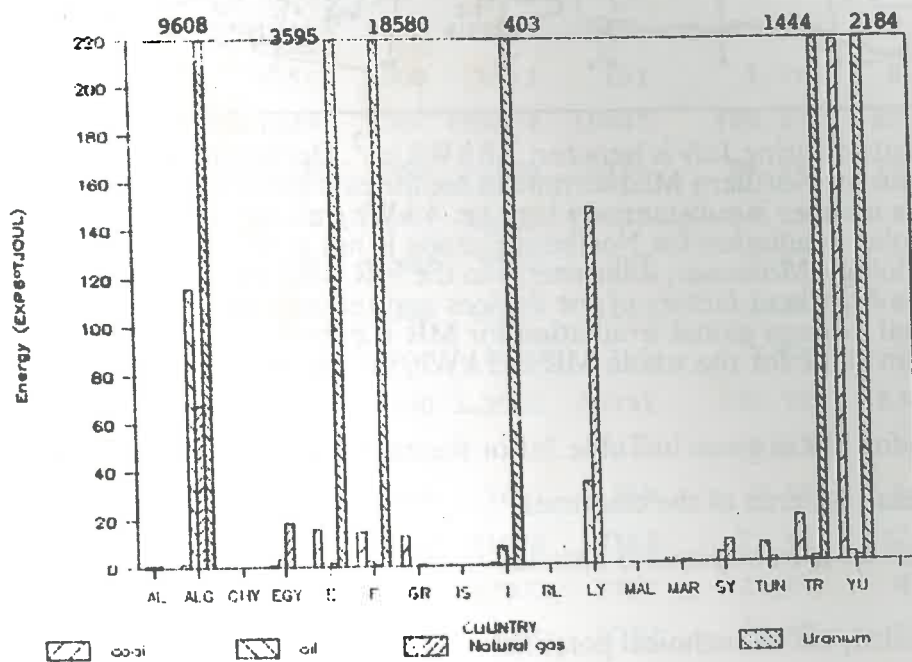


Fig. 22 Mediterranean Countries Fossil Fuel Proven Reserves



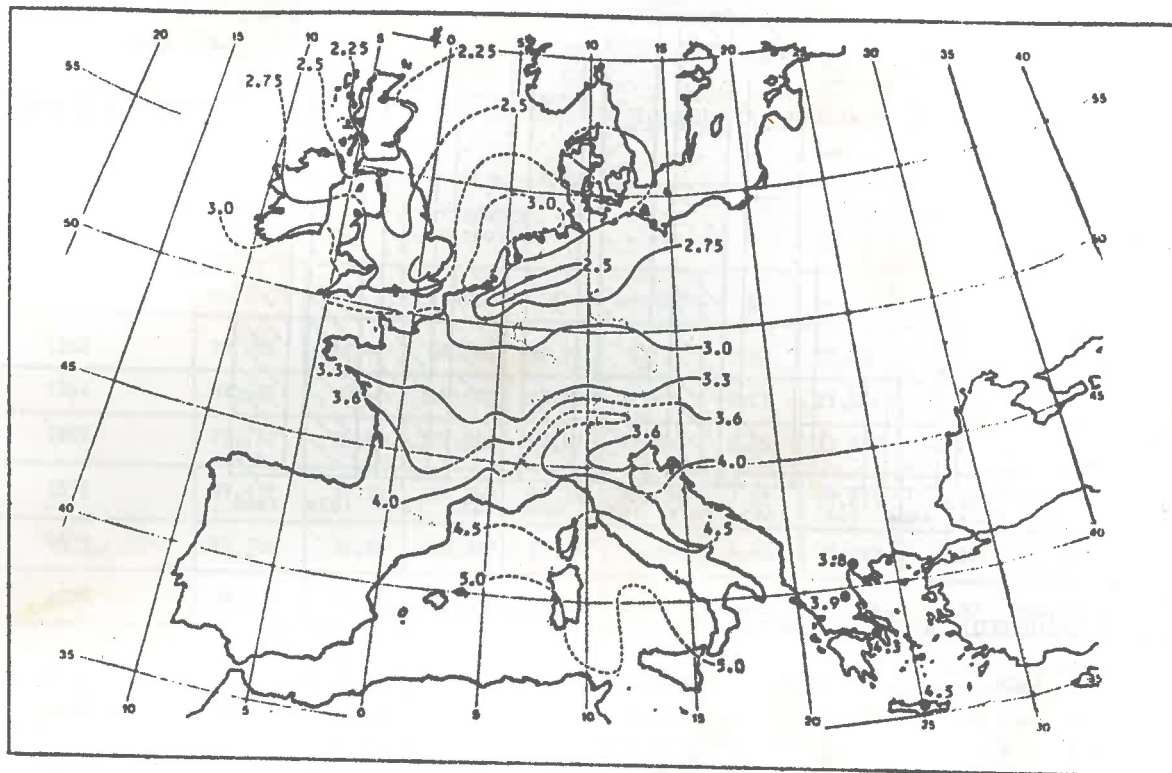
reserves of fossil fuels. Energy dependance MC is in time interval 1960-1980 approximately constant and had a value of 0.65 and 0.64 respectively.

4.1 Solar Energy

Solar energy is an energy source of low energy density and high intermittence. It can be easily collected in the form of low temperature thermal energy. On the other hand, the efficiency to convert solar energy to electricity is generally low. For harvesting of solar energy large areas are needed.

As it is shown in figure 23 the Mediterranean region (MR) is one of the richest in the world with respect to the solar irradiation.

Fig. 23 Annual average global irradiation on a horizontal surface (10 years means, kWh/m² day) (31)



The daily global irradiation during July is between 7-8 kWh/m². During the worst part of the year solar irradiation for Northern Mediterranean countries is between 1-3 kWh/m², while for the south this number is substantially high i.e. 4 kWh/m². Notice, that for this period (winter time) solar irradiation for Northern Europe is not useful at present state of the art of solar technology. Moreover, solar energy in the MR is subject to low seasonal variations. This favours high load factors of the devices and reduces storage capacities. Finally, the solar annual average global irradiation for MR is between 4 and 6 kWh/m² day. A reasonable mean value for the whole MR is 5 kWh/m² day or $I_y = 1825$ kWh/m² year.

Solar energy potential for MR is given in Table 3. For the calculations it was presumed:

- for theoretical potential: I_y . area of the countries
- for technical potential: I_y . area of possible installation of solar energy equipment (1/10 of the countries area)
- for economic potential: 1/100 of technical potential

In the calculation is included also the Mediterranean Sea area, which part can be exploited for harvesting of solar energy.

$Q_{cc,th}$ - thermal potential (economic) with conversion efficiency 0.25

$Q_{cc,e}$ - electric potential (economic) with conversion efficiency 0.05

The results are very promising. Only area of cca 3300 km² is needed to harvest total energy consumption (from fossil fuels) in the year 1980 in MR with today's technology but not of today's price of energy mix. Therefore only part of desert area in Libya, Egypt or free Mediterranean Sea area (mostly coastal area) are needed for solar energy conversion.

Open are the capital costs, energy system and willingness of the mankind to go in solar era. For more precise calculations of the solar energy potential, more detailed set of the solar data are needed. Some countries have solar data book, some have more general information. It is necessary to collect and review all data in MR on the basis of unic methodology and elaborate more precise solar energy potential map with regard of energy availability. This is of course out of scope of this work. One example of solar data preparation (annex Solar I, with the maps of solar irradiation data for Yugoslavia) is presented.

Rigopoulos (14) has made the calculations, how much the solar energy potential could contribute to the energy demands. The results based on a little higher average of solar irradiation (2000 kWh/m² year) are shown in the table 4. The needed area for the Northern MC is about of factor 10 higher than the percentage of the south MC. While the percentage of all these countries is not inhibitive, for the north MC is of high value. This rather pessimistic forecast has two origins. First, the total energy demand to be met only by solar radiation and second, the overall efficiency of 5% denotes that all solar energy was assumed to be converted only to electricity.

Table 3. Yearly solar energy potential in the Mediterranean countries and Mediterranean sea

Country	Area km ²	I _y kWh/m ² y	Q _{th} Mtoe	Q _t Mtoe	Q _{ec} Mtoe	Q _{ec,th} η=0.25	Q _{ec,c} η=0.05
Albania	28748	1400	3461	346	3.46	0.87	0.17
Algeria	2381741	2000	409659	40966	409.65	102.41	20.48
Cyprus	9251	1900	1512	151	1.51	0.38	0.08
Egypt	1001449	2200	189474	18947	189.47	47.37	9.47
France	547026	1300	61158	6116	61.16	15.29	3.06
Greece	131944	1600	18155	1816	18.16	4.54	0.91
Israel	20770	2000	3572	357	3.57	0.89	0.18
Italy	301225	1600	41449	4145	41.45	10.36	2.07
Lebanon	10400	1800	1610	161	1.61	0.4	0.08
Lybia	1759540	2200	382905	33291	332.91	83.23	16.65
Malta	316	1650	45	4	0.45	0.11	0.02
Morocco	446550	2000	7681	768	7.68	1.92	0.38
Spain	504782	1650	71629	7163	71.63	17.91	3.58
Syria	185180	1700	27073	2707	27.07	6.77	1.35
Tunisia	163610	1700	23920	2392	23.92	5.98	1.20
Turkey	780576	1800	120833	12083	120.83	30.21	6.04
Yugoslavia	255804	1300	28599	2860	28.60	7.15	1.43
Mediterranean sea	2900000	1825	455155	45516	455.16	113.79	22.76
Total	11428912	1829	1797890	179789	1797.89	449.47	89.89

Table 4: Solar energy contribution to the energy demand in the Mediterranean countries

Country	Total Energy Consumed (TWh/year)	Necessary Surface (km ²)	Surface % (All energy in the form of electricity		Surface Percentage (60% of electricity from sun)
			1976	2000	
Albania	-	-	-	-	-
Algeria	112.5	1125	0.05	0.20	0.10
Cyprus	8.2	82	8.9	11.4	5.7
Egypt	181.6	1816	0.19	0.6	0.3
France	2035	20350	3.73	6.7	3.35
Greece	186	1860	1.42	2.5	1.25
Israel	74	740	3.64	8.6	4.3
Italy	1613	16130	5.48	9.8	4.9
Lebanon	23.4	234	2.28	7	3.5
Lybia	35.6	356	0.02	0.08	0.04
Malta	2.7	27	8.4	14.6	7.3
Morocco	60	600	0.13	0.5	0.25
Spain	799	7990	1.6	3.2	1.6
Syria	51.6	516	0.28	1	0.5
Tunisia	30.3	303	0.2	0.6	0.3
Turkey	364	3640	0.47	1.5	0.75
Yugoslavia	410	4100	1.61	3.2	1.6

a. It is assumed that for the Medoterranean Countries the solar radiation yearly is 2000kwh/m²

b. Collection x Conversion efficiency is assumed 5%

SOLAR ENERGY - ANNEX 1

Solar data for Yugoslavia (29)

The first map Fig. 24 shows the numbered meteorological stations and towns for which the data are given on the next 13 maps.

On the maps I to XIII (Fig. 25) the daily mean sum of the solar global irradiation on a horizontal surface (Wh/m^2) for each month in the year and yearly average (map XIII), are presented.

Fig. 24 Locations and members of the meteorological station and other towns for which the solar data are given (29)

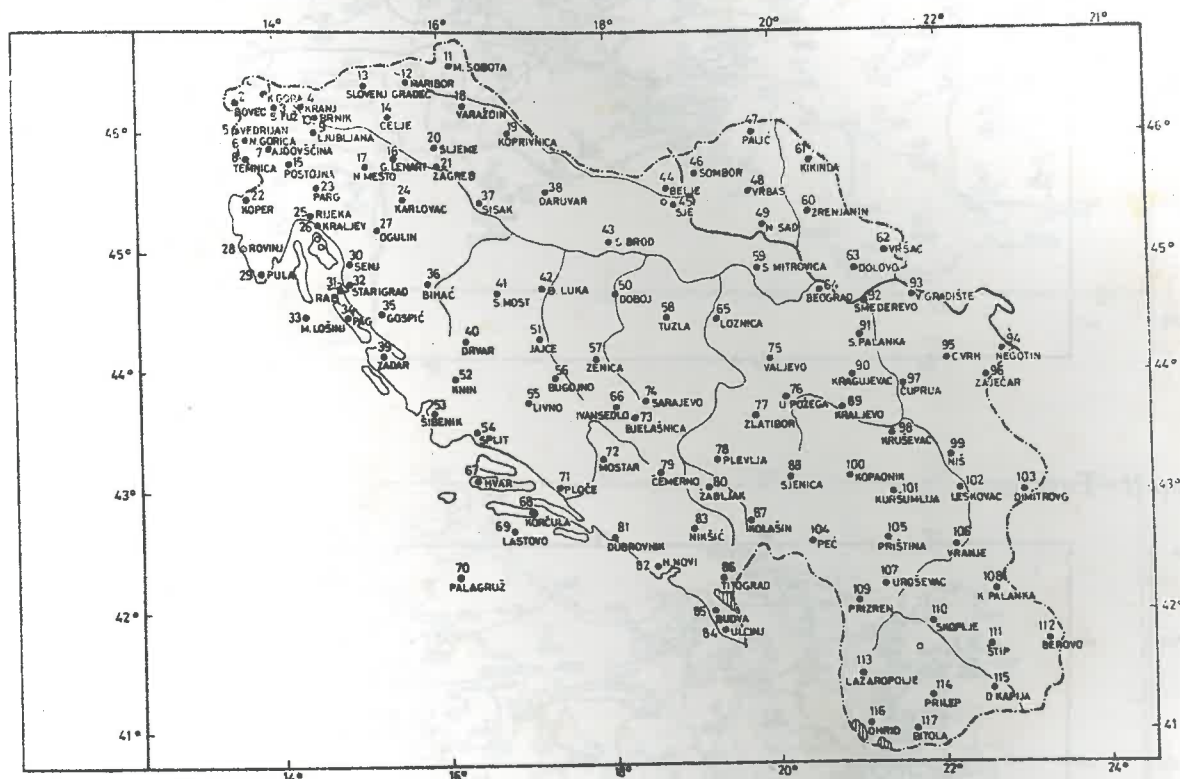
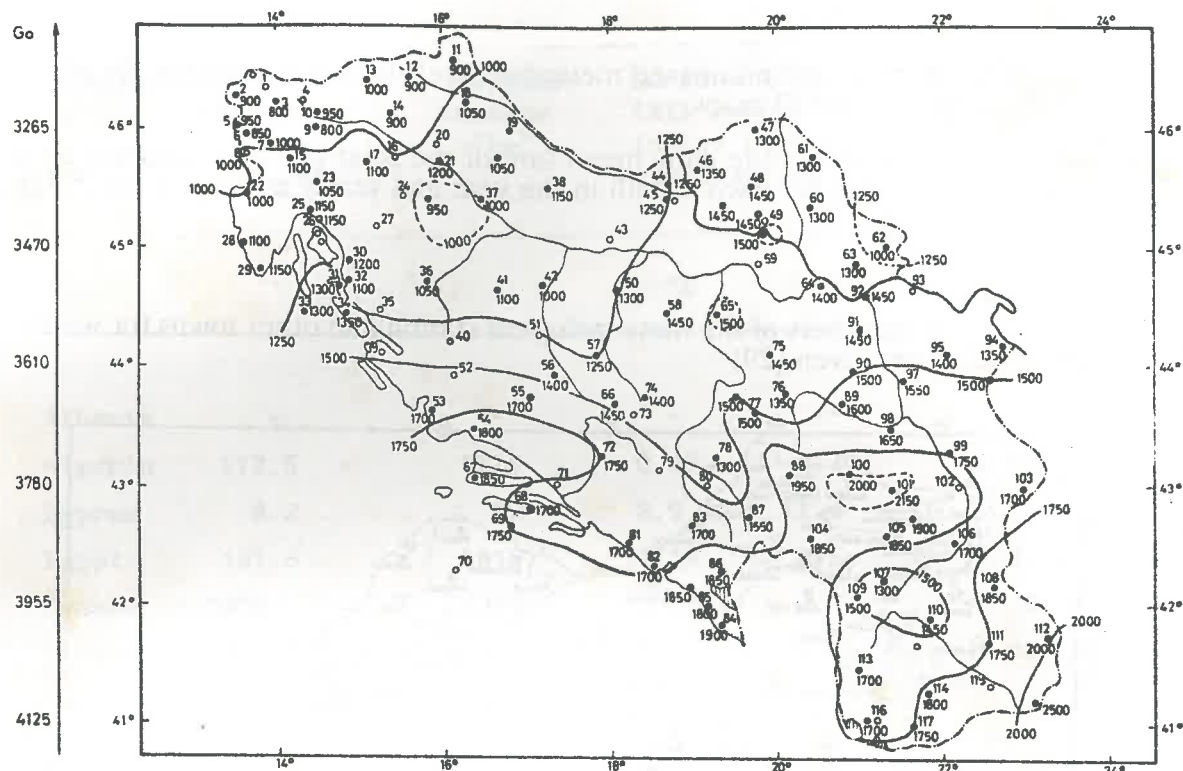
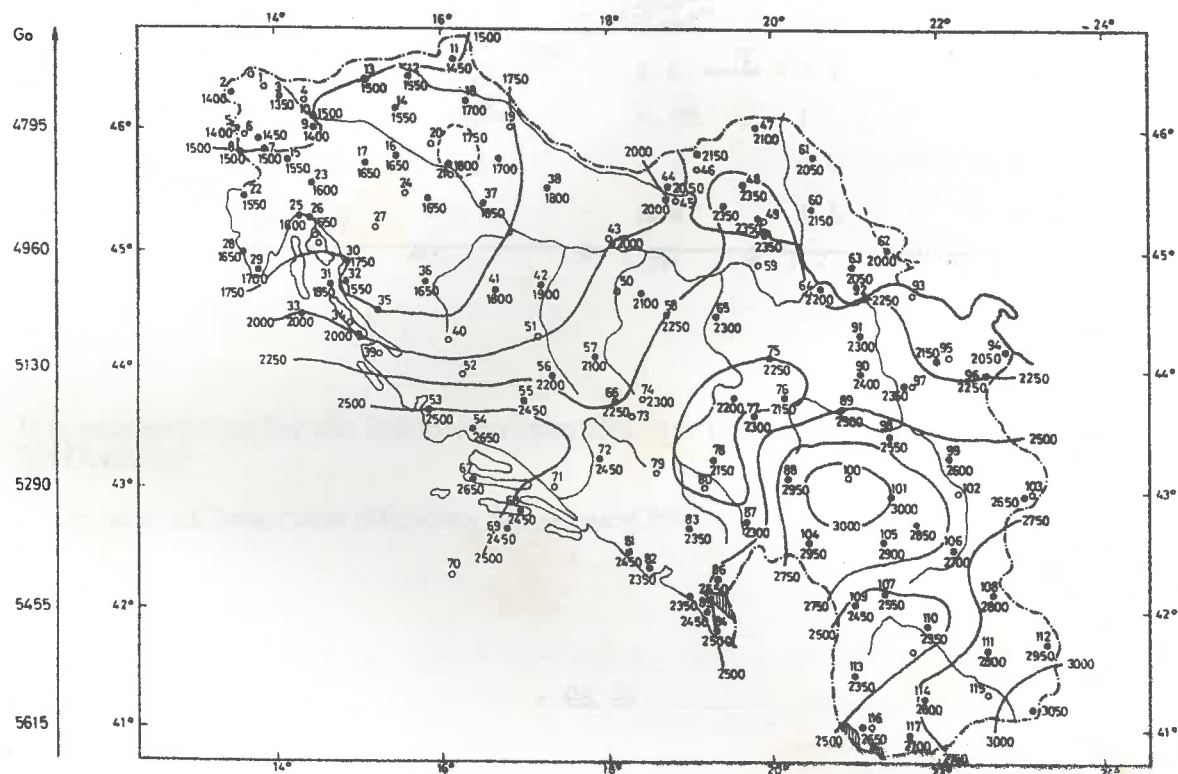


Fig. 25 Map I to XIII - The daily mean sum of the solar global irradiation on a horizontal surface (in Wh/m^2) for each month in the year and yearly average (map XIII) (29)

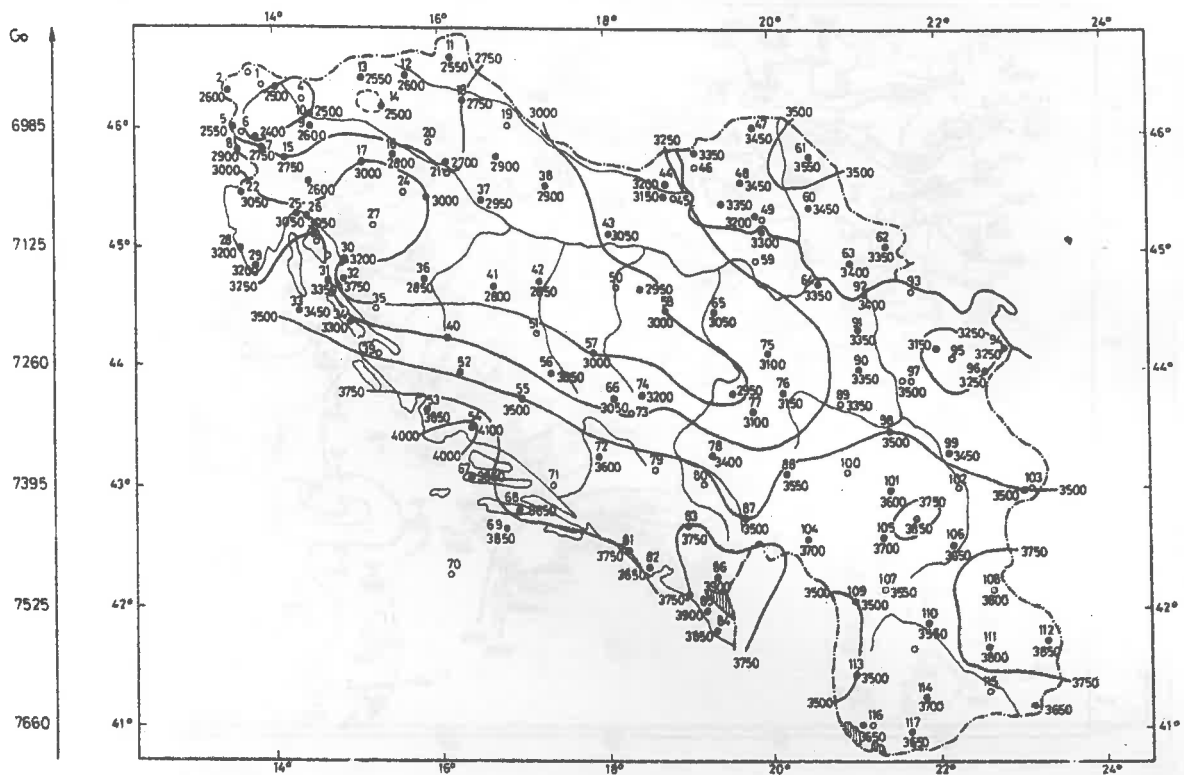
Map I - January



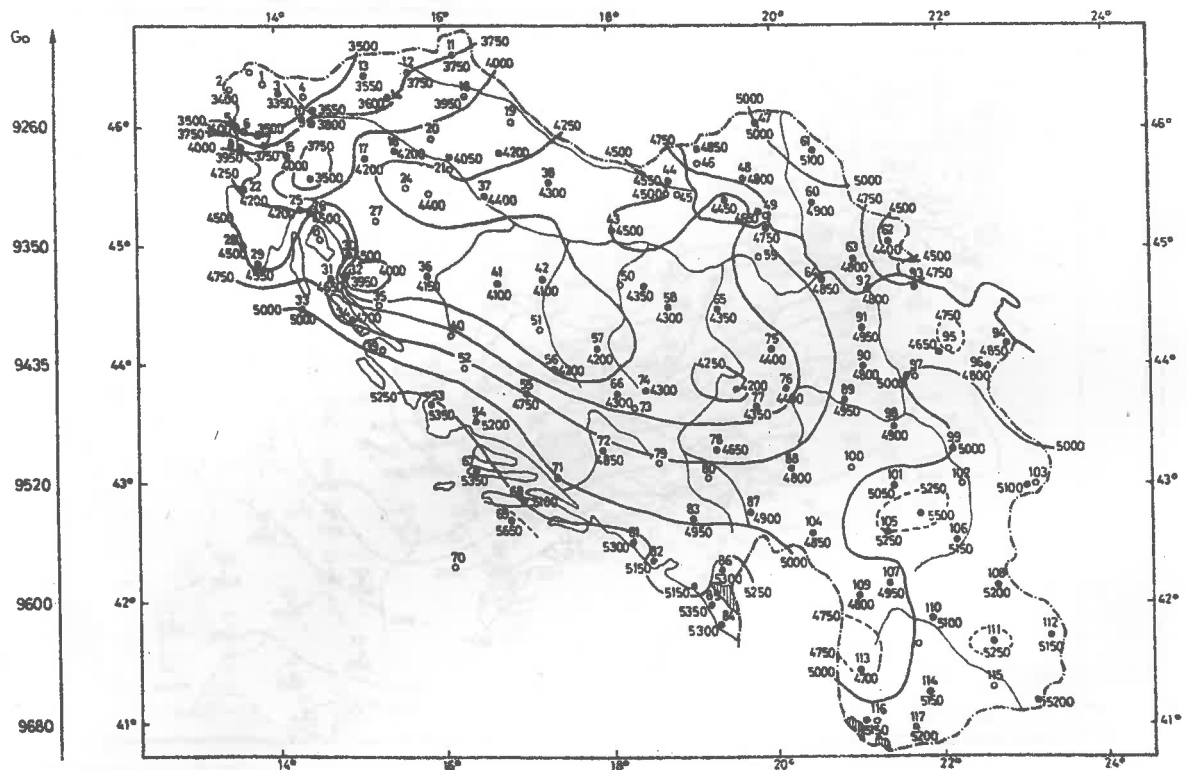
Map II - February



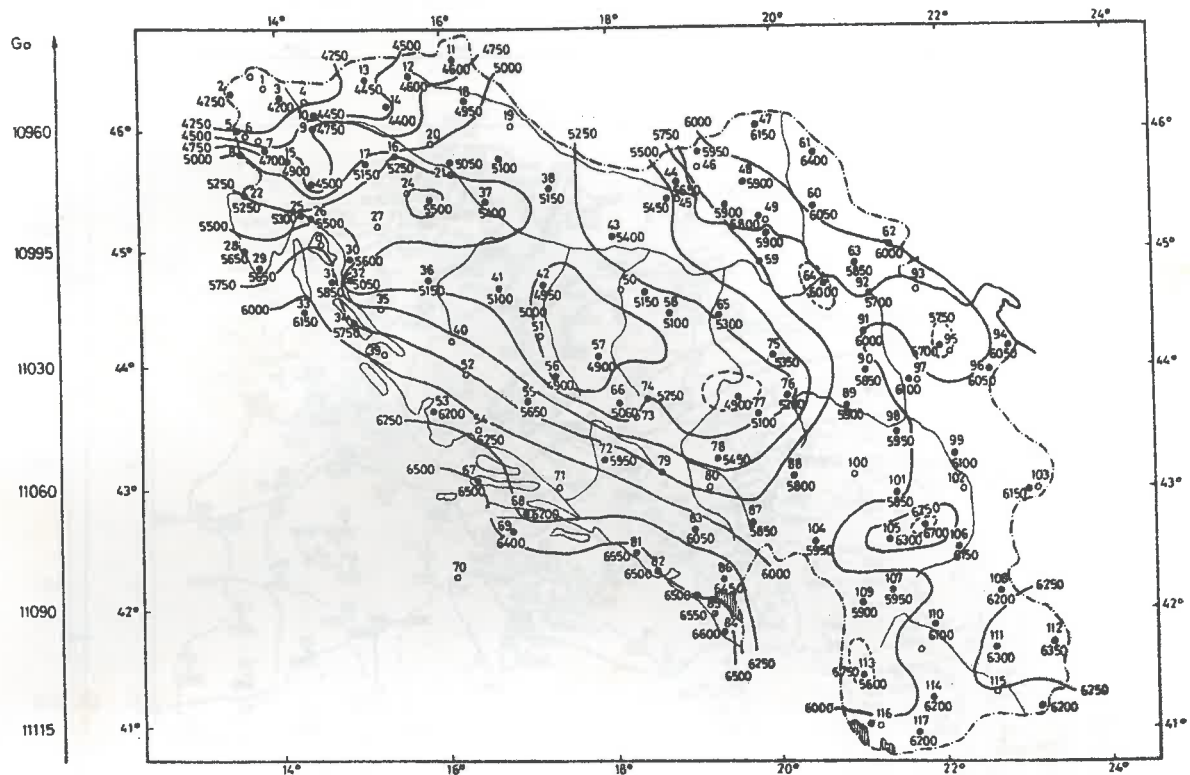
Map III - March



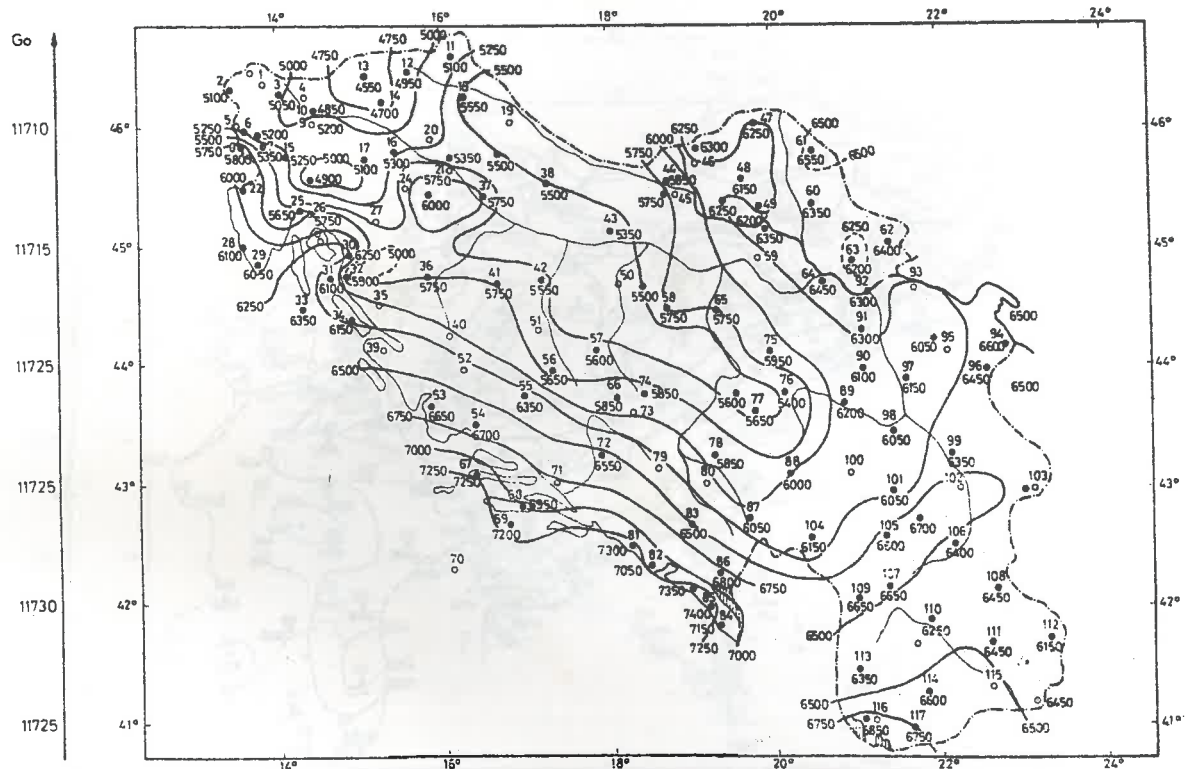
Map IV - April



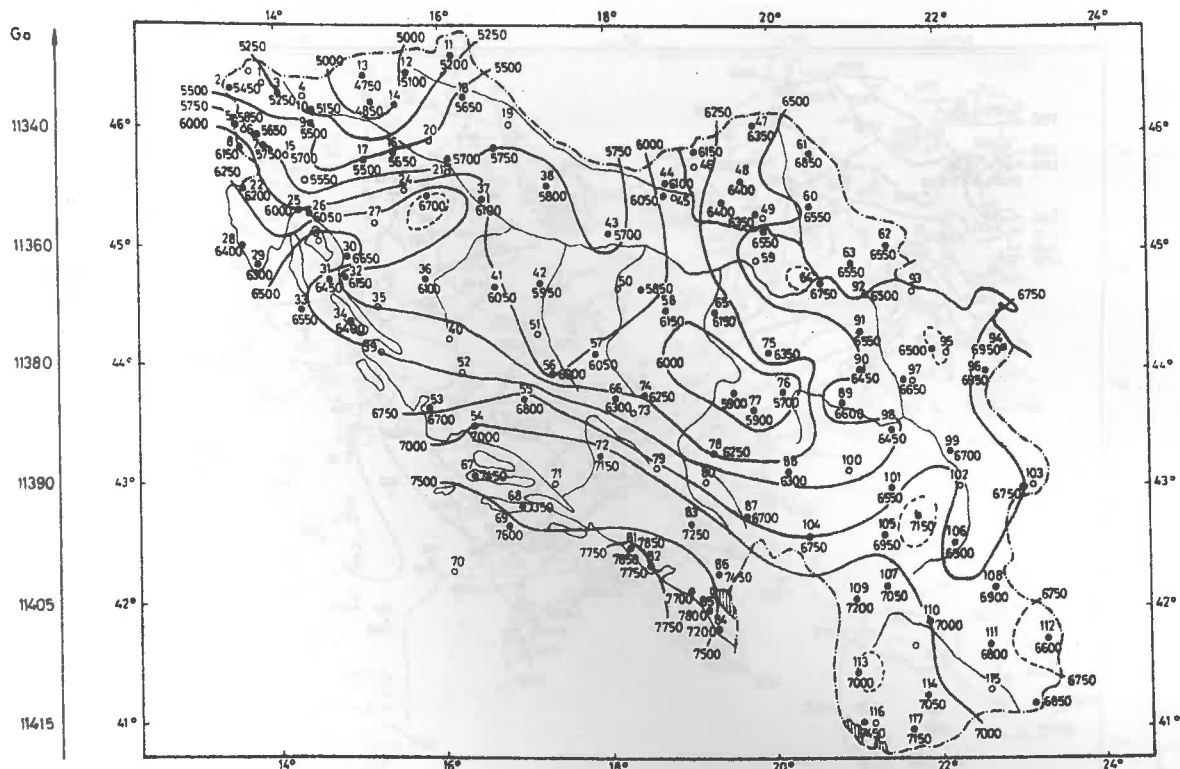
Map V - May



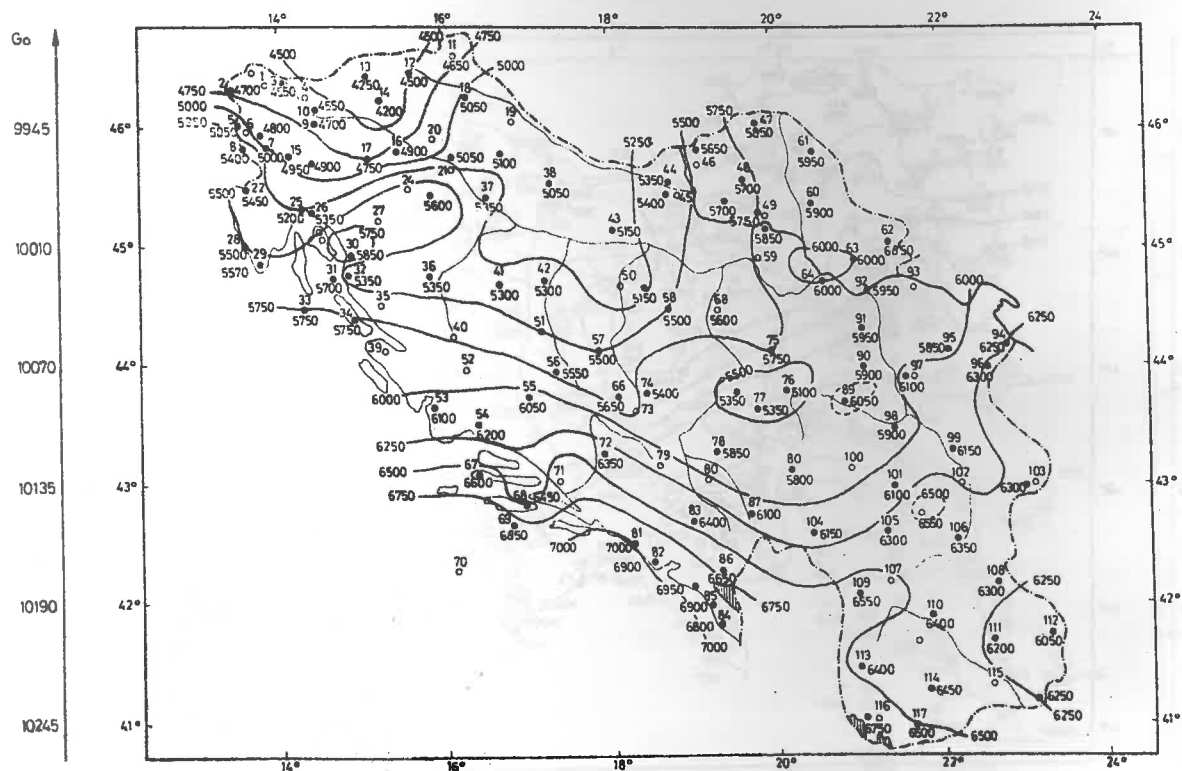
Map VI - June



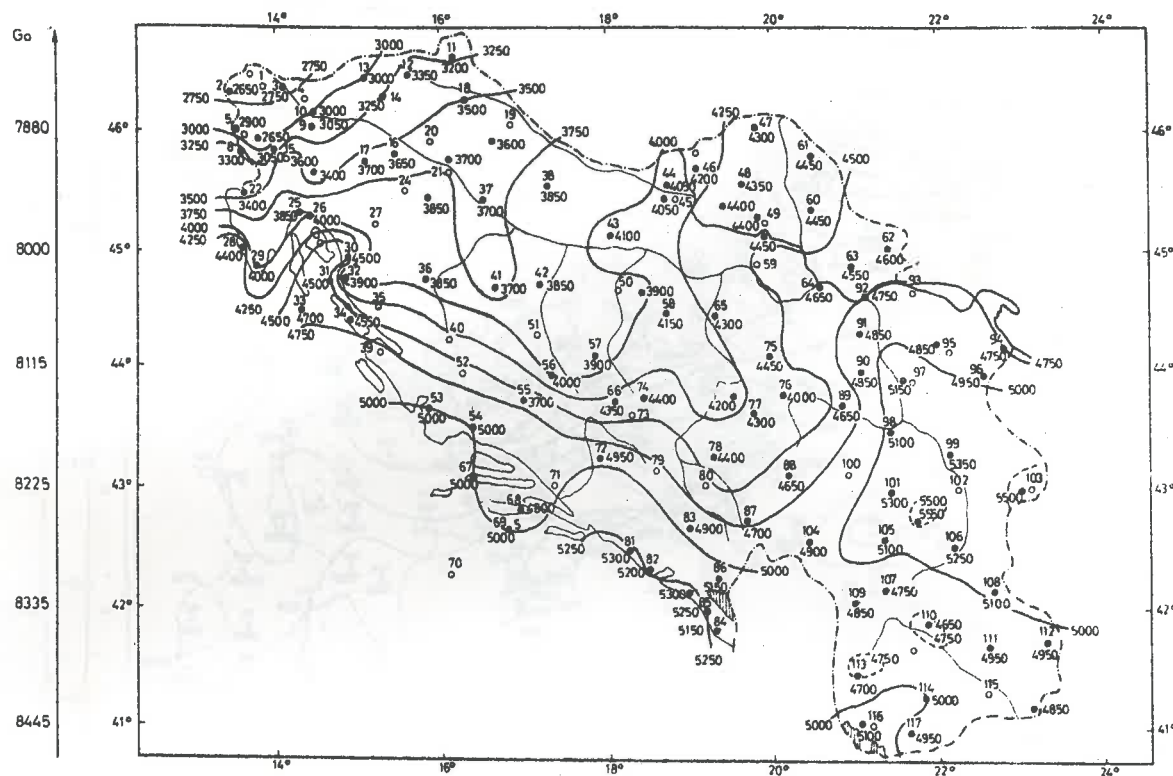
Map VII - July



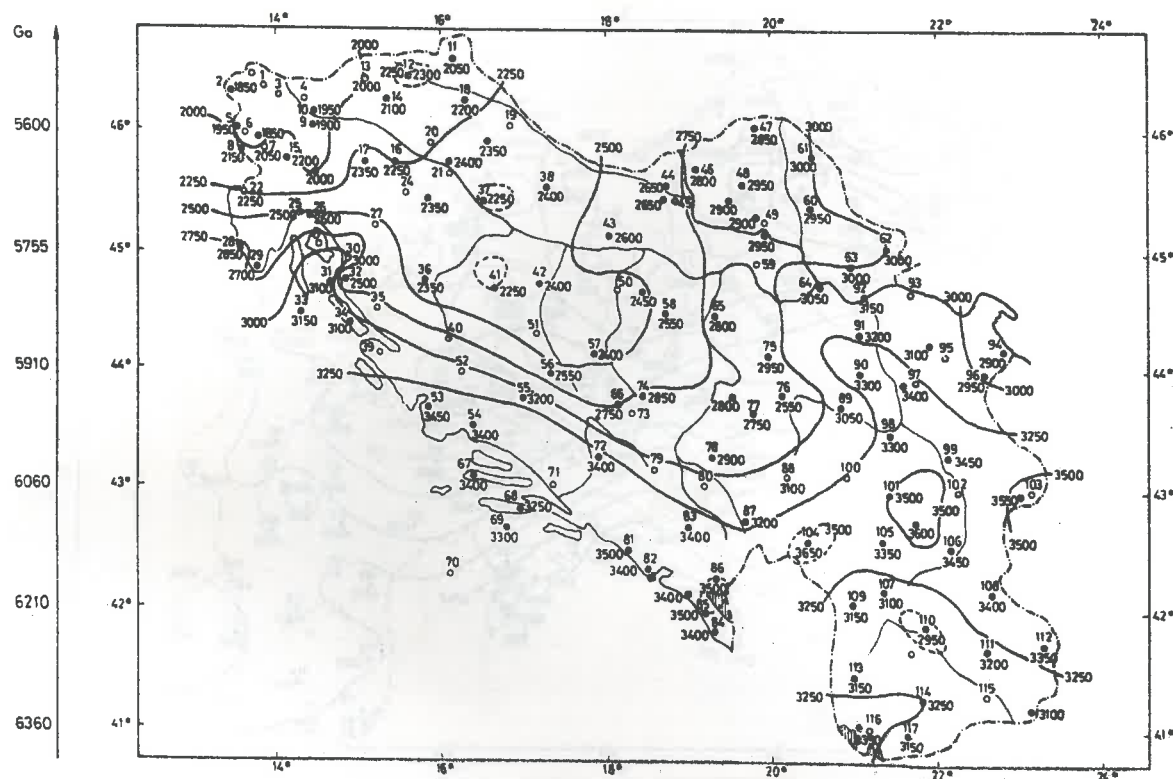
Map VIII - August



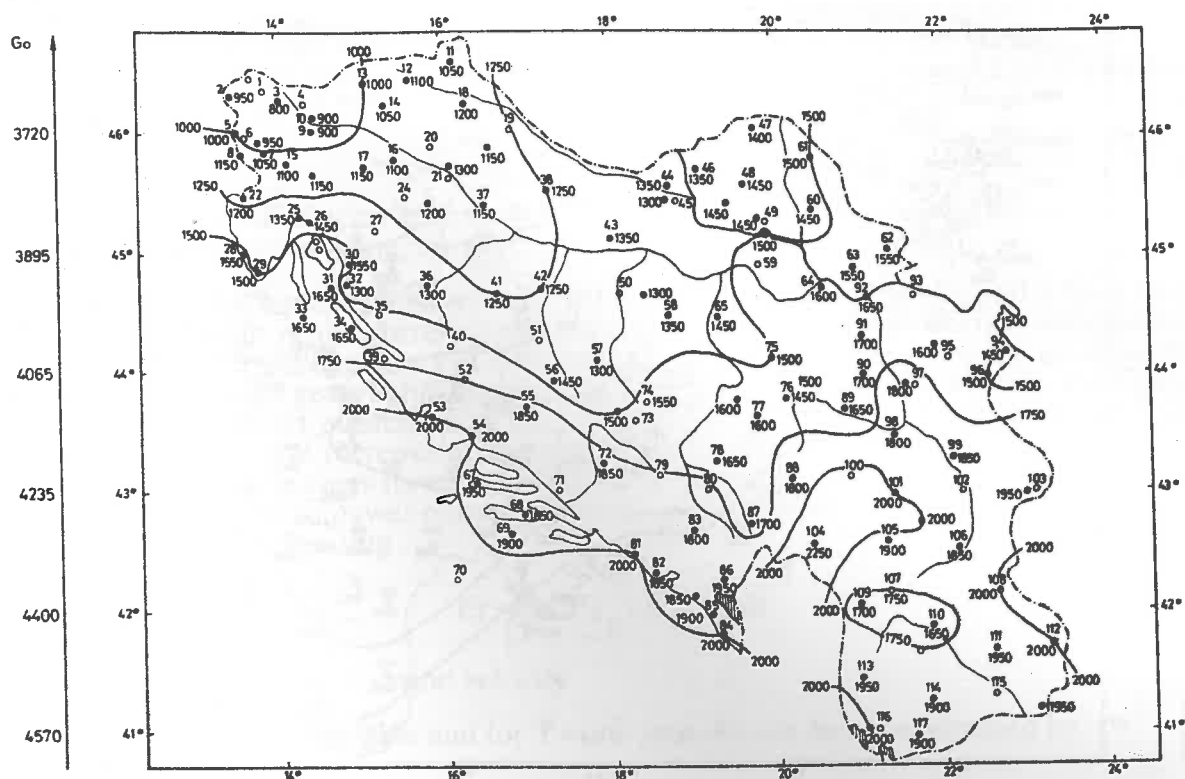
Map IX - September



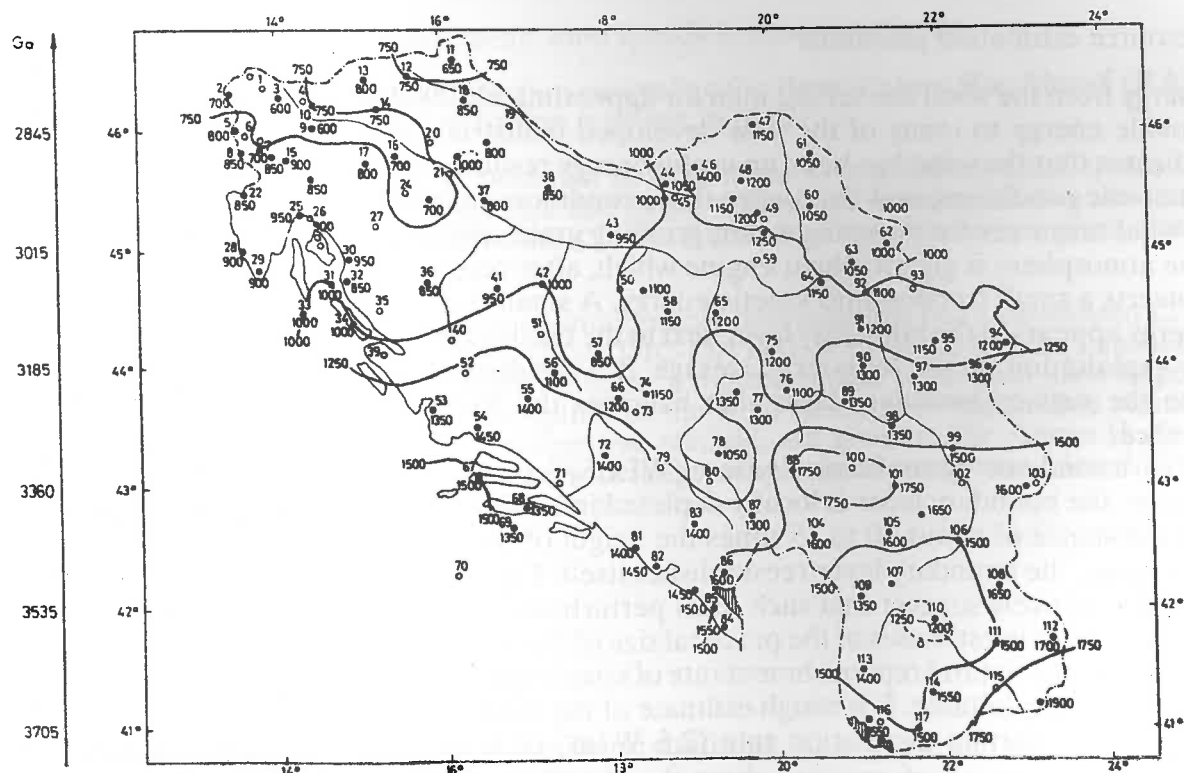
Map X - October



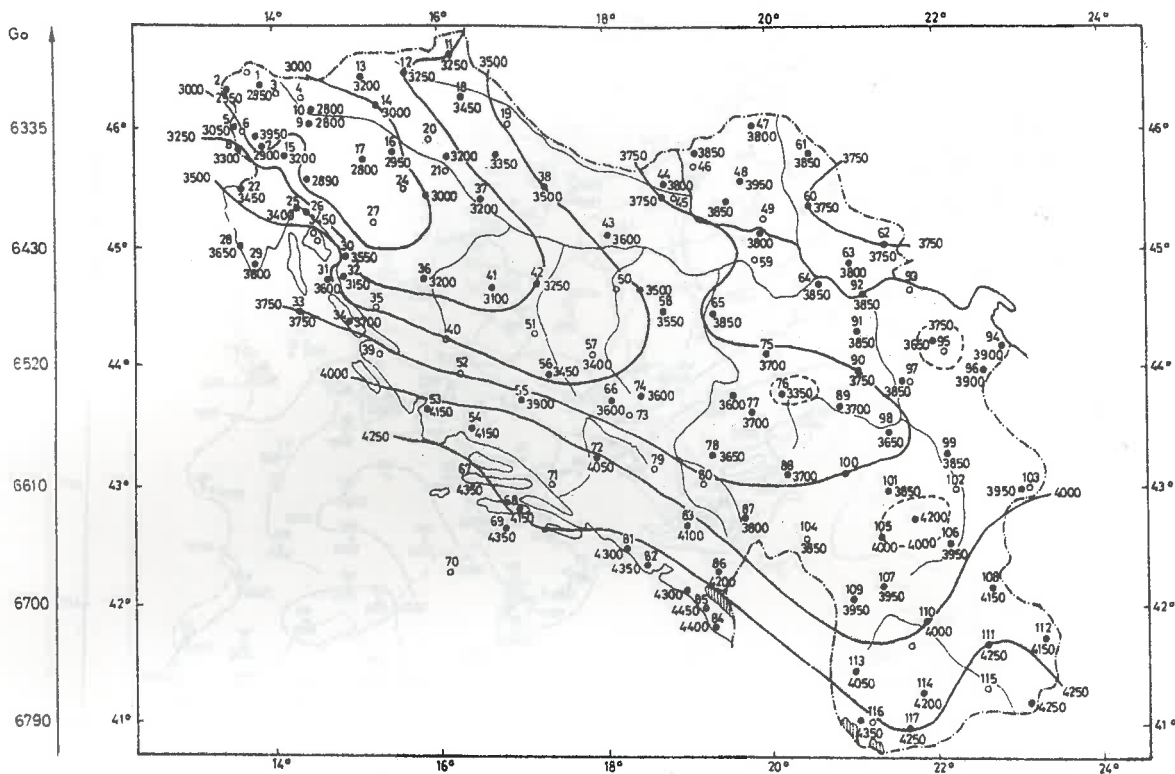
Map XI - November



Map XII - December



Map XIII - Yearly mean



4.2. Wind Energy

Resource estimation problems

Energy from the wind has served man for approximately 2000 years and, in fact, helped to provide energy to many of the now developed industrial countries. Historical evidence indicates that the wind has been an useful energy resource in times of need and favorable economic conditions, and that under these conditions man adapted the capricious nature of wind resources for pumping water, grinding grain, and later generating electricity.

The atmosphere is gigantic heat engine which, after receiving its input of solar radiation, converts a small fraction into kinetic energy. A small fraction of the atmospheric kinetic energy appears in the boundary layer next to the earth's surface and is potentially available for exploitation. In the long-term average, it is the downward transport of kinetic energy into the surface boundary layer that balances the frictional dissipation at the earth's surface.

When a wind energy conversion system (WECS) is placed in the boundary layer to extract energy, the boundary layer is locally depleted in kinetic energy downwind of the machine for a distance of about 10 to 15 times the height of the machine (with its rotor). Beyond this range, the boundary layer reestablishes itself. Experience with wind machines to date would intuitively suggest that such local perturbations are acceptable. However, current discrepancies in estimates of the practical size of the wind energy resource depend on what fraction of the natural replenishment rate of kinetic energy in the boundary layer is deemed reasonably exploitable. For rough estimate of the wind energy resource we can use about 10% of the normal dissipation rate (2.5 W/m^2 of land area). Such a rough estimate, however, utilizes no information about the distribution of the resource in space (15).

To calculate the actual wind power that can be obtained by a particular wind generator, one has to find the integral of the generator performance curve multiplied by the frequency at various wind speeds, i.e. the wind speed probability density function $f(v)$. Of the two distributions most often used to represent $f(v)$ the Rayleigh and the Weibull, most of researchers (16, 17, 18, 22) have chosen the second since it is more general. For the weibull distribution, $f(v)$ is given by

$$f(v) = k/c (v/c)^{k-1} \exp(-(v/c)^k)$$

where v is the wind velocity, k and c are the Weibull shape and scale parameters, which are related to the mean value, m_v and the variance of the wind (see 18).

To represent the frequency distribution of the wind field, isopleths of c and k have been plotted on the map of the corresponding region (19). Unlike solar energy, wind power, because of its dependence on the third power of the wind speed, is not as smoothly distributed and local geographic features, such as hill, surface characteristics, even large structures, may affect substantially its value. After adjustments to account for local conditions such as the increase at the top of a hill, channeling, sheltering and surface roughness variation, values for c and k can be used to calculate the wind energy flux E_f , or to estimate the mean power output of a wind energy generator by multiplying its power curve by $f(v)$ and integrating

$$E_f = 1/T \int_0^T 1/2 \rho v^3 dt$$

(T - time, ρ - air density, v - wind velocity)

For data in the Beaufort scale and for T =one year, E_f can be approximated by

$$E_f \cong 1.95 \sum_{i=1}^{12} (0.01 f_i v_i^3)$$

f_i - annual frequency of occurrence of the i -th Beaufort intensity and v is the mid point wind velocity

Wind energy flux E_f from various mean wind speeds is shown on fig. 26.

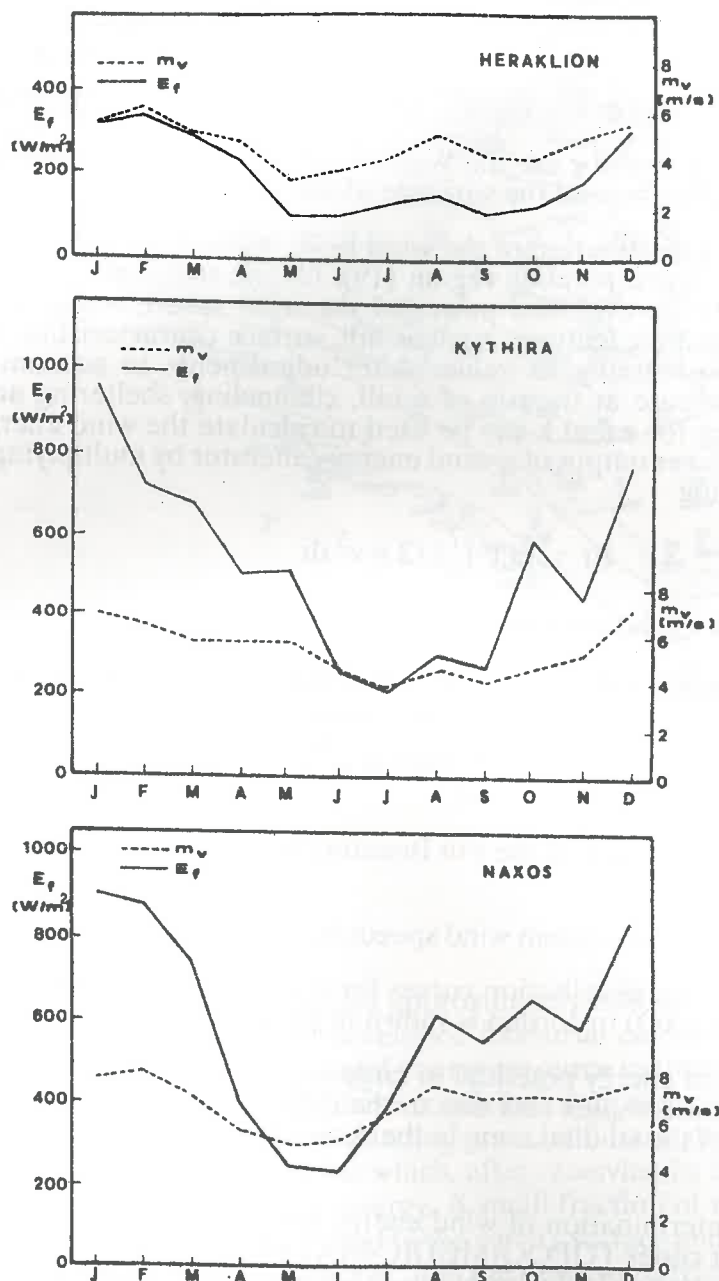
Annual cumulative frequency distribution curves for the three station Ras Munef (RA), Mafrag (MA) and Aqaba (AQ) in Jordan is shown in fig. 27.

The determination of wind energy potential in large areas with relatively small amounts of meteorological data is a complex task due to the difficulties in extrapolating the data from stations to the rest of the studied area. In the Annex I. of this chapter are given some rules for siting

New methodology for determination of wind energy potential has been developed (21) based upon the computer codes TOPOG-MEDIC-MATHEW from the LLNL (Lawrence Livermore National Laboratory) which obtains a 3-dimensional wind field used in pollutant dispersion analysis. Their description of the wind fields gave reasonable results. Data for Spain obtained with this, inexpensive method, are given in the Annex II. As a result of the simulation mostly areas with large wind speed were considered. The developed methodology consists of five steps:

- definition of the topography
- definition of the surface winds
- definition of the upper surface winds
- definition of the wind shear and atmospheric condition
- analysis process

Fig. 26 Monthly mean values for the maximum available wind energy flux E_f (—) in W/m^2 and the mean wind speed m_v (---) in m/s for high (Naxos), medium (Kythira) and low (Heraklion) energy potential station (19)

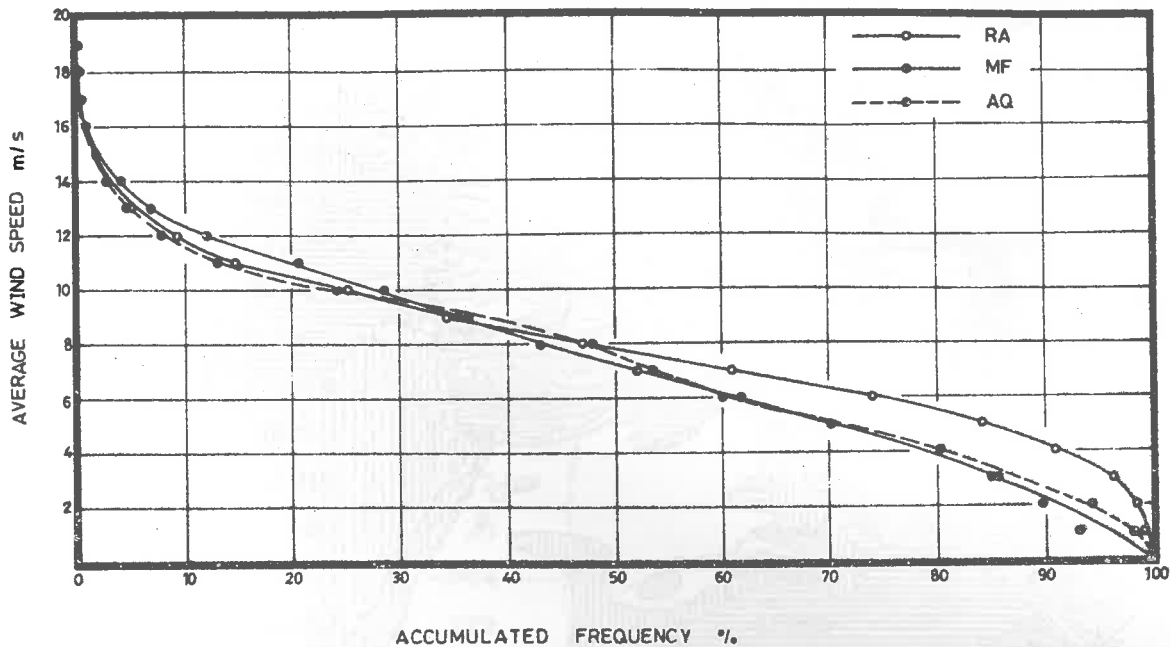


The results of the simulation for each month are the maps with the isovents, allowing the identification of the areas with the largest potential. With these data the maximum power available (P_M) in those areas can be obtained (see 21). The usable wind potential P_u , is found from P_M as follows:

$$P_u = P_M K_t$$

Where K_t is a correction factor for each subarea that consider terrain characteristic, land utilization etc. Finally, the total wind energy resource of the whole area is calculated integrating the values of P_u of all subareas.

Fig. 27 Annual cumulative frequency distribution curves for the three stations (RA, MF and AQ) in Jordan (20) requirements (20) including regional screening methodology.



Wind potential

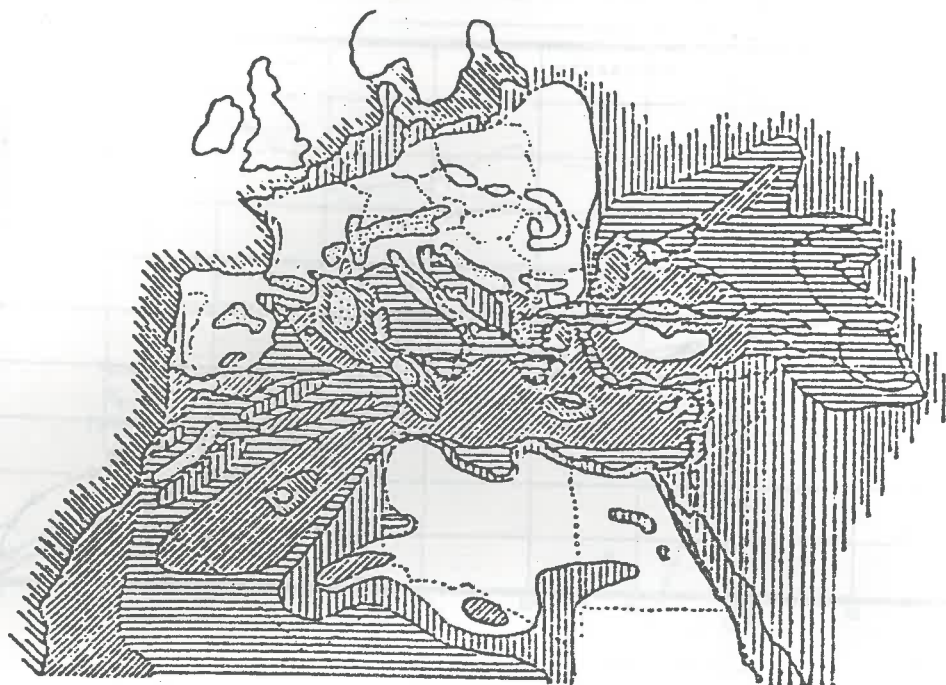
If the total wind energy is compared to the total solar irradiation the result is that the wind energy is 0.2% of the total solar irradiation. The Mediterranean region is one of the most favorable for the use of wind energy, because annual mean wind's speed is quite high. Fig. 28 shows (14) the mean wind speed and classes of wind energy flux (WEF) for the Mediterranean region.

Quantitative estimation of the wind energy potential for the Mediterranean countries cannot be done, since the necessary data are available in limited quantity and quality. Available data for Spain, Greece and Yugoslavia are given in Annex II. A rough estimation on the basis of energy dissipation ($1/10$ from 2.5 W/m^2) and land area is presented in table 5.

Because of land use limitations the real energy potential is only $1/4$ of the calculated values.

Rigopoulos (14) has made the calculations, how much the wind energy potential could contribute to the electric energy demands. The results are shown in the table 5a.

Fig. 28 Classes of wind speed and energy flux (14)



	1	2	3	4	5	6	
10m	0 — 4.4	4.4 — 5.1	5.1 — 5.6	5.6 — 6.0	6.0 — 6.4	6.4 — 7.0	SPEED m/s
	0 — 100	100 — 150	150 — 200	200 — 250	250 — 300	300 — 400	WEF W/m ²
50m	0 — 5.6	5.6 — 6.4	6.4 — 7.0	7.0 — 7.5	7.5 — 8.0	8.0 — 8.8	SPEED m/s
	0 — 200	200 — 300	300 — 400	400 — 500	500 — 600	600 — 800	WEF W/m ²

Table 5: Theoretical wind energy potential

	Area MC km ²	WE MC TWh	Area MR km ²	WE MR TWh
Albania	28748	63	28748 ?	63 ?
Algeria	2381741	5	68294	150
Cyprus	9251	20	9251	20
Egypt	1001449	2190	403716	884
France	547026	1198	46248	101
Greece	131944	289	100278	219
Israel	20770	46	4474	10
Italy	307225	672	226685	497
Lebanon	10400	23	2668	6
Libya	1759540	3854	600000 ?	1314 ?
Morocco	446550	979	41950	92
Malta	316	0.7	316	0.7
Spain	504782	1106	25504	56
Syria	185180	405	4200	9
Tunisia	163610	359	45712	100
Turkey	780576	1708	122612	268
Yugoslavia	255804	560	42448	93
		13477.7		3882.7
Mediterranean Sea	2 900 000			6351

MR - Mediterranean region only

WE - Wind energy

Table 5a: Wind energy contribution to the electric energy demand in the Mediterranean countries

Country	Electrical energy consumed		% Surface required		
	1976	TWh 2000	1976		2000
			LT	HT	HT
Algeria	35	70	0.5	0.17	0.34
Cyprus	2.4	4.8	9	3	6
Egypt	53.8	107.6	2	0.7	1.4
France	590.2	1180.4	38	12	24
Greece	54	108	14.5	5	10
Israel	21.5	43	37	12	24
Italy	468	936	56	18	36
Lebanon	6.8	13.6	23	7.5	15
Libya	10.3	20.6	0.2	0.07	0.14
Malta	0.8	1.6	87	28	56
Morocco	17.5	35	1.4	0.40	0.80
Spain	232	464	16.5	5	10
Syria	15	30	3	0.9	1.8
Tunisia	8.8	17.6	2	0.64	1.28
Turkey	106	212	5	1.6	3.2
Yugoslavia	119	238	16.5	5	10

* The % surface values for the year 2000 are the most pessimistic ones due to the extreme assumption that the electrical energy is the 60% of the total energy needed.

** For the year 1976 Electrical Energy was assumed to be the 30% of the total energy needed.

WIND - ANNEX I

Table 6: Identification of resource, site selection and evaluation

1. Regional screening

Objective: to identify on a subregional scale the wind energy-rich areas as to location, extent and intensity

Method(s): (a) regional flow models;
(b) structured wind surveys; (c) use of biological/anthropogenic indicators

Output: Preliminary information on location and extent of resource; data for design of documentation of wind resource

2. Preliminary resource documentation

Objective: to measure or obtain data on mean hourly wind speed (V) and direction for 1 year period in subregional area

Method(s): design and implement appropriate scale measurement (10 m level) for application

Output: velocity duration curves on hypothetical WECS output or WECS capacity factor

3. Refinement of documentation

Objective: to improve estimate of plant capacity factor by analyzing quality of wind resource

Method(s): obtain data on b_v and b_t from data sample, identify periods where in lack of steadiness of resource makes WECS operation infeasible

Output: Adjusted WECS output, or capacity factor

4. Seasonal, monthly variations in resources

Objective: to document seasonal and monthly time dependence of resource

Method(s): normal data processing

Output: same as 2

5. Representivity of data sample

Objective: to determine if the data set used in regional screening and site documentation are representative of a "mean" or typical wind year

Method(s): use subjective and/or objective pattern recognition techniques to analyze specific and long-term regional data bases

Output: comparison of specific data set to mean regional set for similarity

6. Selection of favorable subregional scale terrain characterizing

Objective: to locate within the subregional area terrain exposures that minimize transients adverse to WECS

Method(s): (a) wind surveys and typical wind energy-type days, or
(b) corresponding wind tunnel simulating, and (c) aero dynamics
experience judgment

Output: enumeration of subregional sites of favorable terrain exposure

7. Determination of spatial homogeneity of subregional site

Objective: to obtain confirmatory field evidence that the "site" is situated away from regions of gradients in V during typical windy days

Method(s): (a) wind survey techniques using conventional or remote sensing (LSA) measurement systems

Output: supporting data on a spatial extent of the wind maxima identified in (1) and documented in (2)

8. Development of subjective, biological indicators supporting hotspot location and extent

Objective: to observe during wind surveys evidence of vegetation distortion, leaf stripping, etc., supportive of location and extent information developed from other techniques

Method(s): field observations, mapping of indicators provided by plant-tree response to prevailing high winds

Output: same as 7

9. Awareness of anthropogenic indicators of windy areas

Objective: to compile experience related to the region as to the location of subregional hot spots

Method(s): examples of relevant data sources are highway patrol experience with wind related accidents, lineman experience in maintenance, shelter belts, etc.
Output: preliminary data on locations of hot spots

Table 7: Site Requirements: Relationship of Site-Specific Characteristics to Design Parameters

1. Function: Selection of design parameters for wind loading of the tower structure

Data Needed: discrete, extreme gust input for scales > 100-200 m

Objective: to design WECS towers to withstand large wind loads of low probability

Comments: (a) Being addressed in the U.S. national program;
(b) data records developed in the prototype programs are of marginal use due to their shortness of record;
(c) long records from existing high wind areas should be investigated

2. Function: Selection of design parameters for wind stress analysis of components

Data Needed: turbulence spectra from multiple sensor arrays in frequencies of 5 to 0.1 Hz and scale d to 200 m

Objective: to design WECS components to withstand large stress levels originating from differential wind loading

Comments: same as 1(a)

3. Function: Design of equipment and strategies for orienting WECS into direction of wind

Data Needed: wind directional 0.01 Hz variations

Objective: to assess strategies and energy requirements for orienting existing WECS into the wind

Comments: Early prototype operations in diverse geographic areas will furnish data for this area; siting in regions of topographically organized flow can reduce this operating consideration

4. Function: Estimation of severe operation conditions

Data Needed: classification and frequency of severe storms (thunder-storms, tornadoes, foehn winds, hurricanes)

Objective: to aid in evaluating trade-offs between hazardous operating conditions, high resource potential, and more conservative WECS design

Comments: it should be noted that the electrical transmission towers on Island of Guam sustained surface wind in excess of 190 mph without structural failure during the typhoon season of 1976

Table 8: Environmental Impacts and Land-Use Considerations

1. Noise both audible and infrasound

Comment: impacts in early projects minimized by conservative siting for large-scale WECS

2. Aesthetics and visual intrusion

Comment: principal visual intrusion from towers; clean, nonpolluting energy sources may have inherent aesthetic values contributing to their acceptance; improved siting techniques may minimize

3. Microclimate effects

Comment: research in progress in (U.S.) National Program

4. Possible tree removal

Comment: minimize by time-scale site selection when possible; high-wind sites are frequently devoid of trees in several climate regimes

5. Hill alteration to promote winds

Comment: low-probability engineering option unless proven cost-effective

6. Preemption of agricultural lands

7. Risk of personal or property injury from flying blades, tower accidents etc.

Comment: occupational safety codes need to be developed for severe weather periods

8. TV signal interference

Comment: remedial measures appear technically feasible, including composite blades rather than metal, electric filters on TV sets affected, cable service, and site selection

9. Hazards to birds and other wildlife through collision or disorientation

Comment: research performed to date in (U.S.) National Program indicates that this concern is not a problem

10. Navigation hazard to ships if offshore and to aircraft if on mountaintops

Comment: adequate navigation warning system needs design and early documentation to gain acceptance

11. Construction impacts of ancillary facilities, i.e. roads, transmission sites, storage systems, outbuildings

Comment: standard site-development work associated with engineering projects; conservative siting procedures would use existing transmission lines whenever practical

12. Restriction of further building in an area that might block winds

Comment: some zoning to protect a large resource may be necessary if compatible with control of visual intrusion

13. Fencing and other security measures to protect generators from vandalism

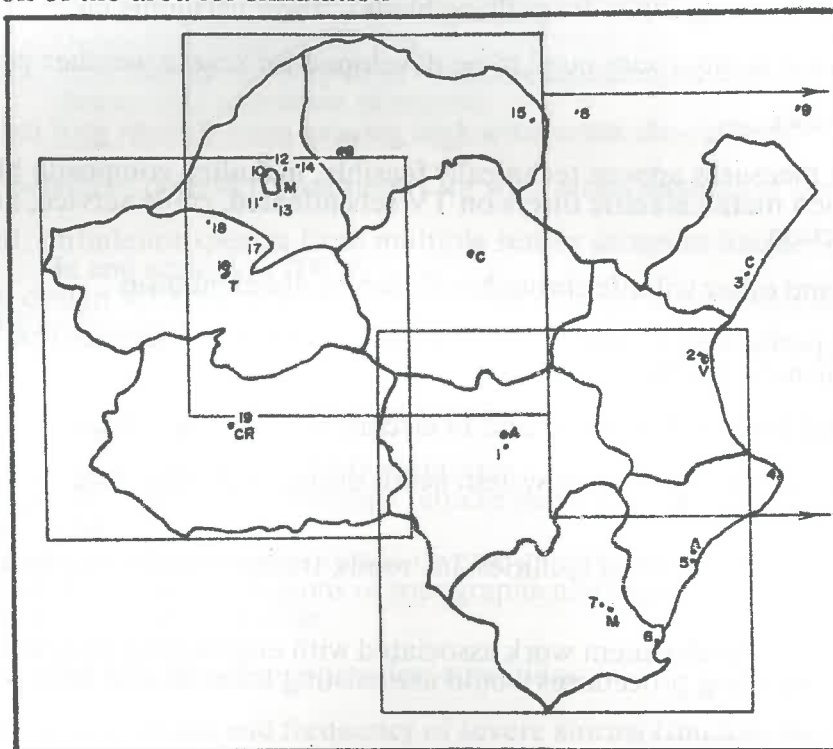
Comment: Security measures may be no greater than for other large-energy options

Wind energy potential in Spain

Results of simulation for Eastern and Central Parts of Spain

Model TOPOG-MEDIC-MATHEW

Fig. 29 Plot of the area under study showing the location of the surface stations and the division of the area for simulation



- | | |
|--------------------------|----------------------|
| 1. Los Llanos | 11. Cuatro Vientos |
| 2. Manises | 12. Barajas |
| 3. Almazora | 13. Getafe |
| 4. Cabo de San Antonio | 14. Torrejon |
| 5. El Altet | 15. Molina de Aragon |
| 6. San Javier | 16. Toledo |
| 7. Alcantarilla | 17. Esquivias |
| 8. Calamocha | 18. Valmojado |
| 9. Observatorio del Ebro | 19. Ciudad Real |
| 10. Ciudad Universitaria | |

Table 9: Characteristics of the different observatories used in the study

Month	Mean Velocity (m/s)	Direction
January	10.2	NNW
February	9.5	NNW
March	9.8	WNW
April	9.7	SE
May	9.6	W
June	6.3	SSW
July	5.6	SSW
August	4.8	SE
September	9.4	SSW
October	10.5	WNW
November	7.5	NW
December	12.4	WNW

Fig. 30 Isovents (m/s) at 10 m above surface for January

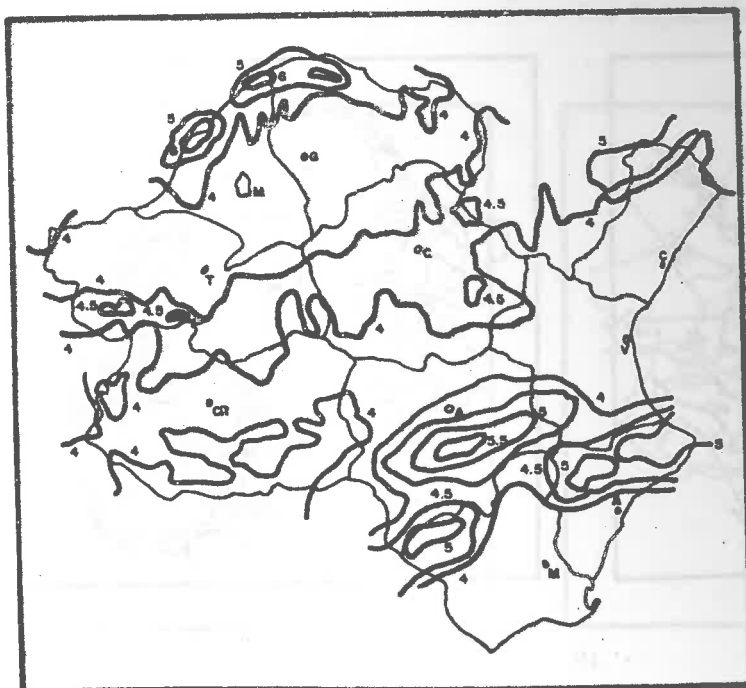


Fig. 35 Isovents (m/s) at 10 m above surface for June

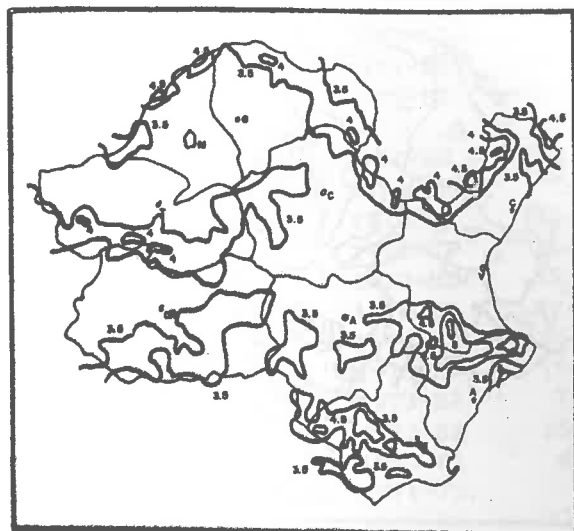


Fig. 36 Isovents (m/s) at 10 m above surface for July

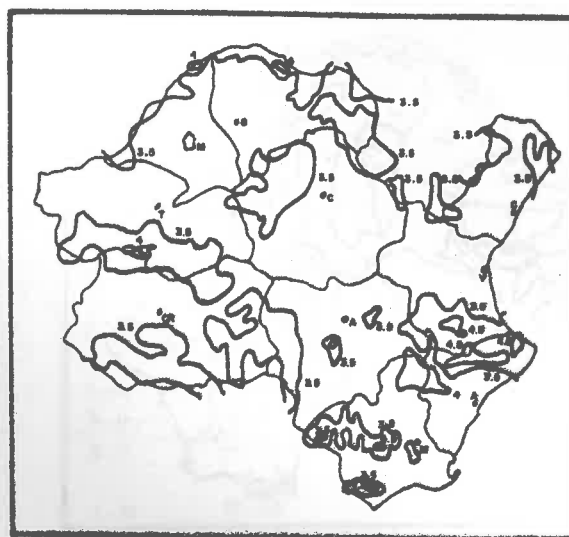


Fig. 37 Isovents (m/s) at 10 m above surface for August

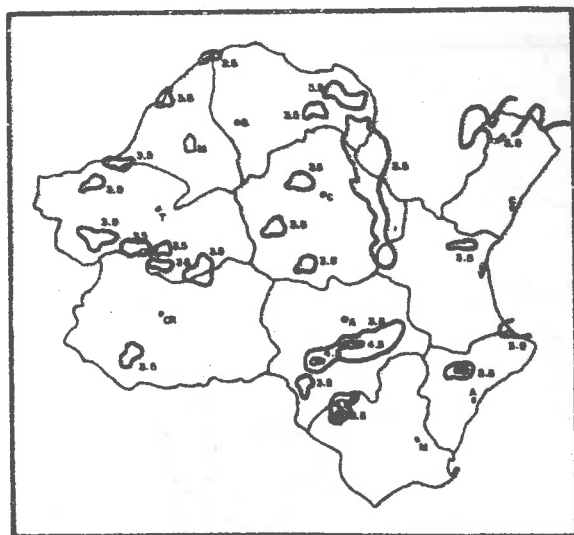


Fig. 38 Isovents (m/s) at 10 m above surface for September

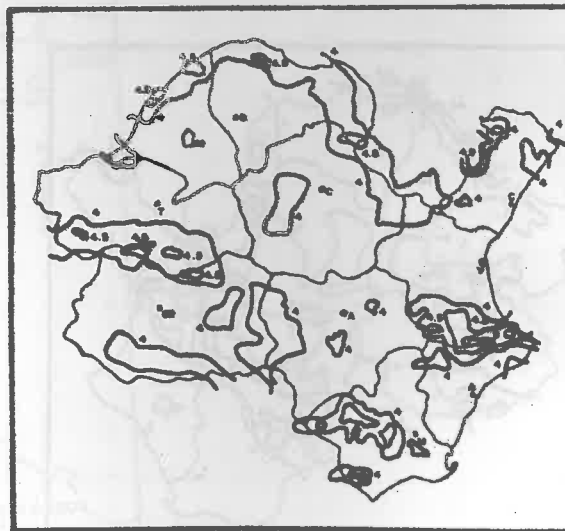


Fig. 40 Isovents (m/s) at 10 m above surface for November

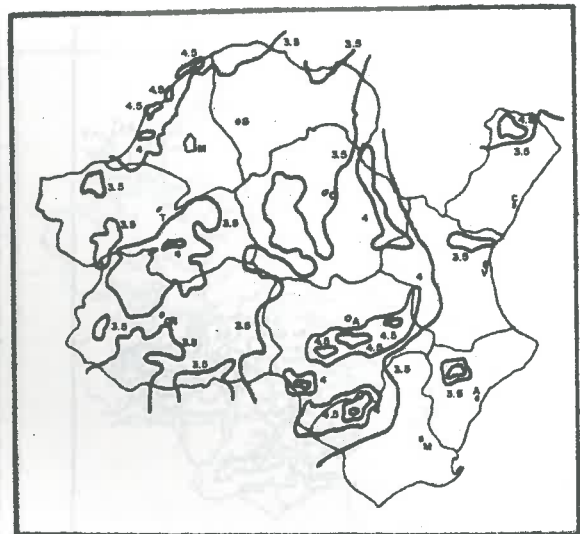
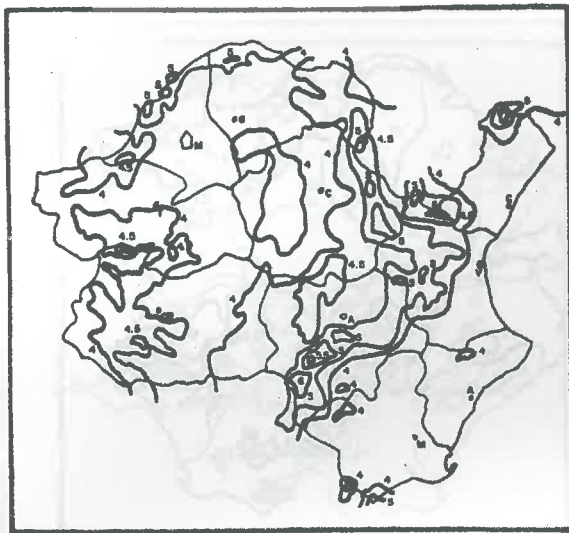


Fig. 42 Subareas with the largest wind energy potential

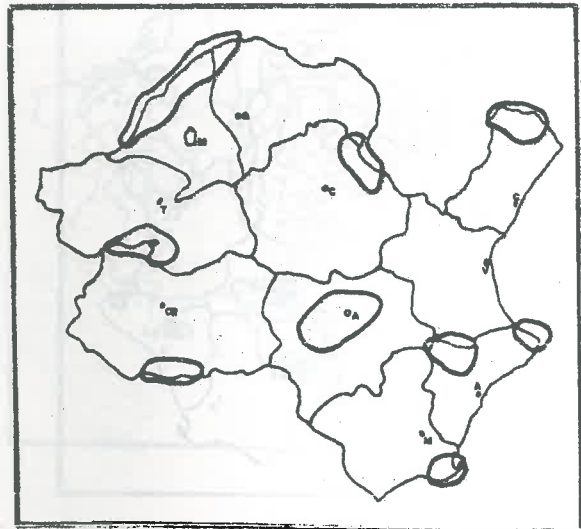
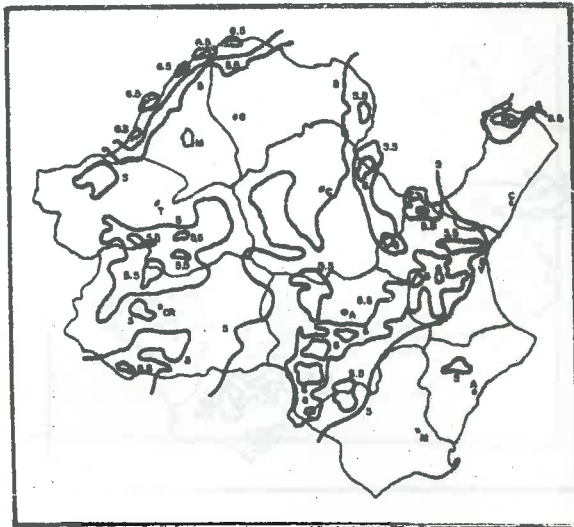


Table 10: Mean values of velocity and direction at the upper surface

Observatory Name	Period analyzed	Apparatus height	Annual m. veloc.	Exponent of wind share
Los Llanos	1973-82	13.6	4.8	0.17
Manises	1973-82	19.6	4.0	0.20
Almazora	1979-82	20.0	3.9	0.34
Cabo de San Antonio	1960-68	8.0	6.1	0.17
El Altet	1973-82	5.0	4.8	0.14
S. Javier	1973-82	15.0	4.5	0.17
Alcantarilla	1973-82	10.2	3.1	0.17
Calamocha	1973-82	13.5	3.5	0.17
Ob. del Ebro	1973-82	11.9	3.7	0.22
C. Universita.	1973-82	14.0	2.4	0.40
Cuatro Vientos	1973-82	15.0	3.1	0.20
Barajas	1973-82	7.0	3.6	0.25
Getafe	1973-82	15.0	3.5	0.20
Torrejon	1973-82	4.5	3.9	0.20
Molina de Aragon	1971-72,			
	1975-82	13.0	2.8	0.22
Toledo	1973-82	15.0	1.4	0.34
Esquivias	1977-80	10.0	6.5	0.17
Valmojado	1977-80	10.0	4.2	0.17
Ciudad Real	1973-82	5.7	3.4	0.34

Wind Energy Potential in Greece

Fig. 43 The location of the stations utilized in the present study

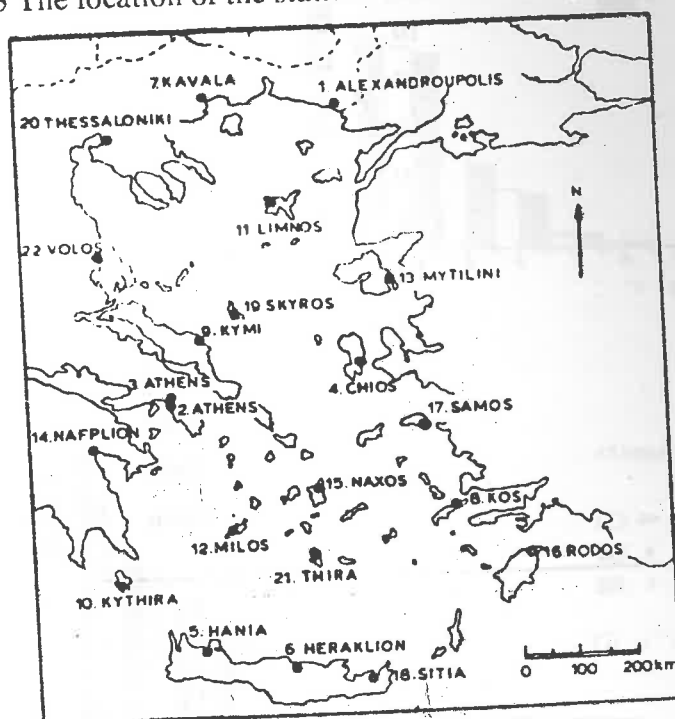


Table 11: List of the stations in Fig. 45 along with some additional information on their operational duration and characteristics

Station	Daily Observational Frequency	Height of Observation (m)	Starting Date
Alexandropolis	8	10	1946
Athens	Continuous	10	1946
Athens-Observatory	Continuous	10	1900
Chios	5	5	1947
Hania	3	7.5	1945
Haraklion	8	10	1947
Kavala	8	15.4	1949
Kos	3	4	1948
Kymi	3	6	1948
Kythira	8	13.6	1949
Limnos	8	13.4	1931
Milos	8	10	1947
Mytilini	8	8.5	1952
Nafplion	3	2	1954
Naxos	8	10	1955
Rodos	8	8	1950
Samos	8	10	1946
Sitid	6	3.5	1961
Skyros	8	6	1931
Thessaloniki	8	9	1947
Thira	3	2	1960
Volos	3	2	1956

Fig. 44 Probability density distribution of the wind speed

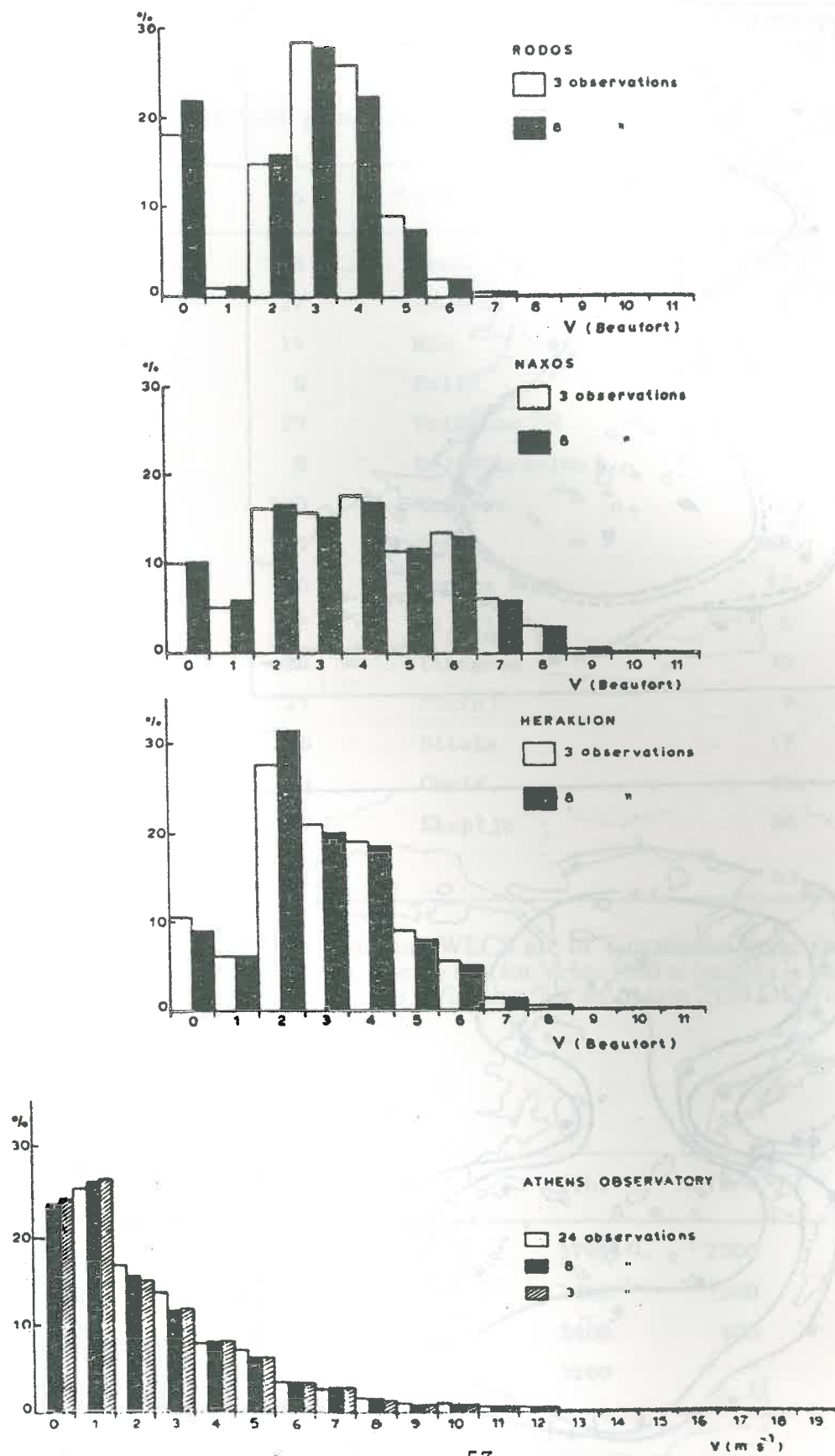
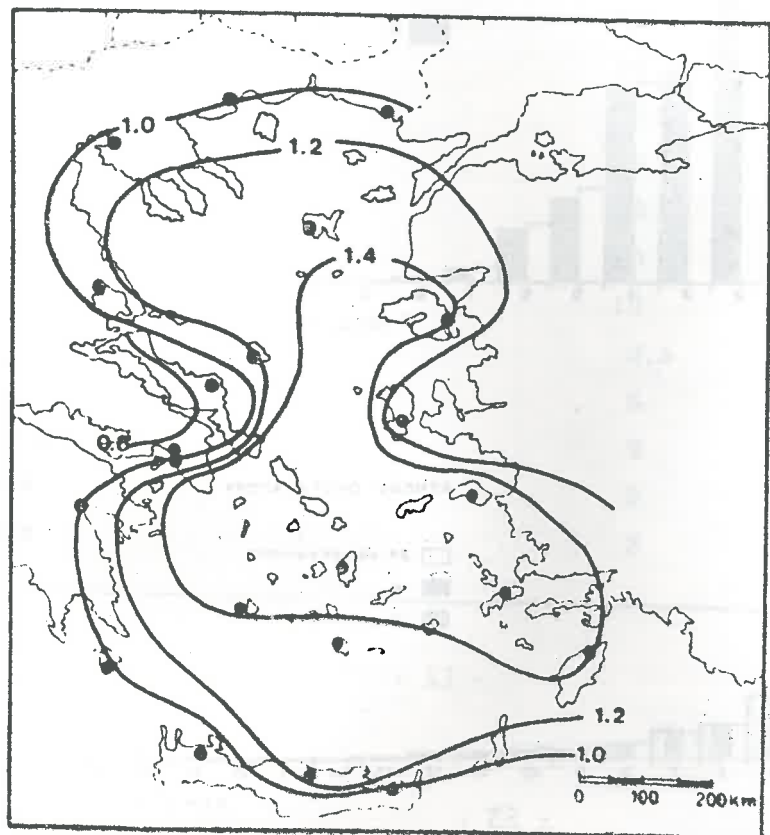
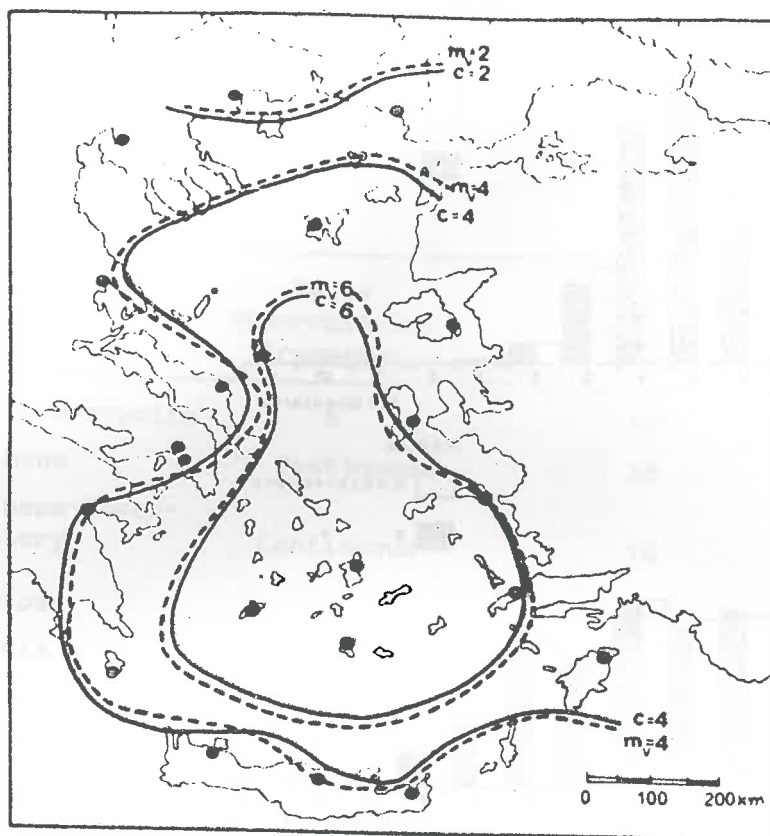


Fig. 45 Plot of the scaling weibull parameter c , k and mean wind speed m_v



WIND ENERGY POTENTIAL IN YUGOSLAVIA

There are no available data for the large area of wind potential. The wind energy flux for most promising locations, obtained from rough estimation of wind profile to the height of 100 m is shown on the Table 12.

Table 12: Daily mean with wind speed above 12 m/s (Period 1949-58)

Location	n	Location	n
Celje	4	Tuzla	2
Koper	37	Beograd	124
Ljubljana	15	Niš	21
Maribor	8	Palić	21
Gospić	29	Priština	77
Osijek	8	Sr. Mitrovica	60
Palagruža	100	Valjevo	16
Senj	111	Vršac	168
Sljeme	120	Herceg Novi	12
Split	138	Pljevlja	5
Zagreb	26	Titograd	33
Banja Luka	21	Ulcinj	9
Bjelašnica	276	Bitola	17
Gacko	73	Ohrid	41
Mostar	192	Skoplje	20
Sarajevo	57		

The most promising locations for installing WECS are in Yugoslavia Vršac (north-east Yugoslavia) and Senj (coastal region). Energy flux for Vršac (100 m height) is 1400 W/m^2 for 1450 h/yr and 250 W/m^2 for 4500 h/yr. With this flux we obtain 2550 kWh/m^2 yearly. Wind in the Senj region is more favorable.

Table 13: Wind energy data for Senj

	%	v(m/s)	T(h)	Ef(W/m ²)
NE	19	9.6	1700	2300
E	28	7.5	2400	1300
other	28	3.0	2400	400
calm	25		3100	

With this flux we obtain $8000 \text{ kWh/m}^2\text{yr}$.

Makarska with $2600 \text{ kWh/m}^2\text{yr}$ and Smederevo with $3000 \text{ kWh/m}^2\text{yr}$ are other two possible locations for WECS.

4.3. Hydroenergy

This form of solar energy is of high quality and can be converted easily to the electricity. It is not evenly distributed in all parts of the Mediterranean region. Map of the rivers in region is shown on figure 46. Northern Mediterranean countries seem to be quite rich in hydropower for big and of course, the small hydropower plants. Although big hydro is exploited in general, the small hydro is brought back to importance since oil crisis. Fig. 47 represents the market share of hydropower in Mediterranean countries from 1960 to 1980 (Electricite primaire), which vary from 14.23% (1960) to 12.44% (1980) of total energy demand (14). See Table 14.

Available potential for new large or small hydropower plants is given for some countries:

	No of plants	Power	Energy output
France	1300	1300MW	-
Spain	118	110MW	-
Greece	1000	1000MW	-
Yugoslavia (new)	96+300	6400MW	43TWh

Total economic exploitable resource of hydropower in Yugoslavia is about 71 TWh from 110 TWh as technical possible (27).

Fig. 46 Rivers in Mediterranean Region

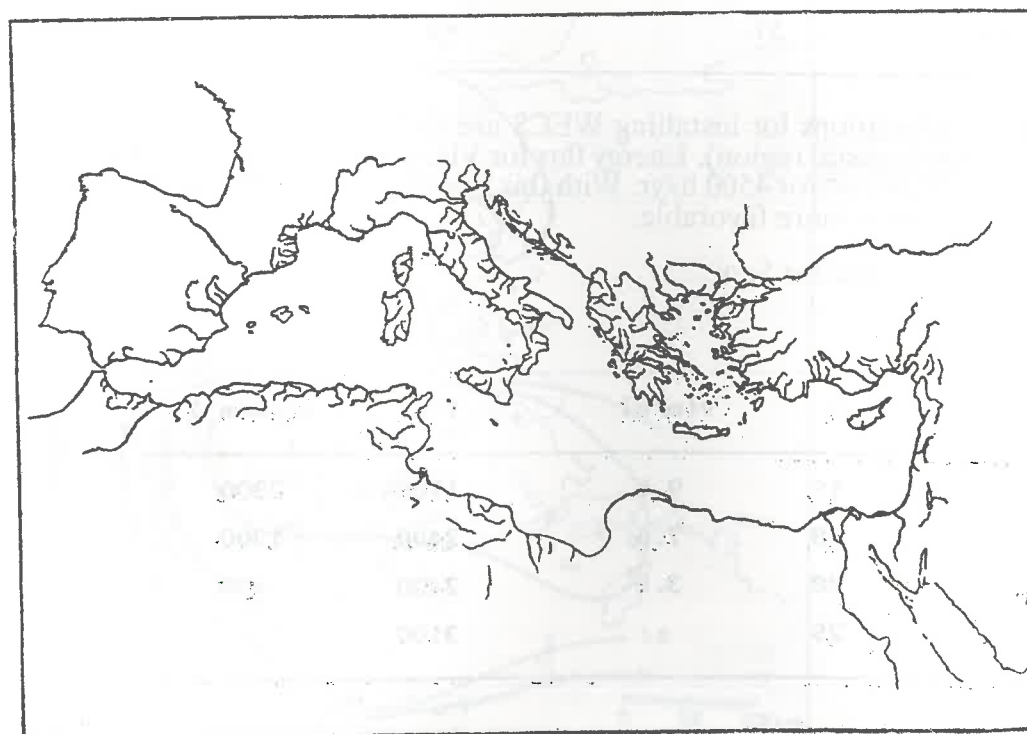


Fig. 47 Development of primary energy demand

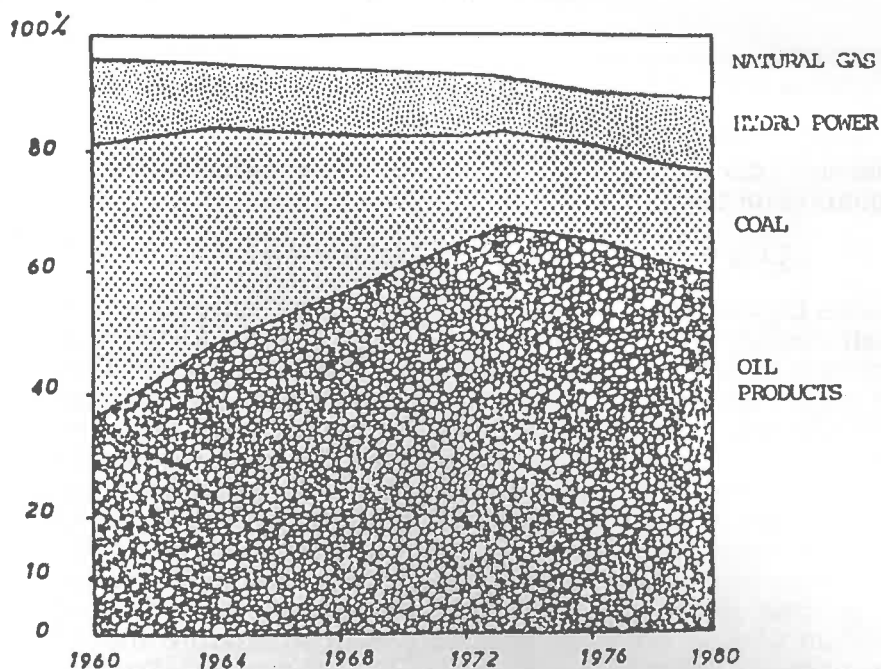


Table 14: Hydro power plants capacity and electricity production in year 1980 in the Mediterranean Countries

Countries	Power (MW)	Energy prod. MTOE	Part of total energy (%)
Algeria	286	0.066	0.86
Albania	?	0.309	13.00
Cyprus	-	-	-
Egypt	2550	2.132	14.24
France	19282	29.723	16.59
Greece	1415	0.861	5.88
Israel	-	0.037	(-0.59)
Italy	15580	13.319	9.62
Lebanon	246	0.189	10.18
Libya	-	-	-
Malta	-	-	-
Morocco	452	0.336	6.81
Spain	13500	7.820	11.18
Syria	427	0.488	7.21
Tunisia	28	0.005	0.18
Turkey	2131	2.817	11.49
Yugoslavia	6330	6.053	17.18
Total	62227	64.081	12.44

4.4. Biomass

The biological conversion of the sun's energy into useful products is the foundation of our development of energy derived from fossil fuels and food from agriculture.

Photosynthesis, which takes place entirely within the chloroplasts of green plants, is a conversion of the sun's energy into chemical energy in the reduced carbon compounds. An empirical equation for this process is



where $h\nu$ represents the energy of the incident light, n is the number of photons (related to the quantum efficiency), at the $h.h\nu$ is the total energy required for the process. (CH_2O) represents the photosynthetic product, one sixth of a glucose molecule. The liberation of one molecule of oxygen requires the transfer of four electrons. The free energy stored by this process is 477 kJ/mole (0.133 kWh/mole) of CO_2 reduces. The theoretical maximum energy efficiency for the photosynthetic reduction of CO_2 to glucose is 28.9%; because photosynthetically active radiation constitutes only about 43% of the total solar radiation (between 400 and 700 nm) this efficiency must be multiplied by 0.43. So the value of 12.3% is often quoted as the maximum efficiency of plants when it is assumed that there is total light absorption and no respiratory losses of fixed carbon. Normally, the loss of incident energy has been estimated to be about 20%, and respiration losses are about one third of the total fixed carbon. Overall efficiency of plant growth is therefore about 6.6%. Actual efficiency for p.e. of sugarcane is 2.8% (112 t/ha yr of total dry matter) and sugarbeet has only 0.8% (33 t/ha yr of total dry matter) (12, 13).

Mediterranean ecosystem produces between 1-15 tons of dry weight per hectare and per year. Agricultural crops may yield up to 35 t/ha yr. This energy form needs intensive manpower for cultivation and collection.

Present use of Biomass in the Mediterranean countries is presented in the Table 15 as noncommercial energy (13).

Table 15: Noncommercial energy use in the MC

Year	1960		1978		1980	
	Mtoe	%	Mtoe	%	Mtoe	%
Wood	22.26	75.7	14.37	50.1	14.36	48.1
Vegetable and Animal Waste	7.14	24.3	14.29	49.9	15.50	51.9
Total	29.40	100	28.66	100	29.86	100
Total en. use	176.2	16.7	490.2	5.8	515.1	5.8

The figures 48 and 49 show the time dependent development of noncommercial energy use in different countries and composition change.

Fig. 48 Noncommercial energy use in the MC

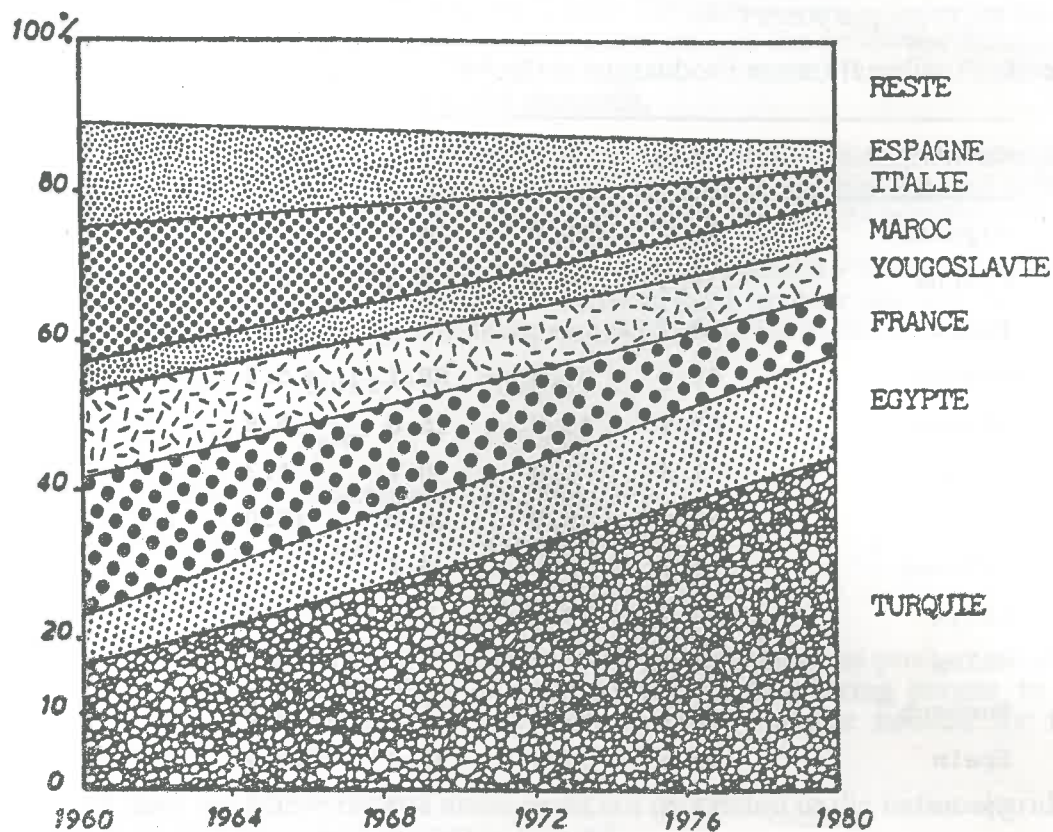
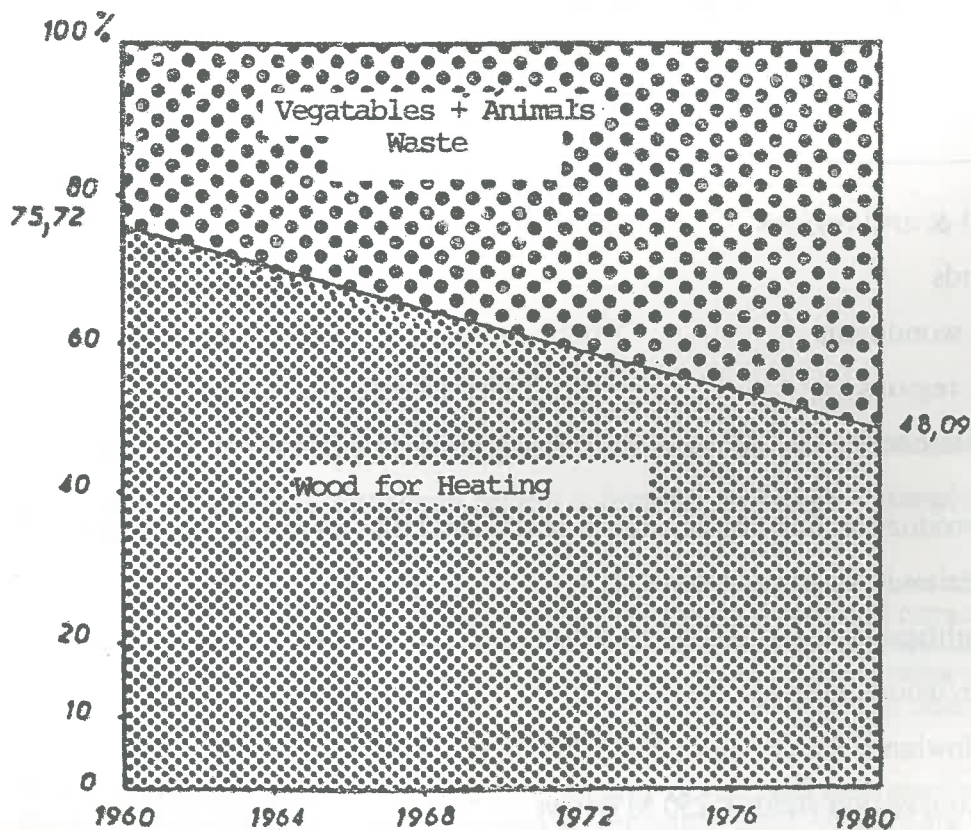


Fig. 49 Noncommercial energy-composition change in the MC



Calculations for the Biomass energy which can be produced in the Mediterranean countries are shown in Table 16 on the basis that only one tenth of the land surface can be used for these purposes (14).

Table 16: Possible Biomass Production in the MC

Country	1	2	3	4	5
Algeria	23.5	105.7	24.9	1.8	155.9
Cyprus	1.4	0.3	1.0	0.6	3.3
Egypt	8.9	-	-	17.7	26.6
France	59.3	37.8	88.1	5.3	190.5
Greece	12.1	15.3	15.8	5.8	49.0
Israel	1.3	2.4	0.7	1.3	5.7
Italy	38.9	15.0	38.3	18.0	110.2
Lebanon	1.1	-	0.4	0.5	2.0
Libya	8.1	19.5	3.2	0.8	31.6
Malta	0.04	-	-	-	0.04
Morocco	24.7	36.5	31.4	3.0	95.6
Spain	64.6	32.1	92.3	18.4	207.4
Syria	17.5	24.6	2.7	3.2	48.0
Tunisia	13.9	9.5	3.1	0.9	27.4
Turkey	88.1	79.9	122.0	12.7	302.7
Yugoslavia	24.9	18.5	55.9	0.9	100.2
Total	388.34	397.1	479.8	90.9	1356.14

1 - agricultural & arid regions

2 - meadowlands

3 - forests and woodlands

4 - fresh water regions

5 - total biomass energy

For Biomass production only the one tenth of the available areas were considered.

For the calculation it is assumed that

1 km² of agricultural region yields 3.143 MWh/yr

1 km² of forest/woodland region yields 6.053 MWh/yr

1 km² of meadowlands region yields 2.917 MWh/yr

1 km² of irrigated region yields 6.250 MWh/yr

As it is clear for the south Mediterranean countries only Algeria and Morocco can produce substantial Biomass energy. Moreover, the predicted total Biomass production of 1356 TWh is only 21% of total energy demand in year 1980 (6363 TWh). A comparison between the energy demands for the Mediterranean countries and the predicted Biomass production shows that only a few countries such as Algeria, Morocco, Tunisia, Turkey and Syria can approach the needs of their energy demands.

Yugoslavia, Greece and Spain could get some energy backup about 25% of the total energy demand. Considering the increase in the energy demand, which is estimated to be doubled by 2000, one comes to the conclusion that the benefit for the above countries will be halved.

Another feature of this energy source is the manpower needed for the collection of biomass in large scale use. If one man is needed for 10 ha to work for biomass production, then the listed countries would need the following numbers of active biomass workers.

France	500000	Turkey	700000
Italy	300000	Syria	155000
Greece	130000	Yugoslavia	260000
Algeria	500000	Spain	540000
Morocco	250000	Libya	85000

These figures show that a policy to implement large scale biomass production will have to cope with serious social problem of keeping and/or transferring people to a sort of agricultural life. Open is also the question of energy source needed for fertilizers, agriculture machinery etc.

For small scale use where remote areas exist, not connected to the national grid, Biomass could contribute a large part of energy needed.

4.5 Geothermal Energy

Total heat stored within the top 6 km from the Earth surface at temperature above 200°C is probably higher than the energy content of all fossil fuel resources. There are two forms of geothermal energy:

- the wet heat source (water, vapor)
- the hot dry rocks

The first can be classified in three categories:

- low temperature water, up to 90°C
- intermediate temperature water, 90 - 150°C
- high temperature water, above 150°C

Estimation of the world accessible geothermal potential vary between 0.3 to 2 billion toe.

The status in the Mediterranean region is hopeful, although a complete survey does not exist.

Italy is the pioneering country where from 1913 the first power plant of 250 kw(e) was put into operation at Larderello in Tuscany. In 1979 the total installed capacity was 450 MW(e) compared to the 1600 MW(e) throughout the world. With the data available at the moment from Italy, about 100 GWyr(e) could be extracted from all the territory. Since, this energy source is not a renewable one a certain policy is to be followed to determine the installed power in connection with the time of operation.

The Geothermal potential of France is mainly of low and intermediate temperature. In Paris Basin geothermal water system is presently used. According to the Bureau de

Recherche Geologiques et Minieres resources identified in France are about 445000 TWh(t). Because of economical and technological reasons only a small amount of this energy can be extracted. This is estimated about 2,100 TWh(t), which is equivalent to about 180 million tons of oil. From the other Northern Mediterranean countries Spain is poor in geothermal potential. Yugoslavia possesses low enthalpy Geothermal Energy. The Mediterranean orogenic zone includes Morocco, Northern Algeria, Northern Tunisia, Northern Libya, Greece, Italy and Turkey. The potentials of Mediterranean countries in Geothermal resources are shown in table 17.

Table 17: Availability of Geothermal resources in the Mediterranean area (Ref. to 3-5 km depth)

Country	Resources for direct uses (20 to 160-180°C)	Resources for electrical and other uses (>150°C)
Albania	+	-
Algeria	+++	++
Cyprus	+	-
Egypt	+	-
France(a)	+++	+(++)a
Greece	+++	+++
Israel	++	-
Italy	+++	+++
Lebanon	+	-
Libya	+	-
Morocco	++	+
Malta	+	-
Spain(a)	++	+(+)a
Syria	++	-
Tunisia	+++	++
Turkey	+++	+++
Yugoslavia	++	+

(a) including overseas territories

SYMBOLS

+++ sure or very probable

++ probable

+ unknown, but possible

- unprobable or absent

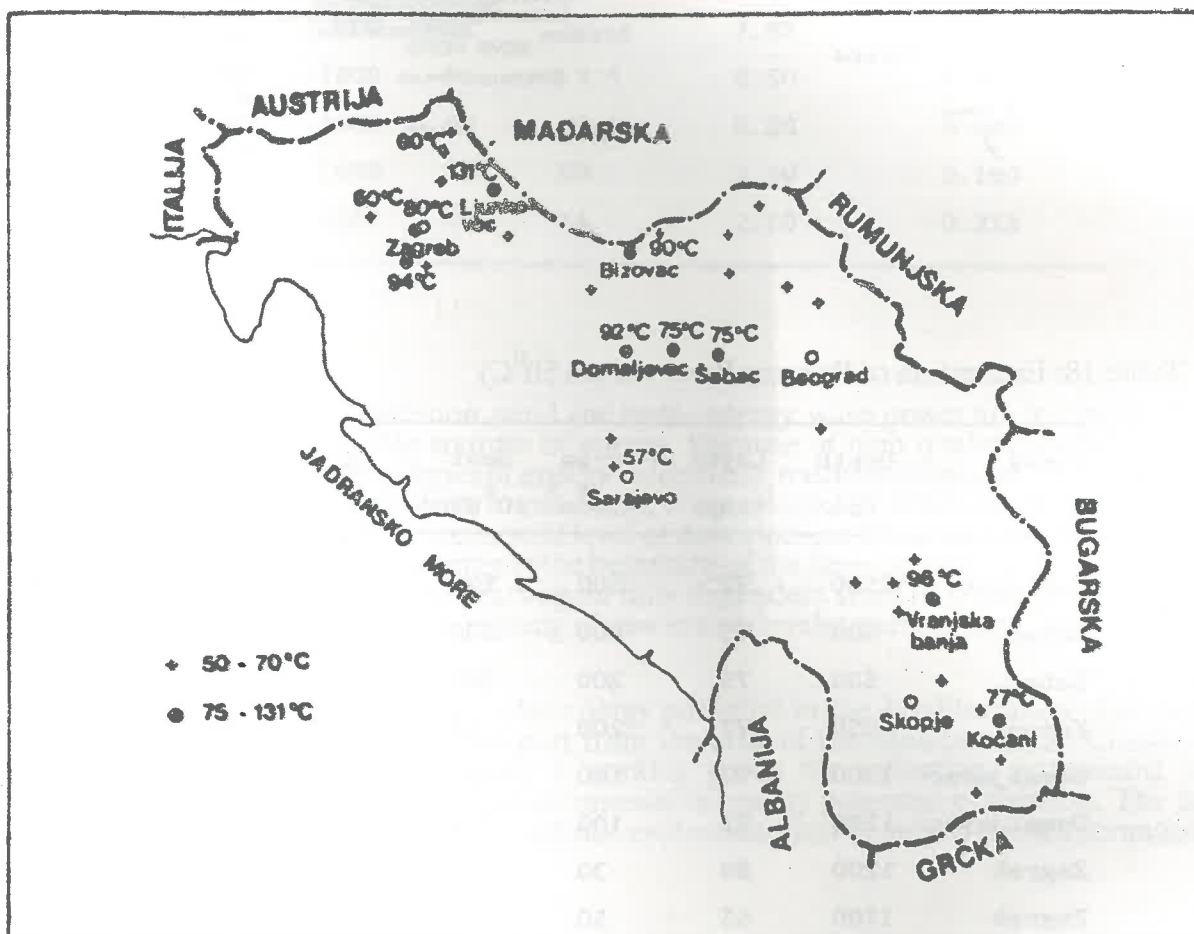
Greece has a Geothermal potential which could produce for the next 30 years about 750 MW electric i.e. 6.57 TWh per year. On the other hand, Greece can extract large amounts of hot water with temperatures above 70°C. A 10 MW electric plant has already started being installed in Melos island.

Turkey belonging to the same zone is expected to possess large amounts of Geothermal potential. A 17 MW power plant is under construction.

From the southern Mediterranean countries there have been identified places with Geothermal potentials in Algeria ten years ago. Its high enthalpy resources are considered potentially good.

The Yugoslav geothermal energy potentials are rather high. Figure 50 shows the locations with the existing bores with thermal water.

Fig. 50 Locations of important geothermal fields in Yugoslavia



In the next figure 51 an overview of the locations of thermal hot water wells in the region of Slovenia is shown.

The table 18 presents an evaluation of primary reserves of the geothermal energy, whereas Table 19 shows the characteristics of individual bores made in oil searching and which are partly already used for heating of buildings and green houses. The evaluation of the available potential is given in the form of water cooling to 50°C.

Fig. 51 Region with geothermal hot water wells in Slovenia, YU

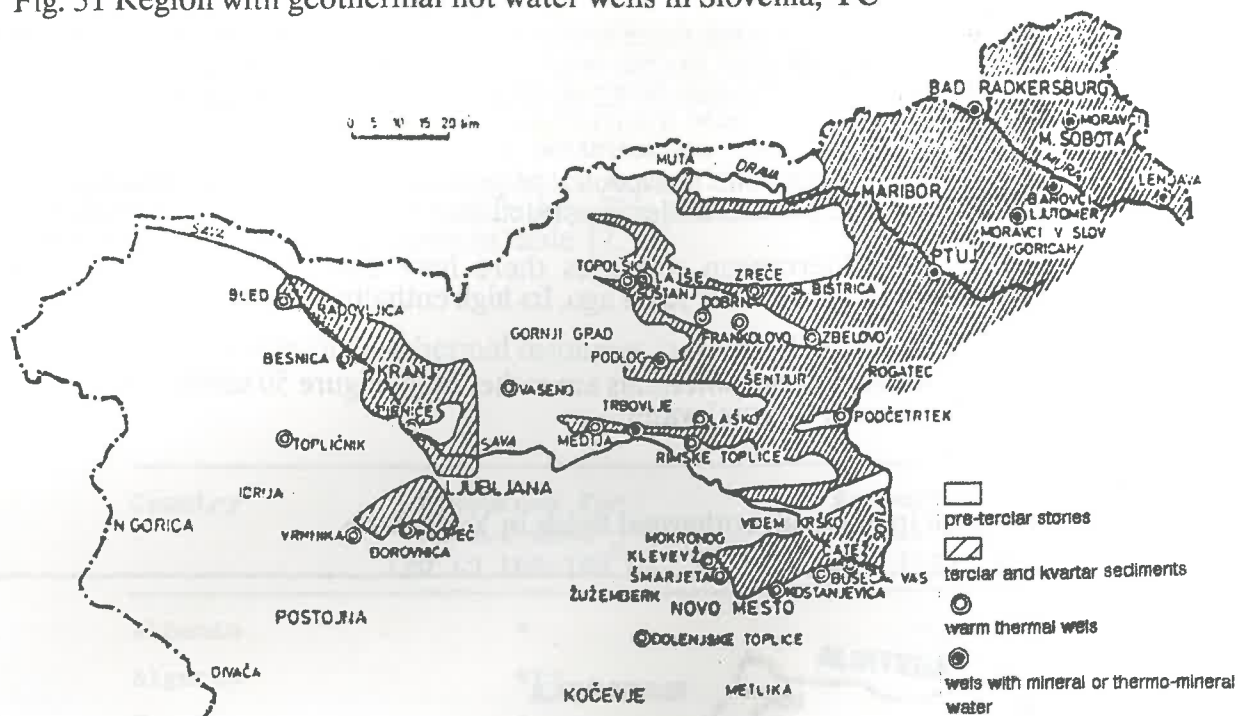


Table 18: Estimation of Primary Reserves (to 50°C)

Field	Depth (m)	Layer temp.	Area 10 ⁶ m ²	Heat 10 ⁶ MWht	Qpr	Reserves category
Karlovac	2500	92	500	120	1800	AR
Šabac	500	75	800	800	4448	AR
Šabac	500	75	200	100	239	SR
Kočani	350	77	200	10	36	PR
Domaljevac	1200	92	100	60	180	SR
Domaljevac	1200	92	100	420	1260	AR
Zagreb	1200	80	30	9	6	PR
Zagreb	1100	65	50	20	10	SR
Zagreb	1500	85	50	20	25	AR
Lunjkovec	2400	125	100	20	107	PR
Lunjkovec	2400	125	100	100	535	SR

PR - proven reserves

AR - additional reserves

SR - speculative reserves

Table 19: The Characteristics of some Geothermal Locations

Field	Depth (m)	T (°C)	Capacity kg/s	N (to 50°C) MWt	Oil equival. 10 ³ kg/h
Šabac	500	75	40	4.20	0.361
Kočani	400	77	150	16.96	1.458
Domaljevac	1300	92	20	3.50	0.301
Zagreb	1200	80	50	6.30	0.542
Zagreb	800	60	5	0.20	0.017
Lunjkovec	2300	120	23	6.74	0.579
Kutnjak	2500	131	23	7.80	0.670
Bizovac	1800	96	2.5	0.50	0.043
Bizovac	1600	82	3.6	0.50	0.043
Moravci	1000	60	50	2.10	0.180
Karlovac	2500	94	14	2.50	0.215

5. CONCLUSIONS

Solar energy, as global irradiation, wind and hydro energy, wave power are for the life time of mankind an inexhaustible sources of energy. Because of high quality - exergy value - can be converted in all other types of energy - electricity, mechanical power, heat, chemical bounded energy etc. Constraints, to use more, this ecologically clean energy sources, are based on social, technical and economic level of development of our society. The man was totally dependent from solar energy at the beginning of the development of our civilization, and will be after some hundred years again fully dependent from it. If this opinion means end of our civilization and/or beginning of new era of development of new, "solar society", is the open question.

For more detailed answer about solar energy potential in the Mediterranean Countries or Mediterranean Region (smaller part from the area of the Mediterranean Countries) there is a urgent need to establish a working group for collecting, systemizing and dissemination of all data, connected to renewable energy potential evaluation. The lack of the appropriate methodology for such one evaluation must be solved on an international basis.

NOMENCLATURE

Energy conversion units, used in this work

1 EJ = 10^{18} J = 24 Mtoe (tons of oil equivalent)

1 PJ = 10^{15} J

1 TJ = 10^{12} J

1 GJ = 10^9 J = 0.278 MWh

1 toe = 1.5 tco (ton of coal equivalent)

1 toe = 42 GJ = $42 \cdot 10^9$ J = 11.68 MWh

1 ton of fuel wood = 0.38 toe

1 ton of uranium = 8000 toe (present nuclear reactor)

1 ton of uranium = 500000 toe (fast breeder nuclear reactor)

1 toe = 10034 Mcal

1 tce = 7000 Mcal

1 kWh = 3.6 MJ

MC - Mediterranean countries

MR - Mediterranean region (coastal area of MC)

BIBLIOGRAPHY

1. Rogner H.H., Energy in the World, XVIIth International Congress of Refrigeration, Wien 1987, Tom F pg. 41-64
2. WEC: Energy - needs and expectations, World Energy Conference 13th Congress, Synthesis of the Proceedings, Cannes - France, 1986 pg. 64-176
3. Grubler, A. and N. Nakićenovič: The Dynamic of Methane Technologies, WP-87-02, IASA, 1987 Laxenburg, Austria
4. Marchetti, C.: When will Hydrogen Come? Int. J. Hydrogen Energy, Vol. 10, No. 4 Pergamon Press Ltd., U.K. 1985
5. Frisch, J.R.: Future Stresses for Energy Resources, WEC, 1986, London, Graham & Trotman
6. Rogner H.H., The IASA'83 Scenario of Energy Development, Proc. Int. Symp. Risks and Benefits of Energy Systems, Vienna, 1984, IAFA
7. Gold, T.: The Origin of Natural Gas and Petroleum, and the Prognosis for Future Supplies, Annual Review of Energy, Vol. 10, Paolo Alto, California
8. Hafele, W. et al: Das Konzept der neuartigen horizontal integrierte Energiesysteme - der Fall der Null Emission, KFA Jahresbesicht 1983/84
9. Novak, P. et al: New Alternatives in Energy System (Slovenian), RSS Report 1984, Faculty of Mech. Eng. Lj.
10. Novak P., Zupančič J.: Energy Scenarios and his Environmental Impact (Slovenian) Proc. 2. Simp. on Energy, SAZU, 1987, Lj., YU
11. Novak P., et al: Project of new Slovenian Energy System, Report RSS 1986, Faculty of Mech. Eng. Lj., YU
12. Bassham J. A.: Science 197, 630 (1977)
13. Schneider T. R.: Energy Conversion 13, 77 (1973)
14. Rigopoulos M. R.: Energy Old and New, Plan Bleu, Expertise No. 4, UNEP/WG 100/INF 10, 1983, Sophia Antipolis
15. Knox, J. B. et al: Meteorology and Alternative Energy Resources, Chapter 18 from Atmospheric Science and Power Production, DOE 1978, USA
16. Allen J., Bird R.A.: The Prospects for the Generation of Electricity from Wind Energy in the UK, DOE Rpt. No. 21, London 1977, UK
17. Justus C.G. et al: Nation-wide Assessment of Potential Output from Wind-powered Generators, J. Appl. Meteor. 15, 673-678 (1976)
18. Hennessey, J.P. Jr.: Some Aspects of Wind Power Statistics, J. Appl. Meteor. 16, 119-128 (1977)
19. Salas D.P. et al: An Analysis of Wind Power Potential in Greece, Solar Energy, 30, 6 pp. 497-505, 1983
20. Habali, S.M. et al: Assessment and Applications of Wind Energy in Jordan, Solar Energy 40, 2 pp. 99, Pergamon Press, London, 1988
21. Adell, L. et al: Development of a Methodology for the Estimation of Wind Energy Resources in Relatively Large Areas: Application to the Eastern and Central Parts of Spain, Solar Energy, 38, 4, pp. 281-295, 1987

22. Gupto B.K.: Weibull Parameters for Annual and Monthly Wind Speed Distributions for Five Locations in India, *Solar Energy*, 37, 6, pp. 468-471, 1986
23. Gburčik, P.: Meteorološki uslovi za podizanje aero-energetskih centrala, KGH, 3/1980, Beograd, Yugoslavia
24. Žlebnik, L.: Možnosti izkorišćanja geotermalne energije v Sloveniji, Expert Meeting on Geothermal Energy, 1987, Radenci, YU
25. Čubruć, S.: Procjena rezervi geotermijske energije nekih najznačajnijih polja u Jugoslaviji, Int. Conf.: Alternative Energy Sources Today and for 21st Century, Solar En. Soc. Croatia, Brioni 1988, p. 435
26. Plan Bleu: Donnees sur L'Environnement dans le bassin mediterraneen, Version Provisoire, Julliet 1987, p. 104
27. Projekcija razvoja energetike Jugoslavije, SKE 1983, Bgd., YU
28. Berrah, E.M.N.: Energies nouvelles et anciennes UNEP/WG 100/INF 10 1983
29. Popović, M. et all: Raspodela globalnog sunčevog zračenja nad Jugoslavijom, KGH 2/1978, Beograd, Jugoslavija, pp. 31-41
30. Papadopoulos, I.: Solar Energy use on the Cyprus, PAP - 11/ME - 5102 - 83- 05, 1984
31. CEC: European Passive Solar Handbook, EUR 10 683, Brussels, 1986

2. THE ROLE OF WOMEN IN ENERGY-INTENSIVE ECONOMY:
THE CURRENT STATUS AND ADVANCEMENT OF THE COOPERATION
OF WOMEN IN THE ENERGY-INTENSIVE ECONOMY

by

Dr. Marija Lap-Drozg

The following contribution deals with the formal employment of women and their informal employment in housekeeping, which applies, in the Republic of Slovenia, to 95% of women in the 15 to 75 age bracket.

The weekly amount of time dedicated to housekeeping in Slovenia takes into account the time allotted to food preparation, cleaning, washing, ironing, mending, sewing, shopping, planning chores and the family budget.

Structural tendencies: revenues, free time, budget, and preferences of the household, explained by geometric integration.

The decrease in the amount of household chores is evidenced by modern equipment in households and permanent consumer goods.

The author proposes a formal education in these skills, a research in home management and work from the point of view of energy conservation and introduction of counseling work, together with a transfer of the knowledge into the urban and rural environments.

1. EMPLOYMENT OF WOMEN AND HOUSEKEEPING

Women form the majority of the Yugoslav population, accounting for 51.2% of the 22,354,000 inhabitants of Yugoslavia according to the latest 1981 census.

The share of women in the population varies in each republic and region. The foreseeable changes exhibit a tendency towards balance (Projection of the population of Yugoslavia 1979-2000).

For the economically active population of Yugoslavia, the number of employed women and its absolute and relative increase is significant. In 1985, the gainfully employed women accounted for 62.3% of the entire female population, with the tendency towards aging clearly noticeable.

The actual employment of women depends on demographic, economic, technological, social, psychological and individual factors. Thus, female employment has been on a constant increase, reaching, in 1985, 37.8%.

Most women are employed in non-economic activities, where their percentage shows a slight majority of all the employed. Most women are thus employed in health services (76.2%), and slightly more than half in education and culture (53.8%).

In the sphere of economy, a slight majority of women are employed in tourism and catering industry (60.1%), and half in financial and other institutions (50.8%) and commerce (49.4%).

This average varies from republic to republic. Thus, the above average percentage of employed women is applicable to the Republic of Slovenia, central Serbia and the Republic of Croatia.

The selected indices of the activity of women in the Republic of Slovenia are the following:

The number of women employed in the energy-intensive economy is negligible: 1% in mining, 1.4% in the oil industry. A slightly higher percentage is found in power supply (7.6%), food industry (9.8%) and the highest in the textile industry (33.3%).

The various intensity of employed women in individual activities, branches and disciplines is the result of technological (high requirements, work organization) and health-related factors (the protection of women against health hazards), with the relevant importance nelegated to the traditional attitudes towards the employment of women. It is interesting to note that the technologically most advanced disciplines are increasingly employing women and thus extending the number of professions traditionally occupied by women. On the other hand, the service industry is the industrial branch employing women to a greater extent.

Women employment is widespread. Employment and housekeeping are geographically and economically separated. Most work related to the care of family members is performed by women, and is unpaid within the framework of the household. There is no market alternative here.

Research shows that, in the Republic of Slovenia, 95% of women in the age group 15 to 75 years perform the informal job of housekeeping. (Boh K., 1985). Thus women perform jobs such as food preparation, sewing clothes, knitting, gardening, maintenance of the apartment/house/farm.

TIME ALLOTTED WEEKLY TO HOUSEWORK IN THE REPUBLIC OF SLOVENIA

We measured the total amount of time used for food preparation every week and separately, the amount of time used for the preparation of breakfast, lunch and supper; washing, ironing, mending, sewing, shopping, work planning, expenditure planning, family budget. For individual housekeeping tasks, the amount of time spent on them was measured separately for the wife and the husband.

1. In farm households, the amount of time spent by women on housekeeping exceeds the 42-hours work week; in these households, men's help is insignificant.

Thus, women on farms put in on average a 48-hours week, which is 6 hours more than the 42-hours work week.

Most time (20 hours, or 42%) is spent by peasant women for meal preparation and 12 hours for house-cleaning, which amounts to almost a quarter of the used time. 18% of all time is used for washing and ironing, and the remaining 15% for other household chores (sewing, mending, shopping, planning of work and expenditures, family budget).

Men in farm household spend 3.4 hours on housework. Their responsibility is shopping, planning of work and expenditures and family budget.

In a farm households women spend more than 42 hours a week for household chores; in these households men pitch in with half of the required time.

Women in mixed households put in a 44-hour week in housekeeping, which is two hours more than the usual 42-hour work week.

Most time, 19 hours or 44%, is used for food preparation, 9 hours or 21% for house cleaning, 9 hours for washing and ironing and the remaining time (14%) for other household chores such as sewing, mending, shopping, planning of work, expenditures and family budget.

Men mostly deal with planning of work and expenditures, shopping and family budget, and devote an insignificant amount of time to other household tasks.

In a mixed household, men and women spend on average 51.3 hours on household chores, with wife performing 85.2% and husband 14.8% of the total amount of work.

The figures show that my initial assumption that the man performs half of all household work was incorrect.

3. The largest amount of time for housekeeping per week applies to non-peasant household; the men also help more.

The man and the woman in a non-peasant household devote an average of 51.4 hours to household chores.

The largest amount of hours is spent on housekeeping by the man and the woman in a non-peasant household.

STRUCTURAL TENDENCIES: REVENUES, FREE TIME, BUDGET AND PREFERENCES OF THE HOUSEHOLD

Household work is composed of a variety of tasks, of which the value product is of different volume. Income is interpreted in kind. For our purposes, time relations will be divided into the following combinations:

- revenues/income
- free time
- budget and
- subjective preference of the household

Revenues

As far as the household attempts to attain the highest possible level of need satisfaction, the relation income - free time is designated with a tangential point. The household implements the income OE-1, which is composed of the normal and the natural income and free time OE-1. Work time F-1-F is used in the non-profitable sense F-2-F, and in the profitable sense F-1-F-2. Any deviation from the distribution of work time or a change in the combination of income and free time, results in a lower level of need satisfaction.

Insofar as the household attempts to avoid the deterioration of the level, the relation between time distribution and the ensuing relation income-free time is shown as stable. With the aid of the diode, work - free time, we can estimate that changes will be effected by the following determinants:

- a) change in the profit-making household pay
 - b) prices of market goods
 - c) controlled change of the maximum productivity of the food preparation and housekeeping work
- K a) Changes in payment price on the market and productivity of maintenance work have no bearing on the available time which means that OF remains constant. However parts of the unproductive work can become obsolete and have with higher payment a higher maximum productivity. Under equal conditions, the gainfully oriented raises in payment lead to the reduction of the time of household work. The drop in payment is reversely proportional.
- K b) The change in price in the market can be, like the payment change, geometrically integrated. The increase in price means, under the same conditions, the real decrease of payment and vice versa. The raise in price in the market force for the tendentious increase value of the maximum productivity of the household work.

K c) In the opposite direction acts the change of the food preparation and household tendencies. If the productivity of the household work is on the increase (e.g., as the consequence of improved equipment) or improvement of home economics education, the food preparation and household work spreads, under equal conditions, to the detriment of gainful work.

The changes in this method allow only the conclusions of the structural tendencies e.g., change of the ratio between the time of the household work and the gainful work time or income in kind and the cash income. The combination of all the work and free time, or the income and free time is faced with the preferences of the household. Eventually the gainful household conditions have increased substantially. Under the same conditions on the basis of the management of time, income, and energy, we achieve a reduction of the household work time. Empirical research has shown that the household work time varies only slightly or remains constant.

2. REDUCED WORKLOAD OF WOMEN IN DOMESTIC HOUSEHOLD

The economic condition and employment are important indicators of the social status of women. In the future, it will be necessary to measure also the actual shares of incomes of the man and woman generated by gainful employment and their contributions to the family supplies or of the members of the family contributed by their informal work.

The social, political and economic aspects of the women's issues and the family in our country are considered with the following attitude: the family spends on food, housing, clothing and in addition it needs certain activities/services, which enable the everyday use of these goods and services (cleaning, housing, washing and pressing clothes and similar). These services can be to a large extent carried out by a special agency, a services company. Here, all the possibilities which are offered to us must be taken into account: "use of new, technically more advanced materials for the residence, clothing, etc., which are more durable and which require a lesser amount of work; new distribution of work in the family and getting every member of the family used to such a reduced workload in his home to share in the chores and finally it is necessary to consider also the new organization of services which can be carried out outside the home by the specialized services". (Tomsic, 1976)

YUGOSLAV HOUSEHOLDS EQUIPPED WITH PERMANENT CONSUMER GOODS IN 1985

	%
Electric cooker	64.1
Gas cooker	9.4
Electric/gas cooker	20.1
Electric stove	24.1
Water heater	61.1
Refrigerator	82.2
Vacuum cleaner	60.8
Black-and-white TV set	61.4
Color TV set	23.0
Washing machine	61.0
Dish washer	1.9
Car	36.3

STATISTICS ON HOUSEHOLD APPLIANCES IN SLOVENIA

All households have a washing machine and almost all (over 80%) of the households have an electric cooker, a gas cooker a refrigerator and a freezer. More than a majority (74%) of the households have a vacuum cleaner and a good half of them have a pressure cooker. A negligible percentage of polled households have a polishing machine (11%) and a dish washer (14%).

In terms of the individual types of households the statistics on household appliances are the following:

1. All rural households have a washing machine, almost all (91%) have a refrigerator and a freezer, 83% have an electric cooker, and more than half of them (58%) have a vacuum cleaner and a gas cooker, and half of them have a pressure cooker. Few of the households (17%) have a dish washer.

A comparison between the non-rural households, occupying an apartment or a single-family home, reveal the following differences in household appliances:

- every household in the apartment has a gas cooker, while the figure stands at 83.38% for single-family houses;
- only half of the apartment households have a freezer, while 83.3% of the households in single-family houses have freezers;
- no household in an apartment has a dish washer, while none of the households in the single-family house has a polishing machine.

3. All of the polled mixed households have a washing machine and almost all of them (81%) have a freezer; 63% are equipped with a vacuum cleaner and slightly less than a half with a pressure cooker. On the other hand, these households are poorly equipped with dish washers (27%) and polishing machines (18%).

A comparison in the mixed households in terms of the type of household (apartment or family house) the following differences have been observed:

- in the family houses all households have a washing machine, an electric cooker and a refrigerator;
- In farm houses most households have a pressure cooker, and an electric cooker, while this holds true of only 16% of the households living in a family house;
- only some farm houses are equipped with polishing machines.

4. PROPOSALS AND CONCLUSIONS

The inclusion of energy-oriented and technological content into the education and research and promotional area should become one of the major characteristics of the present and the future.

EDUCATION AND GUIDANCE

The conservation of human's environment and the use of renewable sources of energy should give rise to the responsibility for the protection and advancement of the quality of life. Contents should not be treated by way of the individual school subjects, but should be integrated into the existing curriculum of the compulsory and vocational education. The goals are the following:

- presentation of the energy situation
- sufficient energy supply is the first condition for development
- the majority of developing countries are dependent on the importation of oil
- the needs of the households and farming can be met with renewable sources of energy (solar, hydro, marine, biomass, etc)
- renewable sources of energy contain a great potential for the replacement of oil.

At the university-level of education the following are the main quality basis for the technical, economic, and organizational studies:

- specific problems
- interdisciplinary orientations
- select orientations

RESEARCH

Should focus on the local management of energy.

MAIN TARGETS

- study of the needs and supply of energy with emphasis on renewable energy sources
- analysis of the work and cost effectiveness from the viewpoint of the work input and used energy, particularly for the man and woman
- analysis and assessment of the use of local energy sources.

INTENSIFICATION, CONSULTATION ACTIVITIES AND TRANSFER OF KNOW-HOW FOR THE RURAL AND URBAN ENVIRONMENT

MAIN TARGETS

- rational use of energy with emphasis on renewable energy sources
- rationalization of work with the aid of devices and appliances
- construction and renovation oriented towards energy saving
- new technologies and devices confronted with tradition and customs

SPECIAL TARGETS

- feasibility study of the involvement of women as individual or organized proponents of new ideas and practical demonstration of new appliances and devices.
- repeated performance of test programs for the study of the use of household appliances and involvement of women in such programs

FORM OF ACTIVITIES

- exhibitions and cultural events
- lectures, seminars, workshops
- contributions carried by the mass media

BIBLIOGRAPHY

Women New and Renewable Sources of Energy, INSTRAW/ILO-TURIN Centre multi-media training package, 1990.

Women in the World Economy, INSTRAW, Oxford University Press. New York, 1987

Module EW II. The Role of Women in NRSE, INSTRAW/ILO-TURIN Centre multi-media training package, 1990

Projekcija Stanovništva Jugoslavije 1970-2000. Sav. zavod za stansko. Belgrade, 1973

Zene in druzbeno ekonomski razvoj, XII, Medunarodni Seminar, Belgrade, 1987

D. Pucko: The Incorporation of Women in the Development Planning, INSTRAW Seminar, Santo Domingo, 1983

A. Wertheimer-Baletic. Ekonomska aktivnost stanovništva, Demografski aspekti, SK, Zagreb, 1978.

V. Tomsic, Zenska, delo, druzina, druzba, Ljubljana, 1976

- sanitation objectives
 - SO2 pollution reducing for 30% (concerning to y. 1980) (European air pollution reducing convention)
 - pollution reducing in cities in 3rd - 4th class - (Zagorje, Trbovlje, Hrastnik, Ljubljana,)
- sanitation strategy
 - new regulations for boundary emission concentrations (with time-limit 0-5 y. for sanitation)
 - regulations for classifying cities in four classes of air quality (1988) - sanitation programs for 3rd and 4th class
 - ecological tax law (for 30% sanitation budget)
 - tax law for all other owners which pollute
 - import of additional 600 mio m3 gas from Algeria y. 1991 130 mio m3, y. 1992 350 mio m3, y. 1995 600 mio m3
 - regulations tension for heat protection in buildings for 30%
 - credits for energy conservation projects in frame of 5% energetical investments for year
- stimulation/discharging of taxes and other similar measures by bying, production and use of articles using NRE
- stimulation of minoring electricity use
 - on account of gas use in commercial, households, industry
 - new households appliances generation, cogeneration,...
- development and introduction of new and exchange of old consumptions technologies for energy conservation and flue gases cleaning
 - development of gas aparatous with small NOx emission
 - development of stoves and boilers for coal, wood and oil with small CO, NOx and particles emission
 - flue gases desulphurisation technologies development
 - cheap isolation technology for old buildings
 - development of new generation of household's aparatous with small electricity consumption
 - stimulation of bike use and similar traffic vehicles
 - development of electro car, metanol motor (hibrid vehicle)
 - development of scroll compressors and new applications of heat pumps
 - low-cost solar systems applications

EXPECTED ENVIRONMENTAL PROTECTION RESULTS

- emission minoring to y. 1998 (in industry, commercial, households) without traffic: SO₂ for ab. 60%, NO_x for ab. 30%, particles for ab. 70%, ash for ab. 55%, CO₂ for ab. 30%
- minoring of emission of individual pollutants in sectors at zero PE growth

CONCLUSION

- strategy of zero energy use of PE with conserved growth of GDP
- radical changes by electricity use and other fossil fuels with gas
- sanitation of CPP and other sources of heat generation with new flue gas cleaning technologies
- use of ren. water energy
- use of other NRSE
- improvement of heat isolation of buildings
- substitution of wasteful energy technologies with new not greedies
- general energy conservation
- economical encouraging and measures at rational energy use
- tensioned regulations and other measures

will in the accepted radical energy scenario case of future development in R Slovenia enable emission reducting for ab. 50% in cities even to 80%. This scenario is in this moment for us the only resonable resolution.

J.Zupančič, P.Novak, B.Suvorov

Univerza v Ljubljani
Fakulteta za strojništvo
Ljubljana, Murnikova 2, Jugoslavija

Abstract

Present fuel mix for domestic and tertiary use causes in Slovenia, populated mostly in basins, substantial air pollution. Analyzing the energy use trends of individual sources for about twenty years and their effects on pollution in basins, the long-term concept of energy supply for domestic and tertiary use until the year 2020, which is ecologic and economical acceptable, has been proposed. In the ecological scenario earth gas in final energy supply for domestic and tertiary use has a growth of 4 to 29 %, renewed sources from 20 to 32 % (hydro, solar, wood). The result is reduction of air emission for about 80 %. The technology concept and the way of realization has been discussed.

INTRODUCTION

Exploitation of natural sources (fuels and hydroenergy), electricity production, heating systems in buildings with different fuels and the use of technological out-of-date means of transport caused great ecological damage in Slovenia. Air emissions of toxic agent became greater by three times in the last 25 years. With the insertion of permanent measuring stations for measuring the SO_2 concentration and parts throughout the year, we established what air we breathe. Measurements in the period from 1979 until 1989 showed that over 30 % of population live under such condition, which are defined by WHO as noxious and a cause for great morality. Standards for permitted air emissions were obsolete. In addition to it nobody took care for paying attention to these. The worst situation happens to be in places with extreme inversion where emission according to the quantity is much lesser than emission of coal-heating power stations (TPP). The woods in Slovenia had to pay their debit.

The inspection of the terrain in the years 1985 and 1987 showed, that in the year 1987 44 % of the wood has been damaged. The fir-tree has been most damaged (94.1 %), it follows the spruce (78.2 %) and the pine-tree (59.2 %). The research of the genetic material of spruces showed damages a lot before effects of the illness can be visually seen. According to genetic damages of spruces great centers of air pollution can be enumerated (Mežica - lead mine, Šaleška basin - coal-heating power station, Šoštanj; Drava and Savinja Basin - Maribor, Celje; city-out-skirts-traffic a.s.o.).

About 60 % of damage in the woods was caused by polluted air, the rest by other meteorological influences. It is clear, that the illness shows its effects not at once but in

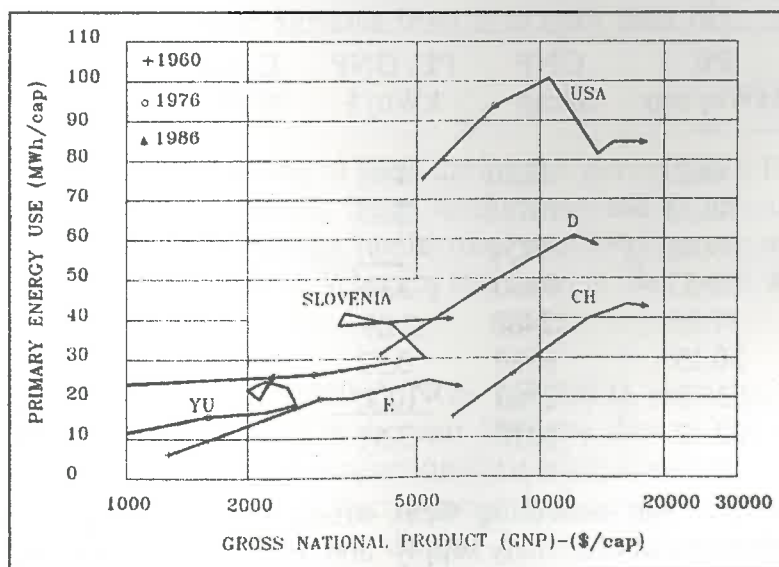
time. Therefore we must act immediately, since old emission will still cause damage in our woods.

Because of this alarming situation the society of Slovenia has organized itself and made a new program for development and the way of life in Slovenia. In June 1987 the following guide-lines of the future development have been accepted at special conference for ecology, energy and savings: no increase of use of primary energy (PE), reconstruction of coal-heating power stations, moratorium over erection of nuclear power stations and feasibility study for closing the uranium mine, the exploitation of renewed energy sources, the exchange of technologies with great energy consumption, the stimulation of energy saving, immediate changes could be enabled. The Assembly of Slovenia accepted the decision of mentioned conference and demanded from the Government to realize it. In this way the activities for the decrease of environment pollution began.

ENERGETIC DEVELOPMENT IN SLOVENIA

Slovenia with its less than 2 million inhabitants needed in 1989 for the satisfaction of all needs 282 PJ of primary energy respectively 167 PJ of final energy. The part of electrical energy in the final energy comes to 22.2 % which is much above the percentage the developed countries have.

On the picture 1 we can see the relation between the use of the primary energy and gross national product per capita in the period from 1960 to 1986 (according to the World bank data). From the diagram we can see that all countries, especially in the year 1979, enlarged their gross national product whereby the needed primary energy was reduced. Which means, that they went over to a qualitative development and recycling of raw materials. Only Yugoslavia and Slovenia made negative changes, which can be seen nowadays in the negative effects in the society.



Picture 1: Needed primary energy and gross national product per capita in the period 1960 - 1986 /3/

Historical development of needed primary end final energy is shown on picture 2, where the guide-lines of the future development are drawn in, as it is foreseen by energetic. Until the year 1985, where certainty dominated in Slovenian energetic of planning the energetic development with the help of linear correlation on the basis of trends in the past years, we got plans, which were totally unrealistic.

Picture 2: Historical development of needed primary and final energy in Slovenia and development trends until 2020 /1,6,7/

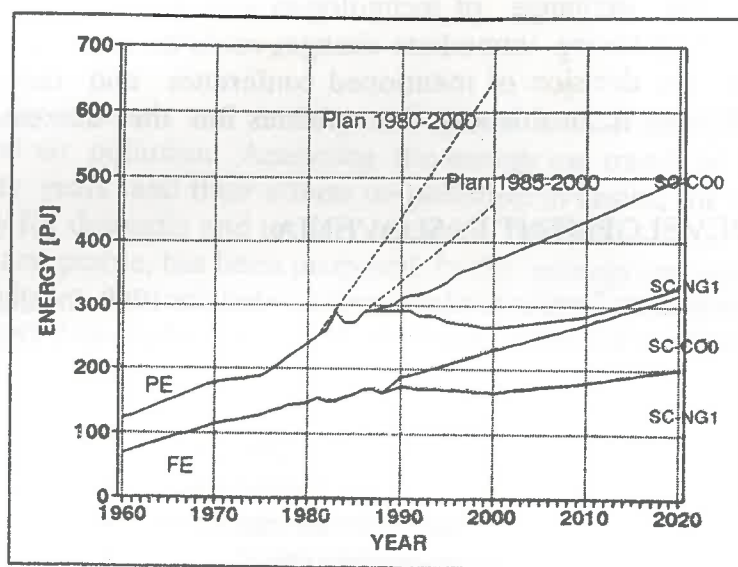


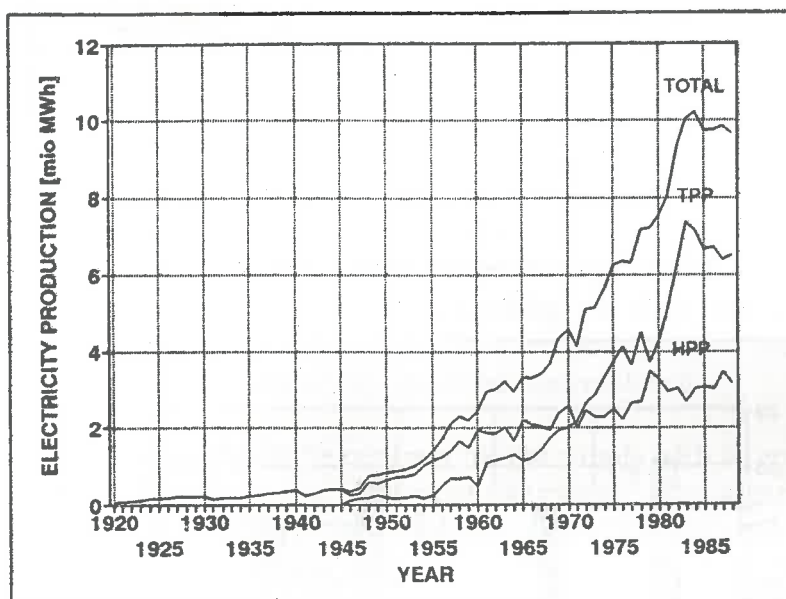
Chart 1 Characteristical indicators of power supply and effectiveness for some other countries in year 1986

Country	PE MWh/cap	GNP \$/cap	PE/GNP kWh/\$	El./cap MWh/cap	El./GNP kWh/\$	perc. of el. in FE 1985
Great Brit.	44.21	8870	4.98	5.2	0.59	14.9
France	42.33	10720	3.95	6.7	0.63	15.9
Slovenia	39.68	5150	<u>7.7</u>	5.69	<u>1.1</u>	20.7
Austria	39.53	9990	3.96	6.04	0.6	16.3
Japan	37.05	12480	2.89	5.9	0.47	20.2
Italy	30.15	8550	3.53	3.3	0.39	16.2
Yugoslavia	23.73	2300	<u>10.32</u>	3.1	<u>1.35</u>	19.1
Spain	22.42	6210	3.61	3.3	0.53	17.7

The chart 1 illustrates that something went wrong with planning of industry development and herewith also of electricity supply and coal mining. Slovenia needed about twice as much primary energy and electricity then other countries. The data for Yugoslavia look even worse. From this we may infer, that there are great structural incorrectnesses and uneffectiveness with exploitation of primary fuels. Because of such politics lay the electricity part, as the most expensive and of prime quality, already in

1985 above countries with a much greater gross national product and a better living standard. On the other hand the smaller gross national product did not make it feasible to invest in ecological reconstruction. Therefore the electric power-supply company became the greatest ecological problem in Slovenia.

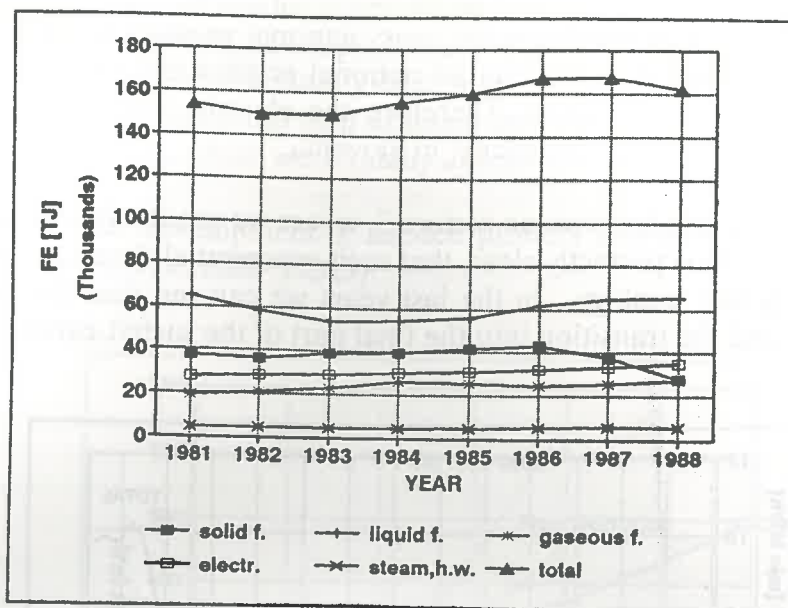
The unnormal development is shown on picture 3, where we see the growth of electricity production in Slovenia. It is perfectly clear, that such exponential development pace had to end not regarding the ecology. In the last years we can see that the development became stabilized and the transition into the final part of the surfeit-curve.



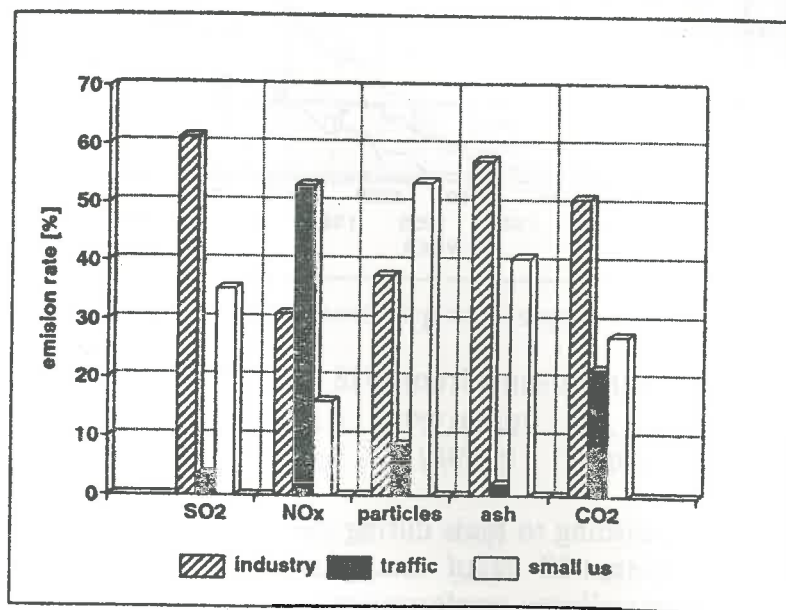
Picture 3: Electricity production in Slovenia from 1918 until 1988 /4/

The use of the final energy according to fuels during the period 1981-1988 is shown on picture 4. Here it is noteworthy that 50 % of total energy use in industry goes to only four industry branches (black metallurgy, nonferrous metallurgy, paper mill and production almost exclusively electric power. Whereby their part in the gross national product comes to only 15 %.

On picture 5 emission of SO₂ (229.000 t), NO_x (47.100 t), particles (33.200 t), CO₂ (12,790.000 t) and ashes (1,382.000 t) in the year 1988 are shown. The emission of the coal-heating power stations is added proportionally to every consumption sector according to the used electric power. Great discrepancies appear with the definition of the emission factor in the traffic, since we do not have our own measurement of real emission of NO_x. From the shown we can make a global picture on basis of which the plans for the ecological reconstruction in Slovenia have been made.



Picture 4: Needed final energy in Slovenia during y.1981 - 1988 /7/



Picture 5: Emission distribution according to the use of final energy in Slovenia in the year 1988 /8/

ECOLOGICAL RECONSTRUCTION

Proceeding on the fact, that with the reduction of air pollution three basic problems appear which are connected with technology: pollution by central energy stations (coal-heating power station, district heating station) - high emission sources, pollution by industry and bulk consumer - low and middle emission sources, pollution by means of transport (traffic); the joint strategy is based on following starting points: - Slovenia has

to reduce its emission of SO₂ by 1992 for 30 % in comparison to the emission from 1980, which stands in connection with the convention for national air pollution in Europe. Slovenia must quickly reduce the emission in towns where the situation is the worst (Zagorje, Trbovlje, Ljubljana, Celje, Maribor).

Some new regulation have been accepted (in the beginning of 1988) about limiting values and concentrations of air emissions which changed the old values from 1977 and stand in agreement with TA Luft. To the present polluters reconstruction time-limits have been recommended which take from 0 to 5 years and depend on trespassing of emissions. In that way we got legal basis for drastic reduction of present emissions.

In april 1988 the regulation for new grouping of settlements into zones according to the air quality (emission) was accepted. As a result Slovenia is divided into 4 zones. On the basis of these zones the government has to prepare reconstruction plans for III. and IV. zone, where the air pollution lies over the permitted value.

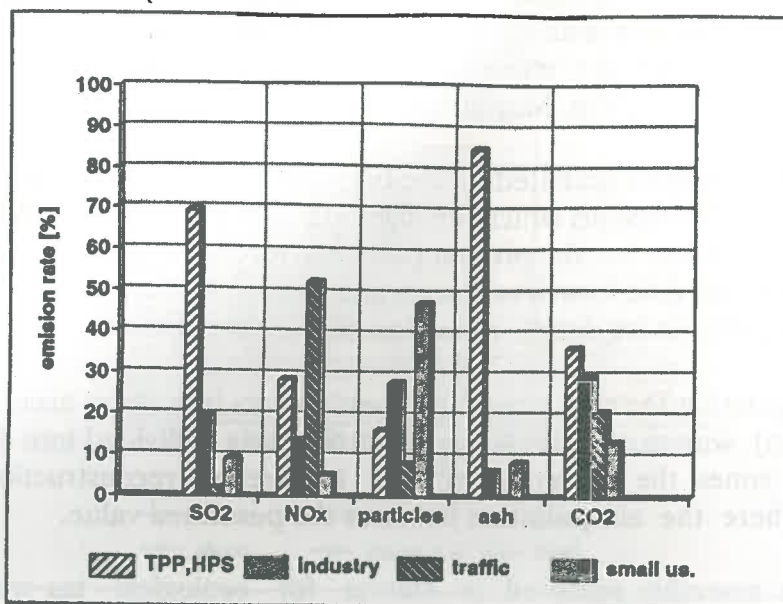
In january 1990 the assembly accepted a statute for ecological tax which should guarantee 30 % of capital needed for the reconstruction. The tax is paid by electric power users for the reconstruction of coal- heating station and district-heating-stations. From july 1990 on all other polluters should pay the tax according to their emissions. In case, there is no emissions, taxes must not be paid. That would represent the second step whit which means for the reconstruction could be accumulated.

The third step would be the sealing of the contract for the supply with larger quantities of earth gas in Slovenia from Algeria in the amount of 600 mio m³ (fco Algeria) with coal, fuel oil, masute and also electricity for bulk consumers and industry could be compensated. At the end of 1990 and in the beginning of 1991 130 mio m³, in 1993 350 mio m³ and 1995 already 600 mio m³ earth gas would be imported.

The fourth step represents the intensification of regulation for thermal insulation of buildings by 30 % (values are in force which are recommended by JUS U.J5.600).

And in addition a credit was opened for rational energy use with an app. worth of 5 % of total annual investment into energetic. On pictures 6 and 7 the result of this strategy, to which greater consumption of renewed sources (biosubstance, hydroenergy, solar energy) and reduced use of electricity for thermal purposes is added. On the picture 6 the distribution of emission according to the quantity of emission is shown. It is especially worth mentioning that desulphuralisation and denitrification cause the reduction of particles, since also electric filters are being exchanged or reconstructed.

Desulphuralisation of powerful coal-heating power stations is determined in the first place for salvation of our woods. But we have to make clear that the situation in the cities does not change significantly with the reduction of the emission of coal-heating power stations and district-heating stations. According to the mentioned facts in the Analysis of development possibilities for energetic in Slovenia in the years 1990- 2020 we also worked on the so called radical or gas scenario of energy use. There we included maximal possible rationalization in industry, insulation of present buildings and

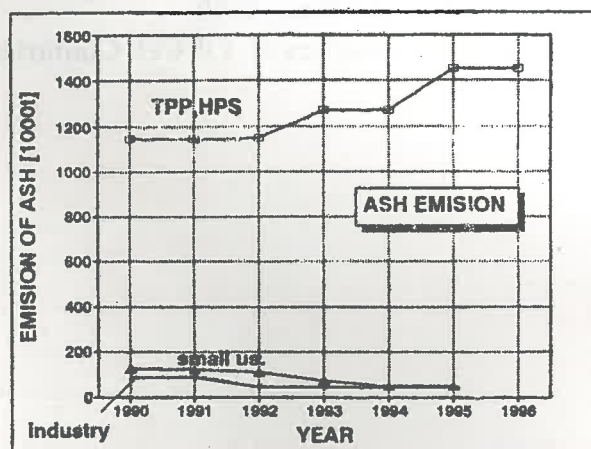
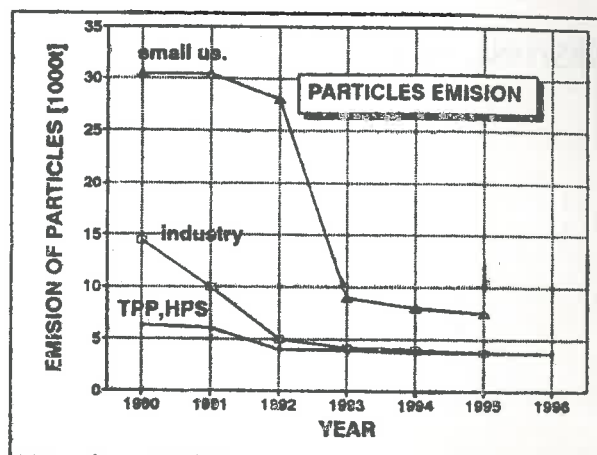
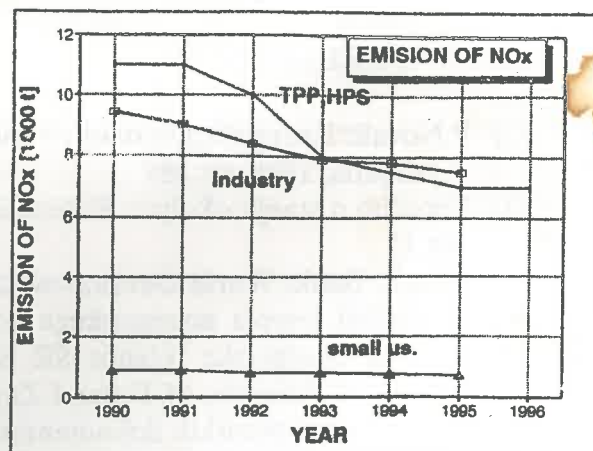
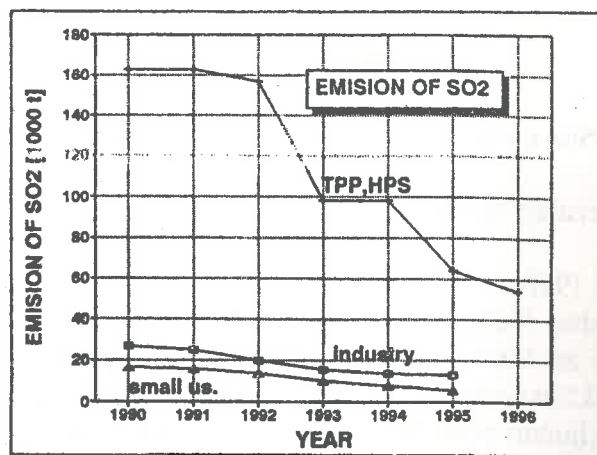


Picture 6: Distribution of emission in Slovenia in 1988 according to the emission quantity

stricter regulation for permitted thermal losses in new buildings ($\Phi_w \leq 5 + 10 A/V$) and gas mains in settlements. For the year 1995 we planned the use of 410 mio m³ earth gas for bulk consumers. Until the year 2020 it will amount to 515 mio m³. Because of the introduction of earth gas and the import of clean coal the emissions in industry and bulk consumers will decrease until the year 1998 by: SO₂ app. 60 %, NO_x 30 %, particles 70 %, ashes 55 % and CO₂ app. 30 %. But the question about the traffic emissions remains open. Petrol without lead and the usage of emulsions with raw-oil combustion will partly lessen the emission. The NO_x emission will decrease very little. Because of economical crisis we do not expect the means of transport to change in short time.

NEW TECHNOLOGIES

Activities on reduction of air pollution are connected with the development of new technologies for a rational energy use and the exchange of out-of-date technologies for cleaning the exhaust fumes respectively fuel combustion. New technologies which will be stimulated: - development of gas equipment with little NO_x emission - development of technology for desulphuralisation of exhaust fumes - development of technology for insulation of old buildings - development of a new generation of household appliances with lesser electricity consumption - the use of bicycles and similar means of transport will be stimulated - development of electric car and methanol engine for hybrid cars - development of new compressors for thermal pumps - development of economy-priced solar systems.



Picture 7: Reduction of emission of individual polluters in Slovenia (app. zero growth of primary energy) until the year 1995

SUMMARY

Immense air pollution in Slovenia cities and great damages in the woods forced us to work out complex strategies for the reduction of pollution with parallel introduction of energy savings, cleaning of exhaust fumes, fuel substitution and exchange of technology. Our goal is to reduce the emission of every polluter by about 50 % until the year 1995, to keep the needed primary energy on the present level whereby neither the production nor the living standard should be reduced. The realization of this strategy has been enabled by legal and economical means (new emission values, ecological tax) for which it will be necessary to dispense 1 % from the gross national product. With development funds new technologies for rational usage of energy will be stimulated, since it represents the cheapest way to reduce the emission.

LITERATURE

- /1/ P.Novak: Energetika in okolje v Sloveniji, Slovenija 88 - okolje in razvoj, SAZU, Ljubljana, 1989, str.289
- /2/ Poročilo o stanju okolja v Sloveniji, Poročevalec Skupščine SRS, XVI, št.5/1, 2, str.15
- /3/ World Bank: World Development Report 1978 ... 1988
- /4/ Statistični letopis energetskega gospodarstva Slovenije, 1988, ISE, Ljubljana, 1989
- /5/ Predlog energetske bilance SR Slovenije za leto 1990, Rep.komite za energetiko
- /6/ J.Dekleva, P.Novak, M.Tuma, J.Zupančič, B.Suvorov: Strokovne podlage za pripravo srednjeročnih planskih dokumentov ... ,Zaključno poročilo o delu - 1.faza, Ljubljana, 1990
- /7/ Analiza razvojnih možnosti energetike Slovenije v obdobju 1990-2020, Verzija 4, EIMV, Ljubljana, 1990
- /8/ Energy Balances of OECD Countries 1985/1986, IEA, OECD, Paris, 1988

INSTRAW



United Nations
International Research and Training Institute
for the Advancement of Women

P.O. Box 21747
Santo Domingo, Dominican Republic
Telephone (809) 685-2111
Facsimile (809) 685-2117 Telex (326) 4280 WRA SD

Printed in Santo Domingo, Dominican Republic
English-500-INSTRAW/SER.A/28