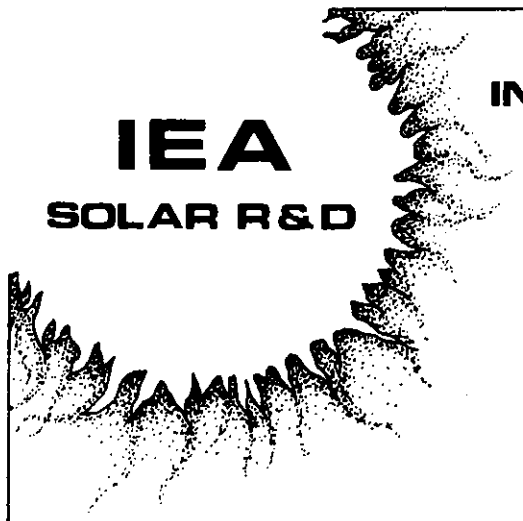

INTERNATIONAL ENERGY AGENCY

solar heating and
cooling programme

task II
coordination of R&D on solar heating and cooling components and systems

survey and review of national R&D plans

Subtask B

august 1984

SURVEY AND REVIEW OF NATIONAL R,D & D PLANS

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August 1984

This report is part of the work within the IEA Solar Heating and Cooling Programme,
Task II: Co-ordination of Research and Development on Solar Heating and Cooling Components and Systems,
Subtask B : Survey and Review of Existing R,D &D Plans

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ABSTRACT

This document provides information on national R,D and D plans regarding solar heating and cooling systems and components. The compilation is based on the reports submitted during 1983 and 1984 by the representatives of countries participating in Task II of International Energy Agency (IEA) Solar Heating and Cooling Programme. The countries which contributed reports are Austria, Belgium, Denmark, Greece, Japan, the Netherlands, Norway, Sweden and the United States. The contact persons for each country participating in Task II are listed in Appendix 2.

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1. PREFACE

International Energy Agency

In order to strengthen cooperation in the vital area of energy policy, an agreement on an International Energy Programme was formulated among a number of industrialized countries in November, 1974. The International Energy Agency (IEA) was established as an autonomous body within the Organization for Economic Cooperation and Development (OECD) to administer that agreement. Twenty countries are currently members of the IEA with the Commission of the European Communities participating under a special arrangement.

As one element of the International Energy Programme the participants undertake cooperative activities in energy research, development, and demonstration. A number of new and improved energy technologies which have the potential of making significant contributions to our energy needs were identified for collaborative efforts. The IEA committee for energy, research and development (CRD), assisted by a small Secretariat, coordinated the energy research development, and demonstration programme.

Solar Heating and Cooling Programme

In July, 1975 Solar Heating and Cooling was selected as one of the sixteen technology fields for multilateral cooperation. The objective was to undertake cooperative research, development demonstrations and exchanges of information in order to advance the activities of all participants in the field of solar heating and cooling systems. Several tasks were developed in key areas of solar heating and cooling. A formal implementing agreement was prepared, covering the contributions, obligations and rights of the participants, as well as the scope of each task. The agreement has been signed by the seventeen countries and the Commission of the European Communities. The overall programme is managed by an Executive Committee, while the management of each task is the responsibility of an Operating Agent who acts on behalf of the other participants. The tasks of the IEA Solar Heating and Cooling Programme and their respective Operating Agents (lead organization responsible for the task) are:

I Investigation of the Performance of Solar Heating and Cooling systems - Technical University of Denmark

II Coordination of Research and Development on Solar Heating and Cooling Components - Agency of Industrial Science and Technology, Japan

III Performance Testing of Solar Collectors - Kernforschungsanlage Jülich, Federal Republic of Germany

IV Development of an Insolation Handbook and Instrumentation Package - United States Department of Energy.

V Use of Existing Meteorological Information for Solar Energy Applications - Swedish Meteorological and Hydrological Institute.

VI Performance of Solar Heating, Cooling and Hot Water Systems Using Evacuated Collectors - United States Department of Energy.

VII Central Solar Heating with Seasonal Storage - Swedish Council for Building Research.

VIII Passive and Hybrid Solar Low Energy Buildings - United States Department of Energy.

IX Solar Radiation and Pyranometer Studies - Canadian Atomospheric Environment Service.

Collaboration in additional areas may be considered as projects are completed or fruitful topics for cooperation are identified.

TASK II - COORDINATION OF RESEARCH AND DEVELOPMENT ON SOLAR HEATING AND COOLING COMPONENTS AND SYSTEMS

The objective of this Task is to increase the effectiveness of the national R&D programmes related to the development of solar heating, cooling and hot water supply systems and components for buildings, including the application in industrial process heat. By the sharing of information and expertise it is hoped that duplication of effort can be avoided and development of solar heating & cooling components and systems accelerated.

The subtasks included in this project are:

A. Summary of Solar Energy R&D Projects

B. Survey and Review of Existing R, D&D Plans

C. Survey on Commercialization of and Operating Experience with Solar Heating and Cooling Systems and Components

D. Organization of Workshops

The Participants in this Task are Austria, Belgium, Denmark, Greece, Italy, Japan, the Netherlands, Norway, Sweden and the U.S.A.

2. INTRODUCTION

The objective of Task II of the International Energy Agency (IEA) Solar Heating and Cooling Programme is to increase the effectiveness of national R&D programmes related to the development of solar heating, cooling and hot water supply systems and components for buildings, as well as industrial process heat applications. This is accomplished by sharing information on various aspects of national programmes and related solar heating and cooling activities in the participating countries.

Under the Subtask B, Survey and Review of National R, D&D Plans, Task II Participants have exchanged information on their national R&D plans for solar heating and cooling systems, through annual experts meetings and through periodic surveys of national R&D programmes. (note: This subtask was formerly labeled as Subtask C, and earlier reports carried the Subtask C designation.)

For this as well as earlier surveys on R&D plans, the Participants prepared their reports based on the reporting format which is found in Appendix 1. The Operating Agent then compiled and summarized the input from the various countries. This document reflects the status in member countries as of the end of 1983.

This report contains six chapters on national R&D plans: 1) National solar goals, 2) Summary of solar heating and cooling R&D and D programmes, 3) Organizational structure of national solar programmes, 4) Government funding level, 5) Major research laboratories/institutions involved in solar heating and cooling and 6) Government incentives.

Nine out of eleven Task II participating countries submitted information for this report. These are: Austria, Belgium, Denmark, Greece, Japan, Netherlands, Norway, Sweden, and the U.S.A. No reports were received from Italy and Spain.

3. NATIONAL SOLAR GOALS

In this section, national goals for energy contribution from solar heating and cooling technology in the Task II participating countries are examined. Data is provided on both projected solar contribution to national energy demand and projected numbers of solar heating and cooling installations. (See Table 3.1 and Table 3.2)

The projections are based on a wide variety of factors which fluctuate from time to time. In particular, the nature of the oil market and oil prices will be the major parameters to affect the long range planning, in addition to the trends of the world economy. The uncertain nature of these parameters makes accurate projections very difficult.

However, the importance to mutual energy security of government support for long range planning, for R&D and D, and for commercialization of renewable energy sources, including international cooperative efforts, has continued to be emphasized at recent Summit meetings of industrialized nations. Additionally, IEA scenarios such as World Energy Outlook issued in April, 1983, and the ETSAP report on Energy After the Eighties have projected the rise of oil prices beyond the year 2000 with the decrease of recoverable fossil fuels and the need to take appropriate action now. National efforts directed at achieving the maximum use of solar heating and cooling systems comprise one part of a comprehensive, long-range energy conservation and diversification programme.

As indicated, projections are subject to fluctuation and challenges as to accuracy. However, they are useful in that they serve as indicators of the national commitment to solar development and utilization and the perception of the potential of the technology in each country.

3.1 Projected Solar Contribution to National Energy Demand

The projected contribution by all renewable energy technologies and by solar heating and cooling to total national energy demand are listed

in Table 3.1. Those countries which refrained from providing long term projections might still be formulating these figures or hesitate to make predictions because of uncertain factors. Projected contribution from solar heating and cooling has not drastically varied from the figures in the earlier reports on National R&D Plans, and has stayed within less than 3 percent of national energy demand by the year 2000.

3.2 Projected Number of Solar Heating and Cooling Installations

Data on solar heating and cooling installations are found in Table 3.2. Both the number of solar heating, cooling and domestic hot water (DHW) systems installed through 1981 and the projected number of future installations are tabulated. Through 1981, the United States and Japan together have installed over 3,400,000 active solar systems. 60,000 passive heating systems have been built in the U.S. while Japan has stressed DHW systems. Solar cooling appears to be of interest only to Jpan and the United States. Denmark and the Netherlands have moderately revised their former projections. Although no reports were submitted from Italy and Spain, solar collectors of more than 64,000 m^2 have been manufactured in Spain through 1981.

Although no major changes regarding long term projections can be seen when comparing the figures in Tables 3.1 and 3.2 with those in earlier surveys, some short term uncertainty and changes appear to have taken place as a result of new governments and policy changes. General information on the present situation can be found in the following sections of this report and in the Subtask C Survey on Commercialization.

Table 3.1 Projected Solar Contribution to National Energy Demand

	All Renewable Energy Technologies*				Solar Heating and Cooling			
	Percent of National Energy Demand		Contribution to Total National Energy Demand (M *kl* oil equivalent)		Percent of National Energy Demand		Contrition to Total National Energy Demand (M *kl* oil equivalent)	
	1990	2000	1990	2000	1990	2000	1990	2000
AUSTRIA	----	5 ~ 10	----	1,400 ~ 2,800	----	2 ~ 3	----	600 ~ 900
BELGIUM	< 1	1 ~ 2	0.33	0.79	< 1	< 1	0.008	0.018
DENMARK	----	3.3	----	0.8	----	0.2	----	0.04
GREECE	0.182**	----	29.12**	----	1.81**	----	29.00**	----
ITALY	----	----	----	----	----	----	----	----
JAPAN	1.7	3.6 ***	8.0	19.0 ***	1.0	1.4 ***	4.7	7.3 ***
NETHERLANDS	----	1 ~ 4	----	1 ~ 3	----	0.5 ~ 2	----	0.5 ~ 1.5
NORWAY	----	1	----	0.1	----	< 1	----	< 0.1
SPAIN	----	----	----	----	----	----	----	----
SWEDEN	----	----	----	----	0.2 ~ 0.6	----	0.1 ~ 0.3	----
USA	8.2	12.4	189.3	313.7	0.5	0.6	10.8	16.22

* Non nuclear and non-fossil energies

** as of 1983

*** as of 1995

Table 3.2 Solar Heating and Cooling Installations - Actual and Projected

	Solar DHW		Solar Heating & DHW		Solar Cooling		Passive Heating		Industrial Process Heat	
	Through 1981	Projected*	Through 1981	Projected*	Through 1981	Projected*	Through 1981	Projected*	Through 1981	Projected
AUSTRIA	3,000 ~ 5,000	20,000 (2000)	50	1,000 (2000)	---	---	20	300 (?) (2000)	10	200 (?) (2000)
BELGIUM	---	na	202	na	---	---	na	na	na	na
DENMARK	---	---	2,900	50,000 (2000)	---	---	---	---	---	---
GREECE	---	---	40,000	40,000 (1984)	---	---	---	---	---	---
ITALY	---	---	---	---	---	---	---	---	---	---
JAPAN	3,000,000	6,000,000 (2000)	840	4,000,000 (2000)	328	2,000,000 (2000)	---	na	153	300,000 (2000)
NETHERLANDS	1,500	100,000 (2000)	2,000	150,000 (2000)	---	---	na	na	---	---
NORWAY**	20	---	10	---	---	---	10	---	---	---
SPAIN	---	---	---	---	---	---	---	---	---	---
SWEDEN	4,850	na	25	na	---	---	100	na	7***	13*** (1985)
USA	350,000	na	50,000	na	2,000	na	60,000	na	45	na

* Figures in parentheses indicate projected year.
** Projected solar heating and cooling installations in the year 2000 will be estimated up to 10,000.
*** District heating.

4. SUMMARY OF SOLAR HEATING AND COOLING R&D PROGRAMMES

In this section, the objectives, areas of emphasis and main features of the national programmes in the Participating Countries are briefly stated. The objectives of the various national solar heating and cooling R&D programmes have been different from each other, depending on the market requirements as well as climatic and topographic conditions.

However, all countries are conducting R&D to address the technical barriers related to performance, cost, reliability, durability, etc. At the same time, some government have also enacted policies which promote market development and support the growth of the solar industry.

An overview of the specific trends in each participating countries can be seen by reviewing the information provided by each country on the following pages.

4.1. AUSTRIA

To secure Austria's energy supply and to minimize negative impacts on the economy and on the environment, the energy policy and research in Austria are aimed at

- *optimizing the exploration for and the use of domestic resources of energy or those rarely used up to now, such as biomass, solar and geothermal energy,*
- *substituting hydrocarbons as far as possible,*
- *reducing energy consumption through more efficient energy use,*
- *securing the necessary energy imports by diversifying supplier countries and energy sources.*

Meteorological Conditions and Potential for Solar Energy Utilization

In Austria the insolation values vary as follows: March to May up to 450 kwh/m², June to August 520 kwh/m², September to November 250 kwh/m² and

December to February up to 160 kwh/m². The annual global radiation sum is of the order to 1,000 to 1,400 kwh/m².

The daily sum of insolation on cloudless days in the summer period may be as high as 8 kwh/m²d.

The daily variations of insolation on cloudless days are highly dependent on the seasonal cycle. In summer, the maximum attains some 0.9 kw/m², in spring some 0.6 kw/m² and in winter some 0.25 kw/m².

During the period from May to September, an average of 45 percent of total insolation is diffuse radiation, from October to April about 65 percent.

The unfavorable ratio of maximum (June) and minimum (December) irradiation in Austria is obvious. Ratios of 8 : 1 are possible. In the case of space heating, energy demand is thus highest when supply is lowest.

Due to the meteorological conditions solar systems in Austria are used mainly for domestic hot water heating and for swimming pool heating during the summer period.

Market Penetration

The use of solar systems has been increasing in Austria since 1975. Until the end of 1983 about 134,000 m² of collector area were installed, about 65 % of which are used for swimming pool heating and 35 % for domestic hot water heating.

At present state of technology, the direct utilization of solar energy for space heating is not yet economical in Austria. Otherwise heat pump systems are increasingly used for space heating with air, water or soil as sources of heat.

Research, Development and Demonstration in the Field of Solar Heating Systems

Research and development works in connection with components and systems for utilization of solar energy were concentrated in Austria in past years on the following subjects:

The development and testing of economical and efficient collectors and solar systems for swimming pool and domestic water heating; the objective is to reach a life time of more than ten years.

The development and testing of heating systems with direct (collectors) or indirect (heat pumps) utilization of solar energy, spcial consideration being given to ecological and economic aspects.

In order to add to scientific findings specific data and experience with operating systems, the "Austrian Measurement Network for the Utilization of Solar Energy" was established in 1976. On behalf of the Austrian Federal Ministry for Science and Research about 50 test stations with solar and/or heat pump systems were installed by the end of 1983. The Austrian Solar and Space Agency (ASSA) co-ordinates these test stations, evaluates the results and provides all those interested with the information required.

Energy Policy and Research

A. The Institutional System

Austria is a Federal State. The Federal Government (BUND) and the Federal Provinces (Länder), within their respective fields of competence, are each responsible for energy matters including research and development.

At the federal level, Federal Ministries are responsible for energy matters, including research and development, with respect to their specific area of activity.

Matters of energy policy are handled by the Federal Ministry for Trade, Commerce and Industry.

The responsibility for the co-ordination of energy research and development at the federal level rests with the Federal Ministry for Science and Research.

B. Goals and Principles of Energy Policy

To secure Austria's energy supply and to minimize negative impact on the economy and on the environment, the energy policy and research in Austria are aimed at:

Optimizing the exploration for and the use of domestic resources of energy, in particular by further exploitation of hydropower, and new sources of energy or those rarely used up to now, such as biomass, solar and geothermal energy,

Substituting hydrocarbons as far as possible,

Reducing energy consumption through more efficient energy use,

Securing the necessary energy imports by diversifying supplier countries and energy sources.

The energy policy of the Federal Government emphasizes the exploration for oil, natural gas and coal deposits, and in particular the expansion of both large- and small-scale hydropower. The power plant expansion programme provides for the continuous expansion of hydropower. Besides the construction of large- and medium-size plants, particular attention is given to the expansion of small hydropower plants. As such small plants have considerable potential for future energy supply, a number of measures have been taken for their promotion, such as tax reduction, loans and interest allowances.

C. Goals and Principles of Energy Research

The objective of the Austrian Concept of Energy Research is to ensure that work sponsored from public funds is in concormity with the goals of Austria's energy policy and takes into consideration concerns of the economic and research policy, including environmental factors. Austria's Concept of Energy Research was first established in 1974 and is being updated periodically.

D. Special Measures for the Promotion of Solar Technologies

If their application meets specific energy policy requirements, solar systems qualify for tax advantages as energy saving investments.

Standards for solar collectors are already available in Austria. Guidelines and recommendations for planning, design and operation of solar systems have been elaborated by the Austrian Solar and Space Agency (ASSA) based on the results gained with existing facilities.

Reliability, cost-effectiveness, serial production of parts and components, and better information on technologies are preconditions of using new and renewable sources of energy. Appropriate documentation, teaching and demonstration materials have been elaborated in Austria, in order to provide information to all interested and to promote the use of solar systems.

The introduction of new technologies requires good training of technical manpower. For this purpose, seminars are held in regular intervals, dealing with the planning design and operation of solar systems. Between 1977 and 1983 more than 250 seminars were held in Austria on this subjects.

4.2. BELGIUM

The R, D&D efforts aim to create in Belgium the necessary scientifical and technical know-how to enable the development of Belgian solar industry. Main efforts are concentrated on

- *residential heating, both active and passive*
- *heat storage*
- *solar applications for agricultural purposes*
- *development of design tools*

Most of the R&D projects concerning solar heating and cooling are treated within the National R&D Energy Program.

This program is managed by the Sciences Policy Office of Belgium. The Projects are executed by university laboratories, research centers and industries.

The last two years research in the field of active solar heating for domestic purposes is less intensive. Experience with existing commercial installations has shown that most of them are technically good but that pay off time is too high to permit large scale commercialization.

This is mainly due to the high systems cost and the rather low solar energy potential in Belgium (around 950 kwh/m^2 year). Supplementary efforts have been initiated for the development of passive solar heating, which can make a substantial contribution to energy concervation in Belgium.

The other research efforts are concentrated on solar drying of agricultural products, air conditioning and cooling and desalination.

4.3. DENMARK

Reducing the cost of active solar systems focusing on a systematization of the whole construction of systems with different sizes and surroundings.

Stimulate the use of passive solar energy in new as well as existing buildings by giving the municipal planning and technical divisions guide-lines and by making architects interested in the field through competitions and exhibitions.

Research Laboratories

As can be observed from the Subtask A Report of R&D projects in Denmark all but one of the projects are carried out by either the Thermal Insulation Laboratory at the Technical University of Denmark or at the Technological Institute.

Passive Systems

Part of the work is focused on the development of new components, solar walls, hybrid solar walls, thermo-siphon solar water heaters. By the participation in Task III of the International Energy Agency Solar Heating and Cooling Programme a broad range of problem areas of passive and hybrid solar low energy buildings, i.e. from system simulation to the monitoring of demonstration projects.

Active Systems

Active solar heating systems for domestic hot water and heating is still the dominating area of solar research in Denmark. The main emphasis is put on obtaining reliable, cost-effective systems. The development of new or improved components is the aim of six projects and the rest covers systems development.

Seasonal Storage

The two projects on seasonal storage both deal with aspects of uninsolated large scale warm water stores.

4.4. GREECE

The main features of overall programme is to improve through R and D the performance, to do basic research technology, development and to apply the standards.

According to the five-year national programme, the solar energy research and development has an important role to play. For the moment seven projects are under application or active.

4.5. JAPAN

Sunshine Project Promotion Headquarters, AIST, MITI has three programmes on active systems from 1980 - 1985 such as:

- *basic studies on testing and evaluation procedures of solar components and systems as well as solar collector & heat storage materials,*
- *development of solar industrial heat processes of cascading and fixed temperature models,*
- *long term heat storage by underground & chemical reaction techniques.*

Housing Industry Division, MITI has a passive systems and components programmes.

Organization

The Sunshine Project Promotion Headquarters, AIST, MITI is responsible for R&D on active solar heating and cooling systems as well as on solar industrial process heat systems. The passive solar systems and components R&D is subsidized by the Housing Industry Division of MITI.

Active SHC System

The first generation R&D on active solar heating and cooling systems have terminated by 1980 (as 7 year programme since 1974). Basic studies on materials and components as well as testing procedures both on component and systems are still being pursued after 1980, while commercialization efforts are vigorously concentrated by the industry.

Passive and Hybrid Systems

R&D Projects on passive and hybrid systems as well as materials and components have been inaugurated since 1980 as for the five year programme in which eleven private sectors are being funded. System analysis and components research are the main topics in these projects. Another 6 year programme on passive system is also funded by the Ministry of Education to 7 - 19 universities since 1980 for system analysis studies.

FUNDING

FY(M yen)

	1983	1984
Active solar	1,270	706
Passive solar	385	242
Total	1,655	948

4.6. THE NETHERLANDS

main goals:

- *Stimulation of research and development projects leading to cost reduction, higher efficiencies, higher reliability of solar systems.*
- *Demonstration of economic feasibility of solar installations in utility buildings and in agriculture or industry.*
- *Field testing of improved solar systems for space heating in combination with seasonal storage.*
- *Market analyses on basis of system studies and econimic assessments.*
- *Stimulation of fundamental long term research e.g. direct conversion etc.*
- *Signaling of non technical impedements.*
- *Dissemination of information.*
- *Stimulation of industrial activities.*

The 44 Solar Projects are operated under the umbrella of a national research programme on solar energy. This coordinated programme is dedicated to the research, development and field testing of solar energy conversion systems. The main goal is the introduction of solar systems that proved to be the most successful in phase I of the programme. This means mainly thermal conversion of solar energy for low temperature applications.

Swimming pool heating by solar energy, a mature technique now, is no longer supported. Also no support is given to cooling and climate control due to the specific climatological conditions. Solar boilers have been demonstrated sufficiently, although the market response is slow.

A central focus in the programme is space heating. Simplified systems, passive installations and seasonal storage are the main topics. A very important activity is the transfer of knowledge and information.

4.7. NORWAY

Over a 5 year period evaluate the technical and economical possibilities for solar energy utilization in Norway.
The area of emphasis are:

- *to predict the solar radiation in different locations in Norway through measurements and simulation models.*
- *a further development of cheap and simple solar energy systems integrated in buildings. Those systems are found to be most cost effective so far.*

Solar energy is not expected to take a substantial part of the toral national energy demand in Norway in this century. Norway has a very favourable energy situation and almost 60% of the domestic energy consumption is renewable hydro electricity. The oil production in 1983 was 10 times the oil consumption.

Since 1975, 15 mill.NOK (2 mill.US$) have been funded to 30 solar energy projects. The governmental fundings have been decreased from 1980 to 84, corresponding to appr. 8 man-years in 1980 and 3-4 in 84. In addition to the R&D fundings there is a budget for experimental buildings. The amount for solar energy from this budget is appr. 0.5 mill.NOK in 1984.

Solar Radiation

About 20 -30% of the R&D fundings has been used in projects to get a better understanding of the amount and distribution fo solar radiation. The global radiation per year differs between 1,000 KWh/m² in the south-east part to 600 KWh/m² in the northern part. The global radiation during the heating season is at about the same level in both the northern and the southern part. This is due to the fact that the heating season is almost 300 days in the north of Norway compared to about 200 days in the south.

A "Radiation Handbook" for Norway will be completed in 1984. The handbook will be updated with new radiation data from measuring stations in the coming years.

Passive Solar Projects

Norway participates the IEA passive solar project and the national programme is therefore almost identical with the Task VIII programme. All the Norwegian passive solar activities are canalized through this project. At least two experimental buildings will be built in connection with this work.

The Norwegian passive project is a cooperation between different research institutions and we have made a reference group with representatives from industries, energy suppliers, consulting engineers and architects.

Active Solar Systems

There is almost none R&D projects in Norway dealing with commercial solar water heating systems, neither for DHW or space heating. The Norwegian

research programme in active solar systems deals mostly with building integrated systems. Most of the systems are air-heating systems. The only present R&D system with a water-collector is a project with a trickle solar collector. The system using this collector is integrated in walls and roofs and the cost is expected to about appr. 350 NOK/m² (50 US$/m²).

The air-heating solar systems are both for DHW and spce heating. The most promising one is a 150 m² air-collector system on a Squash-center producing hot water for showers etc. The total installation cost for the system is about 500 NOK/m². The system will be measured in 1983/84.

A project at the Technical University in Trondheim plans to use the indoor solar simulator to do thermal small scale experiments with buildings and solar systems. The scope is to get theoretical models which can be used in practical small scale experiments.

By 1984 an evaluation report of the Norwegian active solar houses will be worked out, and this will be the basis for the future R&D projects.

Commercial

The commercial activity is for the moment almost zero, but a lot of architects has been interested to build big semi-climatic glaszones in larger buildings. It is expected that those types of buildings can be well suited for solar energy systems at reasonable costs.

4.8. SWEDEN

Goal: to investigate the feasibility of Solar Energy for heating of buildings by 1985.

Area of emphasis and main feature:

- *Basic research - long time durability of collectors, simulation models*
- *Systems - development of DHW, district heating and seasonal storage systems*
- *Emphasis on seasonal storage systems*

Background

The solar programme for space heating is managed by the Swedish Council for Building Research. The main goal of the Swedish energy policy is to reduce the oil dependence. This has so far been achieved by energy conservation, nuclear energy introduction, use of other fuels and heat pumps. As a result of a referendum and parliament dicision nuclear power is to be gradually phased out until the year 2010. Therefore, Sweden interest is now directed towards R&D on domestic energy sources.

The Solar Programme

Solar insolation amounts to about 1,000 kwh/m² year on a horizontal surface, i.e. about the same as in central Europe. However the distribution of this energy throughout the year is less favourable than in many other countries. Irradiation on a horizontal surface in Stockholm is about 15 times less in December than in June, and in the far north the insolation is zero during some winter months. Further limitations on solar energy are imposed by the proportion of diffuse radiation, which amounts to about 50% of global radiation, and the number of days with alternating sun and cloud cover.

A target-oriented solar energy programme, known as the Solar 85 programme, was established at the end of the 1970s. Apart from R&D the programme contained a market goal of solar contirbution by 1990 in the range of 1-3 TWh. The R&D part of this work is administered by the council.

Objectives for the solar heating programme:

- component development: Increased performance and reduced costs, better durability
- solar heated domestic hot water: Development of low cost systems for multi-family housing units and monitoring of systems in detached houses
- solar collectors in combination with district heating and block centrals: Establishment of full scale systems and monitoring of systems already in operation

The first stage of the programme was directed towards the development and evaluation of a variety of system concepts. During the second stage, from 1982 and onwards, a few interesting system types developed towards better cost efficiency. The programme is now in its third stage which also includes evaluation of the programme and the technology.

The Market

Several small industries developed during 1974 - 1980. Most of them concentrated on domestic hot water systems. Production reached its peak in 1980, more than 20,000 m² of collectors sold. After that sales decreased rapidly. In all some 60,000 m² of collectors have been installed during the last ten years. Favourable subsidies have been offered to buyers of solar equipment. This year, 1984, 50% of the approved installation cost is subsidized. The low price of electricity has been the major obstacle for solar introduction.

A number of evaluation groups freestanding from the council have been following different parts of the programme. Apart from the evaluation they have contributed with input data for the Solar 85 model, the market model used for the prediction of solar storage and heat pump contribution to the Swedish solar energy system.

THE UNITED STATES

Solar heating and cooling is the responsibility of the U.S. Department of Energy's Office of Solar Heat Technologies which comes under the Assistant Secretary for Conservation and Renewable Energy. The Programme is divided between the Active Heating and Cooling and the Passive and Hybrid Systems Divisions.

Programme Goals

The goal of the U.S. Solar Heating and Cooling Programme is to provide industry with a technology base that will enable it to develop components and systems that efficiently and cost-effectively convert solar energy into usable thermal energy. This is accomplished by (1) supporting long range and high risk R&D having high benefit potential and by (2) transferring research results to industry.

Specific goals of the Active Solar Programme are:

- To improve cost/performance ratios by a factor of two to four over that of today's state-of-the-art active solar systems
- To achive improvements in component and system reliability and durability to assure 20-year service life of active solar systems.

Specific goals of the Passive Solar Programme are:

- To facilitate development of solar cooling technologies that, when integrated with daylighting strategies, are capable of reducing the amount of electricity used in nonresidential buildings by 60 percent.
- To developed advanced technologies that improve performance of passive and hybrid solar heating systems by at least a factor of two over current technology, while mitigating off-season adverse effects.

Program Emphasis

To achieve the above goals, the following areas of programme emphasis have been established:

Active Solar

1. Advanced Research and Analysis
   - Collector Materials & Components
   - Thermal Storage
   - Absorption Cooling
   - Rankine Cooling
   - Desiccant Cooling
2. Systems Research and Analysis
   - Systems Testing and Analysis
   - Performance monitoring
   - System Effectiveness Research
   - Test Procedures and Performance Criteria

Passive Solar

1. Systems R&D

- Passive Heating and Cooling Performance Analysis
  - Non-residential buildings
  - Residential buildings
  - Daylighting systems
  - Cooling
- Performance Testing and Evaluation
  - Performance monitoring
  - Simulation Code Validation
  - Design Tools
- Heat Transfer Research

2. Advanced Materials and Components

- Solar Load Control
  - Aperture Materials and Components
  - Daylighting enhancement
- Thermal Storage Materials
  - Phase change materials
  - Masonry
  - Desiccants
- Thermal Transport Subsystems
  - Thermal diodes

Funding

(in millions $US)

	FY83	FY84
Active Solar	6.7	8.4
Passive Solar	5.0	8.5

5. ORGANIZATIONAL STRUCTURE OF NATIONAL SOLAR PROGRAMMES

The organizational structure of government R&D programmes for solar heating and cooling (and other renewable energy technologies as well) are sometimes transformed with the evolution of programmes and/or the shift of administrations. This section provides the following updated information for each participating country:

a. Government agencies and specific divisions involved in solar energy programmes, including the areas of responsibility of each.

b. An organization chart showing the offices responsible for solar heating and cooling and their position on the overall renewable energy programme.

AUSTRIA

a) Austrian Solar and Space Agency: Coordination of R&D

b) Austria is a Federal State. The Federal Government (Bund) and the Federal Provinces (Länder), within their respective fields of competence, are each responsible for energy matters including research and development.

At the federal level, Federal Ministries are responsible for energy matters, including research and development, with respect to their specific area of activity.

Matters of energy policy are handled by the Federal Ministry for Trade, Commerce and Industry.

The responsibility for the co-ordination of energy research and development at the federal level rests with the Federal Ministry for Science and Research.

On behalf of the Federal Ministry for Science and Research, the Austrian Solar and Space Agency is responsible for the co-ordination in the field of solar energy research as well as for information and education activities.

By a federal law enacted by Parliament in 1979 the Federal Government is obliged to submit to the Austrian National Assembly (Nationalrat) a comprehensive annual report on energy policy ("Energiebericht der Bundesregierung") as well as a report on the state-of-the-art and on the objectives of research and development in Austria ("Österreichischer Forschungsbericht").

BELGIUM

a) Prime Minister's Office - Science Policy - National R&D Energy Programme: R&D

Ministry of Economic Affairs

Nuclear Research Center of Mol: R&D
Fund for Industrial and Agricultural Research: R&D
Office for Energy Conservation: Application

Ministry of Public Work: End Use

Building Office: End Use
National Institute for Social Housing: Agreement Procedure
Fund for School Buildings: End Use

b) Not available

DENMARK

a) Thermal Insulation Laboratory, Technical University of Denmark: Research, Testing & Demonstration

Department for Heating and Ventilation, Technological Institute: Testing & Demonstration

b) There is only a part of one office for renewable energy R&D in the Ministry of Energy.

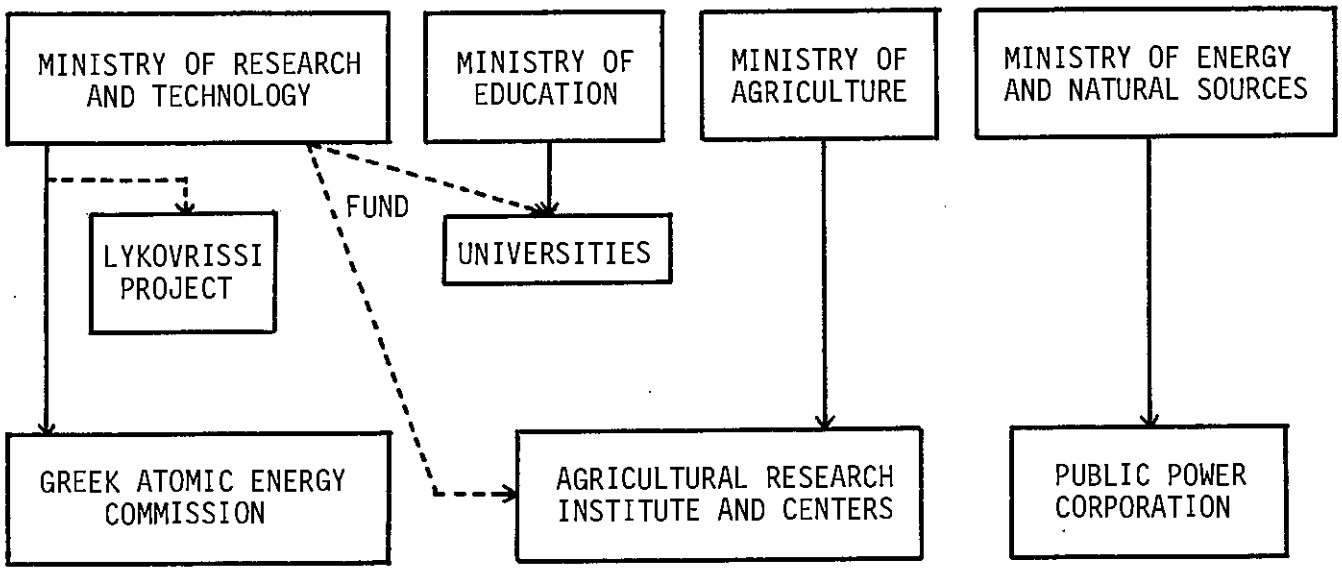
GREECE

a) Ministry of Research and Technology: Monitor of Res. Activities

Public Power Corporation (DEME): Photovoltaics, Wind Energy, Geothermal Energy

Ministry of Agriculture: Greenhouse, Biomass

b)



JAPAN

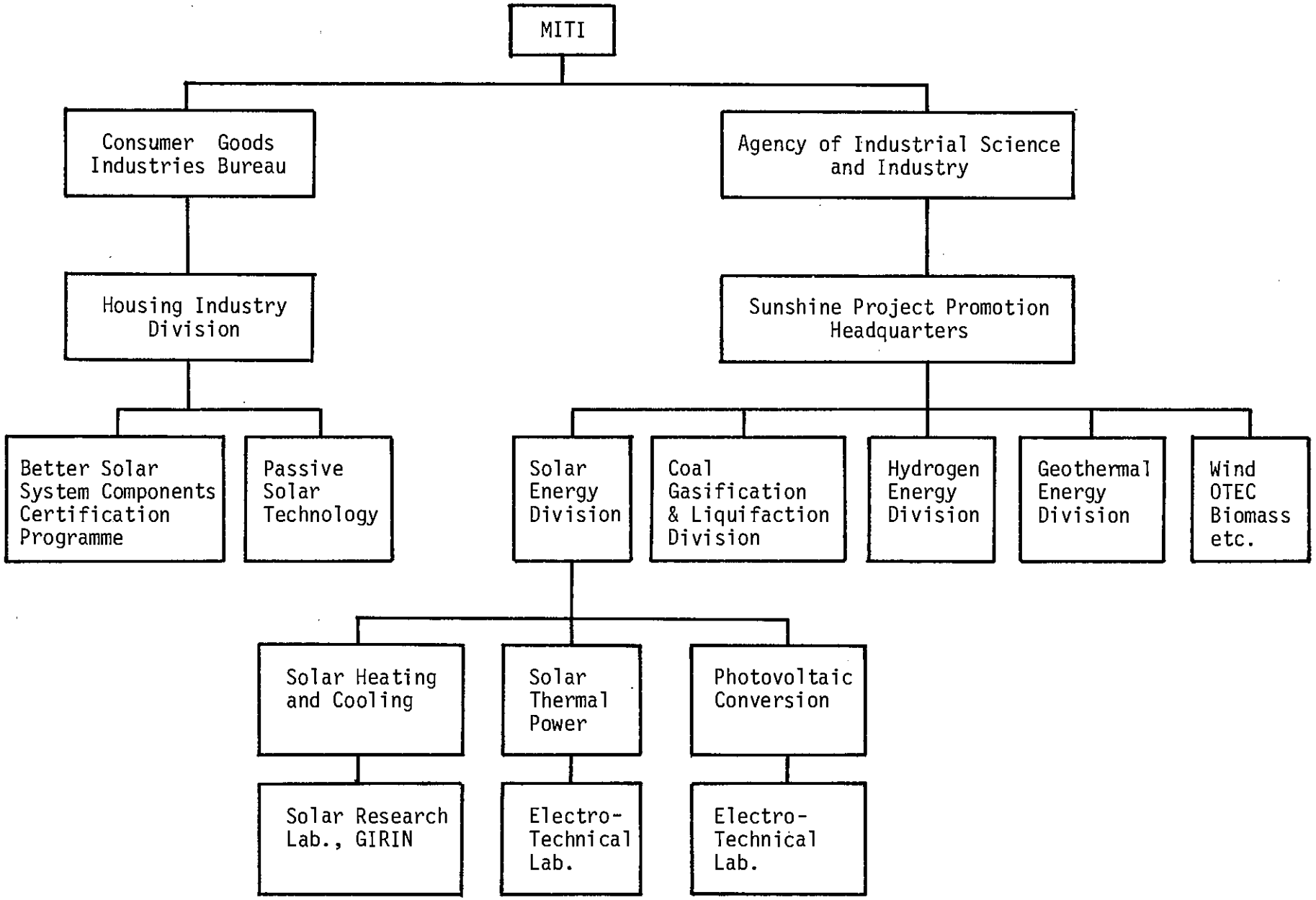
a) Sunshine Project Promotion Headquarters,
Agency of Industrial Science and Technology,
Ministry of International Trade and Industry:

Solar Heating and Cooling, Solar thermal Power,
Photovoltaic Conversion,
Wind, OTEC, etc.

Housing Industry Division,
Consumer Goods Industries Bureau,
Ministry of International Trade and Industry:

Passive Solar Heating and Cooling

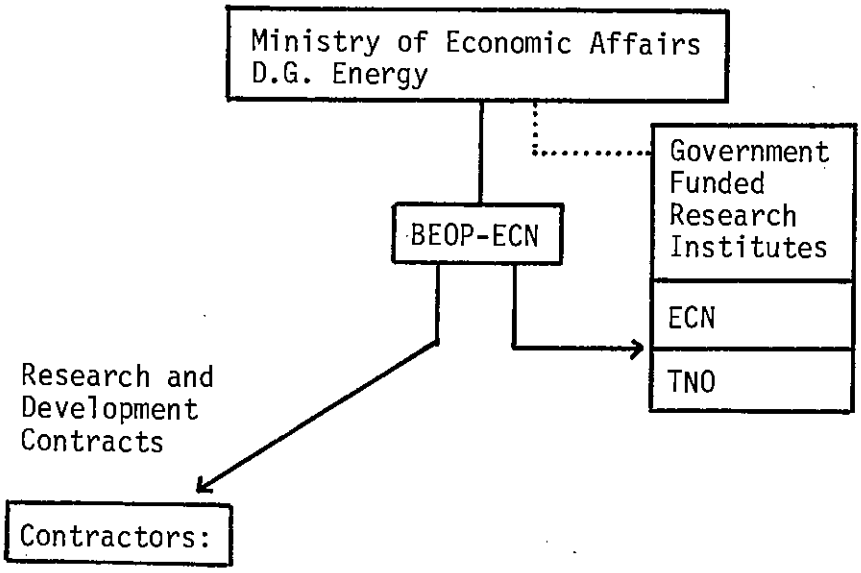
b) ORGANIZATION CHART OF JAPANESE SOLAR ENERGY PROGRAMME



NETHERLANDS

a) Ministry of Economic Affairs, Directorate General for Energy
Bureau for Energy Research Programme Management BEOP (BEOP-ECN)
Organization for Applied Scientific Research TNO.

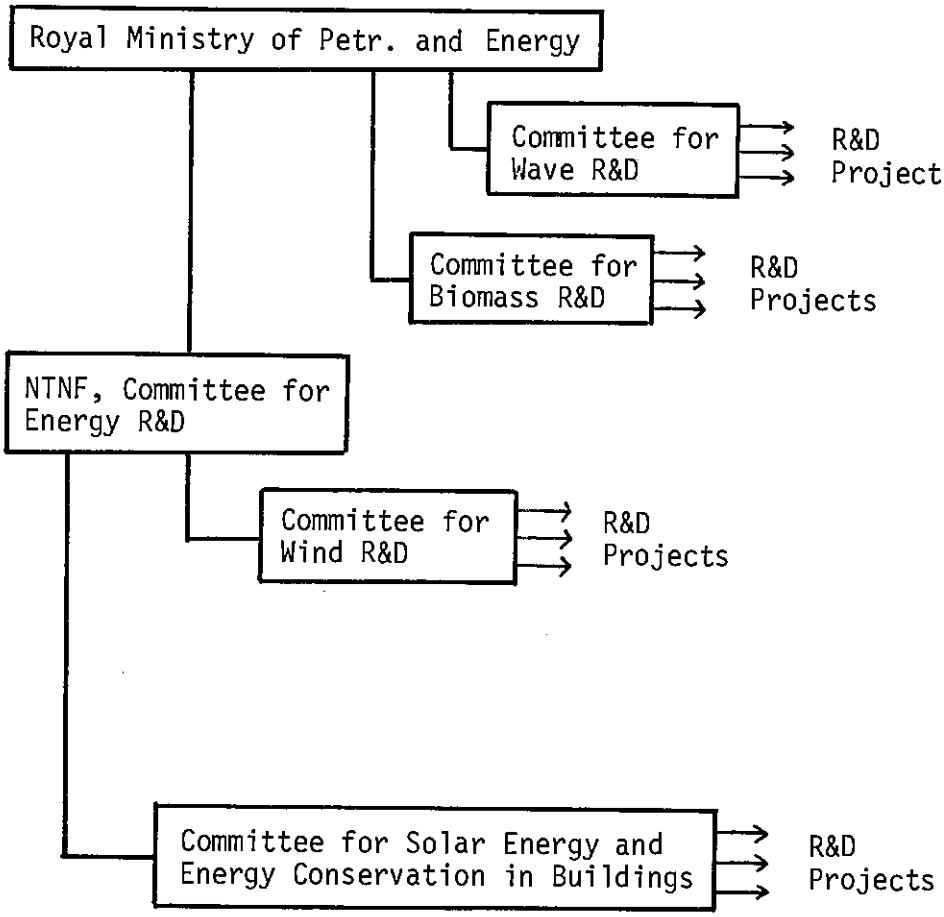
b)



NORWAY

a) The Energy Department of the Royal Ministry of Petroleum and Energy (OED)
Royal Norwegian Council for Scientific and Industrial Research (NTNF)

b)

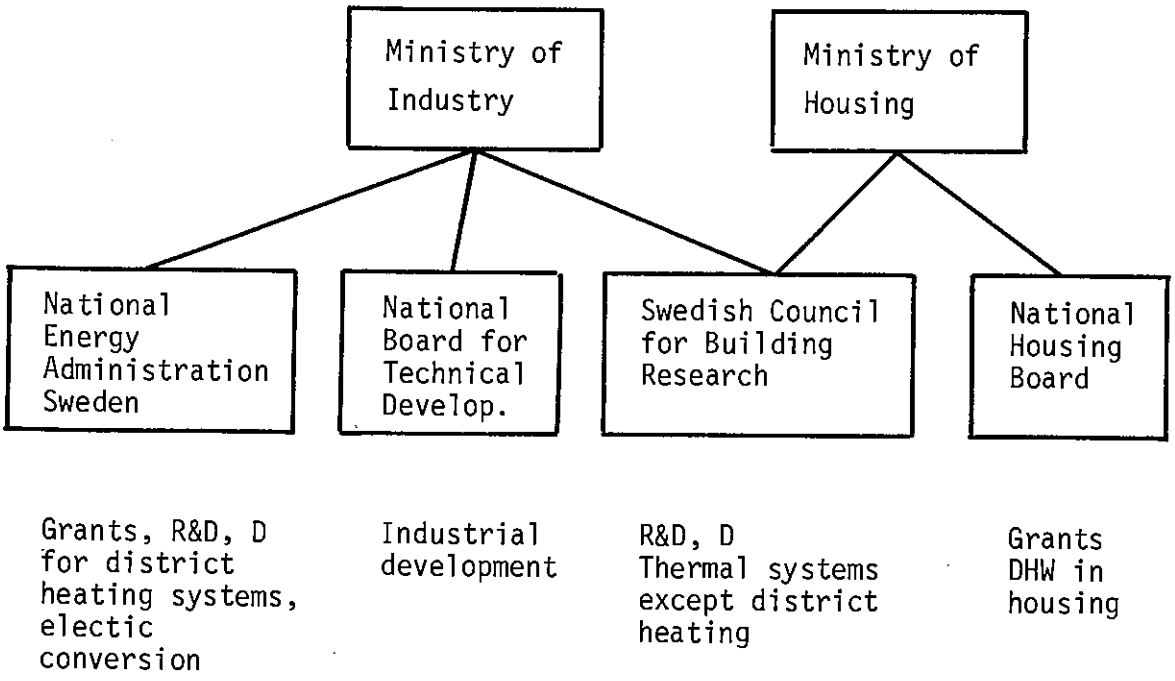


SWEDEN

a) Swedish Council for Building Research - Solar R&D,D - related to buildings

That part of the programme which deals with the conversion of solar radiation to electricity and fuel is administered by "National Energy Administration, Sweden", while industrial development work is dealt with by the National Swedish Board for Technical and administered by the National Housing Board. The "National Energy Administration, Sweden" is also responsible for funding of all other solar projects.

b)



THE UNITED STATES

a) U.S. Department of Energy: Research and Development

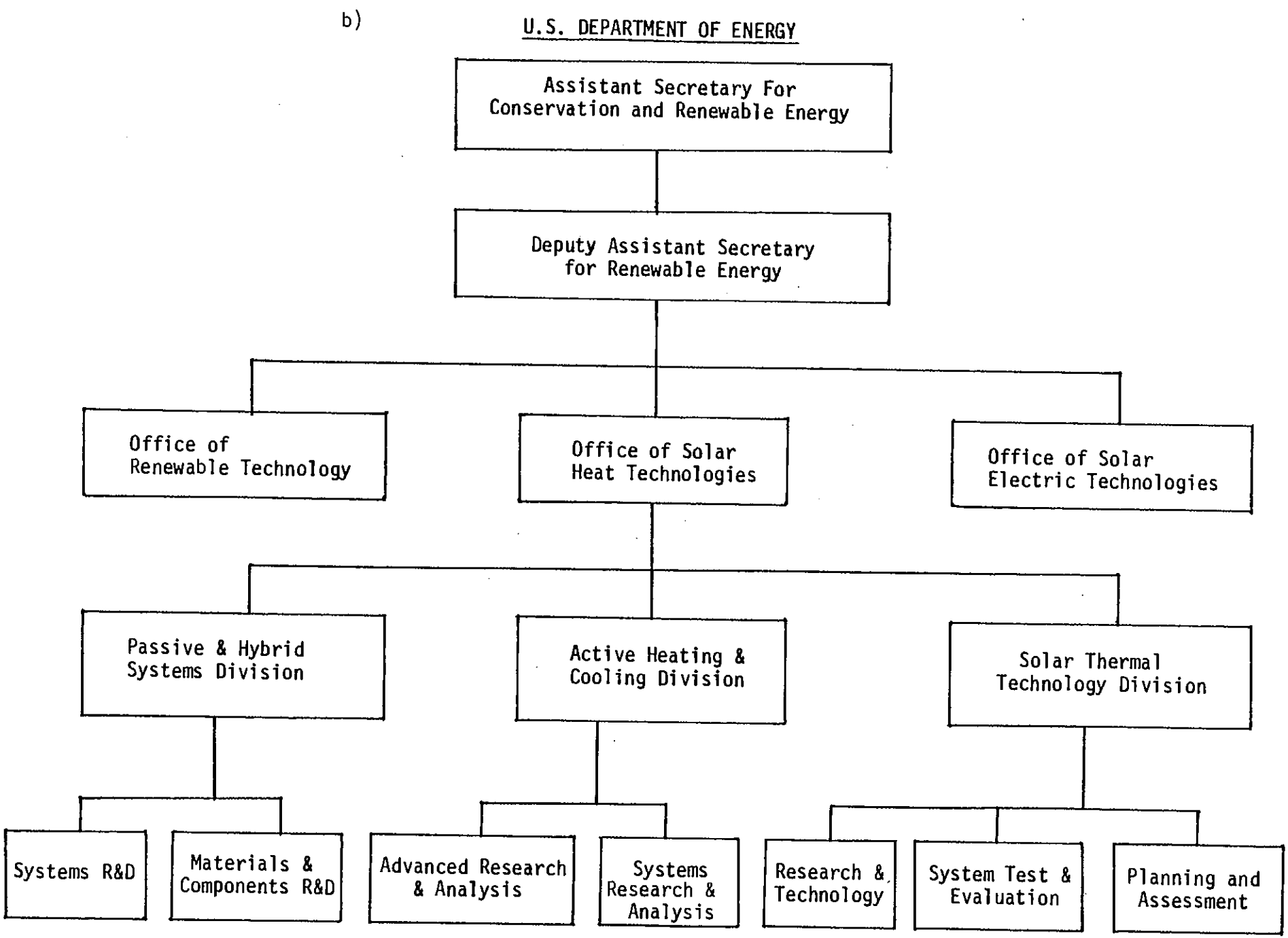
U.S. Department of Housing and Urban Development: Conservation and Energy Bank (subsidized loans)

U.S. Department of the Treasury: Renewable energy tax policy

U.S. Department of Commerce: Trade promotion--standards

U.S. Department of Agriculture: Support for space conditioning of livestock shelters, greenhouses/ residences, water heating, crop drying facilities

b)


U.S. DEPARTMENT OF ENERGY
Assistant Secretary For Conservation and Renewable Energy
Deputy Assistant Secretary for Renewable Energy
Office of Renewable Technology
Office of Solar Heat Technologies
Office of Solar Electric Technologies
Passive & Hybrid Systems Division
Active Heating & Cooling Division
Solar Thermal Technology Division
Systems R&D
Materials & Components R&D
Advanced Research & Analysis
Systems Research & Analysis
Research & Technology
System Test & Evaluation
Planning and Assessment

6. GOVERNMENT FUNDING LEVEL

Funding levels for solar heating and cooling R&D projects by governments of participating countries are reviewed in this section. Tables 6.1, 6.2, and 6.3 give the funding levels in 1975, 1980 and 1983, respectively. The budgets for all renewable energy technology are also listed for reference.

In 1975, Austria, Japan, Netherlands, and the U.S. had initiated funding for renewable energy projects, including solar heating and cooling. Other countries began shortly afterwards. It appears that renewable energy funding was highest in 1980 although detailed data from Greece and Spain are missing. It seems that the effects of the so-called oil glut and price decline, as well as other factors such as achievement of energy conservation, are seen in the 1983 figures. Such drift can be observed more clearly in Fig. 6.1 and 6.2. Although the figures for intervening years are absent, one can discern the overall trend of funding level in participating countries. The trend in Fig. 6.1 does not coincide with that of Fig. 6.2, i.e., an increase of funding for renewable energy technology projects does not necessarily mean an increase of funds for solar heating and cooling R&D projects.

The following abbreviations used in the tables: A: Austria, B: Belgium, D: Denmark, G: Greece, J: Japan, NL: Netherlands, N: Norway, SWED: Sweden and US: the USA.

It is noted that the funding level by the U.S. both on renewable and solar energy projects is remarkably high although it showed a significant decrease in 1983. In 1984, solar heating and cooling project funding showed a small increase to 16.5 M$ from 15.2 M$ in 1983. Austria and Belgium showed a similar decline, but the funding level by other participants generally increases after 1980 as in the cases of Denmark, Japan, Netherlands and Sweden.

Such phenomena might be ascribed to very complex reasons such as major changes in government policy, election of new governments, world-wide economic recession, etc.

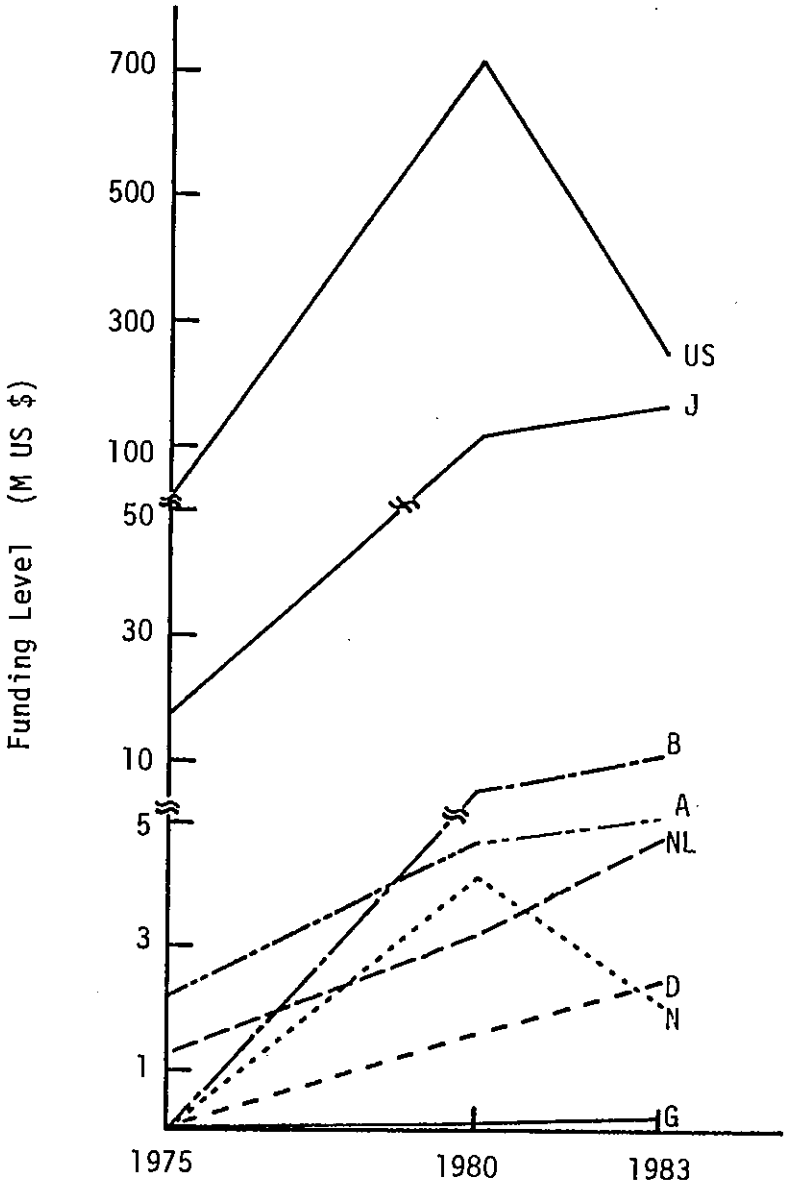


Fig. 6.1 Funding level of all renewable energy technology

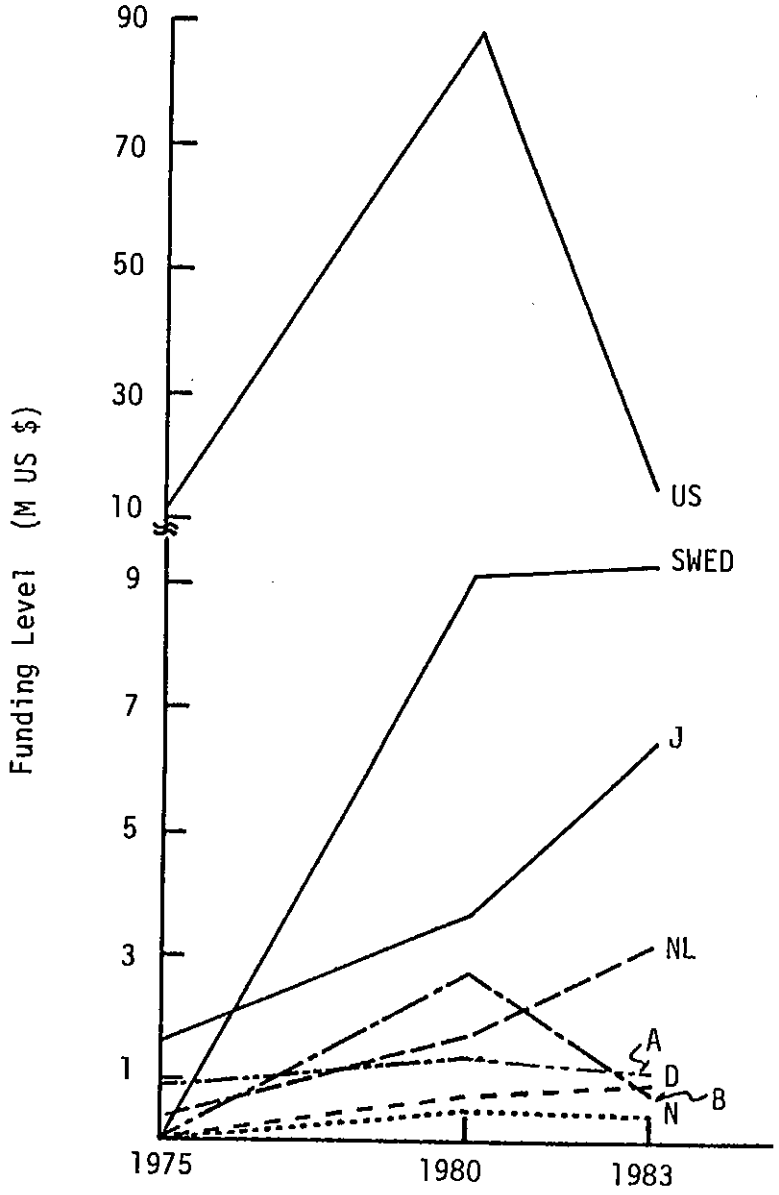


Fig. 6.2 Funding level of solar heating and cooling R&D projects

6.1. Funding Level in 1975 (M US$)

	All Renewable Energy Technology	Solar Heating & Cooling RD & D								Non R&D*
		DHW	Heating		Cooling		IPH	Others	Total	
			Active	Passive	Active	Passive				
AUSTRIA	2.2	0.9					0	0	0.9	0.2
BELGIUM	0	0	0	0	0	0	0	0	0	0
DENMARK	0	0	0	0	0	0	0	0	0	0
GREECE	0	0	0	0	0	0	0	0	0	0
ITALY	---	---	---	---	---	---	---	---	---	---
JAPAN	17.4	0.87				0	0	0.78	1.65	0
NETHERLANDS	1.28	---	---	---	---	---	---	---	0.32	0
NORWAY	0	0	0	0	0	0	0	0	0	0
SPAIN	---	---	---	---	---	---	---	---	---	---
SWEDEN	0	0	0	0	0	0	0	0	0	0
USA	55.2	5.2	6.0	0	1.0	0	0.5	0	12.7	0.5

* Marketing, Info. etc.

6.2. Funding Level in 1980 (M US$)

	All Renewable Energy Technology	Solar Heating & Cooling RD & D								Non R&D*
		DHW	Heating		Cooling		IPH	Others	Total	
			Active	Passive	Active	Passive				
AUSTRIA	4.5	1.35					0	0	1.35	0.2
BELGIUM	7.68	1.57	0.2	0.34	0	0	0	0.6	2.79	na
DENMARK	1.55	0	0	0.36	0	0	0	0.36	0.72	0
GREECE	0.50	---	---	---	---	---	---	---	---	---
ITALY	---	---	---	---	---	---	---	---	---	---
JAPAN	125	2.0		0.13	0.13	0	0.22	1.22	3.69	0.3
NETHERLANDS	3.2	1.44			0.16				1.6	---
NORWAY	4.1	0.07	0.23	0	0	0	0	0	0.53	---
SPAIN	---	---	---	---	---	---	---	---	---	---
SWEDEN	---	9.24			---	---	---	---	9.24	---
USA	720	20	22	20	7.0	9.3	10.5	---	88.8	19.7

* Marketing, Info. etc.

6.3. Funding Level in 1983 (M US$)

	All Renewable Energy Technology	Solar Heating & Cooling RD & D					IPH	Others	Total	Non R&D*
		DHW	Heating		Cooling					
			Active	Passive	Active	Passive				
AUSTRIA	5.1	0.45					---	0.76	1.16	0.78
BELGIUM	11.8	0.2		0.06	0.03	0	0	0.44	0.72	---
DENMARK	5.1	0.27	0.44	0.07	0	0	0	0	0.78	---
GREECE	0.27	---	---	---	---	---	---	---	---	---
ITALY	---	---	---	---	---	---	---	---	---	---
JAPAN	175	1.13		1.36			3.61	0.46	6.56	0.2
NETHERLANDS	4.8	---	---	---	---	---	---	---	3.2	---
NORWAY	2.08	0.1	0.15	0.19	0	0	0	0	0.44	---
SPAIN	---	---	---	---	---	---	---	---	---	---
SWEDEN	---	9.36			0	0	0	0	9.36	---
USA	264.2	6.7			5.0		3.5	---	15.2	---

* Marketing, Info. etc.

7. MAJOR RESEARCH LABORATORIES/INSTITUTIONS INVOLVED IN SOLAR HEATING AND COOLING

Expanding on the information in Section 5 on Organization Structure of National Solar Programmes, the names and locations of major research laboratories/institutions involved in solar heating and cooling R&D projects are listed below. The areas of research in which they are involved are indicated.

AUSTRIA

Names and Location of Labs	Area(s) of Research
* Austrian Solar and Space Agency, Garnisongasse 7, A-1090 Vienna Prof. G. Faninger	Co-ordination
* Austrian Research Centre Seibersdorf A-2444 Seibersdorf	Low temperature and process heat
* Research Centre Graz Elisabethstrasse 11, A-8010 Graz	Heating and cooling
* Zentralanstalt für Meteorologie und Geodynamik Hohe Warte 38, A-1180 Vienna	Meteorology
* Institut für Festkörperphysik, Univ. Vienna Kopernikusgasse 15, A-1060 Vienna	Photovoltaic
* Institut für Allgemeine Physik, Technical University Vienna Karlsplatz 13, A-1040 Vienna	Low temperature and process heat
* Institut für Hochbau für Architekten, Technical University Vienna Karlsplatz 13, A-1040 Vienna	Passive solar systems

Names and Location of Labs	Area(s) of Research
* Institut für Wärmetechnik, Technical University Graz Kopernikusgasse 24, A-8010 Graz	Low temperature heat, heat pumps
* Inst. für Physik für Bauingenieurwesen, University Innsbruck Technikerstrasse 5, A-6020 Innsbruck	Passive solar systems
* Institut für Experimentalphysik, University Innsbruck Schöpfstrasse 41, A-6020 Innsbruck	Photovoltaic

BELGIUM

Names and Location of Labs	Area(s) of Research
* Centre de Recherches sur l'Energie Solaire, Service de Thermodynamique-FPMs Boulevard Dolez, 31, 7000 Mons Prof. Bougard and Prof. Pilatte	Solar Water Collectors Solar Heating Systems Chemical Storage Desalination and Refrigeration
* Afd. Toegep. Mechanica en Energie-conversie, Katholieke Universiteit Leuven Celestijnenlaan 300 A - 3030 Heverlee Prof. Dutre	Solar Air Collectors Solar Application with Air Collectors - latent heat storage
* Fondation Universitaire Luxembourgeoise Rue des Déportés 140 - 6700 Arlon Prof. Poncelet	Sensible Heat Storage with Solar Collectors
* Studiecentrum voor Kernenergie Boeretang - MOL Dhr. Vandeplas	Refrigeration, Evacuated Collectors
* Fak. Toeg. Wet. - Afd. Burgerl. Bouwkunde, Vrije Universiteit Brussel Pleinlaan 2 - 1050 Brussel Prof. J. Van Loey	Passive Solar Energy

Names and Location of Labs	Area(s) of Research
* Unité d'Architecture Université Catholique de Louvain Place du Levant 1 1348 LOUVAIN-LA-NEUVE A. Deherde	Passive Solar Energy

DENMARK

Names and Location of Labs	Area(s) of Research
* Thermal Insulation Laboratory, Technical University of Denmark Building 118, DK-2800 Lyngby Prof. Vagn Korsgaard	Active & Passive Solar Heating Components and Systems Seasonal Storage Systems
* Physics Laboratory III Building 309 C Technical University of Denmark DK-2800 Lyngby Prof. Niels I. Meyer	Photovoltaic Cells
* Technological Institute, Department of Energy Technology Gregersensvej, P. O. Box 141 DK-2630 Tåstrup Jan Sachse, Head of Department	Testing of Solar Equipment
* Meteorological Institute Lyngbyvej 100 DK-2100 Copenhagen Ø, Denmark Kund Frydendahl, Head of Section	Solar Radiation

GREECE

Names and Location of Labs	Area(s) of Research
* GAEC/NRC Demokritos, Aghia Paraskevi Attiki, GR 153, Greece Dr. A. Spyridonos and P. Andronikos	Heat Pipe, Cooling with Thermo- compression, Test Facility

Names and Location of Labs	Area(s) of Research
* University of Patras, Physics Dept., School of Mechanical Engineering Prof. R. Rigopoulos & Prof. Lefas	Solar Collectors, Cooling Systems
* Technical University of Athens Chemical Engineering Dept. Athens GR 10677 Prof. N. Koumoutsos & Prof. G. Saravakos	Solar Water and Air Collectors Conservation of Energy
* Dimocrition University of Thrace, School of Electrical Engineering, Xanthi GR 67100 Prof. G. Vachtsevanos	Solar Collectors, Test Facility
* Aristotelion Univ. of Thessaloniki, School of Architecture, School of Mechanical Engineering Thessaloniki GR 54 Prof. M. Papadopoulos & Prof. G. Sotiropoulos	Passive Systems, Modelling and Simulation
* University of Ioannina Ioannina G1246 F. Triantis	Interseasonal Storage in the Ground

JAPAN

Names and Location of Labs	Area(s) of Research
* Solar Research Laboratory, Government Industrial Research Institute, Nagoya 1 Hirate-cho, Kita-ku, Nagoya 462 Dr. T. Noguchi	Testing Procedure on Solar Collectors, Collector Materials Research, Heat Storage Techniques, Desiccant System Studies, Photochemical Heat Storage, Solar Pond Study, DHW, SHC, Standardization
* Solar Energy Laboratory, Electrotechnical Laboratory 1-1-4 Umezono, Sakura-mura, Niihari-gun, Ibaragi 305 Dr. T. Tani	Solar Thermal and Electric Power Generation System Study, Solar Collectors, Thermal Energy Storage

NETHERLANDS

Names and Location of Labs	Area(s) of Research
* TPD-TNO Stieltjesweg 1 2600 AD Delft	Collector testing, Storage systems
* Technische Hogeschool Eindhoven Den Dosch 2, 5612 AZ Eindhoven	Collector development, Storage systems
* Technische Hogeschool Delft Lorentzweg 1, 2528 CJ Delft	Spectral selective layers, Systems
* Rijks Universiteit Groningen Nijenborg 18 9747 AG Groningen	Idem
* Netherlands Energy Research Foundation ECN Westerduinweg 3, 1755 ZG Petten	System studies, Swimming pools

NORWAY

Names and Location of Labs	Area(s) of Research
* SINTEF (The Foundation of Scientific and Industrial Research at the Norwegian Institute of Technology) N-7034 Trondheim-NTH	DHW, Active and passive heating systems, Chemical Heat Storage
* Institute of Energy Technology P. O. Box 40, N-2007 Kjeller	DHW, Active Solar Heating
* University of Oslo Institute of Physics	DHW, Active Solar Heating

Names and Location of Labs	Area(s) of Research
* University of Oslo Institute of Chemistry	Latent Heat Storage
* Institute of Architecture St. Olavsgate, N-Oslo 1	Active and Passive

SWEDEN

Names and Location of Labs	Area(s) of Research
* Studsvik Energiteknik AB S-611 82 Nyköping	Collectors, Active systems and seasonal storage
* Swedish Board of Metrology, Borås	Collector, Testing, Durability
* Swedish State Power Board, Älvkarleby	Collectors, Testing, Long time performance
* Sydkraft	Collectors, Systems with heat pumps
* Royal Institute of Technology, Dept. of Building Installations	Collectors, Active systems
* Lund Institute of Technology	Passive systems
* Chalmers University, Dept. of Building Service	Monitoring and evaluation of systems, System studies

UNITED STATES

Names and Locations of Labs	Area(s) of Research
* Lawrence Berkey Laboratory Berkeley, California 94720	Active solar cooling (M. Wahlig) Non-residential passive system (R. Kammerud) Passive heat transfer (R. Kammerud) Passive load control R&D (R. Kammerud) Daylighting (R. Kammerud)
* Argonne National Laboratory Argonne, Illinois 60439	CPC collectors (W.Schertz) Thermal Storage (A. Michaels)
* Brookhaven National Laboratory Upton, New York 11973	Thin film collectors (W. Wilhelm)
* Los Alamos National Laboratory Los Alamos, New Mexico 87545	Passive Residential H&C (R. Jones)
* Solar Energy Research Institute Golden, Colorado 80401	Passive system T&E (L. Flowers) Active & passive materials (G. Gross) Desiccant cooling (F. Kreith) Active system effectiveness (J. Thornton) Active systems analysis (L. Flowers) Passive simulation code valid. (R. Judkoff)
* National Bureau of Standards Washington, D.C. 20234	Test Procedures (B. Dikkers) Passive exper. systems res. (B. Dikkers)

8. GOVERNMENT INCENTIVES

In this section, a brief description is given of government incentive measures in the participating countries, including tax credits, low interest loans, etc. Through the discussions at the Task II Experts Meetings and the "Workshop on National Solar Heating and Cooling Programmes," it was confirmed by the Participants that one of the most importnat factors in promoting and accelerating the growth of solar energy industry and solar sales is the establishment of goverment incentives in the participating countries. The statements by the Participants are as follows:

AUSTRIA

If their application meets specific energy policy requirements, solar and heat pump systems qualify for tax advantages as energy saving investments.

Even under the meteorological conditions of Austria, appropriately designed solar and heat pump systems can reduce the demand for conventional energy (e.g. oil, gas, coal, electricity). This has been demonstrated by examination of selected plants and by the experience gained since 1974 with solar and heat pump systems operated within the framework of the "Austrian Measuring Network for the Practical Use of Solar Energy".

Tax credits

Special measures for the promotion of solar and heat pump technologies concern tax reduction for owners of solar and heat pump systems (for private and commercial utilization)

BELGIUM

For demonstration projects on energy conservation including solar heating and cooling, up to 50% of the total cost of the project (limited number).

For development of new products in the field of energy conservation including solar heating and cooling, the government can support up to 100% of the total cost.

Tax credits

None

Loans (low interest or guarantees)

Industries, developing a prototype can request a loan without interest for part of the total project cost.

DENMARK

For all installations of renewable energy there is given subsidy to the owner. The subsidy is 30% at the moment. For projects with an attractive economy of energy (often large collective plants) there is a possibility of extra subsidies up to 35% of the rest, i.e. 54.5% of the total.

GREECE

Tax credits

Tax credits 30,000 DRCH (300 US$) deductable from the taxable income.

Loans (low interest or Guarantees)

70% of the value of solar heating system (including installation expenses) payable in three years (6 months installment) with interest rate 17%.

Other

For commercial systems there are grants up to 30% of the value of system including installation. The loan in this case is up to 40%.

JAPAN

Low interest bank loans and tax reduction on installations of solar heating, cooling and DHW systems (reduction of initial cost of solar systems).

Subsidies to the solar heating, cooling and DHW systems installed in local government buildings such as schools, hospitals, office buildings etc. (50%).

To establish testing and evaluation procedures as well as standards on solar systems and components, including on reliability and durability.

To promote demonstration of solar systems for governmental buildings.

Tax credits

Special amortization of solar systems for commercial buildings (30%).

Tax reduction on property tax (25%) for three years.

Tax reduction of investiment (7%).

Loans

Low interest bank loans on solar systems

for residential buildings: 5.5% interest 5 years pay back

for commercial buildings: 6.5% interest 10 years pay back

NORWAY

Government fundings for R&D projects applied both to residential and commercial systems.

Fundings for prototype buildings/systems/components.

SWEDEN

A target-orientated solar energy program, known as the Solar 85 program, was established at the end of the 1970s, with the main purposes of establishing

a sound fact and information basis on which an energy policy decision concerning the introduction of solar heating could be taken in the middle of the 1980s, and also of making a real contribution towards meeting energy demands through utilisation of solar energy amounting to 1 - 3 TWh/year by 1990. Most of this program is administered by the Council.

The main points of the Solar 85 program are as follows:

A considerable increase in research, development and trials building work:

Establishment of competence and resources for improving our knowledge of solar conditions in various parts of the country:

The use of solar heating in public buildings as an instrument for the introduction of solar heating technology to the market:

Progressively increasing resources for solar heating technology in national and local government training, advisory and information work in the energy sector:

Establishment of competence and resources for technical testing of solar heating components and systems:

Modification of building standards and grant and loan rules to encourage the spread of solar heating methods, and

Local authority planning with the object of facilitating the introduction of solar heating in the built environment.

THE UNITED STATES

Active Solar Incentives

Federal incentives are primarily in the form of tax credits for residential homeowners and business firms who install solar and renewable energy systems on their property. Many states provide tax credits and/or forego collection of sales tax and property tax.

Passive Solar Incentives

Primary federal government incentive for new passive commercial buildings is the shortened, 15-year depreciation period available under the Economic Recovery Act of 1981 (ERTA) (P.L. 97-34).

Tax credits

Residential Tax Credit -- 40% of cost of active solar system up to a maximum credit of $4,000.

Business Investment Tax Credit -- 15% of cost of renewable energy equipment.

ERTA provides for the following tax credits for rehabilitating buildings (commercial retrofit applications): (1) 15% for nonresidential buildings at least 30 years old; (2) 20% for nonresidential buildings at least 40 years old; and (3) 25% for certified historic structures.

Loans (low interest or guarantees)

Conservation and Solar Energy Bank will provide an interest subsidy to borrowers.

Appendix 1 Reporting Format of Subtask B

IEA Task II Subtask B

SURVEY AND REVIEW OF NATIONAL SOLAR HEATING & COOLING R&D PLANS

COUNTRY: _____

1. National Solar Goals

a. Projected Solar Contribution to National Energy Demand

	% of National Energy Demand	Contribution to Total National Energy Demand (In mill. Kl oil eq.)	Year
All Renewable Energy Technologies*			
Solar Heating & Cooling			

b. Projected Number of Solar Heating & Cooling Installations

Type	Number of Installations through 1981	Projected (Give Year)
Solar DHW		
Solar Heating and DHW (Active)		
Solar Cooling		
Passive Heating		
Industrial Process Heat		

2. Summary of Solar Heating and Cooling RD&D Programmes

(Brief statement of R&D goals, area of emphasis and main features of overall programme)

* Non-nuclear and non-fossil energies

3. Organizational Structure of National Solar Programme

a. List government agencies and divisions involved in solar energy technologies and areas of responsibility of each:

b. Provide an organization chart showing offices responsible for solar heating and cooling, and their position in overall renewable energy programme.

4. Government Funding Level (in National Currency)

	1975	1980	1982
a. All renewable energy technologies			
b. Solar Heating & Cooling RD&D			
DHW			
Heating			
Active			
Passive			
Cooling			
Active			
Passive			
IPH			
Other_____			
Non R&D			
(Marketing, Info. etc.)			

5. Major Research Laboratories/Institutions involved in Solar Heating and Cooling

Names and Locations of Labs	Area(s) of Research

6. Government Incentives

(Give brief description of incentive measures: whether they apply to residential or commercial systems; whether they apply to owners or builders, manufactures etc.)

Tax credits

Loans (low interest or guarantees)

Other

Appendix 2. LIST OF PARTICIPANTS - TASK II

"COORDINATION OF RESEARCH AND DEVELOPMENT ON SOLAR HEATING AND COOLING"

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