IEA

SOLAR R&D

INTERNATIONAL ENERGY AGENCY

programme
to develop and test
solar heating
and cooling systems

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

survey and review of national R&D plans

october 1981

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

H. Hayashi and R. Namikawa

Sunshine Project Promotion Headquarters
Agency of Industrial Science and Technology, MITI, Japan

and

T. Noguchi

Solar Research Laboratory, GIRI Nagoya
Japan

October 1981

This report is part of the work of the

IEA Solar Heating and Cooling Programme
Task II: Coordination of R & D on Solar Heating and Cooling Components
Subtask C: Survey and Review of National R & D Plans

Document #_____ Distribution: Unrestricted

Additional copies can be ordered from:

Sunshine Project Promotion Headquarters
AIST, MITI
1-3-1 Kasumigaseki, Chiyoda-ku
101 Tokyo Japan

Price: yen

ABSTRACT

This document provides an overview of national research and development (R&D) plans for solar heating, cooling and hot water supply systems. This document is based on information submitted during 1980 by representatives of countries participating in Task II of the International Energy Agency (IEA) Solar Heating and Cooling Programme. The countries which contributed data are Austria, Belgium, Denmark, Federal Republic of Germany, Greece, Italy, Japan, Netherlands, Spain, Sweden, Switzerland and the United States. Data on the following subjects are included in this report:

- National solar heating and cooling goals and projections
- Government incentive measures
- Research organizations
- Statistics on production of solar components and buildings
- Major manufacturers
- Status of solar standards
- Barriers to application

The contact persons for each country participation in Task II are listed in Appendix 2.

Table of Contents

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 on Energy Research and Development (CRD), assisted by a small Secretariat, coordinates the energy research, development, and demonstration programme.

SOLAR HEATING AND COOLING PROGRAMME

Solar Heating and Cooling was one of the technologies selected by the IEA for a collaborative effort. 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 for this Programme, covering the contributions, obligations and rights of the Participants, as well as the scope of each task, was prepared and signed by 15 countries and the Commission of the European Communities. The overall programme is managed by an Executive Committee, while the management of the tasks is the responsibility of Operating Agents who act on behalf of the other Participants.

The tasks of the IEA Solar Heating and Cooling Programme and their respective Operating Agents are:

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

II. Coordination of R & D on Solar Heating and Cooling Components - Agency of Industrial Science and Technology, Japan

III. Performance Testing of Solar Collectors - Kernforschungsanlage Julich, 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 Application - 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 Heat Storage - Swedish Council for Building Research

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

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

The development of effective components is crucial to the successful performance of solar sysrems. The objective of Task II is to coordinate the Participants' component R & D programmes by exchanging information on activities involving major system components (e.g., collectors, heat storage units, air conditioning units, controls). The exchange of researchers between Participating Countries was to be another aspect of this task, but has not been feasible. By the sharing of information and expertise it is hoped that duplication of effort can be avoided and component development accelerated.

The subtasks included in this project are:

A. Survey of Component R&D Projects

B. Exchange of Solar Energy Research Personnel, especially in the area of component R & D

C. Survey and Review of National R&D Plans for Solar Heating and Cooling components.

Subtask B has been deleted at the Task II Expert Meeting in 1981.

The Participants in this Task are Austria, Belgium, Denmark, Germany, Greece, Italy, Japan, the Netherlands, Spain, Sweden, Switzerland and the USA.

2. Introduction

The objective of Task II of the IEA Solar Heating and Cooling Programme is to increase the effectiveness of national R & D programmes related to the development of components for solar heating, cooling and hot water supply systems.

Under Subtask C, Task II Participants have exchanged information on their national R & D plans for solar heating and cooling components. The Task II experts meetings have been the only forum within the IEA Solar Programme for discussion of national programme plans, policy, and related topics. This report gives an overview for the interested reader on national programmes and policies in the member countries. For preparation of this report, the Operating Agent distributed a format (see Appendix I) which was completed and returned by the Participants. The Operating Agent then summarized and compiled the information for publication. This document reflects the status in member countries as of the end of 1980.

The report contains eight chapters on national R & D plans: (A) national solar goals and projections, (B) government incentive measures, (C) structure and organization of national R, D&D programmes, (D) solar component production/sales, (E) solar installations, (F) major solar heating and cooling component manufacturers, (G) status of national component standardization efforts, and (H) problems in application.

3. NATIONAL SOLAR ENERGY GOALS AND PROJECTIONS

In this survey, the national goal for energy supply from solar heating and cooling technology within the Task II Participating countries is examined. The compiled data are presented in Table 1. Figures in parentheses give the year the goal is expected to be achieved. Blanks indicate that either no figures were reported by the Participants, figures were not available, or data was still under investigation.

Table 1. National Goals for Solar Contribution to Energy Supply

	Energy supply by solar energy (million *kl* oil equivalent)		Percent to national total energy demand (%)	
AUSTRIA			3	(2000)
BELGIUM			1	(2000)
DENMARK	0.5	(1995)		
FRG	1.5	(2000)	0.7	(2000)
GREECE	0.5	(1980 - 1985)	2	(1980 - 1985)
ITALY	0.5	(1985)	0.28	(1985)
JAPAN	2.1	(1985)	0.34	(1985)
	5.2	(1990)	0.94	(1990)
	6.7	(1995)	1.27	(1995)
NETHERLANDS			1 - 2	(2000)
SPAIN				
SWEDEN				
SWITZERLAND			3	(2000)
USA	0.31	(1981)*		
	7.15	(1985)*		
	72.31	(1990)*		

* USA figures listed represent passive & active contributions only.

As evidenced by Table 1, the target goals by the Participating countries vary widely from 0.1 to 72.3 million *kl* of oil equivalent. The target goal years shown in the Table differ

respectively also. However, it might be concluded that the importance of solar energy R, D and D has been well recognized by the Participating countries in their respective policies. In addition to the figures in Table 1, comments which were supplied by the Participants are presented below:

AUSTRIA

Austria's energy supply depends largely on foreign sources. At present about 65 % of the total energy required is imported and the expected "dependence factor" for 1985 amounts to 80 %. The energy sources are distributed as follows: 50 % oil, 20 % gas, 17 % coal, 12 % electricity. Of Austria's total energy consumption, 40 % is used for residences and public services, 35 % for industry, and 25 % for transport.

Low temperature heat accounts for about 45 % of the total energy requirement. Thus Austria is very interested in energy technology which would reduce demand for fossile fuels and electricity for the production of low temperature heat by using forms of energy which need not be imported. Solar Energy, for example, used in direct and indirect ways, with active or passive systems, and also the utilization of biomass are both attracting much attention.

Because the energy situation in Austria demands a concentration of efforts on research, development, demonstration of technologies which use renewable energy sources, most R&D activities in the field of energy concern these topics. The principles and aims for energy R&D and D activities are set forth in the "AUSTRIAN PROGRAMME FOR ENERGY RESEARCH". Major tasks of this programme are activities in the fields of development and testing of solar heating systems.

For the year 2000 the contribution of solar energy is expected in the range of about 3 % of the total energy supply. That should be reached by active and passive solar technologies used in direct and indirect ways - with the help of heat pumps - for the production of low temperature heat.

BELGIUM

The 1979 government "R-D" budget was roughly 2.865 billions Belgian francs (BF), = 90.10^6 US $, of which 186 million BF (6.5 %) were devoted to the "National Energy R-D Programme" (non-nuclear).

The main goal is to lower oil import to less than 50 % of primary energy in 1985. At that time, nuclear energy should give 50 % of the electricity supply.

The target by solar energy supply in Belgium, described in the Table, is based on the above stated national energy supply programme.

DENMARK

In the energy political statement from the Ministry of Trade and Industry "Dansk Energipolitik 1976" (Danish Energy Policy 1976),

300,000 solar systems are expected to be built before 1995. One-third of these systems will be combined solar and heat pump systems and the others as ordinary solar heating systems.

FEDERAL REPUBLIC OF GERMANY

In the German government energy programme, the projected figures on solar systems for the year 2000 total about 3.4 million systems and details are shown in the next table.

	Solar Systems (Thousands)	Collector Area (Mio m^2)	Saved Primary Energy (Mio tce/yr)
Private Pools	269	2,69	0,11
Public and Commercial Pools	2,8	2,80	0,20
1+2 Family Houses, Hot Water Supply	2464	19,71	1,03
1+2 Family Houses, Heating and Hot Water Supply	440	26,40	1,37
Multi-Storey Buildings, Hot Water Supply	215	10,75	0,56
Commercial Buildings, Heating and Hot Water Supply	9,9	1,18	0,05
Agricultural Application and LT-Process Heat	5,4	0,81	0,04
TOTAL	3406,1	64,34	3,35

KFA — POSSIBLE SITUATION OF LT-SOLAR COLLECTOR APPLICATION IN THE FRG IN THE YEAR 2000 — STE

GREECE

In the Greek national plan, solar energy will cover 2 % of the energy need or 450 x 10^3 equivalent ton of oil from 1980 to 1985. Scientific Research and Technology Agency decided to accelerate the policy. The energy part of the programme will be $ 24 million for the five year period for 1979. In the initial year of the programme, the total funds of R & D and D will be $ 4.1 million.

ITALY

The Italian government has proposed that ENEL will install 100,000 solar heaters in the south of Italy (100,000 m^3 of oil/year saved).

JAPAN

According to the Japanese plan to supply 5.2 million Kl oil eq. energy

in 1990, it is estimated that solar heating and cooling systems will be constructed as follows:

(a) 7.8 million residential houses (30% of 1980 - 1990 newly-built residential ho'ses and 15% of retrofit systems in 1979)

(b) 6,500 commercial buildings (15% of 1980 - 1990 newly-built buildings)

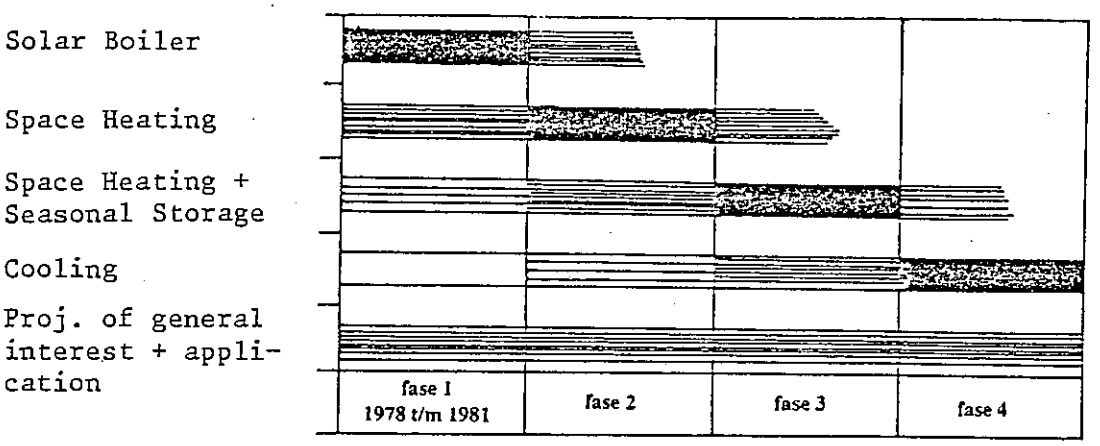
(c) 19,000 factory buildings (30% of factories with more than 30 employees in 1979)

To supply 6.7 million *kl* oil eq. energy in 1995, about 10 million residential solar houses and others are expected.

NETHERLANDS

The goal of the first phase of the National R, D and D programme on solar energy is:

- the development and introduction of solar hot water systems;
- the development of space heating;
- the development of seasonal thermal storage systems.



——— = large scale
——— techn. demonstr.

in 2000 1-2% of total energy comsumption should be covered by solar.

SPAIN

During the years 1970 through 1980, Spain developed a national demonstration programme in which 6,000 m^2 of flat plate solar collectors were installed in public buildings and some businesses. During 1981 the number of the solar installations will be increased. The programme on R&D for 1981 will principally concern development of standards for durability and reliability of solar collectors and the improvement of components and installations.

SWEDEN

The short time goal is to make an evaluation of solar potential in Sweden before 1985. At that time the future development of solar energy will be decided by the Swedish Parliament. 3 TWh of solar energy by 1990 has been suggested, but this is not yet an official goal.

SWITZERLAND

There is presently no national programme for R & D of solar energy in Switzerland. However, the government tries to encourage R & D and introduction of solar energy projects. Plans are underway and are being examined at the governmental level.

USA

The US goal for energy supply by solar heating and cooling systems shown in Table 1 is broken down by active and passive as follows:

Litres of Oil Savings

Technology	1981	1985	1990
Active	1.97×10^8	55.3×10^8	548.94×10^8
Passive	1.16×10^8	16.25×10^8	174.08×10^8
Totals	3.13×10^8	71.55×10^8	723.02×10^8

4. GOVERNMENT INCENTIVE MEASURES

Since the development of solar energy as an energy resource it still in an early stage and the solar energy industry is fairly young throughout the world, it is quite indispensable for the governments of the participating countries to stimulate the R & D efforts, disseminate the relevant information, and establish legislation to promote the commercialization of solar heating and cooling systems. The information reported on government incentives has been summarized by the Operating Agent into four categories - R, D & D, Tax, Loans and Legislation.

4.1 Research, Development and Demonstration (R, D & D)

AUSTRIA

Within the Federal Ministries the energy RD & D budget has been increased substantially during the last year, from 15.5 mio S in the year 1977 to 74.4 mio S in 1980. The total budget for Austrian energy research & development projects (Federal Ministries, universities, research centers and research funds) amounted to 374.5 mio S in 1980.

In the industrial field also the energy RD & D activities were increased by special government research funds from 38.35 mio S in 1977 to 114.10 mio S in 1980. The additional budget from the industry for energy RD & D-activities amounted to 222.17 in 1980.

A high percentage of this budget has been applied for projects in the field of new and renewable energy sources.

BELGIUM

R & D	"National R-D program" + other governmental funds + contributions to IEA & European Commission	28.4 M (BF) 0.95 M (US $)
DEMONSTRATION	"National R-D program"	3.2 M (BF) 0.1 M (US $)
COMMERCIALI-ZATION	Several public buildings under construction (Department of Public Works and Economic Affairs, ...)	unspecified

DENMARK

R & D and D	1980 - 82: The national solar energy research program is an integrated program of R & D and D	10 M (Dcrs) 2 M (US $)
COMMERCIALI-ZATION	1979 - 1980: 30 % subsidy for private investments in renewable energy sources	70 M (Dcrs) 14 M (US $)

FEDERAL REPUBLIC OF GERMANY

	1974	1975	1976	1977	1978	1979	1980	Total
Mil DM	0.7	10.1	21.0	24	29	31	35	150.8
Mil US $	0.35	5.05	10.5	12	14.5	15.5	17.5	75.4

From: Solar Energy Technologies Program, 1977 - 1980

A decision on the continuation of the programme has not yet been made.

GREECE

R & D	National R & D on material, systems and industrial solar systems (1980)	4.5 M (Dr) 100th (US $)
DEMONSTRATION	Subsidy for solar system R.D in private company (1980)	9.3 M (Dr) 211th (US $)

ITALY

R & D	CNR-PFE-SPES materials, components conversion systems (prototype) heating cooling, electricity production, desalination, weather.	1977 - 1980 13 M (US $)

JAPAN

R & D and D	National R & D and D projects on materials, systems and industrial process heat system	510 M (yen) 2.0 M (US $)
COMMERCIALI-ZATION	Subsidy for public buildings with solar systems (subsidy ratio is 50% of solar systems cost ....from 1980)	3 B (yen) 12 M (US $)

NETHERLANDS

R & D	during, and as part of, the first phase of the National Program	7.5 M (US $)
DEMONSTRATION AND COMMERCIALI-ZATION	see above + incidental subsidies	2.5 M (US $)

SPAIN

R & D		until 1980 1.3 1981 1.2 Pta
DEMONSTRATION		until 1980 1.1 1981 0.4 Pta
COMMERCIALI-ZATION		until 1980 0.2 1981 0.8 Pta

SWEDEN

R & D and demonstration funded by the Swedish Council for Building Research:

	1978 - 81		1981 - 84	
	SWK(M)	$(M)	SWK(M)	$(M)
Energy Systems and Implementation	-	-	15	3.5
Solar Energy Technology	86	20	42	9.5
Heat Pumps	-	-	89	20.5
Water Heat Storage	35	8	84	19.5
Ground Heat Storage	45	10	63	14.5
Thermochemical Energy Storage	10	2	38	8.5
Heat Distribution	-	-	48	11
Total	176	40	379	87

SWITZERLAND

R & D budget in Switzerland is 13 Mil Sfr, equal to 7.6 Mil US $.

USA

R & D	Active system development (FY 81)	18.5 M(US $)
	Passive system development (FY 81)	13.5 M(US $)
DEMONSTRATION	Market test and Applications (FY 81) Active Buildings	11.8 M(US $)
	Market test and Applications (FY 81) Passive Buildings	6.2 M(US $)
	Federal buildings solar (FY 81) Applications	2.0 M(US $)
COMMERCIALI-ZATION	Solar information (FY81)	1.4 M(US $)
	Market development and Training (FY 81) Active	13.4 M(US $)
	Market development and Training (FY 81) Passive	13.7 M(US $)
	Market analysis (FY 81)	4.9 M(US $)

4.2 Tax Credits

AUSTRIA

Tax reductions and special promotion measures are granted for energy saving investments in industry as well as in buildings. For all cases the energy saving effects have to be proved.

The utilization of solar systems and heat pumps for low temperature heat production is specially encouraged by tax reductions and favourable credits.

FEDERAL REPUBLIC OF GERMANY

10 % income tax reduction for ten years for an unlimited amount of investment costs is granted.

GREECE

Tax allowance for the amount paid for the purchase/installation of solar water heaters up to 681 $ per case or of 10 % taxable income is granted.

JAPAN

Low tax rate for solar systems for commercial buildings is granted.

ITALY

Tax reduction and special promotion are being examined by the government.

NETHERLANDS

For commercial applications tax deductions or investment subsidies are granted.

SWEDEN

The interest rate on loans for solar installations is tax deductible as on all other loans for demonstaration systems.

USA

Federal Solar Tax Credit

Residential - 40% of the first 10,000 Jan 81 thru Dec 85
Commercial - 15% of the expenditures Jan 81 thru Dec 85
Industrial - 15% of the expenditures Jan 81 thru Dec 85

State Solar Tax Credit
Reference SERI-/SP-434-470 Document
Most states have tax credits ranging from 15 to 55%;
enacted for 5 - 10 years.

4.3 Loans

DENMARK

Solar energy systems on new houses can be financed on the same long term basis (20 years) as the house itself.

FEDERAL REPUBLIC OF GERMANY

Grants to amout to 25% of the investment costs which may be in the range of 4,000 DM (2,000 US $) to 12,000 DM (6,000 US $) per dwelling. Total: 4.35 Mrd DM (2.18 billion US $) under a five year programme.

GREECE

Loans free of interest of up to 35% of total cost, in commercial use, repayable in 10 yearly installments, the first starting two years after installation.

ITALY

Laws concerning promotion of development and introduction of alternative energy are being examined by the government.

JAPAN

Low interest bank loan for commercialization (from 1980)

	Total budget
5.5% for residential houses	2.2 B (yen)
6.5% for commercial buildings	8.8 M (US $)

NETHERLANDS

For investments in the private sphere subsidies and guaranteed loans are available for first of a kind demonstration projects.

SWEDEN

For solar heated domestic hot water supply systems (8 m^2), bank loans are granted. The loans limit is 700 $ for 2,000 $ system cost.

USA

State Loan Programme Reference SERI-/SP-434-470 Document

4.4 LEGISLATION

AUSTRIA

In order to ensure the energy supply the Austrian government took intensive measures in July 1979 which are accomplished by an operation agenda. The measures for energy policy and energy researcn are controlled permanently by the government. At present many promotion measures for energy saving are in force.

BELGIUM

Laws on energy conservation (building insulation, working condition, etc) No laws on solar energy use.

FEDERAL REPUBLIC OF GERMANY

Modernisation and Energy Conservation Act gives details regarding tax reduction and loans.

JAPAN

Laws concerning promotion of development and introduction of alternative energy are being examined by the government.

SPAIN

Energy conservation law (published during 1981)

SWITZERLAND

A proposal for a constitutional amendment to implement a comprehensive energy policy is in preparation.

USA

1. The Solar Heating and Cooling Demonstration Act of 1974 (P.L. 93-409) established the National Solar Heating Demonstration Program which was carried out by the National Aeronautics and Space Administration (NASA), The Department of Housing and Urban Development (HUD) and the National Science Foundation (NSF). The program was designed to demonstrate the use of solar heating and solar heating and cooling technologies for both residential and commercial applications. Activities included monitoring performance of installations, collecting and evaluating performance data, and publishing information regarding the systems.

2. The Energy Reorganization Act of 1974 (P.L. 93-438) reorganized and consolidated solar research related functions into the Energy Research and Development Administration (ERDA). Activities included policy planning, coordination, support and management of energy R & D programs, research, information development and dissemination, and participation in international energy research.

3. The Solar Energy Research, Development and Demonstration Act of 1974 (P.L. 93-474) established a solar energy coordination and management project within ERDA to coordinate the research, development and demonstration activities of several Federal agencies including NASA, HUD, NSF, Atomic Energy Commission (AEC) and the Federal Power Commission (FPC).

4. The Federal Non-Nuclear Energy Research and Development Act of 1974 (P.L. (93- 577) established a comprehensive national program of basic and applied research and development for potential energy sources, including solar, within ERDA. The Administration was directed to incorporate existing programs established by P.L. 93-409 and P.L. 93-473 as well as initiate new activities. In addition, ERDA was directed to undertake demonstration projects of key technologies.

5. The Energy Conservation and Production Act of 1976 (P.L. 94-385) created electric utility rate design initiatives, including those favorable to solar energy; authorized the Federal Energy Administration (FEA) to promulgate energy conservation performance standards for new buildings; and prescribed state conservation planning guidelines.

6. The Department of Energy Reorganization Act of 1977 (P.L. -91) established the Department of Energy and transferred to DOE most solar energy related activities from FEA, ERDA and other agencies and departments.

7. The Solar Photovoltaics Energy Research Development and Demonstration Act of 1978 (P.L. 95-590) prescribed specific goals for the application of photovoltaics, delineated the duties of the Department and authorized the expenditure of funds over a ten year period.

8. The Energy Tax Act of 1978 (P.L. 95-618) established special residential tax credits for qualified conservation and renewable resource expenditures, and established special business tax credits for energy property and equipment. Residential owners received a credit of 30 percent of the first $ 2,200 expended for solar energy equipment.

9. The National Energy Conservation Act of 1978 (P.L. 95-619) established secondary financing and loan insurance mechanisms for conservation improvements and solar systems, established new Federal conservation and solar programs for schools, hospitals and public buildings, authorized DOE to demonstrate solar energy heating and cooling systems in Federal buildings and established a photovoltaic energy commercialization program for procuring and installing these systems on Federal buildings.

10. The Crude Oil Windfall Profit Tax Act of 1980 (P.L. 96-223) amended P.L. 95-618 to increase tax credits to 40 percent of the first $10,000 for conservation and solar systems, and modified the definition of solar energy systems. It also modified some portions of the business investment tax sections relating to solar energy, and increased the credit to 15% of expenditures.

11. The Energy Security Act of 1980 (P.L. 96-294) established the Solar Energy and Energy Conservation Bank within HUD with the same corporate powers as the Governmental National Mortgage Association (GNMA). The bank was authorized to make payments to financial institutions to provide assistance to owners of existing buildings to install solar energy or to provide assistance to builders of new or renovated buildings containing solar energy systems. Funds for the bank have not been appropriated.

5. STRUCTURE AND ORGANIZATION OF NATIONAL R, D AND D PROGRAMMES

The purpose of this chapter is to clarify the structure and organization of national R, D and D programmes for solar heating and cooling systems in the Participating Countries. The numbers of laboratories and researchers are listed in the Table 2.

Table 2. Research Laboratories and Researchers in Solar R, D & D

	Number of laboratories	Number of researchers
AUSTRIA	22	60
BELGIUM	6	70
DENMARK	2	20
FRG	30	250
GREECE	3	9
ITALY	10	50
JAPAN	2	-
NETHERLANDS	15	50
SPAIN	-	-
SWEDEN	6	-
SWITZERLAND	-	-
USA	40	220

Note: Mark - means unknown or under investigation.

The respective national structure to promote R, D & D and the names of research organizations involved are provided below:

AUSTRIA

1. The institutional system in Austria

   Austria is a federal state. Under the Austrian federal constitution, science, research and technology do not fall within the exclusive responsibility of any single body. To the extent that research and development are related to matters within the sphere of competence of the Federation (Bund), they are a federal responsibility; otherwise they are responsibility of the Federal Provinces (Länder).

All ministries are responsible for research and development in their respective fields of competence. The responsibility for the co-ordination of science and research at the federal level rests with the Federal Ministry for Science and Research. The Ministry is directly responsible for science in general, for the universities, federal museums, scientific documentation and information and for science education, etc.
All universities are financed by the government and fall under the responsibility of the Federation. The Federal Provinces Governments and municipalities are responsible for R & D policy falling within their respective spheres of competence. For that purpose they run inter alia, special institutes, participate in research institutions or award research contracts.
Apart from the university budget, the most important instruments of research promotion by the Government are the Science Research Promotion Fund, the Industrial Research Promotion Fund and special funds for research activities in housing, road construction, energy etc.

2. Main Research Institutes

2.1 CO-ORDINATION AND INFORMATION

Austrian Solar and Space Agency, ASSA
Garnisongasse 7, A-1090 Wien

2.2 NAMES OF MAIN LABORATORIES

Research Center Seibersdorf
2345 Seibersdorf

Research Center Graz
Elisabethstraße, 8020 Graz

2.3 RESEARCH INSTITUTES

Zentralanstalt für Meteorologie und Geodynamik
Hohe Warte 38, A-1190, Wien

Bundesversuchs-und Forschungsanstalt Arsenal
Lilienthalgasse 11, A-1030 Wien

Österreichisches Institut für Bauforschung
An der langen Lüssen 1, A-1190 Wien

Universität Wien:

Institut für Theoretische Chemie und Strahlenchemie
Währingerstraße 17, 1090 Wien

Institut für Festkörperphysik
Kopernikusgasse 15, 1060 Wien

Technische Universität Wien

Institut für Allgemeine Physik
Karlsplatz 13, 1040 Wien

Institut für Verfahrenstechnik und Technologie der Brennstoffe
Getreidemarkt 9, 1060 Wien

Institut für Energiewirtschaft
Karlsplatz 13, 1040 Wien

Institut für Technische Wärmelehre
Getreidemarkt 9, 1060 Wien

Institut für Elektrische Maschinen
Gußhausstraße 25, 1040 Wien

Institut für Hochbau, für Architektur und Entwerfen I
Karlsplatz 13, 1040 Wien

Technische Universität Graz

Institut für Wärmetechnik
Kopernikusgasse 24, 8010 Graz

Universität Innsbruck

Institut für Physik für Bauingenieurwesen
Technikerstraße 13, 6020 Innsbruck

Institut für Experimentalphysik
Schöpfstraße 41, 6020 Innsbruck

Universität Linz

Institut für Physik
Auhof, 4045 Linz

2.4 Industry

Vereinigte Metallwerke Ranshofen/Berndorf
Postfach 35, 2560 Berndorf

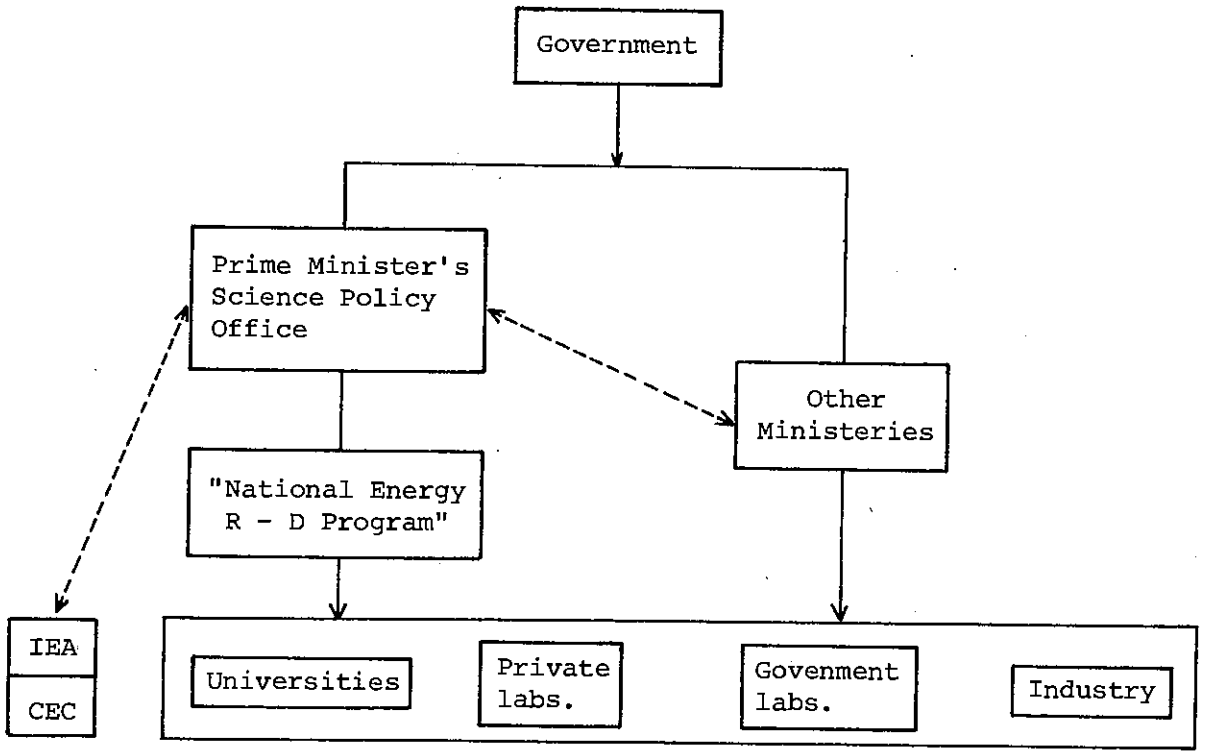
VOEST Alpine Montan AG
4020 Linz

ÖMV - AG
Otto-Wagner-Platz 5, 1090 Wien

Vogel & Noot AG
8661 Wartberg

BELGIUM

1. Organization chart of National R & D/D



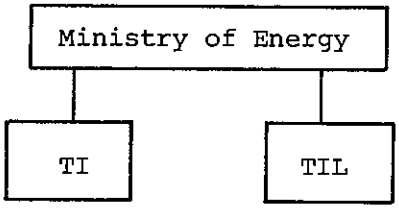
IEA : International Energy Agency
CEC : Commission of the European Communities

2. Names of main laboratories

Faculté Polytechnique de Mons
Katholieke Universiteit Leuven
Université de liége
Fondation Universitaire Luxembourgeois
Inst. Recherche Météorologique
Centre Energie Nucléaire

DENMARK

1. Organization chart of National R, D & D



TIL : Thermal Insulation Laboratory at the Technical University of Denmark

TI : Technological Institute Department for Heating and Ventilation

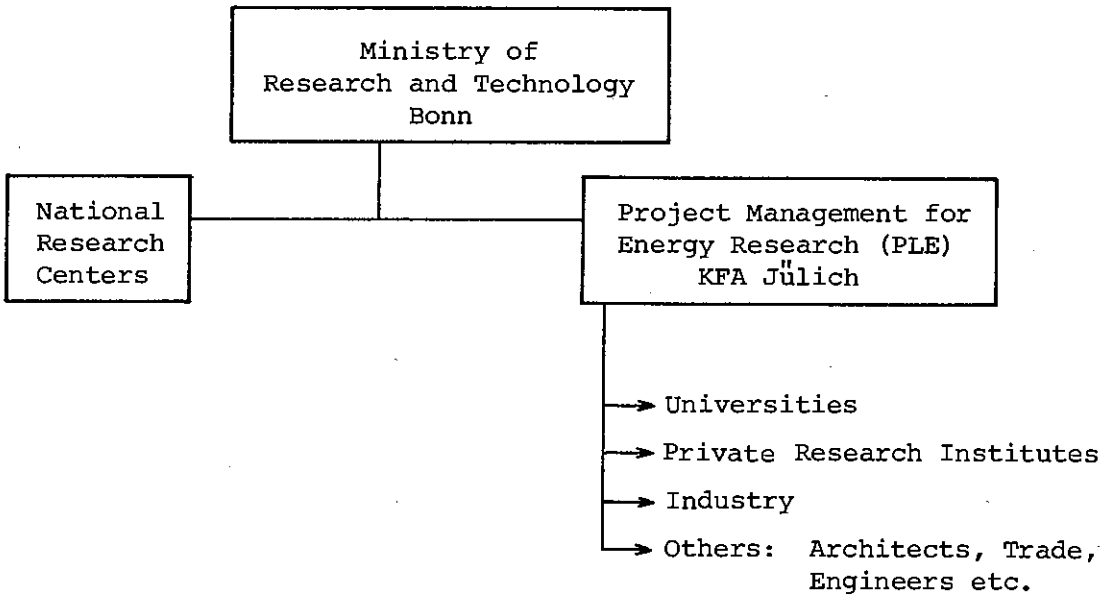
2. Names of main laboratories

Thermal Insulation Laboratory
at the Technical University of Denmark (TIL)

Technological Institute
Department for Heating and Ventilation (TI)

FRG

1. Organization chart of National R, D & D



2. Names of main laboratories

Nuclear Research Center, KFA - Jülich

Deutsche Forschungs- und Versuchsanstalt
für Luft- und Raumfahrt, KFVLR - Stuttgart

Inst. f. Kerntechnik u. Energieumwandlung e.V.
Holderbuschweg 52, 7000 Stuttgart 80

RWE - AT
Kruppstrasse 5, 4300 Essen 1

Zentrales Forschungslabor der Brown, Boveri u. Cie AG
Eppelheimer Strasse 82, 6900 Heidelberg

Lichttechnisches Institut der Uni. Karlsruhe
Kaiserstrasse 12, 7500 Karlsruhe 12

Batelle Institut e. V.
Postfach 900160, 6000 Frankfurt/Main 90

Fachber. Physik, Uni. Konstanz
Postfach 7733, 7750 Konstanz

Klaus Esser KG
Postfach 2909, 4000 Düsseldorf 1

Fachhochschule für Technik, Fachbereich Versorgungstechnik
Kanalstrasse 33, 7300 Esslingen

Dornier System GmbH
Postfach 1360, 7990 Friedrichshafen

Energietechnik GmbH
Mehrzweckhalle Wiehl, 5276 Wiehl 1

Messerschmitt-Bölkow-Blohm, Unternehmensbereich Raumfahrt
Abteilung RX-13, Postfach 801169, 8000 München 80

Institut für Thermodynamik und Wärmetechnik der Univ. Stuttgart
Seidenstrasse 36, 7000 Stuttgart 1

Süddeutsche Metallwerke GmbH
Impexstrasse 5, 6909 Walldorf

Philips Forschungslabor
Postfach 1980, 5100 Aachen

Jenaer Glaswerke Schott u. Gen.
Hattenbergstrasse 10, 6500 Mainz

Institut für Theorie der Elektrotechnik der Univ. Stuttgart
Breitscheidstrasse 3, 7000 Stuttgart 1

Entwicklungs- und Forschungslabor
Kreuzstrasse 105, 7850 Lörrach 6 - Haagen

GWB Gesellschaft für wirtsch. Bautechnik GmbH
Gnesener Strasse 4-6, 8000 München

Maschinenfabrik Augsburg Nürnberg AG
-Neue Technologien- Abt. ET
Dachauer Strasse 667, 8000 München 50

Technische Fachhochschule Berlin
Luxemburger Strasse 10, 1000 Berlin 65

Fachbereich 6, Technische Hochschule, Darmstadt
Hochschulstrasse 1, 6100 Darmstadt

Klöckner u. Co., Abt. Wärmetechnik
3016 Seelze 2

Rütgerswerke AG
Mainzer Landstrasse 217, 6000 Frankfurt/Main 1

KA-Planungs GmbH Heidelberg
Im Breitspiel 7, 6900 Heidelberg

Sektion Physik, Universität München
8000 München 2

Institut für Systemtechnik und Innovationsforshcung
der Frauenhofer Gesellschaft
Breslauer Strasse 48, 7500 Karlsruhe 1

Georg Bucher GmbH,
Waltershofener Strasse, 8901 Neitingen-Ostenfeld

Techn. Fachhochschule Berlin
Luxemburger Strasse 10, 1000 Berlin 65

Flachglas AG, DELOG-DETAG
Auf der Reihe 2, 4650 Gelsenkirchen

GREECE

1. Names of main laboratories

Greek Atomic Energy Commission

University of Patras, Physics Dep.

ITALY

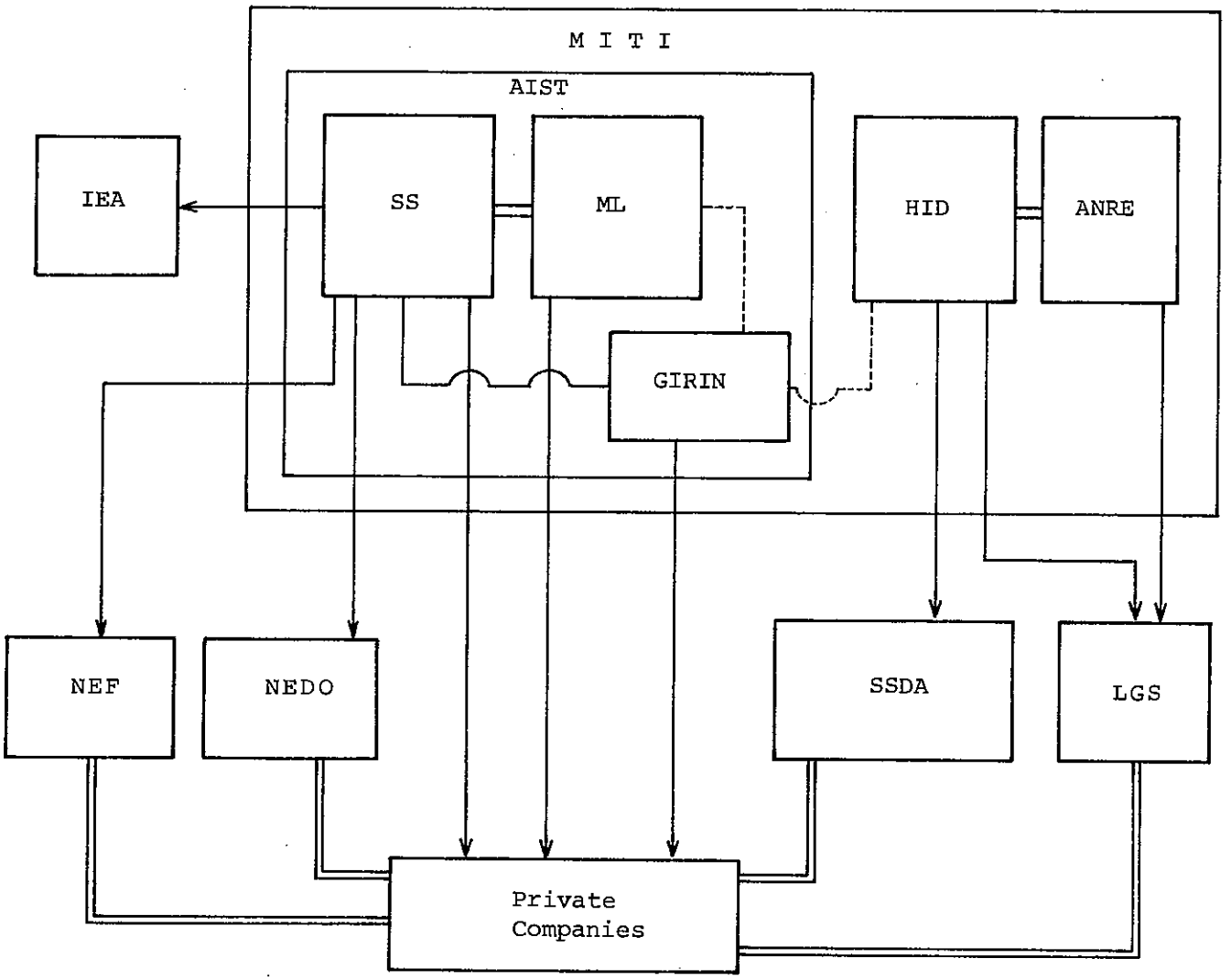
1. Names of main laboratories

CNR IFA	-	Rome
CNR LAMEL	-	Bologna
CNR CNPM	-	Milano
CNR LATEF	-	Padova
CNR ICITE	-	Milano
CISE SEGRATE	-	Milano
PHOEBUS	-	Catania
CRAIES	-	Verona
Ciraes Univ. of Calabria	-	Cosenza

Istituto Fisica Univ. Napoli

JAPAN

1. Organization chart of national solar systems R, D & D



MITI : Ministry of International Trade and Industry

AIST : Agency of Industrial Science and Technology

SS : Sunshine Project Promotion Headquarters

ML : Moonlight Project Headquarters

HID : Housing Industry Division

GIRIN : Solar Research Laboratory
Government Industrial Research Institute, Nagoya

IEA : International Energy Agency

NEDO : New Energy Development Organization

SSDA : Solar System Development Association

NEF : New Energy Foundation

ANRE : Agency of Natural Resources and energy

LGS : Local Governments

2. Names of main research laboratories

Solar Research Laboratory, G.I.R.I. Nagoya

Electro Technical Laboratory

3. Names of major R & D commercialization center

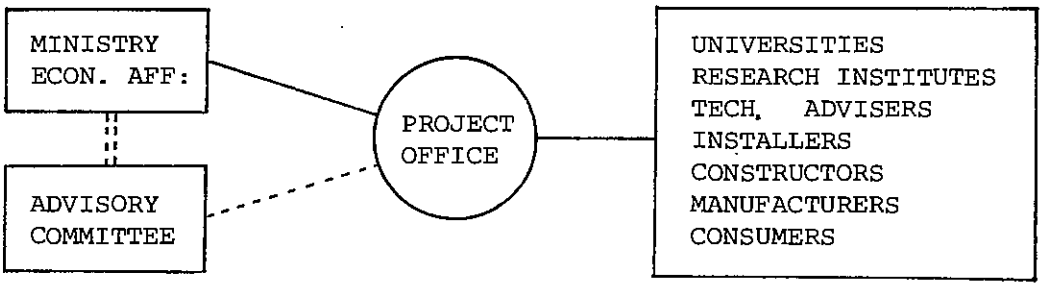
Solar Systems Development Association

New Energy Foundation

New Energy Development Organization

NETHERLANDS

1. Structure and organization chart of national R & D in solar energy



2. Names of main research laboratories

Delft University of Technology

Eindhoven University of Technology

University of Groningen

Bouwcentrum Rotterdam

Delft Soil Mechanics Laboratory

Organization for Applied Scientific Research - Apeldoorn

Institute of Applied Physics TNO-TH-Delft

Institute of Organic Chemistry TNO Utrecht

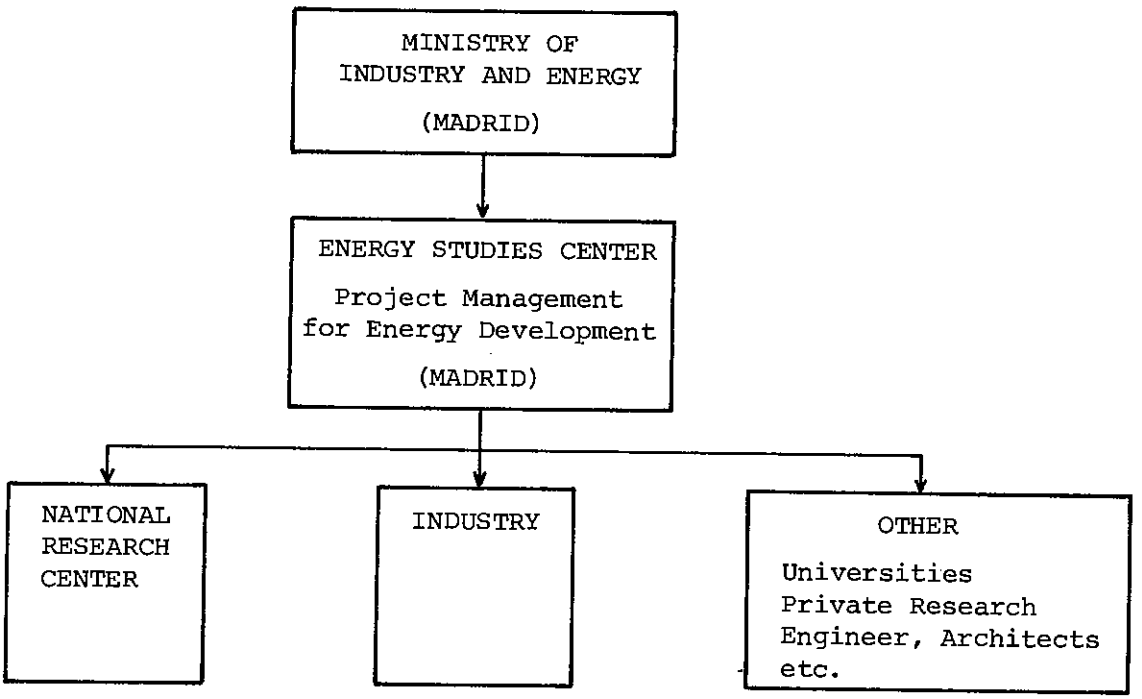
Netherlands Energy Research Foundation ECN Petten

VEG-Gasinstituut Apeldoorn

Kema Arnhem

SPAIN

1. Structure and organization of national R & D on solar energy



Note:

There is no single manager for the R & D programme in Spain. However, for solar energy R & D the major organization is the Ministry of Industry and Energy, although independently other organizations and ministries supply funds for the solar R & D.

2. Names of main research laboratories

Instituto Nacional de Tecnica Aeroespacial (INTA) : Torrejón de Ardoz, (Madrid)

Auxini-Casa : Plaza Marqués de Salamanca, 8 (Madrid-6)

Instituto Nacional de Optica Daza Valdes : Serrano, 123 (Madrid)

Cristaleria Española : Paseo Castellana, 77 (Madrid-16)

Cointra, S.A. - Alcala de Henares (Madrid)

Universidad Complutense de Madrid, Facultad de Fisicas, Dpto. Termologia/Madrid

Universidad de Granada,Grupo Autonomo Nuevas Energias, Dpto. de Fisica (Granada)

Centro de Estudios Hidrograficos, Paseo Bajo de la Virgen del Puerto, 3-Madrid

E.T.S.I., Cátedra de Mecánica de Fluidos (Madrid)

E.T.S.I. - Universidad de Las Palmas de Gran Canaria

SWEDEN

1. Names of main research laboratories

Studsvik Energiteknik AB

Swedish Board of Metrology, Borås

Swedish State Power Board, Älvkarleby

Sydkraft

Royal Institute of Technology (2)

SWITZERLAND

1. Government organizations responsible for solar R & D:

Federal Office of Energy

Federal Office for Education and Science

Board of the Federal Institute of Technology

Federal Office for Economic Stabilization and Growth Policies

Federal Office for Foreign Economic Affairs

2. Names of main research laboratories

Federal Institute of Technology

Federal Institute for Reactor Research

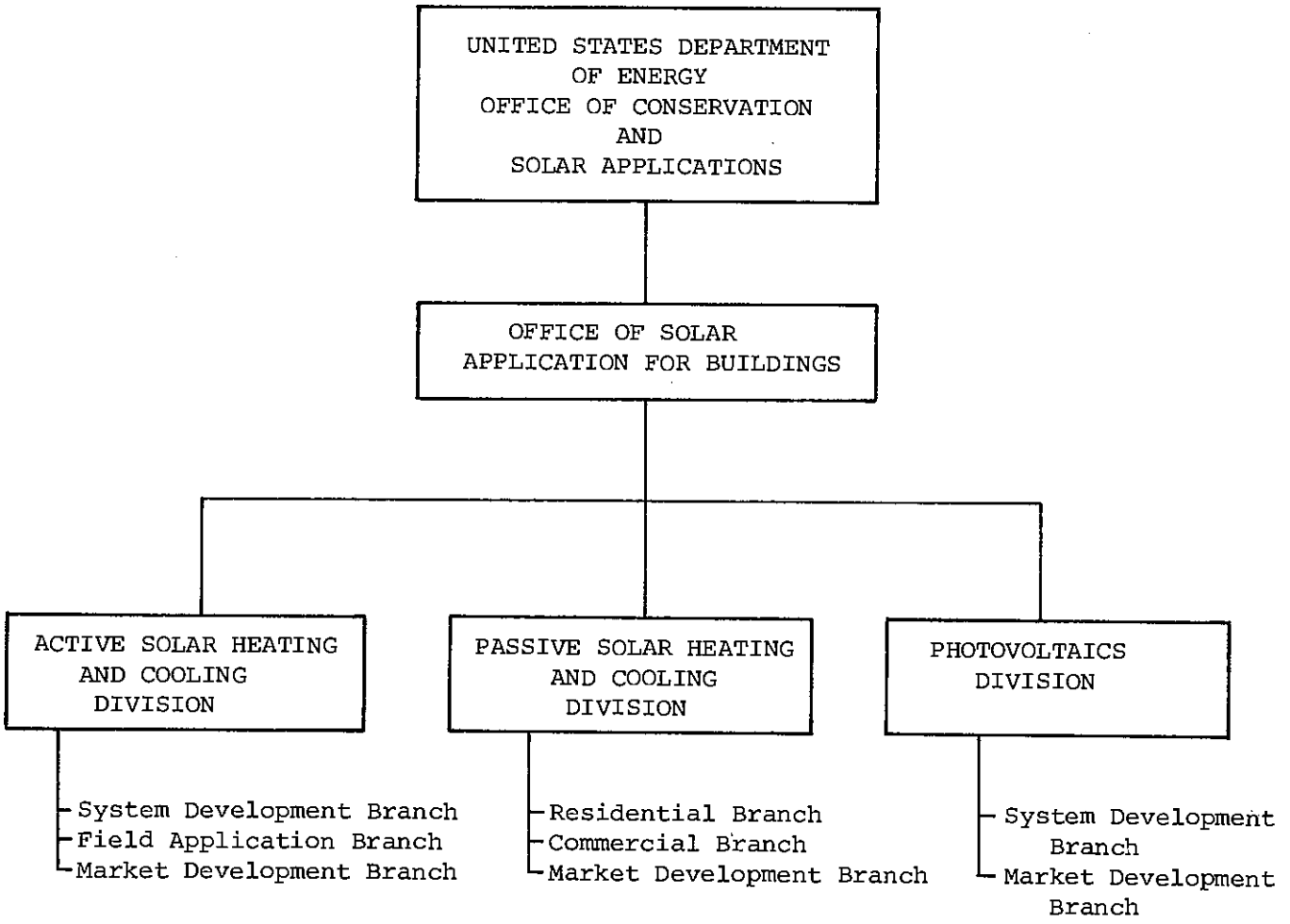
Swiss Meteorological Institute

Federal Laboratories for Materials Testing and Research

Universities (cantonal)

USA

1. Organization chart of national R, D & D for solar heating and cooling



2. Names of major R & D laboratories

Argonne National Laboratory

Brookhaven National Laboratory

Lawrence Berkely Laboratory

Los Alamos Scientific Laboratory

Solar Energy Research Institute

National Bureau of Standards

NASA Marshal Space Flight Center

3. Names of major R & D Commercialization Centers

Northeast Solar Energy Center

Western Solar Utilization Complex

Mid-America Solar Energy Complex

Southern Solar Energy Center

6. SOLAR HEATING AND COOLING COMPONENT PRODUCTION/SALES

Statistics on production and/or sales of solar components in commercial markets give an indication of the growth of the solar energy industry and the degree of market penetration. In the demonstration and commercialization stages, the establishment of a statistical methodology and the collection of component and system production information are crucial for energy policy planning. Task II Participating Countries have been attempting to secure statistical data on solar component production/sales activity. The data available to date on collectors is summarized in Table 3.

Table 3. Statistics on Solar Collector Manufacturing

	1979 (* for 1980)		Total (~1979)	
	area (m^2)	cost (US$)	area (m^2)	cost (US$)
AUSTRIA	80,000	16 million	150,000*	30 million*
BELGIUM	-	-	10,000	-
DENMARK	31,450	20 million	17,878	10 million
FRG	-	-	-	-
GREECE	-	-	40,000	5.45 million
ITALY	10,000	-	15,000	-
JAPAN	42,144**	-	93,637**	-
NETHERLANDS	1,000	0.175 million	1,500	0.265 million
SPAIN	8,000	1.5 million	12,000*	2.3 million*
SWEDEN	-	-	30,000	-
SWITZERLAND	-	-	38,000	22.3 million
USA	1,400,000	126 million	4,600,000	414 million

Note: 1. Mark - means unknown or under investigaion.
2. ** Solar water heaters of about 1,600,000 m^2/year are not included.

Only three participants have provided statistics on other solar components.

7. SOLAR SYSTEM INSTALLATIONS

The Operating Agent distributed a form for reporting solar system installations, those constructed prior to 1979 and those built during 1979. The format was to describe the present status of solar systems in the respective countries which have been constructed prior to 1979; and those built during the FY 1979. Each Participant was to classify their buildings as residential, apartment, commercial, building or industrial application; as well as indicating the application, i.e. DHW, heating/DHW, and heating/cooling/DHW. However, since incomplete information was submitted in many cases, only the total number of solar heating and cooling system installations is given in Table 5. This is followed by more detailed information on each country.

Table 5 Total Solar Systems Installed

Country	Installed solar systems (~1979)
AUSTRIA	2,000*
BELGIUM	100
DENMARK	1,700
FRG	10,000
GREECE	18,252
ITALY	11
JAPAN	3,445**
NETHERLANDS	550***
SPAIN	17
SWEDEN	1,400
SWITZERLAND	2,500
USA	115,000

* 4,000 for 1980.
** Solar water heaters are excluded.
*** Government Supported only.

AUSTRIA

MARKET PENETRATION FOR SOLAR SYSTEMS

COLLECTOR PRODUCTION:	56,900 m^2	(1980)
EXPORT:	36,400 m^2	(1980)
IMPORT:	2,600 m^2	(1980)

INSTALLED SOLAR SYSTEMS 1980

	AUSTRIA	EXPORT
SWIMMINGPOOL HEATING (SH) :	240	530
DOMESTIC WATER HEATING (DH) :	850	1,970
COMBINATION SH + DH :	250	530
SPACE HEATING :	30	-
TOTAL :	1,370	3,030

INSTALLED COLLECTOR AREA IN AUSTRIA

Year	1975	1976	1977	1978	1979	1980
m^2/year	100	2,200	3,500	7,000	27,800	23,100
TOTAL m^2	100	2,300	5,800	12,800	40,600	63,700

APPLICATIONS

	1975 - 1979	1980
SWIMMINGPOOL HEATING (SH) :	36 %	18 %
DOMESTIC WATER HEATING (DH) :	43 %	62 %
COMBINATION SH + DH :	18 %	18 %
SPACE HEATING :	3 %	2 %

DISTRIBUTION OF SYSTEMS ACCORDING TO THE COLLECTOR AREA

	1975 - 1979	1980
10 m^2	24 %	48 %
10 to 30 m^2	57 %	32 %
30 to 70 m^2	13 %	13 %
70 m^2	6 %	7 %

DENMARK

	CONSTRUCTED IN 1980		TOTAL (~ 1979)	
	GOVERNMENTAL SUPPORTED	TOTAL	GOVERNMENTAL SUPPORTED	TOTAL
RESIDENTIAL HOUSES	600	2,600	200	1,700
APARTMENTS		?	200	3
COMMERCIAL BUILDINGS		?		8 - 10
INDUSTRIES				
TOTAL				
HEATING				
HEATING AND COOLING				
(HOT WATER SUPPLY) ONLY				
OTHERS				
TOTAL				

FEDERAL REPUBLIC OF GERMANY

Total installed DHW and SHS 1980: approximately 10,000 more than 80% of them being DHW.

The latest market analysis (PESA, March 1980) shows the following distribution:

House Heating	1%
House Heating and Domestic Hot Water	8%
Domestic Hot Water	65%
Swimming Pools	22%
Other Combinations	4%
	100%

Further questions concerning age and governmental support cannot be answered in detail.

GREECE

	CONSTRUCTED IN 1979		TOTAL (~ 1979)	
	GOVERNMENTAL SUPPORTED	TOTAL	GOVERNMENTAL SUPPORTED	TOTAL
RESIDENTIAL HOUSES			-	18,182
APARTMENTS			3	2
COMMERCIAL BUILDINGS			-	66
INDUSTRIES			-	1
TOTAL			3	18,252
HEATING			3	-
HEATING AND COOLING			-	-
(HOT WATER SUPPLY) ONLY			-	18,252
OTHERS			-	-
TOTAL			3	18,252

ITALY

	CONSTRUCTED IN 1979		TOTAL (~ 1979)	
	GOVERNMENTAL SUPPORTED	TOTAL	GOVERNMENTAL SUPPORTED	TOTAL
RESIDENTIAL HOUSES	10	10	10	10
APARTMENTS				
COMMERCIAL BUILDINGS	1	1	1	1
INDUSTRIES				
TOTAL	11	11	11	11
HEATING	11	11	11	11
HEATING AND COOLING				
(HOT WATER SUPPLY) ONLY	11	11	11	11
OTHERS				
TOTAL	11	11	11	11

JAPAN

	CONSTRUCTED IN 1979		TOTAL (~ 1979)	
	GOVERNMENTAL SUPPORTED	TOTAL	GOVERNMENTAL SUPPORTED	TOTAL
RESIDENTIAL HOUSES	2	1,048	16	2,889
APARTMENTS	0	12	1	31
COMMERCIAL BUILDINGS	3	232	7	499
INDUSTRIES	0	10	1	26
TOTAL	5	1,302	16	3,445
HEATING	0	90	0	340
HEATING AND COOLING	5	60	16	146
(HOT WATER SUPPLY) ONLY	0	1,140	0	2,922
OTHERS	0	12	0	37
TOTAL	5	1,302	16	3,445

NETHERLANDS

	CONSTRUCTED IN 1979		TOTAL (~ 1979)	
	GOVERNMENTAL SUPPORTED	TOTAL	GOVERNMENTAL SUPPORTED	TOTAL
RESIDENTIAL HOUSES		250 (DHW)	18	300
APARTMENTS	250	250	250	250
COMMERCIAL BUILDINGS	-	3	1	5
INDUSTRIES				
TOTAL	250	500	270	550
HEATING	250		265	
HEATING AND COOLING	-		-	
(HOT WATER SUPPLY) ONLY	-	250	5	300
OTHERS	1	5	3	10
TOTAL				

SPAIN

	CONSTRUCTED IN 1979		TOTAL (~ 1979)	
	GOVERNMENTAL SUPPORTED	TOTAL	GOVERNMENTAL SUPPORTED	TOTAL
RESIDENTIAL HOUSES	-			
APARTMENTS	-			
COMMERCIAL BUILDINGS	15	?	22	?
INDUSTRIES	2	?	2	?
TOTAL	17		24	

HEATING	-	?		?
HEATING AND COOLING	-	-		?
(HOT WATER SUPPLY) ONLY	15	?		?
OTHERS				
TOTAL				

SWEDEN

	CONSTRUCTED IN 1979		TOTAL (~ 1979)	
	GOVERNMENTAL SUPPORTED	TOTAL	GOVERNMENTAL SUPPORTED	TOTAL
RESIDENTIAL HOUSES			95 - 99 %	1,400
APARTMENTS				2
COMMERCIAL BUILDINGS				5 - 6
INDUSTRIES				1
TOTAL				

HEATING				10 - 20
HEATING AND COOLING				-
(HOT WATER SUPPLY) ONLY				≈1,400
OTHERS				4
TOTAL				

SWITZERLAND

Total solar heating and cooling systems installed during 1979 FY was 1,100. Total number of the solar systems constructed up to 1979 is classified as:

	CONSTRUCTED IN 1979		TOTAL (~ 1979)	
	GOVERNMENTAL SUPPORTED	TOTAL	GOVERNMENTAL SUPPORTED	TOTAL
RESIDENTIAL HOUSES			-	2,070
APARTMENTS			-	210
COMMERCIAL BUILDINGS			-	220
INDUSTRIES			-	-
TOTAL			-	2,500

HEATING			-	1,150
HEATING AND COOLING			-	-
(HOT WATER SUPPLY) ONLY			-	580
OTHERS			-	410
TOTAL			-	2,500

USA

	CONSTRUCTED IN 1979		TOTAL (~1979)	
	GOVERNMENTAL SUPPORTED	TOTAL	GOVERNMENTAL SUPPORTED	TOTAL
RESIDENTIAL HOUSES	-	-	1,345	162,700
APARTMENTS - NO. OF UNITS	-	-	10,339	
BUILDINGS FOR BUSINESS & INSTITUTIONAL	86	-	288	1,700
INDUSTRIES/AGRICULTURAL	-	-	68	68
TOTAL		-	12,040	164,400**

HEATING	45*	-	6,465	17,900
HEATING AND COOLING	22*	-	502	502
(HOT WATER SUPPLY) ONLY	19*	-	5,005	146,000
OTHERS	-	-	68	68
TOTAL				

* Statistics for business and institutional only.

** Passive 5,000 - 10,000
Active 110,000 - 160,000, about 90% DHW.

Mark - means under investigation.

8. MAJOR SOLAR HEATING & COOLING MANUFACTURERS

Names, addresses and products of major solar heating & cooling components manufacturers in the Participating Countries are listed in Table 6. Names and addresses of the trade associations to which these manufacturers are affiliated are listed in Table 7. Although some of the columns remain blank because a particular format was not specified, the information should still be useful from the technical and commercial viewpoint. Because of space limitations only "major" manufacturers are listed. Detailed and additional information on the names of solar heating & cooling components makers can be obtained by contacting the respective Participants. It should be noted that the IEA does not endorse any one or all of the products over any others manufactured by any of these or other manufacturers. This listing is purely for informational purposes.

The Swiss report listing about 150 manufacturers and/or dealers of solar components was in German and was therefore omitted. The American report was so extensive that the Operating Agent has condensed and rearranged the U.S. listing as shown in Table 6. The US has many more manufactures than listed. The report might simply reference SERI's manufactures list/Database and not mention special companies.

Table 6. Solar Heating & Cooling Component Manufacturers

country	name	address	products
AUSTRIA	P. Hinteregger AG	Hietzinger Kai 125, 1130 Wien	
	MEA-Maschinen und Energieanlagen GmbH	Engerwitzdorf, 4210 Gallneukirchen	
	Stiebel Eltron GmbH	Villacherstraße 53, 9800 Spittal/Drau	
	H. Thalhammer KG	Griesplatz 19/20, 8020 Graz	
	Vereinigte Metallwerke Ranshofen/Berndorf AG	Leobersdorfer Straße 26, 2560 Berndorf	
	Vogel & Noot AG	8661 Wartberg	
BELGIUM	Finimetal - EFEL S.A., Dept. Energie Solaire		Collector
	Glaverbel S.A.		Collector
	Le Chassis Métallique Belge		Collector
	Portal S.A.		Collector
	S.I.S. S.A. (Sicièté Industrielle Solaire)		Eng. & Collector
	Solar Technik P.v.b.a.		Instal.
DENMARK	AR-CON Solvarme	Jyttevej 18, 9520 Skørping (08) 39 16 15	
	Dæmpa A/S	DK 5690 Tommerup (09) 76 13 11	
	E.W. Rasmussen Horsens A/S	Færøvej 2, 8700 Horsens (05) 62 98 11	
	H.S. Kedler	Postbox 30, 6880 Tarm (07) 37 15 11	
	Dansk Solvarme K/S	Kabelvej 5, 9310 Vodskov (08) 25 62 66	

- continued -

country	name	address	products
FRG	There are about300 manufacturers and/or dealers on the German solar market. Most of them belong to one of the following 3 associations which is listed in Table. 7		
GREECE	BP CALPAC	12-14 Dimitressa St. Athens 612	
	SOLE. EPE	14 km National Road Athens-Lamia, metamorfosis	
	CALORIA ABEE	24 Al Panton St. Pantios, AThens	
	FAETHON	22 Argolidos St. Ampelokipi Athens	
	THIA	30 Arxelaou St. Pagrati, Athens	
	SOLAR THERM	84 Vouliagmenis Ave. Hellinikon, Attiki	
ITALY	Heliosil	Milano	
	Solaris Pragma	Roma	
	Montedison Denogami	Novara	
	Montedison Donegani	Napoli	
	Pirelli	Milano	
	Reflexoterm Pamsol	Olbia	
	ACE	Sulmona	
	Cesen	Genova	
	Fiat Eng.	Torino	
	Philco Italiana	Gergamo	
	Polivar	Pomeai	
	Polivar Pomezia	Rome	
	SGS Ates	Milano	

- continued -

country	name	address	products
ITALY	Samifi Babcock	Milano	
	Sunk Sunlife	Pordenone	
	Zanussi	Pordenone	
JAPAN	ASAHI GLASS CO., LTD.	1-2 Marunouchi 2-chome, Chiyoda-ku, Tokyo (03) 218 - 5622	Collector
	AZUMA KOKI CO., LTD.	326 Minoridai, Matsudo, Chiba (0473) 63 - 5131	Hot Water Supply and Solar Heating, Collector, Storage Tank
	CHOFU SEISAKUCHO CO., LTD.	8-4 Minatomachi, Chofu-cho, Shimonoseki, Yamaguchi (0832) 46 - 0111	Solar Collector, Storage Tank
	CHUBU CREATE INDUSTRIAL CO., LTD	1-1-25 Miwa, Nagano, Nagano (0262) 43 - 2711	Collector, Storage tank
	CORONA SALES CO., LTD.	7-7 Higashishinbo, Sanjo, Niigata (02563) 2 - 2111	Solar Collector, Storage Tank with Pump
	FUJI ELECTRIC CO., LTD.	New Yuraku-cho Bldg. 12-1 Yuraku-cho, 1-chome, Chiyoda-ku, Tokyo (03) 211 - 7111	Solar System, Solar Water Heater, Solar Collector

- continued -

country	name	address	products
JAPAN	HITACHI CHEMICAL CO., LTD.	2-1-1 Nishishinjuku, Shinjuku-ku, Tokyo (03) 346 - 3111	Solar System, Solar Water Heater, Solar Collector, Solar Water Pre-Heating System
	HITACHI LTD.	34 Shinanomachi, Shinjuku-ku, Tokyo (03) 357 - 2311	System Planning & General Contracting, Auxiliary Heat Source Unit, Heat Pump, Absorption Chiller, Rankine Cycle Engine, Convector & Storage Tank
	ISHIKAWAJIMA-HARIMA HEAVY INDUSTRIES CO., LTD.	3-2-16 Toyosu, Koto-ku, Tokyo (03) 534 - 2425	General Contractor, Collector, Storage Tank, Rankine Cycle Engine
	KAJIMA CORPORATION	1-2-7 Motoakasaka, Minato-ku, Tokyo (03) 404 - 3311	General Contractor, Architectural Technology
	KAWASAKI HEAVY INDUSTRIES, LTD.	World Trade Center Bldg. 2-4-1 Hamamatsu-cho, Minato-ku, Tokyo (03) 435 - 2971	Solar Collector, Absorption Chiller, Boiler
	KUMAGAI GUMI CO., LTD.	17-1 Tsukudo-cho, Shinjuku-ku, Tokyo (03) 260 - 2111	Engineering, Architectural and Construction in General Contractor
	MARUBENI CORPORATION	1-4-2 Ohtemachi, Chiyoda-ku, Tokyo (03) 282 - 2192	Sales Activity
	MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.	1006 Kadoma, Osaka (06) 908 - 1121	Solar Energy Equipment System
	MATSUSHITA ELECTRIC WORKS CO., LTD.	1048 Kadoma, Osaka (06) 908 - 1131	Solar System

- continued -

country	name	address	products
JAPAN	MATSUSHITA HOUSING PRODUCTS CO., LTD.	800 Tsutsui-cho, Yamatokoriyama, Nara (07435) 6 - 1121	Solar Energy Equipment System, System Design of Industrial-use, Solar Collector, Storage Tank, Floor Heating System
	MATSUSHITA SEIKO CO., LTD.	6-2-61 Imajuku Nishi, Jyoto-ku, Osaka (06) 934 - 2131	Collectors, Storage Tank, Temp. Difference Thermostat, Heat Pump Unit
	MISAWA HOMES CONPANY LTD.	2-4-5 Takaido-higashi, Suginami-ku, Tokyo (03) 331 - 1111	Prefabricated Houses
	MATSUBISHI ELECTRIC CORPORATION	Mitsubishi Electric Bldg. 2-2-3 Marunouchi, Chiyoda-ku, Tokyo (03) 218 - 2956	Collectors, Storage Tanks, Heat Pump Unit, Controller, etc.
	MITSUBISHI HEAVY INDUSTRIES LTD.	Shin Tamachi Bldg. 5-34-6 Shiba, Minato-ku, Tokyo (03) 455 - 5711	Collector, Storage Tank, Pump, Compressor, Refrigerating & Air Conditioning Machinery
	NICHIEI KAIHATSU CO., LTD.	1-4-17 Kamitakaido, Suginami-ku, Tokyo (03) 304 - 0511	Solar System, Consultant Services
	NIPPON SHEET GLASS CO., LTD.	4-8 Doshomachi, Higashi-ku, Osaka (06) 591 - 6431	Cover Glass for Solar Collectors, Glass Fiber Insulation
	NISHIDEN PIPE INDUSTRY CO., LTD.	Mitsui Bldg. 2-1-1 Nihonbashi-Muromachi, Chuo-ku, Tokyo (03) 279 - 4020	Collector, Pipe
	NITTAKU SANGYO CO., LTD.	5-34 Awazaki-cho, Kanazawa, Ishikawa (0762) 38 - 2211	Solar Water Heater

- continued -

country	name	address	products
JAPAN	NORITSU CO., LTD.	Meikai Bldg. No. 32 Akashi-cho, Ikuta-ku, Kobe (078) 391 - 3361	Solar Water Heater, Solar Collector and its System
	OHBAYASHI-GUMI, LTD.	2-3 Kanda Tsukasa-cho, Chiyoda-ku, Tokyo (03) 292 - 1111	General Contractor
	SAGINOMIYA SEISAKUSHO, INC.	2-55-5 Wakamiya, Nakano-ku, Tokyo (03) 330 - 1111	Automatic Controller for Solar
	SANYO ELECTRIC CO., LTD.	100 Dainichi Higashimachi, Moriguchi, Osaka (06) 901 - 1111	Collector, Storage Tank, etc.
	SANYO MACHINE WORKS, LTD.	Oki-mura, Nishiharu-cho, Nishikasugai-gun, Aichi (0568) 21 - 1111	Nontracking Concentrating Collector, Heat Pump, System Design for Large Scale Air Conditioning and Process Heating
	SEKISUI CHEMICAL CO., LTD.	2-4-4 Kinugasa-cho, Kita-ku, Osaka (06) 365 - 2280	Solar Energy Equipment System, Collector, Heat Storage Tank, Heat Pump
	SHARP CORPORATION	22-22 Nagaike-cho, Abeno-ku, Osaka (06) 621 - 1221	Collector, Storage Tank, Pump, Other
	SHIMIZU CONSTRACTION CO., LTD.	2-16-1 Kyobashi, Chuo-ku, Tokyo (03) 535 - 4111	Architects & General Contractors
	SHOWA ALUMINUM CORPORATION	2-12 Kanda Ogawa-machi, Chiyoda-ku, Tokyo (03) 295 - 8429	Solar Collectors, Natural Circulating Type Solar Water Heaters, Integral Metal Roof with Solar Collector
	TAISEI CORPORATION	1-25-1 Nishishinjuku, Shinjuku-ku, Tokyo (03) 348 - 1111	General Contractor

- continued -

country	name	address	products
JAPAN	TAKASAGO THERMAL ENGINEERING CO., LTD.	4-2-8 Kandasurugadai, Chiyoda-ku, Tokyo (03) 255 - 8211	Air-conditioning Contractor
	TAIKO KIKAI INDUSTRIES CO., LTD.	209 Shimotabuse, Tabuse-cho, Kumage-gun, Yamaguchi (08205) 2 - 3111	Collector, Storage Tank, Pump, Control Panel, etc.
	SOLAR GIKEN MFG. CO., LTD.	2-2-7 Minami, Hongo-dori, Shiroishi-ku, Sapporo, Hokkaido (011) 862 - 6625	Solar Collector & Storage Tank
	TOKYO SANYO ELECTRIC CO., LTD.	Sanyo Yushima Bldg. 4F 3-10-15 Hongo Dunkyo-ku, Tokyo (03) 815 - 1111	Solar System, Collector, Absorption Chillers
	TODA CONSTRUCTION CO., LTD.	1-7-1 Kyobashi, Chuo-ku, Tokyo (03) 562 - 6111	General Contractors
	THE ZENITAKA CORPORATION	2-2-11 Nishi-honmachi, Nishi-ku, Osaka (06) 531 - 6431	General Contractors (Design & Construction of solar System)
	THE FURUKAWA ELECTRIC CO., LTD.	2-6-1 Marunouchi, Ciyoda-ku, Tokyo (03) 286 - 3482	Collector, Storage Tank, Pipe, Pump, Control Devices, Floor Heating Panel
	TAKUMA CO., LTD.	1-3-23 Hama, Dojima, Kita-ku, Osaka (06) 346 - 5161	Collector, Heat-Exchanger, Storage Tank
	TAKENAKA KOMUTEN CO., LTD.	8-21-1 Ginza, Chuo-ku, Tokyo (03) 542 - 7100	Design, Construction & General Contracting of Buildings and Houses
	TOSHIBA CORPORATION	Toshiba Bldg. 5F 5-2-1 Ginza, Chuo-ku, Tokyo (03) 574 - 5648	System Design and Installation, Collector, Heat Storage Tank, Absorption Refrigerating Machine

- continued -

country	name	address	products
JAPAN	TOSHIBA HOUSE & LIVING INDUSTRY CO., LTD.	1-6 Kanda Surugadai, Chiyoda-ku, Tokyo (03) 233 - 2858	Solar Energy System, Hot Water Supplying Appliance, Air Conditioning Appliance
	TORAY INDUSTRIES, INC.	2-2 Nihonbashi-Muromachi, Chuo-ku, Tokyo (03) 245 - 5631	
	TOYO NETSUKOGYO KAISHA, LTD.	2-5-12 Kyobashi, Chuo-ku, Tokyo (03) 562 - 1351	Solar System Engineering(Planning, Designing, Construction, Trial Operation & Adjustment, Maintenance)
	YAMATAKE HONEYWELL CO., LTD.	Nagai International Bldg. 2-12-19 Shibuya, Shibuya-ku, Tokyo (03) 409 - 7171	Solar Control System
	YAZAKI CORPORATION	Mita Kokusai Building 17F 1-4-28 Mita, Minatoku, Tokyo (03) 455 - 8811	Solar Collector, Water Fired Chiller, Fan-Coil and Air Handling Unit, Cooling Tower, Solar Water Heater, Solar System Control Devices
NETHERLANDS	BRONSWERK B.V.	Amersfoort 033 - 39911	
	DRU	Ulft 08356 - 4951	
	EBS	Grave 08860 - 3992	
	BRINK	Staphorst 05225 - 1444	
	CALCOL	Tiel 03430 - 5244	
	UBBINK	Doesburg 08334 - 9004	
	PHILIPS	Eindhoven 040 - 756716	
	WED. JOH. Verhulst	Waalwijk 04160 - 34911	
	NYS EN VALE	Nijmegen 080 - 772146	
	SOLARGIE	Kwintsheul 01742 - 5650	

- continued -

country	name	address	products
SPAIN	ANDRES BARBERA	San Roque, 4 REUS (Tarragona)	
	APLICACIONES DE LA ENERGIA SOLAR, S.A. (APLESA)	Capitán Haya, 50 Madrid-50	
	APLICATIONES SOLARES, S.A.	Casanova, 199 Barcelona-36	
	APLISOL, S.A.	Apartado Correos, 185 Lerida	
	ATON ENERGIA SOLAR, S.A.	Monjas de Santa Catalina, 8 Lalencia	
	BREX, S.A.	Villanueva, 29 Madrid-1	
	CELUFLEX, S.A.	Doctor Balari, 142 Sabadell (Barcelona)	
	CETE, (S.A.)	Ctra. de Sabadell a Granollers, Km. 6,3. Apartado de Correos, 54 Palau de Plegamans (Barcelona)	
	COBRA, S.A.	General Moscardó, 3 Madrid-20	
	COINTRA, S.A.	Ctra. Aeropuerto Torrejón Km. 2,400 Alcala de Henares (Madrid)	
	CRISTALERIA ESPANOLA CONSULTORA, S.A.	Centro Azoa (Paseo de la Castellana, No. 77) Madrid-16	
	DESARROLLOS TECNICOS DE APLICACION SOLAR, S.A. (DETASSA)	Plaza de Pizarro, No. 1 Majadahonda (Madrid)	
	ECOSOL, S.A.	Urb. Villarosa, 2 y 3 Malaga	
	ENERGIA SOLAR, S.A.	Alberto Alcocer, 41, 90, 93 Madrid-16	
	ENERGIA SOLAR UNIVERSA, S.A.	Gran Via, 86, pl. 22-3, G-5 Madrid	
	ENERGISOL BALEAR, S.A.	Fray Luis Jaume, 13, 10 Palma de Mallorca (Baleares)	
	ESE (ENERGIA SOLAR ESPANOLA)	Franco de Castilla - 23 - La Cuesta La Laguna Tenerife	
	FUTURTEC, S.A. (TECNISOL)	Vallehermoso, 40, bajo Madrid	
	HELIOTECNICA, S.A.	Capitán Haya, 55, 30, 4 Madrid-20	

- continued -

country	name	address	products
SPAIN	INISOLAR SOCIEDED PARA EL DESARROLLO DE LA ENERGIA SOLAR, S.A.	Plaza Marqués de Salamanca, 8 Madrid	
	IN-SOL, S.A.	Almogávares, 68-70, 70 Barcelona-18	
	INSTALACIONES J-7, S.A.	Julio Sáez de la Hoya, 8, 70, Ofic. 2 Burgos	
	LAMINADOS DE ALUMINIO ESPECIALES, S.A.	Wagner, s/n, Pol. Ind. Can Jardi. RUB (Barcelona)	
	LUMELCO, S.A.	Serrano, 205 Madrid-16	
	OLIVERO DOMENICO HISPANIA, S.A.	Alberto Alcocer, 32 Madrid-16	
	PANSOLAR, S.A.	Zaorejas, 8 Madrid	
	PATENTES SIMPLEX AEROTERMICA, S.A.	Avda. Concha Espina, 63 Madrid	
	POLISOLAR IBERICA, S.A.	Apolonio Morales, 31 - Avda. José Antonio, 5 Madrid La Orotava (Madrid Tenerife)	
	PRODUCTOS PIRELLI, S.A.	Gran Via de las Cortes Catalanas, 614 Barcelona-7	
	RAYOSOL	Apartado, 81 Torremolinos (Malaga)	
	RIERSOL	Palau de Plegamans, 5 Mollet del Valles (Barcelona)	
	SADRYM (S.A. DE RACIONALIZACIÓN)	Crt. de Cádiz, Km. 550, 200 Aptdo. 40 de Sevilla Dos Hermanas (Sevilla)	
	SAINTA (SOCIEDED ANONIMA DE INGENIERIA Y TECNOLOGIA)	Melquiades Alvarez, 17 10 Oviedo.	
	S.E.H. (SOCIEDED DE ENERGIA HISPANA)	Numancia, 85-87 Barcelona-29	
	SILVASOL	Mayor No.3 Javea (Alicante)	
	SISTEMAS Y APLICACIONES ENERGETICAS, S.A. S.A.E.S.A.	Aznar Molina, 15-17 Zaragoza-2	
	SISTEMAS SOLARES SUR, S.A.	Avda. San Francisco Javier, s/n Edificio Sevilla 2, Planta 90 Sevilla-5	

- continued -

country	name	address	products
SPAIN	SOCIEDED ESPANOLA DE CARBUROS METALICOS, S.A.	Consejo de Ciento, 365 Barcelona-9	
	SOLARWATT ESPANOLA, S.A.	Empresa del Consorcio Brown Boveri Av. Ferrán Alsina, 40-42 Sabadell (Barcelona)	
	SOL Y TECNICA, S.A.	Valdecaleras, 3, 60 A Madrid-33	
	ANDRES SURIA, S.A.	Napoles, 49, Sta. Maria de Barbara (Barcelona)	
	APLICACIONES DE LA ENERGIA, S.A. (APLESA)	Capitán Haya, 50 Madrid-20	
	SPECIFIC DYNAMICS IBERIA, S.A. ENERGIA	Torrelaguna, 61 Madrid-27	
	TECASOL, S.A.	Av. Concordia, 22 Sabadell (Barcelona)	
	TECNICA DE TRANSMISION SOLAR, S.A. (T.T.S.)	Ricardo Soriano, 60 - Dir. Postal. Aprtado 338 Marbella (Malaga)	
	TECNICAS ENERGETICAS, S.A.	Entenza, 242, Industria, 60 Barcelona-29 Calali (Barcelona)	
	TECNICAS DE INTEGRACION ENERGETICA, S.A. (T.E.I.E.S.A.)	Calabria, 33, Bajos Barcelona	
	TELESON	Obispo Irurita, 22 Mislata (Valencia)	
SWEDEN			
SWITZERLAND	There are about 150 manufacturers and/or dealers in Switzerland. Most of them belong to the associations which is listed in Table 7.		

- continued -

country	name	address	products
USA	ADVANCED ENERGY TECHNOLOGY INC.	Los Gatos, LA	Collector, Solar Systems
	ALPHA SOLAR CO.	Cincinnati, OH	Collectors, Solar Systems
	BLUE WHITE INDUSTRIES	Westminster, CA	Solar System Component
	CALIFORNIA SUN ENERGY	Sunnymead, CA	Collector, Collector Component, Solar Systems, Passive Systems and Component
	COLT INC.	Rancho Mirage, CA	Collector
	COLUMBIA CHASE SOLAR ENERGY	Holbrook, MA	Collector, Collector Component Solar System
	COPPER STATE SOLAR PRODUCTS INC.	Phoenix, AZ	Collector, Collector Component, Solar Systems, Solar System Component
	DOW CORNING CORPORATION	Midland, TX	Collector Component, Solar System Component
	EASTMAN CHEMICAL PRODUCTS INC., Plastic Division	Kingsport, TN	Collector Component, Passive Systems and Component
	ELMWOOD SENSORS, INC.	Cranston, RI	Solar System Component
	ENERGY MONITORING SYSTEM INC.	Mountain View, CA	Solar System Component
	ERGENICS	Wyckoff, NJ	Collector, Collector Component, Solar Systems, Passive Systems and Component

- continued -

country	name	address	products
USA	F. W. BELL INC.	Orlando, FL	Solar System Component
	GENERAL EXTRUSIONS INC. General Solar System Div.	Youngstown, OH	Collector, Collector Component Solar Systems
	GLASTEEL TENNESSEE INC.	Duarte, CA	Collector Component
	GOETIL AIR CONDITIONING	Phoenix, AZ	Collector, Solar Systems
	HELDOR ASSOCIATE	Clifton, NJ	Collector Component, Solar Systems, Passive Systems and Component,
	HOLLIS OBSERVATORY	Nashua, NH	Solar System Component
	HYPERION INC.	Boulder, CO	Collector, Solar Systems, Solar System Component Passive Systems and Component
	INSULTEK CORPORATION	Rockaway, NJ	Solar System Component
	SOLCOOR INC.	Los Angeles, CA	Collector, Solar Systems, Solar System Component
	SOICOOR INC.	Los Angeles, CA	Collector, Solar System Component
	JACOBS-DEL SOLAR SYSTEMS INC.	Pasadena, CA	Collector, Solar Systems
	MONITOR LABS. INC.	Sandiego, CA	Solar System Component
	LIBBEY OWENS FORD COMPANY	Toledo, OH	Collector
	MUELLER BRASS COMPANY	Port Huron, MI	Solar System Component
	NORTHRUP INC.	Hutchins, TX	Collectors, Solar System Component
	MYSON INC.	Falmonth, VA	Solar System Component
	NEW JERSEY ALUMINUM, EASCO CORPORATION	New Brunswick, NJ	Collector Component

- continued -

country	name	address	products
USA	OLIN BRASS	East Alton, IL	Collector
	OLYMPIC SOLAR CORPORATION	Canton, OH	Collector Component
	RHEEM/RUUD WATER HEATER DIV. CITY INVESTING COMPANY	Atlanta, GA	Collector, Collector Component, Solar Systems, Solar System Component
	RAYPAK INC.	Westlake Village, CA	Collector, Solar Systems
	REVERE SOLAR AND ARCHITECTURAL PRODUCTS INC.	Rome, NY	Collector, Solar Systems, Solar System Component
	SUNPOWER SYSTEMS CORPORATION	Tempe, AZ	Solar Systems, Solar System Component
	SOLAR DEVELOPMENT INC.	Riviera Beach, FL	Collector, Collector Component, Solar Systems
	RICHOEL INC.	Carson City, NV	Solar Systems, Solar System Component
	SOLAR KINETICS INC.	Datlas, TX	Collector
	AMERICAN SOLAR KING CORPORATION	Waco, TX	Collector, Solar Systems, Solar System Component
	SOLAR THERMAL SYSTEMS, Div. of Exxon Enterprises Inc.	Burlington, MA	Collector, Solar Systems, Solar System Component
	SUNPOWER SYSTEMS CORPORATION	Tempe, AZ	Collector, Solar Systems, Solar System Component
	SUNSPOOL CORPORATION	Palo Alto, CA	Solar System Component
	TACO	Cranston, RI	Solar System Component
	GENERAL ELECTRIC COMPANY	Philadelphia, PA	Collector, Solar System
	OWENS-ILLINOIS INC.	Toledo, OH	Collector

- continued -

Table 7. Solar Industry Trade Associations

Country	Name	Address	Numbers of member corporations
AUSTRIA	Arbeitsgemeinschaft Solartechnik	Bauernmarkt 13,1010 Wien	
FRG	Bundesverband Solarenergie e.V. BSE	Kruppstrasse 5 D-4300 Essen 1 Tel. 0201/1853392	about 300
	Deutsche Gesellschaft für Sonnenenrgie e.V. DGS	Geothestrasse 28 D-8000 München 2 Tel. 089/533816	
	Verein Deutscher Ingenieure e.V. VDI	Fachvereinigung Sonnenenergie Graf-Recke Strasse 84 D-4000 Düsseldorf 1 Tel. 0211/62141	
GREECE	Solar Energy System Maker's Association (EKSEHE)	12-14 Dimitressa Str. Athens 612	
JAPAN	Solar System Development Association (SSDA)	Shinbashi Fuji Bldg., 19-2 Shinbashi 2-chome Minato-ku, Tokyo Tel. 03 574-8263	about 50
SPAIN	ADESA ASENSA ASOCIACION CASTELLANA DE ENERGIA SOLAR	Osario, 16. (Sevilla - 3) Numancia, 87-89 (Barcelona-29) (Madrid)	
SWITZERLAND	Schweizerische Vereinigung für Sonnenenergie (SSES) Societé Suisse pour l'énergie Solaire	Grossbuch 16, 8964 Rudolfstetten Tel. 057/5 12 18	
USA	Solar Energy Industries Association (SEIA)	1001 Connecticut Ave., N.W. Suite 800 Washington,D.C. 20036	

9. STATUS OF NATIONAL STANDARDS DEVELOPMENT

As R, D&D of solar components and systems progresses, standardization will become a very important issue in the commercialization of solar technologies. Definition of terminology, requirements, specifications of component and systems performance, and component testing procedures etc., have to be established as standards either at the national or international level. The status of efforts by the Task II Participants in national standardization is summarized in Table 8.

Table 8 Status of National Standardization

	No standards	In preparation	Internal standards	National standards
AUSTRIA				X
BELGIUM	X			
DENMARK		X		
FRG				X
GREECE				X
ITALY		X		
JAPAN		X	X	X
NETHERLANDS				X
SPAIN				X
SWEDEN		X		
SWITZERLAND		X		
USA				X

Seven countries have already established national standards on certain solar components, and four countries are in the process of developing national standards. IEA Solar Task III has worked in the areas of collector test procedures, but the issue of international standardization of solar systems components will have to be addressed by the ISO (International Standards Organization). Details on the status of national standardization by the Participants were provided as follows:

AUSTRIA

At the end of 1980 the following standards for solar heating systems have been set up by the Austrian Institute for Standardization (Österreichisches Normungsinstitut).

1. M 7700: Solar Energy; terms and definitions
2. M 7710: Flat plate collectors for the use of solar energy; performance requirement
3. M 7711/1: Testing procedures for the determination of the standardized collectors stagnation temperature (indoor-test)
4. M 7711/2: Testing procedures for the determination of the standardized collectors temperature (outdoor-test)
5. M 7711/3: Temperature and pressure tests
6. M 7711/4: Determination of conversion and heat loss coefficient
7. M 7711/5: Testing of weathering resistance of optical properties

FEDERAL REPUBLIC OF GERMANY

The DIN (Deutsches Institut für Normung) has worked out the following standardizations (DIN 4757).

1. Solar heating plants working with water mixtures heat transfer fluids; safety requirements
2. Solar heating plants working with organic heat transfer fluids; safety requirements
3. Solar heating plants; solar collectors, definitions, requirements, tests.

GREECE

The Greek standards ELOT 388.1 and 388.2 cover the solar water heater collector.

ITALY

A proposal of regulation has been prepared by C.N.R. - U.N.I. on solar heating components in Italy.

JAPAN

Solar System Development Association (SSDA) which consists of about 52 private company members is now examining the SSDA standards on solar components and systems with the support by the Solar Research Laboratory, GIRIN. In a few years these standards may be authorized to Japan Industrial Standards (JIS). Japanese Industrial Standards on solar water heater has already been established in 1979 as JIS A 4111.

NETHERLANDS

In Netherlands there exists or will exist national standards for the following solar systems components.

1. Code of practice Solar Boiler Systems
2. Code of practice Space Heating Systems

3. Standards of thermal performance test of collectors
4. Standards of other performance test are in preparation level.

SPAIN

Standard INTA 610001 "Quasi-steady state test of flat plate solar collector" (Published in 1979) has been accepted as the Spanish Official standard.

SWEDEN

Collector testing standards will be approved in January 1981.

SWITZERLAND

SOFAS (Swiss Association of solar energy specialists) has initiated standards preparation.

USA

There exist or will exist the following standards on solar heating and cooling components in the USA.

1. HUD Intermediate Minimum Property Standards Solar Heating and Hot Water Systems
2. ASHRAE Thermal performance testing Procedure 95-75
3. Building Energy Performance Standard (being developed)
4. NBS Solar Heating and Cooling Performance Requirements (draft)
5. Model Document for Code Officials on Solar Heating and Cooling of Buildings. DOE/CS/4281-1 (Third Edition)
6. Collector Safety Standards (Underwriters Laboratories late 1980)

10. PROBLEMS IN APPLICATION

The problems in solar components application indicated by each participant are summarized in the Table 9.

Table 9. Summary of Problems in Solar Component Application

	Not familiar to public	Economic factor		Technical factor			Lack of related market organi-zation	Lack of support by govern-ment or regula-tional problems	Others
		high initial cost	high maint-enance and running costs	lack of reliability or durability	lack of seasonal storage	low efficiency			
AUSTRIA		X	X	X					
BELGIUM	X	X	X		X				
DENMARK		X	X	X					
FRG		X		X		X	X		
GREECE	X						X	X	
ITALY		X	X	X					
JAPAN	X	X	X			X			
NETHERLANDS			X	X				X	X
SPAIN		X		X		X			
SWEDEN		X		X					
SWITZERLAND		X	X		X				X
USA	X	X	X	X					

As shown in Table 9, most of the Participants consider economic factor as the main problem in solar components application. Concerning the technical factors, many countries have pointed out the lack of reliability or durability of solar systems components. To understand more details of these problems, comments by the Participants are summarized as follows:

AUSTRIA

(1) Solar- and heat pump systems are at present applied for swimming pool and/or domestic water heating. Solar systems for space heating require - due to the meteorological conditions in Austria - an economic solution of the problem of anticyclic phasing of energy requirements and energy supply. Several concepts have been developed and are now being tested with the goal to find an optimum between capital costs and energy output.

(2) Solar systems require additional investment, and this can only be amortized when the system is highly efficient and has a long working life as well as low maintenance cost. These necessities are not always achieved.

FEDERAL REPUBLIC OF GERMANY

In FRG there exists some trend to combine solar systems with heat pump.

SPAIN

The cost of the installations hinders commercialization. It is difficult to mount solar installations in multi-family buildings (typical of Spanish housing). Low quality of the solar components contributes to the difficulty.

SWITZERLAND

In Switzerland there are minor problems concerning the preservation of natural beauty.

Appendix 1

FORMAT FOR OUTLINE OF NATIONAL R & D PLAN
FOR SOLAR HEATING AND COOLING

COUNTRY: _____

A. NATIONAL R & D TIME SCHEDULE AND GOALS [PLEASE WRITE DOWN ENERGY SUPPLY]

B. GOVERNMENT INCENTIVE MEASURES

			AMOUNT BUDGET
R & D/D BUDGET	R & D		( ) (US$)
	DEMONSTRATION		( ) (US$)
	COMMERCIALIZATION		( ) (US$)
TAX	R & D		( ) (US$)
	DEMONSTRATION		( ) (US$)
	COMMERCIALIZATION		( ) (US$)
LOANS	R & D		( ) (US$)
	DEMONSTRATION		( ) (US$)
	COMMERCIALIZATION		( ) (US$)
LEGISLATURE			

C. STRUCTURE AND ORGANIZATION OF NATIONAL R & D/D

NAMES OF MAIN LABORATORIES

NUMBER OF LABORATORIES: _____

NUMBER OF RESEARCHERS : _____

D. STATISTICS ON SOLAR COMPONENTS (PRODUCTION OR SALES)

	1979	TOTAL (~ 1979)
COLLECTORS	( ) M^2 (US$)	( ) M^2 (US$)
THERMAL ENERGY STORAGE	( ) (US$)	( ) (US$)
SOLAR COOLING	( ) (US$)	( ) (US$)
OTHERS	( ) (US$)	( ) (US$)
TOTAL	( ) (US$)	( ) (US$)

E. STATISTICS ON SOLAR HOUSES, BUILDINGS AND OTHER APPLICATIONS

	CONSTRUCTED IN 1979		TOTAL (~1979)	
	GOVERNMENTAL SUPPORTED	TOTAL	GOVERNMENTAL SUPPORTED	TOTAL
RESIDENTIAL HOUSES				
APARTMENTS				
COMMERCIAL BUILDINGS				
INDUSTRIES				
TOTAL				

SPACE HEATING				
SPACE HEATING AND COOLING				
(HOT WATER SUPPLY) ONLY				
IPH, SWIMMING POOL HEATING ETC.				
TOTAL				

F. NAMES OF MAIN SOLAR HEATING COOLING COMPONENTS MAKERS

G. STATUS OF NATIONAL STANDARDIZATION ON SOLAR HEATING AND COOLING COMPONENTS

H. PROBLEMS IN APPLICATION

I. OTHERS

Appendix 2

LIST OF CONTACT PERSONS - TASK II

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

Country	Institution	Contact Person	Telephone & Telex
AUSTRIA	Austrian Solar and Space Agency (ASSA) Garnisongasse 7 A-1090 Vienna	Prof. G. Faninger	(0222) 1438177 Tlx: 76560 assa a
BELGIUM	Faculté polytechnique de Mons 31 Boulevard Dolez 7000 Mons	Prof. André Pilatte	(065) 338191
DENMARK	Thermal Insulation Laboratory Technical University of Denmark Building 118, DK-2800 Lyngby	Mr. Ove Jorgensen	(02) 883511 Tlx: 375 29 DTH
FEDERAL REPUBLIC OF GERMANY	Kernforschungsanlage Jülich GmbH Programmgruppe Systemforschung und Technologische Entwicklung Postfach 1913, D-5170 Jülich	Dr. Michael Meliss	(02461) 613001 Tlx: 0833556 kfa d
GREECE	Nuclear Research Center Democritos, Agis Puraskevi Attikis	Prof. A. Spyridenos	651 31 11-119
ITALY	CNR Progetto Energetica Via Nizza 128 00198 Roma	Dr. Franco Vivona	(0039) 6-854383 Tlx: 612322 CNR PFEI
JAPAN	Sun Shine Project Headquarters Agency of Industrial Science and Technology MITI 1-3-1 Kasumigaseki, Chiyoda-ku Tokyo	Mr. H. Hayashi	(03) 434-5647 Tlx: 22916 EIDMITI J

Country	Institution	Contact Person	Telephone & Telex
NETHERLANDS	Stichting Energieondersock Centrum Netherland Westerduinweg 3 Petten (NH)	Dr. K. A. Nater	02246-6262 Tlx: 57211
SPAIN	Instituto Nacional de Técnica Aeroespacial Torrejon de Ardoz Madrid	Dr. Ing. L. R. Nadal	--------
SWEDEN	AB Svenska Fläktfabriken S-551 84 Jönköping	Mr. Ove Strindehag	036-118500 Tlx: 70100
SWITZERLAND	Ecole polytechnique fédérale de Lausanne Dept. de physique 33 Ave. de Cour CH-1007 Lausanne	Dr. André Faist	021-264621 Tlx: 24478 EPFVDCH
UNITED STATES OF AMERICA	U.S. Department of Energy Office of Conservation and Renewable Energy 1000 Independence Ave. S. W. Washington D.C. 20585	Dr. F. H. Morse	(202) 252-8084 Tlx: 710 8220176 DOE FRSTL WSH