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COUNTRY NOTEBOOKS ON ALTERNATIVE ENERGY SOURCES FOR AUSTRALIA, JAPAN AND NEW ZEALAND

MASTER

By
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Ian Calder
Susan Farnsworth
Ramon Novo
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September 1979

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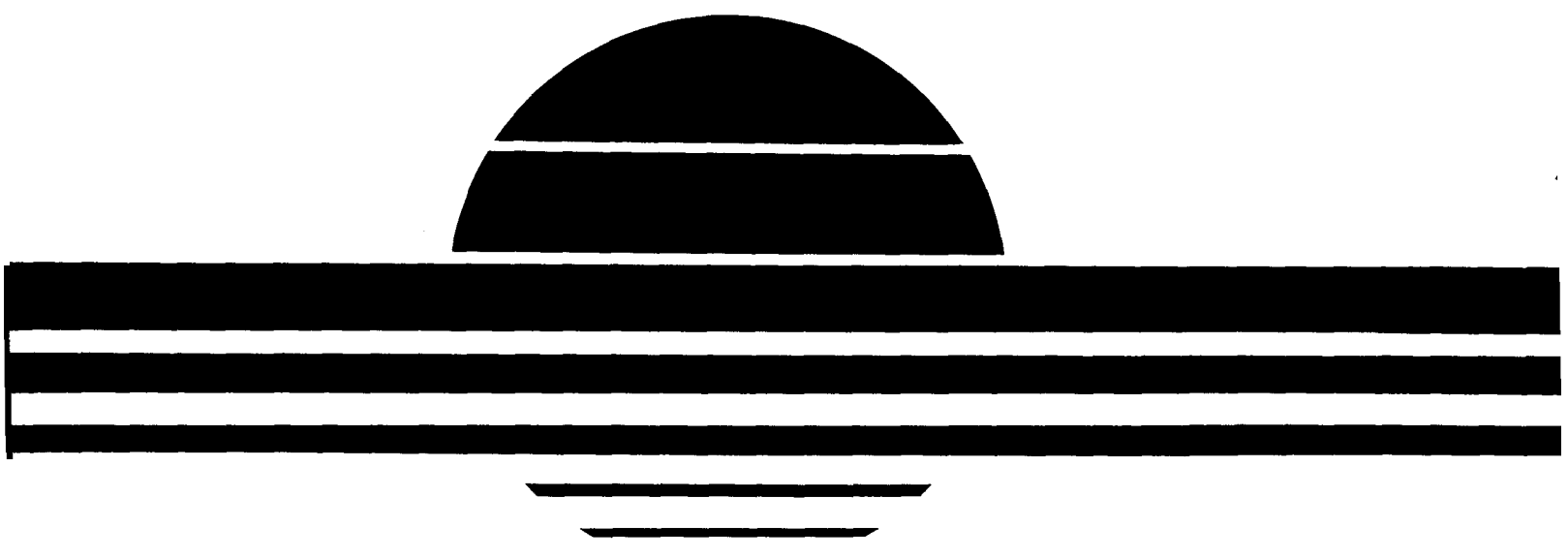
Systems Consultants, Inc.
Washington, D. C.



U.S. Department of Energy

Solar Energy

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SEPTEMBER, 1979

Prepared For:

THE UNITED STATES DEPARTMENT OF ENERGY
Office of Solar Applications
International Solar Commercialization Working Group (ISCWG)
Washington, D. C. 20545
(Under Contract DE-AC01-79CS30028)

COUNTRY NOTEBOOKS

INTRODUCTION

This energy notebook is the second in a series of reports prepared as energy guides to selected countries in Southeast Asia, focusing on the industrialized countries of: Australia, Japan and New Zealand. It is to be used as an aid in assessing the potentials for solar energy related technologies. It was specifically designed as a reference manual that could be employed by U.S. industries in developing a solar energy commercialization strategy.

Country assessment was based on factors deemed critical to the successful commercialization of solar energy technologies. For each country, the following criteria were considered:

1) Renewable Energy Resources Potential
   - Insolation, wind and hydropower potential
2) National and Human Energy Needs
   - Population
   - GNP/capital
   - Existing reserves
   - Energy imports
3) Distribution Problems
   - Transportation and distribution adequacy
   - Degree of urbanization
   - Population dispersion
4) Interest in and Commitment to Solar Energy Development
   - Experience in solar
   - Existing policies
   - Future plans
5) Availability of Capital and Manufacturing Capabilities
   - Manpower
   - Vocational training programs
   - Manufacturing capabilities
   - Capital availability
6) Opportunities for U.S. Business Involvement
   - Trade relations with U.S.
   - Attitude toward foreign investment

Australia, Japan and New Zealand were selected because of their developing solar technology markets. For each country, information has been assembled concerning energy resources, energy economy, governmental energy activities, institutions and individuals involved in energy, and a list of project summaries. In addition, a descriptive national sketch of each country has been provided outlining relevant geographic, economic, and governmental data pertinent to an accurate and realistic assessment of the potential for solar energy commercialization.

Although this notebook is the result of many long and tedious hours of research, it does not presume to be complete and precisely current. On the contrary, many informational gaps were identified in its preparation and, due to the dynamics of the world energy situation the information will require constant updating. This document should be regarded as an initial reference manual. It provides its reader a working knowledge of the energy situation in Southeast Asia, useful in assessing solar energy commercialization.

I

COMMONWEALTH OF AUSTRALIA


INDONESIA
INDONESIA
ARAFURA SEA
CAPE YORK
Darwin
GULF OF CARPENTARIA
INDIAN OCEAN
Wyndham
Derby
NORTHERN TERRITORY
Cooktown
Cairns
CORAL SEA
Townsville
Cloncurry
QUEENSLAND
Alice Springs
Rockhampton
WESTERN AUSTRALIA
Charlesville
SOUTH AUSTRALIA
Brisbane
Bourke
Darling
NEW SOUTH WALES
Geraldton
Coolgardie
Perth
Port Augusta
Adelaide
Murray
Newcastle
Sydney
CANBERRA
AUSTRALIAN CAPITAL TERRITORY
Albany
VICTORIA
Melbourne
TASMANIA
TASMANIA
Hobart
INDIAN OCEAN
AUSTRALIA
International boundary
Internal administrative boundary
National capital
Interna administrative capital
Railroad
Road
International airport
0 200 400 600 Kilometers
0 200 400 600 Miles
120
132
144
156
12
24
36
48

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COMMONWEALTH OF AUSTRALIA

I. ENERGY PROFILE

A. RESOURCES

1. Climate

The climate ranges from tropical in the north to cool and temperate in the southeast, southwest and Tasmania. The North has hot, humid and rainy summers and somewhat longer dry, warm winters. The south has sunny dry summers and mild, rainy winters. There is some winter snow in the eastern highlands and Tasmania. Except on the east coast, rainfall is generally inadequate and variable. There are periodic droughts and floods.

The table on the following page presents parameters of climatological data representative of nearly homogeneous climatic area. The data are average (or representative) values based on a sample of climatological data available from weather stations within the area. The area data do not imply that the specific condition simultaneously exists at all locations within a country or large climatic area. In rolling and mountainous terrain, there may be considerable variation in the data from one location to another within the climatic area.

MEAN NUMBER OF DAYS WITH SKY COVER LESS THAN 3/10 AND VISIBILITY EQUAL TO OR GREATER THAN 3 MILES.

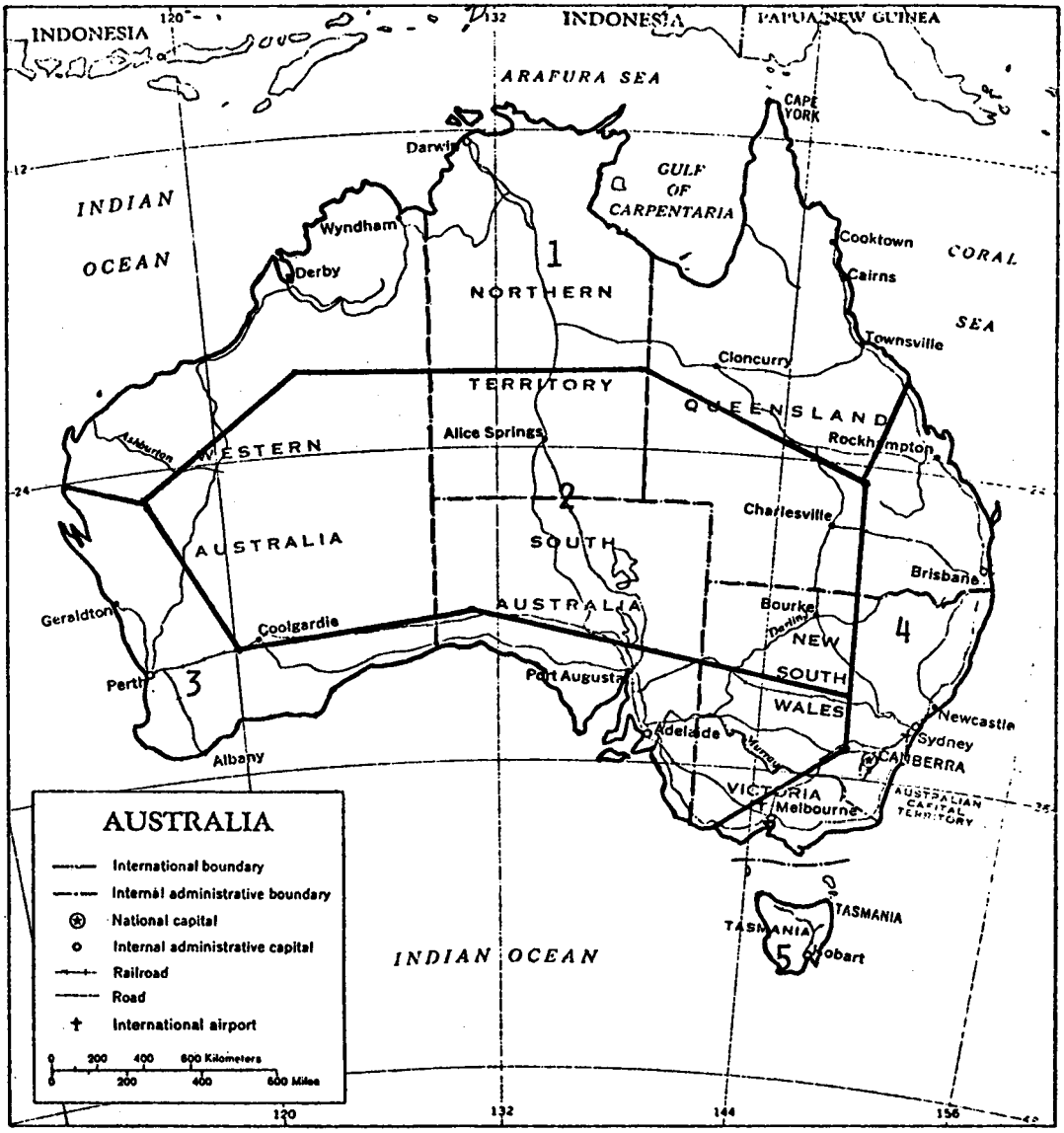
The average of the number of days when, at a specified hour during the day in the specified month, the portion of the sky covered with clouds was observed to be equal to or greater than 3 miles.

MEAN NUMBER OF DAYS WITH SURFACE WIND 4-10 KNOTS AND TEMPERATURE 33-89°F AND NO PRECIPITATION

The average of the number of days when, at a specified hour during the day in the specified month, the surface wind speed was equal to or greater than 4 knots, but no greater than 10 knots, the temperature was equal to or greater than 33°F but not greater than 89°F and there was no precipitation.

Parameter Description		Area 1 N. Coast	Area 2 Interior Desert	Area 3 S. Coast	Area 4 E. Seaboard	Area 5 Tasmania	Area 6 Detached Islands
Max Mean Temp (°F)		89	82	73	74	63	75
Min Mean Temp (°F)		68	55	53	52	46	66
Largest Mean Precip (in)		92.2	15.5	44.3	95.4	40.0	92.7
Smallest Mean Precip (in)		4.7	3.0	5.9	7.8	22.5	19.8
	Time LST						
No. days when surface wind	0900	178.7	133.3	138.8	[a]141.8	[a]167.6	[b]147.8
was 4-10 knots, temperature	1500	141.4	120.2	110.1	[a]142.2	[a]155.4	[b]133.8
was 33-89°F and no precip.	2100	156.0	135.0	146.8	[a]123.1	[a]161.5	[b]105.9
	0300	147.1	128.6	143.3	[a] 98.8	[a]151.1	[b]120.0
No. days when sky cover was	0900	168.9	221.0	147.8	[a]141.2	[a] 85.6	[b] 54.4
less than 3/10 and visibility	1500	161.1	191.8	148.0	[a]119.8	[a] 71.1	[b] 50.9
was greater than 3 miles.	2100	203.0	233.2	186.0	[a]187.7	[a]140.8	[b]104.4
	0300	208.0	251.4	187.3	[a]176.1	[a]126.8	[b] 83.0

LST = Local Standard Time [a] = LST + 1 hour [b] = LST + 2 hours



2. Renewable Resources

a. Solar radiation:

Place	Mean solar radiation on horizontal surface: Best month, $MJ.m^{-2}day^{-1}$	Mean solar radiation on horizontal surface: Worst month, $MJ.m^{-2}day^{-1}$
Alice Springs	26.7	14.8
Darwin	23.2	18.4
Hobart	23.2	5.1
Melbourne	24.9	6.3
Perth	28.8	9.4

b. Biomass: Wheat and sugar cane are the biggest agricultural crops and waste from them is very large. Wheat straw amounts to about 15 million tons annually. Sawmill residues amount to more than 4 million tons annually. Wood left in the forest as branches and stumps equal 10 million tons.

c. Tidal wave: The north-west coast of Australia has an exceptional tidal range, and it has been estimated that the tidal power potential of this area is 300,000 MW.

d. Geothermal: Australian goechemists have been making some studies of the few "hut" areas of the earth's crust in Australia, but it appears unlikely that these areas would be suitable for power generation.

e. Hydropower: The hydropower potential of Australia is limited. The greatest potential for future development is in Tasmania with about 3000 MW. About half of the country's hydroelectric potential has already been developed.

f. Wind: South Australia has suitable sites for wind installations, but the load factor is low and Australia does not appear to be a favorable location for wind energy.

g. Other: Australia produces 10 million tons of wood annually.

3. Non-Renewable Resources

a. Oil: There are 1.6 billion bbls of oil reserves in Australia and production is 436,365 bbls/day.

b. Natural Gas: Reserves of natural gas are 38 trillion cubic feet. Production is 7 billion cubic meters. There are 800 million bbls of naturally occuring LPG reserves and production is 18 million bbls annually.

c. Coal: Total proven reserves of coal in the country are 29000 x 10^6 tonnes. Production is 80 million short tons/year.

d. Uranium: 56,500 tons of uranium have been proven with an additional 95,000 tons indicated and probable.

B. ENERGY ECONOMY

1. Supply Descriptor

In 1975, oil supplied 48% of all primary energy, coal 40% and natural gas 7%. The remainder was supplied by bagasse 2%, hydroelectric 2%, and wood 1%.

About 65% of oil is supplied from indigenous sources at present, however, this will drop to 25% by 1985 if no new oil fields are discovered. All of the natural gas requirements are provided from domestic sources and prospects are good that these sources can be available for 50 years. All coal requirements are met by domestic sources and coal reserves are large in relation to annual consumption.

2. Conversion Descriptor

Transportation uses 40% of available energy and 47% is required as heat at various temperatures. Electricity requires 13% of available energy.

Primary energy for the generation of electricity is coal 81%, oil 7%, natural gas 6%, and hydroelectric 6%.

3. Transport/Distribution Descriptor

The overall transportation system and its associated services are well developed. Most of the public railroad mileage is concentrated within 200 miles of the coast. The use of different rail gauges by various state-owned systems has handicapped Federal Government efforts to achieve an integrated national rail network, although recently, all continental state capitals have been linked to a standard gauge system.

The main towns, particularly in the east and southeast, are served by lateral roads and by roads connecting them to port cities. Further inland, however, roadways remain unimproved.

A natural gas pipeline grid supplies gas to many of the provincial cities from various gas fields.

3. Transport/Distribution Descriptor (continued)

An electrical grid is well established in the highly populated areas, however, no electrical grid exists in northwest or central Australia.

4. End Use Descriptor

- Oil is the main source of energy for transportation and most of the country's heating needs.
- Coal resources are used internally for electricity production, smelting and process heat.
- Natural gas is used for electricity production and heating.
- Homes consume only 6% of energy in Australia while industry consumes 50%.

5. Statistics

a. Supply:

Source	Joules x 10^{18} per year (1977)
Oil	1.320
Coal	1.148
Natural Gas	0.258
Renewable	0.095
Hydro	0.049
Total	2.870

PRODUCTION OF ELECTRICITY (1976)	
Thermal	61,003 x 10^9 kWh
Hydro	15.596 x 10^9 kWh
Total	76.598 x 10^9 kWh

INSTALLED ELECTRIC GENERATING CAPACITY (1976)	
Thermal	16,625 MW
Hydro	5,595 MW
Total	22,220 MW

b. Projections of demand: It is estimated that Australian primary energy consumption by the year 2000 will be 7.5×10^{18} joules per year.

c. Imports/exports: Australia is a net exporter of energy by a small margin since its exports of coal in energy terms slightly exceed imports of oil.

6. Energy Needs

Coal reserves are so large that the primary energy needed for electric power is considered secure for several decades.

Natural gas is expected to become a major source of energy for industry by 1985, but reserves are such that it cannot be relied on much beyond 2025.

The most urgent need is to find a replacement for oil which is the main source of energy for transportation.

7. Peculiarities

a. Special problems: Australia has higher reserves of coal and uranium per capita than any other country. Their gas reserves are second only to the USSR and the Middle East. However, 50% of energy consumed is oil while oil reserves are only 1% of their total fossil fuels. Coal, on the other hand, supplies 41% of their energy needs yet makes up 95% of the country's reserves, while natural gas consumption at 9% represents 4% of reserves. Australia, with approximately 28% of the world's uranium reserves, has no nuclear power program and future uranium production will be almost entirely for export.

Very inexpensive electric power costs, nearness of large population to immense sources of coal for electricity generation, and Australia's generally mild climate have not provided many incentives for utilization of solar energy technologies.

b. Special opportunities: The general concensus of the Solar Energy Industries Association of Australia is that the bulk of U.S. business opportunities in the Australian solar energy industry will center in either licensing agreements with existing Australian solar energy manufacturing firms and/or in export of high technology components for use in equipment to be manufactured locally.

In the short to medium term, opportunities exist in solar domestic water heating, solar air conditioning, swimming pool heating, industrial solar water heating equipment and photovoltaic cells. In the long term, opportunities will exist for American technology to build solar power towers and ocean thermal energy conversion systems.

8. Project Summaries

Volume I (A Directory of Australian Solar Energy Research and Development, Department of National Development), of the three volume Australian Solar Summary, describes 134 current solar energy R and D projects. A few of the projects that are in the implementation or demonstration phase are listed on the following Project Summary sheets.

INSTITUTION/ORGANIZATIONS	CONTACT	ACTIVITIES
Beasley Industries Pty Ltd	E. Beasley	Industrial Collectors: In conjunction with the CSIRO Solar Energy Studies unit under the direction of Mr. R.N. Morse, Beasley Industries have produced the first doubled glazed low-iron glass industrial collectors used in Australia. The collectors are installed on a demonstration project at Queanbeyan NSW and are being installed on another at a brewery in Adelaid South Australia. The absorber panels are coated with electrodeposited chrome black selective surfaces.
South Australian Gas Company	W. Iwanicki	Solar/Gas Water Heater Development Aim: To design and construct a prototype roof-mounted solar/gas domestic water heater. Aspects Involved: Domestic hot water consumption assessment, solar panel evaluation, appliance design, experimental work and testing. Nature of Project: Prototype demonstration.
Australian Government Department of Construction	P. Becker	Solar Water Heating: Large-scale application of solar water heaters to dwellings in Darwin.

INSTITUTION/ORGANIZATIONS	CONTACT	ACTIVITIES
CSIRO Solar Energy Studies Unit	R.N. Morse	Demonstration Projects: The solar energy demonstration projects form part of Australia's contribution to the CCMS Solar Energy Pilot Study under which participating countries undertake to exchange information and cost effective applications of solar energy. Demonstration projects evaluated include: Solar Hot Water Systems at • the Somers Yacht Club near Melbourne • the Sacred Heart College in Adelaide • the CSIRO Phytotron building in Canberra • industrial process heating for can warming in Queanbeyan, NSW.
The University of New South Wales, Faculty of Architecture Research Group - Solarch Group	John A. Ballinger	The Solar Experimental House Mk 1: The project involves the design, construction and monitoring of an experimental, prefabricated solar house at Fowlers Gap, the University of New South Wales Arid Zone Field Station 120 km north of Broken Hill, NSW. The aim is to study and demonstrate the architectural integration of solar energy in domestic building by both passive and active means.

INSTITUTION/ORGANIZATIONS	CONTACT	ACTIVITIES
University of Melbourne Mechanical Engineering Department	W.W.S. Charters	Solar passive wall heating systems Intensive numerical computational studies have been carried out on the applicability of the Trombe Michel wall concept to house heating in the Melbourne area. A test cell incorporating variable slot control and wall geometry has been constructed. Performance testing will be carried out to establish the effects on the air flow of temperature stratification in the room and gap width between the glazed wall and the collector element.
Australian Government Department of Construction	P. Becker	Low energy housing: Participation with CSIRO on low energy consumption housing with an emphasis on both active and passive use of solar energy. Passive heating of buildings: Maximising passive use of solar energy in buildings, particularly government housing.
Comalco Ltd.	J. Leigh	Applications of Solar Energy in Mining Areas: The aim of the project is to use solar energy for domestic air conditioning in mining towns.

INSTITUTION/ORGANIZATIONS	CONTACT	ACTIVITIES
University of Queensland Department of Architecture	Mr. S.V. Szokalay	Design of Houses for Hot Humid Regions and Suitable for Adding Solar Air Conditioning: The project is designed to examine the climatic suitability of houses in hot-humid regions of Australia and to produce an optimum design for a house that would, without air conditioning, perform at least as well as any current design but would be suitable for subsequent installation of air conditioning. The project aims to design and construct such a building where the reduced air conditioning requirement is satisfied by a primary solar powered system.
University of Melbourne Mechanical Engineering Department	W.W.S. Charters	Air cooled absorption cycle solar systems: A design optimisation has confirmed that a lithium bromide/water absorption cycle system can be operated from a solar heated source and use air cooling in place of the conventional cooling tower concept. A laboratory prototype unit has been constructed, preliminary performance tests are at present being evaluated. The aim of this project is to develop a system capable of being solar operated in arid regions or regions where the water quality is suspect.

INSTITUTION/ORGANIZATIONS	CONTACT	ACTIVITIES
The BHP Co. Ltd. - Melbourne Research Laboratories	Dr. W.J.McG. Tegart	Solar Energy: The project aim was development of a reduced vapor pressure water heating solar collector, and a solar powered air conditioning unit, aimed at mining areas. Construction and extensive testing of solar water heating and solar air conditioning systems - heating units are presently operating at Groote Eylandt and Melbourne and others are planned for Port Hedland and Paraburdoo (WA). The air conditioning system R&D includes the development of a solar/ mechanical converter.
Australian Government Department of Construction	P. Becker	Solar air conditioning: Construction of a solar air conditioning office building in Townsville, Queensland, to test the design methods, component performance, and the economics of solar air conditioning. The building will have a conventional water chiller and extensive monitoring equipment to allow for long term comparisons.
University of Queensland Department of Chemistry	L.E. Lyons	Thermal electric conversion: To operate and evaluate a solar thermal electric (total energy) system coupled to a small building.

INSTITUTION/ORGANIZATIONS	CONTACT	ACTIVITIES
Australian Telecommunications Commission Research Laboratories, Physical Sciences Branch	G. Mitchell and B. Chisholm	Evaluation of solar power module packaging: To evaluate the environmental resistance, under simulated laboratory conditions, of solar cell arrays intended for possible use on the Alice Springs - Tennant Creek Microwave Carrier System. Includes tests of the packaging to see if it can withstand high/low temperatures, high humidity and condensation, solar radiation, dust abrasion, etc.
University of Queensland Department of Mechanical Engineering	Dr. N.R. Sheridan	Performance Estimates of Concentrating Solar Collectors: The objective is to predict the performance of a photovoltaic total energy system. A computer simulation of a concentrating solar collector system, using a ray tracing technique, was then compared with the measured performance of a parabolic cylinder concentrator. Initial investigations have also been made in a stationary-reflector-tracking-absorber concentrator. The proposed use of the device is for an autonomous energy system.

INSTITUTION/ORGANIZATIONS	CONTACT	ACTIVITIES
University of New South Wales	Professor D. Haneman	Solar Energy Conversion: The aims are to convert solar energy to electricity plus hydrogen and heat by an integrated method. Emphasis at present is on producing an economically competitive system which will provide energy for local consumption. Laboratory research and pilot plant tests are in progress. The method is based on large area sheets of semi-conductor polycrystalline film immersed in a shallow pond of electrolyte and exposed to sunlight. The present pilot plant has low efficiency, low cost and durability. Research on more efficient systems is in progress.
Western Australia Institute of Technology, Department of Electrical Engineering	Trevor Marshall	The Solar Powered Generation of Electricity: The project aims to identify those areas of energy usage where Solar Thermal Processes may be usefully employed. The first phase that of a literature search has been completed. A pilot plant has been designed and awaits funds to allow its implementation.

C. GOVERNMENT ENERGY ACTIVITIES

1. Energy Policy

While Australia does not have a planned national energy policy, the Government's immediate energy goal is to reduce her dependence on imported oil. The Government has therefore indicated five areas of support and cooperation: effective use of existing resources and energy conservation, increase the availability of indigenous crude resources, production and use of synthetic fuels, use of alternative fuels and improved coal utilization.

A Report on Solar Energy, from the Senate Standing Committee on National Resources, calls for the establishment of an energy policy for Australia and contends that the lack of an overall policy has hindered R&D progress for alternative energy sources. However, until a long term energy policy is formulated, it is imperative that solar energy research continue to maintain a sufficient level of funding.

Key funding agencies are: CSIRO, Electric Research Board (ERB), Australian Research Grants Committee (ARGC), National Energy Research Development and Demonstration Committee (NERDDC), and Australian Mineral Industry Research Association (AMIRA).

a. Ministry

Department of National Development
P.O. Box 5, Canberra Act 2600
Minister, Mr. Kevin Newman
Assistant Secretary, Energy Office,
Dr. Alastair Christie
Principal Executive Officer, Energy
R&D Division, C. Hughes

b. Structural descriptor

The Department is responsible for the overall energy development and electric power. It includes Hydrocarbons, Uranium, Electric Power and Energy Planning divisions. The Planning Division formulates overall energy policy objectives. The Department is also in charge of financial and manpower resources devoted to R&D in Australia and it has conducted a pilot survey of energy R&D activities in CSIRO. In 1976/77 there were 93 projects in solar energy R&D which included developing improved

b. Structural descriptor (continued)

selective surfaces, studying the properties of absorbers, testing collectors and demonstration projects. The Minister has recently set up the National Energy Advisory Committee (NEAC), part of whose responsibilities are to make recommendations concerning energy research and development in Australia.

An extensive review of research and development projects in Australia may be found in the Department's A Directory of Australian Solar Energy Research and Development, Canberra, Australia, 3 Volumes. The Directory lists 143 solar energy research projections; 30 are conducted by CSIRO, 80 in universities and other educational bodies, 19 in industry and 14 in other government organizations.

c. Funding

The 1976-77 financial report on energy R&D indicated a total expenditure of $A3.1 million in solar R&D.

2. Principal Energy Involved Offices

a. Name

National Energy Research, Development and Demonstration Council (NERDDC)
Chairman, Mr. J.B. Kirkwood

b. Structural descriptor

Under the Government's energy policy approach, the Council advises the Minister for National Development on the development and coordination of a national program of energy research, development and demonstration. In particular, the Council examines R&D efforts to ensure that they reflect the Ministry's priorities and indicates those areas being neglected or receiving unnecessary duplication of effort.

b. Structural descriptor (continued)

In September 1978, seven Technical Standing Committees, covering all aspects of energy R&D were established to assist NERDDC in the selection of government grants.

The Chairman of the Committee on Solar-Thermal Conservation and Magneto Hydrodynamics is Professor C.N. Watson-Munro (University of Sydney). The Committee for Solar-Electric, Hydrogen, Transporation, Batteries and Environment is chaired by Professor L.E. Lyons (University of Queensland).

c. Funding

The budget for FY 1978/79 - 1980/81 provides $A15.40 million. Of this amount solar thermal, conservation and MHD will receive 9.63%, and solar electric, hydrogen transport and batteries will receive 11.59%. Other program areas are Technology of Synthetic Fuels, 30.19%, Technology of Fossil Fuel Resource Assessment, 10.69%, Coal Mine Site Technology, 20.49%, Technology of Coal Utilization, 12.42% and Nuclear Energy, 4.99%.

The 1978/79 program of R&D projected $A1,368,020 for solar industrial applications which include collectors, wind research and solar architecture. Part of the R&D funds will be derived from the coal research levy of 5 cents/tonne, which with accruals from last year will provide approximately $6 million.

NERDDC funds are additional to those which the Government provides through CSIRO, AAEC, the Australian Research Grants Committee and the Australian Industrial Research and Development Incentives Board.

a. Name

Commonwealth Scientific and Industrial Research Organization (CSIRO)

b. Structural descriptor

CSIRO consists of a number of departments involved in various aspects of energy R&D. Those working in alternative energy sources are indicated:

- Solar Engineering Unit
  CSIRO Division of Mechanical Engineering
  P.O. Box 26
  Highett, Victoria 3190
  Director: Mr. W. R. Read

  In June 1978 CSIRO formed a Solar Engineering Unit within the Division of Mechanical Engineering in Melbourne, from the former Solar Energy Studies Unit. A function of the new Unit is to direct attention to areas of application of solar heating with the best potential, especially for conserving liquid fuel, and to conduct developmental investigations and demonstration studies for this purpose. The Unit also maintains contact with solar heating research, development and demonstration activities in Australia and overseas. In addition, it provides data needed by research workers on solar energy and contributes to the analysis of present technology. The CSIRO Solar Engineering Unit has two solar industrial heat generation systems in operation, one providing hot water for a soft drink can warmer and the second for beer pasteurization. Additional projects involve CSIRO and the Solar Energy Research Institute of Western Australia for a bottle washer installation at Perth. Another, between CSIRO and the New South Wales Energy Authority for process water heating in an abattoir is in the advanced design stage. A milk pasteurization installation being funded by the Victorian Solar Energy Research Committee is expected to be installed within the next few months.

  Collector test facilities have been developed to obtain the absolute performance characteristics of solar collectors for research purposes. Facilities include both indoor and outdoor test rigs, covering an operating temperature range from 1°C to 300°C. Currently CSIRO is the only agency providing test results on collectors. CSIRO has also developed a roof integrated solar air heater which has been installed in a Low Energy Consumption House in Melbourne.

b. Structural descriptor (continued)

Mr. W.R. Read, solar heating applications, solar timber kiln, solar stills.
P.I. Cooper, solar stills
Senior Technical Officers: E.T. Davey, David Proctor, Mr.K. Peck, R.V. Dunkle, Donald Close, M. Kovarik, J.H. Reid

- Division of Mechanical Engineering Field Station at Griffith, N.S.W. Field experiments are being conducted on solar water heating distillation and timber drying installations.

- Division of Atmospheric Physics
  P.O. Box 77, Mordialloc, Vic. 3195
  B.G. Collins
  G.W. Paltridge
  The National Center for Radiation Instrument Calibration, and Analyses: the availability and character of solar radiation for Australia.

- Division of Building Research
  P.O. Box 56, Highett, Vic. 3190
  J.W. Spencer
  E.R. Ballantyne
  P.J. Walsh
  L.F. O'Brien, Thermal insulation
  R.K. Hill
  Determine a method of building design based on climatic data.

- Division of Irrigation Research, Private Bag, Griffith, N.S.W. 2680.
  K.V. Gartoli
  E.S. Trickett
  Working on plastic greenhouses and solar radiation measurements.

- Division of Plant Industry
  P.O. Boc 1600
  Canberra City, A.C.T. 2601
  R.M. Gifford
  CSIRO has been involved in R&D in the production of ethanol. The goal of the program is to produce 70,000 tonnes per day of ethanol by the year 2000 from wood and plant material. About 200 million tonnes of wood and plant material are required annually to produce ethanol at this rate.

b. Structural descriptor (continued)

- Division of Food Research
  Delhi Road, North Ryde, N.S.W. 2113
  W. Szulmayer
  Work involves concentration of solar heat.

- CSIRO Experimental House, Highett, Victoria
  Malcolm Peck
  The experimental house with an integrated roofing system was built by Jennings Institute. It has been operating since December 1978 but there is no data available.

- Division of Mineral Chemistry
  P.O. Box 124, Port Melbourne, Vic. 3207
  A.F. Reid
  A.F. Wilson
  Development of selective surfaces.

c. Funding

CSIRO will receive an estimated $3 million in R&D by the Commonwealth Government.

- a. Name

National Energy Advisory Committee
Chairman: Mr. G.J. Lynch

b. Structural descriptor

The function of NERC is to advise the Minister for National Development on matters relating to energy including Australia's energy reserves, and factors which may influence energy supply and demand, the cost of energy and the assessment and development of Australia's energy resources.

- a. Name

The Australian Science and Technology Council (ASTEC)
Professor R. Street, Chairman of the Energy Committee

b. Structural descriptor

Conducting a study of current energy research and development activity in Australia.

- a. Name

  Australian Academy of Science

  b. Structural descriptor

  Advisory body which recommends energy objectives and R&D programs undertaken by the Australian government.

- a. Name

  Atomic Energy Commission
  45 Beach Street
  Coogee, N.S.W. 2034
  Dr. D.H. Bradhurst
  Ivan Mayer

  b. Structural descriptor

  R&D on producing hydrogen by photoelectrolysis.

- a. Name

  Solar Energy Research Institute of Western Australia (SERIWA)
  365 Wellington Street, Perth
  Tel:326-4240
  Mrs. Susan Saunders, Executive Officer;
  Dr. R.R. Booth

  b. Structural descriptor

  Western Australia depends on oil for approximately 70% of its energy needs and has less than three percent of Australia's total fossil fuel resources. Consequently, the development of alternative energy resources is of much importance. To promote and encourage alternative energy, the Solar Energy Research Institute was established in late 1977 shortly after the passing of the Solar Energy Research Act, 1977. The Institute is charged with the responsibility of:

  - encouraging the general development of solar energy within the State and fostering solar research,
  - undertaking research projects and evaluating such projects,

- investingating matters referred to it by the Minister for Fuel and Energy,

- coordinating solar energy research projects undertaken by others within the State by agreement,

- receiving and considering applications for funding and allocating research funds,

- monitoring and evaluating solar research projects funded by the Institute,

- maintaining a library of information relating to solar energy, and

- collaborating with other bodies interested in solar research both within the State and elsewhere. Areas of R&D interest to the Institute are water heating, small to medium scale power production, air conditioning and industrial applications and mineral processing.

Finally, SERIWA promotes public awareness of matters relating to solar energy research and informs the general public of specific and general developments.

The Institute is empowered to enter into agreements with others, to conduct research activities itself and it may apply for, or join with others applying for patent rights and industrial design registrations.

Approved grants commit SERIWA to $822,220 over the next three years involving projects with a total value in excess of $3.5 million. SERIWA is also involved in project testing with the Energy Commission, for domestic water heaters, University of Western Australia (Department of Mechanical Engineering) in high temperature collector systems and WAIT (Department of Mechanical Engineering) in flat plate collectors. In addition, SERIWA will be purchasing commercial

b. Structural descriptor (continued)

and semi-commercial solar collectors available outside the State, systematically testing their characteristics and providing the information to interested groups. SERIWA has joined the State Energy Commission in its Project RAPSI, aimed at the systematic investigation of the cost and feasibility of providing energy requirements in remote areas of Western Australia by alternative means. It is sponsoring a A$2 million project in alternative energy sources and windpower.

c. Funding

In FY 1978/79 SERIWA received an initial grant of $250,000 and an additional $600,000 in 1978/79 from the Government of Western Australia. The following projects are receiving support from SERIWA as of April 1979:

PROJECT	AMOUNT APPROVED $	TIME PERIOD	TOTAL PROJECT VALUE ($A000's)
SERIWA			
Purchase of Research Equipment Data Logger for use by Project 410/32 - WAIT Solar Air Conditioning	16,400		16.4
Data Logger wind and radiation measuring equipment for use by Project 710/48 - Kounis Metal Industries	16,500		16.5
Purchase of Collectors Flat Plate, Concentrating, Vacuum Tube, Solar Cells and others for demonstration and test purposes	4,000		4.0
Dissemination of Information	12,000		5.0
Reference Library	1,000		1.0
Test Facility at WAIT	18,220		23.0
STATE ENERGY COMMISSION OF W.A.			
Solar Air Conditioning Northern Gas Depot	30,900	2 yrs.	75.0
UNIVERSITY OF WESTERN AUSTRALIA			
Low Cost Indirect Solar Water Heater Faculty of Architecture and Edwards Hot Water Systems	13,600	1 yr.	13.6
Radiative Cooling for Air Conditioning Applications - Department of Mechanical Engineering	42,000	2 yrs.	68.0
Low Cost Concentrating Solar Collectors for Industrial and Mineral Processing Applications - Department of Mechanical Engineering	56,500	2 yrs.	82.5
Monitoring Solar Air Conditioning for two houses in the Pilbara - Department of Mechanical Engineering and AMIRA	45,000	2 yrs.	450.0

c. Funding (continued)

PROJECT	AMOUNT APPROVED $	TIME PERIOD	TOTAL PROJECT VALUE ($A000's)
WESTERN AUSTRALIAN INSTITUTE OF TECHNOLOGY			
Trickle Plate Collector Department of Mechanical Engineering	1.800	1 yr.	6.0
Monitoring Performance of Lithium Bromide Absorption Solar Air Conditioning Unit Department of Mechanical Engineering	8,800	1 yr.	62.0
Materials Performance Department of Physics	9,600	2 yrs.	13.8
MURDOCH UNIVERSITY			
Solar Radiation Measurements Institute for Environmental Sciences	8,200	2 yrs.	14.7
Investigation of Solar Monitoring Information - Institute for Environmental Sciences	10,800	½ yr.	10.8
Cadmium Sulphide Copper Sulphide Solar Cells - School of Mathematical and Physical Sciences	34,200	2 yrs.	72.0
SOLAR WATER HEATER MANUFACTURERS			
Chrome Black Treatment Bath Facility S W Hart and Co Pty Ltd	55,000	2 yrs.	1,700.0
Development of Low Cost, High Performance Collector S W Hart and Co Pty Ltd	50,000	2 yrs.	
GENERAL MANUFACTURERS/BUILDERS/COMPANIES			
Monitoring Solar House at Greenmount Quark Pty Ltd/WAIT	25,400	3 yrs.	100.0
Industrial Solar Air Conditioning Kounis Metal Industries	45,700	1 yr.	140.0
Demonstration and Monitoring of a Solar Space Heated House Unibuild Pty Ltd	18,000	2 yrs.	159.0
Industrial Solar Air Conditioning Using Concentrating Collectors National Iron & Steel and University of W A (NIS contribution $15,000)	50,400	1 yr.	128.3

c. Funding (continued)

PROJECT	AMOUNT APPROVED $	TIME PERIOD	TOTAL PROJECT VALUE ($A000's)
Pritchard Steam Engine Testing for Solar Use National Iron & Steel and University of W A (NIS ontribution $10,000)	74,300	2 yrs.	90.0
INDIVIDUALS			
Solar Energy School Project John XXIII College	600	1 yr.	1.2
Construction of a Solar Water Heater Using the Heat Pipe Principle W. L. James	12,800	½ yr.	12.8
United States survey for SERIWA funded projects P. M. Driver	500	1 mo.	1.5
STATE AND LOCAL GOVERNMENT			
Solar Monitoring Equipment Shire of Carnarvon	10,000	1 yr.	14.0
Solar Passive and Active Design in SHC House - SHC/SERIWA	50,000	2 yrs.	205.0
INTERSTATE CO-OPERATIVE VENTURES			
Industrial Solar Water Heating CSIRO/SERIWA and Solo Kool Drinks (CSIRO contribution $35,000)	85,000	2 yrs.	90.0
TOTAL	822,220		3,576.1

a. Name

New South Wales Solar Energy Advisory Committee
E.A. Woodley, Chairman

b. Structural descriptor

Formed within the Energy Authority of N.S.W. The Committee's purpose is to advise and encourage R&D efforts in solar technology.

- a. Name

  Victoria Solar Energy Research Committee
  Mr. B. W. Court

  b. Structural descriptor

  The Committee is the official organ of the Victorian Government to promote the use of solar energy in the public and industrial sectors.

  c. Funding

  A$200,000

- a. Name

  Queensland Energy Resources Advisory Council
  Mr. J.T. Woods, Chairman

  b. Structural descriptor

  The Council is responsible for the planning and exploitation of the State's energy resources and recommends plans for the optimum use of all sources.

- a. Name

  South Australia State Energy Research Advisory Committee (SENRAC)
  Mr. B.P. Webb

  b. Structural descriptor

  Assesses R&D projects in South Australia and recommends to the Government those projects which require financial assistance.

  c. Funding

  A$200,000

- a. Name

  Tasmania Energy and Resources Committee
  A.B.K. Lohrey, Chairman and Minister for Resources and Energy

  b. Structural descriptor

  The Committee's responsibility is to encourage energy conservation in Tasmania. It is also in charge of gathering all information relating to the State's mineral and energy requirements.

3. Legal

a. Incentives, barriers

- Incentives

As part of the Government's goal to develop a national energy plan, Australia has established energy pricing levels to encourage conservation The price of domestic crude oil has been raised to world parity which should provide a competitive advantage to the natural gas utilities.

The Government has also recently applied a levy to coal production to help finance coal research and is now considering the possibility of extending this to other forms of energy.

- Barriers

In Sydney, the electric rate structure penalizes solar installations as the Sydney electric commission allows a drop in rates from 6.28¢ kwhr if a large storage vessel is installed for domestic hot water, but does not extend this to solar installations.

In Queensland, if a solar system is put on the roof to heat domestic hot water, there is no sales tax, but if the same system is used for home heating, there is a 15 to 19% sales tax imposed by the Federal Government.

4. Political

Under the Australian Constitution, energy is one of the residual repsonsibilities which remain with the individual states. Presently, three states have acted to promote solar energy R&D. Western Australia has established, as a statutory body, the Solar Energy Research Institute of W.A. (SERIWA), Victoria has appointed a Solar Energy Research Committee to advise its Minister for Minerals and Energy, and the South Australian Minister for Mines and Energy recently announced grants for solar energy R&D, recommended by his Energy Advisory Committee. New South Wales and Queensland are also moving to establish similar groups so it is likely that the Federal Government and all the mainland states will be involved in solar R&D work. However, with numerous groups working on soalr R&D at the Government level there will be a problem in coordination. Thus, the Institution of Engineers' Working Party on Solar Energy has recommended the formation of an Australian Energy Council to coordinate the development of solar energy R&D programs.

5. International

a. Organization involvement

Member of: ADB, AIOEC, ANZUS, CIPEC (associate), Colombo Plan, Commonwealth, DAC, ELDO, ESCAP, FAO, GATT, IAEA, IATP, IBA, IBRD, ICAC, ICAO, IDA, IEA, IFC, IHO, ILO, International Lead and Zinc Study Group, IMCO, IMF, IOOC, IPU, ISO, ITC, ITU, IWC--International Whaling Commission, IWC--International Wheat Council, OECD, U.N., UNESCO, UPU, WHO, WIPO, WMO, WSG.

b. Bilateral agreements

There are four broad Science and Technology Agreements which provide an umbrella for cooperation in energy projects. These Agreements are with USA, USSR, India and the Federal Republic of Germany.

There are also a number of more specific Agreements which have been concluded, most within the last year. They are:

- Coal Information Agreements with the U.K. Coal Board and the U.S. Department of Energy
- An Agreement with Japan to cooperate in the fields of coal utilization, solar energy and energy conservation
- Additionally, negotiations are proceeding for a coal agreement with the U.S. Bureau of Mines and a solar energy agreement with the U.S. Department of Energy.
- United States/Australia Agreement for Scientific and Technical Cooperation 1979. To encourage joint research projects, exchange of scientists, seminars and planning information. Most of the activity involves direct cooperation between governmental agencies and labs in both countries.

D. INSTITUTIONS INVOLVED IN ENERGY

1. Academic

- **Name:** Flinders University
  Bedford Par, South Australia 5042

  Department: Institute of Solar and Electrical Conversion

  Fields of energy interest: Measurements of the output of a standard Dunlite generator and wind speed are being conducted. The results will serve as a data base for the manufacturer's development programme.

  Key personnel: John Bockris, solar-hydrogen energy system.

- **Name:** University of Western Australia,
  Nedlands, Western Australia 6009

  Department: Mechanical Engineering
  Faculty of Architecture
  Department of Physical and Inorganic Chemistry

  Funding: Received A$71,050 (FY 78/79) from SERIWA.

  Fields of energy interest: Faculty of Architecture is constructing an inexpensive collector made of steel using an inert liquid to absorb the heat.
  Department of Mechanical Engineering evaluation of radiative cooling for air conditioning applications and development of a low cost concentrating solar collector for industrial and mineral process heating.
  Department of Physical and Inorganic Chemistry to evaluate the suitability of the photogalvanic effect for the conversion of solar energy into electricity.

  Key personnel: Department of Mechanical Engineering
  D.D. Carruthers, heating and cooling
  Mr. P.M. Driver, B. Landro
  P.G. McCormick
  Department of Physical and Inorganic Chemistry; T.I. Quickenden,
  Mrs. G.K. Yim

1. Academic (continued)

- Name: University of Queensland, St. Lucia, 4067

  Department: Architectural Science Unit
  Department of Chemical Engineering
  Department of Mechanical Engineering

  Fields of energy interest: Architecture: involved in the design of "Solar City", 35 km south of Brisbane, which is planned to include 4000 houses and all supporting facilities of a self-contained community of 15-18,000 people. Chemical Engineering: production of ethanol. Department of Mechanical Engineering: Work has begun on the development of a thermal-electrical solar power module which could be applied to supply power to (a)isolated farm houses (b)isolated townships and (c)urban residences. Results of this work will be applied to a housing project on a 1383 acre site in Brisbane, Queensland which will feature solar water heating for all houses. In addition, standards for rating domestic solar water heaters are being examined. Development of a Stirling cycle solar engine is also in process.

  Key personnel: Department of Mechanical Engineering; M.W. Gunn, L.E. Lyons, N.R. Sheridan, R.K. Pillay, I. Ahmad, M.K. Peck
  Architectural Science Unit; S. V. S.V. Szokokay and M. Arch
  Department of Chemical Engineering; Don Nicklin

- Name: Western Australian Institute of Technology, Hayman Road, South Bentley, W.A. 6102

  Fields of energy interest: Investigate the use of solar hot water systems for the State Fuel and Power Commission.

  Key personnel: J.J. Harler

1. Academic (continued)

- Name: The University of New South Wales
  Broken Hill Division
  P.O. Box 334, Broken Hill, N.S.W. 2880

  Department: Department of Mining and Mineral Sciences

  Fields of energy interest: Solar air conditioning system components.

  Key personnel: I. L. MacLaine-Cross

- Name: The University of New South Wales
  P.O. Box 1, Kensington, N.S.W. 2033

  Department: Mechanical and Industrial Engineering, Electrical Engineering
  Department of Architecture
  School of Physics

  Fields of energy interest: Mechanical and Industrial Engineering; solar radiation observations, photovoltaic conversion, solar water heaters.
  Electrical Engineering; new semi-conductor structures for solar energy conversion, domestic utilization of solar energy, remote power generation.
  Department of Architecture; passive solar designs.
  School of Physics; refrigeration, hydrogen production, thermo-electric generation, linear concentrators, concentrators for industry.

  Key personnel: Mechanical and Industrial Engineering
  P. Sivyer, C.M. Sapsford, B.L.E. Gan, C.C. Ang, L.W. Davies.
  Department of Architecture, John A. Ballinger,
  School of Physics; J.E. Guitronich, F.M. Steenbeske, L.B. Harris

1. Academic (continued)

- Name: James Cook University of North Queensland
  Townsville, Qld. 4811

  Department: Department of Engineering
  Department of Physics

  Funding: The Department of Engineering completed a funded program under CSIRO of $14,955.

  Fields of energy interest: The Department of Engineering is studying the use of absorbent bed energy storage and its incorporation in a solar timber-drying system. The Department of Physics is conducting measurements of infra red radiation.

  Key personnel: D.S. Close, Department of Engineering

- Name: W. S. & L. B. Robinson College
  University of New South Wales,
  Broken Hill Division,
  P.O. Box 334, Broken Hill,
  N.S.W. 2880

  Department: School of Chemistry

  Fields of energy interest: Fixation of nitrogen by solar energy.

  Key personnel: K.G. O'Brien

- Name: Ballarat College of Advanced Education
  Geer Avenue, Mt. Helen,
  Victoria 3350

  Department: School of Engineering

  Fields of energy interest: Windmill design.

  Key personnel: Len J. Cubitt
  Les. J. McGrath

1. Academic (continued)

- Name: University of Melbourne
  Parkville, Victoria 3052

  Department: Mechanical Engineering Department

  Fields of energy interest: Development of low cost stable selective surfaces on copper, aluminum and steel for low and moderate temperature applications. The Department also conducts system performance tests on heating and cooling systems involving solar absorption refrigeration cycles and solar boosted heat pumps and solar collectors. In the area of solar architecture studies are being done with integrated roof structure solar absorbers and heat pipe solar water heating systems. Work in heat transfer in solar systems has concentrated on convection effects in cellular structure and heat pipe condensation. A final area of work is the effect aging and weathering has on materials in surface absorption and emission properties.

  Key personnel: W.W.S. Charters, Chairman, solar boosted heat pump systems
  W.D. Chen
  C.W. Dixon

- Name: The New South Wales Institute of Technology
  P.O. Box 123, Broadway
  N.S.W. 2007

  Department: School of Physics and Materials

  Fields of energy interest: Work is being done on the use of electrolytically deposited layers of selective absorbers of solar radiation; cadmium sulphide cells; solar absorption cycle cooling system for buildings.

  Key personnel: Dr. M.A. Green, MIS Solar cell for metal, insulator, semi-conductor. T.M. Sabine, G.B. Smith, M. Riley, Dr. John Guitranich, developed a new stationary collector design. Professors Harry Messell and Charles Watson Monroe, evacuated tube cell-glass collector.

1. Academic (continued)

- Name: The Australian National University Canberra, A.C.T.

  Department: Department of Engineering Physics, Energy Conversion Group Research School of Physical Sciences

  Funding: Solar conversion project has received $210,000 per year from research funds and government support.

  Fields of energy interest: Design of a thermo chemical absorber for a solar power plant. Mr. Carden has been involved in a technique to facilitate the storage of solar energy. In this technique heat is extracted from collection mirrors using a heat absorbing chemical reaction--the decomposition of ammonia into nitrogen and hydrogen.

  Key personnel: O.M. Williams
  P.O. Carden, Senior Fellow, Head, Energy Conversion Group
  Brian Edwards, control scheme for collector deflections from wind gusts.
  Dr. S. Kaneff, solar high temperature chemical conversion project.

- Name: Capricornia Institute of Advanced Education, M.S. 76, Rockhampton, Q.H. 4700

  Fields of energy interest: Have been recording global insolation since August 1973. Solar heated swimming pools. Application of photovoltaic cell modules for communication repeater stations in remote localities.

  Key personnel: J.W. Bugler

1. Academic (continued)

- Name: University of Sydney
  Sydney, N.S.W. 2006

  Department: Department of Mechanical Engineering, School of Physics, Department of Architectural Sciences

  Funding: The University received a grant of $1 million to support solar energy research from the Government of New South Wales. A $6 million grant has been received from Saudi Arabia for the development of an evacuated tube all-glass collector.

  Fields of energy interest: Department of Architecture; a project is underway to study the implications of solar energy in the design of buildings. In conjunction with the New South Wales Institute of Technology work is being conducted on the effect of heat control glass on solar energy fluxes.
  School of Physics; research of surface coatings on all-glass tubular evacuated collectors.
  Department of Mechanical Engineering; development of a solar simulator which has been operating since September 1978. The cost of the simulator is estimated to be $A10,000.

  Key personnel: J.J. Greenland, Department of Architecture; P. Krusi, R. R. Schmid, Department of Mechanical Engineering; G.L. Harding, B. Window, C. Horwitz, A.R. Collins, D.R. McKenzie, Department of Physics; Professor C.N. Watson-Munro, Professor of Plasma Physics

1. Academic (continued)

- Name: The University of Sydney
  Energy Research Center
  Sydney, N.S.W. 2006

  Department: School of Physics

  Funding: $130,000

  Fields of energy interest: Interdisciplinary research in the field of solar energy. The Center is working on selective surfaces, photo-thermal conversion and plant conversion. They are also conducting tests on an evacuated double-wall glass solar energy collector.

  Key personnel: Professor M.G. Pitman, energy capture and transfer in photo-synthesis.
  Professor R. Prince, chemical engineering.
  Professor J.C. Still, biomass
  Professor C.N. Watson-Munro, Physics Department; Chairman of the Steering Committee of the Energy Research Center.
  D. R. McKenzie

2. Research/Government

- Name: Fowler's Gap Arid Zone Research Station

  Fields of energy interest: Solar powered weather station

  Key personnel: I.L. Maclaine-Cross

- Name: Environment Council (NT) Inc.
  P.O. Box 2120, Darwin, N.T. 5794

  Key personnel: Trevor R. Lee, B.Arch (Hons.), Solarwise Project Office

2. Research/Government (continued)

- Name: Conservation of Primary Energy (COPE) Pty Ltd.
  P.O. Box 39963
  Winnellie, N.T.

  Fields of energy interest: Darwin Solar Village Project aims at achieving energy self-sufficiency for about ten families.

- Name: National Standards Laboratory
  University Grounds, City Road
  Chippendale, N.S.W. 2008

  Department: Division of Physics

  Key personnel: J.V. McAllan

- Name: The Australian Mineral Development Laboratories
  Flemington Street
  Frewville, S.A. 5063

  Fields of energy interest: A study to determine the energy requirements of the mineral industry. That preparation which is low-grade heat (less than 120°) could be provided by solar energy using current technology.

- Name: Australian Mineral Industries Research Association Ltd. (AMIRA)
  Clunies Ross House
  191 Royal Parade
  Parkville, Victoria 3052

  Fields of energy interest: Engaged in R&D of equipment and techniques on behalf of its mining industry; sponsors and is actively involved in solar power applications for the mining industry.

  Key personnel: Dr. John C. Nixon, President

2. Research/Government (continued)

- Name: Broken Hill Proprietary
  Melbourne Research Laboratories
  P.O. Box 274, Clayton
  Victoria 3168.

  Fields of energy interest: Design of a low-cost solar water heater for mass production and the development of cheap selective surfaces.

- Name: Fuel and Power Commission of Western Australia
  16 St. George's Terrace,
  Perth, W.A. 6000

  Fields of energy interest: Conducted a study of domestic solar hot water system design to determine how a reduction in the capital cost of these units could be achieved.

- Name: Post Master General Department
  Long Line and Telepower Equipment Branch
  7th Floor, 57 Boerke Street
  Melbourne, Victoria 3000

  Fields of energy interest: Solar power systems within the APO. The Department has installed a 73.5 watt, 12 volt solar array for a trial period at Wonaminta Hill, to power a V.H.F. subscriber concentrator.

  Key personnel: A.L. Holderness
  M.R. Mack

- Name: State Electricity Commission of Victoria
  15 William Street
  Melbourne, Victoria 3000

  Fields of energy interest: Utilization of solar energy for domestic water heating.

  Key personnel: J.E. Hayes
  G.E. Smith

2. Research/Government (continued)

- Name: Bureau of Meteorology
  Box 1289K, G.P.O. Melbourne
  Victoria 3001

  Department: Department of Science

  Fields of energy interest: Solar radiation data

  Key personnel: P. Shaw

3. Non-Profit

- Name: Australian Standards Association
  191 Royal Parade
  Parksville, Melbourne 3052

  Fields of energy interest: Establishes standards for solar products. However the standards are not mandatory unless adopted by the relevant state authority, i.e., the electricity or gas commissions. Installation codes were released May 1979 with others regarding designs and performance and testing expected later in the year.

  Key personnel: Warren Muller

- Name: International Solar Energy Society (ISES)
  Science Centre
  P.O. Box 123
  Nedlands, W.A. 6009

  Fields of energy interest: In addition to its international activities in the solar field, the society maintains a directory on solar energy literature in Australia.

  Key personnel: Mr. Philip Driver

4. Corporate

There are currently twenty to thirty firms involved in the Australian solar industry. However, 90 percent of the domestic solar collectors are produced by 2 companies.

- Name: Solar Energy Industries Association of Australia c/o Metal Trade Industry Association 165 Eastern Road South Melbourne, Vic. 3205

  Fields of energy interest: To help further development of the solar industry market, this group supplies names of solar appliance, equipment and component manufacturers and wholesalers to members. The Association has invited US solar companies to use the Association as a vehicle for promoting product information in Australia.

  Key personnel: Kai Wallenius
  Graham B. Jackson, President
  Hector L. Ford, Secretary

- Name: The Australian Innovation Corporation Limited Prudential Building 150 Queen Street Melbourne 3000, Victoria Tel:67-7796

  Fields of energy interest: The firm, acting for a group of Australian companies, identifies and appraises items of solar energy technology that might offer areas of joint development work and/or licensing in Australia. They are particularly interested in the fields of solar heating and cooling for domestic and commercial purposes, and solar collectors.

  Key personnel: J.H. Seidler, General Manager

4. Corporate (continued)

- Name: Lucas Industries, Brisbane

  Department: Battery Division

  Fields of energy interest: Sells solar power photovoltaic arrays for cathodic protection.

  Key personnel: Neill Reed, Manager

- Name: Amalgamated Wireless (Australasia) Limited (AWA)
  P.O. Box 96, North Ryde
  N.S.W. 2113

  Department: Research Laboratory

  Funding: Grant of $614,000 awarded in 1978 for work in Papua New Guinea.

  Fields of energy interest: The AWA is converting Papua New Guinea's entire trunk telecommunications network from battery power to solar power. The AWA has also built and installed several small systems in Australia, including solar energy systems for powering a substantial portion of the communications network for the Momba-Sydney gas pipe line project. The Research Laboratory is involved in work to improve techniques for the direct conversion of solar energy by photovoltaic and thermoelectric means. AWA has developed a solar-powered radio subscribers' telephone equipment which will be used by the Australian Post Office.

- Name: Westinghouse Electric
  Power Systems
  G.P.O. Box 4203
  Sydney, N.S.W. 2001

  Fields of energy interest: Research on silicon chips.

  Key personnel: Walter Cohn

4. Corporate (continued)

- Name: South Australian Gas Co.
  35 Waymouth Street,
  Adelaide 5000
  South Australia

  Fields of energy interest: Sells solar hot water systems, a pre-heat Beasley combination for gas and solar with a low pressure hot water storage tank at $700 with a one year warranty.

- Name: Solarex Sydney

  Fields of energy interest: The firm is a 50-50 joint venture with Solarex, Rockville, Md. Their current market is in the use of photovoltaic panels for communication and navigation systems.

  Key personnel: Bryan Ford, Manager

- Name: Solar City/Metalcraft
  Box 175 P.O.
  Neutral Bay 2089
  Brisbane

  Fields of energy interest: Has been in the solar business for four years. They market hot water systems and air conditioning.

  Key personnel: R.S. Thomsen, President and Marketing Director

- Name: International Solar Design Systems
  554 Lutwyche Rd.
  Lutwyche, Brisbane 4030

  Fields of energy interest: Designed the Pineapple Plantation, a motel near Brisbane which gets 82% performance for solar hot water. The cost was $11 per square foot; about 20 sq. meters.

  Key personnel: Peter Noble

4. Corporate (continued)

- Name: Zane Solar Installation
  8 Sunshine Blvd.
  Miami Keys, City of Gold Coast

  Fields of energy interest: Has designed a swimming pool heating system utilizing the thermal potential of the roof. This company is also working with a medium temperature collector which is being tested by CSIRO.

  Key personnel: Mr. Peter Parker

- Name: Solar Film Products
  124 Lutwyche Road
  Windsor, Queensland 4030

  Fields of energy interest: Imports various solar products including solar window films, and photovoltaic panels. Expected sales in 1979 to gross $65,000.

  Key personnel: Bill Smetana, President

- Name: Solahart
  112 Pilbara St.
  Welshpool, Western Australia

  Fields of energy interest: The firm is considered to be the top producer in Australia and one of the oldest, having been in business for 24 years. They manufacture a combined tank and collector unit (a Thermosiphon) system which is mounted on the roof.

- Name: Philips
  161 Starts Street
  South Melbourne

  Fields of energy interest: Philips is just beginning solar cell production at their semi-conductor facility in Hendon, S.A.

  Key personnel: Ray Milner, Technical Representative

4. Corporate (continued)

- Name: Yazaki Pacific Pty Ltd.
  165 Eastern Road
  South Melbourne

  Fields of energy interest: Marketing a 1.3 ton absorption chiller for A$2,500 and collectors priced at A$346 for 2 square meters.

  Key personnel: R.P. J. Simmonds, Marketing Manager

- Name: Beasely Industries Pty Ltd.
  Bolton Avenue
  Devon Park, South Australia 5008

  Fields of energy interest: Manufacturers of complete hot water systems, collectors and swimming pool panels. They expect to do 500 installations per year in Southern Australia and Victoria.

  Key personnel: Carl Bulay, Export Sales Manager

- Name: Raypak Australia Pty Ltd
  195 Lennox St.
  Richmond, Victoria 312

  Fields of energy interest: Have designed and manufactured a parabolic collector for industry and commercial use. Expect sales of 1,000 in 1979 at $40 per square meter.

  Key personnel: Geoff Richards, Sales Manager

- Name: Solartech Industries
  17 Brighton Road
  St. Kilda, Victoria 3182

  Fields of energy interest: Manufactures hot air flat plate collectors as part of their roofing with special selective surface on aluminum and a photovoltaic electric generating tracking unit.

  Key personnel: O.M. Pearson

4. Corporate (continued)

- Name: Spectrolab
  34-40 Clayton Road,
  North Clayton, Victoria 3168

  Fields of energy interest: Spectrolab is producing a range of photovoltaic power supplies with systems from 5W to 1kW commercially available. Applications include VHF/UHF repeaters, microwave relays, instrument and control systems, environmental data stations, offshore platforms and data buoys, railroad signals and controls, traffic and security systems, and cathodic protection systems.

- Name: Somer Solar Installations
  Sandy Point Road
  Somers Victoria 3927

  Funding: Total sales revenue in 1978 was $250,000.

  Fields of energy interest: Manufactures a swimming pool collector and a hot water system.

  Key personnel: Bob Cooper

- Name: Autonomous Energy Systems
  24 Jersey Parade, Carnegie,
  Victoria 3163

  Fields of energy interest: Design, development and marketing of integrated energy systems. The project aims to develop and analyze the performance of "micro" energy systems using renewable energies.

- Name: Braemar Industries Limited
  400 Princess Highway
  Noble Park
  Australia

  Fields of energy interest: Produces liquid storage tanks and vacuum tube collectors.

4. Corporate (continued)

- Name: Coles, K.G. & Company Pty Ltd.
  15-17 Bourke Road
  Alexandria

  Field of energy interest: Produces solar panels.

- Name: Davey, F.W. and Company Pty Ltd.
  Box 120
  Oakleigh, Australia

  Fields of energy interest: Produces wind power generation systems and wind energy subsystems.

- Name: Fin-Tech Industries Pty Ltd.
  40 Fendell St.
  Guildford, Australia

  Fields of energy interest: Produces solar panels.

- Name: International Marketing Pty Ltd.
  1396 Malvern Road
  Tooronga, Australia

  Fields of energy interest: Produces hot water heating systems.

- Name: Quirk's Victory Light Company Pty Limited
  33 Fairweather Street
  Bellvue Hills, Australia

  Fields of energy interest: Produces wind power generation systems.

- Name: Smaller's SolaHeeta Company Pty Ltd.
  10 Goongarrie Street
  Bayswater, Australia

  Fields of energy interest: Produces hot water heating systems.

4. Corporate (continued)

- Name: Sola-ray Appliances
  Perth, Australia

  Fields of energy interest: Produces hot water heating systems.

- Name: Solar Hot Water Systems
  34 Flinders Road
  Earlwood, Australia

  Fields of energy interest: Produces solar panels.

- Name: Southern Cross Engine and Windmill Company
  One Grand Avenue
  Granville, Australia

  Fields of energy interest: Produces wind power generation systems, windmills, and pumps.

- Name: Thermax Electric Water Heaters Pty Ltd.
  P.O. Box 173
  Hamilton Central, Australia

  Fields of energy interest: Produces hot water heating systems.

- Name: Turbon Engineering
  Birubi Street
  Coorparoo, Australia

  Fields of energy interest: Produces hot water heating systems.

- Name: Western Ironworks Pty Ltd.
  1 Strang Street
  South Fremantle, Australia
  Tel:335-6400

  Fields of energy interest: Produces hot water heating systems, commercial hot water systems.

4. Corporate (continued)

- Name: Williams and Company
  P.O. Box 22, Williams Parade
  Dulwich, Australia

  Fields of energy interest: Produces windmills

- Name: Dunlite Electrical Co. Pty Ltd.
  21-27 Frome Street
  Adelaide

  Fields of energy interest: Manufactures two models of high quality reasonably-priced wind electric generators. These have been used in remote places in Australia and the ESCAP region for the past 20 years for domestic power supply as well as for power supply to communications relays and navigational aids.

DUNLITE WIND-ELECTRIC GENERATORS

Model	Starting speed (km/h)	Rated speed (km/h)	Rated output (watts)	Rated voltage (V DC)
L	--	--	14	32,36
M	16	40	2,000	24,32,48 115

II. NATIONAL PROFILE

A. GEOGRAPHIC

1. Name

Commonwealth of Australia

2. Country Descriptor

a. Location: Australia, the smallest continent, is located below the Southeast Asian Archipelago and is bounded on the east by the Pacific Ocean and on the west by the Indian Ocean.

b. Area/population: 2.9 sq.mi. (7.5 million sq.km); 14 million

c. Latitude/longitude: 10°41'S and 43°39'S/113°9'E and 153°39'E

d. Capital and key cities with population: Capital: Canberra, 215,400; Cities: Sydney, 3,021,300, Melbourne, 2,603,000.

e. Language: English

B. ECONOMIC

1. Economic System Descriptor

The economy is based on a system of free enterprise with considerable Federal Government controls in the fields of banking, credit, agriculture, minerals and energy. To aid economic growth, the Federal and State Governments invest heavily in transportation and education facilities; electric power and housing. Participation in international trade is of fundamental importance to the economy.

2. Economy Descriptor

a. Scale: Labor force; 7% agricultural
25% industrial

b. Production: 42% GNP industrial
8% GNP agricultural

c. Balance of trade: US-$1.3 billion

d. Inflation rate: 7.9% (Australia Consumer Price Index FY 77/78)

e. Budget: expenditures A$24.4 billion
revenues A$26.7 billion

3. Currency

a. Name: Australian dollar

b. Exchange rate: A$1 = US$1.23

c. Detail: Floating

4. GNP/GDP

a. 3 year series $A million: GDP 1974/75 60,575
1975/76 71,278
1976/77 82,224

b. Per capita: U.S.$6,764

5. Foreign Trade

a. Exports: (1977) $13.39 billion

b. Principal trade partners: (Export) Japan, 27.6%; U.S. 9.1%, New Zealand, 6%. (Imports) U.S. 20.5%; Japan 19.6%; U.K. 13.5%.

c. Total U.S. imports: (1977) U.S.$2.5 billion

6. Foreign Investments

The Australian Government is actively seeking foreign investment, and the latest government budget with its anti-inflationary bias is directly aimed at creating a favorable atmosphere for foreign investment. The government is counting heavily on increased investment to set the country further on the road to recovery. In keeping with this approach, the Australian government has adopted a pragmatic policy in its foreign investment guidelines to accomodate investors.

6. Foreign Investments (continued)

In April 1976, the Liberal Government issued a new statement in which it encouraged foreign investment in the country's business and mineral exploration. The Government emphasized that foreign investors would be encouraged to actively seek Australian participation in each new project but that most projects would be allowed to proceed, should Australian participation not be readily available.

C. GOVERNMENTAL

1. Chief of State

Head of State: H.M. Queen Elizabeth II
Governor General (represents Queen Elizabeth II):
Sir Zelman Cowen, C.M.G.
Prime Minister (Head of Government):
Rt. Hon. J. Malcolm Fraser, C.H.

2. Government Structure Descriptor

a. Type: The Commonwealth Government was created with a Constitution patterned in part on the U.S. Constitution. The powers of the Commonwealth are specifically defined in the Constitution and the residual powers remain with the States. Australia is a fully independent nation within the Commonwealth. Queen Elizabeth II is the Sovereign, represented throughout Australia by a Governor General and in each State by a Governor. The leader of the political party or coalition of parties that wins a majority of the seats in the House of Representatives is named Prime Minister. The Prime Minister and his Cabinet wield actual power and are responsible to the parliament, of which they themselves must be elected Members.

b. Political subdivisions: There are seven federated States which are, New South Wales, Victoria, Queensland, South Australia, Western Australia, Tasmania, Australia (capital territory) and 1 Territory, (Northern Territory).

c. Legal system:Based on English common law, Commonwealth of Australia Constitution Act passed 1900. High Court has jurisdiction over cases involving interpretation of the Constitution; accepts compulsory ICJ jurisdiction with reservations.

d. Branches: The legislative power is vested in a Federal Parliament consisting of H.M. the Queen, represented by the Governor-General, a Senate and a House of Representatives.

Ten Senators from each State and two representing the Northern Territory are elected for 6-year terms, with half elected every 3 years.

At the apex of the court system is the High Court of Australia. It has general appellate jurisdiction over all other Federal and State courts and possesses the power of constitutional review. The High Court consists of a Chief Justice and six Justices, each of whom is appointed by the Governor-General in Council, and has both original and appellate jurisdiction. The Federal Court consists of a Chief Justice and twenty-one other Judges. The Australian Conciliation Arbitration Commission comprises a President and a number of Conciliation Commissioners.

3. Diplomatic Names and Addresses

a. In U.S./U.N.

Embassy
1601 Massachusetts Avenue, N.W.
Washington, D.C. 20036
(202)797-3000

Ambassador Alan P. Renouf
Science Attache: Dr. Whittem
Commercial Attache: Mr. Surft

U.N. Mission
885 Second Avenue
New York, N.Y. 10017
(212)421-6910

Ambassador: His Ex. H.D. Anderson
Minister: Mr. R.J. Greet
Counsellor: Mr. I.C. James

b. U.S. in Country

Canberra - U.S. Embassy
Moonah Place
Canberra, A.C.T. 2600
Tel. 062-73-3711
Telex AA 62104

AMB: Philip Henry Alston, Jr.
DCM: Christopher A. Squire
ECO/COM: Richard Kirby
COM: Malcolm H. Churchill
POL: David Passage
LAB: James F. Shea
CON: Rufus Curlew
ADM: Donald E. Rau
RSO: Brian B. Flanagan
SCI: V. Raymond Dickey
AGR: Brice K. Meeker
PAO: Robert L. M. Nevitt

- Melbourne - Consulate General
24 Albert Road
South Melbourne, Victoria 3205
Tel. 699-2244

CG: Paul M. Popple
COM: James C. Curran
CON: Thomas B. Killeen
BPAO: Peter L. Quasius

- Sydney (CG) 36th Floor,
T&G Tower, Hyde Park Square
Park and Elizabeth Sts.,
Sydney 2000, N.S.W.
Tel. 235-7044

CG: John R. Davis, Jr.
ECO/COM: John P. Wentworth
CON: Ralph T. Jones
BPAO: Alfred V. Boerner

- Brisbane - Consulate General
141 Queen Street, Brisbane 4000
Tel (07) 221-1338

PO: Thomas E. Cummings
COM: Clifton C. Stanley
CON: Richard C. Dunbar

b. U.S. in Country (continued)

- Perth - Consulate
  246 St. George's Ter.
  Tel. 22-4466

  PO: Martha Carbone
  COM: David L. Boerighter
  CON: Betsy L. Anderson
  BPAO: Charles A. McGinley, Jr.

4. Government Funding

a. Budget:(FY 78-79): A$ million

Defense	2,501
Education	2,498
Health	2,914
Social Security and Welfare	8,015
Urban and Regional Development and the Environment	363
Economic Services	1,753
General Public Services	134

D. NATIONAL INSTITUTIONS

1. Political Parties

- Liberal Party of Australia: Federal Secretariat, National Headquarters Bldg., cnr. Blackall and Macquarie Sts., Barton, A.C.T. 2600; founded 1944; the Party supports private enterprise, individual liberty and initiative, and social justice. It is committed to Australia's development, prosperity and security; Federal Pres. M.J.N. Atwill; Parliamentary Leader Rt. Hon. J. Malcolm Fraser, C.H.

- National Country Party of Australia: John McEwen House, National Circuit, Barton, A.C.T. 2600; founded 1916; formerly called the Country Party; principal objectives are balanced national development based on free enterprise, with special emphasis on the needs of people outside the major metropolitan areas; Federal Parliamentary Leader Rt. Hon. John Douglas Anthony; Federal Sec. Peter P. Warrick.

- Australian Labor Party: John Curtin House, 22 Brisbane Avenue, Barton, A.C.T. 2600; founded 1891; supports the democratic socialization of industry, production, distribution and exchange; Leader of the Federal Parliamentary Party the Hon. William Hayden; National President Neil L.C. Batt, M.H.A.; Gen. Sec. David Combe.

- Australian Democratic Labor Party: 155-159 Castlereagh St., Sydney, N.S.W.; founded 1956 following a split in the Australian Labor Party; Pres. J.D. Brosnan; Gen. Sec. John Kane.

- Australian Democrats Party: 400 Flinders St., Melbourne, Vic. 3000; founded 1977; comprises the former Liberal Movement and the Australia Party; Party Leader Donald L. Chipp.

- Communist Party of Australia: 4 Dixon St., Sydney, N.S.W. 2000; founded 1920; independent of both Soviet and Chinese influence; Pres. L. Carmichael; Jt. Sect. E. Aarons, J. Palmada, M. Robertson; publ. Tribune (weekly).

- Communist Party of Australia (Marxist-Leninist): 168 Day St., Sydney, N.S.W. 2000; founded 1967 after split in Communist Party of Australia; supports Chinese principles; Chair. E.F. Hill.

1. Political Parties (continued)

- Socialist Party of Australia: 392 Sussex St., Sydney, N.S.W.; founded 1971; aims to bring about a socialist society in Australia through public ownership of the means of production and working-class political power, and to build a united front of workers allied to other progressive forces; fosters international cooperation; Pres. P. Clancy; Gen. Sec. P. Symon

Other political parties include the Farm and Town Party.

2. Religion

31% Anglican, 12% Roman Catholic, 8.6% Methodist, 8% Presbyterian

3. Universities

University of Adelaide: Adelaide, S.A. 5001; 673 teachers; 9,345 students.

The Australian National University: Canberra, A.C.T. 2600; 780 teachers, 5,272 students.

Deakin University: Geelong, Vic. 3216; c. 180 teachers, 2,100 students.

Flinders University of South Australia: Bedford Park, S.A. 5042; 325 teachers, 3,985 students.

Griffith University: Nathan, Qld. 4111; 136 teachers; 1,200 students.

James Cook University of North Queensland: Townsville, Qld.; 202 teachers, 1,854 students.

LaTrobe University: Bundoora, Vic. 3083; 489 teachers, 8,886 students.

Macquarie University: North Ryde, N.S.W. 2113; c. 590 teachers, c. 10,300 students.

University of Melbourne: Parkville, Melbourne, Vic; 1,036 teachers, 15,796 students.

Monash University: Clayton, Vic.; 1,024 teachers, 13,751 students.

3. Universities (continued)

Murdoch University: Murdoch, W.A. 6153; 136 teachers, 1,812 students.

University of New England: Armidale, N.S.W. 2351; 480 teachers, 8,014 students.

The University of New South Wales: Kensington, N.S.W. 2033; 1,083 teachers, 18,520 students.

University of Newcastle: Newcastle, N.S.W. 2308; 331 teachers, 4,621 students.

University of Queensland: Brisbane; Qld. 4967; 1,159 teachers, 18,517 students.

University of Sydney: Sydney, N.S.W. 2006; c. 1,200 teachers, 17,667 students.

University of Tasmania: Hobart; 280 teachers, 3,399 students.

University of Western Australia: Nedlands, W.A. 6009; 640 teachers, 9,865 students.

University of Wollongong: Wollongong, N.S.W. 154 teachers, 2,429 students.

4. Corporations

The following are some of the major industrial companies in Australia, arranged by sector.

MINING AND METALS

Alcoa of Australia Ltd.: 535 Bourke St., Melbourne, Vic.; cap. $A200m.
Bauxite miner and producer of alumina; producer of aluminum ingot and fabricator of aluminum extrusions, tube, rod, bar, sheet, plate and foil.
Chair. Sir Arvi Parbo; Man. Dir. G. Haymaker, Jr.; employees: 4,700.

BH South Ltd.: 459 Collins St., Melbourne, Vic. 3000; founded 1918; cap. $A26.8m.
Mining of zinc, phosphate and copper; copper smelting and refining; mineral exploration.
Five main subsidiary companies; Chair. and Exec. Dir. J.M. Tyler; employees (incl. subsidiaries) 944.

4. Corporations (continued)

Boral Ltd.: 10th Floor, 221-223 Miller St., North Sydney, N.S.W. 2060.
Quarrying of construction sand and gravel; ready-mixed concrete; road construction; miscellaneous metal work. Chair. Sir John O'Neill, O.B.E.; Sec. Peter C. Breese; employees: 5,500.

British Phosphate Commissioners: 515 Collins St., Melbourne, Vic.; mines phosphate on behalf of the New Zealand, U.K., and Australian governments, from Ocean Island, Central Pacific; are also managing agents for Christmas Island Phosphate Commission for mining at Christmas Island and for distribution from there and from Ocean Island and Nauru, to Australia and New Zealand; Commissioners: M.C. Timbs (Australia); W.D.M. Bremner (New Zealand); Richard N. Posnett (U.K.); Gen. Man. A.E. Gaze.

The Broken Hill Proprietary Co. Ltd.: 140 William St., Melbourne, Vic. 3000; founded 1885; cap. p.u. $A442m. Mining, iron and steelmaking, oil and natural gas, exploration and development, iron-stones, manganese and coal mining. Operates in every state of Australia, the Northern Territory, Papua New Guinea, Indonesia, Taiwan and Malaysia. Exploration activities in Indonesia, Malaysia, the Philippines and New Zealand. Twenty-four subsidiary companies; twelve major associated companies; Chair. and Dir. of Admin. Sir James McNeill; Chief Gen. Man. B.T. Loton; employees: 62,000.

Consolidated Gold Fields Australia Ltd.: Gold Fields House, Sydney Cove, N.S.W. 2000; cap. $A26.1m. Numerous mining interests throughout Australia. Chair. S.L. Segal; Man. Dir. B.C. Ryan.

Conzinc Riotinto of Australia Limited: 95 Collins St., Melbourne, Vic. 3001; founded 1976; cap. issued $A160.2m. CRA is a mining, development and investment company and, through its subsidiary and associate companies, has wide and various interests in most metals and minerals of economic importance, principally copper, iron ore, lead-zinc, aluminum, uranium, nickel, coal, petroleum and natural gas. The CRA group operates mining and processing ventures which extend into fabrication, distribution and marketing. Active exploration and research programmes are maintained. CRA's principal interests are in: Bougainville Copper Ltd. (copper), Australian Mining Smelting Ltd. (lead/zinc), Hamersley Holdings Ltd. (iron ore), Comalco Ltd. (bauxite), IOL Petroleum Ltd. and Mary Kathleen Uranium Ltd. Chair. and Man. Dir. R.H. Carnegie; Deputy Chair. F.F. Espie, O.B.E.

4. Corporations

EZ Industries Ltd.: 390 Lonsdale St., Melbourne, Vic.; founded 1956; cap. $A50.4m.
Operates as a holding company for the wholly-owned operating subsidiaries, Electrolytic Zinc Company of Australasia Ltd., The Emu Bay Railway Company Ltd., EZ Europe Ltd. and America Ltd. Lead and zinc mining and concentrating; transport of concentrates; fertilizer production; marketing in Europe and U.S.A. of zinc metal and cadmium.

John Lysaght (Australia) Ltd.: 50 Young St., Sydney N.S.W.; P.O.B. 196, G.P.O., Sydney, N.S.W. founded 1921; cap. $A100m. Manufacture of coated and uncoated steel sheets and coils; roofing, walling and floor decking, electrical laminations. Twenty subsidiary companies incl. abroad
Chair. E. Gosse; Man. Dir. S.W.H. Fairbairn; employees 6,760.

Metal Manufactures Ltd.: 168 Kent Street, Sydney, N.S.W.; founded 1916; cap. $A37.9m.
Manufacturers of copper and other non-ferrous wire stand and tubes, covered wire and strip, cables, and steel cored aluminium conductors. Eight wholly-owned subsidiary companies and some partly-owned subsidiaries; Man. Dir. Dr. D. Stewart; employees: 6,500.

M.I.M. Holdings Ltd.: 160 Ann St., Brisbane, Qld.; cap. $A142.9m. Mining and milling of silver-lead zinc and copper smelting and refining of copper and silver-lead; mining of coal and iron ore.
Chair. Sir James Foots; employees: 7,000.

North Broken Hill Holdings Ltd.: 459 Collins St., Melbourne Vic. 3000; founded 1912; cap. $A150m. Mines and treats lead, silver and zinc ore for the production of lead and zinc concentrates; mineral exploration. Chair. M.L. Baillieu; Exec. Dir. R.L. Baillin; employees: 1,051.

Peko-Wallsend Ltd.: 47-53 Macquarie St., Sydney, N.S.W. 2000. Holding company for miners of gold, bismuth, copper, tungsten, coal, mineral sands, and manufacturer of industrial pumps.
Chair. John S. Proud; Chief Exec. D. S. Stewart; Sec. Allan Edwards; employees: 3,082.

Tubemakers of Australia Ltd.: 1 York St., Sydney, N.S.W. 2000; founded 1964; cap. $A40m. Manufacturer of steel and cast iron pipes, tubes and fittings; merchandiser of steel products. Several subsidiary companies; Chair. Sir Ian McLenna; Man. Dir. J.G. Gosse; employees: 7,000.

4. Corporations (continued)

Western Mining Corporation Ltd.: 459 Collins St., Melbourne, Vic. 3001; founded 1933; cap. $A103.7m. Mining of nickel, iron ore, gold, talc, uranium, aluminium, coal and mineral sands.
Chair. and Man. Dir. A.H. Parbo; employees: 4,200.

MOTOR VEHICLES

Chrysler Australia Ltd.: 1284 South Rd., Clovelly Park S.A.; issued cap. $A21.3m. Manufacturers of cars and trucks, service parts, accessories, automotive components, engines.
Chiar. T. J. Andersen; Man. Dir. I.E. Webber; employees: 7,400.

Ford Motor Company of Australia Ltd.: 1735 Sydney Rd., Campbellfield, Vic.; founded 1925; cap. $A50m. Manufactures for sale in domestic and export markets passenger and commercial motor vehicles, tractors, construction equipment, implements and parts and accessories.
Chair. and Man. Dir. Sir Brian Inglis; employees: 14,318.

General Motors-Holden's Ltd.: 241 Salmon Street, Port Melbourne, Vic. 3207; founded 1926; cap. $A140m. GMH is a wholly-owned subsidiary of General Motors Corporation. Manufactures Holden, Torana, Gemini, Sunbird and Statesman passenger vehicles, Holden commerical vehicles, and Holden engines for marine and industrial use. Assembles Chevrolet and Bedford commerical vehicles. Manufacture and distirbution of spare parts and accessories. Assembles Terex earth-moving equipment.
One subsidiary company; Man. Dir. C.S. Chapman; employees: 21,410.

International Harvester Company of Australia Pty Ltd.: 211 Stuart St., South Melbourne, Vic. 3205; founded 1912; cap. $A20m. Manufacturers and marketers of tractors, farm equipment, trucks, etc.
One subsidiary company; Chair. and Man. Dir. Ben G. Lasrich; employees: 4,000.

Leyland Motor Corporation of Australia Ltd.: 332-342 Oxford St., Bondi Junction, N.S.W. 2022. Manufacturers, assemblers and distributors of cars, light and heavy commercial motor vehicles and marine engines; importers and distributors of selected high class motor cars made by the parent company, B.L. Limited of England, Branches in N.S.W., Victoria, Queensland, S. Australia and Western Australia.
Chair. David Andrews; Man. Dir. Frank Andrew; Employees: 3,000.

4. Corporations (continued)

Repco Ltd.: 630 St. Kilda St., Melbourne, Vic. 3004. Manufacturer of automotive components and service equipment, accessories, hand and machine tools, industrial products and services. Largest suppliers of original equipment to vehicle manufacturers in Australia; has overseas manufacturing and/or merchandising operations in: the U.K., New Zealand, Canada, India, South Africa, Singapore, Hong Kong, Thailand, Malaysia and the U.S.A.
There are also associated companies in Australia, South Africa, Singapore, Hong Kong and India; Joint Man. Dirs. Anthony B. Avery, David J. McGrath; employees: 11,200.

PETROLEUM

Ampol Petroleum Ltd.: 84 Pacific Highway, North Sydney, N.S.W. 2060; founded 1936; cap. $A60.8m. Producers and importers of crude oil; oil refiners; transporters of crude and refined product; marketers to service stations and industry. Six subsidiary companies; all at home; Chair. Sir Walter M. Leonard, D.F.C.; Man. Dir. and Chief Exec. Alfred E. Harris; Chief Gen. Man. Richard C. H. Mason; employees: 2,296.

The British Petroleum Company of Australia Ltd.: BP House, 1 Albert Road, Melbourne, Vic. 3004; founded 1962; cap. $A110m. The Holding Company for the BP Group Companies in Australia; wholly-owned by the British Petroleum Company Ltd., U.K. Activities in Australia: refining, marketing, exploration, transportation of petroleum products, fertilizer production, coal production and mineral exploration. Twelve subsidiary companies; Chair. J. Darling; Man. Dir. A.W. Gorrie; employees: 4,000.

Esso Australia Ltd.: Esso House, 127 Kent St., Sydney N.S.W. 2000; cap $A30m. All spheres of the petroleum business. The parent company is the Exxon Corporation through Esso Eastern Inc.
Five subsidiary companies; six associated companies; Chair. and Man. Dir. Richard J. Kruizenda; employees: 1,900.

Mobil Oil Australia Ltd.: 2 City Rd., Melbourne, Vic. 3205; founded 1895; cap. $A50m. Marketers in Australia and Pacific Islands of a full range of petroleum products. Subsidiary companies: 5 at home, 1 in Papua New Guinea; Chair. and Man. Dir. J. B. Leslie.

4. Corporations (continued)

Petroleum Refineries (Australia) Pty. Ltd.: 2 City Rd., Melbourne, Vic. 3205; cap. $A10m. Petroleum refiners. Chair. J. B. Leslie; Man. Dir. W.R. Yeo; employees: 558.

Shell Australia Limited: Shell Corner, 155 William St., Melbourne, Vic. 3001, P.O.B. 872K; inc. 1958; cap. $A70m. Manufactures and markets petroleum and petroleum products and chemicals; exploration and production of oil, gas and minerals. Fourteen subsidiary companies; Chair. and Man. Dir. L.T. Froggatt; Sec. N.Ducas.

H. C. Sleigh Ltd.: 160 Queen St., Melbourne, Vic. 3000; founded 1895, inc. 1947; cap $A44.3m. Petroleum marketers, oil exploration, shipping exporting, coal mining, woodchip production, meat-processing, travel service, customs and forwarding, finance and aviation. Thirty-one subsidiary companies; Chair. and Chief Exec. P.H. Sleigh; Man. Dir. Dr. M. H. Searby; employees: 2,000.

RUBBER

Dunlop Australia Ltd.: 108 Flinders St., Melbourne, Vic. 3000; cap. $A88.7m. Marketing and manufacturing. Six operative groups: Dunlop Automotive and Industrial: tires, automotive rubber products, batteries, belting-hoses, irrigation and water purification units; Dunlop Textiles/Clothing: knitted and woven fabrics, clothing, domestic textiles and furnishings, blankets, fabric printing and dyeing; Dunlop Footwear: footwear; Dunlopillo Sleepmaker: mattresses, inner-spring bases, latex and polyurethane foam, steel-framed furniture; Dunlop-Slazenger: sporting goods, under-water equipment and marine sportswear; Ansell: latex dipped and cured rubber goods. Chair. Sir Robert Blackwood; Man. Dir. L.M. Jarman; employees: 19,000.

The Goodyear Tyre and Rubber Co. (Australia) Ltd.: 4 Yurong Street, Sydney, N.S.W.; cap. $A26.6m. Manufacturers of tires and tubes, industrial rubber products, general rubber products, fan belts, shoe soling; adhesives. Goodyear aviation products, film packaging; distributors of Goodyear chemical products. Chair. E.R. Culler; employees: 3,400.

4. Corporations (continued)

Olympic Consolidated Industries Ltd.: 393 Swanston St., Melbourne, Vic. 3000; cap. $A40m.
Holding company for manufacturers of tires and tubes for cars, trucks and tractors, electric wires and cables for transmission and telecommunication, conveyor and transmission belting, industrial nylon and plastics and polyurethane foam products, thermal insulation contracting; operates over 170 tire service stations and retreading factories throughout Australia. Four subsidiary companies; Chair. and Chief Exec. Ian F. Beaurepaire; Deputy Man. Dir. Edward R. Bomphrey; employees (including subsidiary companies): 5,500.

PAPER AND PULP

Australian Paper Manufacturers Ltd.: South Gate, South Melbourne, Vic. 3205; founded 1868; cap. $A136m. Australia's principal producer of wood-pulp, paper and paperboard. Subsidiary companies: 10 at home, 2 in New Zealand; Chair. P.J.V. Ramsden; Man. Dir. S.D.M. Wallis; employees: 4,800.

Associated Pulp and Paper Mills Ltd.: 459 Collins St., Melbourne Vic.; G.P.O. Box 509H, Melbourne, Vic. 3001; founded 1936; cap $A40.42m.
Manufacturers of various papers and boards as well as paper merchandising and converting, forestry, farming and mining and production of filler and superfine coating clays. Twelve subsidiary companies in Australia and Papua New Guinea; Chair. Wilfred O. Brookes, C.B.E., D.S.O.; Man. Dir. W.H. Thornton; employees: 4,850.

FOOD AND DRINK, ETC.

AMATIL Ltd.: Box 145, G.P.O., Sydney, N.S.W. 2001; founded 1927; cap. $A68.9m.
Tobacco, cigarette and cigar production, printing and packaging, food and beverage production, light engineering, poultry farming, frozen vegetables, meat products and hotel operation. About 90 subsidiary companies, of which 10 are overseas; Chair. Sir Noel Foely, C.B.E.; Deputy Chair. H. Widdup; employees: over 13,000.

4. Corporations (continued)

Cadbury Schweppes Australia Ltd.: 636 St. Kilda Rd., Melbourne, Vic. 3004; founded 1971; cap $A31.16m. Manufacture and distribution of chocolate and sugar confectionery, jams, soft drinks, fruit juices and milk bary syrups. Chief Exec. J.R. Urquhart; Man. Dir. (Drinks) D.J. Hughes; Man. Dir. (Confectionery) C. Thompsett; employees: 4,250.

Carlton and United Breweries Ltd.: 16 Bouverie St., Carlton, Vic.; cap. $A67m.
Thirty subsidiary companies; Chair. Sir Edward Cohen; Gen. Man. L.J. Mangan; employees: 3,500.

Henry Jones (IXL) Ltd.: 20 Garden St., South Yarra, Vic. 3141; founded 1909; shareholders funds $A40m. Jam manufacturers, fruit and meat canners, vegetable juice, tomato and frozen food processors. Interests in shipping, timber, hop growing, television and raido. Major interests are in Australia, South Africa, the United Kingdom and Hong Kong. Subsidiary companies: 33 at home, 7 in South Africa, 2 in the U.K.; Chair. T. Marcus Clark; Man. Dir. J. D. Elliott.

Petersville Australia Ltd.: 258-294 Wellington Rd., Mulgrave, Vic. 3170; founded 1929. Processor of vegetables, ice cream, dairy products, meat and pastries. Manufacturer of sheet metal and refrigeration products. Importers of gourmet foods. Chair. Sir Charles McGrath, O.B.E; Man. Dir. J.S. Shaw; employees: 5,500 (approx.)

Philip Morris Ltd.: 252 Chesterville Rd., Moorabbin Vic. 3189. Manufacturer of tobacco products. Chair. William R. Irvine; Man. Dir. Hamilton Hurley; employees: 1,700.

Tooth & Co. Ltd.: Kent Brewery, Broadway, N.S.W. 2007; founded 1835; cap $A70.3m. Brewersk wind and spirit merchants. Chair. W.L. Fesq; Vice-Chair. R.H. Minter; Man. Dir. H.T. Alce.

Unilever Australia Export Pty. Ltd.: 1-33 Macquarie St., Sydney, N.S.W. 2000. Marketing ice cream, food, edible oils, toiletries, soap and detergents. Fourteen subsidiary companies; employees: 5,000.

4. Corporations (continued)

MISCELLANEOUS

Acmil Ltd.: 168 Walker St., North Sydney, N.S.W. 2060. Manufacturers of all kinds of specialized building materials and bricks, clay pipes, corrosion control PVC furnishing fabrics, electrical accessories, plastic houseware, containers and toys, rubber carpet underlays, aluminum and timber windows and doors, custom plaster moulders, glass merchants, timber millers and shop fitters. Ten subsidiary companies in Australia, two abroad; Chair. Sir John Marks; Man. Dir. L.W.R. Cave; employees: 7,000.

Ansett Transport Industries Ltd.: 489 Swanston St., Melbourne, Vic. 3000. Airline and road passenger and freight services, general trading, manufacturing, hotels and tourist resorts, television station operation, general insurance. Chair. and Man. Dir. Sir Reginald M. Ansett, K.B.E.; Exec. Gen. Managers Ralph L. Cooper, Frank Pascoe; employees: 13,516.

Australian Consolidated Industries Ltd.: 550 Bourke St., Melbourne, Vic.; founded 1872; auth. cap. $A100m. Manufactures and distributes glass containers, float, decorative rolled and wire reinforced glass, pressed and blown glassware and pyrex ovenware, fiberglass insulants and textiles, plastic piping, corrugated fiber containers--Australia, New Zealand, South East Asia, Papua New Guinea and Fiji. One hundred and twenty-two subsidiary companies, 50 in Australia, 72 abroad (N.Z., Fiji, Papua New Guinea, Indonesia, Singapore, Malaysia and Hong Kong); Chair. Andrew Grimwade; Gen. Man. R.W. Brack; employees: 21,000.

Blue Metal Industries Ltd.: 6 O'Connell St., Sydney, N.S.W. 2000; founded 1952; cap. $A32.42m. Quarrying; supply of all types of aggregates, road base and sand materials; manufacturing and laying of pre-mixed asphaltic materials; building stone and terrazzo ready-mixed concrete; timber milling and merchandising; furniture manufacture and retail; builders hardware and bricks; concrete roofing tiles; pre-cast and pre-stressed concrete; fly-ash; road transport; tire retread manufacture and processing; general engineering mining; dairy farming; cattle breeding. Man. Dir. R.A. Robson.

4. Corporations (continued)

Brambles Industries Ltd.: Gold Fields House, I Alfred St., Sydney Cove, N.S.W. 2000; founded 1875; cap. $A24.8m. Materials movement and distributions, including industrial plant hire, equipment pools, scheduled freight forwarding by road, rail, sea and air, heavy haulage, logistical support programs for major projects, marine towage and transportation, pollution control services, etc. Chief Exec. Officer Warwick J. Holcroft; employees: 5,000.

CSR Ltd.: 1 O'Connell St., Sydney, N.S.W. 2000; founded 1855; issued, cap. $A121m. Sugar milling, refining and marketing, manufacture of building and construction materials, mining and mineral exploration, industrial chemicals and gases, distillery products, sheep, cattle, shipping, macadamia nuts, research and development. Thirty-one subsidiary companies; Chair. Sir John Dunlop; Gen. Man. R.G. Jackson; employees: 16,000.

Commonwealth Industrial Gases Ltd., C.I.G.: 46 Kippax St., Surry Hills, N.S.W.2015. Manufacturers and suppliers of industrial and medical gases, electric and gas welding equipment and consumables, safety equipment, medical equipment, ground engaging tools, food freezing equipment, paint sprays and safety equipment. Industrial and medical gas plants throughout Australia; equipment and welding consumables factories in Melbourne. Overseas subsidiaries in Papua New Guinea, Fiji, Indonesia and Thailand, each with its own gas manufacturing facilities. Chair. Sir Kenneth Humphreys; Man. Dir. J.A. Davidson; employees: 4,022.

Containers Ltd.: 265-275 Franklin St., Melbourne, Vic. 3000; founded 1950. Manufacturers of metal food and beverage cans, aerosols, plastic containers and other packaging material. Man. Dir. R.J. Langman; Gen. Man. L.N. Price; employees: 3,600.

J. Hardie & Co.: 65 York St., Sydney, N.S.W. 2000. Manufacturers of asbestos and cement products. Chair. D.K. Macfarlane; Sec. B.K. Sugg; employees: 3,000.

The Herald and Weekly Times Limited: 44-74 Flinders St., Melbourne, Vic. 3000; founded 1902; cap. $A31.9m. Newspaper proprietors, publishers, printers, radio and television broadcasters. Twenty-four subsidiary companies; Chair. Keith D. Macpherson; employees; 3,500.

4. Corporations (continued)

ICI Australia Ltd.: ICI House, 1 Nicholson St., Melbourne, Vic. 3000. Manufacturers of industrial explosives, industrial and agricultural chemicals, dyes, plastics, fibers, paint, fertilizers, etc.' 62 percent owned by Imperial Chemical Industries, United Kingdom. Chair. and Man. Dir. D.R. Zeidler C.B.E.; Deputy Chair. and Man. Dir. A.W. Hamer; Sec. R.L. Wilson; employees: 12,350.

Kodak (Australasia) Pty. Ltd.: 173 Elizabeth St., Coburg, Vic. 3058. Manufacturers of sensitized photographic materials, photographic chemicals and equipment; distributors and retailers. One subsidiary company in New Zealand; Chair. and Chief Exec. Officer J.W. Chester; employees: 3,500.

McPherson's Ltd.: 500 Collins St., Melbourne, Vic. Distributors of industrial products and machine tools. Also manufacturers of pumps for industrial and agricultural purposes, mechanical fasteners, and cold formed parts, cutting tools, fence and gate fittings, friction materials. Chair. W.D. McPherson; Man. Dir. M.B. Addison; employees: 5,000.

Theiss Holdings Ltd.: 146 Kerry Rd., Archerfield, Qld. 4108. Construction engineering; coal mining; merchandising of commerical vehicles. Chair. Sir Leslie Thiess, C.B.E.; Man. Dir. Alex L. Morkoff; employees: 4,900.

Thomas Nationwide Transport Limited (TNT): TNT Plaza, Tower 1, Lawson Square, Redfern, N.S.W. 2016; founded 1946; cap. and res. $A93m. (1976-77). Local, bulk, refrigerated and long-haul trucking, rail, sea, air freight forwarding, bond and free stores, warehousing, customs agents, courier services, computer services, armed security, pallet hiring, forklift distribution, waste disposal, ship owners and operators. Operates in Australia, Canada, the U.S.A., Brazil, the U.K., Europe, Malaysia, Singapore, Taiwan, Hong Kong, the Philippines, Mexico and New Zealand. One Hundred and seventy Australian overseas subsidiaries; Chair. F.W. Millar; Man. Dir. and Chief Exec. Sir Peter Abeles; Chief Gen. Man. J.R. Cribb, O.B.E.; employees: 11,000.

4. Corporations (continued)

RETAIL AND WHOLESALE TRADE

Burns Philp & Co. Ltd.: 7 Bridge St., Sydney, N.S.W. 2000. General merchandise wholesalers; general and shipping agents. Chair. and Man. Dir. James D. O. Burns; Sec. B.C. Porter.

G.J. Coles & Co. Ltd.: 236 Bourke St., Melbourne, Vic. 3000; cap. $A72.3m. Variety chain stores, supermarkets and food stores. Three grocery subsidiary companies; Chair. Sir N. C. Coles; employees: 44,000.

Dalgety Australia Ltd.: 38 Bridge St., Sydney, N.S.W. 2000; cap. $A30m. Wool selling brokers, stud stock specialists, livestock exporters, finance, produce salesmen, suppliers of graziers' and farmers' merchandise and agricultural seeds requirements, wholesale merchandisers, shipping and travel agents, stevedores, insurance agents, pastoralists, exporters, mining and industrial equipment manufacturers, bus and coach builders, domestic and commerical air-conditioning manufacturer. Twenty-two subsidiary trading companies in Australia Chair. William J. Vines, C.M.G.; Man. Dir. R.B. Vaughan; Sec. J. S. Burgess; employees: 3,500.

Elder Smith Goldsbrough Mort Ltd.: Elder House, 27-39 Currie St., Adelaide, South Australia; cap. $A34.86m. Importers and exporters, wool brokers, general merchants, land and livestock insurance, shipping and station owners, trustees and executors, merchant bankers, rural and real estate financiers, steel and metal distributors, coastal marine service, stevedoring and general transport operators. Five main subsidiary companies; Chair. Sir Norman Young; Deputy Chair. J.I.N. Winter; Man. Dir. and Chief Exec. H.C. Schmidt; employees: 5,321.

David Jones Ltd.: 86-108 Castlereagh St., Sydney, N.S.W. 2000; founded 1838; cap. $A40m. Department store chain retailers; 28 stores in Australia; trades under name of Buffums in California, U.S.A.; one manufacturing interest, Selby shoes (Aust.) Ltd. (footwear). Chair. Charles B. Lloyd Jones; employees: 12,500.

4. Corporations (continued)

The Myer Emporium Ltd.: 250 Elizabeth St., Melbourne, Vic. 3000; founded 1925; cap. $A95.3m. Holding company of the largest group of department and discount stores in the Southern Hemisphere. Maj. department stores in all States. Chair. K.C. Steele; Man. Dir. K.A. Rosenhal; employees:29,995.

Waltons Ltd.: George, Park and Pitt Sts., Sydney, N.S.W. 2000; founded 1926; cap. $A23.8m. Department store chain retailers. Chair. John S. Walton; employees: 7,712.

Woolworths Ltd.: 534 George St., Sydney, N.S.W. 2000, cap. $A64.4m. Chain store proprietors. Chair. Sir Theo Kelly, O.B.E.; Joint Gen. Mans. W. Dean, H.P. Simons; employees: 36,200.

E. COUNTRY OVERVIEW

1. General

- Eighty-five percent of Australia's population live in urban areas. About 60% of the people live in the eight administrative capital cities.
- Age distribution: 28.4%, 0-14; 59.2%, 15-59; 12.4%, 60+

2. Climate

- Parts of the tropical north experiences rainfalls of 60-100 inches, while the interior of the country has less than 10 inches of rain a year. The southeast and southwest have adequate gentle rains of about 40 inches annually.
- The north is affected by southeastern dry trade winds in winter. The south is affected by westerly winds in winter which bring rains to the southwest and western slopes of Tasmania. In the summer, the prevailing winds are easterly.

3. Economy

a. Agriculture:

- Per capita arable land: 8.1 acres
- Five percent of the land is cultivated, while 48% of the land is used for grazing. Australia produces 30% of the world's wool.
- The major agricultural products are cereals, sugarcane, fruits, grazing animals and dairy products.
- In acreage and value of output, wheat is the most important crop, averaging 52% of the acreage under crop and 38% of the gross value of rural production. 80% of the annual crop is exported.
- Fish catch (1975) 103,300 metric tons.

b. Trade:

- Significant changes in trade patterns have occured since World War II. The United Kingdom is now much less important than formerly. Asian countries have recently become prominent buyers of Australian products exports. Japan is Australia's best export market-first in the case of wool-and now ranks second as a source of value of Australian exports to Japan. The Republic of China has been the largest Australian market for wheat.

c. Industry:

- Australia is one of the most highly industrialized countries in the world. Industry contributes 42% of the GNP.

- The industrial structure has had no close economic integration with neighboring countries and it has been geographically dispersed into several centers of production.

- Few major or minor industries are indigenous in the sense that they have developed mainly on the basis of the country's own financing, ownership, natural advantage and technological ability. A large part of the manufacturing sector remained substantially a collateral branch of British, American or European manufacturing.

- Major industrial products include transportation equipment, iron and steel, textiles and chemicals.

d. Mining:

- Australia is a leading supplier of many minerals including lead, zinc, gold, iron ore, manganese, bauxite, coal, rutile, zircon and ilmenite.

- Eighty commercially significant minerals are produced in the country.

4. Living Conditions

a. Health:

- There are generally good conditions of health care, nutrition and sanitation.
- Life expectancy: male, 67 years; female, 74 years
- Infant mortality rate: 17.9 per 1,000 births
- Doctors: 1 for every 865 people
- Population per hospital bed: 83
- Total number of medical facilities: 2,197
- The provision of social services and welfare benefits is generally considered one of the most important functions of government.

b. Housing:

- In 1966, over 84% of housing units were privately owned. Seventy percent of these private homes were owner occupied.
- In 1971, the average housing unit had five rooms with an average of .7 persons per room.
- Housing built by government financing is available at relatively low rental rates and is highly covered; the number of applicants usually exceeds the number of dwellings.
- Electrification is virtually universal throughout Australia; only 1.6 percent of the dwellings in 1971 were without electricity. In some cases urban expansion has outpaced water and sewerage services, but only 1.1% of dwellings were without any toilet facilities, and most (89.3%) had flush toilets.

c. Water

- The availability of water is crucial for settlement. One third of Australia is desert while another third contains marginal grazing areas.
- Water retention and irrigation are difficult because of undependable rainfall and high evaporation rates.

d. Education:

- The literacy rate is 98.5%.
- School attendance is compulsory and free between the ages 6-15 (16 in Tasmania); except those exempted on account of distance, for whom a separate form of education is provided.
- The Minister of Education and an Education Department headed by a director general are responsible for forming educational policies and putting them into effect and deals with all aspects of education within each state.

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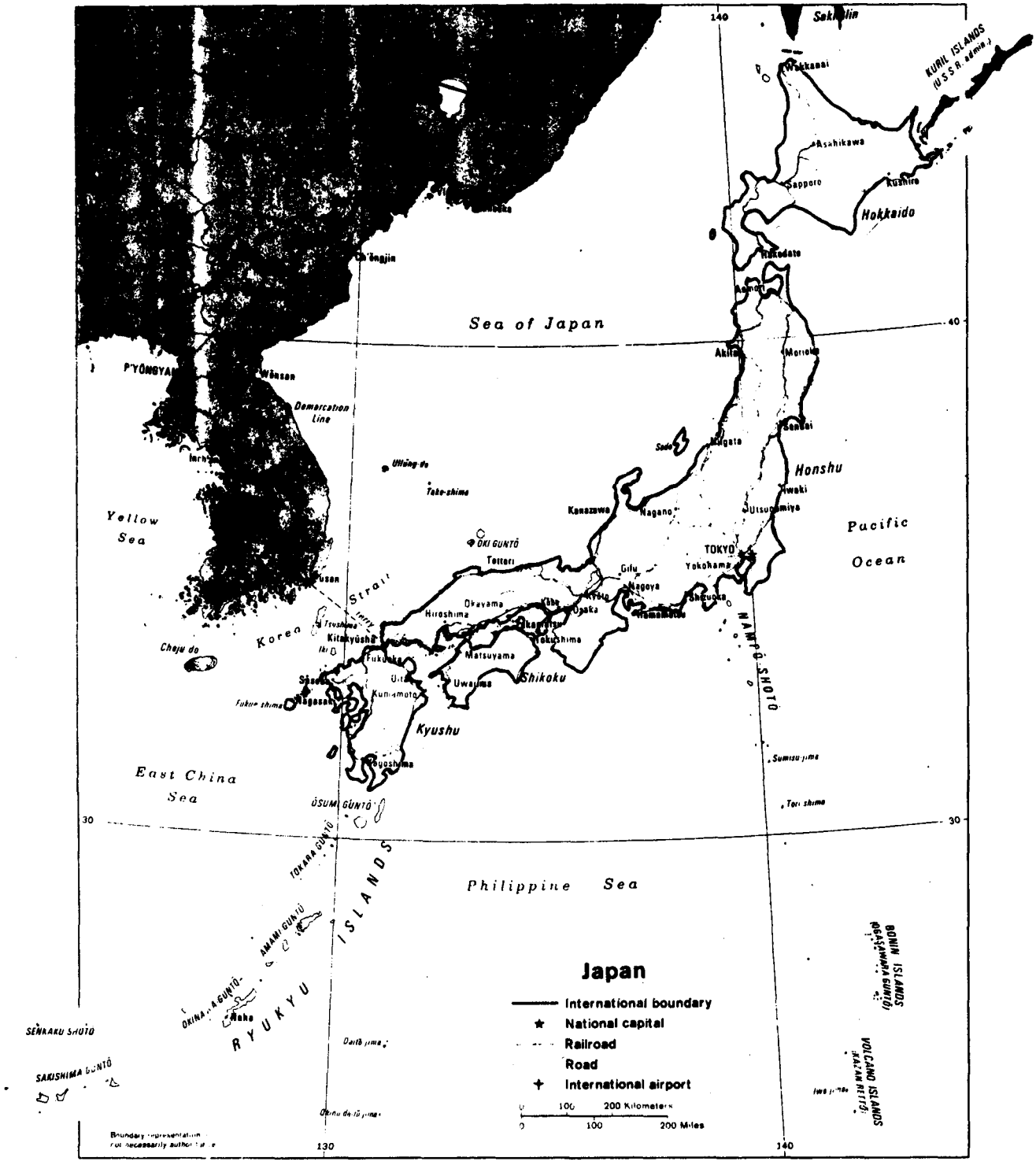
APPENDIX

ADB	Asian Development Bank
AIOEC	Association of Iron Ore Exporting Countries
ANZUS	ANZUS Council; treaty signed by Australia, New Zealand and the United States
ASPAC	Asian Pacific Council
CIPEC	Intergovernmental Council of Copper Exporting Countries
DAC	Development Assistance Committee (OECD)
ELDO	European Space Vehicle Launcher Development Organization
ESCAP	Economic and Social Council of Asia and the Pacific
FAO	Food and Agricultural Organization
GATT	General Agreement on Tariffs and Trade
IAEA	International Atomic Energy Agency
IATP	International Association of Tungsten Producers
IBA	International Bauxite Association
IBRD	International Bank for Reconstruction and Development
ICAC	International Cotton Advisory Committee
ICAO	International Civil Aviation Organization
IDA	International Development Association
IEA	International Energy Agency
IFC	International Finance Corporation
IHO	International Hydrographic Organization
ILO	International Labor Organization
IMCO	Intergovernmental Maritime Consultative Organization
IMF	International Monetary Fund
IOOC	International Olive Oil Council
IPU	Inter-parliamentary Union
IRC	International Red Cross

ISO	International Science Organization
ITC	International Tin Council
ITU	International Telecommunications Union
OECD	Organization for Economic Cooperation and Development
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
UPU	Universal Postal Union
WHO	World Health Organization
WIPO	World Intellectual Property Organization
WMO	World Meteorological Organization
WSG	International Wool Study Group

II

JAPAN


Sea of Japan
Yellow Sea
East China Sea
Philippine Sea
Pacific Ocean
Korea Strait
Demarcation Line
Honshu
Hokkaido
Shikoku
Kyushu
RYUKYU ISLANDS
NAMPŌ SHOTŌ
KURIL ISLANDS (U.S.S.R. admin.)
BONIN ISLANDS
VOLCANO ISLANDS
SENKAKU SHOTŌ
SAKISHIMA GUNTŌ
AMAMI GUNTŌ
TOKARA GUNTŌ
ŌSUMI GUNTŌ
OKI GUNTŌ
PYÖNGYANG
Wönsan
Chöngjin
Inchon
Pusan
Cheju do
Ulleung do
Take-shima
Fukue shima
Tsushima
Iki
Sado
Sakhalin
Wakkanai
Asahikawa
Sapporo
Kushiro
Hakodate
Aomori
Akita
Morioka
Sendai
Niigata
Iwaki
Utsunomiya
Kanazawa
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TOKYO
Yokohama
Shizuoka
Tottori
Okayama
Hiroshima
Kobe
Osaka
Yamaguchi
Tokushima
Matsuyama
Uwajima
Kitakyūshū
Fukuoka
Saga
Nagasaki
Kumamoto
Kagoshima
Naha
Sumisu-jima
Tori-shima
Daitō-jima
Okinawa-daitō-jima
Iwo-jima
Japan
International boundary
National capital
Railroad
Road
International airport
0 100 200 Kilometers
0 100 200 Miles
Boundary representation not necessarily authoritative
130
140
30
40

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I. ENERGY PROFILE

A. RESOURCES

1. Climate

Northern island of Hokkaido has short, cool summers and long cold, snowy winters. Northern Honshu has a milder climate while central and southwestern Japan are humid and subtropical. Rainfall is generally adequate throughout the main islands, ranging from 40 to 120 inches annually. All regions are subject to fifteen to thirty typhoons each year, mainly in late summer and early fall.

Mean temperatures vary from around 23°F in the winter in northern Japan to around 83°F in summer in central Japan. The climate is generally similar to that of the east coast of the United States.

The table on the following page presents parameters of climatological data representative of nearly homogeneous climatic area. The data are average (or representative) values based on a sample of climatological data available from weather stations within the area. The area data do not imply that the specific condition simultaneously exists at all locations within a country or large climatic area. In rolling and mountainous terrain, there may be considerable variation in the data from one location to another within the climatic area.

MEAN NUMBER OF DAYS WITH SKY COVER LESS THAN 3/10 AND VISIBILITY EQUAL TO OR GREATER THAN 3 MILES.

The average of the number of days when, at a specified hour during the day in the specified month, the portion of the sky covered with clouds was observed to be equal to or greater than 3 miles.

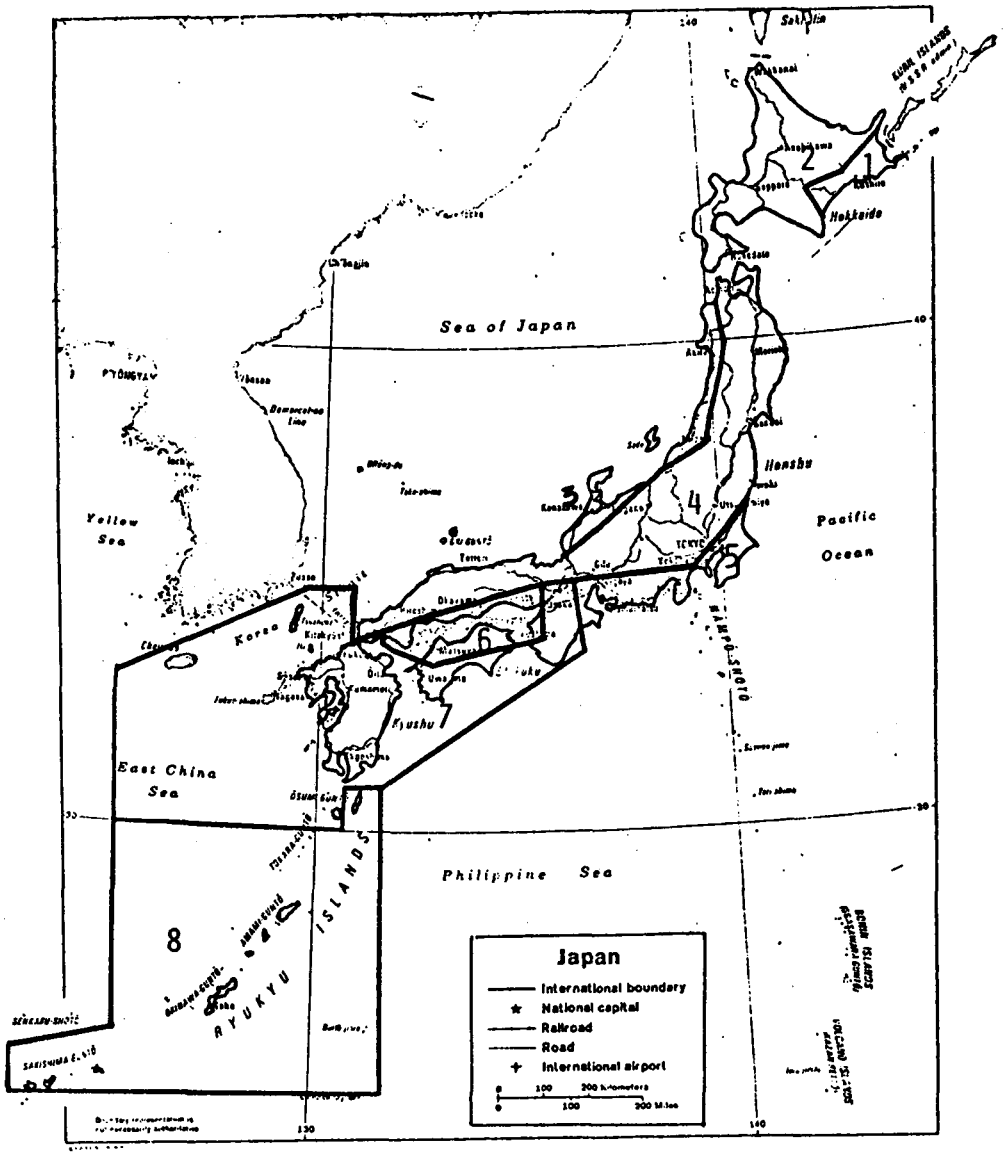
MEAN NUMBER OF DAYS WITH SURFACE WIND 4-10 KNOTS AND TEMPERATURE 33-89°F AND NO PRECIPITATION.

The average of the number of days when, at a specified hour during the day in the specified month, the surface wind speed was equal to or greater than 4 knots, but no greater than 10 knots, the temperature was equal to or greater than 33°F but not greater than 89°F and there was no precipitation.

Parameter Description		Area 1 Hokkaido Plains	Area 2 Hokkaido Mts.	Area 3 NW Coast	Area 4 Central Mts.	Area 5 S. Plains	Area 6 Lowlands	Area 7 S. Slopes	Area 8 Detached Islands
Max Mean Temp (°F)		49	52	62	62	67	68	69	75
Min Mean Temp (°F)		34	37	48	46	52	52	53	63
Largest Mean Precip (in)		42.9	54.3	104.3	94.5	136.6	77.8	107.2	130.6
Smallest Mean Precip (in)		42.9	35.4	60.9	32.6	51.7	43.9	48.4	95.1
	Time LST								
No. days when surface wind was 4010 knots, temperature was 33-89°F and no precip.	0900	[a]125.3	99.9	146.3	144.2	161.1	141.6	149.3	Data Not Available
	1500	[a]149.6	122.6	164.4	175.5	161.8	187.5	164.9	
	2100	[a]102.2	98.7	141.1	143.0	159.2	135.9	147.8	
	0300	[a]88.0	81.6	134.7	114.9	135.9	139.0	137.5	
No. days when sky cover was less than 3/10 and visibility was greater than 3 miles.	1900	[a]84.6	49.8	59.9	85.2	77.7	91.8	79.9	
	1500	[a]108.5	59.7	58.3	77.3	79.7	85.7	80.6	
	2100	[a]133.1	78.4	86.5	108.5	110.5	132.5	125.5	
	0300	[a]133.9	82.3	87.8	110.9	106.7	129.7	116.5	

LST = Local Standard Time

[a] = Measurements taken 1 hour late



2. Renewable Resources

a. Solar radiation:

Month	Langleys/Day
March	300 to 400
June	350 to 450
Sept.	300 to 350
Dec.	100 to 200

b. OTEC/tidal wave: A site for wave power generation test has been selected 3 km off Yura, Tsuruoka City in Yamagata Prefecture. An average of more than 3 meters wave height for 50 days in winter is expected.

c. Geothermal: Because of the high level of volcanic activity in Japan, geothermal energy is an important sector of the government's energy plan. A goal of 3000 MW has been set for 1990. As of September 1977, there were four small geothermal powerplants operating in Japan with a projected capacity of 68 MW. The areas with the greatest geothermal potential include the island of Hokkaido, Iwate Prefecture, Oita Prefecture, Akita Prefecture, and Miyagi Prefecture.

d. Hydropower: A source of abundant hydropower is on the island of Honshu in the Chuba region. It is anticipated that hydropower could provide 50,000 MW of capacity by 1990. Hydropower development has placed greater emphaisi on pumped storage schemes recently. In March 1977, 30% of aggregate hydropower generating plants were pumped storage powerplants.

e. Wind: Japan's potential wind energy is considered to be roughly equivalent to its hydroelectric potential.

3. Non-Renewable Resources

a. Oil: Japan's 1971 production of crude oil was 5,529,000 bbls. In 1970, there were approximately 1500 wells producing less than 1% of consumption.

b. Natural Gas: Domestic production of natural gas in 1975 was 2.4 mtoe.

c. Coal: Coal reserves are estimated to be about 20 billion tons. Approximately 60% is bituminous, 30% semibituminous, 6% anthracite, and 3% lignite. Production in 1975 was approximately 20 million tons.

d. Uranium: Japan is extremely poor in uranium resources.

B. ENERGY ECONOMY

1. Supply Descriptor

- During the Japanese FY 1975, the composition of the supply of primary energy was nuclear (1.7%), hydropower (5.7%), geothermal (0.1%), coal (16.5%), and natural gas/oil (76%). In 1975, approximately 88% of the primary energy supply was imported energy, 73% was oil. The share of oil imports in the total primary energy is forecast to decline to 61% by 1985 as a result of increased reliance on nuclear energy. If projected energy consumption figures through the year 2000 hold true, Japan will have to meet an energy shortage equivalent to 0.25 to 1.4 billion kiloliters of oil assuming an annual consumption growth rate of 4.0%.

- The electricity sector plays a major role in utilizing alternative energy sources such as nuclear power, coal and LNG. It is important to reduce the dependence on oil in this sector in the light of long-term stable supply of electricity. To this end, it is intended to diversify power resources by development of nuclear power, coal-fired power, LNG/LPG-fired power, hydropower and geothermal power with a view to reducing oil dependence in this sector from about 67% in 1975 FY to about 39% in 1985 FY (about 22% in 1990 FY).

- It is intended to develop and bring in LNG as an important alternative energy source. LNG is an important pollution-free energy source for Japan which has severe environmental protection standards. Its increased utilization is to be promoted mainly for electricity generation and town gas.

- It is intended to maintain domestic coal production at the current level of 20 million tons a year. Imported steam coal is expected to increase to 16 million tons per year in 1985 through increased utilization mainly in the electricity sector. Stable trade relationships are promoted with coal producing countries. Various constraints on coal production and usage, such as transportation, burning and

1. Supply Descriptor (continued)

disposal of emitted smoke and ashes should be overcome through technological development.

- Nuclear power has the largest supply potential in the medium and long term, and will become an independent energy source once a nuclear fuel cycle is established. Its development will be actively promoted.

  To this end, the government will endeavor to obtain public confidence in nuclear safety; to promote international cooperation; and to strengthen a domestic management system of nuclear materials in accordance with current international statutes regarding non-proliferation.

  The following measures have been proposed by the Government in order to prepare a foundation for nuclear utilization:

  - Facilitate secured supply of uranium resources.
  - Promote commercialization of uranium enrichment services.
  - Prepare for construction of private reprocessing facilities.
  - Promote establishment of radioactive waste disposal management facilities.

- The R&D activities related to such technology fields as expanded coal utilization, reliability and safety of nuclear power, advanced type reactor including FBR, nuclear fusion, new energy and energy conservation, will be promoted according to the national program by both governmental research institutes and private research institutes under governmental contracts. Voluntary R&D activities by private institutes in the above fields will also be promoted.

- International cooperation in R&D activities will be actively encouraged and will be coordinated with national R&D activities.

- In 1977, 18,625 km of seismic surveys were completed and eight offshore exploratory wells were drilled in water up to 200 meters deep in search of hydropower resources.

2. Conversion Descriptor

Total installed generating capacity at the end of the Japanese fiscal year on March 31, 1977 was approximately 117,000 MW. More than 71% of total capacity was represented by thermal plants, 22% by hydro plants and 6% by nuclear plants. Ten percent (10%) of the thermal capacity was derived from LNG power plants, approximately 84% from power plants using oil, and the remainder mainly from coal-fired power plants.

3. Transport/Distribution Descriptor

- Railway traffic (1975): 200.7 billion passenger-miles
  29.43 billion net ton-miles

- Motor vehicles in use: 17,236,000 passenger cars
  (1975) 10,315,000 commercial vehicles
  manufactured: 5,424,000 passenger cars
  (1977) 3,072,000 commercial vehicles

- Civil aviation: (1977) 14,166,000 passenger-miles
  (1977) 699,639,000 freight ton-miles

- Chief ports: Yokohama, Tokyo, Kobe, Osaka, Nagoya, Chiba, Kawasaki, Hakodate

- Although railroads have been affected by the sharp rise in competition from road transportation since the 1960's much more than have shipping and air transport, they continued in the early 1970's to be the backbone of the transportation system. Over 16,000 route miles of national and privately operated rail lines made it possible to travel or to ship goods by rail to almost any provincial city and to larger towns. Japan has been a world leader in the development of high-speed, long-distance passenger rail service since the opening in 1964 of the ultramodern 320 mile high-speed line linking Tokyo and Osaka.

- With the exception of the 215 mile expressway between Tokyo and Osaka, road conditions have generally failed to keep pace with the exceptional expansion of vehicular traffic. In 1973 the road system was distinctly inferior to that in other advanced countries. Road expansion and improvement were seen as important national needs during the 1970's and to the mid-1980's.

3. Transport/Distribution Descriptor (continued)

- Japan's electric public utility system consists of 10 privately owned regional electric power companies each of which provides an integrated system of electric power generation, transmission and distribution in a specified area. The transmission grids of the nine regional public utility companies on the four major Japanese islands are interconnected in order to provide an interchange of power among the regional areas.

4. End Use Descriptor

- Of the total power demand, approximately 77% is used for industrial and commercial purposes, and 23% for residential consumption. The iron and steel industry alone used more electricity than was consumed for lighting. Among industrial users, chemicals and allied products followed iron and steel ; nonferrous and the paper industry were the next largest.

- Beginning in 1968 the peak load period changed from winter to summer, owing to the widespread use of air conditioning in new buildings. Approximately 1.5% of the total energy used in residences in Japan is used for cooling.

- Although Japan's electric energy production is the third largest in the world, the per capita residential consumption of electric power is still lower than other developed countries in Western Europe and North America.

- For the last decade oil consumption has grown 3.4 times as large as that in 1960 with an average annual increase rate of 11%, double the world average during the same period. Almost zero growth has been observed after the oil crisis.

5. Statistics

a. Supply:

Type of Energy	Quantity (JFY 1975)
Domestic Oil & Gas	3.5 million kl
Domestic Coal	18.6 million tons
Imported LNG	5.05 million tons
Imported Coal	62.8 million tons
Imported Oil	286.0 million kl

a. Supply: (continued)

Type of Plant	Megawatts
Thermal	83,476
Hydro	25,955
Nuclear	7,441
TOTAL	116,872

PLANNED FUTURE NUCLEAR AND OIL FIRED PLANTS

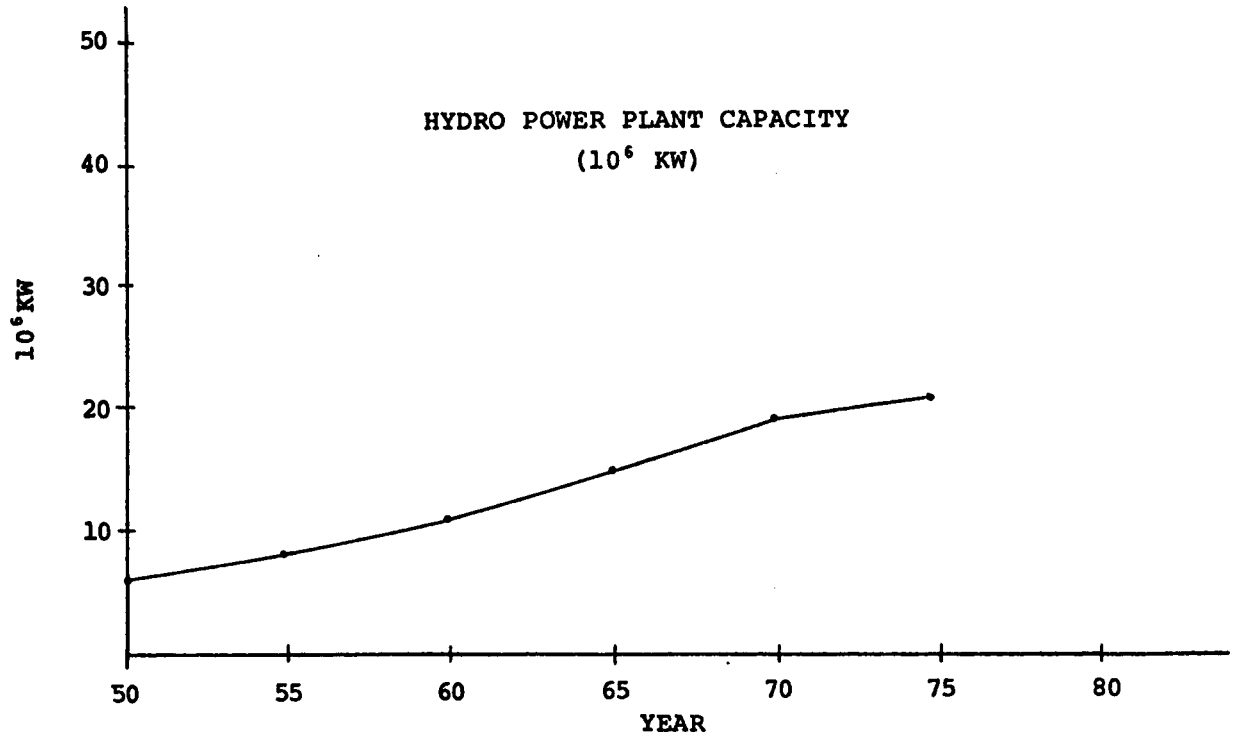
Nulear Utilities	Name	Capacity MWe	Const. Start	Commercial Operation	Capital cost per yen/kWh	Fuel Cost Per yen/kWh
Hokkaido	Kyowa-Tomari	579	6/76	9/82	5.51	2.52
Tohoku	Namie-Odaka-1	825	10/76	2/84	6.16	2.28
	Namie-Odaka-2	825	10/76	2/85	4.80	2.40
Tokyo	Fuku-Shima-2	1,100	10/76	5/84	5.57	2.84
	Noto-1	1,100	2/77	11/84	5.32	2.38
	Noto-2	1,100	4/77	9/85	6.40	2.99
Hokuri Ku	Noto-3	500	10/77	7/83	6.26	1.24
	Noto-4	1,000	12/76	7/85	5.88	2.35
Kansai	Noto-5	825	12/76	6/83	6.03	482.23
	Noto-6	825	5/77	12/83	4.90	2.23
	Noto-7	1,200	5/77	6/84	6.30	2.16
	Noto-8	1,200	9/77	12/84	4.98	2.16
Chugoku	Noto-9	800	9/77	3/84	5.83	1.72
Kyushu	Noto-10	890	7/77	7/84	3.88	2.93
Tohoku	Akita	600	5/77	12/79	2.46	7.90
Chuba	Atsumi	700	6/76	8/79	1.76	7.00
Hokuriku	Noto-A	500	5/76	7/80	1.96	7.51
Kansai	Noto-B	375	12/77	4/81	4.83	8.00
	Noto-C	375	4/77	6/81	1.96	8.00
	Noto-D	375	4/77	8/81	1.97	8.00
	Noto-E	600	5/77	5/82	4.12	7.66
	Noto-F	600	5/77	7/82	1.95	7.66

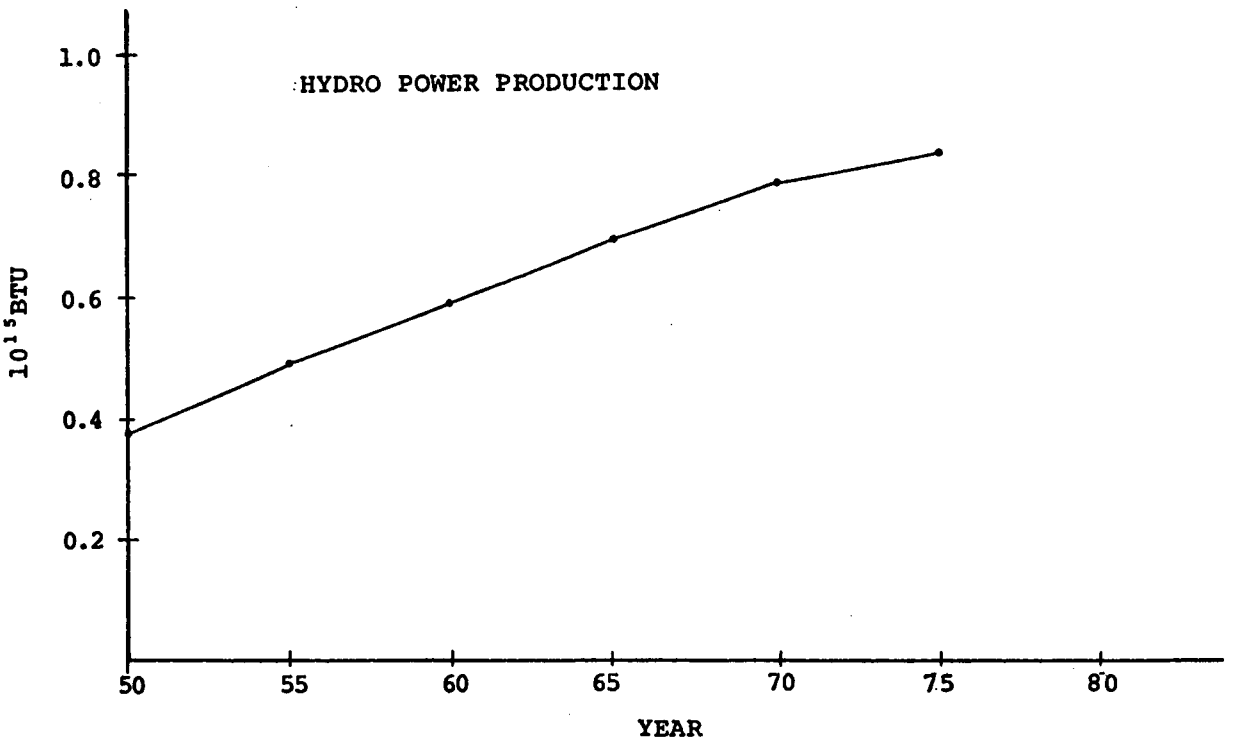
Source: Cable 270650Z October, 77 Fr: FM Amembassay Tokyo to ERDA

a. Supply: (continued)

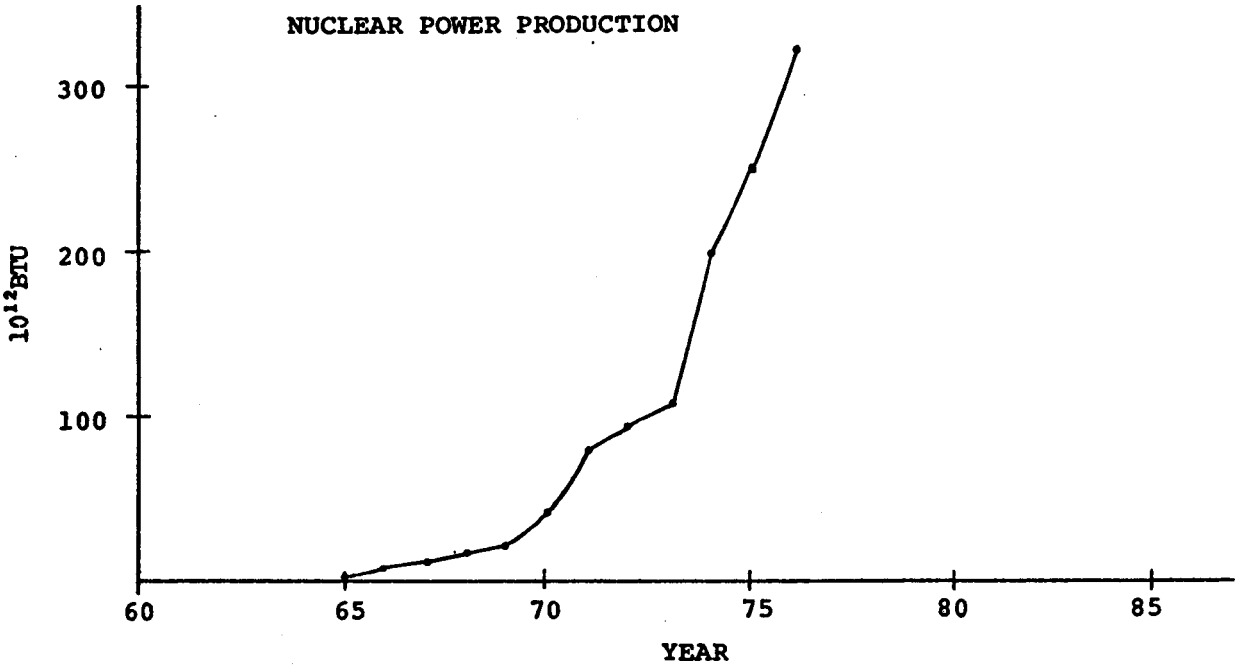
PETROLEUM INDUSTRY PRODUCTION AND PROCESSING (1977)		
Commodity	Unit of Measure	Quantity
PRODUCTION		
Crude oil	1,000 KL	689
Natural gas, gross production	1,000 K^3	2,804,064
PETROLEUM REFINING		
Refinery Input		
Crude oil	1,000 KL	248,660
Unfinished oils	1,000 KL	6,522
Other	1,000 KL	15,329
Total		270,511
Refinery Output		
Gasoline:		
Aviation	1,000 KL	25
High octane motor	1,000 KL	3,556
Regular	1,000 KL	27,656
Total		31,237
Kerosene and jet fuel:		
Jet fuel	1,000 KL	3,828
Kerosene	1,000 KL	25,331
Total		29,159
Fuel oils:		
Distillate:		
Diesel oil	1,000 KL	18,263
Residual	1,000 KL	127,802
Total		146,065
Lubricants:		
Lubricating oils	1,000 KL	2,200
Greases	1,000 KL	61
Total		2,261
Minor products:		
Liquefied refinery gas (LRG):	1,000 KL	5,904
Petrochemical feedstock (Naptha)	1,000 KL	20,159
Paraffin oil and wax	1,000 KL	180
Asphalt and Bitumen (excluding natural) and road oil	1,000 KL	4,468
Petroleum coke	1,000 KL	275
Unfinished oils for further refining (shipped)	1,000 KL	7,031
Refinery fuel		
Heavy fuel oils & other	1,000 KL	6,284
Refinery losses or gains	1,000 KL	17,488
Total output	1,000 KL	270,511

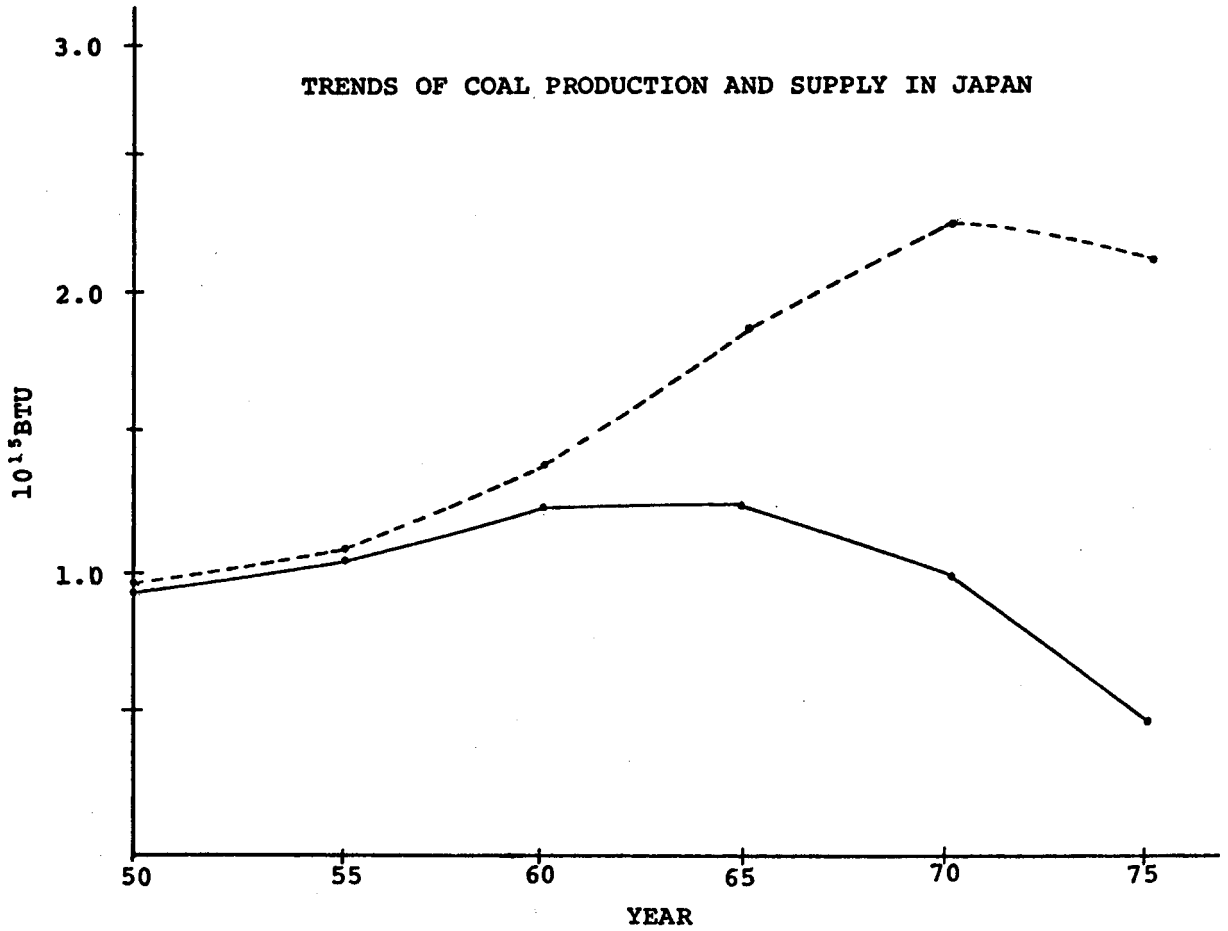
a. Supply: (continued)





a. Supply: (continued)





b. Projections of demand: Japan's total energy demand increased nearly fourfold from 91 mtoe in 1960 to 346 mtoe in 1975. It is forecast to grow at a rate of 6.9% per year to 675 mtoe by 1985 with industry continuing to dominate demand with over 60% of the total consumption.

Total electric energy production was estimated at 542 billion KWh in fiscal 1977, of which 87% was by public utility plants and 13% by captive electric power systems. Total production is projected to reach 747 billion KWh in fiscal 1982 and 813 billion KWh in fiscal 1985.

Type of Energy	Projection JFY 1985
Domestic Oil & Gas	8 million kl
Domestic Coal	20 million tons
Imported LNG	24 million tons
Imported Coal	96 million tons
Imported Oil	505 million kl

PROJECTED GENERATING CAPACITY
(Public Utilities Only)
March 1985

Type of Plant	Megawatts
Hydro	38,210
Thermal	103,750
Nuclear	24,420
	166,380

ENERGY SUPPLY DEMAND FORECAST FOR 1985 & 1990

	1985	1990
Crude oil imports	420-440 Mil. KL	470-498 Mil. KL
LNG imports	24-30 Mil. tons	34-44 Mil. tons
Nuclear	27-33 Mil. KW	45-60 Mil. KW
Hydroelectric	19.5-22.5 Mil. KW	25.5-26.5 Mil KW
Geothermal	0.5-1.0 Mil KW	25.5-26.5 Mil KW

Source: Ministry of Trade and Industry; June 7, 1977

b. Projections of demand:

TENTATIVE OUTLOOK OF LONG-TERM ENERGY SUPPLY AND DEMAND			
Item \ Year	Fiscal Year 1975 (Actual Performance)	Fiscal Year 1985	
		Base Rate	Accelerated policy case
Type of Energy	Quantity (Composition rate, %)	Quantity (Composition rate, %)	Quantity (Composition rate, %)
Hydro power Ordinary hydro-power Pumping-up hydro-power	 17.8 mil.k 7.1 mil.kw (5.7)	 19.5 mil.kw 19.5 mil.kw (3.3)	 ~22.5 mil.kw ~18.5 mil.kw (3.9)
Geothermal power	0.05 mil.kw (0.1)	0.5 mil.kw (0.1)	~ 1.0 mil.kw (0.3)
Oil and natural gas production	3.5 mil.kw (0.9)	8.0 mil.kl (1.2)	~11.0 mil.kl (1.7)
Coal production	18.6 mil.tons (3.4)	20.0 mil.tons (2.0)	~20.0 mil.tons (2.1)
Nuclear power	6.62 mil.kw (1.7)	26.0 mil.kw (5.4)	~33.0 mil.kw (7.4)
LNG imports	5.05 mil.tons (1.8)	24.0 mil.tons (4.9)	~30.0 mil.tons (6.4)
Coal imports (Steam coal)	62.34 mil.tons (13.1) (0.5 mil.tons)	93.0 mil.tons (10.7) (6.0 mil.tons)	~102.0 mil.tons (12.4) (16.0 mil.tons)
New energy	———	———	~ 2.3 mil.kl (0.4)
Sub-total	104 mil. kl (26.6)	195.0 mil.kl (27.8)	~228.0 mil.kl (34.5)
Oil imports (LPG)	286 mil. kl (73.3) (5.89mil.tons)	505.0 mil.kl (72.2) (14.0 mil.tons)	~432.0 mil.kl (65.5) (20.0 mil.tons)
Total	390 mil. kl (100)	700.0 mil.kl (100)	660.0 mil.kl (100)

c. Imports/exports: In 1975, Japan imported almost 87% of its total energy requirements.

Type of Energy	Mtoe* Imported (1975)
Oil	249.2
Coal	47.9
Gas	6.7
TOTAL	303.8

6. Energy Needs

In fiscal 1975 Japan consumed 390 million kl of energy in oil equivalent of which about 75% was oil almost entirely imported from abroad. How to secure a stable supply of energy is one of the most important problems for Japan. Over 500 million kl of oil imports in 1985 FY will be required if Japan is to achieve the goal of 6% annual economic growth between 1975 and 1985.

Japan anticipates that it will be heavily dependent on imported oil, coal and LNG through the year 2000 with nuclear, geothermal and solar not becoming an important source of energy until at least the year 2050.

7. Peculiarities of the Energy Economy

a. Special problems:

- Japan's environmental protection standards are the severest in the world and the environmental aspect has affected decisions on the siting of energy related facilities. The Electric Power Industry Council foresees the possibility of a serious electric energy shortage in the future due to the difficulty of obtaining sites for power generating plants.

- In light of current problems related to plant siting, pollution, and fuel, 100% realization of power plant construction plans by the electric utility companies may be impossible to achieve. This is particularly true with respect to achieving nuclear power development goals because of strong opposition from environmentalists. Another major problem for the development of nuclear power in Japan is fuel availability. Japan must rely on foreign sources for supplies.

b. Special opportunities:

Becuase of the high level of volcanic activity in Japan, the development of geothermal energy is one of the important sectors of the Government's "Sunshine Project" with a total of 3000 MW set as the goal by 1990. Japanese manufacturers lead in the development of generators suitable for geothermal power applications, however, drilling technology lags; and technical assistance is being sought.

8. Project Summaries

The Japanese Government started the "Sunshine Project" in 1974 as a national R&D project for the purpose of developing new energy resources to meet energy requirements in the future. The major elements of the project are:

- Solar energy
- Geothermal energy
- Coal gasification and liquefaction
- Hydrogen energy
- Supporting research

The solar energy program includes solar thermal power generating systems, photovoltaic conversion systems, and solar heating, cooling and hot water supply systems.

The goals of the project are:

- Construction from 1976 through 1978 of four types of solar houses and buildings (providing heating, cooling and hot water).

- Construction and operation by 1980 of experimental solar thermal power generating plants with a capacity of 1000 KWe.

- Development by about 1990 of solar cells having a cost/watt which is 1/100 of the present cost.

A budget of 1.5 billion yen in fiscal 1977 and 2 billion yen in 1978 has been assigned to the solar program. The management of the "Sunshine Project" is under the Sunshine Project Promotion Headquarters set up at the Agency of Industrial Science and Technology, Ministry of International Trade and Industry.

8. Project Summaries (continued)

a. Solar Thermal Power Generation Systems

Two pilot plants having a capacity of 1000 KWe will be constructed and in operation by 1980 to identify problems which must be solved for the practical application of large scale commercial plants. The R&D of materials, machines and components, system characteristics and system design are being conducted. Construction is expected to start in 1978 at Nio in Kagawa Prefecture.

Two different types of pilot plants are being studied. The Tower Type or Central Receiver Type, is designed to obtain high temperature heat by concentrating the sunlight upon a thermal absorber set up on a high tower by means of many plane mirrors installed on the ground surface. Heat is stored in a heat storage device and supplied, when necessary, to steam trubines to operate generators for electric production.

In the other type, the Plane-Parabola, plane mirrors reflect light on cylindrical parabolic mirrors and are concentrated on a tubular absorber located on the linear focus of the mirror to obtain a high temperature. To increase the capacity of a generating system a number of combined units of plane mirrors and cylindrical parabolic mirrors will be required.

The Electric Power Development Co., Ltd. has been selected by the Government for the development of the two systems and will be the main contractor for the construction and operation of the plants. Fundamental research and development has been conducted by the Electrotechnical Laboratory on high performance cylindrical parabolic mirrors, materials and components for collectors, method of heat storage and a small scale power plant. The Laboratory is also acting as technical advisor to the Electric Power Development Company.

b. Photovoltaic Conversion Systems

Research and development activities in the following areas are being conducted with the objective of reducing the cost of solar cells by a factor of 100 by 1990.

- R&D on methods for continuous production of silicon ribbon crystal. Research is currently being carried out on multigrowth of crystals using the vertical growth method. The horizontal growth method has also been studied. A continuous supply of polysilicon fed into a furnace to pull an endless silicon ribbon has been attempted with this method.

- Research on thin film techniques focusing on finding an effective method for preparing high quality films and finding compatible substrates suitable for thin-film solar cells.

- R&D on a method of producing low cost and high durability solar cells using compound semiconductors. Studies are being conducted on a heretofore junction cell using CdTe-CdS.

- Study on the automatic and continuous fabrication method of solar cell arrays. The fabrication processes of junction formation, electrode formation and encapsulation have been developed.

- R&D on the feasibility of photovoltaic power generation systems. The development of techniques of solar cell applications was started in JFY 1978.

c. Solar Heating, Cooling and Hot Water Supply Systems

Research and development of solar heating, cooling and hot water supply systems suited for private homes, apartments and large buildings are being carried out with the goal of demonstrating practical application by the 1980's.

Major areas under development include:

- Selective absorption materials with low cost and high durability.

- High and low temperature collectors of low cost and high durability.

- Refrigerators and heat storage devices with high efficiencies.
- Study of building structures suited for solar energy utilization.
- Performance test procedures for collectors.

INSTITUTION/ORGANIZATIONS	CONTACT	ACTIVITIES
Government Industrial Research Institute Solar Research Laboratory 1 Hirati-Machi, Kita-Ku, Nagoya	T. Noguchi Chief of Solar Research Laboratory	High-temperature furnace, heating and cooling, power production
Waseda University Department of Architecture Nishiokubo, Shinjuku-ku Tokyo 160, Japan	K. Kimura, Professor	Heating, cooling, solar house
Osaka Institute of Technology 5-16-1 Omiya, Asahi-ku Osaka 535	Y. Saito	Collectors
Kagakin University 1-24 Nishi-Shinjuku Shinjuku, Tokyo	Y. Nakjima	Storage tanks
Electrotechnical Laboratory Tanashi, Tokyo	S. Sawata	Selective surfaces, thermal power
Kajima Institute of Construction Technology 2-19-1 Tobitakyu, Chofu-shi Tokyo, Japan	Mr. Kenji Shimokawa	Solar heating and cooling for large buildings
Energy Division Electrotechnical Laboratory 5-4-1 Mukodai-machi Tanashi-shi, Tokyo	Dr. Takashi Horigome Chief of Energy System Section	Thermal power generation
Turbine and Compressor Division Ishikawajima-Harima Heavy Industries Co., Ltd. 2-16, 3-chome, Toyosu Koto-ku, Tokyo	Mr. Masanori Watanabe Manager, Development Department	Research and development of Solar Rankine Cycle Engine

INSTITUTION/ORGANIZATIONS	CONTACT	ACTIVITIES
Operation Bureau Sunshine Project Electric Power Development Co., Ltd. 1-8-2 Marunouchi, Chiyoda-ku Tokyo, Japan	Mr. Jujio Ishikawa Director, Engineering Office Sunshine Project	Pilot plant development for solar thermal power generation
Osaka University Department of Electrical Engineering Toyonaka-city, Osaka, Japan	Professor Yoshihiro Hamakawa	Photovoltaic conversion
Electronic Device Division Electrotechnical Laboratory 5-4-1, Mukodai-machi, Tanashi-shi Tokyo, Japan	Mr. Yutaka Hayashi Senior Researcher	Solar Cell R&D
Department of Aeronautics and Astronautics Tokai University Tomigaya, Shibuyaku Tokyo 151, Japan	Professor Yoshio Kato	Wind energy
The United Nations University 29th Floor, Toho Seimei Bldg. 15-1, Shibuya 2-chome Shibuya-ku, Tokyo, Japan	Dr. Walter C. Sheaver Program Officer Natural Resources	UN University solar activities
AIST Ministry of International Trade And Industry	Mr. Taira Sunami Director of Sunshine Project for Solar Energy	
Science and Technology Agency	Mr. Koichi Yamaura Director, Office of International Research & Development Cooperation	

INSTITUTION/ORGANIZATIONS	CONTACT	ACTIVITIES
Ministry of Foreign Affairs Scientific Affairs Division	Mr. Kunisada Kume Director	
Japan Industrial Technology Association	Mr. Tsuneo Momota Executive Director	
Ashikaga University	Professor Ushiyama	Wind Energy
Mechanical Engineering Laboratory Agency of Industrial Science Ministry of International Trade & Industry	Mr. Hachiro Mizutani Senior Researcher	Wind energy, marine biomass systems
AIST, MITI	Fumio Koshikawa Director	Geothermal
Waseda University, Tokyo	Dr. Ken-Ichi Kimura Professor, Department of Architecture & President Solar Energy Society of Japan	
Ministry of International Trade and Industry Agency of Industrial Science and Technology Sunshine Project Headquarters	Mr. Yoshio Tayeneuma Counselor of Technical Affairs. Mr. Taira Sunami Director for Solar Energy Development Programs	
Institute of Energy Economics	Mr. Setsuo Takahaki Director of Research Affairs Mr. Tadaaki Kawano Staff Researcher	

INSTITUTION/ORGANIZATIONS	CONTACT	ACTIVITIES
National Institute for Research Advancement	Teruo Umayabashi Senior Staff Researcher	
Sharp Corporation	Mr. Akira Fujii, Manager of Foreign Affairs Department	
Solar Systems Promotion Association Room 440 Hibiya Kokusai Building 2-go Kan 2-3 Uchisaiwai-cho Chiyoda-ku, Tokyo, Japan	Mr. Doko President Mr. Takyu Managing Director Mr. Aoki Staff	
Department of Electrical Engineering Osaka University Toyonaka City, Osaka, Japan	Yoshihiro Hamakawa Professor	
Materials Engineering Division Mechanical Engineering Laboratory AIST, MITI, 4-12-1 Igusa Suginami-ku, Tokyo, Japan	Dr. Kenichi Matsuno Senior Researcher	
Research Institute of Industrial Science Tokai University 1117 Kitakaname, Kiratsuku-shi Kanagwa-ken, Japan	Kazuichi Seki Assistant Professor	
Mitsubishi Research Institute	Dr. Kiyoshi Nagata, Manager International Operations Section Osami Ozeki, Senior Researcher Techno-Economics Department Yoshio Sato, Research Director Mngr. Techno-Economics Dept.	

C. GOVERNMENT ENERGY ACTIVITIES

1. Energy Policy

Japan's current energy policy was defined on the basis of the "Basic Direction of General Energy Policy" adopted by the Ministerial Council on General Energy Policy (reorganized as Ministerial Council for the Promotion of General Energy Policy in February 1977) on December 19, 1975.

The overall objective of Japanese energy policy is to secure energy supplies to ensure economic growth. Japan needs to obtain access to reliable and diversified energy imports while reducing the relative dependence on imported oil.

The basic elements of Japan's energy policy strive to reconcile energy and environmental policy issues, provide optimal allocation of public funds among the energy programme and other sectors, coordinate energy R&D policy with overall energy policy and cooperate with municipalities to get site approvals for energy projects.

In line with the energy policy, the following directions were given.

(1) Effective utilization of domestic energy, promotion of the development of nuclear energy as quasi-domestic energy, dispersion of risks with diversification of imported energy sources.

(2) Stable supply of oil as the mainstay of energy supply for the time being.

(3) Promotion of energy conservation (development of technology for energy conservation, advancement of heat control, etc.)

(4) Development of technology for new energy (the technology for nuclear fusion, solar energy, geothermal energy, coal liquefaction and gasification, hydrogen energy, etc., as well as new types of nuclear reactors such as advanced thermal reactors, fast breeder).

1. Energy Policy (continued)

The Advisory Committee for Energy to the Minister of International Trade and Industry has recently presented a detailed and comprehensive interim report emphasizing the following "seven basic pillars".

(1) Promotion of energy conservation in all areas of energy consumption.

(2) Maximum utilization of domestic energy resources such as hydropower, oil, natural gas, coal and geothermal energy.

(3) Promotion of overseas development and import of alternative energy resources with high supply potential such as nuclear power, coal and LNG.

(4) Assurance of secure and stable supply of primary energy resources through diversification of supply sources and enhanced cooperation with supplier countries.

(5) Maintenance of stockpiles of various energy resources commensurate with the demand situations.

(6) Promotion of smooth siting processes for the energy-related facilities through better understanding and cooperation by the public.

(7) Pursuit of maximum contributions of energy technology in the development of alternative energy resources, conservation and new energy R, D&D.

Although the Government intends to actively promote nuclear power for the country's energy needs, particular emphasis was placed on four areas of renewable energy sources:

- Solar Energy

  To promote development of technology for solar energy heating, cooling and hot water supply.

  To promote development of technology for large scale solar power generation plants and R&D on high efficiency photovoltaic power generation system. Four projects currently under observation are described on the following page:

(1) Hirakata Solar House, a single family dwelling, uses assembled units of evacuated glass tubular collector developed by Sanyo Electric Company which are installed on the roof and south facade. Ohbayashi-Gumi Construction Company constructed the low energy house with a re-enforced concrete structure to which outside insulation was applied. For the windows, they have utilized double windows plus insulated panels.

(2) Ayase Solar House is a retrofitted single family house. Mitsubishi-Electric Company developed a small compression type of refrigeration machine driven by Rankine-cycle engine working at 90°C of vapor generation temperature, 38°C of condensing temperature and 5°C of evaporating temperature with Rankine-cycle COP of 9.983, refrigeration cycle by $NH_4Al(SO_4)_2 \cdot 12H_2O$ was developed. Taisei Construction Company developed a plug-in-type of thermal storage door incorporating insulation panels.

(3) Kikunodai Solar Apartment of Tokyo Electric Power Company is a three storied concrete structure designed and constructed by Takenaka Komuten Construction Company. Eighteen families have been living in it since the winter of 1978. For this building, IHI Heavy Industries Company developed a refrigeration machine incorporating a heat pump operated by solar heat source and air heat source combined with Rankine-cycle driven engine of 1500 rpm at 12 kW output against 14600kcal/h input.

(4) A solar school building for the Department of Energy Engineering of Ôita University was constructed in March 1977 by the Kajima Construction Company. A 30 RT of solar absorption machine developed by Kawasaki Heavy Industries Company is installed in the annex. This machine operates with single effect by solar energy at 0.7 of COP and with double effect by auxiliary energy at 1.0 of COP. A radiant cooling and heating ceiling system projected by the Kajima Company is helping to raise the COP of the refrigeration machine. A special type of storage tank with two pairs of weir to avoid mixing was developed by Toyo Engineering Company.

1. Energy Policy (continued)

- Geothermal Energy

  To promote R&D on methods for estimating the amount of geothermal energy resources available and R&D on exploration and excavation technologies.

  To promote development of a binary cycle power generation system using steam and hot water and a volcanic power generation system.

  To promote development of multi-purpose utilization technology of geothermal energy and environment protection technology.

- Biomass Conversion

  To promote R&D on biomass conversion technology and to evaluate the possible contribution of biomass conversion to the future supply of energy.

- Ocean Energy

  To promote R&D on utilization of ocean energy, such as wave power generation, ocean thermal gradient power generation for practical application.

The FY 78 White Paper on Science and Technology in Japan noted these characteristics of Government research. Thirty percent of R&D funds are used for development, 40% for basic research. Nuclear energy and space development programs account for about 80% of the R&D budget. Fifty percent of Government R&D money goes to universities, 20% to government research institutes, usually as subsidies or contracts.

a. Ministry

Ministry of International Trade and Industry (MITI)
1-3-1 Kasumigaseki, Chiyoda-ku, Tokyo

Minister: Mr. Masumi Esaki
Director for Solar Energy Development Programs: Mr. Raira Sunami.
Director, Office of International Research and Development Cooperation: Mr. Koichi Yamaura.
Counselor of Technical Affairs: Mr. Yoshio Tayeneuma.

a. Ministry (continued)

A working group has been established to provide overall coordination of projects and an interchange of information between projects.

Joint Committee
Chairman: Professor F. Hamakawa,

Systems Working Group
Chairman: T. Tani, Electrotechnical lab

Component Working
Chairman: Prof. T. Takahashi,
Tokyo Institute of Technology

Materials Working Group
Chairman: S. Arai Kamatuskinzoku Co.

Measurements Working Group
Chairman: Prof. A. Ushirokawa
Tokyo University

b. Structural descriptor

MITI has a Secretariat role for the Ministerial Council on the promotion of General Energy Policy which coordinates energy related policies among the different ministries. It is in charge of establishing and implementing non-nuclear R&D policy, specifically the Sunshine Project, started in 1974.

The R,D&D program for new energy technology is largely defined by the Energy Technology Committee of Council for Industrial Technology and its sub committees. At the actual implementation stage of the program, the Policy Committee and the Promotion Committee established for the project are respectively responsible for each detailed planning and coordination for the execution of the project. These Committees are composed of staff officials of AIST and MITI and recognized experts (including experts from the companies to which the project is commissioned, in case of the Promotion Committee).

b. Structural descriptor (continued)

The R,D&D projects which are commissioned to industry and other institutions are under the supervision of the Management Committee composed of MITI officials.

In the case of wave power, the Japan Marine Science and Technology Center under the AIST implements and reviews the project of a wave power generation system with wave breaking effect.

The Sunshine Project has the following immediate goals:

(1) To construct by 1980, solar houses and buildings providing heating, cooling and hot water supply.

This includes:

- Development of selective absorption materials with low and high durability.
- Development of both high temperature and low temperature collectors with low cost and high durability.
- Development of refrigerators and heat storage devices with high efficiency and low cost.
- Study of the building structures suited for solar energy utilization.
- Development of solar heating, cooling and hot water supply systems with a high cost performance.
- Study of performance testing of collectors.

Under this project, AIST, MITI has funded the construction of four different types of solar houses: a new single family house, a retrofitted single family house, a multi-family apartment and a 3 storyed school building. Construction of the house and the fabrication of mechanical components and systems were assigned to the large companies by MITI.

b. Structural descriptor (continued)

Besides the MITI experimental program, private constructors are building and selling solar houses, some with cooling units. MITI Home Industry Division estimates the number of these homes to be below one thousand.

(2) To construct and have operating by 1980, solar thermal experimental power generation plants with a capacity of 1000 kWe. The construction site has currently been set for Nioocho, Kagawa prefecture and Shikoku.

(3) To develop by 1990, solar cells which would reduce the cost/watt to less than 1/100 of the present level:

- R&D on the method of continuous production of silicon ribbon crystals so as to supply material of silicon solar cells at a low price and in large quantity.
- R&D on the Vertical Growth Method and the Horizontal Growth Method. Current research for the former has focused on multi-growth of crystals. Continuous supply of polysilicon into the furnace has been attempted for the latter to "pull out" endless silicon ribbon.
- R&D on the feasibility on the use of a highly efficient silicon thin-film solar cell in order to reduce the required quantity of high priced and high purity silicon.
- R&D on the method of production of a low price and high durability solar cell by using compound semi-conductors.
- Study of the automatic and continous fabrication method of a solar cell and arrays. This includes the development of the fabrication process of function formation, electrode formation and encapsulation.
- R&D on the feasibility of photovoltaic power generation systems.

b. Structural descriptor (continued)

Schedule for Photovoltaic Power Generation Development	
Phase 1 April 1974 - March 1981	Basic Research & Technology
Phase 2 1981 - 1986	Pilot Plant Production (10-100 kW) and System Tests
Phase 3 1986-1999	Increased Production (1000 kW) and Use in Applications
1991-2000	Photovoltaics will enter operational phase and be capable of replacing annually about 1% (1000 MWe) of the conventional electrical generation.

- Sunshine Project Program participants in solar cell R&D:

Sharp Corporation:	Low Cost Automated Si Cell Production Concentrating Systems - Si Solar Cells Encapsulant Materials Testing
Toshiba Corporation:	Silicon Ribbon - Vertical Pull
Nippon Silicon Company:	Silicon Ribbon - Horizontal Pull
Hitachi Ltd.:	Silicon Thin Film Cells - CVD
Nippon Electric Company:	Silicon Thin Film Cells - Plasma Deposited
Matushita Electric Industrial Company:	CdS-CdTe Cells
Electrotechnical Laboratory AIST, MITI:	Basic Research Activities - Series Connected Monolithic Cell Array, SnO_2/n-Si Cell, Efficiency , Lifetime and Diffusion Length Measurements.

b. Structural descriptor (continued)

Central Research Institute of Electric Power Industry:	Photovoltaic Power Generation System
Kyoto University:	In_2O_3/p-Si cells
Osaka University:	Amorphous Si p-i-n/stainless steel cells

(4) Development of a System of Wave Power Generation and Breakwater for the Effective Use of Coastal Space (Phase I 1976-79, Japan Marine Science and Technology Center). This entails developing a device and a system for wave power generation as well as for effective use of broken coastal space. A device to be developed at the Marine Science and Technology Center has a maximum output of 2000 KWe and weighs 500 tons.

(5) Exploration and Extraction of Geothermal Energy; Programme to develop technology for exploring and assessing geothermal resources as well as technology for excavating high-temperature rock in order to reduce the risks involved in development.

- Power Generation Utilizing Hot Water: Programme to develop the technology for high-efficiency heat exchange, etc., and to develop a high-efficiency 10,000 kw-level binary-cycle power generating system by the late 1980's. Construction is presently being advanced on two systems (hot water type, combination hot water and steam).

- Volcanic Power Generating System: Programme to develop the technology for fracturing into hot dry rock, for forming man-made hot water systems, etc., and to develop a 10,000 kw-level, high-efficiency, large-capacity volcanic and hot dry rock power generating systems by the mid-1990's.

- Multi-purpose Utilization of Geothermal Energy: Programme to develop technology for transporting geothermal fluids, and to develop geothermal energy utilization systems for regional heating, agriculture, and other purposes.

b. Structural descriptor (continued)

- Environmental Preservation: Programme to develop technology for environmental preservation in order to prevent adverse effects on the natural environment and ecosystem from the extraction and utilization of geothermal fluids.

- By 1980 the Project hopes to have constructed a simulation rest facility for geothermal power generation.

(6) Hydrogen Energy Technology: A wide ranging programme was established in the following five areas with the aim of developing large scale hydrogen production and utilization system by the year 2000:

  - Production of hydrogen
  - Transportation and storage of hydrogen
  - Utilization of hydrogen
  - Save handling of hydrogen

- A 1980 goal is to construct a high temperature high pressure electrolysis plant.

(7) Coal Gasifying and Liquefying Technology: Programme to establish the technology for manufacturing synthetic natural gas by pressurized fluidized gasification process, fused thermo-medium gasification process and develop a large capacity synthetic natural gas manufacturing plant by the late 1980's.

  - Develop synthetic natural gas manufacturing plant of 50,000 m^3/day.

  - R&D on gasification process, gasifying furnace, equipment, materials, safety technology.

  - Design, construction and operating research of gasifying plants of 7,000 m^3/day-level and 50,000 m^3/day-level.

- Coal Gasifying Electric Generating Technology: Programme to develop a large capacity gasifying plant for electric power generation by establishing the low-calorie gas manufacturing technology.

b. Structural descriptor (continued)

- Develop a gas manufacturing plant of 2,000 tons/day coal treating capacity for gas electric generation.

- R&D on design, construction and operating research on small-scale and medium-scale gasifying plants.

- Develop a gas-turbine-steam-turbine complex-cycle electric power generating system of 200,000 kW-level.

- Plasma Gasification Technology: Programme to establish the technology for economically manufacturing hydrogen and acetylene by plasma electric discharge.

  - Design and construct a furnace having plasma generating power source of 2,000 kW-level capacity.

(8) Coal Liquefying Technology: Programme to establish several technologies for manufacturing synthetic crude oil from coal, including direct-hydrogenerating liquefaction technology and extract-hydrogenerating liquefaction technology. Develop a synthetic crude oil manufacturing plant by the early 1990's.

- To achieve this goal, the Project will develop a 30 tons/day-level solvent-purified coal manufacturing pilot plant.

c. Funding

Japan's proposed solar budget (Sunshine Project) is as follows:

TIME	PROPOSED BUDGET
1974-1980	800,000,000 yen ($4,000,000)
1981-1985	2,000,000,000 yen
1986-1990	2,500,000,000 yen
1991-1995	2,000,000,000 yen
1996-2000	2,000,000,000 yen
TOTAL	9,300,000,000 yen ($47,000,000)

c. Funding(continued)

In 1977, Japan's total energy and nonenergy R&D budget, was $3.27 billion, approximately 3% of the total government budget, which in 1977 totalled $107 billion.

R&D Breakdown by area	Percentage and amount in $ Million, 1977
Solar	1.1%; 5.65 million
Wind	- ; .01 million
OTEC	0.1%; 0.62 million
Biomass	- ; 0.28 million
Geothermal	2.1%;11.10 million

FY 78 (April 1978 - March 1979) Budget for Project Sunshine was ¥5000 million ($US 27.5 million). About ¥2000 million was for solar energy projects, mainly solar thermal power generation. ¥200 million was for photovoltaic R&D. The solar energy portion of the budget for FY 78 was 1/3 greater than for FY 77. However, photovoltaics did not grow accordingly, much to the concern of those working in the Sunshine Project.

2. Principal Energy Involved Offices

a. Name

Agency of Industrial Science and Technology (AIST)
Director of Geothermal Energy Development:
Fumio Koshikawa, AIST, MITI.

b. Structural descriptor

The Agency is in charge of both R&D and technology related to the administration of the Ministry of International Trade and Industry. In regard to the work concerned with energy R&D, it is promoting the "Sunshine Project" i.e., large scale R&D of solar geothermal, coal gasification and liquefaction and hydrogen.

Through close ties between the Government and industry, effective mechanisms are planned for the commercialization of new technologies. In the case of solar heating and cooling, measures for promoting early market penetration are already under consideration by the Government.

c. Funding

Funds for renewable energy R&D are from the Sunshine Project budget.

a. Name

Consumer Goods Industries Bureau, MITI

b. Structural descriptor

Under MITI, the Bureau started a three year project in 1974 to promote solar houses with space heating and hot water supply and research and development. R&D work has been assigned to Toshiba Electric Company and Toshiba Housing Industries Company, Sharp Company and Eidai Construction Company.

a. Name

Ministry of Foreign Affairs
Director of Scientific Affairs Division:
Mr. Kunisada Kume

- a. Name

  Agency of Natural Resources and Energy

  b. Structural descriptor

  The Agency, as an external agency of the Ministry of International Trade and Industry (MITI), is in charge of overall administration concerning production, distribution, consumption, etc. of mineral resources and various forms of energy including electricity.

- a. Name

  Council for Industrial Technology

  b. Structural descriptor

  Being an advisory organ to the MITI in the field of industrial technology, the Council deliberates how to promote the development of industrial technology, a basic policy line of "Sunshine Project".

- a. Name

  Ministerial Council on Promotion of General Energy Policy. Chaired by the Prime Minister.

  b. Structural descriptor

  The Council was established for coordinating the Ministers concerned with important issues on promotion of general energy policy, chaired by the Prime Minister. Energy R&D is regarded as one of the main parts of the general energy policy. The Agency of Natural Resources and Energy for the MITI plays the role of Secretariat for the Council.

- a. Name

  Council for Science and Technology
  President: Dr. Koji Fushimi

  b. Structural descriptor

  The overall energy R, D&D policy, as a part of a general science and technology policy, is established and reviewed by the Council for Science and Technology, through the coordination of the governmental agencies concerned and recognized experts from industry and academic circles.

b. Structural descriptor (continued)

The Council is the supreme advisory organ to the Prime Minister for the basic policy of science and technology. The Council is now deliberating on "a basic plan of energy R&D" under the direction of the Prime Minister.

- a. Name

Advisory Committee for Energy

b. Structural descriptor

Being an advisory organ to the Minister of International Trade and Industry, the council studies and deliberates important issues concerned with overall and long term policies for ensuring a stable and rational energy supply.

According to the Advisory Committee for Energy, in order to achieve the Accelerated Energy Policy Objectives, total investments in the energy sector in 1976-1985 will be 68 trillion yen, or about 2 times the amount of investments of previous 10 year periods. Total Government funds allocated to implement this program, 1976-1985, will be 7 trillion yen.

Japan does not see insurmountable difficulties for the economy to generate energy investment capital of this magnitude. 500 billion yen have been included in the financial budget for 1978-1979, of which 130 billion yen will come from revenues raised by a new tax on crude oil and petroleum products. (3.5% tax rate). However, Japan's budget commitments do not extend beyond any one fiscal year and budget increases are limited to that percentage allowed in previous years.

- a. Name

Science and Technology Agency
Director of International Affairs: Mr. Toshio Sugawara

b. Structural descriptor

Organization to establish and implement R&D policy; coordinates all government R&D activities in Japan (excluding the research activities of colleges and universities which is under the jurisdiction of the Ministry of Education). The Agency plans all research activities and promotes

b. Structural descriptor (continued)

national projects in "new" research areas--especially in the nuclear field. It has overall responsibility for all facet's of Japan's extensive nuclear R&D program. In addition, the Agency serves as Secretariat for the two principal policy advisory organizations to the Prime Minister in the areas of overall science and technology and nuclear energy (i.e. the Council for Science and Technology and the Atomic Energy Commission).

The Institute of Resources at STA has been researching Japan's potential application of wind energy.

The Science and Technology Agency funded the construction of Soka Solar House which has a flat plate collector with selective surface of 42 m^2 and a H_2O-LiBr absorption refrigeration machine.

ENERGY BALANCE OF SOKA SOLAR HOUSE (Mcal/day)

Period		AUG. 1975	AUG. 1976	DEC. 1976	JAN. 1977
Number of Days Measured		18	14	30	10
Solar Radiation on Collector		194.3	142.4	101.7	121.5
Collection		41.3	25.2	21.7	25.0
Hot Water Load - Total		4.3	1.6	10.7	12.7
Hot Water Load - Solar		3.9	1.5	2.1	4.9
Heating Load - Total				19.3	27.9
Heating Load - Solar				7.0	7.9
Cooling Load - Total		34.6	24.6		
Cooling Load - Solar		11.4	6.9		
Solar Heat to Generator		22.7	11.6		
Total Load	3+5+7	38.9	26.2	29.9	40.6
Solar Energy Used - Output	4+6+8	15.4	8.4	9.1	12.8
Solar Energy Used - Input	4+6+9	26.6	13.3	9.1	12.8
Solar Energy Lost	2-12	14.7	12.2	12.6	4.4
System Efficiency	12/1	0.079	0.092	0.089	0.105
Use Factory	12/2	0.644	0.518	0.419	0.512
Overall Collector Efficiency	2/1	0.213	0.177	0.214	0.206
Percentage Solar - Hot Water	4/3	0.91	0.90	0.194	0.386
Percentage Solar - Heating	6/5			0.365	0.283
Percentage Solar - Cooling	8/7	0.33	0.28		
Percentage Solar - Total	11/10	0.40	0.34	0.304	0.315
Absorption Chiller COP	8/9	0.50	0.59		

b. Structural descriptor (continued)

ELECTRIC POWER CONSUMPTION OF SOKA SOLAR HOUSE
(kwh/day)

Season	Cooling		Intermediate		Heating	
Period	1/7-8/10	12/7-12/10	9/10-1/11	13/10-8/11	11/11-1975	9/11-1976
Household Total (Cooking, Lighting, etc.)	11.9	12.9	12.4	10.9	11.7	13.9
Domestic Hot Water (Off-peak Electricity)	5.4	5.9	9.6	12.6	10.9	11.1
Heating & Cooling	22.1	17.3	4.7	5.0	18.2	22.1
Heat Pump	10.9	7.7		0.4	11.1	14.8
AC Fan & Pump	4.0	3.7			2.8	2.2
Heat Source Pump	0.4	0.2	0.7	0.6	0.1	0.2
Cooling Tower	1.3	0.8				
Auxiliary Heater for Absorption Chiller	1.1	0.5	0.8	1.0	1.1	1.3
Collector Pump	1.0	1.0	0.1	0.07	0	0.01
Total Heat Exchanger	0.1	0.03	2.6	2.8	3.1	3.5
Controls	3.2	3.5				
Total	40.4	36.2	26.7	31.4	40.8	50.2

3. Legal

a. Laws, incentives, barriers

Laws

Most of the legislative measures dealing with energy R&D are related to the organizational set up. It is usual practice in Japan that administrative measures such as promotion of R&D programs, payments of commission fees, subsidy, etc. are budgetary appropriations. In February 1977, legislation was passed to establish the Ministerial Council on the Promotion of General Energy Policy. Legislation for formulating a plan for the Sunshine Project, with long term targets in new energy R&D, was passed in July 1974.

- The Research Development Corporation of Japan contributes to the development and the commercial application of the results of scientific research with the following measures (mainly applied to the results of universities and government and municipal research institutes)

  - To contract out to private enterprises the development and commercial application of new technologies which are extermemly difficult to be applied commercially
  - To diffuse the developed technology
  - To intermediate between the owner of the technology and a candidate user for licensing.

  The number of projects the Corporation contracted out amounts to 140 and funding amounts to about 20 billion yen (as of March 1976) since its foundation.

- The Research Association for Promotion of Mining and Manufacturing Technology Systems was legislated in May 1961 for the promotion of joint researches among private companies and the research associations. 34 associations were established and 27 of them remain.

a. Laws, incentives, barriers (continued)

Incentives

Through the following measures, the Government of Japan intends to provide efficient use of energy by large-scale energy users.

In the industrial sector

(1) by the application of the Heat Management Law of 1951
(2) provide tax and financial incentives to facilitate the introduction of energy saving equipment
(3) promote administrative guidance for improved energy management in small and medium factories
(4) shift to a less energy intensive industrial structure over a long-term period.

Residential/commercial sector

(1) further improve energy consumption efficiency of household appliances
(2) consider establishing insulation standards and energy conservation standards for buildings
(3) strengthen educational activities and public campaign for energy conservation

Transportation sector

(1) improve energy consumption efficiency of each transportation facility
(2) consider the desirable sharing of various transportation means.

Based on the Industrial Standardization Act enacted in 1949, the AIST is conducting various activities such as establishing the Japanese Industrial Standards (JIS) and operating the JIS Marking Systems.

The industrial standardization is designed to promote the improvement of the quality of mining and industrial products, the rationalization of production process, the simplification of transaction and the protection of consumers.

Incentives (continued)

Apart from the wide participation of industrial experts in various energy technology advisory bodies and commissioning of R,D&D projects to private enterprises, there is no government measure to facilitate R, D&D in private sector and commercial application specifically in energy areas. However, there are long established measures common to all technologies for promotion of R, D&D in private industry and commercial application:

- Subsidies for R, D&D effort were initiated in 1950. The total subsidies from 1950 to 1976 amount to approximately 33.6 billion yen for about 3,910 programs. In 1976, about 3.9 billion yen was granted for 133 items. One of the six main areas of technologies subsidised in 1976 was the conservation of resources and energy.

- A tax credit for the increase in R, D&D expenditure is granted if R, D&D expenses exceed the largest amount of such expenses of any preceding accounting periods since 1966. Twenty percent of such excess amount may be deducted from the corporation tax. The maximum amount deductible is 10% of the corporation tax.

- The AIST plays an important role in allocating long-term loans of the Japan Development Bank to encourage the utilization of new technology developed by private enterprises. The sum of loans furnished in 1975 were approximately 26 billion yen for 42 items. The Small and Medium Enterprises Agency of the MITI also has taken similar measures for the loans of Small and Medium Enterprises Loan Corporation.

Barriers

The following items are identified by the Japanese Government as the principal obstacles or constraints in the way of enhancing energy R, D&D activities and commercial application.

Barriers (continued)

- Lack of qualified man in new energy technology areas
- Lack of funds for long-term large-scale energy R, D&D
- National Park Law restricting geothermal facilities.

b. Policies

Japan's energy prices are normally set by the market mechanism, excepting three: kerosene, electricity and local coal. Kerosene policies have been kept low as a social welfare policy. This hampers conservation and substitution of oil by other fuels. Electricity tariffs cover average production costs, including a return on capital of 8% to utilities and there is a progressive tariff structure for the residential sector. In industrial and commercial sectors, higher tariffs are applied to additional and newly contracted demands to cover increasing marginal costs. To facilitate acceptance by a municipality of sites for electricty generation, the Government will pay, to the area involved, compensation for social investments or infrastructure. These monies have been increased to 6 billion yen per 1000 MW for plants whose construciton starts in FY 78 and FY 79. They are financed by a tax on electricity of 0.085 yen/kWh; the budget for 1978-1979 was 522 billion yen.

4. Political

The energy issue has received much attention in the political arena, as evidenced by the Government's implementation of the Sunshine Project in 1974. The Government is also committed to international cooperation in R&D in renewable energy sources.

5. International

a. Organization involvement

Member of: ADB, ASPAC, Colombo Plan, DAC, ESCAP, FAO, GATT, IAEA, IBRD, ICAC, ICAO, IDA, IEA, IFC, IHO, ILO, International Lead and Zinc Study Group, IMCO, IMF, IPU, IRC, ISO, ITC, ITU, IWC--International Whaling Commission, IWC--International Wheat Council, OECD, U.N., UNESCO, UPU, WHO, WIPO, WMO, WSG

b. Bilateral agreements

- September 6, 1978 US-Japan issued a statement regarding the two countries' cooperation in science and technology to promote research and development on new energy sources and other fields. Joint projects on solar energy conversion-photosynthesis and geothermal energy will be emphasized. Solar research includes biological hydrogen production, photophysical and photochemical solar energy conversion, photochemical production of hydrogen and high energy compounds.

- May 1979 US-Japan Energy R&D Agreement - A ten year agreement for energy R&D in areas of refined coal liquids process, fusion, geothermal development and solar. More than $100 million has been designated for geothermal development and $75 million for R&D on solar photosynthesis.

- A US-Japan agreement for cooperation in hydrogen energy was signed on July 15, 1974.

- US-Japan signed an agreement on geothermal cooperation, June 15, 1978.

- Through the Overseas Economic Cooperation Fund of Japan, the GOJ is lending approximately US $18.67 million to Papua New Guinea to finance part of the Warongoi Hydroelectric Project in East New Britain.

- In R&D cooperation in the IEA, Japan is developing components for solar building heating and cooling and hot water supply system.

D. INSTITUTIONS INVOLVED IN ENERGY

1. Academic

- Name: Osaka University
  Toyanaka-city, Osaka

  Department: Department of Electrical Engineering

  Fields of energy interest: Development of an amorphous Si p-i-n/stainless steel cells with 4.5% efficiency.

  Key personnel: Professor Yoshihiro Hamakawa
  Y. Saito, solar dehumidification system
  H. Tsubomura, cells

- Name: Tokyo Institute of Technology
  Meguro-ku, Tokyo

  Department: Physical Electronics

  Fields of energy interest: The Institute has been active in the following areas: (1) molecular beam epitaxy; (2) AlGaAs/GaAs heterojunciton solar cells; (3) ZnTe and ZnCdTe semi-conductor optoelectronic devices; and (4) GaAs thin film solar cells by peeled film technology.

  Key personnel: Dr. Kiyoshi Takahashi
  Dr. Yasuharu Suematsu

- Name: Waseda University, Nishiokuto, Shinjuku-ku, Tokyo 160

  Department: Architecture

  Fields of energy interest: Solar House development; solar dehumidification system.

  Key personnel: Professor Ken-Ichi Kinuwa - President of the Solar Energy Society of Japan

1. Academic (continued)

- Name: Ashikaga University

  Fields of energy interest: Wind systems

  Key personnel: Professor Ushiyama

- Name: Tokai University, Tomigaya, Shibuyaku, Tokyo 151

  Department: Aeronautics and Astronautics

  Key personnel: Professor Yoshio Kato

- Name: Kagakin University

  Fields of energy interest: Storage tanks

  Key personnel: Y. Nakajima

- Name: University of Tokyo Bynkyo-ku, Tokyo

  Department: Sogoshikenjo School of Engineering

2. Research/Government

- Name: Mechanical Engineering Laboratory, AIST, MITI 4-12-1 Igusa, Suginami-ku, Tokyo

  Department: Materials Engineering Division

  Funding: Sunshine Project

  Fields of energy interest: Under MITI, the lab does R&D on wind turbines

  Key personnel: Dr. Kenichi Matsuno
  Mr. Hachiro Mizutani, Senior researcher

2. Research/Government (continued)

- Name: Electrotechnical Laboratory, AIST, MITI, 5-4-1 Mukodai-machi, Tanashi-shi, Tokyo

  Department: Energy Division

  Funds: Receives research funds under the Sunshine Project

  Fields of energy interest: Fundamental R&D on high performance cylindrical parabolic mirrors, materials and components for collectors, method of heat storage and a small scale power plant. The lab also acts as a technical advisor to Electric Power Development Company.

  Key personnel: Dr. Takashi Herigome, Chief of Energy Section
  Mr. Yutaka Hayashi, Sr. researcher
  S. Sawata, selective surfaces, thermal power

- Name: Hirachi Central Research Laboratory Kokubunji-shi, Tokyo

  Department: Advanced Semi-conductor Device Technology

  Size: 1200 employees (750 research and 400 support)

  Fields of energy interest: Under the Sunshine Project Hitachi is involved in the development of basic technology for CVD thin film silicon solar cells. The job is divided into two parts: preparation and characterization of films on inexpensive substrates and fabrication and evaluation of cells produced from such films.

  They have deposited silicon films on Al_2O_3, graphite, quartz and refractory metal foils.
  However, this produced relatively low-efficiency cells. Currently they are using various types of metallurgical-grade (m.g.) silicon as the substrate. They claim to have

2. Research/Government (continued)

Fields of energy interest: obtained 10.8% efficiency with an 8 cm^2 cell, AM1, 28°C. Continued R&D for a pilot plant using a heat collection system and thermal storage with two objectives: (1) the stable operation under the various solar-radiation-conditioning (2) overall efficiency of more than 10%.

Key personnel: Dr. Takashi Tokuyama, Chief Researcher
Dr. Tadashi Sartoh, Sr. Researcher

- Name: Mitsubishi Research Institute (MRI)

Key personnel: Dr. Kiyoshi Nagata, Managu, International Operations Section; Osami Oseki, Senior Researcher, Techno-Economics Department; Yoshio Sato, Research Director, Manager Techno-Economics Department.

- Name: The Institute of Energy Economics Mori Building, 28 Shiba-Nishikubo, Sakuragawa-cho, Minato-ku, Tokyo

Fields of energy interest: Conducts energy economic studies

Key personnel: Mr. Setsuo Takagaki, Director of Research Affairs;
Mr. Tadaki Kawano, Staff Researcher

- Name: The Government Industrial Research Institute, AIST, MITI, 1-chome, Hiratemachi, Kita-ku, Nagoya

Department: Solar Research Laboratory

Fields of energy interest: As an arm of AIST, the Insitute works on the Government's Sunshine Project: high-temperature furnace, heating and cooling, power production.

Key personnel: Dr. Tetsuo Noguchi

2. Research/Government (continued)

- Name: Ministry of Construction, Tokyo

  Department: Building Research Institute

  Fields of energy interest: Conducted a study to store the summer heat within a bulk of soil from the ground surface down to 4 m beneath the house.

  Key personnel: Mr. T. Tsuchiya

- Name: Kajima Institute of Construction Technology 2-19-1 Tobitakyu, Chofu-shi, Tokyo

  Key personnel: Mr. Kenji Shimokawa

- Name: Osaka Institute of Technology, 5-16-1 Omiya, Asahi-ku, Osaka 535

  Department: Mechanical Engineering

  Fields of energy interest: Solar collectors

  Key personnel: Y. Sato

- Name: Ministry of Transport
  Port and Harbour Research Institute
  1-1,3-chome, Nagase, Yokosuka-shi,
  Kanagawa-ken

  Department: Marine Hydrodynamics

  Key personnel: Mr. Kinji Moriyama

- Name: Japan Information Center of Science and Technology 5-2, 2 chome, Nagata-cho, Chiyoda-ku, 100 Tokyo

- Name: Japan Weather Association Research Institute, Tanen Building, 3-16-6 Kanda, Nishiki-cho chiyoda-ku, 101 Tokyo

3. Corporate

- Name: Sharp Corporation, Engineering Center, Tenri-shi, Nara

Department: Solar Cell Project Team
Central Research Laboratories

Size: 400 employees

Funds: Mainly from Sunshine Project budget, most likely supplemented by company funds.

Fields of energy interest: The organization is oriented to product development, production and marketing. Solar cells are produced by the Semiconductor Division of the Electronic Components Group. They are currently producing 2 million pieces per month which go into products such as electronic watches, hand calculators, outdoor clocks, lighthouses and telemetering equipment. A solar cell "piece" might be a 30 cm^2 cell for a lighthouse or a 0.2 mm^2 cell (cut from a larger cell) for a watch.

Sharp's part in the Sunshine Project involves technology development exclusively: (1) silicon solar cell and module fabrication process development suitable for automation; (2) concentrator array (silicon solar cell) development; and (3) encapsulant material exposure testing. They have recently completed the development of a prototype automated pilot scale cell production machine, starting with silicon wafers. This pilot unit is approximately 275 cell/hour. The cell efficiency is now about 10% (AM1). Their goal over the next two years is to increase efficiency to 13% (AM1). Junction formation is accomplished using spray-on commercial diffusant. The commercial diffusant solution

3. Corporate (continued)

Fields of energy interest:

is diluted to about 1/40 of the concentration normally employed for I.C. devices. Grids and back electrodes are screen printed using metal pastes. A new paste formulation was developed for making contracts on shallow junction cells (1mμ); the resulting contact penetration after firing is about 0.05 mμ. A Ag/Al paste is used for the back contact to provide a back surface field. The encapsulant materials exposure program consists of both outdoor, real-time exposure and accelerated tests in typical "weatherometer" equipment. The concentrator array program is utilizing a circular Fresnel lens. For an operational 500 watt peak array composed of 80-40x40 cm lens, solar cell active area for each lens is 13.3 cm^2. Concentration ratio is 59 and optical efficiency was quoted as 80% and cell efficiency, 8% at 100°C. Two axis tracking is used.

Sharp produces 100% of the solar cells used on Japanese spacecraft and 80% of the terrestial solar cells sold by Japanese manufacturers (Nippon Electric Co. provides remaining 20%). Photovoltaic application development goes back to the early 1960's.

DOMESTIC MARKET OF SOLAR BATTERY
(From 1963 to 1977)

Organization	Watts	Applications	
The Japan Maritime Safety Agencies	10,000	Light house, Light buoy	L
The Ministry of Construction	4,139	Water level, Level of rainfall, etc.	T,R
Local Self-Governing Body	1,285	Water level, Level of rainfall, etc.	T,R
The Electric Power Development Co.	908	Water level	T
The Meteorological Agency	342	Seismometer, Wind direction, Wind velocity, Level of rainfall, etc.	T
The Japan Broadcasting Co.	69	TV/FM station	R
The Water Resources Development Public Co.	173	Water quality monitor, Water level, Level of rainfall, etc.	T,R
The Electric Power Co.	259	Level of rainfall, Snow depth, Water level, etc.	T,R
The Hokkaido Development Bureau	470	Water level, Level of rainfall, etc.	T,R
Others	1,613	Warning systems, Measuring systems, etc.	T,R
Total Watts	19,258		

L: Light house, buoy T: Telemetering station R: Relay station

OVERSEAS MARKET OF SOLAR BATTERY
(From 1963 to 1977)

	Application						
	Light house	Light buoy	Radio station	Relay station	Telemetering station	Others	Total Watts
Indonesia	7	13		2			914
Korea	8			1	35		394
Australia				1		*152	314
Malaysia	1				15		306
Taiwan				2	12		263
Philippines				1	8		117
Singapore	1	7					86
South Africa						**4	70
Canada		1					33
New Guinea		1					35
Bangla Desh					4		28
Thailand					2		26
Pakistan			1				17
Arabia		1					13
Colombia							4
Total							2,620

*gas detector
**stop light for railway

3. Corporate (continued)

- Name: Sanyo Electrical Company
  Moriguchi City, Osaka-ken

  Size: 2,006 employees

  Fields of energy interest: Development of an evacuated glass tubular collector which has been installed on the roof of the Hirakata Solar House

  Key personnel: Yoshiro Nakayama

- Name: Ohbayashi-Gumi Construction Company

  Fields of energy interest: Constructed Hirakata Solar House House, a low energy house with a reinforce concrete structure to which outside insulation was applied. There are double windows plus insulated panels.

- Name: Mitsubishi-Electric Company
  Mitsubishi Bldg. 2-3
  Marunouchi, 2-chome, Chiyoda-ku,
  Tokyo

  Fields of energy interest: Development of a small compression type of refrigeration machine driven by Rankine-cycle engine. It is currently being tested in the Ayase Solar House.

  Key personnel: President Sadakazu Shindo

- Name: IHI Heavy Industries Company

  Fields of energy interest: For the Kikunodai Solar Apartment, the Company developed a refrigeration machine incorporating a heat pump operated by solar heat source and air heat source combined with a Rankine-cycle engine.

3. Corporate (continued)

- Name: Kawasaki Heavy Industries Company
  Nissei-Kawasaki Bldg. 16-1
  Nakamachidori 2-chome,
  Ikuta-ku, Kobe

  Fields of energy interest: Developed a solar absorption machine currently used in a solar school building for the department of Energy Engineering at Oita University.

  Key personnel: President, Zenji Umeda

- Name: Nippon Electric Company
  33-1 Shiba 5-chome,
  Minato-ku, Tokyo 108

  Fields of energy interest: Produces 20% of the terrestial solar cells sold in Japan.

  Key personnel: President, Tadao Tawaka

4. Non-profit Activities

- Name: Japanese Solar Energy Society (JSES)

  Size: 700 members

  Key personnel: Dr. Ken-Ichi Kimura, President (Professor, Department of Architecture, Waseda University, Tokyo)

- Name: Solar Systems Promotion Association
  Room 440 Hibiya Kokusai Building
  2-go Kan 2-3 Uchisaiwai-cho,
  Chiyoda-ku, Tokyo, Japan
  Tel: 591-2385, -2386

  Fields of energy interest: A trade association formed in May 1978 with the following member companies who can be contacted through the Association:

  Azuma Koki Co.; IHI; Obayashi-Gumi; Kajima Corp.; Kawasaki Heavy Industries; Saginomiya Works; Sharp Corp. (Sharp Setsubikiki K.K.) 7-19 Kami Minami 3-chome Hirano-ku, Osaka 547; Showa Aluminum Co.; Sekisui Chemical Co., Ltd.; Taisei Corp.; Takenaka Komuten Co., Tokyo Sanyo Denki Co.; Toshiba; Toshiba Jutaku Sangyo Co., Shufunotomo Building, 1-6 Kanda Surugadai Chiyoda-Ku, Tokyo 101; Toyo Netsu Kogyo Co.; Toyo Rayon Co.; Nippon Ita Garusu Co.; Hitachi, Ltd.; Matsushita Jusetsu Kiki Co.; MHI; Mitsubishi Electric Co.; Yazaki Sogyo Co.; Mita Kokusai Building 4-28 Mita 1-chome Minato-Ku, Tokyo 105; Yamatake-Honeywell Co., Hitachi Kasei Co.

  Key personnel: Dr. Doko, President; Mr. Takyu, Managing Director; Mr. Aoki, Staff; (Staff includes 4 persons detailed from Member Companies)

- Name: Japan Industrial Technology Assoc.
  Executive Director:
  Mr. Tsuneo Mamota

II. NATIONAL PROFILE

A. GEOGRAPHIC

1. Name

Japan

2. Country Descriptor

a. Location: Japan, a chain of rugged mountainous islands, lies in a 2,000-mile (3,200 km)-long arc off the east coast of Asia. It comprises four main islands: Hoddaido, Honshu, Shikoku, and Kyushu, and more than 3,300 smaller islands.

b. Area(mi^2)/population: 147,470 sq.mi. (381,945 sq.km.); 113 million

c. Latitude/longitude: 31°-45°N/127°-145°E

d. Capital and key cities; population:
Capital: Tokyo, 11.6 million; Osaka, 2.8 million; Yokohama, 2.6 million; Nagoya, 2 million; Kyoto, 1.4 million.

e. Language: Japanese; English is widely used in foreign trade.

B. ECONOMIC

1. Economic System Descriptor

Japan's natural resources are extremely limited and only 19% of its limited land area is presently suitable for cultivation. It is the third largest of the industrialized economies and depends greatly on imported raw materials and fuel. Giant conglomerates in industry, finance and trade coexist with widespread less productive small and medium-scale enterprises. Government influence, while pervasive, is exercised through informal, indirect and cooperative arrangements.

2. Economy Descriptor

a. Scale: Labor force; 11% agriculture, forestry and fishing
34% manufacturing, mining and construction
48% trade and services
5% government

b. Production: 6% of NDP Agriculture

c. Balance of trade: $+17.5 billion (1977)

d. Inflation rate: (consumer price change 1977) 8.1%

3. Currency

a. Name: Yen

b. Exchange rate: US$1 = 220 Yen

c. Detail: Floating

4. GNP/GDP

a. 5-year Series $U.S.:

1972	$ 91.1 million
1973	111.7 million
1974	132.2 million
1975	146.3 million
1976	562.17million

b. Per capita$U.S.: $5,980 (1976)

5. Foreign Trade

a. Principal trade partners: (Exports) U.S. 25%, E.C. 11%, Communist countries 6%, Australia 3%. (Imports) U.S. 18%, E.C. 5%, Communist countries 5%, Australia 8%.

b. Total U.S. imports:$10.5 billion (1977)

6. Foreign Investment

In early 1976 the Japanese government completed a program of official liberalization with respect to most direct investment from overseas. Four industries were exempted from this liberalization; licensing policy sometimes inhibits new investment, whether domestic or foreign, such as financial services.

Investment from overseas may be either in wholly-owned subsidiaries or in joint ventures.

6. Foreign Investment (continued)

New direct foreign investments in Japan during recent years have been modest. A limiting factor has been the impact which the recession of the mid-seventies in Japan has exerted on investment from foreign as well as from domestic sources. The rise of the yen, with its impact both on initial and on operating costs, also has acted as a strong deterrent during 1978.

C. GOVERNMENTAL

1. Chief of State

His Imperial Majesty Hirohito, Emperor of Japan.

Government Leader

Prime Minister Masayoshi Ohira

2. Government Structure

a. Type: Japan's parliamentary government, based on the English system, is a constitutional monarchy that operates within the framework of a Constitution which became effective on May 3, 1947. Sovereignty, previously embodied in the Emperor, is now vested in the people and the Emperor is the symbol of the State.

b. Branches: The Government consists of an executive branch which is responsible to the legislative branch and an independent judicial branch.

Executive power is vested in a Cabinet composed of the Prime Minister and the Ministers of State; all must be civilians. The Prime Minister who must be a Member of the Diet, is appointed by the emperor on designation by the Diet. He has the power to appoint and remove his Ministers within the Cabinet. The majority of Ministers must be from the Diet.

c. Political subdivisions: 47 prefectures (including Ryukyus).

d. Legal system: Based on the civil law system with British-American influence; judicial review of legislative acts in the Supreme Court; accepts compulsory ICJ jurisdiction, with reservations.

e. Elections: General elections held every 4 years or upon dissolution of the Lower House, triennially for one-half of the Upper House. Universal suffrage over age 20; secret ballot for all elective offices.

f. Political conditions: Japan is one of the most politically stable of all postwar democracies. Since its formation in 1955, the Liberal Democratic Party (LDP) has remained the party in power.

3. Diplomatic Names and Addresses

a. In U.S./U.N.

The Japanese Embassy
2520 Massachusetts Avenue, N.W.
Washington, D.C. 20008
(202)234-2266

Ambassador: Mr. Fuluhiko Togo
Economic Minister: Yoshiro Hatano
Minister: Mr. Hironari Masago

U.N. Mission
866 United Nations Plaza
Second Floor
New York, New York 10017
(212)421-9580

Ambassador: Mr. Isao Abe
Deputy Permanent Representative: Mr. Seiya Mishida
Envoy Extraordinary: Mrs. Ogata

b. U.S. in Country

- US Embassy Tokyo
10-1 Akasaka 1-chome
Minato-ku 107
APO San Francisco 96503
Tel:583-7141
Telex:2422118

b. U.S. in Country (continued)

AMB: Michael J. Mansfield
DCM: William C. Sherman
ECO/COM: Jack B. Button
FIN: William McCamey
COM: Joseph F. Christiano
POL: Albert L. Seligman
LAB: Robert M. Immerman
CON: Ronald A. Gaiduk
ADM: Leona M. Anderson
RSO: Rufus D. Putney
SCI: Justin L. Bloom
AGR: Dudley G. Williams
PAO: Clifton B. Forster

- Naha, Okinawa--Consulate General
No. 2129 Gusukuma, Urasoe City
APO San Francisco 96248
Tel:0988-77-8142, 0988-77-8627

PO: Ulrich A. Straus
POL/COM: Edmund H. Kelly
CON: Dean L. Welty

- Osaka-Kobe - Consulate Generals
Osaka
9th Floor, Sankei Bldg., 4-9,
Umeda 2-chome
APO San Francisco 96503
Tel:(06)341-2754/7
Kobe
10, Kano-cho 6 chome, Ikuta-ku, Kobe 650
Tel:(078)331-6865/8

CG: Thomas W. Ainsworth
ECO/COM: Frances J. Caffrey
CON: David L. Hobbs
BPAO: William G. Maurer

- Fukuoka - Consulate
5-26 Ohori 2-chome, Chuo-ku,
Fukuoka-shi 810
Tel:(092)751-9331

PO: David A. Pabst
ECO/COM: Alvin H. Chin
CON: Lawrence S. Kujubu
BPAO: Karl F. Olsson

b. U.S. in Country (continued)

- Sapporo - Consulate
  North 1 West 13,
  APO San Francisco 96503
  Tel:221-5121/3

  PO: Donald B. Westmore
  CON: Daniel T. Fantozzi
  BPAO: Philip C. Harley

4. Government Funding

a. Budget breakdown: (1978/79 in billion yen)

Social Security	9,126
Education/Science	4,299
Public Works	9,540
Local Finance	5,993

D. NATIONAL INSTITUTIONS

1. Political Parties

The Political Funds Regulation Law provides that any organization which wishes to support a candidate for an elective public office must be registered as a political party. There are over 10,000 registered parties in the country, mostly of local or regional significance. The conservative Liberal Democratic Party has the support of big business and the rural population and is also by far the richest of the political parties. The proportion of votes for the two socialist parties has increased slowly at each election since 1952. The split between the two parties reflects a longstanding division between supporters of a mass popular party (now represented by DSP) and those seeking a class party on Marxist lines. The Communist Party of Japan split in 1964, the official party being independent, supporting neither the U.S.S.R. nor the People's Republic of China. In the 1976 elections the militant religious organization Soka Gakkai increased its representation in the Diet through its political wing, the Komeito. The Socialists and Communists also made gains. There are also a number of small extreme right-wing political organizations. In the Upper House election of July 1977, the Liberal-Democratic Party lost its overall majority. The Socialists and Communists also suffered reverses.

Liberal-Democratic Party (Jiyu-Minshuto): 7, 2-chome, Kirakawacho, Chiyoda-ku, Tokyo; founded 1955; programme includes the establishment of a welfare state, the build-up of industrial development, the leveling up of educational and cultural systems and the revision of the Constitution where necessary; follows a foreign policy of alignment with the U.S.A.; 1.5 million mems. (1978); Pres. Takeo Fukuda; Chair. Yasuhiro Nakasone; Sec. Gen. Masayoshi Ohira; publ. Jiyu Shimpo (weekly).

Socialist Party of Japan (Nihon Shakaito): 1-8-1, Nagatacho, Chiyoda-ku, Tokyo; founded 1945; aims at the establishment of collective non-aggression and a mutual security system, including Japan, the U.S.A., the U.S.S.R. and the People's Republic of China; 45,000 mems. (1977); Chair. Ichio Asukata; Sec.-Gen. Shinnen Tagaya; publ. Shakai Shimpo (twice a week).

1. Political Parties (continued)

Komeito (Clean Government Party): 17 Minamimto-machi, Shinjuku-ku, Tokyo; founded 1964; based on middle-of-the-road principles and humanitarian socialism, promotes policies in best regard of "dignity of human life"; 141,000 mems. (1977); Founder Daisaku Ideda; Chair. Yoshikatsu Takeiri; Sec.-Gen. Junya Yano; publs. Komei Shimbun (daily), The Komei (monthly), Komei Graphic (monthly).

Democratic Socialist Party (DSP)(Minshu-Shakaito): Shiba Sakuragawa-cho, Minato-ku, Tokyo; founded 1961 by Right-Wing Socialists of the Social Democratic Party of Japan; aims at the pursuit of an independent foreign policy; 35,000 mems. (1975); Chair. Ryosaku Sasaki; Sec.-Gen. Saburo Tsukamoto; publs. Shukan Minsha (daily), Gekkan Kakushin (monthly).

Communist Party of Japan: Sendagaya 4-26-7, Shibuya-ku, Tokyo; founded 1922; 400,000 mems. (1978); Chair. (Central Cttee.) Sanzo Nosaka; Chair. (Presidium) Kenji Miyamoto; Chief Sec. Tetsuzo Fuwa; Publs. Akahata (daily and weekly), Zen-ei (monthly), information Bulletin for abroad (irregular).

New Liberal Club: Shin Jiyu Club, Nagata-cho, Chiyoda-ku, Tokyo; founded 1976 by splinter group of Liberal-Democratic Party; Chair. Yohei Kono.

2. Religions

Most Japanese observe both Shinto and Buddhist rites; about 16% belong to other faiths; including 0.8% Christian.

3. Universities

Chiba University: 1-33 Yayoicho, Chibashi; 991 teachers, 7,910 students.

Gifu University: Monzen-cho, Naka-cho, Kakamiga-harashi, Gifu-Ken 1,; 628 teachers, 4,086 students.

Gumma University: 3 Showa-Machi, Maebashi-city; 588 teachers, 4,194 students.

Hirosaki University: 1 Bunkyo-cho, 036 Hirosaki City, 527 teachers, 4,259 students.

3. Universities (continued)

Hiroshima University: 1-1-89 Higashi-senda-machi, Hiroshima; 1,300 teachers, 9,715 students.

Hitotsubashi University: Kitatama-gun, Tokyo; 254 teachers, 3,990 students.

Hokkaido University: Nishi 5, Kita 8, Sapporo; 1,858 teachers, 10,042 students.

Ibaraki University: 2127 Watarimachi, Ibaraki Pref., Mito; 481 teachers, 5,346 students.

Kagawa University: 121 Saiwai-Cho Takamatsu-Shi, Kagawa-Ken; 262 teachers, 3,020 students.

Kagoshima University: Uerata-cho, Kagoshima; 759 teachers, 7,286 students.

Kanazawa University: 1-1 Marunouchi, Kanazawa City; 732 teachers, 5,587 students.

Kobe University: Rokko, Nada-ku, Kobe; 971 teachers, 9,728 students.

Kumamoto University: Kurokami-machi, Kumamoto; 700 teachers, 5,500 students.

Kyoto University: Yoshida-Honmachi, Sakyo-ku, Kyoto; 612 professors, 15,092 students.

Kyushu University: Hakozaki, Fukuoka City, Fukuoka Prefecture; 1,879 teachers, 11,721 students.

Nagasaki University: 1-14 Bunkyo-cho, Nagasaki; 620 teachers, 4,000 students.

Nagoya University: Furo-cho, Chikusa-ku, Nagoys; 1,530 teachers, 8,564 students.

Nara Women's University: Kita-Uoya-Nishi-Machi, Nara City; 306 teachers, 1,215 students.

Niigata University: Asahimachidori I-Bancho, Niigata; 920 teachers, 6,395 students.

Ochanomizu Women's University: 1-1, 2-chome, Otsuka, Bunkyo-ku, Tokyo; 239 teachers, 1,698 students.

3. Universities (continued)

Okayama University: Tsushima, Okayama; 976 teachers, 7,076 students.

Osaka University: 36 Joancho, Kita-ku, Osaka; 1,339 professors, 11,951 students.

Osaka University of Foreign Studies: 8-chome Uehonmachi Tennoji-ku, Osaka; 130 teachers, 1,754 students.

Saga University: Honjo-Machi I, Saga City; 338 teachers, 3,441 students.

Saltama Univeristy: 255 Shimo Okubo, Urawa City; 388 teachers, 5,805 students.

Shimane University: 1060 Nishikawatsu-cho Matsue-chi, Shimane-ken; 277 teachers, 3,254 students.

Shinshu University: Asahi 3-1-1, Matsumoto, Nagano-ken; 954 teachers, 6,197 students.

Shizuoka University: Oaya 836, Shizuoka-Shi 422; 540 teachers, 7,085 students.

Tohoku University: Katahiracho, Sendai; 2,500 teachers, 10,990 students.

University of Tokushima: 6 Shinkuraocho, 2-chome Tokushima-shi, Tokushima-ken; 720 teachers, 3,640 students.

The University of Tokyo: Hongo, Bunkyo-ku, Tokyo; 3,765 teachers, 18,538 students.

Tokyo Medical and Dental University: 5-45, 1-chome Yushima, Bunkyo-ku, Tokyo; 590 teachers, 1,250 students.

Tokyo University of Foreign Studies: 51 Nishigawara, 4-chome, Kita-ku, Tokyo; 108 teachers, 2,503 students.

Tottori University: 1, 5-chome, Tachikawa-cho, Tottori City; 606 teachers, 3,040 students.

Toyama University: 3,190 Gofuku Toyama City; 370 teachers, 4,329 students.

3. Universities (continued)

University of Tsukuba: Sakura, Niihari, Ibaraki 300-3.

University of the Ryukyus: 1, 3-chome, Tonokura-cho, Naha, Okinawa; 529 teachers, 4,836 students.

Wakayama University: 278 Sekido, Wakayamasi; 226 teachers, 2,844 students.

Yamagata University: 1-4-12 Koshirikawa-machi, Yamagata City; 450 teachers, 4,500 students.

Yamaguchi University: Shimmichi, Yamaguchi; 777 teachers, 6,440 students.

Yamanashi University: Kofu City, 4-4-37 Takeda; 327 teachers, 2,855 students.

Yokohama National University: 702 Ohokahachi, Minamiku, Yokohama; 416 teachers, 6,103 students.

PUBLIC, PREFECTURAL AND MUNICIPAL UNIVERSITIES

Fukushima Medical College: Fukushima City; 238 teachers, 598 students.

Kyoto Prefectural University of Medicine: 465, Kajii-cho Kawaramachi, Hirokoji, Kamikyo-ku, Kyoto; 249 teachers, 819 students.

Mie Prefectural University: Torii-cho, Tsu; 520 teachers, 3,907 students.

Nagoya City University: 1 Kawasumi, Mizuho-cho, Mizuhoku, Nagoya; 382 teachers, 1,785 students.

Nara Medical University: 840 Shijo-cho, Kashihara-shi, Nara; 250 teachers, 430 students.

Osaka City University: 459 Sugimotocho, Sumiyoshi-ku, Tokyo; 855 teachers, 6,448 students.

Sapporo Medical College: S.I, W. 17, Sapporo City; 297 teachers, 565 students.

Shizuoka College of Pharmacy: 2-2-1 Oshika, Shizuoka-shi; 100 teachers, 600 students.

3. Universities (continued)

Tokyo Metropolitan University:1-1-1 Yagumo, Meguro-ku, Tokyo; 488 teachers, 4,465 students.

University of Osaka Prefecture: 804 Mozu-Umemachi 4-cho, Sakai, Osaka; 635 teachers, 4,567 students.

Wakayama Medical College: 9 Kuban-cho, Wakayama City; 240 teachers, 403 students.

Yokohama Municipal University: 4646 Mutsuura-machi, Kanazawa-ku, Yokohama; 298 teachers, 17,779 students.

PRIVATE UNIVERSITIES

Aoyama-Gakuin University: 4-4-25 Shibuya, Shibuya-ku, Tokyo 150; 339 teachers, 17,779 students.

Asia University: 5-24-10 Sakai, Musashino-shi, Tokyo 180; 296 teachers, 9,017 students.

Azabu Veterinary College: 1-17-71 Fuchinobe, Sagamihara City, Kanagawa; 62 teachers, 1,000 students.

Bukkyo University: 96 Kitahananobo-cho, Murasakino, Kita-ku, Kyoto; 200 teachers, 4,100 students.

Chuo University: 3-9 Kanda-Surugadai, Chiyoda-ku, Tokyo; 1,311 teachers, 34,204 students.

Daito Bunka University: 1-9-1 Takashimadaira, Itabashiku, Tokyo; 150 teachers.

Doshisha University: Karasuma Imadegawa, Kamikyo-ku, Kyoto; 396 teachers, 20,275 students.

Fukuoka University: 11 Nanakuma, Fukuoka; 463 teachers, 21,356 students.

Gakushuin University: 1-1057 Mejiro-cho, Toshima-ku, Tokyo; 219 teachers, 6,339 students.

Hannan University: 4-35, 5-chome Amami, Higashi, Matsubara City, Osaka; 138 teachers, 3,045 students.

Hiroshima Jogakuin College: 13-1, Higashi 4-chome, Ushita, Hiroshima City; 50 teachers, 900 students.

Hokkai Gakuen University: 8-60, Asahimachi, Sapporo 062; 141 teachers, 6,600 students.

3. Universities (continued)

Hosei University: 17-1 Fujimi 2-chome, Chiyoda-ku, Tokyo; 485 teachers, 29,614 students.

International Christian University: Osawa, Mitaka-shi, Tokyo; 135 teachers, 2,000 students.

Iwate Medical University: 19-1 Uchimaru, Morioka, Iwate; 349 teachers, 1,488 students.

The Jikei University School of Medicine: 3-25-8 Nishi Shinbashi, Minato-ku, Tokyo 105; 851 teachers, 1,206 students.

Kanagawa University: 3-chome Rokkaku-Bashi, Kanagawa-ku, Yokohama; 200 teachers, 10,000 students.

Kansai University: 3-35 Yamate-cho 3-chome, Suita-shi, Osaka; 477 teachers, 24,980 students.

Kanto Gakuin University: Muutsuura 4834 Kanzawa-ku, Yokohama; 409 teachers, 7,572 students.

Keio University: Mita, Minato-ku, Tokyo; 1,050 teachers, 26,000 students.

Kinki University: 321 Kowakae, Higashiosaka, Osaka; 450 teachers, 24,000 students.

Kogakuin University: 10-28 Higashi 4-chome, Shibuyaku, Tokyo; 564 teachers, 12,937 students.

Komazawa University: Komazawa 1-chome, Fukazawa-machi, Setagaya-ku, Tokyo; 360 teachers, 19,000 students.

Konan University: Okamoto Motoyama-cho, Higashi Nada-ku, Kobe City; 174 teachers, 7,000 students.

Kurume University: 67 Asahi-machi, Kurume-shi, Fukuoka-ken; 392 teachers, 3,961 students.

Kwansei Gakuin University: Uegahara, Nishinomiya-shi, Huogo-ken; 274 teachers, 14,289 students.

Kyoto Women's University: 17 Kita Hiyoshi-cho, Imakumano, Higashiyama-ku, Kyoto; 115 teachers, 2,187 students.

Kyoto College of Pharmacy: 5-Nakauchi-cho, Misasagi Yamashina Higashiuama-ku, Kyoto; 47 teachers, 1,474 students.

3. Universities (continued)

Matsuuama University College of Commerce: Bunkyo-cho, Matsuyama 790; 150 teachers, 4,136 students.

Meiji University: Kanda-Surugadai 1-1, Chiyoda-ku, Tokyo-To; 1,427 teachers, 33,313 students.

Meijo University: Yagoto-Urayama, Tenpaku Showa-ku, Nagoya; 470 teachers, 18,000 students.

Miyagi Gakuin Women's College: 1-6, Chuo 4,-chome, Sendai City; 134 teachers, 1,518 students.

Nanzan University: 18 Yamazato-cho, Showa-ku, Nagoya 466, 170 teachers, 4,655 students.

Hihon University: 6-16 Nishi-Kanda, 2-chome, Chiyoda-ku,Tokyo; 4,855 teachers, 97,224 students.

Nippon Dental College: 9-20 I-chome, Fujimi, Chiyoda-ku, Tokyo; 347 teachers, 2,151 students.

Notre Dame Women's College: 1-2 Minami Nonogami-cho, Shimogamo, Sakyo-ku, Kyoto; 96 teachers, 1,084 students.

Okinawa University: Kokuba, Naha, Okinawa; 270 teachers, 2,835 students.

Rikkyo University: Nishi-Ikeburkuro, Toshima-ku, Tokyo; 764 teachers, 12,475 students.

Rissho University: 160 4-chome, Higashi-Osaki, Shinagawa-ku, Tokyo; 98 teachers, 3,536 students.

Ritsumeikan University: Kyoto-shi, Kamikyo-ku, Hirokoji-dori Termachi; 300 teachers, 21,000 students.

Ryukoku University: Fukakusa-Isukamoto-cho, Fushimiku, Kyoto

University of the Sacred Heart: Hiroo 4-chome, 3-1 Shibuya-ku, Tokyo; 219 teachers, 1,731 students.

Sapporo University: 243-2, Nishioka, Toyohira-ku, Sapporo; 94 teachers, 6,421 students.

Science University of Tokyo: 103 Kagurazaka, Shinjuku-ku, Tokyo; 360 teachers, 14,500 students.

3. Universities (continued)

Seijo University: 6-1-20 Seijo, Setagaya-ku, Tokyo; 133 full-time, 145 part-time teachers, 3,871 students.

Seisen Women's College: 3-chome, 16 Ban 21 Go, Higashi-Gotanda, Shinagawa-ku Tokyo; 108 teachers, 1,373 students.

Senshu University: Chiyoda-ku Kanda Jinbo-cho, Tokyoto; 288 teachers, 20,903 students.

Showa Women's University: 1-chome, Taishido, Setagayaoku, Tokyo; 110 teachers, 1,981 students.

Sophia University: Chiyoda-ku, Kioicho 7, Tokyo; 788 professors, 8,797 students.

Takushoku University: 3-4-14 Kobinata Bunkyo-ku, Tokyo; 208 teachers, 7,034 students.

Tamagawa University: 6-1-1 Tamagawa Gukuen Machida-shi, Tokyo; 507 teachers, 6,252 students.

Tenri University: 1050 Somanouchi-cho Tenri City, Nara; 246 teachers, 2,248 students.

Tohoku Gakuen University: 1 Minami-Rokken-Cho, Sendai; 244 teachers, 12,768 students.

Tokai University: 2-28 Tomigaya, Shibuya-ku, Tokyo; 921 teachers, 26,648 students.

Tokyo College of Economics: 7-1 chome, Minamicho, Kokubunji, Tokyo 185; 279 teachers, 7,840 students.

Tokyo College of Pharmacy: 600 Kashiwagi 4-chome, Shinjuku-ku, Tokyo; 200 teachers, 2,000 students.

Tokyo Women's Medical College: 10 Kawada-cho, Shinjuku-ku, Tokyo; 441 teachers, 594 students.

Toyo University: 5-28-20 Hakusan, Bunkyo-ku, Tokyo; 393 full-time teachers, 20,889 students.

Tsuda College: 1491 Tsuda-Machi, Kodaira City, Tokyo; 80 teachers, 2,700 students.

Waseda University: Totsuka-Machi, Shinjuku-ku, Tokyo; 2,400 teachers, 44,691 students.

3. Universities (continued)

TECHNOLOGICAL UNIVERSITIES

Akita University: 1-1 Tegata Gakuencho, Akita City; 513 teachers, 3,385 students.

Chubu Institute of Technology: 1200 Matsumoto-cho, Kasugai-shi Aichi Prefecture; 159 teachers, 5,784 students.

Ehime University: Himata-cho, Matsuyama 790; 490 teachers.

Fukui University: Makinoshima-cho, Fukui.

Himeji Institute of Technology: Idei Himeji, Hyogo; 150 teachers, 1,100 students.

Iwate University: 3-18-8 Ueda, Morioka, Iwate; 400 teachers, 3,600 students.

Kobe University of Mercantile Marine: Fukae, Honjo-cho, Higashimada-ku, Kobe.

Kyoto University of Industrial Arts and Textile Fibres: Matsugasaki-Hashigamicho, Sakyo-ku, Kyoto.

Kyushu Institute of Technology: 752 Nakabaru, Tobata, Kitakyushu; 100 teachers, 2,000 students.

Miyazaki University: 100 Funatsuka-cho. Miyazaki; 275 teachers, 2,741 students.

Muroran Institute of Technology: 26 Mizumuoto-cho, Muroran; 170 teachers, 2,219 students.

Musashi Institute of Technology: Tamatsutsumi 1-chome, Setagaya-ku, Tokyo 158.

Nagoya Institute of Technology: Gokisho-cho, Showa-ku, Nagoya, 580 teachers, 4,000 students.

Sagami Institute of Technology: 1-1 Nishi Kaigan Tsujido Fujisawa City; 200 teachers, 2,200 students.

Tokyo Electrical Engineering College: Kanda-Nishi-kicho, Chiyoda-ku, Tokyo; 570 teachers, 7,900 students.

Tokyo University of Agriculture: 1-1-1 Sakuragaoka, Setagaya-ku, Tokyo; 431 teachers, 9,104 students.

3. Universities (continued)

Tokyo University of Agriculture and Technology: 1-8 Harumi-cho, 3-chome, Fucho-shi, Tokyo.

Tokyo Institute of Technology: 12-1 Ookayama, 2-chome, Meguro-ku; 840 teachers, 4,987 students.

Tokyo University of Fisheries: Konan 4-5-7, Minato-ku; Tokyo.

Tokyo Univeristy of Mercantile Marine: Echujima 2-1-6 Fukagawa Koto-ku, Tokyo; 109 full-time teachers, 860 students.

University of Electrocommunications: 1-5-1 Chofugaoka, Chofu-shi, Tokyo 182; 228 teachers, 2,728 students.

4. Corporations

The following are among the leading 75 industrial establishments in Japan ranked by sales (in US dollars).

Nippon Steel Corporation: Shin Nittetsu Bldg., 6-3 Otemachi 2-chome, Chiyoda-ku, Tokyo 100; founded 1970; sales $9,038m.; cap. and res. $1,218m. Chair. Yoshihiro Inayama; Pres. E. Saito; employees: 77,489.

Toyota Motor Co. Ltd.: 1, Toyota-cho, Toyota, Aichi; founded 1937; cap. 73.330m. yen. Manufacturers of foreign cars, trucks and parts. Pres. Eiji Toyoda; employees: 45,600.

Hitachi Ltd.: New Marunouchi Bldg. 5-1, Marunouchi 1-chome, Chiyoda-ku, Tokyo; founded 1910; sales $6680.4m.; cap. and res. $1,990.3m. Manufacture and sale of electric utility apparatus and electrical equipment, consumer products, communications and electronics equipment, measuring instruments, industrial machinery, rolling stock, wire, cable and other products. Chair. Kenichiro Komai; Pres. Hirokichi Yoshiyama; employees: 143,014.

Nissan Motor Co. Ltd.: 17-1, Ginza 6-chome, Chuo-ku, Tokyo; founded 1933; sales $8,435.9m.; cap.p.u.$262.7m. Manufacture and sale of automobiles, rockets, textile machinery, other machines and appliances and parts. Chair. Katsuji Kawamata; Pres. Takashi Ishihara; employees: 56,400.

4. Corporations (continued)

Mitsubishi Heavy Industries, Ltd.: 5-1, Marunouchi, 2-chome, Chiyoda-ku, Tokyo; founded 1950; sales $6,137.2m.; cap. and res. $705.7m. Shipbuilding, ship repairing, prime movers, chemical machinery, industrial machinery, heavy machinery, rolling stock, precision machinery, steel structures, construction machinery, refrigerating and air-conditioning machinery, agricultural machinery and engines, aircraft, special purpose vehicles, space systems. Principal subsidiary companies in Japan and Brazil and other countries; Chair. Gakuji Moriya; Pres. Masao Kanmori; employees: 109,300.

Matsushita Electric Industrial Co. Ltd.: 8-2, Hamamatsucho 4-chome, Minato-ku, Tokyo; founded 1918; sales $5,736.6m.; cap. and res. $2,146.6m. Manufacture and sales of electrical and electronic home appliances, including radio, television receivers and parts, communication equipment, medical equipment, batteries, electric light bulbs, and electric motors. Ten major subsidiary companies in Japan; manufacturing and sales companies in 26 countries; Chair. Aratoro Takahashi; Pres. Masaharu Matsushita; employees:83,081.

Toshiba Corporation: 1-6, Uchisaiwaicho 1-chome, Chiyoda-ku, Tokyo; founded 1904; cap. sales $4,459.9m.; cap. and res. $606.4m. Manufacture, sale and export of electric appliances, apparatus and instruments; heavy electric machinery. Overseas offices in 24 countries; Chair. Keizo Tamaki; PRes. Kazuo Iwata; employees: 105,000.

Idemitsu Kosan Co. Ltd.: 1-1, Marunouchi 3-chome, Chiyoda-ku, Tokyo; founded 1911; sales 4,425.7m. cap. and res. $41.2m. Manufacture and sale of petroleum products and petrochemicals and related enterprises. Chair. Keisuke Idemitsu; Pres. Masami Ishida; employees: 11,040.

Nippon Kokan K.K.: 1-1-2, Marunouchi, Chiyoda-ku, Tokyo 100; founded 1912; cap. 146,276m. yen (1977). Manufacture and sale of pig iron, steel ingots, tubes plates, sheets, bars and shapes, special steels and ferro-alloys, coal derived chemicals, chemical fertilizers, refractories and slag wool; engineering and construction of pipelines, steel plants, steel structures, water treatment plants, diesel engines; shipbuilding, tankers, bulk carriers, cargo ships, container ships, chemical carriers. Pres. Hisao Makita; employees: 40,806.

4. Corporations (continued)

Sumitomo Metal Industries Ltd.: 5-15, Kitahama, Higashiku, Osaka; founded 1897; cap. 110,419m. yen. Manufacture and sale of pig iron, steel ingots, steel bars, shapes, wire rods, tubes, pipes, castings, forgings, rolling stock parts. Fifty subsidiary companies in Japan; 10 offices abroad; Chair. Hosai Hyuga; Pres. Noboru Inui; employees: 30,200 (1977).

Mitsubishi Chemical Industries Ltd.: 5-2 Marunouchi 2, Chiyoda-ku, Tokyo; founded 1934; cap. 45.637m.yen. Manufacture and sale of coke and coal-tar derivatives, dyestuffs and intermediates, caustic soda, organic dyestuffs and intermediates, caustic soda, organic solvents and chemicals, reagents, ammonia derivatives, inorganic chemicals, pesticides and herbicides, fertilizers, food additives and pharmaceutical intermediates. Pres. Eiji Suzuki; employees: 3,773.

Kobe Steel Ltd.: 36-1, Wakinohama-cho 1-chome, Fukiai-ku, Kobe; founded 1905; sales $3,678.1m.; cap. and res. $483.7m. Manufacture and sale of iron, steel and non-ferrous metals and their alloys, cast iron, cast and forged non-ferrous metals and their by-products; electrodes, industrial and chemical machinery and appliances. Chair. Hideo Sugisawa; Pres. Kokichi Takahashi; employees: 43,129.

Kawasaki Steel Corporation: 1-1-28, Kitahonmachi-dori 1-chome, Fukiai-ku, Kobe 651; founded 1950; sales $3,544 m.; cap. and res. $774.9m. Manufacture and sale of plates, sheets, structural steels, tubular products, castings and forgings, welding electrodes, prefabricated products and iron powder. Chair. Ichiro Fujimoto; Pres. Eiro Iwamura; employees: 37,315.

Taiyo Gyogyo (Taiyo Fishery) Co. Ltd.: 1-5-1 Marunouchi, Chiyoda-ku, Tokyo; founded 1880; sales $2,993.5m.; cap. and res. $84.9m. Fishing, processing and sale of agricultural marine and meat products; canned and frozen salmon, crab, etc.; food processing, marine transport, export and import; refrigeration, ice production and cold storage; manufacture and sale of pharmaceuticals, organic fertilizers and sugar; culture and sale of pearls; breeding and sale of mink. Pres. Tojiro Nakabe; employees: 20,585.

4. Corporations (continued)

Maruzen Oil Co. Ltd.: 3, 1-chome, Nagahoribashi-suji, Minami-ku, Osaka; founded 1933; sales $2,883.8m.; cap. and res. $46.9m. Import, refining and sale of petroleum; production and sale of petro-chemicals. Chair. Kazuo Miyamori; Pres. Sanae Honda; employees: 4,603.

Honda Motor Co. Ltd.: 27-8, 6-chome, Jingumae, Shibuya-ku, Tokyo; founded 1948; sales 852,000 m.yen. cap. and res. 29,000m.yen. Manufacturer of automobiles, motorcycles, power tillers, general purpose engines, and portable generators. Eleven foreign subsidiaries in ten countries; Pres. Kiyoshi Kawashima; Vice-Pres. Kihachiro Kawashima; employees: 20,200.

ToaNenryo Kogyo Kabushiki Kaisha: 1-1 Hitotsubashi 1-chome, Chiyoda-ku, Tokyo; founded 1939; sales $2,333.9m.; cap. and res. $314.7. Petroleum refining. Principal subsidiary companies: Nichimo Sekiyu, Tonen Sekiyu, Kagaku Co. Ltd.; Chair. Masaji Nambu; Pres Akira Matsuyama; employees: 4,077.

Mitsubishi Electric Corporation: Mitsubishi Building, 2-3, Marunouchi, 2-chome, Chiyoda-ku, Tokyo; founded 1921; sales $2,273.4m.; cap. and res. $413.7. Manufacturing and sales of electrical machinery and equipment (for power plant, mining, ships, locomotives and other rolling stock, aircraft), domestic electric appliances, radio communication equipment, radio and fluorescent lamps, lighting fixtures, refrigerators, lifts, electric tools, sewing machines. Chair. Ken Okubo; Pres. Sadakazu Shindo; employees: 66,997.

Ishikawajima-Harima Heavy Industries Co. Ltd.: 4 Otemachi, 2, Chiyoda-ku, Tokyo; founded 1889; sales $2,103.0m; cap. and res. $365.6m. Ship-building and ship repair service; manufacture, sale of and repair service for ship turbines and boilers, aircraft gas turbines, atomic power equipment, hauling equipment, iron and steel manufacturing plant, mining and civil engineering machinery, hydro- and thermal electric generating equipment, pneumatic and hydraulic machinery, chemical plant, steel structures. Chair. Renzo Taguchi; Pres. Hisashi Shinto; employees: 36,060.

4. Corporations (continued)

Toyo Kogyo Co. Ltd.: 3-1 Shinchi, Fuchu-cho, Aki-gun, Hiroshima 730-91; founded 1920; sales $2,523.1m; cap. and res. $350,1m.; Manufacturing and sale of "Mazda" passenger cars and three and four wheel commercial vehicles; "Toyo" rock drills, machine tools, gauge block and coated sand. Manufacturing agreement with Perkins Engines (diesel) of U.K. Nine subsidiary companies at home; subsidiaries in Australia, Belgium, the U.S.A., Canada, Thailand and the Federal Republic of Germany; Pres. Yoshiki Yamasaki; employees: 29,548.

Sumitomo Chemical Co. Ltd.: 15, 5-chome, Kitahama Higashi-ku, Osaka; founded 1913; cap. 73,227m.yen. Manufacture and sale of chemical fertilizers, dyestuffs, pharmaceuticals, agricultural chemicals, intermediates, organic and inorganic industrial chemicals, synthetic resins, processing resins, synthetic rubber and rubber chemicals. Several subsidiary companies; Chair. Norishige Hasegawa; Pres. Takeshi Hijikata; employees: 11,179.

Mitsubishi Oil Co. Ltd.: 1-2-4, Toranomon, Minato-ku, Tokyo; founded 1931; sales 765,156m. yen; cap. 15,000m. yen. Refining, import and marketing of petroleum products and petrochemicals. Pres Takeo Watanabe; employees: 2,913.

Kawasaki Heavy Industries Ltd.: Nissei-Kawasaki Bldg., 16-1 Nakamachidori 2-chome, Ikuta-ku, Kobe; founded 1896; Sales $1,964.6m.; cap. and res. $368.9m. Manufacture and sale of shipbuilding, rolling stock, aircraft, machinery, steel structure, engines and motorcycles. Chair. Kiyoshi Yotsumoto; Pres. Zenji Umeda; employees: 39,414.

Nippon Mining Co. Ltd.: 10-1, Toranomon 2-chome, Minato-ku, Tokyo; founded 1905; sales $2,094.6m.; cap. and res. $145.1m. Mining, refining and sale of non-ferrous alloys; drilling, refining and sale of petroleum; metal processing and general chemical production. Chair. Takaharu Kawai; Pres. Shonosuke Niwano; employees: 6,384 (1977).

Nippon Electric Co. Ltd.: 33-1, Shiba 5-chome, Minato-ku, Tokyo 108; founded 1899; sales $1,922.5m; cap. and res. $290.3m. Manufacture and sale of telephone, video communications systems, carrier transmission, radio communication and broad-casting, satellite, data processing equipment, electron tubes and semi-conductors, electronic equipment, domestic electric applicances. Chair. Koji Kobayashi; Pres. Tadao Tawaka; employees: 61,111.

4. Corporations (continued)

Asahi Chemical Industry Co. Ltd.: Tokyo Kaijo Bldg., 2-1, Marunouchi 1-chome, Chiyoda-ku, Tokyo; founded 1931; sales $1,886.6m.; cap. and res $439.1m. Manufacture and sale of synthetic fibres, chemical fibres, acrylonitrilemonomer, plastics, synthetic rubber, explosives, construction materials, foods and fine chemicals. Pres. Kagayaki Miyazaki; employees: 25,364.

Sanyo Electric Co. Ltd.: 18 Keihan Hon-dori, 2-chome, Moriguchi City, Osaka-ken; founded 1947; sales $1,833.4m; cap. and res. $346.8m. Manufacture and sale of electrical and electronic machinery and appliances--refrigerators, washing machines, electric fans, television and radio sets, bicycle dynamos, bicycle accessories, dry batteries, flashlights, etc. Pres. Kaoru Kue; employees: 16,103.

Daikyo Oil Co. Ltd.: 1, Kyobashi 1-chome, Chuo-ku, Tokyo; sales $1,800.2m; cap. and res. $38.9m. Petreolum products. Chair. Hirotaka Mitsuda; Pres. Yoshiro Nakayama; employees: 2,006.

Kanebo Ltd.: 3-80 Tomobuchi-cho, Miyakojima-ku, Osaka; founded 1889; sales $1,637.4m.; cap. and res. $125.0m. Manufacture, bleaching, dyeing, processing and sale of cotton yarns, cloth and thread, worsted and woolen yarns, woolen fabrics, nylon and polyester yarns and fabrics, carpets, spun silk yarns, silk thread spun from waste, silkworm eggs, silk fabrics, rayon staple, spun rayon yarns and fabrics, synthetic resins; cosmetics, pharmaceuticals, foodstuffs and household goods. Chair. and Pres. Junji Itoh; employees: 29,205.

Kubota Iron and Machinery Works Ltd.: 22 Funade-cho, 2-chome, Naniwa-ku, Osaka; founded 1890; sales $1,575.3m.; cap. and res. $579.0m. Manufacture and sale of cast iron pipes, steel ingot moulds, general castings, internal combustion engines, machine tools, measuring instruments, tractor, tiller, planting machine and general farming equipment, home and utilities, asbestos sheet, manufacturing, sale and installation of plant, flood gates and other steel structures, building materials. Pres. Keitaro Hiro; employees: 1,900.

4. Corporations (continued)

Showa Denko K.K.: 13-9, Shiba Daimon 1-chome, Minatoku, Tokyo 105; founded 1939; sales $1,543.3m.; cap. and res. $185.4m. Manufacture and sale of aluminium, petrochemical products, fertilizers and thermochemical products. Pres. Haruo Suzuki; employees: 12,219.

Sony Corporation: 7-35, Kita Shinagawa 6-chome, Shinagawa-ku, Tokyo 141; founded 1946; sales $1,505.1m.; cap. and res. $684.1m. Manufacture and sale of television sets, radios, tape recorders, etc. Chair. Masaru Ibuka; Pres. Akio Morita; employees: 22,713.

Isuzu Motors Ltd.: 22-10 Minami-oi 6-chome, Shinagawa-ku, Tokyo; founded 1937; sales $1,489.9m.; cap. and res. $224.4m. Manufacture and sale of trucks, buses, special purpose vehicles, passenger cars and internal combusion engines. Pres. Toshio Okamoto; employees: 18,500.

Toray Industries Inc.: 2-chome, Nihongashi-Muromachi, Chuo-ku, Tokyo 103; founded 1926; sales $1,460.1m.; cap. and res. 501.6m. Manufacturers of nylon, Toray Tetoron (polyester fibre), Toraylon (acrylic fibre), Torayca (carbon fibre), plastics and chemicals. Chair. Kizo Yasui; Pres. Tsuguhide Fujiyoshi; employees: 28,524.

Toyobo Co. Ltd.: 8 Dojima Hamadori, 2-chome, Kita-ku, Osaka 530; founded 1882; sales $1,387.1m.; cap. and res. $194.4m. Manufacture and dyeing, bleaching, printing, finishing and sale of cotton yarns and fabrics, woolen and worsted yarns and fabrics, polyester yarns and fabrics and various artificial fibres; manufacture and sale of films, resins and biochemicals. Chair. Kunio Kawasaki; Pres. Ichiji Ohtani; employees: 27,161.

Komatsu Ltd.: 3-6, Akasaka 2-chome, Minato-ku, Tokyo; founded 1921; sales $1,487.4m.; cap.and res. $504.1m. Manufacture of bulldozers, motor graders, shovel loaders, dump trucks, forklift trucks, snow vehicles, presses, dozer shovels and tunnel boring machines. Pres. Ryoichi Kawai; employees: 24,604.

4. Corporations (continued)

Bridgestone Tire Co. Ltd.: 1 Kyobashi 1-chome, Chuo-ku, Tokyo; founded 1931; sales $1,306.5m; cap. and res. $429.3m. Manufacture of all kinds of rubber tyres and tubes, transmission and conveyor belts and hoses, foam rubber, polyurethane foam, golf balls. Chair. Kanichiro Ishibashi; Pres. Shigemichi Shibmoto; employees: 22,423.

Ube Industries Ltd.: 7-2 Kasumigaseki 3-chome, Chiyoda-ku, Tokyo 100; founded 1942 sales $1,252.6m.; cap. and res. $171.1m. Mining production, processing and sale of coal, iron ore, limestone, silica, clay, chemical fertilizers, tar products, sulphuric acid, nitric acid, oxalic acid, ammonium nitrate, ammonia, pharmaceuticals, cement, caprolactam, high pressure polyethylene, industrial machinery and equipment, cast steel products, cast iron products, iron and steel bars. Pres. Kanichi Nakayasu; Vice-Pres. Toyozo Fujimoto; employees: 16,498.

Hitachi Shipbuilding & Engineering Co. Ltd. (Hitachi Zosen): 1-1-1 Hitotsubashi, Chiyoda-ku, Tokyo; founded 1881; cap. 42,410m. yen. Ship-building, ship repairing, remodeling and scrapping; manufacture of diesel engines and turbines, marine auxiliary machinery and fittings. Manufacture of industrial machinery and plant for chemicals, paper, petroleum, sugar, cement and iron, steel bridges, and steel structures, environmental equipment, offshore equipment. Thirty subsidiary companies at home; Pres. Takao Nagata; employees: 22,000.

Kirin Brewery Co. Ltd.: Kashiwabara Bldg., 4, Kyobashi 1-chome, Chuo-ku, Tokyo; founded 1907; sales $2,766m.; cap. and res. $439m. Production and sale of beer and soft drinks. Chair. Yasusaburo Sato; Pres. Shuji Konishi; employees: 16,311.

Snow Brand Milk Products Co. Ltd.: 13 Honshio-cho, Shinjuku-ku, Tokyo; founded 1950; sales $1,151.3m.; cap. and res. $85.1m. Manufacture of liquid milk, condensed and powdered milk, butter, cheese, ice-cream, infant foods, instant foods, margarine, fruit juices, frozen foods, imported wine distribution. Chair. Yoshichi Kodama; Pres. Yoichi Yamamoto; employees: 10,775.

4. Corporations (continued)

Sumitomo Electric Industries Ltd.: 15, Kitahama 5-chome, Higashi-ku, Osaka; founded 1911; cap. 18,863m.yen. Manufacture of electric wires and cables, high carbon steel wires; sintered alloy products; rubber and plastic products; disc brakes; radio-frequency products. Chair. Isamu Sakamoto; Pres. Masao Kamei; employees: 11,000 (March 1978).

Matsushita Electric Works Ltd.: 17-15, Shimbashi 6-chome, Minato-ku, Tokyo; sales$1,125.9m.; cap. and res. $300.6m.; lighting fixtures and building materials. Chair. Konosuke Matsushita; Pres. Masaharu Niwa; employees: 11,779.

Furukawa Electric Co. Ltd.: 6-1 Marunouchi 2-chome. Chiyoda-ku, Tokyo; founded 1896; sales 264,736.2m. yen; cap. and res. 18,972.2m. yen. Manufacture and sale of electric wires and cables, non-ferrous metal products. Pres. Masao Funahashi; employees: 5,962.

Toa Oil Co. Ltd.: Shin Otemachi Bldg., 2-1, Otemachi 2- chome, Chiyoda-ku, Tokyo 100; founded 1924; sales $1,054.8m.; cap. and res. $905,000. Petroleum products. Chair. Masayuki Echigo; Pres. Ichihei Kishida; employees: 872.

Teijin Ltd.: 1-1, Uchisaiwai-cho 2-chome, Chiyoda-ku, Tokyo, and 11, Minami Hommachi 1-chome, Higashi-ku, Osaka; founded 1918; sales $1,157.9m.; cap. and res. $282.4m. Manufactures of fibres, yarns and fabrics from polyester fibres (Teijin Tetoron), nylon, polyvinyl chloride fibre (Teijin Teviron), acetate, acrylic fibre (Teijin Beslom), polycarbonate resin (Panlite), acetate resin (Tenex) petro-chemicals, pharmaceuticals. Fifty-three subsidiary companies; Pres. Shinzo Ohya; employees: 10,543.

Takeda Chemical Industries Ltd.: 27 Dosho Machi 2-chome, Higashi-ku, Osaka; founded 1925; sales $1,032.9m.; cap. and res. $497.5m. Manufacture and distribution of pharmaceuticals, industrial chemicals, cosmetics, food additives; enriched foods and drinks, agricultural chemicals, fertilizers. Chair. Kanzaburo Morimoto; Pres. Shinbei Konishi; employees: 19,482.

4. Corporations (continued)

Koa Oil Co. Ltd.: Nihon Bldg., 6-2, Ohte-machi 2-chome, Chiyoda-ku, Tokyo; sales $1,019.1m.; cap. and res. 48.4m. Petroleum products. Chair. Awashi Jochi; Pres. Teruo Noguchi; employees: 1,417.

Oji Paper Co. Ltd.: 7-5, Ginza 4-chome, Chuo-ku, Tikyo 104; founded 1949; cap. 14,148m. yen (April 1977). Newsprint, packing paper and printing paper. Pres. Fumio Tanaka; employees: 4,503 (March 1977).

Mitsui Engineering and Shipbuilding Co. Ltd.: 6-4, Tsukiji, 5-chome; Chuo-ku, Tokyo 104; founded 1937; cap. 30,335.m. yen. Shipbuilding and industrial machinery. Pres. Isamu Yamashita; employees: 15,200.

Dainippon Printing Co.: 12, Ichigaya Kaga-cho 1-chome, Shinjuku-ku, Tokyo; sales $992.2m.; cap. and res. $339.9m. Printing, packaging, paper products. Chair. Takashi Murotani; Pres. Orie Kitajima; employees: 12,300.

Asahi Glass Co. Ltd.: 1-2, Marunouchi 2-chome, Chiyoda-ku, Tokyo; founded 1907; sales $1,354.0m.; cap. and res. $551.0m. Manufacture and sale of flat glass, TV bulbs, Alkali and other chemicals, and refractories. Associated and subsidiary companies in India, Indonesia, Thailand and the U.S.A.; Pres. Hideaki Yamashita; employees: 10,756.

Fujitsu Ltd.: Furukawa Sogo Bldg., 6-1, Marunouchi 2-chome, Chiyoda-ku, Tokyo 100; founded 1935; sales $965.8m.; cap. and res. $295.1m. Manufacture and sale of electronic computers and data processing equipment, telephone equipment, etc. Pres. Taiyu Kobayashi; employees: 31,170.

Ajinomoto Co. Inc.: 6 Kyobashi 1-chome, Chuo-ku, Tokyo 104; founded 1909; sales $962.0m.; cap. and res. $207.2m. Manufacture and sale of seasonings, oil products, foodstuffs, etc. Numerous subsidiaries and overseas offices; Chair. Saburosuke Suzuki; Pres. Bunzo Watanabe; employees: 5,890.

Mitsui Toatsu Chemicals Inc.: Kasumigaseki Bldg., 2-5, Kasumigaseki 3-chome, Chiyoda-ku, Tokyo; founded 1933; sales $939.1m.; cap. and res. $147.7m. Industrial chemicals, fertilizers and resins, etc. Pres. Toshio Sueyoshi; employees: 9,511.

4. Corporations (continued)

Mitsubishi Petrochemical Co. Ltd.: 5-2, Marunouchi 2-chome, Chiyoda-ku, Tokyo; sales $934.4m.; cap. and res. $117.4m. Plastics and chemicals. Pres. Hisashi Kurokawa; employees: 5,523.

Nippondenso Co. Ltd.: 1-1 Showa-cho, Kariya-shi, Aichiken; founded 1949; cap. 9,627m. yen. Car electrical equipment, air conditioners, radiators, fuel injection pumps, instruments, spark plugs, etc. Chair. Takeaki Shirai; Pres. Fubito Hirano; employees: 22,126.

Unitika Ltd.: J.P. Bldg., 3-4, Nihombashi Muromachi, Chuo-ku, Tokyo; founded 1889; sales $903.7m.; cap. and res. $126.5m. Manufacture and sale of synthetic and natural fibres and fabrics; production of plastic resin and film; plant and machinery engineering. Chair. Kenzo Obata; Pres. Shinrokura Kodera; employees: 13,553.

Mitsui Mining and Smelting Co. Ltd.: 1-1, 2-chome, Nihonbashi Muro-machi 2-chome, Chuo-ku, Tokyo; founded 1950; sales $851.7m.; cap. and res. $101.3m. Copper and zinc and related products, construction materials, grinding wheels and pollution prevention devices. Pres. Shimpei Omoto; employees: 7,821.

Nissan Shatai Co. Ltd.: 10-1, Amanuma, Hiratsukashi, Kanagawa-ken 254; founded 1949; sales $866.8m.; cap. and res. $63.6m. Auto-bodies for passenger cars and small trucks. Chair. Katsuji Kawamata; Pres. Matsanobu Aoki; employees: 7,612

Fuji Photo Film Co. Ltd.: 26-30, Nishi Azabu 2-chome, Minato-ku, Tokyo 106; founded 1934; sales $1,243.2m.; cap. and res. $557.0m. Films and photographic materials. Pres. Kusuo Hirata; employees: 15,431.

Mitsubishi Rayon Co. Ltd.: 8, 2-chome, Kyobashi, Chuo-ku, Tokyo; founded 1933; sales $847.8m.; cap. and res. $104.2m. Manufacturer of acrylic fibre, polyester filament, polypropylene filament, rayon and non-woven fabrics, carbon fibre, etc. Principal subsidiary companies include: Mitsubishi Acetate, Mitsubishi Burlington, Nitto Chemical; Chair. Kisaburo Shimizu; Pres. Shuzo Kanazawa; employees: 6,859.

4. Corporations (continued)

Sharp Corporation: 22-22 Nagaike-cho Abeno-ku, Osaka 545; founded 1912; sales $806.8m.; cap. and res. $151.3m. Manufacture and sale of TV sets, acoustic equipment, domestic electrical appliances, industrial machines and medical equipment. Chair. Tokuji Hayakawa; Pres. Akira Saeki; employees: 10,334.

Toppan Printing Co. Ltd.: 5-1, Taito 1-chome, Taito-ku, Tokyo 110; founded 1900; sales $195.6m.; cap. $73.7m. General printing. Pres. Kaichi Sawamura; employees: 8,700.

Hino Motors Ltd.: 1-1, Hinodai 3-chome, Hino-shi, Tokyo 191; founded 1942; sales $792.0m.; cap. and res. $131.4m. Diesel trucks, buses and cars. Chair. Masanobu Matsukata; Pres. Masashi Arakawa; employees: 7,700.

Nisshin Steel Co. Ltd.: Shin Kokusai Bldg., 4-1, Marunouchi 3-chome, Chiyoda-ku, Tokyo; founded 1928; sales $790.9m.; cap. and res. $141.2m. Manufacturer of ordinary steel, stainless steel, special steel and various secondary products. Pres. Nobuo Kaneko; employees: 9,823.

Nisshin Flour Milling Co. Ltd.: 19-12 Koami-cho, Nihon-bashi, Chuo-ku, Tokyo; founded 1900; cap. 7,858m.yen. Production and sale of wheat flour, formula feeds and prepared mixes. Chair. Hidesaburo Shoda; Pres. Yoshio Ishii; employees: 2,983.

Sumitomo Heavy Industries Ltd.: New Ohtemachi Bldg., 2-1, Ohte-machi 2-chome, Chiyoda-ku, Tokyo; founded 1934; sales $786.7m.; cap. and res. $181.1m. Industrial machinery and shipbuilding. Pres. Tsunesaburo Nishimura; employees: 14,275.

Shiseido Co. Ltd.: 5-5, Ginza 7-chome, Chuo-ku, Tokyo; sales $1,022.7m.; cap. and res. $296.0m. Cosmetics and toiletries. Pres. Kichibee Yamamoto; employees: 11,845.

Nippon Suisan Kaisha Ltd.: 6-2, Otemachi 2-chome, Marine fisheries and fish products. Chair. Masataka Suzuki; Pres. Juro Osoegawa; employees: 7,500.

Meiji Milk Products. Co. Ltd.: 6, Kyobashi 2-chome, Chuo-ku, Tokyo 104; founded 1917; sales $736.6m.; cap. and res. $65.0m. Dairy products. Chair. Masanori Ono; Pres. Keijo Fujimi; employees: 6,294.

4. Corporations (continued)

Mitsui Mining Co. Ltd.: 1 Nihonbashi Muromachi 2-chome, Chuo-ku, Tokyo 103; founded 1911; sales $734.4m.; cap. and res. $28.5m. Coal, petroleum, building materials, coke. Pres. Shingo Ariyoshi; employees: 1,680.

Dainippon Ink and Chemicals Inc.: 3, Nihombashi Tori 3-chome, Chuo-ku, Tokyo; founded 1937; sales $731.4m.; res. $116.4m. Printing inks, chemicals, building materials, etc. Pres. Katsumi Kawamura; employees: 6,837.

Mitsubishi Metal Corporation: 5-2, Ote-machi 1-chome, Chiyoda-ku, Tokyo 100; founded 1950; sales $945.7m.; cap. and res. $111.3m. Copper, zinc and metal-processed products. Pres. Yoshihiro Inai; employees: 4,990.

Morinaga Milk Industry Co. Ltd.: 33-1, 5-chome, Shiba, Minato-ku, Tokyo; founded 1949; sales $688.6m.; cap. and res. $53.3m. Manufacturer of condensed milk, powdered milk, butter, cheese, ice-cream, liquid milk. Offices in cities all over Japan; Chair. Isamu Ohno; Pres. Heihachi Ino; employees: 5,067.

E. COUNTRY OVERVIEW

1. General

- Japan is the fourth most densely inhabited nation in the world, with over 725 people per square mile. However, the population is unevenly distributed; most people are concentrated in urban areas and in farming areas located on the coastal plains and in a few interior basins. Over 76% of the population lives in cities.

- Age distribution: 24%,0-15; 69%, 15-64; 7% 65+.

- Of the total land area, 16% is arable and cultivated, 3% grassland, 12% urban and waste, 69% forested.

2. Climate

- Although the country is a series of islands, its close proximity to the Asian continent results in greater influence by continental climatic factors than by marine ones.

- Surrounded by water, Japan has generally humid weather throughout the year. Regional climatic variations range from subtropical in Kyushu to cool temperatures in Hokkaida.

- Rainfall is adequate throughout the islands. Most receive forty or more inches of rain annually.

- Japan's unstable geological position causes occasional earthquakes; approximately 1,500 occurrences each year, though most are minor tremors.

3. Economy

- In absolute terms, Japan imports more raw materials than any other industrial nation.

- The trend in the large-scale business sector during the 1970's has been towards the expansion in the size of units and the strengthening of capitalization. Mergers have increased Japan's ability to compete in the world market.

- Japan's economic system is characterized by a close, cooperative, and mutually supportive relationship between government and business.

3. Economy (continued)

- Japan's exports earn only about 13% of its gross national product (GNP).

a. Agriculture:

- Farmers produce about 50% of the caloric intake of the present population on less than 14 million acres under cultivation. Japan is self-supporting in rice production.

- At present, there is a ratio of 4,700 persons per square mile of cultivable land.

b. Fishing:

- Japan's 1976 fish catch was 10.6 million metric tons, accounting for 15% of the world's total.

c. Forestry:

- Forest land covers a total of 63 million acres or 68% of the national land area.

- Despite her abundant resources, Japan has turned to foreign sources for timber to such an extent that imports are more than the domestic output.

d. Industry:

- Japan ranks as the third largest industrial power in the world, and second as the world's largest plastic producer.

- The manufacturing industry is characterized by a wide disparity in size of firms and plants.

- The annual production capacity of the steel industry was 120 million tons in 1973, of which one third was exported. The industry is highly dependent on imported raw materials.

e. Mining:

- Although there is a considerable variety of minerals in Japan, the contribution of the mining industry has been low due to their insufficient quantities for the country's requirements.

4. Living Conditions

- The average Japanese enjoys a standard of living equal with those of other highly developed and industrialized societies and economies.

  a. Health:

  - Large-scale epidemics of infectious diseases have been brought under control and the overall quality of services and facilities is steadily improving.
  - Life expectancy: males, 70.2 yrs.; females, 75.6 yrs.
  - Infant mortality 12.4 per 1,000 live births.
  - In 1970 there were approximately 119,000 physicians in Japan; one doctor for every 890 people. However, the distribution is very uneven.
  - 7,974 hospitals, 68,997 general clinics.

  b. Education:

  - Japan has attained one of the highest literacy rates in the world at 95.5%.
  - Japan's education system is based on a vertically integrated structure that provided for nine years of compulsory elementary and secondary education, three years of upper secondary education and four years at the higher education level.
  - In 1972 there were 63 technical schools with 5,387 full/part-time instructors and 46,707 students.
  - To improve education opportunities for the working youth, correspondence schools have been established. Technical training within industry has been increasingly linked with part-time and correspondence schools.
  - Technical colleges were instituted in 1962 and train students to be highly qualified technicians below the professional level. Only 20% of the sixty technical colleges are private; all but 2% of the enrollment is male.

c. Housing:

- By 1972, roughly 70% of the population was located in cities and over half the urban population crowded into three cities: Tokyo, Osaka and Nagoya.

- The social welfare of many Japanese workers is to some extent provided for by industrial paternalism. An employee and his family often live in company housing, free or at a low rental charge.

- The greater portion of the population own their own homes where the average floor space is about 126 square feet per person.

- Lower income families in the cities are housed in large apartment buildings constructed of wood and plaster.

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APPENDIX

ADB	Asian Development Bank
AIOEC	Association of Iron Ore Exporting Countries
ANZUS	ANZUS Council; treaty signed by Australia, New Zealand and the United States
ASPAC	Asian Pacific Council
CIPEC	Intergovernmental Council of Copper Exporting Countries
DAC	Development Assistance Committee (OECD)
ELDO	European Space Vehicle Launcher Development Organization
ESCAP	Economic and Social Council of Asia and the Pacific
FAO	Food and Agricultural Organization
GATT	General Agreement on Tariffs and Trade
IAEA	International Atomic Energy Agency
IATP	International Association of Tungsten Producers
IBA	International Bauxite Association
IBRD	International Bank for Reconstruction and Development
ICAC	International Cotton Advisory Committee
ICAO	International Civil Aviation Organization
IDA	International Development Association
IEA	International Energy Agency
IFC	International Finance Corporation
IHO	International Hydrographic Organization
ILO	International Labor Organization
IMCO	Intergovernmental Maritime Consultative Organization
IMF	International Monetary Fund
IOOC	International Olive Oil Council
IPU	Inter-parliamentary Union
IRC	International Red Cross

ISO	International Science Organization
ITC	International Tin Council
ITU	International Telecommunications Union
OECD	Organization for Economic Cooperation and Development
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
UPU	Universal Postal Union
WHO	World Health Organization
WIPO	World Intellectual Property Organization
WMO	World Meteorological Organization
WSG	International Wool Study Group

III

DOMINION OF NEW ZEALAND

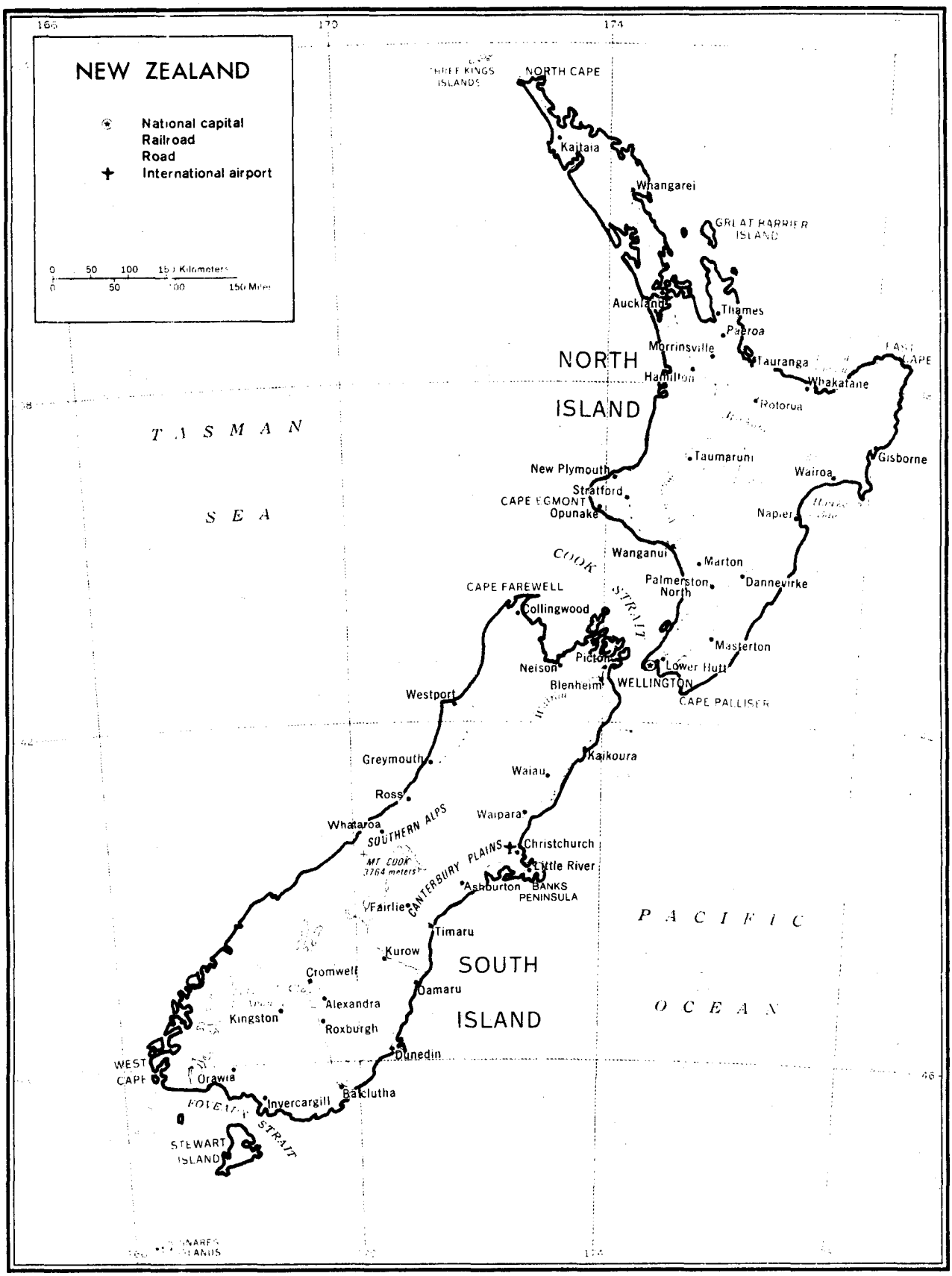

NEW ZEALAND
National capital
Railroad
Road
International airport
0 50 100 150 Kilometers
0 50 100 150 Miles
THREE KINGS ISLANDS
NORTH CAPE
Kaitaia
Whangarei
GREAT BARRIER ISLAND
Auckland
Thames
Paeroa
Morrinsville
Tauranga
Hamilton
Whakatane
NORTH ISLAND
Rotorua
TASMAN SEA
Taumaruni
Gisborne
New Plymouth
Wairoa
Stratford
CAPE EGMONT
Opunake
Napier
COOK STRAIT
Wanganui
Marton
Palmerston North
Dannevirke
CAPE FAREWELL
Collingwood
Masterton
Nelson
Picton
Lower Hutt
Blenheim
WELLINGTON
CAPE PALLISER
Westport
Kaikoura
Greymouth
Waiau
Ross
Waipara
Whataroa
SOUTHERN ALPS
MT COOK 3764 meters
Christchurch
CANTERBURY PLAINS
Little River
Ashburton
BANKS PENINSULA
Fairlie
PACIFIC OCEAN
Timaru
Kurow
SOUTH ISLAND
Cromwell
Damaru
Alexandra
Kingston
Roxburgh
Dunedin
WEST CAPE
Orawia
Balclutha
Invercargill
FOVEAUX STRAIT
STEWART ISLAND

TABLE OF CONTENTS

DOMINION OF NEW ZEALAND

I. ENERGY PROFILE

A. RESOURCES

1. Climate

New Zealand extends from 33° to 47° latitude with most areas receiving about 2000 hours of sunshine each year. A continuing eastward migration of anti-cyclones takes place at roughly weekly intervals, with most of the centers passing through the north-east of the country. The low pressure troughs which separate these anti-cyclones bring cold southerly or south-westerly winds which pass with the approach of the next anti-cyclone. The weather changes rapidly, but there is a relatively equatible climate with an annual average temperature of about 13°C, and an annual range of from 8-11°C. In the populated areas, temperatures above 28°C or below 4° are unusual. The country's weather is well defined as a result of an extensive network of meteorological stations maintained by the New Zealand Meteorological Service.

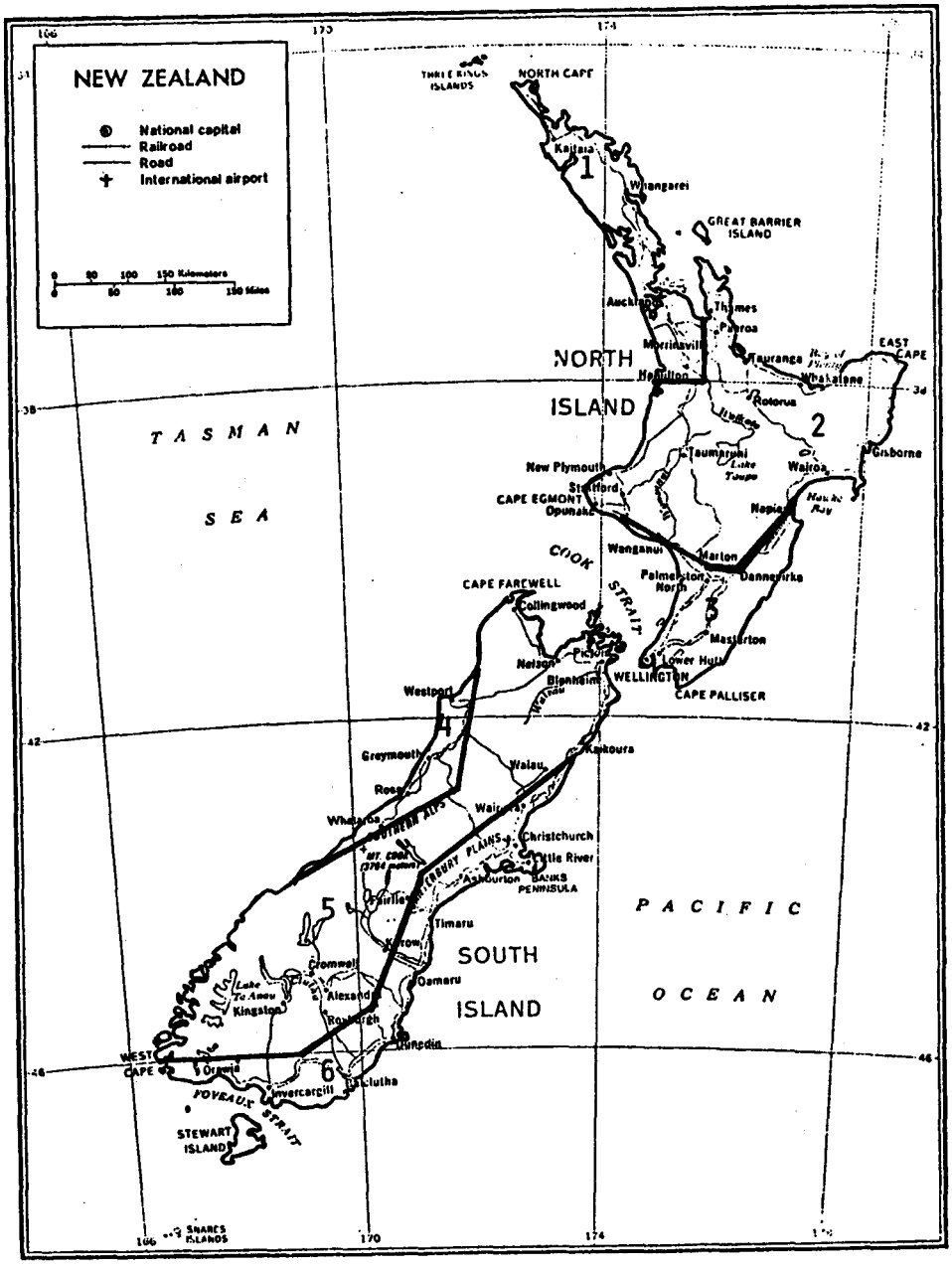
The table on the following page presents parameters of climatological data representative of nearly homogeneous climatic areas. The data are average (or representative) values based on a sample of climatological data available from weather stations within the area. The area data do not imply that the specific condition simultaneously exists at all locations within a country or large climatic area. In rolling and mountainous terrain, there may be considerable variation in the data from one location to another within the climatic area.

MEAN NUMBER OF DAYS WITH SKY COVER LESS THAN 0.3 AND VISIBILITY EQUAL TO OR GREATER THAN 3 MILES.

The average of the number of days when, at a specified hour during the day in the specified month, the portion of the sky covered with clouds was observed to be less than 0.3 and the visibility was observed to be equal to or greater than three miles. (Continued on page III-3.)

Parameter Description		Area 1 N. Lowlands	Area 2 Central Highlands	Area 3 S. Lowlands	Area 4 W. Coast	Area 5 Central Mts.	Area 6 E. Coast
Max Mean Temp (°F)		67	65	64	60	62	60
Min Mean Temp (°F)		50	47	47	46	43	43
Largest Mean Precip (in)		80.5	62.1	47.4	143.5	38.4	45.5
Smallest Mean Precip (in)		45.0	38.4	29.0	85.0	13.3	20.9
	Time LST						
No. days when surface wind was 4-10 knots, temperature was 33-89°F and no precip.	1100	[a]119.2	[a]121.0	[a]137.1	141.4	96.5	112.5
	1700	[a]131.7	[a]120.9	[a]133.9	114.0	81.6	114.9
	2300	[a]121.9	[a]136.4	[a]153.5	94.2	61.4	117.2
	0500	[a]116.4	[a]112.5		107.0	91.4	100.0
No. days when sky cover was less than 3/10 and visibility was greater than 3 miles	1100	[a] 48.4	[a] 87.3	[a] 82.2	92.3	127.7	78.9
	1700	[a] 64.2	[a]108.1	[a] 96.0	99.2	130.4	72.4
	2300	[a]128.7	[a]152.4	[a]162.6	120.4	155.2	112.2
	0500	[a] 92.7	[a]111.8		104.6	148.7	82.9

LST= Local Standard Time
[a] = Measurements taken 1 hour late



1. Climate (continued)

MEAN NUMBER OF DAYS WITH SURFACE WIND 4-10 KNOTS AND TEMPERATURE 33-89°F AND NO PRECIPITATION.

The average of the number of days when, at a specified hour during the day in the specified month, the surface wind speed was equal to or greater than four knots, but no greater than ten knots, the temperature was equal to or greater than 33°F but not greater than 89°F and there was no precipitation.

2. Renewable Resources

a. Solar radiation: For more than 60 years records of hours of bright sunshine have been made in this country with Campbell-Stokes sunshine recorders - some 72 sites are furnished with these instruments. Stations equipped with Eppley Pyranometers have been established at 5 sites since 1954. Daily averages of total horizontal radiation for these centers and for each month of the year are shown below.

NEW ZEALAND RADIATION AVERAGES

(megajoules/m^2day)

	Wellington	Auckland	Ohakea	Invercargill	Christchurch
JAN	23.4 ± 1.8	22.7 ± 1.9	24.2 ± 2.5	21.2 ± 1.8	22.8 ± 1.5
FEB	19.3 ± 1.7	19.7 ± 1.2	20.6 ± 2.9	18.1 ± 1.6	19.7 ± 0.6
MAR	14.8 ± 0.8	16.1 ± 1.5	15.6 ± 1.4	12.6 ± 1.5	14.4 ± 0.6
APR	10.3 ± 0.9	12.1 ± 1.7	11.5 ± 1.0	8.1 ± 0.7	10.4 ± 0.7
MAY	6.4 ± 0.4	8.3 ± 0.8	7.4 ± 0.6	5.2 ± 0.2	6.4 ± 0.3
JUN	5.2 ± 0.8	6.8 ± 0.7	6.0 ± 0.4	3.6 ± 0.3	5.0 ± 0.5
JUL	5.3 ± 0.8	7.5 ± 0.9	8.3 ± 0.4	4.6 ± 0.4	5.5 ± 0.3
AUG	8.2 ± 1.0	10.2 ± 0.9	9.5 ± 0.9	7.5 ± 0.6	9.0 ± 0.3
SEP	12.6 ± 1.8	14.1 ± 1.6	13.8 ± 1.8	12.0 ± 1.3	12.4 ± 1.0
OCT	17.2 ± 1.1	17.5 ± 1.9	17.8 ± 1.4	16.5 ± 1.3	18.3 ± 0.8
NOV	20.4 ± 1.9	20.9 ± 2.3	22.7 ± 1.8	20.1 ± 1.3	22.8 ± 1.5
DEC	22.9 ± 2.1	22.7 ± 1.7	23.6 ± 2.0	22.3 ± 1.3	24.2 ± 1.5
YEAR	14.0 ± 0.3	14.8 ± 0.8	14.9 ± 0.4	12.7 ± 0.5	14.2 ± 0.2

b. Geothermal: Geothermal heat flow is much greater than average in the volcanic regions of New Zealand between Mt. Ruapehu in the center of the North Island and White Island off the east coast. The use of geothermal energy in New Zealand is far from new; the Maoris in Rotorua used it for centuries to cook their food. Large-scale exploitation of geothermal energy began in New Zealand with the Wairakei power station, commissioned in 1958, and was the first in the world to produce electricity from geothermal hot water. (A much earlier station, at Lardarello, in Italy, uses natural steam).

At Wairakei the bores yield a mixture of steam and hot water. The steam is separated at the well-head and transmitted through large pipes to the station where it is used to drive the turbo-generators. The station's maximum output, 160 MW, is a small fraction of New Zealand's total electricity generating capacity of 4625 MW. However, it runs almost continuously at near maximum output so that its annual energy output of 1200 GWh is of much greater significance than its capacity would suggest. A further power station is also planned for construction on the Broadlands field.

The total amount of heat stored in the rocks of the volcanic zone is vast. The size of this resource, and the resulting impracticality of exhausting it, is the basic reason for classifying geothermal energy as a renewable source. Many of the problems with geothermal energy derive from, or are exacerbated by, the low efficiency with which geothermal energy can be converted to useful energy forms. At Wairakei less than 10 percent of the energy extracted from the ground is converted into electricity. Even where the energy is used more directly for heating purposes, as in industry, the overall efficiency of the low temperature of the geothermal heat rarely approaches 50 percent.

The main reason for this low efficiency is the low temperature of the geothermal heat, compared with that achieved in the combustion of fossil fuels.

c. Hydropower: As of 31 March 1978 major controlled storage was as follows:

Storage Lake	Storage GWh	Percent Full
Taupo	16.6	3.2
Waikaremoana	9.0	5.9
Tekapo	578.7	107.0
Pukaki	279.1	39.7*
Hawea	104.3	36.6
Te Anau	268.9	108.7
Manapouri	87.9	60.4

*Pukaki percent full is expressed in terms of the expected useful volume at this state in the filling programme.

Potential generation available from North Island inflows was 89 percent mean and the overall utilization was over 99 percent. Potential available from South Island inflows was 77.1 percent mean with a 97 percent utilization.

Hydroelectricity has a long history in New Zealand. Since its first generation in 1888 it has become, and is likely to remain, New Zealand's most valuable energy resource.

The potential annual yield from hydroelectric schemes is some 58,000 GWh per annum. The potential for hydroelectricity is four times greater than the output of the present hydro-stations, which are capable of generating 17,500 GWh electricity in an average year.

The supply of hydroelectricity is limited by the available water flows. Sufficient storage volume is available in most of the major catchments to modify the flow of water to suit electricity demands on a season-to-season basis. However, little can be done to smooth out year-to-year variations. The reliability of supply is greatly increased by a supplementary source, usually a thermal power station, used to make up the short in a dry year.

d. Wind: It appears wind energy in New Zealand could be developed at a lower cost than in most other parts of the world, but the capital cost would still be high. The selection of good sites is most important and certain windy areas are being investigated to determine if they would be suitable.

d. Wind: (continued)

Although New Zealand cannot fund energy research on the scale of larger countries, a nationally effective and internationally responsible program for energy research and development has been established. The New Zealand Energy Research and Development Committee acts as advisor to the National Research Advisory Council on the energy research undertaken by Government departments. It also administers a scientific cooperation agreement with the United States which places emphasis on energy. The committee also oversees a substantial amount of government funded contract work.

3. Non-Renewable Resources

a. Oil: Oil exploration in New Zealand began in 1865. In all, about 200 holes, most of them shallow and comparatively unproductive, were drilled before more serious and deeper drilling began in 1959 at Kapuni, situated at the base of Mt. Egmont in the North Island. The Kapuni field is New Zealand's only significant onshore petroleum accumulation yet discovered. In 1977, condensate from Kapuni provided 15 percent of New Zealand's oil requirements. When onshore exploration by private interests stopped, the Government in 1977 initiated its own exploration program.

Offshore exploration licenses were first issued in 1965. In 1969 sizeable quantities of natural gas and associate condensate, together with some crude oil, were found at Maui. The Maui gas field is situated about 50 kilometers from the Taranaki coast off the North Island. The field is now being developed and the gas produced is being used for electricity generation, and as a premium fuel. Prospects for significant onshore discoveries of crude oil do not appear promising. But there are better chances of finding condensate associated with gas in a gas field.

Potential petroleum reserves are known or suspected in many areas of both the North and South Islands. The highest hopes are held for Taranki, but most of the rock structures there are complicated and deep, and therefore relatively expensive to drill. Offshore prospects appear brighter with interest centered on the area off the Taranki coast and in the Great South Basin.

PETROLEUM STOCKS AND INTERNATIONAL BUNKERS

AS AT DECEMBER 31, 1976

Crude Oil	Motor Gasoline	Jet Fuel and Kerosene	Distillate Fuel Oil	Residual Fuel Oil
230,442	170,921	56,837	158,523	84,581

a. Oil: (continued)

In 1976, 90 percent of New Zealand's oil was imported; 3/4 as crude and partly refined feedstocks for refining at the Marsden Point Refinery and the remainder imported as refined products. Most aviation fuel comes from Australia. Other lubricants, (kerosene, chemicals and detergents) are imported from the Middle East, Australia and Singapore. Imports are used primarily for:

- fuel for vehicles (most)
- electricity generation
- heating industrial boilers
- heating private homes

b. Natural Gas: New Zealand's total natural gas reserves of 1,665,000 GWh can be compared with the present rate of gas consumption of some 17,760 GWh per annum. This generous reserves production ratio, together with the fact that natural gas already provides one-sixth of New Zealand's primary energy, indicates that natural gas is capable of becoming a key element in the country's energy future.

Natural gas is making significant inroads into industrial and commerical oil markets. It is also capable of supplying most of the energy required by households within those areas in which it is distributed.

Liquified petroleum gas, or LPG, can be extracted from natural gas and consists of propane, butane or a mixture of the two. Propane has been produced at Kapuni since 1973 and reached 7000 tons in 1977. The plant is now able to produce 20,000 tons of propane and butane a year, although so far butane has not been marketed. The Government has decided because of the growing energy supply problem that no exports should be permitted and the LPG extraction scheme should be tailored to meet New Zealand's needs only. LPG could, for example, be a substitute for gasoline and diesel fuel.

c. Coal: Most of New Zealand's coal fields were discovered in the 1880's. Coal was the major source of energy for industry, transport, households, and gas manufacturing until the 1950's. Coal production dropped from a peak in 1960 of 3 million tonnes to approximately 2 million tonnes in 1971. By 1977, coal production had increased to 2.3 million tonnes.

Coal is New Zealand's largest known fossil energy resource. Total resources are estimated at 1,180 million tons. Present development is based on measured reserves of 211 million tons. Further exploration is required to establish the existence and recoverability of the reserves, but it appears that coal will play a substantially expanded role in New Zealand's energy future.

At present about $2 million a year is being allocated for coal exploration. The long-term objective is to discover extensions to the presently known resources. This will cost about $60 million and take at least 15 years.

The economics of exporting coal are affected by transport costs. New Zealand's distance from all likely overseas markets accentuates this problem. Only the bituminous coal of the West Coast has practical export potential as other types have too low an energy content per ton. Even here it is only metallurgical coking coal, highly valued for its ability to be used for steel making, which offers a serious prospect for profitable exports.

The Ministry of Energy is coordinating available information and planning exploration programs. Coal exploration has been intermittent and concentrated on the shallow, easy-to-mine coal; on high quality resources; and on immediate requirements. In recent years an extensive program to determine the nation's coal resources more accurately has begun and is expected to take a decade or longer.

d. Nuclear: As New Zealand has no known uranium or thorium deposits of economic significance any nuclear power development in New Zealand would need to be based on imported fuel. A commitment to nuclear power would be a major and controversial step unlikely to take place before the year 2000. Energy forecasters are already finding the demand for electricity in New Zealand is not growing at the speed they had expected.

B. ENERGY ECONOMY

1. Supply Descriptor

- The New Zealand energy program has been designed to displace oil through aggressive development of indigenous resources and pricing policy tailored to promote substitution of oil by natural gas and coal. A significant decrease of oil's share of non-transport markets is projected. There would appear to be potential for further displacement of oil, noteably in the food processing industries. The availability of natural gas or coal on economic terms will be the deciding factor.

- Environmental considerations of increased use of coal do not appear to be a limiting factor due in large part to the very low sulfur content of New Zealand coal. The coal option for increased industrial use does not however seem to have been fully exploited. The 1974 Coal Report made a number of recommendations related to marketing practices, transportation quality of product, etc., that appear desirable for the Government to adopt but some have not been acted upon.

- Curtailment of electricity load growth by conservation and substitution to direct use of natural gas is also a critical policy element of the New Zealand program. The improvement in the overall energy efficiency by substitution of electricity generated by natural gas by direct gas use is calculated to be 60 percent. The Government in 1977 increased the allocation of natural gas available for reticulation and introduced modest subsidies to encourage gas use in households.

- The year 1977 has been a very heavy one for the power development branch, which has been hampered by loss of staff, changes in major planning parameters, and involvement in public hearings.

  Because of dropping load estimates, generation capacity has to be carefully planned in case of a possible future resurgence in demand. The apparent downturn in load growth makes it extremely difficult to predict future thermal station fuel requirements. It also demonstrates the need for a strategy to ensure fuel availability if low load predictions prove incorrect.

1. Supply Descriptor (continued)

Adjustments are being made to development proposals in line with the Government's aim of encouraging the development of indigenous renewable energy resources. Because of this, and the downturn in load growth, investigation work for the Buller coal-fired power station has been scaled down.

- In the view of the IEA Team, increasing electricity tariffs to the level of the cost of bringing on new generation capacity is critical to the success of this strategy. Direct intervention to provide reticulated gas to promising markets in the North Island would also appear to warrant consideration. In the South Island, promotion of town gas from LPG as competition for electricity in the household sector might yield some advantage. On the latter point, the use of LPG in the transportation sector should have higher priority.

- A very high proportion of the population has access to relatively cheap electricity, nearly 90 percent of which is generated from hydro or geothermal sources, supplying about 20 percent of the country's total energy needs. However, an end of these low cost hydroelectric developments will soon be approached. Only a small part of the geothermal potential is being used.

- There are large coal deposits, in thick seams, well distributed, and sufficient for several centuries at current rates of consumption. Coal provides only about 20 percent of the country's energy and its contribution has been declining for a generation or more. Large natural gas reserves have been located, and the prospects of further gas or oil discoveries are considered to be good, but the pace of exploration is slow. Only 2 percent of New Zealand's energy comes from gas at present but this will grow when established off-shore fields are exploited.

- Very little indigenous oil is available at present although about 58 percent of total energy requirement is served by oil and this dependence has been rising steadily for many years. Like many other countries since the Second World War, the economy has come to depend on imported oil, not for lack of indigenous energy resources, but for reasons of cost, convenience, and pollution abatement.

1. Supply Descriptor (continued)

Through development of the country's coal and natural gas reserves and exploitation of remaining hydro and geothermal potential, New Zealand is well placed to achieve substitution of oil with indigenous energy forms in nontransport markets and thereby prevent oil imports from increasing above current levels.

NEW ZEALAND
DETAILS OF GENERATION FOR PUBLIC SUPPLY

Generated by ——	1978 Units Generated	1977 Units Generated
New Zealand Electricity Department	20 794 837 990	20 464 952 530
Supply authorities —		
Egmont	1 535 784	1 583 072
King Country	26 576 000	28 852 700
New Plymouth	16 416 000	16 358 000
Palmerston North	10 915	20 768
Poverty Bay	950	1 960
Taranaki	22 313 544	23 638 680
Taumarunui	5 814 760	4 838 040
Taupo	12 703 084	17 185 760
Tauranga City Council	18 737 200	20 662 831
Tauranga Joint Generation Committee	70 157 700	57 598 580
Wairarapa	4 177 330	3 535 420
Waitomo	14 464 500	15 485 500
Waitemata	79 700	127 340
Wanganui-Rangitikei	1 191 000	1 669 800
Buller	...	1 794
Dunedin	181 672 400	154 235 200
Marlborough	6 349 224	8 023 082
Otago Central	53 928 550	55 746 944
Tasman	487 281	1 012 704
West Coast	13 808 284	20 011 679
	450 424 206	430 589 854
Purchased from non-supply authorities	19 859 680	18 698 663
Total generation	21 265 121 876	20 914 241 047
Peak for public supply	3848.2 MW	4074.3 MW

1. Supply Descriptor (continued)

SUPPLY DESCRIPTOR FOR THE NEW ZEALAND ELECTRICITY DEPARTMENT AND ELECTRICAL SUPPLY AUTHORITIES FOR THE YEAR ENDED 31 MARCH 1978					
		Hydro	Steam	Oil/Gas	Total
Generating stations	No.	67	4		80
Installed capacity	MW	3,776.9	1,242.4	614	5,633.7
Generation	GWh	14,591.9	5,873.4	803.2	21,268.5
Maximum load	MW				3,848.2
Retail sales of electricity	GWh				18,908.8
Consumers	No.				1,309,958
Population (mean)	No.				3,128,800
Population (total)	No.				3,145,900
Generation per head of mean population	kWh				6,798
Generation per head of total population	kWh				6,761
Retail sales of electricity per head of mean population	kWh				6,043
Retail sales of electricity per head of total population	kWh				6,011
Retail sales per total consumers	kWh				14,435
Electrical fires reported during year	No.				39
Electrical accidents during year (fatal)	No.				6
Electric ranges (domestic)	No.				964,284
Electric water-heaters (domestic)	No.				1,009,310

ELECTRICITY GENERATION, ACTUAL AND RETAIL SALES (For Public Supply)									
March Year	Means of Generation		New Zealand Generation			Retail Sales to Consumers			
	Hydro	Thermal (1)	Total (Actual)	Daily Average	Per Head of Mean Population	Domestic	Non Domestic	Total	Per Consumer (2)
	GWh			MWh	kWh	GWh			kWh
1973.. ..	14,109	3,144	17,254	47,270	5,884	7,388.9	7,641.2	15,030.2	13,035
1974.. ..	14,151	3,963	18,114	49,629	6,047	7,439.6	8,507.7	15,947.3	13,486
1975.. ..	14,197	4,155	18,352	50,279	5,996	7,553.5	8,718.8	16,272.3	13,394
1976.. ..	16,873	3,198	20,071	54,839	6,465	8,402.6	9,247.7	17,650.3	14,133
1977.. ..	14,927	5,987	20,914	57,299	6,702	8,398.0	10,313.9	18,711.9	14,617
1978.. ..	14,589	6,676	21,265	58,261	6,796				

(1) Includes oil generation.

(2) "Consumer" refers to individual connections.

Source: Ministry of Energy.

COAL, GAS AND PETROLEUM PRODUCTION												
December Year	Coal Production(1)				Gas Production				Petroleum Production			
	Bituminous	Sub-Bituminous	Lignite	Total	Gas Manufactured by Gasworks	Natural Gas Supply(2) To Gas Undertakings	Natural Gas Supply(2) To Other Consumers(4)	Total Production	Motor Spirit	Diesel	Fuel Oil	Other(3)
	Tonnes (000)				Megajoules (million)				Litres (000)			
1972 ..	382	1,647	152	2,181	1,275.3	4,484.1	4,962.1	10,721.5	1,765,660	808,440	891,875	359,200
1973 ..	422	1,902	145	2,469	1,246.9	5,469.3	5,816.9	12,533.1	1,516,953	717,187	907,513	587,805
1974 ..	422	1,998	144	2,564	1,330.5	7,602.1	5,279.4	14,212.0	1,710,863	731,283	940,529	688,488
1975 ..	457	1,819	137	2,412	1,297.3	9,928.4	3,796.6	15,022.3	1,656,259	670,373	811,740	323,982
1976 ..	448	1,867	171	2,486	1,308.7	11,873.3	25,402.9	38,584.9	1,911,793	816,188	864,985	475,283
1977 ..	397	1,692	166	2,256	1,235.0	12,235.9	47,301.6	60,772.5	1,744,106	793,214	826,965	378,570

(1) Source: Ministry of Energy.
(2) Source: Natural Gas Corporation
(3) Consists of bunker fuels and bitumen and also power station fuel.
(4) Includes use by Natural Gas Corporation in production.

1. Supply Descriptor (continued)

- Supply authority and consumer cooperation has been sought to conserve storage and help limit fuel expenditure by voluntary conservation of electricity.

  Although consumption was successfully held below guideline levels in 1978, the amount of thermal generation required was much higher because of record low hydraulic inflows.

  South Island inflows during the period July-September inclusive were only 56 percent of mean compared with the historical record of 61 percent mean.

  Exceptionally low hudraulic inflows in the South Island in the July-September period necessitated drawing down all storage lakes to very low levels, Manapouri and Te Anau being close to the permitted minimum levels.

  Although it had not recovered from the previous winter period, and in spite of the known inconvenience to local residents, it was also necessary to withdraw storage from Lake Hawea. Drawdown ceased on 30 September.

  Lake Pukaki was drawn well below expected levels and Tekapo B power station, commissioned on 1 August, ceased generating on 18 September because of the low Pukaki level.

- The nuclear investigation section of the New Zealand Electricity Department has been participating in the hearings of the Royal Commission on Nuclear Power Generation. The section has also assumed responsibility for geothermal field evaluation and investigation of other proposed methods of generating electricity including windpower and energy from biomass.

2. Conversion Descriptor

- For many years New Zealand had a predominately hydro-based electricity system, supplemented by a few small thermal stations. But as the more favorable dam sites were exploited, capital costs of hydroelectricity production increased steadily until the cost of power from thermal stations became competitive.

- In the late 1950's and 1960's New Zealand's hydroelectric system was supplemented by thermal power stations. The Wairakei geothermal station, the Maremere coal-fired station were both built within that decade and the trend continued until the 1970's. New Zealand's first thermal power station designed for continuous base load duty is the New Plymouth gas/oil fired station, using New Zealand's indigenous resources. The completion of this 600 MW station doubled output from fuel-fired power stations from 1974 to 1977. The 1000 MW Huntly power station now under construction will be able to burn either coal or gas.

- The resource depletion policy for natural gas in New Zealand is addressed in terms of the desirability of utilizing natural gas for electricity generation. The New Zealand authorities have indicated that natural gas from the second Maui platform might be reinjected if it was not required for electricity generation. Electricity conservation and substitution to direct use of natural gas will undoubtedly decrease this need in the 1990's. Additional coal-fired electricity generation, utilizing both domestic and foreign production and for nuclear plants would, however, appear necessary to meet post 1990 generation requirements.

- It is anticipated that preparatory work on nuclear power generation will not be shelved even if it is decided that nuclear power will not be required much before the end of this century. A public education program on the nuclear power option, in particular with respect to nuclear safety, waste disposal and other fuel cycle issues would be a prerequisite to the forthcoming public debate.

2. Conversion Descriptor (continued)

PRODUCTION OF ELECTRICITY (In Thousand Million Kilowatt Hours)			
YEAR	TOTAL	THERMO	HYDRO
1972	17.254	1.970	15.284
1973	18.114	2.801	15.373
1974	18.352	2.906	15.446
1975	20.064	1.924	18.140
1976	20.910	4.755	16.155

INSTALLED CAPACITY OF PUBLIC ELECTRIC GENERATING PLANTS BY TYPE (In Thousand Kilowatts)			
YEAR	TOTAL	THERMO	HYDRO
1972	4093	630	3463
1973	4293	630	3663
1974	4653	990	3663
1975	4901	1238	3663
1976	5125	1462	3663

3. Electricity Transmission

- In the Auckland district, the Kaitaia, Maungaturoto, Penrose, Mt. Roskill, Otahuhu, Takanini, Mangere, Wiri, and Kaikohe substations are under design and construction.

  Design and construction work was completed at Pukenui, Albany, and Henderson substations. Survey work commenced on the Otahuhu-Pakuranga 220 kV line.

  Construction continued on the Huntly-Otahuhu 220 kV line, and was completed on the Kaitaia-Pukenui 50 KV line.

  In the Hamilton district, design and construction work continues at Arohena, Edgecumbe, Hamilton, Kawerau, Mt. Maunganui, Kopu, Te Matai, Kinleith, Tarukenga, Western Road (Huntly), Waikino, and Waiotahi substations. Extensions at Rotorua and Te Awamutu substations were completed.

  Investigation work was started on the Hairini-Mt. Maunganui 220 kV transmission line and on the deviation of the Tarukenga-Egecumbe 110 kV line to Owhata.

  Construction work is being done on the deviation of the Whakamaru-Otahuhu 2220 kV line into Huntly power station, and work was completed on the deviation of the Edgecumbe-Ohaduri 220 kV line into Kawerau, and on wiring the second circuit of the Hairini-Tarukenga 220 kV line.

  In the Napier district, the Redclyffe, Whadatu, Gisborned, and Tolomaru Bay substations are under construction.

  Extensions at Woodville substation were completed.

  Investigation work began into a 220 kV line route to Pandora off the existing Redcliffe-Whirinaki line.

  Construction has begun on the Whakatu end of the Redclyffe-Whakatu 220 kV line. Landowners at the Redclyffe end objected to the line and made representations to the Ombudsman. Following the inquiry, further investigations are being made.

3. Electricity Transmission (continued)

Work continues on the Gisborne-Tokomaru Bay 110 kV line following a deviation to avoid tapu areas.

In the Palmerston North district, design work continues on the Bunnythorpe, Linton, Tangiwai and Wilton, and continues on Central Park, Haywards, and Paraparaumu substations.

Construction was completed at Brunswick and Opunake substations.

Survey work started on the Hawera-Stratford 110 kV line. Construction began on the Bunnythorpe-Linton section of the Bunnythorpe-Wilton 220 kV line, and on the deviation of the Bunnythorpe-Tokaanu 220 kV line into Tangiwai substation. Construction was completed on the Opunake-Stratford 110 kV line, and on the Central Park-Wilton 110 kV line.

In the Nelson district, design and construction work continues on Inangahua, Kikiwa, Waimangaroa, and Westport substations.

Survey work continues on the Waimangaroa-Westport 110 kV line and was completed on the Kikiwa-Inangahua 220 kV line.

Construction continues on the Islington-Kikiwa 220 kV line, and on the Inangahua-Waimangaroa line.

In the Christchurch district, design work started on a 66 kV substation at Kaikoura and an interconnection at Greymouth, and continues on work for a new substation at Culverden and extensions at Addington and Hororata substations.

Construction started at Albury substation and continued at Bromley, Islington, Springston , and Timaru substations.

Survey work started on the Culverden-Kaikoura 66 kV line and construction continues on the Islington-Kikiwa 220 kV line.

3. Electricity Transmission (continued)

In the Dunedin district, design work began for Glenavy and Halfway Bush substation extensions, and construction was started.

Construction continues on extensions at Invercargill and Oamaru substations.

Additions to Gore, South Dunedin and Tiwai substations were completed and work continues on the Ohau A - Twizel 220 kV line.

4. End Use Descriptor

TOTAL COAL CONSUMPTION DISTRIBUTION
(In Tons)

MARKET	1973	1974	1975	1976	1977
Gas works	85,100	88,200	83,500	75,200	74,800
Electric power	663,000	829,900	710,100	729,800	746,300
Dairy factories	303,900	297,100	303,500	322,600	364,700
Freezing works	101,600	107,000	102,100	120,600	128,000
Cement and limeworks	275,800	313,000	288,500	288,800	230,500
Brick, tile and pottery	14,400	15,200	14,200	13,600	8,200
Paper mills	69,900	95,400	88,300	81,300	80,600
General industries	237,100	126,300	118,800	159,100	175,700
Domestic	288,300	333,300	274,300	293,500	291,300
Steel and carbonisation	105,400	107,000	123,600	120,300	137,300
Hospitals and heating	234,900	241,400	233,900	250,800	264,700
TOTALS:	2,379,400	2,553,800	2,340,800	2,458,300	2,502,100

CONSUMPTION OF REFINED PRODUCTS
FOR THE PERIOD JULY 1, 1976 TO DECEMBER 31, 1976
(In Metric Tonnes)

Motor Gasoline	Jet Fuel and Kerosene	Distillate Fuel Oil	Residual Fuel Oil
812,802	126,437	559,453	325,348

4. End Use Descriptor (continued)

ENERGY USAGE	
High Temperature	
Heat	12½%
Low Temperature	
Heat	35%
Transport	40%
Power	12½%

ENERGY CONSUMPTION (1976)	
SOLID FUELS:	65% industry; 19% domestic; 16% commercial
OIL:	67% transport; 24% industry; 7.5% domestic 1.5% commercial
GAS:	73% industry; 13% domestic; 14% commercial
ELECTRICITY:	46% domestic; 39% industry; 15% commercial; less than 1% transport
TOTAL ENERGY CONSUMPTION:	37.5% transport; 35.5% industry; 16% domestic; 11% commercial

The pattern of energy consumption for domestic usage is well known, but is not well documented for industry, particularly in regard to temperature requirements. Estimates suggest that a breakdown, as illustrated above, would be realistic. High temperature heating is defined as temperatures exceeding 200°C and is confined to industry only, and low temperature heating is mainly concerned with temperatures below 120°C.

4. End Use Descriptor (continued)

END USE OF ELECTRICITY IN NEW ZEALAND YEAR ENDED 3-31-78			
Consumer	Electricity Consumed kWh	Number of Consumers	Average kWh per Consumer
Farming	435,596,290	73,325	5,941
Domestic	8,313,665,719	1,083,893	7,670
Commercial	2,906,501,589	141,021	20,610
Construction Works	77,959,535	1,683	46,322
Public Lighting	115,397,504	1,358	84,976
Miscellaneous Manufacturing (Not included below)	146,014,051	950	153,699
Manufacture of Mechanical and Electrical Equipment	316,359,115	1,868	169,357
Manufacture of Textiles, Leather, Rubber Products and Apparel	241,886,386	1,024	235,961
Mining (Excluding coal)	121,624,404	393	310,143
Coal Mining	22,227,078	66	336,774
Manufacture of Glass, Pottery, China and Building Materials	245,650,846	526	467,017
Manufacture of Chemicals and and Chemical Products	179,701,940	352	510,517
Food, Beverage, and Tobacco	1,000,818,868	1,841	543,628
Wood, Paper, and Pulp Products	1,915,134,458	1,522	1,258,301
Urban Traction	6,667,758	3	2,222,586
Iron and Steel Basic; Non-ferrous Metals	2,838,003,917	132	21,500,030
Railway Traction	25,549,690	1	25,540,690
TOTAL	18,908,750,148	1,309,958	14,435

COMMERCIAL ENERGY CONSUMPTION (In Million Metric Tons of Coal Equivalent and In Kilograms Per Capita)						
			Consumptions			
Year	Aggregate	Per Capita	Solid Fuels	Liquids Fuels	Natural Gas	Hydro Nuclear Electricity
1972	9.215	3178	1.790	5.223	0.322	1.880
1973	10.033	3397	2.023	5.742	0.385	1.883
1974	10.675	3543	2.119	6.216	0.440	1.900
1975	10.048	3273	1.971	5.376	0.469	2.231
1976	11.349	3617	2.021	6.069	1.272	1.987

4. End Use Descriptor (continued)

The annual energy consumption in New Zealand is roughly equivalent to the energy content of 14,000,000 tons of good quality coal. Energy consumption has been rising fairly steadily since 1951 by about 3.7% a year. The per capita consumption is equivalent to about 3.4kW of continuous power, a relatively low ratio of energy consumption to GNP, reflecting the agricultural basis of the economy.

Apart from aluminum and steel smelters, New Zealand's industry is not at present a heavy consumer of energy. In fact consumption is mainly concentrated in only four areas - food processing, forest products, cement and fertilizer manufacturing. The country has no petrochemical industry; more than two-thirds of the oil is used in internal combustion engines and the rest mainly in heating and steam raising. The major use planned for natural gas is the generation of electricity.

5. Statistics

a. Supply: Projected consumption of primary energy envisages a continuing increase although the emphasis will shift from imported oil to indigenous fuel. Thus coal which in 1973 was supplying 18% of primary energy will, by the year 1985, be supplying 17%. Electricity generated by hydro and geothermal stations will show little change in proportion of energy supplied (16.4% in 1973 - 15.0% in 1985). It is planned, however, that the contribution from imported oils should drop from 59.7% in 1973 to 30.1% in 1985, the difference being made up by an expanding natural gas industry (3.8% to 30.9%) and indigenous oil is obtained as distillate from the natural gas wells and excludes the possibilities of finding significant oil deposits in this country.

CURRENT NEW ZEALAND ENERGY SOURCES	
Oil	58%
Gas	2%
Coal	20%
Electricity (hydroelctric & geothermal)	20%

DEPARTMENT OF STATISTICS, WELLINGTON PROJECTION OF ELECTRICITY GENERATION, 1978-88 May 2, 1978	
Year Ending March	Projected Total Generation (GWh)
1978 (actual)	21 262
1979	22 118
1980	22 940
1981	23 816
1982	24 707
1983	25 750
1984	26 808
1985	27 912
1986	29 145
1987	30 355
1988	31 626

Generation — Maximum Demand Estimates				
Year	Power		Increase	
	Upper MW	Lower MW	Upper %	Lower %
Actual				
1973-74	3 558	3 558	2.3	2.3
1974-75	3 508	3 508	-1.4	-1.4
1975-76	3 865	3 865	10.2	10.2
1976-77	4 074	4 074	5.4	5.4
1977-78	3 848	3 848	-5.5	-5.5
Prospective				
1978-79	4 359	4 337	13.3	12.7
1979-80	4 553	4 500	4.5	3.8
1980-81	4 807	4 666	5.6	3.7
1981-82	5 101	4 866	6.1	4.3
1982-83	5 325	5 005	4.4	2.9
1983-84	5 516	5 111	3.6	2.1
1984-85	5 710	5 217	3.5	2.1
1985-86	5 926	5 349	3.8	2.5
1986-87	6 139	5 474	3.6	2.3
1987-88	6 361	5 604	3.6	2.4
1988-89	6 590	5 738	3.6	2.4
1989-90	6 830	5 875	3.6	2.4
1990-91	7 055	6 015	3.3	2.4
1991-92	7 290	6 160	3.3	2.4
1992-93	7 530	6 309	3.3	2.4

Generation — Annual Energy Estimates				
Year	Energy		Increase	
	Upper GWh	Lower GWh	Upper %	Lower %
Actual				
1973-74	18 114	18 114	5.0	5.0
1974-75	18 352	18 352	1.3	1.3
1975-76	20 071	20 071	9.4	9.4
1976-77	20 915	20 915	4.2	4.2
1977-78	21 265	21 265	1.7	1.7
Prospective				
1978-79	22 024	21 919	3.6	3.1
1979-80	22 951	22 701	4.2	3.6
1980-81	24 166	23 491	5.3	3.5
1981-82	25 568	24 446	5.8	4.1
1982-83	26 627	25 111	4.1	2.7
1983-84	27 547	25 617	3.5	2.0
1984-85	28 475	26 123	3.4	2.0
1985-86	29 507	26 751	3.6	2.4
1986-87	30 523	27 348	3.4	2.2
1987-88	31 584	27 971	3.5	2.3
1988-89	32 675	28 607	3.5	2.3
1989-90	33 823	29 261	3.5	2.3
1990-91	34 899	29 934	3.2	2.3
1991-92	36 019	30 625	3.2	2.3
1992-93	37 164	31 333	3.2	2.3

5. Statistics (continued)

PRIMARY ENERGY SUPPLY
(Quantities in Million Metric Tons of Coal Equivalent)

	PRODUCTION OF PRIMARY ENERGY					IMPORTS	EXPORTS	BUNKERS
Year	Total Primary Energy	Coal & Lignite	Crude Pet Nat.Gas Liquids	Natural Gas	Hydro Nuclear Electricity	———	———	———
1972	4.189	1.780	0.206	0.322	1.880	6.007	0.028	0.801
1973	4.532	2.025	0.238	0.385	1.883	6.142	0.009	0.736
1974	4.687	2.105	0.243	0.440	1.900	6.882	0.021	0.765
1975	4.887	1.980	0.207	0.469	2.231	6.239	0.010	0.603
1976	6.001	2.030	0.711	1.272	1.987	6.039	0.012	0.658
1977		2.019	1.041	2.172				

FORECASTED DOMESTIC ENERGY PRODUCTION
(Million Metric Tons of Oil Equivalent)

	1960	1973	1975	1976	1980	1985	1990
Oil	—	0.2	0.2	0.5	0.5	0.6	0.7
Gas	—	0.1	0.4	0.9	1.8	3.0	4.0
Coal	2.1	1.7	1.4	1.7	1.7	2.1	3.2
Hydro/Geothermal	1.8	3.6	3.8	3.9	4.8	6.0	6.3
Net Oil Imports	1.5	4.0	3.9	3.7	3.7	3.8	3.9
Total Energy Supply	5.4	9.8	10.3	10.9	12.5	15.4	18.2
Net Oil Imports As A Percent of Total Energy Produced	27.8%	40.3%	38.0%	34.1%	29.3%	24.6%	21.7%
Population (Millions)	2.4	3.0	3.1	3.1	3.2	3.3	3.5
Total Energy Supply Per Capita	2.28	3.25	3.32	3.5	3.9	4.7	5.2

b. Projections of demand

ENERGY SCENARIOS FOR NEW ZEALAND[1]

			Continuation		Low New Zealand Pollution		Limited Growth	
		1975	2000	2025	2000	2025	2000	2025
Population	Millions	3.1	4.2	5.0	4.2	5.0	3.6	3.7
GNP per capita (1973) prices	dollars	2591	4840	8060	4490	4490	3782	4112
Primary energy per capita	GJ	134	285	498	179	179	130	151
Total consumer energy	PJ	302	816	1621	594	594	368	332
Domestic energy per capita	GJ	11	19	27	17	17	13	13
Commercial energy per employee	GJ	43	75	128	63	63	58	60
Industrial consumer energy	PJ	103	361	849	238	238	122	112
Steel production	kt	110	1000	1500	850	850	110	110
Pulp production	kt	946	4300	12000	2400	2400	1300	1300
Aluminum production	kt	96	220	220	110	110	10	10
Fuel use in Cement, Glass, etc.	PJ	15	40	79	31	45	15	10
Fuel use in Food Processing	PJ	23	44	66	26	22	21	18
Car kilometers	km	13	30	36	23	27	13	8
Aviation fuel	PJ	12	56	109	33	51	21	20
Total transport energy	PJ	126	343	460	217	310	136	104
Total primary energy	PJ	415	1196	2512	747	924	471	556
Electricity generation	PJ	71	322	550	134	180	81	86
Nuclear	PJ	0	9	363	0	0	0	0
Other thermal (including geothermal and in-plant)	PJ	15	200	48	29	36	6	5
Non thermal	PJ	56	203	139	105	144	75	81
Solid fuel	PJ	65	423	446	112	179	68	95
% Coal remaining	Z	100	77	36	90	71	92	85
Gas (Incl. wood gas)	PJ	12	346	103	172	161	62	35
% Natural gas remaining	%	100	60	20	71	29	86	80
Liquid fuel	PJ	213	375	631	275	370	173	102
Geothermal heat extracted	PJ	56	105	180	52	7	61	61
Energy Imports	PJ	205	314	1597	221	320	154	0
% Imported primary energy	%	49	26	64	30	35	33	0

Abstract--Three scenarios for New Zealand's energy future have been researched. Each scenario has a theme which is used as a basis for calculation of energy demand in all sectors. The energy supply is worked out using a strategy which is also based on the theme. The themes tend to be an exaggeration of what is seen of three major thought streams present in our society today and are as follows:

Continuation. Continuation of policies and trends which apply today; emphasis on economic growth measured in terms of per capital productivity; continued exploitation of the country's potential for agricultural and industrial development.

Low New Zealand Pollution. Postulation of a society which sets out to minimize site-specific pollution especially from industry, power production, while still having comparatively high economic growth.

Limited Growth. Economic growth rate reduced to zero by 2000; move to renewable sources for energy; concern for environmental degradation.

[1]G.S.Harris, M.J.Ellis, G.C.Scott, J.R.Wood and P.H.Phillips
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ESTIMATES OF ANNUAL kWh CONSUMPTION

South Island

Supply Authority	Millions of kWh					
	Actual + Estimate	Estimated				
	1977-78	1978-79	1979-80	1980-81	1981-82	1982-83
Ashburton	132	133	140	145	150	154
Bluff	12	13	14	16	16	17
Buller	59	63	70	76	81	87
Central Canterbury	318	328	338	348	358	369
Christchurch	1,204	1,250	1,325	1,400	1,480	1,570
Dundedin	665	685	716	748	782	817
Heathcote	38	40	42	44	46	49
Invercargill	183	185	187	189	191	193
Kaiapoi	18	19	19	20	21	22
Lyttelton	15	15	15	15	16	16
Marlborough	143	147	152	154	158	162
Nelson	85	86	88	89	91	92
North Canterbury	158	163	172	183	188	200
Otago	154	160	166	175	184	193
Otago Central	132	137	147	158	168	177
Riccarton	42	42	43	44	44	45
South Canterbury	211	220	230	236	243	251
Southland	332	342	349	361	373	385
Tasman	245	258	274	292	494	542
Timaru	101	103	104	105	107	108
Waitaki	120	120	127	137	164	202
West Coast	113	120	125	131	137	143
NZE	2,600	2,700	2,701	2,702	2,702	2,699
South Island Total	7,080	7,329	7,544	7,768	8,194	8,493
New Zealand Total	19,878	20,601	21,358	22,132	23,080	24,117

ESTIMATES OF ANNUAL kWh CONSUMPTION

North Island

Supply Authority	Millions of kWh					
	Actual + Estimate 1977-78	Estimated				
		1978-79	1979-80	1980-81	1981-82	1982-83
Auckland	2,745	2,827	2,929	3,040	3,143	3,253
Bay of Islands	162	166	170	177	183	188
Bay of Plenty	382	420	448	464	493	524
Cambridge	60	63	66	68	71	74
Central Hawke's Bay ...	65	66	69	75	81	85
Central Waikato ...	397	409	424	440	460	483
Dannevirke	57	58	60	61	62	64
Egmont	146	158	168	175	178	181
Franklin	183	187	189	192	195	197
Hamilton	116	119	121	124	128	131
Hawke's Bay	714	746	772	843	875	932
Horowhenua	247	255	259	267	275	283
Hutt Valley	946	958	984	1017	1053	1093
King Country	79	113	233	263	294	313
Manawatu-Oroua ...	248	262	271	281	300	309
Napier...	67	68	69	71	72	74
New Plymouth	226	240	248	256	264	272
North Auckland	297	299	307	310	327	441
Palmerston North ...	175	181	189	196	204	212
Poverty Bay	183	186	192	199	206	213
Rotorua	223	231	240	249	259	269
Taranaki	159	167	173	178	182	185
Tararua	43	44	44	45	45	46
Taumarunui	19	19	20	21	22	23
Taupo...	94	96	100	105	110	115
Tauranga C.C.	44	45	46	47	48	49
Tauranga E.P.B. ...	256	268	280	296	312	326
Te Awamutu	94	97	99	100	102	104
Thames-Coromandel ...	25	25	26	26	28	28
Thames Valley	901	923	941	958	975	992
Wairarapa	189	192	196	200	204	208
Wairoa B.C.	20	19	20	20	20	21
Wairoa E.P.B.	28	28	28	28	29	30
Waitemata	962	999	1038	1095	1143	1202
Waitomo	118	132	134	144	146	164
Wanganui-Rangitikei ...	356	367	380	404	417	437
Wellington	698	718	734	751	768	786
Whakatane	36	36	37	38	38	39
Whangarei	76	77	78	80	80	81
NZE	962	1,008	1,032	1,060	1,094	1,197
North Island Total ...	12,798	13,272	13,814	14,364	14,886	15,264

5. Statistics (continued)

PROJECTED ENERGY DEMAND (kWh x 10^6)						
Type of Consumption	1977-78	1978-79	1979-80	1980-81	1981-82	1982-83
Domestic	8 434	8 642	8 922	9 237	9 554	9 888
Non-domestic	10 544	11 006	11 445	11 871	12 469	13 130
Commercial	2 823	2 929	3 046	3 170	3 316	3 474
Farming, coal & other mining public services	702	732	744	770	785	815
Major industrial	4 211	4 370	4 400	4 483	4 531	4 676
Other industrial	2 808	2 975	3 255	3 448	3 837	4 165
Losses	896	949	986	1 020	1 053	1 096
Total	19 874	20 597	21 353	22 128	23 076	24 114

PERCENT INCREASE IN PROJECTED ELECTRICITY CONSUMPTION						
Type of Consumption	1977-78*	1978-79	1979-80	1980-81	1981-82	1982-83
Domestic	0.4	2.5	3.2	3.5	3.5	3.5
Commercial and public services	2.5	3.7	4.0	4.1	4.6	4.8
Industrial, farming & mining	2.0	5.5	8.0	5.7	9.8	8.1
Major industrial	2.4	3.8	0.7	1.9	1.1	3.2
Distribution losses	0.9	6.0	3.8	3.4	3.2	4.1
Total (including NZAS)[1]	1.4	3.6	3.7	3.6	4.3	4.5
Total (excluding NZAS)[1]	1.2	3.6	4.2	4.1	4.9	5.1
ELECTRICITY CONSUMPTION BY PERCENT COMPOSITION						
Type of Consumption	1977-78	1978-79	1979-80	1980-81	1981-82	1982-83
Domestic	42.3	41.9	41.7	41.6	41.3	40.9
Commercial and public services	14.2	14.2	14.2	14.3	14.3	14.4
Industrial, farming & mining	17.3	17.7	18.4	18.8	19.8	20.5
Major industrial	21.7	21.7	21.1	20.7	20.0	19.7
Distribution losses	4.5	4.6	4.6	4.6	4.6	4.5
Total	100	100	100	100	100	100

*Actual plus estimate

[1]NZAS: *New Zealand Aluminum Smelters

c. Imports/exports

PETROLEUM IMPORTS BY PRODUCT CATEGORY AND COUNTRY OF ORIGIN
FOR PERIOD JULY 1 1976 TO DECEMBER 31 1976

Country of Origin	Crude Oil[1] SITC Nos 331.01.00 331.02.00 (metric tons)	Motor Spirit SITC No 332.10.21 (litres)	Jet Fuel[2] and Kerosene 332.20.10 332.20.20 332.20.39 332.20.41	Distillate Fuel Oil SITC No 332.30.00 (litres)	Residual Fuel Oil 332.40.00 (litres)	Illuminating Kerosene SITC No 332.20.31 (litres)
Australia	40,025	81,306,598	128,850,390	103,936,800	20,885,579	15,375,879
Bahrain	75,002	13,701,278	Nil	27,505,457	Nil	1,011,075
Iran	784,851	17,467,247	1,773,785	Nil	Nil	Nil
Korea - Republic of	Nil	26,141,084	Nil	Nil	Nil	Nil
Kuwait	264,028	Nil	Nil	Nil	Nil	Nil
Netherlands	Nil	Nil	15,490	Nil	Nil	Nil
Saudi Arabia	303,611	13,511,035	Nil	7,336,893	Nil	Nil
Singapore	100,526	11,302,109	52,300,617	25,917,781	Nil	,289,400
United States	Nil	Nil	143,231	Nil	Nil	Nil
Yemen Arab Republic	4,987	Nil	Nil	Nil	Nil	1,261,850
Yemen Democratic Republic	Nil	Nil	1,210,604	Nil	Nil	Nil
	1,573,030	163,429,351	184,294,117	164,696,931	20,885,579	22,938,204

[1]Includes crudes of all gravities and partly refined.
[2]Includes white spirit.

PETROLEUM EXPORTS BY PRODUCT CATEGORY AND COUNTRY OF DESTINATION
FOR PERIOD JULY 1 TO DECEMBER 31 1976

(In litres)

Country of Destination	Motor Gasoline	Jet Fuel and Kerosene	Distillate Fuel Oil	Residual Fuel Oil
Gilbert Islands	Nil	Nil	349,155	Nil
Nauru	Nil	Nil	744,443	Nil
Norfolk Island	Nil	2,090	Nil	300
Pitcairn Island	418	600	6,270	Nil
Ships' Stores	17,724	288	47,205,490	91,577,054
Western Samoa	Nil	2,327	Nil	Nil
	18,142	5,305	48,305,358	91,977,354

VOLUME OF PRINCIPAL IMPORTS

YEAR	PETROLEUM Crude	PETROLEUM Partly Refined	MOTOR SPIRIT	DISTILLATE FUELS	KEROSENE & WHITE SPIRIT
(June)	(tonnes)		(litres x 1000)		
1972	1945.6	825.5	400,712	254,643	248,959
1973	2260.3	915.4	347,386	295,648	315,059
1974	2472.8	804.2	766,093	510,802	334,029
1975	2535.7	902.5	486,337	378,625	385,889
1976	1863.4	899.2	694,053	408,987	376,718
1977	2166.0	844.2	434,550	375,990	371,619
1978	1681.6	661.6	674,788	559,832	451,367

6. Peculiarities of the Energy Economy

New Zealand is in many respects fortunate in her energy resources. At least 99 percent of the population has access to relatively cheap electricity (domestic rate about 1.2 U.S. cents per kWh) and this, combined with a relatively mild climate, means that there are only a limited number of areas where solar energy can be expected to make any immediate impact.

There is no significant amount of domestic air conditioning although major commercial buildings and some factories are cooled during the mid-summer months. With relatively cheap power available there is no immediate prospect for solar refrigeration, solar cooking, or solar distillation. A consideration of all the relevant factors suggest that solar energy will be used in New Zealand first for heating water and perhaps later for space heating - all other applications seem improbable at the moment.

The most promising application is clearly domestic solar water heating since over 99 percent of New Zealand homes have a continuous hot water supply and the vast majority of these are electrically heated storage systems - conventionally 180-270 litre cylinders heated to about 150 F. One quarter of all the electric power generated is used for heating domestic hot water and since temperature requirements are modest, the possible savings considerable, and the solar water heater the most technically advanced of solar energy appliances, domestic solar water heating is easily identified as the first choice for study. Investigations have shown that solar water heaters could supply up to half the domestic hot water demand representing a 2 to 3 percent saving on primary energy usage overall.

Because of New Zealand's comparatively low electricity tariff rate few solar heating units have been installed by householders. In addition, as electricity demands are highest during days of low solar radiation, solar water heaters do little to reduce peak electricity demands.

INSTITUTION/ORGANIZATIONS	CONTACT	ACTIVITIES
Department of Scientific and Industrial Research, Physics and Engineering Laboratory Private Bag, Lower Hutt	R. F. Benseman	Water heaters, solar collectors, space heating
Lincoln College, Department of Mechanical Engineering Cantebury	R. E. Chilcott	Wind generators, low-cost anemograph
Auckland University Department of Mechanical Engineering Auckland	J. R. Wood	Large scale wind generators
The National Dairy Laboratory Private Bag Hamilton	Mr. J.W.R. Currier	
The Agricultural Engineering Department Massey University Palmerston North		Solar Water Heaters for Dairy Applications
AHI, L.J. Fisher & Co., Ltd. Box 2183 Auckland	Mr. B. Wright	Solar water heaters
Zip Holdings Ltd. P.O. Box 30669 Lower Hutt	Mr. O. M. Kendon	Solar water heating

C. GOVERNMENT ENERGY ACTIVITIES

1. Energy Policy

The escalation of oil prices in the early 1970's resulted in a rapid resurge of activity in solar energy research.

Through two of its agencies, the Department of Scientific and Industrial Research (DSIR) and the Ministry of Energy (MOE), the Government of New Zealand (GNZ) is actively encouraging the development of a viable solar water heating industry.

The Government has stated its intention to reduce dependence on imported oil from 44% in 1975 to 35% in 1985 through conservation and greater reliance on domestic coal, gas, hydro and geothermal. Unofficial year 2000 projections indicate a 20% increase in geothermal (electricity) between 1985 and 2000, and a 5% contribution from "other" sources (wood waste and geothermal heat). R&D objectives are directed at analyzing the potential contribution of non-conventional technologies to domestic energy supplies by 2000. There is much emphasis on determining the national energy resource base. New Zealand has relatively, limited scientific and financial resources available. Therefore R&D will be focused on a limited number of areas and will emphasize adapting overseas technology developments to New Zealand's needs.

The Government took a number of other administrative measures last year to enhance energy conservation. It set a monetary limit on fuel oil purchases for electricity generation. In order to improve low industrial energy efficiency, the Government last year offered tax (100% immediate write-offs for insulation of energy measuring equipment) and profitability incentives, instituted energy audits, and established the Energy Advisory Service for industry. In the Ministry of Energy Bill there are provisions for regulations that will require large energy users and prospective users to report the energy aspects of their development plans to the Ministry. This year tax write-offs were extended to equipment for re-cycling waste material, heat exchange, waste heat recovery, insulation of buildings, sealing of energy leaks, new plant using indigenous energy resources, and ancillary environmental control equipment. In addition, the 10% sales tax is rebated on all the above items.

a. Ministry

Ministry of Energy, Private Bag, Wellington,
Hon. W. F. Birch; Deputy Secretary: Ian Dick

b. Structural descriptor

The Ministry of Energy was created through combining the Ministries of Energy Resources, the Mines Department and the New Zealand Electricity Department and will provide a more comprehensive review of available energy resources and their systematic development. The MOE coordinates all GNZ energy programs and policies, and for solar energy it oversees the recently instituted interest free loan scheme for domestic solar water heaters.

It is intended that the new ministry would take over from the Ministry of Works and Development responsibility for the administration of geothermal energy legislation, and the remaining functions of the Department of Trade and Industry regarding energy pricing excepting retail margins on petroleum products. A new company or set of companies is to be formed by the Government to undertake on-shore oil exploration and carry out the functions of the present Natural Gas Corp. and Offshore Mining Co. Ltd.

New Zealand's national goals are designed to reduce dependence on overseas energy sources from 60% of total energy consumption to 30% by 1985. This is to be achieved through increased development of indigenous resources (mainly coal and natural gas).

In support of this policy the New Zealand government announced in September 1978, its intention to make New Zealand as self sufficient as possible in transport fuels through the use of Maui Gas.

The Electricity Division of MOE is conducting preliminary studies for utilization and possible integration of wind energy into New Zealand's electricity system. Information for wind energy is based on the US Mod O 100 machine and the Canadian 200 kW Magdalen Islands Darrieus machine.

c. Funding

Between FY 1975/76 to FY 1977/78, the Government's energy R&D budget grew by 52%; the total R&D budget increased by 29% The strong R&D emphasis on indigenous resources reflects the Government's policy on increasing reliance on these sources.

Total energy R&D budget was $NZ 3715 (thousands) in 1977, which was out of the total budget for R&D of $NZ 78680 (thousands). Of this:

FY77 Solar: $NZ 137,000-(primarily heating& cooling)
Wind: $NZ 136,100
Biomass: $NZ 433,400
Geothermal: $NZ 513,600

FY78 Solar: $NZ 157,500
Wind: $NZ 182,200
Biomass: $NZ 507,900
Geothermal: $NZ 613,100

Budget Comparison Measures[1]	1975	1977/78
Gross Domestic Product	13.24	12.5 (1976 est.)
Population (thousands)	3087	3100 (est.)
TPE (MTOE)	10.3	
Oil Imports (million tons)	4.15	3.93 (1976)
Government Energy R&D ($ thousands)	2494	3863 (Propos.)
Private Sector Energy R&D	307	709 "
Total Energy R&D	2801	4572 "
Total Government R&D	62207	81827 "
Government Energy R&D per capita ($)	0.81	1.21
Total Energy R&D per capita	0.91	1.43
Energy R&D/GDP Indicator*	.021	.035
Energy R&D Oil Import Indicator+	.67	.85 (1976)

[1] IEA statistics

*Measures percentage of GDP devoted to energy R&D

+A measure of R&D response to oil import levels, defined as Total Energy

2. Principal Energy Involved Offices

a. Name

New Zealand Energy, Research and Development Committee (NZERDC), Private Bag, Wellington

Chairman: Dr. Maiden, Vice-Chancellor, Auckland University; Executive Officer: G.S. Harris

b. Structural descriptor

Established in 1974. The New Zealand Energy Research and Development Committee advises the National Research Advisory Council (NRAC) on the energy research undertaken by Government departments and the private sector. It provides financial support for energy R&D through contracts with Government departments, universities, research institutions and consultants.

The NZERDC has set the following priorities for energy R&D in New Zealand.

(1) Projects that determine current and future energy demand,

(2) Projects concerned with conservation and more efficient use of energy,

(3) Projects concerned with the assessment of indigenous energy resources,

(4) Projects concerned with assessment of the human, financial and organizational resources for increasing energy production and use,

(5) Projects concerned with economic, technological and environmental aspects of energy use and production over the next 15 years,

(6) Projects concerned with economic, technological and environmental aspects of energy use and production beyond the next 15 years.

Where the NZERDC identifies through its own initiative or through suggestions made to it, a need for research in a particular area it will seek proposals from suitable organizations to carry out the work. The NZERDC encourages public discussion of issues concerning energy

b. Structural descriptor (continued)

research by arranging meetings with interested groups, providing speakers and publicity material and various other public relations activities. Through this public involvement, individuals, business firms, research institutes, universities etc. are encouraged to submit proposals and suggestions for energy research projects to the Committee.

The NZERDC holds meetings at which contractors give a short presentation on the progress of their research and also submit annual statements detailing work to be carried out, a budget and quarterly reports to the Committee. Research carried out within government departments is subject to departmental review, and to overall review by the National Research Advisory Council.

In the report, Energy Scenarios for New Zealand, published in 1977, the NZERDC presented policy-makers with projections of three assumed scenarios to the year 2025. The "Continuation" scenario assumes continuation of past policies, attitudes and institutions affecting the energy sector, but assumes the introduction of nuclear power. Economic growth along present lines remains a high priority, and energy imports increase steadily. In the "Low New Zealand Pollution" scenario some sacrifice in economic growth is accepted in order to maintain the quality of the physical environment. No nuclear energy is assumed, and energy imports decline and eventually level off around 2025. In the "Limited Growth" scenario emphasis is placed on the shift to renewable resources, primarily wood. Imports decline until they reach zero in 2025, and no nuclear energy is introduced. The NZERDC produced a popularized newsheet version of its report to stimulate public awareness of energy policy issues, and to stimulate discussion.

The committee, upon its formation, immediately funded projects in the energy sector totaling $820,000, although specific allocations to solar research was only a fraction. Many of the projects, however, will have direct influence on solar energy R&D, as energy usage needs become more clearly defined.

b. Structural descriptor (continued)

Starting in 1978, NZERDC began funding a wind energy resource survey, compiling detailed measurements of wind conditions at four sites throughout New Zealand. These sites vary in topography and exposure to prevailing winds. In addition, GNZ is continuing to expand its network of measuring instruments, especially in the North Island.

c. Funding

Prior to April 1977 funds for the NZERDC were included in the budget of the Department of of Scientific and Industrial Research. Since April 1977 the NZERDC has been funded through the Ministry of Energy and its financial support has been restricted to non-government projects.

a. Name

New Zealand Department of Scientific and Industrial Research (DSIR), Wellington

Director General: Dr. E. I. Roberston

b. Structural descriptor

D.S.I.R. through its Head Office staff is a focal point for international scientific contacts in energy and is represented on the National Committee of World Energy Conference. The Department is the signatory on New Zealand's behalf to the Solar Heating and Cooling Agreement of the International Energy Agency and to the Memorandum of Understanding (dealing with solar energy) of the Committee on the Challenges of Modern Society (NATO).

The GNZ, through the D.S.I.R., is presently evaluating, testing and experimenting with a variety of solar energy devices as an ongoing policy. D.S.I.R. research in the solar field has concentrated on solar water heaters as this consumes about one-quarter of all the electric power generated. In addition, D.S.I.R. is investigating various conversion processes. There is a need for small domestic scale burners and several models are under test. Until recently,

b. Structural descriptor (continued)

commercial development had been proceeding in a very haphazard manner and private industry's research lacked coordination. However, recent developments such as the government loan scheme and its implications, the forming of an industry body and the drafting of manufacturing standards are having the effect of bringing the industry together. Consequently the industry's approach to research and development is becoming more professional. The industry, although it will never be large (only approximately twelve firms are approved manufacturers), is now firmly established.

D.S.I.R.'s geothermal coordination assists in the smooth execution of its multi-disciplinary research effort, and provides specialist geothermal personnel to a wide range of overseas countries--as aid and as commercial activities.

D.S.I.R. provides practical assistance and advice on almost every aspect of production and process engineering, including problems involving raw material, design, manufacture and storage. Three divisions within the D.S.I.R. have been set up specifically to provide research for industry. They will provide advice and assistance on, for example, improvements in conventional machining methods, product testing, machine alignment and balancing. These divisions are:

Physics and Engineering Laboratory,
The Auckland Industrial Development Division
The Christchurch Industrial Development Division.

Within D.S.I.R., the Forestry Research Institute under Dr. D. Bassett is conducting work in biomass.

Geothermal Laboratory - R. Allis, investigator
H. M. Bibby

Other D.S.I.R. personnel involved in renewable energy: R.F. Benseman, Section Head, heat transfer, solar work; W.J. Cousins, biomass energy; T.G. Haskell, solar space heating.

- a. Name

  The National Research Advisory Council (NRAC)

  b. Structural descriptor

  The NRAC is the primary agency responsible for advising the GNZ through the Minister of Science and Technology, on the ideal level of research for New Zealand and on the relative priorities between all scientific and technological activities.

- a. Name

  Ministry of Works and Development

  Hon. William Young

  b. Structural descriptor

  Investigation of preliminary wind power projects for Chatham Island, Stewart Island, and on assessment of wind power for pumping water on Mana Island.

  c. Funding

  $NZ 1,500 for Chatham Island Project
  $NZ 2,000 for Stewart Island Project
  $NZ 500 for Mana Island Project

- a. Name:

  New Zealand Atomic Energy Committe
  c/o D.S.I.R., Private Bag, Lower Hutt

  Chairman: C.K.Stone, Executive Secretary:
  J.T. O'Leary

  b. Structural descriptor

  Responsible to the Minister of Science. New Zealand does not have any nuclear power plants nor is there a nuclear power research program. Should New Zealand decide to go nuclear it will have to rely on foreign sources for technology, components and fuel. In the event New Zealand does adopt nuclear power, the New Zealand Atomic Energy Committee and the New Zealand Electricity Department have been working on safety criteria and licensing arrangements. Manpower is being trained overseas. However, it is felt that with increased hydro and geothermal development a nuclear power plant would most likely not be needed before the year 2000.

c. Funding

Presently, there is no funding for nuclear power.

- a. Name

Department of Trade and Industry

Hon. Lance Adams-Schneider

b. Structural descriptor

The Department has its own productivity center which was set up to inform industry of the many organizations offering advice and assistance, to encourage the use of these organizations, and to help industry select the most relevant service. Through the productivity center, companies wishing to undertake research and development may approach several institutions or universities for assistance.

- a. Name

New Zealand Industrial Research and Development Grants Scheme

Chairman of the Advisory Committee: R.J. Andrews.

b. Structural descriptor

The Government provides grants through the NZIRDGS to firms that increase their R&D effort, such as improved energy using appliances, methods of production etc.

c. Funding

The total grant for energy related research was about $NZ 43,000 in 1974.

3. Legal

a. Laws, incentives

Energy Resources Levy Act 1977. At the start of 1977, the Government implemented price increases aimed at encouraging conservation, and ensuring economic exploitation of indigenous resources. It structured energy price differentials so as to encourage interfuel substitution. The SLT review called these actions "a strong positive measure." Natural gas prices were increased by 40%, coal by 25%, manufacturing by 25-30%, and electricity by 37%. Natural gas prices were set 15% below fuel oil prices, and delivered coal prices are about 32% below this level. At the beginning of 1976 New Zealand's fuel oil price was the highest in the IEA, but its gasoline tax was the third lowest. The policy is a strong inducement to the use of alternatives to aid the conservation of all energy resources and their most efficient use. New Zealand will monitor energy prices in their relationship to each other to ensure the continuing effectiveness of the pricing policy.

The Government makes grants under the N.Z. Industrial Research and Development Grants Scheme to firms that increase their R and D effort. (The Chairman of the Advisory Committee responsible for the scheme is Mr. R.J. Andrews). The total grant for energy related research was about $NZ 43,000 in 1974 and grants were for the development of improved energy using appliances, improved methods of production etc.

There does not appear to be any regulatory impediments to expanding inudstrial energy R, D&D. The problems affecting an increased energy R&D are socioeconomic shortages of trained personnel, the small size of New Zealand firms and a hesitation by management to invest in energy conservation where the energy cost is a production cost.

The Ministry of Energy oversees the free loan scheme for domestic solar water heaters which provides for up to $NZ 500 towards the purchase and the installation of approved solar water systems. The D.S.I.R. tests and approves systems for the scheme. The $500 loan is

a. Laws, incentives (continued)

sufficient to cover approximately half the cost of the purchase and installation. The loan scheme is administered through local power distribution authorities. Domestic water heating is the only area in the solar energy field presently being assisted in this manner. (However, because of New Zealand's comparatively low electricity tariff rate, few solar heating units have been installed by householders.)

The GNZ has also instituted a thermal insulation programme (1975) which provides homeowners with a free loan of $400 for ceiling and wall insulation. The loan is administered by local gas and electricity authorities and must be paid back in a few years.

The extended tax incentive scheme: In 1976 a scheme was introduced whereby capital expenditure on a limited range of energy conservation equipment was eligible for a 100 percent write-off for income tax purposes in the year in which the expenditure was incurred. This scheme has now been extended (by the Income Tax Amendment Act, No. 2, 1977) to provide an incentive for a much wider range of capital expenditure on energy conservation, and to include capital expenditure for the use of indigenous energy resources (including petroleum and electricity). Any business carried on in New Zealand is entitled to claim the 100 percent write-off of qualifying capital expenditure for the purposes of energy conservation, and use of indigenous energy resources.

The Development Finance Corporation (DFC) was set up in its present form in 1973 by the Government to provide financing for the establishment of new industries or for the developmement, extension or assistance of any industry carried on in New Zealand. Another of its purposes was to encourage and promote investment in the industrial development of New Zealand by providing technical assistance and advice.

a. Laws, incentives (continued)

Under the 1976 budget, DFC was appointed by the Government to administer its program of incentives for industrial research and development. There are three main forms of finance.

A) Project Grants: Grant assistance for specific projects will be limited to those costs associated with the applied research and development stage. There is a maximum grant level of $NZ 20,000 for any company or group of companies in any one year. Grant finance will be taxable to the recipient, as a reduction either of his deductible expenditure or of the capital cost of equipment for depreciation purposes.

B) Commencement Grants: Where a business has not begun any program of research and development, an alternative commencement grant may be applied for, to assist in the establishment of a research and development facility. An annual limit of $NZ 20,000 applies, for a maximum duration of two years.

C) Investment Finance: A variety of forms of investment finance is available covering the whole range of pre-commercial development activity, excluding basic research. That is, such finance may be provided both for applied research and development and for any subsequent pre-commercial development costs. Investment finance is intended to provide a suitable return to DFC, should the project be commercially successful but not to penalize the recipient should the project fail. No limit has been set for the amount of investment finance for individual projects but, as for the project grants, the applicant will be required to provide an acceptable level of financial commitment to the project.

As well as finance, DFC may provide advisory or referral services on the legal, patent, technical or commercial aspects of a project. Basic research is not eligible for assistance. The DFC uses the definition of industrial research and development which is based on the international standard definition devised by the OECD. In accordance with the objectives approved by the Government the definition has been modified to emphasize the commercial aspect.

a. Laws, incentives (continued)

Tax Incentives: Under Section 144 of the Income Tax Act, 1976, it states, "In calculating the assessable income derived by any taxpayer during any income year, the Commissioner may allow such deduction as he thinks fit in respect of any expenditure incurred by the taxpayer during that year in connection with scientific research directly relating to the trade or business carried on by the taxpayer, except so far as the expenditure relates to an asset in respect of which a deduction for depreciation is allowable under this act."

Depreciation allowance: Under Section 113 of the Income Tax Act, 1976, the following allowance is recorded: "Additional depreciation allowance for plant, machinery, and equipment used for scientific research - (1) where the Commissioner is satisfied that any taxpayer engaged in any business has acquired, installed, or extended any asset, being plant, machinery, or equipment to be used exclusively for the purposes of scientific research directly relating to that business, the Commissioner may, in his discretion, subject to Sections 111 and 117 of this act, allow, in respect of the income derived by the taxpayer during the period of five years from the date on which he has commenced to use that asset for the purposes of research as aforesaid, a deduction by way of depreciation (in addition to any deduction by way of depreciation in respect of that asset under Section 108 or Section 112 of this act in that period) of an amount that, together with the total of all deductions by way of depreciation in respect of that asset under the said Sections 108 and 112 in that period, is equal to the cost of that asset.

The amount of any deduction allowed under this section shall be allowed in such of the years comprised in the period of five years as aforesaid as the Commissioner determines and be of such sum in respect of any such year as the Commissioner thinks fit.

a. Laws, incentives (continued)

Without limiting the discretion of the Commissioner under this section, it is hereby declared that he may refuse in whole or in part to allow any deduction under this section in any case where he is not satisfied that complete and satisfactory accounts have been kept by or on behalf of the taxpayer."[1]

b. Policies

- A Cabinet decision in November 1973 requires that, before a decision is made, an environmental impact report must be prepared for all Government projects and the report audited by the Commission for the Environment.

- The Town and Country Planning Act 1953 and subsequent Amendments requires that all private projects comply with district and regional planning schemes. The local authority responsible for such schemes must take environmental considerations into account when approving any planning scheme and may impose environmental restrictions on projects. Local authorities may also require an environmental impact report to be submitted to the Commission for the Environment.

  Within the Government, conservation measures include purchasing small, energy efficient cars, and mandatory insulation for new state housing and Government buildings. However, there is no provision for a retrofit program.

- <u>Tarriffs</u>

  Electricity tariffs cover about two-thirds the cost of providing new electricity production. Government policy is to attempt to eliminate this gap, so that electricity tariffs reflect the real cost of the increasing demand for electricity to the consumer.

  New Zealand has established voluntary guidelines with additional support from an energy education programme and a Government sector conservation programme. Electricity consumption has been reduced from 3 to 8 percent below the guidelines.

[1] United States Department of State, "Telegram" 05307, September, 1978.

b. Policies (continued)

- Transportation

As petroleum taxes are at a relatively low level, New Zealand hopes to realize energy savings in transportation by significantly increasing motor fuel taxes. Also, the Government has allocated funds for the improvement of urban passenger transport services and is investigating the implementation of car-pooling schemes. The Government has lowered speed limits and placed a tax on cars relative to their engine size. As a result there is an increase in consumer buying of smaller cars.

- Thermal Insulation Program

In April 1978, the Government instituted mandatory insulation standards for all new buildings. These standards fall short of full insulation, which would reduce the energy requirement for house heating by 60 percent. A thermal insulation programme was introduced in 1975, providing homeowners with an interest free loan up to $400 for ceiling and wall insulation, to be paid back in four years. These loans are administered by local gas and electricity supply authorities. However, despite the programme, the number of houses insulated under this program is very low. Out of the total 25,000 to 27,000 new homes constructed, only 3,000 to 5,000 were insulated under the program.

- Industry

With rising oil prices, industry has shown increasing interest in converting to coal fired boilers. The use of coal and natural gas has been encouraged by the 1976 energy price policy which established coal prices at 68% of fuel oil prices. The pricing gap allowed for the higher costs incurred for coal-fueled steam-raising equipment and storage sites.

Monetary incentives for industrial energy efficiency include tax and profitability incentives and a 100% tax write-off for equipment investments in burning waste material, heat exchange, waste heat recovery, insulation and plants using indigenous energy resources. The government has also set a monetary limit on all oil purchases for electricity generation.

4. Political

- In May 1978, the Government of New Zealand issued "Goals and Guidelines", the country's energy strategy, for public discussion. These guidelines noted the Government's recent achievements and the need for additional activities.

  - A coherent pricing policy has been developed and is being implemented. Energy prices in New Zealand will be used as a policy instrument to effect both energy conservation and energy substitution away from oil. There is some hesitation within the Government to fully implement this policy for two reasons: the continuing inflation and the political sensitivity to major price increases on products from state owned industries.

  - Several measures have been implemented to reduce the transport sector's oil requirements by increased efficiency, particularly in road transport.

  - A range of measures have been put into effect to facilitate and encourage conservation and efficient use of energy, and the substitution of indigenous energy sources for oil and electricity.

  - A greatly increased programme of exploration and investigation of our energy resources is underway.

  - Research and development into further opportunities for the reduction in energy requirements and new technologies for energy production and conservation has been stepped up.

  - A re-orientation of strategy in favor of increased use of renewable resources, with an increased concern for the longer term consequences of present day decisions has begun. A rationalization of government administration of the energy sector has recently been accomplished by the formation of the Ministry of Energy through the merging of the Ministry of Energy Resources, the Mines Department and the New Zealand Electricity Department.

  - A great increase in the level of public awareness and acceptance of the need for conservation and increased efficiency in the use of energy has been achieved.

- New Zealand has played a willing part in international efforts to improve the world energy outlook.

A number of areas requiring further action are:

- Establishment of broader based energy planning arrangements.

- Continued review of the energy pricing policy.

- The critical area of the transport sector's dependence on imported oil will require continuing efforts.

- Further measures will be needed to make the most effective and efficient use of natural gas and coal resources as alternatives to imported energy.

- Policies for private involvement in petroleum exploration will need frequent review to ensure that exploration can continue on terms which are in New Zealand's best interests.

- Research and development priorities need to be reviewed regularly.

- The question of an appropriate weighting of long-term effects against present benefits needs to be resolved.

- Effective environmental procedures will need to be instituted which do not unnecessarily delay vital projects.

- A rationalization of energy distribution is needed.

- The public acceptance of the need for energy conservation needs to be sustained and developed into effective nationwide conservation efforts.

- The goals and guidelines of the energy policy will need to be reviewed and updated in the light future changes in our circumstances. The area of renewable resources received much comment in the public discussions of the policy paper.

4. Political (continued)

Solar energy can and should make a far more significant contribution than Goals and Guidelines envisages, in the view of I.S.E.S. and others. I.S.E.S. claims that solar energy has the potential to meet at least 50% of industrial low grade energy demands which are not subject to ripple control.

Energy Developments Ltd. say that if the cost of electricity reflected today's generating costs, solar water heating for domestic use would probably need little in the way of incentives and that the installation of solar water heating should take precedence over the encouragement given to consumers to use gas.

Furthermore, the paper gives scant attention to the possibilities for the development of solar space heating and cooling, in the view of D.G. Stevens of I.S.E.S.

There are some conflicting viewpoints on the prospects for the development of biomass as an energy source in New Zealand.

On the basis of present knowledge, biomass "offers the most feasible renewable system" in the view of the New Zealand Institute of Chemistry. There would be problems associated with the very large demand on land as well as environmental and fire hazards. Nevertheless New Zealand already has the expertise and high priority should be given to such research and development.

On the basis of the Wairakei experience, many advocate the greater use of geothermal power for electricity generation, claiming that further development of geothermal power has been held back by the division of responsibilities between the energy departments. The submission states that the future now looks brighter, but past delays are deplorable in view of the valuable expertise New Zealanders have given to other countries.

The N.Z.A.S. argue that the geothermal resource could supply much greater energy quantities directly in industry and district heating. The industrial use of geothermal energy has been hampered by protracted negotiations over the price to be paid and by the virtual monopoly of the Ministry of Works and Development over deep geothermal drilling.

4. Political (continued)

There is some comment on the prospects for using wind as an energy source for electricity generation and for non-electrical wind powered systems to pump water, heat or compressed air. The potential for small rural installations for farmsteads warrants further investigation.

There has been considerable discussion on the Government's pricing policy and conservation measure, and, in the view of the Wellington Chamber of Commerce, "a woeful lack of commercial reality" in energy pricing. The different energy sources should be costed according to their particular actual costs, plus social costs, and on that basis should compete freely on the market. "Market forces will determine the prices and the optimum use of resources better than any centralized bureaucracy, no matter how well intended." The N.Z. Manufacturers' Federation say that present pricing policy unnecessarily discourages the use of indigenous fuels at a time when these should be promoted. The margins for gas and coal are often insufficient to compensate for the higher cost of purchasing and operating the plant to use these resources. The Federation also claims that there should be increased scope within pricing systems for larger consumers to negotiate lower rates appropriate to their demands.

In addition, a case for different energy policies for the North Island and the South Island, based on the different resources of each, has been advanced.

The Government's energy conservation incentives in existing policies are felt by some to be adequate. There is consistent comment that a commercial enterprise is not going to reduce its profits by conserving energy.

5. International

a. Organization involvement

Member of: ADB, ANZUS, ASPAC, Colombo Plan, DAC, ESCAP, FAO, GATT, IAEA, IBRD, ICAO, IEA, IFC, IHO, ILO, IMCO, IMF, IPU, ISO, ITU, OECD, U.N., UNESCO, UPU, WHO, WMO, WSG

OECD/International Energy Agency (IEA):
New Zealand has signed the IEA agreements on solar heating and cooling, wind energy conversion systems, heat pumps and two of the coal agreements.

The degree of New Zealand participation in IEA energy R and D cooperative activities has been limited by the differing resources and demand characteristics of collaborating countries; by distance, and by limited resources of personnel and finance. New Zealand's involvement in the Solar Heating and Cooling Agreement is expected to involve approximately four man-years of effort. New Zealand contribution under the Wind Agreement will be $12,180. The GNZ contribution under the two coal agreements has not yet been finalized.

Total gross official aid deliveries to LDC and multilateral agencies, FY 75, $80.1 million.

b. Bilateral agreement

NZ/US Joint Agreement: On August 9, 1977, Dr. Robertson, Director General of the New Zealand Department of Scientific and Industrial Research, signed the Memorandum of Understanding concerning the cooperative information exchange relating to the development of solar heating and cooling systems in buildings.
Status: A joint programme of geothermal research underway; exchange of information and exchange visits of scientists and administrators continuing.

D. INSTITUTIONS INVOLVED IN ENERGY

1. Academic

- **Name:** Massey University
  Palmerston North

  Department: The Agricultural Engineering Department

  Fields of energy interest: Biomass. Use of solar energy for hot water in dairy sheds; in conjunction with the National Dairy Laboratory. A typical dairy farm would use a 16 unit milking machine, requiring 800 litres of hot water each day at a temperature of 93°C for hygiene purposes. Units incorporating thermosiphon flow, single pass heating, pump and control circulation have been developed. These units are under consideration for integration with the standard dairy hot water cylinders which are normally heated electrically.

  Key personnel: Dr. P. Phillips (public attitudes to energy)

- **Name:** University of Auckland
  Private Bag, Auckland
  Phone: 792-300 Ext. 9576

  Department: Mechanical Engineering Division

  Size: $NZ 25,000 from NZRDC for research in wind energy.

  Fields of energy interest: Solar houses.
  Analysis of the technical and economical feasibility of the integration of wind power into the New Zealand electricity supply system. Testing of Canadian-made vertical-axis wind-electric machine.

2. Research

- Name: Physics and Engineering Laboratory
  D.S.I.R.
  Private Bag, Lower Hutt
  Phone: 666-919

Fields of energy interest:

The design of an indirect solar collector made of steel and incorporating within the collector plate the heat exchanger made of copper (U.S. Patent Application No. 544,797). This unit was being produced in 1976.
The development of small pumping systems as a substitute for thermosiphon circulation between collector and tanks.
The development of a simple solar water heater to provide warm water for hand washing - collector and storage are enclosed in a single shroud and prototypes with storage of about 200 litres/sq.m. of collector are being tested.
In cooperation with the Department of Works and Development, working on the design and installation of a solar space heating system for a laboratory.

Design and installation of forced circulation solar water heaters to provide hot water for hand washing. These are to be installed on several Government buildings.
A test facility has been built capable of testing up to six solar water heating systems at a time. A rig has been assembled for the testing of collector plates to the standard recommended by the National Bureau of Standards, or following a test procedure recommended by the Australian CSIRO.

2. Research (continued)

Key personnel:	Dr. Stephenson (solar house, heat pumps) Dr. M. O'Sullivan (geothermal) Prof. A.L. Titchener (biomass) Mr. V.A.L. Chasteau (wind) J.R. Wood J. Aggett (release of trace elements from geothermal power developments) Robert Brerig (solar water heater design) R.J. Clegg (wind energy survey)
Support resources:	The University is able to provide specialist technical investigations, market related assignments, research for interested companies, local bodies, etc.

- Name: Lincoln College, Canterbury

Department:	Department of Agricultural Engineering
Fields of energy interest:	Research into the energy cost of crop production. Presently, the energy conversion efficiency of wheat at the farm gate is about 0.1 percent. At this efficiency, to produce the food energy consumed by the average resident requires a land area of about 0.1 acre. Therefore, population density should not exceed 10 persons per hectare of agricultural land.
Key personnel:	Prof. A. Ward (wind) Prof. A. Mulcock (biomass) Mr. J. Taylor & Mr. Philling (agriculture conservation) R.E. Chilcott (wind) W. A. Nick Braun (transport fuel from agricultural biomass) Carl Henderson (biomass, solar energy)

- Name: University of Otago

Fields of energy interest:	Wind, solar, heat pumps.

2. Research (continued)

Key personnel: Mr. K. Dawber (wind)
Prof. P. Edwards (solar)
Dr. C. Carrington (heat pumps)

- Name: Victoria University of Wellington

Fields of energy interest: National Energy Model

Key personnel: Mr. B. Smith
George Baird (design strategies for energy efficient buildings)
D.A. Christoffel (geothermal prospecting)

- Name: University of Canterbury
Christchurch Ph. 792-260 Ext.575

Department: Mechanical Engineering

Fields of energy interest: Biomass, wind energy, turbine design and performance.

Key personnel: Dr. D. Lindley (wind)
Dr. A. Metcalf (biomass)
A.J. Bowen, Senior lecturer
Neil Cherry (wind resource assessment)
R.G. Flay (aerogenerator design and operation)
K.P. Grimshaw (hydro and wind)

2. Research (continued)

Fields of energy interest: Solar radiation measurements are to be made at a number of inclinations and directions to establish correlations between horizontal radiation and radiation received on inclined surfaces.

Key personnel: Dr. M.L. Probine (solar energy)
R.F. Benseman (collection, testing and evaluation of solar water systems)
Dr. W.H. Robinson (solar air heaters)
Mr. D. McKnight (computer simulation & solar radiation)

Support resources: The lab is a division of DSIR.

- Name: The National Dairy Laboratory
Private Bag, Hamilton
Phone: 62-830

Fields of energy inreresst: The institute investigates and provides advice on improved methods for saving costs in the manufacturing of traditional dairy products. It is conducting field tests to determine the possible solar contribution in terms of quantity and temperature of hot water available for use in dairy sheds. A typical dairy farm would use a 16-unit milking machine which requires 800 litres of hot water each day at a temperature of 93°C for hygiene purposes. Units have been made incorporating thermosiphon flow, single pass heating, pump and control circulation, etc. Thought has been given as to how units of this type can be integrated with standard dairy hot water cyclinders which are normally heated electrically.

2. Research (continued)

Fields of energy interest:	An installation currently under test consists of a 16m^2 bank of collectors inclined at 35° to the horizon and mounted on a milking shed roof to face north-northwest. A circulating pump and an 800 litre storage tent are located under the roof. The heated water is used to fill two conventional 200-litre hot water heaters twice a day, and the electrical supply is used only to boost the water temperature to 90°C or more. From March to August 1975, the installation averaged a solar input of about 200 w/m^2 of collector area. A small-scale solar water heater has been installed at the Kaikoura youth hostel.
Key personnel:	Mr. J.W.R. Currier (dairy farm solar water heaters) R. Selwyn Jebson (heat pumps)
Support resources:	National Dairy Laboratory is a division under the Ministry of Agriculture and Fisheries.

- Name: Applied Biochemistry Division
D.S.I.R.
Private Bag, Lower Hutt

Fields of energy interest:	Biomass
Key personnel:	Dr. R.W. Bailey
Support resources:	Receives full government support as a division of D.S.I.R.

- Name: Cawthran Institute
D.S.I.R. Private Bag, Lower Hutt

Fields of energy interest:	Biomass

2. Research (continued)

Key personnel: Dr. Uptgraff

Support resources: As a division of D.S.I.R., the Institute receives governmental support for its programs.

- Name: New Zealand Research and Development Committee (NZRDC)

  Department: Authorized a two-year project, 1974-76, to be carried out by Lincoln College, the University of Canterbury, Otago University and the New Zealand Meteorological Service.

  Funds: $NZ 41,000

  Fields of energy interest: Identify advanced farm, rural and remote systems in which significant energy demands can be met by the use of wind power.
  Detail the specific output and operating requirements of such systems.
  Prepare specifications for wind-powered systems to meet such requirements.

- Name: Building Research Association of New Zealand
  Private Bag, Porirua, Wellington
  Phone: 338-012

  Fields of energy interest: Solar water systems.

  Key personnel: Mr. J. Baty, appraisal of solar water systems.

- Name: University Grants Committee

  Funding: $NZ 5,150 for research in performance of wind turbine systems.
  $NZ 3,400 rural boundary layer.

2. Research (continued)

Fields of energy interest: Performance characteristics of wind turbine systems for advanced farm, rural and remote use. Has resulted in the establishment of a generalized method to predict energy output performance of typical wind turbines in arbitrary wind regimes. Confirmation is to be obtained with an 8 kW machine, currently at an early stage of construction.
Rural boundary layer -- the design and production of a 20-m guyed, welded steel instrumentation mast.

- Name: The Meteorological Service and Oceanographic Institute

  Fields of energy interest: The Institute is considering a wave measurement program.

- Name: New Zealand Agricultural Engineering Institute

  Fields of energy interest: Carries out research and development work in agricultural engineering and provides a consultative service in this field to manufacturers.

3. Corporate

New Zealand Energy R and D investment in the private sector, excluding oil and gas exploration outlays, is modest in comparison with government expenditures, although it has more than doubled during the past three years from NZ$ 300,000 in 1975-76 to NZ$ 682,000 in 1977-78. The increase in total industrial energy R and D is due primarily to the relatively very large rise in expenditures for conservation R and D. These increased by over 500% during the above three years, and for 1977-78 are projected to account for 59% of private sector energy R and D. Coal R and D share of the total declined from 47% in 1975-76 to 16% in 1977-78. Solar energy technologies will recieve 9% in 1977-78 of which 6% will be for heating, and the remainder divided between wind power, ocean energy, and biomass.

Private sector expenditures for oil and gas exploration, after a slight decline between 1975-76 and 1976-77, show a very significant increase of 73% projected for 1977-78, reaching NZ$ 27.3 million.

Aside from the oil and gas exploration R and D mentioned above, there are large scale energy R and D projects in the private sector involving improved processes for steel production and wood processing; low cost solar water heating systems; pyrolysis of wood wastes; and general utilization of wastes in industry.

Private sector energy R and D amounted to 12% of government expenditures in 1975-76 and is projected to be 18% in 1977-78. The strong emphasis on conservation in the private sector reflects the fact that major companies are carrying out significant process-improvement projects. A comparison of absolute levels of funding indicates a complementarity in terms of technology areas supported by government and industry. The complete absence of private sector R & D in the geothermal area is to be compared with 25% of government R & D outlays in this area.

3. Corporate (continued)

The most important constraints to increased energy R and D activity in the private sector are the small size of most N.Z. firms, a shortage of funds, and a shortage of qualified supervisory personnel. The DFC is able to provide a certain amount of financing to high-risk projects, but where DFC support is not available the willingness of the private sector to undertake such investments is reduced. To the extent that energy costs are still a small part of total production costs, management tends to give higher priority to non-energy costs. Finally, a shortage of trained staff to carry out design and supervisiion necessary to the application of energy-conserving technologies is an impediment, which can be partially mitigated through the use of consultants. [Figures are from OCED/IEA]

The following are members of the New Zealand Solar Equipment Manufacturers Association, P.O. Box 9130, Wellington.

- Carnahan-Anderson Ltd., Box 34-074, Birkenhead, Auckland. Mr. P. Carnahan

- Transheat Ltd., Box 20-060, Christchurch Mr. J. Snackers.

- Energy Developments Ltd. P.O. Box 6919, Auckland. Mr. H. Chapman

- Brugger Industries Ltd., Private Bag, Wainuiomata. Mr. F. Brugger

- Electron Flow Ltd., P.O. Box 7040, Wellesley St., Auckland. Mr. B. Reddell

- Sun Heating Systems Ltd., P.O. Box 24-073, East Linwood, Christchurch. Mr. A. Boyce

- Zip Holdings Ltd., P.O. Box 30-669, Lower Hutt. Mr. O. Kendon.

- Colt Ventilation and Heating, P.O. Box 4182, Christchurch. Mr. Hollingworth

- Solaris Industries Ltd., 80 Bruce McLaren Rd. Henderson. Mr. W. G. Crump

- Monorail Chairlift Ltd., P.O. Box 10368, Wellington.

3. Corporate (continued)

- Sunpower Industries Ltd., P.O. Box 8761, Auckland
- Associated Solar Power Ltd., P.O. Box 5065, Papanui, Christchurch
- Morrison Industries Ltd., P.B. Hastings.

• Name:	Atti, L.J. Fisher & Co., Ltd. Box 2183, Auckland
Fields of energy interest:	Integrated Solar Water Heating System - This project is concerned with the making of a prototype solar collector constructed mainly from plastic and including integral insulation. Other components of the system are also to be made from plastic.
Key personnel:	Mr. B. Wright
• Name:	Zip Holdings Ltd., P.O. Box 30669 Lower Hutt
Fields of energy interest:	Domestic Solar Water Heating System - This project is concerned with the investigation of solar absorber manufacture and of a solar pump, to arrive ultimately at a commercially viable domestic solar water heating system. The solar pump would obviate the need for an electric pump in solar heating installations which have a hot water storage tank below the absorber.
Key personnel:	Mr. O.M. Kendon

- Name: Solar Equipment Manufacturers' Association of New Zealand
  P.O. Box 9130, Wellington
  Phone: 843-688
  Telex: N.Z. 31129

  Key personnel: Mr. S. Atkins, Executive Officer

- Name: Alexander and Poore
  2 Whitaker Place, Auckland, 1
  Phone 793-909

  Fields of energy interest: Construction engineers, wood waste utilization.

  Key personnel: M.G. A. Atcheson

- Name: A. H. T. Ltd., Private Bag, Auckland
  Phone: 599-105

  Department: Corporate Manufacturers

  Fields of energy interest: Solar and wind systems

  Key personnel: P.M. Skinner, Special Assignments Officer

- Name: Energy Consultants Ltd.,
  P.O. Box 9661, Wellington

  Fields of energy interest: Developers of solar water heating.

- Name: Energy Developments Ltd.
  P.O. Box 6919, Auckland
  Phone: 760-385

  Fields of energy interest: Solar water heating, solar powered heat pumps, solar space heating and cooling

  Key personnel: L. Hugh Chapman, principal
  Mary E. Chapman
  T. Gribben
  J.D.C. Laing

II. NATIONAL PROFILE

A. GEOGRAPHIC

1. Name

Dominion of New Zealand

2. Country Descriptor

a. Location: New Zealand is located in the southwest Pacific about 1,200 miles (1,931 km) southeast of Australia. It consists of two main islands--North Island and South Island--separated by Cook Strait, Stewart Island, a smaller island to the south, and various other small coastal islands.

b. Area (mi^2)/population: 103,736 sq.mi.(268,675 sq.km.); 3,105,000 (1976)

c. Latitude/longitude: 34°S20'-47°S20'/166°E30'-178°E30'

d. Capital and key cities; population: Capital: Wellington, 350,900; Auckland, 801,200; Christchurch, 327,200; Hamilton 156,100; Dunedin, 120,400.

e. Languages: English, Maori

f. Ethnic groups: Europeans 89.9%, Polynesian 10.1%.

B. ECONOMIC

1. Economic System Descriptor

The New Zealand economy is characterized by a high degree of dependence on agriculture, especially livestock farming, and the export of agricultural products, notably temperate foodstuffs. However, there has been an effort to promote industry in order to diversify the economy to protect it from the fluctuations in the export market. While industry now employs twice as many workers as agriculture, New Zealand's dependence on wool, meat and dairy products persists.

2. Economy Descriptor

a. Scale: Labor force; 13% Agricultural
33% Manufacturing
99% Transportation
24% Commerce

b. Production: 10% Agricultural
25% Industry

c. Balance of trade: $US-46 million (1976)

d. Inflation rate: 14.6% (1978)

3. Currency

a. Name: Dollar

b. Exchange rate: NZ$1 = US$1.0495 (June 1979)

c. Detail: New Zealand's dollar valuation is a weighted "basket" of currencies of the country's main trading partners.

4. GNP/GDP

a. 3-year Series $NZ million: GNP

1974/75	$ 9,452
1975/76	10,914
1976/77	12,786

b. Per capita $ U.S.: 4,106 (1976)

5. Foreign Trade

a. Principal trade partners: (Exports) U.K. 20%, Japan 13%, Australia 12%, U.S. 11%. (Imports) Australia 21%, U.K. 17%, Japan 15% U.S. 13%.

b. Total U.S. imports: $NZ 425,961 (1976/77 '000)

6. Foreign Investment

The New Zealand Government clearly recognizes the need to encourage an inflow of foreign investment on a selective basis to assist in its basic economic goal of achieving the highest possible standard of living for the people of New Zealand. The Government particularly encourages investment proposals that introduce new or improved technology, make substantial sums of capital available for the development of local resources, or assist in obtaining increased access to overseas markets for New Zealand exports.

All foreign investment in New Zealand, whether direct or in the form of licensing or royalty agreements, requires the prior approval of the Government. Any proposal by an overseas person or entity to take over control of 25% or more of the capital stock in a New Zealand company, also requires prior approval by the Government. In general, foreign companies will need to raise the largest portion of their capital and borrowing overseas, leaving the local money market largely to New Zealand companies.

C. GOVERNMENTAL

1. Head of State

Queen Elizabeth II, represented by Governor General Keith Jacka Holyoake; in office since October 26, 1977.

Head of Government

Prime Minister Robert David Muldoon;
in office since November, 1975.

2. Government Structure Descriptor

a. Type: Independent state within Commonwealth, recognizing Elizabeth II as Head of State.

b. Political subdivisions: 105 counties, 136 boroughs, 12 town districts.

c. Legal system: Based on English law, with special land legislation and land courts for Maori tribesmen; Constitution consists of various documents, including certain acts of the U.K. and New Zealand Parliaments; legal education at Victoria, Auckland, Cantebury, and Otago Universities; accepts compulsory ICJ(International Court of Justice) jurisdiction, with reservations.

d. Branches: Unicameral legislative (General Assembly called Parliament); Cabinet responsible to Parliament; 3-level court system (Magistrates, Courts, Supreme Court, and Court of Appeal).

e. Elections: Held at 3 year intervals or sooner if Parliament is dissolved by the Prime Minister; last election held November, 1975.

f. Political parties and leaders: National Party (Government), Robert D. Muldoon; Labour Party (Opposition), Wallace E. Rowling; Social Credit Political League, Bruce Beetham; Communist Party, George Victor Wilcox; pro-Soviet Socialist Unity Party, George Edward Jackson.

g. Voting strength (1975 election): National Party 55 seats, Labour Party 32 seats.

3. Diplomatic Names and Addresses

a. In U.S./U.N.

Embassy
19 Observatory Circle, N.W.
Washington, D.C. 20007
Phone Number: 265-1721

Ambassador Mr. Norrish
Economic Counselor Mr. David Smyth
Minister Mr. Hugo Judd

U.N. Mission
1 United Nations Plaza
25th Floor
New York, N.Y. 10017
(212)827-1960

Ambassador/Permanent Representative Mr. Francis
Minister Mr. Martin

b. U.S. in Country

Embassy
Wellington: 29 Fitzherbert Ter, Thorndon
P.O. Box 1190
Tel:722-068
Telex:NZ3305

Ambassador Armistead I. Selden, Jr.

DCM: Theresa A. Healy
ECO/COM: Richard H. Imus
COM: John E. Hall
POL: Richard J. Dols
LAB: James H. Holmes
CON: William A. Colwell
ADM: J. Leonard Buflo
AGR: James M. Benson
PAO: James F. Anderson

Consulate General
Auckland: 5th Floor, Old Northern Building
Queen & Wellesley St., or
P.O. Box 7140 Wellesley St.
Tel:375-102, 30-992

PO: Warren Slater
CON: Lorraine Takahashi

4. Government Funding

a. Budget breakdown: (1977/78, $NZ million)

Administration	479
Defense	248
Development of Industry	630
Education	807
Social Services	1,569
Health	808
Transport and Communications	248

D. NATIONAL INSTITUTIONS

1. Political Parties

Communist Party of New Zealand: 37 St. Kevin's Arcade, Auckland; pro-Chinese; 300 mems.; Gen. Sec. Victor Wilcox; publ. People's Voice (weekly)

Labour Party: P.O.B. 6146, Te Aro, Wellington; founded 1916; the policy of the Party is the maximum utilization of the Dominion's resources for organizing an integral economy to distribute goods and services so as to guarantee to every person able and willing to work an adequate standard of living; New Zealand Pres. Hon. A.J. Faulkner; Gen. Sec. J.F. Wybrow; Parliamentary Leader Rt. Hon. Wallace E. Rowling

New Democratic Party: Nelson; founded May 1972; aims to dismantle the centralized government and restore maximum freedom for each individual to control his environment; Leader J.B. O'Brien.

New Zealand National Party: Corner Customhouse Quay and Hunter St., Wellington 1; founded 1936 the National Party represents the Conservative and Liberal elements in New Zealand politics; it stands for maintenance of democratic government; and the encouragement of private enterprise and competitive business, coupled with maximum personal freedom; Parliamentary Leader R. Hon. Robert D. Muldoon; Gen. Dir. and Sec. P.B. Leay.

Social Credit Party: 170 Cuba St., Wellington I; founded 1954; aims to reform the monetary system through restoring the ownership and use of the nation's financial credit to the people through a national credit authority; 10,000 mems.; Leader Bruce C. Beetham; publ. New Guardian (monthly).

Socialist Unity Party: Box 1987, Auckland; founded 1966; Marxist socialist; Pres. G.H. Andersen; Sec. George Jackson; publ. New Zealand Tribune and Socialist Politics.

Values Party: P.O.B. 137, Wellington; founded May 1972; humanist-ecological party devoted to creating a just and sustainable world; Leader Tony Kunowski; Deputy Leader Margaret Crozier; Publ. Vibes.

2. Religions

90% Christian, 9% none or unspecified;
1% Hindu, Confucian and other.

3. Universities

University of Auckland: Private Bag, Auckland I;
750 teachers, 10,519 students.

University of Canterbury: Christchurch I;
550 teachers, 7,369 students.

Massey University: P.O. Palmerston North;
460 teachers, 10,480 students.

University of Otago: P.O.B. 56, Dunedin;
1,180 teachers, 6,680 students.

Victoria University of Wellington: Private Bag,
Wellington; 390 teachers, 7,013 students.

University of Waikato: Hamilton; 180 teachers,
3,130 students.

Lincoln College: Canterbury; constituent college
or University of Canterbury; 155 teachers,
1,320 students.

4. Corporations

The following are the major industrial enterprises in New Zealand, selected on the basis of ordinary paid-up capital:

CONSTRUCTION AND CEMENT

Fletcher Holdings Ltd.: Great South Rd., Penrose 6, Auckland; cap. p.u. $NZ32.37m. (1977).
Sawn timber, wood panel products and general manufacturing, steel processing and merchandising, forestry, housing, commercial and industrial development/construction. Thirty six subsidiary companies in Australasia and South-East Asia, fifty associated companies; Chair. and Man. Dir. J.C. Fletcher; employees: 6,150

Golden Bay Cement Co. Ltd.: Third Floor, Conference Chambers, Farish St., Wellington; founded 1909; cap. p.u. $NZ11.1m. (December 1976).

4. Corporations (continued)

Winstone Ltd.: Eden House, 44 Khyber Pass Rd., Auckland; founded 1864; cap.p.u. $NZ23.1m. (1977). Holding company for subsidiaries in the supply and manufacture of materials for the construction industry, quarry owners and processors of metal aggregates and sands; glass merchants; land developers; residential housing developers; forestry owners and timber pulp and chip processors; road and civil engineering contractors. Chair. A.H. Winstone; Man. Dir. B.D. Bamfield; employees: 3,400.

FOOD AND DRINK

Dominion Breweries Ltd.: "Waitemata House", Cnr. Albert and Wyndham Sts., Auckland I; founded 1930; cap. p.u. $NZ14.9m. (December 1976). Brewers, bottlers, wine and spirit merchants, hotel proprietors. Chair. and Man. Dir. Sir Henry Kelliher.

New Zealand Breweries Ltd.: 15-17 Murphy St., P.O.B. 211, Wellington, N I; founded 1923; cap. p.u. $NZ23.1m. (December 1976). Brewers, bottlers and hotelkeepers. Branches in Auckland, Palmerston North, Wellington, Christchurch, Hamilton and Dunedin. Six associated companies; Chair. Sir Clifford Plimmer, K.B.E.; Chief Executive J. Macfarlane.

Southland Frozen Meat and Produce Export Co. Ltd.: 12 Esk St., Invercargill; founded 1882; cap. p. $NZ9.1m. (December 1976). Freezing works proprietors. Manufacturers of frozen meat, sliped wool, pickled pelts, hides, tallow, casings, meat meal. Chair. A.F. Gilkison; employees: 1,600.

Waitaki NZ Refrigerating Ltd.: 159 Hereford St., I, Christchurch; founded 1881; cap. p.u. $NZ28.6m. (1976). Producers and exporters of lamb, mutton, beef, fancy meats, wool, pelts, hides, tallow, casings, liver meal, meat and bone meal, blood and bone, dried blood and neatsfoot oil. Chair. R.P. Thompson; Vice-Chair. J.A. Valentine; employees: 3,800.

4. Corporations (continued)

Wattie Industries Ltd.: Fitzroy Ave., Hastings; founded 1934; cap.p.u. $NZ34.3m. (1977). Food processing and industrial supplies. Holding company for Wattie Group comprising; J. Wattie Canneries Ltd., General Foods Corp. (N.Z.) Ltd., Cropper - NRM Ltd. and subsidiaries.
Chair. D.F. Mcleod; Man. Dir. G.J. Wattie; employees: 6,952.

FORESTRY, PULP AND PAPER

N.Z. Forest Products Ltd.: O'Rorke Rd., Penrose, Auckland; founded 1935; cap.p.u. $NZ74.4m. (1977). Company has at Penrose two wallboard mills and associated remanufacturing and woodgrain printing departments, a mineral fiber board plant, a multiple paper bag factory and a polyethylene extrusion plant. At Kinleith are timber mills, two kraft pulp mills, a paper mill, veneer mill, shook mill and chemical extraction and plywood mill. At Whakatane is a timber mill and a paper-board mill and at Mataura a paper mill.
Chair. A.G. Wilson; Joint Man. Dirs. D.O. Walker, J.T. Currie; employees: 8,160

Tasman Pulp and Paper Co. Ltd.: Kawerau, Bay of Plenty; cap. p.u. $NZ 19.4m. (1977). Manufacturers of newsprint, sulphate pulp, sawn timber, turpentine and Tall oil. Chair. J.C. Fletcher; Man. Dir. W.W. Olsen; Sec. I.G. Clinkard.

STEEL

New Zealand Steel Ltd.: Private Bag, Glenbrook, South Auckland; cap. p.u. $NZ 25.7m (1977). Manufacturers of iron-sand concentrate, sponge iron, steel galvanized sheet and pipe. Chair. F.R.A. Hellaby.

Steel and Tube Holdings Ltd.: UDC House, 104 The Terrace, Wellington; cap. p.u. $NZ12.9m. (1977). Holding company. Sixteen subsidiary companies; Chair. F.H. Kember; Chief Exec. D.C. Thurston.

4. Corporations (continued)

MISCELLANEOUS

Alex Harvey Industries Ltd.: 752 Gt. South Rd., 6, Auckland; founded 1886; cap. p.u. $NZ21.6m. (1977). Manufacturers of glass bottles and jars, tube vials, bent glass, domestic and commercial glassware and lightingware, metal and tin containers, food beverage, aerosol and general line cans, torches, pails and drums, closures, injection and blow molded bottles, containers and vials, industrial bulk containers, moldings and extrusions, plastic closures, plastic pipe, tube and pipe fittings, polythene drainage pipe, rigid PVC pipe, rigid plastic sheet, polythene film, bags and shrink film, cellophane and polythene bags, gummed tape, reinforced aluminium foil insulation, laminated plastics, wallboards, corrugated and solid fibres containers, boxes, fibreglass wool, aluminium sliding doors and windows, insect screens for doors and windows, roof tiles, metal bathroom equipment, office equipment, shelving, kitchen hardware and utensils, commercial and stationery printers. Seventy-four operating units; Chair. H.N. Avery; Gen. Man. C.M. Cairns.

Cable Price Downer Ltd.: C.P.D. House, 108 The Terrace, C.I., Wellington; founded 1854; cap.p.u. $NZ17.8m.(1977). Holding company for the Cable Price Downer Group of Companies.
Chair. R. W. Steele.

Challenge Corporation Ltd.: Challenge House, 105-109 The Terrace, Wellington I; founded 1861; cap.p.u. $NZ27.7m. (1977). Through main subsidiaries: stock and station agents, woolbrokers, woolscourers, livestock and bloodstock salesmen, seed merchants, real estate and insurance agents, suppliers of farm equipment and finance, wine and spirit merchants, agricultural seed merchants, motor vehicle dealers, manufacturers of motor mowers, bicycles and turf care equipment, home appliance retailers, residential land developers, financiers for customer credit, plant and equipment leasing and related investments, money market dealers and merchant bankers; through main associated companies: national department store chain owners, developers and managers of shopping centers and office building, manufacturers and distributors of motor vehicles. Chair. R.R. Trotter; employees: 5,000.

4. Corporations (continued)

Dalgety New Zealand: P.O.B. 1397, Wellington; cap. p.u. $NZ17.5m (December 1976). Manufacturers of carpets, underlays, mattresses, pillows, tires, tubes, retreads, general rubber goods, plastic foam, footwear and footwear components, wools and yarns, elastic, laces, polyester ropes, webbings, steel furniture, molded and extruded plastic products, glues and marine coatings and sports equipment. Chair. I.D. Reid; Man. Dir. G.E. Pearce; Gen. Man. H.M. Titter; employees: 5,355.

ICI New Zealand Ltd.: ICI House, Molesworth St., Wellington (P.O.B. 1592); founded 1935; cap.p.u. $NZ17.5 m. (December 1976). Importers and manufacturers of agricultural and horticultural chemicals, polyester resins, medical and veterinary pharmaceuticals, alkalis, general chemicals, plastics, explosives, metals, salt, pigments, coated fabrics, dyestuffs, slide fasteners, wallpapers; factories--Lower Hutt, Mount Mauganui, Christchurch, Auckland and Levin. Seven subsidiary companies in New Zealand; Chair. and Man. Dir. D.B. Green; employees: 2,250.

New Zealand Farmers' Fertilizer Co. Ltd.: 31-33 Great South Rd., Remuera 5, Auckland; founded 1916; cap. p.u. $NZ9.7m. (1977). Manufacturer of fertilizers, sulphuric acid, copper sulphate, sulphate of alumina, chrome sulphate; supplier of pumice. Chair. P.C.I. Crookes; Man. Dir. P.G. Riddell; employees: 530.

New Zealand Motor Corporation: P.O.B. 2599, Wellington; cap. p.u. $NZ15m. (December 1976). Motor assembly and distribution.

New Zealand Newspapers Ltd.: 20 Shortland St., I, Auckland; founded 1870; cap. p.u. $NZ8.6m. (1977). Newspaper proprietors. Branches in Auckland and Christchurch. Chair. G.T. Upton; Man. Dir. N.P. Webber.

New Zealand Refining Co. Ltd.: P.O.B.44, Whangarei; founded 1961; cap. p.u. $NZ24m. (1977). The company operates Whangarei Refinery at Marsden Point, which refines petrol, diesel oils, fuel oils and bitumen. Gen. Man. S. Bouma; employees 200.

4. Corporations (continued)

Rothmans Industries: P.O.B. 3281, Auckland; cap.p.u. $NZ11m. (December 1976). Cigarettes and tobacco manufacturing.

U.E.B. Industries Ltd.: 1-11 Short St., P.O.B. 37, Auckland I; founded 1948; cap. p.u. $NZ28.1m. (1977). Manufacturers of tufted and woven carpets and carpet yarn. Also manufacturers of cardboard containers and cartons, packaging lines, polystyrene, wood-wool and cement slabs, steel-framed furniture, etc. Eight subsidiary companies in New Zealand, three abroad; Man. Dir. G.S. Phillips; employees: 4,000.

E. COUNTRY OVERVIEW

1. General

- North Island: 44,281 sq. mi.
  South Island: 58,093 sq. mi.
  Stewart Island: 670 sq. mi.
  Chatham Island: 372 sq. mi.

- Age distribution: 29%, 0-15; 10%, 15-18; 33%, 20-44; 14.8%, 45-59; 13.2%, 60+

- 68% of the population lives in urban areas with populations over 25,000.

- Within New Zealand there are wide variations in the density of population. North Island has approximately 19.8 persons per square kilometer; the South Island has approximately 5.6 persons per square kilometer.

2. Climate

- The influential factors for New Zealand's climate are its position in the middle of the ocean and the shape and topography of the country. The chain of high mountains which extends from south-west to north-east through the length of the country, is a barrier in the path of the prevailing westerly winds. This produces sharper climatic contrasts from west to east.

- Winds from a westerly quarter prevail in all seasons, with a general tendency to increase in strength from north to south. However, considerable local modifications to the general air flow occur during its passage across the mountainous terrain.

- The average rainfall for the whole country is high, but ranges from as little as 300 mm in a small area of central Otago to over 7,000 mm in the Southern Alps.

3. Economy

a. Agriculture:

- Concentration on extensive pastoral farming, in which New Zealand has a comparative advantage owing to its benign climate and low population density. Its development to a high state of efficiency have yielded productivity levels not matched so far except in hydroelectric generation and forestry.

- New Zealand is virtually self-sufficient in wheat. Barley, maize, peas and potatoes are other significant crops.

- Since the early 1900's there has been no sizeable increase in the area of land used for farming.

b. Fishing:

- Catch was 65,525 metric tons in 1975

- Fishing is not a major industry, although there has been considerable effort to encourage its development.

- Marine fish and rock lobsters are the main products, in addition to a small oyster farming industry.

c. Forestry:

- Forestry has grown in importance with the maturing of the first man-made forests.

d. Mining:

- Apart from climate and water power, New Zealand is not well endowed with readily exploitable natural resources.

e. Industry:

- Industrial output has been growing at an average annual rate of 5 to 6 percent.

e. Industry (continued)

- A protectionist policy towards the domestic market has been successful to the extent that domestic production accounts for a high proportion of finished goods in New Zealand, but it has made manufacturing very dependent on imports of raw materials, semi-finished goods and fuel, as well as plants and equipment.

- Only half of the manufacturing output comes from factories employing more than 100 workers. Those employing more than 500 workers account for only a fifth.

4. Living Conditions

a. Health:

- The death rate per 1,00 live births under 12 months is 13.8%.

- Life expectancy: males 69 years, females 75 years.

- Ratio of available beds at public institutions per 1,000 was 7.3; and at private licensed hospitals 1.2.

- Population per physician: 739 (1975)

- There are a total of 204 public health institutions and 154 licensed private hospitals.

b. Education:

- Literacy rate of 98%.

- The present system is based on free education on a national and secular basis for both European and Maoris between the ages of 5 and 13.

- There is a ratio of one teacher to 31 pupils in primary and intermediate schools.

- About 12% of secondary school graduates go on to the university level. There are six universities and one agricultural university.

- There are 14 technical institutes and technical corresponsdence institutes. The latter has approximately 300 full-time tutors and 21,712 students.

c. Housing:

- The standard house is about 100.3 square meters in area, single-storyed and normally built of timber, with a roof of galvanized rion.

- Approximately 90% of the dwellings completed annually are built for private home ownership.

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APPENDIX

ADB	Asian Development Bank
AIOEC	Association of Iron Ore Exporting Countries
ANZUS	ANZUS Council; treaty signed by Australia, New Zealand and the United States
ASPAC	Asian Pacific Council
CIPEC	Intergovernmental Council of Copper Exporting Countries
DAC	Development Assistance Committee (OECD)
ELDO	European Space Vehicle Launcher Development Organization
ESCAP	Economic and Social Council of Asia and the Pacific
FAO	Food and Agricultural Organization
GATT	General Agreement on Tariffs and Trade
IAEA	International Atomic Energy Agency
IATP	International Association of Tungsten Producers
IBA	International Bauxite Association
IBRD	International Bank for Reconstruction and Development
ICAC	International Cotton Advisory Committee
ICAO	International Civil Aviation Organization
IDA	International Development Association
IEA	International Energy Agency
IFC	International Finance Corporation
IHO	International Hydrographic Organization
ILO	International Labor Organization
IMCO	Intergovernmental Maritime Consultative Organization
IMF	International Monetary Fund
IOOC	International Olive Oil Council
IPU	Inter-parliamentary Union
IRC	International Red Cross

ISO	International Science Organization
ITC	International Tin Council
ITU	International Telecommunications Union
OECD	Organization for Economic Cooperation and Development
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
UPU	Universal Postal Union
WHO	World Health Organization
WIPO	World Intellectual Property Organization
WMO	World Meteorological Organization
WSG	International Wool Study Group

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