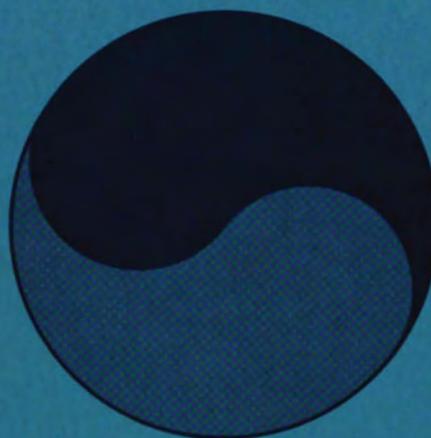


Staff Summary Report



SEMINAR ON
**Industrial
Energy Conservation**

SEMINAR ON
**Solar Space
Heating and Cooling**

Joint Continuing Committee for
Scientific Cooperation:
Ministry of Science and Technology
Republic of Korea and
National Academy of Sciences
United States of America

NATIONAL ACADEMY OF SCIENCES
Washington, D.C. 1975

STAFF SUMMARY REPORT:

SEMINAR ON INDUSTRIAL
ENERGY CONSERVATION

SEMINAR ON SOLAR
SPACE HEATING AND
COOLING

Held in Seoul, Korea

13 - 15 November 1974

Jointly sponsored by

Ministry of Science and Technology

Industrial Advancement Administration
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This report is a staff-prepared summary of the Seminar on Industrial Energy Conservation and the Seminar on Solar Space Heating and Cooling, held in Seoul, Korea, November 13 - 15, 1974. The seminars, part of a series of activities initiated by the Ministry of Science and Technology - National Academy of Sciences Joint Committee on Scientific Cooperation, were jointly sponsored by the Ministry of Science and Technology, the Industrial Advancement Administration of the Ministry of Commerce and Industry, and the U.S. National Academy of Sciences, and were held under the auspices of the Korea Energy Management Association (industrial energy conservation) and the Korea Atomic Energy Research Institute (solar space heating and cooling). Participation by the National Academy of Sciences was made possible through funds provided by the Office of Science and Technology, Bureau for Technical Assistance, Agency for International Development (contract AID/csd-2584, Task Order 1), and by the Ministry of Science and Technology and the Industrial Advancement Administration, Ministry of Commerce and Industry of the Republic of Korea.

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I

INTRODUCTION

In 1973 the Ministry of Science and Technology (MOST) of the Republic of Korea and the National Academy of Sciences (NAS) of the United States of America established a Joint Committee for Scientific Cooperation, the main purpose of which is to provide recommendations on specific application of science and technology to Korea's economic and social development. The kinds of issues considered are:

- the development of long-range policy for science and technology;
- the governmental structure for science and technology;
- national needs and priorities for research and development in specific economic sectors; and
- policy and educational issues related to scientific and technical manpower needs.

In addition to consideration of the overall prospects and plans for science and technology, MOST also wants outside views on institutional needs and the application of science and technology to development of particular sectors. In this regard, one function of the joint committee is to recommend topics or problem areas that seem to call for the kind of in-depth scrutiny possible through workshops or advisory groups. These

specific, intensive activities are held as needed and as possible; the joint committee meets regularly on an annual basis.

The possibility of holding a 1974 seminar on selected aspects of Korea's energy situation was raised at the first annual meeting of the Joint Committee in Seoul in 1973. The idea was again discussed and endorsed at the 1974 annual meeting in Washington, and it was agreed that the seminar would be held in Korea sometime in November 1974.

Energy conservation is a vitally important topic for Korea, a country with limited natural energy resources. The country's economic and social development plans are geared to industrial growth and major expansion of exports of manufactured goods. In light of the current rise in the price of energy sources, Korea must give special emphasis to using energy efficiently, to conserving it as much as possible, and to developing a greater variety of energy sources.

Planners and managers in Korean government agencies and private industry have been addressing the complex energy problem for some time. Since conservation clearly is a very important part of industrial energy strategy, MOST and other agencies felt it would be useful to exchange ideas and experience related to energy conservation in industry with an American group. As a result, the concept of a seminar sponsored by the Joint Committee was formulated.

As a specialized topic related to energy conservation, the Joint Committee recommended that a short seminar on solar space heating and cooling should be held in conjunction with the seminar on industrial energy conservation. Research on solar heating recently has been started in

Korea, and it was felt that it would be timely to hear of R and D experience elsewhere in solar space heating and cooling.

Arrangements for the seminars were jointly planned and coordinated by the Bureau for Technical Cooperation of MOST and the Board on Science and Technology for International Development of the NAS.

II

OBSERVATIONS AND CONCLUSIONS

1. Industrial Energy Conservation Seminar

The basic purpose of the seminar was to bring together engineers, scientists, government officials, and industrial managers to exchange information and experience on industrial energy conservation. More specifically, the objectives of the discussions were:

- to survey the latest state of knowledge of both the technical and economic aspects of the seminar topic;
- to discuss the most promising applications of industrial energy conservation techniques in the Korean context from the point of view of effectiveness, cost, and social acceptability;
- to recommend, based on the considerations in the preceding items, promising areas of research that can be carried further in Korea on energy conservation; and
- to recommend policies and activities that can be carried out by both the public and private sectors to increase industrial energy conservation.

From the interest and level of discussion by the Korean participants at the seminar, it was apparent that there is both a strong awareness of

the need to increase the conservation of energy in the industrial sector and a willingness to take action that will make increased levels of conservation a reality. An energy management law (called the Heat Management Law) was enacted in January 1974 and provides for the regulation and better management of Korea's energy-intensive heavy industries. The Korea Energy Management Association (KEMA), one of the sponsors of the seminar, is an industrial association mandated by the energy legislation to provide technical assistance and promote cooperation among energy-intensive industries. Membership in the Association is required for industries with a certain minimum level of energy use. Since late 1974, the government also has supported a nationwide campaign of information and education designed to reduce Korea's oil consumption by 10 percent.

In light of the energy conservation program on which Korea already has embarked, the seminar discussions could focus not on the need for conservation but on an exchange of experience in industrial conservation and consideration of how to approach the problems encountered in conservation efforts.

The morning session of the seminar began with brief remarks by Mr. Kim Yong-Wan, President of KEMA, and Mr. Chang Yie-Joon, Minister of Commerce and Industry. The keynote address by Dr. Choi Jong-Wan outlined Korea's major issues with regard to energy and the national policies for addressing these issues. Dr. Park Han-Woung made a presentation on Korea's long-range energy supply and demand outlook, and described energy-related research projects that are being carried out. Dr. John Gibbons followed with an overview of energy conservation practice and problems in the United States.

In the afternoon session, Mr. Kim Sang-Yon presented a case study on combustion problems of thermal power plants. Dr. Marquis Seidel discussed some of the important economic aspects of industrial energy conservation in the United States. A presentation on energy management in United States industry, illustrated with many detailed examples and suggestions, was given by Mr. Irving Snyder. Closing remarks were made by Mr. Kim Ip-Sam, seminar chairman.

All the seminar participants were able to raise questions and take part in discussion following each major presentation, and a general discussion session was held at the end of the first day. On the morning of November 15, a final discussion session was held so that conclusions could be reached on the basis of the November 13 sessions.

The seminar participants felt that, in general, Korean energy policies and programs are soundly conceived and should be pursued with vigor. Specific conclusions included the following:

- Better monitoring (such as stack gas monitoring) of industrial processes should be carried out. Monitoring equipment is available ranging from very simple and inexpensive instruments to highly complex monitoring systems. KEMA should provide industry with information on monitoring technology and give assistance in the selection of appropriate monitoring equipment.

- In general, Korean industry would benefit by the improvement of existing processes and equipment. It seems likely that 10 to 20 percent energy savings could be achieved with moderate capital investment.

- The training of industrial managers should be strengthened with regard to energy management, and more continuing in-service training opportunities should be provided. Energy management should be incorporated

into the engineering curricula of Korean universities. The short training courses provided by KEMA should include economic as well as technical aspects of energy management, such as opportunities for cost saving or financial incentives for energy conservation.

- To encourage and make feasible better long-range energy planning on the part of industry, as well as the capability to reevaluate existing plans, the appropriate government agencies should keep industry abreast of relevant economic trends and projections.

- Channels should be established for a continuing exchange of information between Korea and the United States on energy research.

In addition to the foregoing conclusions, several related observations were made by the NAS participants. They include the following:

- Energy savings in the residential sector will mostly be associated with improving the traditional ondol (below-floor heating) system and increasing thermal insulation. It seems that insulation warrants greater attention than is being given and that caulking and weatherstripping campaigns could be very useful.

- Systems studies should be made of the energy efficiency of transportation systems, especially the freight system. Heavy emphasis seems to be placed on highway transport, which is 100 percent dependent on imported oil, and perhaps more use could be made of rail and ocean shipping, which are much more energy-efficient.

- To encourage equipment changes in industry that will increase the energy efficiency of production, KEMA might usefully focus on a few selected plants and develop case studies that will motivate others to follow suit.

- The new energy management law should be an effective mechanism for encouraging large energy users to accelerate the rate at which they conserve energy. A close association between MOST, KEMA, the Korea Institute of Science and Technology (KIST), and the Korea Atomic Energy Research Institute (KAERI) will be important to keep good technical innovations flowing into the industrial sector. It would be useful for KEMA to establish teams with monitoring equipment to support the energy conservation work of individual companies. The teams could be supported partly by KEMA membership fees and partly by fees charged to the companies. The teams could benefit from participation by engineering professors and students and they, in turn, would benefit from their involvement with real industrial problems.

- Comprehensive economic/engineering trade-off studies should be made to outline and evaluate alternative energy futures for Korea.

- The industrial sector should explore possible opportunities to develop new products and new export markets that have arisen as a result of high energy costs.

- The government should give careful consideration to electric power rates. In the wake of major fuel price increases, rates now only cover fuel costs and therefore the total actual cost of power probably is at least 50 percent higher. Price-induced energy conservation will not occur until the government's major subsidy of electrical power is ended. If an increase in power rates were announced a year or more in advance, it is likely that a great deal of energy conservation action would result.

- The government should consider the establishment of an electricity tax (such as 1 percent) that would be used to support applied R and D, including technologies for increasing the efficiency of generation and use, and site selection and purchase for new generating plants.

2. Solar Space Heating and Cooling Seminar

The objectives of the seminar on solar space heating and cooling were essentially the same as those of the industrial energy conservation seminar, namely:

- to survey the latest state of knowledge of both the technical and economic aspects of the subject;
- to discuss promising applications of solar heating and cooling technology in Korea;
- to suggest promising areas of research on solar heating and cooling that might be pursued in Korea; and
- to suggest other policies and activities in relation to solar heating and cooling that should be considered in Korea.

Interest in solar heating and cooling is relatively new in Korea, and research and development on the topic is just beginning. The present R and D activities are centered at the Korea Atomic Energy Research Institute, which has responsibility for a wide range of energy research besides atomic energy. Because the solar activities are in the initial stages, KAERI felt it would be extremely useful to obtain information on solar heating and cooling R and D in the United States and to have discussion of their own research approaches.

At the morning session of the seminar, Dr. George Löf made a comprehensive presentation on solar heating and cooling developments in the United States and elsewhere, and provided a detailed account of current solar heating and cooling experiments at Colorado State University.

During the afternoon session, Dr. Cha Jong-Hee made a presentation on KAERI's solar research activities. The participants then inspected the KAERI research apparatus and the seminar closed with a general discussion session.

Dr. Lof made a number of observations about solar heating and cooling in Korea, including the following:

- Solar space heating has promise of some very useful applications in Korea, and the solar research program of KAERI is of high value and importance.

- The research at KAERI has been directed at the heating of water for subsequent use in space heating in buildings, but it should also include solar air heating with pebble-bed storage. Parallel efforts would not greatly increase the cost of the program and would permit comparison of the two systems.

- Future solar research topics that may be appropriate for Korea include: development of solar air heating systems; examination of the materials availability in Korea for various components in solar energy systems; investigation of possible combinations of the ondol and solar heating systems; the possible role of solar water heating.

- The solar research personnel in Korea should establish good channels of communication with solar research groups elsewhere, perhaps through arrangements with specific institutions and through membership in the International Solar Energy Society.

- Good coordination, technical exchange, and policy support will be important among KAERI, other research institutes, and appropriate government agencies to obtain useful applications from the solar research work.

A longer seminar or workshop held in the near future might be a useful way to encourage coordination and identify future research priorities.

III

AGENDA AND PARTICIPANTS

Agenda

For the NAS participants, the agenda for their week in Korea involved a day of preparatory briefings, one and a half days of industrial energy conservation seminar discussions, a day of field visits to different industries, and a half-day lecture session with industrial managers and engineers. One day was also devoted to the special seminar on solar space heating and cooling.

The actual schedule was as follows:

Tuesday, 12 November 1974

MORNING

Courtesy call on Minister of Science and Technology

Visit Korea Electric Company (KECO)

Luncheon by President of KECO

AFTERNOON

Background visits:

- Korea Industry Advancement Administration (KIAA)
- Korea Energy Management Association (KEMA)
- Korea Atomic Energy Research Institute (KAERI)
- Korea Institute of Science and Technology (KIST)

Dinner by Vice President of KIST

Wednesday, 13 November 1974

MORNING	Seminar on Industrial Energy Conservation
	Seminar luncheon by KEMA
AFTERNOON	Continuation of seminar
	Dinner by Director-General of KIAA

Thursday, 14 November 1974

MORNING AND AFTERNOON	Seminar at KAERI on solar space heating and cooling presented by Dr. George Lof
	Industrial field visits by other NAS participants:
	- Hankuk Paper Manufacturing Company
	- Hankuk Glass Industry Company
	- Inchon dock and locks

Friday, 15 November 1974

MORNING	Final discussions of seminar on industrial energy conservation
AFTERNOON	Public lecture session on industrial energy conservation
	Dinner by President of KAERI

The industrial energy conservation seminar session on November 13 was chaired by Mr. Kim Ip-sam, Vice President, KEMA. Final discussions on the morning of November 15 were led by Dr. John Gibbons, chairman of the NAS participants. The schedule of the November 13 session was as follows:

- 09:30 Registration
- 10:00 Opening ceremony
- Opening remarks by
Mr. Kim Yong-wan
President
The Korea Energy Management Association
- Congratulatory remarks by
Mr. Chang Yie-joon
Minister
Ministry of Commerce & Industry
- Introduction of Chairman
Mr. Kim Ip-sam
- 10:30 Keynote address by
Dr. Choi Jong-wan
Administrator
Industrial Advancement Administration
- 10:50 Coffee break
- 11:00 "Korea Long Range Energy Supply and Demand Plan and Research
Project Activities" by
Dr. Paek Han-woung
Director, Technical Information Department
Korea Institute of Science and Technology
- 11:20 General discussion
- 11:40 "Overview of Energy Conservation: Practice and Problems
in the United States" by
Dr. John H. Gibbons
Director, Environmental Center
University of Tennessee
- 12:00 General discussion
- 12:20 Luncheon by President of KEMA
- 14:00 "Study on the Combustion in the Steam Power Plant" by
Mr. Kim Sang-yon
Chief, Power Generating Department
Korea Electric Company, Ltd.
- 14:20 General discussion
- 14:40 "Economic Aspects of Industrial Energy Conservation in
the United States" by
Dr. Marquis R. Seidel
Office of the Chief Engineer
Federal Power Commission

- 15:00 General discussion
- 15:20 Coffee break
- 15:40 'Energy Management in United States Industry' by
 Mr. Irving G. Snyder, Jr.
 Technical Manager
 Technology Center Administration
 Dow Chemical USA
- 16:10 General discussion
- 16:30 Closing remarks by
 Mr. Kim Ip-sam
 Vice President
 The Korea Energy Management Association

Participants

NAS Participants

JOHN H. GIBBONS, Director, Environmental Center, University of Tennessee,
NAS Panel Chairman

GEORGE O. G. LÖF, Professor of Civil Engineering, Colorado State University

MARQUIS R. SEIDEL, Economist, Office of the Chief Engineer, Federal Power
Commission

IRVING G. SNYDER, JR., Technical Manager, Technology Center Administration,
Dow Chemical USA

Local Participants

KIM IP-SAM, Vice President, The Korea Energy Management Association,
Seminar Chairman

BAE SOON-HOON, Assistant Professor, The Korea Advanced Institute of Science

FRANCIS G. BOLLO, Consultant, International Executive Service Corps

RICHARD M. BROWN, Assistant Resident Representative, United Nations Development
Program

CHAI NAM-HO, Manager, Production Department, Lucky, Ltd.

CHI DONG-BUM, Managing Director, Hankuk Paper Manufacturing Company, Ltd.

CHOI JONG-WAN, Administrator, Industrial Advancement Administration

CHUNG DO-WON, Chief, Planning Room, Kangwon Industrial Company, Ltd.

CHUNG TAE-SOO, Manager, Technical Department, Korea Pacific Chemical Corp.

HA WON-SOO, Director, Sangyong Cement Company, Ltd.

HAN JUNG-SUK, Director, Bureau of Energy Development, Ministry of Commerce
and Industry

HONG WAN-KI, Chief of Engineering Section, Lotte Confectionery Company, Ltd.

HWANG YONG-KYUN, Manager, Engineering Department, Sam Yang Foods Industrial
Company, Ltd.

JEONG WOON-SOU, Senior Counselor, Ministry of Science and Technology

KANG YONG-SIK, Professor, Engineering College Chungang University
KIM DAE-KI, Assistant Refinery Manager, Honam Oil Refinery Company, Ltd.
KIM DONG-IL, President, Korea Petroleum Industrial Development Center
KIM HYONG-SOP, President, Sinil Construction Company, Ltd.
KIM IN-DEUK, Chairman, Hankuk Slate Company, Ltd.
KIM KAK-CHOONG, Vice President, Kyungbang Ltd.
KIM KYONG-SHIK, Senior Counselor, Ministry of Science and Technology
KIM MAN-HWAN, Chief, Technical Guide Center, National Federation of Medium
Industry Cooperatives
KIM SANG-YON, Chief, Power Generating Department, Korea Electric Company, Ltd.
KIM SOON-HYUK, Managing Director, The Korea Energy Management Association
KIM SUNG-HWAN, Chief, Planning Section, National Industrial Standards
Research Institute
KIM TONG-HEE, Vice President, Chon Engineering Company, Ltd.
KIM YOON-KIE, President, Korea Federation of Science and Technology Societies
KIM YOUNG-SAING, Vice President, Korea Engineering Company, Ltd.
KWON JUNG-WHAN, Chief, Business Promotion Department, Korea Chamber of
Commerce and Industry
KWON OH-SOO, Director, The Korea Energy Management Association
LEE CHANG-KUN, Director, Atomic Pile, Korea Atomic Energy Research Institute
LEE HEE-SOO, Professor, Yonsei University
LEE JONG-RAK, Chief, Planning Room, Chosun Firebrick Industrial Company, Ltd.
LEE KWANG-HO, Vice President, Daehan Coal-Mines Association
LEE YOUNG-HO, President, Daehan Chemical Machinery Manufacturing Company, Ltd.
PAIK YONG-HOON, President, Korea Industrial Development Research Institute
PARK HAN-WOUNG, Director, Technical Information Room, Korea Institute of
Science and Technology

PARK WON-HEE, Head, Chemical Process Development Laboratory, Korea
Institute of Science and Technology

GEORGE D. REASONOVER, Chief of Engineering, United States Agency for
International Development

RO SUNG-TACK, Professor, Engineering College, Seoul National University

SHIN YONG-BACK, Senior Consultant (PE), Korea Productivity Center

SHIN YOUNG-SOO, Chief, Technical Section, Ilssin Ind. Co., Ltd.

SONG HEUN-TAEK, Director, Daehan Boiler Manufacturing Company, Ltd.

WON YONG-DAI, Director, Bureau of Quality Control, Industrial Advancement
Administration

YANG SUL-HYUN, Director, The Korea Energy Management Association

IV

HIGHLIGHTS AND COMMENTS

Planning and Preparation

Plans and arrangements for the seminars were coordinated by MOST staff members Kim Hyung Ki, Director, Bureau for Technical Cooperation, and Chang Sang Kwon, Deputy Director of the Bureau, and by NAS staff member John Hurley, Professional Associate, Board on Science and Technology for International Development. Arrangements for the industrial energy conservation seminar were made on behalf of KEMA by Kim Yung Boo, Charge of International Relations. Arrangements for the solar space heating and cooling seminar were made on behalf of KAERI by J. K. Chung, Charge of Public Relations.

Several weeks before their departure for Korea, the NAS participants met in Washington for a one-day briefing session. Meeting with the participants were BOSTID Staff Director Victor Rabinowitch, John Hurley, and Newman Hall, former AID science advisor in Korea. The objectives of the seminar and plans for the agenda were discussed, along with the roles of individual participants. Substantial background information on Korea's energy situation was presented by Dr. Hall and discussed with him.

Workshop Participation

About 50 Korean participants were involved in the industrial energy conservation seminar along with the NAS participants. Other participants included: Mr. Francis Bollo, an International Executive Service Corps consultant to KEMA; Mr. George Reasonover, Chief of Engineering for USAID in Korea; and Dr. Richard Brown, Assistant Resident Representative of the UNDP in Korea. The Korean participants, listed in section III of this report, represented about 18 private companies, 6 industrial associations, 4 universities, 4 government ministries and agencies, 6 government or public research institutes, and the major electric utility corporation.

A broad range of interests and experience with energy problems was represented among the NAS panel members. Panel chairman John Gibbons, Director of the Environmental Center of the University of Tennessee, has had a long involvement with energy conservation research, most recently as Director, Office of Energy Conservation, Federal Energy Administration, and before that at Oak Ridge National Laboratory. George Löf leads solar heating and cooling research at Colorado State University, is associated with a private firm that designs and manufactures solar heating and cooling systems, is the current president of the International Solar Energy Society, and has been a research associate of Resources for the Future for a number of years. Mark Seidel, head of engineering economics for the Office of the Chief Engineer, Federal Power Commission, was previously the senior economist and chief of systems studies for the Office of Energy Conservation and Environment of the Federal Energy Administration and also has carried out energy conservation research for the

Environmental Protection Agency. Irving Snyder, technical manager of the Technology Center Administration Department for Dow Chemical, is responsible for coordinating Dow's worldwide efforts on energy conservation and also has been involved with the work of the Sub-Council on Technology of the National Industrial Energy Conservation Council.

The one-day seminar on solar space heating and cooling involved 15 - 20 Korean participants and NAS participant George Lof. The Korean participants consisted of research staff from the Korea Atomic Energy Research Institute and the Korea Institute of Science and Technology, and faculty and graduate students from the Korea Advanced Institute of Science and one or two other institutions.

An audience of about 225 people attended the lecture session on industrial energy conservation held on November 15. The audience consisted mainly of top-level managers and engineers from a variety of Korean industrial firms.

Organization of the Seminar

The arrangements for the seminar were carefully planned and the meetings went very smoothly.

The industrial energy conservation seminar on November 13 was held in a large conference hall at the Tower Hotel, where the NAS participants stayed while in Seoul. The hall was well-equipped with a good sound system, projection equipment, and simultaneous translation facilities. The solar heating and cooling seminar was held in a very pleasant conference room at KAERI, as was the final half-day session of the industrial

energy conservation meeting. The public lecture session on the afternoon of November 15 was held in the Press Salon, a large hall in the heart of the city.

At the November 13 seminar, simultaneous translation was available so that participants could use both Korean and English. At the November 15 lecture session, consecutive translation was used for the presentations by NAS speakers. English was used for the solar heating and cooling seminar and the closing discussions of the energy conservation seminar. These arrangements proved to be workable and no major problems of language arose.

The field visits to several plants that were arranged for the NAS participants were useful. The visits provided a better perspective on the processes, equipment, and energy management typical of Korean industry.

The hospitality of the Korean sponsors and participants was more than generous, and the NAS group felt that almost any way of conveying their appreciation was inadequate. Luncheons and dinners in some instances provided an exposure to Korean cuisine and customs and in all instances afforded a pleasant and welcome opportunity for the American and Korean participants to become better acquainted on a personal basis. These personal contacts are important not only as an immediate mechanism for the exchange of ideas and experience, but also because they frequently lead to a continuing future exchange of information.

Perspective

The seminar on industrial energy conservation and the associated seminar on solar heating and cooling were the first two specific activities held in connection with the MOST - NAS program of scientific cooperation. The meetings dealt with topics of considerable importance and urgency and addressed them in a very practical way.

Korea has given considerable attention to the careful planning and wise management of energy. The purpose of the seminars, therefore, was not so much aimed at identification of problems or recommendations for new policies as at the exchange of practical experience and suggestions for better ways to implement existing policies and legislation.

The very active participation of private industry in the seminar helped to ensure that the discussions were realistic and sufficiently detailed. The joint sponsorship of the meeting and combined public and private participation also was an experiment that successfully added new dimensions to the MOST - NAS scientific cooperation program.

The Minister of Science and Technology has maintained an active interest in the program of scientific cooperation and met with the NAS participants early in their stay in Seoul. His support and ideas continue to be an important stimulus in the activities of the MOST - NAS program. A further stimulus to the November seminar was the fact that the Minister of Commerce and Industry displayed his interest by participating in the opening ceremonies on November 13.

Finally, it should be noted that Korea provided very tangible support for the NAS participation in the seminar. The air travel expenses for the NAS panel members were covered by MOST, while local hotel expenses were covered by the KIAA. The NAS staff costs were covered under a contract with the Office of Science and Technology, Bureau for Technical Assistance, U.S. Agency for International Development.