options
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The solar option

C.R. Bell, F. Jager

The search for renewable energy sources has placed the various possibilities for solar energy utilization in the center of the worldwide energy discussion. Many hope that it will provide an energy supply that is more evenly distributed over the globe. However, looking more closely into the matter, it soon becomes evident that solar energy conversion systems suitable for large scale substitution for fossil fuels would be highly capital intensive even in more favorable regions. IIASA's Solar Energy Group is attempting, as part of the Institute's Energy Systems Program, to estimate realistically to what extent and where solar energy could be implemented, and under what constraints.

The actual efficiency of a solar energy conversion system is directly related to the climatic conditions of its location. In regions such as Central Europe, the collection and conversion of solar energy is at least twice as expensive as in North Africa, in the Southwestern United States, or in the middle Asian part of USSR. The factor determining this difference is the amount of solar radiation--the insolation--received on the surface of the earth, and the proportion of direct solar radiation--that is, sunshine--in that amount. Linked to this factor are the technological options that can be implemented in the various regions, as is shown in Table 1. This gives a sampling of solar energy inputs, their levels are examples of the measured global radiation onto a horizontal surface in representative locations. The "global radiation" consists primarily of direct solar radiation (sunshine) and diffuse solar radiation (cloudy days). The "more useful" solar energy source is, of course, direct sunshine: it can be concentrated by heliostats (sun tracking mirrors) to produce high temperatures for generating steam that can power turbo-generators for production of electricity; and it can be used--again by concentration with mirrors--to increase the energy input on high cost energy absorbing surfaces such as photovoltaic arrays. In such a concept the energy output is increased, while the area of the expensive cells is decreased.

Diffuse solar radiation, on the other hand, cannot be concentrated. It can therefore be used only by either non-concentrating, high quality flat plate collectors for low temperature applications such as water and space heating systems, or by photovoltaic cells (without concentration), which deliver electricity from diffuse radiation as well. The overall system efficiencies of such photovoltaic arrays are generally in the order of 12 percent, and their cost at present is prohibitively high for large scale applications. It is very unlikely that they will contribute to a tangible decrease in fossil fuel demand before the year 1990.

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In Central Europe about half of the solar radiation is diffuse, which significantly reduces the amount of solar energy that can be converted to useful heat or to electricity. However, the solar energy inputs can be improved by proper orientation and inclination of the collector surface (i.e. South, 40°). This is a requisite for reaching the overall system efficiencies quoted in Table 1.

In the favorable desert regions with an annual solar energy input of over 2,300 kWh (thermal) per square meter, direct sunshine may exceed 3,000 hours per year, while a typical Central European value is near or below 1,500 hours per year, with a total solar radiation closer to 1,100 kWh (thermal) per square meter per year. The variations are as unpredictable as the weather, of course, and often relatively close locations have distinctly different potentials of the use of solar energy. For example, the elevation of a site and the quality of the air are among the contributing factors, which means that the polluted air in industrial areas significantly decreases the level of solar energy conversion potential.

Solar-Thermal-Electric Concepts

The practical solar energy conversion options are therefore dependent not only on the solar energy input levels, but also on the amount of direct sunshine. A large scale development of solar power plants in the favorable desert regions would permit generation of electricity in the terawatt range (1 TW = 1 billion kW) and the production of hydrogen or ammonia, making storage and transport of energy possible. An evaluation of current solar-thermal-electric concepts (STEC) shows that a field of heliostats concentrating solar energy on a receiver placed on top of a high tower currently offers a potentially competitive option in the long term. A 100 MW (electric) base load power plant of this kind, operating with an energy storage system in a favorable region and a number of hours comparable to those of a conventional power plant of today (6,000 hours per year), would require approximately 1.6 square kilometers of heliostat area distributed on a site of 4.0 square kilometers to minimize shadowing effects and provide space for maintenance operations. The 45,000 heliostats (the number is dependent on the design concept) would be concentrating the solar energy onto the receiver on a tower up to 200 meters high, generating steam for electricity production. Thermal energy storage in the working fluid of the system would provide for continuing operation when there is no sunshine.

STEC in Europe

Introducing the STEC option in "moderate" regions is more difficult, because of the increased proportion of diffuse solar radiation that reduces the attainable inputs for energy conversion and increases the requirements for energy storage. Nevertheless, electric power generation in these regions may still prove desirable when prices for fossil fuels increase significantly.

A recently completed case study on Austria indicates that practical use of STEC, connected with the existing network of hydroelectric power plants and their hydro-storage capacities, may be possible. This kind of hybrid installation could become attractive sooner than the base load version previously described, and might contribute to the reduction of demand for non-renewable fuels.

Solar Energy Input kWh(th)/m^2 · year	Typical Options and Outputs	Estimates of Attainable Systems Efficiencies (thermal)	(electric)	Typical Regions
2300 and above	Electric power generation and/or hydrogen production	0.60	0.20	Desert regions of North Africa, Southwest USA, Australia, etc.
1200 to 2200	Electric power generation. Industrial process heat. Heating and cooling	0.40 to 0.55	0.10 to 0.18	Moderate regions of North and South America; Asia, Australia, and primary regions of Southern Europe, etc.
1000 to 1100	Water and/or air heating for residential buildings and low grade process heat.	0.30 to 0.40	0.08 to 0.10	Secondary regions of Europe, Asia, Africa, North and South America, etc.

TABLE 1. Solar Energy Inputs and Possible Solar Options

The technology for building such power plants is in a phase of near term development. In fact, prototype versions are being planned and a few are even in construction. However, because of the large size of the plant for its relatively modest production capacity, and the high cost of thermal energy storage, such a plant would be about three to five times as expensive today as a conventional fossil fuel or nuclear power plant. In the long run the rising costs of fossil fuels along with further innovations in solar technology are expected to bring STECs into a more competitive position--after all, they do not require fuel.

In the event that the cost of photovoltaic arrays is reduced from the present US $17,000 per peak kW to less than $ 500, which may be the case in ten years, construction of large scale direct solar energy conversion plants may become competitive. However, the energy storage requirements would be more difficult to meet, because of the absence of working fluid that facilitates heat storage in STEC plants.

In addition, some Mediterranean countries also offer attractive solar electricity potentials. Assuming the implementation of the solar power tower concept, Figure 1 illustrates the relation of land use, potential solar electricity production and currently generated electricity in these countries.

Owing to the dilute nature of solar energy, a truly large area is required for collectors. It is often noted that one percent of a country's total area could be acceptable for solar energy plants. As indicated in Figure 1, Southern European countries could cover their present electricity demand with less than one percent land use. Still, in this case thousands of square kilometers would be covered by collector fields, representing a substantial impact on the environment. In addition to public acceptance of these huge collector

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Dr. Fredy Jäger, FRG, joined IIASA in March 1976 to work on the systems aspects of large-scale conversion of solar energy. He is from the Institute of Nuclear Energy of the University of Stuttgart.

fields, a number of questions must be solved prior to large scale deployment of solar plants. One of the more technical problems is, for example, the

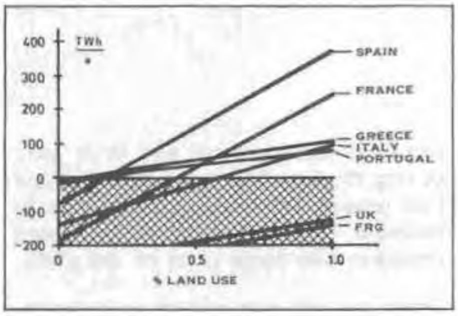

Figure 1: Potential solar thermal electricity generation vs. present electricity demand as a function of land use

determination of energy storage requirements in an electricity distribution grid with an increasing share of solar plants. additional large scale storage will affect system reliability and also increase overall electricity generation costs, a problem at present being studied by IIASA's Methodology Group.

Large scale constraints

History has taught us that it takes approximately five decades until a new energy source captures the majority of the market. Assuming that in countries such as France or Italy one percent of the land will be covered with heliostats within fifty years, some of the constraints of large scale solar electricity use can be determined. The building materials required turn out not to be a critical issue, as it should be possible to divert about five percent of the present annual steel production in these countries to solar electricity plants. But capital investments for solar systems are at present several times higher than for fossil fuel or nuclear power plants. These substantial capital requirements appear to be much more of a handicap than the material demand. However, some economic studies give rise to the hope that--at least in developed countries--national economies would not be overburdened by these capital allocations.

High capital costs of solar plants lead to non-competitive electricity generation costs. Only a sharp rise in fossil costs and no increase in capital requirements for solar plants through additional investments for protection of the environment--as in the case of nuclear and fossil fuels--could make solar electricity competitive by the end of the century. In case we decide to go ahead with the construction of solar plants, we will have to identify institutions or groups of society willing to invest capital in a venture with no immediate financial return.

Solar in the medium temperature range

The application of solar energy conversion systems in the field of medium grade industrial process heat (i.e. 100° to 200° C), and for space and water heating for family houses, may become economically attractive much sooner: when shortages of natural gas and heating oil develop.

The solar options in moderate and secondary regions (as shown in Table 1) are subject to similar considerations. To achieve adequately high substitution levels for fossil fuels, the number of installed and operating systems must be quite large; this means a considerable diversion of capital, materials, and, to a lesser degree, manpower. Because the alternatives are many and the attainable system efficiencies are subject to numerous uncertainties, some practical reference systems had to be developed to facilitate a reasonable assessment of the impact that large scale implementation of the most adaptable options would cause. This problem is compounded by uncertainties in insolation and cost data and in numerous other economic, social and institutional criteria. These questions must be resolved before solar energy can become practical in the secondary regions of Central Europe, where the demand for low grade heat for residential heating of space and water significantly affects the necessary oil imports.

IIASA is currently studying the possibilities of accelerating the use of solar energy conversion systems in the Federal Republic of Germany as part of the Energy Systems Program. Because of the moderate insolation levels in Central European latitudes, emphasis is directed to low temperature applications, mainly for space and water heating purposes.

Substituting fossil

The energy substitution potential of solar systems for combined space and water heating is estimated to be equivalent to 35 to 50 liters of heating oil per square meter of flat plate solar collector per year, depending upon the design and quality of such devices. This means, for example, that if a system is expected to reduce the heating oil consumption of a one-family house by 50 percent, somewhere between 30 and 40 square meters of solar collector surface have to be installed. The average saving of oil might then be in the 1,000 to 2,000 liter range per house per year, which is roughly equivalent to 6 to 12 barrels of heating oil (not crude oil). The energy requirements of heating water alone are only about 15 percent of the total heating demand. This figure clearly indicates that concentrating only on solar water heating systems would not lead to the desired effect of saving ample amounts of fossil fuels.

It is obvious that millions of houses would have to be equipped with solar systems before a significant level of substitution could be reached. In the case of the FRG, for example, the substitution of about two percent of primary energy by solar energy in the low temperature category by the year 2000 would require capital investments of roughly 20 billion dollars. In this case, 30 percent of all residential houses would be equipped with solar space and water heating systems by the year 2000, supplying about 10 percent of the heating energy for private homes.

A Sensitivity analysis

In order to evaluate the market penetration possibilities and the various constraints, a sensitivity analysis for identifying the governing parameters was made. Among these parameters were further technology development, mass production, and cost of heating oil. Based on the assumption that heating oil will cost twice as much in ten years as today, Figure 2 shows the impact these factors have on economic competition between solar and conventional oil heating systems. If a solar system that is now on the market for $ 10,000 starts operating today, it is far away from economic break-even during its lifetime of 20 years. The

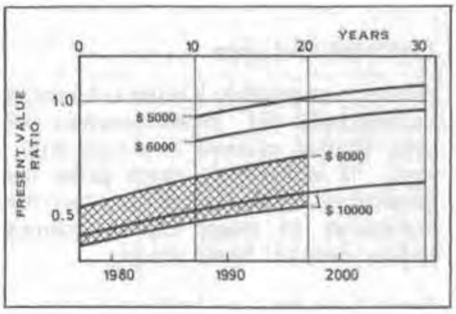

Figure 2: Break-even analysis for solar space and water heating systems in Central Europe

break-even line is defined as the line where the ratio of the present values (discounted total costs) of oil heating and solar heating systems equals 1. Variations such as drastic reduction of capital investment, increased life expectancy of the system, improvement of overall system efficiency, or a tripling of heating oil costs in ten years are within the shaded range and do not basically change the situation. Only a fairly low capital investment and the start of operations ten years from now yields an acceptable break-even point within a further decade. Therefore, we will probably see only scattered initiatives by individual house

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Yet another constraint

Are we altering the earth's climate?

J. Williams*

One of the most important tasks of IIASA's Energy Program is the identification of constraints on energy production and consumption. Many of these constraints have been given worldwide attention in recent years, but comparatively little has been said about the possible impacts of man's activities on our climate. Climatic changes have been observed on local or regional scale: urbanization leads to increased temperatures, increased cloudiness, increased rainfall, and other climatic changes. These observations make it necessary to ask whether our future activities could cause continental or even global climatic changes - even irreversible changes.

It is already clear that man's activities have caused inadvertent climatic changes at least at the scale of cities; and it is becoming increasingly apparent that man's activities could soon have an impact on global climate. It is therefore of great importance to investigate the nature of the "Climate System", the causes of climatic change, and to determine the impacts that man's activities could have.

IIASA's Energy Systems Program is investigating the impacts of different energy options (nuclear, solar, coal) on the global climate. The investigation, supported by the United Nations Environment Program (UNEP), will contribute to the Energy Program's overall evaluation of the medium-to-long-term energy options.

Climate is a very complex and non-linear system, composed of five sub-systems: atmosphere, ocean, cryosphere (snow and ice), land, and biosphere, which interact with each other. There are three ways in which energy systems can have an impact on the climate system:

- First, they can add heat to the system.

- Second, they can change the constituents of the atmosphere, in particular the carbon dioxide, water vapor and particle content of the atmosphere (other constituents are also changed, but are of less significance).

- Finally, energy systems can change the characteristics of the land surface, especially the "albedo" (which is the reflectivity of the land), the surface roughness and hydrological characteristics.

Evaluating three options

Nuclear power plants release waste heat. Energy production through coal means waste heat and changes in the atmospheric constituents, especially carbon dioxide and particles. The solar option changes the characteristics of the land surface. It is with regard to these effects that our energy options have to be evaluated.

There always have been climatic changes--natural changes. It is against these natural changes that we must compare the possible changes caused by man. Meteorological observations have only been recorded during the last 200 years or so and it is only during the last 100 years that we have had enough information to be able to estimate how the climate has been changing over large parts of the globe.

There are still not enough meteorological stations to give us a clear picture of how the climate is changing over the Southern Hemisphere, and the number of stations in the Northern Hemisphere, away from densely populated areas, is barely adequate. For the period for which we have no recorded observations, the climatologists must use proxy records, such as tree-rings, pollen, ocean sediments, and ice layers, to derive information about the earth's past climate. About 10 million years ago, a substantial cooling of the earth's climate occurred, mountain glaciers grew in the Northern Hemisphere and the Atlantic ice sheet grew; this time is taken as the beginning of the present ice age. During the last one million years, continental ice sheets have advanced and retreated in the Northern Hemisphere, with a period on the order of 100,000 years. At present we are in an interglacial period, which began when the ice sheets covering North America, Europe and Asia retreated some 10,000 years ago. The peak of the interglacial warmth was about 5-7,000 years ago, when it was warmer than today. The period from about 1430 to 1850 A.D. is referred to as the Little Ice Age, when in Europe and North America it was markedly colder than today. Within the last 100 years the Northern Hemisphere experienced a warming between the years 1800 and 1940 on the order of 0.6° Celsius, and between 1940 and 1970 a cooling of about 0.3° Celsius. There is some evidence that this cooling has now stopped.

The nuclear option

The impact of waste heat on climate has been studied by IIASA in a joint project with the Meteorological Office in the United Kingdom (the details of this work have been published in two IIASA Research Memoranda*). A computer simulation model of the atmosphere that was developed at the Meteorological Office at Bracknell, U.K., is being used to study the effects the release of large amounts of waste heat would have on the Northern Hemisphere. The concept of large-scale nuclear energy parks determined the scenarios selected for investigation. 10 to 20 times as much energy as the earth's population is using today was

*Dr. Jill Williams from the U.K. came to IIASA in August 1976 from the Climatic Research Unit of the University of East Anglia, Norwich, England, to work on the impact of energy systems on climate.

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owners and possibly a more substantial development by implementation of solar heating systems in public buildings. It is certainly much easier for government funded institutions than for individuals to invest capital without seeking early economic return.

Apart from delay in starting operations, reduction of capital investment will mean a decisive improvement for implementation of solar options, as has been demonstrated by the sensitivity analysis. The most promising way to reduce solar hardware costs will be mass production. However, industry is not likely to build up mass production capacities without an assured market. On the other hand, consumers will not buy the systems unless they are competitive. This will eventually lead governments--provided they are in favor of solar energy--to subsidies, either to producers or to consumers, thus resolving this dilemma. Such support is likely to be in the billion dollar range for each percent of primary energy substitution. It is during the next few years, while experimental solar systems are being tested, that a decision will have to be made--for or against large scale implementation of solar energy options.

released into the atmosphere in different simulations at points representing energy parks. It can be concluded from the results of these simulations with the atmospheric circulation model of the Meteorological Office that the waste heat has had an impact not only in the vicinity of the energy parks, but also in other regions of the Northern Hemisphere. The response of the simulated atmosphere varied according to the location of the energy parks, the total amount of heat, and the manner in which the heat was inserted. Further work on the subject of waste heat will include a study of the impact of megalopoli on climate.

The fossil fuel option

The subject of carbon dioxide and climate has recently been receiving a lot of attention at IIASA and elsewhere. Since the beginning of the Industrial Revolution the large-scale combustion of fossil fuels has been releasing CO_2 into the atmosphere. The carbon dioxide content of the atmosphere has risen from about 290 parts per million volume (ppmv) at the end of the 19th Century to more than 320 ppmv at the present. About half of the fossil fuel CO_2 released each year remains in the atmosphere, while the rest goes into the oceans and possibly the biosphere. The significance of the increase of atmospheric CO_2 is apparent when the radiative properties of the gas are considered. CO_2 is relatively transparent to the incoming shortwave radiation from the sun, but it absorbs quite significantly the long-wave radiation coming from the earth's surface. Part of this energy absorbed by the CO_2 gets radiated back to the earth's surface and thus the CO_2 acts as a sort of blanket. An increase in the atmospheric CO_2 content therefore implies an increase in the earth's surface temperature.

If we continue to burn fossil fuels at an increasing rate, then the atmospheric CO_2 content could be twice its pre-Industrial Revolution level within the next 50 years. Simple but reliable models have shown that a doubling of the atmospheric CO_2 content would lead to a 1.5 to 3 degrees Celsius temperature increase. Details of the climatic changes to be expected are still not determined, but it is clear that questions regarding the sources and sinks of carbon dioxide, the impact of increasing atmospheric CO_2 on the climate, and the consequent implications for environment and society require urgent attention. It is hoped that a workshop will be held at IIASA in early 1978 in which the problem of carbon dioxide, climate and society will be addressed.

The solar option

If solar energy, which is the third main option, were used to provide for the energy requirements of, say, 10 billion people, the amount of land that would be covered by arrays of heliostats (mirrors which focus the incoming solar energy on to a tower--see article in this issue--where the consequent high temperatures are used to produce secondary energy carriers, e.g. electricity, hydrogen) would be on the order of several million square kilometers. The large-scale changes of reflectivity, surface roughness, and possibly hydrological characteristics could have an impact on local, regional, and, possibly, global climate. A workshop was held at IIASA at the end of 1976 to discuss the impact of solar energy conversion systems on climate. At this workshop, the physical characteristics of several solar energy conversion systems were described and their climate implications were discussed. Available tools (models and case studies) for studying these climate impacts were also outlined. The proceedings of this workshop will soon be published and further studies of this problem will be made in cooperation with other institutions using climate models and also with case studies.

It is clear that man's conversion of energy, whether by nuclear, fossil fuel or solar systems, could have an impact on global climate. This constraint on the use of energy systems will have to be taken into account when options are compared and strategies developed. While there is still much to be learned about the climate system and the nature of climate variability, our present tools and available knowledge must be used to give at least a warning of possible inadvertent climatic changes and their consequences.

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*RM-76-79: Murphy et al.: The Impact of Waste Heat Release on Simulated Global Climate. December 1976. $ 1.50
RM-77-15: Williams et al.: Further Studies of the Impact of Waste Heat Release on Simulated Global Climate: Part 1. April 1977. $ 1.50
RM-77-34: Williams et al.: Further Studies of the Impact of Waste Heat Release on Simulated Global Climate: Part 2. April 1977. $ 2.50

Professor Howard Raiffa of Harvard University, Director of IIASA during its initial years from 1972 - 1975, returned to the Institute in June for a three-week visit (our picture shows him together with his successor, Dr. R.E. Levien, right). Prof. Raiffa's visit was only the beginning of an "invasion" of alumni coming to Laxenburg to continue their participation in our research activities: During a three-week stay, Prof. C.S. Holling and his team of ecologists from the University of British Columbia worked on the completion of their book on "Adaptive Impact Assessment" and held an exceptionally successful task force meeting attended by analysts and decision makers to review the draft manuscript. From the GDR, we welcomed back Prof. Hans Knop, who has been putting the finishing touches to the TVA study while participating in the Shinkansen Conference. In the Resources and Environment Area, Prof. Wes Foell has returned from the University of Wisconsin to continue his work on the interactions between energy and the environment. Prof. Sergio Rinaldi and his team from Milan have come back to carry on their water quality model investigation. We have had shorter, but valuable visits from Dr. Eric Wood of Princeton, who is completing a manuscript on real-time management of water resources for our international series; Prof. Alan Manne from Stanford, who has been working with the Energy Program; and Prof. George Dantzig, also from Stanford, who visited the Energy and Food Programs and the Systems and Decision Sciences Area; and recently, Prof. Leonid Kantorovich arrived from Moscow to spend two months at the Institute.

High-speed railways

THE FUTURE OF MASS TRANSPORTATION?

The impacts of modern mass transportation systems on the economy, on population development and migration, and on the environment were intensively discussed at IIASA at the end of June when the Institute's Management and Technology Area held a conference on Japan's famous bullet train "Shinkansen". During this four-day conference, some 70 economists, environmentalists, and experts in railroad development and population dynamics investigated this most advanced railway system of the world. The Shinkansen Conference was the first stage of IIASA's third case study on large-scale development programs.

The word "Shinkansen" literally means "new trunk line", but in reality it is much more than a modern high-speed rail system operating in the densely populated corridor between Tokyo and Hakata in Japan. Conceived by the Japanese National Railways (JNR) in the late 1950s, and opened for passenger service in October 1964 after only five years of construction time, the accomplishments of the Shinkansen project are highly impressive. More than 1 billion passengers have used this revolutionary means of transportation since the first 500 km line started operating between Tokyo and Osaka. An additional 500 km now connect Osaka with Hakata, and construction of Shinkansen lines is continuing. Plans call for the linking of all major islands of Japan with the Shinkansen system--a total length of over 7000 km.

Why would IIASA consider the Shinkansen an appropriate subject for a major international conference? The Management and Technology Area of IIASA is concerned with a series of case studies on large-scale planning programs and their relationship to regional development. The two previous case studies conducted by the Institute focused on the Tennessee Valley Authority (TVA) in the United States and the Bratsk-Ilimsk Territorial Production Complex (BITPC) in the Soviet Union. The Shinkansen is a good example of a systems analytic approach to solving the specific problem of increased mobility needs between major population centers.

Fast, safe, and reliable

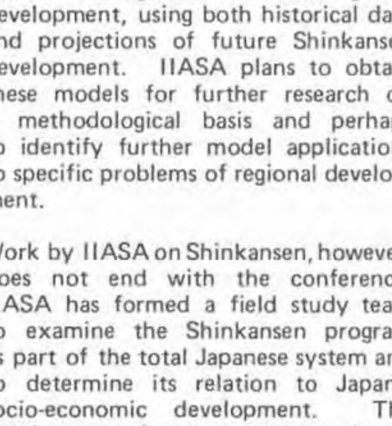
Before the inauguration of the Shinkansen, trips between Tokyo and Osaka, for example, required an overnight stay when ground transportation was used. It is now possible for businessmen and tourists to travel between the two cities, carry out their activities, and return the same day. Highly impressive is the safety record of the Shinkansen: although maximum speeds of more than 200 km/h are reached, giving the train an average speed of 136 km/h (including stops!), there has not been a single fatal accident since the first line started operating in 1964. The most important impact, however, can be seen in the accelerated growth of the major cities along the line and the transformation of the corridor into a huge megalopolis. These two aspects of the Shinkansen--the use of systems analysis in planning reliable and safe high-speed transportation through the use of sophisticated electronics, control devices, and computer applications, and the subsequent impacts on regional and cross-regional development--convinced IIASA of the usefulness of conducting a case study of the Shinkansen project.

The conference consisted of a four-day program of plenary and discussion sessions. The Japanese delegation, under the leadership of Koichi Miyasawa, included a team of sixteen from JNR, headed by the Deputy Chief Technician, Masayuki Nishida. During the first day of the meeting, papers on the history, operation, and problems of the Shinkansen were presented. The second and third days dealt with problems of the safety and automatic control system, determination of the social and economic impacts, environmental problems, management and operational systems, and land development. The final day was devoted to a general plenary session to discuss the results of the conference and the relevance of the Japanese experience for Europe and North America.

Preliminary results

One highlight of the conference was the presentation of two very complex computer simulation models developed in Japan, which attempt to define the effect of the Shinkansen transportation system on regional and cross-regional development, using both historical data and projections of future Shinkansen development. IIASA plans to obtain these models for further research on a methodological basis and perhaps to identify further model applications to specific problems of regional development.

Work by IIASA on Shinkansen, however, does not end with the conference. IIASA has formed a field study team to examine the Shinkansen program as part of the total Japanese system and to determine its relation to Japan's socio-economic development. The Shinkansen, of course, will be closely examined in its own right; but it is of special interest to IIASA's NMOs to determine the subsequent impact on Japanese society, and whether similar transportation systems would be advantageous for Europe or North America on a cross-regional or international basis.



"The International Institute for Applied Systems Analysis is one of the most remarkable international institutions we have; it was founded at a time when detente was a hope and it now stands the test at the time of implementation of this policy."

Dr. Bruno Kreisky
Federal Chancellor of
Austria

News from IIASA

"IIASANET" coming along

Two important events have taken place recently in the development of "IIASANET", as it is becoming known. First of all, on-line access is now permanently available to CNUCE (the Italian National University Center of Electronic Computation) on a leased line, and interactive computation at the Computing Research Center, UNDP, Bratislava, has become a reality. While neither of these two links is yet on a packet-switched basis, this, the second phase in implementing IIASANET, is most important for the general practical experience gained on use of the systems. Scientists from the Areas are already using the powerful machines at CNUCE, in particular for support of the SESAME/DATAMAT system developed by William Orchard-Hays of our Energy Program.

Students' program at IIASA

This summer, for the first time, IIASA will be running a summer students' program. Approximately 12 to 15 advanced graduate students (mainly from the USA and the Soviet Union) will be spending between two and three months (from June through August) working with the research areas as research assistants. The purpose of the program is to familiarize the students with IIASA's work in systems analysis and to impart some of the spirit of international cooperation which plays an important role at IIASA. Besides working in the areas, the students will also have a special program of seminars and other activities.

Prof. Wolf Häfele,

Deputy Director of IIASA and Head of the Institute's Energy Systems Program, has been elected a Foreign Associate of the National Academy of Engineering of the United States.

Decision makers at IIASA

Applied research demands close interaction between analysts and decision makers. One way to achieve this is for the analyst to go to the decision maker. In many instances IIASA has followed and will continue to follow this path. However, there is a second possibility: to bring the decision maker to the analyst. For IIASA, this has the advantage of making his experience and concerns available to a larger group of IIASA staff and of exposing him to a wider range of IIASA work. It also provides an opportunity for decision makers from different countries who face the same problems to come together to share experiences. This June marked an especially auspicious beginning for our efforts in this direction. We were pleased to welcome the Deputy Minister of Agriculture of the Soviet Union, Dr. Boris Runov, for a ten-day stay. He spent his time in intense interaction with the members

of our Food and Agriculture Program as well as in discussions with the Institute Leadership. (Our picture shows him with Prof. Ferenc Rabar, left, the Head of IIASA's Food and Agriculture Program.) In addition to Deputy Minister Runov, we have had the honor and pleasure of playing host to Mr. John Busterud, former Chairman, Council on Environmental Quality, Executive Office of the President, Washington, Dr. Martin Holdgate, Director General of Research, Department of the Environment, London, and Mr. W. Evan Armstrong, Assistant Deputy Minister, Environment Canada (from left, together with Dr. W. Matthews of IIASA's Resources and Environment Area. They were here attending Professor Holling's task force on Adaptive Assessment of Ecological Policies.

Recently Published

Collaborative Publications

CP-77-002, Methods of Systems Analysis for Long-Term Energy Development, Yu.D. Kononov, editor, $2.50

CP-77-003, The Bratsk-Ilimsk Territorial Production Complex, Proceedings of the Second IIASA Conference on Case Studies of Large-Scale Planning Projects, March 22-25, 1976, H. Knop, editor, $14.20

Research Reports

RR-77-007, Optimal Allocation of Artificial In-Stream Aeration, S. Rinaldi, R. Soncini-Sessa, $1.50

RR-77-009, Dual Systems of Dynamic Linear Programming, A. Propoi, $1.50

RR-77-010, Stable Taxation Schemes in Regional Environmental Management, S. Rinaldi, R. Soncini-Sessa, A.B. Whinston, $2.50

RR-77-011, Quotatone Apportionment Methods, M.L. Balinski, H.P. Young, $1.50

RR-77-012, Traffic Control Systems Analysis by Means of Dynamic State and Input/Output Models, H. Strobel, $3.50

RR-77-013, Lobbying and Campaigning with Applications to the Measure of Power, H.P. Young, $2.50

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