options

a IIASA news report

... published quarterly
by the International Institute
for Applied Systems Analysis

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The WELMM Approach

M. Grenon*

The traditional ways of estimating costs in energy and mineral deployment need to be replaced. A new approach developed at IIASA allows the expression of the costs of resource deployment in terms of water, energy, land, manpower, and material demands. This may be a first step to an integrated and interdisciplinary systems approach to resource management.

Liquid fuels nowadays represent a large part of the energy demand in most countries and especially in developed countries. The market penetration of oil has been one of the most rapid in the history of energy, partly because it is a very convenient energy to produce, use, and transport. It is clear therefore that the demand for liquid fuels will retain an important share of the world energy demand during the coming decades. On the other hand, the conventional oil resources that have been proved to date do not seem capable of sustaining this demand in the long term; it is therefore wise to begin thinking about alternatives to conventional oil, i.e., "Synfuels."

Synfuels can be produced from different energy sources, and by means of different technologies: tar sands and oil shales are of particular interest, as well as fuel from coal liquefaction, or alcohol from biomass (sugar cane or manioc, for example).

*Professor Michel Grenon, an international consultant on energy problems and policies, joined IIASA's Energy group in January 1974.

These alternatives generally rely on resources that quite often have a *low energy content*, and on technologies that, at present, have *strong environmental and socioeconomic impacts*. A 140,000-barrels-per-day (bpd) facility for tar sands in Canada will, for example, require the use of up to 1.5×10^6 bpd of water (i.e., about 10 bpd of water for every barrel of oil), will use 20,000 acres during its lifetime, and will need 7,000 to 8,000 workers for its construction. Although very different, the same type of potential constraints on large-scale development exist for the Brazilian alcohol program: the use of an important share of unused arable land for the future cultivation of sugar cane presents, apart from the risks inherent to a strong one-crop agriculture, the disadvantage of withdrawing good pieces of land from other potential agricultural use.

These examples of the new liquid fuels clearly show that an energy strategy has strong systems implications with a complex set of natural and human resources.

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These implications, if not carefully studied, might lead to the emergence of severe conflicts. In fact, once natural resources are considered at specific locations, in specific forms or in economic terms, conflicting requirements appear, which call for a systems analysis method that will first assess and then try to balance them.
For this purpose, the WELMM method has been developed at IIASA and first applied to the problem of determining energy strategies. WELMM stands for an assessment of the *requirements* and the *availability* of Water, Energy, Land, Materials and Manpower resources. This method aims to provide sufficient knowledge in order to carry out a global analysis that takes into account both quantitative and qualitative interrelations of these resources. The spirit of this approach can be roughly summarized by the motto, "Man does not consume energy alone, but WELMMITE." The WELMM approach was initially developed within the framework of the Energy Program; its natural further development is continuing in the Institute's Resources and Environment Area.

In the following section we will describe two main topics:

- The development and organization of various data bases, which are the basic tools of the WELMM analysis. The data bases were developed by the Resource Group (1979) with the collaboration of many outside organizations because the WELMM analysis could not rely on poor and often incoherent existing data.
- Different applications of the WELMM approach which are being used to obtain insight into certain energy strategies.

WELMM's Basic Tools

In order to assess the WELMM requirements for different energy supply options and the availability of such resources at national, regional and global levels, the first step is to collect, analyze, and list all relevant information in a suitable format so as to allow its easy handling and manipulation for desired applications. Two types of data bases have been developed: the *Facility Data Base* and the *Resource Data Bases.*

The Facility Data Base contains the WELMM resource requirements for *constructing* and *operating* various typical energy facilities — e.g., coal mines, oil fields, coal unit trains, pipelines, tankers, conversion plants, or power plants. In fact, these "facilities" are industrial units considered at one of the stages of valorization of an energy resource. Each stage can be characterized by a process — e.g., gaseous diffusion, centrifugation and laser for uranium enrichment, or pipeline and tanker for crude oil transportation. An energy facility can be associated with each process. Fortunately, there is a tendency towards size standardization that makes WELMM resource accounting easier — e.g., gaseous diffusion plants of 10-million separative work units, crude oil tankers of 250,000 to 300,000 deadweight tons, nuclear reactors of 1,000 and 1,300 MW(e). Ultimately, it might be possible to have standards for similar facilities, for a given technology, and for a certain industrial development of a given geographical region.

To date, approximately 100 facilities have been studied at IIASA, of which about 50 have been computerized. Additionally, 65 coal mines have been studied (the target is to represent 100 mines) and their data have been entered and managed in the Facility Data Base somewhat differently because of the specific character of the extraction processes when compared with other facilities.

The management system used for the Facility Data Base is called INGRES and was developed at the University of California at Berkeley and adapted at IIASA. Supplementing INGRES is a system called ENERTREE which was developed at IIASA; ENERTREE links the data base and the application programs, thereby permitting a hierarchical access and simplifying the task of the end user.

The Resource Data Bases

In addition to the accounting of WELMM requirements as discussed above, another type of accounting is needed and has to be done in parallel. Here the focus is on determining a region's potential to contribute, through its resources, to the national or even international economy. These "regional accounting" schemes form what we call Resource Data Bases. Two types of Resource Data Bases are currently being set up, depending on the type of regional accounting desired. Indeed, because there are two different ways of defining a region, two different accounting methods and two types of data have been used.

For the first method, we start with a given natural deposit and draw around it the region that would be affected by possible exploitation. This requirement is served by the *Global Resource Data Base*, which collects information on WELMM resources associated with giant or supergiant deposits of fossil and mineral fuels. Data are gathered on the geographical and geometrical parameters of the deposit and its possible status in the McKelvey classification (identified, hypothetical, speculative, subeconomical, and so on), on the geological parameters of the deposit and its geological environment, on the possible simultaneous occurrences of other minerals and/or fuels, on potential, present, or past exploitation, and on historical production. In addition, data on land and water resources associated regionally with the deposit are gathered and filed, especially for the various factors that would be of importance should the exploitation of the resource be planned on a large scale. This data base has so far been developed only for unconventional oil resources, which seem to be of particular importance for future energy strategies.

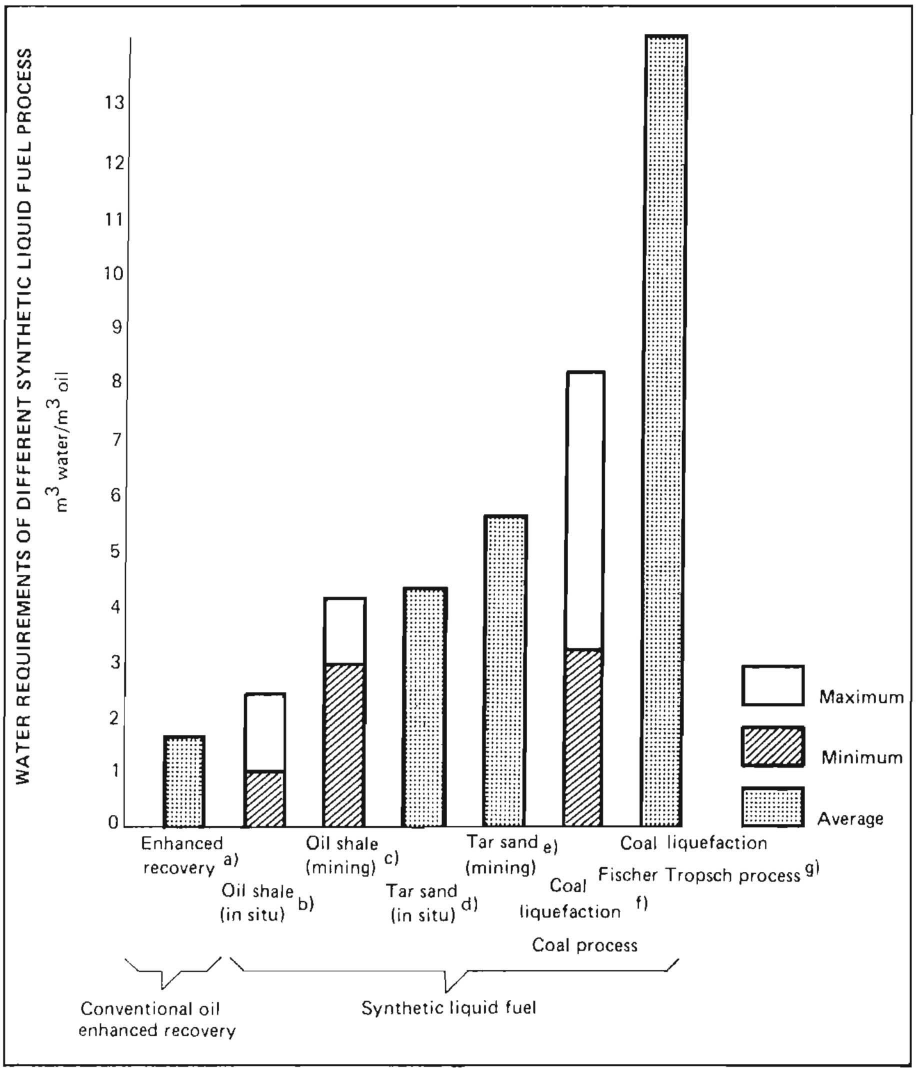
The second method for defining a region is to take into account the social, geographical, political, or administrative determinants. One is then able to estimate all the potentials of that particular area: energy and mineral deposits, solar resources, biomass, availability of land and water, and so forth. The main concern of this data base is then no longer a giant resource (an energy deposit in a certain area), but a collection of "small potentials" that are of particular importance for selecting an optimal local regional energy strategy. This data base is called the *Regional Resource Data Base* and includes information from different fields; the WELMM parameters are divided as follows: *water* — permanent water, underground water, rain gauge; *resources* — fossil and fissile resources, geothermal resources, wind, solar; *land* — land use and land cover, topography, geology, geophysics; and *population* — density of habitation, and so on. The Regional Resource Data Base is being developed and tested over an area of 10,000 km^2 in southern France; this region has been divided into unit cells of 1 km^2, for which information provided by, for example, the Geological Survey, Landsat, and the Geographical Institute is recorded.

WELMM Applications

WELMM data can be combined either statically or dynamically in order to compare energy strategies on a local, national, regional, or global basis.

First, different processes and technologies have been studied. For example, nine energy chains producing electricity have been compared with special attention to their land and material requirements. There were four chains producing electricity from coal, three from nuclear power and two from solar power. Different processes for producing liquid fuels (synthetic fuel from coal and fuel from unconventional oil) were also studied. These two studies brought useful insight into the resource and human constraints of technologies and processes that an energy strategy has to rely on. An example of the results of such a WELMM analysis for some new synthetic liquid fuels is shown in the figure.

Secondly, at a regional or national level, supply schemes have been designed in order to meet a predefined demand for a country or a group of countries. For example "all-solar" and "all-nuclear" scenarios have been studied for France, showing the extreme constraints of such supply schemes especially on materials, manpower, and land-use. Mixed scenarios are now being compared.



Water requirements for different synthetic liquid fuels compared with enhanced recovery of oil. An example of results obtained through a WELMM analysis of energy technologies.

Finally, at the local level, a study is being carried out on the way a small region can use its local resources in order to achieve better regional development. This study uses the Regional Resources Data Base and attempts, as a first step, to make an assessment of the regional solar resources and the way in which they can contribute to the local energy requirements without coming into conflict with past and planned agricultural policies. A comparison of the advantages of a centralized supply strategy as opposed to a decentralized one will be of particular interest in the study of the simultaneous exploitation of the regional solar potentials. We are currently making such a study, sponsored by the Energy Power Research Institute (EPRI), for photocell technology.

Apart from all these "in-house" applications, interest has been shown in applying the WELMM approach to the development of the resources of the northern semiarid region in Mexico (an agreement has already been signed), and in assessing the WELMM impacts of the alcohol and oil shale programs in Brazil (an agreement is under discussion).

Reducing WELMMITE Constraints

The solution to one resource problem should not create a shortage of another resource. For example, one should not choose an energy option that places too high a constraint on land or water.

The type of information that is obtained from a WELMM analysis may provide decision makers with additional knowledge of the natural resource aspects related to energy strategies. This is especially true since physical data are not likely to fluctuate as widely as monetary data. In fact, when prices or financial data are either lacking or uncertain (which is often the case for long-term strategies and new technologies) it is useful to express the natural (and human) resources in physical terms or, as we say, in "WELMMITE" requirements and to emphasize their systems implications and interrelations.

This new systems approach to energy — or more broadly speaking to development strategies — supplements classical economic analysis, and is a possible building block of multiattribute, multicriteria decision-making analysis.

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Being Environmentally Prepared

For several years, a scattering of scientists and administrators in several countries have been making environmental management adaptive to nature's surprises. They are convinced that their techniques will work for a variety of environmental problems in all kinds of national settings, and they want to spread the word. Last year, some of them wrote a book on the adaptive approach. Now the book has become the basis for IIASA's first Executive Report. The report puts the adaptive approach into a few words, as noted in the following article.

An encounter with a crocodile on a mountainside may not be very likely, but nature is full of surprises. And, when environmental management fails to allow for them, the results can be disastrous. Such disasters in the face of good intentions are so common that scientists and administrators specialized in environmental matters generally agree that something must be done.

A number of these environmental experts now feel that something has been done. At the least, they feel that adaptive environmental assessment and management is the most promising approach to environmental problems yet to be devised. Its champions say the approach offers effective and relatively inexpensive assessment procedures for determining the impacts of environmental proposals. And later, after programs have been initiated, they claim it keeps management flexible.

The approach evolved from research on renewable resource problems in different national settings — disease control in Venezuela and Argentina, range and wildlife management in the U.S., oceanographic problems in Europe, ecological process studies in the USSR, pest management systems in Canada, and others. Articles on two of these problems have appeared in OPTIONS: spruce budworm and forest management in Canada (Winter 1977, page 1) and land use and development in Obergurgl, Austria (Summer 1978, page 3).

Last year, with help from IIASA, the United Nations Environment Programme, and several other institutions, some of the scientists who developed the adaptive approach wrote a book on their findings: *Adaptive Environmental Assessment and Management* (Wiley, 1978). A review of the book also appeared in OPTIONS (Autumn 1978, page 6). The book makes adaptive techniques available to anyone who wants to try them.

Recently, the adaptive approach as described in the book has become the subject of the first in a new series of IIASA publications. These are Executive Reports, designed to convey IIASA-related research findings to a wide readership, especially to those who can act on them, such as executives in government and industry.

IIASA Executive Report 1: Expect the Unexpected puts the adaptive approach into a few words. To respond to environmental problems, adaptive environmental assessment and management brings together representatives of the constituencies involved right away. A carefully chosen team defines the problem, puts boundaries on it and the information essential to address it, gathers this information, uses it to build computer models, uses these models to develop alternative plans, explains the plans and possibly recommends one of them to people with authority to act, and reviews the problem situation after action has been taken.

Change is an integral part of the program from the earliest planning stages onward. This sets the stage for an ongoing, evolving program rather than a one-shot attack on the problem. Knowledge gained in efforts to assess, regulate, manage, and monitor man's environmental impact is used to improve these efforts.

To keep the proceedings open to change, the adaptive approach depends on close interaction of people. The executive report notes that the approach starts with a meeting of a small group, usually led by someone from an environmental agency with a problem. The group includes at least one person who is familiar with adaptive techniques. This initial group defines the problems to be addressed and sets limits on the types and amounts of information needed to resolve them.

Agreement is not sought at the outset

Once the objectives of the contemplated program have been sketched out, the group must choose or recommend a project leader, a "core team," and some prospective participants in a series of workshops. Core team members attend all these workshops to provide continuity. Outside experts participate in the workshops occasionally to offer fresh views and detached evaluations of the progress.

Workshop participants reflect a wide range of opinion. Since the adaptive approach is meant to resolve conflicts, the project leader does not seek a consensus at the outset. Free discussion among individuals representing conflicting factions promotes the development of programs that are both workable and flexible.

Flexibility is also encouraged by keeping the accumulation of data to an essential minimum. Quantified information must bear directly on the specific problems that have been singled out for solution. This information is converted into one or more computer models. Then, as key links between factors are identified, needs for new data to define these relations more precisely are likely to emerge. A research phase preceding the next workshop introduces the new information as it becomes available and is needed. When the model is built, alternatives can be tested and recommendations made.

The process involves continuing interaction among managers, experts, and analysts. Upon completion of the project, the managers return to their organizations with a set of well-articulated plans. Then monitoring begins. Subsequent workshops can be part of a continuing process of evaluation. Monitoring allows management people to evaluate the program continually and adjust to the unexpected when it occurs.

The report sketches out a year-long assessment project, suggests how computer modeling is used, and ends with a simple case study of the adaptive approach in action. *IIASA Executive Report 1: Expect the Unexpected: An Adaptive Approach to the Environment*, International Institute for Applied Systems Analysis, A-2361 Laxenburg, Austria. Single copies may be obtained free of charge from the IIASA Publications Department.

Adaptive Environmental Assessment and Management, edited by C.S. Holling, ISNB 0-471-99632-7, can be ordered from John Wiley and Sons Ltd., Baffins Lane, Chichester, Sussex PO19 1UD, England. The price is $16.50.

Innovation and Efficiency

H.-D. Haustein and H. Maier*

Innovation, the process of creation, development, use, and diffusion of a new product or process for new or already identified needs, has become a topic of concern for both developed and developing countries. The causes and motivations for the concern differ widely from country to country.

Some countries that have taken the superiority of their technological ability for granted are now faced with a slowdown in the rate of productivity advance and a tendency to stagnate. Other countries, which in the past were successful in generating social and technological change, now have to realize that the current economic environment, especially the resource situation, needs new technological, managerial, and social approaches in order to deal with the new circumstances.

		Take-off	Rapid growth	Maturation	Saturation
Example		Microelectronics	Agricultural machines	Textile industry	Shoemaking industry
Predominant type of change in production units		New establishments	Enlargements	Total modernization	Rationalization
Degree of technology change	Product	Very high	High	Medium	Low
	Process	Low	Medium	High	Low
Technological policy for growth: mainly oriented towards		Push	Push and compensation	Compensation	Compensation and continuation

Table 1. Life cycle of an industry.

At the same time, developing countries are faced with growing imbalances between their responsibility to secure and improve the living conditions of more and more people and their technological and social capability to use their natural and human resources. Certainly the social systems in these countries are different, but all countries share a need to manage technology in a way that will improve production efficiency in order to create goods that will satisfy human needs.

Despite claims to the contrary, we do not believe that these problems can be solved by using today's technology, much less yesterday's. We have to realize not only that it is in the nature of technological innovation that nobody can be sure that his advanced technological position can be held indefinitely, but also that many current problems (shortage of energy and other natural resources, the growing imbalance between natural and human resources, and so on) are consequences of deeper structural problems in the world economy. We believe that many of the difficulties in the present structure of the world economy reflect a reduction of social and technical innovation. Therefore, we can now find in many countries a strong desire to develop a national innovation policy in order to overcome this stagnation.

IIASA Workshop

Development of effective innovation policies is a universal problem, which fits well into the research directions of IIASA. Research on innovation policies started at IIASA in 1978, and at the end of 1979 a workshop entitled "Innovation Policy and Firm Strategy" was held. The 60 participants from 17 countries showed great interest in one key problem which has been studied by the Innovation Task group in the Management and Technology Area: socioeconomic efficiency, its pattern in the innovation cycle and the opportunities for management to control it. The decline in productivity growth rates over the last 15 years in all developed countries is a great challenge to socioeconomic management.

The workshop indicated a desirable focus for the future work of the Innovation Task group at IIASA. Efficiency and structural change are closely linked with basic innovations in major industries. Therefore we will concentrate our efforts on four industries: the energy industry, the microelectronics and computer industries, mechanical engineering, and the forest and paper industry. We will study individual case histories in these industries at the take-off stage, the stage of rapid growth, the stage of maturation, and the stages of saturation and crisis. This work must be done in close connection with experts from the industry and we hope to obtain results that will help to improve the management of firms at the national and global level.

Dynamic Efficiency in the Innovation Cycle

Innovation is not a goal in itself, and it is not possible to measure the rate and importance of innovations by calculating their frequency or identifying the input and output characteristics of a single innovation. The main purpose of an innovation is to improve the efficiency of the production unit that adopts the innovation, in comparison with the efficiency of the entire production system. By efficiency we mean the input/output ratio that the production unit can realize under the given economic circumstances.

Therefore, knowledge about the development of the relationship between the efficiency of the production units that have adopted the innovation and the average efficiency of all production units that are producing competitive goods to meet special needs is quite crucial for an understanding of the different strategies of firms within the process of their development and the scope of opportunities to influence the firms through national innovation policy.

The dominance of special types of innovation (basic innovation, improvement innovation, or pseudoinnovation), the role of product and process innovations, the typical barriers and stimuli, and appropriate management skills and tools very much depend on the stage of development of the ratio between these different types of efficiency. We will try to demonstrate this approach with the following scheme (Figure 1).

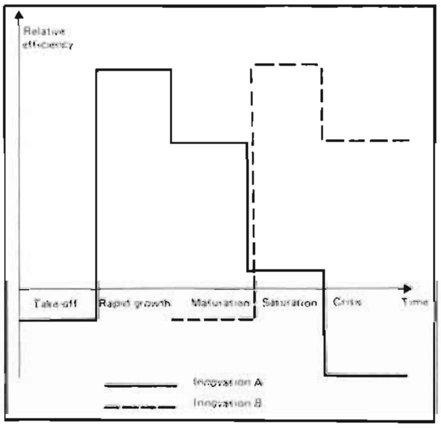

Figure 1. Dynamic efficiency in the main stages of an innovation.

To grasp the nature of the innovation process, its impact on the economic performance of the country, and to identify the appropriate managerial actions to shape and stimulate the innovation process, it is very important to understand the five different stages through which the innovation process usually runs:

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*Professor Heinz-Dieter Haustein of the Economic University "Bruno Leuschner" in Berlin, GDR, joined IIASA's Management and Technology Area in August 1979.
Dr. Harry Maier of the Central Institute of Economic Sciences of the GDR, joined IIASA to work with the Management and Technology Area in July 1978.

Innovation and Efficiency

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- *Stage I:* The take-off stage of a basic innovation. For most basic innovations (for example, nuclear energy and solar energy) the efficiency of the innovating unit will be lower in this stage than the average efficiency of the production system as a whole. Most companies follow a "wait and see" policy because they feel that no matter how advantageous it would be to be first, it is more profitable to let someone else assume the costs and risks of product development.
- *Stage II:* The stage of rapid growth and the gaining of a "monopoly rent" from innovation. The opportunity to gain "extra high efficiency growth" from the innovation is very important as a stimulus for the decision to implement an innovation.
- *Stage III:* The stage of maturation with a large number of imitators. During this stage, production units improve their ability to imitate product and process innovations that were generated in other production units. The greater the advantages of adopting an innovation in terms of productivity increase, production quality, and process uniformity, the more rapidly its diffusion will occur.
- *Stage IV:* Saturation stage with the prospect of stagnation. During this stage, incremental innovations especially become more and more important. Cost reduction and the increase of labor productivity are the main results. Because production has become capital intensive, and large scale, the implementation of major change in either product or process becomes difficult. This makes these production units more and more vulnerable to alternative technical solutions. But this is also the latest point at which a new direction of production may be started.
- *Stage V:* The stage of crisis. Production units that were not able to respond creatively to the new circumstances and the new radical technological options will now try to hold their position through product differentiation, superficial design changes, larger efforts in marketing and advertising, and the improvement of old technologies. Incremental innovations become more and more pseudoinnovations.

We analyzed the time path of relative efficiency in the case of incandescent lamps. Figure 2 shows the relationship of annual increases in efficiency of the lighting industry (incandescent lamps) to those of general electrical engineering, assumed to be a constant 6 percent per year. The history of incandescent lamps shows a rapid increase in the efficiency of the first stage due to the transition from the laboratory to mass production and the subsequent reduction of costs.

The stage of rapid growth reached a peak before the First World War. At the same time gas lighting began to decline: the battle had been won by electric lighting.

After the First World War, there was a long period of smaller improvements. The strongly monopolized industry was not willing to change the product's characteristics. Only the introduction of fluorescent lamps before the Second World War gave a certain push to the improvements in incandescent lamps. After the Second World War we had a typical saturation stage in the lamp industry, with large-scale effects and important process improvements. The new halogen lamp brought a positive

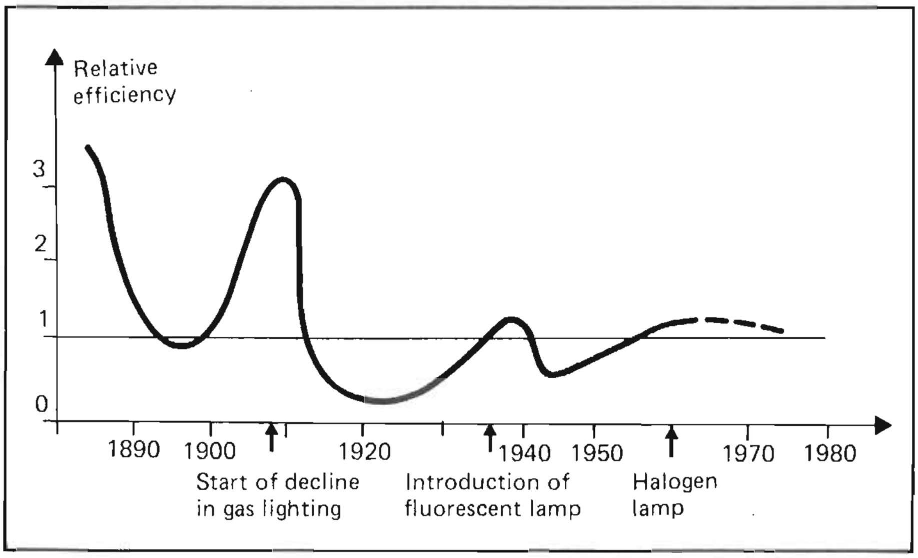

Figure 2. Relationship of annual increases in efficiency of the lighting industry (incandescent lamps) to those of electrical engineering.

impact on production characteristics and so the saturation stage may continue.

Therefore we have, in the case of incandescent lamps, 15–20 years of "take-off" stage, 15 years of "rapid growth," 20–25 years of "maturation stage," and more than 35 years of "saturation." A similar pattern of efficiency development was identified by Abernathy (1978) for the U.S. automobile industry.

Efficiency development is determined by the improvement of product and process characteristics and it does not necessarily follow an invisible line of technological possibilities. It is more likely to be shaped by hard economic interests, such as competition with gas lighting, cartel policy, and other factors. The typical upswing and downswing pattern is certainly an invariant, although its specific time pattern is not, and that is where economic and organizational stimuli can play a role.

National Innovation Policy and Firm Strategy

The relationship between government innovation policy and firm strategy, or the balance between macroeconomic stability and microeconomic stability, cannot be improved in a straightforward manner by investing heavily in science and technology without

- Taking into account the different roles of basic innovations, improvement innovations, and pseudoinnovations
- Improving the capability of society to provide information about future fields of innovation
- Identifying different side effects from innovations and implementing measures to stimulate the positive effects of the technology while blocking the disadvantages
- Strengthening the scientific and educational infrastructure for innovation
- Realizing that government action concerning innovation can cause very different results in different stages of the innovation process
- Taking into account the global dimension of innovation

The State of the Art

The exploration of innovation is itself a process that has run through different phases of investigation and in which different topics and analytical tools have dominated. It is possible to distinguish three phases in our efforts to better understand the innovation process over the last 2 decades:

- The beginning of the 1960s, in which problems of R&D management, planning, and forecasting were at the center of attention.
- The mid-60s, in which it was recognized that higher expenditure in R&D does not automatically result in a higher rate of innovation. The result was the sequential model of innovation which stressed the importance of technological realization and commercialization for successful innovation.

- The beginning of the 70s, in which it was recognized that demand for innovation and a production unit's ability to adopt an innovation very much depend on the economic environment in which the innovation has to operate and on the stage of development of the production unit.

The dialectic of our thinking brought us back to problems that such economists as David Ricardo, Karl Marx, and Josef Schumpeter have left us. Obviously we are now faced with the need for a new step in the analysis of the innovation process. The central question for innovation research is, What are the conditions and implications for the realization of basic technological innovation in major production fields to overcome the expected shortage of natural resources, such as energy and minerals (Häfele 1979) and to secure the better use of human resources and genuinely improve living, working, and educational and cultural conditions of people and their health standards on both the national and global level?

The current shortages and imbalances are not unique from a historical point of view. Mankind has always found ways in the past of overcoming these problems with the help of basic technological and social innovations. However, this was mostly done in a spontaneous manner, through a slow learning process of shocks and catastrophes, with disastrous consequences for people. We see a commitment for systems analysis to help implement new forms of social, innovative learning that can avoid national and international catastrophes, and to

- Give innovation policy a more concrete orientation towards human needs
- Create societal protection mechanisms against unintentional, indirect, or delayed disadvantages of technology
- Secure interlinkage between technological and social innovation
- Contribute significantly to solving global problems

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News from IIASA

The November Council Meeting

The IIASA Council, the governing body of the Institute, held its thirteenth meeting in Laxenburg on November 16 and 17, 1979. As it always does at its November meetings, the Council gave final consideration to, and approved, the Research Plan and Budget for the coming year. In addition, the Council explored new research directions for the Institute in the eighties. This discussion was of particular importance since the Energy Systems Program will soon publish a major report of its findings and is expected to complete most of its activities by the end of 1981. Similarly, the Food and Agriculture Program expects to complete its currently planned work in the early 1980s. The Council gave preliminary consideration to a number of candidate topics for future research programs, such as Regional Development, Global Climate, Risk, and Industrial Change. Since the decision is of major importance for IIASA's future, the Council members expressed their desire to consider the alternatives in more detail and to discuss them in the NMO's. Plans for research to follow the Energy Systems and Food and Agriculture programs will be developed further during 1980.

The Council also approved the preliminary program for the Second IIASA Conference, which will be held in Laxenburg from May 19 to 22, 1980. This second major forum, required by the IIASA charter to provide broad scientific and technical advice to the Council and the director, will report on the Institute's activities and achievements during the past 4 years. The theme adopted for this conference is "Applied Systems Analysis: From Problem through Research to Use."

As on previous occasions, the Council voted the title of "IIASA Honorary Scholar" to officers of the Council who are leaving. Mr. Jacques Lesourne, representative of the French Association for the Development of Systems Analysis, retired from the Council after having served the body for 5 years; he was vice-chairman of the Council from 1974 to 1978. His place will be taken by Mr. Andre Danzin, former director of the Paris-based Institute for Research on Informatics and Automation (IRIA).

Mr. Jacques Lesourne, member of the IIASA Council (1974–1979) and IIASA Honorary Scholar.

Dr. Andrei Bykov

Also voted an Honorary Scholar was Dr. Andrei Bykov of the Soviet Union, who has served as Secretary to IIASA since the Institute's inception and who has played a major role in IIASA's development. Dr. Bykov is assuming new responsibilities as deputy director of the All-Union Research Institute for Systems Studies in Moscow. His successor is Dr. Arkady Belozerov, also of the Soviet Union.

FAP Demonstration

In early November, IIASA's Food and Agriculture Program — led by Professor Ferenc Rabar from Hungary — demonstrated its Simplified System of National Food and Agriculture Models to representatives of the FAO, UNCTAD, the OECD, and IIASA's own collaborating institutions. The Simplified System is the first step in IIASA's systems analysis of the global food situation. By simulating the behavior of world markets under different national agriculture policies, the model will begin to provide insights into ways to make the global distribution system more effective. As each of the collaborating national research groups produces refined versions of the models of their national agricultural economic systems, these will replace the simplified models to improve the validity of the simulation. The 2-day demonstration established the feasibility of the system for use by national groups developing their own models, and as a methodological tool in its own right.

Conference Report

Forestry: An Issue for the Eighties – and for IIASA

Forests provide mankind with its greatest renewable resource: wood. They are the basis for one of man's most capital-intensive industries, with a capital–production ratio of 7:1 per year. In addition, wood has always been one of man's primary energy resources. During the past decades, however, burning wood for energy has become less and less important. The use of wood for the production of pulp, paper, and lumber for various purposes has become dominant. The development of vast industries linked to the use of this renewable resource has led countries to take the step from simple "mining" of the forest – i.e., cutting trees without reforestation – to careful management of this resource. Forest management involves complex decision processes ranging from those that determine the right place and time to cut trees to those that organize reforestation programs.

This huge industry is at present going through a major transition. New, advanced technologies in forest management and in wood processing are being introduced, demanding more sophisticated management approaches. In addition, the dramatic increases of oil and gas prices are upsetting the relationship between their prices and the price of wood. This could again seriously distort energy production and distribution patterns, and also reintroduce wood as a serious energy alternative in some places.

This highly complex resource deployment problem and the conflicting objectives in forest use have led IIASA to initiate a new interdisciplinary study within its research topic "Industry – Issues for the Eighties." At a recent workshop at the Institute, some 50 managers and scientists from industry, research institutes, and universities from NMO as well as non-NMO countries came together to explore the scope and possibilities of this new venture. During their meeting, the participants not only focused on "national" production problems, but also on the world market. It was suggested that IIASA should carry out a world market study, making use of its existing work on world economic modeling. At present, 98 percent of the pulp and paper imports of OECD countries are exports from other OECD countries – a situation not likely to change dramatically in the short run. In the long run, however, new forest industries in countries such as Brazil could make a very strong impact on the world market. Apart from these market considerations, the conference participants emphasized the need to develop advanced overall methods for forest management that will take into account new technologies and that could be used as guidelines for new forest resource development. This work would be done in close collaboration with industries and scientific institutions in the traditional forest industry countries of Finland, Norway, Sweden, Canada, the United States, Japan and the Soviet Union. IIASA's role in this work would mainly be twofold: as an information center and as a consultant on methodological questions. This work would include a critical review of the state of the art of systems analysis in the forestry sector, studies of computer applications in the pulp and paper industry, inquiries on innovation problems, investigation of regional effects of the forest industry, and an assessment of the role of the forest industry in national economies.

Discussions are now taking place within the major countries concerned. A workshop to discuss and compare existing forest sector models will be held later this year, and it is hoped that the world market study will be launched in 1981.

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OPTIONS
a IIASA news report
Published quarterly by
The International Institute
for Applied Systems Analysis
Public Information Section
A-2361 Laxenburg, Austria
phone 02236/7521
telex 079137
Editor: Peter R. Schlifke
Layout: Atelier Dorfinger-Klapetz
Printed by Novographic
Vienna, Austria