

ENERGY RESOURCES AND SOCIETAL NEEDS:
FUTURE STRATEGIES AND ALTERNATIVE FUTURES

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Statements made by the participants in the Salzburg Seminar in American Studies were summarized by the rapporteur without the benefit of checking with the speakers. It is hoped that these summaries have not abused the sense of the contributors' ideas.

P r e f a c e :

On Saturday, 28 June, IIASA--represented primarily by the Energy Project--hosted at Schloss Laxenburg a Symposium held jointly with the Salzburg Seminar in American Studies, on the theme:

"Energy Resources and Societal Needs:
Future Strategies and Alternative Futures".

This was part of the Salzburg Seminar's 3-week, 162nd Session on "Energy, Population and Affluence: The Future of the Earth's Resources".

The Symposium was attended by 92 persons (including sixty Fellows and Faculty of the Salzburg Seminar)--see List of Participants attached. It consisted of a morning session at which six papers written by Seminar Fellows were presented and discussed--see List of Papers attached. The afternoon session was devoted to a panel discussion on the theme of the Symposium, in which Faculty members of the Seminar and IIASA scholars participated.

The Symposium was opened by Prof. Raiffa, who welcomed the participants to the first in a series of IIASA/Salzburg Seminar Symposia.

The questions dealt with by the Symposium reflected the concern with growing demand for energy, its impact on the environment, questions on what causes wasteful energy consumption, whether it is a moral problem, what are the limits to growth of consumption, what is the role of education, could standards for energy and environment be set and implemented, what is the decision making process, and finally what could be the role of

international organizations and IIASA in these global matters that transcend national boundaries.

In his closing statement, Prof. Häfele noted that at Salzburg, where he had earlier addressed the Seminar, and at the Laxenburg Symposium, the discussions had shown no disagreement on the thinking that energy is not resource limited--a view that was not shared by the "Club of Rome" and news media. However, living without resource constraints would not mean an easy situation. Responsibly handling large physical amounts of energy, because of their impact on climate, atmosphere, hydrosphere, ecosphere, sociosphere, constitutes a tremendous burden, particularly since it calls for decisions that have to be made on the basis of assessments, without trial and error. While we are beginning to learn in these matters to cope with the dimensions of time, we have not yet sufficiently understood the dimension of space. The new technology requires large territories that often stretch over many national boundaries, as for instance in the case of the solar energy project in the Canton Islands (that was discussed at the Salzburg Seminar). Changing technology from thousand megawatt stations to a terrawatt dimension calls for operations on a global basis. Here it is believed that many environmental concerns could disappear under the ground rules applying to a properly handled global mechanism. While these matters call for more technological R+D work, the situation in many countries is that the conditions for creative R+D have decreased. This is depressing, because the most difficult technological problems are still to come. On this point, the discussions at Salzburg and Laxenburg showed large agreement within the group that the most pressing problems were of an institutional nature, with respect to time, space and increasing compartmentalization of nations (instead

of regional or global approaches). The problem of interaction between technology and the socio-economic domain, was reflected in the Panel's discussions on the setting of standards, regulations and procedures for their implementation. This was considered to be the "hottest" and most difficult question, one that IIASA has had in mind for some time. Prof.Häfele recalled the historic experience in "push and pull" for standard setting, and found that the situation is better now than it was 100 years ago, when industrialization started. Therefore, one should perhaps look at the global political situation in terms of internal, social politics and not as foreign policy. This outlook would require an international mechanism, for handling social questions, as well as technology.

Finally, Prof.Häfele invited the group to reflect on the relative position of science. He remarked that we should look at the limitedness of the domain of science. A statement frequently heard is that once you deal with a problem scientifically, you have the most comprehensive, the objective approach. However, such a statement can no longer be fully maintained. Particularly in modern physics, and following from that in other disciplines as well, thorough reflections on the cognition value of objectivity have been made. Much clearer than ever before, the dimensions of values and thereby non-objectifiable elements, have emerged. This is quite relevant for systems analysis, as it applies to decision making, where a scientific analysis of the optimal policy mixes is in itself a tool for decision taking. There is no substitute for values. However, if we reflect on the relative position of science, its domain and features, and if we face the full richness of reality as a whole--then chances are good for doing a scientific job well.

I. Discussion of the Papers Presented

W.Häfele (IIASA) thanked the Fellows of the Salzburg Seminar for the presentation of their papers that provided a good introduction to the issues and problems raised by the energy resource question.

R.Gardner (Salzburg Faculty) opened the discussion, stating that he agreed with much of what had been said but drew attention to two strains of what he called romanticism that he had detected in the presentations: one a firm belief in the industrial growth rates as a good thing and the index of progress. He referred to the projected growth of industry in the paper on "Energy Resources and Societal Needs in Rumania: Future Strategies and Alternative Futures" presented by Petre Prisecaru and Ottavian Olarw). The other "romanticism" was the assumption that people, manipulated by the media, craving for power and possessions, indulge in excessive consumption and that education could change consumption, as indicated in the papers on "Energy and Social Organization" by A.Bressand and "Some Cultural and Individual Aspects of Energy, Population and Affluence" by H.Wenidoppler. In Prof.Gardner's view, one cannot re-educate people against material consumption, wants and desires that are fundamental and thus solve the energy problem. Rather, he emphasized the need for better societal management, energy conservation through technology, and recycling of resources used in material goods.

P.Prisecaru (Rumania) pointed to the reality of his country's projected industrial growth rate as the only possibility for the nation's reaching higher standards of living.

W.Häfele pointed out that the problem was not so much whether a certain growth rate can be achieved, but whether it induces an im-

balanced environment. In reply to this question

P.Prisecaru (Rumania) drew attention to the Rumanian Government's program on Environmental Protection that had been adopted throughout the country.

W.Häfele invited IIASA scholars to make statements on the theme of the symposium that related to the specific aspects of their work in the IIASA Energy Project.

C.Marchetti observed that Bressand's paper did not indicate to the newcomers--to whom it is directed--the essential tools to sort out the important and the possible from the trivial. One such tool is "energy analysis" where all energy used at various levels in the system in order to produce a certain good or service, is accounted for. He took as an example the case of the recycling of glass from bottles, which at the present stage of technology would result in zero savings of energy (because of the energy required to melt the used glass). He also drew attention to trends in economic and technological developments, leading to greater efficiency of energy utilization, and hence savings of energy. As an example he gave the 60 years' history of energy consumption for producing ammonia, where the specific energy consumption (Kcal/kg) has been reduced about 60 times in the last 60 years.

Mr.Charpentier, working at IIASA on the engineering approach of the analysis of energy consumption, drew attention to the fact that 75% of the world population had an annual energy consumption of less than 2KW per capita, that 22% (including Sweden, German Federal Republic and France) consumed 2-7 KW per capita, while 3% (U.S.,

Canada) consumed more than 7KW per capita. Not attaching too much value to these averages, he found the study of budgets, or composition of energy consumption more interesting.

He referred to the analysis of minimum budgets of around 2KW per annum per capita comprising food production, private transportation and household heating and lighting and use of various appliances, which are important for the analysis of energy consumption relative to income and prices. Moreover, he had found that at the level of 8-9 KW per annum per capita, the energy item expense budget of a Western European middle class was very similar to that of an average American family.

Mr.Moss asked what were the minimum requirements of energy consumption, what would be an objective structure, what would be the impact of the cultural "factor".

Prof.Harrison Brown found it opportune to pursue the discussion of points raised by Prof.Gardner why is mankind going to where it is going, how does it happen that luxury goods become necessities? How is it that goods that do not meet the biological needs for survival, do enter the models for future consumption and energy demand? What are the roots to the energy demand?

In the ensuing discussion on how the decisions for energy consumption are derived at, Mr.H.Köpp (F.R.G.) referred to the Netherlands' experience with carless Sundays, where the public's acceptance

of government decisions provided an illustration of the potential for re-education.

Mr.H.Wenidoppler restated his feelings that not everybody in a Western society could make his own decisions on what he really needed (i.e. intimidated by advertising, feeling like a dropout when buying a small car) stating the need for re-education of the consumer to avoid utter chaos.

Mr.Gruen [recalling Mr.Gardner's statement on romanticism] urged for a human scale of mankind's activities, and that the use of energy be balanced at a level not too far below and not too far above the markstone of human needs. Thus, basic research was required to find out what were the markstones of our society's needs for energy, in order to save mankind (from a disastrous imbalance).

Prof.Häfele stated that there was need for research on the ground rules, the technology for standards to be set up, and their application. In this connection he recalled the US experience in setting standards on the emission of SO₂ [sulphur] control, that were subsequently altered in the light of needs developed from the oil crisis. It was emphasized that the underlying scientific problem was how to set up the standards and what could be done to implement the standards.

Prof.Häfele then invited Mr.Avenhaus to make a statement on Mr.Ar's paper on the "Question of Population, Energy and Environment in Turkey".

Mr. Avenhaus remarked that the presentation of Mr. Ar was of a very special interest to the members of the IIASA Energy Systems Project because a sub-project had been established since the beginning of this year where it is tried to develop "societal equations", i.e. equations relating to state variables, as population, gross national product, energy consumption etc. for a model society. At a later time, education should be included as another state variable. Referring to this sub-project, and in line with the comments given by Mr. Brown, Mr. Avenhaus was interested to know whether the Turkish government or any group in Turkey had given thought to the future development of the state variables discussed by Mr. Ar, if not in form of quantitative relations between these variables, then at least in a quantitative form. As an example, Mr. Avenhaus asked if there simply was a goal in the form of "increasing energy consumption" or if there was a goal that related energy consumption growth and population growth for the time being as well as for the future.

Mr. E. Ar (Turkey) indicated that Turkey was rich in fuel resources (including lignite), and that with expected nationalization more fuel could be produced, that there was also awareness of pollution, but not much coordination between these policies. Turkey had these slogans: "More energy must be produced" and "more consideration is needed for the environment", but as stated above, there was no coordination as yet.

Prof.Häfele drew attention to the process of decision taking and recalled Sweden's nation-wide debate on alternate fuel sources to be used to sustain a growth rate of energy consumption that is to amount to 2% annually for the next 10 to 20 years, after which time it is to level off.

Miss Holmstrom (Sweden) re-affirmed that the government had financed 2/3 of the cost of study circles to educate the public for a debate on national energy questions, that took place all over the country. It resulted in certain parts of the population not wanting nuclear energy, whereas others felt that societal needs for energy must be met, and that this needs to be done by nuclear energy.

Mr.T.Winnicki (Poland), referring to Mr.Ar's presentation on the environmental education problem stated that as professor of environment engineering, he found that there was a tremendous shortage of individual and social consciousness of the environment. He had suggested use of the term "eco-culture" that should be considered as kind of education from the very early stage up to the university level both in social sciences and engineering technical sciences. Primarily, he had thought about conventional nature preservation and some shortages of certain raw materials and about consciousness of designing new technologies and products in the meaning of environmental purity. After a few discussions and listening to Prof.Brown, he came to the conclusion that this was only part of the problem, because we had reached a very difficult psychological point on the freedom to take an individual decision in a democracy. He felt that it was probably not the time any more to give the individual the opportunity to make some of the important decisions that had to be taken by society.

Mr. Bressand recalled that technological decisions have the greatest impact on our lives. He disagreed with Prof. Winnicki on the role to be given to the technocrats and thought that one of the major challenges of our time was the education of scientists and the public to allow for better democratic processes.

Mr. Weyss (IIASA) made a statement to the effect that the minimum requirements of energy and the economic growth rates need to be looked at in absolute terms and not in percentages. A poor country which has less than one kilowatt per capita consumption has the right to a faster growth (e.g. a rate of 10 or 15 percent) to reach the so-called "minimum" of 2 kilowatt per capita consumption mentioned in Charpentier's report.

Prof. Häfele pointed out that this would lead to a restatement of the problem mentioned earlier on who sets the standards for energy consumption.

Mr. E. Hödl (Germany) made a remark on Prof. Brown's thinking of an "objective structure" which is conditioning people in their decision taking. He felt that while this objective structure exists, in a way, we do not know exactly how it functions. What was the influence of private enterprise on this objective structure? Would it become necessary to somewhat limit the autonomy of private enterprise in a society in which private enterprise made the main decisions on energy resources, environment, etc.?

Prof. Häfele pointed out that private enterprise has a time horizon of 7 to 10 years, while the energy decisions must count with a much longer time span, of 30 to 50 years. And the problem was how to bridge this gap? In this connection, he invited Prof. Tsvetanov to make a statement on his work on energy demand, that was part of IIASA's Energy Project.

Mr. Tsvetanov recalled the 2 lectures given by Prof. Häfele in Salzburg (26 June) on IIASA's work in the field of energy resources and societal needs. He indicated that part of the energy project carried out at IIASA were the energy demand studies, consisting of "conceptual problems" (linked with other IIASA work in systems analysis), the engineering approach to energy demand (see Mr. Charpentier's statement, p. 5-6) and finally the econometric analysis of energy demand, which investigates the elasticity of response of energy consumption to the change of income, prices and other determinative factors. In this context, he asked what were the relationships between technology, demand function, and preference functions. To keep the discussion simple, he assumed that the technology could be represented by linear inequalities which relate the final demands to gross outputs and resource endowments. Thus we have

$$1) \quad q \leq Ax$$

$$2) \quad q \leq Br$$

where the inequalities represent the constraints under which the economy of a country or a region must operate.

In addition, there is a preference function for the economy. The preference function may simply be the market demand functions in the case of a market economy, or the plan in the case of a planned economy, or some mixture of the two in a mixed economy. The economic problem can be seen as maximizing the preference function $u(q_1 \dots q_n)$ subject to the constraints of the technology:

$$\max u(q_1 \dots q_n)$$

subject to

$$q \leq Ax$$

$$q \leq Br$$

He then offered the following remarks:

1. When considering the preference function for an individual sector, such as the energy sector, it is important to note that determination of the preference function is one of the most difficult parts of the problem in projecting future resource needs or in making policy analysis.
2. In both planned and unplanned economies the preference function reflects the relative valuation (or tradeoff) between different final goods that the economy can produce, and differences in the tradeoff will lead to quite different patterns of resource utilization.
3. The two important final goods - the value of environmental quality and the value of energy consumption may have different relative valuation in different economies. Depending on these very different results, different standards and technologies will be used for control of emission, or for location of industry. For the market economy countries it is possible, mathematically to integrate a set of market demand functions where the quantities demanded are a function of prices, income, tax and institutional structure to determine a preference function. For goods which are allocated by central planning, the preference function is formulated by the planners. Nevertheless a large share of the final goods are allocated in part by decisions of individual consumers or firms. The knowledge of the individual decisions is very important in guiding the planning process and could be represented by a consumer response function which relates the desired quantity of final goods to the income of the individual consumers or

firms and the relative price of different consumer goods:

$$q \leq f(y, p)$$

where q is the purchases of the final demand vector, y is the income and p the vector of prices of final goods, including taxes.

On the basis of these considerations Dr. Tsvetanov gave a formulation of the economic problems. He emphasized his feeling that the preference functions are an essential ingredient in making future projections, in performing policy analysis and in understanding the evolution of energy systems. Most models, for example either ignore international or interregional trade or model trade as a competitive process. The main problem is how to model the reaction of nations or regions to possibilities for trade. In the light of recent events on the international energy market, one suggestion would be to assume that each region plan so as to maximize the preference function of that region, and that the equilibrium of this joint maximization could be considered as a possible outcome to the process of international trade.

Prof. Häfele emphasized that IIASA is not engaged in providing the solutions to problems, but that it is IIASA's task to prepare scientifically the ground on which a solution may be possible.

For this reason IIASA is engaged in making an analytical study of the energy demand in Western and Eastern economies that might some day serve in the decision taking process of governments.

Mr. de Jong (Netherlands) raised the question of what would happen if each country took their decision on nuclear power programmes in isolation? He made a specific reference to the Netherlands, that because it was so densely populated, had a problem where to set up nuclear power plants.

Prof. Häfele replied to this question by indicating that on this question IIASA had prepared a major study "Applications of Nuclear Power other than for Electricity Generation". This paper had been submitted to the European Nuclear Conference held in Paris, April 21-25, 1975.

Mr. V. Gruen referred to the Swedish debate on energy and recalled a poll taken in Austria, where 55% of the persons asked had stated that they considered atomic energy as more dangerous than conventional energy sources, and where 33% had been in favour of a stop to building more atomic energy plants even if it meant giving up energy consumption. He considered the option of the 33% to use less energy as a significant popular acknowledgement, given the lack of public education on energy questions.

Mr. Grenon (IIASA) made a statement on the energy crisis, defining it as a relation between demand and supply, believing that there is more supply than we think. He also saw a need for revising energy demand, composed of the level of consumption and population projections, since in his view the population explosion was not progressing as expected.

II. Panel Discussion of the Themes of the Symposium

Prof. Raiffa called on IIASA scientists to continue with their presentations before embarking on a general discussion by the Panel.

J. Weingart (IIASA) prepared a commentary on the paper "Energy - Some British Options" by Mr. Tresham. His main points were that;

- 1) If the proposed tidal barrage facility (4.5Gwe) were developed, it would produce 15 percent of the total 1971 kilowatt hours of electricity or displace about four percent of total primary energy in the U.K. Hence it could not be considered an energy option of any significance unless it were characteristic of a much larger generation potential from tidal power.
- 2) The wave machine generation proposal of Mr. Tresham was interesting in that the annual production of 65 million metric tons coal equivalent of energy (in the form of electricity) would correspond to 20,000 Mwe (on the average) and would produce roughly 70 percent of the total Kwhe produced in 1971. He questioned the detailed sources of such projections (cost, technology, potential capacity in the UK) etc.
- 3) Some of the specific statements made by Mr. Tresham regarding environmental degradation, the role of technology and the role of the environmentalists, were subject to strong argument. For example, his statement that "an unrelenting technology has turned this planet into a slum" was challenged on the grounds that an unrelenting population growth was much more characteristic of places in the world which could be described as slums and that more and better used technology would undoubtedly be required, not less, together with reduction in population growth in order to improve conditions in these places.

Mr. Weingart made a final comment on the role of technology in improving the lot of the bulk of world population. He pointed out (as had Harrison Brown and others in the past) that the per capita "standing crop" of materials in the industrialized countries is enormous compared to that in the poor countries. To provide a world of seven billion people with a standard of living requiring the same per capita materials requirements as in the rich nations today would require over a hundred years using the total 1972 world output of metals, concrete and other materials for over a century.

Hence, he concluded, if we are concerned about attempting to do something significant about the conditions of life for most people in the coming fifty years, we will need models for human settlements which "overlap" the Western models, which can provide attractive levels of housing, sanitation, communication, food production, nutrition, etc. with far smaller per capita requirements for materials and energy. The development of effective alternatives of replication of the West in the poor countries is, Dr. Weingart feels, a major challenge for the coming hundred years.

Prof. Raiffa called for discussion by the Panel.

Prof. Harrison Brown reverted to the question of personal consumption and asked what were the limits, if any, to the growth of energy demand [assuming that there were no technological limits]. What would be the effect of a 10% growth in US affluence? Will European, Japanese societies approach the US level of consumption of materials and services, will the US level of consumption continue to grow?

He saw several categories of consumption consisting of "personal" (including housing, food, education, communication, culture, recreation, personal services) and public consumption (including military), and felt while for some of the sub-items a limit could be envisaged, there was virtually no limit in sight for the consumption demands imposed by military requirements and certain personal consumption as culture and recreation. He therefore thought that the US "standing crop of materials" required would also go up, and hence its energy requirements. He also cited empirical evidence for the growth of needs for certain items (i.e. cars) in reply to a question from Mr.Koepp (FRG) and he thought that a study of the various elements of consumption patterns was very important.

Mr.J.Galbraith drew attention to the institutional constraints. He stated that measuring well being by comparing GNP, or stocks of equipment, or materials used per capita would not permit valid comparisons between countries. He felt that (US) private companies engaged in R+D had no interest in implementing the result of the research and therefore had rather a retarding influence. He therefore felt that the limitations to the development of technology were of an institutional nature (in Western countries).

Dr.J.W.McKie remarked on the statement concerning "wasteful habits" of consumption developed in the USA that were socially conditioned, not related to wants, and needed to be curbed. He thought that behavioral scientists find it difficult to define human "levels of wants", "levels of preference", and asked what was the mechanism to control and alter levels of want? He thought that instead of philosophizing on want, one should rather talk of "redistribution of income". Referring to the remarks on defects of private enterprise decisions in free market economies in allocating resources and

hence consumption, he asked whether centrally planned economies could do better, and what mechanism would they have for long term decisions?

Prof. Raiffa asked the Panel for more comment on the control mechanism.

Prof. L. Moss (USA) commented on Prof. Gardener's statement on the liberating influence through the acquisition of goods. He felt that the marginal benefit of certain appliances was rather low, yet energy consumption was high. Moreover, no "liberating influence" was felt, as people had to maintain their appliances. He believed that the market forces would regulate energy consumption, and that a "high" price of energy would re-allocate resources, a process in which the poor will be hurt more than the rich, and that this was a case for re-allocation of income? As to the specific question should government or private enterprises make decisions on long term energy planning, he doubted that a central bureaucracy was best equipped for such task, and advocated the use of the market system, but with attention to income distribution.

Mr. Rabar (IIASA), reverting to the earlier discussion on "wasteful consumption" stated that consumption by one group could become a moral problem when it endangered the consumption by "others", who could be defined as "whole humanity" or "future generations".

He referred to the 3 dimensions of the problem of an expanding society that called for a re-examination of the meaning of "others" and recalled a recent conference that showed the impact of a doubled world population on food requirements. He drew

attention to the "Club of Rome" presentation of a model that shockingly showed that from the technological point of view there were no limits to doubling food production, and that the constraints were economic and institutional.

Mr.Sazanov (USSR, IIASA) made a statement to the effect that the developed countries' concept of measuring development by (high) quantities of materials, i.e. energy consumed, needed to be changed. May be the ratio of low energy input per output (i.e. France) versus high energy input per output (i.e. Saudi Arabia), was a better criterion for measuring achievements in development.

Mr.Walters (IIASA) recalled that the Industrial Revolution had at first created very poor life styles, and when entrepreneurs had been asked to improve conditions they had responded like today's industry towards environmentalists. However, technology had worked to bring about decent conditions. Thus, as regards Mr.Galbraith's statement on how best to implement (useful) technology, and get the decision makers to invest, it was necessary to use imaginative bargaining techniques.

Mr. Hans Flederer (Germany) made a statement on re-education, finding that we must keep in mind that industry does not just want to destroy the environment. If there were limits to what industry was doing, it was up to government to point out these limits, as it had been done for instance in the case of DDT.

Prof. Raiffa introduced Dr. Gorham, IIASA scholar of the Urban and Regional Systems, and asked him to summarize the views.

Mr. W. Gorham recalled Harrison Brown's concern with the absence of limits to certain types of consumption in large countries, and their possible impact. He shared Prof. McKie's and Moss' worries with selecting aspects of consumption which are acceptable or not acceptable. He recalled their reliance on the market to make the allocations, and Prof. McKie's view that this was a problem of redistribution; he referred to Mr. Rabar's statement on consumption as a moral issue, and he recalled the view that political leaders operated with a time horizon that was too short.

With all the elements that go into decision making, he saw one avenue, namely minimum levels of consumption. He also felt that there was need to qualify the indicator (heretofore GNP per capita) for meeting of the human wants.

Mr. Marvanyi (Hungary) thought that the avenue opened up by Mr. Gorham led to nowhere. A changing of consumer habits would require a change of the fiber of society. He therefore agreed with Prof. Gardner's statement on the romanticizing of economic growth as well as consumption.

Prof. Majone (IIASA) gave some further comments on the question of the regulatory activities of governments. He referred to the U.S. who had about 50,000 standards, and nobody had ever tried to see whether taken together they made sense, or as is more often the case, they were not contradictory. He considered this as an example for the fact that we know very little about the methodology of the complex activities that result in setting a standard, or the choice of alternative ways of regulating the economy. He felt that neither the "public interest" theory (whereby government acts as custodian of

ill defined public interest) nor the "capture theory" (where government issues regulations that are captured for the interests of particular pressure groups) could really explain the complexities of the ways in which governments are setting regulations. Thinking in particular of the energy and environment field, he suggested that we have to look at the problems of standard setting and the alternatives in a somewhat broader perspective than has been done so far. Since the traditional model of national choice, as we have it in economic theory, is essentially incomplete, it can not explain the decision reaching process, through which a standard is set. As reflected in the symposium's discussions, the difficulty was that the model for the decision maker was an objective function, with constraints set up to optimize this objective function. Whereas in the standard setting game, the real issues are that we ought to modify the existing constraints.

He also referred to other, important, aspects of government decision making as revealed in the experience with Sweden's public opinion policy on energy. He felt that it had become necessary to look at the problem of "institutional choices", and that we should change our models accordingly.

Mr.L.Moss - As regards the (market) mechanisms to deal with environmental problems - recalled that the objectives were set by society (not the economists) and that for decision making better information was needed on the political process. He indicated that regulatory mechanisms would work well, when the technology was available and the cost of implementing the control was not too high, whereas when the cost is high, as for instance in cutting down on sulphur emission, then regardless of whether or not technology is known, the regulatory decision will be slow to come forth. For this reason, it was necessary to use economic incentives to introduce control measures.

Dr. C. Marchetti (IIASA) indicated a possible organization of the subjects discussed in a causal line over three levels. First comes the definition of objective and values. The problem is whether or not society has to fit a grand design. The answer would have been obvious in the middle ages, entelecheia, or the final cause being an essential element in the intellectual fabric. The immense success and sophistication of the biosystem, that Darwin showed to obey rigorous rules but not pursuing a final objective, seems to give a lead. Although the point has been indirectly touched on various occasions during this meeting, no constructive contribution has appeared. The second level is that of means and constraints. Concerning the means it appears that society exerts a vigorous influence not only on the development of technology, but also on its invention, and on the development of scientific ideas. The history of science and technology shows inescapably that "demand" has always been the driving force and the key to success. The question of consumerism has been raised many times. Man has always been greedy. What makes the difference is that our society is capable to produce goods in a far larger measure than the previous ones. The fact that these goods appear in many cases to be of bad quality appeared to him as caused by a lack of imagination on the side of the producers and perhaps the consumers, in discovering and developing new "needs" or ways of satisfaction. Concerning the constraints many analysts tend to concentrate on external constraints, as it is well demonstrated in the "limits to growth" predicaments. By taking an engineering approach it can be easily demonstrated that simple fixes can displace these constraints by one or two orders of magnitude. All this leads to conclude that the externalization of problems is certainly a lie and probably bad

tactics. We have to work on society to find real long term solutions. Last but not least he emphasized time, which acts essentially as a constraint. As Prof.Häfele had shown with the market penetration curves, introducing new ideas, a new product, or a new technology takes a very long time.

Prof.Gardner made a statement on 3 specific items in the realm of Societal Management:

- 1) The need for radical change in our educational system;
- 2) The imperative need for a much greater role of international public organizations and private transnational organizations.
- 3) The problem of assisting the developing countries in coping with what the Club of Rome calls the "Problematique", and where he might suggest a role for IIASA.

1) Concerning education, he found that there are interrelated problems of societal management, and wondered whether our school systems provide adequate teaching. He would find it very useful if the universities were to add one additional year to teach other disciplines that would enable the graduates to be better prepared for an understanding of the complexity of today's problems.

2) While all governments are pre-occupied with short-term matters, what are the counter-veiling influences that could take up the cause of the ocean, the fish, the unborn? He felt that there was a need for international bargaining to gain access to materials, and that this bargaining should go through international organizations.

3) Finally, while Western countries have such organizations as the OECD, and the Eastern have COMECON, he asked what do the developing countries have? If we are not to create new institutions, why not increase the role of UNIDO to aid the developing countries with the assistance of IIASA and OPEC in coping with their energy problems?

The statement by Prof. Gardner drew considerable comment from the participants.

Dr. Botkin (Salzburg) felt that there should be international support for the interdisciplinary nature of the need for education and the multi-national approach to the matter.

Mr. R. Hickman (UK) indicated the trend in geography teaching in British schools was to include land use, environmental problems, etc. through the open university.

Mr. Sagarin supported the idea of the comprehensive education system with involvement in all facets of society; stating that we do need consciousness in our society of the consequences of what we are doing (to others), so as to get action.

Prof. Harrison Brown, commenting on the interdisciplinary approach, which he supported, did not believe that the problem would be solved in the universities, because they would not change their modus of operation. He rather felt that some other kinds of institutions are necessary, like in the U.S. "Resources for the Future", the "Urban Institute", etc. Among the international organizations, he mentioned CERN (Geneva), IIASA and the European Molecular Research Institute in Heidelberg as scientific institutes that were making an attempt to cross international boundaries, concentrating on extensive, important activities, to bring about international interactions. From this point of view, IIASA was a very important organization.

Prof. Häfele informed the Symposium of IIASA's cooperation with the UN agencies, the IAEA, UNEP and WHO, aiming at synthesis and comparisons of their studies.

Prof. Raiffa drew attention to the fact that IIASA is a "non-governmental" and "international" institute. Although this is extremely desirable for the conduct of the research program, it is less desirable for financial dealings with governments.

He recalled UNIDO's earlier suspicions about IIASA, but found that UNIDO now feels that IIASA, though largely composed of developed countries, could also work towards the development of the developing countries. He also indicated that UNEP, itself oriented towards the developing countries, is now farming out certain research to IIASA.

He stated that IIASA might move into the educational field by starting an experimental program for practitioners and managers on aspects of applied systems analysis, especially dealing with problems of the environment, energy, industrialization, etc. He also mentioned the IIASA project carried out under the leadership of R. Levien on the "State of the Art of Applied Systems Analysis". Part of it could be converted into teaching materials that would also be useful for the developing countries.

Finally he referred to his conversation with the Secretary General of the United Nations on a IIASA-UN project enabling scholars from the developing countries to study at IIASA, as a means of assistance to developing countries.

Appendix 1.

L i s t o f P a r t i c i p a n t s

SALZBURG SEMINAR IN AMERICAN STUDIES

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Dr. Ergun AR, Bogazici University, Istanbul.

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Mr. Atilla BILGÜTAY, Middle East Technical University, Ankara.

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Mr. Levern W. FAIDLEY, Food and Agricultural Organization, Rome.

Mr. David FISK, Energy Dynamics Section, Building Research Station, Department of the Environment, Garston, England.

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Mr. Hans KOEPP, Department of Forestry, University of Göttingen.

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Mr. Hans PFLEGER, DEGUSSA Company, Frankfurt.
Mr. Petre PRISECARU, International Market Research Institute, Bucharest.
Mr. Jerzy PRUCHNICKI, Institute of Environmental Engineering, Technical University of Warsaw.
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Consultant

Appendix 2.

L i s t o f P a p e r s

Papers by Salzburg Seminar Fellows:

1. E. Ar, Turkey
On the Questions of Population, Energy, and Environment
in Turkey
2. A. Bressand, France
Energy and Social Organization
3. P. Prisecaru and O.Olaru, Rumania
Energy Resources and Societal Needs in Rumania
4. J. Pruchnicki, Poland
Some Aspects of Environmental Policy for Demographic and
Economic Growth in Poland
5. C. Tresham, U.K.
Energy - Some British Options
6. H. Wenidoppler, Austria
Some Cultural and Individual Aspects of Energy, Population
and Affluence

Background Papers:

1. V. Benko, Czechoslovakia
Energy Resources and Societal Needs - The Case of
Czechoslovakia
2. G. De Jong, Netherlands
Energy Resources and Societal Needs in the Netherlands
3. J. Galbraith, USA
A Comment on Private Investment in Alternate Energy Sources