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West Europe Report

SCIENCE AND TECHNOLOGY

(FOUO 7/80)

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CONTENTS

EEC: ATTEMPT TO FORMULATE COMMON EUROPEAN ENERGY POLICY

Paris REVUE DE L'ENERGIE in French Mar 80 pp 153-159

[Text] During a press conference organized by the Information Office of the European Communities in Paris, Jean Saint-Geours presented and commented on the report to which his name is habitually given and the exact title of which is "For Economic Growth in Energy."

This study has been made at the request of the Commission of the European Communities. It does not deal with energy savings, but rather seeks to determine how growth and energy consumption can be dissociated. It takes as a beginning hypothesis the proposition that 4-percent growth is indispensable to Europe at least for the next 10 years, for demographic and psychosociological reasons and because it will be indispensable to the Community for adapting to the rapidly evolving world economic system. On the other hand, important progress cannot be made in the rational use of energy without investing, and a certain amount of growth is necessary so as to produce the funds necessary for these investments.

Mr Saint-Geours attributes the failure to work out a European energy policy to: institutional differences among the member states; very different fundamental situations; excessive submission to market laws for 15 years. But he considers that the absence of a common energy policy makes Europe run immense risks on the political, economic and social levels.

We publish below the summary and Chapters 10 and 11, concerning the strategy advised and the recommendations made by the report.

10. Strategy

10.1. In order to take properly into account the data and problems of the present and of the future, as enunciated and discussed by the Group, the strategy that it recommends varies with the horizon viewed. But this differentiation should not lead to segmentation of the outlooks, for it is necessary to strive to prepare, during each period, the solutions to the problems of the following one.

10.1.1. Between now and 1985-1990: the working population continues to grow throughout Europe, and this among other reasons makes sustained economic growth necessary. The supply of hydrocarbons does not pose technical problems, because the reserves are sufficient; but the scarcity of alternative energy sources and political positions taken may restrict the quantities available and raise prices. There is a risk that the trends toward rational use of energy will not assert themselves spontaneously, and the various fleets are only in the process of being replaced.

10.1.2. As the year 2000 approaches, the necessity of creating new jobs decreases or disappears (varying from one country to another); the approaching severe shortage of hydrocarbons presents the risk of further swelling prices; there are saturations of durable goods; and finally, the measures taken previously to save energy can have their full effect.

10.1.3. Beyond that time, if the important fact is the development of new modes of energy production capable of decreasing Europe's dependence considerably, the problematics of economic growth are definitely more confused in terms of macroeconomic balance, if only because the demographic data may be altered, new products will have come into existence, and lifestyles and modes of consumption will have had the space in which to change in function of a modification of social and personal values.

One sees that ruptures are possible in the coming years and that it is better to prepare to counter their harsh consequences.

10.1.4. The actions to be taken in the immediate future will be concentrated first of all on dealing with the problems of employment, the environment and energy dependence. They must at the same time diminish even more strongly the European economy's energy vulnerability for the following period. Throughout the entire 50 years to come, the most advisable orientation appears to be to open and expand to the maximum the range of the possibilities in three interconnected areas: lifestyles, modes of use of energy, and the modes of production of energy--an orientation already outlined in the preceding three chapters.

10.2. Despite the progress already made in rational use of energy, despite the existence of a sizable potential for further progress, it may be feared that strong economic growth in the coming years will entail a sizable increase in energy consumption, generating trouble and ruptures.

In the EEC countries, though, it is not realistic to sacrifice economic growth to minimization of energy consumption, despite the uncertainties of sufficient and regular supply. On the contrary, it is necessary to cause or permit more growth than in the last 5 years: growth which--to give an idea of it--is closer to 4 percent than to 2 percent.

What are the reasons that militate in favor of sustained growth?

10.2.1. First of all, the necessity of providing jobs for a growing working population. The political, social and moral equilibrium of Europe would be in peril if one did not doggedly strive to decrease the present number of unemployed. Doubtlessly, as has been seen, a certain dissociation between economic growth and increase in the number of jobs is to be feared. Nevertheless it may be thought that quite a strong link can subsist--on the one hand, if collective or personal services can be developed, which will have favorable effects on energy consumption and the environment; and on the other hand, to the extent that equipment-goods and consumer-goods industries making use of advanced techniques expand.

10.2.2. These two new directions in the structure of production activities are also indispensable if it is desired to counterbalance the depressive effects of external competition on the basic and intermediate-product industries.

10.2.3. But in addition, it is not paradoxical to assert that sustained growth would have the effect of powerfully encouraging rational use of energy in the medium term. Only such growth can be at the same time satisfactory growth in relation to the traditional economic and social objectives and active growth on the level of energy savings. It would accelerate the renewal of the equipment fleets--machinery, buildings, means of transport--and would thus permit the adoption of energy-saving solutions. It would give additional financial means to business enterprises and households, which could thus facilitate adaptation of existing equipment and housing to the new energy situation.

In contrast, "while low economic growth limits energy consumption in the short term, it retards the rational use of energy over the long term by delaying the establishment of equipment that is more efficient from this point of view."[1]

10.2.4. Likewise, growth can, if well-oriented, make it possible not only to compensate for but especially to avoid the perverse and troublesome effects attributed to it. We should stress once again the synergy that can be achieved between energy-savings policy and environmental policy: the technologies that depend less on energy are also, in general, the one that pollute less; thermal insulation goes hand in hand with insulation from sound; using collective modes of transportation means at the same time saving enerby and natural space; recovery of materials is useful, and even necessary, from both points of view. The environment as well as energy-saving can benefit from the changes made possible by sustained growth.

10.3. But while good economic growth permits or encourages rational use of energy, it does not at all guarantee it. And the risk--stated at the begin-

1. Cf D. Yergin, op cit, p 19, in Volume 2, "Working Documents of the Group."

ning of the present chapter--of seeing resumption of brisk growth accompanied by high consumption of energy, which would also compromise its continuity, does indeed exist.

The action of each government, and the European Community as a whole, in solidarity, should be aimed at making the principal agents in the economy recognize this relationship and make it specifically operative in each sector of use.

10.4. The risks engendered by dependence and the conditional relationship with growth are so great that under these circumstances, one could not be contented with a limited policy. A limited policy means one that is restricted to elimination of wastage without intervention in the economic mechanisms or modification of the structures of production and consumption. This, in a way, is the first degree in the strategy of dissociation of economic growth from energy consumption. The system of references is constituted by the present prices.

A second policy level is often presented as a limitation of energy demand by intervention in the economic system (without necessarily taking the form of supplementary burdens on the public budgets). They can, for example, involve quantitative restriction, norms, or even the fixing of certain prices. It is probable that this policy is the one that presents the most difficulties of application and encounters the most objections.

In any case, the extent and gravity of the problems to be solved necessitates a policy that is more complete and more fundamental in nature than in the past. The use of energy resources must be limited to the maximum compatible with rational combination of them with the other factors of production, and the efficiency of each "energy chain" must be aimed at continuity of supply at the lowest collective cost in the long term. In this sense, energy savings depend on an "economics of energy."

The economics of energy considers energy savings as an energy resource, to be treated rationally. This means that this "new" energy is one of the elements of a system in which the instantaneous costs and prices must be established, if possible, within the perspective of the costs and prices of the future; in which the investments that lead to use of energy and the investments to rationalize this use must be calculated on the basis of these prices; in which the technologies and innovations that can permit this rational use are promoted by governmental actions in an extensive and varied amnner; and finally, a system that includes a research and development strategy applicable to all the stages of the energy chain. It is in this perspective that our first recommendations will be presented.

10.5. Such a policy is not principally of a technical order. Moreover, it is a policy that necessarily extends over a long period of time. Here we encounter the field of action that touches on cultural, social and personal values.[2]

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2. This point will be the subject of recommendations in 11.3.7.

Chapter 11

11. Recommendations

At the conclusion of this first reflection on the problematics of the dissociation of economic growth from energy consumption and of the attempt at strategic forecasting which it has brought to this subject, the Working Group considered it useful to classify its recommendations in three different categories, so as to take account both of the importance of the options to be taken and of the work that remains to be done.

The first set of recommendations is united and guided by the idea of solidarity among the countries of the EEC and of harmonization of their economic and social conditions.

The second set complements the first one by enumerating the principal elements of an energy-savings policy that can be recommended to all countries.

The third set proposes improvements in our knowledge of the economics of energy, which still has many gaps in it, and of the complementary work and studies, some of which could be undertaken in the second phase of reflection by the Group.

A. For a Community Strategy of Economic Growth in Energy

11.1. Statement

Neither the rate nor the content of the economic growth of the member countries of the EEC in the last 5 years will enable them to achieve their economic and social objectives--especially those relating to employment--while at the same time decisively reducing their energy dependence.

At least until 1990, the EEC needs sustained growth in order to adapt its economy to the evolution of competition and to the new technologies, as well as to ensure employment.

However, this orientation can be implemented only if, simultaneously, the means for minimizing energy consumption are really in place. It is advisable here to repeat the strategy formulated in the preceding chapter: in the future, the cumulative process "so much more energy, so much more economic growth, so much more energy" must be replaced by the conditional relation: "the more rational the use of energy is, the more easily will economic growth comply with the objectives of the European Community, both by virtue of its rate and by its composition and its durability."

11.1. Recommendation

Vigorous and coherent political action is indispensable for convincing the principal agents of the economy of the principle that has just been laid down and for implementing it in each sector of energy use. Political action limited to urging elimination of waste, without intervention in the economic system or modification of the structures of production and consumption, is not sufficient. The changes and replacements that are the driving forces of growth must serve systematically and in a coordinated manner to promote the rational use of energy.

The commitment and understanding of the citizens of the member countries will be all the greater if the political action is perceived as an element of a Community-scale strategy aimed at achieving effective economic growth in energy consumption--a strategy in which each member state fully participates. This strategy should also result in broader understanding among the industrial nations of the West.

11.2. Statement

The report has examined the dissociation of economic growth from energy consumption under three aspects: the technological potential for rationalization of this consumption, the context and the economic conditions of dissociation, and the social and institutional factors.

It is not at all certain that the "spontaneous" trend toward dissociation will firm up considerably. Thus there are strong reasons why the member states of the EEC should strive to reach the highest possible limit of dissociation between economic growth and energy consumption. This maximum dissociation is within our reach only if there exists the political will to make all factors converge in its favor: the technological, economic, social and institutional factors.

11.2. Recommendations

11.2.1. Technological Factors Favorable to Dissociation

The establishing of common minimal norms constitutes an advantageous contribution by each to the collective savings effort. It facilitates diffusion of the technologies of rationalization. It harmonizes the conditions of international competition. Some Community recommendations have already been published on this subject. They should be broadly supplemented by new recommendations, voluntary agreements or regulatory provisions applicable to the whole of the EEC.

Progress in rational use of energy depends largely on the magnitude of the research and development effort:

--the field of R&D regarding energy is vast, and the European countries will have to take an interest in all the energy-savings technologies in the comin years;

--the development of an energy-savings industry that will be important for the level and composition of growth depends on R&D;

--the United States and Japan are or will be suppliers of energy-savings technologies; Europe should take this into account so as to avoid any lag, or better, to retain or acquire a lead in certain fields (the automobile, for example);

--so much the more in that, in a world strategy, these technologies will be of interest to the developing countries also, permitting considerable extesnion of the markets.

11.2.1.1. Establishment of Common Minimal Norms of Technical Performance

Such establishment of norms can be effected by voluntary agreements among the industries and the member states within a Community framework, or by legal provisions established at the Community level. These minimal norms should be applied to the following products, whether they are imported or produced in Europe:

--automobiles;
--heating installations;
--the principal household appliances.

In certain cases, it will be necessary to offer to the producers and users of these products financial advantages for implementation of programs to put the norms into practice.[3]

11.2.1.2. An Important Community Research, Development and Demonstration Program

In addition to greatly increased efforts to develop the technologies capable of saving energy, greater attention should be devoted to the economic and social questions connected with diffusion of them and their effective utilization. This point is treated more fully in 11.2.3. below.

11.2.1.3. Creation of a European Data Bank on the Energy-Saving Technologies

The information in such a bank would be available as a public service to the professions interested--industrial firms, architects, construction companies. In the creation of this data bank, priority should be given to the collecting of data relating to new and existing buildings.

The data bank should provide a basis for the technical agreements between the EEC and the other industrial countries, as well as with the Third World.

11.2.2. Economic Factors Favorable to Dissociation

The member states of the EEC should adopt a common price-system approach, for it is a major determinant of energy production and consumption.

3. This theme is developed more fully in recommendation 11.3.5.

The energy prices charged today reflect only imperfectly the foreseeably increasing scarcity of the energy sources available. Certain of these prices have decreased in real value since 20 years ago if one takes into account the real increase in incomes and despite the big hikes since 1973. If one considers the financing needs implied by the new production capacities to be built, one may consider that certain sages of electricity are subsidized [as published]. The price of energy is too often used either as a means of stemming inflation or as a means of social policy, at the expense of a long-term energy policy. Finally, information on the prices and costs of the different forms of energy utilization is often lacking.

Consequently, the Working Group recommends that the member countries make an agreement on harmonization of their price policies on the basis of the following principles:[4]

(a) The prices of energy should at best cover the expenses necessary for replacement of the resources. The producers' use of their receipts should be watched closely and oriented. Specific social compensation can be implemented for the limited categories of persons that may be affect by this policy.

(b) The costs and prices of the different "energy chains" should be made clearer, so as to enable the collectivity to make the most rational comparisons and utilizations.

(c) The prices of energy, the cost of equipment that uses energy, and the consumption by this equipment should be publicized as much as possible and should be subject to Community regulation.

(d) Likewise, the costs and financial yields of the investments intended for economizing on energy expenditure should be publicized as extensively as possible.

These questions and those raised in this regard in Chapter 5 should be subject to periodic review of energy-price practices by each of the member countries within the framework of the European Community.

The costs of labor as a production factor are increased by taxes and Social Security levies. On the other hand, the costs of energy appear low vis-a-vis the long-term costs of its supply. This situation leads to an imbalance in the terms of choice of the production factors, encouraging the capital-intensive and energy-intensive forms of economic activity. To correct these

4. However, the Group is well aware of the fact that principles are involved here. On the one hand, definition of costs (in particular, replacement of resources) is a delicate matter in practice; on the other hand, the implementation of price policies is subject to procedures that are highly complex and difficult to orient in the direction of energy savings.

tendencies, it would be useful to study the conditions and consequences of a significant reduction of the imposition of labor as a production factor.

11.2.3. Instituional and Social Factors Favorable to Dissociation

11.2.3.1. The institutional and social factors fall principally under the responsibility of the member states. Nevertheless, the Community's institutions can play an important role in the support of national efforts, by sponsoring the development, at the level of Europe, of interdisciplinary studies aimed at furnishing a more objective bases for discussion of the great sociotechnological problems of the future.

11.2.3.2. Changes in the structure of European society cannot occur without the involvement and participation of the European citizens in the decision processes. This is largely a problem of education and culture, and the media should should give it an important position. It is necessary to develop better understanding of the needs and the technological possibilities, to make science and technology accessible to those who are in a position to use them, the understand better the desires and behavior of individuals. All these factors should help to promote the emergence of plural forms of society.

11.2.3.3. The creation of a true European scientific community would seem to be an essential institutional innovation, of such a nature as to encourage the establishment of the technological basis for a new energy-frugal economy. A paper has been written on this subject by Prof I. Prigogine and Prof U. Colombo, the conclusions of which are as follows. In the initial phase, emphasis will be placed on scientific cooperation within the framework of the present institutions; it is of prime importance that the Community bodies make possible, by the confrontation of ideas, a certain coherence of the various sectorial policies and coordination of strategies in the scientific domain; in this phase, it is especially necessary to facilitate the mobility of researchers and of knowledge.

In the longer term, it appears desirable to arrive at European R&D structures to overcome the difficulties due to the compartmentation of the present situations.

11.2.3.4. The Commission of the European Communities thus has an important role to play by developing greater attention to the collective interest in the matter of energy, and a broader consensus on the relationships between energy policy and more general political problems. Actually, these problems --maintenance of a common market of goods and services without discrimination or unfair commercial practices, common foreign-trade policy, agricultural policy, the European monetary system, and more generally, relations between the EEC and the Third World--are gradually tending to define a unified entity.

In the face of the other principal forces in the world, an energy policy for the Community is an obvious necessity.

B. The Other Elements of a Complete Policy of Dissociation between Economic Growth and Energy Consumption Recommendable to the Member States

11.3 Statement

It should be up to each member state to supplement the common orientations just outlined in function of its particular situation and its own objectives. Nevertheless it appears useful to formulate the elements of a complete and integrated policy on the rational use of energy. This comprehensive approach could be expressed, on the part of the Commission, by a guideline program aimed at informing and encouraging action, among interested parties, public opinion, and governments.

Of course, these elements are of different natures--on the one hand, because they affect both institutions and behavior and also technological and economic aspects of the problem, and on the other hand because some may have rapid effects while others are aimed at long-term results. Their common objective, though, is to create a climate favorable to investment aimed at achieving greater dissociation between economic growth and energy needs.

Of course, it is not only in the area of rational use of energy that the governments are striving to create a climate favorable to investment. The energy policies and the energy-savings policies should be combined with the policies on industrial restructuring and employment far more directly and awarely than has been the case so far. More precisely, the principal areas of action in this regard are public demand, financial support of firms, adequate reulation, and improvement of the scientific infrastructure.

11.3.1. Norms

In addition to those referred to in 11.1., minimal norms on efficiency of energy use (or maximum-consumption norms) should be applied to the methods of construction of new buildings--housing, offices, administrative buildings (schools, hospitals, etc).

Of course, these advisory activities can be taken on on a large scale only if a sufficient number of experts and professionals are trained for this function. This is why it is desirable for training courses for such experts and professionals to be created in the technical-training organizations.

11.3.4. Measurements, Regulation and Monitoring

It is important to promote devices for measurement, regulation and monitoring in all the sectors of consumption. The market exists. The technologies are developing, especially in microcomputers. The phenomenon therefore has some chance of occurring spontaneously. However, it can be aided by certain specific measures:

--encouragement, by information and financial stimuli, of adoption of these devices in vehicles, in electrical household appliances and in the lighting and heating of buildings;

--encouragement, by information and financial stimuli, of adoption of such devices in the industrial processes;

--requirement to equip offices and and the individual units in collective residential buildings with meters and thermostats;

--extension of electronic traffic regulation in the principal urban centers.

In the same order of ideas, energy-consumption display should be made common on the principal kinds of industrial and domestic equipment.

11.3.5. Financial Provisions

It is indispensable to establish considerable financial stimuli to compensate for the gap between the psychological outlook of private decision-makers and the terms of amortization for energy-saving equipment. This applies both to insulation of homes and to industrial equipment. A number of countries have already done this, especially for renovation of existing buildings in southern Europe.

Often, though, incentives seem insufficient to produce substantial changes. The sums involved are not large enough to trigger a decision. Too little information is provided to decision-makers. The financial circuits are not accustomed to dealing with this kind of problem.

Generally speaking, a closer link should be established between energy-savings information and the financial circuits, with the nature and habits of decentralized decision-makers taken into account--business enterprises, on the one hand, and households on the other.

As regards the former, we note the importance of financial stimulation supplementing energy-saving programs coordinated between the public authorities and the industrial branches or the big firms. The organisms specializing in financing for industry and the modes of financing that they usually offer ((lease-credit, loans with subsidized interest) offer a ready-made framework that can be adapted to the energy-saving objective.

For households, the financial institutions should organize forms of energy-savings surveys and advice.

The public authorities' field of action on the conditions for financing of energy-saving equipment is especially vast and diversified: the often have financial networks available to them; and they exercise extensive powers over the volume and conditions of allocation of credit to the economy, through regulations or subsidies.

The impact of the financial action of the public authorities depends largely on the quantity of the sums involved. Thus, only subsidies of a certain amount seem to trigger decisions in the area of energy-saving. Furthermore, in their own domain the public authorities have to acknowledge the importance of the financial aspect; for example, in the organization of public transport capable of replacing private transport so as to improve the community's energy balance sheet, the investments must be sufficient to produce interest in public transportation.

In any case, the public authorities have at their disposal, through the tax system and the public budgets, a sizable set of financial stimuli.

Finally, the Group recommends, on a general level, that the measures that tend to rationalize the use of energy--whatever kind they may be--be financed at least to the level at which the result (energy saved per unit of cost) is equal to the marginal cost of supplies. This can lead to a far higher level of savings than would normally be achieved by consumers with short-term outlooks. And this is particularly true if the cost is measured in all its elements instead of being limited solely to the direct cost of the investments.

11.3.6. Energy Savings Considered as "Good Business"

There are many actions that the member states can take to encourage development of the rational use of energy as "good business" ("a business opportunity"), both in the small companies and in the big ones. It is a well-known fact that a great deal of the materials and equipment designed for saving energy (heat pumps, total energy systems, certain insulation materials, microelectronic applications) are sold by small and medium-size firms.

The national, regional and local authorities are among the most important investors and consumers. One immediate measure should be to establish policy directives applicable to public purchases at these three levels. Public purchases should take the rational use of energy into account and should be founded on evaluation of the choices by calculation of cost-benefit. This policy could be formulated in obligatory terms for public projects. In the United States, for example, every purchase by the federal government has to involve an evaluation of any energy-using equipment in terms of operating cost over its lifetime.

The importance attached to purchase price and the tendency to minimize equipment costs at the expense of higher operating costs often derive from controls and regulations established by the central government. This situation should be reviewed.

There is also a mass of norms and requirements that apply to public purchases and date from the time when energy was cheap and abundant. They can have the effect of engendering energy-expensive practices. This situation too should be reviewed.

Attention should also be devoted to the taxation structures that discourage energy-savings investment and equipment that consumes little energy. The best-known example is that of real-estate taxes, in which improvement of an existing housing unit in order to save energy can lead to revision of the basis of taxation and an increase in tax. Even more fundamentally, it can happen that a tax system constructed in accordance with its own criteria has the effect of favoring the purchase and use of equipment that consumes relatively large amounts of energy or uses it inefficiently. The extent of this "bias" in the present tax systems should be examined more attentively.

Knowledge that the government's purchases will reflect evaluation of the terms of choice by a cost-benefit method will encourage firms to innovate. Characteristics defining high energy-performance characteristics can be proposed jointly at a higher purchase price. In certain cases--military expenditures, for example--performance specifications for equipment and materials could be fixed at a very high level so as to encourage a faster rate of innovation and to ensure contracts in the initial development stages, at high costs.

In general, great attention should be devoted to energy-saving in development of governmental policies aimed at encouraging the innovating industries --and actually, these policies are frequently based on a good many of the measures that have been discussed regarding the rational use of energy: norms, financial support and, for demonstration purposes, data banks and, of course, governments' purchasing practices.

11.3.7. Political, Social and Cultural Context

In this area, it is up to the EEC states to start doing what is possible, to encourage the tendencies that appear favorable, to establish the material norms that come under their competency and that can influence the internal norms that individual and social values constitute. These three axes of action can be explored better in the second phase of our work.

11.3.7.1. Doing what is possible means, for example, making labor, wage, and social-services regulations more flexible so as to permit innovations in the nature and form of activities, whether commercial or not. It also means diversifying the norms in the "energy chains," so as to permit several solutions--which may be independent of one another--for the utilization of energy. It also means giving the local collectivities more freedom for purposes of better adaptation. Finally, and more generally, it means eliminating from the regulations anything that uselessly impedes initiative that can generate innovation and interdependence.

11.3.7.2. Encouraging the tendencies that appear favorable can apply specifically to the social, cultural and personal values that emerge and to the changes of behavior that go in the direction of an energy-frugal society. This is the case, for example, with all measures that can encourage the development of decentralized social self-organization, especially in the cultural context and in that of the social services. In this regard, a study group made some proposals in "a project for Europe" at the end of 1977. These proposals are aimed at facilitating the birth of a third system of social organization, of activities and of life, rich in services, aspiring to greater stability, economical of energy, alongside the economic system and the administrative system. These proposals appeared entirely valid to the Group, with regard to the mission with which it was charged.

11.3.7.3. Modifying certain norms or imposing new ones will take the form of actions applying both to the energy sector itself and to the tenor of economic activity. This third degree of political action requires close attention to the elements of the collective interest and a good relationship with the opinion of the citizens in our democratic regimes.

A good example of intervention in the energy sector is the imposition--accompanied by explanations that challenge collective and social values--of norms for transportation and for heating.

Action tending to influence the nature of economic activities comes under political headings and parties' programs, and often falls into the public budget for its implementation.

In this regard we can mention the interest, in education, of cultural promotions relating to the arts--and the art of living--and the beneficial character of encouragement of the skilled professions. It is also the area in which the amount and distribution of public investments in health, education, culture and leisure are capable of playing a big role.

C. Improvement of Knowledge and Supplementary Studies

11.4. The Group noted that there are many insufficiencies in the statistical data and that many phenomena and relationships concerning the energy questions are poorly known. There is even in this situation a real obstacle to a detailed and well-documented study of dissociation between economic growth and energy consumption. Consequently, progress in this area is indispensable.

11.4.1. It is usually difficult to draw up energy balance sheets, whether it involves measuring the effects of a technology or the impact of a policy. The interest of cost-effectiveness analyses should be recalled here. The Commission has already started work in this direction to evaluate the effects of specific energy-saving measures in the different sectors of use. Complete information of this type would be useful at the level of Europe and of the member states.

11.4.2. However, such an approach encounters its limits in analysis of complex systems--a fact that has been widely observed as a result of the American and European experience.

However, there is a need to clarify and draw up the balance sheets of the "energy chains" and "energy networks" in other than macroeconomic terms, which conceal a sizable part of the options and the possible technological variants. In effect, analysis of the energy chains will have to take into account, on the one hand, the energy contents of products and services, and on the other hand, the changes that the new energies bring to the traditional models of energy systems.

Such analyses should permit comparisons among the different forms of energy. In this regard, it would seem useful to the Group to study, in a second phase of its work, three fundamental questions for the future:

--the penetration of electricity, in order to determine the best uses of electricity from the point of view of the energy balance sheet and from the point of view of the costs (investments and operating costs) on the entire "chain";

--the production and utilization of forms of degraded energy;

--use of autonomous forms of energy: Prof Colombo's scenario for the year 2030 proposes extensive use of solar energy accompanying a breakdown of the present forms of urbanization and a real decentralization of activities; thus it appears necessary to study the possibilities for diffusion of such solutions and to analyze their social and economic as well as technical conditions and implications.

11.4.3. The Group has been aided in its thinking by the work of the IIED [expansion unknown] on the United Kingdom. Insofar as studies of such completeness do not exist for the other member states, it seems useful to start them rapidly so as to have a coherent set of basic data on the energy questions in the Community. For such is not the case today: the European statistics do not permit precise analysis of the uses of energy and the recent trends in this area. Thanks to studies of the IIED type, it may be hoped to develop a statistical apparatus that is both necessary and effective.

11.4.4. It is advisable to reach agreement on the methodology for establishing energy scenarios for the year-2000 time frame. The MEDEE [expansion unknown] model should be used by each member state of the Community and for the Community as a whole. But it would be useful to test, on this occasion, considerably bolder hypotheses of dissociation between economic growth and energy consumption.

11.4.5. In the same spirit, studies of a macroeconomic nature should be carried out to evaluate the investment expenses that would be entailed by realization of the various energy-savings hypotheses envisioned for activating the "technological potential," as well as the additional jobs created directly or indirectly.

11.4.6. The Group to undertake [as published] two complete studies centered on the energy aspects, for important sectors of use. This would involve going into detai' on several questions which it is too difficult to deal with at an exces ively comprehensive level.

11.4.6.1. A first study would concern the automobile. It should have a prospective character, cover the whole of the Community, and involve the following aspects, in function of an energy-savings policy: the place of the automobile in the production system, its place in the consumption functions, collective and social costs, influence of international competition, role and impact of regulations, etc.[5]

11.4.6.2. A second study could concern housing. It should be of a sociological, psychological and institutional nature, and should deal with the behavior of the agents in this sector, their relationships and their decision-making systems.[5]

11.4.7. Hierarchization of Energy Sources and of Their Uses

Several recent events have brought out the vulnerability of the European countries in the area of energy. The risk described at the beginning of the report thus takes concrete form in actual events.

However, these countries remain ill-prepared for radically altered supply conditions. Sharp rises in the price of oil and threats of shortage still take the Western economies and societies by surprise.

Thus the Group proposes to study more completely the implications of ruptures of various elements of the energy situation. In particular, the processes of diffusion of the sharp rises in the prices of imported energy in the economy, and the hypothesis of sharply reduced supply availability, could be examined.

A study of the price rises could answer three questions: What repercussions did the rises of 1973 (and if possible, of 1978-1979) have in the various countries of the Community? Can an economically and socially more satisfactory diffusion of these rises be conceived of? How will the economies react, in the medium term, to a series of sharp jumps?

Secondly, it would be necessary to study lower levels of dependence that would nevertheless enable the economy of the EEC to continue to function without serious economic and social troubles, despite alterations of the world market's conditions of supply. These studies should take account of the respective particular situations of the member states and show how their solidarity could be organized.

In this regard, two sets of priorities have to be defined and compared: one of them has to do with the supply of energy, taking into account the most autonomous and most efficient forms of production, transformation and distribution; and the other set of priorities must show a hierarchization of uses, going so far as to determine the energy necessary to the economic and especially the social survival of a society.

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5. The specifications developed for these studies will be found in Appendix 10.

11267
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FRANCE

TEN-YEAR OUTLOOK FOR SPECIAL STEEL INDUSTRY

Paris LE PROGRES SCIENTIFIQUE in French Nov-Dec 79 pp 53-56

[Article by B. Vieillard-Baron and B. Biot]

[Text] The position of steel as primary construction material does not appear to be threatened in the near future, even if its consumption should come to a standstill or suffer a slight decline.

Higher-cost, but lighter or substantially higher-performance materials such as aluminum, already in widespread use, titanium, some plastic materials, and carbon fibers when their cost price will have reached competitive level, will be substituted for steel when considerably lighter weight is in demand without reduction of overall mechanical strength. This change has already been initiated in the automobile industry and in railroad rolling stock.

Substitute materials have been, or will be, suggested to resist corrosion or abrasion, or for use at extreme temperatures.

However, steel will retain a predominant position in much heavy equipment because of its relatively low cost, its high flexibility of use, its production technology, its well-known applications, also of the abundance of its raw materials in the world, and of the relatively modest quantity of energy required for its manufacture and application.

Still, to remain competitive and preserve for the French iron metallurgy an honorable position in the world, steel producers will have to improve continuously the production processes, performance, and adaptation of the material.

In the case of special steels we shall specify in the following lines the principal areas in which at this time the probable evolution during the coming years can be anticipated.

Processing of Liquid Steel

When used alone the pure-oxygen converter supplied with pig iron by blast furnaces, a well known procedure in mass iron metallurgy, is poorly adapted to the production of alloyed special steels. But some development will occur in plants where liquid pig iron is made available by metallurgical equipment located outside the furnace.

The open-hearth furnace is on the way to total disappearance.

The ac, or even the dc, electric arc furnace will maintain for some time its predominant position in the preparation of special steels, especially since the direct use of prereduced products or granulated pig iron, instead of the selected scrap normally employed, should result in a reduction of its total energy consumption and in lowering the cost of steel because of the possibilities derived from supply diversification. The electric furnace will be used specifically in the smelting operation, and property adjustment operations will be conducted metallurgically outside the furnace.

It should be observed incidentally that the use of very ordinary scrap (old tincans, etc.) is retarded by the present impossibility to eliminate elements such as copper, tin, arsenic, or antimony, which degrade some of the properties of steel. It is not anticipated that the problem will be solved in the near future, except by sorting.

Finally the vacuum remelting processes (VAR) and slag remelting processes (ESR) will be improved in particular by information monitoring of the parameters which control the solidification of the metal.

Collaterally with these advances the plasma furnace will probably be developed either to produce ordinary steel directly from the ore without passage through a blast furnace, or to prepare special steels im improved physico-chemical or environmental conditions.

Steel Casting and Solidification

The adaptation to special steels of continuous casting, a process already in widespread use in the case of ordinary steels, will provide for a substantial decrease in sizing operations and for the elimination of pattern making.

To obtain the best results protection of the casting will be extended to general practice, and methods providing for a better control of the conditions of solidification of the product will be used, such as centrifugal continuous casting which maintains the properties in the case of bars and long articles, or electromagnetic agitation which is now being developed.

When the metal is to be cast in the form of standard ingots, especially in the case of thick products, research on ingot-mold process curves or the use of methods derived from slag remelting will influence in the future the conditions of solidification, which will result in improved properties and in a substantial reduction of the subsequent transformation work.

Molding

An important fraction of the cost of moldings results from the generally manual finishing of single or limited-quantity production parts. The finishing operation is intended to repair the metallurgical defects which develop in the part on cooling (pinholes, microcontraction, inclusions, etc.), or merely to remove the part from the mold and improve the surface conditions or dimensional precision. This is one of the reasons for the development, in the case of small parts, of the precision molding process based for example on the use of ceramics. With the necessary adjustments it should be extended to parts of any weight.

Hot or Cold Transformation of Steel

To reduce material and energy consumption and lower the cost price steel transformation industrialists will make increased efforts to obtain parts presenting as much as possible the final specifications, and to eliminate or reduce intermediate reheating or heat treatment operations.

The following processes will be developed:

Hot-die casting without burs;

New cold-deformation techniques such as hydroflame treatment already used in France;

Thermomechanical transformations to impart directly to steel its properties of use by forging or rolling, eliminating subsequent heat treatment;

Isothermal shaping which should facilitate the use of low-forgeability metals, while providing for elements of satisfactory precision;

Powder metallurgy and its adaptation to a wide range of steels or alloys, especially of alloys which cannot be forged or cast by conventional methods; the flexibility of this method should also permit shaping to dimensions approaching very closely those of the finished part, which would further reduce material and energy consumption; and

Isostatic or isothermal compacting which would result in improving the quality of parts produced by powder metallurgy and of some castings.

Also, by speeding up experiments on high-performance tools (for example the Creusot 900-ton forging press or the Interforges 65,000-ton die-casting press, completing their equipment when necessary), it should be possible to produce in very good conditions a wide range of complex, large-size parts whose manufacture could not be considered to date by research agencies.

Finally it is possible that development will continue in surface treatments and coatings, especially by the ionic method, to improve the utilization of parts used in the mechanical industry by improving their surface properties.

Use of Metallurgical Products by Welding

In exclusive respect to materials the principal advances to be expected in the next few years will relate to:

Improved knowledge of weldability and of the metallurgical conditions necessary for the reduction to practice of different processes (preliminary and subsequent heating temperatures, welding energy, etc.);

Formulation of new, more readily welded steel varieties; and

Improvement of built-up products (welding electrodes and wires) better adapted to specific cases, especially in respect to the problem of heterogeneous stainless-alloyed steel units.

Processes also will evolve. We shall refer only to the metallurgical advantage of those processes which exclude the intermediate melting step (diffusion welding in the superplastic phase, etc.).

Properties of Metallurgical Products

In the view of the uninformed observer the product called steel may appear to have been stabilized for a long time.

This is not true at all. The iron metallurgist must continuously adapt steel to the more and more refined application properties required by constructors, and 1980 steel is quite different from steel manufactured 10 years earlier. In the next decade the shortage of some metals will induce laboratories to formulate steels containing less alloy products (nickel, molybdenum, cobalt, etc.), but whose application properties (mechanical properties, corrosion resistance, etc.) will be identical, or preferably better, to provide for lighter-weight or longer-life structures, and thus economize energy and raw materials.

Also, by adjusting the chemical composition and the conditions of transformation, attempts will be made to reduce costs by eliminating some operations such as heat treatments.

The improvement in analytic precision obtained by steel mills in both the primary elements and the low-content elements will contribute to facilitating this research and, when necessary, to an improvement in the specific nature of products for different applications (nuclear, aeronautical).

Besides, the development and improvement of monitoring methods (automatic inclusion counting, focused ultrasonic examination, various mechanical rupture tests, etc.) already have resulted in a substantial improvement in the processing conditions and reproducibility of the properties of steel, and therefore in the reliability of structures. This trend should continue.

New Iron-Base Materials

The apparently remarkable properties of metallic glasses (magnetic, elastic, stainless properties, etc.), and the relative simplicity of their manufacturing range should provide for them a wide scope in a large variety of industries.

Many problems, however, must still be solved.

These few remarks demonstrate clearly that steel is a material in continuous renewal in respect to processing and transformation conditions, as well as to the regular improvement in its application properties to the great benefit of users.

All the conditions for the continuation and growth of this evolution are present at this time.

9456
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SWEDEN

STUDY MADE OF SWEDEN'S BIOENERGY POLICY

Paris LE PROGRES SCIENTIFIQUE in French Nov-Dec 79 pp 33-40

[Text] The importance of the cost of oil and the assurance of a continuous energy supply in case of crisis are the arguments which induced the Swedish Government to turn toward the use of biomass-derived resources for energy purposes. The intensive use of agricultural, and especially forest, waste is also cited very often. It is quite obvious also that a decrease in fertilizer consumption through nitrogen fixation by some cereals would reduce the overall energy amount.

For Sweden the production of biomass is especially promising as a method of solar-energy utilization. The seasonal variations on which sunshine depends directly are large and do not correspond to the energy demand. Therefore a basic principle in the development of solar energy is to stress long-time storage. In the present situation it would be hazardous to attempt a very long-term forecast of the possibilities of bioenergy development. Some of the elements whose development will directly influence bioenergy are the development of associated energy sources, the use of biomasses for other purposes, general research on photosynthesis, and research on nitrogen fixation.

The Biomass Resources of Sweden

The first step consists in evaluating the present and future biomass resources to determine the available theoretical energy sources of biological origin. It is basically necessary to know, be it approximately, the range of these resources to extrapolate the extent of long-term hydrocarbon economy on the basis of present and potential techniques.

A preliminary inventory has been conducted in the program subsidized by the National Administration for the Development of Energy Sources (NE). Its purpose is to provide a first estimate of the quantity of biomass produced at this time in agricultural activities (cultivation, animal farming, forests, horticulture). The following main conclusions can be drawn:

1. The area of Sweden is 411,615 km^2, of which 7 percent are tillable, 57 percent are woods, 57 percent are estates, excluding fields, and 31 percent are built-up areas or sterile soil;

2. The tillable soil, about 3 million hectares, produces annually at this time 30 million tons of biomass whose mean dry-material substance is 65 percent. These 30 million tons correspond approximately to 85 percent cereal and 15 percent grassland;

3. The 12,000-hectar horticultural and truck-gardening area provides for an annual harvest of 0.55 million tons of biomass whose dry-substance content averages 18 percent;

4. The wooded area of 23.5 million hectars produces approximately 117 million tons of biomass annually, with a dry-substance content of about 20 percent;

5. Animal farming provides 32 million tons of manure containing 14 percent by weight of dry substances;

6. The biomass production of uncultivated soil, about 12.8 million hectars, can be estimated very roughly at about 6 million tons annually;

7. A total of about 153 million tons of biomass is produced annually in a 39-million hectar area. The proportion of dry substances at harvest time averages 29 percent by weight.

Only 88 million tons of the 153 million tons of biomass are harvested with the following distribution:

	Millions of tons
Foodstuffs and raw materials	74.1
Animal feed	4.4
Other use	0.4
Total biomass sold	78.8
Animal feed consumed in situ	6.9
Other produced-consumed biomass	0.4
Returned to the soil	1.2
Waste	0.7
Total	88.0

The 11.3 million tons of biomass sold or consumed as animal feed are converted by the addition of synthetic livestock food to 32 million tons of manure, of which 21 million tons are recovered and scattered in the fields, while the remainder is partially lost in pastureland.

The Bioenergy Program of Sweden

The biomass energy potential was rediscovered recently as a renewable and probably soft energy source. It should be observed, however, that the utilization of this potential is not new since wood, peat, and dung have provided in substance for the Swedish energy needs until the coming of coal. But for bioenergy--a general term which covers technologies or disciplines such as agricultural machinery and molecular biology--to be economically durable resources and methods must be tallied, the products (fuels, animal feeds, etc.) obtained at the end of the chain must be defined, and the technological and economical feasibility of each approach must be studied. The interdisciplinary nature of bioenergy has induced the Swedish leaders to assign the coordination and administration of the Bioenergy Program to a single organization, the National Administration for the Development of Energy Sources (NE).

The 1975-1978 period has been marked especially by projects for the inventory of biomass resources. In 1977 NE proposed 3 plans for bioenergy development in 78-81. These three levels of ambition differed by their budgets covering 3 years (45 Mkrs, 75-85 Mkrs, and 125-175 Mkrs). A low intermediate proposal was adopted by the Swedish Government when a credit of 58 Mkrs (1 kr=1 FFR) for bioenergy research was included in the NE budget for the National Fuels program which covers bioenergy, peat, and heat exchange. 842 Mkrs were appropriated for all the research related to energy during that period. It must be observed that an effort is really being made in respect to bioenergy since the Energy Production section specifies 393 Mkrs divided in the proportion of 105 Mkrs for wind energy, 103 Mkrs for National Fuels, and 65 Mkrs for fusion, to cite only the 3 most important programs. In addition the production, distribution, and use of synthetic fuels (methanol, ethanol) and synthetic gases are included in the budget covering Synthetic Fuels for Vehicles and consisting of 22 Mkrs granted by NE.

Breakdown of the Bioenergy Budget

	Mkrs 1978-81
Basic research	3
Environment and ecology	3
Available-land inventory	4
Energy-producing forests	22
Forest energy (waste)	10
Miscellaneous types of biomass	3
Conversion to fuel	1
Large-scale tests	8
Planning and recording	4
Total	58

For comparison 15 Mkrs are available for research on peat, and 30 Mkrs for heat exchange (burners and adapted furnace designs).

Therefore the Swedish bioenergy policy is based on 2 main propositions: energy-producing forests and recovery of waste from forest use. The item Large-Scale Tests provides for the financing with subsidies and loans of direct applications of operations related to energy-producing plantations.

A relatively large share is devoted to international activities, especially in IAE where Sweden initiated a common program of forest-biomass research. The participation of Swedish researchers in the study of the biological treatment of sewage in the United States has been assigned a contribution of 500,000 krs by NE.

The present stage of bioenergy development is essentially an information, analysis, and test phase in respect to the energy resources of forests. The authorities are awaiting the first tangible research results which would clearly demonstrate the attractiveness of forest bioenergy. It is now too early to express conclusions, and the NE budget reflects this expectancy. However Professor Olle Lindstrom of the Royal Polytechnic Institute of Stockholm announced on 9 April 1979 that oil imports can be eliminated by cultivating energy-producing forests in 7 percent of the wooded lands (1.7 Mha). These affirmations have raised a controversy with the representatives of the forest industries and the Waters and Forests Service, and reveal the uncertainties of the hopes derived from bioenergy. Professor Lindstrom analyzed the different routes for the conversion of biomass to a usable form of energy. NE supported this analysis with 470,000 krs for the year 1978. The report entitled "Biofuels" should be available in June 1979.

The Secretary of State in charge of energy questions has appointed a study commission on new energies. The work will first cover the use of coal and solar energy, but a study of forest-waste recovery also appears in the directives given to the Commission.

Energy Production From Biomass

The Energy-Producing Forests

The use of forests exclusively for energy purposes is not practical at this time in Sweden. The first condition for use is access to soil adapted to this type of cultivation. This condition is also one of the main limiting factors for this source of energy.

The area assigned to energy-producing plantations depends substantially on the resulting output and the energy content of the harvested biomass. Therefore the research activities financed solely and totally by NE relate to the selection of rapid-growth plants, harvesting methods, biomass manipulation, combustion, and raw-material processing. It should be observed that 22 million Swedish kronor have been introduced into the budget of the three-year plan (1979-1981) adopted by NE. For comparison it should be remembered that 103 Mkrs are assigned to research on the production and use of national fuels. The financially more important research projects are now conducted at the Stockholm Waters and Forests School by Professor Gustav Siren's team. Since 1976 9 Mkrs have been appropriated for development studies on the crossbreeding of poplars with rapid-growth willows.

In the tests intensive cultivation of limited areas has resulted in an annual production of 2-4 kg/m of trunks and branches. After cutting down to chips and drying the calorific value ranges between 11 and 22 kwh per square meter per year.

The experts of the Commission on Energy estimate that the annual contribution of energy-producing plantations may be a minimum of zero in 1990 and reach 5 Twh in the year 2000, and a maximum of 6 Twh in 1990 and 62 Twh at the end of the century. Rating 1 Twh as 0.0860 Toe as done by the Swedish Ministry of Industry, the higher hypothesis would supply the equivalent of 500,000 tons of oil per year in 1990, and 5 million tons annually in 2000. These figures are used by the Secretary of State for Energy in his draft budget for fiscal year 79-80, but Kurt Heden, in charge of the NE bioenergy program, is less specific in his predictions since he estimates as between 1 and 25 million tep the share of energy-producing forests in the energy supply.

The necessary energy-producing forest area ranges between 0.3 Mha and 1.25 Mha, as determined by the degree of use. The inventory of lands capable of supporting such single cultivations indicates that about 1 Mha is available according to the study conducted by Professor Siren. The distribution among types of land is as follows: 1/3 fallow land and abandoned agricultural land; 1/3 swampy undergrowth and lake shore land; and 1/3 swamp. But 1 Mha of swampland can be used.

The selection of the areas to be cultivated exclusively for energy purposes will be difficult since 0.3 Mha of forests are planted every year, and the land can be used more profitably for other harvests. The distance between the land and the use centers, the availability of sufficient irrigation, and the critical limit under which other energy sources would be more economical, are some of the obstacles which should be overcome by biological, technological, and economic research.

Aside from the work of Professor Siren, wiich absorbs over 3 years more than half of the budget appropriated for energy-producing forests, a detailed inventory of the lands available for such cultivation is being conducted by the Waters and Forests School (Professor Hagglund, Umea) with a budget of 1.1 Mkrs.

In addition the firm SIKOB, specializing in agricultural equipment, is studying designs for new tractors and other forest machines applicable to energy-producing forests. The NE Commission has appropriated 300,000 Mkrs for these activities. The influence of energy-producing forests on scenery is not neglected since NE provides 50,000 krs for a study of this question.

The effect of fertilizers on the surrounding flora and fauna is being studied for one year by 3 teams of the Waters and Forests School at Uppsala, with a total subsidy of 452,000 krs from NE. To reduce the cost in fertilizers and improve the resistance of trees to insects and diseases alders may be selected since they can fix nitrogen. Work on this tree is conducted at the University of Umea (78-79 budget: 172,000 krs).

In view of the high potential of energy-producing forests and of the immensity of the work to be done before this energy source can be used rationally, and above all profitably, Sweden participates very actively in the common research program od IEA as the coordinating country. Sweden pays annually 200,000 krs toward the implementation of the forest biomass program.

Forest Energy

This term designates the potential energy represented by wood (branches, stumps) or leaves made available as waste by forestry.

The potential of Forest Energy in Sweden

During the periods of forced isolation endured by Sweden timber and waste have been found to be excellent substitutes for imported fuels. The total resources of Sweden in sawmill timber are estimated at 2.3 x 10^9 m^3 steres or 3 x 10^9 steres, including stumps, branches, leaves, and other dry needles. In the atmosphere (25 percent humidity) this represents 500 Mtep. This figure should be compared to the annual Swedish hydrocarbon imports of about 35 Mtons. Roughly the annual deforestation corresponds to a total of some 84 million steres. Of this total 3 Msteres are difficult to use, and 6 Msteres are left on the spot.

Ultimately the annual felling of forests amounts to 75 Msteres, i.e. 14 Mtep in a dry atmosphere.

The waste from tree felling, transport, and sawing is estimated theoretically at 46 million m^3 (1). For various reasons this waste is not totally coverable. When the only method of transportation of the wood is rafting recovery is impossible. From the viewpoint of economy one obstacle is the transportation costs which exceed the savings dreived from the use of waste. Biomass conversion for other purposes may not be profitable. The quantity of energy provided by waste is not certain since for example the calorific value of bark is zero when the humidity ratio is above 75 percent. The recovery

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recoverable. When the only method of transportation of the wood is rafting recovery is impossible. From the viewpoint of economy one obstacle is the transportation costs which exceed the savings derived from the use of waste. Biomass conversion for other purposes may not be profitable. The quantity of energy provided by waste is not certain since for example the calorific value of bark is zero when the humidity ratio is above 75 percent. The recovery of stumps and roots poses 2 problems. The first problem is a matter of beauty since deforested land will show large gaping holes, and the second problem is mechanical since the presence of stones retained by roots heavily damages blades in the sawing operation. Finally the elimination of waste deprives the soil of a significant nutrient fraction.

In summary, after the biological and ecological restrictions have been established only 34 million m^3 of waste are left. Because of these technical limitations only 22 Mm^3 of waste can be used. The needs of the papermaking industry absorb 13 Mm^3, which leaves about 9Mm^3 of waste usable as fuel, i.e. 1.5 Mtep. All these figures are provided by NW in a report dated June 1977. Professor P.O. Nilsson, a collaborator in a great project called Total Use of the Tree and specialist in forest energy, estimates the energy value of waste at 2 Mtep.

Special attention must be given to the recovery of bark and sawdust, which is easy since they are produced as waste in the wood treatment plants. Thus 7 Mm of bark are available every year, the equivalent of about 0.6 Mtep. 90 percent of the bark is used as fuel or as raw material in some industries. Sawdust (1.4 Mm^3 or 0.06 Mtep) is used practically in totality as raw material or fuel.

The Projects

NA has appropriated 10 Mkrs, i.e. 10 percent of the budget for the 1978-81 period for the item Forest Energy of its National Fuels program. The principal projects concern the mechanization and rationalization of felling and transportation. The progress which may occur in this area will influence the parallel development of energy-producing plantations.

But to date the most important project has been that concerning the total use of wood, started in 1973 and implemented between 1974 and 1977. Its purpose was to inventory the quantities of wood abondoned on the spot after use, and the possible methods of collection, transportation, and use as fuel or raw material of this waste. One of the conclusions of the study was that short-rotation, energy-producing forests would provide fuel at a cost higher than the recovery of forest waste, and that very intensive mechanization alone would result in a drop in prices. The budget applicable to this 3-year project was 12 Mkrs granted in equal shares by the Administration for Technological Development (STU), the Waters and Forests Service, and the professional forestry organizatinns. This budget will be increased by the 19-20 Mkrs which were paid by enterprises for collection, conversion, and treatment.

Professor P.O. Nilsson is now conducting for NE a study intended to establish the conditions for the recovery of forest waste to produce energy. Three Mkrs have been authorized for this study since 1977.

The ecological balance of forests, which is disturbed by the removal of waste, is also the subject of studies financed partially as the item Ecology in the NE program with 3 Mkrs, partially by the Environmental Protection Agency (SNV = Naturvardsverket).

Other Types of Biomass

The biomass energy potential is available in two forms: that of a biomass cultivated or produced solely for its energy properties, and that of waste rejected in an activity other than energy production.

As a complement to energy-producing forests other rapid-growth plants are to be studied from the viewpoint of energy production. The sunflower is an annual whose growth reaches 79-104 g/m daily with a photosynthesis efficiency of 75 percent. Other likely plants are hollyhock or stalked plants (Polygonum cospidatum and Polygonum sachalinense) which grow readily in waterlogged soil. Sugarbeets and even English turf (ray grass) may constitute useful fuels to the extent where energy-producing cultivation can benefit from the progress in agricultural output for energy purposes, and are being studied technologically and economically by Kockums Agrar. Five hundred and ninety thousand krs have been appropriated by Ne for this research in 1978.

Drying and storage plants are equipped with solar pickups and make extensive use of the greenhouse effect. NE has paid 240,000 krs to the community of Umea to study the feasibility of structures of this type. In his presentation of the partial report the person in charge stated that: 30 percent of the dry substance could be economized (also improving the protection against insects); simple computerized automation permitted the selection of the humidity ratio on the basis of the fuel being dried and provided for uniform fuel quality; and for a plant handling some tens of thousands of tons the operational costs are estimated at 2 Mkrs per year.

Research on algae, especially Dunaliella, are conducted by the team of Professor Carl-Goran Heden. The appropriated budget is larger than 1 Mkrs since 1977. The straw produced by cereal harvesting amounts to 5.5 M tons per year over 1.6 Mha. With a calorific value of 3,700 kcal/kg straw constitutes the equivalent of 2 Mtons of oil per year. Also, straw is completely useless in agriculture, but its recovery must be very economical to compete with other energy sources. The conversion of straw and other energy sources. The conversion of straw and other biomass products to powder was awarded a credit of 1.2 Mkrs between 76 and 78 (Professor Abom, Chalmers Polytechnic Institute). But to our knowledge the recovery of straw is not the subject of a specific study.

In contrast the study of the feasibility of the use of some types of reed as energy source has been supported by a credit of 400,000 krs since 1977 (professor Sven Bjork, Lund). Finally the entry Miscellaneous Types of Business has been awarded a budget of 3 Mkrs.

Basic Research on the Use of Biomass Energy and Biological Processes

Basic research is under the National Basic Sciences Research Council (NFR). This organization receives the amount of 3 Mkrs for the 1978-1981 period. The general budget of NFR contains a 1.4 Mkrs credit for 1979 for research linking biology and energy. A relatively small portion (0.5 Mkrs for 1979) of the common program Energy-Connected Basic Research conducted by NFR, STU, and Studsvik Energiteknik A.B. is devoted to bioenergy.

The results of the present research may determine the choices open in bioenergy and therefore the research subjects are the broadest possible. Four lines of activity have been determined: enzyme and cell techniques, photosynthesis and biomass, and finally cell energy.

Some of the most important projects for which all the credit sources are consolidated are:

Study of the catalysis mechanisms and structures of photorespiration control enzymes: Professor C.I. Branden, Uppsala, for 1978-81, R. Branden, lecturer, Goteborg;

Relation among nitrogen fixation, photorespiration, and photosynthesis by algae: Professor Bergman, Uppsala;

Energy use of nitrogen fixation by the alder: Professor Eliasson, Umea; the application of these studies to energy-producing plantations by the same team is also supported by NE;

Metabolism and butanol-and acetone-formation control mechanisms in microorganisms in anaerobic medium: Professor Gatenbeck, Stockholm;

Development of enzyme or microbe strains to produce liquid fuels (ethanol, butanol) from biomass (cellulose): Professor K. Mosbach, Lund;

Manipulation of the genetic code of Bacterium subtilis for energy purposes: Professor L. Philipson, Uppsala;

Study of photosynthesis mechanisms: Professor P.A. Albertsson, Lund, Professor Egneus, Goteborg; and

Relation among hydrogen production, nitrogen fixation, and photosynthesis by Rhodospirillum: Professor H. Baltscheffsky, Stockholm.

The Role of the Government in Bioenergy Development

It will be recalled that the Director General of the National Agency for Industry (SIND) is the chairman of the Commission on Solar Energy and Oil-Substitute Fuels.

The National Agency for Industry (SIND) examines closely the problems arising from the large-scale use of biomass as energy source. Through NE, which is administratively under the Ministry of Industry, SIND has promoted the develppment of energy-producing forests. But, according to Mats Hojeberg, energy director at SIND, the biomass will replace only a small percentage of fossil fuels, and the largest number of means at the lowest price must be sought to reduce the dependence on petroleum products.

Plants using new technologies or new compounds can be financed up to 50 percent by SIND: thus 11 Mkrs have been invested in 1978 to permit a saving of 24,000 tons of oil per year.

SIND encourages the use of chips as fuel since the technologies are available at this time, but the organization (distribution, drawing of contracts, product standardization) is lacking.

It is absolutely certain that communities must have a more important part in biomass production and in the planning of their needs. A survey is being conducted on this matter in the communities.

Conclusions

The potential importance of Swedish forestry has induced the Government to finance research demonstrating the real possibilities of forest energy, i.e. of the recovery of waste at all the levels of timber use, and the longer-term possibilities of energy-producing plantations. The change to the large-scale use of forest energy would reduce hydrocarbon imports by about 10 percent. The hopes derived from energy-producing forests and their effects on the environmnnt are less well known, but very recently Kurt Heden indicated that the Swedish oil imports could be reduced by 20-30 percent by the end of the next decade, provided that the decisions on investments are made now. Government intervention is primarily in the form of financial support of pilot plants and assistance in the creation of a market for vegetable-origin fuels. Along this line two experimental projects have been authorized on 20 July 1979 by the National Administration for the Development of Energy Sources (NE).

In the NE biomass program, and more specifically in the energy-producing forests subprogram it was decided to start in the spring of 1980 large-scale plantations to experiment on different varieties (birch, alder, and especially willow and poplar) capable of rapid growth and high output. Tests will also be conducted on the adaptation of mechanical equipment and different irrigation methods.

One project is assigned to the Public Property Administration (Domanverket) which will use a block of some 100 hectars on the territory of the Surahammar community. Independent owners and cooperatives have associated to conduct the same experiments on 100 hectars divided into lots of 10-20 ha. The first results will be recorded in 1983. Over a period of 5 years the budget necessary for each project is estimated at 10-15 Mkrs. The scientific responsibility for the work will be in the hands of Professor G. Siren of the Stockholm Agricultural School. The object of these projects is to present the economic, technical, and ecological conditions of the use of energy-producing forests to permit a political decision by 1985.

Let us repeat that at the international level Sweden is the coordinating country for the IEA energy-producing forest project. The other types of biomass are the subject of knowledge-acquiring research, but apparently no industrial effort is now in progress.

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END