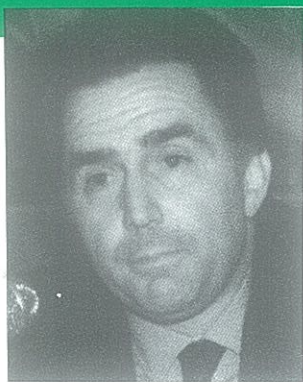




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THE EUROPEAN PERSPECTIVE

ENERGY IN THE 90's

V. REINOSO

Every year, the Spanish Nuclear Society holds a monographic meeting devoted to analyze the results of the Spanish nuclear power plants throughout the previous year. This meeting is attended by all the plant directors/managers. The following article reproduces the conference presented by Victoriano Reinoso at 1990's meeting.

Although the tension caused by world attention to the Persian Gulf events since last August makes it difficult to provide a wider perspective, it seems relevant to review some of the conditioning factors that in my opinion are more stable in the long run, as I am convinced that reasonable ways will be found to solve the current conflict.

As I will be dealing with opinions and criteria, I think that they should be looked at by avoiding abrupt changes from optimism to pessimism, thus providing a coherent framework for analyzing the evolution of energy problems.

From our reflections on the energy situation of the past and analysis of future forecasts, several factors emerge. These factors must be considered and at the same time made compatible with the energy plan within a global approach to energy. These factors are the economy, the security of supply and the environment.

But before continuing, I think it is appropriate to comment on the recent Persian Gulf crisis. These events, serious in themselves, have once again demonstrated the West's enormous dependence on oil and the excessive concentration of it in a very unstable area. Dependence, concentration and instability are the three factors that determine the vulnerability of the world's energy system, particularly in the most developed countries.

There is no doubt that even if an armed conflict is avoided and the economic consequences are controlled, Iraq's action has sent a warning signal that we must not ignore. At present, consumer countries still have a certain capacity for action, but they were gradually losing it as their oil consumption increased. In fact, in just a few years (since 1986 when oil prices dropped so dramatically), most countries increased their energy consumption, particularly of petroleum products, and cut

back on the energy saving and conservation measures that in the past had produced such good results.

With oil consumption and in broader terms with foreign energy dependence, it is necessary to "put up our guard", and Saddam Hussein's coup reminded us that we were lowering it.

Bearing this in mind, we may now review the conditions under which we should analyze the perspectives for energy.

On one hand, it is undeniable that humanity's sustained development requires an energy supply, without which progress would be impossible. By development, I refer not only to economic development, but also to the social and human development of nations.

Creating wealth and welfare requires energy. As the energy content per unit of wealth is subject to reduction, it holds that energy-related actions should be accompanied by improved efficiency, which in turn requires a revision of the complete energy cycle: namely production, transport and consumption.

The oil crises in 1973 and 1979 were undoubtedly the circumstances that mobilized efforts to reduce energy consumption. To a certain extent, what we could call the "new energy resource" was discovered from conservation and energy saving measures put into effect as a result of these crises. The continuation of this policy is a must for this decade, and the different energy policy guidelines are recognizing this fact. However, we must be realistic and recognize that the best incentive for saving is price, and thus a policy of low prices in relative terms, as is the case in the current situation, does not encourage conservation and saving efforts.

On the other hand, we have witnessed and I think that we will continue to witness what we could denominate a change in "society's energy behavior" or

"the new social energy demand", which can be described as a growing concern in public opinion about safety and the environment. This had led to the progressive inclusion in industrial projects, specifically in those related to energy generation or transformation, of systems and equipment to reduce the probability of accidents and to mitigate their effects, as well as to prevent or reduce any environmental impact.

In this respect, particular attention is paid nowadays to the global warming of our planet due to the so-called "greenhouse effect", the production of "acid rain" or destruction of the ozone layer, and the generation and treatment of conventional and radioactive solid and liquid wastes. All these circumstances give rise to different and often contradictory opinions in the analysis of the debate on the future of energy.

The importance of energy issues is relative according to the level of analysis. For example, solutions to supply and demand problems expressed in global terms tend to ignore regional differences, and therefore their validity for offering solutions to local energy problems is limited.

On the other hand, environmental protection is to a large extent considered in global and transnational terms—the opening up of the eastern European countries is an obvious example of the times—and often the importance of a regional focus is not taken into account. While there is a deep concern for these subjects in many sectors, the approach to finding solutions differs, depending on whether it is the ecologist's, sociologist's, politician's or energy supplier's point of view.

Thus, energy operators and suppliers are trapped among various considerations such as a guaranteed and efficient supply, environmental protection, limitations of technical resources and capital, and the needs of the less prosperous classes. This is the complexity of the debate.

Another aspect that should be borne in mind on the energy scene is consumption and its evolution. Primary energy demand depends on factors such as demographic and economic growth, energy intensity and others.

At present, there is a world population of about 5,200 million people. It is estimated that this figure will reach 6,250 million by the year 2000.

As for the global economic growth of GDP in the next decade, it is forecast in a range of 2.4% to 3.2%, depending on the country and on the scenario used.

The global growth of consumption up to the year 2000 varies in terms of the hypotheses established; an increase of 25% is considered reasonable.

As regards energy efficiency, it is anticipated that certain improvements can still be made, although the trends of recent

years seem to contradict this, and in any case it should be pointed out that variations exist depending on the country.

Having made these comments, I will now focus on the European energy perspective and in particular on the European Community.

The EC is an important element on the worldwide scene. With a population of 320 million inhabitants, it holds the lead worldwide in importing energy products and places second after the U.S. in absolute energy consumption.

In energy terms, it is only 55% self-sufficient, and thus needs to import 45% of its energy products to cover its demand.

Although the European Community does not have a community energy policy, which in the strict sense could be compared to other policies such as the agricultural one, progressive community action will lead to common legislation and policies to the extent that they are needed for the purpose of the internal market.

Recently, some definitive steps have been taken, such as initiatives to integrate the European dimension in planning for new energy investments and for developing a community system for electricity and gas price transparency. A Directive on this subject was recently approved.

THE INTERNAL ENERGY MARKET

Steps are being taken within the community to implement the internal energy market. The fundamental objectives in this field are to improve competitiveness, which would help to lower prices and costs, and to integrate and optimize the energy grids.

The concept of energy is too wide to apply common standards and market rules that would be valid for all the energy sectors.

On the other hand, in view of the fact that energy is a strategic asset and that security of supply is essential, the principles applied to most goods and services in relation to the internal market are not exactly transferable.

It is true that the market for oil and petroleum products, given the characteristics of the products and their consumers, has characteristics of a "free" market and is open to competition. On the other hand, coal has social and environmental implications that make it difficult to define this market in that way.

However, where it is truly difficult to fully implement the internal market, and specifically the Common Carrier concept, is in the fields of gas and electricity, particularly in the former.

In order to achieve an open market

between producers and consumers in these sectors, first it is necessary to resolve a series of problems or obstacles and to know the "community energy model", which at present is nonexistent. In any event, the following problems or obstacles can be mentioned: harmonization of energy policies, common standards in matters of safety and environment, fiscal harmonization of different taxes currently levied on various energies, transparency not just in prices but particularly in costs so as to prevent transfers to other sectors, and free access to the sources of the different primary energy supplies.

It is not easy to solve these problems in the short run, and although the trend is quite clear, it should be a slow process if we do not want to create worse problems than the ones that are to be solved.

The creation of the internal market within community borders should not be an end in itself, but rather a means to better optimize the community's energy system. In any event, the road towards the internal energy market for gas and electricity will probably result in greater cohesion in the planning of supplies and in improved network integration, thus promoting international exchanges between community countries.

On the other hand, development of the internal energy market provides the opportunity for strengthening links between the different community regions. Smoothing over differences between regions will be especially important for peripheral countries such as Spain.

ENVIRONMENT

The uncontrolled production, transport, transformation and use of energy can contribute to environmental deterioration by affecting the landscape, water and atmosphere.

The fear of these possible effects, in addition to those caused by accidents and risks inherent in the energy sectors, has turned public opinion against large new projects in the fields of energy production and transformation, which has resulted in an emphasis on maximizing the utilization and extension of the operating life of existing facilities, or extending them by using the current sites.

Measures have been adopted throughout the community to reduce SO₂ and NO_x emissions. However, we are still far away from the full implementation of currently available technologies for reducing these emissions. In addition, in the recent second international conference on climate, a proposal was presented to reduce CO₂ emissions by 20% by the turn of the century.

It should be noted that at present there are no efficient CO₂ reduction technolo-

gies, and the only solution is to change the fuel. Therefore, the question is to what extent and at what cost will the community pursue improvements in this field.

Insofar as elimination of radioactive waste is concerned, this is a very long-term problem and the basic question is if the suitable technology is available. The answer is essential to gain public confidence in order to continue with nuclear power developments.

As for the global concerns about environmental deterioration, there is still no scientific consensus regarding the magnitude and implications of this problem. Nevertheless, measures must be taken. The community's policy is only a small part of the answer, and its effect will be very limited if consistent standards are not adopted elsewhere in the world.

Of course, it should be remembered that the energy sector is not the only one that contributes to environmental contamination. CO₂ emissions are responsible for about 55% of all gases that produce the "greenhouse effect", and a large part of these gases do not come from energy sector activities.

EASTERN EUROPE

The extraordinary changes taking place in Eastern Europe and the USSR will profoundly affect the European Community. It is too early to understand all the consequences of these changes since they are still in the process of development, but until a complete analysis can be made, it seems appropriate to make some observations on the energy aspects.

Before entering into the analysis, I think it is relevant to quote the words of Vaclav Havel in his first speech as the President of Czechoslovakia, which I believe reflects the overall energy situation in the Eastern countries. "Our obsolete economy is wasting the little energy that we have. (...) We have contaminated our soil, our rivers and the forests that our ancestors bequeathed us, and today we have the most contaminated environment in Europe (...). But this is not the main problem; the worst problem is that we live in a contaminated moral environment."

The different analysts that have studied the energy situation in the Eastern countries emphasize that since Stalin's time, the communist countries have based their development on intensive energy consumption.

This recalls Lenin's statement that "communism is Soviet plus electrification". It also underlines the fact that in the absence of free market conditions, "energy costs have been ignored". At present, the Eastern countries' energy problems do not arise "from a lack of energy sources, but rather from industry's ex-



LA OPERACION DE LAS CENTRALES NUCLEARES ESPAÑOLAS EN 1990

Manuel Acero (Past President of the SNE), Victoriano Reinoso and Francisco Vighi (President of the SNE) during the meeting.

cessive and inefficient energy consumption and from its environmental impact". The latter aspect could be qualified as catastrophic.

If we now refer to the case of the Soviet Union, it should be noted that the economic development and the population are concentrated in the Western or European zone. However, more than three quarters of their energy resources are located in Siberia, Central Asia and the Far East. The distance between supply and consumption is of even greater importance when we consider that the coal, oil and gas reserves in Western Siberia are being depleted and the search for new resources has to be shifted to the north, the east and offshore. These facts are the reason that large quantities of fixed productive capital in the decades of the 70's and 80's have been wasted in the search for reserves.

On the other hand, we should note the Soviet Union's failure to reduce energy consumption per GDP unit in comparison to the other industrialized powers. The Soviet Union has reduced by 15% the energy consumption per GDP unit in the last two decades, compared to a 71% reduction in the U.S.A., 72% in Great Britain and 78% in Japan. Furthermore, most of the reduction in the Soviet Union was achieved in the 70's.

USSR energy demands were and are high as a result of the cold climate, the above mentioned factors of long distances between energy sources and consumption, and the failure to save on fuel and electricity. In this respect, it is noteworthy that the energy sector has "devoured" between 30% and 40% of the country's total industrial investment in the past decade. A logical conclusion of this analysis is that it would seem more advisable to approach energy planning in the Soviet Union more in terms of energy saving and efficiency than in terms of increased production, as the latter would involve large investments that would be difficult to manage in light of the current economic situation.

With regard to the energy sources used to generate electricity, it should be noted that the proportion of coal (mainly lignite) used in the East European countries is never lower than 25% (Hungary) and reaches 80% of primary energy consumption in Poland and the former East Germany. A large percentage of gas is used in the USSR (the leading producer and exporter of natural gas in the world, with 38% of known reserves in 1988), and in Hungary and Romania, where it accounts for 25% of the energy transformed into electricity. Fuel-oil is barely used to generate electricity in the former GDR, but it accounts for 20% in Bulgaria and Romania.

Hydraulic energy only has relative importance in the USSR and Romania. The importance of nuclear generation, to which we will return later, varies from country to country; it does not exist in Poland and Romania, while in Czechoslovakia and Bulgaria it accounts for 25% of total generation and amounts to almost 40% in Hungary.

As regards the East European countries' self-sufficiency, I will refer specifically to electricity. Here, the Soviet Union is the main supplier, having exported more than 29,000 million kWh in 1987 that were "absorbed" by the energy deficits of Poland (—1.8 TWh), GDR (—4 TWh), Czechoslovakia (—3.6 TWh), Romania (—4.8 TWh) and Bulgaria (—4.5 TWh). Hungary is a different case with its extensive foreign dependence, which forced it to import 25% of its electricity consumption.

Thus, the East European countries' short —and medium— term supply is complemented by imports from Russia, which acts as a "monopolistic" supplier, since the interconnection of electricity transport systems between the East and the West European countries poses technical difficulties due to the different transmission modes.

From the energy point of view, the USSR is the privileged partner in the East. The problem is that even though it has more

than enough fuel reserves, it needs large investments of productive capital to exploit them, and due to the current economic situation these investments will require foreign finance.

In the other East European countries, the economic development model of the past, which was based on continuous and uncontrolled growth of energy consumption based on development of domestic production or energy imports, does not seem to suit the imperatives and assumptions of efficiency and competitiveness.

A possible rise in energy demand in the Soviet Union could cause a decrease in energy trade between the East European countries, particularly in connection with energy exports from the USSR, which could result in a decrease in the volume of energy markets worldwide, which in turn could force the European Community to contribute to supplies to Eastern Europe. One of the sectors that could be under pressure is the electricity supply industry.

Another important problem to be confronted by these countries is the environmental deterioration that they are suffering due to the predominance of solid fuels in their energy systems. In addition to their low calorific value, these fuels have ash and sulfur contents that, together with the near absence of purification systems, have had significant effects on the environment. It is still early to provide reliable figures, but even so we can mention examples such as SO₂ emissions, which averaged 150 kg per inhabitant and year in Eastern Europe, compared to the European Community average of 61 kg per inhabitant and year. If we refer to the effects of atmospheric contamination on nature, the data are no more encouraging. In all the above mentioned countries, it is estimated that more than 30% of the forests are damaged and that a large number of rivers and lakes are practically dead due to uncontrolled dumping of toxic wastes.

In the nuclear sector, the protests about power plant safety in Eastern Europe have been made public. In this respect, it is important to note that the German government has decided the closing of four Soviet manufactured nuclear reactors, as they are considered too dangerous and too expensive to modify. On the other hand, the shutdown of nuclear plants and several lignite plants in former East Germany will mean a reduction of 7,760 MW in installed power, which will result in a worrisome capacity deficit. This situation could be similar in the other East European countries and even in the USSR.

The Soviet Union's 1986-1990 five-year plan included provisions for replacement of oil by natural gas in thermal power plants, increased coal consumption, improved use of Siberia's hydroelectric

potential, and installation of nuclear power plants to cover increased demand in the USSR's European territories. But these ambitious nuclear plans, which in any event would have required longer construction periods than in the West, collapsed after the 1986 Chernobyl nuclear plant accident and the subsequent ecological outcry.

Since the accident occurred, seven URRS nuclear power plants, some in operation and others under construction, have been closed or put under moratoria, and it is estimated that 26 reactors will have to be closed in the East European countries.

Due to the implications of an accident in a reactor similar to the Chernobyl type, the European Community should provide as much technological support as possible to assure that both the project and the operational safety standards in nuclear power plants that are operating in Eastern Europe are on the same level as in Western Europe. To this end, the announced Pan-European energy conference to be held in June, in accordance with the Lubbers plan recommendations, will be a very positive development.

ENERGY TECHNOLOGY

Not all the questions posed have a technological solution. But we must hope that new technologies continue to be introduced and disseminated, and that they can serve to significantly ease our current concern regarding the environment and the safety of energy.

Renewable energy sources, advanced nuclear reactors, fusion, hydrogen, and superconductors all can play an important role in a more distant future, even though their potential contribution to the world's energy market is difficult to assess. Nevertheless, if the potentially important benefits of these technologies are to be exploited in the long run, a serious commitment must be made to research and develop them.

In this respect, the technologies of clean use of coal and the combined cycle developments and improvements are noteworthy, as they could make significant contributions from the standpoints of energy efficiency and the environment.

ENERGY SECURITY

The balance between domestic production and imports is changing, as it is anticipated that the latter become more important in the community's supply. This equally affects oil, coal, gas and uranium. As a result, the reliable availability of these supplies at moderate prices

continues to be an issue of particular interest to all community members.

The present trends underline the need to develop the foreign dimension of the community's energy policy; thus, energy security continues to be an important issue.

ENERGY SOURCES

I will now review the different energy sources and will begin with oil, as it is currently the most important. The future of the OPEC is of crucial importance for the evolution of the oil market. We could discuss the greater or lesser cohesion between the organization's members, but since the reserves are increasingly concentrated in a few Middle East countries, the difficulties that affect political relations in this region will acquire an even greater significance. Therefore, in my opinion, the community must continue to promote economic and industrial cooperation with the Gulf producing countries. In the long term, it will be necessary to make viable investments in new productive capacity in the most important producer countries to safeguard the oil market's stability.

Likewise, since the production of countries that do not belong to the OPEC is important to maintain the stability of the international oil market, it is necessary to maintain and even increase investments in areas that are presently under development and where exploration is not as intense.

I would like to emphasize how important oil is for the world's energy, not only due to its political and economic consequences, but also due to the significant participation of this energy source in the developed countries' energy supply system in the years to come. But this circumstance is also related to others to be taken into account, such as its price volatility and the general uncertainty surrounding this energy source, as the present situation so irrefutably proves. In any event, and although the outcome of the current situation proves to be the least traumatic, it will take some time before all economies can recover from the real effects. Therefore, we should not again forget this new lesson that demonstrates the vulnerability of the Western economies because of their energy dependence. For this reason, measures should be taken to limit oil consumption by means of saving and substitution by other more stable sources. But this is only possible with a level of prices that provides a permanent incentive for these measures. Therefore, it would be desirable to stabilize the price of oil above 20 dollars a barrel, in real terms, throughout this decade.

As for coal, European production has

been decreasing during recent years. In the future, this industry will continue to be under pressure, since production in low cost areas outside Europe have created a highly competitive market.

In addition, most of the community's coal imports come from suppliers that are no less reliable than Europe's own suppliers.

It is admitted that community coal production should be reduced and that the process must be thoroughly planned. In particular, new industrial and infrastructure investments will have to be made in those areas of the community affected by decreased production.

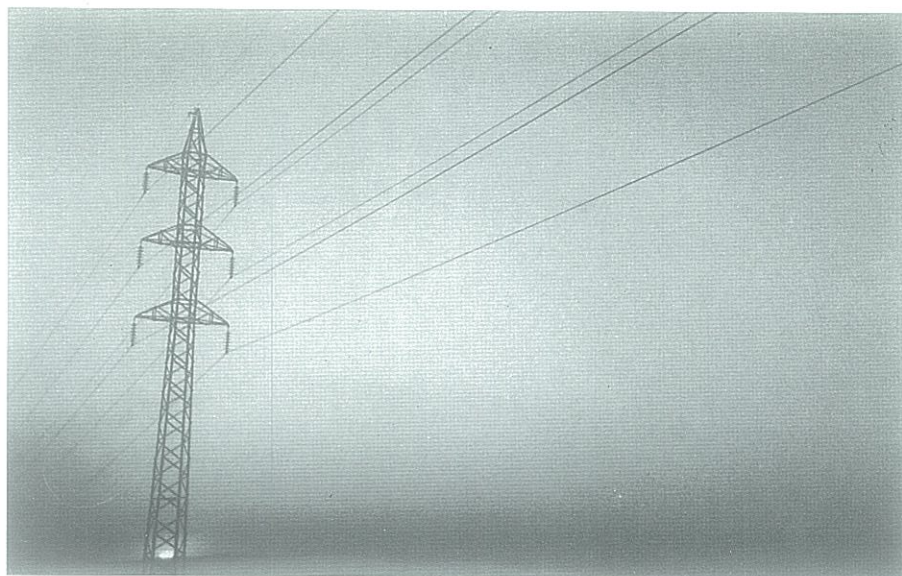
Since in the next twenty years the nuclear contribution to Europe's electricity supply will not be as large as many analysts had predicted five or ten years ago, and since fuel-oil and gas power plants will probably not compensate for increased demand, coal-fired electrical generation will probably have to be increased. Therefore, assuming the probable cutback in European coal production, coal imports will have to increase.

In this case, although a greater foreign dependence of the community's coal industry should not pose a risk insofar as security is concerned, in view of the quantity and location of worldwide reserves, it may create a risk insofar as prices are concerned.

Therefore, coal will continue to be an important fuel for electric power generation. For this reason, at a time of growing concern for the environment, more progress should be made in R&D to improve the efficiency and cleanliness of this fuel. It is foreseeable that natural gas will be used more in the Community, especially in the electric sector. Gas offers environmental advantages in comparison to coal (virtual absence of SO_2 and less CO_2 emission), which makes it particularly attractive for use in densely populated areas.

Natural gas is very efficient in combined cycle plants (and even more so in cogeneration), and the technology is very suited to the construction of relatively small modular units. These facts, together with the low cost of investment per installed unit of capacity, means that combined cycle gas-fired plants will probably occupy a prominent position in Community planning.

As the contribution of the member states' gas supply decreases, we will observe a greater dependence on supplies from Norway, the USSR, Algeria and the Middle East. Thus, it is advisable to study the construction of gas pipelines to establish connections to the production areas, within the framework of industrial cooperation agreements between the Community and these countries. There are very large gas reserves outside the Community, but due care should be taken that a greater dependency on



imports, which now seems inevitable, does not lead to a new threat to the security of the energy supply.

The role that nuclear energy plays in the Community varies significantly from one member state to another. France and Belgium produce about 70% of the electricity from this source, while other countries have rejected it as an option. There is still no consensus, either in the political or public arena, regarding the role that nuclear energy should play in the future. The difficulties associated with the expansion of nuclear capacity are not only due to acceptance of the technology. There is also an imbalance between the need for short development times and low investment cost per unit of installed capacity on one hand, and on the other hand the financing, the construction periods and the risk realities of nuclear energy. The challenge faced by nuclear engineers is to develop technologies better suited to these changing needs. For this reason, there is a growing interest in developing in Europe a standard reactor type that will combine safety, economy, and reduced construction periods to make this energy more competitive. Steps have already been taken in this direction.

The fact that using nuclear energy instead of fossil fuels is one way to reduce atmospheric pollution, and in particular the greenhouse effect, has increased the interest in development of new designs for nuclear power plants and of new nuclear technologies.

But if the above is true, it is also a fact that the safe disposal of radioactive wastes continues to be of utmost concern. In addition, a large number of reactors will be shut down in Community countries

in the next twenty years, and this will contribute substantially to the amount of waste that must be eliminated. This is without a doubt the "outstanding examination" that the nuclear industry must "pass" this decade if it wants to undertake new developments for the future.

There is only a small contribution of other renewable sources (small hydro, solar, eolic, biomass power plants) in the Community as a whole, although in some areas they could satisfy 10% of the primary energy needs. In fact, in many cases the economics of renewable technologies competes favorably with fossil fuel options. These energy sources are especially appealing in relatively isolated zones where the infrastructure is weak or natural resources abound.

Due to a series of reasons (national supplies, environmental problems, regional development), the renewable energy sources will probably play an increasingly important role in the long run. However, since costs must be reduced in order to make the renewable energy technologies more competitive, they will succeed in playing their role only if more effort is devoted to research and development. In fact, there are good R&D perspectives in connection with the advances required to market certain technologies, for example in the field of eolic or photovoltaic energy.

In relation to electricity, the forecast for demand is that it will continue to grow during the decade of the 90's. Even accounting for important saving measures, the electricity growth rates will continue to be positive even in the next century.

The implications of growing demand relate not only to investments in new

generating capacity, but also to the more efficient use of transport networks. The matter of investments is complicated by the difficulty of choosing between different possibilities of fuel sources. However, it is obviously necessary to maintain a balanced and flexible range of options. As explained above, current concern about emissions requires new investments to reduce SO₂ and NO_x by means of technical solutions, and CO₂ by fuel substitution.

Gas has clearly become an appealing fuel for electricity generation, and nuclear energy is essential to guarantee the supply. However, in view of the enormous volume of required electricity and the problems inherent in these two energy sources, it will not be politically or economically feasible to stop using coal for electricity generation. Therefore, besides improving the quality of coal supplies, efforts must be devoted to developing more efficient and cleaner coal combustion technologies.

Finally, the efficiency with which the consumer uses electricity should be of increasing concern. This concern should be shared by the consumers who pay the bills and the utilities that must build

new plants; plant construction will necessarily involve many uncertainties and difficulties for all the reasons indicated above.

To summarize after this brief and necessarily quick review, we can appreciate the role that is played by economic and environmental aspects in the world of energy. On the other hand, understanding technology's role in improving production processes and the more efficient use of energy will allow us to better appreciate the factors that affect both supply and demand.

All options will continue to be controversial. Will we be able to rely on a cleaner use of coal on one hand, and on the other expect design improvements for eliminating wastes in nuclear plants? These are the questions for which answers must be provided if we are to carry on without increased opposition from public opinion.

Imports will increase. This is a reality that must take the foreign element into account and that is worrisome in light of current events.

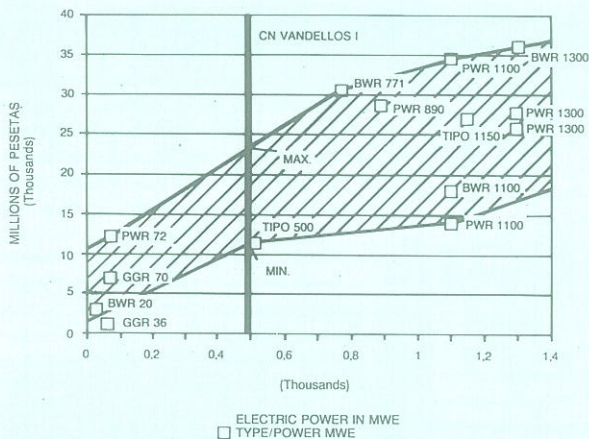
Perhaps it is inevitable that so much attention is paid to the environment, given its importance in scientific, political

and public debates. But we must not lose sight of other objectives. Security of supplies has become a priority today, and it should not be considered as a passing situation but should continue to be an important concern in the future. Establishing policies based on environmental problems that hardly pay attention to the growing dependence on imports could have very negative consequences. Likewise, the adoption of costly long-term environmental control strategies could hinder economic growth.

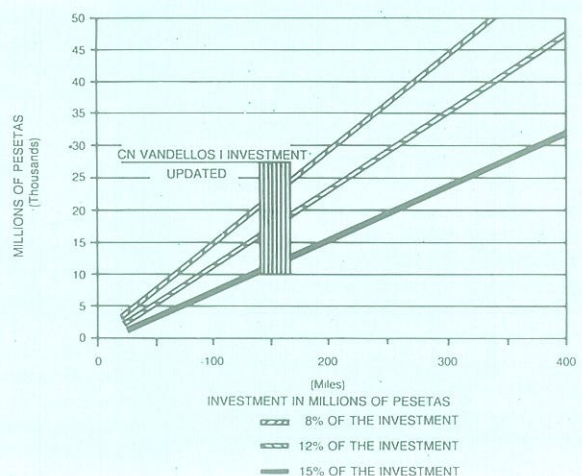
Economic growth should be accompanied by improved efficiency of energy use, and the new wealth created should make it possible to attain, in the long run, a wider range of environmental improvements.

In short, the growing connection between energy problems and an increasing number of sociological aspects, and the impact that energy uses have on other fields with which they may enter into conflict, in my opinion more than justify the slogan "energy and life" that has been chosen for the international energy conference to be held in Madrid in 1992, which I believe will summarize current trends on energy thought.

from page 36



F III Decommissioning Cost versus Electric Power.



F IV Decommissioning Cost versus Updated Installation Cost.

Within this range of points, if we draw a straight line through abscissa $x = 500$ MW, we will obtain maximum and minimum values for decommissioning Vandellós I by reference to other installations that range from 24,000 to 12,000 million pesetas.

These data have been obtained from a bibliographic approximation and thus

should be treated with the caution implicit in this method.

As regards cost estimates by reference to other decommissionings in terms of the updated cost of the installation, there are different publications that explain the cost of decommissioning in terms of a percentage of the updated installation cost (immediate level 3 decommissioning),

although these percentages are different depending on the publication that has been consulted, ranging from 8% to 15% of the updated investment cost. These values correspond to decommissioning costs that range from 11,200 to 25,500 million pesetas and, as in the previous case, the data should be treated with the caution implicit in the method.