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ENERGY IN EUROPE

Energy policies and trends in the European Community

Number 9 December 1987

Commission of the European Communities □ Directorate-General for Energy

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Contents

Abbreviations and symbols

:	no data available
-	nil
0	figure less than half the unit used
kg oe	kilogram of oil equivalent (41 860 kjoules NCV/kg)
M	million (10^6)
t	tonne (metric ton)
t = t	tonne for tonne
toe	tonne of oil equivalent (41 860 kjoules NCV/kg)
fob	free on board
cif	cost-insurance-freight
MW	megawatt = 10^3 kWh
kWh	kilowatt hour
GWh	gigawatt hour = 10^6 kWh
J	joule
kJ	kilojoule
TJ	terajoule = 10^9 kJ
NCV	net calorific value
GCV	gross calorific value
ECU	European currency unit. The ECU is a composite monetary unit consisting of a basket of the following amounts of each Community currency: BFR 3.71 — HFL 0.256 DKR 0.219 — IRL 0.00871 DM 0.719 — LIT 140 DR 1.15 — LFR 0.14 FF 1.31 — UKL 0.0878
USD	US dollar
EUR 10	Total of member countries of the EC before accession of Spain and Portugal in 1986
EUR 12	Total of member countries of the EC
I or —	discontinuity in series
of which	the words 'of which' indicate the presence of all the subdivisions of the total
among which	the words 'among which' indicate the presence of certain subdivisions only

Introduction

At a time when the eyes of the world turn once more to the Gulf, it is opportune to reflect on the changing role of oil in our energy supplies and to look at some of the ways of reducing our dependence on this region.

The first article in this issue traces the evolution of oil consumption since the second oil shock in 1979 — brought about mainly by political instability in the Gulf — to the present day and puts forward some thoughts on its possible development until 1995. For the future, two price scenarios (USD 18/barrel and USD 25-30/barrel) are used which result in a range of possible levels of consumption (from 485 to 560 million tonnes of oil/year). While this review does not predict major disruptions to supply, these are always possible and the European Community is prepared for such events. The second article describes the emergency measures which the Community could take in the event of a future oil crisis.

The major increases in oil prices brought about by the 1979 oil shock resulted in large decreases in the consumption of oil by the Member States. Consumption fell by 7.5% in 1980 and by 1985 was 22% lower than in 1979. However, in 1986 the price of crude oil fell by 60% while oil demand in the European Community only rose by 3%! This might be taken to indicate that energy prices are less important than we used to think. The article **'Do oil and energy prices matter?'** examines — and disagrees with — this view.

The article **'So forecasting is easy!'** is a personal view on possible energy futures and the uncertainties surrounding these, by the Head of DG XVII's 'Analyses and forecasts' division. While this paper is centred around reflections upon the past and likely future role of 'king or citizen oil' it also briefly discusses some of the new technologies and improvements in energy efficiency that are having an impact on energy demand.

Third-party financing or, as it is called in our fifth article 'performance contracting' is more than just a new method of financing increasing efficiency of energy use. It usually includes a package of services such as the design, financing and installation of energy efficiency measures and the regular maintenance and service of the equipment. It was the subject of a seminar sponsored by the Commission and held in Luxembourg in October 1987 at which this paper was presented.

The development and exploitation of renewable forms of energy is likely to play an increasingly important role in the longer term. This was the subject of a recent Communication from the Commission to the Council which is described in a short article.

Greater use of nuclear power has been advocated by many to reduce dependence on imported fuels. However, to reduce the level of the uranium imports required to fuel the nuclear reactors it will be necessary to further develop the fast breeder reactor (FBR). The article here reports on the results of a Commission-sponsored study which examined how the gap between the costs of constructing a current technology reactor and those of constructing the recently completed FBR, *Superphenix 1*, could be narrowed by building a series (or batch) of the more advanced reactor type.

The next article casts a backward glance at the amount of financial support from the Community to the energy sector in 1986 and analyses the distribution of the funds concerned. This support totalled 4 321 MECU of which 1 091 MECU took the form of grants and 3 230 MECU the form of loans.

The last article brings us back to the present day with our most recent short-term energy outlook for the European Community.

The section **'Community News'** describes many of the recent events which could have an impact on energy and energy policy in the European Community. These cover a wide range of meetings including meetings of the Energy Council, the meeting of the Research Council which adopted the framework programme for technology research and development (1987-91) and a variety of seminars on energy planning, third-party financing, coal production technology and energy efficiency in industry. There are also short articles in this section on improving the efficiency of electricity use and the meeting of the Governing Board of the International Atomic Energy Agency.

Finally, the section **'Technology focus'** contains articles on the development of a long-range navigation system for use in the exploration of the North Sea, on the transhipment of coal slurries and on the centralized management of heating systems.

Table 2
Short- and long-term price and income elasticities for motor gasoline

Country	Short-term price[1] elasticity	Longer-term price[2] elasticity	Short-term income[3] elasticity	Longer-term income[3] elasticity
FR of Germany	– 0.13	– 0.10	—[4]	1.12
France	– 0.55	– 0.21	0.50	—[4]
Italy	– 0.44	—	0.50	0.63
The Netherlands	– 0.31	—	—	0.82
Belgium	– 0.44	– 0.11	1.35	0.29
United Kingdom	– 0.17	– 0.14	0.15	1.13

[1] Direct price effect.
[2] Indirect effect through changes in the vehicle stock.
[3] Effect of changes in private consumption.
[4] Other variables present.

(ii) Exploration at a more aggregate level of the **effects over time in changes in price at different price levels.** There is some evidence to suggest that the long-term demand response to price changes depends both on the absolute level of prices and upon whether prices are rising or falling. Some of the research underlying the model used by the Commission services for simulating the behaviour of the world oil market (Aisling) points to a lower response to a fall below previous peak oil price levels than to an increase above them. This can be explained theoretically by factors such as more competitive pricing by other fuels in a bid to retain market shares when the price of oil is falling (with a rising oil price, the price of alternatives has also tended to rise, reinforcing the trend towards saving, but not sufficiently to remove the incentive to switch out of oil), the maintenance of a regulatory environment which discourages re-investment in oil-burning equipment (take, for example, the Community Directive of 1975 which limits oil use in power stations, and which remains in force), the fall in relative cost of non-oil burning equipment. Table 3 below outlines the results for Europe, the USA, Japan and the rest of OECD.

Table 3
Aisling model
OECD: Price elasticities of oil demand by region

Region	Short-term	Long-term increase to new peak	Long-term fall below peak
EUR 10	– 0.06	– 0.47	– 0.24
USA	– 0.05	– 0.64	– 0.30
Japan	– 0.08	– 0.80	– 0.31
Rest of OECD	– 0.04	– 0.45	– 0.24

Energy prices and economic change

The full impact of changes in energy prices occurs only as price changes work themselves through the economy as a whole. Some of them are discernible relatively quickly, others take some time to be felt. These economic effects occur as energy becomes cheaper or more expensive in relation to other factors of production (capital and labour) — affecting the level of investment and expenditure on labour in industry — and in relation to other items of private consumption, affecting both the pattern of consumption and savings ratios.

The **substitutions** that thus occur between factors of production have been studied by a number of research workers in Europe in the development of an energy-oriented macro-sectoral model (Hermes) financed under the European Community's research programme into energy systems analysis. Table 4 gives an example of findings for two key industrial categories.

Table 4
Long-term price elasticity[1] of different factors of production in industry

	Intermediate goods			Capital goods		
	K	L	E	K	L	E
Investment (K)	– 0.15	0.20	– 0.05	– 0.39	0.63	– 0.24
Labour (L)[2]	0.06	– 0.06	0.74	0.08	– 0.37	0.29
Energy (E)	– 0.00	0.20	0.20	– 0.06	0.63	– 0.56

[1] The table shows the full effects of changes in the real price of K, L and E on demand for K, L, E over a period of 8 to 10 years. It is derived from data for France.
[2] Labour (L) is not a direct measure of employment but of expenditure on wages and salaries.

This shows how important the effects seem to have been. In the capital goods industries every 10% increase in energy prices has meant a cumulative reduction over the following 8 to 10 years of 2.4% in investment expenditure and a rise in expenditure on wages and salaries of 2.9%.

Conclusions

Energy and oil prices do matter. The absolute level, the direction in which they are moving and are expected to move, and the relative prices of each fuel all play a role, directly and indirectly, in influencing the pattern of energy demand and supply, as well as impacting on the economy more widely. Economic science is not yet capable of providing as much guidance to policy-makers as they would wish on how those influences will be exerted during the coming years, but considerable progress has been made in isolating historically the longer-term effects of price.

Just as it would be wrong to try to predict the future solely on the basis of a sophisticated but imperfect understanding of the role of prices in the past, it would be equally unwise to ignore prices altogether and to suppose that energy demand will be determined overwhelmingly by non-price factors such as autonomous technical change, demographic change, life-style modifications, etc. The challenge for further research and for analysts trying to peer into the longer-term future is to find ways of integrating econometric techniques with the more technological and sociological.

In the meantime, however, the analyst or the policymaker who looks only at the short term and ignores the potential longer-term effects of price does so at his peril. Econometrics has been described, misleadingly, as akin to driving straight ahead while only looking in the rear-view mirror. It may be just as dangerous to stare resolutely ahead without ever glancing behind.

[1] The US figure implies an elasticity of -0.08, that for Japan of around -0.035 and that for Europe of -0.05, before account is taken of the income effects. The recorded figure for the Community is significantly below the real short-term elasticities derived from previous historical data (close to -0.1%) which were used for much short-term estimation in the mid-1980s — see *Energy in Europe* No 5, September 1986. These apparent elasticities derived from the change in crude oil prices are of course lower than those observed on the basis of the smaller falls that occurred in the prices of oil products to the consumer over this period. But the latter elasticities too are relatively small, bearing in mind that the figures for most oil products are based on information about deliveries, some of which we know went into stock.

[2] See *Energy in Europe* No 6.

[3] See separate article entitled 'So forecasting is easy!'.

So forecasting is easy!

An invitation to Mr Kevin Leydon, Head of DG XVII's Analyses and Forecasts Division to address[1] the Royal Irish Academy provided the occasion to reflect on energy futures and the uncertainties surrounding these, and why earlier forecasts were often off the mark. While this article draws on the work of Mr Leydon and his colleagues in the Commission Services, the arguments and interpretations presented are personal to the author and do not in any way commit either the Commission or any other Community institution.

Setting the scene

Leonard Silk, the eminent American economist, set the background to the new forecasting environment in his recent article in *Foreign affairs*[2] when he described the current state of the world economic and financial system. He identified a range of dangers to the system including:

(i) the high volatility of exchange rates;

(ii) huge imbalances in trade and growing protection; these having been compounded by the inability of developing countries to meet their debt obligations;

(iii) continuing fears of inflation in the midst of sharp declines in oil and commodity prices;

(iv) sluggish growth in the industrial and developing countries alike;

(v) persistent over-capacity and unemployment;

(vi) aggravating the strings of clashing national interests were uncertainty and conflict among the major nations of the West over the right policies for solving this complicated set of problems.

To this list may be added the current failure of confidence in the world's stock markets. This listing indicates the general economic and financial environment within which the energy sector will operate.

The immediate origins of the current situation in the energy market go back two years. From mid-1985 there were indications of a major change in Saudi policy, the consequences of which were the subject of much debate during the autumn and early winter. With the OPEC decision in December 1985 to seek market share rather than to defend the price levels and all that this implied for Saudi Arabia in its previous role as swing producer, the market responded by marking down the price of crude oil by 50% during 1986. This change in oil policy coincided with the devaluation of the US dollar; reducing substantially the purchasing power of the lower revenue.

Going into 1987 the energy markets were for the moment 'buyers' markets', with reduced balance-of-payments pressures and lower inflation in oil importing countries increasing the scope for resources to be directed towards investment or debt liquidation and growth in the Community economies. But so far the growth had not materialized.

Those who believed this fall in oil prices would boost economic growth were disappointed, producers were aghast at the loss in revenue, consuming countries were pleasantly surprised that demand response was modest and energy analysts worked late trying to anticipate events in the short term and revamped their earlier forecasts!

Where is the herd?

Some commentators have remarked on the sociability of energy forecasters and their tendency to move in herds. Skimming the published literature suggests the herd lying in the range of 48 million to 54 million barrels a day (mbd) for world oil demand in 1995 (excluding centrally-planned economies). This spread is significant in itself; perhaps more significant is the difference in estimates for developing countries and for maturer economies. For the former, estimates range between 14 to 18 mbd and for the OECD area between 34 to 38 mbd. The uncertainties surrounding these numbers include:

(i) the rate of world economic growth (and the future role of the US dollar);

(ii) the outlook for energy and oil demand and supply in other major industrialized countries and particularly in the United States;

(iii) the prospects for the developing countries that are not oil exporters;

(iv) oil production policy in oil exporting developing countries and particularly OPEC;

(v) oil production and export policy in the centrally-planned economies.

The follies of forecasting

Will the current string of forecasts prove as erroneous and as short-lived as those of the preceding 15 years? Forecasts made in the mid-1970s for 1985 suggested a world oil demand of between 60 and 75 mbd. The actual outcome was nearer 50 mbd. Similarly forecasts for the year 2000 offered ranges between 75 and 90 mbd. As time went on, the early 1980s vintage forecasts identified a range of between 60 and 72 mbd. By the mid-1980s the forecasts were reduced to between 48 and 54 mbd, which in fact is lower than the actual consumption in 1980.

Why was demand overestimated and supply underestimated? Forecasts for the mid-1980s, which were made before the first oil shock, turned out to be obsolete almost at once. This was a consequence of the substantial rise in the cost of energy and the subsequent impact on the various factors of production. These influenced the long-term economic growth rate resulting in energy consumption estimates which were much too high. But simply at the time we did not recognize the major turning points which were occurring in the economic structure. The essentially political decisions to raise oil prices beyond a certain level impacted substantially on the fundamental relationships between labour, capital and energy.

A second feature was the growth in interdependence, not only in economic matters but also in geo-politics, which had created a structure facilitating the transmission of economic shocks from one sector through the whole economic system. A major change in the price of oil therefore not only affected the relationships within the sector itself but had consequences right through the economic structures and indeed the world trading system.[3] The problem of inflation, balance of payments and debt was severely affected by the sudden transfer of enormous rent from one economic agent to another.

Changes in perceptions

Was the oil shock sufficient in itself to set in motion such a disturbance in the world economic system? Notwithstanding the importance of oil it was not in itself sufficient. There were other major changes occurring. The **post-war consensus,** based on the Bretton Woods agreements, was faltering and confidence in our understanding of the economic process was being undermined by inflation, low growth and the first major signs of serious unemployment.

In addition to macroeconomic changes a number of other influential factors were at work.

Firstly the relationship between the **North and South** was raising issues of economic welfare at a world level. The argument about a new international economic order was coming to a head. Because of the geographical distribution of oil resources, where essentially the reserves were in the 'South', the argument about the oil price left the energy sector and became an issue in this wider debate about the reshaping of the international order. The importing and exporting countries thus approached the oil price question from fundamentally different standpoints. Industrial countries saw this as essentially an oil and energy issue while countries in the 'South' and particularly OPEC insisted on giving equal emphasis to the totality of the North/South dialogue, both because they saw themselves as part of the 'South', and because they had a special interest as oil producers in discussing other aspects of the world economy.[4]

Geo-political events were also playing an important role. The emergence of *détente* between the super-powers facilitated the development of gas supplies from the USSR to Western Europe. Politics also played a major role in the Middle East. The link between disturbances in the oil market and war is a highly correlated one. Disruptions, either physical or in price terms, are linked directly to the war situation in the Middle East. Many Arab oil scholars have suggested that the Palestinian question is fundamental to the oil issue. Added to this is, of course, the Iraq/Iranian war and the idealogical undertones supporting that war. Essentially the Middle East is the centre of the world oil reserve. Geo-politics will therefore continue to play a major role, if not an increasing one, given the general assumption that OECD dependence on the Middle East for its oil resources will grow in the coming decade.[5]

A powerful intellectual force which influenced both consuming and producing countries was the **Club of Rome report**[6] on the new international order. The energy thinking was based on the belief in the depleting nature of oil and the rate at which this depletion was taking place. This is an example of Malthusian thinking in the twentieth century; largely ignoring the influence of technology, price and the need nations have to secure their strategic resources. The intellectual and emotional appeal of this argument was extremely powerful and influenced not only producing countries but also those who intellectually rejected the idea as such.

Yet while this debate was raging, oil engineers were busily working on their platforms bringing in new fields not only in the industrialized world but perhaps more importantly in the Brazils and other regions of the developing world. Acceptance of this pessimistic view, which ignored the role of technology in innovation, has had major impact not only on the attitudes of producing countries but also in the industrialized world. Implicit in the industrial energy policy is the acceptance, however uncomfortable that is, of the need for a high price for oil and thus for high cost energy. But this has major repercussions for industrial and social development.

The 1970s were a period of major fundamental changes in the macroeconomic structure, reflecting the stresses and strains in the production process arising from inflation, debt and rising interest rates. This undermined confidence in managing the crisis. Simultaneously, the geo-politics of the Middle East were introducing complex and long-lasting influences. This was taking place against a background of developing debate between the North and the South in which the oil issue had a fundamental role. The intellectual climate of the era was essentially pessimistic and Malthusian. Serious doubts were raised regarding the survival of the world financial system.

Narrowing the range of uncertainties

The essential task of energy analysts is to narrow the range of uncertainties and to identify plausible orders of magnitude for the future evolution of the critical variables that will determine the medium- and long-term energy outlook.

In looking towards the next 'vintage' in energy analysis, there are a number of key factors, each complicated and subject to its own dynamic, which will influence the outcome of the energy sector. Amongst these are:

(i) changes in the structure of the economic process;

(ii) shifts in perceptions about the geo-political situation;

(iii) the influence of technological innovation, both on the supply and the demand for energy (including concern about environmental issues);

(iv) the dynamics of the oil sector itself and the interaction between this sector and other fuels.

Energy and the economic process

The impact of and the reactions to the first two oil shocks had major repercussions on the economic process. The weight of oil in international trade is sufficient to maintain this important relationship and while in value terms the measurement of this relationship will vary according to the oil price, strategically oil will remain an important variable in the world trading process.

The reaction to these shocks by countries in different economic groupings at a world level had important repercussions on the economic structures. In general industrialized countries[7] reduced their oil dependency by a series of actions, including energy saving, substitution and lower energy content in the GDP function. Particularly notable here is the Japanese experience where there was a substantial reduction, through an aggressive energy savings policy, in the energy content in GDP. Equally Japanese policy was active in diversifying the source of fuel imports. France replied by developing indigenous resources, i.e. nuclear, and took up the challenge from the oil shocks by increasing substantially the supply of 'national energy' in addition to substitution and conservation policies.

By contrast, countries in the developing world did not succeed in reducing the energy content in GDP to the same extent. Oil consumption decreased largely because of recession, but nonetheless there was in a number of key countries an increase in domestic resources through investment in oil exploration and development. In an interesting paper presented to the 13th Congress at the World Energy Conference, the Institute for Economic and Legal Issues in Energy at Grenoble calculated the reduction in the rate of oil dependency. They distinguished two types of broad responses, those which in addition to reducing the wastage in energy use sought to invest in the energy sector and those countries which concentrated largely on improving their trading position.[8]

Recovering the trading losses due to higher prices by increased manufacturing exports was one strategy developed to respond to the earlier crisis. Japan, Germany, Italy and South Korea generated large manufactured goods surpluses which far exceeded the energy deficit. Countries therefore have the alternative of compensating for their energy vulnerability by an aggressive commercial policy on external markets. This is not necessarily in contradiction with a policy of orientating investment towards the energy sector to improve national energy security. The problem was always how to get the mix right.

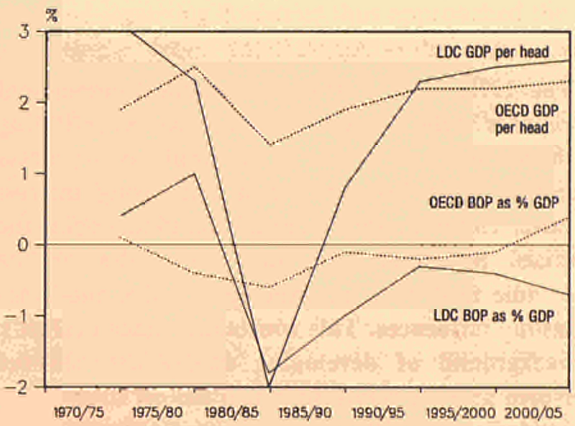
The most striking result of the last decade of turbulance was **the decoupling of the energy/GDP relationship.** For the Community, energy demand was essentially flat for the period 1973/85, despite an increase in GDP of 24%. This change in the relationship between gross domestic product, industrial output and energy demand is the result of changing industrial structures, energy conservation, shift in product mix within industry and orientation towards higher value added. The change in industrial structure and product mix was a response to the changes in the capital, labour and energy production ratios and the continued search for economic growth.

Perhaps the major impact of the energy shock was not so much on the direct relationship between energy and output but rather on the world economic system itself where the impact led to enormous instability, inflation and balance-of-payments problems. Rhys and Davis[9] have argued that countries experiencing faster than average productivity growth have tended also to achieve greater than average declines in energy use per unit of value added. This is due essentially to the structural change within the manufacturing sectors, shifting the structural mix towards lighter, higher value-added industries and enabling an increase in both labour productivity and energy-use efficiency. Over the period 1972-81 value added per person employed increased in Japan by 113% and in the United States by 25%. The energy use per unit of value added fell in Japan by 54% and by 24% in the United States.

The industrial process itself will be affected by inflation and real interest rates which will also impact on exchange rates. The oil sector particularly is influenced by the **exchange rates** because oil is denominated in US dollars. During the 1980s the oil producers perceived a fall in the value of their oil but those in the non-dollar area were confronted with a rising price because of the appreciation of the dollar against their currencies. The coincidence of a substantial fall in the oil price with the consequences of the 'Plaza Agreement' meant that non-dollar area consumers benefited substantially. One further influence which will be specific to the Community area is the decision to progress towards the internal market by 1992. This raises issues regarding the economic structures of companies and the 'rules of the game' to apply within the Community area.

Consequently, taking a position on any future oil price path requires some assumptions about the key macro-economic factors. But these themselves are subject to major degrees of uncertainty. Figure 1 looks at one possible outcome on GDP per head (wealth) and the balance of payments as a percentage of GDP (debt) in the principal trading regions. Such a view suggests that the balance-of-payments position in the developing countries will remain critical, with the risk of limiting growth and maintaining pressures on the world financial system.

Figure 1:
GDP per head (average annual % change)
Balance of payments as % of GDP



Source: CISI-Wharton/EEC.

Geo-politics

Oil prices in the future, as indeed in the past, will be hostage to the fortunes of politics and particularly to the politics of the Middle East. Current events in the Gulf clearly illustrate the nature of the risks involved. The Arabian Peninsula represents the world's 'reserve oil well'. Any assessment of the price-tag must take into account an appreciation of Saudi policy.

The USSR also represents a major source of energy to Western Europe in particular but also on the world oil market. The earlier initiatives in *détente* were accompanied by the opening-up of the Soviet gas fields to Western consumers. The Gorbachev initiative in the internal domestic economy of the Soviet Union may have important repercussions on the geo-politics of Western European energy. Conventional wisdom had it — and indeed there are some traces of it remaining — that by the end of the century the Soviet Union and the centrally- planned economies as a whole would become net importers of oil. This implies an additional call on the world market of somewhat in the order of 1 to 2 mbd. Last year the Soviet Union and the other CPE countries exported just under 2 mbd to the OECD area.

There is no doubt that the management of existing oil fields has posed problems for the Soviet authorities. Problems are technical but perhaps essentially ones of economic management. Secretary-General Gorbachev's initiatives to improve the economic management of the Soviet economy are addressed to such problems, both in the energy and other economic sectors. Consequently, one must question whether the earlier rather pessimistic views of Soviet resources in the future have to be accepted. To maintain those views suggests that the Gorbachev or similar initiatives will fail.

In addition to the oil fields the Soviets have, of course, enormous reserves of gas, but this gas, while important in the balance-of-payments issue, is unlikely to replace oil as a major earner of foreign exchange because European demand for gas is expected to be relatively flat. There are also alternative supplies from Norway and from Algeria. Consequently, to earn the foreign reserves needed, the Soviet Union may be required to manage their energy exports with some care. The Soviets are and have been in the past exceptionally shrewd capitalists in managing their export energy portfolios.[10] Therefore, taking together the potential for economic reform and the continuing requirements for foreign exchange (the external debt has been growing at a very high rate) one should reconsider the view held by certain commentators that the USSR and the CPEs as a whole are becoming net importers of energy. How the relationship will evolve in the future will obviously be linked to the strategic geo-political relationship between the East and the West but if one follows the logic of the disarmament discussions, this is one geo-political area where tensions may relax rather than tighten.

Technology, energy efficiency and environment

Malthus's dire predictions about world starvation did not come to fruition because of technology. Similarly, the belief in the 1970s in the imminent depletion in the 1990s of the world's oil reserves will not come to fulfilment for considerable time because of technology. Schumpeter is more relevant than Malthus! The impact of technological innovation is the hallmark of a dynamic economy. Even if, as has been argued, we are economically stagnating, none the less the expectations of technological progress over the next decade are extremely important. This will apply to the economic process as a whole but also to the supply and demand side for energy and for oil. The issue of oil reserves is one of nature and of man's capacity to find and exploit at reasonable costs. Professor Odell has consistently argued that there is more oil available at reasonable costs than conventional wisdom had it. He was proved right in the past — will he continue to be correct in the future?

The answer lies essentially in technical 'fixes'. Even when the engineering knowledge and capability is present market inertia may be such as to delay or fail to develop these into the market-place. Some argue that with the absence of the price incentive similar to that of the 1970s, energy efficiency will decrease and this will bring forward the next price shock — a variation of the Hog Cycle. On the supply side the most important incentives are those which encourage investment.

Demand also has a role to play. There is certainly a concern particularly if public authorities were to lessen the signals to the market-place by de-emphasizing energy efficiency, e.g. higher speed limits, relaxing housing insulation, etc. (See 'What has been happening to energy efficiency' — *Energy in Europe* No 7, July 1987). But there are non-price forces which can compensate — the need to remain competitive in regional and world markets will require manufacturers to ensure their product reflects the state of the art in technology and in cost-effectiveness. There are problems in forecasting the nature of the impacts of current R&D because the effects are often cumulative and arrive from an unforeseen synthesis of different technologies.

With the benefit of hindsight it is easy to identify, for example, the seeds of the growth in air traffic which came about since the last war. The embryo technology of the jet, radar, traffic management and other engineering features were present even in the early 1940s. How many were able to synthesize these various isolated and independent streams of technology and put together a scenario which predicted today's volume of air traffic?

Energy efficiency and technology

Energy efficiency is closely linked to technical progress. The changes in industrial output impact directly on the energy input requirement. The link between energy, technical progress and productivity growth are interwoven and it is very difficult to predict the cumulative effect of this interaction. That it does occur is evident from the Japanese experience.

Our own analysis of the changes in energy efficiency suggest that while there continues to be some improvement this is not as fast as in the past and may indeed be slowing down. Between 1979 and 1983 final energy demand fell by 12%. This represented 90 million tonnes of oil equivalent. Closer examination suggests that about a quarter of this was attributable to changes in the climate, lower level of economic activity, changes in the structure of economic output (energy intensive industries suffered disproportionately during the recession) and the substitution of gas and electricity with higher energy efficiency for oil producers. The remaining 75% seems to be attributable to genuine improvement in efficiency whether through better housekeeping, discrete energy-saving investments or improved technology.

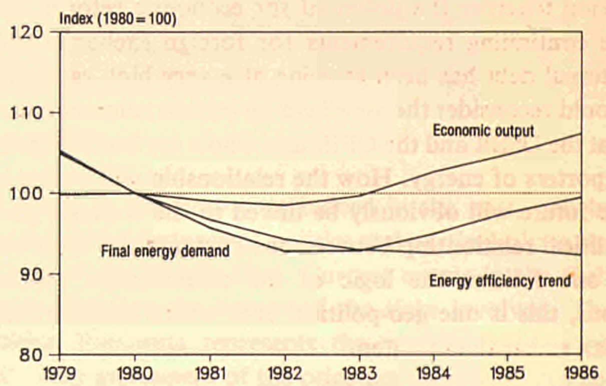
When analysing the results by sector the most clear-cut case is in respect of the residential sector where 'energy efficiency' improvements reduced energy demand by nearly twice as much as climatic factors. In the industrial sector the picture is more complicated. On the face of it the overwhelming share of the reduction in demand for energy was the result of 'energy efficiency improvements' and only a small share was due to structural change.

Looking at the effects of industrial change within industrial branches as a result of process changes, substitution of materials or changes in the nature of products, one finds both good and bad news. The gradual shift to production of steel from electric arc systems (a process change) has of course been increasing specific electricity demand, while energy intensity in the construction materials industry on the other hand has been falling because of a shift away from the use of cement to the use of other somewhat less energy-intensive products (substitution of materials). On balance, the effects have been to push down total energy demand for the three branches combined, although not by very large amounts.

Perhaps the most disappointing sector from an overall energy efficiency standpoint has been transport. Passenger transport registered a net improvement in efficiency because of a technically more efficient vehicle stock, but this was insufficient to compensate for the upward pressures on demand of increased travel and a shift from public transport to the private car. In the freight transport sector, technical improvements in vehicle efficiency were more than offset by poor load factors in a period of recession.

Figure 2 shows recent trends in final energy demand, economic output and energy efficiency. While there continues to be some improvement in energy efficiency, the rate of improvement seems to be slowing down since 1982. This is challenging the perhaps over-enthusiastic arguments cited above. Perhaps it is simply the short-term situation of change slowing down after the last oil shock — now seven years old. None the less, the warning is valuable in recalling that no matter what the latent potential is, it has to be realized in the marketplace.

Figure 2:
European Community (EUR 12)
Final energy demand, economic output and energy efficiency trends (1979-86)



Source: EEC/DGXVII.

The potential is certainly there for major improvements. If one looks at the R&D supply technology, for example, in the electricity sector, there are some promising prospects; including a new generation of gas turbines, advanced nuclear reactors, fuel cells, wind power and photovoltaics.

Equally for energy end-use, technology could have even more far-reaching consequences. Increased end-use productivity in current applications such as improvements in motor coupling efficiency, domestic space heating, and commercial lighting will extend energy supplies. Perhaps the most significant effect will be derived from R&D on new electricity uses. The thrust of industrial policy in the Community and indeed in the OECD area is to develop

Table 2
Short- and long-term price and income elasticities for motor gasoline

Country	Short-term price[1] elasticity	Longer-term price[2] elasticity	Short-term income[3] elasticity	Longer-term income[3] elasticity
FR of Germany	– 0.13	– 0.10	—[4]	1.12
France	– 0.55	– 0.21	0.50	—[4]
Italy	– 0.44	—	0.50	0.63
The Netherlands	– 0.31	—	—	0.82
Belgium	– 0.44	– 0.11	1.35	0.29
United Kingdom	– 0.17	– 0.14	0.15	1.13

[1] Direct price effect.
[2] Indirect effect through changes in the vehicle stock.
[3] Effect of changes in private consumption.
[4] Other variables present.

(ii) Exploration at a more aggregate level of the **effects over time in changes in price at different price levels.** There is some evidence to suggest that the long-term demand response to price changes depends both on the absolute level of prices and upon whether prices are rising or falling. Some of the research underlying the model used by the Commission services for simulating the behaviour of the world oil market (Aisling) points to a lower response to a fall below previous peak oil price levels than to an increase above them. This can be explained theoretically by factors such as more competitive pricing by other fuels in a bid to retain market shares when the price of oil is falling (with a rising oil price, the price of alternatives has also tended to rise, reinforcing the trend towards saving, but not sufficiently to remove the incentive to switch out of oil), the maintenance of a regulatory environment which discourages re-investment in oil-burning equipment (take, for example, the Community Directive of 1975 which limits oil use in power stations, and which remains in force), the fall in relative cost of non-oil burning equipment. Table 3 below outlines the results for Europe, the USA, Japan and the rest of OECD.

Table 3
Aisling model
OECD: Price elasticities of oil demand by region

Region	Short-term	Long-term increase to new peak	Long-term fall below peak
EUR 10	– 0.06	– 0.47	– 0.24
USA	– 0.05	– 0.64	– 0.30
Japan	– 0.08	– 0.80	– 0.31
Rest of OECD	– 0.04	– 0.45	– 0.24

Energy prices and economic change

The full impact of changes in energy prices occurs only as price changes work themselves through the economy as a whole. Some of them are discernible relatively quickly, others take some time to be felt. These economic effects occur as energy becomes cheaper or more expensive in relation to other factors of production (capital and labour) — affecting the level of investment and expenditure on labour in industry — and in relation to other items of private consumption, affecting both the pattern of consumption and savings ratios.

The **substitutions** that thus occur between factors of production have been studied by a number of research workers in Europe in the development of an energy-oriented macro-sectoral model (Hermes) financed under the European Community's research programme into energy systems analysis. Table 4 gives an example of findings for two key industrial categories.

Table 4
Long-term price elasticity[1] of different factors of production in industry

	Intermediate goods			Capital goods		
	K	L	E	K	L	E
Investment (K)	– 0.15	0.20	– 0.05	– 0.39	0.63	– 0.24
Labour (L)[2]	0.06	– 0.06	0.74	0.08	– 0.37	0.29
Energy (E)	– 0.00	0.20	0.20	– 0.06	0.63	– 0.56

[1] The table shows the full effects of changes in the real price of K, L and E on demand for K, L, E over a period of 8 to 10 years. It is derived from data for France.
[2] Labour (L) is not a direct measure of employment but of expenditure on wages and salaries.

This shows how important the effects seem to have been. In the capital goods industries every 10% increase in energy prices has meant a cumulative reduction over the following 8 to 10 years of 2.4% in investment expenditure and a rise in expenditure on wages and salaries of 2.9%.

Conclusions

Energy and oil prices do matter. The absolute level, the direction in which they are moving and are expected to move, and the relative prices of each fuel all play a role, directly and indirectly, in influencing the pattern of energy demand and supply, as well as impacting on the economy more widely. Economic science is not yet capable of providing as much guidance to policy-makers as they would wish on how those influences will be exerted during the coming years, but considerable progress has been made in isolating historically the longer-term effects of price.

Just as it would be wrong to try to predict the future solely on the basis of a sophisticated but imperfect understanding of the role of prices in the past, it would be equally unwise to ignore prices altogether and to suppose that energy demand will be determined overwhelmingly by non-price factors such as autonomous technical change, demographic change, life-style modifications, etc. The challenge for further research and for analysts trying to peer into the longer-term future is to find ways of integrating econometric techniques with the more technological and sociological.

In the meantime, however, the analyst or the policy-maker who looks only at the short term and ignores the potential longer-term effects of price does so at his peril. Econometrics has been described, misleadingly, as akin to driving straight ahead while only looking in the rear-view mirror. It may be just as dangerous to stare resolutely ahead without ever glancing behind.

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[1] The US figure implies an elasticity of -0.08, that for Japan of around -0.035 and that for Europe of -0.05, before account is taken of the income effects. The recorded figure for the Community is significantly below the real short-term elasticities derived from previous historical data (close to -0.1%) which were used for much short-term estimation in the mid-1980s — see *Energy in Europe* No 5, September 1986. These apparent elasticities derived from the change in crude oil prices are of course lower than those observed on the basis of the smaller falls that occurred in the prices of oil products to the consumer over this period. But the latter elasticities too are relatively small, bearing in mind that the figures for most oil products are based on information about deliveries, some of which we know went into stock.

[2] See *Energy in Europe* No 6.

[3] See separate article entitled 'So forecasting is easy!'.

So forecasting is easy!

An invitation to Mr Kevin Leydon, Head of DG XVII's Analyses and Forecasts Division to address[1] the Royal Irish Academy provided the occasion to reflect on energy futures and the uncertainties surrounding these, and why earlier forecasts were often off the mark. While this article draws on the work of Mr Leydon and his colleagues in the Commission Services, the arguments and interpretations presented are personal to the author and do not in any way commit either the Commission or any other Community institution.

Setting the scene

Leonard Silk, the eminent American economist, set the background to the new forecasting environment in his recent article in *Foreign affairs*[2] when he described the current state of the world economic and financial system. He identified a range of dangers to the system including:

(i) the high volatility of exchange rates;

(ii) huge imbalances in trade and growing protection; these having been compounded by the inability of developing countries to meet their debt obligations;

(iii) continuing fears of inflation in the midst of sharp declines in oil and commodity prices;

(iv) sluggish growth in the industrial and developing countries alike;

(v) persistent over-capacity and unemployment;

(vi) aggravating the strings of clashing national interests were uncertainty and conflict among the major nations of the West over the right policies for solving this complicated set of problems.

To this list may be added the current failure of confidence in the world's stock markets. This listing indicates the general economic and financial environment within which the energy sector will operate.

The immediate origins of the current situation in the energy market go back two years. From mid-1985 there were indications of a major change in Saudi policy, the consequences of which were the subject of much debate during the autumn and early winter. With the OPEC decision in December 1985 to seek market share rather than to defend the price levels and all that this implied for Saudi Arabia in its previous role as swing producer, the market responded by marking down the price of crude oil by 50% during 1986. This change in oil policy coincided with the devaluation of the US dollar; reducing substantially the purchasing power of the lower revenue.

Going into 1987 the energy markets were for the moment 'buyers' markets', with reduced balance-of-payments pressures and lower inflation in oil importing countries increasing the scope for resources to be directed towards investment or debt liquidation and growth in the Community economies. But so far the growth had not materialized.

Those who believed this fall in oil prices would boost economic growth were disappointed, producers were aghast at the loss in revenue, consuming countries were pleasantly surprised that demand response was modest and energy analysts worked late trying to anticipate events in the short term and revamped their earlier forecasts!

Where is the herd?

Some commentators have remarked on the sociability of energy forecasters and their tendency to move in herds. Skimming the published literature suggests the herd lying in the range of 48 million to 54 million barrels a day (mbd) for world oil demand in 1995 (excluding centrally-planned economies). This spread is significant in itself; perhaps more significant is the difference in estimates for developing countries and for maturer economies. For the former, estimates range between 14 to 18 mbd and for the OECD area between 34 to 38 mbd. The uncertainties surrounding these numbers include:

(i) the rate of world economic growth (and the future role of the US dollar);

(ii) the outlook for energy and oil demand and supply in other major industrialized countries and particularly in the United States;

(iii) the prospects for the developing countries that are not oil exporters;

(iv) oil production policy in oil exporting developing countries and particularly OPEC;

(v) oil production and export policy in the centrally-planned economies.

The follies of forecasting

Will the current string of forecasts prove as erroneous and as short-lived as those of the preceding 15 years? Forecasts made in the mid-1970s for 1985 suggested a world oil demand of between 60 and 75 mbd. The actual outcome was nearer 50 mbd. Similarly forecasts for the year 2000 offered ranges between 75 and 90 mbd. As time went on, the early 1980s vintage forecasts identified a range of between 60 and 72 mbd. By the mid-1980s the forecasts were reduced to between 48 and 54 mbd, which in fact is lower than the actual consumption in 1980.

Why was demand overestimated and supply underestimated? Forecasts for the mid-1980s, which were made before the first oil shock, turned out to be obsolete almost at once. This was a consequence of the substantial rise in the cost of energy and the subsequent impact on the various factors of production. These influenced the long-term economic growth rate resulting in energy consumption estimates which were much too high. But simply at the time we did not recognize the major turning points which were occurring in the economic structure. The essentially political decisions to raise oil prices beyond a certain level impacted substantially on the fundamental relationships between labour, capital and energy.

A second feature was the growth in interdependence, not only in economic matters but also in geo-politics, which had created a structure facilitating the transmission of economic shocks from one sector through the whole economic system. A major change in the price of oil therefore not only affected the relationships within the sector itself but had consequences right through the economic structures and indeed the world trading system.[3] The problem of inflation, balance of payments and debt was severely affected by the sudden transfer of enormous rent from one economic agent to another.

Changes in perceptions

Was the oil shock sufficient in itself to set in motion such a disturbance in the world economic system? Notwithstanding the importance of oil it was not in itself sufficient. There were other major changes occurring. The **post-war consensus,** based on the Bretton Woods agreements, was faltering and confidence in our understanding of the economic process was being undermined by inflation, low growth and the first major signs of serious unemployment.

In addition to macroeconomic changes a number of other influential factors were at work.

Firstly the relationship between the **North and South** was raising issues of economic welfare at a world level. The argument about a new international economic order was coming to a head. Because of the geographical distribution of oil resources, where essentially the reserves were in the 'South', the argument about the oil price left the energy sector and became an issue in this wider debate about the reshaping of the international order. The importing and exporting countries thus approached the oil price question from fundamentally different standpoints. Industrial countries saw this as essentially an oil and energy issue while countries in the 'South' and particularly OPEC insisted on giving equal emphasis to the totality of the North/South dialogue, both because they saw themselves as part of the 'South', and because they had a special interest as oil producers in discussing other aspects of the world economy.[4]

Geo-political events were also playing an important role. The emergence of *détente* between the super-powers facilitated the development of gas supplies from the USSR to Western Europe. Politics also played a major role in the Middle East. The link between disturbances in the oil market and war is a highly correlated one. Disruptions, either physical or in price terms, are linked directly to the war situation in the Middle East. Many Arab oil scholars have suggested that the Palestinian question is fundamental to the oil issue. Added to this is, of course, the Iraq/Iranian war and the idealogical undertones supporting that war. Essentially the Middle East is the centre of the world oil reserve. Geo-politics will therefore continue to play a major role, if not an increasing one, given the general assumption that OECD dependence on the Middle East for its oil resources will grow in the coming decade.[5]

A powerful intellectual force which influenced both consuming and producing countries was the **Club of Rome report**[6] on the new international order. The energy thinking was based on the belief in the depleting nature of oil and the rate at which this depletion was taking place. This is an example of Malthusian thinking in the twentieth century; largely ignoring the influence of technology, price and the need nations have to secure their strategic resources. The intellectual and emotional appeal of this argument was extremely powerful and influenced not only producing countries but also those who intellectually rejected the idea as such.

Yet while this debate was raging, oil engineers were busily working on their platforms bringing in new fields not only in the industrialized world but perhaps more importantly in the Brazils and other regions of the developing world. Acceptance of this pessimistic view, which ignored the role of technology in innovation, has had major impact not only on the attitudes of producing countries but also in the industrialized world. Implicit in the industrial energy policy is the acceptance, however uncomfortable that is, of the need for a high price for oil and thus for high cost energy. But this has major repercussions for industrial and social development.

The 1970s were a period of major fundamental changes in the macroeconomic structure, reflecting the stresses and strains in the production process arising from inflation, debt and rising interest rates. This undermined confidence in managing the crisis. Simultaneously, the geo-politics of the Middle East were introducing complex and long-lasting influences. This was taking place against a background of developing debate between the North and the South in which the oil issue had a fundamental role. The intellectual climate of the era was essentially pessimistic and Malthusian. Serious doubts were raised regarding the survival of the world financial system.

Narrowing the range of uncertainties

The essential task of energy analysts is to narrow the range of uncertainties and to identify plausible orders of magnitude for the future evolution of the critical variables that will determine the medium- and long-term energy outlook.

In looking towards the next 'vintage' in energy analysis, there are a number of key factors, each complicated and subject to its own dynamic, which will influence the outcome of the energy sector. Amongst these are:

(i) changes in the structure of the economic process;

(ii) shifts in perceptions about the geo-political situation;

(iii) the influence of technological innovation, both on the supply and the demand for energy (including concern about environmental issues);

(iv) the dynamics of the oil sector itself and the interaction between this sector and other fuels.

Energy and the economic process

The impact of and the reactions to the first two oil shocks had major repercussions on the economic process. The weight of oil in international trade is sufficient to maintain this important relationship and while in value terms the measurement of this relationship will vary according to the oil price, strategically oil will remain an important variable in the world trading process.

The reaction to these shocks by countries in different economic groupings at a world level had important repercussions on the economic structures. In general industrialized countries[7] reduced their oil dependency by a series of actions, including energy saving, substitution and lower energy content in the GDP function. Particularly notable here is the Japanese experience where there was a substantial reduction, through an aggressive energy savings policy, in the energy content in GDP. Equally Japanese policy was active in diversifying the source of fuel imports. France replied by developing indigenous resources, i.e. nuclear, and took up the challenge from the oil shocks by increasing substantially the supply of 'national energy' in addition to substitution and conservation policies.

By contrast, countries in the developing world did not succeed in reducing the energy content in GDP to the same extent. Oil consumption decreased largely because of recession, but nonetheless there was in a number of key countries an increase in domestic resources through investment in oil exploration and development. In an interesting paper presented to the 13th Congress at the World Energy Conference, the Institute for Economic and Legal Issues in Energy at Grenoble calculated the reduction in the rate of oil dependency. They distinguished two types of broad responses, those which in addition to reducing the wastage in energy use sought to invest in the energy sector and those countries which concentrated largely on improving their trading position.[8]

Recovering the trading losses due to higher prices by increased manufacturing exports was one strategy developed to respond to the earlier crisis. Japan, Germany, Italy and South Korea generated large manufactured goods surpluses which far exceeded the energy deficit. Countries therefore have the alternative of compensating for their energy vulnerability by an aggressive commercial policy on external markets. This is not necessarily in contradiction with a policy of orientating investment towards the energy sector to improve national energy security. The problem was always how to get the mix right.

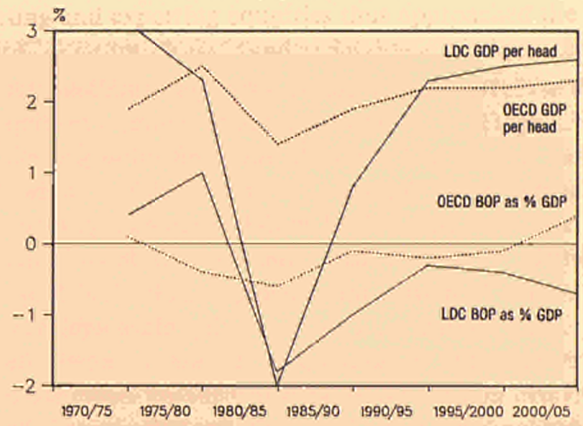
The most striking result of the last decade of turbulance was **the decoupling of the energy/GDP relationship.** For the Community, energy demand was essentially flat for the period 1973/85, despite an increase in GDP of 24%. This change in the relationship between gross domestic product, industrial output and energy demand is the result of changing industrial structures, energy conservation, shift in product mix within industry and orientation towards higher value added. The change in industrial structure and product mix was a response to the changes in the capital, labour and energy production ratios and the continued search for economic growth.

Perhaps the major impact of the energy shock was not so much on the direct relationship between energy and output but rather on the world economic system itself where the impact led to enormous instability, inflation and balance-of-payments problems. Rhys and Davis[9] have argued that countries experiencing faster than average productivity growth have tended also to achieve greater than average declines in energy use per unit of value added. This is due essentially to the structural change within the manufacturing sectors, shifting the structural mix towards lighter, higher value-added industries and enabling an increase in both labour productivity and energy-use efficiency. Over the period 1972-81 value added per person employed increased in Japan by 113% and in the United States by 25%. The energy use per unit of value added fell in Japan by 54% and by 24% in the United States.

The industrial process itself will be affected by inflation and real interest rates which will also impact on exchange rates. The oil sector particularly is influenced by the **exchange rates** because oil is denominated in US dollars. During the 1980s the oil producers perceived a fall in the value of their oil but those in the non-dollar area were confronted with a rising price because of the appreciation of the dollar against their currencies. The coincidence of a substantial fall in the oil price with the consequences of the 'Plaza Agreement' meant that non-dollar area consumers benefited substantially. One further influence which will be specific to the Community area is the decision to progress towards the internal market by 1992. This raises issues regarding the economic structures of companies and the 'rules of the game' to apply within the Community area.

Consequently, taking a position on any future oil price path requires some assumptions about the key macro-economic factors. But these themselves are subject to major degrees of uncertainty. Figure 1 looks at one possible outcome on GDP per head (wealth) and the balance of payments as a percentage of GDP (debt) in the principal trading regions. Such a view suggests that the balance-of-payments position in the developing countries will remain critical, with the risk of limiting growth and maintaining pressures on the world financial system.

Figure 1:
GDP per head (average annual % change)
Balance of payments as % of GDP



Source: CISI-Wharton/EEC.

Geo-politics

Oil prices in the future, as indeed in the past, will be hostage to the fortunes of politics and particularly to the politics of the Middle East. Current events in the Gulf clearly illustrate the nature of the risks involved. The Arabian Peninsula represents the world's 'reserve oil well'. Any assessment of the price-tag must take into account an appreciation of Saudi policy.

The USSR also represents a major source of energy to Western Europe in particular but also on the world oil market. The earlier initiatives in *détente* were accompanied by the opening-up of the Soviet gas fields to Western consumers. The Gorbachev initiative in the internal domestic economy of the Soviet Union may have important repercussions on the geo-politics of Western European energy. Conventional wisdom had it — and indeed there are some traces of it remaining — that by the end of the century the Soviet Union and the centrally- planned economies as a whole would become net importers of oil. This implies an additional call on the world market of somewhat in the order of 1 to 2 mbd. Last year the Soviet Union and the other CPE countries exported just under 2 mbd to the OECD area.

There is no doubt that the management of existing oil fields has posed problems for the Soviet authorities. Problems are technical but perhaps essentially ones of economic management. Secretary-General Gorbachev's initiatives to improve the economic management of the Soviet economy are addressed to such problems, both in the energy and other economic sectors. Consequently, one must question whether the earlier rather pessimistic views of Soviet resources in the future have to be accepted. To maintain those views suggests that the Gorbachev or similar initiatives will fail.

In addition to the oil fields the Soviets have, of course, enormous reserves of gas, but this gas, while important in the balance-of-payments issue, is unlikely to replace oil as a major earner of foreign exchange because European demand for gas is expected to be relatively flat. There are also alternative supplies from Norway and from Algeria. Consequently, to earn the foreign reserves needed, the Soviet Union may be required to manage their energy exports with some care. The Soviets are and have been in the past exceptionally shrewd capitalists in managing their export energy portfolios.[10] Therefore, taking together the potential for economic reform and the continuing requirements for foreign exchange (the external debt has been growing at a very high rate) one should reconsider the view held by certain commentators that the USSR and the CPEs as a whole are becoming net importers of energy. How the relationship will evolve in the future will obviously be linked to the strategic geo-political relationship between the East and the West but if one follows the logic of the disarmament discussions, this is one geo-political area where tensions may relax rather than tighten.

Technology, energy efficiency and environment

Malthus's dire predictions about world starvation did not come to fruition because of technology. Similarly, the belief in the 1970s in the imminent depletion in the 1990s of the world's oil reserves will not come to fulfilment for considerable time because of technology. Schumpeter is more relevant than Malthus! The impact of technological innovation is the hallmark of a dynamic economy. Even if, as has been argued, we are economically stagnating, none the less the expectations of technological progress over the next decade are extremely important. This will apply to the economic process as a whole but also to the supply and demand side for energy and for oil. The issue of oil reserves is one of nature and of man's capacity to find and exploit at reasonable costs. Professor Odell has consistently argued that there is more oil available at reasonable costs than conventional wisdom had it. He was proved right in the past — will he continue to be correct in the future?

The answer lies essentially in technical 'fixes'. Even when the engineering knowledge and capability is present market inertia may be such as to delay or fail to develop these into the market-place. Some argue that with the absence of the price incentive similar to that of the 1970s, energy efficiency will decrease and this will bring forward the next price shock — a variation of the Hog Cycle. On the supply side the most important incentives are those which encourage investment.

Demand also has a role to play. There is certainly a concern particularly if public authorities were to lessen the signals to the market-place by de-emphasizing energy efficiency, e.g. higher speed limits, relaxing housing insulation, etc. (See 'What has been happening to energy efficiency' — *Energy in Europe* No 7, July 1987). But there are non-price forces which can compensate — the need to remain competitive in regional and world markets will require manufacturers to ensure their product reflects the state of the art in technology and in cost-effectiveness. There are problems in forecasting the nature of the impacts of current R&D because the effects are often cumulative and arrive from an unforeseen synthesis of different technologies.

With the benefit of hindsight it is easy to identify, for example, the seeds of the growth in air traffic which came about since the last war. The embryo technology of the jet, radar, traffic management and other engineering features were present even in the early 1940s. How many were able to synthesize these various isolated and independent streams of technology and put together a scenario which predicted today's volume of air traffic?

Energy efficiency and technology

Energy efficiency is closely linked to technical progress. The changes in industrial output impact directly on the energy input requirement. The link between energy, technical progress and productivity growth are interwoven and it is very difficult to predict the cumulative effect of this interaction. That it does occur is evident from the Japanese experience.

Our own analysis of the changes in energy efficiency suggest that while there continues to be some improvement this is not as fast as in the past and may indeed be slowing down. Between 1979 and 1983 final energy demand fell by 12%. This represented 90 million tonnes of oil equivalent. Closer examination suggests that about a quarter of this was attributable to changes in the climate, lower level of economic activity, changes in the structure of economic output (energy intensive industries suffered disproportionately during the recession) and the substitution of gas and electricity with higher energy efficiency for oil producers. The remaining 75% seems to be attributable to genuine improvement in efficiency whether through better housekeeping, discrete energy-saving investments or improved technology.

When analysing the results by sector the most clear-cut case is in respect of the residential sector where 'energy efficiency' improvements reduced energy demand by nearly twice as much as climatic factors. In the industrial sector the picture is more complicated. On the face of it the overwhelming share of the reduction in demand for energy was the result of 'energy efficiency improvements' and only a small share was due to structural change.

Looking at the effects of industrial change within industrial branches as a result of process changes, substitution of materials or changes in the nature of products, one finds both good and bad news. The gradual shift to production of steel from electric arc systems (a process change) has of course been increasing specific electricity demand, while energy intensity in the construction materials industry on the other hand has been falling because of a shift away from the use of cement to the use of other somewhat less energy-intensive products (substitution of materials). On balance, the effects have been to push down total energy demand for the three branches combined, although not by very large amounts.

Perhaps the most disappointing sector from an overall energy efficiency standpoint has been transport. Passenger transport registered a net improvement in efficiency because of a technically more efficient vehicle stock, but this was insufficient to compensate for the upward pressures on demand of increased travel and a shift from public transport to the private car. In the freight transport sector, technical improvements in vehicle efficiency were more than offset by poor load factors in a period of recession.

Figure 2 shows recent trends in final energy demand, economic output and energy efficiency. While there continues to be some improvement in energy efficiency, the rate of improvement seems to be slowing down since 1982. This is challenging the perhaps over-enthusiastic arguments cited above. Perhaps it is simply the short-term situation of change slowing down after the last oil shock — now seven years old. None the less, the warning is valuable in recalling that no matter what the latent potential is, it has to be realized in the marketplace.

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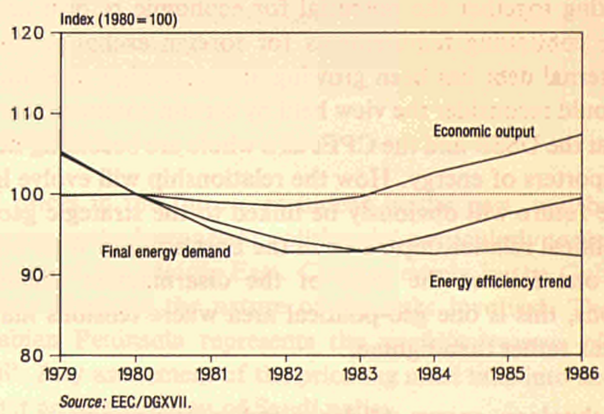
European Community (EUR 12)
Final energy demand, economic output and
energy efficiency trends (1979-86)



Source: EEC/DGXVII.

The potential is certainly there for major improvements. If one looks at the R&D supply technology, for example, in the electricity sector, there are some promising prospects; including a new generation of gas turbines, advanced nuclear reactors, fuel cells, wind power and photovoltaics.

Equally for energy end-use, technology could have even more far-reaching consequences. Increased end-use productivity in current applications such as improvements in motor coupling efficiency, domestic space heating, and commercial lighting will extend energy supplies. Perhaps the most significant effect will be derived from R&D on new electricity uses. The thrust of industrial policy in the Community and indeed in the OECD area is to develop higher added value sectors: sectors more linked to electricity use than to other fuels.[11]

Similarly in the oil sector, application of state of the art technology will reduce the cost of exploration and development of smaller oil fields than were previously available. But there is cause for concern. Will this potential be realized or will an era of low oil prices allow a relaxation of the effort toward greater technical efficiency? Whatever one's answer to these questions, one thing is clear: energy supply and demand efficiency is the most important single factor influencing energy levels over the long run. When one looks back at the earlier energy studies, the lack of attention to this factor is perhaps the most striking.

Public concern about environmental issues has now developed to a stage where energy choices will be influenced by the environmental impact. The link between energy and climate is important. The combustion of fossil fuels results in carbon dioxide (CO_2) and nitrous oxide (N_2O). These gases, particularly CO_2, effect the earth's radiation balance. Scientific opinion[12] suggests that an increase in concentration of CO_2 from 300 PPM to 600 PPM is likely to cause the global average temperature to rise by ± 1.5 degrees centigrade. The objective here is not to look in detail at this argument but simply to take note of the importance which environmental considerations will play in energy policy discussions.

Again the interaction between technology and the energy/environmental debate will be important. Solutions to the environmental issue are closely related to the technology issue in the energy sector itself. Developments in cogeneration, fuel cells, energy storage, more high efficient gas turbines, super heat pump energy accumulation systems and super conductive electric power generation equipment combine to give not only more efficiency in the energy sector but also to reduce the environmental impact.

'King oil or citizen oil'

One influential view is that while oil is plentiful at the moment and OPEC's influence weak, it is only a matter of years before OPEC regains its driving role in determining the world price of oil and pursues an aggressive high oil price policy. The argument runs on the basis of increasing oil demand in response to the substantial price fall in 1986, with reducing supply from non-OPEC sources. The reported fall in US production of 0.7 mbd is quoted to support this latter argument.

One needs to distinguish between the geology/economics of oil and the role of political influence. In the 1970s the arguments for increasing oil prices were based on geology and demand factors. Depletion of oil resources at an early date was one of the standard views adopted while simultaneously oil demand would continue to rise at rates lower than historic trends but none the less bullish; so that quickly, and in some cases from 1985[13] onwards, it was argued that we would be in a major crisis.

Today's conventional wisdom is somewhat different; reserves are sufficient to cover expected oil demands into the early twenty-first century; the prevailing price reflects a closer relationship with the long-run supply curve and technology is influencing the cost of production and improving the discovery rate. The concern is not therefore with geology and demand but rather with confidence and politics. Confidence in the future of oil requirements justifying continued investment and politics because OPEC has a choice between two fundamentally different strategies. This choice is between a high price/low volume strategy and a low price/high volume one.

In determining the outcome over the next 15 years, the challenge for oil is:

(i) to compete with demand from developing gas and electricity networks;

(ii) to compete with technology/energy efficiency on the demand side;

(iii) oil-to-oil competition.

This challenge will be played out against short-term versus long-term economic interests, political 'accidents', reactions to the macroeconomic situation and to the revenue requirements of producing States. In the short term, oil has the characteristic of many other commodities and will react to short-term 'future expectations'. The power of short-term influences on longer-term thinking should not be underestimated.

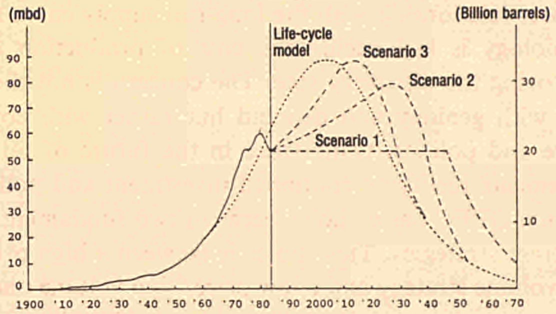
The fundamentals affecting the medium- to long-term outlook for oil depend on one's views on:

(i) the reserve situation;

(ii) the price level required to cover the costs of putting oil on the market.

Figure 3 shows, using a life cycle model,[14] world oil production estimates well into the next century. These are based on an assumed two trillion barrels of ultimate recoverable oil reserves. The three scenarios examine the consequences of different oil production rates — zero growth after 1984, 1% and 2% annual rate of growth. Placing the different ranges of oil demand forecasts on this we note that certainly on the basis of the more recent estimates, much below those of earlier vintages, there seems no geologically-based pressure on the supply and demand balance until 2010-20.

Figure 3:
Models of the world's oil production (2 trillion barrels)

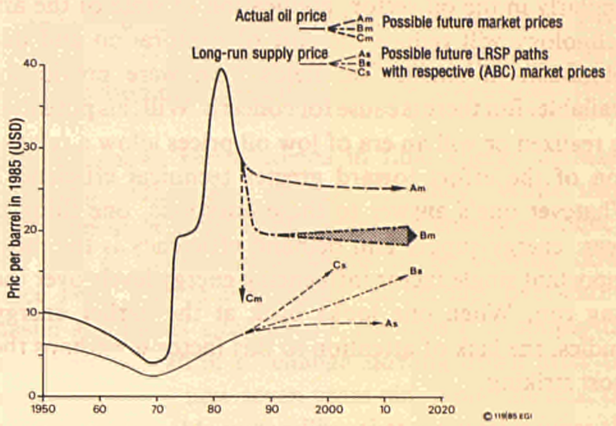


Scenario 1
(production growth at an annual rate of 0% after 1984)
Current production levels will continue until the year 2045 and then decrease.
Scenario 2
(at an annual rate of 1%)
Oil production levels will increase by about 50% over the current levels by the year 2025, and will then start decreasing.
Scenario 3
(at an annual rate of 2%)
Oil production levels will increase by about 60% over the current levels by the year 2010 and will then start decreasing.
Source: Institute for Energy Economics, Tokyo 1987.

Figure 4 tracks the actual price of oil and relates this to Professor Odell's estimated long-run supply price.[15] The argument here is that the forecasts for oil prices are converging more with the long-run supply price than was previously the case, but none the less remain substantially above the ratio established in the period 1950-70. Consequently, the argument would run that the reserve situation indicated above is compatible with the price required from the consumer to cover the necessary production levels.

Figure 5, reflecting work done by the French Petroleum Institute,[16] suggests that there are substantial cost reduction potentials available. The estimate of production costs for 1985 at a world level was calculated at USD 5-6 a barrel. Following the trend this would suggest a cost estimate of between USD 10-12 in the year 2000; but there is another scenario based on improved technology.

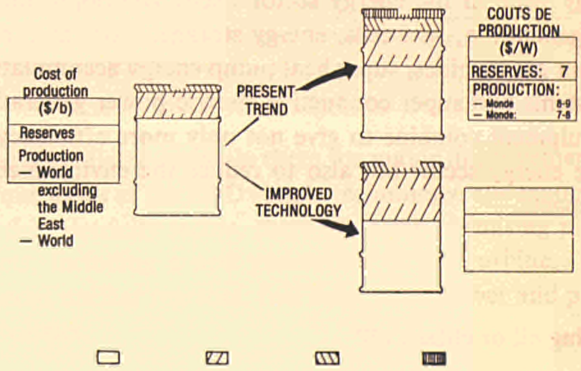
Figure 4:
The long-run supply price and the market price of oil, 1950-2020



Am — Slow downward drift of oil price under conditions of institutionalized intervention in the market, leading to continued decline in demand for oil and continued instability in the market.
Bm — Near future (1986) price cut of 25-30% so stimulating demand but with continued propensity for investment in oil exploration and exploitation. Thereafter, relatively narrow long-term price range under conditions of sustainable supply/demand relationships.
Cm — Under price collapse conditions the actual oil price returns to a level close to the LRSP. Demand stimulated with consequential steeper slope to the LRSP curve so creating a potential for relatively near future renewed upward price pressures and price fluctuations.
Source: Prof. P. Odell.

If this line of reasoning is correct then we may expect an increase in supply of 'new oil' in the Western World from 1.7 mbd to 4.2 to 6.2 mbd in 2000, an average world cost of USD 7-8 (USD 8-9 excluding the Middle East; this compares with a figure of USD 6-7 today). The cost reductions implied in developing new oil would also impact on conventional oil.

Figure 5:
Cutting costs: Impact on proven oil reserves



Source: Balaceana, J. C. and Hopper, W. H., New oils, technical strategies, economics and policy, 13th Congress of the World Energy Conference.

Critics to the arguments developed here may accept the reserve, price and cost arguments but argue that the problem is essentially political and will point to the fact that the world's oil reserve lies essentially in the Middle

East and consequently security of supply is determined by the stability in this region.

The role of OPEC

When OPEC took control of the determination of prices in 1973 it was aided by two factors; the first was 'confidence' based on the political situation, and indeed, war situation, in the Middle East. The second factor was the demand situation and the lack of alternative sources to meet this demand other than from OPEC.

Demand has fallen and is not expected to rise at the same rate as previously. Oil has been decoupled from economic growth at least in the developed countries but also this potential exists in the developing countries of the world.

The history of oil prices from 1973 reflects different replies to the fundamental strategic question: should OPEC follow a high price/low volume strategy or a low price/high volume one? The 'bottom line' is the revenue returns to the producing countries. OPEC revenue declined from a high in 1980 of USD 279 billion to an estimated USD 75 billion in 1986.

But an aggressive oil price policy will encounter the three challenges mentioned above, i.e. competition from gas and electricity, even faster improvements in end-use technology and continuing oil-to-oil competition, both between OPEC producers and between OPEC and non-OPEC producers. Certainly prices can fluctuate widely in the short term, and probably will, but the margin of manoeuvre is much more constrained than was the situation in 1973. The search for new links between producers and end-users will also provide an incentive towards greater stability.

While oil may have lost its throne, it is none the less a major fuel and will continue to be so for many years to come. The instability in the demand/supply relationship has improved. Oil had too dominant a role previously. Now, with the development of gas and electricity networks and improving end efficiencies and choices with multi-firing possibilities, the market structure is more robust than before.

Concluding comment

The arguments presented are not a forecast; they indicate the range of possibilities and developmental opportunities which lie in the future. World prices have fluctuated in the past and there is no reason to believe that in the future they will not maintain this characteristic. Their prediction is highly uncertain but there are sufficient strategic variables which can, by active policy measures, alleviate the shocks along the route, if not eliminate them.

Energy analysts can take some heart from the conclusions from a very useful report prepared a few years ago on *The future of oil prices.*[17] 'The emphasis should not be on trying to get forecasters to build a better mousetrap. Rather the emphasis should be on the users' side — to better understand what a forecast is, its limitations, and what it cannot do — and to focus on the assumptions, not on the number. This will enable the decision-maker to go beyond forecasting to a more constructive planning process, more suited to the challenges ahead. That process should be guided by the recognition that uncertainty — and volatility and turbulence — are inherent in the future of oil. The industry will continue to change, probably not in smooth evolution, and prices will fluctuate. The perils of prophecy call for a new orientation in forecasting, strategic planning, and decision-making. Firms cannot predict the future, but they can plan and be prepared for it, and so turn uncertainty into opportunity.'

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Third-party financing—a novel method of accelerating energy efficiency investments

This article was the keynote speech at a recent Commission seminar on third-party financing held in Luxembourg. The author is Mr James Wolf, the Executive Director of the Alliance to Save Energy, a Washington-based non-profit coalition of business, government, and consumer leaders dedicated to increasing the efficiency of energy use. In this article, Mr Wolf introduces the concept of third-party financing and examines the evolution of the technique in the United States.

Third-party financing — or 'performance contracting' — is a growing, dynamic industry in the United States. Like any new industry, it endured turmoil and change in its early years. It is still evolving in terms of the services offered to energy users and the types of firms in the industry. But most importantly, energy users, utilities, and governments acknowledge that performance contracting can and should play an integral role in an overall strategy of supplying our energy needs.

Performance contracting is the term we use to describe a comprehensive approach for obtaining energy efficiency improvements. It is much more than just a novel method of financing. It typically includes a package of services: the design, financing and installation of energy efficiency measures, and the regular maintenance and service of the equipment.

The key features and benefits

Its two key features are firstly, there is no up-front capital investment by the energy user and secondly, the payments by the energy user are in some way tied to the energy savings that are actually achieved. This second feature is why we call it performance contracting, the energy user pays only for performance. If there are no energy savings from the equipment, the energy user does not pay. In addition, any payments for the equipment and services are guaranteed to be less than the value of the energy savings realized. A variety of types of contracts fit within this definition of performance contracting — shared-savings agreements, installment purchases, guaranteed leases, or sales of energy contracts.

Performance contracting satisfies numerous needs and provides many attractions to the energy user. First, performance contracting firms provide the financing for the energy improvements. When interest rates are high or capital is difficult to access, this is the most obvious attraction. This was particularly true in the United States during the late 1970s, when the industry first started.

There are four other significant benefits of performance contracting that make it appealing to the energy user. These are the technical engineering expertise of performance contracting firms, their ability to service and maintain equipment, their willingness to assume several of the risks involved in investing in energy conservation projects, and the convenience of 'one-stop shopping'.

These benefits may be highly valued by energy users because of staff limitations. Some energy users do not have proficient energy engineering staff committed to evaluating technology opportunities or new applications. Other firms do not have a staff dedicated to service and maintain equipment to ensure it is performing at peak effectiveness.

These benefits may also be highly valued because of the attitudes or concerns of the management of the energy user. Management may be risk averse, declining to invest in conservation opportunities for several reasons. They may fear 'technical risk' — that a technology will not achieve the engineering savings estimates. They may fear 'economic risk' — for example, that future energy prices will not rise as fast as projected and consequently the return on the conservation investment would be lower than forecast. A performance contract may be attractive to these managers because they shift these risks to another party.

Finally, management may value the convenience provided by a performance contracting firm. Instead of going to several firms — technical audit firms, engineering design firms, contractors, banks and others — to procure conservation improvements, the energy user goes to one source.

Energy users will evaluate these advantages of performance contracting differently. Some will be more attracted to one of the attributes, while others may focus on them equally. The final performance contract that is negotiated will have to reflect the specific needs of the energy user.

Energy service companies

New businesses known as energy service companies — or Escos — were the first firms to offer performance contracting in the United States. The growth of Escos changed the energy conservation market dramatically. The attractiveness of their new marketing strategy was immediately recognized by manufacturers and vendors of equipment. These businesses began to offer new financing programmes for their products as well. They feared that they would lose to Escos, sales that had been made to traditional customers if they did not offer these new options. They also found these new programmes allowed them to sell products to energy users who previously had been unresponsive to their sales promotions.

The firms offering performance contracts now include Escos, manufacturers and vendors of specific energy efficiency equipment, architectural and engineering firms, subsidiaries of utilities and other entities. Each of them has seen new markets develop as the concept of performance contracting permeates the market.

In the United States, performance contracting in the broadest sense is a rapidly growing industry. From the Esco perspective, a majority of the business is presently in developing alternative energy supply sources — primarily small scale cogeneration. This development has been fostered by changes in regulatory laws enacted several years ago and the continuing problem of high electricity prices, due in part to the great expense of new nuclear generating plants.

Escos are, however, also successfully marketing performance contracting for conservation improvements. The market in which this is growing most rapidly is what we call the 'institutional' sector — non-profit institutions such as schools and universities, hospitals, and governmental facilities. Indeed many governments — local, State as well as our federal government — enacted special laws to permit and encourage use of performance contracting in their jurisdictions as well as their own facilities. The institutional sector alone encompasses a multi-billion dollar market.

The market

The reason this sector is growing most rapidly is that non-profit institutions find almost all the attributes of performance contracting attractive. Schools, universities, and hospitals are always short of capital. If capital is available, their first priority is always the fulfilment of their primary mission. They will hire more teachers or purchase new diagnostic equipment before paying attention to energy costs. They also often do not have the in-house technical expertise needed to evaluate technology options, to design them for installation, or to service and maintain them.

One college's experience with performance contracting demonstrates its attractiveness. An Esco installed USD 1.2 million of equipment reduced the college's energy use by 45%. These energy savings are worth USD 538 000 a year and are now being shared by the college and Esco. The college receives 20% — currently over USD 100 000 a year in savings.

Government is another prime candidate in the institutional sector to take advantage of performance contracting. Those in government — at least in the United States — well know the difficulty of obtaining funds for projects. Whether at the local, State or federal level, there is intense competition for funds — for education, roads, police, basic research, defense and other perceived critical needs. Making major expenditures of scarce taxpayer dollars for energy savings may not have much immediate political payoff. No politician wants to raise taxes — especially if there are alternative means to provide a service or accomplish an objective. Performance contracting allows governmental facilities to reduce their energy costs without the expenditure of taxpayer dollars — a politician's dream.

Several governmental officials have recognized these benefits. When school districts have signed performance contracts, mayors have issued press releases proclaiming new teachers will be hired financed by the energy savings — all at no cost to the taxpayer. Last year our federal government enacted legislation to permit performance contracting in federal buildings and facilities. Several demonstration projects are now being sponsored by the Department of Energy's Federal Energy Management Programme.

There is also some performance contracting activity in the commercial and industrial sectors, but these market areas are developing more slowly. Shared-savings programmes in particular are developing slowly because these energy users are often reluctant to share any energy savings with an outside firm. After months of discussions with commercial or industrial firms about energy savings opportunities, the Escos often found that the energy users would then finance and complete the project themselves. The Escos engaged in a long, expensive, educational process in convincing the energy user that real savings are achievable. For the Esco, however, there is no benefit unless a performance contract is signed. Accordingly, they are concentrating their marketing efforts on other sectors.

The necessary skills

We have learned that to be successful performance contracting firms require skills in three essential areas — engineering, financing, and marketing. If a firm lacks any of these three skills, it will fail.

Good engineering is required as the backbone of a successful performance contracting firm. Providing capital for inappropriate or poorly engineered technology is a prescription for disaster.

Equipment that is well designed and engineered will generate energy savings when financed and installed. Inappropriate or poorly engineered technology — even when financed and installed — will never generate savings. Some firms in the United States mistakenly concentrated only on the financing aspects, and not the engineering soundness of their early proposals.

The required financing skills include not only knowing how to structure successful deals, but also how to ensure sound capitalization of the company to sustain cash flow. Sound capitalization is essential because of the timing inherent in the structure of a performance contract. The Esco bears all the up-front costs, but achieves its return over a long period of time. While typically five to seven years, the contracts may be as long as 10 years.

Several factors can affect Escos during this long contractual period. Most in the United States, for example, did not forecast the decline in oil and natural gas prices which we have experienced the last few years. Since Escos did not project this decline when they entered into performance contracts several years ago, they overestimated their revenues. To assume the risks of widely fluctuating energy prices, Escos must have adequate capitalization or access to financing.

The third requirement for success is marketing skill — one that many firms in the US initially did not focus on because they underestimated the marketing barriers to performance contracting. We need to better understand the concerns, attitudes and behaviour of the end user. Technical feasibility or cost-effectiveness of technology may not even be their primary consideration. They may be more worried about operational control of their facility, or some other issue. Performance contracting must be marketed — potential users will not be lined-up around the block.

While performance contracting has many attractions to an energy user, it is a new concept. The legal and institutional arrangements of performance contracting are not widely understood by the potential clients of Escos. These will take time to explain and appreciate.

Another marketing barrier is that often several departments in an organization will have to get involved in making a decision whether to sign a performance contract. Some of the people in these departments will be initially totally unfamiliar with performance contracting and only have a limited interest — if any — in energy. For a school, it may include the School Board; for a hospital, the Board of Directors.

Performance contracting involves much more than dealing with just the energy engineer and procurement department. This is both a benefit and burden of the comprehensiveness of the performance contracting approach. Escos must know — and incorporate in their internal financial plan — that it takes several months to more than a year to successfully negotiate a performance contract, and several years to realize the full income potential of the project.

Government involvement

Having assessed performance contracting from the perspective of both the energy user and Esco, it is appropriate to turn to the question of government involvement. Governments have essential roles and responsibilities to nurture and promote performance contracting if they are committed to making energy users more energy efficient. Their actions should be designed to address issues in all the areas necessary for success — engineering, financing and marketing. At least five specific actions should be taken.

First, governments should review their own laws and regulations to ensure there are none which unintentionally restrict the use of performance contracting or make it unduly burdensome. In the United States, this has included enacting special laws to permit governments to enter into long-term contracts. In addition, procurement regulations have been reviewed and revised. Since the Esco proposes both what it is willing to do to a facility and what type of shared-saving arrangement it desires, the traditional 'low-bid' approach to buying technology is not workable.

Second, governments should actively promote the use of performance contracting in their own facilities. This will help firms in the industry both by giving them receptive customers and by setting a showcase example for other energy users that performance contracting is viable and beneficial.

In Massachusetts, for example, the State entered a performance contract which has resulted in a 35% reduction in energy bills in a building complex. The USD 2.7 million cost of the equipment was paid for by the Esco, not the taxpayer. Indeed, in just two years over USD 2.3 million in energy costs has been saved. The State — or taxpayers — have received 50% of this bonanza. It certainly is a showcase.

Our federal government recognizes the need to promote performance contracting. Last year it enacted legislation allowing performance contracting in federal facilities. This year, however, it is considering legislation specifically encouraging the use of performance contracting. The legislation contains, for example, incentives for agencies which use performance contracting. It allows them to keep a portion of the energy savings for their own budgetary use. Their annual appropriation from the Congress will not go down automatically to reflect their decreased energy costs.

Third, governments should sponsor seminars for energy users explaining both the advantages and disadvantages of different performance contracting approaches, and how they compare with other options to obtain energy improvements. This educational effort is essential to complement the marketing efforts of the firms in the industry.

As noted, energy users will find performance contracting a totally new approach for procuring energy savings investments. The Escos themselves will not be credible marketers of the concept because they will be viewed as merely trying to sell their services. They will be received with great scepticism.

To educate energy users, governments should sponsor seminars conducted by organizations with no vested interest in the product. We at the Alliance to Save Energy — as a non-profit institution which doesn't manufacture, install or provide conservation technology — have been sponsored by several of our State governments to conduct seminars for energy users. We have prepared manuals and guidebooks which explain how to evaluate performance contracting and the features in a contract. The seminars are typically day-long sessions, and conducted separately for two audiences — one for non-profit or institutional organizations; the other for commercial and industrial firms.

We encourage Escos to attend these seminars and allow them to make brief presentations to the audience about their services. This allows energy users to meet several competitors simultaneously, and provides Escos with exposure to several potential clients at once. It is an efficient marketing tool from the perspective of both the Escos and energy users. We, however, retain control and responsibility for the guidebook and the overall instruction at the seminar.

The fourth role of government is to sponsor demonstrations of actual performance contracting deals by providing technical assistance or other incentives for the project. One State demonstration, for example, targets schools and local municipalities. The State conducts seminars, prepares model contracts and makes personnel available to review technical proposals and help negotiate final contracts. The government worked with the associations representing school districts and municipalities so that the lessons from the demonstration project would be able to be easily transferred to other facilities.

Another demonstration is being conducted by the Alliance. We are pooling several energy users — small social service agencies that typically would not be served by Escos — and assembling them as a package for an Esco. We are providing technical assistance to the smaller agencies. We are pleased that eight Escos expressed interest in bidding on the package and the agencies are now in the final selection stages. We are hopeful this will be a model for smaller agencies across the country.

The fifth action for governments is to provide special support services. The nature of these services will vary depending on economic conditions and the state of the industry. It might include, for example, approving engineering methodologies to establish baseline energy consumption; certifying technical competence and financial soundness of firms; providing insurance of energy savings if not privately available; or providing financial backing to Escos for projects designed to serve selected end-users. Different levels of government in the United States are providing many of these services. For example, one State established an approved bidders list of Escos after reviewing the financial and technical competence of firms; another State is establishing a pool of money available to Escos as financing for projects designed to serve local governments within that State.

Conclusions

Performance contracting is not a panacea for the energy challenges that face us. It is, however, evolving in the United States into an integral component of private and public strategies to make us more energy efficient. This evolution needs the active participation and support of businesses, governments and consumers — an Alliance devoted to seizing the opportunities presented.

Performance contracting will, I am confident, grow and flourish in the European Community. I hope there are relevant lessons for you from both the successes as well as the failures we have experienced in the United States. I hope that our experience will enable you to develop and promote a performance contracting industry appropriate for your energy needs, culture, and economies. The energy markets are global; we are truly interdependent. Performance contracting works — it will help us all achieve our common goal of energy efficiency.

Proposal for a Council Recommendation to the Member States on developing the exploitation of renewable energy sources in the Community (COM(87)432 final of 28 September 1987)

On 16 September the Commission approved a Communication to the Council containing a proposal for a Council Recommendation to the Member States on the development of renewable energy sources in the Community.[1]

Prior to this, in November 1986, on a proposal from the Commission, the Council had adopted a Resolution on a Community orientation to develop new and renewable energy sources,[2] in which it emphasized the need for adequate development of these sources in the Community.

This Communication has been drawn up with a view to achieving the aims set out in the orientation; among other things, it lists the priorities as regards developing renewable energy sources as a whole. In addition, as part of the work envisaged in the orientation, the Commission intends to submit to the Council later on proposals, sector by sector, concerning the specific problems involved in exploiting these sources.

In the Communication the Commission analyses the present situation, the prospects and the obstacles to the development of renewable energy sources, and in particular those which in the present state of the art offer the best prospects for increased penetration of the energy market, namely:

(i) solar energy (thermal and photovoltaic);

(ii) biomass and energy from waste;

(iii) wind energy;

(iv) hydroelectricity and, in particular, low-power installations.

The main conclusions drawn from the analysis carried out are as follows:

(a) progress in developing renewable energy sources has been substantial following the energy crises, thanks to the variety of programmes launched. However, the price trends for conventional forms of energy have started affecting development in recent years, and there is still a risk of a major slowdown which could compromise the results already achieved, demobilize researchers and engineers and irreversibly weaken the young renewable-energy equipment industry. This would be all the more serious in that the industry has a considerable development potential capable of meeting the needs of the developing countries as well as those of Community countries;

(b) in addition, the use of renewable energy sources is being hindered by several obstacles which are not directly related to their competitiveness. The main obstacles are legislative and administrative procedures which are inadequate or non-existent, barriers to the free movement of equipment in the run-up to the completion of the internal market, the terms for supplying electricity generated from renewable resources to the public grid, a lack of understanding of the potential and possibilities offered by renewable sources, especially at regional and local level, and the lack of appropriate financing structures;

(c) consequently, although renewable energy sources could well cover up to 5% of the Community's energy needs by the year 2000, this will not be achieved unless the obstacles are removed and the development of these sources is encouraged.

The Commission therefore proposes an initial series of measures which the Council should recommend the Member States to undertake; basically, the aim is:

(i) to introduce appropriate legislation and administrative procedures;

(ii) to pursue or step up research, development and demonstration programmes;

(iii) to circulate information about the potential, production possibilities, experience gained and the technical equipment available;

(iv) to promote industrial cooperation and enlarge the markets (common rules for certification, etc.);

(v) to ensure satisfactory terms for sales of electricity generated from renewable energy sources;

(vi) to establish appropriate, flexible financing structures.

The message contained in the Commission's Communication to the Council is that the present relaxation of tension on the world energy scene and the abundance of conventional energy sources may well continue for a time — one that is difficult to predict but is certainly not unlimited — and those energy sources are not inexhaustible. We should not now hesitate to take action to improve our energy supply in the future through greater diversification and optimum exploitation of our resources. The promotion of renewable energy sources is a long-term task; it must not be allowed to depend on unpredictable events, nor must too much be expected of it too soon. Only by pursuing a resolute, positive long-term policy aimed at developing renewable energy sources, and by paying less attention to short-term phenomena, will these sources be able to play a significant rather than a marginal role in the Community's energy balance.

[1] COM(87) 432 final of 28.9.1987.
[2] OJ C 316 of 1.12.1986.

Economics of building fast breeder reactors

From the start of the commercial nuclear power programmes and through the 1950s and 1960s, it was generally accepted that the spent fuel from the early types of nuclear reactors would be reprocessed and the resulting plutonium burned in fast breeder reactors (FBRs). In this way, the limited quantities of uranium then discovered would be sufficient to fuel the world's nuclear power programmes for centuries rather than decades.

The major advantage of the FBR over other types of reactors, such as the light water reactors (LWRs) which now produce the large majority of the Community's nuclear electricity and the gas cooled reactors in use in the United Kingdom, is that this type of reactor can extract over 50 times more energy from natural uranium. Using the FBR reactor would mean that the energy extractable from known uranium resources would be at least twice that from exploitable coal reserves and more than an order of magnitude greater than from the world's oil resources.

With the slow growth in energy demand during the last decade, coupled with the successes of the uranium explorers which have resulted in the discovery of large new deposits, there is less incentive to economize on the use of uranium. Given the fact that the present level of uranium resources is sufficient to cover the requirements of the present generation of nuclear power reactors into the next century, the FBR will not be introduced on a significant scale — as a matter of necessity — for several years.

However, the fast breeder reactor has several interesting features in addition to economies in the use of uranium which would suggest that its introduction should not be delayed until uranium became in short supply. Of particular importance are the benefits from the point of view of safety of using liquid metal (sodium) as a coolant. The fact that the metal remains liquid over a wide range of temperatures even at atmospheric pressure, together with its very high thermal conductivity (about 80 times that of water) and its high latent heat of vaporization means that it is a very efficient material for carrying the heat away from the core under normal operating conditions. These features can also be very beneficial under certain possible accident situations. Another important advantage of the fast breeder is that it has an even smaller impact on the environment than the light water reactor, releasing even less heat and radioactive effluents to rivers, seas or the atmosphere.

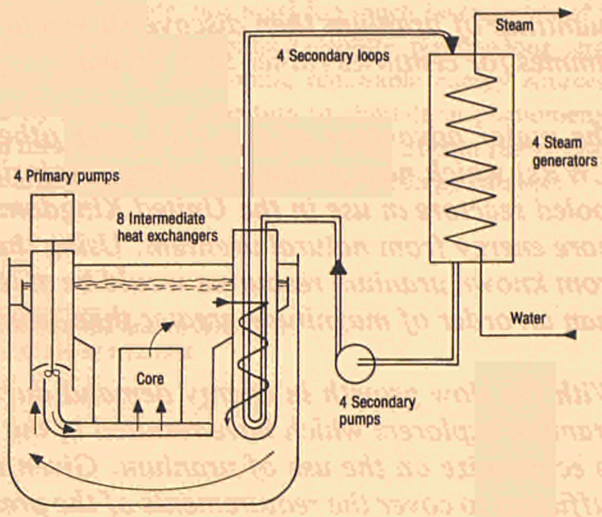
The major present drawback to the fast breeder is its initial capital cost. The first commercial scale FBR, Superphenix 1, cost around 2.5 times more per installed KWh than comparable pressurized light water reactors (PWRs) in France. Figures such as this have caused some people to dismiss the reactor type as uneconomic. They would be very relevant if the cost of building Superphenix 1 — a prototype — was to be representative of that of future FBRs. To investigate this possibility, the Commission placed a contract for a study on the effect on costs of building several FBRs in a batch, i.e. in a similar fashion to the way LWRs are constructed in some countries.

The following article is based on the results of this study which showed that the gap between the costs of building FBR and PWR could be substantially reduced. These results were reported to a conference on Fast Breeder Systems held in Richland, USA from 13 to 17 September 1987.[1]

In the early 1970s, the French government decided to pursue strongly the nuclear option for the generation of electricity. It was, however, realized that while this would help to reduce the country's dependence on imported oil, it would require ever-growing quantities of uranium. While France does have substantial resources of natural uranium — the largest in the Community — these could not support the size of programme envisaged beyond the turn of the century. Therefore, while external supplies were available, it was considered important to follow the development of the much more uranium-efficient fast breeder reactor — especially as concern was being expressed over the limited extent of the world's uranium resources.

In 1977, following on from the successes of the experimental fast reactor Rhapsodie — operating since 1967 — and the bringing into operation of the demonstration fast reactor Phenix in 1976, construction began of the world's first commercial size breeder reactor — Superphenix 1 — at Creys-Malville near Lyons. Initially three Community Member States were involved directly in the project — France, Italy and the Federal Republic of Germany. This was later increased to five by the participation of Belgium and the Netherlands and then to six by the inclusion of the United Kingdom. The reactor was completed in 1985 and came fully on line in 1986.

Fig. 1:
Flow chart of a Superphenix - type pool breeder NSSS



Source: Novatome

Superphenix

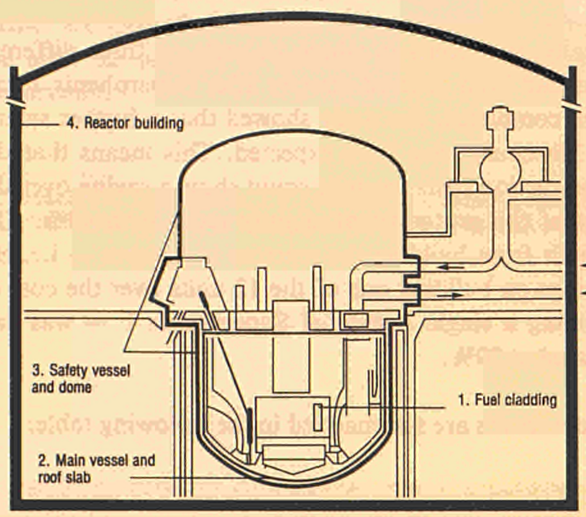
Superphenix 1 is a liquid metal-cooled fast breeder reactor (LMFBR), i.e. it is a reactor in which fast neutrons ejected during the heat producing fission reaction in the core produce ('breed') more plutonium than is consumed.[2] It has a rated thermal power of 3 000 MW and its net electrical output is 1 200 MWe. The nuclear steam supply system (NSSS) consists of a reactor core sitting in a large pool of molten sodium (see Figure 1). This primary sodium system transfers the heat produced in the core to the intermediate heat exchangers. From there it is carried in the secondary sodium circuit to a steam generator. From this point the plant is very similar to more conventional generating stations with the steam driving turbogenerators to produce the electricity.

The reactor core consists of a central part surrounded by a series of blankets. The central part contains the fuel assemblies, made up of pins of uranium and plutonium oxides, which produce the heat and the control rods used — as the name implies — to control the reaction and to shut down the reactor. The blankets consist of depleted or natural uranium which capture neutrons escaping from the central core and also act as a radiation shield. The core contains a little less than 5 tonnes of plutonium and, including the blankets, over 100 tonnes of uranium.

The full core sits in a large pool containing 3 500 tonnes of molten sodium. This sodium is pumped up through the core taking away the heat of the reaction. Before entering the core, the sodium has a temperature of 395°C. On leaving the core its temperature is 545°C. As mentioned earlier, the use of sodium as a coolant has distinct advantages. The large quantity of sodium in the pool, its low viscosity and its excellent thermal conductivity means that the system has a considerable thermal inertia. This gives the operator several hours in which to take action after shutdown before the core overheats and is damaged.

Between the reactor's fuel and the outside environment there are four barriers (see Figure 2). The stainless steel cladding of the fuel; the containment formed by the main stainless steel reactor vessel and its cover; the primary containment consisting of a safety vessel and dome; and the secondary containment of the reactor building constructed of one metre-thick reinforced concrete.

Fig. 2: Containment system



Economic comparisons with other plants

Superphenix 1 is a prototype. Because it is a prototype it was expensive to build. Its cost of construction — in terms of French francs per KWh of installed capacity — was around 2.5 times that of pressurized water reactors (PWRs) operating in France.

It is unfair and misleading to make such a comparison. There are already hundreds of PWRs operating throughout the world. In France there were 49 units in service by the end of 1986 and 44 of these had been completed during the past 10 years. The more recent PWRs have therefore benefited from many years of experience in construction of the type and, even more importantly, from the benefits of scale arising from batch production. On the other hand, Superphenix 1 is the first of its kind and it was built as a single unit.

However, in order to ensure the continuation of fast reactor development, it is essential to demonstrate that future projects can be financially viable in relation to the more traditional light water reactors (LWRs). For this reason, the Commission contracted Novatome — the builders of the nuclear steam supply system (NSSS) for Superphenix 1 and *Electricité de France* (EdF) — responsible for the overall project as well as the conventional construction work on the site — to calculate the cost savings which could be obtained by batch production of fast breeder reactors.

The method used to evaluate cost savings

The first stage of the study was to determine the current cost of building an exact replica of Superphenix 1. It was assumed that this would be done by the same suppliers, using the same regulations and standards as for Superphenix 1. However, because the reactor would not be a prototype, savings could be made on some of the construction costs (e.g. by using existing machining equipment) and by improved scheduling to reduce the construction time.

The second stage was to evaluate the effect of batch production of reactor units, using several different scenarios:

(a) two reactor units, both on the same site;
(b) four reactor units, all on the same site;
(c) 12 reactor units, with four reactors on each of three different sites.[3]

On the siting of the reactors, for the nuclear part of the plant, all the sites have the same characteristics as that for the prototype at Creys-Malville. For the non-nuclear part of the plant, three different types of site were considered:

(i) a site similar to that for Superphenix 1 (open cooling circuit, air cooling system for second and all following units). This type of site was studied for all three scenarios;

(ii) a 'dry' site similar to that for the reactor at Civaux, France (riverside, closed cooling circuit). This type of site was only studied as one of the three sites for Scenario c;

(iii) a site similar to the location of the reactor to be built at Le Carnet, France (seaside, cooling circuit open to the sea). This type of site was only studied as one of the three sites for Scenario c.

Other variables studies included 'twinning' units on two and four unit sites (having some equipment and installations common to two units) and a reduction in the component and spare part inventory relative to Superphenix 1.

Consultations with suppliers

Wherever possible, the original suppliers were consulted concerning the tenders for each scenario.

For the nuclear steam supply system (NSSS), the manufacturers contributing to the study represented two-thirds of the original supplies and installations for Superphenix 1. Analysis of the remaining one-third of the cost was based on replies/estimates obtained from other manufacturers making similar equipment or offering similar services to the original Superphenix suppliers. This analysis also took into account Novatome's knowledge gained from experience of the design and construction of Superphenix 1. Those engineering costs that were over and above the component costs were also analysed.

For the non-nuclear steam supply system (non-NSSS), 20 companies and manufacturers were contacted, which together had been awarded contracts for Superphenix 1 covering 70% of the cost of this part of the plant. These included: main civil engineering contractors; suppliers of the main machine room equipment; suppliers of ventilating and air conditioning equipment; and all suppliers of electrical equipment and installations. The remaining tenders — representing the remaining 30% of the cost — were analysed individually by EdF.

Results

The study showed that building a second Superphenix, using the same suppliers, no new research, re-use of existing machining equipment and placing the orders immediately after completion of Superphenix 1, would have resulted in a saving of a little over 26% of the construction costs (27% for the NSSS and 25% for the non-NSSS part of the project). It also showed that the replica would take 30 months less to build which, taking into account interest charges, would have resulted in savings on the overall investment cost of 31.5%.

Moving to two units on the one site would result in a **further** saving of 11%, 8.5% on the NSSS and 13.8% on the non-NSSS. The reason for the difference in the savings is that 'twinning' has a greater impact on the non-NSSS part of the plant.

Increasing from two units on a site to four units on a site gives an additional saving of 7%. Here the savings on the NSSS are a further 8.5%, mainly as a result of further economies brought about by batch production of the major equipment, while the savings on the non-NSSS only increase by 5.3%.

Finally, in a scenario where 12 units on three different sites had been ordered directly after Superphenix 1 had been completed, the study showed that a further saving of 3% could have been expected. This means that the construction costs per unit could show a saving over the cost of the prototype of slightly more than 40%. The benefit from building the reactors in batches — i.e. the savings on building one of the 12 units over the cost of building a single *replica* of Superphenix 1 — was calculated at 20%.

These results are summarized in the following table:

Compared methods of construction	NSSS	Savings % non-NSSS	Total Unit
Reconstruction/ Superphenix 1	− 27	− 25	− 26
2 units/reconstruction	− 8.5	− 13.5	− 11
4 units/2 units	− 8.5	− 5.3	− 7
12 units/4 units	− 4.5	− 1.5	− 3
12 units/Superphenix 1	− 41.5	− 39.0	− 40.5
12 units/reconstruction	− 20.0	− 19.5	− 19.8

In summary, removal of the 'prototype effect', i.e. building a second Superphenix 1, would be expected to result in a saving of 26% of the cost of construction. Building the reactors in batches would result in cost savings of a further 20% (12 unit batch). If savings on interest charges, resulting from reductions in construction schedules, are also taken into account the overall savings on investment costs would be at least 45%.

Substantial savings could be made in constructing a number of fast breeder reactors following the same design as Superphenix, though the unit cost would still exceed that of a conventional light water reactor by something in the region of 50%. However, studies are now going ahead on the further development of a new European FBR. In addition to benefiting from all the experience of having built a commercial-sized fast reactor, the new design should also have more favourable economics as a result of a variety of technological advances during the last decade. Of course, a new prototype could not be expected to have comparable economics of construction with a series built PWR, though the gap between the two could well be narrower (than between Superphenix and a PWR) and would be further reduced after removal of the 'prototype effect' and after the benefits of building in batches are taken into account.[4]

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[1] Charrault, J-C.; Macqueron, J. F.; Grangier, Y.; Leduc, J. and Lion, R.; 'The effect on costs of building fast breeder reactors identical to SPX1 in batches'. Paper presented at the symposium on Fast Breeder Systems, Richland, USA, September 1987.

[2] Ertaud, André; 'Superphenix'. Published by Novatome (France).

[3] Though this scenario — leading to over 14 GWe of new electricity capacity over a short period of time — may seem rather large, it is in line with nuclear capacity additions achieved by some countries in the past. It is a rate which could be required to be repeated in the future, certainly on a Community scale.

[4] It is worth noting that in its 'Illustrative nuclear programme for the Community' (COM(85)401 final) the Commission proposed that the development of the FBR should aim at an economically competitive design for such a reactor being on offer by 2005 and being brought into commercial service towards 2015.

Financial support (grants and loans) from the Community to the energy sector in 1986

In 1986 the Community granted the energy sector financial support (grants and loans) totalling **4.3 billion ECU**, of **which 1 091.1 million ECU took the form of grants** and **3 230.4 million ECU** took the form of **loans.**

Grants from the General Budget and the ECSC Budget

The very considerable increase in European Regional Development Fund grants for energy infrastructure in 1986 meant that Community grants to the energy sector were **above the 1 billion ECU** mark, compared with 885.9 million ECU in 1985.

Table 1 gives a breakdown of grants by budget heading for 1985 and 1986:

Table 1
Community grants to the energy sector in 1985 and 1986, by budget heading

	1985		1986	
	MECU	%	MECU	%
Energy (Chapter 70)	150.0	16.9	158.6	14.5
Energy R&D (Chapter 73)	387.1	43.7	364.5	33.4
ERDF	247.1	27.9	420.3	38.5
Integrated Mediterranean programmes	—	—	1.4	0.1
ECSC Budget	101.7	11.5	146.3	13.5
Total	885.9	100.0	1 091.1	100.0

With 420.3 million ECU the ERDF is once again, as in 1983, the main purveyor of Community funds (38.5% of the total) for the energy sector, exceeding the appropriations from the research and development chapter (33.4%).

The ERDF grants were allocated to a large extent to the generation and distribution of electricity in Greece in particular and the natural gas network in Spain and Italy.

Aid from the energy chapter (Chapter 70 of the General Budget) essentially concerns new energy technologies: oil and gas technological development projects (37.9 million ECU in 1986) and demonstration and industrial pilot projects (113.3 million ECU in 1986).

With 14.5% of the total, the energy chapter is slightly ahead of the ECSC Budget (13.4%). Nevertheless, ECSC grants (146.3 million ECU) reached the highest level for the last six years as a result of the considerable amount of aid granted to the redeployment of workers (Article 56 (2)(b) of the ECSC Treaty) in the United Kingdom (80.9 million ECU).

The breakdown of the energy grants paid out in 1985 and 1986 by sector is set out in Table 2.

Table 2
Community energy grants in 1985 and 1986, by sector

	1985		1986	
	MECU	%	MECU	%
Solid fuels	123.5	13.9	164.9	15.1
Oil and gas	113.4	12.8	214.8	19.7
Nuclear energy	319.4	36.0	338.0	31.0
— fission	121.2	13.7	150.7	13.8
— fusion	198.2	22.3	187.3	17.2
Electricity	175.2	19.8	236.7	21.7
New and renewable energy sources	73.5	8.3	55.4	5.1
Rational use of energy	75.8	8.6	74.2	6.8
Others	5.1	0.6	7.1	0.6
Total	885.9	100.0	1 091.1	100.0

The contraction of **solid fuels** in both absolute and relative terms in 1986 and in 1985 compared with 1984 is the result of the lack of success before the Council of the new Commission proposal to transfer extra resources of 60 MECU to the ECSC Budget in order to increase social welfare aid for workers in the coal industry. In 1984, the same amount was assigned by the Council for the restructuring of the coal industry.

The funding for **nuclear energy** (338 million ECU in appropriations for commitments), the sector which continues to be the biggest single recipient of Community funds, is entirely from the research appropriations which are allocated primarily to the European fusion programme (170 million ECU), followed by JRC direct action relating to fission (reactor safety, radioactive waste management, fissile materials, nuclear fuels and the operation of the HFR reactor) with 121.8 million ECU.

The major expansion of ERDF assistance benefited the **hydrocarbons** sector (mainly natural gas), followed by the **electricity** sector, both of which increased in relative terms compared with 1985 (21.7% in the case of **electricity** and 19.7% in the case of **oil and gas** in 1986). The drop in subsidies granted to **new and renewable energy sources** and to the **rational use of energy** is the result of a different annual allocation of total resources planned in the 1985-88 R&D programme in this area.

Table 3 gives a more detailed breakdown for 1986.

Loans granted to the energy sector under the Community's financial instruments

Loans to the energy sector reached record levels in 1986, amounting to 3 230.4 million ECU. The increase, amounting to 27.4% in real terms compared with 1985, was not significantly influenced by the accession of Spain and Portugal since the loans granted to them by the Community's financial institutions (from the EIB's resources only) were comparatively small in 1986.

Despite this trend, energy's share (37.8%) of the total amount of loans granted by the Community's four financial instruments is still less than in some earlier years (e.g. 1981 and 1983). However, the energy sector is still the main user of available funds as a result of Community grants and loans.

The total 1986 amount of 3 230.4 million ECU breaks down as follows:

By source of funding

(i) With 2.6 billion ECU, the **EIB** was once again the main source of Community funds for the energy sector. Although smaller than in 1985, the EIB's share of the total amount of loans granted to the energy sector is still some 80%, while the nominal increase over 1985 is 15.8%.

The three loans from the **New Community Instrument** (NCI) in the energy sector totalled 91.1 million ECU, including 8.7 million ECU in the form of a global loan to Italy. The other two loans were granted to a coal-fired power station in Ireland and a district-heating network in Denmark.

(ii) **Euratom** loans, which had fallen off in recent years because of the gradual depletion of the ceiling authorized by the Council, took off again in 1986, following the increase to 3 000 MECU decided upon in December 1985. In fact, the total amount of loans in 1986 more than doubled compared with 1985 (443.2 compared with 211.0 million ECU), reaching the highest level since the existence of this lending instrument. By the end of 1986, the Commission had paid out a total of 2 577.5 million ECU since the beginning of Euratom lending activities.

(iii) With a loan to a German company of 103.6 billion ECU, in 1986 the **ECSC** resumed its intervention in favour of the coal industry, following the very low rate of involvement in 1984 and the total lack of involvement in 1985.

ECSC loans to finance power stations (Article 54(2) of the ECSC Treaty) have been declining since 1983. In 1986 only one loan was granted, namely 8.7 million ECU in the Federal Republic of Germany.

Nine loans at subsidized interest rates totalling 9.6 million ECU were paid out for investment to promote consumption of Community coal in industry in the Federal Republic of Germany, Ireland and Italy.

By recipient sector

With a very similar total to that of 1985, the **nuclear** sector kept its first place in the Community borrowing stakes (accounting for approximately 36% of the total). The nuclear energy loans, totalling *1 155.9 million ECU*, were more evenly divided in 1986 between the EIB and Euratom and were granted to virtually all the countries carrying out a nuclear power station building programme. For the first time in several years, Belgium did not call upon Community funds to finance its nuclear installations.

As in 1985, the **oil and gas** sector was in second place behind nuclear energy as regards the utilization of Community loans, albeit limited to the EIB's own resources.

These EIB loans made it possible to carry out a vast range of projects from the development of oil and gas fields in Italy and natural gas fields in the United Kingdom to natural gas networks in Denmark, Spain, the Federal Republic of Germany and Italy, and the modernization of refining centres in Greece.

A total of 786.1 million ECU of loans was granted by the EIB (729.6 million ECU), the NCI (47.8 million ECU) and the ECSC (8.7 million ECU) to assist **electricity** generation, transmission and distribution projects. About half of the loans in question were granted to Italy for primary electricity generation projects and transport infrastructure and transfrontier interconnection projects. It was of particular interest to the objectives of the Community's energy policy that five loans (four EIB loans and one ECSC loan) were granted in the Federal Republic of Germany to power stations using or converted to solid fuels.

The 103.6 million ECU loan granted by the ECSC (Article 54(1) of the Treaty) to a German coal company made it possible, after two very poor years, to improve the situation as regards Community lending to the **solid fuels** sector.

Nevertheless, we are still very far removed from the levels of 1982 and 1983 when the EIB and the NCI, alongside the ECSC, financed productive investment in the sector, in particular in France, Greece and Ireland.

The funding of investment to encourage **rational use of energy** and the **use of new energy sources** was, at 306.5 million ECU, lower in 1986 than in 1984 and in 1985. In 1986 the Federal Republic of Germany joined the ranks of the two countries which generally use Community funds for this type of investment, namely Italy and Denmark, with a loan for a major district heating network in Saarland.

The (EIB) global loan technique for small- and medium-scale investment by industries and local authorities in line with the Community energy objectives in these two areas was only used in Italy in 1986.

By recipient Member State

Although its share was lower than in 1984 and 1985, Italy remained the largest borrower of Community energy investment funds, with 1.9 billion ECU and 33% of the total amount of loans granted to the energy sector in 1986.

By calling upon the EIB's own resources and Euratom loans, in particular to finance its nuclear programme (power stations and waste storage) and the development of natural gas fields in the North Sea, the **United Kingdom** borrowed nearly 1 billion ECU and is very close on the heels of Italy (approximately 30% of the total). Nearly two-thirds of the total loans to the United Kingdom from the EIB, the ECSC and Euratom are for the financing of energy sector budgets.

Unlike in the past, 1986 stands out, where **the Federal Republic of Germany** is concerned, because of its considerable amount of applications for Community funding for the implementation of a wide range of energy projects: nuclear power stations, thermal power stations and co-generation plant (coal and lignite), and district heating networks fuelled by residual heat, and gas pipelines, totalling 447.6 million ECU, accounting for nearly 14% of the total amount of Community funds lent to the energy sector.

France called upon Euratom only for the financing of the Flamanville nuclear power station and the European Superphénix project and on the EIB for two electricity projects totalling 245.4 million ECU; Its share (7.6%) was less than in previous years.

Denmark generally borrows from the EIB (own resources and NCI resources), mainly to finance energy projects. In 1986 over 80% of the loans granted to this country as a whole, totalling 227.9 million ECU, concerned two natural gas transmission and distribution projects (73.1 million ECU) and six district heating network construction and extension projects (154.8 million ECU).

A very big loan of over 100 million ECU was granted in Greece for the modernization of the structure of the refining industry. Two loans were also granted in **Greece** to build two small hydroelectric power stations and a high-voltage line (24.5 million ECU in all).

After two years of virtual absence from the Community capital market for energy investment, in 1986 **Ireland** came back more or less to its 1983 borrowing level. Two EIB loans and one NCI loan were granted to the public electricity enterprise for the building of a thermal coal-fired power station and the extension and upgrading of the high-voltage network (117.0 million ECU in all). An Article 54(2) ECSC loan, with interest rebates, for investment to promote the sale of Community coal was also granted to Ireland.

The two new Member States made their first appearance in the sphere of Community financing of energy investment with three EIB loans granted in **Spain** (27.3 million ECU in all) for the construction of an hydroelectric power station and a gas pipeline network and in **Portugal** (29.1 million ECU) for a series of electricity projects.

Belgium, the Netherlands and Luxembourg were not involved in Community lending activities in 1986 in the energy sector.

Table 3
Community grants for energy projects in 1986 by recipient sector and source of funding (General Budget and ECSC Budget)

	MECU	%
1. Solid fuels		
General Budget	164.9	15.1
Demonstration projects	18.6	1.7
Liquefaction and gasification	18.4	1.7
ERDF	0.2	—
ECSC Budget	146.3	13.4
Interest subsidies	5.9	0.5
Coking coal	6.0	0.5
Research and development	22.4	2.1
Redeployment of workers	112.0	10.3
2. Oil and gas	214.8	19.7
Community technological development projects	37.9	3.5
ERDF	176.9	16.2
3. Nuclear fission	150.7	13.8
Transport and radioactive materials	0.4	—
Research and development	150.3	13.8
Direct action — JRC	121.8	11.2
Cost-sharing	28.5	2.6
4. Nuclear fusion		
Research and development	187.3	17.2
Direct action — JRC	17.3	1.6
Cost-sharing	170.0	15.6
5. Electricity	236.7	21.7
ERDF	235.8	21.6
IMPs	0.9	0.1
6. New and renewable energy sources	55.4	5.1
Demonstration projects	39.8	3.6
ERDF	1.7	0.2
Research and development	13.9	1.3
Direct action — JRC	6.4	0.6
Cost-sharing	7.5	0.7
7. Rational use of energy	74.2	6.8
Demonstration projects	55.1	5.0
Energy saving	34.5	3.2
Substitution of oil and gas	20.6	1.8
ERDF	5.7	0.5
IMPs	0.5	—
Research and development	12.9	1.2
Direct action — JRC	5.0	0.5
Cost-sharing	7.9	0.7
8. Energy planning	6.6	0.6
9. Others	0.5	—
Grand total	1 091.1	100.0

Table 4
Loans granted (MECU)
1986

	Solid fuels	Oil and gas	Nuclear energy	Electricity	Rue & NRES	Total	%
EIB	—	878.3	712.7	729.6	253.6	2 574.2	79.8
NCI	—	—	—	47.8	43.3	91.1	2.8
ECSC	103.6	—	—	8.7	9.6	121.9	3.7
Euratom	—	—	443.2	—	—	443.2	13.7
Total	103.6	878.3	1 155.9	786.1	306.5	3 230.4	
%	3.2	27.1	35.7	24.6	9.4		100

Table 5
Loans granted 1986

(MECU)

	D	DK	E	F	GR	IRL	I	P	UK	EC	%
EIB	302.2	193.3	27.3	22.3	125.1	69.2	939.4	29.1	866.3	2 574.2	79.8
NCI	—	34.6	—	—	—	47.8	8.7	—	—	91.1	2.8
ECSC	121.0	—	—	—	—	0.9	—	—	—	121.9	3.7
Euratom	24.4	—	—	227.1	—	—	97.6	—	98.1	443.2	13.7
Total	447.6	227.9	27.3	254.4	125.1	117.9	1 045.7	29.1	964.4	3 230.4	
%	13.8	7.0	0.8	7.6	3.9	3.6	32.6	0.9	29.8		100

Table 6
Loans granted to the energy sector by Community financial institutions

(MECU)

	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
EIB	379.5	737.8	997.0	1 112.2	1 451.4	1 228.5	1 643.3	1 894.7	2 231.3	2 574.2
NCI			149.5	108.0	93.6	131.4	315.4	250.0	9.4	91.1
ECSC	216.9	297.6	278.7	323.2	57.2	302.9	396.2	124.4	90.8	121.9
Euratom	96.9	70.2	152.4	181.3	357.6	361.8	366.4	186.0	211.0	443.2
Total	693.3	1 105.6	1 577.6	1 724.7	1 959.8	2 024.6	2 721.3	2 455.1	2 542.5	3 230.4

Short-term energy outlook in the European Community

Introduction

From now on the short-term energy outlook will cover the whole of the Community of Twelve, i.e. including Spain and Portugal. This important extension of our field of analysis alters the Community's energy profile, since on the basis of the (provisional) annual energy balance for 1986 the increase in total gross inland energy consumption for that year was 1.8% for the Community of Ten plus Spain, but 8.2% for Portugal, with the result that the increase in energy consumption for the Community of Twelve (EUR 12) was nearly 2% (Box A).

It should also be pointed out that as a result of revising the data, the trend for 1986 (a year in which the price of oil fell considerably) is significantly different from the estimates in **Energy in Europe** *Nos 7 and 8 in which the increase in total energy demand in 1986 was put at only 1% (Boxes B and D).*

However, the data available at the time of writing (covering six to eight months of the current year) would seem to bear out the forecast made in Nos 7 and 8 which indicated that overall energy demand would remain virtually stable in 1987. According to our present estimates, and assuming normal weather conditions in the fourth quarter of 1987, the increase in apparent total energy consumption in the Community of Twelve should not exceed 0.6%.

However, this picture of stability conceals a major redistribution of the major forms of energy, and in particular a spectacular breakthrough by gas (of the order of 6%). At the same time, solid fuel demand was sluggish, oil product demand fell by just under 2% and nuclear power generation increased, but by less than originally forecast.

These developments are to a large extent attributable to the significant increase in the price of oil. Barring an (unlikely) slump at the end of the year, the average (cif) price for crude oil imported by the Community in 1987 should be around USD 18/b compared with USD 14.4/b in 1986.

Any forecast for 1988 is subject at present to considerable uncertainty. Following the stock exchange crash of 19 October 1987 the world economic outlook is very uncertain.

Is there a risk of a recession in the United States in 1988 and/or 1989? How would this affect the European economy? How much will the dollar be worth in 1988? Will the price of oil slump again? These are just some of the questions which add to the uncertainties attaching to any forecast.

In this climate of uncertainty our forecasts for 1988 are based on a few key working assumptions: that the GDP growth rate for the Community of Twelve will be low but positive (1.5% on average) and that neither oil prices nor the dollar will slump, in other words the price of crude will remain unchanged in current ECU terms.

On the basis of these assumptions and normal weather conditions, overall energy demand in 1988 is likely to be slightly higher than in 1987.

Natural gas is likely to continue to make inroads, but at a slower pace (increasing by 2%), while solid fuels and especially oil products should continue to lose ground. In all probability electricity *demand will increase slightly, in line with GDP, and nuclear energy will continue to expand, at a rate between 3 and 4%.*

However, since this set of assumptions is, like any other set of assumptions, open to discussion a few alternative scenarios are illustrated enabling readers to get an idea of the possible alternative developments next year (Box F).

We shall now move on to a more detailed presentation of recent trends and the latest short-term forecasts done by the Directorate-General for Energy (DG XVII) for EUR 12.

As a result of the transition to EUR 12 the previous version of the short-term energy model (STEM) has not been used, and instead a prototype of the new version of the model (STEM 12 being prepared by DG XVII) enabled us to carry out a few simulations and test the internal consistency of the forecasts. As usual, however, market information has also been used.

This analysis is based on the statistics available as at 10 November 1987.

Box A

From the Community of Ten to the Community of Twelve

The following table summarizes the changes caused by the transition from EUR 10 to EUR 12.

Gross inland energy consumption

	1980	1981	1982	1983	1984	1985	1986
				'000 toe			
EUR 10	945 650	912 383	886 349	887 122	912 109	948 319	965 709
Spain	69 606	69 340	67 009	67 035	68 383	70 303	71 595
Portugal	9 528	9 373	10 376	10 454	10 437	10 283	11 126
EUR 12	1 024 784	991 096	963 734	964 611	990 929	1 028 905	1 048 430
				Percentage change			
EUR 10		– 3.5	– 2.9	0.1	2.8	4.0	1.8
Spain		– 0.4	– 3.4	0.0	2.0	2.8	1.8
Portugal		– 1.6	10.7	0.8	– 0.2	– 1.5	8.2
EUR 12		– 3.3	– 2.8	0.1	2.7	3.8	1.9
				Percentage share of the total			
EUR 10	92.3	92.1	92.0	92.0	92.0	92.2	92.1
Spain	6.8	7.0	7.0	6.9	6.9	6.8	6.8
Portugal	0.9	0.9	1.0	1.1	1.1	1.0	1.1
EUR 10	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Sources: 1980-84: Energy Statistical Yearbook 1985, Eurostat.
1985: Revised annual balance, 18 November 1987.
1986: Provisional balance, 18 November 1987.

Box B

Data sources and definitions

On the occasion of this transition to EUR 12 and in order to avoid any confusion, it would be useful to give some details about the source and content of the data used in this report.

The main source of data is the monthly Eurostat publication *'Energy: Monthly statistics'*. The data in question cover the main energy variables with a comparatively short time-lag (three to five months on average). However, these data are not directly comparable with the annual statistics published in the Eurostat Yearbook. In other words, the sum total for 12 months may be rather different from the value for the year as a whole published later in the Yearbook. In addition, there are several differences between the definitions. By way of an example, the monthly statistics relate to deliveries and not consumption; the stocks measured monthly do not always include all the stocks measured annually; inputs to power stations exclude private generation, etc.

In some cases we have made certain adjustments to bring the monthly data more into line with the annual data. Nevertheless, there are still some significant differences. In addition, by their very nature the monthly data are frequently revised, and this may lead to considerable changes in certain time series.

The monthly data are also a source of information for the quarterly primary energy balances (expressed in toe) published by Eurostat every three months. Consequently, these balances may be slightly different from the annual balance published later, particularly where stock changes are concerned. In addition, these balances exclude certain energy sources which are recorded in the annual balance as, for example, household refuse, etc.

(box B continued)

In earlier numbers of **Energy in Europe** these balances, after a number of slight adjustments, provided a source of information for Tables 1 and 2 in the annex. However, as these balances were not regularly revised following revision of the basic data it was possible that certain initial errors might be perpetuated.

For this reason, from this edition onwards we would prefer to update the data periodically as and when the basic data are revised. This explains certain differences which readers may note if they compare the toe data in Tables 1 and 2 of the annex with the figures published in Eurostat's monthly bulletin.

Working assumptions

The key assumptions underlying the energy forecasts for the Community of Twelve are shown in Table I.

The 1.5% growth rate is less than the Commission's September 1987 forecast (2.3%). Unfortunately, the Commission had not adjusted its macroeconomic forecasts by the time of writing of this report. Consequently, the 1.5% assumption may turn out to be rather pessimistic.

However, quite apart from these internal trends the European economy will be affected to a greater or lesser extent in 1988 by the economic situation in the United States, which is quite unpredictable on the basis of the information currently available. For this reason, we are giving a brief alternative projection (Box F) based on a 2.5% assumption.

Table I
EUR 12: Main forecasting assumptions

	1985	1986	1987	1988
		Percentage growth		
GDP	2.5	2.5	2.2	1.5
Consumer expenditure	2.6	4.1	3.1	1.75
Industrial production	3.4	2.0	1.4	1.0
Inflation	6.1	3.6	3.3	3.5
1 ECU = USD	0.760	0.983	1.151	1.223
Average crude oil import price				
(cif, USD/b)	27.5	14.5	18.1	19.2
(cif, ECU/b)	36.4	14.9	15.7	15.7
(cif, 1986 ECU/b)	37.7	14.9	15.2	14.7
Degree days — Difference from the 'mean'	11.7	0.7	8.0	0.0

Source: Eurostat, DG XVII.

We considered using, as a working assumption, a crude oil import price unchanged in ECU terms. However, experience has shown that the price of oil can vary considerably with slight fluctuations in supply or demand on the world market. To illustrate this we have carried out two simulations with our world oil market model (Aisling) which show two alternative situations of balance on the oil market, one with 19.2 current dollars a barrel in 1988 and the other with 14.2 current dollars a barrel. The results are given in Box C.

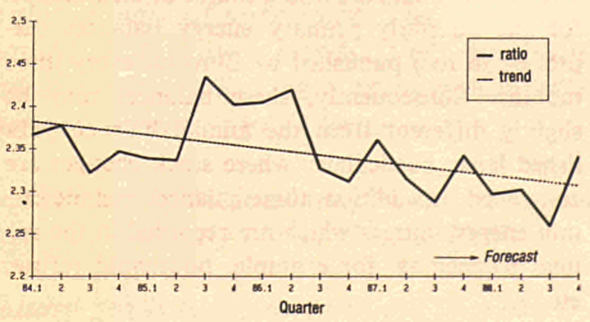
In addition, Box F gives an alternative projection for 1988 based on an average price of USD 14.2/b.

Energy prices

(i) Crude oil

In the wake of OPEC's decisions at the end of 1986 crude prices steadily increased between December 1986 and

Graph 1 — EUR 12: Quarterly energy ratio (seasonally adjusted gross inland consumption/real GDP index)



Graph 2 — EUR 12: Quarterly marcoeconomic indicators

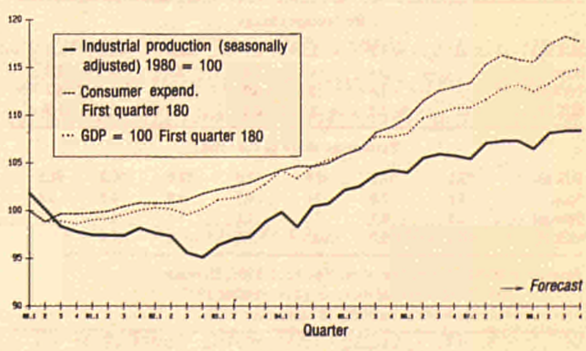


Table II
EUR 12: Average crude oil import price (cif)

	$USD/b	ECU/b	Percentage change on previous period (in ECU)
1983	30.05	33.76	– 2.3
1984	29.00	36.75	8.9
1985	27.59	36.16	– 1.6
1986	14.42	14.65	– 59.5
1987 (9 months)	17.94	16.83	
1 Q 1985	27.86	40.73	5.4
2 Q 1985	27.57	37.98	– 6.8
3 Q 1985	26.74	34.06	– 10.3
4 Q 1985	28.00	32.83	– 3.6
1 Q 1986	20.56	22.28	– 32.1
2 Q 1986	12.74	13.28	– 40.4
3 Q 1986	11.33	11.18	– 15.8
4 Q 1986	13.40	12.91	15.4
1 Q 1987	17.12	15.22	17.9
2 Q 1987	18.13	15.77	3.6
3 Q 1987	18.60	16.49	4.6
January	16.77	15.08	10.6
February	17.44	15.44	2.4
March	17.40	15.37	– 0.5
April	18.06	15.74	2.4
May	18.11	15.58	– 1.0
June	18.23	15.98	2.6
July	18.58	16.53	3.4
August	18.87	16.90	2.2
September	18.30	15.99	– 5.4

Sources: 1. Commission of the European Communities, *Bulletin of energy prices, 1/87*
2. DG XVII, *Registration of crude oil imports,* 10/87.

August 1987 when, because of the troubles in the Gulf, prices reached their maximum level (average cif import price for the Community of USD 18.9/b. Since then there has been a slight fall, with the result that the average (cif) price for 1987 should, we think, be around USD 18/b.

However, the value of the dollar fell considerably in 1987 in relation to European currencies, so the increase in prices in ECU terms was much lower, as Table II indicates.

How are prices likely to develop in 1988? Just before 19 October several observers came to the conclusion that the price of crude would be stable in 1988 or even increase slightly. A figure of USD 20/b was beginning to be seriously envisaged. The situation changed suddenly at the end of October. As the demand forecasts were down to a greater or lesser extent, the feeling emerged that there was surplus supply. Against this background the OPEC meeting scheduled for December 1987 takes on considerable importance.

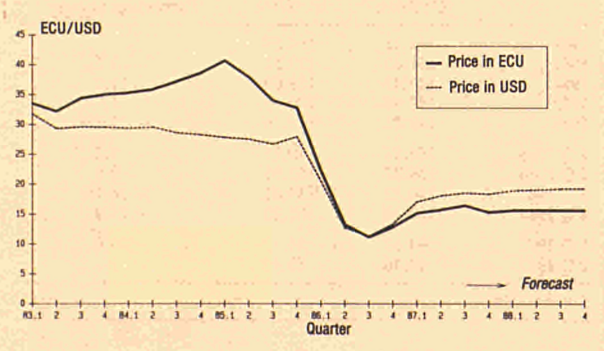
As Box C shows, it is very difficult to make a short-term forecast for the price of oil in the present conditions. Moreover, the decisive factor as far as the European economies are concerned is the import price expressed in national currency. This necessitates an additional forecast about the parity of the dollar. In view of the volatility of the exchange markets it will be understood why we have decided to adopt a 'neutral' working assumption, i.e. an unchanged current price expressed in ECU for 1988.

(ii) Oil products

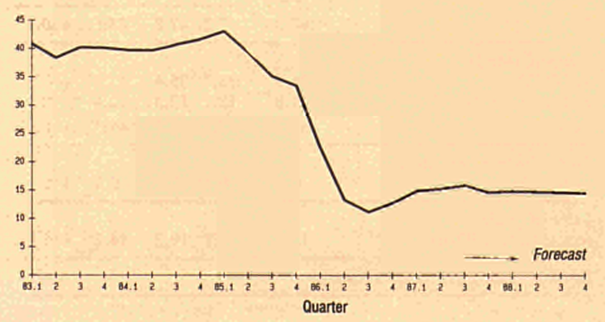
Extending the scope of our analysis to all 12 countries makes it necessary to alter the variables for the average final consumer prices for all energy products, including of course those relating to oil product prices. The values indicated in Table III below are weighted averages of the prices in the 12 Community countries.

On the basis of the information for the first three quarters of 1987 average oil product prices have increased

Graph 3 — EUR 12:
Average crude oil import price/barrel (cif)



Graph 4 — EUR 12:
Real price of imported crude oil/barrel (cif)
in ECU 1986



Box C

The price of oil: will 1988 be a repeat of 1986?

The forecasts made in this article are based on the assumption that oil prices expressed in ECU will not alter in 1988 compared with 1987. This assumption presupposes the maintenance of discipline within OPEC. However, if world growth slows down and hence the demand for oil is low, the possibility of a further reduction in the price of oil cannot be ruled out in 1988.

To illustrate this point, using DG XVII's Aisling model we have carried out a simulation illustrating how the price of crude could fall by USD 5 compared with the reference case.

The following table indicates two scenarios which are, it should be made clear, based on exactly the same macroeconomic assumptions as our forecasts for the Community: comparatively weak world growth and a slight decrease in the value of the dollar relative to the main European currencies and the yen.

According to this model, if OPEC brought an additional 1.3 million barrels a day onto the market, the average price of crude might fall by USD 5 despite the considerable reduction in OECD production, in particular in the United States.

This price slump is attributable to the low short-term price elasticity of world demand. In this eventuality, 1988 would be a repeat of 1986.

The world oil market: two scenarios for 1988
(excluding the centrally-planned economy countries)

	1986	1987	1988A	1988B	Diff
Supply (Mbd)					
1. OPEC production	19.3	18.8	19.3	20.6	+ 1.3
2. Production of OECD and rest of the world	25.3	25.5	25.7	25.1	− 0.6
3. Net exports from CPE countries	1.9	1.9	1.8	1.8	0.0
4. Processing gains	1.0	1.0	1.0	1.0	0.0
Total	47.5	47.2	47.8	48.5	+ 0.7
Demand (Mbd)					
1. OECD	34.9	35.2	35.4	35.9	+ 0.5
2. Rest of the world	11.8	12.1	12.3	12.4	+ 0.1
Total	46.7	47.3	47.7	48.3	+ 0.6
Stock changes, statistical difference	0.8	− 0.1	0.1	0.2	+ 0.1
Price of crude (calculated, USD/b)	13.6	18.1	19.2	14.2	− 5.0

Source: Aisling model (DG XVII).

slightly. However, on average for the year as a whole they are likely to be lower than in 1986.

Table III
EUR 12: Oil product prices in ECU
Percentage change on previous period

	Gasoline (ECU/1 000 l)	%	Diesel (ECU/1 000 l)	%	Heating oil (ECU/1 000 l)	%	RFO (ECU/t)	%
1984	718 962	3.8	481.426	5.5	370 298	5.5	239.352	18.6
1985	752 359	4.6	505 879	5.1	395 758	6.9	239 082	− 0.1
1986	624 504	−17.0	396 368	−21.6	257 897	−34.8	117 918	−50.7
1987 (9 months)	616 724		392 681		243 957		114 812	
1 Q 85	738 712	− 0.1	514 939	2.6	421 089	8.1	287 904	11.8
2 Q 85	781 681	5.8	516 453	0.3	401 036	− 4.8	248 270	−13.8
3 Q 85	756 154	− 3.3	491 626	− 4.8	371 390	− 7.4	215 718	−13.1
4 Q 85	732 887	− 3.1	500 498	1.8	389 516	4.9	204 434	− 5.2
1 Q 86	663 029	− 9.5	437 337	−12.6	310 914	−20.2	162 129	−20.7
2 Q 86	623 982	− 5.9	409 777	− 6.3	270 136	−13.1	115 649	−28.7
3 Q 86	610 446	− 2.2	375 570	− 8.3	225 596	−16.5	89 986	−22.2
4 Q 86	600 560	− 1.6	362 787	− 3.4	224 940	− 0.3	103 910	15.5
1 Q 87	609 380	1.5	384 556	6.0	242 920	8.0	108 296	4.2
2 Q 87	621 080	1.9	382 611	− 0.5	236 243	− 2.7	113 984	5.3
3 Q 87	619 711	− 0.2	410 875	7.4	252 707	7.0	122 157	7.2

Sources: DG XVII: Oil Bulletin; IEA; DG XVII estimates.

It is expected that oil product prices will stabilize in 1988 on the basis of our crude oil price assumption.

(iii) Natural gas

Table IV clearly shows that gas import prices reflect, with a slight time-lag, oil price fluctuations, in accordance with the mechanisms provided for in gas contracts. The steady fall since the beginning of 1986 speeded up in the fourth quarter of 1986 and the first quarter of 1987.

Table IV
Average (cif) price of imported natural gas

	USD/toe	ECU/toe	Percentage change
1982	161.25	164.59	
1983	151.80	170.52	3.6
1984	149.47	189.69	11.2
1985	152.96	200.45	5.7
1986	143.85	146.16	− 27.1
1 Q 1986	166.83	180.75	− 5.2
2 Q 1986	156.27	162.95	− 9.8
3 Q 1986	140.82	139.01	− 14.7
4 Q 1986	109.20	105.20	− 24.3
1 Q 1987	94.63	84.12	− 20.0
2 Q 1987	94.76	82.40	− 2.1

Source: IEA.

As import prices affect the final consumer prices, the latter have also tended to fall.

Table V (indices of average prices in ECU terms: provisional DG XVII estimates) indicates these trends. For example, the average gas prices for industry fell by nearly 20% in 1986. These price trends increased the relative competitiveness of gas and were no doubt one of the main factors in its rapid expansion in 1987.

Table V

EUR 12: Average final consumer price for natural gas: Indices (first quarter 1984 = 100) and percentage change on previous quarter

	Households		Industry	
1984	103.2		103.9	
1985	108.2	4.8	112.8	8.6
1986	100.7	– 6.9	92.3	– 18.2
1987* (6 months)	85.8		67.5	
1 Q 1984	100.0	1.7	100.0	1.9
2 Q 1984	103.2	3.2	102.7	2.7
3 Q 1984	106.6	3.3	105.0	2.2
4 Q 1984	103.0	– 3.4	107.8	2.8
1 Q 1985	104.7	1.7	112.2	4.0
2 Q 1985	108.8	3.9	114.3	1.9
3 Q 1985	112.5	3.5	113.6	– 1.6
4 Q 1985	106.9	– 5.0	111.1	– 2.2
1 Q 1986	106.0	– 0.9	108.4	– 2.4
2 Q 1986	103.8	– 2.0	98.4	– 9.2
3 Q 1986	99.5	– 4.1	88.0	– 10.5
4 Q 1986	93.5	– 6.1	74.6	– 15.2
1 Q 1987*	85.9	– 8.1	68.6	– 8.1
2 Q 1987*	85.7	– 0.2	66.4	– 3.1

* Provisional estimate.
Sources: IEA; DG XII estimates.

Table VI
EUR 12: Industry: relative price of natural gas, indices (first quarter 1984 = 100)

	Gas/RFO	Gas/coal
1 Q 1984	100 000	100 000
2 Q 1984	98 783	104 815
3 Q 1984	99 381	104 568
4 Q 1984	94 643	106 327
1 Q 1985	88 052	109 693
2 Q 1985	104 064	110 852
3 Q 1985	119 010	110 088
4 Q 1985	122 752	107 204
1 Q 1986	151 078	104 574
2 Q 1986	192 288	100 018
3 Q 1986	221 093	91 048
4 Q 1986	162 383	78 470
1 Q 1987	143 165	72 719
2 Q 1987	131 740	

Sources: Tables III, VI and VII.

Our forecasts for the end of 1987 and particularly for 1988 are to a large extent determined by the relative prices for natural gas, especially in industry.

In this connection, it is interesting to examine the trends for the relative prices for gas compared with RFO (residual fuel oil), and compared with the coal used by industry (Table VI).

It emerges from Table VI that gas has recently become more competitive compared with coal since the end of 1985, and compared with RFO in particular since the fourth quarter of 1986.

We have assumed that this general downward trend in gas prices could fade to a greater or lesser extent towards the end of 1987, particularly where households are concerned.

However, it may well be that the relative price of gas will continue to improve, albeit very slightly, compared with other fuels in industry.

(iv) Coal

There has been some delay in receiving the information concerning the price of coal, so the consumer price trends after the first quarter of 1987 are as yet unclear.

Table VII
EUR 12: Average price of imported steam coal (USD and ECU/toe)
Average final consumer prices (ECU/t)
Percentage change on previous quarter

	Imported steam coal			Households		Industry	
	USD/toe	ECU/toe	%	ECU/t	%	ECU/t	%
1984	51.0	64.7		193.8		94.1	
1985	51.6	68.2	5.4	203.6	5.1	97.0	3.1
1986	48.3	49.3	– 27.7	203.5	– 0.0	92.7	– 4.4
1987 (6 months)	43.6	37.3					
1 Q 1985	51.0	74.6	9.6	199.5	– 0.6	96.2	0.7
2 Q 1985	52.3	72.0	– 3.4	202.2	1.4	97.1	0.9
3 Q 1985	50.6	64.5	– 10.5	203.5	0.7	97.1	0.0
4 Q 1985	52.5	61.5	– 4.5	209.3	2.8	97.5	0.4
1 Q 1986	50.2	54.4	– 11.6	207.3	– 1.0	97.5	0.0
2 Q 1986	49.4	51.5	– 5.3	204.5	– 1.4	92.6	– 5.0
3 Q 1986	47.8	47.2	– 8.4	201.1	– 1.7	91.0	– 1.7
4 Q 1986	45.8	44.1	– 6.5	201.1	– 0.0	89.6	– 1.5
1 Q 1987	43.2	38.4	– 13.0	201.3	0.1	88.8	– 0.9
2 Q 1987	44.0	38.3	– 0.4				

Sources: Commission of the European Communities, *Bulletin of energy prices*, 1/87; IEA; DG XVII estimates.

Box D

What happened in 1986?

How did energy demand develop in the Community in 1986? We now have a clearer answer to this very interesting question, remembering that 1986 was a year in which oil prices fell very considerably.

The following table summarizes how our statistical information about 1986 developed according to the two sources available: the quarterly balances and the annual balances.

According to the most recent estimates overall energy demand increased by just over 2% in 1986, i.e. more rapidly than was thought earlier on the basis of the quarterly data.

This table illustrates in fact the differences which exist according to the sources and the extent of possible revisions. By way of comparison, the figures used for the relevant tables in the annex were as follows:

Gross inland energy consumption
Consolidated quarterly data

(Mtoe)

	Energy in Europe Nos 7 and 8			Energy in Europe No 9		
	1985	1986	%	1985	1986*	%
	EUR 10			EUR 12		
Solid fuels	218.0	210.6	− 3.4	240.3	231.1	− 3.8
Oil	412.9	420.1	1.7	456.3	472.2	3.5
Natural gas	182.1	184.5	1.3	184.5	186.8	1.3
Nuclear	116.4	123.2	5.8	125.5	138.2	10.1
Primary electricity	11.8	12.0	1.7	15.5	15.2	− 1.9
Other	1.2	1.2	0.0			
Total	942.4	951.6	1.0	1 022.2	1 043.5	2.1

* Provisional estimates, data available on 10 November 1987.

Source: DG XVII.

In addition, the first provisional annual balance for 1986 provides information about the trend in the demand for oil products during this period of rapidly falling prices.

Final consumption of oil products

(Mt)

	1985	1986	Percentage change
1. Gasoline	91 255	95 068	4.2
2. Kerosene	21 789	22 788	4.6
3. Gas oil/fluid fuel oil	158 885	167 498	5.4
4. Residual fuel oil	39 689	38 469	− 3.1
5. Other	19 373	20 307	4.8
Total	330 991	344 130	4.0
1. Industry	51 672	53 275	3.1
2. Transport	172 316	181 525	5.3
3. Households and others	107 003	109 330	2.2
Total	330 991	344 130	4.0

Source: Statistical Office of the European Communities, annual balances,
1985: Unpublished revision, 18/11/87,
1986: Provisional unpublished estimates, 18/11/87.

These figures indicate that, with the exception of residual fuel oil, final consumption of oil products increased significantly in 1986. However, when one considers the extent of the price variation, it will be seen that the short-term elasticities are low, even though they may be higher than was thought hitherto.

Gross inland energy consumption

(Mtoe)

	Quarterly balance				Annual balance			
	1985A	1985B	1986	%	1985A	1985B	1986	%
	EUR 10				EUR 10			
Solid fuels	218.6	218.6	210.8	−3.6	217 983	218 050	212 650	− 2.5
Oil	411.3	411.0	419.7	2.1	416 131	416 131	426 615	2.5
Natural gas	181.2	182.1	184.5	1.3	182 347	182 347	184 220	1.1
Nuclear	115.1	115.0	121.9	6.0	118 336	118 336	128 758	8.8
Primary electricity	16.0	16.0	15.9	−0.6	12 045	12 045	11 944	− 0.8
Other					1 410	1 410	1 452	3.0
Total	942.2	942.7	952.8	1.1	948 252	948 319	965 709	1.8
	EUR 12				EUR 12			
Solid fuels	238.4	238.4	229.7	−3.6	237 656	238 394	232 126	− 2.6
Oil	456.4	456.1	465.9	2.1	462 673	462 673	474 290	2.5
Natural gas	183.5	184.5	187.0	1.4	184 699	184 699	186 843	1.2
Nuclear	122.5	122.5	131.7	7.5	125 711	125 711	138 473	10.2
Primary electricity	19.9	19.9	19.3	−3.0	15 764	15 764	15 037	− 4.6
Other					1 664	1 664	1 661	− 0.2
Total	1020.7	1021.4	1033.6	1.2	1028 167	1028 905	1048 430	1.9

Sources: Statistical Office of the European Communities
A. Quarterly balances:
1985A: Energy monthly statistics 4/86,
1985B, 1986: Energy monthly statistics 4/87;

B. *Annual balances:*
1985A: Energy Statistical Yearbook 1985, published in March 19877,
1985B: Unpublished revision, 18/11/87,
1986: Provisional unpublished estimate, 18/11/87.

The main conclusion to emerge from Table VII is that despite the considerable fall in world prices and hence in import prices in 1986, inland prices went down only very slightly. This was no doubt detrimental to the consumption of coal in the Community.

Import prices may continue to fall a little before the end of 1987 and then stabilize at that level next year. Consumer prices might also fall slightly in 1988.

By way of conclusion, it should be pointed out that the present consumer price formation mechanisms for the various fuels are somewhat unclear, with the result that a degree of uncertainty remains concerning relative price movements at the end of 1987 and in 1988. It may well be, therefore, that unforeseeable changes in relative prices will affect the specific demand for individual fuels rather significantly.

Overall energy

As indicated in the introduction, a major revision of the data relating to 1986 indicates that, contrary to what was thought earlier, total energy consumption increased by approximately 2% (2.1% on the basis of the consolidated quarterly data) in that year. These differences are set out in Box D.

The main point which emerges from the data is the larger increase in oil consumption than previously reported, which tends to show that the short-term price elasticity of demand is not quite as low as had been thought hitherto (see article *'Do oil and energy prices matter?'* on page 13). In addition, it would seem that nuclear heat production increased more rapidly than originally estimated.

In 1987, following a particularly cold first quarter in which overall energy consumption was 0.7% up on the first quarter of 1986, there has been a reversal of the trend. Thus, at the end of the first three quarters of 1987 overall energy consumption did not appear to have returned to a level equivalent to that of 1986.

Despite the spectacular growth of natural gas (7.2% in the first seven months of the year), the big drop in oil product consumption, the stagnation of solid fuels and the slower than expected growth of nuclear power have resulted, during that period, in slightly lower energy consumption than in the corresponding months of 1986.

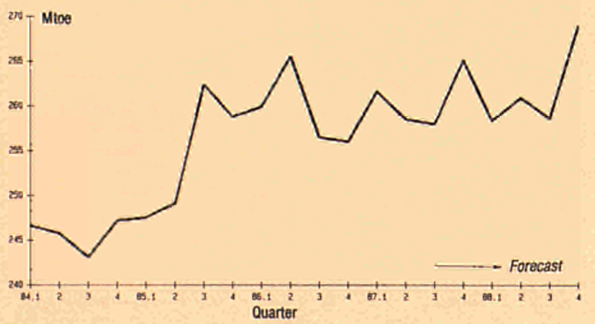
However, barring unexpectedly good weather, all the conditions seem likely to be met, particularly as regards prices, for a recovery in consumption in the fourth quarter. Ultimately, therefore, overall consumption in 1987 might be some 0.6% up on 1986.

According to our forecasts, slower economic growth in 1988 will be the main factor influencing energy trends.

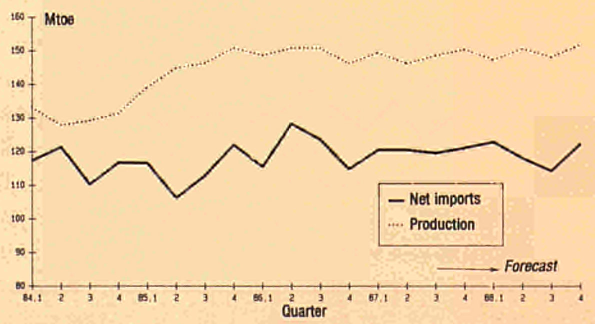
With an unchanged current crude price level, oil will continue to lose ground, mainly to natural gas and nuclear power. Moreover, unless the price of coal slumps unexpectedly, it would seem that solid fuels have hardly any chance of occupying the ground lost by oil.

Things might change, however, if for one reason or another (considerable weakening of world demand and/or lack of discipline among OPEC countries) crude prices again fell significantly (Box C). In this case (which now seems much more probable than an abrupt increase in prices, which would only result from unforeseeable supply-side factors), the consumption profile would of course be quite different. This eventuality is examined in Box F.

Graph 5 — EUR 12: Seasonally adjusted quarterly energy consumption



Graph 6 — EUR 12: Seasonally adjusted quarterly primary energy supply



For a better understanding of these forecasts, a more detailed analysis should be made by major energy category.

(i) Oil

The demand profile differs from one product to another. Gasoline deliveries, which increased by nearly 5% in 1986, will no doubt rise again in 1987. However, it is likely that in 1988 deliveries will level off under the combined effect of the following three factors: lower growth, an end to or a slowing-down of the fall in real prices, and the spin-off effects of the renewal of the car stock.

On the other hand, the demand for kerosene/jet fuel, which is less sensitive to price variations, will probably increase again next year.

It is almost certain that demand for heating oil will be lower in 1987 following the consumer stockpiling which occurred in 1986. However, a slight increase in deliveries is on the cards in 1988 once these stocks have been exhausted. A 2% increase in heating oil and diesel deliveries is therefore predicted for 1988.

The long-term trend to use alternatives to residual fuel oil will probably continue. In 1986 deliveries fell by some 3.5 million tonnes despite favourable prices and stockpiling by power stations. In 1987 a further reduction is expected, possibly once again in excess of 3 million tonnes, mainly to the benefit of natural gas. On the basis of our price assumptions and under the combined effect of lower demand from power stations and a slowing-down in industrial production, it is possible that this downward movement will continue and even speed up in 1988.

It may well be, however, that this trend will be limited by certain technical factors. In that case, our forecast for 1988 and possibly for the last two quarters of 1987 might overestimate the reduction in demand. The factors which would appear to explain the profile of this time series are indicated in Box E.

Lastly, our forecast is that the slight reduction in demand for other oil products which began in the second quarter of 1987 will continue until the end of 1988.

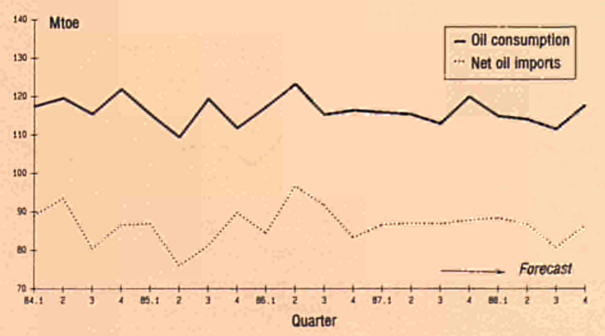
By way of conclusion, total deliveries which, in 1987, were nearly six million tonnes lower after seven months than in the corresponding period of 1986, could, for the year as a whole, be some seven million tonnes down on 1986. In 1988 they will probably continue to fall, by approximately four million tonnes (a reduction of 0.8%).

On the basis of our assumptions concerning production (slight decrease) and stock changes which are very difficult to forecast, the Community's net import needs will be lower. As a result, net imports as a proportion of inland oil consumption could fall from 70.7% in 1987 to 70.2% in 1988.

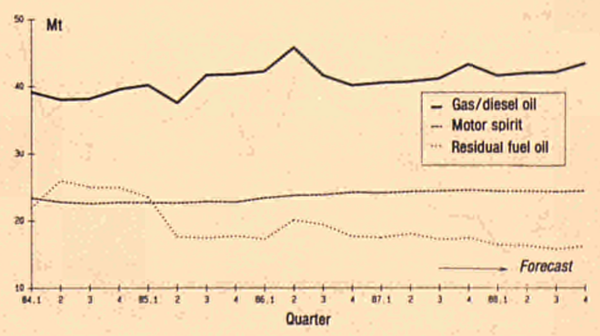
(ii) Gas

After 1986, a year in which consumption increased slightly, 1987 was a spectacular year for natural gas. Thanks to a particularly favourable price environment (Table VI), gas consumption increased very rapidly in the first two quarters of the year. Of the major consuming countries, the most spectacular increase was in Germany (19% in the first seven months of 1987). The bad weather in the early months of the year no doubt contributed towards this trend.

Graph 7 — EUR 12: Seasonally adjusted quarterly oil consumption and net imports



Graph 8 — EUR 12: Seasonally adjusted oil products consumption



Box E

Deliveries of residual fuel oil

In recent years the use of residual fuel oil has constantly decreased. Total deliveries in EUR 12 fell from 155 million tonnes in 1980 to 75 million tonnes in 1986. According to our forecasts this downward trend may well continue in 1987 and 1988.

For a better understanding of these trends and the reasons underlying our forecast, it would be interesting to be able to pinpoint the various factors affecting deliveries. Econometric analysis enables us to obtain an initial response to this question, although the reality is much more complicated.

The following table highlights the separate effects of the various factors which seem to affect deliveries of residual fuel oil in the period 1986-88.

RFO deliveries

(Mt)

	1985	1986	1987	1988
Total deliveries	78.1	74.6	70.8	65.5
Change		– 3.5	– 3.8	– 5.3
Determining factors:				
1. Electricity-generating sector		– 3.8	1.0	– 1.2
2. Industrial production		1.0	0.7	0.5
3. Price of RFO		8.4	0.4	0.2
4. Price of other fuels		– 1.1	– 1.7	– 0.8
5. Structural changes		– 7.7	– 5.1	– 4.0
6. Other		– 0.3	0.9	0.0
Total		– 3.5	– 3.8	– 5.3

It will be noted that an important role is played by what might be termed 'structural changes', meaning a long-term trend made up of several phenomena: changes in industrial structure, improvements in efficiency, and substitution independent of short-term price fluctuations, etc.

Since it is very difficult to predict such changes, there will always be a considerable amount of uncertainty attaching to any forecasts of deliveries of fuel oil.

Although we do not have complete information about final consumption by sector, it would seem that demand was strong both in industry and in households. In addition, as will be seen further on, consumption increased considerably in power stations in 1987.

Thus, despite a marked increase in production (4.4% in the first seven months), imports increased, covering nearly 36% of consumption in the Community.

This exceptional state of affairs is unlikely to be repeated in 1988. Our forecasts indicate that, given normal weather conditions, the average increase in gas consumption should be around 2%. Accordingly, natural gas should continue to make inroads in industry, replacing fuel oil to some extent. At the same time, the development of the distribution networks should encourage consumption in households.

Be that as it may, the demand for gas is rather sensitive to variations in relative prices, as has been seen in the past. If the trend in relative prices differs from what we have assumed, this could have a significant effect on consumption.

(iii) Solid fuels

The solid fuel market in 1987 was particularly sluggish.

Although, because of a statistical change made at the beginning of 1987 (to include the black lignite which is produced in Spain and used almost exclusively in power stations under hard coal instead of under lignite) the 1987 data are not strictly comparable with the 1986 data, there has been a reduction in deliveries of coal in all sectors.

However, it should be noted that our information about consumption and stock changes in power stations is not particularly clear. Nevertheless, following major stockpiling in 1985 and 1986, it would seem that stocks levelled off in 1987, although the situation differs to a great extent from one country to another. Consequently, the data relating to the increase in deliveries probably underestimates the increase in coal use in the electricity-generating sector. If black lignite is left out of the calculations, coal consumption in power stations would seem to have increased by 2 to 3% in 1987. This explains a slight increase in apparent consumption (after black lignite consumption is added) despite the reduction in total deliveries.

A further reduction in production, of the order of six to seven million tonnes, is forecast for 1988. Total deliveries will probably decrease further, despite a slight increase in deliveries to industry. The coking sector will probably again be affected because of weak demand from the steel industry.

Thus, overall, and despite the uncertainty surrounding power stations, solid fuel consumption could fall by about 0.5% in 1988.

(iv) Electricity

The rate of growth in demand for electricity in 1987 would seem to be 2.8 to 3%, slightly higher than the average rate for 1986. The difference is mainly attributable to the weather conditions at the beginning of the year. Where 1988 is concerned, lower growth is expected, in the vicinity of the GDP growth rate.

There are some interesting features about 1987 where electricity generation is concerned.

First of all, the increase in the production of nuclear heat would seem to be much slower than in 1986 (2.5% compared with 10%). On the basis of the available statistics, net nuclear electricity production was lower during the first half of 1987 compared with the corresponding period 1986 in the United Kingdom and Belgium and virtually came to a halt in Italy.

In addition, hydroelectricity production has decreased, particularly in Spain and Italy, and conventional thermal electricity production has increased. All fuels seem to have benefited from this increase, especially natural gas. This is the case in particular in Italy and Germany (over 30% in the first half of the year).

The case of Germany is fairly characteristic. During the first six months of 1986 overall consumption in conventional thermal power stations increased by 2.2%. Consumption of coal and lignite fell and consumption of oil products and gas increased considerably.

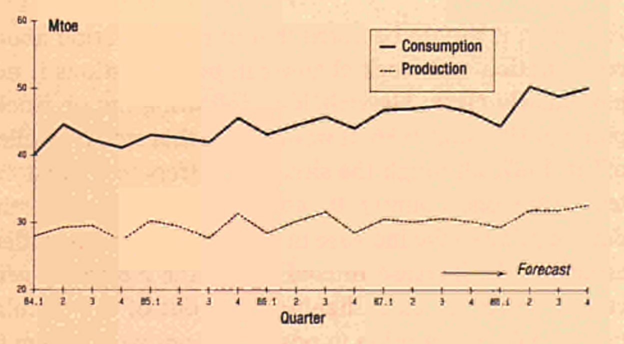
For 1988 our forecasts assume an increase in nuclear power production and a slight reduction in conventional production. All fuels except natural gas and lignite will probably be affected.

(v) Net imports

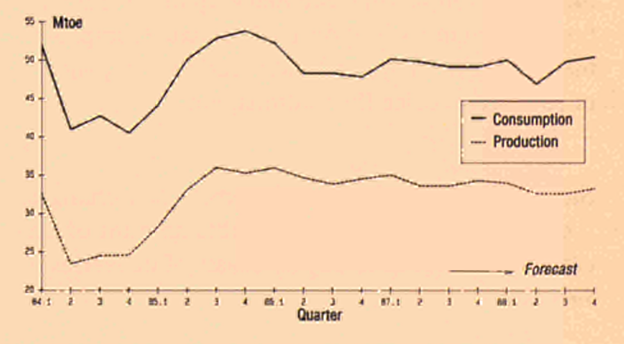
On the basis of these forecasts, the Community's net energy import requirements should again fall in 1988.

Net imports as a proportion of total primary energy consumption in 1988 could be around 44%, oil's share falling to below 32%.

Graph 9 — EUR 12: Seasonally adjusted natural gas supply and demand



Graph 10 — EUR 12: Seasonally adjusted hard coal consumption and production



Box F

Three alternative scenarios for 1988

As indicated in the introduction, the macroeconomic environment for 1988 is very uncertain. We are therefore putting forward some alternative scenarios.

Scenario A: More rapid economic growth. The average GDP growth rate in 1988 is assumed to be 2.5% compared with 1.5% in the reference forecast.

Scenario B: Price (cif) of imported crude oil USD 14.2/b compared with USD 19.2/b in the reference forecast.

Scenario C: Colder year than usual (+ 9 degree days).

The following table sets out the differences compared with the reference forecast:

1988: Three alternative scenarios
Gross inland primary energy consumption

(Mtoe)

	Reference forecast	Difference compared with the reference forecast: Scenario A	Scenario B	Scenario C
Solid fuels	230.0	+ 3.6	− 3.5	+ 0.8
Oil	458.5	+ 5.8	+ 8.3	+ 0.5
Natural gas	202.7	+ 2.2	+ 1.6	+ 2.9
Nuclear and primary electricity	161.8	+ 0.3	0.0	0.0
Total	1 053.0	+ 11.9	+ 6.4	+ 4.2

In the specific case of Scenario B deliveries of oil products might alter as follows:

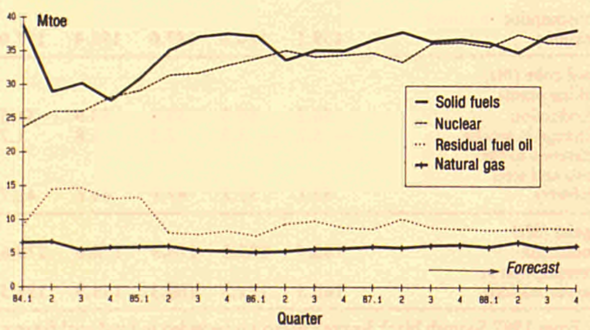
1988: Scenario B (fall in the price of oil)
Inland deliveries of oil products

(Mt)

	Reference forecast	Difference compared with the reference forecast
Gasolene	97.8	+ 0.6
Kerosene/jet fuel	23.8	+ 0.1
Gas oil and fluid fuel oil	169.8	+ 2.9
Residual fuel oil	65.5	+ 3.1
Other oil products	75.6	+ 1.0
Total	432.5	+ 7.7

It should be pointed out that these three scenarios are independent of each other, in other words their effects could be cumulative. In the event, for example, of more rapid growth with a lower price and a cold year, overall primary energy consumption in 1988 could exceed 1 075 Mtoe, whereas if the converse is true (low growth, high prices and good weather), it could be around 1 030 Mtoe.

Graph 11 — EUR 12: Quarterly inputs for electricity generation (seasonally adjusted)



Graph 12 — EUR 12: Seasonally adjusted electricity production

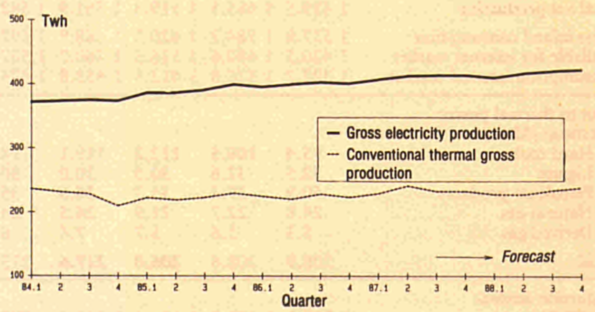


Table 1 — EUR 12
Primary energy balance
(Last revision: 23 November 1987)

(Mtoe)

	1984	1985	1986	1987	1988
Primary production					
Solid fuels:	141.4	168.2	173.5	171.3	167.3
Hard coal	105.3	132.7	139.2	136.7	132.6
Lignite	36.2	35.5	34.3	34.5	34.6
Oil	145.5	149.2	150.1	144.2	142.2
Natural gas	119.4	126.7	123.6	128.2	131.6
Primary electricity	14.8	14.4	14.0	13.3	13.6
Nuclear	104.2	125.5	138.2	141.4	146.5
Total	**525.3**	**583.9**	**599.4**	**598.4**	**601.2**
Net imports					
Solid fuels:	57.9	63.7	60.3	61.5	63.3
Hard coal	57.0	63.6	60.5	62.0	64.2
Oil	349.2	334.0	356.3	348.6	342.2
Natural gas	57.3	59.4	64.6	70.9	70.7
Electricity	1.5	1.2	1.2	1.2	1.7
Total	**465.9**	**458.3**	**482.5**	**482.2**	**477.9**
Change in stocks					
Solid fuels:	—15.3	— 5.0	5.8	3.8	2.7
Hard coal	—12.6	— 1.3	5.1	1.8	0.8
Coke	— 3.5	— 2.6	1.5	1.2	1.2
Oil	— 3.5	0.7	3.7	— 0.3	— 3.4
Natural gas	0.4	1.6	1.4	0.5	— 0.5
Total	**—18.5**	**— 2.7**	**11.0**	**4.1**	**— 1.1**
Bunkers	23.8	26.2	30.5	28.8	29.4
Gross inland consumption					
Solid fuels:	217.4	240.3	231.1	231.1	230.0
Hard coal	177.7	201.0	197.7	199.0	198.1
Coke	2.7	1.2	— 2.6	— 1.8	— 2.5
Lignite	37.0	38.1	35.9	33.8	34.4
Oil	474.5	456.3	472.2	464.4	458.5
Natural gas	176.2	184.5	186.8	198.5	202.7
Nuclear	104.2	125.5	138.2	141.4	146.5
Primary electricity	16.3	15.5	15.2	14.5	15.3
Total	**988.7**	**1022.2**	**1043.5**	**1049.9**	**1053.0**
Net imports as % of consumption					
Hard Coal	32.1	31.6	30.6	31.2	32.4
Oil	70.1	69.2	70,9	70.7	70.2
Natural gas	32.5	32.2	34.6	35.7	34.9
Total	**46.0**	**43.7**	**44.9**	**44.7**	**44.2**
Oil imports as % of total energy consumption	34.5	31.9	33.2	32.3	31.6

Table 2 — EUR 12
Electricity: Supply, disposal and generation
(Last revision: 23 November 1987)

	1984	1985	1986	1987	1988
Electrical power *(TWh)*					
Total generation	1 499.9	1 570.4	1 606.0	1 654.9	1.677.8
Total generation without pumping	1 482.9	1 551.7	1 588.7	1 639.5	1 662.1
of which:					
Primary	172.1	166.9	163.0	154.7	158.6
Derived:	1 310.8	1 384.8	1 425.7	1 484.8	1 503.5
Nuclear	399.0	483.2	522.0	542.6	567.1
Conventional thermal	911.7	901.6	903.6	942.2	936.4
Total net production	**1 419.5**	**1 485.5**	**1 519.3**	**1 561.9**	**1 582.8**
Gross inland consumption	1 517.9	1 584.2	1 620.2	1 668.9	1 697.7
Available for internal market	1 420.5	1 480.6	1 516.3	1 560.7	1 587.0
Consumption internal market	1 322.2	1 376.8	1 413.5	1 453.8	1 474.3
Input to thermal power stations *(Mtoe)*					
Hard coal	95.4	108.5	112.2	119.1	118.2
Lignite	32.5	32.6	30.5	30.0	30.0
Petroleum products	50.9	39.3	35.7	36.6	35.5
Natural gas	24.8	22.7	21.9	24.5	24.8
Derived gas	5.3	5.6	5.7	7.4	6.9
Total	**208.9**	**208.6**	**206.0**	**217.6**	**215.3**
Production nuclear heat *(TWh)*	1 212.1	1 459.7	1 606.4	1 644.5	1 703.0

Table 3 — EUR 12
Oil and natural gas: Supply and disposal
(Last revision: 23 November 1987)

	1984	1985	1986	1987	1988
1. Oil *(Mt)*					
Primary production	144.0	147.7	148.5	142.6	140.6
Change in stocks	—3.5	0.7	3.8	—0.4	—3.4
Net imports	348.1	331.2	354.0	345.9	339.5
Bunkers	24.5	27.0	31.4	29.7	30.3
Apparent consumption	471.2	451.2	467.3	459.3	453.2
Inland deliveries:					
Motor gasoline	91.6	91.2	95.6	97.8	97.8
Gas/diesel oil	155.9	162.2	170.4	166.5	169.8
Heavy fuel oil	98.2	78.1	74.6	70.8	65.5
Kerosenes	21.0	21.7	22.8	23.4	23.8
Other products	78.9	77.2	78.9	77.4	75.6
Total	**445.6**	**430.4**	**442.3**	**436.0**	**432.5**
Power stations:					
Consumption	53.3	41.1	37.3	38.3	37.1
2. Natural gas *(Mtoe)*					
Primary production	119.4	126.7	123.6	128.2	131.6
Change in stocks	0.4	1.6	1.4	0.5	—0.5
Net imports	57.3	59.4	64.6	70.9	70.7
Apparent consumption	176.2	184.5	186.8	198.5	202.7
of which:					
Power stations:	24.8	22.7	21.9	24.5	24.8
Final consumption (est)	145.8	154.6	157.0	165.5	169.3

Table 4 — EUR 12
Solid fuels: Supply and disposal
(Last revision: 23 November 1987)

	1984	1985	1986	1987	1988
1. Hard coal *(Mt)*					
Primary production	172.6	217.5	228.2	224.1	217.4
Recovered production	6.0	7.6	6.8	4.7	4.8
Change in stocks:					
Collieries	— 8.0	—10.3	0.3	2.6	1.8
Power Plants	—13.0	8.1	8.2	0.4	—0.4
Total	**—21.1**	**— 2.2**	**8.4**	**3.0**	**1.4**
Net imports	86.4	96.4	91.7	93.9	97.3
Apparent consumption	286.1	323.7	318.3	319.8	318.1
Deliveries to:					
Power plants	146.0	188.9	195.2	198.8	196.6
Coking plants	75.1	81.3	78.1	71.4	68.7
All industries	28.8	33.6	31.3	30.4	31.6
Households	16.0	18.3	18.1	16.6	16.1
Patent plants	2.8	3.4	3.4	3.1	3.1
Other	1.6	1.8	1.4	1.6	1.5
Total	**270.2**	**327.1**	**327.5**	**321.7**	**317.7**
Consumption in power stations	159.1	180.8	187.0	198.4	197.0
2. Hard coke *(Mt)*					
Coking plants					
Production	56.2	60.8	58.4	53.9	51.5
Change in stocks	— 5.2	— 3.9	2.2	1.8	1.7
Deliveries to the iron and steel industry	52.1	53.2	47.9	44.6	41.7
3. Lignite *(Mt)*					
Production	186.4	183.0	176.9	178.0	178.6
Consumption in power stations	168.5	171.3	160.3	153.9	155.5

Note: From 1987 Spanish black lignite ('negro') is included in hard coal figures.

Table 5 — EUR 12 Quarterly primary energy balance
(Last revision: 23 November 1987)

(Mtoe)

	1 Q 86	2 Q 86	3 Q 86	4 Q 86	1 Q 87	2 Q 87	3 Q 87	4 Q 87	1 Q 88	2 Q 88	3 Q 88	4 Q 88
Primary production												
Solid fuels:	45.5	43.0	40.2	44.8	44.1	41.8	40.5	44.9	43.1	40.8	39.5	43.9
Hard coal	36.3	34.7	32.3	35.9	35.4	33.7	32.0	35.6	34.3	32.7	31.1	34.5
Lignite	9.2	8.3	8.0	8.9	8.7	8.1	8.4	9.3	8.8	8.1	8.4	9.3
Oil	39.5	36.1	37.7	36.7	37.7	35.1	34.4	37.1	36.9	34.7	34.0	36.6
Natural gas	43.4	25.8	20.5	34.0	46.6	25.7	19.9	36.0	44.7	27.2	20.7	39.0
Primary electricity	3.5	4.7	3.1	2.7	3.4	4.3	3.1	2.6	3.5	4.4	3.2	2.6
Nuclear	38.5	32.4	30.4	36.8	39.5	30.8	32.2	38.8	40.6	34.7	32.4	38.8
Total	**170.4**	**142.0**	**132.0**	**155.0**	**171.3**	**137.7**	**130.1**	**159.4**	**168.9**	**141.8**	**129.7**	**160.8**
Net imports												
Solid fuels:	13.9	16.9	14.6	15.0	14.6	15.5	14.9	16.6	15.4	13.5	15.7	18.8
Hard coal	13.8	17.1	14.7	14.9	14.4	15.3	15.5	16.8	15.2	14.3	16.0	18.7
Oil	83.4	94.3	94.8	83.9	85.5	84.8	89.9	88.4	87.3	84.5	83.4	87.0
Natural gas	17.5	15.0	14.0	18.1	19.6	18.4	14.5	18.4	19.5	17.9	14.8	18.5
Electricity	0.1	0.7	0.4	0.0	0.2	0.4	0.6	0.1	0.1	0.7	0.7	0.2
Total	**114.9**	**126.8**	**123.8**	**117.0**	**119.9**	**119.1**	**119.8**	**123.4**	**122.3**	**116.6**	**114.5**	**124.6**
Change in stocks												
Solid fuels:	– 7.1	6.5	6.2	0.3	– 4.9	2.3	5.8	0.6	– 5.0	2.9	4.8	0.0
Hard coal	– 6.9	6.4	5.6	0.0	– 5.3	1.8	5.2	0.0	– 5.4	2.7	4.2	– 0.6
Coke	0.0	0.2	0.7	0.6	0.2	0.1	0.5	0.5	0.2	0.0	0.5	0.4
Oil	– 7.4	4.3	10.6	– 3.7	– 5.2	2.2	5.3	– 2.5	– 3.5	2.6	– 0.3	– 2.1
Natural gas	– 6.5	3.9	5.0	– 1.1	– 6.9	5.2	3.9	– 1.6	– 5.1	3.5	4.0	– 2.9
Total	**–20.9**	**14.7**	**21.8**	**– 4.5**	**–17.0**	**9.7**	**14.9**	**– 3.5**	**–13.6**	**9.0**	**8.5**	**– 5.0**
Bunkers	7.2	8.0	7.9	7.3	6.9	7.2	7.3	7.4	7.2	7.4	7.4	7.4
Gross inland consumption												
Solid fuels:	67.3	54.1	49.4	60.3	64.1	55.5	50.0	61.5	64.1	52.0	50.8	63.2
Hard coal	57.8	46.2	42.1	51.6	55.6	47.7	42.8	53.0	55.4	44.9	43.4	54.4
Coke	– 0.2	– 0.7	– 1.0	– 0.7	– 0.4	– 0.1	– 0.8	– 0.5	– 0.4	– 0.6	– 0.9	– 0.6
Lignite	9.7	8.6	8.2	9.4	8.9	8.0	8.0	9.0	9.1	7.7	8.2	9.4
Oil	123.1	118.1	114.1	117.0	121.5	110.5	111.7	120.6	120.6	109.3	110.3	118.3
Natural gas	67.3	36.8	29.5	53.2	73.1	38.8	30.6	56.0	69.3	41.6	31.5	60.4
Nuclear	38.5	32.4	30.4	36.8	39.5	30.8	32.2	38.8	40.6	34.7	32.4	38.8
Primary electricity	3.6	5.4	3.5	2.7	3.6	4.6	3.6	2.6	3.6	5.1	3.8	2.8
Total	**299.8**	**246.9**	**226.9**	**269.9**	**301.8**	**240.4**	**228.2**	**279.5**	**298.1**	**242.6**	**228.8**	**283.5**
Net imports as % of consumption												
Hard coal	23.9	37.1	34.9	28.8	25.8	32.1	36.2	31.7	27.3	31.9	36.8	34.4
Oil	64.0	74.7	77.7	67.5	66.6	72.1	75.5	69.1	68.3	72.5	70.8	69.2
Natural gas	26.0	40.7	47.5	34.1	26.8	47.3	47.5	32.8	28.1	43.1	46.9	30.7
Total	**37.4**	**49.7**	**52.7**	**42.2**	**38.8**	**48.1**	**50.9**	**43.0**	**40.0**	**46.7**	**48.5**	**42.8**
Oil imports as % of total energy consumption	27.1	37.0	40.4	30.3	27.7	34.3	38.2	30.8	28.6	33.8	35.3	29.9

Community news

Informal meeting of Energy Ministers

An informal meeting of Energy Ministers took place, at the initiative of the Danish Presidency, in Denmark on 21 September 1987. Three themes were discussed at the meeting — encouraging the more efficient use of energy; stimulation of new and renewable energies and the relationship between energy and the environment with particular reference to the Brundtland report.

At the meeting **Commissioner Nic Mosar** underlined the impact these three topics had on the long-term energy security of the EC and on the attainment of the 1995 Community energy objectives. Now that energy prices were low the outlook for improved energy efficiency and the possibility of a greater contribution from new and renewables were now more uncertain. Energy policy must act to support continuity in the investments necessary to ensure that the potential for further energy efficiency and new and renewable energies was realized. Since both these elements are by and large environmentally beneficial their continued development would improve the environmental aspects of energy use.

The two themes of energy efficiency and new and renewable energies have been under discussion at recent energy councils and a detailed recommendation on new and renewable energies, which is designed to assist the development and exploitation of these energies, was to be considered by Ministers at their meeting in November. At the informal meeting Ministers felt that some of the problems facing the greater commercialization of new and renewable energies needed more detailed consideration. Suggested follow-up on this aspect was to be proposed by the Commission at the next meeting of Energy Ministers in November.

Energy Council—13 November 1987

The Council of Ministers met in Brussels on 13 November. The meeting was chaired by **Mr Svend Erik Hovmand,** Minister for Energy (Denmark). The Commission was represented by **Mr Nic Mosar,** Commissioner for Energy.

On the basis of a Communication from the Commission the Council released a recommendation on developing the *exploitation of renewable energy sources* in the Community. The Council also took note of the Commission's intention to organize for autumn 1988 an international conference, among the objectives of which would be to identify opposition to the commercialization of such sources of energy.

On the basis of a Communication from the Commission concerning improvements in the *efficiency of electricity use,* the Council recognized the importance of this objective and took note of the intention of the Commission to present to the Council, in the course of the second quarter of 1988, in association with all the partners concerned (producers, distributors and consumers of electricity) a work programme in this field.

The Council had an exchange of views on the Commission's proposal for a directive concerning information on the *energy efficiency of buildings.* It emphasized the importance that it attaches to the problems of energy efficiency in general and noted that the building sector accounts for more than 38% of the Community's final energy consumption. The Council invited the Commission to reflect on the possibility of the conclusions taking the form of a Recommendation rather than a Directive.

Concerning the study of the costs supported by the refining industry in Member States in order to conform to environment legislation, the Council expressed the view that it should be given greater depth by contacts between the Member States and the Commission.

Finally, the Council had an exchange of views on the oil situation and on the energy aspects of bioethanol.

The Research Council adopts the framework programme for research and technological development (1987-91)

In Brussels on 28 September the European Community Research Ministers formally adopted the framework programme for research and technological development (1987-91) which had been under discussion for a year and on which the Council had adopted a mutually agreed position at the end of July. The 1987-91 programme will provide a general framework for the Community's activities in the field of research and technology for the next five years. It sets out the objectives, priorities and overall budget for these activities and the breakdown by major sector.

It is based on the Single Act which formally assigns the Community responsibilities concerning research and technological development. The underlying philosophy is simple: the intention is not, of course, to transfer to the Community level a maximum amount of research being conducted in Europe (a pointless exercise) but rather to carry out on a Community scale all the research which, for one reason or another, it is more useful, more profitable, and more effective to conduct at that level: research in areas where the problems which, in the nature of things, affect the European Community as a whole, e.g. protection of the environment and health; research which is beyond the financial and human resources of individual Member States, such as research into controlled thermonuclear fusion; research which will help to complete the internal market by providing the basis for common standards; and research in areas where it is essential to make maximum possible use of the complementary knowledge and skills existing in Europe. The latter is the most general case.

The Decision of 28 September sets the total amount deemed necessary for the framework programme at 5 396 million ECU (of which no more than 4 533 million ECU will have to be committed before the end of 1991), without prejudice to the 1 084 million ECU for programmes already decided upon or in progress. The total amount represents the sum allocated to specific programmes to be adopted during the period.

There are eight main areas of activities and the breakdown between them is as follows:

Framework programme of Community activities in the field of research and technological development (1987-91)

Breakdown of the amount deemed necessary between the various activities envisaged

(million ECU)

1.	Quality of life		375
1.1.	Health	80	
1.2.	Radiation protection	34	
1.3.	Environment	261	
2.	Towards a large market and an information and communications society		2 275
2.1.	Information technologies	1 600	
2.2.	Telecommunications	550	
2.3.	New services of common interest (including transport)	125	
3.	Modernisation of industrial sectors		845
3.1.	Science and technology for manufacturing industry	400	
3.2.	Science and technology of advanced materials	220	
3.3.	Raw materials and recycling	45	
3.4.	Technical standards, measurement methods and reference materials	180	
4.	Exploitation and optimum use of biological resources		280
4.1.	Biotechnology	120	
4.2.	Agro-industrial technologies	105	
4.3.	Competitiveness of agriculture and management of agricultural resources	55	
5.	Energy		1 173
5.1.	Fissions nuclear safery	440	
5.2.	Controlled thermonuclear fusion	611	
5.3.	Non-nuclear energies and rational use of energy	122	
6.	Science and technology for development	80	80
7.	Exploitation of the sea bed and use of marine resources		80
7.1.	Marine science and technology	50	
7.2.	Fisheries	30	
8.	Improvement of European S/T cooperation		288
8.1.	Stimulation, enhancement and use of human resources	180	
8.2.	Use of major installations	30	
8.3.	Forecasting and assessment and other back-up measures (including statistics)	23	
8.4.	Dissemination and utilization of S/T research results	55	
		Total	5 396

An examination of the breakdown shows that energy research (area 5) still accounts for a significant proportion of Community research and technological development. The basic principle underlying the Community's activities in this area is to maintain and develop a European technological capacity which is as diversified as possible, since the best way of guaranteeing the European Community's energy self-sufficiency is to diversify its energy sources and ensure a close match between the forms of energy exploited and the needs.

With this aim in view, the Community's endeavours will continue to be deployed in various directions, covering controlled thermonuclear fusion, fission energy and non-nuclear energy — meaning alternative energy sources, optimum exploitation of fossil energy sources, rational use of energy, etc.

Where fusion is concerned, research will continue under the JET programme and detailed design work will be started on the NET, the next major experimental fusion machine. Focusing mainly on nuclear safety problems, the Community's activities in the fission sphere will relate to reactor safety and radioactive waste management (JRC activities and shared-cost programmes) and the decommissioning of nuclear installations. The 1985-88 non-nuclear energy research programme will be followed by a new, fourth programme once it is completed.

European Parliament

Plans went ahead for a major public hearing organized by the Committee on Energy, Research and Technology of the European Parliament on European coal policy to take place in Brussels on 1 December morning and 2 December afternoon. Amongst those invited were **Dr Helga Steeg** (IEA, OECD); **Dr H. Messerschmidt** (FR of Germany); **Mr Gheyselinck** (Belgium); **Mr Cerezuela** (Spain); **Dr Tamburrini** (Italy).

Amongst the subjects being examined are: the present state of the world coal markets, prospects for transforming that market in the years to come with particular emphasis on international trade questions and social and regional consequences of changes in the structure of the coal market.

Further information can be obtained from the Secretariat of the Committee on Energy — **Ms Tove Fihl**, European Parliament, Office 5/57, Schuman Building, L-2929, Luxembourg.

The Committee will also be examining in the weeks ahead the revision of thermonuclear fusion research project and changes to the JET regulations. One question the Committee will be looking at very closely will be the advantages and opportunities for international cooperation between the Community and its main competitiors in the fusion field — Japan, USA and the USSR.

The STOA (Science and Technology Option Assessment) project set up, under the aegis of the Commission, a workshop on thermonuclear fusion in Oxford, England on 12 and 13 November. Amongst those participating were: **Mr Rolf Linkohr** (FR of Germany, S); **Mr Bernhard Sälzer** (FR of Germany, PPE); **Mr Gordon Adam** (United Kingdom, S). The rapporteur is **Mr Alman Metten** (The Netherlands, S).

The Committee had adopted, some months ago, a report on fast breeder reactors which was presented to the September plenary session of the European Parliament by **Mr Michel Poniatowski,** Chairman of the Committee (France, LDR). On his recommendation, however, Parliament decided to send the report back to Committee in view of the new situation following incidents at the Superphenix reactor at Creys-Malville in France. The Committee has appointed **Mr Madron Seligman** (United Kingdom, ED) to take over the report. He will be commenting on decisions which the French Government is expected to take at the end of this year concerning the future of the project.

Mrs Bloch von Blottnitz (FR of Germany, ARC) will be reporting to the Committee on an idea put forward by **Mr Robles Piquer** (Spain, ED) to make 1989 the Community year for alternative energy. The rapporteur supports this idea and will be putting her report to the Committee in October and November. If adopted, Parliament will ask the Commission to take on board this proposal.

Economic and Social Committee—the consequences of Chernobyl

The Chernobyl nuclear accident raised once again the question of the operation of nuclear installations and the national and international responsibilities that go with it.

Even if no direct lessons can be learnt from the Chernobyl accident as regards the physical design of Western reactors, since they are fundamentally different, the Member States and the Community should, nevertheless, learn from this accident, and in particular, in the view of the ECSC, pay more attention to nuclear safety.

One of the points raised by Chernobyl is that one can never rule out the possibility of a nuclear accident occurring which will have an impact extending beyond 1 000 kilometres.

The Economic and Social Committee has already repeatedly expressed its concern in the past and has made recommendations on the subject. In 1977, for example, it proposed a nuclear safety code for the Community.

The Committee has once again discussed this issue, and at its July 1987 plenary session adopted an Own-initiative Opinion on the consequences of the Chernobyl nuclear accident (rapporteur: Mr Flum — FR of Germany, Workers' Group, co-rapporteur: Mr von der Decken — FR of Germany, Various Interests Group).

The Opinion compares the safety arrangements in force at Chernobyl and in Western Europe and analyses the nuclear accident. In addition, the Committee draws conclusions from the accident and other accidents which have occurred in the West, in particular as regards improving the safety of nuclear installations and the need for international agreements on the harmonization of reactor safety standards and an international system for evaluating reactor safety.

While emphasizing that the Chernobyl nuclear accident must be seized upon as an opportunity to continue the discussions about the risks and advantages of the new technologies, in conjunction with the economic and social circles, the Committee makes a number of recommendations aimed in particular at the Community institutions.

It urges the Commission to make full use of its powers to make recommendations concerning the limit values for the radioactive contamination of food, and calls upon the Member States to establish the legal basis for setting such limit values.

The Committee also urges that an overall examination of the existing energy supply structure should go hand-in-hand with the planning of complementary or alternative solutions, such as new nuclear fission systems with extensive inherent safety, the enormous potential of energy saving, renewable energy sources, particularly solar energy and the further development of nuclear fusion.

The Committee believes that this approach offers the advantage of economic and technological continuity, a high degree of flexibility, a high level of job security and a socio-political consensus.

ECSC Consultative Committee

At its 265th session of 25 September 1987, the Consultative Committee considered the Commission services' working document revising its report on the market for solid fuels in the Community in 1986 and the outlook for 1987.

The Committee expressed its concern about the developments shown in this report, indicating a further decrease in solid fuels deliveries within the Community. It urged the Commission and Member States to take appropriate measures to bring trends back into line with the agreed Community energy objectives for 1995.

Information symposium on improving productivity through technology: modern management in the coal mines of the European Community

The Commission of the European Communities organizes, regularly, symposia in order to present the results of ECSC research activities on mining engineering and product upgrading. The forthcoming symposium, which will be held in Luxembourg from 4 to 6 May 1988, aims to demonstrate the progress which has been made during recent years in the field of modern mine management, with particular regard to remote monitoring and control, management information systems, colliery systems, planning and reliability. Specialized papers will be read and there will be more detailed discussion in the course of three round table meetings. Further information may be obtained by writing to: P. P. Rotondo, Commission of the European Communities, DG XIII-C-2, L-2929, Luxembourg; Tel. 4301 3166.

Improving the efficiency of electricity use

The Commission continues to give a high priority to its work in the energy savings sector, in line with the agreed Community objective of achieving at least a 20% improvement in the efficiency of final energy demand by 1995. In this context, the Commission has communicated to the Council (COM(87)496 of 27 October 1987) a review of the case for a concerted programme of action throughout the Community to exploit the existing significant potential for improved efficiency in the use of electricity. This communication was considered by the Energy Council at its meeting on 13 November 1987.

In its communication the Commission points out the importance of energy savings in electricity use. This sector accounts for an increasing proportion (currently some 17%) of final energy use in the Community and electricity production accounts for over a third of total primary energy use. Electricity plays a key role in the economic and social life of the Community, contributing to better industrial performance and increased standards of living, and efficiency improvements in its use can bring significant benefits in terms of reduced primary energy requirements, reduction in consumers' electricity bills and reduced need for costly investments in power plants.

The Commission intends to draw up a concerted action programme in this area, in cooperation with Member State governments, electricity utilities, electrical equipment manufacturers, representatives of electricity consumers and other interested parties. It is foreseen that the programme will be drawn up and presented to the Council for discussion by the second half of 1988.

Commissioner Mosar in high level talks with Norway

Commissioner Nic Mosar, together with **Mr Robert De Bauw**, the Commission's Director for Hydrocarbons, and **Mr Christian Waeterloos**, member of Mr Mosar's personal staff, visited Oslo on 28 and 29 September for talks with **Mr Arne Oien**, Norway's Minister for Energy, and officials from his Ministry. The opportunity was also taken to meet **Mrs K. Jesteby**, the Norwegian Foreign Secretary.

Commissioner Mosar and Minister Oien had a wide-ranging discussion on energy matters of mutual interest with particular emphasis on oil and gas. Mr Oien stated Norway's objective to increase gas production in the next few years whilst striving to maintain oil production levels as far as possible into the future. A principal concern of the Norwegian Government was to maintain hydrocarbon development at reasonable levels to avoid overactivity in the oil and gas sector and a too rapid exploitation of resources.

Mrs Jesteby drew attention to the need for international dialogue between oil producers and consumers and highlighted the role of Norway in this respect. Mr Mosar agreed on the necessity of such a dialogue and pointed to Commission efforts to promote exchanges of information with producers, for example with OPEC and OAPEC.

Commissioner Mosar and Minister Oien agreed on the usefulness of the talks and will meet again next year in Brussels.

Energy planning cooperation: China and India

A small group of DG XVII officials, led by **Clive Jones** (Deputy Director-General), visited China and India from 26 October to 6 November. In **China** discussions were held with a wide range of agencies and agreement was reached with the State Science and Technology Commission on the 1988 EC-China Cooperation Programme. This Programme will include the continuation of training activities at five existing and three new China-EC Training Centres, support for energy policy studies, and technical assistance in certain specific energy sectors such as electricity, coal, nuclear safety and natural gas. The group also visited the existing Training Centres at Tianjin and Hangzhou, and took part in the opening ceremony of a joint energy conservation seminar in Shanghai.

The purpose of the visit to **India** was to follow up the agreements made earlier in the year that the EC and India would cooperate in establishing a joint Energy Management Centre in India, and in an Energy Bus programme to provide advice to Indian industry on energy saving. Meetings were held with the Indian Ministries of Energy and Industry, as well as other relevant public and private sector organizations. These resulted in a wide measure of agreement on the role and structure of the new India-EC Management Centre, and on the first phase of the Energy Bus programme. The Indian authorities will now be considering the question of the Centre's location. In the meantime, work will continue on both sides to implement these agreements by establishing the Centre in the course of 1989 and by launching the first Energy Bus operation at the turn of that year.

Seminar on the Community's energy planning activities in Europe and the developing countries — Marseilles, 13 to 16 October 1987

This seminar, which was organized jointly by the ARENE of the Provence-Alpes-Côte d'Azur Regional Council and the Commission of the European Communities, brought together over 120 participants from Europe (local, regional and national representatives of the 12 EEC countries), and from the Third World (China, Indonesia, India, Thailand, Jordan, the Maghreb countries, Argentina, Brazil, Mexico, Senegal, etc.), policymakers, administrators, experts, and research workers and academics.

The purpose of the seminar was to draw lessons from the experiments with energy planning which had been conducted for a number of years in numerous European regions and in certain Third World countries under the auspices of the Commission of the European Communities.

Seminars on this subject have been held by the Commission since 1983 in Brussels, Berlin and Luxembourg.

Marseilles and the ARENE of the Regional Council were selected this year because the Provence-Alpes-Côte d'Azur energy planning project is an exemplary one in the context of the various regional energy planning activities supported by the EEC, in terms both of organization and of the results obtained.

The European Commission has actively supported the efforts of regions in the European Community and countries in the Third World to ensure better planning and control of energy systems for several years now at a time when Europe and many developing countries have felt the full force of the consequences of the energy crisis resulting from the tension (and more recently the volatility) of oil prices. In the first instance, these efforts have focused on a better understanding of energy flows (an understanding which was distinctly lacking in the wake of the various oil shocks), emphasis deliberately being placed on a better understanding of energy demand and the energy demand trend.

Another objective was to help establish appropriate planning instruments so that both the regions of Europe and the countries of the Third World can implement energy-conservation programmes and programmes to use new and renewable energy resources (making the best possible use of local resources), and in so doing diversify their energy resources and increase their self-sufficiency.

It also seemed worthwhile to bring together, under the auspices of the Commission of the European Communities, the various regional authorities in Europe, together with representatives from many of the Third World countries.

These exchanges of experience have helped to bring about a wider dissemination, among the authorities concerned, of planning techniques which have proved their worth in a particular European region or a particular country, and a better overall understanding of energy supply mechanisms at a time when energy still represents one of the major constraints on balanced economic development both in Europe and in the developing countries.

The challenges which our societies must meet between now and the end of the century are known: chronic underemployment in Europe due to an inability to compete on international markets and dramatic technological changes, serious environmental pollution, unequal and imbalanced economic and social development, difficulties for the Third World to finance the investment needed in order to satisfy the needs of the population. Energy plays a central role in all this: where pollution, the spread of deserts in the Third World, indebtedness and technological changes are concerned, energy is a fundamental constraint which must be taken into account in all cases.

These topics were discussed by decision-makers, experts, academics and research workers in Marseilles. This year the emphasis was on the following highly topical subjects: energy and regional development, energy and environment, energy and investment decisions.

Third-party financing seminar — Luxembourg, 8 and 9 October 1987

The seminar was intended to introduce the concept of third-party financing to a wider European public. Third-party financing is the mobilization of private capital to fund energy saving investments by an outside company, using the cost savings themselves to pay for that investment.

One hundred and eighty participants drawn from the financial community, central and local government, engineering consultancies and utilities were addressed by North American and European experts in third-party financing. The model contracts and guidebooks drawn up by the Commission were presented at the seminar and were discussed during workshop sessions.

Energy in industry conference — Berlin, 19 and 20 October 1987

The programme of the Conference presented the 250 participants with several essential aspects of the technologies associated with the rational use of energy in industry. Among the topics presented were:

(i) energy audits;

(ii) heat recovery at low temperatures;

(iii) optimization of industrial processes;

(iv) electricity use management.

Each session consisted of an introduction to the technology followed by the presentation of several practical applications. A round table on the problems of financing energy efficiency investments closed the conference.

European gas conference in Madrid

On 24 and 25 September, Unigas, the Spanish gas association, in cooperation with the Commission of the European Communities, organized the *Jornadas Europeas del Gas* in Madrid. From the EC, contributions were given by representatives of the Commission, the European Parliament and the European Investment Bank.

The purpose of the conference was to inform about the possibilities for the future development of the Spanish gas industry in line with Community energy policy and in view of earlier developments elsewhere in Europe. The conference also dealt with the possibilities of organizing the financing of the required infrastructural investments with the help of Community institutions.

The conference was opened by Mr Fernando Maravell, Secretary-General of the Ministry of Energy and Mineral Resources, and closed by Mr Guillermo de la Dehesa, Secretary of State for Economic Affairs. Mr R. De Bauw, Director of Oil and Natural Gas at DG XVII, delivered a speech on the Community's energy policy and the place of gas therein.

Workshop on energy and employment — Brussels, 30 November to 1 December 1987

In the framework of its activities on regional energy planning in the EC, the Commission has financed several studies analysing the effects of energy-related activities on employment. Moreover, through our various contacts the Commission knows that important work is also being done on the same subject by organizations and institutions in various regions, financed by other sources.

The Commission therefore organized an informal meeting where experiences in this field could be exchanged. The ultimate purpose of this meeting was to draw conclusions which would assist in the orientation of future work.

The presentations made at the Workshop will be published. Further information concerning the outcome of the Workshop can be obtained by contacting Mrs Borg, Directorate-General for Energy, Commission of the European Communities, 200 rue de la Loi, B-1049 Brussels.

Commission hosts meeting of energy forecasting and planning experts

On 6 and 7 October 1987 the European Commission's Directorate-General for Energy hosted in Brussels a meeting of experts on energy forecasting and planning from a number of international organizations (International Atomic Energy Agency, Economic Commission for Europe, International Energy Agency, Nuclear Energy Agency, World Energy Conference and Economic and Social Committee for Western Asia).

This was the sixth annual meeting of a group established under the auspices of the IAEA and which provides a regular forum for exchanges of information among the organizations concerned and for discussion of analytical topics of mutual interest.

On this occasion much of the discussion focused on the fall in oil prices of 1986 and its possible implications for energy demand and supply in the medium and longer term. The energy outlook for the developing countries was widely considered to represent the greatest source of uncertainty for the future. This was felt to underline the importance of efforts to improve energy planning and management in these countries by means of the programmes undertaken by the European Commission, the IAEA and regional organizations in the developing world itself.

The next meeting of the group is expected to take place in spring 1988, probably in Paris. That occasion should provide an opportunity for discussion of the first results of a large-scale forecasting exercise (looking to 2020) which is being undertaken by the staff of the World Energy Conference with the help of the European Commission and many of the other organizations represented at the Brussels meeting. The final results of the study will be presented to the next World Energy Conference in Montreal in 1989.

Two centrifugal slurry booster pumps in series transport the coal to the dewatering plant via a 2.5 km long, 250 mm diameter pipeline.

The dewatering plant (see diagram) combines a series of vibrating screens, centrifuges, cyclones, thickeners and continuous pressure filters. The water that is recovered by the dewatering process will be neutralized before being recirculated to the water storage pond as part of the closed loop system.

The coarse coal dewatering plant has been designed for an operating capacity of 300 t/h dry coal and has a target percentage of coal recovery of 99.5 %, or better, based upon a maximum of 12 % total end moisture.

The system has been designed to allow for coal from various origins in the United States, Australia, the Federal Republic of Germany and Poland.

Unloading unit, dumper/reclaimer and dewatering plant are each controlled by a PLC-type control system. The process is semi-automatic, whereby the operators still play a major role in the supervision and control of the different processes. The set-up of the control system is flexible in order to modify and further automate the process control.

A supervisory system with operator interfaces at the three different plant locations will support the communication between these locations and will supply the plant management with relevant information on the system status. For automatic start, stop and emergency procedures, this supervisory control system plays a crucial role.

The supervisory system will also be used for data monitoring and data acquisition during the test runs.

Market survey and outlook

As part of the project, a recent market survey has been carried out by Tebodin's Department of Economic Studies. The survey shows that new coal handling facilities will be needed in southern Europe (Spain, Italy) and south-east Asia (Indonesia, India, Taiwan) and Japan.

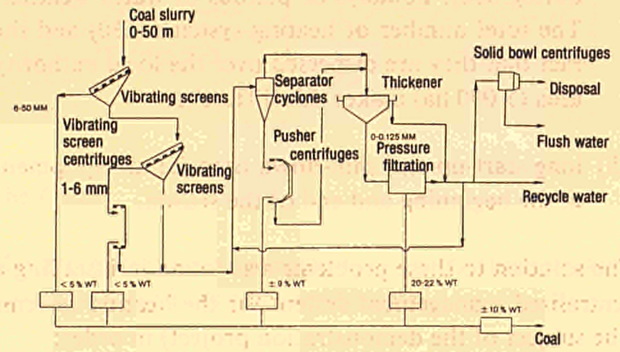
Furthermore, cost comparisons have been made between commercial-size conventional dry and wet slurry transhipment terminals. Based on actual data on five coal terminals under construction in Indonesia, the potential use of slurry systems for newly-built terminals could be assessed. Two out of the five Indonesian cases show a commercial opportunity for slurry unloading.

More in general, the project has led to the following conclusions as regards the commercial outlook for slurry unloading systems:

(i) at locations with deep water access channels, with good port infrastructure and where the client is located fairly close to the coal handling site, dry coal transhipment is preferable to the slurry system;

(ii) when major coal import infrastructure investments are required at locations that are less favourable for dry coal transhipment (mountains, swamps, etc.), there may be scope for initiating studies into coal slurry unloading.

Coarse coal dewatering plant



Centralized management of heating systems in local authority buildings in Rennes

Background — aim of the project

For several years, the city of Rennes (population 200 000) has been concerned to save energy, and projects have been conducted in several areas: household refuse, urban heating, transport, street lighting, municipal vehicles and local authority buildings.

The local authority buildings (405 000 m² of heated floor area, divided into 114 schools, 46 gymnasiums, four swimming pools, 12 crèches and other administrative buildings and cultural, sporting and industrial facilities) have been the subject of a number of projects since 1973: renovation of heating systems, introduction of programming and regulation, loft insulation, separation of circuits, heat pumps. It has thus been possible to obtain an energy saving of 50% under the heading of heating, which represents a yearly saving of more than FF 12 million in 1985. In that year the energy consumption of local authority buildings represented 44% of total consumption for which the municipality was responsible.

Among the projects undertaken, an energy management system has been installed to enable energy consumption to be properly controlled and any drift to be checked. Analysis work carried out has thrown the difficulties encountered into relief:

(i) the difficulty of recording the monthly and daily consumption of buildings;

(ii) the impossibility of stopping the heating systems during short holidays or periods of warm weather. The total number of heating systems (130) and the fact that they are dispersed over the local authority area (5 000 ha) makes this difficult;

(iii) long start-up and shut-down time for all equipment at the beginning and end of the season.

The solution to these problems was found in installing a centralized management system for the heating systems (the subject of the demonstration project) in order:

(i) to monitor and manage the installations in real time;

(ii) while maintaining the same level of comfort, to reduce consumption:

   (a) by rapidly detecting breakdowns in heating components either by means of alarms or by performing calculations on measurements taken in the heating systems;

   (b) by centralized programming of exceptional days when no heating is required;

   (c) by individually shutting down heating systems in cases of mild outside temperatures at the change of season;

(iii) to maintain the occupant's level of comfort by quickly dealing with defective equipment before the users feel any discomfort;

(iv) to obtain incidental indirect economies in materials, supervision, travelling expenses and labour costs.

On 1 December 1980, the Municipal Council decided to implement the project for the 53 heating systems rated at more than 350 kW. The firm Sofrel was chosen to pilot the operation, with the assistance of CIT-Alcatel for the telephone, Missenard-Quint for the heating and Peripheric for the data processing, and the completed work was accepted on 3 November 1982.

The project was financed jointly by the city of Rennes, the Commission of the European Communities and the *Agence française pour la maîtrise de l'énergie* AFME — French Energy Saving Agency.

Description of project

Centralized management of heating systems, in its full sense, has to fulfil three functions:

(i) **the remote alarm function,** which must enable operational faults to be detected and thus enable maintenance teams to intervene rapidly; however, this does not exclude supervisory visits;

(ii) **the remote control function,** which must, principally, enable the heating system as a whole to be started up or shut down. The remote control must thus make it possible to take advantage of holidays or periods of mild weather to shut down the heating, which is important in Rennes at the change of seasons;

(iii) **the telemetry function,** which must enable consumption to be more precisely known and enable temperatures in the installations to be monitored. The use of such measurements enables consumption trends to be followed and precise energy balance sheets to be drawn up by installing an 'energy gauge'.

The system used complements the programming, regulation and, where these are installed, heating optimization systems installed in the heating systems by centralizing the information (alarms, temperature measurements, energy counters, etc.) belonging to each installation and in no case does away with these.

The system consists of:

(a) **transmitters installed in the heating system:** their role, for which they use sensors, is to detect alarm situations (operating faults) and take temperature measurements and energy tallies concerning the heating system and to transmit them to the central unit. Conversely, they also have the role of sending remote commands from the central unit to the corresponding components;

(b) **a central unit installed with the technical services:** the role of this is to collect and process the information received in accordance with the computer programmes developed for it, and to send automatically or manually generated remote commands to the heating systems;

(c) **a means of transmission:** specialized telephone lines which exist within the town and are connected to a private autoswitch. The original feature of the system is that the capacity of the existing lines is doubled by transmitting the data on the high-frequency band, which does not inconvenience telephone users.

Costs and results

The total cost of the project (construction part) amounts to FF 4.26 million, tax included. From the follow-up, which was carried out during the 1984-85 season, there emerges an overall energy saving of some 160 toe/year, or 6.5% of previous consumption.

The corresponding saving in money terms was of some FF 500 000. It should be noted that these results are only due to the remote control and telemetry. The balance sheet for the remote alarm system has not been drawn up.

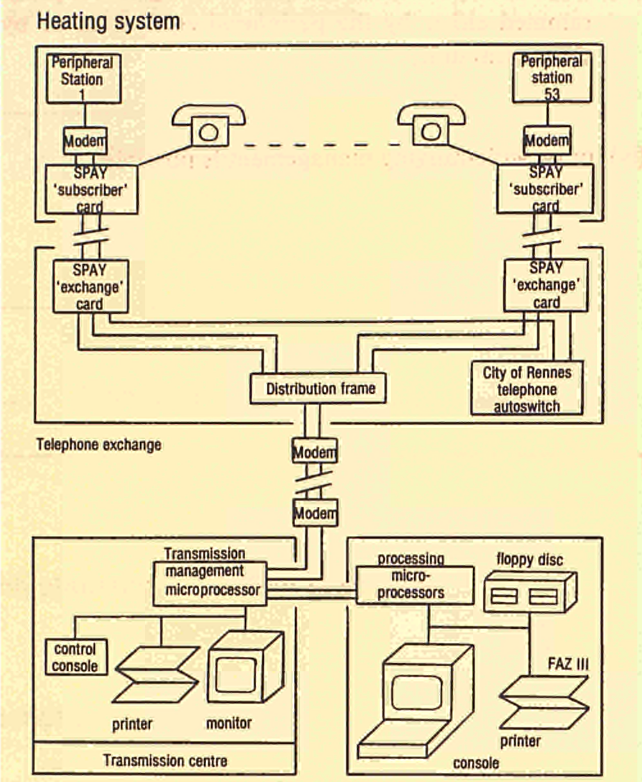
The initial objective (10% energy savings) has thus only partially been achieved. This is due to the fact that buildings had previously been subjected to very extensive improvements, involving both insulation and the optimization of the operation of each unit.

In addition, indirect savings, which it has not been possible to quantify, were obtained:

(i) less travelling time for shutting down and starting up new units and responding to incidents (lack of water, faulty operation of burners, etc.);

(ii) elimination of some routine inspection rounds;

(iii) optimization of maintenance.



General outline

The future

The actual remote management of the heating systems very soon turned out to be inadequate.

Thus, on the initiative of the AFME and after a European conference on remote management, organized at Rennes in June 1983 by the STCELA (Standing Technological Conference of European Local Authorities), an agreement to carry out a study of software was concluded between the AFME, the city of Rennes, the Rennes INSA (*Institut national des sciences appliquées* — National Institute of Applied Sciences), the IRISA (*Institut de recherches en informatique et systèmes aléatoires* — Institute for Research into Data Processing and Random Systems) and the firm Sofrel.

The main characteristics of the software developed are as follows:

(i) they enable the operator to set and modify parameters;

(ii) they make a true dialogue with the operator possible;

(iii) they make possible immediate interrogations, programmed either by the peripheral equipment or by the central unit;

(iv) more wide-ranging management is possible;

(v) operating tools are available (tables, graphs, diagrams, calculations).

These tools make it possible to go a step further in developing more precise and flexible means for energy management.

Document update

Main Commission energy documents, proposals and directives

COM/87/432	Proposal for a Council recommendation to the Member States on developing the exploitation of renewable energy sources in the Community
COM/87/401	Proposal for a Council directive on information on the energy efficiency of buildings
COM/87/1404	Commission decision of 29 July 1987 on the granting of financial support for pilot industrial and demonstration projects in the field of liquefaction and gasification of solid fuels
COM/87/1400	Commission decision of 29 July 1987 on the granting of financial support for demonstration projects in the field of substitution of hydrocarbons by solid fuels
COM/87/1399	Commission decision of 29 July 1987 on the granting of financial support to technological development projects in the hydrocarbons sector

New energy publications

Energy saving

No 49 Inedible rendering by means of the wet pressing process
No 50 Mechanical compression of organic vapours
No 51 The Dutch 1 MW-wind turbine at Wieringermeer
No 52 Use of solid refinery waste as fuel
No 53 Continued electricity production by burning refinery gas
No 54 Centralized management of heating systems in local authority buildings in Rennes
No 55 Upgrading of biogas to raise its calorific value up to hydrogen gas quality standard in the central sewage plant at Suttgart-Mühlhausen
No 56 Drying under pressure

Dumort, A.; Lapillonne, B., *Modèle de demande en énergie pour les pays du Sud*, Office for Official Publications of the European Communities, 1987 - ISBN 92-825-7395-8

Daintith, Terence; Hancher, Leigh, *La stratégie énergétique en Europe: son cadre juridique*, Office for Official Publications of the European Communities, 1987 - ISBN 92-825-6557-2

Demuynck, Myriam; Nyns, E-J.; Palz, Wolfgang, *Installations de biogaz en Europe* - EUR 9096, PYC Edition, Paris, 1987 - ISBN 2-85330-085-4

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