THE SHELL LECTURE 1984

RESTRUCTURING THE ENERGY SYSTEM IN GERMANY SINCE 1973

Hans. K. Schneider
University of Cologne

SURREY ENERGY ECONOMICS CENTRE

Discussion Paper *Number 19* *July 1984*

THE SHELL LECTURE 1984

RESTRUCTURING THE ENERGY SYSTEM IN GERMANY SINCE 1973

Hans. K. Schneider
University of Cologne

SURREY ENERGY ECONOMICS CENTRE

RESTRUCTURING THE ENERGY SYSTEM IN GERMANY SINCE 1973

Hans K. Schneider
University of Cologne

Only a decade has passed since the signals were set for the energy economy and presumably also for the total economy to step into a new era. Ten years ago, a price blast occurred in the Middle East which caused politicians and managers in our countries to shudder. At that time, when new prophets predicted the doomsday of western societies and assured us that the renunciation of consumption was the new form of penance, I was interviewed by 'Speigel' about the prospects and the actions necessary. The least of my worries was that the structural adjustments in the fuel mix, product mix and factor mix - which appeared to be necessary after the world record jump of oil prices - would not be managed adequately, thus causing energy and commodity supply shortages. What troubled me more was the possibility that some economists might not immediately understand the macroeconomic implications of such an erratic oil price rise and that the responsible politicians would thus fail to take adequate measures to stabilize demand and production. I will not discuss these matters any further, but let me just note that this concern did not prove to be unjustified. Overall, it also turned out to be correct that I had anticipated the market mechanism to be the main driving force behind structural adjustments. Where I considerably missed the mark, however, was in my forecasts concerning the speed and the main areas of structural changes in the energy sector. I had not expected such a strong decline in the energy intensity of GDP as it occurred after a short period of time. Also, I had anticipated a considerably stronger reaction of major alternative energy supplies following the oil price shock.

In the first part of my paper I will discuss the following questions

— what are the changes that have taken place on the demand and on the supply side;

— what was the role of energy prices and policy measures in effecting these changes.

After discussing these issues I will attempt to make some conclusions about the implications for economic policy.

It is worth noting that the FRG was self-sufficient in energy supply no more than a quarter of a century ago. By the time of the first oil shock, imports accounted for two-thirds of energy supply - and this figure has not changed since then.

The Development of Energy Consumption Since 1973

In the Federal Republic of Germany the first oil price shock reversed the formerly declining trend of real oil and energy prices. Nonetheless, domestic energy prices rose much more slowly than the price of primary energy (cif-prices) in terms of US-dollars, as the DM/$-exchange rate improved continuously. In real terms, domestic consumer prices for oil products and natural gas even declined after the 1973/74 increase of crude oil prices.

The impact of the second oil price shock on domestic oil and energy prices was - contrary to the first one - strongly reinforced by the deterioration of the DM/$-exchange rate *(Figure 1)*.

Adjustments in the fuel mix, factor mix and product mix which slowly came about after 1974 have been forcefully accelerated in the last few years. These structural adjustments have not yet been completed.

2 In the wake of the oil price development other forms of primary energy as well as oil products became more expensive too with the exception of natural gas. The prices for oil substitutes, however, underwent relatively slower increases, thus opening a wide field of profitable options for oil substitution. This substitution has - until now - almost exclusively taken place in heating energy markets *(Figure 2)*.

3 The most striking result of structural changes in the energy sector is the strong reduction of primary energy use per unit of GDP during the last 10 years.

Shifts in the factor mix and in the product mix have contributed to this reduction. Expensive energy was replaced by capital and labor and the growth of energy intensive production was reduced - at least comparatively.

a In 1983, total primary energy use was far below its historical maximum in 1979 and it was even 4% lower than in 1973 although real GDP has increased by approximately 16% since then. Consequently, a strong decline of the energy intensity of GDP can be stated; it amounts to 18% since 1973. It is a controversial issue of economic policy whether this development is an indication of the beginning of a "decoupling" of energy consumption and macroeconomic production. For the time being, any definite conclusion on this subject hardly seems to be possible *(Figure 3)*.

b Since 1974, the structure of economic production has moved towards less energy intensive products. Shifts in production took place in the sectors of private consumption and investment in plant and equipment, whereas by now no such effects are detectable for export goods. This is the result obtained by using a detailed input-output model which includes a special module for energy use[1]. One explanation may be that the structure of exports has not yet (completely) reacted to the new energy prices. In any case, there is still a lack of satisfactory explanations of energy-price induced changes in the product mix.

On the other hand, attempts to explain the impact of energy prices on the fuel mix in energy intensive industries have been quite successful. I am referring to the results yielded by the Cologne Energy Model KESS. Some results of this model analysis will be discussed later.

c At first sight it might be surprising that specific energy consumption constantly declined in the manufacturing industries even before the first oil price shock. An extremely high level of investment activity in the 1960's and early 1970's can however be regarded as responsible for this development (it should be noted, that the government imposed an investment tax in early 1973 in order to dampen private investment!). These investments, primarily intended to expand capacity and to lower costs, yielded considerable rates of energy-saving technical progress as a by-product. *After* 1973 the marginal efficiency of most investments

1 Rheinisch-Westfälisches Institut für Wirtschaftsforschung, Die Preiselastizität der Energienachfrage, Gutachten im Auftrag des Bundesministeriums für Wirtschaft, November 1983 (not yet published).

became smaller, investment activity consequently slowed down and energy-saving technical progress was reduced. Although heating oil was replaced by cheaper sources of energy, there was at first only a small energy-saving effect. It was not before the second rise of oil prices with its drastically increasing energy costs, that attempts to lower energy inputs per unit of real value added were renewed and reinforced. Due to the low level of investment activity, energy inputs nonetheless failed to reach the downward trend they had had before 1973 in the manufacturing sector *(Figure 4)*.

d In the sector of final energy use, the strongest decline in energy demand after the second oil price shock can be observed for residential uses. Although the number of dwellings increased by approximately 1 million from 1979-1982 and a larger share of central heating systems was installed in this period, total residential energy consumption declined by about 15%. In an analysis jointly undertaken by our institute, (Energiewirtschaft- liches Institut an der Universität zu Köln), the Deutsches Institut für Wirtschaftsforschung and the Rheinisch-Westfällisches Institut für Wirtschaftsforschung[1], it is shown, that the largest part of this decline in specific energy consumption per residence can be attributed to changes in behaviour (such as lower temperature, night setback, controlled fresh air ventilation by opening windows etc.) and not to capital investments. Energy costs have doubled their share of total household expenditures in the last years and this - in combination with declining disposable incomes - has led to a more economical and more conscious use of energy. Although investments for residential modernization and for improvement of heating systems and other energy - intensive appliances were initiated in 1973 and intensified since 1979, the energy conservation effects from these adjustments only had a small impact on the sharp decline in residential energy demand.

This analytical result is of some importance when forecasting the medium-term development of energy demand in the residential sector. Reductions of energy use based on capital investments can be taken to be permanent, whereas changes in (heating) behaviour can be reversed more or less quickly. Provided that economic activity, slightly revived in 1983, will continue to improve, then we might soon observe a renewed

1 Deutsches Institut für Wirtschaftsforschung, Energiewirtschaft liches Institut Köln, Rheinisch-Westfälisches Institut für Wirtschaftsforschung; Analyse des Energieverbrauchs in der Bundesrepublik Deutschland im Zeitraum von 1978-1981, Gutachten im Auftrag des Bundesministeriums für Wirtschaft, Berlin, Essen, Köln, Februar 1973 (not published).

increase of residential energy consumption. The income elasticity of energy demand for residential heating purposes is clearly above 1 in the FRG, whereas the average price elasticity of residential energy demand is sufficiently low to invoke only a small decline of demand due to increasing real prices of fuel oil and gas.

Yet there still remains a wide range of profitable energy-saving investment opportunities in the residential sector. Heat insulation of houses is one area of further progress. Old heating appliances will also continue to be replaced by more efficient heating systems, and all new residences can anyhow be expected to be significantly more energy efficient than the average existing residence. Energy saving investments in the residential sector will thus counteract the effects of renewed increases of disposable income and they will therefore at least weaken possible increases of residential energy demand.

4 Oil has suffered the largest market losses *(Figure 5)*.Its share in total energy supply amounted to 55% in 1973, it declined to 51% in 1979 and it finally fell to 43% in 1983.

The amount of domestic sales of heavy fuel oil was halved during the same period of observation. Until 1979 the substitution of heavy fuel oil in electricity generation was mainly induced by an active energy policy. Afterwards, however, German hard coal - although very expensive when compared to imported coal - began to regain the price competiveness it had lost to heavy fuel oil in electricity generation and in industrial applications before 1973. Public financial support did, of course, have a large part in effecting this development.

Light heating oil was not subjected to intensive competition by its substitutes until the second oil price crisis. Since then it has lost one-third of its sales. The general conclusions we reached for residential energy demand apply also to light heating oil:

It is mainly "behavioural changes" that have so far been responsible for the sharp decline in consumption of light fuel oil since 1979; adjustments through investments have only very moderately contributed to reducing oil consumption. However, in future we can expect that continued energy conservation by

investments and oil substitution will become more and more dominant for the future trend in light oil consumption. A continuation of these investments will in any case prevent another increase of heating oil consumption, even in a medium-term perspective.

Taken together, the demand for gasoline and diesel oil has until recently increased, although growth rates have declined substantially (an exception being the years 1981 and 82, with an absolutely declining demand).

Because of increasing efficiency and declining specific miles performances the demand for gasoline will remain on the downward course it adopted in 1981. For diesel-run vehicles on the other hand, demand can be expected to keep increasing in the nearer future. This estimate is based on the assumption of an unchanged price and cost relationship. The shares of gasoline and of diesel oil respectively in the motor fuel market will crucially depend on their relative price (and the extra investment costs for using diesel oil.

5 In most areas of energy demand, the elasticities of substitution between the various sources of energy are rather high. The same is true for direct and indirect price elasticities. Let me briefly discuss these matters taking the German steel and chemical industries as examples.

a **Chemical industry** For the period from 1974 to 1981 we calculated the price and substitution elasticities for the main sources of energy using the Cologne Energy-Model KESS[1] *(see Figure 6)*:

The own price elasticities of all sources of energy have negative signs. It is hard coal in particular which reacts strongly to relative price variations. Substitutional relations emerged for all fossil energy sources, only electricity use appeared to be largely complementary.

The elasticities were derived from a sectoral production model by using translog functions. The cost shares of the energy sources have developed as shown in *Figure 7*. The cost share of hard coal has decreased from 1960 to 1973. Because of an increase in price and the ensuing substitution of the heavy fuel oil this process has not continued in the last 10 years. But the consumption of hard coal will remain on a low level in future.

6

1 For further information see: D Gottwald, Die Energienachfrage ausgewählter Sektoren des verarbeitenden Gewerbes in der Bundesrepublik Deutschland, in: Zeitschrift für Energiewirtschaft, 1983, Heft 4, S. 262-272.

b **Iron and Steel Industry** Whereas in the chemical industry the cost share of heavy fuel oil has increased in the second half of the 1970's (although less than proportionately), in the iron and steel industry this energy source has been substituted disproportionately through coke. The estimated elasticities in the "Cologne-Energy-Model" support these results *(Figure 8)*.

All own-price elasticities have negative signs. It will attract attention, that there is a rigorous substitutional interrelation between heavy fuel oil and hard coal.

The Development of Energy Supply After 1973

1 The reduction of oil's share in primary energy supply was met by increased shares of natural gas (1973: 10%, 1983: 15%) and nuclear energy (respectively 1% and 6%). Taken together, lignite and hard coal succeeded in holding their market position; the market position of lignite (share 1973: 9%, 1981: 11%) seems to have stablized because of its extremely profitable cost situation; whereas domestic hard coal (share 1973: 22%, 1983: 22%) was only stabilized by subsidies and mandatory measures of economic policy.

2 The expansion of natural gas was realized through relying on foreign sources, in the first instance in the form of increasing imports from the Netherlands (1982: 17,5 Mrd m^3), since 1973 also from the Soviet Union (1982: 10,5 Mrd m^3) and since 1979 from Norway (1982: 8.5 Mrd m^3). Natural gas from domestic sources accounts for one third of the gas supply; potential increases can be assumed to be very small. Intentions are to secure additional supplies from the Soviet Union (about 10 billion m^3) in the next years, and after 1986 from Norway (Statfjord project) as well.

Chances for a further expansion of natural gas will depend crucially on the competitiveness of gas prices. After 1979 domestic gas consumption declined by more than 18%, which is more than the reduction of overall primary energy use. The most substantial market losses emerged in electricity generation and in the industrial sector (market shares in 1979: 30% respectively 41%, 1982: 18% respectively 42%). This is not only a result of the recession but also due to the fact that natural gas was not able to remain competitive

against less expensive coal and nuclear energy. At the same time, energy policy measures constrained demand in the power production sector. However, in the residential and commercial sector the expansion of natural gas shares has continued. In this sector the preferred use of gas (market shares in 1979: 29%, 1982: 39.5%) for heating purposes with the fatal consequence of an increasingly uneven distribution of demand over the year. Considering the take-or-pay clauses for gas purchases this has led to a more costly gas supply. The future development of natural gas will depend highly on the chances for implementation of futher cost efficient storage and for agreements on more flexible price clauses for gas purchases which enable the marketing of gas for industrial boilers and power plants in periods of low demand (interruptible supplies).

The concern that an increasing proportion of Soviet gas could jeopardize the stability of supply is not shared by the majority of energy policy makers.

3 After the first oil price crisis it had been broadly expected that nuclear energy would vigorously increase its share of primary energy consumption and thus lower the dependency on insecure foreign sources. The technical and economic performance of the first commercial nuclear power plants supported these expectations. Actually, during the 1970's substantial delays occured in the build-up of nuclear power which were not primarily caused by technical problems but by the opposition of a part of the public against this new and supposedly dangerous technology. The licensing of new facilities has been delayed. During construction, plants had to be redesigned in order to meet additional security requirements. Operating plants also had to execute backfitting measures. All these factors increased the costs of construction and operation of nuclear power plants substantially. Nevertheless, there is still a cost advantage to nuclear plants at least in base load electricity production compared with nuclear's most important competitor, electricity generation from German hard coal.

Accordingly, nuclear power became the third most important energy supplier for electricity generation next to hard coal and lignite by supplying 21%, despite the constraints for investment and operation. The nuclear power plants presently under construction will raise this share even more after they have been put into operation.

The increases in costs of construction of nuclear power plants and simultaneously the decision to employ German hard coal preferably for electricity production have led recently to a strong rise in electricity prices in real terms in the Federal Republic of Germany and these prices are expected to keep rising. The high electricity prices that have to be expected particularly after termination of the current electricity supply contracts during the second half of the eighties, will jeopardize the international competitiveness of the electricity intensive production within the Federal Republic of Germany (see below).

4 In spite of two oil price shocks, the German coal mining industry has been unable to improve its competitiveness on its own. Surely, the strong drop in demand for German hard coal that began in the sixties and reached its lowest point in 1977 (a sale volume of some 84 mtce) has come to an end. However, this development and the following slight increase in demand have been due to nothing but policy measures.

Presently, about one half of the hard coal production is employed in electricity generation. The German utilities have agreed to a contract with the coal mining companies to raise their coal use by about one third from 1981 until the middle of the 1990's. The use of German hard coal for electricity generation and the construction of coal power are subsidized extensively; these subsidies amounted to 11 billion DMs during the period from 1979 to 1982. Most of these subsidies are financed by the electricty consumer in form of a so-called "coal penny", a surcharge to the electricity prices.

The coal demand of the iron and steel industry also declined substantially, although this form of coal use is subsidized too. This is mainly a result of the structural adjustments that have taken place in the German and West European steel industries. The bulk of the difference between the low world market price and the German hard coal price is transfered to the tax payer.

A slump in demand had also to be coped with in heating markets. No subsidies assigned to special uses are granted in this area - with the exception of district heating.

The ambitious plans to restart the production of synthetic oil and gas on the base of German hard coal have been drastically reduced in the meantime.

After the first oil price shock it had been expected that a new important market would emerge in this field. However, the economic calculations carried out by our institute[1] and by others demonstrate that these projects were not viable even under the assumption of doubled oil prices and substantially lower coal price increases. It is more likely that the production of synthetic gas on the base of lignite and - under certain assumptions - the production of methanol for automobiles will become profitable.

Due to the first oil price crisis the plans have been postponed, to basically clarify the situation of the mining industry and to concentrate on the production from mines that are expected to be competitive in the long run. Instead of adjusting production to market demand, as it had been declared by the Federal Energy Program in autumn 1973, the expansion of the domestic coal use was established as a policy objective again. The costs of hard coal production have increased substantially since 1979.While the cost of coal production had been decreasing in real terms during the period from 1958 until 1970, they rose by more than 10% on yearly average after 1973. Today, it is generally expected that the competitive position of the German hard coal will probably deteriorate drastically, or, at best, not improve.

Imported coal which supplies only 3% of the primary energy is not a significant factor. Its use is constrained by a restrictive import policy for deliveries from outside the European Community. Presently, the price of imported coal amounts only to 50-60% of the list price of the Ruhrkohle. The price difference has substantially grown during the recent years, despite the rising exchange rate of the US-Dollar. As the conditions of production continue to become more unfavourable in the mining industry the difference between the German hard coal prices and the cif-prices (without tarifs) of imported coal will increase.

According to the current import regulations the utilities are allowed to use imported coal only within the framework of contracted obligations to use increasing amount of German steam coal. Imported coal has to meet the additional demand which is not covered by the contracted additional German coal and by additional nuclear energy. As the increase of electricity demand is supposed to be relatively low in the new next few years, the use of imported coal will continue to be constrained. Legislation forces industrial energy users to prove that imported coal is used as a substitute for oil or natural gas. The

---

1 J.F. Ciesiolka, D. Schmitt, Wirtschaftlichkeitsanalyse fort-geschrittener Verfahren der Kohleverdelung, in: Aktuelle Fragen der Energiewirtschaft, Band 121, Munchen 1982.

high investment costs involved in substituting oil or gas by coal, the disadvantages of coal in handling, and the tougher clean air requirements make it difficult to switch to imported coal.

The steel industry has been allowed an import quota of 3 mtce (about 15% of the present demand). This is, however, dependent on a "satisfactory" long-term solution for the use of German hard coal in steel production.

6 Domestic *oil processing* has been in a very difficult economic situation for one decade. The domestic refinery companies have been writing red numbers since 1973 (with the exception of 1979) due to lower demand and to lower prices for oil products. Their prices have been pressured by policy measures and strong competition. According to the calculations carried out at our institute the losses accumulate to more than 14 billion DMs just for the last three years (mid 1980 until mid 1983). Since 1979 primary distilling capacities have already been reduced by about 30%. The domestic demand for oil will continue to decline, even under the assumption of a prosperous development of the German economy. This will be the result of energy policy actions, of a lasting decrease of the energy input per unit of GNP and of a permanent substitution of fuel oils. At the same time, demand will focus on the lighter products, discriminating against heavy fuel oil. The remaining reduction regarded as necessary for domestic primary dis tillation is about 20 million tons of yearly output capacity. This would mean a capacity decline of nearly 45% (to 90 mt yearly capacity) compared to the peak of 1979 (yearly capacity 160 million tons).

The expansion of conversion capacities which has been accelerated since the mid seventies will further increase the share of conversion which at present is 21% (applied to the primary distilling capacity converted for catalytic cracker-units). This process of restructuring that has required extensive investments by the refining companies in a period of high financial losses, was initiated without government support (e.g. import restrictions).

Economic Policy Implications

1 This presentation of German economic development in the last ten years may have demonstrated how intensely policy has interfered in the markets. The

crucial interventions are the measures to protect the German hard coal mining industry as well as the measures to regulate the use of the nuclear energy, measures which are not led by a clear long-term concept. The third point, not especially mentioned in the text, concerns the various measures to enhance energy saving efforts, for instance interventions into electricity rates for households, subsidies and tax reliefs in favour of energy saving investments, subsidies for the extension of district heating.

Consequently the following question arises: What are the lessons we can learn from the performance of market forces and political interventions in the energy system of the Federal Republic?

2 This is my first proposition:

> Energy policy in the Federal Republic had the proclaimed goal of creating the conditions necessary for satisfying energy demand at lowest economic costs.

This goal could not be fulfilled. On the contrary, the legal and institutional framework of economic policy complicates the operations of the market forces, and the different interventions impaired economic efficiency.

a The cost explosion which occurred in the energy supply of the Federal Republic in the last ten years is not only due to the price increases in the international energy markets. In so far as higher costs are required in order to guarantee a higher security of energy supply and a better protection of the natural environment they are to be accepted. However, the actual cost increases are far above that.

I do not deny that nuclear safety and protection of natural environment demands further improvements. But the administrative implementation and the forms of regulation are counterproductive. Excessive bureaucracy inflates costs without creating additional advantages. It is uncontested that better laws and better political management could help to save greater parts of the capital expenditures and also some operating costs. Especially alarming is the deteriorating costs situation of power generation.

Due to the restrictions in investments the share of the base-load power plants is substantially lower than necessary for minimizing the total cost of power generation. Specifically there is too low a share of the nuclear power plants. In the cost calculations which were made by our institute in a study dealing with a cost comparison between nuclear power plants and hard coal power plants, nuclear generated electricity at an operating time of 5,000 h/a is about 5 Pf/kWh cheaper than electricity from domestic hard coal[1].

Comparing the costs of nuclear power plants in the Federal Republic with those in France, there is an obvious cost advantage of new French nuclear power plants (the cost advantage amounts to about 25-30% compared with new German nuclear plants). This cost advantage is primarily due to the fact, that in France the construction program could be carried through without major delays. In the fabrication of the plant components the advantages of mass production could be used. The competitiveness of French power plants has already become apparent. Electricité de France strives to supply German electricity intensive production companies with electricity rates that German electricity companies cannot offer when covering costs.In other industrialized countries which did not follow a "stop and go" course as we did in power plant construction, the electricity rates are essentially more favourable for electricity intensive processes than in the Federal Republic.

Whether the economic advantages of vertically integrated production often occuring in these processes will be sufficient to compensate for higher prices of electricity cannot be definitely judged now.

b During the last years the political interventions into the energy markets have been extended. The federal government e.g. decided to promote energy saving by subsidies (4.35 billion DM-program). The planning of these measures is not based on economic calculations, but only on the declared intention to use less energy per unit of GDP. There is no distorting allocative effect in so far as the program supports those measures for saving energy which the energy consumers would have autonomously taken in view of increasing energy prices. The findings of some recent studies concerning these issues are, that at least 50% of the 4.35 billion DM-program can be regarded as a government gift to the beneficaries.

1 D. Schmitt, H. Junk, Kostenvergleich der Stromerzeugung auf der Basis von Kernenergie und Steinkohle, in: Zeitschrift für Energiewirtschaft, Heft 2, 1981, S. 77-86.

(Consumers who would have undertaken certain investments of the same volume and at the same time regardless of governmental grants can be considered to be free riders). In so far as the subsidizing of energy saving creates distortions in competitive conditions - this occurs frequently where district heating (which has been subsidized with 3 billion DM in the period 1975 - 1983) competes with natural gas and heating oil - a loss of economic efficiency will be the consequence.

c The policy for coal protection during the last quarter of the century is quite distressing with its manifold interventions and subsidies. These costs are tremendous. From 1974 up to 1983 total subsidies intended to stabilize the demand for German coal, to support the coal production, and to help coal miners also with their social insurance amounted to more than 117 billion DM. There are additional burdens for the energy consumers caused by coal policy, especially by the import restrictions on cheap coal from the world market. I will return to matters of German coal policy later.

3 My second proposition is:

The most important motor of structural adjustment was and is the market mechanism, guided by price incentives. In the adjustment process governmental policy had only supplementary functions. In some cases market performance was supported and in other cases it was distorted by policy measures.

The first oil price shock and the following increases of other energy prices slowly led to a change in the long term price expectations for energy. This was the reason for the slow progress of investments and innovations in energy saving and oil substitution. The second energy price explosion accelerated these adjustments rigorously. Thus the oil consumption of the Federal Republic decreased by one quarter compared to the highest level of 1973. Increasing prices and increasing uncertainty about the long term price development constrained the demand for oil substitutes. High energy prices stimulated the efficient use of energy and led to a decrease in total energy consumption of 11% (46 Mtce) since 1979, whereas the GDP 1983 is a little larger than 1979.

There is no controversial discussion in Germany that these important changes are primarily the results of market incentives. Energy policy intervened in the adjustment processes as described above. An acceleration of these adjustments, judged by economic criteria, was achieved in only a few cases. Much more important have been those interventions which complicate or prevent reasonable adjustments (for example in the field of nuclear energy or coal import). In total the interventions caused more distortions than reasonable improvements of market performance.

4 My third proposition refers to the future of the energy economy and energy policy:

> Today there is high uncertainty about future prices of oil and other forms of energy. Uncertainties also emerge with regard to long-run economic development and energy consumption, depending on that development. Therefore energy policy should pursue a strategy which minimizes damage in case of unforeseen and unplanned unfavourable developments.

Up to the beginning of the seventies energy policy had to deal with easy tasks. Energy supply kept pace with a rapidly growing energy demand. Larger disturbances of energy supply did not occur. The primary energy basis extended considerably. Intense competition among the energy suppliers exerted pressure on energy prices. Energy forecasts could be made under stable economic conditions. Even major forecasting errors (the rise of energy consumption was permanently underestimated) had no decisive effects and did not harm economic development, as energy supplies proved to be extremely flexible.

The conditions for our energy policy have completely changed since the first oil price explosion. Estimation of future energy demand has become more difficult, one reason being that economic development is highly uncertain, the other that the development of the specific energy consumption can hardly be forecast. Above all there are serious uncertainties concerning future prices of primary energy and the costs of expanding and restructuring the energy conversion sector (electricity, refineries and others).

The main source of uncertainty is the future development of oil prices. After

the turbulences of the seventies there seems, from today's perspective, to be some relaxation of the oil price development, which might last to the end of the eighties and even longer. However, for the important investment decisions of energy users and energy suppliers the crucial question is which path the development of oil prices will take in the long run.

Some factors which will determine this path have to be considered exogenous from the position of energy consuming industrialized countries; other factors are under their control at least to some degree, especially the development of oil consumption. Energy policy making in the industrialized countries faces a fundamental dilemma. The investment behaviour of energy consumers and of suppliers of alternatives to conventional oil depends on the longer range price expectations for oil: the more these investors rely on the expectation of high oil price increases and concentrate upon energy saving technologies and the development of direct and indirect substitutes of conventional oil, the more it becomes probable that suppliers of conventional oil will moderate their price to prevent the loss of further markets. On the other hand, if investors decided to rely on the hypothesis of long-term low oil prices, consequently postponing or definitely stopping investments in substitutes of OPEC-oil, this sooner or later would cause the next increase of oil consumption and prices.

Most energy policy makers in the Federal Republic of Germany are convinced that the strategy described first will be superior in the long run. It avoids the formation of new bottle-necks with all their risks for national and world-wide economic development. In the short-term this strategy is more expensive for the national economy, not so in the long run.

This strategy of minimum regret may necessitate governmental interventions (e.g. taxes on oil products or subsidies for maintaining some of the costly domestic primary energy productions), when actual energy prices lack sufficient incentives for adjustments indispensable in the long run. At present and during the next few years I regard the necessity of such interventions as being small. Even at their present lower level the oil prices are high enough to support economical and efficient adjustments in the long run.

5 My fourth proposition reads as follows

The adjustment of the domestic refinery sector should proceed without

subsidies. On the other hand economic policy has to provide for fair competitive conditions, nationally as well as internationally.

The adjustment process within the domestic refinery sector has so far taken place without governmental support. The high losses in oil refining could excessively accelerate the process of shutting down capacity and/or they could force companies to totally withdraw from the German market. Less competition on our national market would however have negative consequences for security of supply and the development of oil prices in the long-run.

In my opinion the following basic conditions with respect to the political framework have to be realized in order to attain a well-functioning adjustment process:

a The slogan "Away from oil" should no longer be used as a guide of energy policy strategies in this undifferentiated manner. In the past this slogan has induced policy measures that have resulted in distortions of competition for oil refiners on the German market. Fair competition is not possible except under the proposition that it is not the government which enforces oil substitution. The substitution process should be a result of price patterns and market conditions.

b Subsidies granted in various member countries of the EEC to keep refineries going or to restructure them (or similar measures to "regulate" the markets) burden German refineries - to a certain degree at least. Within the EEC an adjustment process in the refinery sector should be allowed for, which soly reflects site advantages as well as the technical and economic performances of the competitors. Moreover a harmonization of environmental protection policy seems to be necessary. In the present state, German refineries are excessively burdened by the requirements of the clean air act.

c Serious problems exist concerning the exchange of oil between EEC and other parts of the world, especially the socialist block and the OPEC-countries. Imports of oil products from these countries have an important influence on the price level and the structure of the German market. During the last few years they have aggravated the disequilibria and heavily contributed to the red figures of refinery companies.

Imports of refined products from OPEC-countries have not played an important role until now. It should be taken into account, however, that even small imports can have strong impacts on the prices in sensitive international product markets. These markets can therefore be of great importance for liberal oil markets like Germany. The protection against disturbances that are a consequence of such imports does not call for protectionism, but rather for cooperative solutions. For example:

— Joint ventures between national refining companies and OPEC-companies in refinery activities.

— Joint ventures between international companies and OPEC-companies in down-stream activities, especially selling of refined OPEC oil.

— An Arab-European dialogue including a rough coordination of demand forecasts and investment plans.

6 My fifth proposition concerns coal mining and reads as follows:

> We must set the course for a new coal policy. Today we produce too much coal from too many mines at too high a cost.

Subsidies and other protectionist measures have produced a dead-lock.The positive impacts a policy designed to protect indigenious coal production is supposed to have on production and employment in the coal districts according to interested parties have failed to appear - not surprisingly for economists. The only convincing argument in favour of permanent subsidies to domestic coal producers is their contribution to security of supply. This justifies a security premium to be paid per ton of domestically produced coal. However, such a premium would be very much lower than the subsidies which the coal industry actually receives.

In its last report to the German government the Council of Economic Experts has emphasized that coal policy will finally have to face the overall economic policy requirements. The best way to achieve this is gradually to introduce more competition in the coal market. The ultimate purpose of such a policy would be to end up with a level and structure of coal producing capacity that

makes domestic coal production competitive, given a reasonable security premium. I am sure that such an adjustment process will be painful to all those involved in the coal business. But this seems to be the only viable long term solution.

Finally let me report on a further example for the failure of economic policy. It is not directly an issue of energy economics but it has a strong link to the energy sector: the technology policy dealing with the problems of the so called progressed reactor lines.

7 Here is my sixth proposition:

> The outcome of the concentration of German research policy on direct subsidies for large-scale projects demands a fundamental review of the strategy pursued till now. So, for example, the German Fast Breeder and High-Temperature Reactor developments are burdened with serious implementation problems and an enormous waste of public funds, as a result of an inadequate political and legal framework.

The necessity of state-controlled research policy is undisputed in principle. It is derived from the fact that technological developments exert particularly strong external effects. The market mechanism however responds only to private profits from investments, whereas the social benefits can exceed the private profits in a substantial manner. In particular, technological developments in the nuclear energy sector that are extremely protracted, risky and expensive cannot be managed by the industry alone. They must be supported by public research funding. However, the allocation of public funds has to obey the principle of reaching a certain target of technical development by employing a minimum of resources.

Past experiences with the progressed reactor technologies "SNR 300 in Kalkar" and "THTR 300 in Schmehausen" have demonstrated that policy makers in West Germany did leave these rational principles far behind. At first, the completion of the SNR 300 had been projected for November 1979. Today the completion is expected for July 1987; this is a delay of 7½ years. The first cost estimate of 1.5 billion DM (September 1972) had to be continuously increased and amounts to 6.5 billion DM presently. Half of this cost increase results from project delays. Similar delays of the build-up and cost

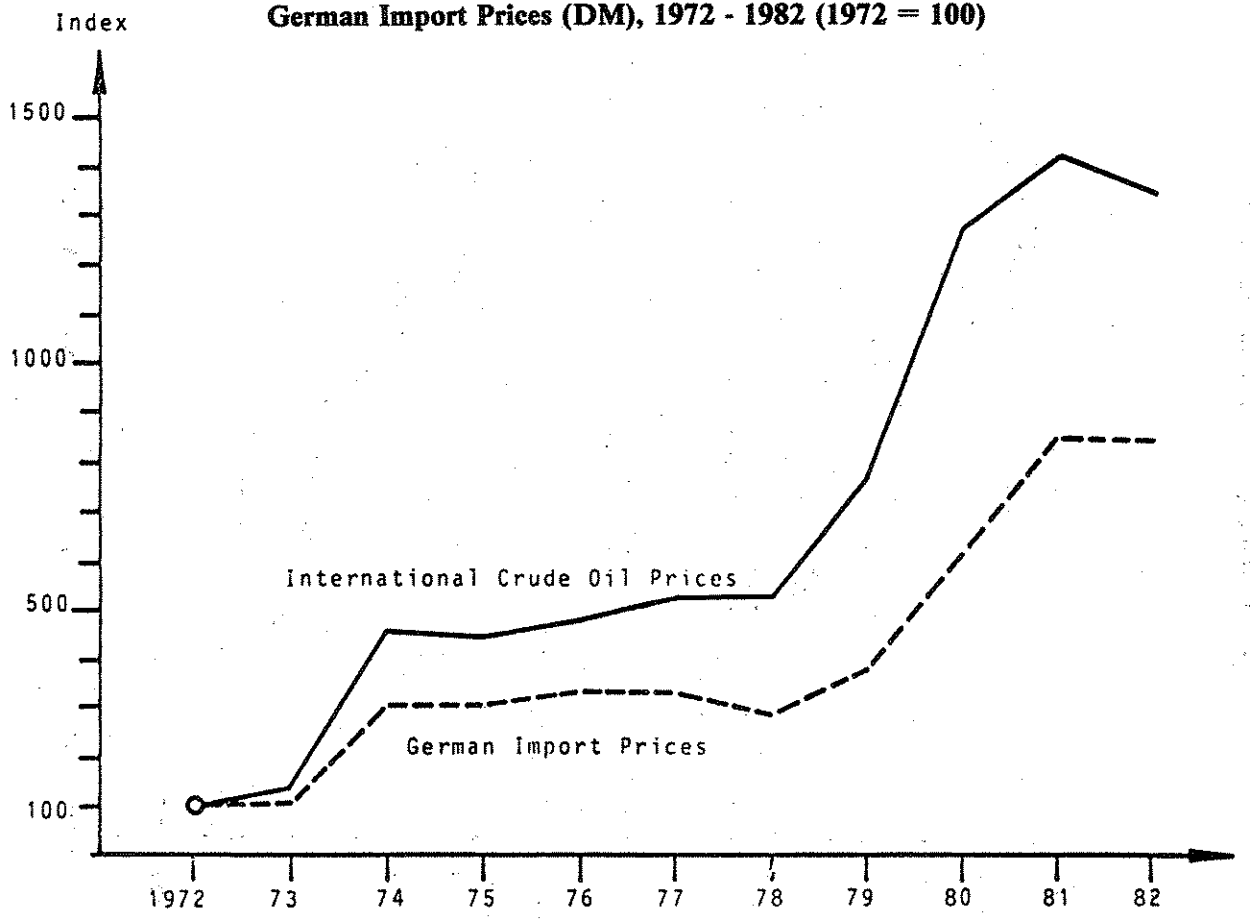
increases have emerged for the THTR 300 (construction delay 9 years, additional costs 3 billion DM). A world quite different from ours can be observed in France. There, the comparable breeder-protypes Phénix and Superphénix will be built up almost in due time and according to the estimated costs.

Admittedly, the development costs of such difficult technologies as the breeder and the high-temperature reactor cannot exactly be foreseen. Certain cost increases beyond the first calculation may be unavoidable. The evaluation of cost increases caused by the strict safety philosophy in German nuclear policy is more problematic. This safety philosophy requires the latest "standard of science and technology" to be taken into account during the construction and operation of nuclear plants. This principle leads to permanent new standards by the approving authorities which cause extreme cost increases, especially for prototypes. However, there remains a substantial share of costs which can be regarded as completely avoidable. There is at first the complex structure of licencing that is caused by the federal political system in West Germany and by plenty of acts and amendments leading to split direction competences and licencing competences and to the involvement of a great many authorities and institutions. This fact induces a difficult and long-drawn-out decision process. The design of the research policy is inefficient, too. The direct subsidizing of single projects combined with the fact that the public authorities bear the risks alone does not sufficiently stimulate private initiatives. Besides the public authorities are not adequately qualified for the efficient guidance of projects or for the appropriate control of schedule and cost.

The government should be active in research policy by improving the market mechanism but not removing it. More indirect tax subsidies of innovations should be prefered. In some cases, direct supports of projects such as prototype-installation or even large-scale demonstration-plants will be necessary in the energy sector. If a direct subsidy is chosen, decisions concerning the priorities of different projects and the distribution of the subsidies must be aligned with economic efficiency. Therefore direct subsidies should benefit such projects, where only a small number of alternative technical solutions exists and where social profits are clearly higher than private profits. In addition, in a system of direct subsidies the self-interest of industries should be mobilized through an increased share of the risk. Last but not least,

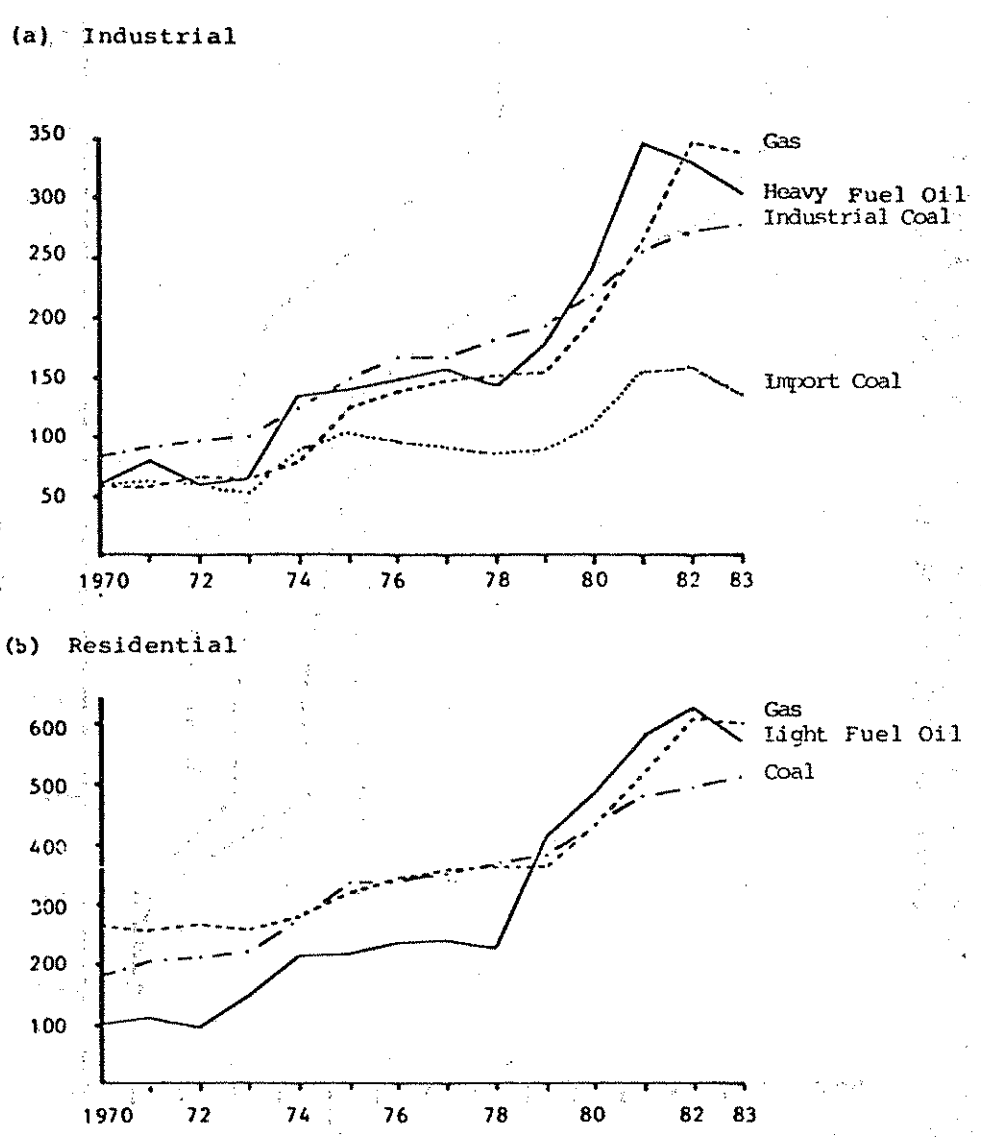
research policy, too, must legitimate itself much more clearly in future than it has done during the past.

Figure 1:
Development of International Crude Oil Prices (US - S) and of German Import Prices (DM), 1972 - 1982 (1972 = 100)



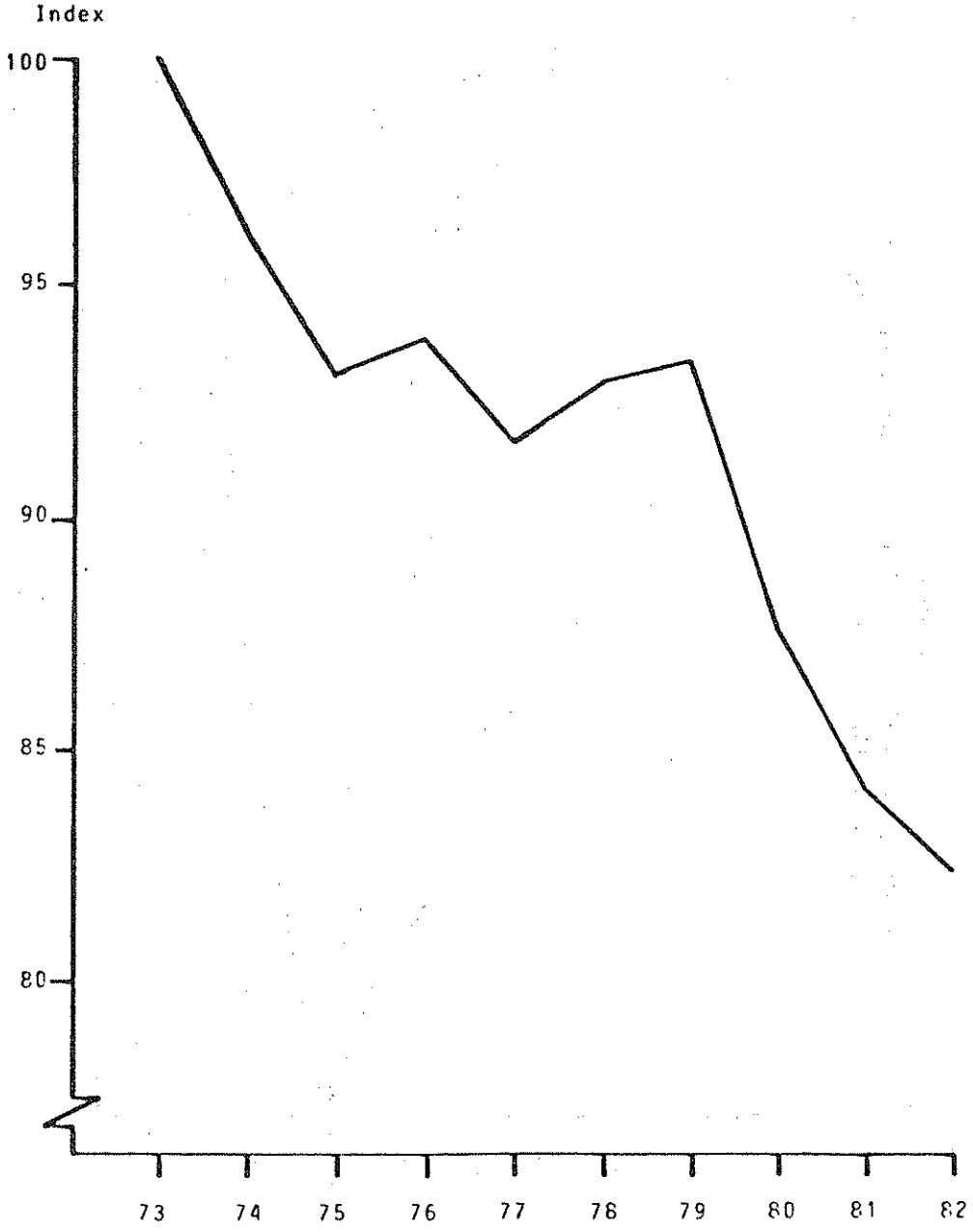
Source:
OECD, Economic Outlook, 1983; Stat. Bundesamt, Fachserie 7, Reihe 4.1

Figure 2:
Thermal Prices of Mayor Energies in the Industrial and Residential Sector of West Germany (DM/t-SKE), 1970 – 1983



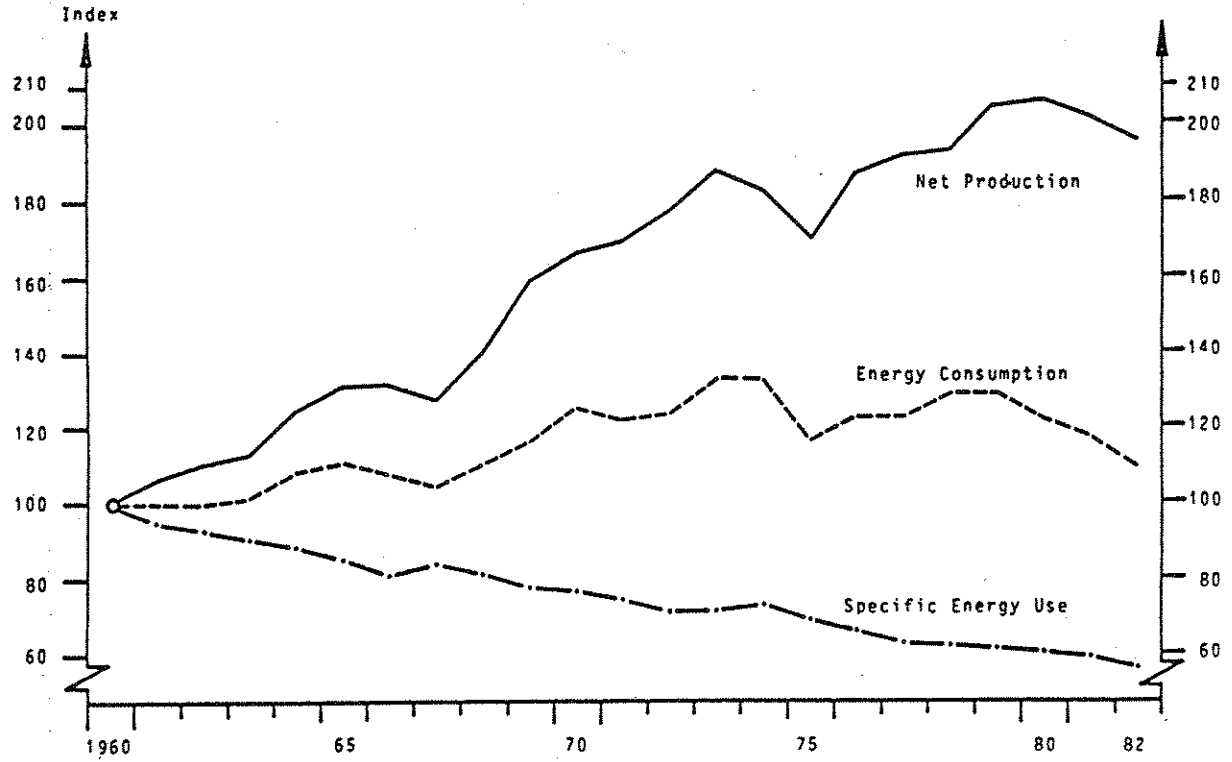
Source:
Energiewirtschaftliches Institut an der Universität Köln;
Statistisches Bundesamt, versch. Fachserien;
Bundeswirtschaftsministerium, Referat 111D3.

Figure 3:
Development of Energy Intensity (PEC:GNP) in West Germany (1973 = 100)



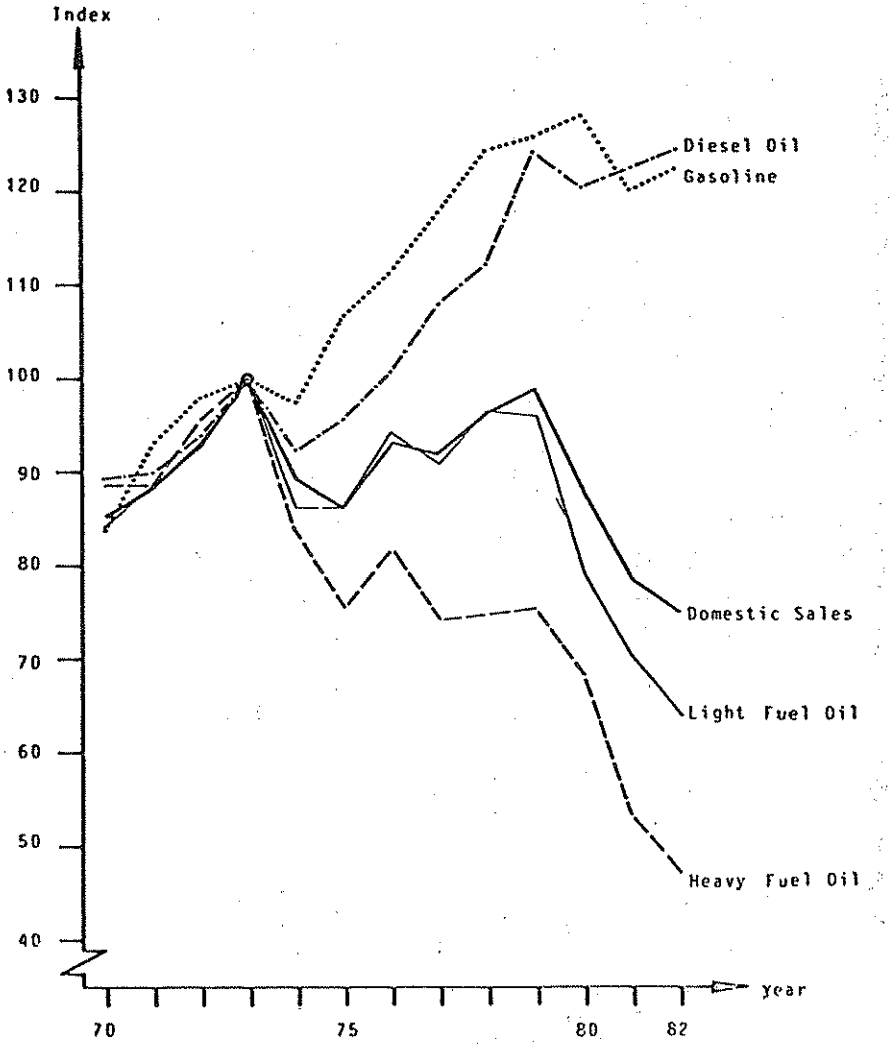
Source:
Energiewirtschaftliches Institut an der Universität Köln

Figure 4:
Net Production, Energy Consumption and Specific Energy Use in the Manufactoring Industry of West Germany, 1960 – 1982



Source:
Energiewirtschaftliches Institut an der Universität Köln

Figure 5:
Development of Sales of Main Mineral Oil Products in West Germany, 1973 = 100



Source:
MWV, Mineralölazhlen 1982, T 27, T 28

Figure 6:
Average Price – and Substitutionh Elasticities in Chemical Industry
Period 1974 – 1981

SUBSTITUTION ELASTICITY

HARD COAL	HEAVY FUEL OIL	: 5,25
	GAS	: 6,31
	ELECTRICITY	: 0,49

HEAVY FUEL OIL	GAS	: 2,11
	ELECTRICITY	:-0,01

GAS	ELECTRICITY	: 0,33

PRICE ELASTICITY

HARD COAL	HARD COAL	:-1,83
	HEAVY FUEL OIL	: 0,69
	GAS	: 0,81
	ELECTRICITY	: 0,33

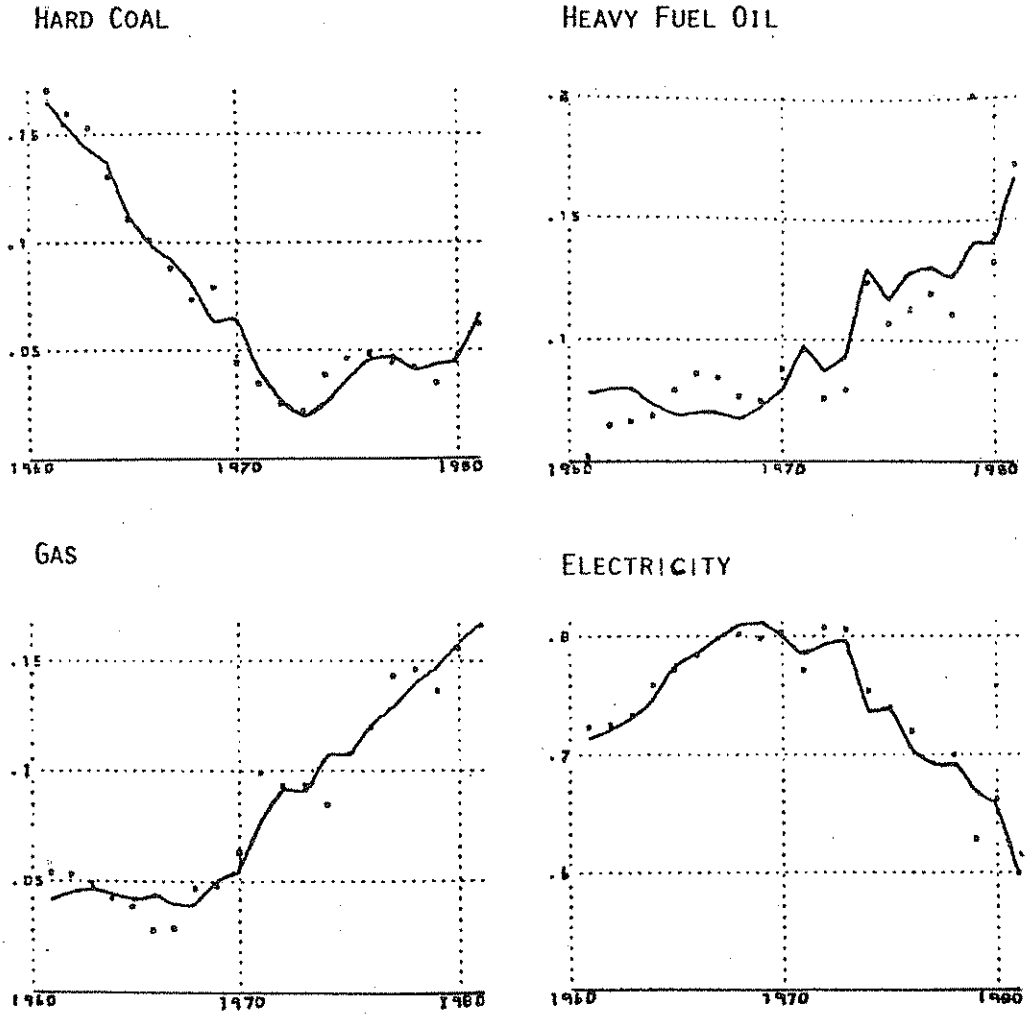
HEAVY FUEL OIL	HEAVY FUEL OIL	:-0,49
	HARD COAL	: 0,22
	GAS	: 0,28
	ELECTRICITY	:-0,01

ELECTRICITY	ELECTRICITY	:-0,07
	HARD COAL	: 0,02
	HEAVY FUEL OIL	:-0,00
	GAS	: 0,04

GAS	GAS	:-0,76
	HARD COAL	: 0,26
	HEAVY FUEL OIL	: 0,28
	ELECTRICITY	: 0,22

Source:
Energiewirtschaftliches Institut an der Universität zu Köln

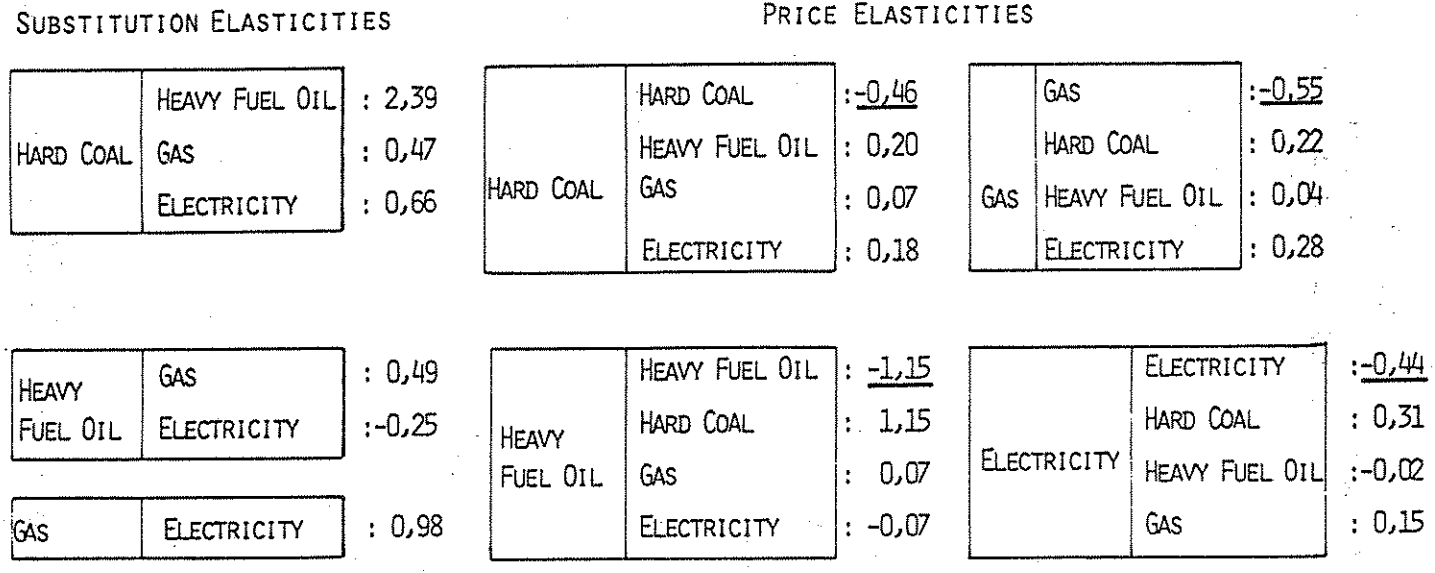
Figure 7:
Actual (Points) and Estimated (Lines) Share of Energy Costs in Chemical Industry, 1960 – 1981



Source:
Energiewirtschaftliches Institut an der Universität Köln

Figure 8:

Average Price - and Substitution Elasticities in Iron and Steel Industries, Period 1974 – 1981



Source:
Energiewirtschaftliches Institut an der Universitä zu Köln